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2024–2029 National Outer Continental Shelf Oil and Gas Leasing Program

Final Programmatic Environmental Impact Statement

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COVER SHEET

2024–2029 National Outer Continental Shelf Oil and Gas Leasing Program
Final Programmatic Environmental Impact Statement

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ABSTRACT

This final programmatic environmental impact statement (Final Programmatic EIS) addresses development of the 2024–2029 National Outer Continental Shelf (OCS) Oil and Gas Leasing Program (2024–2029 Program). The Bureau of Ocean Energy Management (BOEM) is preparing a programmatic environmental impact statement under the National Environmental Policy Act (NEPA) because NEPA provides a well-understood framework for reviewing impacts, the 2024–2029 Program has national implications, and the program presents opportunities for tiering through subsequent NEPA analyses.

This Final Programmatic EIS addresses the purpose of and need for the Proposed Action; identifies alternatives and their screening; describes the affected environment; analyzes the potential environmental impacts of the Proposed Action and reasonable alternatives; and identifies potential mitigation measures to address potential impacts. This document analyzes potential contributions to cumulative impacts caused by oil and gas activities that may result from the 2024–2029 Program. The Final Programmatic EIS analyzes the Proposed Action—leasing in the Gulf of Mexico (GOM) Region (specifically the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area)—as well as a reasonable range of alternatives. The analyses disclose potential environmental effects of oil and natural gas leasing, exploration, development, and production on climate; coastal and offshore marine environments; and offshore marine, sociocultural, and socioeconomic resources.

This document was prepared using the best scientific information publicly available. Where relevant information on reasonably foreseeable impacts was incomplete or unavailable, the need for the information was evaluated to determine if it was essential to making a reasoned choice among the alternatives. If so, BOEM acquired the information, or, if the information was impossible or exorbitantly costly to acquire, BOEM applied accepted scientific methodologies to evaluate available credible scientific information where necessary to provide reasonable estimates for the unavailable information.

This Final Programmatic EIS and the *2024–2029 National Outer Continental Shelf Oil and Gas Leasing Proposed Final Program* are available on the BOEM website at www.boem.gov/National-OCS-Program/.

Summary

BACKGROUND

The National Outer Continental Shelf (OCS) Oil and Gas Leasing Program (National OCS Program) is mandated by Section 18 of the OCS Lands Act (43 U.S.C. §§ 1331 *et seq*.). The Bureau of Ocean Energy Management (BOEM) within the U.S. Department of the Interior is developing the 2024–2029 National OCS Program (2024–2029 Program).[1] The OCS Lands Act requires the Secretary of the Interior (Secretary) to schedule lease sales over five-year periods to best meet national energy needs for that period. In developing a National OCS Program, the Secretary must consider the economic, social, and environmental values of the renewable and nonrenewable resources contained in the OCS, as well as the potential impact of oil and gas exploration activities on other resource values of the OCS and the marine, coastal, and human environments.

This final programmatic environmental impact statement (Final Programmatic EIS) describes and analyzes the potential environmental impacts that could result from leasing, exploration, production, and decommissioning associated with lease sales contemplated in the *2024–2029 National Outer Continental Shelf Oil and Gas Leasing Proposed Final Program* (Proposed Final Program [PFP]) (BOEM 2023a). This Final Programmatic EIS was prepared in accordance with the National Environmental Policy Act (NEPA) (42 U.S.C. §§ 4321 *et seq*.) and implementing regulations.[2] This analysis encompasses the 25 BOEM OCS oil and gas planning areas included in the Draft Proposed Program (DPP; released in January 2018) (BOEM 2018a) and considers a range of alternatives, as analyzed in the Draft Programmatic EIS (released in July 2022) (BOEM 2022a). The Final Programmatic EIS informed the Secretary's Final Proposal and PFP, which was released concurrently with this document.

Development of an OCS oil and gas lease comprises five sequential phases: geophysical exploration, exploratory drilling, development, production, and decommissioning. Environmental reviews are conducted at each stage to the extent required by NEPA. The Final Programmatic EIS focuses on high-level impacts at the national and regional scale. This high-level focus includes the potential effects of area withdrawals and exclusions from consideration for leasing. Under Section 12(a) of the OCS Lands Act, 43 U.S.C. § 1341(a), the President may "withdraw from disposition any of the unleased lands of the outer Continental Shelf." Exclusions are nominated by stakeholders during the public comment period for the DPP in accordance with Section 18(f) of the OCS Lands Act and also may be proposed by the Secretary for analysis. NEPA documents prepared at the lease sale and subsequent stages, such as

[1] This National OCS Program development process initially included OCS lease sales beginning in late 2019, as published in the *2019–2024 National Outer Continental Shelf Oil and Gas Leasing Draft Proposed Program* (DPP) on January 4, 2018. However, the Secretary adjusted the timing of the first sale. As a result, the program name has been changed from the 2019–2024 National Program to the 2024–2029 Program.

[2] The U.S. Court of Appeals for the District of Columbia has ruled that the approval of an oil and gas program does not constitute an irreversible and irretrievable commitment of resources, and that, in the context of BOEM's multiple-stage oil and gas leasing program, the obligation to fully comply with NEPA does not mature until the lease sale stage. Therefore, preparation of an EIS under NEPA (42 U.S.C. §§ 4321 et seq.) is not required at this stage. However, exercising its discretion, BOEM has decided to prepare a Programmatic EIS to inform development of the National OCS Program.

exploration and development plan review, will provide more detail and incorporate any new information.

PFP AND ALTERNATIVES

The PFP advances the Final Proposal of the Secretary in development of the National OCS Program, which is the Proposed Action analyzed in this Final Programmatic EIS. The Secretary's Final Proposal includes up to three potential lease sales in the Gulf of Mexico (GOM) Program Area (which contains the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area). Impacts in this program area are fully addressed by the alternatives analyzed in this Final Programmatic EIS (**Section 1.3**). The analyses in this Final Programmatic EIS consider the geographic scale and regionally unique aspects of the affected environment (**Chapter 2**) and oil and gas development potential across OCS planning areas in determining the environmental consequences that could occur because of oil and gas leasing (**Chapter 4**). In deciding on her Final Proposal, the Secretary considered the analyses—which are informed by relevant research and the BOEM review process—documented in this Final Programmatic EIS.

The four alternatives analyzed in this document are identical to the alternatives presented in the Draft Programmatic EIS; all 25 planning areas are included in this document even though the scope was narrowed in the Proposed Program (BOEM 2022b). Therefore, this document includes additional OCS regions and program areas compared to what is presented in the PFP. This Final Programmatic EIS analyzes the following four alternatives, which are listed by increasing number of planning areas:

- **Alternative A:** *No Action Alternative (No Leasing).* This alternative consists of approval of a 2024–2029 Program that does not schedule any lease sales.
- **Alternative B:** *6 Planning Areas.* This alternative comprises the Chukchi Sea, Beaufort Sea, Cook Inlet, Western GOM, Central GOM, and Eastern GOM Planning Areas.
    - The Proposed Action is the Final Proposal presented in the PFP and is analyzed as **Alternative B(a)**, which includes only the GOM Program Area (comprising the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area not subject to withdrawal under Section 12(a) of the OCS Lands Act).
- **Alternative C:** *9 Planning Areas.* This alternative consists of Alternative B plus the Mid-Atlantic, South Atlantic, and Southern California Planning Areas.
- **Alternative D:** *25 Planning Areas.* This alternative includes 25 of the 26 OCS planning areas (as proposed in the DPP).

AFFECTED ENVIRONMENT

To determine potential environmental impacts from lease sales held under the 2024–2029 Program, this Final Programmatic EIS first describes the environment that may be affected by oil and gas activities under the alternatives during the 40 to 70 years when they may occur. The affected environment chapter (**Chapter 2**) provides a comprehensive picture of current conditions and anticipated future baseline conditions in all BOEM OCS regions and independent of 2024–2029 Program activities (**Figure S-1**). Resources are categorized as physical, pelagic, benthic, coastal, or human and may occur in more than one of these categories (e.g., human activities and interests extend across all other categories). The discussion specifies ecoregions (areas with distinct biology and oceanography) or planning areas (administrative boundaries) when relevant. This document first describes the affected environment at the national level (which includes characteristics common across OCS regions) then provides high-level information at the regional scale.

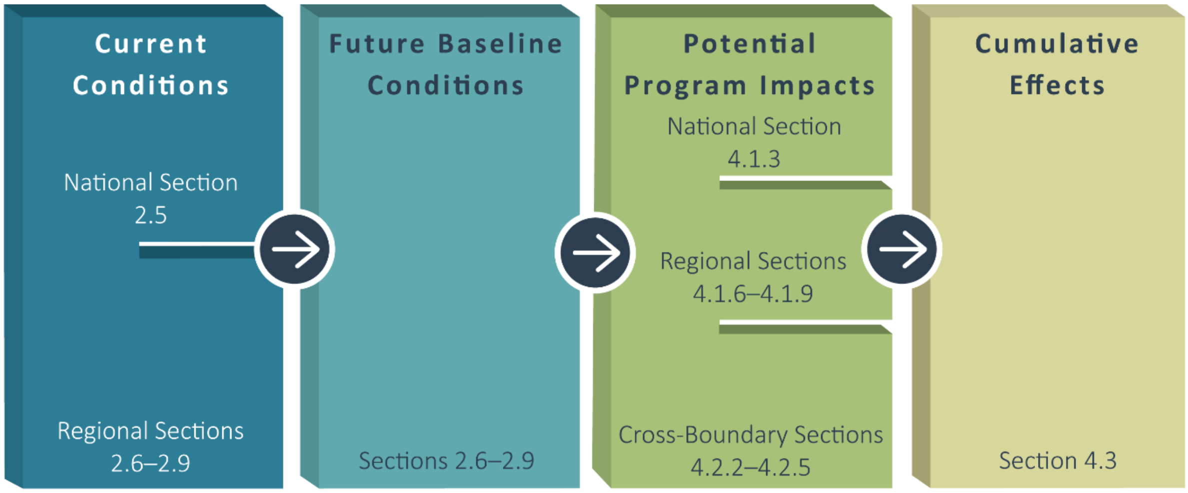

Figure S-1. Organization of the affected environment and environmental consequences

ENVIRONMENTAL CONSEQUENCES

This document provides a programmatic-level description of the potentially significant impacts that could result from leasing under the 2024–2029 Program (**Chapter 4**). NEPA documents prepared at subsequent stages will be tailored to the level of activity being reviewed and will analyze any new information.

BOEM determined which potential impacts to analyze in detail by evaluating whether the impact-producing factors (IPFs) associated with oil and gas activities under the 2024–2029 Program could impact any of 15 different resources. IPFs may occur at any stage of the oil and gas life cycle and affect multiple resources. This document categorizes impacts on resources as either potentially significant or not expected to be significant. Only potentially significant impacts are analyzed in **Chapter 4** of the Final Programmatic EIS; impacts not expected to be significant are discussed in **Appendix A.**

BOEM first discloses the general potential impacts associated with oil and gas activities and then considers the direct and indirect impacts of new leasing under the alternatives (**Section 4.2**). Use of other forms of energy (i.e., energy substitution) occurs with reduced or no leasing, and the analysis considers the impacts of energy substitutions when relevant. Each action alternative analysis also considers cross-boundary impacts (i.e., effects to resources outside the boundaries of the planning area[s] in which an activity occurs). The analysis evaluates cumulative impacts by comparing the incremental contribution of oil and gas development to the impacts of all ongoing and reasonably foreseeable future actions (**Section 4.3**).

Under the No Action Alternative (Alternative A), there would be no new oil and gas development or associated impacts from the 2024–2029 Program, but there could be impacts from energy substitutions. The potential impacts from the 2024–2029 Program are expected to increase as the overall included area increases (i.e., from Alternatives A to D). The greatest overall potential impacts are expected with Alternative D. Alternative C would result in impacts in a smaller geographic area than Alternative D. However, impacts experienced in each individual planning area in any action alternative (Alternatives B–D) are expected to be similar for similar species, habitats, and human activities.

Table S-1 summarizes the potential environmental impacts anticipated for the proposed alternatives. The two planning areas with the highest potential for significant impact interactions are the Chukchi Sea and Beaufort Sea Planning Areas, which are both included under all three action alternatives. However, President Biden reinstated the withdrawal of the entire Chukchi Sea Planning Area and the majority of the Beaufort Sea Planning Area, and subsequently withdrew the remainder of the Beaufort Sea Planning Area (**Section 4.4.1**). A smaller number of potentially significant impacts occurs in the Western and Central GOM Planning Areas, largely because existing infrastructure likely would be able to accommodate additional activities resulting from the 2024–2029 Program. Furthermore, the communities in this area have experienced OCS oil and gas activity for nearly three-quarters of a century. Significant impacts that may already exist could be prolonged by any activities authorized under the 2024–2029 Program, but additional impacts are not expected.

Table S-1. Summary of potential environmental impacts for each proposed alternative

Alternative	Scope	Summary of Potential Environmental Impacts
A	No Action Alternative (No Leasing)	• Employment, income, and related revenues would be impacted in the Western and Central GOM Planning Areas if no new leasing were to occur, given the longstanding history and well-established oil and gas industries and economies that have developed there. Any explicit economic benefits associated with OCS activities in the other regions also may be forgone. • Impacts from energy substitutions due to increased tankering of imported oil may occur in the Pacific, GOM, and Atlantic Regions. • Cross-boundary effects related to oil tankering may occur, especially if oil spills were to occur. • Limited impacts are expected in the Alaska Region.
B	6 Planning Areas	• The anticipated lease sales and associated potential impacts of Alternative B are the most similar to present-day conditions (i.e., currently, most OCS oil and gas production occurs in the GOM). The two planning areas with the highest potential for significant impact interactions are the Chukchi Sea and Beaufort Sea Planning Areas.
B(a)	3 Planning Areas	• The potential impacts that may occur under Alternative B(a) are expected to be less than those expected under Alternative B due to the smaller geographic scope and number of lease sales. • The potential impacts in the Chukchi Sea, Beaufort Sea, and Cook Inlet Planning Areas, and in most of the Eastern GOM Planning Area, would not occur under this subalternative.
C	9 Planning Areas	• The potential impacts that may occur under Alternative C are expected to be less than those expected under Alternative D due to the smaller geographic scope and number of lease sales. • The Mid-Atlantic and South Atlantic Planning Areas host a relatively high degree of anthropogenic activity, such as shipping, military exercises, and commercial fishing; they also serve as important biological areas for many local and migratory species. The addition of oil and gas activity to this dynamic area, where there is currently none, may have lasting impacts on resources, and cumulative and cross-boundary effects are expected to be relatively high.
D	25 Planning Areas	• The potential for OCS impacts increases with increasing number of planning areas and lease sales. Therefore, Alternative D is expected to have the greatest overall potential impacts. • Many of the areas added in Alternative D are more likely to experience impacts because there is little to no existing infrastructure to support oil and gas activities in these areas.

Cumulative Effects

Cumulative effects can be geographic as well as temporal. For example, because environmental resources do not follow administrative boundaries (i.e., planning areas), such resources may traverse several planning areas, receiving impacts in all these planning areas. Therefore, the affected environment is characterized broadly using marine ecoregions, rather than planning areas (**Section 2.3**). Major conclusions from the cumulative effects analysis (**Section 4.3**) include the following:

- Cumulative effects in the Alaska Region would be expected to be higher than in any other OCS region due to ongoing stressors, projections of future climate change, and a greater number of potential impacts from the 2024–2029 Program. Cumulative effects in this region would be fewer if fewer planning areas were included in the 2024–2029 Program.
- Cumulative effects in the Atlantic Region would be expected to be high, second only to Alaska, due to the high density of human population, existing fishing activity, and future projections of climate change. If development occurs under the 2024–2029 Program, impacts from 2024–2029 Program activities would be expected to be high, comparable to other areas with no existing oil and gas activities, such as the Eastern GOM Ecoregion.
- If development occurs under the 2024–2029 Program in the Pacific Region, cumulative effects would be expected to be lower than in the Alaska Region (except for the Cook Inlet Planning Area), but higher than in the Western and Central GOM Ecoregion due to the level of current industrialization in the Pacific Region.
- If development occurs under the 2024–2029 Program in the Eastern GOM Ecoregion, cumulative effects would be expected to be similar to other areas with no existing oil and gas activities and with equivalent levels of anthropogenic pressures (e.g., Atlantic Region). Although the Eastern GOM Planning Area has similar biological resources as the Western and Central GOM Planning Areas, the incremental impact of activities under the 2024–2029 Program in the Eastern GOM Planning Area would be expected to be greater due to the impacts on sociocultural resources.
- The Western and Central GOM Ecoregion stands out as having one of the highest levels of stressors and lowest levels of expected impacts resulting from the 2024–2029 Program, which leads to the lowest relative addition to cumulative effects compared to any other ecoregion.

Potential Environmental Exclusions

BOEM considered a number of areas for exclusion from leasing (**Section 4.5**). Potential exclusion areas were either identified in the DPP as subarea options or nominated for exclusion based on environmental importance or sensitivity. All areas analyzed for exclusion in this document are smaller than a planning area and could be considered for exclusion from leasing, based on their ecological or human-use value, while including the rest of the planning area in the 2024–2029 Program. In the PFP, the Secretary identified three subarea options (portions of program areas) in the GOM Program Area to be carried forward for further analysis at the lease sale stage; these are discussed in **Section 4.5.3**. It should be noted that many of the areas analyzed in the DPP as potential exclusions are in planning areas later withdrawn by the President under Section 12(a) of the OCS Lands Act, 43 U.S.C. § 1341(a). More information on withdrawals is provided in **Section 4.4**.

Analysis of program areas and subarea options can be conducted at any stage of the National OCS Program development process to inform future leasing decisions, because circumstances affecting leasing decisions could change and an analysis conducted on an area is informative even if not directly relevant for this National OCS Program development cycle. An analysis does not indicate that an area or subarea will be available for inclusion in an approved National OCS Program or lease sale. For example, under the December 20, 2016, *Memorandum on Withdrawal of Certain Portions of the United States*

Arctic Outer Continental Shelf From Mineral Leasing, the entirety of the Chukchi Sea Program Area is currently withdrawn from leasing pursuant to Section 12 of the OCS Lands Act, 43 U.S.C. § 1341(a), but this document still includes an analysis of the entirety of the Chukchi Sea, as well as three Chukchi Sea subarea options, because they were presented as part of the Draft Proposal.

Oil Spills

Oil spills are accidental and unauthorized events, but they are considered in the analysis because they may occur and impact the environment (**Section 4.6**). The Final Programmatic EIS analyzes the potential for spills and the potential impact of spills on the environment.

CONSULTATION AND COORDINATION

In preparing the Draft Programmatic EIS, BOEM considered public input received during a 60-day scoping period; for the Final Programmatic EIS, BOEM considered input received during a 90-day public comment period (**Chapter 5**). BOEM invited public comments during the scoping and public comment period via mail, at virtual public meetings, or by online submission at www.regulations.gov. BOEM coordinated, as appropriate, with various other entities, including Federal agencies, state entities, nongovernmental organizations, federally recognized Tribes, Alaska Native Claims Settlement Act Corporations, and Alaska Native villages. BOEM invited other Federal agencies and state, Tribal, and local governments to become cooperating agencies in preparing the Final Programmatic EIS and established cooperating agency status with the National Park Service and the National Aeronautics and Space Administration's Office of Strategic Infrastructure.

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Abbreviations and Acronyms

2024–2029 Program	2024–2029 National Outer Continental Shelf Oil and Gas Leasing Program
AEO	*Annual Energy Outlook*
ANCSA	Alaska Native Claims Settlement Act
BBOE	billion barrels of oil equivalent
BFA	biologically focused area
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CCS	carbon capture and sequestration
CDE	catastrophic discharge event
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	CO_2 equivalent
CO_2e-20	20-year CO_2 equivalent
CO_2e-100	100-year CO_2 equivalent
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
DOCD	Development Operations Coordination Document
DOD	Department of Defense
DPP	Draft Proposed Program
DPS	distinct population segment
EEZ	exclusive economic zone
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	environmental impact statement
ENSO	El Niño-Southern Oscillation
EO	Executive Order
EP	exploration plan
ESA	Endangered Species Act
ESP	Environmental Studies Program
FAA	Federal Aviation Administration
Final EAM	*Final Economic Analysis Methodology for the 2024–2029 National Outer Continental Shelf Oil and Gas Leasing Program*
FMP	Fishery Management Plan
ft	foot or feet
FWS	Fish and Wildlife Service
FY	fiscal year
G&G	geophysical and geological
GDP	gross domestic product
GHG	greenhouse gas
GOM	Gulf of Mexico
GOMESA	Gulf of Mexico Energy Security Act
HAB	harmful algal bloom
HAPC	Habitat Areas of Particular Concern
HPF	Historic Preservation Fund
Hz	hertz
IPCC	Intergovernmental Panel on Climate Change
IPF	impact-producing factor
IRA	Inflation Reduction Act
km	kilometer(s)
kn	knot(s)
LNG	liquified natural gas

LWCF	Land and Water Conservation Fund
m	meter(s)
mi	mile(s)
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
N_2O	nitrous oxide
NAACP	National Association for the Advancement of Colored People
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
National OCS Program	National Outer Continental Shelf Oil and Gas Leasing Program
National Register	National Register of Historic Places
NDC	National Determined Contributions
NECS	Northeast U.S. Continental Shelf
NEMS	National Energy Modeling System
NEPA	National Environmental Policy Act
NEV	net economic value
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
nmi	nautical mile(s)
NMS	National Marine Sanctuaries
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NO_X	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NSB	North Slope Borough
NSF	National Science Foundation
NTL	Notice to Lessees
NWR	National Wildlife Refuge

O_3	ozone
OCS	Outer Continental Shelf
OECM	Offshore Environmental Cost Model
OMB	Office of Management and Budget
OOC	Office of Communications
OSRP	Oil Spill Response Plan
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PFP	*2024–2029 National Outer Continental Shelf Oil and Gas Leasing Proposed Final Program*
PM	particulate matter
$PM_{2.5}$	fine particulate matter
PM_{10}	coarse particulate matter
PTS	permanent threshold shift
SAV	submerged aquatic vegetation
SBM	synthetic-based mud
SC-GHG	social cost of greenhouse gases
SECS	Southeast U.S. Continental Shelf
SLCP	short-lived climate pollutant
SO	Secretary's Order
SO_2	sulfur dioxide
TAPS	Trans-Alaska Pipeline System
TTS	temporary threshold shift
UME	Unusual Mortality Event
USCG	U.S. Coast Guard
USDOI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compound

Chapter 1:

Introduction

1.1 BACKGROUND AND KEY AGENCY RESPONSIBILITIES

This final programmatic environmental impact statement (Final Programmatic EIS) describes and analyzes the potential environmental impacts of oil and gas activities that could occur as a result of lease sales held under the *2024–2029 National Outer Continental Shelf Oil and Gas Leasing Proposed Final Program* (Proposed Final Program [PFP]) (BOEM 2023a).

Federal management of oil and gas resources on the Outer Continental Shelf (OCS)[3] of the United States (U.S.) is governed by the OCS Lands Act (43 U.S. Code §§ 1331 *et seq*.). The OCS Lands Act and implementing regulations include requirements for Federal administration of oil and gas leasing, exploration, development, production, and decommissioning on the OCS. Section 18 of the OCS Lands Act (43 U.S.C. § 1344) requires the Secretary of the Interior (Secretary) to prepare, maintain, and periodically revise a nationwide OCS oil and gas leasing program (referred to as the National OCS Program). The National OCS Program must address, as precisely as possible, the size, timing, and location of leasing activity for the five-year period following its approval (43 U.S.C. § 1344(a)). Additionally, Section 18(a) of the OCS Lands Act requires the Secretary to consider the economic, social, and environmental values of the renewable and nonrenewable resources contained in the OCS, and the potential impact of oil and gas exploration activities on other resource values of the OCS and the marine, coastal, and human environments. The Secretary must identify a schedule of lease sales that balances the potentials for environmental damage, discovery of oil and gas, and adverse impact on the coastal zone (43 U.S.C. § 1344(a)(3)).

In preparing a National OCS Program, the Secretary must analyze and consider the following eight factors (43 U.S.C. § 1344(a)(2)):

1. Existing information concerning the geographical, geological, and ecological characteristics of each region
2. Equitable sharing of developmental benefits and environmental risks among the various regions
3. Location of such regions with respect to, and the relative needs of, regional and national energy markets
4. Location of oil- and gas-bearing regions in relation to other uses of the sea and seabed
5. Interest of potential oil and gas producers in the development of oil and gas resources as indicated by exploration or nomination
6. Laws, goals, and policies of affected states as identified by the governors
7. Relative environmental sensitivity and marine productivity of different areas
8. Relevant environmental and predictive information

To inform development of the National OCS Program, the Bureau of Ocean Energy Management (BOEM) prepared the necessary analyses to address the above eight factors and prepared this Final Programmatic EIS. As a result of challenges to previous National OCS Programs, the U.S. Court of

[3] The OCS is defined as all submerged lands lying seaward of state waters and subject to U.S. jurisdiction and control (43 U.S.C. § 1331(a)).

Appeals for the District of Columbia has ruled that the approval of an oil and gas program does not constitute an irreversible and irretrievable commitment of resources, and that, in the context of BOEM's multiple-stage oil and gas leasing program, the obligation to comply with the National Environmental Policy Act (NEPA) does not mature until the lease sale stage.[4] Therefore, preparation of an EIS under NEPA (42 U.S.C. §§ 4321 *et seq*.) is not required at this stage. However, exercising its discretion, BOEM has decided to prepare a Programmatic EIS to inform development of the National OCS Program and future NEPA analysis that may be required.

This Final Programmatic EIS evaluates potentially significant impacts that could occur from oil and gas activities resulting from lease sales scheduled in the 2024–2029 National OCS Program (2024–2029 Program). This analysis includes discussion of potential impacts in the 25 planning areas included in the 2019–2024 Draft Proposed Program (DPP) released on January 4, 2018 (BOEM 2018a). Additionally, this Final Programmatic EIS explains the assumptions about what is reasonably foreseeable on existing leases and under future National OCS Programs beyond the 2024–2029 Program to inform the baseline upon which the cumulative effects analysis is built (**Section 2.4.2** under *Reasonably Foreseeable Future OCS Oil and Gas*).

> The analyses in this Final Programmatic EIS focus on high-level impacts at the national and regional scale (rather than impacts of individual lease sales or project-specific actions), which is consistent with the Council on Environmental Quality's (CEQ's) *Final Guidance for Effective Use of Programmatic NEPA Reviews* (Boots 2014).

The analyses include consideration of the potential effects of exclusion of certain areas from leasing during the 2024–2029 Program. Potential exclusions may arise pursuant to Section 18(f) of the OCS Lands Act, which requires BOEM to solicit nominations for areas to be either included or excluded from a particular National OCS Program. The Secretary may decide to exclude areas based on consideration of relevant information. Presidential withdrawals are made independent of the National OCS Program decisions in accordance with Section 12(a) of the OCS Lands Act, 43 U.S.C. § 1341(a), which states that the President may "withdraw from disposition any of the unleased lands of the outer Continental Shelf." Information and analyses related to current withdrawals and exclusions identified for this Final Programmatic EIS are provided in **Sections 4.4 and 4.5**.

The Secretary considered the analyses in the DPP, Proposed Program (BOEM 2022b), Draft Programmatic EIS (BOEM 2022a), PFP, and this Final Programmatic EIS before proposing the size, timing, and location of leasing included in her Final Proposal of a lease sale schedule for the 2024–2029 Program.

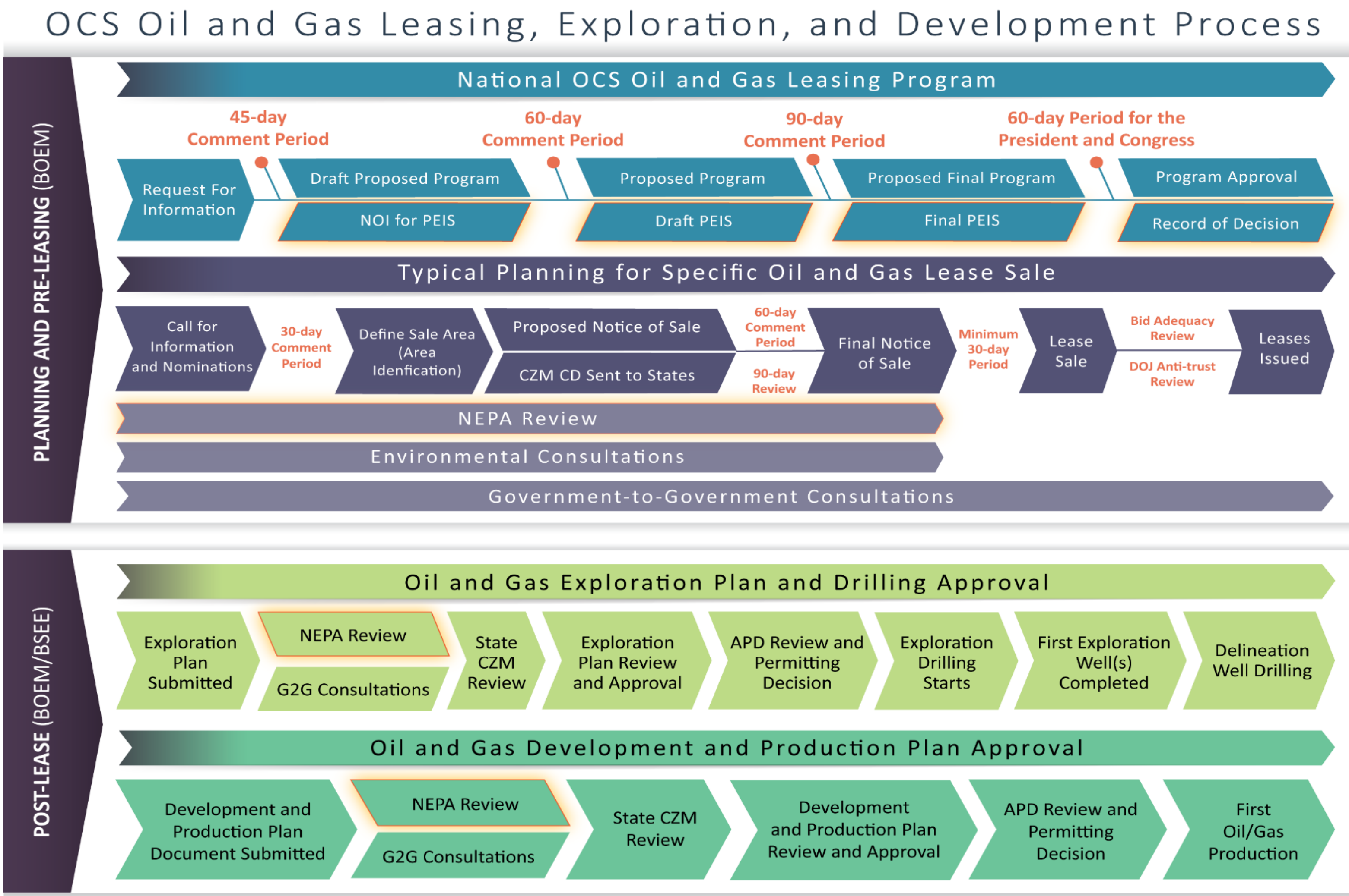
BOEM's OCS oil and gas leasing, exploration, and development process includes the below steps. In addition to the Programmatic EIS for the National OCS Program, BOEM may complete, as appropriate, subsequent environmental reviews at succeeding stages of the OCS Lands Act process (**Figure 1-1**).

[4] *Center for Biological Diversity v. Department of the Interior*, 563 F.3d 466 (D.C. Cir. 2009); *Center for Sustainable Economy v. Jewell*, 779 F.3d 588 (D.C. Cir. 2015)

1. **National OCS Program:** The first stage is the development of a provisional national schedule of lease sales. At the conclusion of this stage, the Secretary approves a National OCS Program.
2. **Lease Sale:** The second stage involves deciding whether to hold individual lease sales proposed in the National OCS Program, determining the areas and terms to include in each lease sale, conducting the lease sales, and issuing leases in accordance with the applicable regulations.
3. **Exploration Plan**: In the third stage, if a lessee chooses to conduct exploration activities, the lessee must submit an exploration plan (EP) for BOEM approval. The EP establishes how the operator will conduct exploration activities and includes information on exploratory drilling operations, well location(s), and other relevant information. Geophysical and geological (G&G) activities are typically associated with the exploration stage and include consideration of requests by industry for permits to acquire site-specific G&G data. Data collection activities may also occur during other stages and need not be tied to a specific lease or leases.
4. **Development and Production Plan:** In the fourth stage, if a lessee discovers and chooses to develop oil or gas from a specific lease, the lessee must submit a development and production plan for BOEM's approval (referred to in the Western GOM as a "Development Operations Coordination Document," or DOCD, and in this Final Programmatic EIS collectively as a "production plan"). The development plan describes the number and location of wells to be drilled, type of production structure, manner of transporting recovered oil and natural gas, and related operations, including a description of decommissioning activities for wells, platforms, pipelines, and other facilities.

BOEM's regulations for lease sales, exploration plans, and development plans can be found at 30 Code of Federal Regulations (CFR) parts 550 and 556. After approval of a National OCS Program, BOEM conducts additional and more specific environmental reviews, as necessary, at each subsequent stage of the OCS Lands Act process. These environmental reviews include more site-specific analysis under NEPA, as well as consultations and coordination under such acts as the Clean Air Act (CAA), Clean Water Act, Coastal Zone Management Act (CZMA), Endangered Species Act (ESA), National Historic Preservation Act (NHPA), Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), and Marine Mammal Protection Act (MMPA). These environmental reviews, along with Tribal engagement and consultation, also consider any new information and address site-specific actions and environmental conditions in more detail.

In addition to the BOEM reviews and approvals listed above, operators must obtain a permit to drill individual wells from the Bureau of Safety and Environmental Enforcement (BSEE) pursuant to a BOEM-approved exploration or development and production plan. BSEE oversees the safety and environmental compliance of OCS oil and gas operations. BSEE's functions include development and enforcement of safety and environmental regulations; permitting OCS exploration, development, and production activities (e.g., drilling permits, OCS pipelines, structure installation, decommissioning); conducting inspections; and ensuring that industry is prepared to respond to oil spills. BSEE regulations related to OCS oil and gas operations are found primarily in 30 CFR parts 250–254.



Key: APD = Application for Permit to Drill; BOEM = Bureau of Ocean Energy Management; BSEE = Bureau of Safety and Environment Enforcement; CD = Consistency Determination; CZM = Coastal Zone Management; EA = Environmental Assessment; EIS = Environmental Impact Statement; G2G = Government to Government; NEPA = National Environment Policy Act; NOI = Notice of Intent; OCS = Outer Continental Shelf; PEIS = Programatic Environmental Impact Statement.

Figure 1-1. BOEM's OCS oil and gas leasing, exploration, and development process

Note: NEPA stages are highlighted with gold.

1.2 PROPOSED ACTION

The Proposed Action addressed in this Final Programmatic EIS is the Final Proposal presented in the PFP, which proposes three lease sales in the Gulf of Mexico (GOM) Program Area (which contains the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area) (**Figure 1-2**).

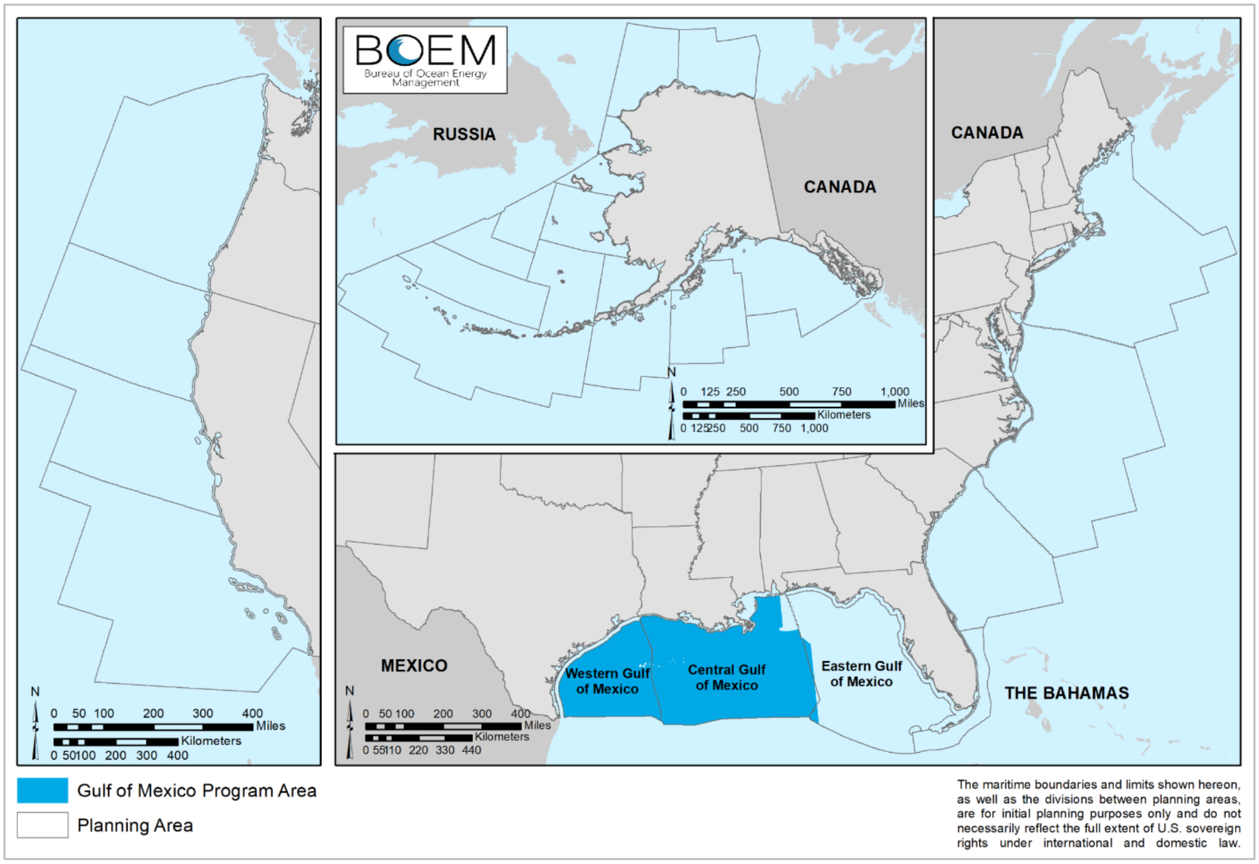


Figure 1-2. Planning areas included in the Proposed Action
The Proposed Action includes the GOM Program Area (which contains the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area).

1.2.1 Purpose and Need

CEQ's regulations implementing NEPA[5] require agencies to specify the underlying purpose and need to which the agency is responding in proposing the alternatives, including the Proposed Action (40 CFR 1502.13). The purpose of the Proposed Action is to propose a series of OCS oil and gas lease sales for the 2024–2029 Program to comply with the requirements of the OCS Lands Act. In doing so, the Secretary

[5] The Notice of Intent for this Programmatic EIS was issued prior to revisions to the CEQ regulations in 2020 and 2022; therefore, the 1978 regulations in 40 CFR Chapter V, as amended in 1986 and 2005, apply to this Final Programmatic EIS.

must determine the size, timing, and location of proposed OCS oil and gas lease sales as precisely as possible.

The need for the Proposed Action is to provide opportunity for oil and gas leasing, exploration, and development on the OCS to meet national energy needs in compliance with the OCS Lands Act. Domestic oil and natural gas supplies help meet domestic energy demand; generate revenues for local, state, and Federal governments; and provide jobs. **Figure 1-3** depicts the Energy Information Administration's (EIA's) historical consumption data from 1950 to 2020. Future consumption may be affected by the need to meet national greenhouse gas (GHG) emissions reduction policies that require substantial reductions of GHG emissions by 2025 and 2030, as part of the U.S. commitment under the Paris Agreement (United Nations Framework Convention on Climate Change 2015), and net-zero emissions by 2050. In addition, state and Federal legislation, such as the Inflation Reduction Act of 2023, have the potential to reduce GHG emissions by shifting the Nation away from carbon-intensive energy sources, such as oil and gas.

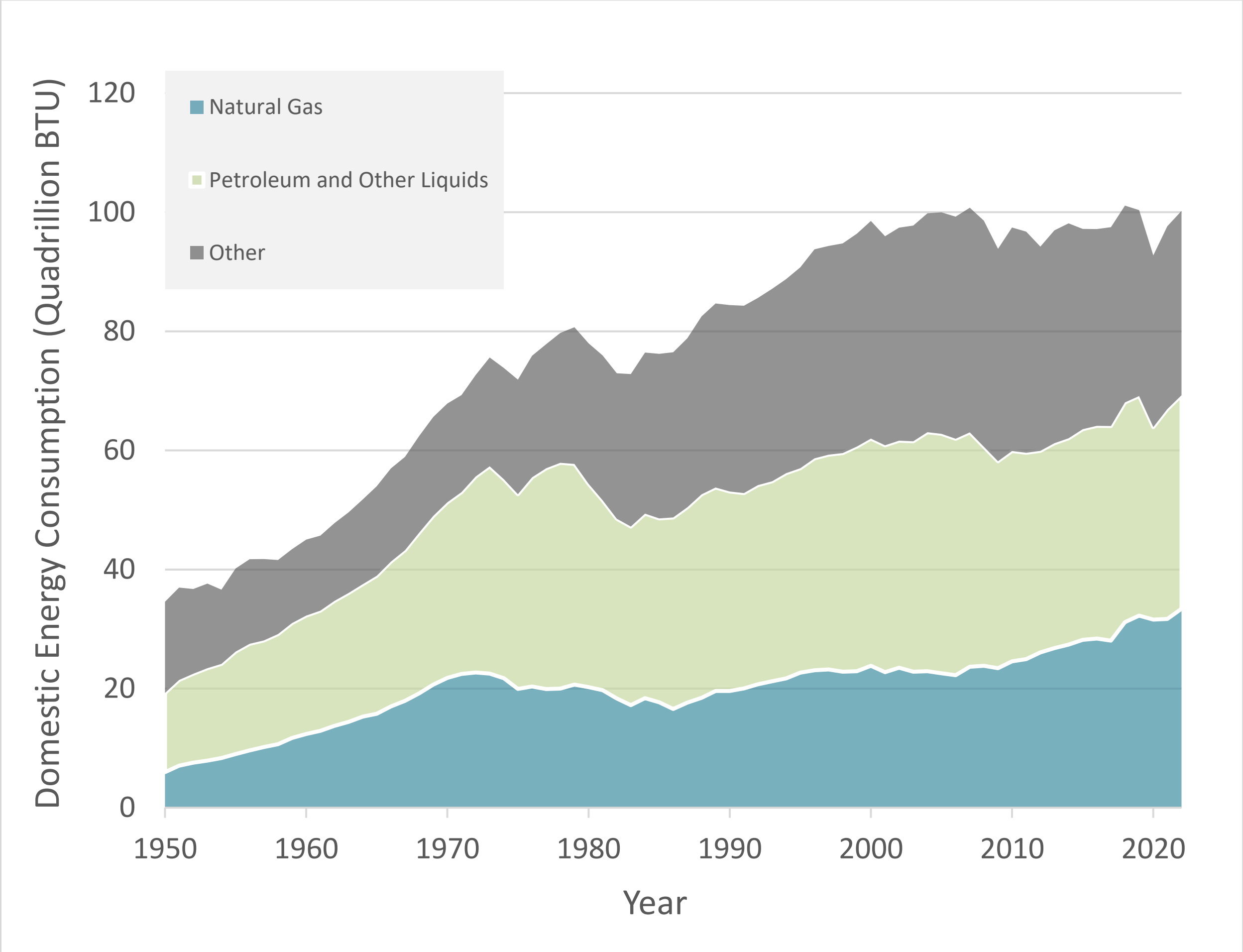


Figure 1-3. Historical U.S. domestic energy consumption by fuel type
Source: EIA (2023a; 2023b)

1.2.2 Scope of Analysis

The National OCS Program development process starts with the broadest consideration of areas available for leasing (all 26 OCS planning areas), which can be narrowed throughout the process. Development of the 2024–2029 Program includes a series of three proposals, each presenting a list of lease sales that specifies the size, timing, and location of the lease sales. Each proposal builds on information gained through the development process for the preceding proposal(s). These proposals are, in order of development, as follows:

1. **Draft Proposed Program (DPP)**—presented in BOEM (2018a)
2. **Proposed Program**—presented in BOEM (2022b)
3. **Proposed Final Program (PFP)**—presented in BOEM (2023a) and shown in **Figure 1-2**

The Draft Programmatic EIS analyzed the DPP. The Secretary used this analysis to inform the Proposed Program. The Final Programmatic EIS analyzes the Proposed Program, and this analysis informed the Secretary's decision on the PFP. The Draft and Final Programmatic EISs also serve to inform stakeholders of potential environmental impacts and provide opportunities for input.

The Proposed Action analyzed in this Final Programmatic EIS is the Final Proposal presented in the PFP—leasing in the GOM Program Area (which contains the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area). Alternative B(a) is the Proposed Action and considers only the GOM Program Area. Alternative B includes areas where oil and gas leasing has occurred most recently (Arctic Alaska, Cook Inlet, and the GOM). Alternative C increases in geographic scope, and Alternative D includes the full scope of the DPP. Alternative A is the No Action Alternative. Notably, the existing DPP was developed under a previous Administration and includes 25 of the 26 planning areas.

Section 12(a) of the OCS Lands Act, 43 U.S.C. § 1341(a), authorizes the President to "withdraw from disposition any of the unleased lands of the outer Continental Shelf." As a result of multiple withdrawals now in effect (**Figure 4-14**), the areas available for consideration for leasing under the 2024–2029 Program have changed during the program development process. Currently withdrawn areas are specifically documented and discussed in **Section 4.4**. Areas withdrawn under Section 12(a) are not available for leasing and do not require Section 18 analysis. All areas included in the DPP are analyzed in Alternative D, though withdrawn areas were not considered for inclusion in the Proposed Program and PFP.

Analysis of program areas (**Section 1.3.2**) and subarea options (portions of program areas) can be conducted at any stage of the National OCS Program development process to inform future leasing decisions, because circumstances affecting leasing decisions could change, and an analysis conducted on an area is informative even if not directly relevant for this National OCS Program development cycle. An analysis does not indicate that an area or subarea will be available for inclusion in an approved National OCS Program or lease sale. For example, the entirety of the Chukchi Sea Program Area is currently withdrawn from leasing pursuant to Section 12(a) of the OCS Lands Act, 43 U.S.C. § 1341(a), but this document still includes an analysis of the entirety of the Chukchi Sea, as well as three Chukchi Sea subarea options, because they were presented as part of the Draft Proposal.

This Final Programmatic EIS is constructed in such a way that the analyses could be applied to alternatives specifying any combination of BOEM OCS planning areas, including planning area combinations that are not treated individually in the stated alternatives. The Final Proposal presented in the PFP includes, wholly or in part, three planning areas[6] within one OCS region (**Figure 1-2**). For purposes of the analyses conducted, the habitat in the relatively small portions of the Eastern GOM Planning Area not withdrawn are indistinguishable from adjacent pelagic and benthic habitats in the Central GOM Planning Area and were incorporated into the analysis of the Central GOM Planning Area. **Table 1-1** lists locations of analyses for the areas included in the Final Proposal.

Table 1-1. Where to find the analysis for areas included in the Final Proposal

Region[1]	Planning Area(s)	Affected Environment & Future Baseline Conditions	Environmental Consequences, Cross-Boundary Impacts, and Cumulative Effects	Withdrawals[2] and Potential Exclusions
GOM	Western GOM Central GOM Eastern GOM	**Section 2.8**—GOM Region Affected Environment	**Section 4.1.8**—Potentially Significant Impacts in the GOM Region **Section 4.2.2.1**—Cross-Boundary Impacts for Alternative B(a) **Section 4.3.4.3**—Cumulative Effects Expected Under Alternative B(a) in the GOM Region	**Section 4.4.3**—Withdrawals in the GOM Region **Section 4.5.3**—Potential Exclusions in the GOM Region

[1] **Sections 2.5** and **4.1.3** of this Final Programmatic EIS include a national overview of the affected environment and environmental consequences, respectively, and are applicable to all OCS regions and region-specific sections in this table.
[2] **Section 4.4** provides an overview of Section 12(a) withdrawals for all OCS regions.

In this Final Programmatic EIS, the affected environment and environmental consequences are organized so that analyses shift in scale from national to regional as the reader progresses through **Chapter 2** and the initial section of **Chapter 4**. **Chapter 2** describes the affected environment in terms of both present conditions and future conditions. Because environmental resources do not follow administrative boundaries, the affected environment is characterized broadly using marine ecoregions. **Chapter 4** analyzes the potential effects of routine activities and accidental events that could occur from the alternatives and describes how impact-producing factors (IPFs) could cause potentially significant impacts in different OCS planning areas. This chapter also analyzes the change in impacts that could result from the withdrawal or exclusion of certain areas from leasing to avoid or minimize potential impacts on sensitive or unique resources. Beginning in **Section 4.2**, the Final Programmatic EIS presents the analyses in terms of the alternatives. The analysis for the No Action Alternative presents the potential impacts that could result as a result of no new leasing. The analysis for Alternatives B–D refers to the analyses in prior sections discussing impacts at a national and regional level. For example, the

[6] The GOM Program Area encompasses the Western GOM Planning Area, most of the Central GOM Planning Area, and portions Eastern GOM Planning Area not withdrawn by the *Presidential Memorandum on the Withdrawal of Certain Areas of the United States Outer Continental Shelf from Leasing Disposition*, issued on September 8, 2020. Under authority of Section 12(a) of the OCS Lands Act, 43 U.S.C. 1341(a), the areas of the OCS designated by Section 104(a) of the Gulf of Mexico Energy Security Act of 2006 are withdrawn from disposition by leasing for 10 years, beginning July 1, 2022.

analysis of Alternative B comprises the relevant national and regionally specific analyses for the areas included in that alternative.

> The current analyses indicate potentially significant impacts are more likely to occur in "**frontier**" planning areas (e.g., Kodiak and Shumagin) than in "**intermediate**" (e.g., Beaufort Sea and Mid-Atlantic) or "**mature**" (e.g., Western and Central GOM) planning areas. The PFP excludes from consideration those planning areas with increased potential for significant impacts—i.e., all frontier and intermediate areas, as well as mature areas with increased potential for significant impacts.

The Final Programmatic EIS analyzes the activities associated with oil and gas leasing for environmental impacts and focuses on impacts that could be potentially significant on particular resources in the OCS areas under consideration if leases are issued and oil and gas activities take place. Programmatic-level analyses and decisions on the scheduling of oil and gas leasing activities are inherently broader and more general than specific decisions at the lease sale and plan stages (e.g., exploration). Subsequent analyses performed at the lease sale and plan stages will provide site-specific detail on the nature, intensity, and duration of potential impacts. The scheduling of lease sales does not necessarily result in associated oil and gas exploration, development, production, or decommissioning activities; however, for the analysis in this Final Programmatic EIS, BOEM assumes that lease sales and resulting activities will occur.

This programmatic analysis recognizes that the intensity of impacts discussed will be dependent on, but imperfectly correlated with, the scale of activities undertaken. The scale of activities and specificity of impact intensity will be dependent upon a number of factors that are largely uncertain now. Those uncertainties include whether lease sales are held as scheduled, where leasing occurs within a planning area, and the amount of acreage leased and subsequently developed. Therefore, more specific analysis of impact intensity will be provided in NEPA documents associated with subsequent decisions.

1.2.3 PFP

The PFP advances the Secretary's Final Proposal for the size, timing, and location of new leasing. The Final Proposal, analyzed as Alternative B(a), includes up to three potential sales in the GOM Program Area (which contains the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area not withdrawn from consideration for leasing under Section 12(a) of the OCS Lands Act) (**Figure 1-2**). **Table 1-1** shows where the analysis for these areas can be found in the Final Programmatic EIS.

In addition to identifying the timing and location of lease sales, the Secretary also identified three subarea options in the PFP to be carried forward for further analysis at the lease sale stage: a 15-mile no leasing buffer offshore Baldwin County, Alabama; DOD proposed exclusion areas; and, a targeted leasing approach in the GOM Program Area. These areas are further described in **Section 4.5.3**.

The Secretary considered the analyses conducted and documented in this Final Programmatic EIS prior to identification of her Final Proposal put forth in the PFP. The areas included in the Final Proposal are encompassed by the full range of alternatives analyzed in the Final Programmatic EIS and informed by relevant research and comments received during the BOEM review process.

The potential environmental consequences associated with the Final Proposal are depicted in **Figure 1-4**. This figure depicts the expected interactions and potentially significant impacts that could result from OCS oil and gas activities in the planning areas included in the Final Proposal. The analyses portrayed in this figure assess the potential for resources to be affected by IPFs generated by National OCS Program activities. A full explanation of resources, stressors, and IPFs is presented in **Section 2.4**; a national overview of potential impacts is presented in **Figure 4-3**; and a full discussion of environmental consequences is available in **Chapter 4**.

Program Areas Included in the Proposed Final Program

Gulf of Mexico

GOM Program Area

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1					S			
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S		S		S		
R.8	S	S		S		S		
R.9	S	S						
R.10								S
R.11				S				
R.12								
R.13								
R.14								
R.15								

S — Potentially significant

S — Potential for significant impacts in the Central (but not Western) GOM Planning Area

Impact-Producing Factors

- I.1 Noise
- I.2 Traffic
- I.3 Routine Discharges
- I.4 Bottom/ Land Disturbance
- I.5 Emissions
- I.6 Lighting
- I.7 Visible Infrastructure
- I.8 Space-Use Conflicts

Resources

- R.1 Air Quality
- R.2 Water Quality
- R.3 Pelagic Communities
- R.4 Marine Benthic Communities
- R.5 Coastal & Estuarine Habitats
- R.6 Fish & Essential Fish Habitat
- R.7 Birds
- R.8 Sea Turtles
- R.9 Marine Mammals
- R.10 Commercial & Recreational Fisheries
- R.11 Archaeological & Cultural Resources
- R.12 Land Use
- R.13 Culture
- R.14 Vulnerable Coastal Communities
- R.15 Recreation & Tourism

Figure 1-4. Potentially significant impacts for program areas included in the PFP

This figure presents information for only the planning areas included in the proposed schedule of leases included in the Final Proposal. The Eastern GOM Planning Area is not listed separately in this figure; for purposes of the analyses conducted, the habitats in the relatively small portions of the Eastern GOM Planning Area not withdrawn are indistinguishable from adjacent habitats in the Central GOM Planning Area and were incorporated into the analysis of the Central GOM Planning Area.

The effects of leasing from the Final Proposal are tied primarily to the planning areas included. The areas within Alternative B(a) have existing oil and gas activities; therefore, a smaller number of potentially significant impacts occurs in the GOM Program Area, largely because existing infrastructure likely would be able to accommodate additional activities resulting from the 2024–2029 Program. Furthermore, people living adjacent to the GOM Program Area have experienced OCS oil and gas activity for nearly three-quarters of a century. Existing significant impacts may be prolonged by any activities authorized under the 2024–2029 Program, but, for many resources, additional impacts are not expected. Due to the long history of oil and gas development within the GOM Program Area, sales scheduled under the 2024–2029 Program would not introduce new significant effects but instead would prolong the significant impacts that already exist.

The GOM Program Area is relatively isolated from a geographic and oceanographic perspective. However, it is possible that activities that occur in the GOM Program Area could produce impacts in adjacent areas where leasing is not proposed. The cumulative analysis in **Section 4.3.4** discusses how activities from the Proposed Action could interact with ongoing or future stressors to create additional impacts; because of existing oil and gas activities in the GOM Program Area, the cumulative effects of leasing from the Proposed Action are expected to be minimal.

In addition to the impacts on individual resources, new oil and gas activity in the GOM Program Area would result in emissions both on the OCS and onshore as the products derived from offshore production are manufactured, distributed, and consumed. This life cycle of oil and gas products releases GHGs at each stage. The information provided in this Final Programmatic EIS is intended to give the public an overview of the life cycle emissions associated with new OCS leasing. **Table 1-2** shows the estimated GHG emissions that would be associated with five leases in the GOM Program Area; this data was developed for the PFP, which analyzed 5 and 10 lease sales in the GOM Program Area. More information on anticipated GHG emissions from leasing can be found in **Sections 2.2.2 and 2.2.3**.

Table 1-2. Estimated domestic life cycle GHG emissions based on the PFP analysis for high, mid, and low activity levels (in millions of metric tons CO_2e)

Program Area	High CO_2e-100 (USEPA)	Mid CO_2e-100 (USEPA)	Low CO_2e-100 (USEPA)	High CO_2e-100	Mid CO_2e-100	Low CO_2e-100	High CO_2e-20	Mid CO_2e-20	Low CO_2e-20
GOM (5 Sales)	1,497.47	964.42	233.80	1,499.86	965.88	234.23	1,528.30	983.24	239.24

Note: See Section 5.3 in PFP for information on the high, mid, and low activity levels. CO_2e-100 and CO_2e-20 are global warming potentials over 20 and 100 years. See **Section 2.2.1** for information on CO_2e. USEPA = U.S. Environmental Protection Agency

The analyses in this Final Programmatic EIS provide a level of detail appropriate for the decision at hand. The high-level analyses summarized in **Figure 1-4** are only intended to identify potentially significant impacts; additional analysis would occur at a later stage when detailed information on proposed activities becomes available.

The potentially significant impacts noted in **Figure 1-4** may be eliminated or reduced through mitigation, new regulations, or remedial action based on subsequent analysis of impacts to support later decisions. Consistent with CEQ guidance on programmatic reviews (Boots 2014), the analyses in this Final Programmatic EIS do not assume that mitigation measures will be taken, even though mitigation is commonly applied at later stages of the National OCS Program when site-specific information becomes available. **Appendix F** presents a sample of regulatory controls that BOEM uses to minimize or avoid these potential impacts. Two of these options were chosen by the Secretary in the PFP as mitigation measures to be applied at the programmatic level: the Live Bottom (Pinnacle Trend) and Topographic Features stipulations.

A detailed description of the analytical method and characterization of impacts is provided in **Section 4.1**.

1.3 ALTERNATIVES

This Final Programmatic EIS analyzes a full range of alternatives, from no new leasing in any planning area (Alternative A) to new leasing in 25 planning areas (Alternative D) as proposed in the Draft Proposal. This Final Programmatic EIS includes a reasonable range of alternatives that compare potential impacts across a broad range of areas to provide a clear and thorough environmental basis for decision-making. The analyses comprise national and regionally specific impact discussions that clearly show the differences in impacts between geographic areas and alternatives.

BOEM analyzed three activity levels of energy production (low, mid, and high) in the economic analysis for the PFP. In analyzing the alternatives for potential impacts, this Final Programmatic EIS assumes the high activity level, unless otherwise noted.

The Secretary's decision on where to schedule new leasing for the PFP can include entire planning areas, planning areas minus exclusion areas, or a combination. The decision, as described in **Section 1.2.3**, narrows the geographic scope of the area proposed for leasing and excludes all frontier and intermediate areas, as well as mature areas with increased potential for significant impacts.

1.3.1 Screening Process and the Range of Alternatives

This Final Programmatic EIS analyzes a reasonable range of alternatives for the Secretary to consider. The alternatives reflect input from public and internal scoping, government-to-government communications and consultations, geographic distribution of OCS planning areas, differences in oil and gas resource potential, and potential for different environmental impacts.

BOEM applied the following five screening criteria to all alternative recommendations considered:

1. Does the alternative meet the purpose of and need for the Proposed Action?
2. Is the alternative defined in relation to the size, timing, and location of lease sales (the decision to be made)?
3. Is the alternative consistent with other requirements of the OCS Lands Act (**Section 1.1**)?
4. Does the alternative have the potential to produce significant environmental impacts that are substantially different from the other alternatives?
5. Is the alternative technically and economically feasible (i.e., not implausible or speculative)?

1.3.2 Relationship of Alternatives to the PFP

The PFP and the Final Programmatic EIS have different ways of referring to areas under consideration for inclusion in the 2024–2029 Program because of the different terms used under the OCS Lands Act and NEPA. The PFP refers to the geographic areas included in the Draft Proposal, Second Proposal, and Final Proposal as "program areas." A program area represents the area within which available blocks could be offered for lease for a scheduled sale. A program area may consist of all (or portions) of a single planning area or a combination of planning areas (or portions of planning areas). The analyses in this Final Programmatic EIS are based on region, ecoregion, or planning area (**Figure 2-4**); this document does not use the term "program area" ***except*** in reference to the 2024–2029 Program and proposed lease sale areas in the GOM Program Area, where multiple planning areas or portions of planning areas have been identified for possible leasing.

Planning area: specific and spatially discrete portion of the OCS used by BOEM for administrative and planning purposes

Program area: area within which lease sales are scheduled in a National OCS Program, consisting of a single planning area (or portion of a planning area) or a combination of planning areas (or portions of planning areas)

Subarea option: option for leasing within a planning area considered in the PFP, such as a discrete area proposed for exclusion from leasing

Exclusion: all areas considered for exclusion from leasing, including subarea options and additional environmentally or culturally important areas

The PFP and Final Programmatic EIS also have different ways of referring to potential exclusion areas. The PFP analyzes "subarea options"—discrete areas smaller than a planning area—which are fundamentally exclusions of certain areas from leasing consideration. The identification of subarea options is not driven solely by environmental factors. However, the Final Programmatic EIS analyzes the subarea options to determine whether there could be a resulting reduction in potential environmental impacts. The PFP subarea options are analyzed in this Final Programmatic EIS in **Section 4.5**, which also includes analysis of additional exclusions that represent environmentally or culturally important geographic areas nominated during the public comment periods or identified by BOEM subject matter experts. The Secretary may decide to implement one or more subarea options or other exclusion nominations (collectively referred to as "exclusions" in this document) based on environmental or other considerations.

1.3.3 Description of Alternatives

1.3.3.1 Alternative A: No Action Alternative (No Leasing, 0 Planning Areas)

Alternative A is the No Action Alternative. Under Alternative A, no new lease sales would be scheduled under the 2024–2029 Program. Under Alternative A, BOEM analyzes the potential impacts of not scheduling new leasing in any of the 25 planning areas included in the Draft Proposal. The analysis of Alternative A considers (1) future baseline conditions if no leasing occurs under the 2024–2029 Program and (2) direct and indirect impacts that could occur *because* no new lease sales are scheduled during that time period. Alternative A considers how the environment could change in the 25 planning areas included in the Draft Proposal over 40 to 70 years, which corresponds to the duration of activities that could stem from any leasing that takes place under the 2024–2029 Program. The "future baseline conditions" in **Chapter 2** describe expected changes to the environment, over time, absent 2024–2029 Program activities.

BOEM estimates that 0.7 to 4.6 billion barrels of oil equivalent (BBOE) of OCS energy production may be forgone under Alternative A relative to a five GOM lease sale scenario, with an estimated 2.97 BBOE of forgone OCS energy production under the mid activity scenario. Future consumption of oil and gas may be less than forecasted because of the need to meet national GHG emissions reduction policies requiring substantial reductions of GHG emissions by 2030 and net-zero emissions by 2050 (**Section 2.2.4**). Production for the other alternatives is estimated to be higher than for the five GOM lease sale scenario (**Section 4.2**).

Forgone OCS production may be replaced by reduced demand and a combination of energy substitutes, such as oil imports; increased onshore oil and gas development; wind, solar, and other renewable energy; nuclear energy; and coal. BOEM estimates the proportion of primary energy substitutes (assuming that current patterns of energy consumption continue into the future) that may replace OCS oil and gas production potentially forgone if leasing proposed in the Draft Proposal does not occur: oil imports at 57%, onshore oil and gas at 23%, reduced demand at 10%, and other sources at 10%.

Section 4.2.1 discusses the expected proportion of energy demand met by each substitute in a scenario based on current energy consumption patterns only incorporating changes likely needed to achieve GHG targets if they are currently being implemented, as well as the OCS areas most likely to be impacted by activities related to that substitute. **Section 4.2.1** also provides information on how substitutes are calculated.

1.3.3.2 Alternative B: 6 Planning Areas

Under Alternative B, the 2024–2029 Program would include planning areas in Alaska where leasing has occurred since 2007 and the GOM Region (**Figure 1-5**). These areas are the Chukchi Sea, Beaufort Sea, and Cook Inlet Planning Areas in the Alaska Region and the Western, Central, and Eastern GOM Planning Areas not subject to withdrawal.

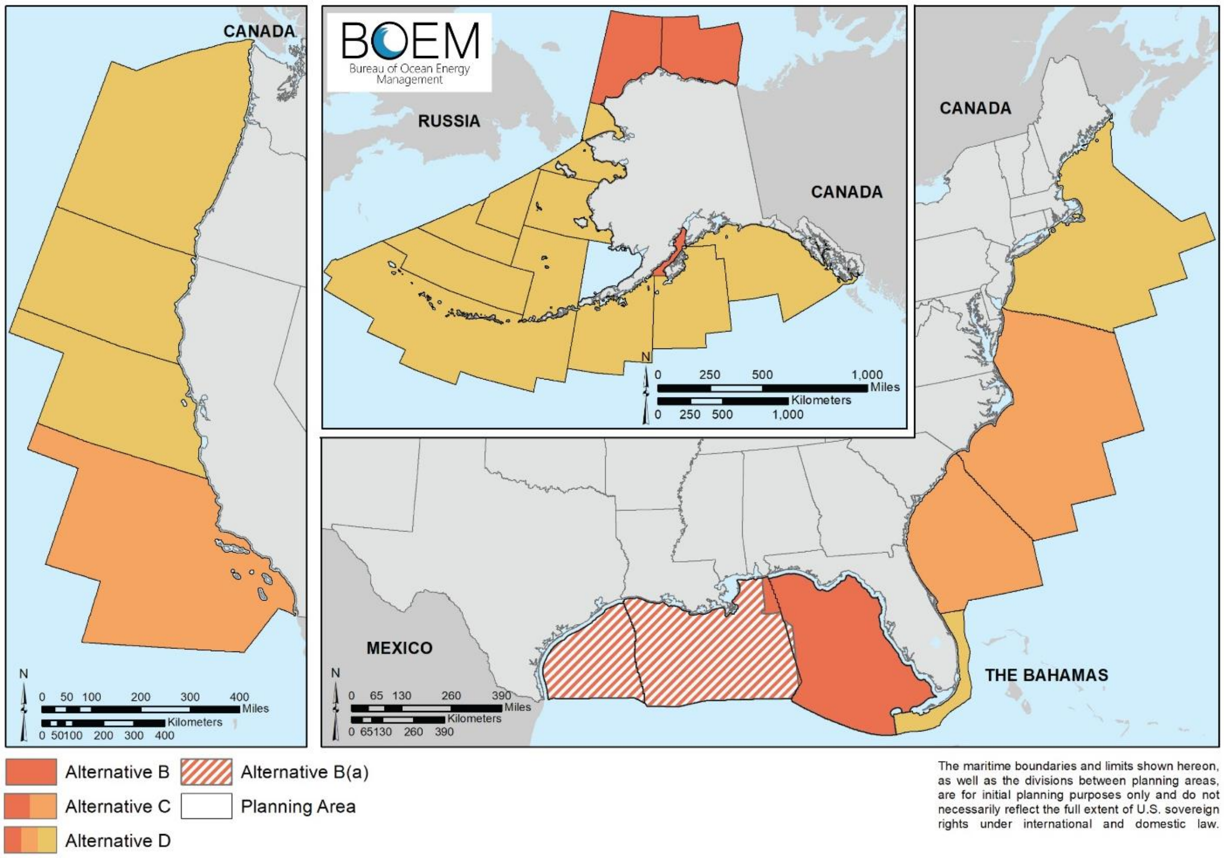
Alternative B(a): This subalternative is the Proposed Action and includes the areas identified for potential leasing in the Final Proposal presented in the PFP: the GOM Program Area (which contains the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area not withdrawn from consideration for leasing under Section 12(a) of the OCS Lands Act) (**Figure 1-2**).

1.3.3.3 Alternative C: 9 Planning Areas

Under Alternative C, the 2024–2029 Program would include the planning areas in Alternative B *plus* the Mid-Atlantic, South Atlantic, and Southern California Planning Areas (**Figure 1-5**).

1.3.3.4 Alternative D: 25 Planning Areas

Under this alternative, the 2024–2029 Program would include the 25 planning areas proposed in the Draft Proposal (**Figure 1-5**).



Alternative A	Alternative B	Alternative C	Alternative D
None	**Alaska Region** Chukchi Sea Beaufort Sea Cook Inlet + **Gulf of Mexico Region** Western Gulf of Mexico Central Gulf of Mexico Eastern Gulf of Mexico	**All of Alternative B** + **Pacific Region** Southern California + **Atlantic Region** Mid-Atlantic South Atlantic	**All of Alternative B and C** + **Alaska Region** Hope Basin Norton Basin St. Matthew-Hall Navarin Basin Aleutian Basin Bowers Basin St. George Basin Aleutian Arc Shumagin Kodiak Gulf of Alaska + **Pacific Region** Northern California Central California Washington/Oregon + **Atlantic Region** North Atlantic Straits of Florida

Figure 1-5. Areas included in Alternatives B–D
Alternatives are additive; areas in Alternative B are also included in Alternative C, and so forth.

1.3.4 Alternatives Considered but Eliminated from Programmatic Evaluation

The CEQ regulations implementing the procedural requirements of NEPA require agencies to rigorously explore and evaluate reasonable alternatives (40 CFR 1500–1508). Alternatives considered but not analyzed in this Final Programmatic EIS, and the reasons for eliminating these potential alternatives from detailed consideration, are as follows:

- **Holding additional OCS lease sales beyond the geographic area of those sales proposed in the Draft Proposal.** During development of the DPP, the Secretary considered all 26 planning areas and proposed including 25 planning areas (**Figure 1-5**). More than one lease sale was proposed in all planning areas that have mid to high resource potential. The one planning area that was not included (the North Aleutian Basin Planning Area) was the only one at the time that was definitively withdrawn from consideration for leasing pursuant to Section 12(a) of the OCS Lands Act and was thus unavailable for leasing.
- **Changing the timing of OCS lease sales in the Draft Proposal**. Changing the timing of lease sales within a five-year period has limited consequence on the onset and duration of impacts because OCS activities resulting from new lease sales are expected to begin and occur at variable points in time over the 40- to 70-year program horizon. Expediting or delaying the timing of lease sales in a single year or until later in the 2024–2029 Program has limited impact on the effects expected or their significance given the long OCS exploration, development, and production cycle.
- **Delaying OCS lease sales pending new technological developments or regulatory reforms**. Technologies, safety standards, and industry practices evolve continually, and Federal agencies regularly revise regulations. The OCS Lands Act's staged decision-making process provides opportunity to incorporate new technologies, standards, practices, and regulations at each stage (**Figure 1-1**). Furthermore, under the OCS Lands Act and the terms of issued leases, lease activities are subject to new or revised regulations and application of best available science and technology. Therefore, an alternative to delay lease sales pending development of new technology or regulatory reform would not produce different impacts than the alternatives already analyzed. Such an alternative would result in impacts that are essentially the same as those from the No Action Alternative (Alternative A).
- **Development of renewable energy sources as a complete or partial energy substitute.** BOEM recognizes that wind and other renewable energy sources are a critical part of the national energy policy, but an alternative that considers renewable energy sources as a complete or partial substitute for OCS oil and gas resources would not meet the purpose of the Proposed Action for this PFP. As stated in **Section 1.2.1**, that purpose is to set a schedule of OCS oil and gas lease sales for 2024–2029. The OCS Lands Act provides that the Secretary shall "prepare and periodically revise ... an oil and gas leasing program" consisting of "a schedule of proposed lease sales indicating ... leasing activity which [s]he determines will best meet national energy needs." For the reasons described in Section 1.2.1, the Secretary has determined that, for this program, oil and gas production are necessary to meet those needs.

- **Excluding OCS leasing in a given region, planning area, or area offshore a specific state.** The Final Programmatic EIS analyzes alternatives that range in scope from 0 planning areas to the 25 planning areas included in the Draft Proposal schedule. This range of alternatives considers the exclusion or inclusion of any of the four regions and any of the 25 planning areas. Likewise, the Secretary, through selecting a feature of one of the existing alternatives in combination with others, can also exclude an area offshore a specific state when balancing all Section 18 factors. Therefore, it is unnecessary to analyze the exclusion of a particular planning area or the area offshore a specific state as a separate alternative.
- **Excluding OCS leasing in certain sensitive areas within planning areas.** The Secretary can exclude certain environmentally or culturally sensitive geographic areas within the planning areas and alternatives analyzed based on information and impact assessment in the Final Programmatic EIS. This Final Programmatic EIS analyzes the exclusion of all OCS planning areas (Alternative A) and the exclusion of some of these areas in other action alternatives (Alternatives B–D). In addition, **Section 4.5** explains the consideration of all subarea exclusion nominations received and analyzes specific areas for potential exclusion based on environmental importance or sensitivity, as well as the potential to mitigate or avoid impacts. The Secretary may exclude any of these nominated areas in conjunction with selection of any alternative. Therefore, it is unnecessary to analyze each nomination for exclusion of a sensitive area as a separate alternative.
- **Holding onshore lease sales instead of offshore lease sales.** Section 18 of the OCS Lands Act requires the Secretary to prepare, periodically revise, and maintain an *offshore* oil and gas leasing program. A schedule of onshore lease sales would not meet the purpose of the Proposed Action. Additionally, such an alternative would be duplicative of the No Action Alternative and its substitution analysis of, among other sources, onshore oil and gas production.

1.4 ORGANIZATION OF THE FINAL PROGRAMMATIC EIS

Each chapter in this Final Programmatic EIS has a unique focus:

- **Chapter 2** depicts the current and future baseline conditions of the affected environment. Implementation of a National OCS Program may unfold over 40 to 70 years, so this chapter describes the affected environment in terms of both present conditions and future conditions. This chapter provides an overview of climate change and its relationship with a National OCS Program. The chapter also introduces IPFs, which are the 2024–2029 Program-related activities or processes that could affect environmental, sociocultural, or socioeconomic resources.
- **Chapter 3** presents illustrations depicting the affected environment and environmental consequences analyzed for the 2024–2029 Program. The graphics and captions broadly characterize the environments and impacts discussed in **Chapters 2 and 4**.
- **Chapter 4** analyzes the potential effects of routine activities and accidental events that could occur from the Proposed Action and alternatives and describes how IPFs could cause potentially significant impacts in different OCS planning areas. This chapter provides a comparison of

alternatives and describes the potential cross-boundary and cumulative effects that could occur under each alternative. Finally, this chapter analyzes the change in impacts that could result from the withdrawal of areas under OCS Lands Act Section 12(a) or potential exclusion of certain areas (smaller than planning areas) from leasing to help avoid or minimize potential impacts on sensitive or unique resources.

- **Chapter 5** describes BOEM's public involvement and scoping process. This process results in input from BOEM subject matter experts; local, state, Federal, and Tribal governments; and the public.
- **Appendix A** discusses impacts that are not expected to be significant.[7]
- **Appendices B through N** provide more information to support this Final Programmatic EIS.

1.5 INCOMPLETE AND UNAVAILABLE INFORMATION

BOEM prepared this Final Programmatic EIS using the best scientific information available, including over 40 years of research funded by BOEM's Environmental Studies Program (ESP) (see **Appendix J** for a list of representative studies). As mandated by Section 20 of the OCS Lands Act, BOEM's ESP develops, funds, and manages rigorous scientific research specifically to inform policy decisions on the development of energy and mineral resources on the OCS. Major research areas include physical oceanography, atmospheric sciences, biological sciences, protected resources, fisheries, anthropology, socioeconomics, archaeological and cultural resources, and environmental fates and effects.

When relevant information was incomplete or unavailable, BOEM evaluated the need for the information to determine if it was essential to making a reasoned choice among alternatives (40 CFR 1502.22). If so, for addressing this uncertainty, BOEM either acquired that information (e.g., through BOEM's ESP) or, if it was impossible or exorbitantly expensive to acquire, BOEM employed existing, credible, and relevant scientific evidence and generally accepted theoretical approaches and research methods. This Final Programmatic EIS describes, where applicable, incomplete and unavailable information and the scientific methodologies used.

1.6 COST-BENEFIT ANALYSIS

The Section 18 analysis in the PFP includes an estimate of the benefits and costs from proposed OCS lease sales. BOEM's net benefits analysis in Section 5.3 of the PFP contrasts the net benefits of leasing and not leasing in each of the planning areas included in the Second Proposal. For a discussion of the net benefits of leasing and not leasing in the areas that are analyzed in this Programmatic EIS but not included in the Second Proposal, see the Proposed Program and Draft Programmatic EIS. Pursuant to CEQ regulation § 1502.23, the net benefits analysis, found in Section 5.3 of the PFP, is incorporated by reference and summarized here.

[7] This approach conforms to the CEQ's regulations for implementing NEPA (40 CFR 1500–1508) encouraging Federal agencies to de-emphasize insignificant issues and instead focus on those issues most pertinent to the analysis and subsequent decision.

The net benefits analysis is presented as an *incremental analysis*—it estimates the incremental difference in net benefits of the 2024–2029 Program versus those of Alternative A. The analysis has four components: incremental net economic value (NEV), incremental environmental and social costs, incremental social costs of GHG emissions, and consumer surplus net of producer transfer.

The NEV of the 2024–2029 Program is calculated as the revenue from OCS production less the private costs of extracting the resources and an adjustment for foreign profits. The incremental NEV is derived by subtracting the estimated NEV of the displaced energy substitutes that may occur under Alternative A from the NEV of the 2024–2029 Program.

The second component of the net benefits analysis uses the Offshore Environmental Cost Model (OECM) to estimate incremental environmental and social costs as the difference in (1) costs of activities associated with the 2024–2029 Program and (2) those of the energy substitutes that may be displaced through energy markets under Alternative A by production from the 2024–2029 Program (Industrial Economics Inc. 2018; 2023b). The OECM considers the impacts associated with OCS production activity and oil spills for six cost categories: (1) recreation, (2) air quality, (3) property values, (4) subsistence harvests, (5) commercial fishing, and (6) ecological impacts. Although these six categories of impacts capture most of the environmental and social costs associated with oil and gas activities, they only reflect costs that can be quantified. Costs that cannot be quantified are not included because they do not directly relate to a monetary value, or quantification is speculative. Unquantifiable impacts are summarized below.

The third component of the net benefits analysis is an estimate from the PFP of the incremental social cost of GHG emissions resulting from upstream exploration, development, and production.

The fourth component, the change in domestic consumer surplus net of producer transfers, includes the benefit consumers receive from slightly lower-priced energy resources (over Alternative A), less the reduced revenue to domestic producers as a result of the same low prices.

The net benefits analysis does not quantify all potential costs and benefits of the Proposed Action or alternatives. The regulations (40 CFR 1502.23) require that the Final Programmatic EIS discuss the "relationship between the [cost-benefit] analysis and any analyses of unquantified environmental impacts, values, and amenities." Non-monetized costs and benefits not presently captured in the cost-benefit model are described qualitatively in **Chapter 4** and also in Industrial Economics Inc. (2023b), Industrial Economics Inc. (2018), BOEM (2022c), and BOEM (2023b).

The following summarizes the unquantified costs and benefits in the net benefits analysis:

- The net benefits analysis quantifies animal mortality and lost habitat through a habitat equivalency analysis (where costs are estimated in terms of the expense to restore or re-create damaged habitat) but does not quantify value above the restoration cost at which society could value the damaged resource. In other words, the analysis does not monetize impacts on unique resources based on rareness or protected status. Additional information is provided in Industrial Economics Inc. (2018; 2023b).

- As discussed, the net benefits analysis includes monetized impacts on ecological resources through oil spills but does not monetize the impacts on these resources from general operations. For example, the analysis does not capture costs from impacts on habitats or organisms from waste cuttings and drilling muds deposited on the seafloor near OCS structures during their construction, operation, or removal; auditory impacts and vessel strikes to marine mammals; or water quality impacts associated with produced water discharged from wells or non-oil discharges from platforms and vessels. The equivalent environmental effects from operations are qualitatively addressed by resource category in **Chapter 4**. For each of these impact categories, key information that would be required to identify, quantify, and monetize impacts is not readily available (e.g., sediment damage to benthic communities per well drilled, relationship between seismic surveying and marine mammal reproduction).
- The net benefits analysis generally does not quantitatively address environmental impacts (beneficial or adverse) related to the construction and operation of onshore infrastructure to support OCS activities. Estimation of other onshore infrastructure impacts in the net benefits analysis would require detail on onshore development that is unknown at the programmatic stage and would be analyzed at the lease sale stage EIS. Industrial Economics Inc. (2018) describes the potential environmental and social costs and benefits associated with onshore infrastructure.

As described above, the third component of the net benefits analysis includes the monetized effects of GHG emissions from exploration and production activities. BOEM also considers the mid- and downstream emissions from OCS leasing and the energy market substitutes in Chapter 5 of the PFP and in Chapter 2 of the *Final Economic Analysis Methodology for the 2024–2029 National Outer Continental Shelf Oil and Gas Leasing Program* (Final EAM) (BOEM 2023b).

As discussed, the net benefits analysis considers the impacts associated with OCS activities less the costs of energy substitutes under Alternative A. Major impacts from OCS activities are included in the net benefits analysis, and the same focused approach is taken with costs associated with Alternative A. The analysis of Alternative A does not account for the ecological costs associated with increased terrestrial oil spills; pollution from produced water discharges associated with increased onshore oil and gas production; increased emissions and increased oil spill risk associated with transporting onshore oil; air emissions associated with the production of biomass energy sources; nor ecosystem and health damages related to releases from coal mines. More information on these costs is included in Industrial Economics Inc. (2018; 2023b).

Chapter 2:

Affected Environment

2.1 INTRODUCTION

This chapter describes the affected environment—the areas and resources potentially affected by activities under the 2024–2029 Program. The affected environment considers both ***current*** conditions and anticipated ***future baseline*** conditions (**Figure 2-1**). Future baseline conditions reflect changes to the current conditions that could occur in the absence of the 2024–2029 Program.

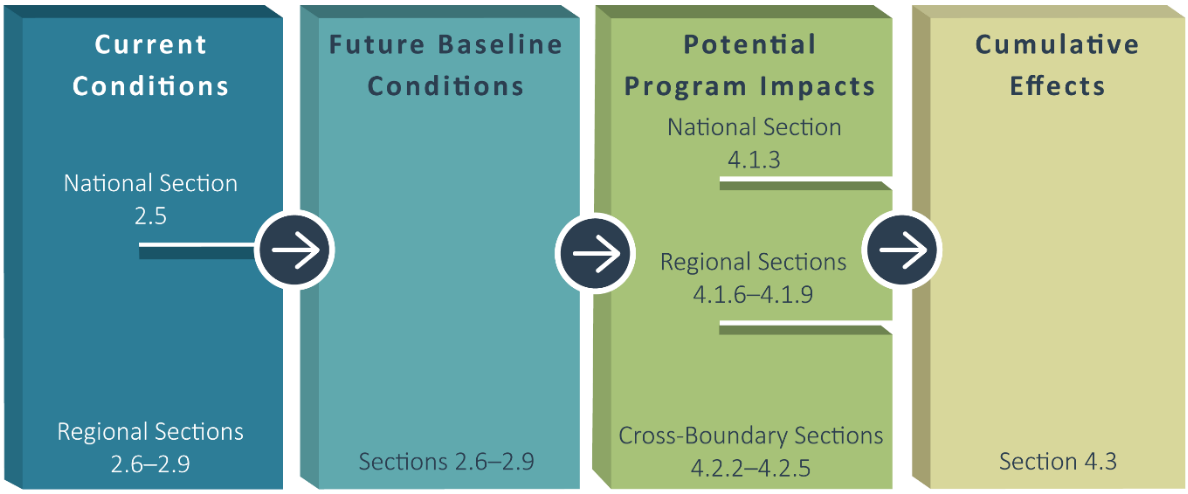


Figure 2-1. Organization of the affected environment and environmental consequences

This Final Programmatic EIS uses the following key terms:

Affected Environment	Physical, biological, and sociocultural resources potentially affected over the next 40 to 70 years (the timeframe when 2024–2029 Program activities could occur). Includes current conditions and future baseline conditions.
Current Conditions	Existing conditions and ongoing trends resulting from past and present actions. Includes separate discussions of nationally and regionally specific resources and trends.
Future Baseline Conditions	State of the environment over the next 40 to 70 years without the activities associated with leasing under the 2024–2029 Program. Considers the impacts of ongoing and future stressors, both anthropogenic and naturally occurring.

Future baseline conditions are predicted by considering the current baseline and likely current and future stressors that may change this baseline over time (**Figure 2-2**). Impacts of leasing under the 2024–2029 Program may occur for 40 to 70 years into the future, depending on the region, so the analysis of impacts for all the alternatives comes from consideration of future baseline conditions.

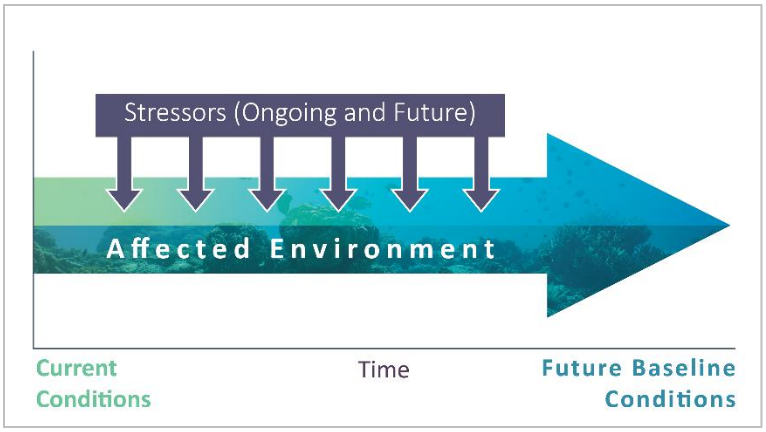


Figure 2-2. Ongoing and future stressors influence current conditions to produce future baseline conditions

The discussion of the affected environment flows from larger to smaller geographic scale to streamline the analysis and reduce repetition. Impacts that occur nationally are discussed first and not revisited at the regional level unless there is information unique to that region.

To help navigate the flow of this discussion, the list below describes the purpose of each section and demonstrates how the analysis progressively narrows in scale.

- Overview of climate change and its relationship to the programmatic analyses (**Section 2.2**)
- Geographic scale of analysis and environments considered (**Section 2.3**)
- Definitions for resources, stressors, and oil and gas IPFs (**Section 2.4**)
- High-level overview of the affected environment and attributes common across all OCS regions, including ongoing and future stressors (**Section 2.5**)
- Regionally unique aspects of the affected environment, organized by current conditions and followed by future baseline conditions (**Sections 2.6 to 2.9**); supplements the high-level national overview and includes only regional distinctions

2.2 CLIMATE CHANGE

Due to its global nature and complexity, climate change is discussed first in this overview section and then throughout the Final Programmatic EIS as it relates to a proposed OCS leasing program alternative or to various analyses. This section also addresses the potential contributions to climate change from a proposed leasing program, as well as substitute sources of energy in the absence of new OCS leasing.

Climate change results primarily from the increasing concentration of GHGs in the atmosphere, which causes planet-wide physical, chemical, and biological changes that substantially affect the world's oceans, lands, and atmosphere. This Final Programmatic EIS discusses climate change as a stressor because changes in the Earth system place stress on environmental resources globally. However, this ever-evolving environment also becomes a new and changing baseline. Thus, climate change acts synergistically with IPFs related to OCS activity to affect marine resources and the people who rely on them.

> The most recent National Climate Assessment puts the climate crisis in stark terms: "Climate change threatens many benefits that the natural environment provides to society: safe and reliable water supplies, clean air, protection from flooding and erosion, and the use of natural resources for economic, recreational, and subsistence activities. Valued aspects of regional heritage and quality of life tied to the natural environment, wildlife, and outdoor recreation will change with the climate, and as a result, future generations can expect to experience and interact with natural systems in ways that are much different than today. Without significant reductions in GHG emissions, extinctions and transformative impacts on some ecosystems cannot be avoided, with varying impacts on the economic, recreational, and subsistence activities they support."
> (U.S. Global Change Research Program 2018)

This broad warning plays out in different ways in each OCS region. The following **four examples** provide a glimpse into the types of impacts being felt across the Nation's oceanic and coastal areas. These examples illustrate projected changes and potential harm to the physical, biological, and human environments expected as a result of climate change. For a more complete discussion of climate change see Intergovernmental Panel on Climate Change (2021) and U.S. Global Change Research Program (2018).

Alaska Region Example: The thawing of long-frozen ground, known as permafrost, has far-reaching consequences. As permafrost melts, it leaves behind soil that can become unstable. This melting can damage or destroy buildings, roads, power lines, archaeological sites, and cultural properties (Hong et al. 2014) constructed on the now-thawed permafrost. Melting glaciers wash the loose soil and associated nutrients into streams, rivers, and oceans, degrading water quality (Toohey et al. 2016). The thawing also releases methane, which adds additional GHGs to the atmosphere (Taylor et al. 2018), creating a feedback loop in which climate change results in additional GHG emissions. Alaska is projected to continue rapidly warming, and these impacts are likely to accelerate (Melvin et al. 2017). These kinds of changes to the physical environment can radically alter ecosystems and change the places in which people live, work, and recreate.

Pacific Region Example: The warming climate along the Pacific Coast has increased the temperature of freshwater streams, making local salmon populations more susceptible to predators, parasites, and disease. Rising temperatures also reduce snowpack, lowering water levels of rivers and streams and making it more difficult for salmon to travel and hide from predators. Tribes and Indigenous peoples affiliated with this region refer to themselves as "Salmon People," are inextricably interconnected with the native populations of Pacific salmon, and have deeply rooted cultural identities and vital subsistence practices tied to salmon (Colombi 2012; Marshall McLean 2018). These types of connections to local resources are threatened as climate change alters regional ecosystems.

GOM Region Example: Along the GOM Coast, rising sea level and increasing temperatures contribute to changes in wetland habitats and the species that depend on those habitats. Due to decreasing frequency of extreme cold events, mangrove forests are expanding northward and replacing another wetland habitat—salt marshes (Cavanaugh et al. 2019). Additionally, the rise in sea level is turning many wetlands along the GOM Coast into open-water areas and bringing more saltwater further inland

(Romañach et al. 2019; Törnqvist et al. 2020). Wetlands protect the coastline; store carbon; provide critical habitat to several species of fish, invertebrates, and birds; and provide recreational opportunities, such as hunting or fishing. Without wetlands, the coastline may become more susceptible to climate change-related impacts, such as higher storm surge, flooding, and erosion. Wetland habitat is critical to protecting a coastline that is expected to receive stronger hurricanes over the coming decades. The loss of wetlands can cause shifts in species ranges, reduce access to fishery resources, and expose coastal communities to increased storm effects.

Atlantic Region Example: The 2020 stock assessment conducted by the Atlantic States Marine Fisheries Commission showed robust lobster stock in the Gulf of Maine and Georges Bank, but Southern New England continued to experience recruitment failures and record low lobster stocks, which have been in decline since 2012. The differing statuses are likely due to a combination of factors, including fishing pressure and climate change. Water temperatures, oceanographic features, and other environmental factors are all affected by climate change and may be driving a shift in lobster distribution, habitat use, recruitment, and populations (Atlantic States Marine Fisheries Commission 2020). Consequently, shifts in stocks could threaten the livelihoods and way of life of some New England fishing communities. Environmental pressures caused by climate change can impact the resources on which local communities depend.

Climate change poses a significant global threat. There is scientific consensus and confidence, as illustrated by a recent report from the Intergovernmental Panel on Climate Change (IPCC) that avoiding the most severe climate impacts by limiting global warming to 1.5°C will require reducing global GHG emissions to net zero by 2050 (Intergovernmental Panel on Climate Change 2021). Net-zero emissions is defined as zero emissions of GHGs or an economy that emits no more GHGs into the atmosphere than are permanently removed and stored each year (Larson et al. 2021).

The International Energy Agency called for an end to all new fossil fuel leasing globally in 2021 if the world is to achieve net-zero GHG emissions by 2050 (International Energy Agency 2021). Chapter 4 of the Final EAM includes a discussion on future changes in energy laws and policies as the U.S. progresses towards its climate goals for a net-zero emissions economy. The chapter also provides a qualitative discussion of the different domestic net-zero pathways and summarizes sensitivity analyses for the impacts on BOEM's net-zero and GHG analyses, assuming changes to U.S. laws and policies will be implemented.

2.2.1 Causes of Climate Change

Key drivers of climate change are increasing atmospheric concentrations of carbon dioxide (CO_2) and other GHGs, such as methane (CH_4) and nitrous oxide (N_2O). These GHGs reduce the ability of solar radiation to re-radiate out of Earth's atmosphere and into space. All three of these GHGs have natural sources, but the majority of these GHGs are released from anthropogenic activity. Since the industrial revolution, the rate at which solar radiation is re-radiated back into space has slowed, resulting in a net increase of energy in the Earth's system (Solomon et al. 2007). This energy increase presents as heat, raising the planet's temperature and causing climate change.

Each GHG affects the atmosphere slightly differently. Some remain in the atmosphere for centuries; others cycle out quickly. Similarly, each GHG has a different ability to prevent solar radiation from escaping the Earth's system, making it difficult to compare different types of GHG emissions. A common technique to address this challenge is to mathematically convert all GHGs into the quantity of CO_2 that would have to be released to have the same effect, frequently referred to as the 100-year CO_2 equivalent, or CO_2e-100. For example, one ton of CH_4 from fossil sources is estimated to have 30 times the global warming potential of CO_2, so one ton of CH_4 is 30 tons CO_2e-100. **Table 2-1** lists global warming potentials of each GHG.

Table 2-1. Global warming potential (in metric tons of CO_2e)

Greenhouse Gas	EPA 100-Year Global Warming Potential (CO_2e)	IPCC 100-Year Global Warming Potential (CO_2e-100)	IPCC 20-Year Global Warming Potential (CO_2e-20)
CO_2	1	1	1
CH_4*	25	30	83
N_2O	298	273	273

Source: USEPA (2021a) and Intergovernmental Panel on Climate Change (2021)
Note: * From fossil sources

Black carbon is a specific kind of fine particulate matter ($PM_{2.5}$) and contributes to Earth's rising surface temperature. Black carbon is a byproduct of burning fossil fuels but can also form through chemical reactions in the atmosphere. It is dark relative to most surfaces, absorbing more solar energy than lighter surfaces. When black carbon lands on snow or ice, it causes melting and exposes a larger area of the ground, which can further increase absorption of solar radiation. Thus, black carbon emitted in the Arctic has a greater impact than black carbon emitted in warmer climates.

Ozone (O_3) protects life when high in the atmosphere but contributes to climate change when present at ground level. It is formed through chemical reactions in sunlight between nitrogen oxides and volatile organic compounds. These two types of chemicals are known as precursors. Both are released when fossil fuels are consumed.

Fluorinated gases are a type of GHG released in trace amounts but are highly efficient at preventing solar radiation from being re-radiated back into space. They have a much longer lifespan than CO_2, CH_4, and N_2O. Fluorinated gases have no natural sources, are either a product or byproduct of manufacturing, and can have 23,000 times the warming potential of an equal amount of CO_2. These gases include hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride, and sulfur hexafluoride. These gases are currently being phased out of the global economy (United Nations 2016).

Several of the pollutants discussed above are known as short-lived climate pollutants, and BOEM can estimate life cycle emissions for some of them, such as CH_4, while others are more complicated. BOEM estimates $PM_{2.5}$ and O_3 precursor emissions for new offshore activity as part of the air quality analysis (**Appendix C**). However, it is not possible to estimate the impact of $PM_{2.5}$ given the challenges of knowing where mid- and downstream activity occurs and the importance of knowing the brightness of surfaces near where fuels are consumed. Similarly, it is not possible for the BOEM to estimate O_3 formation on the OCS at the programmatic stage, although it may be possible to do so at later stages in the National OCS Program, i.e., during the air quality plan approval stage for GOM lease sales and the air quality permit process for Cook Inlet. At no point during the program will BOEM be able to estimate $PM_{2.5}$ or O_3 formation for the midstream and downstream.

2.2.2 GHG Emissions Estimates

The activities associated with offshore oil and gas development release GHG emissions—primarily CO_2, but also CH_4 and N_2O. Examples of these activities include the use of vessels and drilling equipment, and other activities that burn fossil fuels during construction, operations, maintenance, and decommissioning. Emissions from these activities are commonly referred to as *upstream emissions*. **Table 2-2** shows the estimated total upstream emissions associated with the Draft Proposal for new oil and gas development on the OCS. Recognizing the wide range of possible future scenarios, BOEM presents the high, mid, and low activity levels to show a range of possible emission volumes, reflecting the inherent uncertainty in any GHG analysis. A complete explanation of this analysis is available in the Final EAM.

Table 2-2. Estimated upstream GHG emissions from new leasing by program area (in millions of metric tons CO_2e)

Program Area	High CO_2e-100 (USEPA)	Mid CO_2e-100 (USEPA)	Low CO_2e-100 (USEPA)	High CO_2e-100	Mid CO_2e-100	Low CO_2e-100	High CO_2e-20	Mid CO_2e-20	Low CO_2e-20
Cook Inlet	4.46	3.71	0.72	4.46	3.72	0.73	4.56	3.81	0.74
GOM (5 Sales)	16.75	9.51	2.66	17.02	9.61	2.72	20.00	10.83	3.40
GOM (10 Sales)	32.54	13.32	2.66	33.00	13.50	2.72	38.17	15.55	3.40

Note: For more information, see the Final EAM.

On the other hand, if the lease sales were to *not* occur, **Table 2-3** shows estimated upstream emissions from substituted sources. This analysis assumes current policies and laws remain in place. Thus, the analysis assumes energy consumption patterns that do not incorporate possible future changes necessary to meet domestic and global GHG emissions reduction targets. This assumption results in estimates that are both highly uncertain and likely very conservative. However, BOEM is presenting the estimated numbers because they are higher than emissions likely would be if new requirements were put into place to achieve established emissions reduction targets. Therefore, these estimates provide for agency and public review of a "worst-case" level of emissions and corresponding cost. If the U.S. makes progress towards reducing its overall use of fossil fuels by replacing them with lower emitting sources of energy, then substitute sources of energy for OCS oil and gas production would also shift. This shift is anticipated to result in emissions that are lower than those shown in **Table 2-3**, which presents the "business as usual" substitute emissions estimates.

Table 2-3. Estimated upstream GHG emissions from substitute sources by program area (in thousands of metric tons CO_2e)

Program Area	High CO_2e-100 (USEPA)	Mid CO_2e-100 (USEPA)	Low CO_2e-100 (USEPA)	High CO_2e-100	Mid CO_2e-100	Low CO_2e-100	High CO_2e-20	Mid CO_2e-20	Low CO_2e-20
Cook Inlet	10.39	9.77	0.62	11.06	10.39	0.67	18.18	17.00	1.19
GOM (5 Sales)	196.73	126.93	30.11	209.43	135.13	32.06	344.57	222.38	52.82
GOM (10 Sales)	392.71	169.24	30.11	418.05	180.18	32.06	687.50	296.50	52.82

Note: For more information, see the Final EAM.

Several studies have suggested that CH_4 emissions from shallow-water facilities and facilities in state waters in the GOM are emitting significantly more than they are reporting (Ayasse et al. 2020; Gorchov Negron et al. 2023; Gorchov Negron et al. 2020); one case was confirmed by the Office of Inspector General (2022). Although it is possible that new shallow-water facilities could result from the 2024–2029 Program, most new lease sales are in deeper water, where similar studies have shown more accuracy in reported CH_4 emissions. This insight is important because the models BOEM uses to estimate upstream GHG emissions are based on reported data. However, as mentioned by Gorchov Negron et al. (2023), facility-level data "can skew interpretation" because of the differences between their short-duration measurements (< 24 hours) and the monthly facility-level emissions in the Federal inventories. Furthermore, a BOEM study investigated the emission inventory data and calculation methods between calendar years 2017 and 2021 and did not identify any substantive discrepancies for CH_4 (Thé et al. 2023).

The GOM has a very low GHG intensity, meaning that extracting the same amount of oil and gas in the GOM releases fewer GHGs compared to other domestic and foreign oil and gas operations. The deepwater GOM's low GHG intensity is due to several factors, including restrictions on venting and flaring of OCS natural gas, the prevalence of medium API gravity crude oil in the area, and the efficiencies available with larger development facilities. For more on GHG intensity see Section 1.2 in the PFP.

2.2.3 Life Cycle GHG Emissions Estimates

BOEM uses the Greenhouse Gas Life Cycle Energy Emissions Model (Wolvovsky 2023) and OECM (Industrial Economics Inc. 2018; 2023b) to estimate GHG emissions over the entire OCS oil and gas production and consumption life cycle. Therefore, the estimates include consumption (i.e., downstream) and onshore processing and storage of oil and gas products (i.e., midstream). When combined with the upstream emissions discussed in **Section 2.2.2**, these three stages constitute the full life cycle and account for GHG emissions associated with activities that may occur as a result of the approval of a National OCS Program and subsequent non-OCS activities (**Figure 2-3**).

Figure 2-3. Oil and gas production and consumption life cycle

Table 2-4 shows the total domestic life cycle emissions and social costs for each region under a leasing scenario (e.g., the Proposed Action). Emissions are highest in program areas expected to have higher levels of oil and gas production. These emissions are also significantly higher than those in the upstream alone, demonstrating that the vast majority of GHG emissions occur in the mid- and downstream. More information can be found in the Final EAM.

Table 2-4. Estimated life cycle GHG emissions (in millions of metric tons CO_2e) and social cost of GHGs (in billions of 2022 dollars) from new leasing by program area

GHG Emissions Domestic Life Cycle

Program Area	High CO_2e-100 (USEPA)	Mid CO_2e-100 (USEPA)	Low CO_2e-100 (USEPA)	High CO_2e-100	Mid CO_2e-100	Low CO_2e-100	High CO_2e-20	Mid CO_2e-20	Low CO_2e-20
Cook Inlet	83.53	70.04	13.47	83.66	70.08	13.57	85.28	70.68	14.58
GOM (5 Sales)	1,497.47	964.42	233.80	1,499.86	965.88	234.23	1,528.30	983.24	239.24
GOM (10 Sales)	2,993.97	1,286.55	233.80	2,998.69	1,288.52	234.23	3,054.76	1,312.10	239.24

Social Cost of Carbon

Program Area	High	Mid	Low
Cook Inlet	3.81	3.17	0.66
GOM (5 Sales)	68.69	44.91	10.94
GOM (10 Sales)	136.54	59.90	10.94

Notes: For more information, see the Final EAM. The social costs of GHGs presented in this table are based on estimates that assume an average level of statistical damages and a 3% discount rate (Interagency Working Group on Social Cost of Greenhouse Gases 2021).

BOEM considers the potential impact of new OCS lease sales on estimated emissions compared with the emissions from substitute energy sources if leasing were not to occur. **Table 2-5** provides a scenario for estimated life cycle emissions from substituted sources of emissions calculated using baseline information from the *2023 Annual Energy Outlook* (EIA 2023a).

Table 2-5. Estimated life cycle GHG emissions (in millions of metric tons CO_2e) and social cost of GHGs (in billions of dollars) from substitute sources when leasing does not occur in each program area

GHG Emissions Domestic Life Cycle

Program Area	High CO_2e-100 (USEPA)	Mid CO_2e-100 (USEPA)	Low CO_2e-100 (USEPA)	High CO_2e-100	Mid CO_2e-100	Low CO_2e-100	High CO_2e-20	Mid CO_2e-20	Low CO_2e-20
Cook Inlet	79.57	70.39	9.09	80.33	71.04	9.19	88.51	78.10	10.32
GOM (5 Sales)	1,495.84	966.76	232.13	1,509.97	975.86	234.33	1,662.76	1,074.40	258.08
GOM (10 Sales)	2,980.64	1,288.76	232.13	3,008.76	1,300.90	234.33	3,312.92	1,432.27	258.08

Social Cost of Carbon

Program Area	High	Mid	Low
Cook Inlet	3.70	3.25	0.45
GOM (5 Sales)	69.59	45.64	11.01
GOM (10 Sales)	137.83	60.84	11.01

Notes: For more information, see the Final EAM. The social costs of GHGs presented in this table are based on estimates that assume an average level of statistical damages and a 3% discount rate (Interagency Working Group on Social Cost of Greenhouse Gases 2021).

These results are both highly uncertain and likely very conservative. However, BOEM is presenting the estimated numbers because they are higher than emissions likely would be if requirements were put into place to achieve established emissions reduction targets. Therefore, these estimates provide for agency and public review of a “worst-case” level of emissions and corresponding cost. If the U.S. makes progress towards reducing its overall use of fossil fuels by replacing them with lower emitting sources of energy, then substitute sources of energy for OCS oil and gas production would also shift. This shift would result in lower estimated emissions than those presented in **Table 2-4**. BOEM considers some of the uncertainties in Chapter 4 of the Final EAM. Overall, BOEM’s GHG modeling analysis shows the following:

- Calculated upstream emissions from substitute energy sources, which include a reduction in consumption (i.e., reduced demand), are higher than upstream emissions associated with OCS leasing.
- Calculated midstream and downstream emissions from energy market substitutes, which includes a reduction in consumption, are lower than midstream and downstream emissions associated with OCS leasing for both oil and gas.

- Combined calculated upstream, midstream, and downstream emissions from substitute energy sources are similar to OCS leasing in most regions and scenarios.

Overall, the difference between emissions under the leasing versus no leasing scenarios is quite small. The Cook Inlet low scenario is the only area to show a significant reduction in emissions when not holding new lease sales. This result is primarily due to gas substitutions having lower emissions than oil substitutions, and the Cook Inlet low scenario has exclusively gas as expected production. All other areas and scenarios show little difference between leasing and no leasing; estimates using different assumptions could alter whether the Proposed Action, or no action in each region, has higher GHG emissions.

In addition to estimating changes in domestic emissions from OCS production, BOEM's analysis also considers GHG emissions changes from foreign oil production and consumption. BOEM estimates emissions associated with a change in foreign oil production and consumption resulting from the global change in oil prices driven by a lower price in oil resulting from new OCS leasing. BOEM does not provide a quantitative estimate of the change in GHG emissions associated with the foreign oil midstream due to lack of sufficient data on where oil refining would occur and appropriate emissions rates to apply to the refineries that would process the oil. Furthermore, BOEM does not estimate any impacts from a change in foreign gas markets, as it currently lacks data to make these estimates; see Chapter 2 in the Final EAM for additional information.

As a result of lower prices from new OCS oil leasing, BOEM anticipates decreased foreign oil production and increased foreign oil consumption. BOEM's current analysis shows that new OCS leasing likely would result in greater foreign emissions, and thus greater social costs, from global GHG emissions than emissions from substituted sources of energy that would occur under the No Action Alternative. **Table 2-6** provides quantitative estimates of combined upstream and downstream foreign oil GHG emissions.

Table 2-6. Estimated foreign upstream and downstream GHG emissions (in millions of metric tons CO_2e) and social cost of GHGs (in millions of dollars) from not leasing by program area

Emissions

Program Area	High CO_2e-100 (USEPA)	Mid CO_2e-100 (USEPA)	Low CO_2e-100 (USEPA)	High CO_2e-100	Mid CO_2e-100	Low CO_2e-100	High CO_2e-20	Mid CO_2e-20	Low CO_2e-20
Cook Inlet	20.19	19.93	0.20	20.34	20.07	0.21	21.93	21.65	0.25
GOM (5 Sales)	382.83	246.75	57.96	385.59	248.53	58.37	415.54	267.82	62.90
GOM (10 Sales)	775.11	329.13	57.96	780.70	331.50	58.37	841.34	357.23	62.90

Social Cost of Carbon

Program Area	High	Mid	Low
Cook Inlet	904.37	892.99	9.60
GOM (5 Sales)	17,270.73	11,309.27	2,670.78
GOM (10 Sales)	34,661.92	15,084.83	2,670.78

Notes: *Value is less than 500,000 tons but greater than 0. For more information, see the Final EAM. The social costs of GHGs presented in this table are based on estimates that assume an average level of statistical damages and a 3% discount rate (Interagency Working Group on Social Cost of Greenhouse Gases 2021).

Compared to the No Action Alternative, new OCS oil and gas leasing under the Proposed Action likely would result in similar GHG emissions when considering the U.S. domestic market. However, the Proposed Action is estimated to result in higher GHG emissions when considering changes in foreign markets due to increased oil consumption. When domestic and foreign GHG emissions are combined and estimated at the global scale, overall GHG emissions are anticipated to increase as a result of new OCS oil and gas leasing under the Proposed Action.

2.2.4 GHG Emissions Targets and the Carbon Budget

Another way to conceptualize carbon emissions from new OCS oil and gas development is in comparison to emission reduction targets established by the U.S. and the carbon budget, or the emissions remaining before worse consequences of climate change would occur.

The Paris Agreement, to which the U.S. is a party, aims to keep the global average temperature to "well below 2° C above pre-industrial levels" (United Nations Framework Convention on Climate Change 2015). The agreement requires countries to set goals to help stabilize atmospheric GHG concentrations at a level that would limit anthropogenic interference with the climate system to keep the global average temperature increase to within 2° C, and preferably to within 1.5°C. These intermediate goals, which are on the pathway to global net-zero emissions, are referred to as Nationally Determined Contributions (NDCs) (United Nations Framework Convention on Climate Change 2015). The U.S. set its NDCs using domestic emissions from a base year of 2005. In 2005, U.S. net emissions were 6,680,300,000 metric tons of CO_2e (USEPA 2021c). The U.S. achieved its 2020 goal to reduce its net GHG emissions by 17% below 2005 levels, in part due to the coronavirus pandemic. Currently, the U.S. has established NDCs for 2025 and 2030, each with a two-percentage point range (The White House 2021). **Table 2-7** lists the current emissions targets. The U.S. has an additional goal of net-zero emissions by 2050 (U.S. Department of State and U.S. Executive Office of the President 2021); this target is outside of the Paris Agreement framework.

Table 2-7. U.S. domestic GHG reduction targets (CO_2e in thousands of metric tons)

Target Year	Target Net Reduction	Target Net Emissions (Current)
2025[a]	26 to 28%	4,943,422 to 4,809,816
2030[a]	50 to 52%	3,340,150 to 3,206,544
2050[b]	100%	0

Notes: [a] Target submitted to the United Nations as part of the U.S. NDCs.
[b] Target established outside of the Paris Agreement framework.

Table 2-8 compares the estimated emissions from the target year to the U.S. NDCs and shows the percentage of the target that is expected to be consumed under a leasing scenario (e.g., the Proposed Action) and no leasing scenario (i.e., the No Action Alternative). The percentages in **Table 2-8** likely show a worst-case scenario, as there is the potential for carbon capture and storage (CCS) to allow for higher emissions than the targets while still achieving the NDCs. By 2050, with the net-zero emissions target, all GHG emissions would have to be offset by removal of an equal amount of GHGs from the atmosphere, including those resulting from any OCS development. Note that the emissions for both leasing and no leasing in **Table 2-8** include emissions that would occur outside of the U.S., but BOEM is currently unable to isolate just the domestic emissions. Instead, these values represent the emissions that result from supplying the U.S. market.

Table 2-8 Comparison between leasing and no leasing scenarios and U.S. emissions target reductions for all planning areas (CO_2e in thousands of metric tons)

Program Area	Scenario	2025 CO_2e	2025 %	2030 CO_2e	2030 %	2050 CO_2e	2050 %
Cook Inlet	Leasing	0	0.000 to 0.000	6	0.000 to 0.000	3,684	-
Cook Inlet	No Leasing	0	0.000 to 0.000	0	0.000 to 0.000	3,781	-
GOM (5 Sales)	Leasing	25	0.000 to 0.001	6,992	0.209 to 0.218	29,584	-
GOM (5 Sales)	No Leasing	0	0.01 to 0.01	6,286	0.188 to 0.196	30,116	-
GOM (10 Sales)	Leasing	25	0.000 to 0.001	9,269	0.277 to 0.289	39,515	-
GOM (10 Sales)	No Leasing	0	0.000 to 0.000	8,380	0.251 to 0.261	40,148	-

Notes: Percentages represent the amount of the U.S. targets that are estimated be needed by new leasing on the OCS or substitutions. Percentage of 2050 targets consumed by OCS production, or its substitutes, is blank because (by that time period) an equal volume of emissions would have to be removed from the atmosphere to achieve the net-zero emissions target.

Carbon budgets are different from NDCs and other targets set by governments in that they project the amount of global emissions that can be emitted before a certain amount of warming occurs. These budgets can be indexed to different global average temperature increases, but most focus on the 1.5^{o} C and 2^{o} C targets outlined in the Paris Agreement. Estimates of the remaining CO_2 emissions left in the carbon budget do range, but they largely center around 1 trillion metric tons of CO_2 remaining (Friedlingstein et al. 2022; Intergovernmental Panel on Climate Change 2021).

Beyond seeking to reduce future emissions, another approach being aggressively pursued is CCS. This approach would effectively increase the carbon budget by capturing atmospheric or oceanic carbon and removing it from the Earth's system before it would naturally be removed. The technology is relatively new, and though the OCS may play a role in CCS, efforts are currently in their infancy.

With or without large-scale CCS projects, new emissions from OCS development or substitute sources of energy would count against the planet's carbon budget, and new oil and gas leasing would likely result in "locked in" GHG emissions. Although policy changes may curb the amount of emissions from new OCS production, these policy changes may lead to stranded assets on the OCS if an operator is unable to bring fuels to market due to changes resulting from the energy transition.

Finally, many state and local governments have set their own targets for reducing emissions overall or for certain sectors. These targets range widely; many aim for greater and faster reductions than the overall U.S. targets. However, due to uncertainty as to where OCS oil and gas activities will occur, it is unclear how new OCS oil and gas development would affect state and local targets.

2.3 GEOGRAPHIC SCALE AND ORGANIZATION OF ANALYSIS

OCS region: major region of BOEM's jurisdiction (Alaska, Pacific, GOM, Atlantic)

BOEM ecoregion: area with distinct biology and oceanography used specifically in BOEM analyses

Planning area: specific and spatially discrete portion of the OCS used by BOEM for administrative and planning purposes

Program area: area within which lease sales are scheduled in a National OCS Program, consisting of a single planning area (or portion of a planning area) or a combination of planning areas (or portions of planning areas)

Because environmental resources do not follow administrative boundaries, the affected environment is characterized broadly using marine ***ecoregions***, which are areas differentiated by species composition and oceanographic features such as bathymetry, hydrography, productivity, and trophic relationships (Spalding et al. 2007; Wilkinson et al. 2009). This document defines nine BOEM ecoregions (**Figure 2-4**).

For this Final Programmatic EIS, the landward boundaries of the ecoregions extend to the shoreline and include coastal wetlands, estuaries, beaches, and adjacent lands potentially impacted by OCS activities. BOEM's analysis of the human and coastal environments includes coastal areas adjacent to the ecoregions. Section 8.2 of the PFP includes a detailed rationale for the ecoregion boundaries.

Administratively, the Pacific Region includes the State of Hawaii. However, for the National OCS Program, the Pacific Region only includes the four planning areas off the U.S. West Coast.

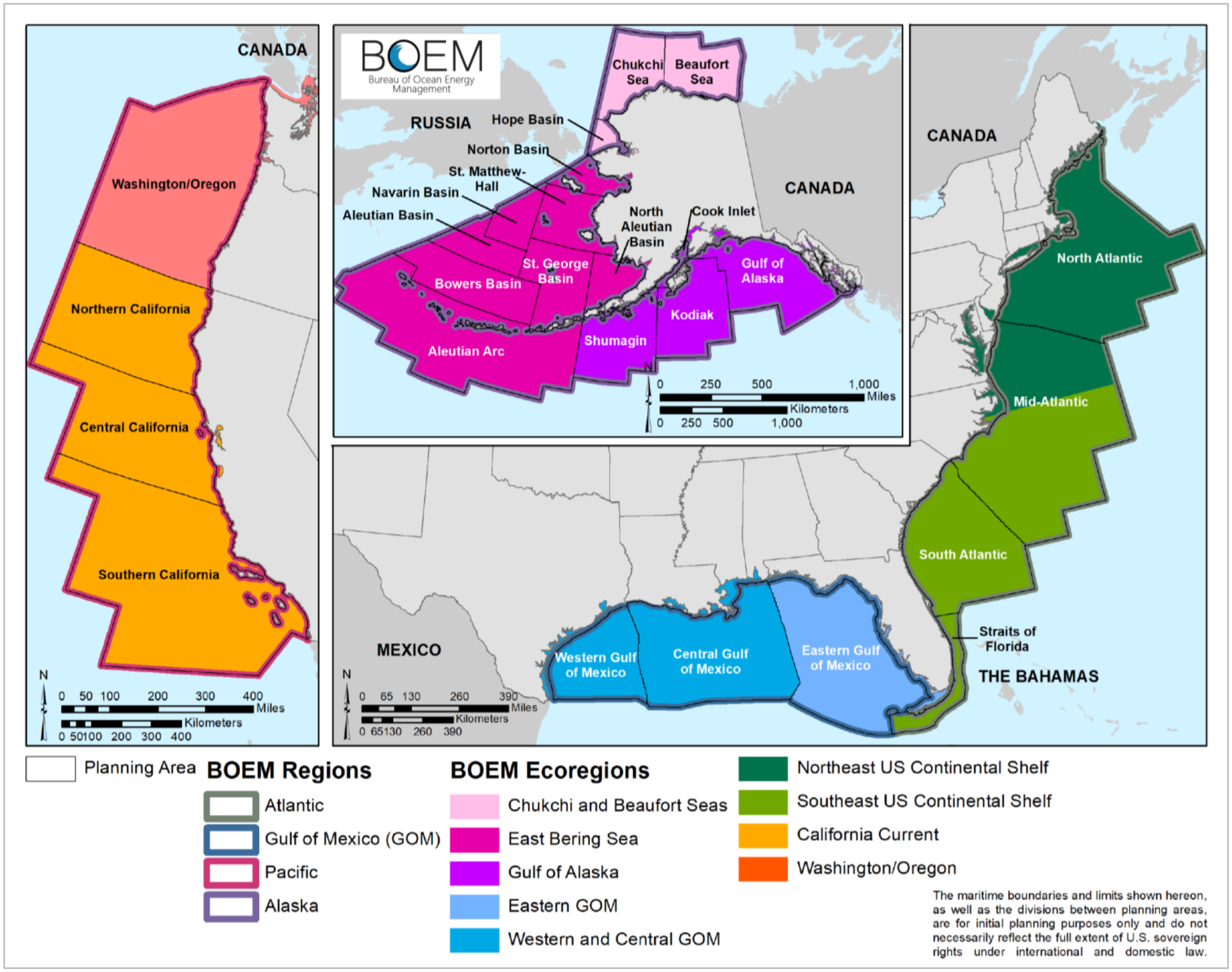


Figure 2-4. BOEM OCS regions, ecoregions, and planning areas

The affected environment of this Final Programmatic EIS analyzes the 25 BOEM oil and gas planning areas[8] included in the Draft Proposal. These planning areas fall within the nine BOEM ecoregions, which in turn fall within the four BOEM regions. Note that the Mid-Atlantic Planning Area is split between the Northeast and Southeast U.S. Continental Shelf Ecoregion.

[8] Planning areas are administrative constructions that closely align with, but do not necessarily correspond to, ecosystem boundaries.

2.4 RESOURCES, STRESSORS, AND IPFS

This Final Programmatic EIS uses the following categories for organizing the analysis:

RESOURCES Components of the affected environment that are analyzed in this Final Programmatic EIS.

STRESSORS Ongoing and future human activities or natural phenomena that could change the condition of the affected environment over the next 40 to 70 years. These stressors result from current, already planned, or reasonably foreseeable future actions and do not include activities associated with the 2024–2029 Program.

IPFS Aspects of the 2024–2029 Program activities or processes that could cause impacts on resources.

The following sections define these categories in more detail.

2.4.1 Resources

RESOURCES are the components of the affected environment analyzed in this Final Programmatic EIS. Resources are labeled with **GREEN CAPITAL LETTERS** and numbers in this document for easy identification. In the following discussion in this chapter, resources are organized into five interrelated "environments." Some resources occur in more than one environment. **Table 2-9** defines each resource.

Physical Environment: non-biological elements of the OCS and adjacent waters, atmosphere, and lands, including the seafloor

Pelagic Environment: that of the water column, from the sea surface to the waters immediately above the seafloor

Benthic Environment: interface between water column and seafloor; in this document, does not include seafloor areas within the coastal environment

Coastal Environment: interface between land and sea (including the water column and seafloor), loosely bounded by the portions of the land and sea that are influenced by their proximity to each other

Human Environment: dynamics in society, including the relationship of people with the natural and physical environment

Table 2-9. Resource definitions and associated environment(s)

Resource	Definition and Associated Environment(s)
R.1 AIR QUALITY	Condition of the ambient atmosphere, particularly in relation to the atmosphere's impact on human health, crops and other vegetation, animals, visibility, and man-made materials such as buildings.
R.2 WATER QUALITY	Condition or environmental health of water reflecting its particular biological, chemical, and physical characteristics, and the ability of a waterbody to maintain the ecosystems it supports and influences.

Resource	Definition and Associated Environment(s)
R.3 PELAGIC COMMUNITIES	Water column of the open ocean and the planktonic organisms that inhabit it; does not include fish, sea turtles, birds, and marine mammals, which are analyzed separately.
R.4 MARINE BENTHIC COMMUNITIES	Living organisms and their associated environment that occur on, within, or near the seafloor; does not include fish, sea turtles, birds, and marine mammals, which are analyzed separately.
R.5 COASTAL & ESTUARINE HABITATS	Living organisms and their associated environment at the land-ocean interface adjacent to OCS regions; does not include fish, sea turtles, birds, and marine mammals, which are analyzed separately.
R.6 FISH & ESSENTIAL FISH HABITAT	Fish include both freshwater and saltwater fish as well as shellfish (e.g., mollusks and crustaceans). Essential fish habitat (EFH) is a management term that refers to the waters and substrate needed for federally managed fish to grow and reproduce.
R.7 BIRDS	Birds that spend at least part of their lives near the ocean, including those that live entirely at sea, migrate over parts of the sea, or live or use coastal habitats for migration, foraging, staging, overwintering, or breeding.
R.8 SEA TURTLES	Turtles that spend most of their lives at sea and come to shore only to lay eggs (i.e., upon hatching, young turtles immediately move back to the sea).
R.9 MARINE MAMMALS	Mammals that spend all or part of their lives in the ocean, including semi-aquatic mammals (e.g., seals, sea lions, walrus, sea otters, and polar bears) and fully aquatic mammals (e.g., manatees, baleen whales, and toothed whales).
R.10 COMMERCIAL & RECREATIONAL FISHERIES	People and industries that rely on harvesting fish for their livelihood (commercial) or for enjoyment (recreational); does not include fish and EFH, which are analyzed separately.
R.11 ARCHAEOLOGICAL & CULTURAL RESOURCES	A district, site, building, structure, or object of cultural or historical significance in the marine or onshore environments, often referring to shipwrecks or submerged pre-contact period sites.
R.12 LAND USE	How communities use natural resources and infrastructure in their region, such as shipyards and shipbuilding, ports, roads, platform fabrication, forestry, agriculture, subsistence, and wilderness areas.
R.13 CULTURE	Socialized patterns of human behavior and understanding that can help define a sense of place, including subsistence fishing, hunting, and gathering.
R.14 VULNERABLE COASTAL COMMUNITIES	Historically marginalized, low-income, or minority communities as defined by Executive Order (EO) 12898 and EO 13175 (**Appendix H**).
R.15 RECREATION & TOURISM	Commercial operations focused on organizing vacations and visits to places of interest to engage in activities such as wildlife viewing, hiking, hunting, camping, diving, sailing, beach visitation, swimming, sightseeing, and taking commercial cruises.

Because of the large geographic scope analyzed, this Final Programmatic EIS cannot discuss every species; instead, it calls out relevant groups, representative species, and particularly sensitive species within a resource category. **Appendix D** provides the scientific names of all species mentioned in the text, as well as ESA status, designated critical habitats, and any ESA-related *Federal Register* notice citations. Chapter 4 and Appendix C of the 2017–2022 Final Programmatic EIS provide more detailed information on some of these resources (BOEM 2016d); the DPP also contains information on ESA-listed species in each OCS region. Similarly, this Final Programmatic EIS cannot discuss every human community or activity that may be affected; instead, it calls out relevant population groups, representative activities, and particularly sensitive communities or activities.

2.4.2 Stressors

As used in this document, **STRESSORS** refer to contributions to ongoing and future impacts from human (anthropogenic) and naturally occurring activities that are not related to the 2024–2029 Program and that could change the condition of the affected environment over the next 40 to 70 years, regardless of whether the activities occur simultaneously with activities under the 2024–2029 Program. Stressors are labeled with **RED CAPITAL LETTERS** and numbers in this document for easy identification. The principal stressors are described below and analyzed in this Final Programmatic EIS. Many of these ongoing activities are also described in the "Other Uses" section (Section 7) of the PFP.

The stressors discussed in this document are the following:

A.1	**CLIMATE CHANGE**
A.2	**EXISTING OIL & GAS**
A.3	**VESSEL TRAFFIC**
A.4	**COASTAL DEVELOPMENT**
A.5	**COMMERCIAL & RECREATIONAL FISHING**
A.6	**RECREATION & TOURISM**
A.7	**POLLUTION**
A.8	**MARINE MINERAL EXTRACTION**
A.9	**RENEWABLE ENERGY**
A.10	**OTHER FEDERAL ACTIVITIES**

A.1 CLIMATE CHANGE

Climate change results primarily from the increasing concentration of GHGs in the atmosphere, which causes planet-wide physical, chemical, and biological changes, substantially affecting the world's oceans and lands. The three largest contributors are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Changes include increases in global atmospheric and oceanic temperature, shifting weather patterns, rising sea levels, and changes in atmospheric and oceanic chemistry (Blunden and Arndt 2020). The impacts of climate change are expected to become more severe over the life cycles of leases that may be issued under the 2024–2029 Program (40 to 70 years) (Intergovernmental Panel on Climate Change 2018). This Final Programmatic EIS assumes that impacts from climate change will occur to some degree, albeit not precisely defined, over the next 40 to 70 years.

Warming temperatures have increased glacial melting and changed the seasonal timing of ice melt and the extent of ice formation in high latitudes. Melting landfast ice leads to increased volumes of water in the ocean, affecting ocean circulation and contributing to sea level rise. Nearly 40% of the U.S. population resides in coastal shoreline counties, and eroding coastlines and threats to coastal infrastructure from sea level rise are a national concern. The decreasing extent and duration of sea ice due to warming has dramatic consequences for Arctic species and subsistence communities that live and hunt on the sea ice (Doney et al. 2012; Steiner et al. 2021) (**Section 2.6**). In the Arctic, warming temperatures also lead to the thawing of permafrost, which may result in increased erosion rates; ground subsidence that destabilizes infrastructure; and the release of GHGs like methane and carbon dioxide.

Climate change can influence weather variability, atmospheric circulation patterns, and, ultimately, the interactions between land, ocean, atmosphere, and ice. Climate change and associated sea level rise are predicted to contribute to the increase in the intensity of storms (Intergovernmental Panel on Climate Change 2018). High-intensity storms, coupled with higher sea levels, could increase coastal flooding and erosion, damage coastal infrastructure, and degrade coastal habitats. Examples of effects of increased storm intensity and frequency include damage of fragile marine ecosystems like coral reefs from increased wave action and seagrass meadows from increased turbidity and nutrient runoff; increased flooding and erosion of coastal communities through loss of natural barriers like shoreline vegetation and dunes to wind and waves; and damage to coastal and marine archaeological sites from wind, waves, and storm surge.

Warming ocean and coastal temperatures may push species to the edge of their optimal temperature ranges. The collective range shifts by individual species could result in broad changes to marine ecosystems, with unpredictable consequences (Doney et al. 2012; Karnauskas et al. 2015; Steiner et al. 2021). For example, zooplankton are particularly sensitive to changes in water temperature because they are short-lived and reproduce rapidly; shifts in their abundance and distribution due to changing temperatures may serve as early indicators of climate change (Chiba et al. 2018; Richardson 2008). Additionally, warming waters may affect the timing of annual events like plankton blooms, potentially changing migration and reproduction in some species, disrupting predator-prey relationships, and causing cascading effects throughout the food web (Ullah et al. 2018). These changes could cause large-scale redistribution of global fishing catch and alter coastal economies (Palacios-Abrantes et al. 2020). Some mobile species may be able to migrate to higher latitudes, but sessile organisms, like mussels, cannot readily do so. Thus, we can expect a shift in certain species' ranges towards cooler waters and the potential loss of other less mobile species (Palacios-Abrantes et al. 2020; Sigler et al. 2011; Simpson et al. 2011). Warmer ocean temperatures also have caused severe bleaching and mortality in reef-building corals, which is expected to continue in future years (Dee et al. 2019; Intergovernmental Panel on Climate Change 2018).

Additional CO_2 in the Earth's atmosphere changes ocean chemistry, affecting marine life. As seawater absorbs CO_2, it becomes more acidic, a phenomenon known as "ocean acidification." Ocean acidification may affect physiological processes, such as those of calcifying species. For example, the exoskeletons and shells of organisms such as crustaceans, corals, and some types of plankton are composed of calcium carbonate and weaken under acidifying conditions. Increased seawater acidity makes it more difficult for these organisms to build and maintain their shells and exoskeletons, potentially impacting individuals and populations (Cattano et al. 2018; Doney et al. 2009; Figuerola et al. 2021). Both shallow and deepwater corals could experience decreased calcification rates and weakened exoskeletons when exposed to acidified seawater (Doney et al. 2009; Thresher et al. 2015). Additionally, ocean acidification may affect the growth and physiology of fishes at different life-history stages. Larval stages may be the most vulnerable (Llopiz et al. 2014), but it is not well understood how some biological processes, such as reproduction and development, in fish may be affected by such environmental conditions (Cattano et al. 2018). Ocean acidification could impact oceanic carbon sequestration because some calcifying plankton play a crucial role in the global carbon cycle (Hofmann and Schellnhuber 2009). Changes to the global carbon cycle could lead to additional impacts on habitats and food webs, potentially triggering larger-scale ecosystem responses. Shipwrecks and other submerged archaeological structures are another example of resources that may be affected by ocean acidification. Harkin et al. (2020) found that more acidic seawater could negatively impact submerged metal structures and shipwrecks, lowering their preservation potential.

All the climate change-related impacts described above may have cascading effects on marine ecosystems because they may act additively or synergistically with other stressors and with the IPFs associated with the 2024–2029 Program (Blunden and Arndt 2020). Marine diseases are one example; host-pathogen relationships are very sensitive to environmental conditions, so climate change may affect disease risk (Burge et al. 2014). For instance, *Perkinsus marinus* (an oyster parasite) thrives in warmer temperatures, and as winters have become warmer, this pathogen has spread northward along the U.S. East Coast (Burge et al. 2014).

Climate change may radically alter social systems and influence how and where people find shelter, employment, healthcare, and recreation. The potential impacts include relocation from coastal areas as sea levels rise, food and water shortages increase, and infectious diseases spread (Intergovernmental Panel on Climate Change 2018; Oppenheimer et al. 2019). Although all humans are already being affected by climate change, it may have a greater impact on younger populations, who will likely live more of their lives in an environment reacting to climate-induced stress (Hansen et al. 2013). Greater impacts are also expected on populations with higher levels of vulnerability, such as people with disabilities (Wolbring and Leopatra 2012), people with fewer resources (Dodman and Satterthwaite 2008), and racial minorities and populations of Native American and Alaska Native peoples (Baird 2008).

A.2 EXISTING OIL & GAS

This stressor refers to all past, present, and reasonably foreseeable oil and gas activities expected to occur on the OCS or in state waters outside of the 2024–2029 Program. Overall, total OCS oil and gas production is expected to rise over the short term but decrease and stabilize at a lower level over the next few decades, as detailed in the PFP. The impacts associated with state and OCS oil and gas activities outside of the 2024–2029 Program are similar in nature to the potential impacts for new oil and gas activity discussed in **Section 4.1** and the potential impacts of accidental oil spills discussed in **Section 4.6**.

Nearly all current OCS oil and gas activity occurs in the GOM Region, with the highest activity level in the Central GOM Planning Area. Oil and gas activity in the Pacific Region is within the Southern California Planning Area; this activity has been limited and is declining, with decommissioning of some platforms expected during the next decade. Future exploration and production on existing leases are expected to continue in the Beaufort Sea, Cook Inlet, Southern California, Western GOM, and Central GOM Planning Areas, as well as a small portion of the Eastern GOM Planning Area.

Past, present, and reasonably foreseeable future oil and gas activities in state waters include activities in the Alaska and GOM Regions and the Southern California Planning Area. No oil and gas exploratory drilling or development has occurred in Atlantic state waters except in the Straits of Florida, and no development has occurred on the Atlantic OCS.

Reasonably Foreseeable Future OCS Oil and Gas

The Final Programmatic EIS makes assumptions about what is reasonably foreseeable on existing leases and under future National OCS Programs beyond the 2024–2029 Program. However, these assumptions do not consider the potential for consequential changes needed to achieve GHG emissions reduction targets. These changes could include promulgation of regulations affecting current energy consumption patterns as well as other policy or regulatory changes that address these reduction targets, especially the national net-zero GHG emissions target for 2050. This target date falls within the active life of new leases under the 2024–2029 Program. With this in mind, BOEM assumes the following for this analysis:

- In the GOM Region, new exploration and development activities are possible under approximately 2,500 active leases, about 70% of which are unexplored, undeveloped, or currently non-producing.
- Based on past experience and expected continuing demand for oil and gas, future National OCS Programs beyond the 2024–2029 Program would likely include leasing in the Western and Central GOM Planning Areas. Seismic surveys may occur in advance of any new leasing.
- Limited exploration, development, and production activity would continue under the few existing leases in the Beaufort Sea and Cook Inlet Planning Areas. Similarly, activities in the Southern California Planning Area would be limited to production and decommissioning under the existing leases located offshore Santa Barbara, Ventura, Los Angeles, and Orange Counties.

- For future National OCS Program leasing in planning areas outside of the GOM, exploration or development activity would not be reasonably foreseeable given low rates of drilling on past leases and the often-controversial nature of oil and gas activity in those areas. Each planning area has unique considerations, but common barriers include difficult and expensive operating environments; limited support infrastructure; oil and gas price volatility; lack of public, Tribal, and state government support; political, technical, and operating challenges; and financial disincentives for prospective leasing, exploration, and development.
- Seismic surveys are reasonably foreseeable anywhere there is proposed leasing activity or where there are active leases on the OCS. In recent years, seismic surveys for oil and gas have been proposed or carried out in all four OCS regions (Alaska, Pacific, GOM, and Atlantic), with the bulk of activity taking place in the GOM.

A.3 VESSEL TRAFFIC

Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014) and is expected to increase 240–1,209% by 2050 (Sardain et al. 2019). The U.S. OCS is no exception to this trend, and growth is expected to continue due to multiple factors, including the increase in human population. In addition to increased shipping along established transit routes, new shipping routes are developing in the Arctic, where decreases in sea-ice persistence and extent make polar vessel operations increasingly viable through larger portions of the year.

Marine traffic causes noise, potential spills, engine emissions, bilge discharges, accidental loss of trash and debris, ship wake, additional lighting, spread of invasive species, and potential for collisions with other vessels and wildlife. Ship lights may cause birds to become disoriented and expend energy circling a vessel or, in some cases, collide with a vessel (Black 2005; Merkel and Johansen 2011). Collisions with ships are one of the primary threats to certain marine mammals, such as the ESA-listed North Atlantic right whale (with the highest risk close to busy shipping ports (Schoeman et al. 2020)) or Rice's whales in the GOM (NOAA 2023b). Implementing conservation measures, such as downward-facing lights and vessel speed restrictions, has helped to reduce impacts on wildlife (Hill et al. 2017; Nielson et al. 2012).

Marine vessel traffic adds noise to the marine environment. Over the last few decades, low-frequency ambient ocean noise has increased substantially due to a steady increase in shipping and is expected to continue increasing (Andrew et al. 2011; Andrew et al. 2002; Erbe et al. 2019; Frisk 2012; Miksis-Olds et al. 2013; Southall et al. 2017). Faster, larger ships generally create more noise and lower-frequency sounds (< 1 kHz), while smaller craft produce sounds in the mid frequencies (1–5 kHz) (Jiménez-Arranz et al. 2020). These ranges overlap with different animals' vocalizations and hearing ranges (McKenna et al. 2013) (**Appendix B**). Mounting evidence indicates that noise in the marine environment could interfere with communication, a phenomenon called *acoustic masking*, in species ranging from fish to marine mammals (Clark et al. 2009; Erbe et al. 2016). In addition to acoustic masking, elevated ocean noise levels increase stress in marine species (Rolland et al. 2012; Sierra-Flores et al. 2015; Wright et al. 2007), which in turn may lower reproductive output and increase susceptibility to disease (Kight and Swaddle 2011). Noise levels are expected to increase (Frisk 2012), unless international coordination efforts can incentivize or mandate the use of quieter ship engines (International Maritime Organization 2014).

Marine shipping has driven the spread of invasive species across the world's oceans, estuaries, and freshwater systems (Ruiz et al. 1997; Sardain et al. 2019). Organisms may be introduced via a ship's ballast water exchange. In the last centuries, the rate of invasion has risen steadily despite increased awareness of this issue (International Maritime Organization 2017; Ruiz et al. 1997; Sardain et al. 2019). New ballast water management regulations implemented in 2017 by the International Maritime Organization aim to address this problem.

A.4 COASTAL DEVELOPMENT

Construction of residential areas, industrial centers, ports, and other infrastructure is expected to continue in the coming decades to match steadily increasing population growth on the coasts (Kildow et al. 2016; Sengupta et al. 2018). Expansions of ports and dredging of port areas likely will continue to accommodate increased shipping and increasingly larger vessels (Merk et al. 2015). To support coastal residents and tourists, construction of additional hotels, resorts, marinas, docks, seawalls, bridges, and roads also is expected to continue in the coming years (Kildow et al. 2016; Sengupta et al. 2018). An increase in built infrastructure may impact the human environment, especially during the construction process, by putting stress on coastal residents and ocean-based resources on which they depend.

Coastal wetlands uptake atmospheric carbon and mitigate climate change (Nahlik and Fennessy 2016). Coastal construction may degrade or destroy coastal habitats and put species at risk (Huettmann and Czech 2006; Todd et al. 2019). Direct habitat loss is particularly problematic for buffer species such as mangroves, which naturally protect the shoreline from storm damage and filter sediments from coastal runoff (Burge et al. 2014; Marshall et al. 2011). Removing shoreline vegetation and replacing it with man-made structures (e.g., seawalls) may exacerbate the risk of storm impacts on coastal communities. Removal or degradation of fish nursery habitats may have cascading impacts on pelagic and benthic ecosystems (Parrish 1989; Serafy et al. 2015). Lighting from man-made infrastructure (e.g., street lights, hotels) near sea turtle nesting beaches may disorient young hatchlings and increase predation (Silva et al. 2017). In some areas, coastal lighting disorients birds and may cause them to collide with man-made structures or divert them from migration routes. Coastal construction may indirectly degrade water quality by increased sedimentation, pollutant runoff, and discharges from construction vehicles. Additional emissions from construction and utilization of new port facilities could affect air quality. Finally, coastal construction activities (such as pile driving, dredging operations, and vessel traffic) add noise to the coastal and marine environment. Increased noise may alter marine soundscapes and affect organisms' ability to navigate, communicate, and forage effectively.

A.5 COMMERCIAL & RECREATIONAL FISHING

Commercial and recreational fishing increase marine traffic and resource consumption, and operations often use equipment that may inadvertently harm wildlife or disturb the seafloor. For example, longline fishing practices, which typically target pelagic species such as swordfish and tuna, unintentionally hook sharks, sea turtles, and seabirds, sometimes resulting in mortality. In the northwestern Atlantic alone, longline catch data indicate that several shark species have declined up to 76% between 1992 and 2005 (Baum and Blanchard 2010). Vertical lines for lobster and crab pots pose an entanglement risk for various marine species, and lobster and crab pots may result in ghost fishing, i.e., the accidental trapping of marine resources by fishing gear left behind as marine debris (Stevens 2021). Certain whales, such as the ESA-listed North Atlantic right whale, are particularly susceptible to entanglements. North Atlantic right whale entanglement mortalities rose from 21% in 1970–2002 to 51% in 2003–2018 (Sharp et al. 2019), and, importantly for this declining population, entanglement seems to have a negative effect on reproductive success in females (Pace III et al. 2017). Abandoned, lost, and discarded fishing lines and gear create hazards to wildlife (Gilman et al. 2021; Wells et al. 1998). Trawl fisheries may disturb benthic habitats (Clark et al. 2016), damage historic shipwrecks (Brennan et al. 2016), and have some of the highest bycatch rates of any fishery (Gilman et al. 2020).

Shifts in species distribution caused by climate change could modify both commercial and recreational fisheries by reducing accessibility, thus potentially reducing harvest rates and impacting fishing communities. Some fishermen may adapt by switching to new target species when stocks shift in distribution. For example, southern New England lobstermen targeted the channeled whelk when American lobster landings declined (O'Brien 2016).

A.6 RECREATION & TOURISM

As coastal tourism continues to grow, environmental pressures associated with recreation and tourism may also increase (Kildow et al. 2016). Beach-going, wildlife viewing, fishing, hiking, hunting, camping, boating, sailing, diving, sightseeing, and commercial cruises could disturb or injure wildlife, increase noise, degrade habitats, and increase traffic. The cruise ship industry was growing particularly rapidly (Johnston et al. 2016) prior to temporary suspension of passenger voyages during the COVID-19 pandemic. Future growth of the cruise ship industry may generate increased air emissions, trash disposal, and gray water discharges in the coming decades (Carić and Mackelworth 2014).

A.7 POLLUTION

There are two major pathways of water pollution into the ocean: marine and terrestrial. Marine sources include discharges from ships and other vessels, as well as other human activities that occur in the water. Vessels periodically release sewage, wastewater, and bilge water, which may have disproportionate impacts on vulnerable coastal communities (USEPA 2020). Most water pollutants, however, result from terrestrial pathways, i.e., agricultural and urban runoff or discrete point source wastewater discharges from industrial sites and sewage plants. These pollutants are released into streams, rivers, bays, and estuaries, and many make their way to the open ocean, where they can stress marine life.

Toxins directly harm the organisms that ingest them and impact the food chain through biomagnification, the process in which chemicals are accumulated in higher trophic levels through predation. Therefore, although filter-feeding benthic organisms may be the first to encounter toxic chemicals, these compounds may also contaminate predatory fish, marine mammals, and seabirds, especially within the context of climate change (Alava et al. 2017; Hosseini et al. 2013). Humans are impacted directly by pollutants in water and by ingesting plants or animals who have consumed or absorbed the pollutants. These effects may be more widespread in vulnerable coastal communities that may not have sufficient access to alternate water or food sources.

Aside from toxic chemicals, excess nutrients in the water may have large-scale ecological consequences. Eutrophication may occur when high levels of nutrients, usually from fertilizers or sewage, enter an ecosystem and trigger overgrowth of plants and phytoplankton. Following the bloom, bacteria begin to break down the primary producers and consume most of the oxygen in the water. This creates low-oxygen (hypoxic) areas, especially near the seabed; these hypoxic areas become uninhabitable to most marine life (Jessen et al. 2015; Vaquer-Sunyer and Duarte 2008). In regions with particularly pronounced riverine discharges, such as the Mississippi-Atchafalaya basin in the GOM, high organic loads (such as from from agricultural activities and urban runoff) lead to low-oxygen conditions, which kill or displace many species and lead to "dead zones" (Bianchi et al. 2010; Rabalais and Turner 2019; Rabalais et al. 2002). Eutrophication can also trigger harmful algal blooms (HABs), such as red tides, that cause neurotoxic shellfish poisoning and respiratory problems in humans and other mammals (Glibert et al. 2018; Kirkpatrick et al. 2004). These blooms have occurred since at least the 19th century and have increased in frequency and spread geographically (Burford et al. 2020; Van Dolah 2000).

Less damaging HABs may also occur in some estuarine and offshore environments—such as in the Indian River Lagoon and portions of the GOM—and impact coastal aquatic vegetation (Hauxwell et al. 2003). Less severe impacts from additional nutrients include increased turbidity and decreased light penetration, which affect benthic organisms like corals. On a healthy coral reef, turf and calcified algae typically occur in a relatively stable balance with live coral, and all compete for space on the reef and access to sunlight. Due to the steadily increasing levels of nutrients in the ocean, fleshy macroalgae have thrived in recent decades, disrupted the balance with live coral, and led to widespread changes on reefs (Hughes et al. 2007; McManus and Polsenberg 2004).

Marine plastic debris is found everywhere, including in the gut contents of pelagic, benthic, deepwater, and coastal species (Browne et al. 2011; Schmidt et al. 2017). The debris may be concentrated in marine sediments by deepwater turbidity currents (Pohl et al. 2020). Toxic compounds found in microplastics may bioaccumulate in the bodies of marine fish, damaging the liver and other organs (Rochman et al. 2013). Plastic ingestion is increasing in seabirds and could impact 99% of all seabird species by 2050 if not mitigated with effective waste management (Wilcox et al. 2015). Like fish, seabirds may accumulate some toxic compounds after ingestion of plastics (Tanaka et al. 2013). Plastics have also been found inside deceased sea turtles and marine mammals (Baulch and Perry 2014; Schuyler et al. 2016).

Air pollutants are airborne particulates and chemicals that act as a stressor for human health, particularly for sensitive populations, such as people with asthma, children, and older populations. These pollutants may negatively affect the respiratory, cardiovascular, and neurological systems of humans and animals. In addition, some air pollutants result in acid deposition, in which the air pollutants interact with water to dissolve the surface of man-made structures or lower the pH of streams. Some air pollutants reduce visibility (USEPA 2018a). Other air pollutants alter the chemical composition of the atmosphere. These impacts may result in depleting the ozone layer, creating acid rain, changing atmospheric temperature, and altering weather patterns. These pollutants are frequently released into the atmosphere and are associated with human activities (such as the use of combustion engines) or the unintentional release of pollutants through equipment leaks, commonly called fugitive emissions (USEPA 2018a).

A.8 MARINE MINERAL EXTRACTION

The extraction of marine minerals (particularly sand and gravel) from the seafloor is not a reasonably foreseeable activity for all OCS regions. OCS dredging activities to date have been limited to the GOM and Atlantic Regions, with increases in the last decade in both the number of agreements and volume of sand requested. As coastal erosion continues to increase from intensified storms and sea level rise, beach nourishment activities are expected to increase (BOEM 2019a). Dredging regulated by the U.S. Environmental Protection Agency (USEPA) and the U.S. Army Corps of Engineers to deepen or maintain channels may deposit material at ocean disposal sites. Marine mineral activities may increase vessel traffic, increasing noise to the marine environment and risk of collisions with wildlife. Dredging activities also may introduce noise into the environment; increase turbidity; alter benthic habitats; and entrain, injure, or kill marine animals (CSA International Inc. et al. 2010).

A.9 RENEWABLE ENERGY

Ocean-based renewable energy is a relatively new industry in the U.S. The Nation’s first commercial offshore wind farm became operational in December 2016 and is located in state waters about 3 mi (4.8 km) off Rhode Island’s Block Island. The first two offshore wind turbines on the OCS were installed off the coast of Virginia Beach in 2020. Currently, there are active commercial leases and a research lease for offshore wind development in the Atlantic Region. Atlantic Region construction and operations plans have been approved for two wind farms (Vineyard Wind 1 and Southfork Wind), and many other plans are in various stages of review. Both Vineyard Wind 1 and Southfork Wind currently are under construction. BOEM is advancing these projects, subject to environmental safeguards, as part of the Administration’s goal to deploy 30 gigawatts of electrical capacity on the OCS by 2030.

In the Pacific Region, similar projects may be developed, although floating turbine foundations are more likely than the fixed bottom foundations due to the deeper water depths. In December 2022, BOEM completed a competitive lease sale that offered five lease areas covering 373,268 total acres off central and northern California. The leased areas have the potential to produce over 4.6 gigawatts of offshore wind energy, enough to power over 1.5 million homes.

In the GOM, BOEM issued a Final Sale Notice for offshore wind leasing on July 21, 2023. Information about this sale can be found at www.boem.gov/renewable-energy/state-activities/gulf-mexico-activities. BOEM held an offshore wind energy lease sale on August 29, 2023, for three areas in the GOM, including an area offshore Lake Charles, LA (102,480 acres) and two areas offshore Galveston, TX (102,480 acres and 96,786 acres).

At the time of preparation of this document, BOEM has not put forward any specific plans or proposals to develop OCS renewable energy in the Alaska Region, but BOEM could issue leases in the future.

Offshore wind turbines and associated equipment may adversely impact wildlife and habitat through noise generation (e.g., during impact pile driving), benthic disturbance (particularly during construction or cable-laying), lighting, and increased collision risk for marine mammals (with operations and support vessels) and birds and bats (with turbines). Offshore wind construction (i.e., pile driving) generates high-energy, impulsive noise, which can affect marine life in various ways (Bellmann et al. 2020; Stöber and Thomsen 2019; Thompson et al. 2020; Tougaard et al. 2009). Geophysical survey tools used during site assessment also introduce noise, but impacts from these sources are expected to be minimal since the sounds are either above the hearing range of most marine species, very short in pulse duration, narrow in beamwidth, or low in overall acoustic energy (or a combination of these qualities). After wind turbines are operational, some noise radiates into the water, but it usually fades to ambient noise levels within ~ 1 km (0.62 mi) from the turbine (Tougaard et al. 2020). Land disturbance, noise, visible infrastructure, space-use conflicts, and other impacts associated with offshore wind turbines could also affect the human environment, marine resources, or coastal communities.

A.10 OTHER FEDERAL ACTIVITIES

Other Federal agencies—such as the U.S. Department of Defense (DOD), National Science Foundation (NSF), U.S. Coast Guard (USCG), U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), and National Aeronautics and Space Administration (NASA)—regularly use the OCS for various purposes (BOEM 2018a). DOD conducts military and naval training, testing, and operations in offshore operating and warning areas, undersea warfare training ranges, and special-use or restricted airspace above the OCS (BOEM 2018a). NOAA, USGS, NSF, and NASA conduct scientific research, including biological and geophysical surveys, in many areas of the OCS. NASA has space launch areas on the OCS, and these launches typically occur from Poker Flat Research Range in Fairbanks, AK; Vandenberg Air Force Base in Vandenberg, CA; Cape Canaveral Air Force Base or Kennedy Space Center in Cape Canaveral, FL; and Wallops Flight Facility on Wallops Island, VA.

Development of aquaculture areas is occurring in some regions and expected to continue. For example, NOAA Fisheries is conducting NEPA analysis to consider identifying one or more Aquaculture Opportunity Areas on the OCS off southern California and the GOM (NOAA 2023a). Such activities may increase air and marine traffic, noise, emissions, fuel spills, bilge water discharges, wildlife disturbance, and accidental releases of hazardous materials (which may impact offshore resources).

CCS is another potential activity reasonably foreseeable on the OCS. Congress directed the U.S. Department of the Interior (USDOI) to develop regulations regarding carbon sequestration on the OCS in the Bipartisan Infrastructure Law of 2021 (P.L. 117-58). Available information regarding processes, facilities, and supporting activities is presently insufficient to assess the potential impacts of CCS activities and how these activities might interact with stressors and activities and IPFs resulting from the 2024–2029 Program. BOEM will continue to monitor new information on potential OCS CCS activities to incorporate into subsequent analyses as appropriate.

2.4.2.1 Stressor Index

In 2008, Halpern et al. (2008) developed a method for quantifying and comparing the relative impact of anthropogenic stressors throughout the ocean. The team compiled publicly available data layers depicting the intensity of 17 anthropogenic stressors within each 1-km^2 grid cell of the ocean. They also mapped the type of ecosystems within each grid cell (e.g., mangrove, coral reef, soft bottom). Using their expert judgment, they derived weighting scores for each stressor-ecosystem relationship. Weighting these relationships allows for a more sophisticated assessment of impacts than simply mapping where the stressors occur. For example, the effect of ocean acidification on coral reefs (weighting function = 1.1) is greater than the effect on soft bottom habitats (weighting function = 0.1). For each 1-km^2 grid cell, the Halpern "anthropogenic impact score" is the sum of each of these stressor-ecosystem relationships and represents the cumulative anthropogenic impacts within that grid cell. In 2015, Halpern et al. added two more anthropogenic stressors and assessed the relative change in cumulative effects over time (Halpern et al. 2015).

The Halpern method complements the qualitative discussion of stressors above (**Table 2-10**), as well as the expected future baseline conditions described in **Sections 2.6–2.9**. BOEM compiled the Halpern et al. data for each of the BOEM ecoregions to provide a visual comparison of the non-National OCS Program, anthropogenic stressors across the OCS. This Final Programmatic EIS refers to this as the *stressor index*.

Table 2-10. Stressor index data source

Stressor	Data Source(s)	Halpern Layer(s) Used
A.1 CLIMATE CHANGE	Halpern	Ocean acidification Sea surface temperature Sea level rise Ultraviolet radiation
A.2 EXISTING OIL & GAS	BOEM and Halpern	Oil rigs
A.3 VESSEL TRAFFIC	Halpern	Shipping Invasive species
A.4 COASTAL DEVELOPMENT	Halpern	Direct human impact Light pollution
A.5 COMMERCIAL & RECREATIONAL FISHING	Halpern	Artisanal fishing Demersal destructive fishing Demersal nondestructive high bycatch fishing Pelagic low bycatch fishing
A.6 RECREATION & TOURISM	BOEM	Not represented in the Halpern data
A.7 POLLUTION	Halpern	Inorganic pollution Nutrient pollution Organic pollution Ocean-based pollution
A.8 MARINE MINERAL EXTRACTION	BOEM	Not represented in the Halpern data
A.9 RENEWABLE ENERGY	BOEM	Not represented in the Halpern data
A.10 OTHER FEDERAL ACTIVITIES	BOEM	Not represented in the Halpern data

Figure 2-5 is a geospatial representation of trends in environmental stressors as assessed by Halpern et al. (2019). Our purpose in including these data is to give further context for understanding potential cumulative effects by visually depicting the direction of change in impacts on the environment without the addition of the 2024–2029 Program. The data used to generate this map comes from the Halpern et al. (2019) data layers, which are based on several years' data (2003–2013) representing the impact of selected stressors on a range of marine ecosystems and taking into account stressor intensity and resource vulnerability. The availability of annual data affected stressor selection to some degree and likely affected the pace of change modeled and relative global trends. The Halpern et al. (2019) data depicted in **Figure 2-5** represent one assessment of global trends based on a scientific model and are presented for context. The trends shown in this map portray the modeled pace of change in ocean environmental conditions.

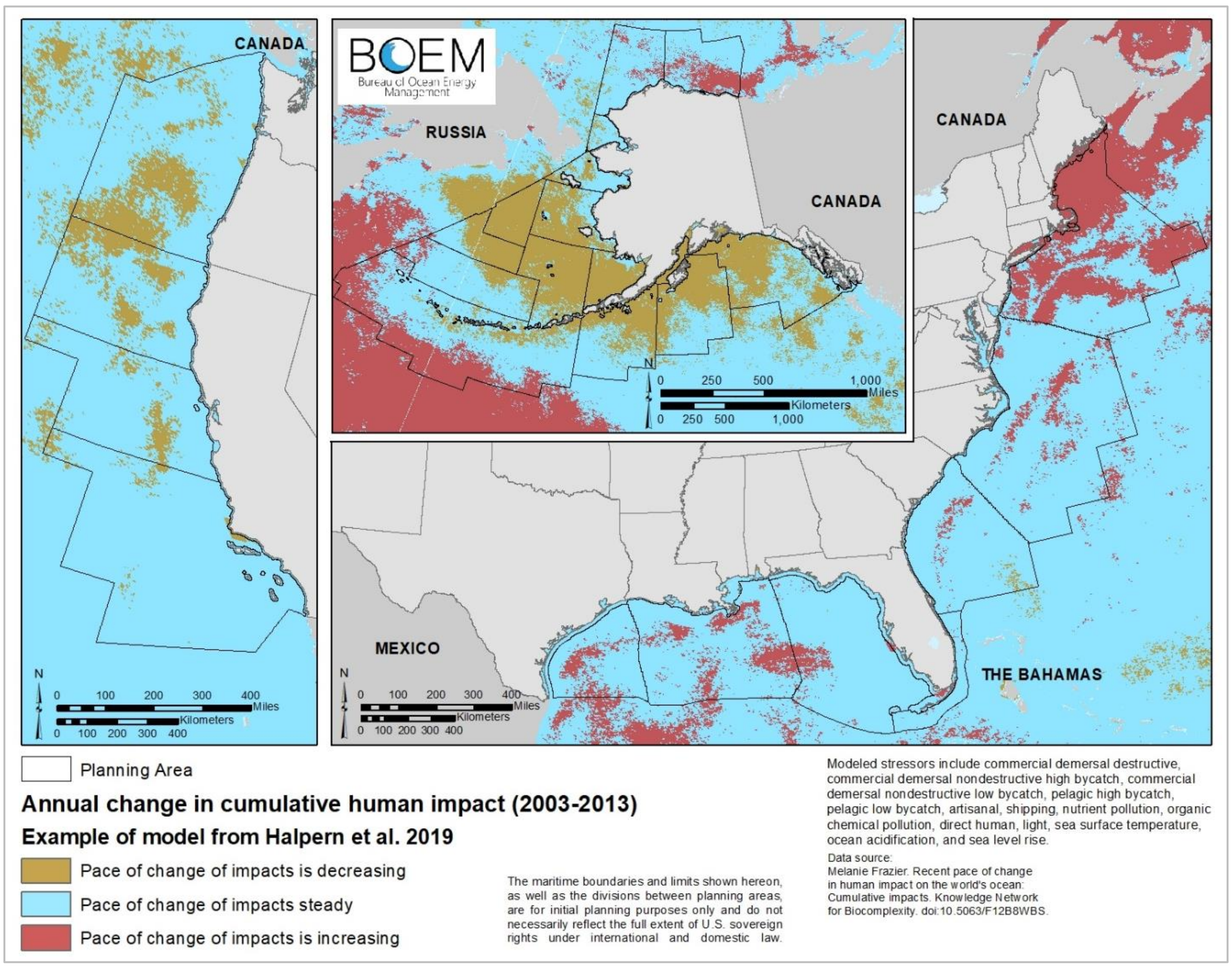


Figure 2-5. Pace of change of non-program impacts from 2003–2013
Source: Halpern et al. (2019)

2.4.3 IPFs

IPFs are 2024–2029 Program activities or processes that could cause impacts on resources (**Table 2-11**). Like the stressors described above, IPFs also "stress" resources. To clearly delineate the two categories for analysis, this Final Programmatic EIS uses the term stressor only for activities not associated with the 2024–2029 Program. IPFs result specifically from 2024–2029 Program activities. IPFs are labeled with **BLUE CAPITAL LETTERS** and numbers in this document for easy identification. The potential impacts on resources from these IPFs are discussed in **Section 4.1**.

Table 2-11. General descriptions of IPFs associated with OCS oil and gas activities under the 2024–2029 Program

Note: Some of the terms used in this table are defined in the glossary (**Appendix L**). Where appropriate, the descriptions discuss associated regulations (**Appendix H**) and mitigations (**Appendix F**).

IPF or Type	Description
I.1 NOISE	See descriptions below of specific types.
Geophysical Survey Noise	There are two main types of geophysical surveys: (1) marine seismic surveys, which generally cover a large area and are deep penetration and high resolution; and (2) geohazard surveys conducted using tools such as side-scan sonars, CHIRP sub-bottom profilers, multibeam echosounders, and small airguns to detect archaeological resources or seafloor features that could be problematic for operations. Marine seismic surveys generally use airguns (stainless steel cylinders filled with pressurized air). Airguns generate a short-duration, high-amplitude signal when air is released. These acoustic impulses are emitted typically at intervals of 5–30 seconds. Airgun noise frequency ranges from 10–5,000 Hz, but most of the acoustic energy is < 500 Hz. See **Appendix B** of this document, BOEM (2014), and BOEM (2017d) for more detail.
Vessel Noise	The noise generated by vessels depends largely on vessel size and vessel speed (McKenna et al. 2013). Small vessels (e.g., crew boats, tugs) are typically quieter but emit noise that is higher in frequency (50–5,000 Hz) than larger vessels (e.g., commercial vessels, cruise ships, supertankers, icebreakers) (Jiménez-Arranz et al. 2020).
Aircraft and Helicopter Noise	Aircraft noise is caused by engine and transmission operation, as well as the movement of propellers and rotors through the air. Turbine helicopters have transmissions and gearboxes that create substantial noise (whining). Airplanes can have either piston or turbine engines in single or multi-engine configuration. This noise can be substantial in air, but penetration of aircraft noise into the water is limited because much of the noise is reflected off the water's surface (Richardson et al. 1995). Therefore, noise from passing aircraft is more localized in water than it is in air and typically is limited to frequencies < 1,000 Hz. All aircraft are expected to follow Federal Aviation Administration (FAA) guidance when flying over land, including at a minimum altitude of 2,000 ft (610 m) over noise-sensitive areas, such as national parks, national wildlife refuges, and wilderness areas (Kaulia 2004). In addition, when flying over marine mammals, aircraft follow guidelines from National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) requiring a minimum altitude of 1,000 ft (305 m) (50 CFR Ch. II § 216.124).

IPF or Type	Description
Drilling and Production Noise	Drilling noise includes mechanical noise from the drill and support equipment, as well as noise from dynamic positioning and propulsion systems. Drilling noise contains low-frequency sounds (10–10,000 Hz); positioning noise is higher in amplitude and lower in frequency (< 1,000 Hz) and can be more directional. Drilling noise can be continuous or transient, and sound levels depend on the type of drilling rig used, water depth, and how well-coupled the noise-producing equipment is to the water. Dynamically positioned drill ships generally produce the highest levels of underwater noise, followed by semi-submersibles; jack-up rigs are the quietest. Production noise is generally low frequency (< 1,000 Hz) and temporally similar to drilling (Jiménez-Arranz et al. 2020).
Pipeline Trenching Noise	Pipelines are trenched using plow and jet burial, generating continuous, transient, and variable sound levels typically 20–1,000 Hz in frequency range (Nedwell and Edwards 2004).
Construction Noise	Installing offshore platforms and associated infrastructure requires dredges, pile-driving equipment, barges, and other equipment. Most acoustic energy from pile driving falls below 1,000 Hz. Construction of onshore ports, docks, ice-bound islands, or caissons can create noise from trucks, earthmoving equipment, and more (Amaral et al. 2020).
Platform Removal (includes explosives use)	Platforms may be removed by placing explosives inside platform legs or conductors 15 to 25 ft (4.6 to 7.6 m) below the seafloor. Although the frequency range of explosive charges can be relatively broad, most of the energy is between 10–5,000 Hz (Urick 1983).
I.2 TRAFFIC	This IPF considers the physical presence of traffic and does not include **I.5 EMISSIONS** produced by these sources.
Aircraft	Helicopters transport people to and from offshore platforms. Helicopters generally maintain a minimum altitude of 700 ft (213 m) over the OCS.
Vessels	Vessels are used for a variety of oil and gas activities, from geophysical surveys in the exploration phase through infrastructure removal in the decommissioning phase. Support vessels transport supplies and crews from the shore to drilling location and look out for sea ice or marine mammals. Barges may transport drill cuttings and spent drilling muds to onshore disposal facilities. Oil spill response vessels may operate near offshore structures or near the shore in response to a spill or to conduct exercises.
Onshore Traffic	Trucks, cars, and other vehicles operate onshore to mobilize, demobilize, stage, and supply offshore activities, as well as support construction and maintenance of onshore ports and other facilities.
I.3 ROUTINE DISCHARGES	See descriptions below of specific types.
Produced Water	Produced water is the largest individual discharge produced by normal operations. Produced water is water brought to the surface from an oil-bearing formation during oil and gas extraction (Neff et al. 2011). Small amounts of oil and other chemicals are routinely discharged in produced water during OCS operations. Produced water discharges are regulated under National Pollutant Discharge Elimination System (NPDES) permits issued by the USEPA (40 CFR Part 435).
Sanitary Waste and Gray Water	Sanitary and gray water wastes are often treated and either discharged into the sea under the applicable NPDES permit or injected into oil-bearing formations to enhance oil production.

IPF or Type	Description
Well Completion and Enhanced Recovery Fluids	Fluids from well completion, well stimulation treatments (including hydraulic fracturing), and reservoir flow enhancement techniques can be discharged with produced water in accordance with NPDES permit requirements. These permits limit toxicity of all effluents and require monitoring and reporting.
Debris	Debris includes trash, tools, or equipment lost overboard, and miscellaneous components left on the seafloor after decommissioning when removal is not logistically feasible (more common in deep water). BSEE enforces marine debris requirements found in 30 CFR § 250.300.
Drilling Muds and Cuttings	Drilling muds are used to lubricate and cool drill bits and pipes and maintain well pressure to prevent loss of well control. Water-based mud is circulated down a hollow drill pipe, through the drill bit, and up the annulus between the drill pipe and the borehole. The mud also carries crushed rock produced by the drill bit to the surface, where these cuttings are removed, and the mud is then recycled back down the well. The primary components of water-based mud are fresh or saltwater, barite, clay, caustic soda, lignite, lignosulfonates, and water-soluble polymers. Both the drilling mud and the separated cuttings may be discharged to the ocean or barged for onshore disposal, depending on NPDES permit requirements. Synthetic-based mud (SBM) may also be used (Neff et al. 2000) and must be disposed of according to NPDES permit requirements.
Miscellaneous	Miscellaneous discharges from facilities and vessels include deck drainage; desalination unit brine; and uncontaminated cooling, bilge, fire, and ballast water.
I.4 BOTTOM/LAND DISTURBANCE	See descriptions below of specific types.
Drilling	Drilling disturbs the seafloor where the well infrastructure and borehole penetrate and where mud and drill cuttings are deposited. The highest cutting concentrations are usually in sediments within 328 ft (100 m) of the platform, but some cuttings may be found up to 1.2 mi (2 km) from the discharge point (Neff et al. 2000).
OCS Infrastructure Emplacement	Structure emplacement disturbs bottom habitat and temporarily increases organic material and suspended sediments in nearby water. Diverse biota, including fish and encrusting algae and invertebrates, may be attracted to the structures or colonize them.
Anchoring	Anchors, anchor chains, and cables for vessels or equipment may disturb the seafloor, re-suspend sediments, and damage habitats or cultural resources. The area and severity of impacts varies with anchor size and extent of contact between the cable and seafloor.
Pipeline Trenching	Pipeline trenching temporarily displaces and re-suspends seafloor sediments.
Onshore Construction	OCS activity may require construction of onshore infrastructure, such as ports and support facilities (repair and maintenance yards, crew services, support sectors), construction facilities (platform fabrication yards, shipyards and shipbuilding yards, pipe coating facilities and yards), transportation infrastructure (pipelines, railroads), and processing facilities (natural gas processing, natural gas storage, liquefied natural gas [LNG] facilities, refineries, petrochemical plants, waste management).
Routine Maintenance	OCS oil and gas infrastructure requires maintenance throughout its lifespan, often with the use of submersibles and other equipment. These maintenance activities may result in disturbance of the seafloor and fauna attached to the underwater infrastructure.

IPF or Type	Description
Structure Removal	OCS platforms are removed using explosives or by cutting structures below the sediment line. After the structures are severed, trawls retrieve and clean up dislodged materials, which causes seafloor disturbance and sediment displacement.
I.5 EMISSIONS	See descriptions below of specific types.
Offshore Facilities	Offshore oil and gas activities emit air pollutants. Activities that produce emissions include drilling operations, platform construction and emplacement, platform operations, and flaring. Emissions may also come from release of volatile organic compounds (VOCs) through transfers, spills, and fugitive emissions.
Onshore Facilities	Onshore oil and gas support facilities, such as heliports, seaports, and other support facilities, emit air pollutants.
Mobile Sources	Vessels, aircraft, and onshore traffic associated with offshore oil and gas activities emit air pollutants.
I.6 LIGHTING	See descriptions below of specific types.
Offshore Facilities	Platforms, drill rigs, construction equipment, vessels, and other OCS components have lights that are required for safety and effective working conditions. Navigation lights must be visible to specified distances to ensure that the facility is visible to other vessels and aircraft. Lighting is also associated with submersibles and other equipment used for underwater maintenance activities. Light is also produced by flaring, which is the burning of waste or excess gas from offshore platforms.
Onshore Facilities	Many onshore facilities have lights for safety and working conditions. These facilities include onshore infrastructure described in the onshore construction description of **I.4 BOTTOM/LAND DISTURBANCE**.
I.7 VISIBLE INFRASTRUCTURE	See descriptions below of specific types.
Offshore and Onshore Facilities	Facilities offshore and onshore may be visible to people or animals (e.g., birds). Visibility varies with distance, infrastructure height, viewer elevation, and weather conditions (e.g., fog, haze, rain).
I.8 SPACE-USE CONFLICTS	See descriptions below of specific types.
Offshore Facilities	Overlapping uses of the OCS (e.g., military and NASA activities, fishing, subsistence hunting and harvesting, and renewable energy) may cause spatial or temporal conflicts among users.
Onshore Facilities	Overlapping onshore activities (e.g., planning and siting of onshore facilities, ports, construction facilities, transportation, and processing facilities) may cause spatial or temporal conflicts among users.
ACCIDENTAL EVENTS (SECTION 4.6)	See descriptions below of specific types.
Reasonably Foreseeable Accidental and Unauthorized Events	Spills of fuel or crude oil may result from accidents, intentional discharges, weather events, and collisions.

2.5 OVERVIEW OF AFFECTED ENVIRONMENT AND ASSOCIATED RESOURCES

> This section describes attributes of the affected environment that are common across all OCS regions. See **Sections 2.6–2.9** for region-specific information.

2.5.1 Physical Environment

The national discussion about the OCS physical environment covers air quality and water quality. Other aspects of the physical environment (e.g., topography and currents) are discussed in the regional descriptions (**Sections 2.6–2.9**).

R.1 **AIR QUALITY** can be degraded by non-anthropogenic sources (e.g., dust or sea salt); however, human activity is responsible for most U.S. ambient air pollution, which includes emissions from industrial and transportation sources, such as power plants, manufacturing, resource extraction, automobiles, vessels, and aircraft. Air quality tends to be the most degraded in metropolitan areas and near other large sources of air pollutants. Additionally, dry climates and rugged terrain can capture pollutants, degrading local air quality (**Figure 2-6**).

The CAA requires the USEPA to establish National Ambient Air Quality Standards (NAAQS) for criteria pollutants to provide protection from adverse effects of certain pollutants. There are two sets of standards. Primary standards protect public health, including the health of sensitive populations, such as people with asthma, children, and older populations. Secondary standards protect public welfare (including visibility), the health of animals and plants, and infrastructure. The criteria pollutants are nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), ozone (O_3), fine ($PM_{2.5}$) and coarse (PM_{10}) particulate matter (PM), and lead (Pb). The criteria pollutants released by OCS sources include NO_2, CO, SO_2, $PM_{2.5}$, and PM_{10}. Nitrogen oxides (NO_X) and VOCs are released by OCS sources and may form O_3 through photochemical reactions. Deposition of NO_2 and SO_2 may harm plants, including agriculture, as well as degrade infrastructure and R.2 **WATER QUALITY**.

> When an area does not meet the NAAQS for a criteria pollutant, the USEPA designates the location as a nonattainment area, and stricter requirements apply.

Although most of the U.S. is in attainment, some coastal areas adjacent to or near the OCS are currently in nonattainment for the types of pollutants that may be emitted from future oil and gas activity, specifically SO_2, PM, and O_3 (USEPA 2018c) (**Figure 2-6**). However, the atmosphere above the OCS is defined by USEPA as “unclassifiable.” The USEPA defines unclassifiable areas as “any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant” (USEPA 2018d).

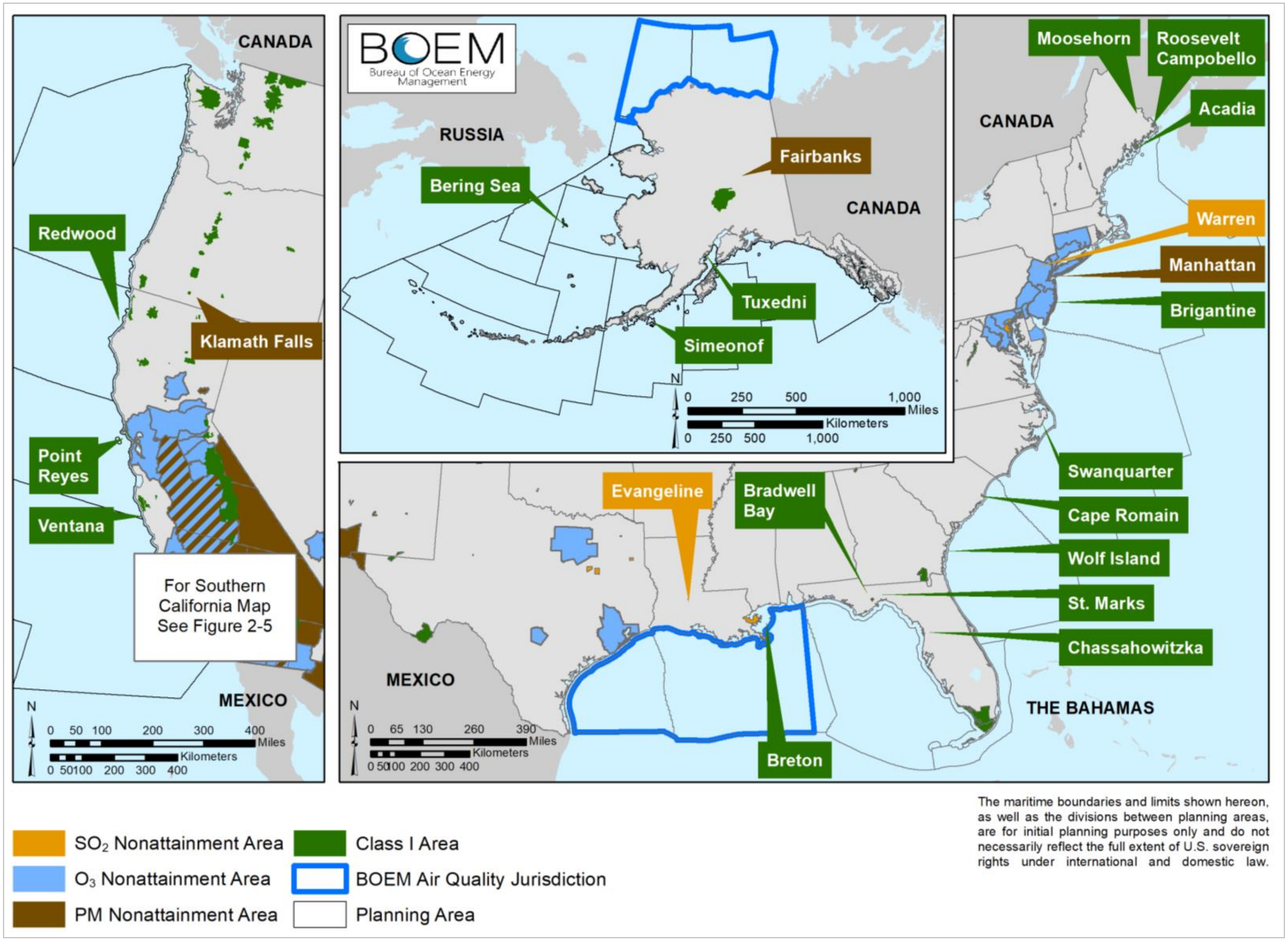


Figure 2-6. National air quality

Labels only denote hard-to-see Class I and nonattainment areas.

Class I areas are defined in the CAA Amendments of 1977 as Federal land with special air quality protections, including visibility. Ambient concentrations of criteria pollutants are more strictly regulated for Class I areas than for Class II areas, which comprise the remainder of the country. New emissions near Class I areas receive additional scrutiny from the responsible Federal land manager (USFS et al. 2010). There are many Class I areas near the OCS (FWS 2013a; NPS 2018a; USFS 2018) (**Figure 2-6**). Other protections are provided to some Federal lands through legislation, such as the National Park Service Organic Act. BOEM will, as appropriate, consider and evaluate potential impacts in these areas and associated mitigation measures to avoid or minimize such impacts in subsequent OCS leasing phases and NEPA documents.

Some OCS areas fall under USEPA's jurisdiction and are regulated to protect OCS air quality. Facilities within 25 mi (40 km) of a state's seaward boundary are subject to onshore regulations, including state and local requirements. However, air emissions for oil and gas facilities in the GOM west of 87.5°W and offshore of the North Slope Borough, AK, fall under BOEM's regulatory jurisdiction (**Figure 2-6**). Section 5(a)(8) of the OCS Lands Act requires compliance with the NAAQS "to the extent that activities authorized under [the OCS Lands Act] significantly affect the air quality of any State." Consequently, BOEM regulates emissions to prevent onshore impacts rather than to prevent exceedance of the NAAQS over the OCS.

Air quality is generally expected to improve as states come into compliance with the NAAQS and reduce concentrations of criteria pollutants in nonattainment areas. States continue to address their air quality challenges through State Implementation Plans, even as the standards have become increasingly stricter since the NAAQS were first implemented. For instance, California's State Implementation Plan requires lower emissions on mobile sources to be phased in by 2051 to address $PM_{2.5}$ and O_3 nonattainment areas across the state (California Air Resources Board 2017).

Clean water is essential for human and environmental health. The primary factors that influence R.2 **WATER QUALITY** are temperature, salinity, dissolved oxygen, chlorophyll content, nutrients, pH (acidity or alkalinity), pathogens, transparency (e.g., turbidity), and contaminant concentrations (e.g., heavy metals and hydrocarbons). Point and non-point discharges of metals and organic compounds may degrade water quality, as may contaminants in sediment if resuspended into the water by anthropogenic activities, storms, or other events. USEPA issues NPDES permits (40 CFR Part 435) to regulate the discharge of pollutants from point sources. These permits generally allow facilities or a group of facilities to discharge a specified amount of pollutants under certain conditions; any discharges greater than those permitted are considered a violation. Pollutants discharged by ships at sea are regulated by the International Convention for the Prevention of Pollution from Ships, and enforcement is carried out by the USCG and other law enforcement agencies.

Water quality can be challenging to evaluate given the many factors that can influence it and given the expansive cross-boundary nature of water bodies. The *National Coastal Condition Report IV* (USEPA 2012) evaluated U.S. water quality based on five indices: water quality, sediment quality, benthic community condition, coastal habitat, and fish tissue contaminants. A good, fair, or poor rating based on a weighted average of the index scores was then assigned for each coastal region of the U.S., as well as nationally. **Sections 2.6–2.9** report this rating where available. Areas with fair or poor ratings are of concern for their potential impacts on human and ecosystem health. These areas are often considered for additional monitoring efforts, have limits placed on activities that may contribute contaminants, or are undergoing remediation efforts to improve the water quality.

2.5.2 Pelagic Environment

The pelagic environment comprises the open-ocean water column from the surface to the sea floor. More than 72% of the OCS is offshore in waters more than 656 ft (200 m) deep, with an average depth of 8,140 ft (2,481 m).

The pelagic environment can be divided into three zones based on water depth and light penetration: sunlight (epipelagic) zone, twilight (mesopelagic) zone, and midnight (bathypelagic) zone (**Figure 2-7**).

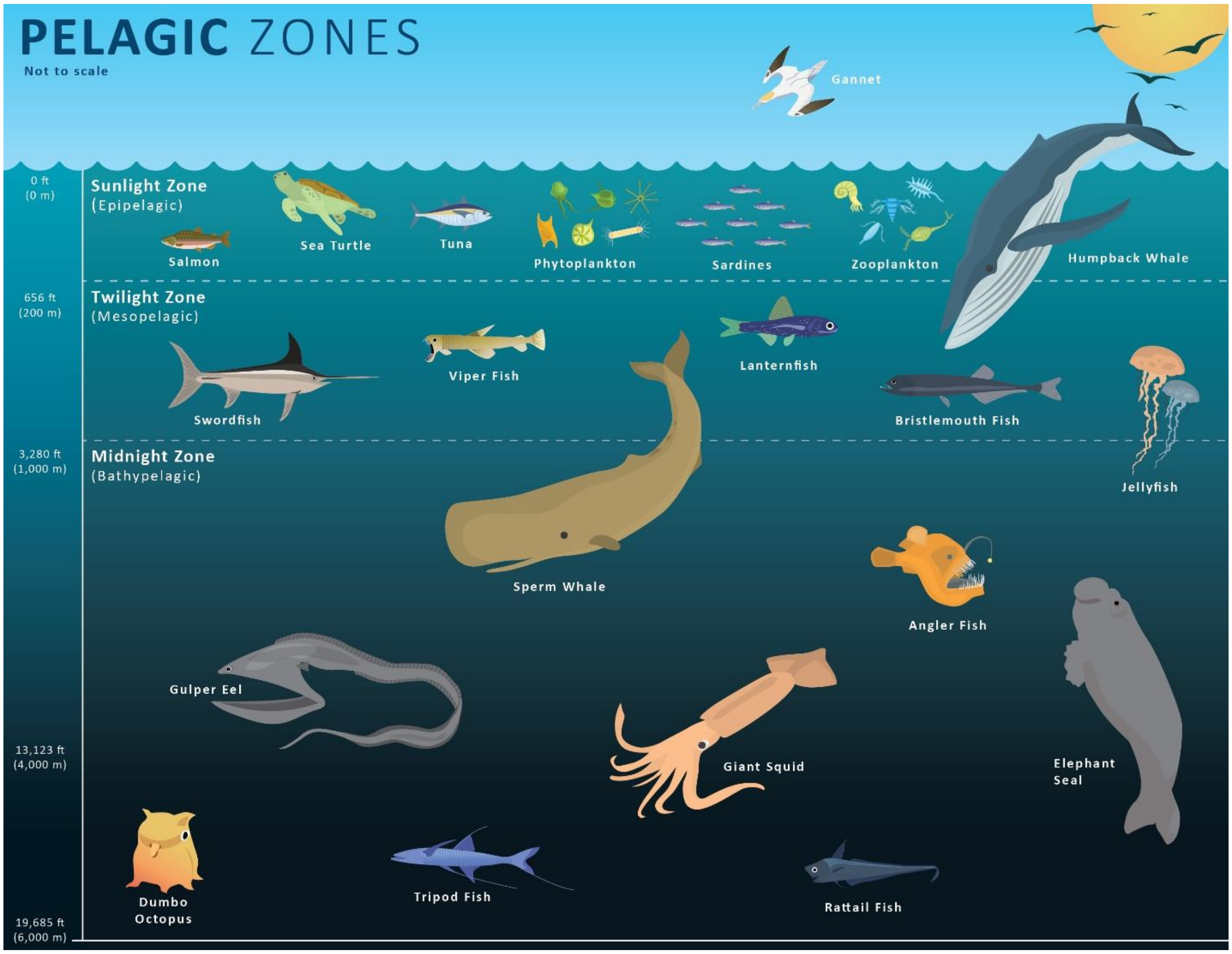


Figure 2-7. Vertical habitat zones of the open-ocean pelagic environment: sunlight zone, twilight zone, and midnight zone

The sunlight zone (the waters that extend from the surface to 656 ft [200 m]) is where marine life is most concentrated. At these depths, there is enough sunlight for primary production by phytoplankton through photosynthesis. Virtually all organic matter in the oceans originates here, though large rivers can also deliver considerable amounts to some coastal areas. Below the sunlight zone is the twilight zone, which extends from 656 to 3,280 ft (200 to 1,000 m). In this zone, sunlight disappears in the water, temperatures rapidly decrease, and many resident organisms are bioluminescent (can create light). Many animals in the twilight zone undergo daily migrations to shallower waters to feed, providing a pathway for surface production to reach deeper waters. The midnight zone extends from 3,280 to 13,123 ft (1,000 to 4,000 m) and is the largest habitat on the planet. It consists of cold, dark waters that are populated by animals adapted to those conditions.

> Photosynthesizing plankton (phytoplankton) form the base of marine food webs and are essential elements of R.3 **PELAGIC COMMUNITIES**. Marine primary productivity is a term used to describe the rate at which phytoplankton produce biomass. Estimates for marine primary productivity in the various BOEM ecoregions are available in the Proposed Program and the PFP.

Microscopic zooplankton consume phytoplankton and are then consumed by larger zooplankton and small fish. The food web continues up to apex predators, which include seals, whales, birds, sharks, and other large fish. Some larger herbivores—such as sea turtles, manatees, and some fish—feed directly on marine vegetation and phytoplankton. Changes in composition and concentrations of plankton may impact the food web. The distribution and abundance of a number of plankton species can serve as indicators of environmental change because of their dependence on ocean currents, rapid population response to changing conditions, and short life cycles (Beaugrand et al. 2015; Richardson 2008).

Many R.9 **MARINE MAMMALS** inhabit the pelagic environment, and some of them migrate vast distances across the globe. Baleen whales are the largest animals on the planet, though they primarily feed on smaller prey. Toothed whales and dolphins feed on R.6 **FISH** and other prey. Although some marine mammals are semi-aquatic (e.g., seals and polar bears), spending time in the water and on land, they do spend considerable amounts of time in the open ocean in search of food. Most marine mammals feed in the sunlight or twilight zones, although some species, like sperm whales and northern elephant seals, can feed into the midnight zone. After hatching, R.8 **SEA TURTLES** spend their lives at sea; only females return to land to nest. Each OCS region supports resident and seasonal non-resident species of migratory R.7 **BIRDS**. Many birds utilize pelagic habitats, feeding on schools of fish and zooplankton in the sunlight zone. High densities of seabirds can be found in areas associated with shelfbreak systems and submerged shallow banks, similar to areas where marine mammals and sea turtles forage.

R.6 **FISH & ESSENTIAL FISH HABITAT** are found throughout the pelagic environment. Most fish species targeted by R.10 **COMMERCIAL & RECREATIONAL FISHERIES** inhabit the sunlight zone, though some species like swordfish and tunas can feed and reside in the twilight zone.

2.5.3 Benthic Environment

Benthic (seafloor) environments are generally classified by geomorphological features such as canyons, seamounts (i.e., underwater mountains), and shoals—or by structure-forming organisms such as corals, oysters, and clams. Substrates (surfaces in or on which organisms can grow) on the OCS vary from fine particle silts and clays to larger grain size sands, cobble, and exposed bedrock. **R.4 MARINE BENTHIC COMMUNITIES** are rich in invertebrates (e.g., sea urchins, clams, crabs) that may burrow into the substrate, attach to hard substrate like rocks, or move around on the seafloor. Many **R.6 FISH** and **R.10 COMMERCIAL & RECREATIONAL FISHERIES** are associated with benthic environments. Hard bottom habitats (also called live bottom) refer to benthic environments characterized by hard substrates such as corals, shells, or rock. BOEM typically requires operators to avoid hard bottom habitats and other sensitive seafloor features, such as chemosynthetic communities (**Appendix F**).

2.5.4 Coastal Environment

R.5 COASTAL & ESTUARINE HABITATS include barrier and deltaic islands, estuaries, coastal wetlands, beaches, and rocky shores. Wave, wind, and tidal energy are dynamic forces that affect the shape of coastlines and the organisms that live there. Coastal estuaries and wetlands have freshwater and marine components that support many resident and migratory species, including invertebrates, **R.6 FISH**, and **R.7 BIRDS**. Subsistence wildlife, such as caribou, depend on coastal habitats as well. These habitats support a valuable **R.15 RECREATION & TOURISM** industry.

Many species, both aquatic and terrestrial, depend on the coast for reproduction, foraging, and resting. Various coastal areas are important nursery habitats for many species of marine **R.6 FISH** that migrate to offshore areas once they reach adulthood. Sandy beaches are important habitat for **R.8 SEA TURTLES,** which lay their eggs in the sand. Coastal vegetation buffers against storms and waves, prevents erosion, provides food and shelter for fish and shellfish, provides nesting and foraging habitat for birds, and improves water quality by filtering pollutants and nutrients from terrestrial runoff. Semi-aquatic **R.9 MARINE MAMMALS** like seals, sea lions, and polar bears spend time both in water and on land and are therefore highly dependent on coastal habitats.

Shallow estuaries provide overwintering habitat for millions of migratory waterfowl, important foraging sites for many **R.7 BIRDS** migrating to or from other continents, and a yearlong home to many marine birds (Burger et al. 1997). Flyways are well-described migratory routes that birds travel between wintering grounds and summer nesting grounds, often covering hundreds to thousands of miles. Resident coastal birds may frequent beaches, marshes, and islands, while migratory seabirds and sea ducks may only return to land to nest.

2.5.5 Human Environment

Understanding how marine resources and the human environment are interconnected is important to informed ocean-use decision-making. Marine and coastal resources play a significant role in generating income and employment and enriching people's lives.

The ***ocean economy*** comprises businesses dependent on ocean resources and includes six economic sectors: living resources (e.g., seafood), marine construction, marine transportation, offshore resource extraction (e.g., oil and gas activities), ship and boat building, and R.15 **RECREATION & TOURISM**.

> In 2018, 40% of the U.S. population (or 128 million people) lived in coastal shoreline counties (NOAA 2021a). Many more people rely on coastal and marine resources for food, tourism, industry, and other resources. Annually, coastal counties contribute more than $9.5 trillion in goods and services, employ 58.3 million people, and pay $3.8 trillion in wages (NOAA 2021a). This large coastal population depends on natural resources for food, health, economic security, cultural benefits, and recreation.

Overall, in 2019, all six sectors of the ocean economy accounted for 3.5 million employees and $351 billion in gross domestic product (GDP). The marine economy supports 162,000 individual business establishments paying out $149 million in wages. Employment in the ocean economy is growing faster than the national average employment growth, and employs more than the combined crop production, telecommunication, and building sectors (NOAA and Office for Coastal Management 2021; 2022).

Ocean economy employment and GDP display some differences among the sectors. For example, R.15 **RECREATION & TOURISM** supports millions of part-time and entry-level jobs and contributes the most to GDP (NOAA and Office for Coastal Management 2022). However, the contributions of this industry to the GDP may seem smaller than expected because wages are generally low. The opposite is true for the offshore mineral extraction sector, which pays the highest wage per employee (NOAA and Office for Coastal Management 2019b). In 2018, even though the offshore mineral extraction sector accounted for only 3% of the total employment in the ocean economy, it contributed 28% to the ocean economy's GDP (NOAA and Office for Coastal Management 2019a). More information on employment, income, and revenues related to OCS oil and gas activities can be found in **Sections 2.5.6 and 2.5.7**.

R.10 **COMMERCIAL FISHERIES** refers to the industry associated with the process of catching and marketing fish and shellfish for sale. It refers to and includes fisheries resources, fishermen, and related businesses (Blackhart et al. 2006). R.10 **RECREATIONAL FISHERIES** refers to the industry associated with harvesting fish for personal use, sport, and challenge (e.g., as opposed to profit). Recreational fishing does not include sale, barter, or trade of all or part of the catch (Blackhart et al. 2006). Commercial and recreational fishing is distinguished from subsistence fishing, in which the fish caught are shared and consumed directly by the families and kin of the fishers rather than being sold at market. The term "ceremonial and subsistence" refers to a harvest category specific to Native American and Alaska Native peoples representing fishing rights granted by treaty (Blackhart et al. 2006). The NMFS works in partnership with the regional fishery management councils, interstate marine fishery commissions, and states to ensure U.S. fisheries are sustainably managed.

On a national scale, R.10 **COMMERCIAL & RECREATIONAL FISHERIES** together generated $58 billion in sales (without imports) and supported 1.7 million jobs in 2018 (NMFS 2021b). **Table 2-12** summarizes the most recently available fisheries economic information broken out by sector and OCS region.

Table 2-12. Summary of commercial and recreational fisheries economics by OCS region in 2018

Commercial (without imports)

OCS Region	Landings Revenue	Income	Sales	#Jobs
Alaska	$1.8 billion	$1.9 billion	$4.4 billion	53,488
Pacific (excluding HI)	$636 million	$1.2 billion	$2.9 billion	39,727
GOM	$890 million	$1.7 billion	$4.8 billion	76,759
Atlantic	$2 billion	$3.1 billion	$8.8 billion	153,669

Recreational

OCS Region	Fishing Effort*	Income	Sales	#Jobs
Alaska	773,700 days	$195 million	$539 million	5,360
Pacific (excluding HI)	4.2 million trips	$1.4 billion	$3.8 billion	29,498
GOM	56 million trips	$5.2 billion	$14.7 billion	128,884
Atlantic	129.2 million trips	$6.7 billion	$17.7 billion	153,915

*Alaska recreational fishing effort is measured in number of days fished; in other regions, fishing effort is measure as number of fishing trips.
Source: NMFS (2021b)

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES** is an overarching category that includes any material remains or evidence of human life or activities that connect us to the past.[9] The cultural resources addressed in this category are considered significant under the NHPA if they meet the criteria of significance and integrity for eligibility on the National Register of Historic Places (National Register) as defined in 36 CFR § 60.4. Archaeological resources are "any material remains of human life or activities that are at least 50 years of age and that are of archaeological interest" (30 CFR § 550.105).

Shipwrecks located on the OCS are an archaeological resource of importance. BOEM maintains regional databases of reported shipwrecks, including those found through oil and gas industry and BOEM-funded surveys. Based on BOEM's analysis and more than 30 years of experience managing impacts on archaeological resources on the OCS, it is estimated that thousands of undiscovered shipwrecks are located on or under the OCS seafloor. Because of limited historical information on the paths taken by ships or how they were lost (e.g., fire, storm, war), it is impossible to predict reliably where a shipwreck may be located.

Submerged pre-contact period (before non-indigenous contact was made with the inhabitants of the North America continent) and post-contact sites may be found on the OCS. Submerged pre-contact

[9] See R.13 **CULTURE** for resources and activities that important for the culture of communities and groups of people in the present.

period sites are archaeological sites that were once terrestrial areas when sea level was much lower than today (i.e., during the last ice age or glacial maximum). These sites are extremely difficult to find, even using current survey technologies.

BOEM's survey guidelines for shipwrecks or other submerged sites are continually updated based on current scientific standards, and future surveys may be used to locate residual, or relict, landforms that were formerly suitable for human habitation and remain accessible in the present landscape. BOEM has developed models of paleocoastlines and areas offshore where there is a greater potential for the presence of submerged pre-contact period sites. Protection of archaeological sites depends on accurately locating a resource and implementing appropriate mitigations, such as buffer zones, to ensure that BOEM-authorized activities do not disturb archaeological resources.

Onshore cultural resources, such as archaeological sites and historic properties, are found in all ecoregions. A historic property is defined as a "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register, including artifacts, records, and material remains related to such a property or resource" (54 U.S.C. § 300308). Traditional cultural properties, historic landscapes, and national historic landmarks are also terms that describe onshore cultural resources (FWS 2019). These resources are under the jurisdiction of Federal or state land management agencies and include pre- and post-contact sites. Examples of cultural resources that are especially pertinent to BOEM's activities include lighthouses, coastal fortifications, stone formations, fish weirs, houses, and other built structures that have viewsheds or other associations with the sea. Traditional Cultural Property is a term describing a site that is eligible for listing on the National Register based on its associations with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community (Parker and King 1992).

R.12 **LAND USE** considerations exist within planning processes to determine how to use lands to support various needs, such as residential, commercial, or industrial development; recreational activity; conservation; and agricultural production. Coastal land use planning must consider infrastructure, such as ports, needed to support ocean use, in addition to purely land-based needs. Coastal areas have unique factors that impact land use decisions because of distinctive environmental characteristics (e.g., wetlands, estuaries, barrier islands, salt marshes, intertidal areas) and human activities that take place on or near the ocean. People often determine that these coastal areas should be protected to preserve them for future generations; for example, many state and national parks and wildlife preservation areas have been established on lands near or on the coast influencing coastal land use considerations. Overall, land use planning and decision-making is an important consideration for the onshore industries that support oil and gas activities on the OCS, as decisions determine where infrastructure can be built.

All coastal states except Alaska participate in the national Coastal Zone Management (CZM) Program and have taken various approaches to managing their coastal lands. The CZM Program is a voluntary partnership between the Federal Government and the U.S. coastal and Great Lakes states and territories authorized by the CZMA of 1972 to address coastal issues. Key elements of the program include protecting natural resources, managing development in high hazard areas, giving development priority to coastal-dependent uses, providing public access for recreation, and coordinating state and Federal actions. For more information on BOEM's CZM work, see www.boem.gov/Coastal-Zone-Management-Act/.

Oil and gas development and production play important roles in determining land use in many communities near the OCS, particularly in the Western and Central GOM Planning Areas. Land use in Southern California, Cook Inlet, and Beaufort Sea Planning Areas is also impacted by oil and gas activities, but on a more limited scale. Some land is used as staging areas for offshore operations and deployment areas for exploration and production equipment, personnel, and supplies used for oil and gas operations on the OCS. There are 13 major infrastructure categories related to offshore oil and gas operations, each of which occupies land. These categories include platform fabrication yards; shipyards and shipbuilding yards; port facilities; support and transport facilities; waste management facilities; pipelines; pipe coating yards; LNG facilities; natural gas processing facilities; natural gas storage facilities; refineries; petrochemical plants; and electric power infrastructure (Dismukes 2011). Support sectors also may utilize land to conduct activities or administer these businesses; these sectors include drilling contractors; underwater contractors (diving); mud, drilling, and lubricants; air transport; water transport; geophysical services; dredging; catering; workover services; and environmental consulting and mitigation (Dismukes 2010). The use of facilities currently located in these areas, as well as trends in new facility development, likely will depend on the level of activity in offshore drilling. In many cases, land used for oil and gas purposes serves both BOEM-authorized activities on the OCS and state-authorized activities closer to shore, as well as land-based activities.

R.13 **CULTURE** is a socialized pattern of behavior and understanding, which can help define a "sense of place" (Center for Advanced Research on Language Acquisition 2014). It is the "set of attitudes, values, beliefs, and behaviors shared by a group of people, but different for each individual, communicated from one generation to the next" (Matsumoto 1996). For purposes of this analysis, culture includes major industries and exports, places, and ways of life closely tied to lands, waters, and natural resources (including a subsistence way of life). Other ethnographic aspects of culture considered in this analysis include customs, values or beliefs, and language or dialect.

The traditional aspects of the sociocultural environment are well established and are not likely to change in the foreseeable future. Subsistence activities are widely practiced throughout the U.S. The most common subsistence activities are hunting, gathering, and fishing, and they vary by region. Subsistence harvest can be done solely for dietary needs, or it can also fulfill sharing traditions, kinship, and the passing of knowledge to younger generations (Kofinas et al. 2015). Impacts on the culture of a given community vary by region, ecoregion, or planning area. BOEM's first Tribal Ocean Summit, held in March 2021, convened 70 distinct Tribal representatives from at least 53 different Tribal nations from across the coasts. The Tribal Ocean Summit enabled a mutual exchange of information and learning to improve working relationships and meaningful government-to-government consultations, and facilitate consideration and avoidance of potential impacts going forward.

The relationship between culture and environmental justice is discussed in more detail under R.14 **VULNERABLE COASTAL COMMUNITIES**.

R.14 **VULNERABLE COASTAL COMMUNITIES** are historically marginalized communities, as defined by EO. EO 12898 establishes Federal agency responsibilities for environmental justice, and EO 13175 establishes Federal agency responsibilities for consultation and coordination with Indian Tribal governments. BOEM uses the *2016 Promising Practices for Environmental Justice Methodologies in NEPA Reviews* (NEPA Committee and Federal Interagency Working Group on Environmental Justice 2016) as guidance for conducting environmental justice analyses and identifying affected minority and low-income populations. BOEM applies sound science and methodologies to both identify vulnerable communities and assess the potential impacts they may experience as a result of BOEM-authorized activities. At the time of writing this Final Programmatic EIS, the environmental justice landscape within the Federal Government continues to rapidly evolve. EO 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All,* signed April 21, 2023, builds upon EO 12898 by complementing and deepening ongoing environmental justice work. Guidance from the CEQ on implementing the new EO is forthcoming and will be incorporated to the extent practicable into subsequent NEPA reviews for leases scheduled under the 2024–2029 Program.

BOEM is currently developing methodologies and best practices to improve upon current methods used to assess impacts to—and more effectively engage with—vulnerable communities at both the national level and region-specific scales. The development of the National Program is a planning process to identify a schedule of OCS oil and gas leases over a five-year period, and the Programmatic EIS is intended to inform national-level planning. The scope of the decision for the National Program affects the level of analysis of environmental justice impacts because environmental justice issues are highly localized and are often community specific. BOEM is committed to advancing meaningful engagement with communities that may potentially be impacted by oil and gas activities. The Bureau carefully considers how engagement with vulnerable coastal communities can be meaningful and can best inform both communities and BOEM's planning processes. BOEM remains open to community-initiated discussions of potential impacts and community-informed mitigation measures. Additional avenues for BOEM, communities, and other organizations working on environmental justice to build relationships and engage on environmental justice issues are available through the BOEM website at www.boem.gov/environment/get-involved.

Environmental justice considerations would be included in NEPA analysis prepared at the regional, lease sale, and subsequent stages and would consider community, county, and state-level information in coastal areas adjacent to the applicable planning area(s). BOEM does not have project-specific information for a lease sale, so assessment of potential impacts at this stage relies on assumed scenarios of potential types and levels of activity that could result from a lease sale. However, the planning period associated with regional lease sales allows time for communities to provide regional and local-level input, including on concerns related to environmental justice.

This analysis uses the USEPA (2021b) definition of ***minority population***, which includes individuals identified in the U.S. Census as not "single-race white and not Hispanic" (i.e., individuals who are American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic).

The fabric of vulnerable coastal communities can be complex and varies by OCS region, ecoregion, or planning area. Environmental justice issues encompass a broad range of impacts on the natural or physical environment and interrelated social, cultural, and economic effects. This analysis examines the composition of the affected area to determine whether minority populations, low-income populations, or American Indian Tribes and Alaska Native peoples are present in each of the regions and planning areas. If so, the analysis considers whether the potential activity may cause disproportionately high and adverse human health or environmental effects. The analysis considers the interrelated cultural, social, occupational, historical, economic, and health-related factors that may amplify the natural and physical environmental effects of the proposed activities. Due to the close, interconnected nature of these factors, vulnerable coastal communities and R.13 **CULTURE** address different aspects of the same topic and are sometimes discussed together.

BOEM recognizes vulnerable coastal communities may experience a complex set of environmental, social, and economic factors that interact to contribute to varying health outcomes within communities. Several resources and indices are available from Federal agencies responsible for collecting and interpreting data on human health. The Centers for Disease Control Environmental Justice Index[10] is a national, place-based tool designed to measure the cumulative impacts of environmental burden and human health. The Environmental Justice Index can identify and map areas most at risk for the health impacts of environmental burden by providing indicators of social vulnerability (e.g., socioeconomic status, housing characteristics), environmental burden (e.g., air pollution, hazardous and toxic sites), and health vulnerability (preexisting chronic disease burden). USEPA's EJScreen[11] tool also includes environmental health-related indicators, such as air pollution and proximity to hazardous sites. As appropriate and practicable, BOEM may employ these and other tools to support assessments environmental justice impacts for lease sales and later stages.

R.15 **RECREATION & TOURISM** activities are an important economic driver for coastal counties due to the number of visitors who spend substantial amounts of money in coastal areas as they enjoy ocean-based attractions and recreational activities. Common recreational activities vary slightly by OCS region based on oceanography and geography, but all regions include activities such as beach-going, wildlife viewing, fishing, hiking, hunting, camping, boating, sailing, diving, sightseeing, and commercial cruises. Many of the coastal and ocean amenities that attract visitors are free, generating no direct employment, wages, or GDP. However, the recreation and tourism sector of the ocean economy, which depends on these free coastal attractions, employs more people and generates more GDP than any other sector of the ocean economy (NOAA and Office for Coastal Management 2022).

On a national scale, the recreation and tourism sector generated $143.2 billion in GDP and $65.6 billion in wages, and supported over 2.5 million jobs in 2018 (NMFS 2018c; NOAA 2016a). **Table 2-13** summarizes economic information for the recreation and tourism sector by OCS region for activities related to the ocean economy.

[10] www.atsdr.cdc.gov/placeandhealth/eji/index.html#:~:text=The%20Environmental%20Justice%20Index%20uses%20data%20from%20the,environmental%20injustice%20on%20health%20for%20every%20census%20tract
[11] www.epa.gov/ejscreen

Table 2-13. Contribution of the recreation and tourism sector to the ocean economy by OCS region in 2018

OCS Region	GDP	Wages	#Establishments	#Jobs
Alaska	$1.2 billion	$581.1 million	1,699	23,192
Pacific	$33.5 billion	$15.8 billion	29,128	553,426
GOM	$16.2 billion	$7.9 billion	16,841	353,298
Atlantic	$71.2 billion	$32 billion	68,410	1,172,811

Notes: Dollar amounts for GDP and wages are rounded and represent estimates.
Sources: NOAA and Office for Coastal Management (2021), NMFS (2018c)

The contribution of the recreation and tourism sector to the economy, including jobs and GDP supported by this sector, may be affected by ecosystem health, water quality, and associated aesthetics (NOAA and Office for Coastal Management 2019a). The tourism industry may also benefit local residents by increasing property values, especially near destination locations, and providing community services from tax revenues (Dean Runyan Associates 2017b). The annual economic contribution from coastal tourism has increased steadily over recent years, and this trend is expected to continue (Kildow et al. 2016). Although recreation and tourism also have a connection to ecosystems and culture, the sector is generally discussed in this document as an industry in the context of its market value.

2.5.6 Employment and Income

Employment and income associated with OCS-related oil and gas activities are relevant considerations when determining the size, timing, and location of leasing. In this document, these economic aspects of the human environment are not analyzed as a resource in the discussions about the affected environment and environmental consequences in **Chapters 2 and 4**. Instead, employment and income are discussed separately because potential effects are more closely linked to oil and gas markets and other economic drivers than to IPFs directly resulting from oil and gas activities.

The oil and gas industry exists within the global economy, and this sector is particularly influenced by market forces such as volatile prices, fluctuating supply and demand, changing costs in production, evolving technologies, government regulation, and geopolitics. These and other factors ultimately impact employment and income patterns by influencing how much profit a project will generate and where a company conducts business. **Figure 2-8** includes BOEM's estimates of the direct, indirect, and induced employment from OCS-related oil and gas activities in fiscal year 2020.[12] The GOM Region is the predominant area of the U.S. offshore oil and gas industry, with the most jobs generated in Texas and Louisiana. BOEM estimates that Texas supported 62,606 jobs and Louisiana supported 37,790 jobs during fiscal year (FY) 2020. However, the nature of the offshore oil and gas industry is such that many

[12] BOEM's estimates of direct employment represent the jobs created by the initial round of industry spending on projects and related activities or purchases potentially resulting from the 2024–2029 Program. *Indirect employment* is created as the initial spending ripples through the economy, and *induced employment* is the result of employee households spending the income received from both direct and indirect employment. Therefore, employment includes all jobs throughout the economy that would be created or sustained by project-related activities resulting from leasing, regardless of the nature of the work or the way the jobs are classified by government statistical agencies. Given the extensive and varied equipment, goods, and services required for oil and gas activities, most of the total employment generated by OCS projects is reported under other sectors.

of those who work on rigs and platforms commute long distances, and there are companies in every U.S. state that provide supporting goods and services. These dynamics highlight the widespread implications of offshore activities and the importance of the oil and gas sector to the national economy. The employment estimates for FY 2020 were significantly lower than previous years due to the global economic shock related to the COVID-19 pandemic, but other general trends in employment (e.g., income) remained similar to previous years.

Potential effects to employment and income depend on area-specific factors, such as population size, employment rate, and income level. One important factor is whether there are existing onshore oil and gas infrastructure and support industries to facilitate development and production. An increase or decrease in need for these onshore components could alter the current economic and demographic baseline of an area. Therefore, it is important to consider whether the proposed lease sales would result in noticeably more or less need for new infrastructure or supporting goods, services, and labor. For example, new projects from future lease sales in the Western and Central GOM Planning Areas would provide continued work for the existing workforce rather than create new jobs. In areas without existing infrastructure, new construction or support activities are likely to result in additional jobs for current residents or to attract new residents to the area. Other aspects of communities or households may also be important considerations and influence socioeconomic effects, such as the employment pattern of the industry or alternate sources of income. For example, some oil and gas industry employees work seasonally in multiple geographic locations or spend part of the year working in another industry (e.g., fishing). The baseline of the economic aspects of the affected environment will be characterized and evaluated in more detail in subsequent regional environmental analyses.

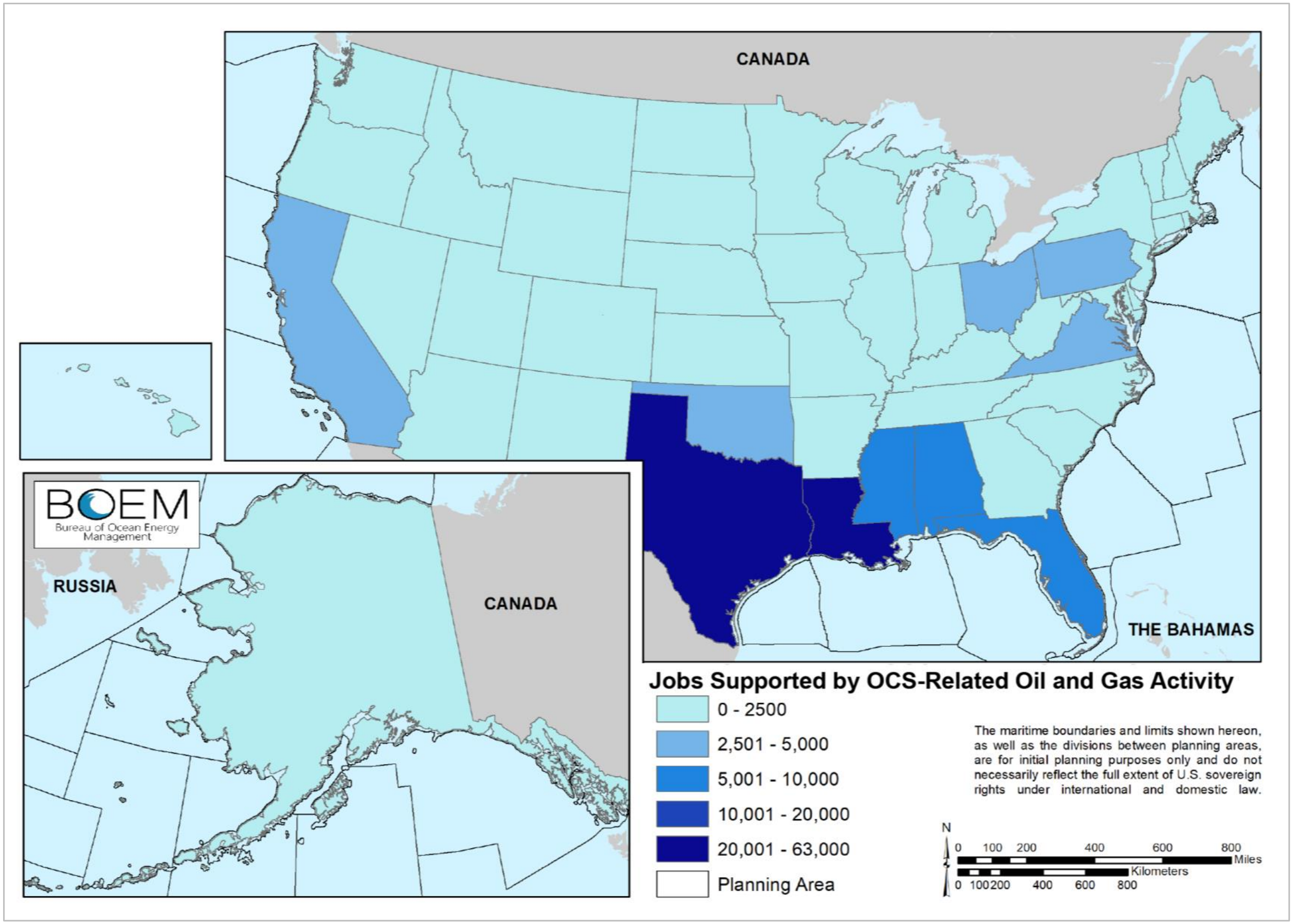


Figure 2-8. Estimated U.S. employment associated with OCS-related oil and gas activities (FY 2020)

2.5.7 Leasing Revenues

The Federal Government collects revenues from oil and gas leasing and production on the OCS through bonus bids, royalties, and rents from lessees; these revenues totaled $5.6 billion in FY 2019, $3.7 billion in FY 2020, $4.1 billion in FY 2021, and $6.5 billion in FY 2022 (ONRR 2020). The U.S. Department of the Treasury retains a large portion of OCS revenues, while other portions are deposited into the Historic Preservation Fund and Land and Water Conservation Fund, shared with states through the Section 8(g) provision of the OCS Lands Act (as amended), or shared with states through the Gulf of Mexico Energy Security Act (GOMESA), which authorized revenue sharing in 2006.

Section 8(g) of the OCS Lands Act, as amended, requires that 27% of the revenues for Federal lease blocks within 3 nmi (5.6 km) of a state's seaward boundary be shared with the state to compensate for oil and gas reservoirs that may be underlying both the OCS and submerged state tidelands. GOMESA allocates specific percentages of OCS revenues to Gulf producing states (Texas, Louisiana, Mississippi, and Alabama) and their coastal political subdivisions, and provides additional revenue to the Land and Water Conservation Fund.

Federal, state, and local governments also receive revenues from the economic activity generated by the subsequent offshore oil and gas development and production, including taxes on corporate profits and personal income taxes from employment. Furthermore, state and local governments receive revenues from property taxes related to onshore support infrastructure.

Sections 2.6–2.9 identify characteristics unique to each region and present both current conditions and future baseline conditions.

2.6 ALASKA REGION

Figures 3-2 and 3-3 show the Alaska Region's current conditions and future baseline conditions.

At nearly 33,904 mi (54,563 km) long, the Alaskan shoreline is the longest in the U.S. and has many bays, islands, and inlets (NOAA 2016e). The Alaska Region includes 15 BOEM planning areas that span three BOEM ecoregions: Chukchi and Beaufort Seas, East Bering Sea, and Gulf of Alaska Ecoregions (**Figure 2-4**). Currently, there are active oil and gas leases in the Beaufort Sea and Cook Inlet Planning Areas.

2.6.1 Physical Environment

The seafloor in the Alaska Region comprises both soft sediments (including abyssal plains) and hard bottom areas. Hard rock areas are common throughout much of the region, including around the Aleutian Islands. Volcanic activity and plate tectonics have created long chains of seamounts. This region features numerous canyons, including Barrow Canyon, which connects the Chukchi Sea and Beaufort Sea Planning Areas. Herald and Hanna Shoals, two shallow areas (66 ft [20 m] below sea level), influence ice patterns, water movement, and distribution of marine life. Major ocean currents (**Figure 2-9**) and their complex interactions affect the waters surrounding Alaska by bringing in nutrient-rich waters, which help drive high primary productivity in the spring and summer months. Freshwater inputs from rivers, land runoff, and ice melt also contribute to the complex dynamics in this region.

The Alaska Region experiences extreme annual temperature variability due to its location. North of the Arctic Circle, the winter months have limited daylight hours, and the summer months bring near-constant daylight. The annual freezing and melting of sea ice influences the transfer of energy between the ocean and atmosphere and has important implications for marine ecosystems (Smith et al. 2017b). Sea ice varies seasonally, and breakup and formation patterns also vary significantly among years.

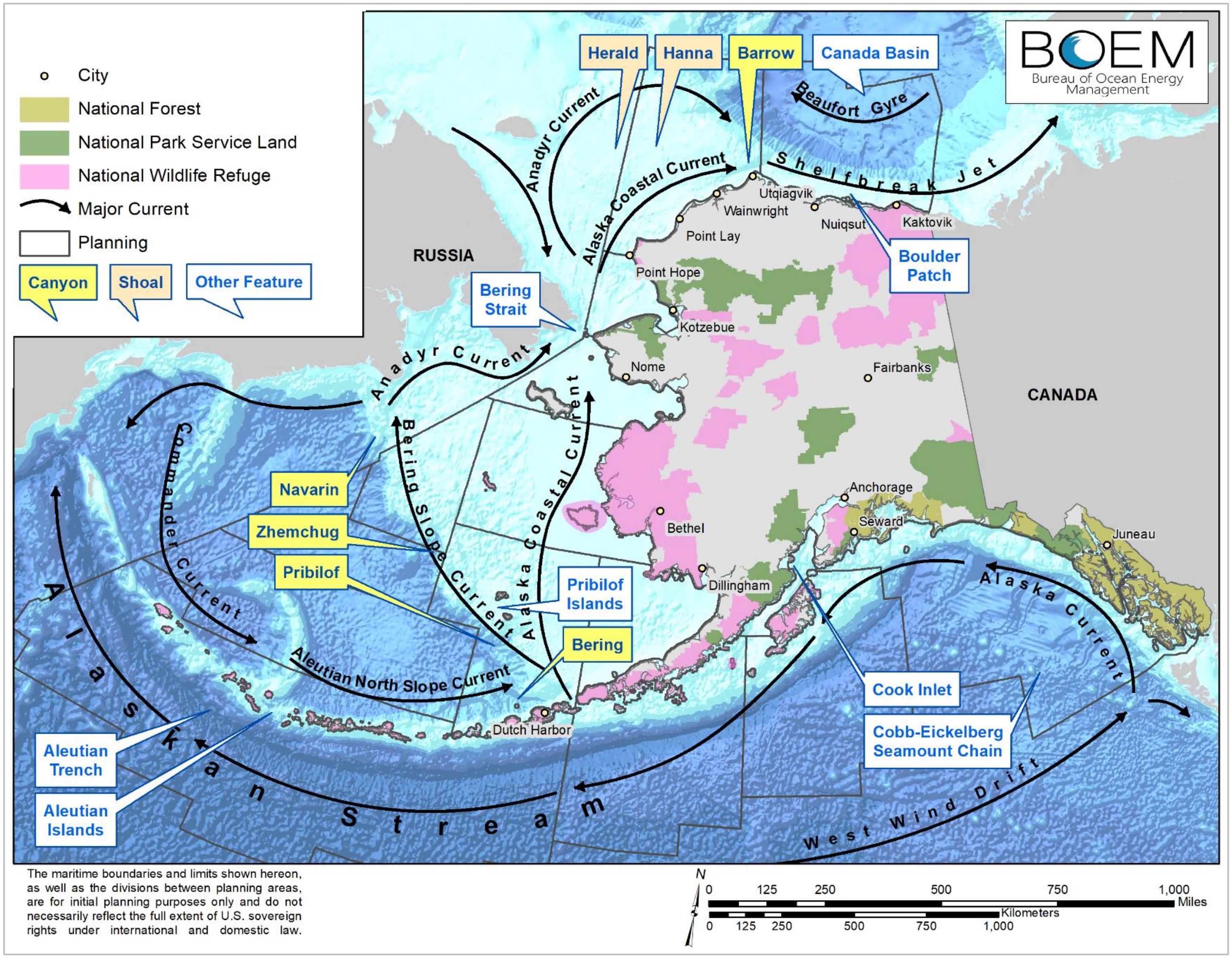


Figure 2-9. Alaska Region physical, political, and land management features

Sea ice forms throughout the Bering Sea each winter and retreats north through the Bering Strait in the spring. In the Chukchi and Beaufort Seas Ecoregion and the northern reaches of the East Bering Sea Ecoregion, open-water season lasts from June through October, with air temperatures generally above freezing and precipitation occurring as rain. The Gulf of Alaska Ecoregion climate is warmer than the rest of the Alaska Region. Sea ice does not regularly occur in the open areas there; however, calving ice and icebergs are common in localized coastal areas in bays and fjords containing tidewater glaciers. These occur throughout the Gulf of Alaska Ecoregion, where glaciers are present. Ice forms periodically in Cook Inlet, Prince William Sound, and Glacier Bay in the winter, and nearshore ice forms along the Alaska Peninsula and the Aleutian Islands in some years.

Arctic areas, including the Chukchi and Beaufort Seas Ecoregion, are experiencing more impacts of climate change than elsewhere on the planet, particularly in the timing and extent of sea ice. The volume of Arctic sea ice at its maximum extent has decreased steadily since 1979 at a rate of about 10% per decade, and the thickness and amount of multi-year sea ice has also decreased (Wassmann 2011; Wood et al. 2015). Before 1980, about three-quarters of the sea ice persisted from one year to the next (multi-year ice). Since the 1980s, the amount of this multi-year ice has declined dramatically (Wassmann 2011). Based on several climate forecasts, the decreasing extent of sea ice is expected to continue (Intergovernmental Panel on Climate Change 2018). Model simulations predict that, depending on global increases in temperature (2.0 or 1.5°C), the Arctic Ocean may be nearly ice-free for at least one summer every 10 or 100 years, respectively (Intergovernmental Panel on Climate Change 2018). Furthermore, the influx of water through the Bering Strait is expected to increase and bring additional warmer and fresher water into the Chukchi and Beaufort Seas Ecoregion (Woodgate 2018).

Current Conditions (Figure 3-2). R.1 **AIR QUALITY** along Alaska's coasts is in compliance with the NAAQS. The only nonattainment area in Alaska is around Fairbanks (USEPA 2018c), which is hundreds of miles from the coast (**Figure 2-6**); thus, the current nonattainment status is unlikely to be influenced by development on the OCS.

R.2 **WATER QUALITY** is relatively pristine in the vast majority of Alaska Region waters because the state's sparse population and remoteness limit pollutants that would degrade water quality (Alaska Department of Environmental Conservation 2017). Water quality may be affected by aerosol deposition, erosion of organic material on shorelines adjacent to the Alaska planning areas, and localized pollution from onshore and offshore oil and gas exploration and production, mining activities, urban runoff, and seafood processing (Alaska Department of Environmental Conservation 2017). Ocean acidification, which may impact marine fauna, is a particular concern in the Alaska Region as well.

Some areas of the state have a higher population density than others. For example, the Cook Inlet watershed contains approximately two-thirds of Alaska's population. The more concentrated populations in such areas may lead to degraded water quality. In the Cook Inlet, point source pollution, such as discharges from municipal and industrial facilities, is rapidly diluted by the energetic tidal currents. Current speeds in the lower Cook Inlet can reach up to 11.8 in/sec (30 cm/sec), which may help minimize the influence of pollutants on water quality (Johnson 2021). The overall condition of south-central Alaska's coastal waters has been rated as good when analyzing water quality, sediment quality, and fish tissue contaminants indices (Alaska Department of Environmental Conservation 2017).

Future Baseline Conditions (Figure 3-3). Alaska's coasts are expected to maintain their R.1 **AIR QUALITY** attainment status in compliance with the CAA. New development along the coast, however, may degrade air quality locally.

Over the next 40 to 70 years, R.2 **WATER QUALITY** in the Alaska Region may be subject to various stressors, such as urbanization; municipal waste discharges; marine vessel discharges; wastewater; persistent contaminants and marine debris; dredging and marine disposal; bridge and coastal road construction; commercial and recreational fishing; recreation and tourism; harbor, port, and terminal operations; industrial activities related to the petroleum industry; mining operations; NASA and other Federal agency operations; and climate change. As a result, overall water quality in the region is expected to decline compared to current conditions.

Ocean acidification is expected to remain an ongoing issue in this region. The Arctic Ocean is predicted to experience the greatest degree of ocean acidification worldwide (Arctic Monitoring and Assessment Programme 2013; Mathis et al. 2015; Mathis et al. 2011). Warming temperatures and decreasing sea ice expose more ocean surface area to atmospheric CO_2, which may decrease the pH of the Arctic Ocean. High-latitude oceans have naturally lower carbonate concentrations than elsewhere, making them more susceptible to impacts from ocean acidification (Fabry et al. 2009).

2.6.2 Pelagic Environment

Current Conditions (Figure 3-2). Primary production in the Alaska Region is highly variable, with spring phytoplankton blooms driving production in the Gulf of Alaska Ecoregion and seasonal melting of sea ice driving production in the Bering, Beaufort, and Chukchi Seas. Microzooplankton are an important element of R.3 **PELAGIC COMMUNITIES**, consuming 57% of daily phytoplankton production and providing food for larger zooplankton (Schmoker et al. 2013). Concentrations of small crustaceans, such as copepods and krill, are highest in the East Bering Sea Ecoregion, especially along the 200-m isobath (Smith et al. 2017b; Springer et al. 1996). These tiny animals are critical food sources for forage R.6 **FISH**, like Pacific herring, smelt, and capelin; the for pass energy to higher levels in the food chain, including salmon, which supports important Alaska R.10 **COMMERCIAL & RECREATIONAL FISHERIES**.

> Ice-associated phytoplankton blooms are critical for pelagic ecosystems in the northern Alaska Region. As sea ice melts each spring, nutrient-rich water seeded with ice algae is exposed to warmer temperatures, triggering an explosive growth of phytoplankton that drives some of the world's highest marine productivity (Grebmeier et al. 2006; Horner and Schrader 1982).

Many pelagic R.6 **FISH** species' habitats span the East Bering Sea Ecoregion through the Chukchi and Beaufort Seas Ecoregion, including Pacific herring and capelin (Smith et al. 2017b). These fishes are key prey for R.7 **BIRDS** and R.9 **MARINE MAMMALS**, whose distributions are tightly linked to their food source. For example, spotted seals choose haul-out areas where forage fishes spawn (Sigler et al. 2009), and kittiwake birds spend most of the winter near the sea-ice edge feeding on Pacific herring in the first 2 ft (0.6 m) below the ocean surface (Hunt Jr. et al. 1981). The ESA-listed Steller sea lion western distinct population segment (DPS) and humpback whale prey upon forage fish as well. Walleye pollock are most numerous in the Bering Sea, while Arctic and saffron cod are among the most abundant fish species in the Chukchi and Beaufort Seas Ecoregion (Smith et al. 2017b).

The Alaska Region provides habitat to many species of marine R.7 **BIRDS**. In particular, the highly productive waters of the Bering Sea shelf break support high densities of seabirds—such as black-legged kittiwakes, murres, and auklets—that travel long distances from massive nesting colonies in the Pribilof Islands, St. Matthew and Hall Islands, and St. Lawrence Island (National Research Council 1996). The northern Bering and southern Chukchi Seas support some of the largest seabird colonies in the world and very large summertime seabird populations, while the Beaufort Sea has very low seabird densities (Kuletz et al. 2015). Although it does not breed in the Alaska Region, the ESA-listed short-tailed albatross spends much of the year feeding in the area (Suryan and Kuletz 2018). Many non-resident migrating seabirds forage here to build body-fat reserves on their way to Arctic nesting grounds. An estimated 7 million birds fly through the Unimak and Akutan Passes, which straddle the East Bering Sea and Gulf of Alaska Ecoregions (Smith et al. 2017b). The seabird species present in the Gulf of Alaska Ecoregion are very similar to those of the East Bering Sea Ecoregion and include gulls, murres, kittiwakes, puffins, auklets, and petrels. Fisheries bycatch is an ongoing threat to marine birds in the Alaska Region, with most bycatch occurring in demersal longline fisheries. Although seabird bycatch is decreasing due to compliance with seabird avoidance regulations, an estimated 3,462 seabirds were caught as bycatch in commercial fisheries in 2020 in Alaskan waters (Krieger and Eich 2021).

R.8 **SEA TURTLES** are rare and infrequent visitors to the Alaska Region and are mostly encountered in the southern Gulf of Alaska Ecoregion. The ESA-listed leatherback sea turtle is most commonly sighted, but there have been instances of green, loggerhead, and olive ridley turtles in Alaskan waters (Hodge and Wing 2000).

Many R.9 **MARINE MAMMALS** use pelagic habitats throughout the Alaska Region. Beluga whales are wide-ranging and opportunistic feeders, moving seasonally to follow R.6 **FISH** and invertebrate prey. The upwelling zone in Barrow Canyon (**Figure 2-9**) in the Chukchi and Beaufort Seas Ecoregion is a particularly important feeding ground for belugas due to high concentrations of Arctic cod in the summer months. There are five distinct stocks of beluga whales in Alaskan waters (Hauser et al. 2014), including the ESA-listed Cook Inlet DPS. Bowhead whales tend to be found near edges of pack ice and feed almost exclusively on zooplankton throughout the water column (Moore and Reeves 1993). They are most abundant in the East Bering Sea Ecoregion during the winter and in the Chukchi and Beaufort Seas Ecoregion during the summer (Moore and Reeves 1993). During the spring migration, bowhead whales move from the Chukchi to the eastern Beaufort Sea. The Beaufort Sea coastal area is a key breeding ground for bowhead whales (Clarke et al. 2015). Gray whales undergo extremely long migrations from tropical to Arctic latitudes; they visit the Alaska Region in the summer to feed on benthic prey (Clarke et al. 2015; Smith et al. 2017b). The ESA-listed North Pacific right whale occurs in the Gulf of Alaska and East Bering Sea Ecoregions; it has designated critical habitat in the Kodiak, North

Aleutian Basin, and St. George Basin Planning Areas. Finally, three humpback whale DPSs visit the East Bering Sea Ecoregion in the summer to feed on zooplankton and small forage fish (Smith et al. 2017b).

Many semi-aquatic marine mammals frequent the pelagic environment to feed in the water column or on the seafloor. These species include Steller sea lions; walrus; and bearded, northern fur, ribbon, and ringed seals. Although they do not spend time on land in the Alaska Region, northern elephant seals migrate from more southern waters to feed offshore and can dive deeper than 5,600 ft (1,700 m) in search of food. Individuals from the ESA-listed western DPS of Steller sea lions were the most common marine mammal bycatch by Alaskan R.10 **COMMERCIAL FISHERIES** from 2014–2018, with approximately 37 individuals caught each year (Muto et al. 2021).

A variety of Alaskan marine species are sensitive to ecological changes caused by warming temperatures. For example, unusually warm conditions from 2014–2016 in the northeastern Pacific, known as the "warm blob," prevented large shoals of Pacific herring from returning to Prince William Sound. Consequently, humpback whales in the sound consumed almost all the fish that were present, leaving little behind for seabirds (Moran 2018). The 2014–2016 marine heatwave caused breeding common murres to suffer reproductive failure in the Gulf of Alaska Ecoregion and southeast Bering Sea, with an estimate of one-quarter of the breeding murres (about 4.5 million R.7 **BIRDS**) dying of starvation (Piatt et al. 2020). Similarly, Pacific cod and other R.10 **COMMERCIAL & RECREATIONAL FISHERIES** experienced large declines in numbers during the presence of the "warm blob" in the Gulf of Alaska Ecoregion (Laurel and Rogers 2020).

*The following threatened or endangered species have critical habitat designated within BOEM planning areas in the Alaska Region (detail and map in **Appendix D**)*

Polar bear: Beaufort Sea, Chukchi Sea, Hope Basin, Norton Basin, St. Matthew-Hall

Beluga: Cook Inlet

North Pacific right whale: Kodiak, North Aleutian Basin, St. George Basin

Northern sea otter: Aleutian Arc, Cook Inlet, Kodiak, North Aleutian Basin, Shumagin

Spectacled eider: Chukchi Sea, Navarin Basin, Norton Basin, St. Matthew-Hall

Steller sea lion (Western DPS): Aleutian Arc, Bowers Basin, Cook Inlet, Gulf of Alaska, Kodiak, North Aleutian Basin, Norton Basin, Shumagin, St. George Basin, St. Matthew-Hall

Steller's eider: St. Matthew-Hall

Future Baseline Conditions (Figure 3-3). Climate change is expected to be the biggest stressor in the Alaska Region over the next 40 to 70 years and may impact many species throughout the food web, including R.3 **PELAGIC COMMUNITIES**, R.6 **FISH**, R.7 **BIRDS**, and R.9 **MARINE MAMMALS**. Ongoing oil and gas activities not associated with the 2024–2029 Program also may present challenges to these resources in some planning areas.

In Alaskan waters, seasonal ice melt related to climate change may prevent ice algal blooms and subsequent peak phytoplankton production from coinciding with seasonal zooplankton reproductive periods or hatching times of pelagic fishes (Eisner et al. 2014; Wassmann 2011). Such mismatches in timing may result in population and recruitment declines for pelagic organisms that feed on primary producers, which in turn may impact larger species like forage R.6 **FISH**, pelagic R.7 **BIRDS**, and R.9 **MARINE MAMMALS**. These changes are expected to continue as oceans become warmer. In addition to food scarcity, pelagic organisms may need to contend with new competition. As species from lower latitudes migrate northward (e.g., copepods through the Bering Strait), they may displace native species, which are already at the northern edge of tolerable environmental conditions and have few options for range shifts (Ershova et al. 2015). Some baleen whales are already exploiting new geographic areas for feeding and may benefit from further shifts in the planktonic community, while fish-eating beluga whales may struggle with food scarcity (George et al. 2015; Harwood et al. 2015; Moore 2016) or increased predation risks (O'Corry-Crowe et al. 2016). The ESA-listed Cook Inlet beluga whale population[13] may be disproportionately affected by future changes due to its small size and slow recovery (NMFS 2010). Warming waters could also expose more marine mammals to HABs (Lefebvre et al. 2016). The precise effects of climate change on pelagic organisms in Alaskan waters are difficult to predict because they vary with species, trophic level, and ecological niche (Harwood et al. 2015).

New sea lanes may open as the Arctic open-water season lengthens and sea ice declines (Hauser et al. 2018); as a result, stressors to the pelagic environment from commercial shipping, commercial fishing, tourism (including cruise ships), and research activities are expected to increase (Pizzolato et al. 2014). In addition, oil and gas development in state waters and on existing Federal leases may affect pelagic habitats and species. These activities could result in behavioral disturbance to wildlife or acoustic masking due to increased noise, disturbance from vessel or aircraft traffic, vessel strikes, routine discharges, bottom disturbance, or non-routine events (fuel or other spills).

2.6.3 Benthic Environment

Current Conditions (Figure 3-2). Barrow Canyon—which spans the Beaufort Sea and Chukchi Sea Planning Areas—creates an area of significant productivity for marine benthic communities. In the Beaufort Sea Planning Area, an isolated hard rock bottom area known as Boulder Patch supports diverse R.4 **MARINE BENTHIC COMMUNITIES**, including kelp, algae, and corals (**Figure 2-9**). In the Chukchi Sea Planning Area, Hanna Shoal supports high benthic biodiversity and provides critical foraging grounds for species such as walrus. Green sea urchins, purple-orange sea stars, fuzzy hermit crabs, and snow crabs commonly inhabit the Chukchi Sea, while the Beaufort Sea contains brittle stars, mussels, and peanut worms (Smith et al. 2017b).

> Hanna Shoal is an example of a “hot spot,” an area of high biological diversity, with species returning yearly.

Nutrients in the highly productive Bering Sea and Strait stimulate benthic communities (Smith et al. 2017b). Shallower than 50 m (164 ft), the benthic community is dominated by sea stars and soft corals, whereas in deeper water, crabs and gastropods dominate. Red king crabs and snow crabs, important

[13] Critical habitat was designated for the Cook Inlet beluga whale DPS under the ESA in 2011 (NMFS 2021a).

R.10 COMMERCIAL FISHERIES species that are food sources for humans and other marine organisms, congregate in large groups covering vast areas of the seafloor in Bristol Bay (Dew 2010). Snow and tanner crabs prefer sandy and muddy areas and have R.6 ESSENTIAL FISH HABITAT along the Bering Sea shelf break (**Appendix E**). Many R.9 MARINE MAMMALS (e.g., walrus and ice seals) feed on the high abundance of benthic invertebrates in the northern Bering Sea and use these areas to rest and breed on sea ice.

The Aleutian trench contains many seamounts, canyons, and cold seeps (**Figure 2-9**). Invertebrate and R.6 FISH species are present in seep communities, using the complex, valuable habitat provided by worms, mussels, and clam hosts (Levin 2005; Rathburn et al. 2009; Suess et al. 1998). Groundfish and scallops are common and important R.10 COMMERCIAL FISHERIES in the Gulf of Alaska Ecoregion (North Pacific Fishery Management Council 2014).

The North Pacific Fishery Management Council has taken action to protect sensitive and rare habitat from fishing impacts in areas encompassed by seven of BOEM's Alaska Region planning areas (North Pacific Fishery Management Council 2017a; 2017b) (**Appendix E**). Atka mackerel is one of the most abundant species in the western Aleutian Islands, and its habitat includes coral and sponge gardens, where the R.6 FISH are thought to spawn (Raring et al. 2016). Habitat Conservation Areas have been designated in the Aleutian Arc and Bowers Basin Planning Areas to protect key areas from fishing impacts (North Pacific Fishery Management Council 2017a; 2017b). Known skate nursery habitat includes areas located in Navarin and St. George Basin Planning Areas (North Pacific Fishery Management Council 2013) (**Appendix E**). Many of the Cobb-Eickelberg Seamounts in the Gulf of Alaska Ecoregion are listed as Habitat Areas of Particular Concern (HAPCs). The faunal community of the Patton Seamount, for example, varies with substrate type and depth and includes corals, sponges, echinoderms, crabs, anemones, rockfish, flatfish, grenadier, and sablefish (Hoff and Stevens 2005). Further designations of coral HAPCs and Habitat Protection Areas occur in the Gulf of Alaska (North Pacific Fishery Management Council 2017a; 2017b) (**Appendix E**).

In the Chukchi and Beaufort Seas Ecoregion, climate change has caused changes to distributions of various invertebrates and R.6 FISH. Species-specific differences may have varying effects on food webs (Orensanz et al. 2004; Wassmann et al. 2011). For example, in the Bering Sea, Greenland turbot biomass has decreased (Bryan et al. 2022) as waters have warmed, while walleye pollock have increased in the Bering Sea (Fissel et al. 2022; Overland and Stabeno 2004). During a shift from cold to warm water temperature in 1977, the Gulf of Alaska Ecoregion's benthic community changed from a crustacean-dominated to a fish-dominated environment, impacting higher trophic level animals and R.10 COMMERCIAL & RECREATIONAL FISHERIES (Anderson and Piatt 1999). Research continues to study the habitat baseline, particularly of the marine flora in the Boulder Patch (Bringloe et al. 2017), which could be crucial to observing changes in the ecosystem.

Future Baseline Conditions (Figure 3-3). Over the next 40 to 70 years, seafloor resources, including R.4 MARINE BENTHIC COMMUNITIES and R.6 FISH & ESSENTIAL FISH HABITAT, may change due to various stressors such as climate change, fishing, and ongoing oil and gas activities. Ongoing oil and gas activities in Federal and state waters may disrupt marine benthic communities, fish, and EFH.

Fluctuations in water temperature could continue to influence **R.6 FISH** distribution and composition of **R.4 MARINE BENTHIC COMMUNITIES**. Projections to 2050 indicate that species invasion and replacement may be most intense in the Chukchi and Beaufort Seas Ecoregion (Cheung et al. 2009). As a result of ongoing and future range shifts, native species may overlap and compete with new species—with uncertain outcomes. Some species could benefit, while others may decline, meaning that resource managers and **R.10 COMMERCIAL & RECREATIONAL FISHERIES** may experience a changing ecosystem (Anderson and Piatt 1999). If the high biomass of shell-building animals in Alaskan waters is affected by ongoing and future ocean acidification, predators like seals, whales, and walrus may lose prey resources or need to adapt their diet (Fabry et al. 2009). Not only do the calcifying organisms (e.g., commercially important crabs and clams) support fisheries, they are also the prey of many other harvested species. In fact, only 3% of commercially caught shelled animals are estimated to be unaffected by ocean acidification (Mathis et al. 2015). Although this suggests the potential for widespread impacts, southern Alaska may be at higher risk to ocean acidification impacts due to a high dependence on vulnerable marine species coupled with forecasted regional ocean chemistry changes (Mathis et al. 2015).

2.6.4 Coastal Environment

Current Conditions (Figure 3-2). **R.5 COASTAL & ESTUARINE HABITATS** of the East Bering Sea and the Chukchi and Beaufort Seas Ecoregions include barrier islands, beaches, wetlands, tundra, and tidal flats. The coastline of the Chukchi Sea includes some of the world's northernmost eelgrass beds (NPS 2016). All these habitats occur within estuarine watersheds in and around bays, lagoons, and river mouths where saltwater and freshwater mix (Wilkinson et al. 2009).

The Gulf of Alaska Ecoregion includes rocky coastlines and numerous fjords, islands, and embayments (Wilkinson et al. 2009). Large salt marshes and mudflats are dominant coastal features along Cook Inlet, particularly along the western shore. At more exposed locations, sand and gravel beaches and rocky shores are quite common (Lees and Driskell 2004).

The Arctic coastline is highly disturbed by the movement of sea ice, which is frequently pushed onshore, scouring and scraping the coastline (Forbes 2011). Fall and spring storms, periods of ice movement, and permafrost thaw cause erosion and flooding along the Chukchi and Beaufort Seas' shorelines (Shell Gulf of Mexico Inc 2015). However, the formation of sea ice during fall dampens shoreline erosion and storm wave action.

Tundra ecosystems dominate the North Slope adjacent to the Chukchi Sea and Beaufort Sea Planning Areas. The Arctic Coastal Plain is a smooth plain on the North Slope, rising gradually inland between 15 to 100 mi (24 to 160 km) from the coast of the Arctic Ocean (Wahrhaftig 1965). Tundra ecosystems are composed of wetlands and marshes over permafrost soils (Wahrhaftig 1965; Walker 1983; Walker et al. 1980). There are no trees in the tundra, but mosses and lichens are abundant. Few animals can survive in such conditions; the most notable species that can survive there are caribou, Arctic fox, Arctic hare, and a variety of migratory bird species.

Caribou are large, hooved mammals distributed among 32 populations or herds in relatively undeveloped areas across Alaska (Alaska Department of Fish and Game 2020). Many herds reside in coastal environments across the region, except near the Cook Inlet, Kodiak, and Gulf of Alaska Planning Areas (Alaska Department of Fish and Game 2020). Caribou herd size naturally fluctuates (e.g., cycles of years of growth followed by years of decline) due to a number of factors such as weather conditions, overpopulation, predation, disease, and hunting (Alaska Department of Natural Resources 2019). Most caribou herds migrate seasonally between their calving area, summer range, and winter range to take advantage of seasonally available forage resources. Female caribou begin migrating from overwintering areas to calving areas in April (Alaska Department of Fish and Game 2015); calving occurs in late May through early June (Alaska Department of Fish and Game 2015; Alaska Department of Natural Resources 2019). During the post-calving period in July through August, caribou generally aggregate in large groups and therefore may be more sensitive to human disturbance (Alaska Department of Fish and Game 2015).

Alaskan waters and coasts support several protected R.6 **FISH** species, including five ESA-listed subspecies of steelhead, the ESA-listed southern DPS of the green sturgeon, and nine ESA-listed subspecies of salmon (including several stocks that support a valuable R.10 **COMMERCIAL & RECREATIONAL FISHERY**). These species are anadromous, moving from marine waters to rivers to spawn; salmon and steelhead use both marine and freshwater environments in Alaska, while green sturgeon use marine waters in Alaska but spawn in freshwater inland streams farther south along the U.S. West Coast. R.6 **ESSENTIAL FISH HABITAT** for the marine juvenile and adult stages of five species of salmon occurs from the coast to the exclusive economic zone (EEZ) boundary in all Alaska planning areas. Coastal and freshwater larval, juvenile, and adult phase EFH is found in select freshwater spawning streams, estuaries, and coastal areas throughout Alaska (North Pacific Fishery Management Council 2012).

> Alaska's rocky coasts provide habitat for colonies of breeding sea R.7 **BIRDS**, while the high abundance of forage fish and crustaceans provides ample food. Each summer, tens of millions of seabirds nest along the Alaska coastline, including gulls, jaegers, terns, storm-petrels, murres, puffins, auklets, kittiwakes, and cormorants (FWS 2021).

Critical habitat for the ESA-listed Steller's eider and spectacled eider has been designated along the eastern coast of the Bering Sea, St. Matthew Island, St. Lawrence Island, and the Aleutian Islands (Alaska Department of Fish and Game 2017b). The ESA-listed Steller's eider also has designated critical habitat along the eastern coast of the Bering Sea, as well as the Aleutian Islands (Alaska Department of Fish and Game 2017c); they overwinter in Cook Inlet and surrounding waters (Larned 2006). Over 85% of the North American population of marbled murrelet, a mostly pelagic bird, breeds in Alaska along the coasts of the Gulf of Alaska and Aleutian Islands (East Bering Sea and Gulf of Alaska Ecoregions); this species is ESA-listed in Washington, Oregon, and California (Alaska Department of Fish and Game 2017a). Kittlitz's murrelets occur in all three Alaskan ecoregions, with the largest breeding densities in the Gulf of Alaska Ecoregion (Day et al. 2020).

Ice-associated R.9 **MARINE MAMMALS** in the Alaska Region include polar bears, walrus, and some seal species. Their ranges typically span between the East Bering Sea and the Chukchi and Beaufort Seas Ecoregions, and their annual movements fluctuate with the formation and disappearance of sea ice.

Polar bears are a top predator in the Chukchi and Beaufort Seas Ecoregion, primarily hunting ringed and bearded seals that spend time at the boundaries of sea ice. Pregnant polar bears build maternity dens in the Chukchi and Beaufort Seas Ecoregion either on ice or on shore; however, a recent survey of data show a higher concentration of dens in or near the Beaufort Sea Planning Area (Durner et al. 2020). Polar bears emerge in March or April to feed; later in the summer, their range shifts farther north as they hunt along the receding pack ice (Smith et al. 2017b). Polar bears have designated critical habitat along the coast and offshore in the Chukchi and Beaufort Seas and the East Bering Sea Ecoregions. The distribution of Pacific walrus partially overlaps with polar bear, but walrus spend the winter on pack ice in the East Bering Sea Ecoregion and move through the Bering Strait to the Chukchi Sea in the summer (FWS 2020). Walrus feed on benthic invertebrates, particularly in areas around Hanna Shoal, where sea ice persists longer into the spring and summer (Smith et al. 2017b). Finally, ice seals such as bearded, ribbon, ringed, and spotted seals are particularly adapted to life on ice. They rest, molt, breed, give birth, and nurse their young on the ice but forage in the ocean. Ringed, ribbon, and spotted seals feed on pelagic R.6 **FISH**, while bearded seals feed on R.4 **MARINE BENTHIC COMMUNITIES**.

Three other species of R.9 **MARINE MAMMALS** occur in the Alaska Region. The ESA-listed western DPS of Steller sea lions gathers on remote islands, and they are found in high densities in the Aleutian Islands. Northern fur seals congregate on the Pribilof and Bogoslof Islands in the East Bering Sea Ecoregion (Gelatt and Gentry 2017; Smith et al. 2017b). The islands serve as rookeries, where both species breed and give birth, but most individuals disperse more widely after the breeding season (Smith et al. 2017b). Both of these species are top-level predators with regionally specific diets, but they feed primarily on schooling R.6 **FISH** species from the intertidal zone to the continental shelf (Sinclair et al. 2005). Additionally, there are three stocks of northern sea otter in the Aleutian Islands and southern Alaska, including the ESA-listed southwest DPS; they forage in the relatively shallow coastal waters for fish and R.4 **MARINE BENTHIC COMMUNITIES** for invertebrates (Gorbics and Bodkin 2001).

Future Baseline Conditions (Figure 3-3). Over the next 40 to 70 years, coastal areas in Alaska are expected to face continued stress from climate change, loss of sea ice, ocean acidification, shipping traffic, water pollution, and commercial fisheries. The intensification of storms and sea level rise may damage R.5 **COASTAL & ESTUARINE HABITATS**, in turn impacting R.7 **BIRDS** that utilize these coastal habitats during their migrations.

Coastal areas in the Chukchi and Beaufort Seas Ecoregion have some of the highest shoreline erosion rates in the Nation (Gibbs and Richmond 2017). As a result of shoreline erosion and potential displacement, caribou in these coastal areas may overgraze their habitat, perhaps leading to a drastic, long-term population decline (Alaska Department of Fish and Game 2015). Climate change could have additional effects on foraging behavior and quality of forage for caribou, as well as habitat use and migration patterns (Mallory and Boyce 2018). Warmer temperatures result in increased melting of ice and permafrost thaw, which contribute to an increase in river discharges, and glaciers in Cook Inlet will likely be subject to rapid volume decrease, which may change freshwater flows into the coastal environment. This trend could in turn increase sediment and nutrient runoff to coastal habitats. Marine heatwaves will likely continue to significantly disrupt populations of marine R.7 **BIRDS** and forage

R.6 **FISH** distributions (Piatt et al. 2020). Furthermore, stream temperatures in the Cook Inlet area are increasing, potentially affecting salmon returns.

Ice-associated R.9 **MARINE MAMMALS** in the Chukchi and Beaufort Seas Ecoregion may face challenges with changing future conditions, particularly the loss of sea ice. Sea ice is diminishing in amount and thickness, making it less viable as a platform for hunting, resting, breeding, and molting (Wassmann et al. 2011). As a result, some species may have to use nearshore areas, pushing them farther from their feeding grounds and into closer proximity with humans (Fischbach et al. 2007; Jay et al. 2012; MacCracken 2012). Polar bears are affected by decreasing sea ice and additional time spent searching for food; substantial population declines are predicted for the future (Regehr et al. 2016).

2.6.5 Human Environment

Current Conditions (Figure 3-2). Communities along Alaska's coast are diverse. Anchorage and Juneau (Gulf of Alaska Ecoregion) are the largest cities with more diverse economies, while other population centers are smaller and more remote. In 2019, Alaska's ocean economy employed 46,197 people (14% of total employment) and generated $8.4billion in GDP (17.6% of total GDP), making ocean-related resources an important part of the state's economy. Alaska was the third largest contributor to the Nation's offshore resource extraction sector (oil, gas, and mining activities) in terms of GDP, behind Texas and Louisiana. This sector accounted for 69% of Alaska's ocean economy and experienced the highest loss in GDP because of a decline in oil prices. R.15 **RECREATION & TOURISM** is another important sector driving Alaska's ocean economy as it employs 51% of the workforce (NOAA and Office for Coastal Management 2022). Alaska's tourism industry grew from 2015 to 2017, adding 3,500 jobs; other sectors shrank during this period (McDowell Group 2018). Employment in Alaska's ocean economy increased by 6.0% in the decade between 2009–2019, but the value of Alaska's marine economy decreased by 26% in terms of GDP over the same decade due to resource price volatility ((NOAA and Office for Coastal Management 2021).

Alaska earned the greatest share of R.10 **COMMERCIAL & RECREATIONAL FISHERIES** harvest (landings) revenue in 2018 ($1.8 billion), contributing 33% of the national total. The region also accounts for approximately 60% of the total U.S. commercial fisheries landings (NMFS 2021b). Based on landings revenue, salmon, Alaska pollock, and Pacific cod are the three most economically valuable commercial species in the region. Alaska's recreational fisheries sector, including for-hire (e.g., charter) and private rental boats, provided 5,360 jobs and contributed $195 million in income to the national economy in 2018 (NMFS 2021b). Popular sport fishing species in the region include salmon (e.g., coho, pink, Chinook), Pacific halibut, and rockfish. Important commercial fisheries in the Bering Sea region of Alaska are groundfish, crab, and salmon. Management for these fisheries is provided under the Bering Sea and Aleutian Islands Groundfish Fishery Management Plan, Bering Sea and Aleutian Islands Crab Fishery Management Plan, and Alaska Salmon Fishery Management Plan. Groundfish (especially Pacific halibut and sablefish) and salmon have had downward economic trends in recent years (NMFS 2021b). Salmon and crab are the largest fisheries in the Gulf of Alaska Ecoregion. Commercial fishing is currently prohibited in the Arctic. Within Cook Inlet, people fish for salmon, Pacific halibut, lingcod, and rockfish from chartered and private vessels or from the shore; they also harvest shellfish, such as clams and crabs. In Cook Inlet and the waters adjacent to Kodiak, Chignik, and the southern Alaska Peninsula, all five species of Pacific salmon are harvested for commercial and recreational fisheries, as well as for subsistence R.13 **CULTURE**. Second only to Alaska's groundfish fishery, Alaska's salmon fishery is one of the largest fisheries in volume and value (BOEM 2016a).

Alaska's coastline and offshore waters are abundant in R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES**. Alaska has a rich maritime history, and some shipwrecks located in OCS waters—many of which are Russian or Japanese ships (BOEM 2011)—are associated with military events dating from 1741 to the present. In the Chukchi and Beaufort Seas Ecoregion, most shipwrecks are associated with the commercial whaling industry (BOEM 2015a); shipwrecks in other Alaska ecoregions include losses from fishing and other trading industries. For more information, see BOEM's Alaskan Shipwreck table (www.boem.gov/about-boem/shipwrecks-alaskas-coast).

The waters offshore Alaska may contain submerged pre-contact period archaeological sites dated between at least 20,000 and 3,000 years before present (Moreno-Mayar et al. 2018). The Bering Land Bridge National Preserve protects several significant archaeological and cultural resources, including a remnant of the Bering Land Bridge that was used as a migration route and connected Asia with North America more than 13,000 years ago during the Pleistocene ice age (Nuttall 2005). The majority of the land bridge now lies below the waters of the Chukchi and Bering Seas (National Park Foundation 2020). Beach ridges at Cape Krustenstern National Monument nearby also protect a 5,000-year archaeological record of sequential human use. Other archaeological sites exist along Alaska's coastline. The planning areas around the Aleutian Islands have the greatest potential for preserved pre-contact period sites in the Alaska Region (Dixon 2001).

R.12 **LAND USE** in the Alaska Region is impacted by who manages lands and how lands are used. Various Federal and state agencies oversee large sections of land in Alaska, including large national parks and wildlife refuges. Regional Alaska Native Claims Settlement Act (ANCSA) corporations are the largest private landowners in the state, which—along with village ANCSA corporations—manage land for the benefit of their Alaska Native shareholders. Subsistence is a primary use of the land in Alaska, where many residents depend on hunting, fishing, and gathering to live. Subsistence and personal-use regulations under state laws apply to all Alaskans, and residents of some communities also qualify for subsistence priority under the Federal Subsistence Management Program.

Land use considerations are unique in the planning areas within the Arctic (East Bering Sea Ecoregion and the Chukchi and Beaufort Seas Ecoregions), because communities along this coastline are small, and there is little infrastructure; these areas are considered frontier and non-industrialized. Oil and gas production around Prudhoe Bay is the primary industrial activity in the area, with two offshore oil and gas projects in state waters near the Beaufort Sea Planning Area and several projects onshore (BOEM 2016d). The Trans-Alaska Pipeline System (TAPS) starts in Prudhoe Bay, landward of the Beaufort Sea Planning Area. There are almost no roads connecting communities to one another throughout most of these areas. For example, Dalton Highway is the sole road connecting the rest of Alaska (Fairbanks in the south) to the North Slope (Prudhoe Bay). Most local travel is done via snow machine, charter plane, or small boat. There are few ports in this area (USACE 2016; World Port Source 2018a), and the majority of the port infrastructure farther west, adjacent to the Hope Basin Planning Area, supports mining operations (Thesing et al. 2006). Vessel traffic in the Chukchi and Beaufort Seas increased 2.3 times between 2008 and 2019 due to new activities beyond cargo transportation; growing traffic supports a variety of activities, including energy exploration and extraction, commercial shipping, fishing, scientific research, and tourism (U.S. Committee on the Marine Transportation System 2019). NASA operates rocket testing and launches from the University of Alaska Fairbanks' Poker Flat Research Range in interior Alaska; designated downrange danger zones and patterns for debris from field tests are located within the Beaufort Sea Planning Area.

Land use in the Gulf of Alaska Ecoregion, where there is generally a higher population density and employment rate than the rest of the Alaska Region, serves a wide range of business and support services for a variety of industries. The Cook Inlet area provides established hubs for air, rail, road, and marine transport throughout the state. Cook Inlet has a well-developed oil and gas industry associated with state leasing. TAPS starts on the North Slope and ends near Prince William Sound in Valdez, where oil is loaded onto tankers (Alyeska Pipeline 2011; Prince William Sound Regional Citizens' Advisory Council 2018). The Gulf of Alaska Ecoregion has three medium-sized ports: Anchorage (a hub for cargo vessels), Valdez (known for oil tankering activity and fishing), and Ketchikan (popular for commercial cruises, ferries, and fishing vessels) (Thesing et al. 2006; World Port Source 2018a). Vessel traffic in this ecoregion is a mix of ferries, fishing boats, cargo ships, and cruise ships (Cruise Line International Association Alaska 2018; Thesing et al. 2006). The road systems landward of the Cook Inlet Planning Area are more developed compared to other planning areas in Alaska.

R.13 **CULTURE** in the areas adjacent to Alaska's planning areas is largely defined by Alaska Native peoples and their cultural and subsistence activities, such as whaling, fishing, and hunting. These activities are important sources of nutrition and are central to many cultural customs (Fall 2018). Approximately 17% of the Alaskan population, primarily Alaska Native peoples living in rural areas, depend on subsistence fishing for food (Mathis et al. 2015). The importance of subsistence is reflected in the high levels of participation; high harvest levels to produce a large portion of the local food supply; extensive sharing of subsistence harvests through kinship and other networks; and large investments of time and money in subsistence equipment, supplies, and activities. In areas (such as Bethel, Bristol Bay, Northwest Arctic Borough, and Wade-Hampton) where the average annual food cost is about twice that of Anchorage, the nutritional (and indirectly, economic) benefits provided by subsistence harvests of many Alaskan species are immediate and critical (Mathis et al. 2015). In many Alaskan communities, subsistence is part of a mixed subsistence-cash economy, in which participation in subsistence activities depends on cash income for equipment and fuel (Keating et al. 2020). Changes in the availability of subsistence resources within affordable travel distances to communities can result in both cultural and economic impacts in subsistence communities.

In the Chukchi and Beaufort Seas Ecoregion in northern Alaska—where Iñupiat peoples make up the majority of the population—subsistence contributes substantially to the region's cultural continuity, well-being, identity, and life satisfaction (Hunsinger and Sandberg 2013; Martin 2012). Subsistence is a dominant component of Iñupiat socioeconomics and holds at least equal importance to that of the cash and wage-earning sectors; the subsistence and monetary components of these systems have become inextricably intertwined (Galginaitis 2014; Huskey 2004). Of particular importance is an annual hunt for R.9 **MARINE MAMMALS**, which coincides with the annual migration of bowhead whales along Alaska's northern coast. In the East Bering Sea Ecoregion (home to the Yup'ik, Cup'ik, Iñupiat, and Unangas communities), familial traditions of hunting, harvesting, and sharing subsistence foods (e.g., seal, walrus, caribou, R.6 **FISH**) are essential for physical and spiritual well-being (Alaska Native Heritage Center 2011).

In the Gulf of Alaska Ecoregion, Native American communities also have historically relied upon subsistence fishing and hunting. In Cook Inlet, subsistence activities provide a sense of identity and support the livelihoods of Alaska Native peoples, such as the Dena'ina, Alutiiq, and Koniag peoples. All five species of Pacific salmon are important resources for communities, accounting for well over 30% of subsistence resources used in most communities and over 60% of subsistence resources used in many communities throughout the region (BOEM 2016a, Table 3.3.3-3). Several personal-use dipnet and setnet fisheries operate throughout the Kenai Peninsula, and a combination of commercial, subsistence, and rod-and-reel fisheries provide salmon for domestic use. Many subsistence users also fish commercially, taking a portion of their commercial harvest for subsistence uses; households that participate in commercial fishing are overall some of the most productive subsistence harvesters (Jones and Kostick 2016; Keating et al. 2020).

Non-salmon fish and large land mammals make up the other main subsistence harvests. Marine invertebrates are also an important subsistence food in some communities. Residents of Alaska Native communities around Cook Inlet harvest marine mammals such as seals, sea lions, and sea otters (Jones and Kostick 2016; Jones et al. 2015).

Recent research by the Alaska Department of Fish and Game, Division of Subsistence, has documented shifts in subsistence harvests for some Cook Inlet communities, in which the diversity of resources (i.e., the number of different types of resources) used for subsistence has declined in recent decades. Additionally, concentration of harvest production in some communities has increased, such that a small number of households harvest most of the resources used within the community and distribute subsistence foods through sharing, underscoring the importance of sharing networks to distributing harvested resources (Keating et al. 2020). However, the harvest, sharing, and use of subsistence resources remains a critically important aspect of maintaining cultural continuity and lifeways in many Cook Inlet communities.

Other defining aspects of R.13 **CULTURE** in communities adjacent to the Alaskan planning areas include R.15 **RECREATION & TOURISM** (fueled largely by the state's natural beauty and resources, and abundance of national parks, wildlife refuges, and national forests) and the oil and gas industry.

R.14 **VULNERABLE COASTAL COMMUNITIES** (including areas with high poverty levels, large minority populations, or both) and communities of Alaska Native peoples are located adjacent to many of Alaska's planning areas. Many Alaska Native peoples have known or potential current and historical ties to the ocean and coastal areas of the U.S. in or shoreward of BOEM planning areas. As mentioned above in R.13 **CULTURE**, many of these communities are highly dependent on subsistence activities, such as whaling, fishing, and hunting.

Around 1,700 Inuit and Yup'ik peoples live in the Arctic and Bering Sea areas and have strong subsistence and cultural ties to the sea (Smithsonian Institution 2020). In the Chukchi and Beaufort Sea Ecoregion, the percentage of minority populations far exceeds the national average of 39.9% (U.S. Census Bureau 2019z), with 64.7% of residents identifying as American Indian or Alaska Native (U.S. Census Bureau 2019t). Minority populations in the North Slope Borough account for 69.1% of the population, with 53.2% of the population identifying as American Indian or Alaska Native (U.S. Census Bureau 2019t). The percentage of residents living below the poverty level in the North Slope Borough (11.1%) is slightly less than the national average (11.8%) (U.S. Census Bureau 2019t; 2019z), and the livelihood of these communities is closely tied to subsistence activities.

In coastal communities adjacent to the East Bering Sea Ecoregion, the average percentage of residents living in poverty is 27.0%, which greatly exceeds the national average and is the highest of Alaska's ecoregions (U.S. Census Bureau 2019e; 2019z). Coastal communities within this ecoregion, such as the Kusilvak and Bethel Census Areas, have poverty levels as high as 35.1% and 32.7%, respectively (U.S. Census Bureau 2019e). As with the communities adjacent to the Chukchi and Beaufort Sea Ecoregion, residents in these areas are highly dependent on subsistence activities. Minority populations in the East Bering Sea Ecoregion represent 88.2% of the population, which is much higher than the national average of 39.9% (U.S. Census Bureau 2019e).

The Alutiiq and Sugpiaq people have inhabited the coastal environments of south-central Alaska for thousands of years. Their traditional lands around the Gulf of Alaska Ecoregion include the Prince William Sound, outer Kenai Peninsula, Kodiak Archipelago, and Alaska Peninsula. The culture of the Alutiiq people centers heavily around the ocean (Alutiiq Museum 2020). Certain areas in the Gulf of Alaska Ecoregion, such as Lake and Peninsula Borough, have a poverty rate of 18.2% (U.S. Census Bureau 2019m). Over 61% of residents in this borough identified as American Indian or Alaska Native (U.S. Census Bureau 2019m). Minority populations in the Gulf of Alaska Ecoregion accounted for 36.0% of the population; this percentage is the lowest found in the Alaska ecoregions (U.S. Census Bureau 2019j; 2019m; 2019ab; 2019ac). Portions of this ecoregion are more developed, are more accessible, and rely less on subsistence activities than other Alaskan ecoregions.

In 2017, visitors spent nearly $1.7 billion in the Gulf of Alaska Ecoregion (out of a statewide total $2.2 billion), making R.15 **RECREATION & TOURISM** in this area one of the state's most important economic sectors (McDowell Group 2018). Attractions include several land and water recreation areas; a few of the more popular places include Katmai National Park and Lake Clark National Park, where visitors enjoy viewing brown bears in coastal areas of both parks; Kenai Fjords National Park, where visitors often go on boat tours to see whales and glaciers; and the Inside Passage, a famous coastal route that is a common cruise ship itinerary (Travel Alaska 2018) and includes Glacier Bay National Park, Sitka National Historical Park, and Klondike Gold Rush National Park. Commercial cruise ships stop in ports throughout the Gulf of Alaska Planning Area. Main ports of call in the southeast include Juneau, Ketchikan, and Skagway; Anchorage, Seward, and Whittier are the main ports in the south-central area.

R.15 **RECREATION & TOURISM** activities in other areas of Alaska are limited. Trips to the Chukchi and Beaufort Seas Ecoregion, which account for 1% of visitor spending in Alaska (McDowell Group 2018), are usually based out of Utqiaġvik, Deadhorse, and Kotzebue. Tourism and recreational opportunities within this ecoregion are limited by terrain, physical access, and distance (BOEM 2016d). Polar bear viewing in Utqiaġvik and Kaktovik has become increasingly popular since 2011 (Alaska Department of Fish and Game 2018c). Passenger cruise ships began scheduling voyages through the Arctic in 2016. The East Bering Sea Ecoregion accounts for approximately 5% of total visitor spending (McDowell Group 2018). Attractions in this area include camping, hiking, hunting, fishing, bear viewing, wildlife excursions, cultural tours, and Gold Rush history tours. The finish of the Iditarod Trail Sled Dog Race brings an influx of tourists to Nome every March. Togiak and the Yukon Delta National Wildlife Refuges (NWRs) are popular camping and hiking destinations, while both King Salmon and the Aleutian Islands are key places for wildlife viewing tours. The Bering Land Bridge National Preserve is another attraction well known for its outdoor recreational activities, hot springs, and geological features (Nuttall 2005). Although the more remote coasts of Wrangell-St. Elias National Park (along the Gulf of Alaska) and Aniakchak National Monument and Preserve (along the Shumagin coastline) may have relatively low levels of recreation use, these areas are highly valued for their undeveloped wilderness and opportunities for solitude.

Future Baseline Conditions (Figure 3-3). Ocean acidification is predicted to cause adverse effects on Alaska's R.10 **COMMERCIAL FISHERIES** and coastal communities in the future. Glacial runoff may influence water chemistry to create more corrosive conditions, which was observed during a comprehensive study conducted by the Alaska Ocean Observing System network in Prince William Sound in 2014 (Alaska Ocean Observing System 2018; NOAA 2014a). Loss of sea ice from melting glaciers in the Gulf of Alaska Ecoregion adds freshwater that drains directly into the ocean, reducing the number of carbonate ions available for organisms to build their shells and skeletons (Alaska Ocean Acidification Network 2020). The extent of ocean acidification in the Arctic Ocean, Bering Sea, and Gulf of Alaska is growing, potentially affecting marine species (e.g., whales, salmon, shellfish, crab) and communities that depend on them for subsistence and economic livelihood (Allen 2017; Mathis et al. 2015; Qi et al. 2017; Roberts 2017). These factors may have adverse effects on Alaska's R.13 **CULTURE** and R.14 **VULNERABLE COASTAL COMMUNITIES** in the future. Risk is highest for rural or remote coastal communities with lower adaptive capacity and a greater degree of dependence on species susceptible to ocean acidification (Allison et al. 2009; Cooley et al. 2012; Halpern et al. 2012; Mathis et al. 2015).

The future baseline of R.10 **COMMERCIAL & RECREATIONAL FISHERIES** in the Chukchi and Beaufort Sea Ecoregion is uncertain. The North Pacific Fishery Management Council approved, and NMFS implemented, an Arctic Fishery Management Plan (FMP) in 2009 (North Pacific Fishery Management Council 2009). Currently, all Federal waters of the U.S. Arctic are closed to commercial fishing for any species of finfish, mollusks, and crustaceans, and all other forms of marine animal and plant life; however, harvest of R.9 **MARINE MAMMALS** and R.7 **BIRDS** is not regulated by the Arctic FMP. The Arctic FMP describes the changing ecological conditions of the Arctic (including warming trends in ocean temperatures), loss of seasonal ice cover, and potential long-term effects from these changes on the Arctic marine ecosystem. More prolonged ice-free seasons coupled with warming waters and changing ranges of fish species could create conditions that could lead to commercial fishery development in the U.S. Arctic EEZ. The North Pacific Fishery Management Council and NMFS acknowledge that emergence of unregulated, or inadequately regulated, commercial fisheries in the Arctic EEZ off Alaska could have adverse effects on the sensitive ecosystem and marine resources of this area, including R.6 **FISH**, fish habitat, and non-fish species that inhabit or depend on marine resources of the U.S. Arctic EEZ, and the subsistence way of life of residents of Arctic communities. The Arctic FMP will not regulate subsistence or recreational fishing or State of Alaska-managed fisheries in the Arctic (North Pacific Fishery Management Council 2020).

To date, R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES** have not been systematically inventoried and evaluated in the coastal and OCS waters of Alaska. Resources, especially shipwrecks, could be discovered through future surveys during oil and gas activities. Further research could identify the location of resources and their condition, which may have deteriorated over time in Alaska's extreme weather conditions. For example, shipwrecks that occur closer to shore or in shallow waters may be damaged by ice gouging.

Increased vessel traffic may affect R.12 **LAND USE**. Vessel traffic in the Chukchi and Beaufort Seas Ecoregion is expected to continue growing, with mid-range estimates around three to four times 2008 levels, due to new ice class vessels, changing shipping routes, planned infrastructure, and energy exploration and extraction (U.S. Committee on the Marine Transportation System 2019). Increasing commercial shipping and R.15 **RECREATION & TOURISM** cruises through the Northwest Passage may contribute to additional marine traffic. In the Gulf of Alaska Ecoregion, port expansions are either underway or scheduled to occur in Ketchikan, Skagway, Anchorage, and Seward, potentially affecting land use. Cruise ship companies are replacing their existing fleets with larger ships that can accommodate more passengers (Cruise Line International Association Alaska 2018), which may increase levels of recreation and tourism and possibly lead to further infrastructure development, such as roads and hotels, to accommodate an influx of tourists. Increasing vessel traffic may lead to greater risk of vessel strikes. Associated vessel traffic noise (Brandon et al. 2021) may lead to acoustic masking, increased stress, and changes in migration routes of R.9 **MARINE MAMMALS** (Davis et al. 2017; Parks et al. 2007; Parks et al. 2011; Rolland et al. 2012), both of which could impact R.14 **VULNERABLE COASTAL COMMUNITIES** that depend on these species for subsistence. With increased oil and gas development near and in the North Slope Borough, the economy, land use, and R.13 **CULTURE** may be altered by socioeconomic dynamics, such as new opportunities for employment, development of support services, and tax revenues. As permafrost continues to thaw throughout the Arctic, coastal communities may need to relocate settlements inland due to the effects of coastal land loss (NOAA 2017f). Settlement relocation may continue to affect vulnerable coastal communities; coastal land loss has been an imminent threat to many Alaskan communities, particularly in Shishmaref, Kivalina, Bethel, and Unalakleet (Smith and Sattineni 2016). Coastal erosion and sea level rise may make land use decisions critical for future infrastructure planning. Furthermore, relocation of entire communities could mean the loss of both present structures and sacred sites that are important to culture and may have potential implications for the preservation of R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES**.

2.7 PACIFIC REGION

Figures 3-6 and 3-7 show the Pacific Region's current conditions and future baseline conditions.

BOEM's Pacific Region includes 7,863 mi (12,654 km) of shoreline covering the Federal waters off Washington, Oregon, and California (NOAA 2016e). The region contains two BOEM ecoregions (Washington/Oregon and California Current) and four OCS planning areas (Washington/Oregon, Northern California, Central California, and Southern California) (**Figure 2-4**). Currently, there are active oil and gas leases in the Southern California Planning Area.

2.7.1 Physical Environment

The continental shelf along the Pacific Coast is relatively narrow (5–40 mi [8.1 km–24 km]) and has a steep continental slope. The seafloor in the Pacific Region has a mix of soft and hard bottom areas. Rocky subtidal habitats are not continuous in the Pacific Region but occur in areas with bedrock outcroppings, seamounts, offshore islands, and fragments of mid-ocean ridge (Garrison 2004). Examples include the Orford Reef off Oregon and Cordell Banks and Gulf of the Farallones off California (**Figure 2-10**). Dynamic major tectonic features, such as the Gorda and Juan de Fuca plates and associated ridges (**Figure 2-10**), create and affect benthic habitat throughout the region.

The ecology of the Pacific Region is primarily driven by its eastern boundary current, the California Current, and its associated undercurrent (King et al. 2011) (**Figure 2-10**). The year-round California Current is a slow, broad, southward flowing current that brings cold, nutrient-rich water from the north Pacific. Along the coast, the prevailing northwesterly winds cause upwelling where surface water is pulled offshore and is replaced by deeper, nutrient-rich, low-oxygen waters. When exposed to sunlight at the surface, these waters support high levels of primary productivity throughout the Pacific Region. The Southern California Bight is an area off southern California extending south from Point Conception, where complex current circulation patterns create a distinct change in fauna. The Channel Islands—some of which are designated as a National Marine Sanctuary (NMS)—create complex circulation patterns and provide habitat to diverse species of R.6 **FISH**, R.7 **BIRDS**, and R.9 **MARINE MAMMALS**. Near Point Conception, a portion of the California Current turns and flows northward, joining the California Undercurrent. Lying beneath the California Undercurrent is an oxygen-minimum zone, which is a decreased oxygen layer that extends from the upper continental shelf to depths of greater than 1,000 m (3,281 ft) (Mullins et al. 1985).

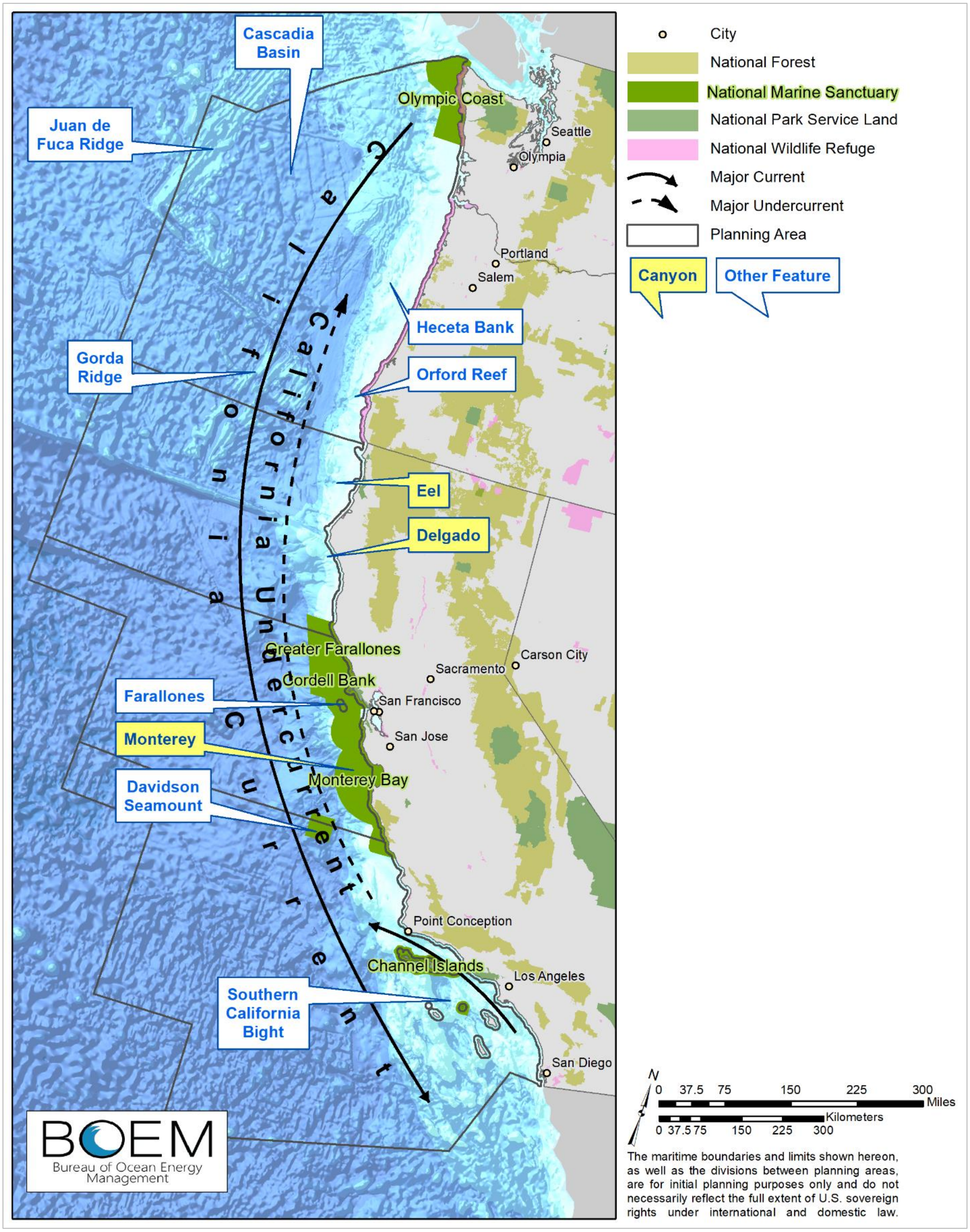


Figure 2-10. Pacific Region physical, political, and land management features

Current Conditions (Figure 3-6). Stagnant air caused by the dry climate and mountainous terrain of the southwest U.S. contributes to R.1 **AIR QUALITY** issues near the Central and Southern California Planning Areas (Wang and Angell 1999). This condition, combined with emissions from California's large metropolitan areas, contributes to the most complex air quality challenge in the U.S. (**Figure 2-11**).

> The South Coast Air Quality Management District (South Coast), which constitutes much of the Los Angeles Metropolitan Area, is particularly vulnerable to degraded air quality that results from emissions released within its boundaries and those released upwind over the Pacific Ocean.

Although the South Coast has reduced $PM_{2.5}$ significantly, it remains in nonattainment. The 2013–2016 drought and recent wildfires resulted in temporary increases in $PM_{2.5}$ concentrations. The South Coast also has the highest O_3 concentrations in the U.S., particularly in spring through early fall, due to the region's dry climate, surrounding mountains, and general airflow from west to east (California Air Resources Board 2017). Northwest of South Coast, Ventura County is designated nonattainment for O_3 and has similar climatic conditions as the South Coast (**Figure 2-11**). These conditions extend northward to areas adjacent to the Central California Planning Area, though with less severe nonattainment designations (**Figure 2-11**).

Washington, Oregon, and northern California have fewer nonattainment areas, in part due to smaller populations and less stagnant air than the Central and Southern California Planning Areas.

Overall, R.2 **WATER QUALITY** in the Pacific Region is rated as good to fair (USEPA 2012). Water quality in this region is affected by regulated point sources and unregulated non-point sources. Major sources of pollutants include agricultural runoff (e.g., pesticides and fertilizer nutrients), wastewater treatment outfalls, chlorinated power plant cooling water, urban runoff, and atmospheric fallout from metropolitan areas. Other important regional inputs include chemicals from harbors, dumping activities, dredging, and discharges from vessel traffic, natural events, military activities, and industrial activities. Ongoing offshore oil and gas operations in southern California contribute relatively higher amounts of anthropogenic hydrocarbon pollutants than these other sources (Lyon and Stein 2010).

In addition to anthropogenic sources, the largest contributors of hydrocarbons to Pacific Region waters, especially in California, are naturally occurring seeps. These hydrocarbon seeps often produce localized, visible sheens on the water and lead to the formation of tar balls commonly found on beaches (Farwell et al. 2009; Hostettler et al. 2004). Hydrocarbon seeps also occur within the Washington/Oregon Planning Area but produce less volume than the seeps within the three California planning areas.

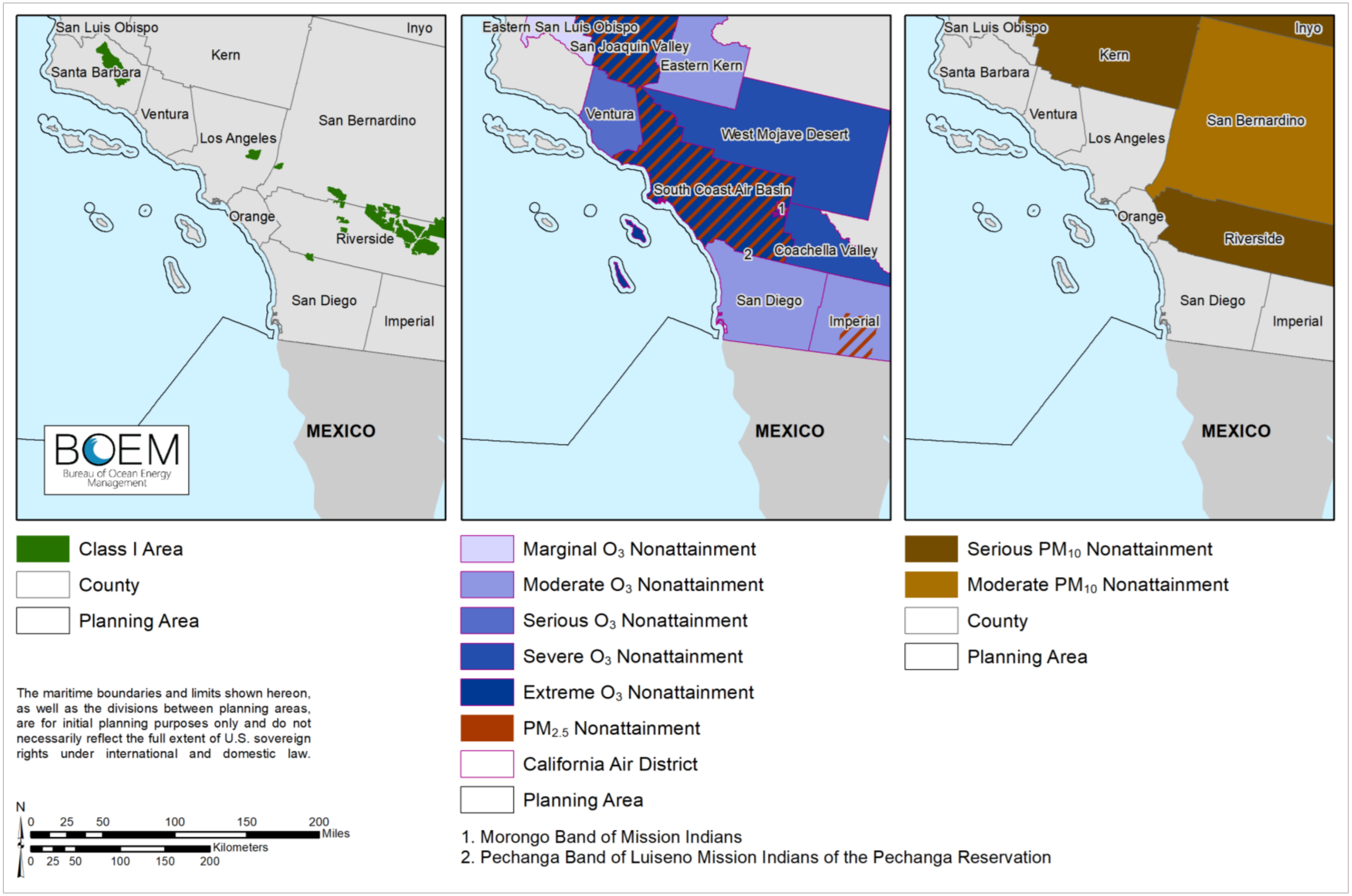


Figure 2-11. Southern California air quality

Nonattainment status is determined by county for PM_{10} and by Air District for $PM_{2.5}$ and O_3.

Future Baseline Conditions (Figure 3-7). R.1 **AIR QUALITY** is expected to remain degraded in the Los Angeles Metropolitan Area. California's State Implementation Plan, which describes California's framework for improving air quality, shows that, despite the state's attempts to reduce emissions from vessels and aircraft via regulations, offshore contributions from vessels to southern California nonattainment areas are expected to rise due to increased vessel traffic (California Air Resources Board 2017). Wildfire seasons have become longer and more intense due to the region's changing climate (Yoon et al. 2015), which may make it more difficult for areas adjacent to the Southern California Planning Area to reduce PM_{10} and $PM_{2.5}$ concentrations (McClure and Jaffe 2018). Air quality in areas adjacent to the Washington/Oregon, Northern California, and Central California Planning Areas is expected to improve as the existing nonattainment areas come into compliance with the CAA in the coming decades.

R.2 **WATER QUALITY** in the Pacific Region may continue to be influenced by activities such as urbanization; municipal waste discharges; agriculture; marine vessel traffic-related discharges; persistent contaminants and marine debris; dredging and marine disposal; bridge and coastal road construction; commercial fishing; recreation and tourism; harbor, port, and terminal operations; military operations; offshore oil and gas activities; natural hydrocarbon seeps; and climate change. In particular, increased urbanization, vessel traffic, offshore oil and gas activities, and climate change may lead to a decrease in water quality in the future. As a result, overall water quality is expected to decline in many areas.

2.7.2 Pelagic Environment

Current Conditions (Figure 3-6). Much of the Pacific Region experiences significant upwelling of nutrient-rich cold water, leading to high levels of primary productivity, especially in the summer months (Schwing et al. 1996). Upwelling exhibits a strong seasonal pattern off central California and areas farther north, with upwelling at its maximum in the late spring and downwelling occurring in the winter (Schwing et al. 1996). During El Niño events, the upwelling forces are weaker, leading to warmer temperatures and lower nutrient content in surface waters, which decreases primary productivity (Jacox et al. 2015; King et al. 2011). Climatic variability in this region (e.g., El Niño-Southern Oscillation [ENSO]) makes it difficult to detect broader oceanographic trends. However, studies have documented an increase in the average temperature of the California Current (Di Lorenzo et al. 2005; Xiu et al. 2018), a decrease in oxygen concentrations (Hoegh-Guldberg et al. 2014), and an increase in acidity in the ocean waters (Chan et al. 2017; Osborne et al. 2019).

The distribution and abundance of R.3 **PELAGIC COMMUNITIES** in the Pacific Region are largely driven by spatial and temporal patterns of upwelling intensity and water mass variability. Zooplankton communities are dominated by copepods and krill but also include jellyfish, pteropods, and larvae of anchovy, sardine, and larger pelagic R.6 **FISH** species like Pacific hake and jack mackerel (Brodeur et al. 2008). Copepods are most abundant in the summer and form temporary aggregations near fronts where phytoplankton are concentrated and larger predators come to feed. Forage fish like anchovies, sardines, and mackerel also feed in these areas; they have R.6 **ESSENTIAL FISH HABITAT** in Pacific Region waters above the thermocline, which extends from the coastline to 200 nmi (370 km) offshore (Pacific Fishery

Management Council 2016b). Some pelagic invertebrates such as jellyfish also feed on plankton and may compete with forage fish for these resources (Brodeur et al. 2008). Monterey Canyon, the largest submarine canyon on the West Coast, is part of a designated NMS (**Figure 2-10**). The deep, nutrient-rich waters near the canyon stimulate a persistent phytoplankton bloom (Ryan et al. 2005); many species of fish, R.7 **BIRDS**, R.8 **SEA TURTLES**, and R.9 **MARINE MAMMALS** congregate to feed in this highly productive environment. Squid, a highly valuable R.10 **COMMERCIAL FISHERY**, are concentrated in the Central California and Southern California Planning Areas (NMFS 2018b; Pacific Fishery Management Council 2016a). Decreases in stocks of forage fish may affect entire pelagic communities because many larger predators, such as birds and marine mammals, rely on them for food.

Salmon are an example of anadromous fish, which spend part of their lives in freshwater to reproduce and grow as larvae and juveniles and are often harvested at sea (Pacific Fishery Management Council 2018). Several Pacific Region salmon stocks are overfished, including the Klamath River fall stock of Chinook and Juan de Fuca stock of coho salmon (NMFS 2018b). All OCS waters from the U.S. and Canada border to Point Conception are R.6 **ESSENTIAL FISH HABITAT** for Chinook, coho, and Puget Sound pink salmon (Pacific Fishery Management Council 2014). Other salmon species are less commonly encountered in marine fisheries. Salmon, especially the larger Chinook, feed on other fish and on marine invertebrates like copepods (Pacific Fishery Management Council 2014). Generally, salmon constitute small portions of other pelagic predators' diets, though some species (e.g., killer whales and seals) eat higher proportions of salmon, especially pink salmon (North Pacific Fishery Management Council 2014). In addition to these harvested species, ESA-listed salmon and steelhead occur in all Pacific planning areas, with higher concentrations in northern regions (NOAA 2016f).

Several species of ecologically, culturally, and commercially important anadromous R.6 **FISH** *occur in the Pacific Region*:

Chinook, chum, coho, pink, sockeye salmon

Steelhead trout

Green and white sturgeon

Larger pelagic predators in the Pacific Region include several highly migratory species such as tuna, swordfish, and sharks. The ESA-listed Eastern Pacific DPS of the scalloped hammerhead, a large pelagic shark species, occurs in continental shelf waters to depths of 3,281 ft (1,000 m) in all Pacific planning areas. The Humboldt squid is a large predatory invertebrate that spans a wide depth range and preys on species from both R.3 **PELAGIC COMMUNITIES** and R.4 **MARINE BENTHIC COMMUNITIES** (Zeidberg and Robison 2007); its range has been increasing northward in the last few decades (Stewart et al. 2014).

The Pacific Region community of R.7 **BIRDS** is large and diverse and includes far-ranging species that come from the Pacific Ocean, Bering Sea, Arctic Ocean, and inland North America. Seabirds occur year-round in both nearshore and offshore environments, but species composition varies seasonally (Adams et al. 2014; Briggs et al. 1981; Mason et al. 2007). In the northern California Current System, Adams et al. (2014) reported similar densities of seabirds in the fall and winter and lowest densities in the summer. Species composition followed a similar trend, with highest diversity in the fall and lowest in the summer. Seabird densities were highest along the inner shelf in waters shallower than 328 ft (100 m) deep and lowest in offshore waters deeper than 656 ft (200 m) deep. Several ESA-listed species occur in the pelagic environment, including the short-tailed albatross, Hawaiian petrel, and marbled murrelet. Pelagic bird species feed in deeper waters that are farther from shore. These species spend much of their time on the water surface or diving for food. Common offshore birds include storm-petrels, albatrosses, shearwaters, fulmars, phalaropes, jaegers, and alcids.

Four ESA-listed R.8 **SEA TURTLES** feed in or pass through the waters of the Pacific Region, though there are no known turtle nesting areas along the U.S. Pacific Coast. The Western Pacific subpopulation of leatherback turtles is usually found in summer and fall off the West Coast, where they come to feed on jellyfish. This population shows continued decline (NOAA 2016d; Tiwari et al. 2013); fisheries bycatch may lead to additional mortality of leatherback turtles (Benaka et al. 2019). Critical habitat for the leatherback overlaps all Pacific planning areas but is most extensive in the Washington/Oregon Planning Area (NOAA 2016d). The East Pacific DPS of green turtles has been sighted from southern Alaska to Baja California Sur, Mexico, but the turtles are mostly found in the Southern California Planning Area (NOAA 2018). NMFS has proposed to designate critical habitat in nearshore waters (from the mean high-water line to 10 km offshore) between San Diego Bay and Mexico. Proposed marine critical habitat also includes *Sargassum* habitat (from 10-m depth to the U.S. EEZ) in the GOM and Atlantic Ocean (88 FR 46572).The ESA-listed North Pacific Ocean DPS loggerhead turtles and olive ridley turtles occasionally occur off California (NOAA 2014b; 2017d).

*The following threatened or endangered species have critical habitat designated within BOEM planning areas in the Pacific Region (detail and map in **Appendix D**):*

Leatherback turtle: Washington/Oregon, Northern California, Central California, Southern California

Green sturgeon (Southern DPS): Washington/Oregon, Northern California, Central California

Pacific eulachon (Southern DPS): Washington/Oregon, Northern California

Tidewater goby: Northern California, Central California, Southern California

Western snowy plover: Washington/Oregon, Northern California, Central California, Southern California

Marbled murrelet: Washington/Oregon, Northern California

R.9 **MARINE MAMMALS** are abundant in the Pacific Region; some migrate through, while others are year-round residents. Humpback and blue whales travel to the Pacific Coast to feed, and gray whales travel through nearshore waters of the region each year during their migration between Alaska and Mexico. Harbor porpoises have resident populations in waters < 131 ft (40 m) along the northern coast (NMFS 2009). Similarly, southern resident killer whales generally reside in nearshore and inland waterways along the coast in the Washington/Oregon Planning Area; NMFS is considering extending critical habitat for this population to offshore waters of the Pacific Region up to 650 feet (200 m) deep. Additional cetaceans that occur in the Pacific Region include other baleen whales (minke, eastern North Pacific gray, sei, fin, and, rarely, Bryde's and North Pacific right whales) and several species of toothed whales, including dolphins, porpoises, beaked whales, and sperm whales (Barlow and Forney 2007; Carretta et al. 2020; Dailey et al. 1993). Eight ESA-listed marine mammal species that occur or may occur in this region are the Guadalupe fur seal and blue, fin, humpback, North Pacific right, sei, southern resident killer, and sperm whales. Resident semi-aquatic mammals of the California Current include California sea lions, Steller sea lion Eastern DPS, northern fur seals, northern elephant seals, and Pacific harbor seals (Barlow and Forney 2007; Dailey et al. 1993). These animals forage at sea and come to land to rest, give birth, and nurse their young. Marine mammals may become entangled in fishing gear and caught as bycatch by various fisheries. In 2015, approximately 92 marine mammals from 20 different stocks were reported as bycatch by U.S. fisheries, including California sea lions, dolphins, and whales (Benaka et al. 2019).

Future Baseline Conditions (Figure 3-7). Over the next 40 to 70 years, R.3 **PELAGIC COMMUNITIES**, R.6 **FISH**, R.7 **BIRDS**, and R.9 **MARINE MAMMALS** in the Pacific Region are expected to face challenges as climate change influences oceanographic conditions, fishing pressure continues, and aquaculture and vessel traffic expands.

Increased warming in the Pacific Region could impact R.3 **PELAGIC COMMUNITIES** that are highly vulnerable to changes in the intensity and mixing of currents, which affects concentrations of oxygen, carbon, and nutrients (Hoegh-Guldberg et al. 2014). However, there is considerable scientific debate about whether increasing temperatures expected from climate change will lead to higher stratification, or whether stronger winds will intensify upwelling (Auad et al. 2006; Hoegh-Guldberg et al. 2014; Xiu et al. 2018). Changes in upwelling intensity could increase nutrient availability in nearshore areas, which may increase primary production but decrease oxygen concentrations due to enhanced microbial activity (Hoegh-Guldberg et al. 2014). These changes may lead to disconnects between phytoplankton and their planktonic grazers. For example, lack of adequate food during the critical larval growth period could harm R.6 **FISH** (Bakun et al. 2015). Some species may shift northward, while other more adaptive species could thrive under the new conditions (Brodeur et al. 2019). For example, jellyfish abundance is on the rise in the California Current, which represents a growing challenge for forage fish that compete for the same prey resources (Brodeur et al. 2008). Humboldt squid are adaptable to changing temperatures and prey availability; their recent range expansion is expected to continue, which could affect pelagic fish stocks (Zeidberg and Robison 2007).

Multiple stressors present ongoing challenges to larger pelagic species in the Pacific Region, and these stressors are expected to continue in future years (Maxwell et al. 2013). R.9 **MARINE MAMMALS** are at risk of vessel collisions, especially in major shipping lanes near San Francisco and Long Beach, CA (Rockwood et al. 2017). HABs can be lethal for animals, including R.7 **BIRDS**; sea lions; sea otters; and gray, humpback, and fin whales (Cook et al. 2011; Jones et al. 2017; McCabe et al. 2016; Miller et al. 2010). Warm-water anomalies may become more common due to climate change and may exacerbate these blooms (McCabe et al. 2016; Van Dolah 2000) and affect R.2 **WATER QUALITY**. Offshore pelagic and highly migratory species—such as sharks, birds, R.8 **SEA TURTLES**, and marine mammals—

increasingly encounter active and abandoned fishing gear and plastic debris, elevating their risk of mortality through entanglement, choking, and ingestion of indigestible and toxic materials (Floren and Shugart 2017; Jepsen and de Bruyn 2019; NOAA 2020b; Schuyler et al. 2016).

2.7.3 Benthic Environment

Current Conditions (Figure 3-6). Rocky intertidal zones are home to many species of macroalgae and macroinvertebrates, including bivalves, octopus, limpets, and sea stars. Species composition varies with the level of wave and tidal exposure. Intertidal and subtidal areas along rocky coasts in the Central and Southern California Planning Areas have been designated as critical habitat for the ESA-listed black abalone.

Rocky benthic habitats in deeper waters are home to species such as sea urchins, deepwater corals and sponges, Pacific octopus, and California spiny lobsters. The ESA-listed Gulf grouper may occur in the Southern California Planning Area, using coastal habitats as juveniles before moving to slightly deeper rocky reefs, seamounts, and kelp beds as adults (NOAA 2016c). Several species of macroalgae are common in the Pacific Region. The best known of these species is the fast-growing giant kelp, which attaches to rocky substrates in less than 98 ft (30 m) of water. This species creates a unique 3-D structure and supports a rich community of marine life (Abbott and Hollenberg 1976; Druehl 1981; Graham et al. 2007). These subtidal kelp forests shrink and reappear each year (Edwards 2019; Krumhansl et al. 2016; Mumford Jr. 2007) and may have large-scale fluctuations resulting from influences such as the ENSO (Edwards and Estes 2006).

Submarine canyons, banks, and seamounts in the continental shelf of the Pacific Region are characterized by diverse R.4 **MARINE BENTHIC COMMUNITIES**. Cobb Seamount supports taxa that are common in coastal waters (Parker and Tunnicliffe 1994), including fleshy brown algae, coralline algae, sea urchins, and rock scallops. Scallops provide substrate for sea anemones, sponges, bryozoans (e.g., moss animals and sea mats), and tunicates (e.g., sea squirts) to live on. In deeper waters, echinoderms (such as crinoids, brittle stars, and predatory sea stars) are dominant. Along the large, rocky Heceta Bank, common species include basket and brittle stars, crinoids, sea cucumbers, sea urchins, several rockfish species, lingcod, flatfish, and shortspine thornyhead (Tissot et al. 2007). There are smaller rocky features off southern Oregon and northern California supporting a high diversity of species (Henkel et al. 2014). The complex bathymetry of the Southern California Bight has diverse habitats for various fishes and invertebrates. The Gorda and Juan de Fuca ridges host rich chemosynthetic communities (Van Dover 2014) (**Figure 2-10**). Several species of deepwater corals occur in the Pacific Region. For example, the Olympic Coast NMS, the Davidson Seamount, and parts of southern California contain a high abundance of gorgonian corals. Waters off southern California and the Olympic Peninsula host stony corals. Sea pens, soft corals, and lace corals thrive in a range of habitats (Kaplan et al. 2010).

Soft bottom habitats are common along the entire Pacific Coast. These mud and sand environments support benthic assemblages composed of clams, burrowing crustaceans, polychaetes, echinoderms, and mollusks, which can differ widely between different sediment types (Henkel et al. 2014). ESA-listed white abalone, a mollusk usually living in water 50 to 180 ft (15 to 55 m) deep, occurs in the Southern California Planning Area and may be found in soft substrates, feeding on kelp drifting from rocky outcrops (NOAA 2016h). Crustaceans, such as Dungeness and red rock crabs, live on coarse sandy sediment along most of the Pacific Coast and support valuable R.10 **COMMERCIAL FISHERIES** (Iribarne et al. 1995; NMFS 2018b).

Over 90 species of bottom-dwelling groundfish—including rockfish, flatfish, and sharks—are managed along the U.S. West Coast and have R.6 **ESSENTIAL FISH HABITAT** in each of the Pacific planning areas (Pacific Fishery Management Council 2016b). Important benthic habitats occur in all Pacific planning areas and include canopy kelp, rocky reefs, and submerged aquatic vegetation (SAV) (e.g., seagrass beds), as well as a variety of submarine features, some of which have been designated HAPCs (Pacific Fishery Management Council 2016b).

Future Baseline Conditions (Figure 3-7). Seafloor resources, including R.4 **MARINE BENTHIC COMMUNITIES** and R.6 **FISH & ESSENTIAL FISH HABITAT**, may be affected by a variety of stressors such as climate change, fishing, marine mineral activities, and ongoing oil and gas activities. Although regulated activities are often required to avoid sensitive areas, bottom-contact activities are expected to continue and may impact marine benthic communities, especially in areas like NMSs. Increases in fishing activity and marine mineral dredging for beach renourishment may continue to disturb benthic habitat and affect both target species and bycatch. Expected decommissioning of oil and gas infrastructure and future offshore renewable energy development may likely have localized, short-duration impacts on the benthic ecosystem.

Warming ocean temperatures and ocean acidification may affect Pacific Region R.4 **MARINE BENTHIC COMMUNITIES**. Although climate change may affect kelp forest resilience and recovery (Edwards and Estes 2006), declining numbers of predators (e.g., crabs, large fish, sea stars) that control the population of kelp-leveling sea urchins may be one of the biggest threats to these diverse ecosystems (Rogers-Bennett and Catton 2019; Steneck et al. 2002). Like shell-building organisms, corals may have decreased size or slower growth due to ocean acidification. Changes in the climate may affect species such as crabs, because the timing of spring is closely correlated with crab larval settlement, subsequent adult abundance, and R.10 **COMMERCIAL FISHERIES** landings—though some crab species may experience declines while others increase (Shanks and Roegner 2007). Changes in regional water and air temperatures may affect rocky intertidal species (Helmuth et al. 2006) and be related to large disease events in sea stars (Miner et al. 2018) and other U.S. West Coast echinoderms.

Continued changes in environmental factors may lead to novel distributions and ranges of corals, R.6 **FISH**, and invertebrates. Current range shifts indicate a general movement of native species northward along the Pacific Coast. Projections for 2050 suggest, with low to moderate likelihood, that local extinctions of native species may occur more in the cold-water regions and less in southern California (Cheung et al. 2009). Potential consequences to the overall benthic community due to the arrival of new species are not fully understood.

2.7.4 Coastal Environment

Current Conditions (Figure 3-6). R.5 **COASTAL & ESTUARINE HABITATS** along the Pacific Region shoreline include island outcroppings, beaches, tidal flats, rocky shores, tidal rivers, wetlands, marshes, estuaries, and SAV. These habitats support a wide variety of aquatic, estuarine, and marine communities, including habitat and nursery areas for juvenile R.6 **FISH**, shellfish, R.7 **BIRDS**, and other wildlife. Bays along the Pacific coastline also host a variety of macroalgae and invertebrate species, including several seagrasses, fiddler crabs, oysters, and mussels. The Pismo clam and Pacific razor clam, two species that burrow in sandy beaches, support R.10 **COMMERCIAL & RECREATIONAL FISHERIES** in some areas (California Department of Parks and Recreation 2021; McLachlan et al. 1996). Sandy beaches also support additional burrowing invertebrates, including polychaete worms and sand crabs.

> Increased wave activity associated with the strong ENSO event in 2015–2016, along with long-term drought conditions and decreasing sediment flow in river discharges, has led to increased erosion of coastal environments from Washington through California in recent years (Barnard et al. 2017).

Pacific Region coastal estuaries and freshwater areas support R.6 **FISH**, particularly those that are anadromous. Adult Pacific salmon return to the same freshwater habitats and die after spawning; their carcasses supply the coastal ecosystem with a significant source of nutrients that sustain invertebrates, trout, otters, bears, eagles, and others (Pacific Fishery Management Council 2014). The coastal or connecting riverine waters of the Pacific Region contain various DPSs of protected steelhead trout and chum, coho, sockeye, and Chinook salmon; each of the Pacific planning areas contains critical habitat for one to five of these anadromous species (NOAA 2016f) (**Appendix D**). Coastal and freshwater R.6 **ESSENTIAL FISH HABITAT** for Chinook, coho, and Puget Sound pink salmon occurs in select freshwater spawning streams, estuaries, and coastal areas from the Washington/Oregon to Central California Planning Areas (Pacific Fishery Management Council 2014). Several stocks of Pacific salmon support an important R.10 **COMMERCIAL & RECREATIONAL FISHERY**.

The ESA-listed southern DPS of the North American green sturgeon uses marine waters in Alaska but spawns in freshwater streams off the U.S. West Coast. Because this anadromous fish spends time in both marine and fresh waters, designated critical habitat overlaps the Washington/Oregon, Northern California, and Central California Planning Areas out to 361 ft (110 m) deep and extends to connecting marshes, estuaries, streams, and heads of tide (**Appendix D**). The ESA-listed southern DPS of the anadromous Pacific eulachon has critical habitat in estuaries and freshwater streams that connect to the Washington/Oregon and Northern California Planning Areas. The ESA-listed tidewater goby is a small coastal and freshwater fish that has critical habitat in California.

Seals, sea lions, and sea otters are common semi-aquatic R.9 **MARINE MAMMALS** that depend on the coastal habitats to rest, breed, and nurse their young. Specifically, the Monterey Bay NMS serves as an important rookery for the northern elephant seal and haul-out area for a number of species, including the Pacific harbor seal, California sea lion, and Steller sea lion (Monterey Bay National Marine Sanctuary 2019).

The Pacific Flyway is an important migratory route for R.7 **BIRDS** and extends from the Alaskan and Canadian Arctic regions southward along the coasts of the U.S., Mexico, and South America to Patagonia. Some species of migrating birds follow the coastline from Alaska to winter in the Pacific

Region, while others continue to migrate down the coast and winter south of the U.S. Key resting and foraging areas along the flyway in the Pacific Region include San Francisco, Monterey, and San Diego Bays. Nearshore species generally occupy relatively shallow waters and take advantage of tides to feed on exposed invertebrates. Common nearshore birds include scoters, loons, grebes, gulls, and terns. Nearshore species occur in highest numbers during the winter months; relatively few remain during the summer. There are four ESA-listed coastal bird species in the Pacific Region: western snowy plover, California Ridgway's rail, light-footed Ridgway's rail, and California least tern. Degradation and disturbance to key resting and foraging areas may decrease available stops along the flyway.

Future Baseline Conditions (Figure 3-7). Ongoing stressors—such as climate change, vessel traffic, coastal development, eutrophication, pollution, existing river dams, and dredging—are expected to continue in the coming years and could strain coastal areas. Sea level rise and a potential increase in storms may inundate and damage R.5 **COASTAL & ESTUARINE HABITATS** (Cai et al. 2014). In some coastal areas such as the San Francisco Bay, erosion is likely to continue due to reduced sediment supply from upstream damming (Barnard et al. 2012). Further erosion may degrade coastal ecosystems and affect resident and migrating R.7 **BIRDS**, as well as R.9 **MARINE MAMMALS** that utilize these areas to rest and birth or nurse their young. Sea otters are particularly vulnerable to marine pollution, especially oil, because their fur must remain clean to keep its insulating properties (Jessup et al. 2004). Sea otters may also ingest harmful or toxic contaminants while grooming their fur.

Warming ocean temperatures and ocean acidification may create inhospitable areas in Pacific estuaries and have consequences for regional R.6 **FISH** and R.10 **COMMERCIAL & RECREATIONAL FISHERIES** (Keppel et al. 2016; Miller et al. 2016). For example, the valuable oyster fishery in the Washington/Oregon Planning Area faces continued threats from eutrophication, river discharge, and coastal ocean acidification from carbon dioxide-enriched upwelling (Eastern Oyster Biological Review Team 2007; Ekstrom et al. 2015). Overall, Pacific coastal habitats are expected to continue to support fisheries at current levels (NMFS 2021b). However, additional stress from warming ocean temperatures and ocean acidification may further impact some species that are currently overfished or threatened with habitat destruction. Expected increases in tourism may also lead to more plastic pollution, coastal development, and recreational fishing pressure.

2.7.5 Human Environment

Current Conditions (Figure 3-6). Communities in the Pacific Region are diverse. Generally, California is more populated and industrialized than Washington and Oregon, but there are urban and rural pockets along the entire coast. In 2018, the ocean economy employed 784,531 people (3.4% of total regional employment), bringing in $70.4 billion dollars (1.8% of total GDP in the region) (NOAA and Office for Coastal Management 2022). R.15 **RECREATION & TOURISM** is the most important sector for the Pacific Region's ocean economy. This region is also critical for the Nation's marine transportation capabilities, as some of the Nation's largest deepwater ports are in the Pacific Region (NOAA and Office for Coastal Management 2019b). The marine transportation sector was also the fastest growing in 2018, adding about 14,000 jobs and experiencing the highest gains in GDP (NOAA and Office for Coastal Management 2021).

The Pacific Region accounts for approximately 10% of the total U.S. R.10 **COMMERCIAL FISHERIES** harvest (landings) (NMFS 2021b). Washington State generated the greatest revenues ($249 million), followed by California ($183 million), and Oregon ($172 million) (NMFS 2021b). Based on landings revenue, some of the Pacific Coast's most valuable commercial species include crab (e.g., Dungeness crab), shellfish (e.g., oysters), shrimp, whiting (hake), salmon, and squid. When imports are excluded, Washington produced the greatest number of jobs in the commercial fisheries sector among the states in the Pacific. California produced the highest income ($6.1 billion) generated by the seafood industry in the Nation, with Washington recording the fifth highest ($2.2 billion) (NMFS 2021b). In 2018, revenue from recreational fishing across the Pacific Region totaled about $5.4 billion. California generated the region's greatest number of jobs (21,145) and income ($961 million) from the R.10 **RECREATIONAL FISHERIES** sector, followed by Washington in both jobs (5,450) and income ($268 million). Popular sport fishing species in the region include rockfishes, Pacific barracuda, and surfperches.

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES** along the Pacific Coast and offshore are heavily influenced by several different geologic and environmental processes (e.g., chemical and physical weathering) that have affected site formation and site preservation on the Pacific OCS. Despite the dynamic environment, many thousands of archaeological sites and historic properties have been identified along the coasts and offshore waters of Washington, Oregon, and California. These sites include pre-contact period sites dating from 14,000 years before present and historic period sites dating from the 18th century (Braje et al. 2019; ICF International et al. 2013).

R.12 **LAND USE** on the Pacific Coast includes a mix of public, private, and Tribal lands. Dominant uses of the coastal areas of the Pacific Region include commercial and recreational fishing, shipping, and military use, with other activities occurring closer to shore and near ports (D'lorio et al. 2015). Land use within each ecoregion varies based on how developed the area is and the needs of the population and businesses. Onshore areas adjacent to the Washington/Oregon Ecoregion are largely undeveloped or rural as major population centers are inland (USDA 2017). The Federal Government manages approximately one-third of Washington lands and half of Oregon lands. Key industries have shaped coastal land use issues in Washington and Oregon, particularly shipping, aquaculture, seafood processing, timber, and R.15 **RECREATION & TOURISM** (Artifacts Consulting Inc. 2011; Bates et al. 2018; Hoelting and Burkardt 2017). Shoreline development in southern Washington (south of Olympic Coast National Park) is primarily driven by construction for vacation and retirement homes (Bates et al. 2018). The California Current Ecoregion is a mix of urban and rural areas. Northern and central California are primarily rural and forested, except for the urban San Francisco Bay area, while southern California has large urban centers in Los Angeles, Orange, and San Diego Counties (U.S. Census Bureau 2010; USFS 2016). The Federal Government manages roughly 46% of California lands (Vincent et al. 2017). Agriculture is an economically important land use; California ranked number one in the Nation for crop cash receipts in 2017, with the top commodities being dairy, grapes, and almonds (California Department of Food and Agriculture 2018).

Natural resource-based industries (i.e., timber and forest products, fishing, seafood processing, ship building, aquaculture, tourism) play an important role in the area's R.13 **CULTURE** (Bates et al. 2018; Hoelting and Burkardt 2017). The rugged coastal landscapes and abundant natural resources of the

Pacific Region are important to the culture and economy of coastal communities. Coastal and marine planning efforts have demonstrated strong public interest in protecting marine resources, marine resource-based economies, and public access to beaches and natural areas (Bates et al. 2018; Oregon Department of Land Conservation and Development 1994).

There are approximately 50 federally recognized Tribes with Tribal lands currently located in the coastal counties of Washington, Oregon, and California (Bureau of Indian Affairs 2016; Mosley 2018). Many federally recognized Tribes and non-federally recognized Tribes in the Pacific Region have known or potential current and historical ties to the ocean and coastal areas of the U.S. in or shoreward of BOEM planning areas. All parts of the Pacific coastline are included in one or more Indian Land Cessions (Royce 1899), indicating that all parts of the Pacific coastline are traditional homelands of one or more Tribes. Tribes whose lands are not currently located near the coast may have current or ancestral ties to the ocean and coast. Many Tribes have strong ties to the marine environment. Many Tribes' health and well-being, livelihood, and cultural identity are inextricably interdependent with living marine resources, such as salmon, whales, Pacific lamprey, and seals. The Makah Tribe, Quileute Tribe, Hoh Tribe, and Quinault Indian Nation have treaties with the U.S. that extend their fishing and harvest rights in usual and accustomed fishing grounds as much as 42 nmi (78 km) from the Washington coastline.[14] In addition to the Tribes' rights mentioned above, the Pacific Coast landscape of Tribal treaty rights, ceded and unceded rights, and trust resources potentially affected by activities under the 2024–2029 Program is varied and complex.

R.14 **VULNERABLE COASTAL COMMUNITIES** (including areas with high poverty levels, large minority populations, or both) and Tribal communities are located adjacent to each of the Pacific Region's planning areas. Many Tribes in the Pacific Region have ties to the ocean and coastal areas of the U.S. in or shoreward of BOEM planning areas and may be dependent on ocean resources for their economic livelihood and cultural identity.

Poverty rates and percentages of minority populations vary across ecoregions and planning areas throughout the Pacific Region. Within the Washington/Oregon Ecoregion, the average percentage of minority populations in Washington and Oregon coastal counties are 35.6% and 24%, respectively, which are both below the national average of 39.9% (U.S. Census Bureau 2019c; 2019d; 2019l; 2019n). The average percentage of people living in poverty in Oregon coastal counties (13.9%) is higher than both the state (12.6%) and national (11.8%) averages. The average percentage of people living in poverty in Washington coastal counties (9.2%) is lower than the national average and comparable to the average for the whole state (10.3%). The average percentage of people living in poverty for the Washington/Oregon Ecoregion (10.4%) is slightly lower than the national average (U.S. Census Bureau 2019c; 2019d; 2019l; 2019n; 2019aa).

In California, the percentage of residents living in poverty in the coastal counties adjacent to the California Current Ecoregion (11.7%) (U.S. Census Bureau 2019q; 2019v; 2019w; 2019x) is about the

[14] 1855 Treaty of Neah Bay, 1855 Quinault River Treaty, Makah Indian Tribe v. Quileute Indian Tribe, 873 F.3d 1157 (9th Cir. 2017)

same as the national average (11.8%) (U.S. Census Bureau 2019z). California's northernmost coastal counties (Mendocino, Humboldt, and Del Norte) had the highest poverty rates at 17.5%, 20.3%, and 20.4%, respectively (U.S. Census Bureau 2019q). Minority populations average 64.0% in coastal counties adjacent to the California Current Ecoregion (U.S. Census Bureau 2019q; 2019v; 2019w; 2019x), well above the national average of 39.9.% (U.S. Census Bureau 2019z). The coastal counties with the highest percentage of minority populations were Los Angeles County (73.9%) and Monterey, San Joachin, Santa Clara, and Alameda Counties (70.6%, 69.5%, 69.4%, and 69.4% respectively) located south and east of the San Francisco Bay area (U.S. Census Bureau 2019w; 2019x).

For the Pacific Region, R.15 **RECREATION & TOURISM** is the top employer (72%) and GDP generator (50%) in the ocean economy sector (NOAA and Office for Coastal Management 2019b). The coastal tourism industry in the Washington/Oregon Ecoregion grew quickly following the construction of Highway 101 in the 1930s; recreation activities continue to contribute significantly to the area's economy and R.13 **CULTURE** (Hoelting and Burkardt 2017). Recreation and tourism is the largest sector of Washington's ocean economy; in 2018, it accounted for 59% of employment and 37% of GDP (NOAA and Office for Coastal Management 2019b). The most popular attractions in the area are related to the coastal setting and outdoor adventure, such as watersports, wildlife viewing, and hiking (Travel Oregon 2017). Olympic National Park is the predominant attraction on the northern coast of Washington, while the southern coast offers nature-based attractions with more tourist amenities. In addition to out-of-state visitors, Washington residents often travel to the coast for recreation, and these trips are a substantial driver for local economies (Bates et al. 2018). Recreation and tourism in Oregon is the largest coastal employer, providing 72% of jobs, while both recreation and tourism and marine transportation combined generate 40% of GDP for the ocean economy (NOAA and Office for Coastal Management 2019b). Many attractions on the Oregon coastline are wilderness-based, as there are many undisturbed areas such as protected forests and beaches.

The length of the California coastline and varied geography and landscapes offer a diverse range of R.15 **RECREATION & TOURISM** opportunities in the California Current Ecoregion. Like the rest of the Pacific Region, recreation and tourism is the largest sector for California's ocean economy, accounting for 75% of employment and generating 54% of GDP in the ocean economy sector (NOAA and Office for Coastal Management 2019b). Tourist attractions include land recreation (e.g., hiking, camping, wildlife viewing) and water recreation (e.g., beach-going, kayaking, surfing) in areas with public access. User fees and concessions revenue from state parks in California provides for almost 46% of the park system's operating costs (California State Parks 2017), demonstrating linkages between nature-based tourist activities, economics, and environmental conservation.

Future Baseline Conditions (Figure 3-7). Decreases in species important for R.10 **COMMERCIAL FISHERIES** (e.g., rockfish and crabs) due to climate-driven disruptions, such as the large mass of warm water in the Pacific Ocean off the coast of North America in 2015 (Grantham et al. 2004), could alter fisheries landings revenue for key target species, such as salmon, crab, and oysters (NOAA 2019b; 2020c).

Seafloor disturbance that could impact both **R.4 MARINE BENTHIC COMMUNITIES** and **R.11 ARCHAEOLOGICAL & CULTURAL RESOURCES** is expected to continue. Seafloor bottom-disturbing events (such as earthquakes) and activities (such as marine mineral dredging, fishing, offshore renewable energy development, or decommissioning of oil and gas infrastructure) could potentially affect underwater archaeological resources like shipwrecks and downed aircraft. Onshore land disturbance from coastal development over time could also affect archaeological and cultural resources.

The population of coastal Washington and Oregon is projected to increase (Crossett et al. 2013), and demographic trends, particularly those related to a low proportion of working age residents, are expected to continue (Bates et al. 2018; Hoelting and Burkardt 2017). The population of coastal California is also projected to increase (Crossett et al. 2013), with a slight increase in employment and income in the Bay Area in particular. However, in Del Norte county (California's most northern coastal county), population is projected to decrease until 2050 (California Economic Forecast 2017).

Climate change could affect **R.11 ARCHAEOLOGICAL & CULTURAL RESOURCES**, **R.12 LAND USE**, **R.13 CULTURE**, and **R.14 VULNERABLE COASTAL COMMUNITIES** in the Washington/Oregon and California Current Ecoregions. The influence of climate change on weather patterns, including storm intensity, fire risk, and drought, could have an effect on the agricultural industry, its laborers, and food costs. The Washington/Oregon Ecoregion is expected to have warmer and drier summers, increased precipitation the rest of the year, decreased snowpack, and higher storm frequency (USEPA 2016). These climatic changes may affect natural resource-based land use and industries, such as timber harvest (through increased forest fires) and fishing, due to reduced species survival and range shifts (Hoelting and Burkardt 2017). Coastal ecosystems, ocean- and coastal-dependent economies, public access to coastal resources, and infrastructure in the California Current Ecoregion are at increased risk from sea level rise, storm surges, and coastal flooding (California Ocean Protection Council 2018).

Existing oil and gas infrastructure in both OCS and state waters offshore southern California is expected to decrease as fields are depleted and structures are decommissioned. This trend may occur faster in state waters because the California State Lands Commission prohibited all new oil and gas leases in state waters in 1994 (California State Lands Commission 2015).

Future offshore renewable energy development is expected off the Pacific Coast, and floating turbines are the most likely technology that will be used (**Section 2.4.2**). BOEM is engaging with the public; Tribal, state, and local governments; Federal agencies; and other stakeholders in California and Oregon on potential leasing for offshore wind in Federal waters.

OCS sand has not yet been used for beach nourishment in the Pacific, but up to 67% of southern California beaches may be completely eroded by 2100 without human intervention (Vitousek et al. 2017), which may increase marine mineral dredging and, therefore, seafloor disturbance.

R.15 RECREATION & TOURISM patterns in the Washington/Oregon Ecoregion may be influenced by population and demographic changes, development of second-home and retirement communities, erosion or other coastal access limitations, and water quality impacts on marine life. Changes also may occur because ocean-based activities, such as stand-up paddle boarding and kiteboarding, are gaining popularity. Due to climate change, increased opportunities for warm weather activities are expected to extend into spring and fall because of longer, drier summers. Climate change may influence where people choose to visit, possibly making northern areas of the Pacific Coast more attractive because of the milder climate. However, it is also possible that tourism may be restricted by fire closures or coastal erosion (Hoelting and Burkardt 2017). Increased visitation to public recreation areas such as parks and campgrounds may result in increased revenues and also increased pressure on resources and facilities (Hoelting and Burkardt 2017).

California Current Ecoregion tourism levels remained relatively stable from 2005 to 2014 and are expected to remain stable in future years (NOAA and Office for Coastal Management 2019b). Data from 2000–2017 show a continued upward trend of travel spending in the state, while national spending on travel during this time also increased but was more volatile, with major downturns in 2003 and 2009. These data indicate that recreation and tourism patterns in California's coastal counties are likely to follow recent trends in the future (Dean Runyan Associates 2017a). However, those patterns may also be impacted by coastal erosion. For example, beach erosion, which is expected to be a particular issue in southern California (Vitousek et al. 2017), may affect the quality or quantity of popular tourist destinations and reduce the number of visitors to the region.

2.8 GOM REGION

Figures 3-10 and 3-11 show the GOM Region's current conditions and future baseline conditions.

The GOM Region comprises 17,141 mi (27,586 km) of shoreline from the southern tip of Texas east to the Florida Keys (NOAA 2016e). The Western and Central GOM Planning Areas constitute the Western and Central GOM Ecoregion, and the Eastern GOM Planning Area is wholly contained within the Eastern GOM Ecoregion (**Figure 2-4**). Currently, there are active oil and gas leases in all planning areas in the GOM Region, but the vast majority of these leases are in the Central GOM Planning Area.

2.8.1 Physical Environment

The dynamic factors that have the greatest influence on the physical environment in the GOM are large-scale ocean currents (**Figure 2-12**) and episodic weather events (e.g., hurricanes) (DiMarco et al. 2004). Warm water originating in the Atlantic Ocean flows through the Caribbean and northward past the Yucatan peninsula into the GOM. This flow, called the Loop Current, loops around the GOM and exits near the Florida Straits to join the Gulf Stream. Loop Current rings (which are seasonal warm-water eddies) separate from the Loop Current and flow in an anticyclonic (or clockwise) pattern in the Western GOM; at times, the boundary of the Loop Current sheds smaller, cold-core, cyclonic eddies (Sturges and Leben 2000). Dynamics of the Loop Current and eddies have an important influence on levels of primary productivity in the GOM Region. Seasonal hurricanes occur in late summer and fall and may cause water column mixing and coastal surges.

The seafloor of the northern GOM has hundreds of salt domes, which are areas where salt has risen upward into overlying sediments to create dome-like structures. These salt domes are important features that are linked to oil and gas reservoirs, as well as the formation of brine pools and other hydrocarbon seeps, found throughout the region. The seafloor of the GOM Region is composed primarily of muddy and sandy sediments. Hard bottom habitats, though far less common than soft bottom environments, are scattered across the GOM and include shallow and deepwater coral reefs, pinnacles, banks, and artificial reefs.

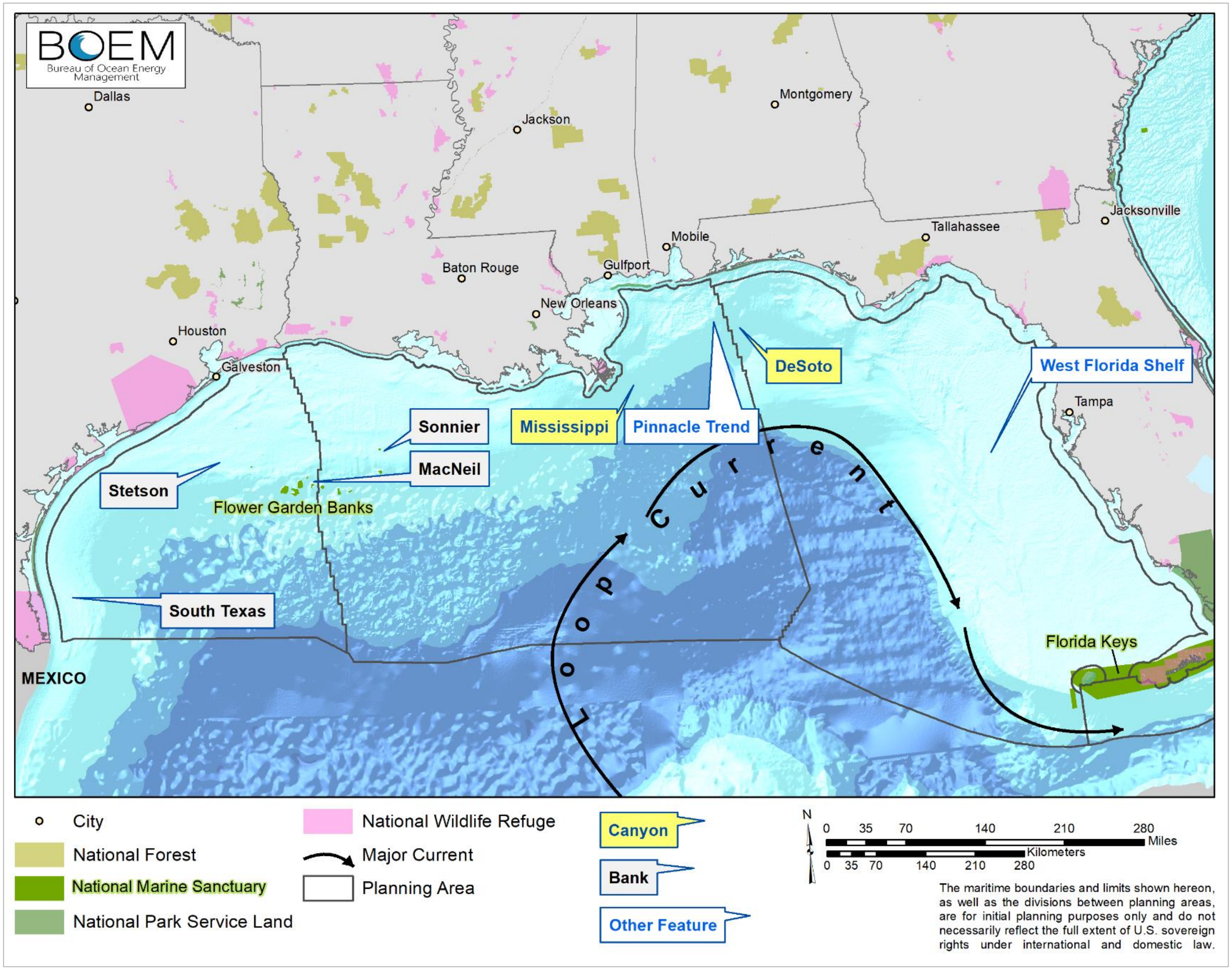


Figure 2-12. GOM Region physical, political, and land management features

Current Conditions (Figure 3-10). R.1 **AIR QUALITY** along the majority of the U.S. GOM Coast is in attainment with the NAAQS. However, the Houston Metropolitan Area in Texas is classified as nonattainment for O_3, and there are smaller SO_2 nonattainment areas in Texas and Louisiana (USEPA 2018c) (**Figure 2-6**). Historically, areas along the GOM Coast (particularly portions of Texas and Louisiana with oil and gas operations in state waters and areas near refineries and other onshore infrastructure) have had substantially more air pollution from onshore and offshore oil and gas facilities than other parts of the U.S. coast.

R.2 **WATER QUALITY** in the GOM Region is generally rated as fair (USEPA 2012). River water flowing into marine waters is a primary influence on water quality within the GOM Region and includes input from 33 major rivers (including the Mississippi River) that drain 31 states (Ellis and Dean 2012). Additional influences on water quality include point source discharges, marine traffic, oil and gas production and development, natural events, and atmospheric deposition. Offshore water and sediment quality are also directly impacted by natural hydrocarbon seeps, which contribute 95% to the total oil inputs (i.e., the combination of natural and anthropogenic sources) in the GOM (Kvenvolden and Cooper 2003; MacDonald et al. 2015; National Research Council 2003c). Storm events have a substantial impact on the quality of coastal waters in the GOM, causing turbidity and runoff events. Agricultural runoff from fertilizer and pesticide use introduces nutrient-rich water into the GOM, which can support large seasonal algal blooms. The decomposition of these large algal blooms may lead to hypoxia (low or depleted areas of oxygen) on the continental shelf of the northern GOM (Obenour et al. 2013; Rabalais et al. 2002; Turner et al. 2012). Additionally, HABs, including brown and red tides, occur almost every year in GOM waters. HABs may cause mortality for R.6 **FISH**, R.7 **BIRDS**, R.8 **SEA TURTLES**, and R.9 **MARINE MAMMALS** and negatively affect human health, R.10 **COMMERCIAL & RECREATIONAL FISHERIES**, and R.15 **RECREATION & TOURISM**.

Future Baseline Conditions (Figure 3-11). R.1 **AIR QUALITY** would likely continue to be degraded in some areas, as major emissions sources, such as seaports, airports, vehicles, power plants, and industrial emissions, would likely continue to contribute to onshore NAAQS exceedances in the near term.

Numerous stressors are expected to continue affecting R.2 **WATER QUALITY** in the GOM. Discharges from ongoing and future OCS oil and gas activities would likely continue and remain an influence on water quality. Other anthropogenic factors—such as urbanization, mining, ocean acidification, and eutrophication (excess nutrients in the water)—are expected to continue to degrade water quality within all GOM planning areas. In particular, hypoxia would likely continue to be an issue of concern for the Central GOM and portions of the Western GOM Planning Area (Obenour et al. 2013; Rabalais et al. 2002; Turner et al. 2012; Turner et al. 2005), which may cause die-offs of R.6 **FISH**, shellfish, corals, and aquatic plants. The incidence of HABs is expected to continue, causing additional stress to GOM resources.

2.8.2 Pelagic Environment

Current Conditions (Figure 3-10). Nutrient inputs to the GOM are highest in coastal waters where nutrient-laden freshwaters are discharged by rivers (particularly the Mississippi and Atchafalaya rivers) (Cardona et al. 2016). These discharges produce a cross-shelf pattern in biological productivity, with the highest productivity occurring along the coasts and gradually declining with distance from shore (Karnauskas et al. 2013). Beyond the shelf edge, nutrient availability is much lower and, consequently, phytoplankton productivity is low. Intrusions of the Loop Current bring low nutrient waters into the GOM, and fronts created by interactions between associated warm and cold-core Loop Current eddies can be important spawning and feeding sites for pelagic species (Zimmerman and Biggs 1999) as they concentrate plankton in otherwise food-poor areas. The Loop Current and its eddies are critical means of larval transport and major drivers of zooplankton abundance and distribution (Biggs and Ressler 2001; Lindo-Atichati et al. 2012; Muller-Karger et al. 2015).

R.3 **PELAGIC COMMUNITIES** include larvae from a wide variety of R.6 **FISH** species, which provide important food resources for larger animals (Biggs and Ressler 2001; Cardona et al. 2016; MacDonald et al. 2015). Hypoxia in shallower waters may also decrease zooplankton concentrations (Kimmel et al. 2010). The composition of pelagic fish varies from the inner shelf (e.g., seatrout and cobia), to middle shelf (e.g., snappers and jacks), and to deep waters (e.g., tunas and mesopelagic fish like lanternfish and bristlemouths) (Biggs and Ressler 2001; Ditty et al. 1988; Muhling et al. 2012). Gulf menhaden inhabit GOM shelf waters to 328-ft (100-m) depth and support one of the largest R.10 **COMMERCIAL FISHERIES** in the U.S. Pelagic species—such as the blue marlin, tuna, and sharks—are often among the top predators. These open-ocean animals can travel long distances and occupy a wide geographic area; many pelagic fishes have R.6 **ESSENTIAL FISH HABITAT** in the GOM and are present seasonally or year-round (**Appendix E**). Many fish, including some highly migratory species such as Atlantic bluefin tuna, spawn in the GOM in late spring and early summer. The Flower Garden Banks NMS in the northern GOM is an important nursery habitat for the ESA-listed giant manta ray (Miller and Klimovich 2017; Stewart et al. 2018). The ESA-listed oceanic whitetip and scalloped hammerhead sharks are both found in GOM offshore waters.

Brown algae *Sargassum* is an important feature of GOM pelagic waters; it can cover widespread areas and form floating mats large enough to be detectable by satellite (Hardy et al. 2018; Hu et al. 2016). *Sargassum* mats also provide food and protection from predation for a wide spectrum of fauna, including larval and juvenile R.6 **FISH** and R.8 **SEA TURTLES** (Casazza and Ross 2008; Dooley 1972). Because of the abundance of small fishes that typically assemble under *Sargassum* mats, larger predatory fish, R.7 **BIRDS**, and R.9 **MARINE MAMMALS** routinely forage in the vicinity of *Sargassum* mats (Casazza and Ross 2008; Moser and Lee 2012).

Common pelagic R.7 **BIRDS** include shearwaters, storm-petrels, boobies, northern gannets, jaegers, phalaropes, petrels, gulls, and terns (Duncan and Havard 1980). Several of these species rely on the *Sargassum* mats to feed and rest (Moser and Lee 2012). Recent studies indicate that the black-capped petrel, under consideration for listing under the ESA, can be found in the northern GOM (Jodice et al. 2021). Species abundance varies by season and in relation to medium-scale features (e.g., the Mississippi River freshwater plume and oceanic eddies) (Ribic et al. 1997).

Five species of ESA-listed R.8 **SEA TURTLES** occur in the GOM planning areas: loggerhead, green, hawksbill, Kemp's ridley, and leatherback (NOAA 2015d). All these species rely on coastal and pelagic waters for foraging needs (Bjorndal 1997; Collard 1990; Davis and Fargion 1996; Fritts et al. 1983a; Fritts et al. 1983b; Godley et al. 2008; NMFS and FWS 2015). Loggerhead turtles range from tropical to temperate regions around the world, but the GOM is a particularly important area for this species. Floating *Sargassum* patches in the Western and Central GOM Planning Areas are federally designated under the ESA as critical habitat for loggerhead turtles (**Appendix D**). The area from Mississippi Canyon to DeSoto Canyon is an important habitat for leatherback turtles, especially near the shelf edge (Davis et al. 2000). NMFS has proposed to designate marine critical habitat in nearshore waters (from the mean high-water line to 20-m depth) off the coasts of Florida and Texas. Proposed marine critical habitat also includes *Sargassum* habitat (from 10-m depth to the U.S. EEZ) in the GOM (88 FR 46572).

*The following threatened or endangered species have critical habitat designated within BOEM planning areas in the GOM Region (detail and map in **Appendix D**):*

Elkhorn and **staghorn corals**: Eastern GOM

Gulf sturgeon: Eastern GOM

Smalltooth sawfish: Eastern GOM, Straits of Florida

Loggerhead turtle: Western, Central, and Eastern GOM

Twenty-one species of R.9 **MARINE MAMMALS** regularly occur in the GOM pelagic environment: a unique evolutionary lineage of baleen whale (Rice's whale, also known as the Gulf of Mexico whale, which was previously considered to be the GOM subpopulation of Bryde's whale) and 20 species of toothed whales and dolphins. Both the Rice's and sperm whale are ESA-listed and have presumed year-round resident populations in the GOM (NMFS 2020a; Van Parijs 2015). The best abundance estimate available for northern GOM Rice's whales is 33 individuals (Hayes et al. 2018); therefore, any mortality events could affect the population's survival. Sperm whale occur throughout the GOM and can dive to depths exceeding 10,000 ft (3,048 m) to feed. The best abundance estimate available for sperm whales in the GOM is 763 individuals; they exhibit a geographic social structure, where females and juveniles of both sexes occur in mixed groups (Hayes et al. 2018; NMFS 2020a).

Sighting records and acoustic detections of Rice's whales in the northern GOM occur almost exclusively in the northeastern Gulf in the DeSoto Canyon area (Hayes et al. 2018). However, recent limited evidence shows that the Rice's whale may be present in the area between the 100-m and 400-m isobaths across the northern GOM (Soldevilla et al. 2022). In 2023, NMFS issued a proposed critical habitat designation for Rice's whale (88 FR 47453); the proposed designation includes waters from the 100-m isobath to the 400-m isobath in the GOM. BOEM expects that NMFS may issue the final critical habitat designation early in the 2024–2029 Program and that the critical habitat designation for Rice's whale will be considered as appropriate in the analyses and preparation leading to individual lease sale decisions under the 2024–2029 Program. As appropriate at the lease sale stage, USDOI may offer additional mitigations or exclude acreage from the sale area to protect listed species and their habitat, including but not limited to the Rice's whale.

In 2022, BOEM and BSEE reinitiated consultation for GOM OCS oil and gas activities addressed in the 2020 biological opinion (as amended) issued by NMFS, in light of new oil spill risk analyses and to incorporate certain conditions of approval previously discussed with NMFS. The Bureaus also indicated that they may seek to conference on proposed critical habitat designations, like the proposed critical habitat designation for the Rice's whale in 2023. While consultation is ongoing, BOEM and BSEE will continue to comply with the ESA and the provisions of the 2020 biological opinion. The reinitiated consultation is expected to be completed and a new or amended biological opinion issued by NMFS early in the 2024-2029 Program. The potential impacts to listed species and the implications resulting from the reinitiated consultation, existing or new biological opinion, new or listed species, and proposed and final critical habitat designations at the time will all be considered, as appropriate, during analyses and preparations for the individual lease sale decisions. Taking into account the biological opinion, listings and critical habitat designations (proposed or final), Interior may at the lease sale stage consider additional mitigations and exclusions of acreage from the sale as appropriate, to protect resources such as listed species and their habitat.

The *Deepwater Horizon* oil spill had lasting effects on the pelagic food web and throughout the water column in the GOM (Fisher et al. 2016; Pulster et al. 2020), with chronic exposure to hydrocarbons affecting populations years after the spill. In addition, large numbers of R.6 **FISH** eggs and larvae were killed or potentially impaired, which may have lasting effects on species' demographics and pelagic food webs (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016).

Future Baseline Conditions (Figure 3-11). Open-water resources, including R.3 **PELAGIC COMMUNITIES**, R.6 **FISH**, R.8 **SEA TURTLES**, and R.9 **MARINE MAMMALS** could be affected by a variety of stressors, such as climate change, fishing, marine traffic, other (e.g., military) activities, and ongoing and future oil and gas activities.

In the open waters of the GOM, sea surface temperature, sea surface height anomalies, and wind speeds have gradually increased over a 20-year period, but primary productivity has not changed (Muller-Karger et al. 2015). During a similar time period, Muhling et al. (2012) reported an increase in numbers and kinds of fish larvae collected from GOM OCS waters. However, model projections based on the temperature tolerance of Atlantic bluefin tuna suggest that spawning intensity could decrease as water temperatures increase (Muhling et al. 2012). Increasing temperatures due to climate change are expected to significantly reduce the flow of the Loop Current (Liu et al. 2012) and may potentially affect the spawning success of pelagic R.6 **FISH** species (such as tuna and billfish) that utilize Loop Current eddies (Dell'Apa et al. 2018). These mixed results suggest that the long-term effects of rising sea surface temperatures on plankton and larval fishes may be species specific, making it difficult to predict overall trends.

Mortality and injury due to fisheries interactions continue to be a problem for certain protected species. Historically, the shrimp trawl fishery has been particularly lethal for R.8 **SEA TURTLES**, though the implementation of turtle excluder devices has helped to reduce mortality in recent years (Valverde and Holzwart 2017). Even so, an estimated 508 sea turtles were reported as bycatch in 2015 (Benaka et al. 2019). From 2010–2014, the GOM shrimp trawl fishery averaged an annual bycatch of 241 R.9 **MARINE MAMMALS** (Benaka et al. 2019). Vessel traffic in the GOM primarily occurs near major ports, such as Port Fourchon, LA, and Houston, TX. As vessel traffic increases in the future, these areas would continue to be high-risk zones for marine mammals and sea turtles. Additionally, resource interactions with military activities are expected to continue in the GOM.

Ongoing and future OCS oil and gas activities may affect the pelagic environment in several ways, particularly in the Western and Central GOM Planning Areas, where there are higher levels of activity. For example, noise and vessel traffic from deep-penetration seismic surveys or decommissioning could cause physiological harm or behavioral disturbance to R.9 **MARINE MAMMALS** (e.g., sperm whales, Rice's whales) and R.8 **SEA TURTLES** (e.g., Kemp's ridley, loggerhead). The small population of Rice's whale is very sensitive to low-frequency sound and may be impacted by further exploration and development along the shelf break in the northeastern GOM, where it mostly occurs (Van Parijs 2015). In addition, ESA-listed sperm whales occur in the GOM (Van Parijs 2015), and geophysical surveys may displace them or reduce their feeding success (Mate et al. 1994; Miller et al. 2009).

2.8.3 Benthic Environment

Current Conditions (Figure 3-10). The nearly ubiquitous soft bottom environments in the GOM are home to demersal R.6 **FISH** and R.4 **MARINE BENTHIC COMMUNITIES**, which include invertebrates like sea stars, crabs, and worms (Rowe and Kennicutt II 2009). Several major submarine canyons, such as Mississippi and DeSoto Canyons, serve as important feeding areas for predators (**Figure 2-12**). Nearshore and shelf habitat may serve as EFH for managed species like shrimp, stone crab, and spiny lobster (Gulf of Mexico Fishery Management Council 2005). The coral reefs of the GOM provide important habitat for many species of invertebrates and fish, including commercially and recreationally important species of snapper and grouper, for which these areas have been designated R.6 **ESSENTIAL FISH HABITAT.** Many HAPCs in the GOM are based on the presence of living coral reefs or hard bottoms, including ESA-listed species such as elkhorn and staghorn coral. Coral EFH includes hard bottom areas on the scattered pinnacles in the Central and Eastern GOM Planning Areas, and banks in the Central (16 features) and Western (21 features) GOM Planning Areas (Gulf of Mexico Fishery Management Council 2016).

> Reefs found in the GOM Region can be natural (e.g., corals) or artificial (i.e., state-managed, USACE-permitted structures) and can occur in both shallow and deep waters. These reefs support many species of invertebrates and R.6 **FISH**, which can then attract higher level predators.

Many GOM species, such as reef R.6 **FISH** and spiny lobsters, are attracted to benthic structures and have high site fidelity. Shelf-edge, mid-shelf, and the South Texas Banks (**Figure 2-12**) habitats support R.10 **COMMERCIAL & RECREATIONAL FISHERIES** (Gulf of Mexico Fishery Management Council 2016). Submerged banks in the Western and Central GOM Planning Areas are isolated areas of higher relief that provide hard bottom habitat for communities of high biomass and diversity. Shallow hard bottom habitats of less than 984 ft (300 m) occurring along the continental shelf of the Central and Eastern GOM Planning Areas (e.g., Pinnacle Trend) house large numbers of sessile invertebrates (e.g., corals, sponges, crinoids) and demersal fishes (Gittings et al. 1992; Thompson et al. 1999). The Western and Central GOM Planning Areas contain the Flower Garden Banks NMS, a system of banks atop salt dome formations. These banks, including those added in the recent expansion of the NMS, are biodiversity hotspots that provide important habitat and represent key examples of coral and algal reefs, and mesophotic and deepwater coral communities in the GOM (NOAA 2020e). The East and West Flower Garden Banks themselves host large communities of predominantly encrusting corals, while other banks in the NMS support a range of sponge, algal, and soft coral communities (Johnston et al. 2013) (**Figure 2-12**). This system attracts reef fishes and large open-water species like whale sharks, hammerhead sharks, jacks, cobias, and rays (NOAA 2016b). The GOM also contains deepwater coral communities that have been found as deep as 9,842 ft (3,000 m) (BOEM 2012a; Brooks et al. 2012).

At least 330 chemosynthetic communities exist in the GOM (BOEM 2016b). Deep-sea sponges, corals, and tubeworms are attracted to these chemosynthetic communities and associated substrates and then in turn attract relatively large numbers and species of invertebrates and R.6 **FISH** to these microhabitats for shelter, feeding, and nursery grounds (BOEM 2017c; Fraser and Sedberry 2008). Slow growth rates of these organisms lead to long-lived individuals and communities (MacDonald et al. 1996); Powell (1995) estimated some chemosynthetic communities to be 500–4,000 years old.

Thousands of oil and gas platforms in the GOM Region attract R.6 **FISH** and other marine life around and onto their submerged legs. Under the Rigs-to-Reefs policy, many decommissioned platforms have had their removal requirements waived and their jackets redeployed as state-managed sites; they now serve as artificial reefs creating marine habitat throughout the GOM. Other types of structures—such as concrete reef balls, pyramids, and intentionally sunk ships—have been placed at planned reef sites throughout the Gulf to increase reef-like fish habitat.

As average water temperatures rise, studies have observed shifts in species range. Tropical corals have shifted from the Caribbean to the GOM (Precht and Aronson 2004). In the northern GOM, R.6 **FISH** and invertebrates have displayed an overall trend of moving into deeper water between 1968 and 2011 (Pinsky et al. 2013). Invasive lionfish, first observed in the northern GOM in 2010, have grown exponentially in number and are commonly found on reefs competing with or preying upon native GOM fish species like vermilion snapper (Dahl and Patterson III 2014).

The *Deepwater Horizon* oil spill variably affected R.6 **ESSENTIAL FISH HABITAT** (e.g., deep coral, mesophotic, and shallow marsh) used by a variety of managed species (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016). R.6 **FISH** communities generally showed dramatic declines in abundance (for multiple species) immediately following the spill but have displayed resilience since then (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016). Sublethal and long-term effects of the spill on fish and their environments are still under investigation.

Future Baseline Conditions (Figure 3-11). Seafloor resources, including R.4 **MARINE BENTHIC COMMUNITIES** and R.6 **FISH & ESSENTIAL FISH HABITAT**, would likely continue to be affected by a variety of stressors, including climate change, fishing, marine mineral activities, and ongoing and future oil and gas activities. Marine benthic communities in the GOM could experience significant challenges from both warming ocean temperatures and ocean acidification. Continued shifts in temperature and stratification may lead to new species distributions and overlaps of corals, fish, and invertebrates (Cheung et al. 2009). Management of invasive species is expected to continue.

Fisheries and marine minerals dredging would likely continue to impact R.4 **MARINE BENTHIC COMMUNITIES** by removing fauna and damaging or destroying benthic habitat, which may degrade the overall quality of benthic habitats in the GOM. Federal and state oil and gas activities would likely continue to impact benthic communities in the Western and Central GOM Planning Areas; these impacts are not expected in the Eastern GOM Planning Area due to the lack of activity. Seafloor features and habitat value may continue to be degraded or lost if impacted by discharges (drilling muds, cuttings, debris) or other bottom disturbance, especially for unique (e.g., corals or chemosynthetic) or sensitive (e.g., HAPCs) benthic habitats (Sulak et al. 2007). Typically applied mitigation measures that require the avoidance of sensitive bottom habitat are expected to reduce or eliminate degradation of these features.

2.8.4 Coastal Environment

Current Conditions (Figure 3-10). The U.S. coastline in the GOM comprises more than 750 bays, estuaries, and sub-estuary systems (USEPA 2012). These R.5 **COASTAL & ESTUARINE HABITATS** provide important nursery grounds and adult habitat for numerous species of R.6 **FISH** and invertebrates, while seagrass beds provide foraging habitat for R.8 **SEA TURTLES** and manatees (Byrnes et al. 2017). GOM coastal waters support stocks of several commercially and recreationally valuable fish and invertebrate species that are managed by NOAA and the Gulf of Mexico Fishery Management Council under seven fishery management plans, each of which designates R.6 **ESSENTIAL FISH HABITAT** (**Appendix E**) for the species managed under that plan. An eighth plan provides for management of aquaculture.

The most common coastal habitats in the GOM include saltwater marshes, saltwater mangrove swamps, and non-vegetated areas such as sandbars, mudflats, and shoals (Dahl and Stedman 2013; Gulf Restoration Network 2004). Wetlands occur along all coastal areas of the GOM, with the highest density occurring in Louisiana and southern Florida (Dahl and Stedman 2013). Levees on the Mississippi River have altered the flow of sediments and nutrients, so wetlands in most areas no longer build up naturally (Kesel 1989). Therefore, widespread wetlands loss in the GOM has occurred over the last century in Louisiana (**Figure 2-13**), Mississippi, and Texas. Although coastal land loss has been noted in all GOM states, Louisiana has experienced the greatest loss, with approximately 1,866 mi^2 (4,833 km^2) of land lost since 1932 (Couvillion et al. 2017).

> Louisiana, Mississippi, and Texas have experienced dramatic wetland loss over the last century, in part due to a lack of sediment input as a direct result of levee construction and freshwater and sediment diversions.

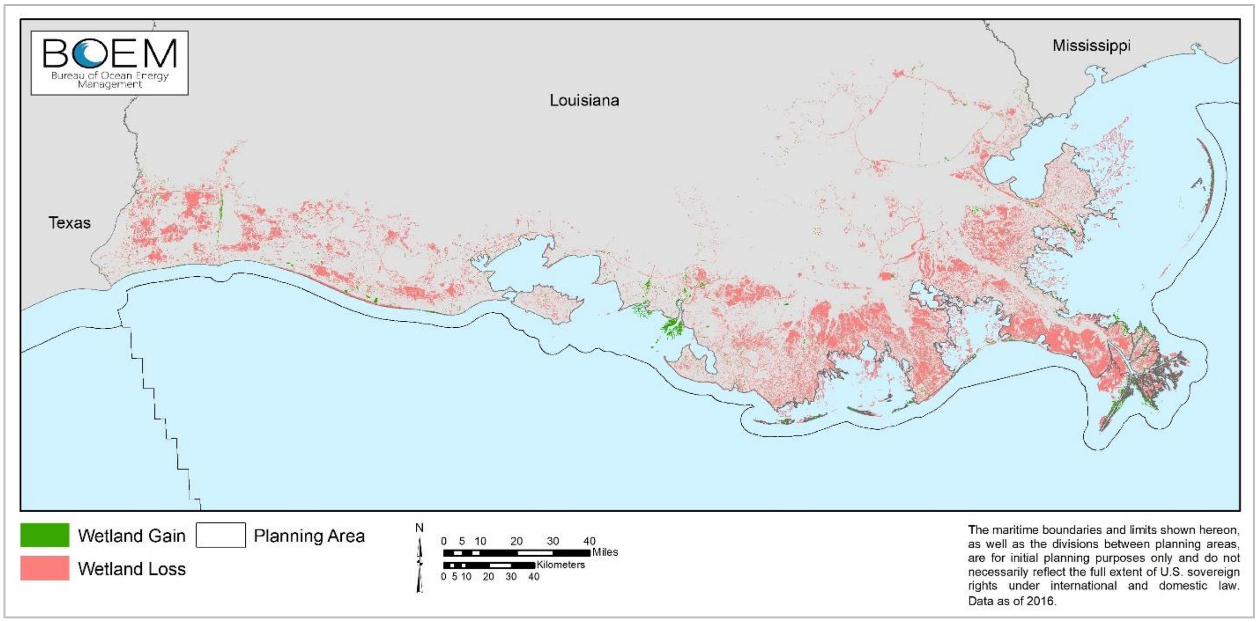


Figure 2-13. Coastal wetland loss and gain in Louisiana (1932–2016)

Barrier islands are present on more than half of the U.S. GOM coastline (BOEM 2015b; Dolan and Lins 1987) and protect the mainland from shoreline erosion by reducing wave action (Rosati 2009; Zinnert et al. 2019). Barrier islands serve as critical stopover areas for numerous migrating R.7 **BIRDS**, which depend on these islands for nesting and winter habitat. Barrier islands also provide habitat for sand-dwelling crustaceans (e.g., mole crabs, ghost shrimp, clams) (Britton and Morton 1989; McLachlan and Brown 2006) and burrowing small mammals (e.g., ESA-listed beach mice, rabbits).

Barrier islands and mainland beaches in the GOM also provide important nesting habitat for several species of ESA-listed R.8 **SEA TURTLES**, including Kemp's ridley, loggerhead, green, leatherback, and hawksbill (Valverde and Holzwart 2017). Though the majority of loggerhead sea turtles nest along the east coast of Florida (82% between 2014–2018), a significant fraction (14%) nest along Gulf Coast beaches (Ceriani et al. 2019). Critical habitat on beaches and in coastal waters has been designated for the loggerhead sea turtle in Florida, Alabama, and Mississippi. Primary nesting sites in the U.S. for the Kemp's ridley sea turtle are in the GOM. Higher mortality rates for some sea turtle species were observed after the *Deepwater Horizon* spill in 2010 (NMFS 2015); sublethal effects may persist in other individuals that were exposed to oil. In addition, sea turtles may be impacted by noise, traffic, coastal lighting, beach renourishment, dredging, and fuel and oil spills—putting them at risk of entrainment, injury, and death.

SAV is a vital component of coastal aquatic ecosystems, with at least 26 species of sea grasses and attached macroalgae growing in the northern GOM (Carter et al. 2011; Cosentino-Manning et al. 2015; Heck et al. 2011). Seagrasses serve important ecological functions, including foraging material for grazers, habitat for marine life, and important nursery grounds for numerous commercially important R.6 **FISH** and invertebrate species. The West Indian manatee, an ESA-listed coastal R.9 **MARINE MAMMAL**, feeds upon SAV and has designated critical habitat in the GOM along the coast of Florida.

Primary threats to the West Indian manatee include habitat loss and fragmentation, entanglements in fishing gear, and collisions with boats. The West Indian manatee population has notably increased in recent years; however, a high level of manatee mortalities on Florida's Atlantic Coast led to the declaration of an Unusual Mortality Event (UME) in 2021 (Florida Fish and Wildlife Conservation Commission 2022).

R.5 **COASTAL & ESTUARINE HABITATS** are home to a diverse array of marine R.6 **FISH** and invertebrates, including some protected species. Mangroves serve as important nursery ground for fish, crabs, and shrimp because they use the expansive roots to protect from predators. Critical habitat for the ESA-listed smalltooth sawfish occurs in the nearshore waters adjacent to the Eastern GOM Planning Area (**Appendix D**). The ESA-listed Gulf sturgeon has designated critical habitat in select rivers and coasts of Louisiana, Mississippi, Alabama, and Florida. Eastern oysters also inhabit these coastal areas and are an ecological keystone species in most estuaries along the Atlantic and GOM Coasts. Oysters and shrimp also support valuable R.10 **COMMERCIAL & RECREATIONAL FISHERIES** in the GOM. Excess nutrients from the Mississippi River and seasonal stratification in the GOM contribute to one of the largest "dead zones" in the world off the Louisiana Coast (Rabalais et al. 2002); these low-oxygen conditions affect plants and animals from the bottom to the top of the food chain.

The R.5 **COASTAL & ESTUARINE HABITATS** of the northern GOM support a variety of coastal and marine R.7 **BIRDS**. Wetland and coastal habitats provide key foraging and resting areas for more than 400 species of songbirds, seabirds, shorebirds, waterfowl, and wading birds (FWS 2013b). Seven ESA-listed marine and coastal birds occur within the northern GOM. The northern GOM coastal areas provide important wintering habitat for many species such as the white pelican, common loon, and a variety of waterfowl and shorebirds. Portions of the shoreline in the northern GOM have been designated as critical habitat for wintering ESA-listed piping plovers, as well as Important Bird Areas for other bird species. Clapper rails and ESA-listed seaside sparrows may spend all their life stages in coastal marshes. The region is a vitally important migration route. Parts of the Central, Mississippi, and Atlantic Flyways are used by hundreds of millions of migratory birds, which converge on diverse coastal and terrestrial habitats along the northern Gulf Coast, where some stay, while others continue to other destinations. Haney et al. (2014) found that laughing gulls, brown pelicans, royal terns, and northern gannets suffered the greatest mortality caused by the *Deepwater Horizon* oil spill in the coastal zone.

Future Baseline Conditions (Figure 3-11). In future years, R.5 **COASTAL & ESTUARINE HABITATS** along the Gulf Coast are expected to experience a variety of stressors such as runoff, water pollution, vessel traffic, coastal development, bottom disturbance, and some level of spills from oil and gas development. The most substantive long-term changes to GOM coastal and estuarine habitats may include conversion of wetlands to other land uses, subsidence, and continuing sea level rise.

Wetlands loss across GOM coastal states is expected to continue. R.5 **COASTAL & ESTUARINE HABITATS** would likely continue to shrink, particularly in Louisiana, due to global sea level rise and local subsidence. This region's shoreline is also expected to continue to erode due to agricultural, residential, and commercial development (Boesch et al. 1994; Day Jr. et al. 2000; Day Jr. et al. 2001). Erosion of shorelines, intensification of storms, and coastal flooding due to climate change may continue to affect coastal communities, particularly R.14 **VULNERABLE COASTAL COMMUNITIES**, in the GOM. In addition, offshore hypoxia has persisted for years (with variations in intensity and size) and is expected to remain for decades to come, with varying effects on the coastal ecosystem. Any stressors that lead to the degradation or loss of key habitat areas for estuarine R.6 **FISH**, shellfish, and R.7 **BIRDS** would likely put additional stress on these species.

Past, current, and future oil and gas activities in the GOM will likely continue to put pressure on R.5 **COASTAL & ESTUARINE HABITATS** and their associated fauna and flora. Persistent long-term effects of the *Deepwater Horizon* oil spill (such as shoreline vegetation loss), may continue in coastal and estuarine wetlands (Turner et al. 2016). Health issues (such as being particularly susceptible to contaminant exposure following *Deepwater Horizon*) were observed in some populations of bottlenose dolphins in heavily oiled coastal areas (Venn-Watson et al. 2015). These studies suggest that some populations may be more susceptible to impacts from additional oil and gas activities.

Populations of coastal R.7 **BIRDS** may continue to be stressed by exposure to routine and accidental discharges and increasing vessel traffic. Similarly, stressors such as water pollution and habitat disturbance, vessel traffic, coastal lighting, and fishing entanglements may continue to impact R.8 **SEA TURTLES** and R.9 **MARINE MAMMALS**.

2.8.5 Human Environment

Current Conditions (Figure 3-10). Communities in the GOM Region depend on the ocean economy for employment and income. In 2019, over 616,000 people were employed in coastal industries (2.8% of total employment in the region), bringing in $115 billion dollars in GDP (4.3% of total GDP in the region). GOM's ocean economy is heavily influenced by the R.15 **RECREATION & TOURISM** industry, which provides for over half of the jobs in this sector, and offshore oil and gas activities, which generate 70% of GDP (NOAA and Office for Coastal Management 2021; 2022). The GOM contributes the highest percentage of GDP in the entire U.S. ocean economy, with Texas contributing a majority of that percentage due to the offshore oil and gas industry (NOAA and Office for Coastal Management 2019b). GDP in the GOM ocean economy increased by 41% from 2009–2019, driven by changes in resource pricing (NOAA and Office for Coastal Management 2021). The oil and gas industry sector as a whole has been operating for decades and plays a central role in the employment base for the Western and Central GOM Planning Areas (Louisiana State University 2017). In contrast, the Eastern GOM Planning Area has few active leases off Florida's Gulf Coast.

The GOM is home to some of the world's most productive R.10 **COMMERCIAL & RECREATIONAL FISHERIES**. The region accounts for approximately 20% of the total domestic commercial and recreational harvest (landings) each year, sustaining the livelihoods of thousands of fishermen and their families, and providing a way of life for coastal communities. Shrimp, menhaden, oysters, and blue crab are some of the Gulf's most important commercial species. The revenue derived from commercial harvest in the GOM accounts for a quarter of the total commercial fishery revenue in the U.S. and is worth approximately $890 million annually (NMFS 2021b). Based on landings revenue, shrimp is the largest fishery in the region, followed by the menhaden and oyster fisheries (NMFS 2021b). Florida generates 126,826 jobs (71,419 on the Gulf Coast and 55,407 on the Atlantic Coast) from recreational fishing, the largest in the Nation. Recreational fishermen in Florida took the most trips (85 million) in the region and in the Nation (NMFS 2021b). Popular GOM sport fishing species include tarpon, red drum, grouper, tuna, mahi-mahi, marlin, and sharks. Gulf Coast estuaries and coastal marshes provide nursery habitat for these commercially valuable marine species.

The GOM coastal zone provides significant ecological and economic value to the region and holds important R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES**. Shipwrecks are scattered throughout the GOM at all water depths. During oil and gas exploration, many shipwrecks have been discovered and listed to the National Register. BOEM's marine archaeologists created virtual 3D models using video footage of a small selection of some of the shipwrecks identified through oil and gas surveys. BOEM posted these sites on the Virtual Archaeology Museum web page at www.boem.gov/environment/virtual-archaeology-museum. The GOM coastline contains archaeological, cultural, and historic sites, many of which are listed on the National Register.

R.12 **LAND USE** in coastal areas of the GOM is a mix of urban, industrial, and rural activities, including manufacturing, shipping, agriculture, and recreation. The Gulf Coast, particularly in the Western and Central GOM Planning Areas, is known for an established offshore oil and gas industry with a network of related onshore support industries. Onshore areas in the Western and Central GOM Planning Areas host an expansive network of oil and gas infrastructure industry, which includes an array of services such as construction facilities, service bases, product transportation, and processing facilities (Dismukes 2010; 2011; The Louis Berger Group Inc. 2004). Other important Gulf Coast industries include commercial shipping, fisheries, tourism, and hospitality (i.e., hotels and restaurants). More than half of the 20 largest U.S. ports are along the Gulf Coast, mostly along the Western and Central GOM Planning Areas (Industrial Economics Inc. 2014).

The GOM Coast has numerous state parks, beaches, and important environmental features that support multiple uses, including R.10 **COMMERCIAL & RECREATIONAL FISHERIES** and R.15 **RECREATION & TOURISM**. Notable features include Padre Island National Seashore, Atchafalaya Basin, Mississippi River Delta, Gulf Islands National Seashore, Mobile Bay, Key Biscayne, and Everglades National Park (BOEM 2016d). Parts of the GOM's sandy seafloor support marine mineral dredging on the OCS to address erosion along beaches and to strengthen the resilience of coastal communities and infrastructure. Since 1995, over 50 million and 2.8 million cubic yards of sand have been leased in the Central and Eastern GOM Planning Areas, respectively (BOEM 2018d).

The R.13 **CULTURE** of the GOM Region varies greatly, from Houston, TX (the fourth most populous city in the U.S.), to smaller metropolitan areas (e.g., Corpus Christi, Galveston, New Orleans, Mobile, Tampa), and to Louisiana's largely undeveloped bayous, inhabited by Tribal and Cajun communities. Culture is also strongly tied to R.10 **COMMERCIAL & RECREATIONAL FISHERIES**, the oil and gas industry, R.15 **RECREATION & TOURISM** (fueled by beaches, especially on the Alabama and Florida Coasts, and vibrant tourist destinations, such as Key West and New Orleans), and the socioeconomic impacts of these industries. GOM's population comprises diverse sociocultural backgrounds. Fishing and shrimping are part of the traditional livelihood for many coastal communities (Austin et al. 2014) and serve as a source of income and subsistence (Regis and Walton 2022). Harvest, sharing, and use of wild resources, including coastal fishing and shrimping activities, are an important part of many rural residents' and communities' cultural connection to the region (Regis and Walton 2022). Some counties and parishes, particularly Harris County, TX, and Lafourche Parish, LA, are more closely connected to the offshore oil and gas industry than others (BOEM 2017c).

The GOM Region is still recovering from the adverse effects of recent hurricanes and the *Deepwater Horizon* oil spill. Coastal land loss continues to have a long-term impact on Louisiana R.14 **VULNERABLE COASTAL COMMUNITIES** (**Figure 2-13**). These events have had disproportionate effects on minority and low-income populations, especially in coastal areas and zones in Louisiana outside levee protection (Hemmerling and Colten 2004; Peterson 2012), and these groups are more vulnerable to any new hazards or natural disasters (Goldstein et al. 2011).

Residents of coastal areas bordering the Western and Central GOM Planning Areas have an average poverty rate of 17.2% (U.S. Census Bureau 2019a; 2019k; 2019p; 2019u; 2019y), exceeding the national average of 11.8% (U.S. Census Bureau 2019z). Some counties in the Western GOM Planning Area (e.g., Kleberg, Willacy, and Cameron counties in Texas) have average rates at or above 25% (U.S. Census Bureau 2019a). On average, minority populations in coastal counties and parishes adjacent to the Western and Central GOM Planning Areas make up 61.8% of the population (U.S. Census Bureau 2019a; 2019b; 2019k; 2019p; 2019u; 2019y), with the highest percentage (91.5%) in Willacy County, TX (U.S. Census Bureau 2019a). Over 60% of the coastal counties and parishes adjacent to the Western and Central GOM Planning Areas have minority populations above the national average of 39.9% (U.S. Census Bureau 2019a; 2019b; 2019k; 2019p; 2019u; 2019y; 2019z).

Vulnerable coastal communities in the Western and Central GOM Planning Areas face historic, ongoing, and potential future burdens resulting from land use and industrial development patterns, land loss and sea level rise, and changes in storm frequency and intensity. In some areas in the region, residents of low-income and racial and ethnic minority communities have been disproportionately impacted by pollution related to industrial activity. In Louisiana, for example, Terrell and St. Julien (2023) documented that communities of color were exposed to 7- to 21-fold higher emissions of criteria air pollutants from oil and gas processing and petrochemical manufacturing facilities than predominantly white communities. Though the impacts were documented in industrialized census tracts statewide, the heaviest concentration of oil and gas processing and petrochemical facilities are within the Industrial Corridor of the lower Mississippi River, between Baton Rouge and New Orleans—an area commonly referred to as "Cancer Alley" (Terrell and St. Julien 2023).

Disparities in health outcomes for low-income and minority communities near oil and gas processing and petrochemical facilities have been described in several areas of the GOM Region, including communities in Louisiana and Texas (Fleischman and Franklin 2017; Johnston and Cushing 2020; Terrell and St. Julien 2023). In addition to emissions-related pollution, minority and low-income communities are often in closest proximity to industrial facilities, and they may bear a disproportionate burden of impacts from industrial accidents and chemical releases linked to extreme weather events, with documented instances of health impacts following accidental and natural disaster-related pollutant releases (Johnston and Cushing 2020). Minority and low-income communities in the GOM Region that historically have been disproportionately burdened with industrial-related pollution are not necessarily located directly along coastal areas but are in counties or parishes that have a combination of natural and industrial connections to coastal and offshore activities (e.g., major rivers and estuaries, shipping channels connecting oil and gas infrastructure).

In some areas along the coast adjacent to the Western and Central GOM Planning Areas, minority and low-income communities face vulnerabilities from land loss and extreme weather hazards. Coastal erosion and subsidence can amplify the vulnerability of communities, infrastructure, and natural resources to flooding and other storm-related hazards (Dalton and Jones 2010). Although the impacts of land loss, flooding, and storms can affect all communities, those with fewer resources to adapt to land loss, or to prepare for and recover from storms, can be especially vulnerable to more severe impacts.

Communities with specific dependencies or connections to coastal environments also can be particularly vulnerable to the impacts of land loss. In the previous few decades, expansion of infrastructure in coastal areas to support offshore oil and gas industries has also impacted vulnerable communities that also may be affected by land loss and storm impacts (Hemmerling et al. 2021). Hemmerling et al. (2021) examined 30 years (1980–2010) of changing trends of risk exposure in southern Louisiana and found that hazard exposure increasingly intensified in coastal areas over much of the study period as deepwater oil and gas activity intensified. The authors found that Native American and Asian communities in the coastal region, who have historically been dependent on the region's fisheries, are disproportionately impacted by the changing patterns of risk exposure.

The average percentage of coastal communities in poverty in the Eastern GOM Ecoregion is 12.7% (U.S. Census Bureau 2019g; 2019h; 2019i; 2019p). Although poverty levels are generally lower than in coastal communities in the Western and Central GOM, the majority of coastal counties have poverty levels greater than the national average, and several counties along the Florida panhandle have poverty rates greater than 20% (e.g., Dixie, Taylor, Franklin, and Gulf Counties) (U.S. Census Bureau 2019i). Coastal areas bordering the Eastern GOM Planning Area have an average minority population of 32.6%, with the highest in Hillsborough County, FL, at 52.3% (U.S. Census Bureau 2019a; 2019h; 2019i; 2019o).

In 2018, coastal R.15 **RECREATION & TOURISM** in the GOM Region contributed 13% of GDP and made up 58% of employment in the ocean economy sector, making this industry the largest employment sector for the region's ocean-based economy (NOAA and Office for Coastal Management 2019b). The recreation and tourism industry influences local R.13 **CULTURE** and contributes to the economy in dollars spent for hotels, restaurants, and retail products for R.10 **RECREATIONAL FISHERIES**, beach activities, and watersports. Millions of individuals participate in a variety of recreational activities in the region's coastal environment each year, including recreational fishing, boating, hunting, wildlife viewing, sunbathing, scuba diving, swimming, surfing, and other water sports. Popular beach destinations in the GOM Region include Galveston, TX; South Padre Island, TX; Grand Isle, LA; Gulfport, MS; Gulf Shores, AL; and along Florida's west coast, particularly near Tampa, Fort Myers, and the panhandle of Florida.

Florida's Gulf Coast counties employ the most tourism industry workers in the GOM Region, and the industry is the largest source of ocean-related GDP in both Alabama and Florida. The R.15 **RECREATION**

& TOURISM industry is also the top employment sector for the ocean economy in Louisiana and Mississippi, but offshore mineral extraction, marine transportation, and ship and boat building are larger sources of GDP in these two states. In Texas, offshore mineral extraction is the top sector for both employment and GDP, followed by tourism (employment) and marine transport (GDP) (NOAA and Office for Coastal Management 2019b).

Future Baseline Conditions (Figure 3-11). Warming ocean temperatures, sea level rise, and ocean acidification may result in biological impacts in the GOM, leading, in turn, to impacts on R.10 **COMMERCIAL & RECREATIONAL FISHERIES**. Of these, warming ocean temperatures may have the most wide-ranging impacts on fisheries in the region (NOAA 2016e; Pinsky et al. 2013; Sydeman et al. 2015).

Although many R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES**—particularly shipwrecks—have been identified due to oil and gas activities in the GOM, additional resources could be identified through future survey efforts. Extreme events, such as hurricanes or other factors, may trigger submarine mudslides, particularly in the Mississippi River Delta Front (Obelcz et al. 2017). These seafloor dynamics have the potential to change the location and integrity of shipwrecks over time.

R.12 **LAND USE** may be altered by industrial development, which is likely to continue for the foreseeable future as coastal areas adapt to ever-changing land use needs. Offshore oil and gas production in the GOM is expected to peak in 2022, start to decline through 2035, and level off by 2050 (EIA 2019). Ongoing oil and gas activities onshore and in both Federal and state waters are expected to continue to be supported by existing onshore infrastructure facilities (e.g., processing, construction, shipbuilding). Marine minerals dredging is expected to continue, particularly in the Central and Eastern GOM Planning Areas, and the demand for sand has been steadily increasing.

The R.13 **CULTURE** of the GOM planning areas likely would continue to be subject to a variety of stressors, particularly coastal development, tourism, climate change, coastal land loss, and overfishing, as well as impacts from ongoing and potential future oil and gas activities in Federal and state waters. Subsistence and recreational harvesting likely would continue in the GOM, although residents have reported their observations of changes in the availability of some resources harvested for subsistence and personal use (Regis and Walton 2022).

> Low-income and minority communities (particularly in areas of high population density) along the coast could experience more intense effects from increased storm surge and coastal land loss (USGS 2017) resulting from major storms and subsidence (USGS 2016). R.14 **VULNERABLE COASTAL COMMUNITIES** are likely to recover less quickly from these impacting factors because fewer financial and non-financial resources are available to these communities.

R.14 **VULNERABLE COASTAL COMMUNITIES** likely will continue to be impacted by intersecting factors related to economic conditions, land use decisions, land loss and subsidence, and other drivers of change in communities. Census data from 1999–2016 indicate that the percentage of people earning low income wages has increased throughout the GOM (Mather 2013). Trends indicate that this increase may continue. Census data from 2000–2016 indicate that minority populations are also gradually increasing throughout the GOM, with the greatest growth in Texas by almost 10%. The average percentage of minority populations in the GOM Region in 2000 was 37.6% and rose to 44.1% by 2016, exceeding the national average by 5.4% (Population Reference Bureau 2018). Trends indicate that this increase may continue, along with a projected rise in population in coastal states. To the extent that demand for oil and gas and petrochemical products drives industrial activity in the region, low-income and minority communities impacted by historic and ongoing pollution and risk associated with these industries will likely continue to face impacts into the foreseeable future.

R.15 **RECREATION & TOURISM** is expected to continue to be a major reason people visit the Gulf Coast, and the industry would likely remain a key generator of income for individuals, businesses, and governments (BOEM 2016d).

2.9 ATLANTIC REGION

Figures 3-14 and 3-15 show the Atlantic Region's current conditions and future baseline conditions.

The Atlantic Region includes 28,673 mi (46,145 km) of shoreline from Maine to the Florida Straits (NOAA 2016e). This region comprises two BOEM ecoregions spanning four planning areas—the Northeast U.S. Continental Shelf (NECS) Ecoregion and Southeast U.S. Continental Shelf (SECS) Ecoregion (**Figure 2-4**). The NECS Ecoregion includes all of the North Atlantic Planning Area and the northern portion of the Mid-Atlantic Planning Area to Cape Hatteras, NC. The SECS Ecoregion stretches from North Carolina to Florida, and includes the Straits of Florida Planning Area, South Atlantic Planning Area, and the southern portion of the Mid-Atlantic Planning Area. Currently, there are no active oil and gas leases in the Atlantic Region.

2.9.1 Physical Environment

Two primary current systems in the Atlantic Region essentially divide the NECS and SECS Ecoregions: the Labrador Current flows southward from the Arctic, and the Gulf Stream flows northward from the GOM (**Figure 2-14**). The Hatteras middle slope lies at the junction of the two ecoregions and is one of the steepest slope environments along the U.S. East Coast. The physical geography of this region leads to complex interactions of these two major currents and influences the position of ocean fronts, stratification of the water column, and upwelling events (Andres 2021; Churchill and Berger 1998), which help drive patterns of productivity and faunal diversity. The Gulf Stream turns east near Cape Hatteras, where eddies may break off and continue northward; these eddies typically have a cold core of slope water surrounded by a warm ring of Gulf Stream water.

The Atlantic Region geological and seafloor environment is diverse and characterized by a patchy distribution of sandy sediments and hard bottom features. Both shallow, warm-water and deep, cold-water coral reefs are found in the region. The NECS has a large number of submarine canyons, including 13 major canyons such as the Baltimore, Washington, and Norfolk Canyons in the Mid-Atlantic Bight (CSA Ocean Sciences Inc et al. 2019; Ross and Brooke 2012). The Atlantic canyons are analyzed as potential exclusions in **Section 4.5**.

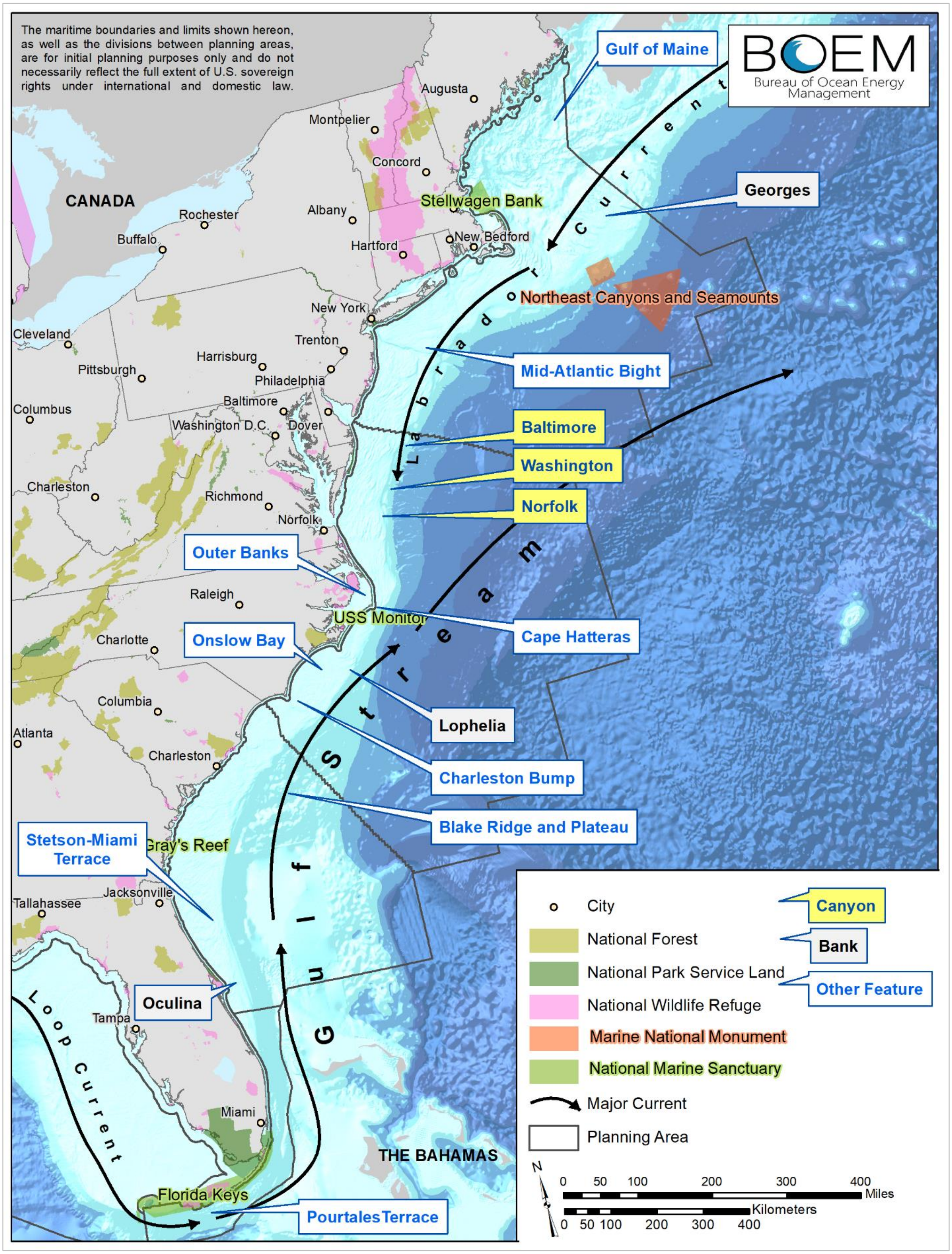


Figure 2-14. Atlantic Region physical, political, and land management features

Current Conditions (Figure 3-14). R.1 **AIR QUALITY** along the majority of the Atlantic Coast is in attainment with the NAAQS. However, O_3 nonattainment areas cover much of the Washington, DC; Baltimore, MD; Harrisburg and Philadelphia, PA; Wilmington, DE; and New York, NY, metropolitan areas, along with two SO_2 nonattainment area covering part of suburban Baltimore, MD, and southern New Hampshire. New York County, NY, also known as Manhattan, is classified as nonattainment for PM_{10}; Eastern Pennsylvania has two $PM_{2.5}$ nonattainment areas (USEPA 2018c) (**Figure 2-6**).

The overall R.2 **WATER QUALITY** condition of the Atlantic Region is rated as fair (USEPA 2012). Water quality in coastal waters of the Atlantic Region is impacted primarily by terrestrial runoff, terrestrial point source discharges, and atmospheric deposition. Activities that impact water quality include urbanization; forestry practices; municipal waste discharges; agriculture; marine vessel traffic-related discharges; wastewater; persistent contaminants and marine debris; dredging and marine disposal; bridge and coastal road construction; commercial fishing; recreation and tourism; harbor, port, and terminal operations; military and NASA operations; renewable energy development; natural events; and climate change. Plumes from the Chesapeake and Delaware Bays, two prominent estuaries along the NECS Ecoregion, influence coastal water quality by increasing turbidity and adding nutrients. These extensive watersheds funnel nutrients, sediment, and organic material into secluded, poorly circulated estuaries that are more susceptible to eutrophication; this pattern closely correlates with population density (USEPA 2012).

Future Baseline Conditions (Figure 3-15). R.1 **AIR QUALITY** in areas near the Atlantic OCS is expected to improve as the existing nonattainment areas come into compliance with the CAA during the coming decades. Emissions sources (such as seaports, airports, vehicles, power plants, and industrial emissions) likely would continue to cause onshore NAAQS exceedances in the near term.

Stressors likely will continue to influence R.2 **WATER QUALITY**. Terrestrial point and non-point source discharges, as well as atmospheric deposition, are expected to continue at present or greater levels and may continue to impact water quality. An increase in activities (e.g., harbor, port, and terminal operations), urbanization, and climate change is also expected, which may contribute to declining water quality in the future.

2.9.2 Pelagic Environment

Current Conditions (Figure 3-14). The R.3 **PELAGIC COMMUNITIES** in the Atlantic Region vary significantly among different water masses and are impacted by seasons, weather, and shelf circulation processes (Lohrenz et al. 2003). Primary productivity is higher in waters of the Labrador Current than in the Gulf Stream (**Figure 2-14**) and is generally highest when waters become re-stratified in spring and summer (Marra and Ducklow 1995). Nutrient-rich, off-shelf water upwells in the core of eddies that form near the deflection of the Gulf Stream; these eddies are important drivers of primary productivity, which in turn leads to high concentrations of zooplankton (Govoni et al. 2010). South of Cape Hatteras, a semi-permanent eddy called the Charleston Gyre supports high chlorophyll concentrations and zooplankton densities (Govoni et al. 2010). This feature serves as important habitat for larval R.6 **FISH** and the black-capped petrel (White 2020b), which has been proposed for listing under the ESA.

Pelagic communities include larvae of R.6 **FISH** and invertebrates (including important R.10 **COMMERCIAL & RECREATIONAL FISHERIES** species), as well as food sources for other pelagic animals, including R.9 **MARINE MAMMALS** (Kenney et al. 1997). In the NECS, copepods and krill support the feeding and migration pathways of large baleen whales (Gavrilchuk et al. 2014), particularly the North Atlantic right whale. Forage fish, such as Atlantic herring and Atlantic mackerel, form large schools in the pelagic zone, concentrating in areas with high zooplankton density (Bachiller et al. 2016). Common pelagic invertebrates include cephalopods, such as longfin, arrow, and shortfin squid (Herke and Foltz 2002), which provide food for toothed whales (Kenney et al. 1997).

In the pelagic zone, highly migratory managed R.6 **FISH** species include tuna, sharks, and billfish, many of which travel long distances across domestic and international boundaries. Most of these species, like the Atlantic bluefin tuna, blue shark, and white marlin, have R.6 **ESSENTIAL FISH HABITAT** in all four Atlantic planning areas (NMFS 2017) (**Appendix E**). In the Atlantic Region, nine highly migratory species are already overfished, and overfishing is occurring on six of those species (NMFS 2019). Additionally, ESA-listed oceanic whitetip shark and the Central and Southwest DPSs of scalloped hammerhead shark occur in all Atlantic planning areas (NOAA 2015c). The ESA-threatened giant manta ray occurs in tropical to temperate waters; though it is not commonly encountered, it is susceptible to targeted and bycatch fishery harvest (Miller and Klimovich 2017). The Atlantic canyons are areas of importance to highly migratory and deepwater fishes and are sites of intense R.10 **COMMERCIAL & RECREATIONAL FISHERIES** (e.g., tilefish, lobsters, red crab, tunas, swordfish) (BOEM 2016d).

Communities of Atlantic marine R.7 **BIRDS** feed along the shelf break near Gulf Stream eddies and shallow banks in areas where prey are concentrated (Lee 2015; Nisbet et al. 2013; Palka et al. 2017). Notable offshore areas with persistent concentrations of seabirds include the Bay of Fundy (where phalaropes feed upon copepods and krill), Georges Bank (where tidal fronts concentrate R.6 **FISH** and zooplankton prey, attracting shearwaters and storm-petrels in summer and Atlantic puffins in winter), and Nantucket Shoals (where hundreds of thousands of sea ducks and loons feed in winter and spring on clams, crustaceans, and fish) (Nisbet et al. 2013; Veit et al. 2016; White and Veit 2020). The black-capped petrel forages in hot spots seaward of Cape Hatteras, NC; near the Atlantic shelf break and submarine canyons system; and in Gulf Stream waters in the South Atlantic Bight (Halpin et al. 2018; Jodice et al. 2015; Winship et al. 2018).

The Loop Current and Gulf Stream are estimated to transport over one million tons of *Sargassum* seaweed from the GOM into the Atlantic Ocean during fall and winter (Gower and King 2011). The distribution and quantity of *Sargassum* along the Atlantic Coast varies (Casazza and Ross 2008), extending as far north as the Mid-Atlantic Planning Area (Dooley 1972). This floating seaweed is important because it provides a place to rest and forage for juvenile R.8 **SEA TURTLES**. As a result, *Sargassum* is a pelagic HAPC and is designated as critical habitat for hatchling loggerhead turtles in the Mid-Atlantic and South Atlantic Planning Areas.

> *The following threatened or endangered species have critical habitat designated within BOEM planning areas in the Atlantic Region (detail and map in **Appendix D**):*
>
> **North Atlantic right whale**: North Atlantic, Mid-Atlantic, South Atlantic
>
> **Loggerhead turtle**: North Atlantic, Mid-Atlantic, South Atlantic, Straits of Florida
>
> **Elkhorn and staghorn corals**: Straits of Florida

Five ESA-listed R.8 **SEA TURTLES** occur in the Atlantic Region. Loggerhead turtles are the most abundant sea turtle in U.S. waters. The Northwest Atlantic DPS of loggerhead occurs along the U.S. Southeast Coast (NOAA 2017d). Critical habitat for loggerhead turtles has been designated for varying life stages on nesting beaches, in nearshore waters, and offshore from North Carolina to Florida (NOAA 2017d). Leatherback turtles occur in the open ocean from Maine to Florida, diving to depths of 4,000 ft (1,220 m) in search of gelatinous prey (NOAA 2016d). The North Atlantic DPS of green turtles and Kemp's ridley turtles inhabit waters along the Atlantic Coast, with the latter ranging farther north during warmer months and moving south during winter and early spring (NOAA 2017c; 2018). NMFS has proposed to designate marine critical habitat in nearshore waters (from the mean high-water line to 20-m depth) off the coasts of Florida and North Carolina. Proposed marine critical habitat also includes *Sargassum* habitat (from 10-m depth to the U.S. EEZ) in the GOM and Atlantic Ocean (88 FR 46572). Hawksbill turtles spend time in both pelagic and coastal areas; this species is primarily tropical and subtropical and is found regularly offshore Florida (NMFS 2020b). In the pelagic environment, sea turtle populations are at risk for entanglement and interaction with marine debris, fisheries bycatch, and ship traffic. From 2012–2016, 841 sea turtles were killed as bycatch in the Atlantic sink gillnet fishery alone (Benaka et al. 2019).

> Five ESA-listed R.8 **SEA TURTLES** occur in the Atlantic, with most concentrated in the South Atlantic and ranging farther north during warmer months. Females nest on sandy beaches in the southeast U.S., especially in Florida. Because they are slow growing, sea turtle populations are vulnerable to disruptions and require time to recover.

Thirty-nine species of R.9 **MARINE MAMMALS** occur in the western North Atlantic: 7 species of baleen whales, 27 species of toothed whales and dolphins, and 4 species of seals. Five ESA-listed species include the North Atlantic right, blue, fin, sei, and sperm whales. Baleen whale species occur in highest abundance in the NECS (especially the Gulf of Maine) following the seasonal zooplankton blooms, and many individuals subsequently migrate to southern waters in winter to breed (Roberts et al. 2016). Small dolphin species more frequently inhabit nearshore waters, especially near Cape Hatteras, where the major currents mix (Roberts et al. 2016). Deep-diving species, like beaked and sperm whales, tend to prefer deeper waters off the shelf break, particularly in the waters overlying and surrounding the Atlantic canyons, where they feed on aggregations of pelagic R.6 **FISH** and squid (Moors-Murphy 2014; Roberts et al. 2016; Stanistreet et al. 2017). Canyon areas in the North Atlantic and Mid-Atlantic Planning Areas (**Figure 2-14**) are an important high-use area for cetaceans, some of which spend the majority of the year in this area (Stanistreet et al. 2017).

> The North Atlantic right whale is a species of very high concern. Its small population—currently estimated at around 400 individuals—has recently shown trends of sharp decline (Kraus et al. 2016; Pace III et al. 2017). Mortality is primarily caused by entanglements and vessel strikes (Rolland et al. 2016; Sharp et al. 2019). Around 80% of the population of North Atlantic right whales has been entangled in fishing gear at least once (Knowlton et al. 2012).

At present, the North Atlantic right whale is the only ESA-listed cetacean with critical habitat in the North Atlantic. There are two critical habitat areas for North Atlantic right whales: feeding grounds in the Gulf of Maine and a calving habitat about 62.1 mi (100 km) wide off the coast of northern Florida, Georgia, and South Carolina (White and Veit 2020). A recent study tracked the location of North Atlantic right whales over a 10-year period and found that their distribution is broader than previously thought; North Atlantic right whales were present along the entire eastern seaboard for most of the year (Davis et al. 2017). After 2010, the North Atlantic right whale general distribution showed a more southerly trend (Davis et al. 2017), though recent data shows that other North Atlantic right whales are moving farther north (Meyer-Gutbrod et al. 2018), likely in response to rapid warming and changing food webs in the Gulf of Maine. The North Atlantic right whale's migration route directly overlaps some of the busiest shipping lanes in the entire OCS, putting the population at risk of interactions with ships. Thirty-four individuals have died since 2017, and an additional 16 free-swimming whales have been documented with serious injuries (Meyer-Gutbrod et al. 2018; NOAA 2021b). In 2017, elevated numbers of dead or seriously injured North Atlantic right whales led to the declaration of a UME (NOAA 2020a). The leading cause of death for this UME is attributed to "human interaction," specifically from entanglements or vessel strikes.

In 2021, an UME was also declared for Florida's Atlantic Coast manatee population due to significant die-offs, despite years of population growth (Florida Fish and Wildlife Conservation Commission 2022). Researchers attribute the UME to starvation due to the lack or seagrasses in the Indian River Lagoon, where poor water quality has led to HABs and widespread seagrass loss in recent years.

Two species of seal are commonly found in the Atlantic Region; the harbor seal has the greatest range (from Maine to the Carolinas), while the gray seal is found north of New York. Three other species—harp, hooded, and ringed seals—are infrequent visitors to the region. Harp, hooded, and ringed seals usually associate with pack ice but may occur in pelagic waters in the northern parts of the NECS (Kovacs 2015a; 2015b). A total of 2,361 marine mammals were reported as fishery bycatch in 2015 in the Atlantic Region, with gray and harbor seals representing 61% of the total (NMFS 2019).

Future Baseline Conditions (Figure 3-15). Components of pelagic ecosystems—including R.3 **PELAGIC COMMUNITIES**, R.6 **FISH**, R.7 **BIRDS**, R.8 **SEA TURTLES**, and R.9 **MARINE MAMMALS**—may be affected by a variety of stressors such as climate change, fishing, and increasing vessel traffic.

Ocean temperatures have risen more steeply over the last several decades in the North Atlantic than in many other parts of the globe (Intergovernmental Panel on Climate Change 2014). Therefore, northerly range shifts in species distribution are expected for species that are critical components of Atlantic food webs, such as copepods (McGinty et al. 2020) and forage R.6 **FISH** (Rose 2005; Suca et al. 2021). In addition, populations of larval fishes like Atlantic cod may decline as waters continue to warm (Pershing et al. 2015).

The expected expansion of East Coast ports may result in increased vessel collisions with marine animals, which have been implicated in injuries and fatalities for several large whale species (Hill et al. 2017; Laist et al. 2014; Muirhead et al. 2018; NMFS 2006). Pelagic sharks, which aggregate and feed at fishing hot spots in the North Atlantic, would likely continue to be vulnerable to capture and mortality from longline vessels as bycatch (Quieroz et al. 2015).

Various human activities may impact North Atlantic right whales and greatly affect the remaining population (Kraus et al. 2016; Pace III et al. 2017). Increasing vessel traffic may lead to greater risk of vessel strikes, and associated vessel traffic noise may lead to acoustic masking, increased stress, and changes in migration routes (Davis et al. 2017; Parks et al. 2007; Parks et al. 2011; Rolland et al. 2012). North Atlantic right whales are particularly vulnerable to entanglement in fishing, crab, and lobster pot lines (Sharp et al. 2019). Entanglements may lead to mortality or decreased overall health due to the difficulty in foraging or swimming with additional drag from entangled gear. The stress from entanglement makes it particularly difficult for females to bear offspring and nurse their calves (Pettis et al. 2017). The effect of this stress, combined with climate-related shifts in copepod abundance (Meyer-Gutbrod and Greene 2014), may explain the lack of new right whale calves observed in 2018 (Weintraub 2018), though 19 new calves have been observed in the 2021 calving season (NOAA 2021b). Only 22 births were observed in the previous four seasons. If current stressors continue, researchers estimate that this population may be functionally extinct in the near future (Walters 2018).

2.9.3 Benthic Environment

Current Conditions (Figure 3-14). Soft bottom habitats host highly diverse R.4 **MARINE BENTHIC COMMUNITIES** of more than 160 taxa, which fluctuate in biomass and have quick colonization times. These animals (including worms, sea stars, clams, and crabs) are more numerous in finer sediments found on the outer shelf (Boesch 1979; Brooks et al. 2006; Tenore 1985); dense clam beds also exist in shallow sandy banks. Nearshore hard bottom habitats in the SECS are patchily distributed in water depths from 13 to 82 ft (4 to 25 m); these low-relief rock outcrops are colonized by worms, sponges, and algae (Continental Shelf Associates Inc 1979; Wenner et al. 1983). These hard bottom areas provide habitat for coral reefs and a variety of R.6 **FISH** and invertebrate species and serve as foraging areas for ESA-listed hawksbill R.8 **SEA TURTLES** (NMFS 2020b). Shallow “worm reefs” of sediment and colonial bristle worms in the Straits of Florida Planning Area support assemblages of algae, invertebrates, fishes, and sea turtles (Gilmore Jr. et al. 1981; Lindeman et al. 2009). Hydrocarbon seeps are present in the Atlantic Region, having first been visually verified at Blake Ridge Diapir in 1995; additional seeps have been discovered over the last decade. These seeps are home to chemosynthetic communities that form complex habitats with a variety of benthic fauna, including bacterial mats, mussels, clams, and tubeworms (Morrison 2018a).

In deeper waters (89–331 ft [27–101 m]), hard bottom habitats supporting sponges, corals, worms, and crabs account for about 25% of the shelf area (Barans and Henry Jr. 1984; Parker et al. 1983; Sedberry et al. 2004). Scientists recently discovered coral reefs approximately 160 mi (257 km) off of Charleston, SC, at depths greater than 2,300 ft (700 m) and covering roughly 85 linear mi (137 km), providing unique deepwater habitat to a variety of R.6 **FISH** and invertebrate species (Adams 2018). The Blake Plateau and Charleston Bump are also prominent SECS features that affect hydrodynamics and attract marine species (Popenoe and Manheim 2001) (**Figure 2-14**). In the SECS, the Florida Keys NMS encompasses 2,900 mi^2 (7,511 km^2), and Gray's Reef NMS spans 22 mi^2 (57 km^2) (**Figure 2-14**). Limestone islands, sandbars, and ancient coral reefs in the Florida Keys NMS and submerged limestone hard bottom in Gray's Reef NMS support a variety of life (Halley et al. 1997; Kendall et al. 2007). Deepwater corals, such as octocorals, solitary scleractinia, and anemones, live in the Atlantic submarine canyons (Baird et al. 2017; Packer et al. 2007). The Northeast Canyons and Seamounts Marine National Monument includes four seamounts (Bear, Mytilus, Physalia, and Retriever) and three canyons (Oceanographer, Lydonia, and Gilbert) for a combined area of 4,913 mi^2 (12,725 km^2) of benthic habitat (**Figure 2-14**).

> Canyons located in the North and Mid-Atlantic Planning Areas, including the Northeast Canyons and Seamounts Marine National Monument, contain corals and hard substrate, which provide complex habitat for many marine animals and R.6 **FISHES** that attract foraging whales and sea R.7 **BIRDS**. The variety of fishes also attracts fishing vessels from throughout the Atlantic Region.

ESA-listed R.6 **FISH** species occur in the Atlantic Region benthic environment. The anadromous, ESA-listed Atlantic and shortnose sturgeon are bottom-dwelling species ranging from the South Atlantic to the North Atlantic Planning Areas. Atlantic sturgeon have critical habitat in streams where spawning occurs (NOAA 2015e; 2017a) (**Appendix D**). ESA-listed smalltooth sawfish occur in the Straits of Florida Planning Area and have coastal critical habitat (NOAA 2015f).

Economically important benthic species from the Mid-Atlantic through the Straits of Florida Planning Areas include corals, golden crab, shrimp, spiny lobster, and the snapper/grouper complex. Benthic features (e.g., live bottom) are important habitat for snapper/grouper, dolphin, and wahoo (**Appendix E**). Many of these species (e.g., hogfish and snowy grouper) are found on the bottom around reefs and structures, with ranges from coastal to open-ocean waters depending on life stage (NMFS 2019).

The North Atlantic Planning Area has a high proportion of R.6 **ESSENTIAL FISH HABITAT**. Canyons, seamounts, banks, and ledges are important fish habitat and have been identified as HAPCs for several species (New England Fishery Management Council 2017). Commercially and recreationally important species found in both the North Atlantic and Mid-Atlantic Planning Areas include scup, black sea bass, summer flounder, tilefish, surfclams, and quahogs (NMFS 2018f). Sea scallops, another important R.10 **COMMERCIAL & RECREATIONAL FISHERY**, are also found in these planning areas. Certain species like Atlantic cod gather in high concentrations to spawn and exhibit high site fidelity from year to year (Skjæraasen et al. 2011), a behavior that has been exploited by fisheries.

Warming ocean temperatures in the Atlantic Region have been correlated with changes to important marine benthic species (Pinsky et al. 2013). Twenty-four of 36 selected R.6 **FISH** species managed in the northeast region (including Atlantic halibut and yellowtail flounder) are shifting their ranges north or moving into deeper water (Nye et al. 2009). The distribution of the commercially important surfclam has shifted toward deeper waters in response to warmer temperatures, likely due to thermal stress (Weinberg 2005). In addition to distribution shifts of native fishes, the invasive lionfish has been found around Atlantic reefs, and its range is spreading northward.

Future Baseline Conditions (Figure 3-15). Seafloor resources, including R.4 **MARINE BENTHIC COMMUNITIES** and R.6 **FISH & ESSENTIAL FISH HABITAT**, may be affected by a variety of stressors, including climate change, fishing, renewable energy development, and marine mineral activities. Climate change models show a high likelihood of extinction of local species by 2050, with species invasion and replacements also occurring but less prominent (Cheung et al. 2009). Given the rapid rate of Atlantic Ocean warming predicted in the coming century (Intergovernmental Panel on Climate Change 2018), animal range shifts may become more commonplace in the future. As ranges for marine invertebrates and fishes in the Atlantic move, contract, or expand, novel interactions among predator-prey combinations and competitors would likely affect the long-term success of individual species and marine benthic communities.

Bottom disturbance activities are expected to continue and may impact R.4 **MARINE BENTHIC COMMUNITIES**, though regulated activities are often required to avoid sensitive areas, especially in areas with special protections (e.g., Northeast Canyons and Seamounts Marine National Monument). Renewable energy development and marine minerals dredging are expected to continue or increase, which may disturb benthic habitat and associated fauna. In addition, fishing activity is expected to remain near the current rate in the SECS and possibly decline in the NECS, which may influence changes to the benthic environment. Climate change and fishing also would likely continue to impact warm-water corals (like those found in Gray's Reef NMS), and a variety of stressors may affect less-studied Atlantic cold-water corals (Roberts et al. 2006).

2.9.4 Coastal Environment

Current Conditions (Figure 3-14). Barrier islands, beaches, tidal flats, rocky shores, tidal rivers, wetlands, marshes, and SAV are common R.5 **COASTAL & ESTUARINE HABITATS** found in both the NECS and SECS Ecoregions of the Atlantic. Barrier islands protect the mainland from wave and current action, particularly during major storms and hurricanes (Oertel 1985; Rosati 2009; Zinnert et al. 2019). Beaches on the mainland and islands provide vital habitats for migratory R.7 **BIRDS** using the Atlantic Flyway, nesting habitat for R.8 **SEA TURTLES** (mainly SECS Ecoregion), and haul-out areas for seals (mainly NECS Ecoregion) (Whitney 2014). Beaches also provide habitat for shellfish and other burrowing organisms. Various beach grasses and dune vegetation provide shade, cover, food, and nesting habitat for animals.

Estuaries, tidal rivers, marshes, and stream habitats along the Atlantic Coast support a wide variety of aquatic, estuarine, and marine communities, including habitat and nursery areas for juvenile R.6 **FISH**, shellfish, R.7 **BIRDS**, and other wildlife. Extensive tidal marshes typically exist on the shoreward side of the Atlantic Coast barrier islands. The Chesapeake Bay, a key coastal habitat near the Mid-Atlantic Planning Area, supports the largest population of Atlantic blue crabs and their valuable R.10 **COMMERCIAL & RECREATIONAL FISHERY** (NMFS 2021b). Eastern oyster populations contribute to the integrity and functionality of estuarine ecosystems by reducing suspended sediment and recycling nutrients in the water column (Eastern Oyster Biological Review Team 2007). In addition, these coastal and estuarine habitats support the American horseshoe crab, which is harvested as bait for other fisheries and by the biomedical industry (Smith et al. 2017a). Horseshoe crab eggs are an important food item of the ESA-listed red knot during the birds' spring migrations (Smith et al. 2017a).

> Seagrasses are important SAV occurring along the Atlantic Coast (except off South Carolina and Georgia), typically on the sound (landward) side of the barrier islands and in estuaries, particularly in Virginia and North Carolina. They tend to occur as patchy or continuous beds in shallow, subtidal, or intertidal unconsolidated sediments in areas with good water clarity. They form highly productive ecosystems, providing water filtration, shoreline erosion protection, and nursery habitat for many R.6 **FISH** and shellfish species. Common seagrass species include eelgrass, widgeongrass, and shoalweed. Seagrass beds have declined worldwide and face potential threats from bottom disturbance activities, die-off events, climate change, and eutrophication (Waycott et al. 2009).

Atlantic salmon R.6 **ESSENTIAL FISH HABITAT** occurs in 30 freshwater, coastal, and brackish areas from Maine to Connecticut; of these, 11 Maine rivers have been designated as HAPCs. The Gulf of Maine DPS of Atlantic salmon is ESA-listed and protected from commercial fishing (New England Fishery Management Council 2017). Additionally, coastal Maine includes designated Atlantic salmon critical habitat. In the North Atlantic and Mid-Atlantic Planning Areas, two bay systems have been identified as important habitat for sand tiger sharks (NMFS 2017). Many ecologically and economically important fish species (such as Atlantic menhaden, Jonah crab, and spotted seatrout) are managed in coastal waters. States often designate protection for R.5 **COASTAL & ESTUARINE HABITATS** (such as nursery grounds) for management and conservation purposes.

Gray and harbor seals frequent the coastal areas of the NECS Ecoregion. These R.9 **MARINE MAMMALS** usually occur closer to shore—feeding on fish, crustaceans, and squid—and haul out to rest on beaches, rocks, and man-made structures (Bowen 2016; Lowry 2016). The ESA-listed Florida subspecies of the West Indian manatee can be found in the SECS Ecoregion (Deutsch et al. 2008).

Many species of ESA-listed R.8 **SEA TURTLES** nest along sandy beaches in the SECS Ecoregion. For example, the Northwest Atlantic DPS of loggerhead nests extensively in Florida, with more sporadic nesting as far north as Virginia (NOAA 2017d). Additionally, leatherback turtles have minor nesting colonies in southeast Florida (NOAA 2016d).

Numerous species of resident and migratory R.7 **BIRDS** occur in the Atlantic Region, and many of these species use large swaths of coastal and marine habitats (Nisbet et al. 2013; White and Veit 2020). Bird species likely to be impacted by OCS activities include seabirds (gulls and terns, cormorants, frigatebirds, northern gannets, boobies, tropicbirds, petrels, shearwaters), waterfowl (loons, grebes, sea ducks), shorebirds (sandpipers, plovers, oystercatchers, stilts), and wetland birds (egrets, herons, wood storks, ibises, roseate spoonbills, cranes, rails). Five ESA-listed marine and coastal bird species occur in this region: Bermuda petrel, red knot, roseate tern, wood stork, and piping plover.

Migrating birds use the Atlantic Flyway, which spans from the Caribbean to the Arctic and covers the entire Atlantic Region. Coastal habitats serve as critical stopover areas for migratory birds to feed and rest; other species use specific coastal areas for nesting. For example, Great Gull Island off New York holds the largest concentration of nesting common terns in the world, and the shores of Long Island provide nesting habitat for 20% of the entire Atlantic piping plover population (FWS 2017; Hays 2011). The ESA-listed roseate tern mainly breeds from eastern Long Island to Cape Cod (Nisbet et al. 2013). In addition to the Atlantic Flyway, several shorebird species migrate over the Atlantic Ocean from Labrador and Nova Scotia to the Lesser Antilles and continuing on to South America (Rappole 1995).

Future Baseline Conditions (Figure 3-15). The impacts on the coastal environment from ongoing stressors—such as climate change, shipping traffic, pollution, marine mineral extraction, renewable energy, and coastal development—are expected to continue in the coming years. For example, an increase in storms and sea level rise may inundate and damage R.5 **COASTAL & ESTUARINE HABITATS**, impacting coastal R.7 **BIRDS** and nesting R.8 **SEA TURTLES**, especially on barrier islands (Von Holle et al. 2019). The Mid-Atlantic Planning Area has experienced more sea level rise than the global mean, and this rate may be increasing (Sallenger Jr. et al. 2012; Titus et al. 2009). If barrier islands continue to diminish, beach nourishment activities may increase turbidity of nearshore waters and species entrainment, especially of ESA-listed sea turtles, which tend to spend time near the seafloor, where sands are removed to be used in beach nourishment. Warming temperatures, eutrophication, and ocean acidification could combine to create inhospitable areas in Atlantic estuaries (such as the Chesapeake Bay) and may have adverse consequences for regional R.6 **FISH** and R10 **COMMERCIAL & RECREATIONAL FISHERIES** (Keppel et al. 2016; Miller et al. 2016). Keystone species have faced recent challenges due to habitat loss and disease (e.g., the decline in the eastern oyster population) (Eastern Oyster Biological Review Team 2007). Several ports (e.g., Boston, MA; Charleston, SC; Jacksonville, FL) are expanding to accommodate megaships (Guillot 2017; Wang and Pagano 2015), and construction may lead to habitat degradation and increased noise levels in nearby areas. Finally, expected increases in tourism may affect the coastal environment with more pollution, coastal development, and recreational fishing in the future.

2.9.5 Human Environment

Current Conditions (Figure 3-14). The Atlantic Coast has a mixture of highly developed urban areas, suburban sprawl, small towns, recreational areas, and undeveloped rural lands. The Atlantic states have pockets of densely populated areas and higher levels of employment and income in metropolitan areas along the coast. In 2019, the ocean economy employed nearly 1.6 million people, bringing in nearly $125 billion in GDP (NOAA and Office for Coastal Management 2022). Overall, R.15 **RECREATION & TOURISM** is the most important sector of the ocean economy in the Atlantic Region, providing the majority of employment and GDP (NOAA and Office for Coastal Management 2019b).

The Atlantic Region is home to some of the most economically important R.10 **COMMERCIAL & RECREATIONAL FISHERIES** in the U.S., sustaining the livelihoods of thousands of fishermen and their families, and providing a way of life for coastal communities. The Atlantic Region accounted for approximately $2 billion of the total $5.4 billion domestic commercial landings revenue in 2018, 74% of which was generated by five New England states: Connecticut, Maine, Massachusetts, New Hampshire, and Rhode Island (NMFS 2021b). American lobster, sea scallop, and blue crab are some of the Atlantic's most economically important commercial fisheries (NMFS 2021b). In 2018, Massachusetts' commercial fisheries generated the largest employment in the region. Recreational fishermen took over 129 million fishing trips in the Atlantic Region in 2018. Eastern Florida generated the greatest employment from recreational fisheries in the region, providing over 55,000 jobs (NMFS 2021b). Popular Atlantic Region sport fishing species include snappers, drums, bluefish, black sea bass, flatfish, scup, striped bass, and wrasses.

The Atlantic Region contains many R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES**, both onshore and offshore, including over 11,000 shipwrecks (TRC Environmental Corporation 2012). The Outer Banks of North Carolina is often referred to as the "Graveyard of the Atlantic," due to the many shipwrecks that have occurred in the shoals, currents, and barrier islands of this area (NOAA 2017e). The wreck site of the USS *Monitor*, a civil war-era ship, is currently an NMS off Cape Hatteras, NC. Shipwrecks are one of the most abundant types of artificial reef habitat in the North Atlantic (Steimle and Zetlin 2000), serving as a R.15 **RECREATION & TOURISM** attraction for scuba diving and creating habitat for R.4 **MARINE BENTHIC COMMUNITIES**. Native American Tribal communities along the Atlantic Coast, as well as communities that were relocated west during the 19th century, have interests in cultural resources located within their traditional lands and offshore due to their historical ties to the marine environment.

With respect to R.12 **LAND USE**, the coastal counties along the Atlantic contain densely populated urban and suburban areas, as well as many ports (Kiln 2016) and shipyards (Bureau of Transportation Statistics 2012; Dismukes 2014). Five out of 10 of the Nation's largest metropolitan areas and four of the Nation's top 25 ports by tonnage are located along the Atlantic Coast (Bureau of Transportation Statistics 2018). Numerous protected areas are also located on the Atlantic Coast, including 7 national seashores, 2 national parks, 2 national recreation areas, 10 national monuments, and 8 national historical sites and parks. NASA operates rocket testing and launches from the Goddard Space Flight Center's Wallops Flight Facility on the eastern shore of Virginia; designated downrange danger zones and patterns for debris from field tests are located within the Mid-Atlantic Planning Area.

No offshore oil and gas development or production currently occurs in the Atlantic Region. In addition, most Atlantic states do not have substantial onshore oil and gas industries. Under BOEM's Marine Minerals Program, parts of the Atlantic OCS are dredged for sand used to address erosion along beaches and to strengthen the resilience of coastal communities and infrastructure (BOEM 2018d).

BOEM has issued wind energy leases off the coasts of Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina. In addition, offshore Wind Energy Areas and Wind Call Areas have been identified off the coasts of North Carolina and South Carolina. BOEM is working to achieve the goal of 30 gigawatts of offshore wind energy by 2030 with plans to potentially hold up to seven new offshore lease sales by 2025 in the Gulf of Maine, New York Bight, Central Atlantic, and offshore the Carolinas. An increase of renewable energy activities offshore may affect R.12 **LAND USE** because of associated industrial development needs. Site assessment and construction activities on these leases may overlap with the timeline of the National OCS Program. Information about BOEM's Offshore Renewable Energy Program, including an interactive map, can be found at www.boem.gov/renewable-energy/state-activities.

The coastal R.13 **CULTURE** of the Atlantic Region varies greatly from large metropolitan areas (such as New York City, Boston, and Miami) to barrier island communities (such as North Carolina's Outer Banks and New Jersey's Long Beach Island), and to quaint New England coastal towns and traditional southern cities. Many historical sites and areas with strong maritime heritage ties are located up and down the Atlantic Coast, including historic colonial communities (such as Yorktown, VA) and historical shipping and whaling communities (such as Mystic, CT). Culture in the Atlantic Region is strongly tied to R.10 **COMMERCIAL & RECREATIONAL FISHERIES**, R.15 **RECREATION & TOURISM**, agriculture, and the socioeconomic impacts of these industries. The area is defined by the multiple Native American Tribal communities that live along the coast and have historical ties to the marine environment. The Atlantic Coast is home to one of America's most unique cultures practiced by the Gullah/Geechee people, who have traditionally lived in the coastal areas and on islands of North Carolina, South Carolina, Georgia, and Florida; this area is a Federal National Heritage area established by the U.S. Congress, called the Gullah/Geechee Heritage Corridor. The Gullah/Geechee living along the coast have a cultural tradition of subsistence fishing and are highly dependent on R.6 **FISH** as a main staple (Gullah Geechee Cultural Heritage Corridor Commission 2012).

R.14 **VULNERABLE COASTAL COMMUNITIES** (including communities with high poverty levels, large minority populations, or both) and Native American Tribal communities are scattered up and down the Atlantic Coast. Several federally recognized Tribes have known or potential current and historical ties to the ocean and coastal areas adjacent to the Atlantic planning areas. Almost 70% of the Tribal communities are in coastal areas adjacent to the North and Mid-Atlantic Planning Areas; these Tribes include the Passamaquoddy Tribe of Pleasant Point, Mashpee Wampanoag Tribe, Wampanoag Tribe of Gay Head (Aquinnah), Narragansett Indian Tribe, Mashantucket Pequot Tribe, Mohegan Tribe, Shinnecock Indian Nation, and others. Farther south, dispersed members of the historically and culturally important Gullah/Geechee community (Yale University 2018), mentioned above in R.13 **CULTURE**, live along the Gullah/Geechee Cultural Heritage Corridor, which runs from the barrier islands along the coast to 30 mi (48 km) inland, from Pender County, NC, at the southern edge of the Mid-Atlantic Planning Area, and to St. Johns County, FL, in the South Atlantic Planning Area.

Within the Atlantic Region, all southernmost states (Florida, Georgia, South Carolina, and North Carolina) have poverty levels above the national average of 11.8%, while several Mid-Atlantic and Northern Atlantic states have poverty levels well below the national average (U.S. Census Bureau 2019r; 2019s; 2019z). However, within these latter states, there are coastal counties and communities with poverty levels exceeding the state and national averages. For example, in Virginia's Portsmouth City (County), 19.2% of the population lives below the poverty level; in Maryland's Dorchester County, 15.4% of the population lives below the poverty level (U.S. Census Bureau 2019f).

Many coastal communities adjacent to the Atlantic planning areas also exceed the 39.9% national average for minority populations (U.S. Census Bureau 2019z). For example, minority populations make up 87.1% of the population in Miami-Dade County (U.S. Census Bureau 2022).

Many of these R.14 **VULNERABLE COASTAL COMMUNITIES** adjacent to the Atlantic planning areas are in areas still recovering from the effects of recent hurricanes, (e.g., Florence and Sandy); they are also affected by higher levels of environmental pollution resulting from power plants, agricultural operations, incinerators, landfills, and other sources. In coastal areas surrounding Wilmington, NC, multiple low-income and largely African American communities have been impacted by coal ash from local power plants and their proximity to swine farming and various other agricultural and industrial activities.

Coastal R.15 **RECREATION & TOURISM** in the Atlantic Region is the largest source of employment and GDP related to the ocean economy. In the coastal areas of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut, recreation and tourism supports 72% of coastal employment and generates 52% of the regional ocean economy's GDP (NOAA and Office for Coastal Management 2019b). Popular destinations include coastal areas such as Acadia National Park in Maine, where people hike, camp, and participate in water-based recreational activities such as kayaking. The coastal roads from Boston to Maine are particularly busy during fall foliage viewing times. Other coastal areas in the northern Atlantic Region are popular sailing areas. For New York, Pennsylvania, New Jersey, Delaware, Maryland, and Virginia, recreation and tourism supports 74% of coastal employment and generates 60% of the regional ocean economy's GDP (NOAA and Office for Coastal Management 2019b). The sandy beaches along this area of the Atlantic Coast are popular destinations for swimming, surfing, and sunbathing. Fishing, kayaking, skim boarding, boating, and wildlife viewing are also popular recreational activities dependent on healthy coastal ecosystems (Mid-Atlantic Regional Council on the Ocean 2014). Diving is common in the marine sanctuaries, as well as on the many shipwrecks and artificial reefs. For North Carolina, South Carolina, Georgia, and the Atlantic Coast off Florida, recreation and tourism generates 79% of coastal employment and 61% of the regional ocean economy's GDP. Florida's Atlantic counties contributed a disproportionately high percentage of employment and GDP to the Atlantic Region's recreation and tourism sector (NOAA and Office for Coastal Management 2019b). Tourism in these areas is mostly based on popular beach destinations, where tourists participate in ocean-based recreation. Overall, recreation and tourism is the top sector supporting employment and GDP of the ocean economy in all states along the Atlantic Coast (NOAA and Office for Coastal Management 2021).

Future Baseline Conditions (Figure 3-15). Due to climate vulnerability, shifts in distribution or abundance have been predicted for Atlantic R.10 **COMMERCIAL & RECREATIONAL FISHERIES** (Hare et al. 2016). Negative impacts are anticipated for many economically valuable fish species in the Atlantic Region, including winter flounder, Atlantic sea scallop, Atlantic cod, and Atlantic mackerel. Positive effects are predicted for other fisheries, such as squid, butterfish, Atlantic croaker, and black sea bass (Hare et al. 2016).

With the exceptions of Maine and Rhode Island, future population levels for coastal states on the Atlantic are all projected to rise in varying degrees, with population projected to increase substantially in urban areas (Weldon Cooper Center for Public Service 2017). Florida is projected to have the highest increase in population by the year 2040 (Weldon Cooper Center for Public Service 2017). An increase in demand for housing, especially in areas where more growth is projected, may impact coastal R.12 **LAND USE**. Renewable energy development is increasing in the Atlantic, potentially affecting other marine uses and activities. Offshore wind projects are likely, as BOEM is actively working with stakeholders on leasing and project approval processes. Both offshore renewable and oil and gas projects may require the development of onshore support industries on the Atlantic Coast. Marine minerals dredging is also expected to continue or increase due to increased sand needs for beach restoration.

Marine-related industries along the Atlantic Coast are expected to continue to grow and affect R.12 **LAND USE**, as demand for port-related activities is projected to increase over time (NOAA 2020f). Industrial areas near existing large ports (e.g., Boston, MA; Baltimore, MD; Norfolk, VA; Charleston, SC) are expected to expand in response to increases in shipping and tourism (e.g., cruise ships). Nearby neighborhoods could experience an increase in ambient noise from cargo handling, construction, vehicles, and vessel traffic (Braathen 2011). To accommodate larger container ships, ports have dredged deeper channels, which may impact the effects of tides, flooding, and storm surge (Morrison 2018b). Future coastal land use and infrastructure along the Atlantic Coast is expected to increase due to a demand for coastal resources and development, particularly from fishing, shipping, and R.15 **RECREATION & TOURISM**.

R.14 **VULNERABLE COASTAL COMMUNITIES** may experience increased health impacts from the expansion of ports or other coastal infrastructure (Maantay 2002b). Parts of coastal areas in the Atlantic Region are still recovering from the adverse effects of major hurricanes (New Jersey Environmental Justice Alliance 2013), such as Hurricanes Florence and Sandy (National Hurricane Center 2017). Communities with limited resources may be more sensitive to storms, hazards, and natural disasters because their financial and social resources may already be strained from prior recovery efforts. The spatial extent of potential damage projected from impacts of climate change (e.g., sea level rise, increased storm surge) is estimated to be the most severe in coastal counties adjacent to the Mid-Atlantic and South Atlantic Planning Areas (Hsiang et al. 2017). Such impacts could affect the R.13 **CULTURE**, traditions, and well-being of coastal communities, such as the Gullah/Geechee people.

The R.15 **RECREATION & TOURISM** industry in the coastal Atlantic Region is the largest source of employment and is showing signs of growth, a trend that is likely to continue, most notably in the North Atlantic and Mid-Atlantic Planning Areas (NOAA and Office for Coastal Management 2019b). Like other areas in the Nation, climate change is expected to alter coastal areas, including popular tourist destinations. Sea level rise, changes in the frequency and intensity of storms, changing ocean temperatures, and ocean acidification may all have impacts on the flora and fauna that attract tourists to these coastal regions.

Chapter 3:

Regional Illustrations

The illustrations in this section summarize and depict the affected environment and environmental consequences analyzed for the 2024–2029 Program. **Figures 3-2 to 3-17** illustrate the following for each of the four OCS regions (Alaska, Pacific, GOM, and Atlantic):

- Current environmental conditions (**Chapter 2**)
- Future baseline conditions (**Chapter 2**)
- Potential impacts of no new leasing (Alternative A) (**Chapter 4**)
- Potential impacts associated with new leasing under the 2024–2029 Program (**Chapter 4**)

Figure 3-1 provides a master key to explain the icons in **Figures 3-2 to 3-17**.

Captions for each illustration provide brief summaries of the illustrations; see **Chapters 2 and 4** for additional information.

Note that these illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Figure 3-1. Master Key for Icons

This Illustration defines the icons used in **Figures 3-2 to 3-17**. The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

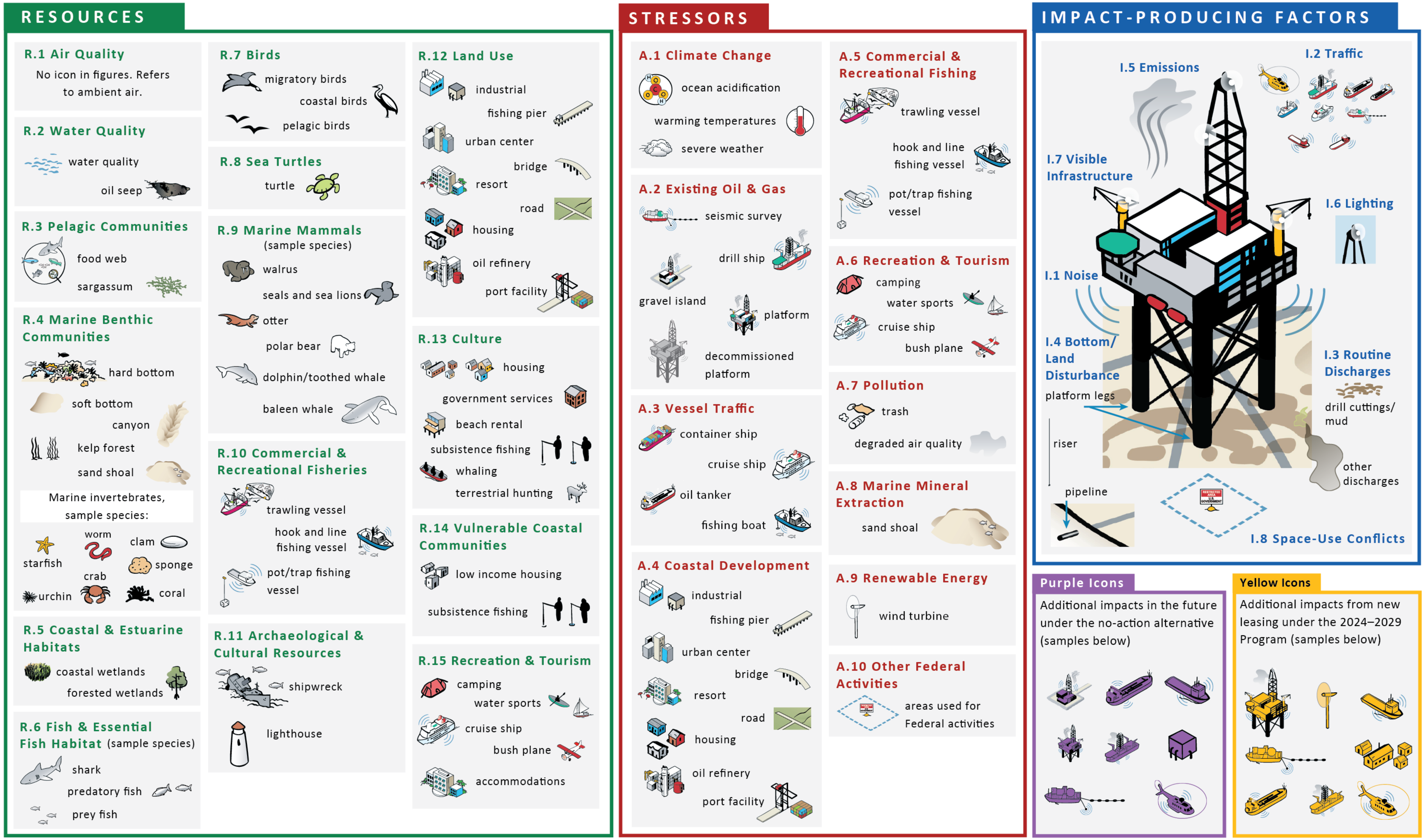


Figure 3-2. Alaska Region—Current Environmental Conditions

*See **Figure 3-1** for the master key to icons and **Chapter 2** for label definitions and additional dicussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Alaska's 6,640 mi (10,686 km) of coastline contains the largest and most diverse marine environments of any of the OCS regions. In Arctic Alaska, the annual formation and melting of sea ice significantly influences the lives of both humans and animals. Subsistence hunters (**R.13, R.14**), walrus, polar bears, and seals (**R.9**) depend on the sea ice for many life-history requirements, such as hunting or birthing. The varied marine communities (**R.4**) of the region—which include many species of invertebrates, fish (**R.6**), and mammals (**R.9**)—inhabit shoals, canyons, and seamounts. For example, Hanna and Herald Shoals in the Chukchi Sea are home to diverse marine invertebrates (**R.4**) and serve as feeding grounds for many species. Coastal and estuarine habitats (**R.5**) include barrier islands, beaches, wetlands, tidal flats, rocky coastlines, islands, fjords, and bays. These coastal habitats also support caribou, an important subsistence (**R.13, R.14**) species in Alaska. Many species of breeding and migrating birds (**R.7**) use rocky coastal areas for refuge and feed on abundant forage fish (**R.6**) offshore. Lands shoreward of the Chukchi and Beaufort Seas are characterized by tundra, extreme remoteness, low human population density (**R.13, R.14**), and long winters (beginning with twilight in fall and moving to 24-hour darkness in winter and 24-hour daylight in summer). Although there is no commercial fishing in the Arctic, elsewhere in Alaska, commercial fisheries (**R.10, A.5**) catch more fish by volume than anywhere else in the U.S. The diverse natural environments and abundant recreational opportunities attract thousands of tourists (**R.15, A.3, A.4, A.6**) to Alaska each year. Air and water quality (**R.1, R.2**) along the vast majority of Alaska's coastline are within national standards, but some aspects of climate change (**A.1**), such as ocean warming and permafrost melt, occur more rapidly than in other regions and are disruptive to human and natural ecology. Oil and gas (**A.2**) are being developed on coastal lands and state submerged lands in areas of Cook Inlet and Beaufort Sea. Existing OCS oil and gas exploration and development are very limited.

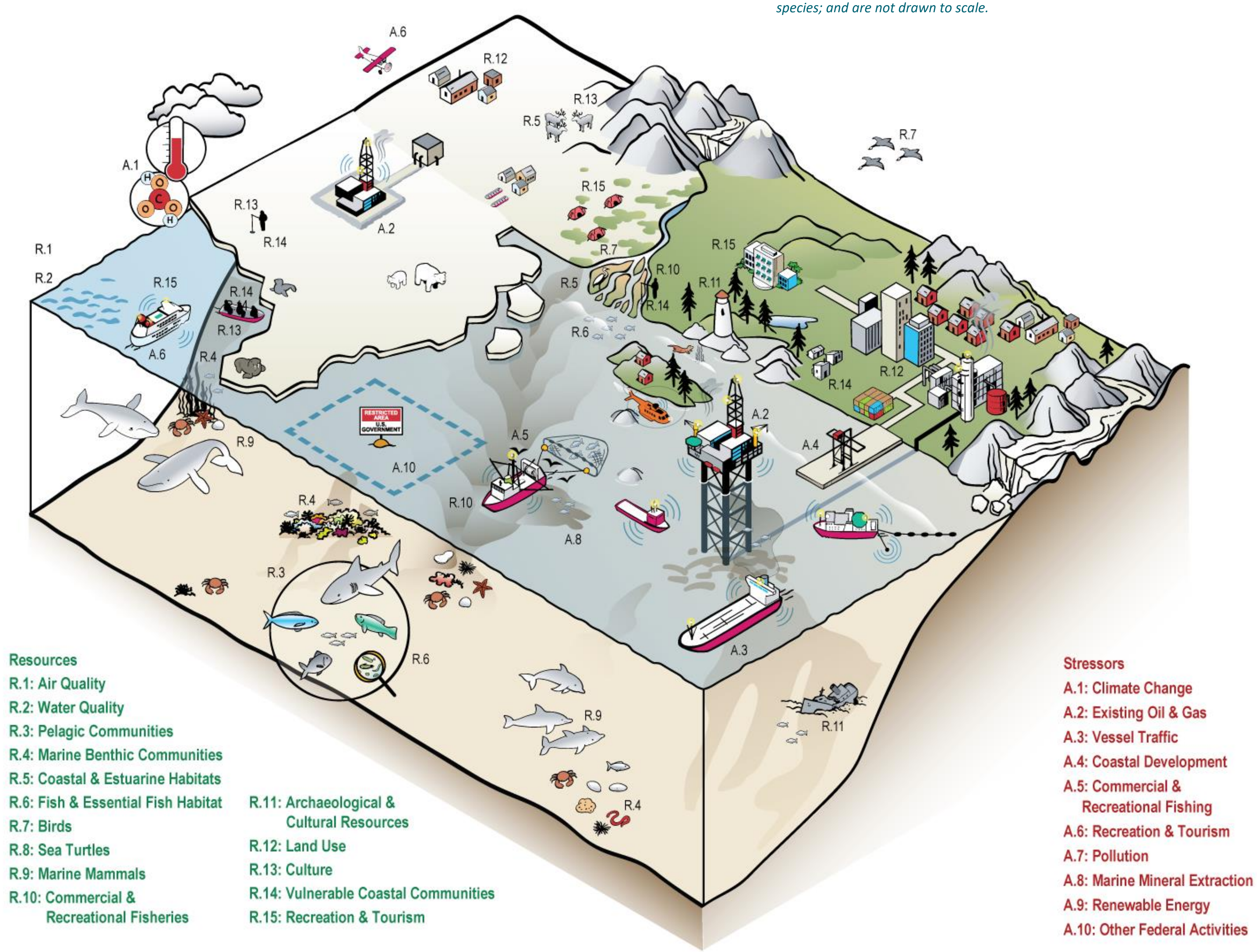


Figure 3-3. Alaska Region—Future Baseline Conditions (40 to 70 years)

*See **Figure 3-1** for the master key to icons and **Chapter 2** for label definitions and additional discussion.*

Climate change (**A.1**) is affecting resources more acutely in Alaska than anywhere in the lower 48, and this trend is expected to continue. Ocean water may be acidified, affecting water quality (**R.2**) and impacting marine food webs. Changing water and air temperature (**A.1**), water quality, and sea-ice dynamics are expected to intensify and may affect many species, including pelagic communities (**R.3**), fish (**R.6**), birds (**R.7**), and marine mammals (**R.9**). Intensified storm surges and sea level rise (**A.1**) may damage coastal and estuarine habitats (**R.5**). Ice-associated marine mammals (**R.9**) and subsistence hunters (**R.13, R.14**) may face challenges with changing conditions. Environmental stress, including water pollution (**A.7**), may also intensify as the Arctic open-water season lengthens, bringing additional commercial shipping (**A.3**) and tourism (**A.6**), such as cruise ships. As permafrost continues to thaw and sea levels rise (**A.1**), many more coastal settlements (**R.14**) may need to relocate farther from the coast. Ongoing and new oil and gas activities (**A.2**) may impact marine benthic communities (**R.4**), fish (**R.6**), and marine archaeological resources (**R.11**).

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

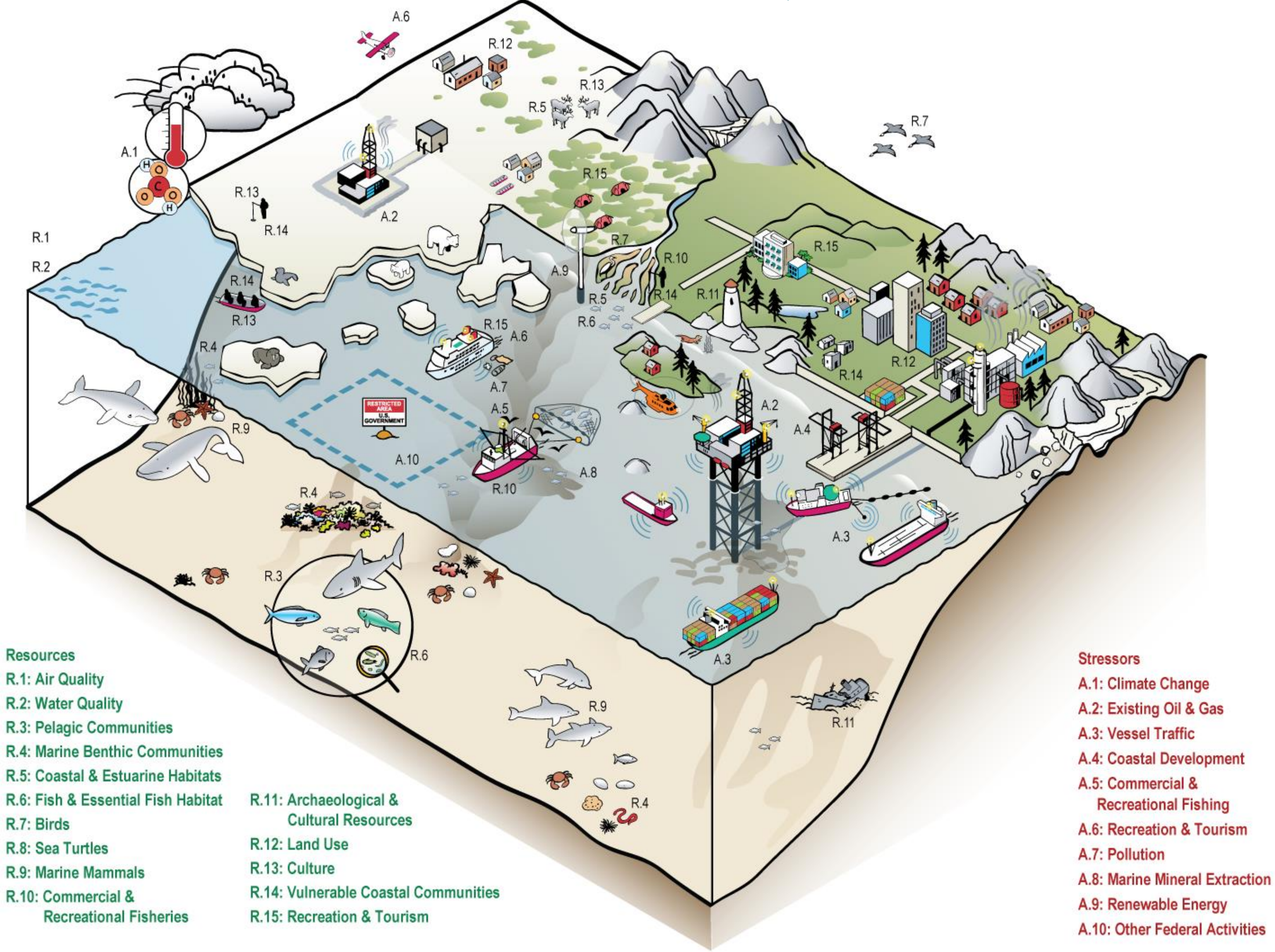


Figure 3-4. Alaska Region—Potential Impacts of Alternative A—No Action Alternative (No Leasing)

*See **Figure 3-1** for the master key to icon,; **Chapter 2** for label definitions, and **Section 4.2.1** for additional discussion.*

Note: This Illustration is identical to **Figure 3-3**, because Alternative A would not be expected to lead to any relevant differences from the future baseline conditions. Any energy substitutes for forgone production in Alaska planning areas would come primarily from outside the state, and no significant environmental impacts from that substitution would be expected within Alaska. Lack of industrialization in Alaska is a major draw for tourists (**R.15**) seeking remote wilderness and wildlife, and conditions for tourism are expected to remain unchanged by OCS activities if leases are not offered under the 2024–2029 Program.

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

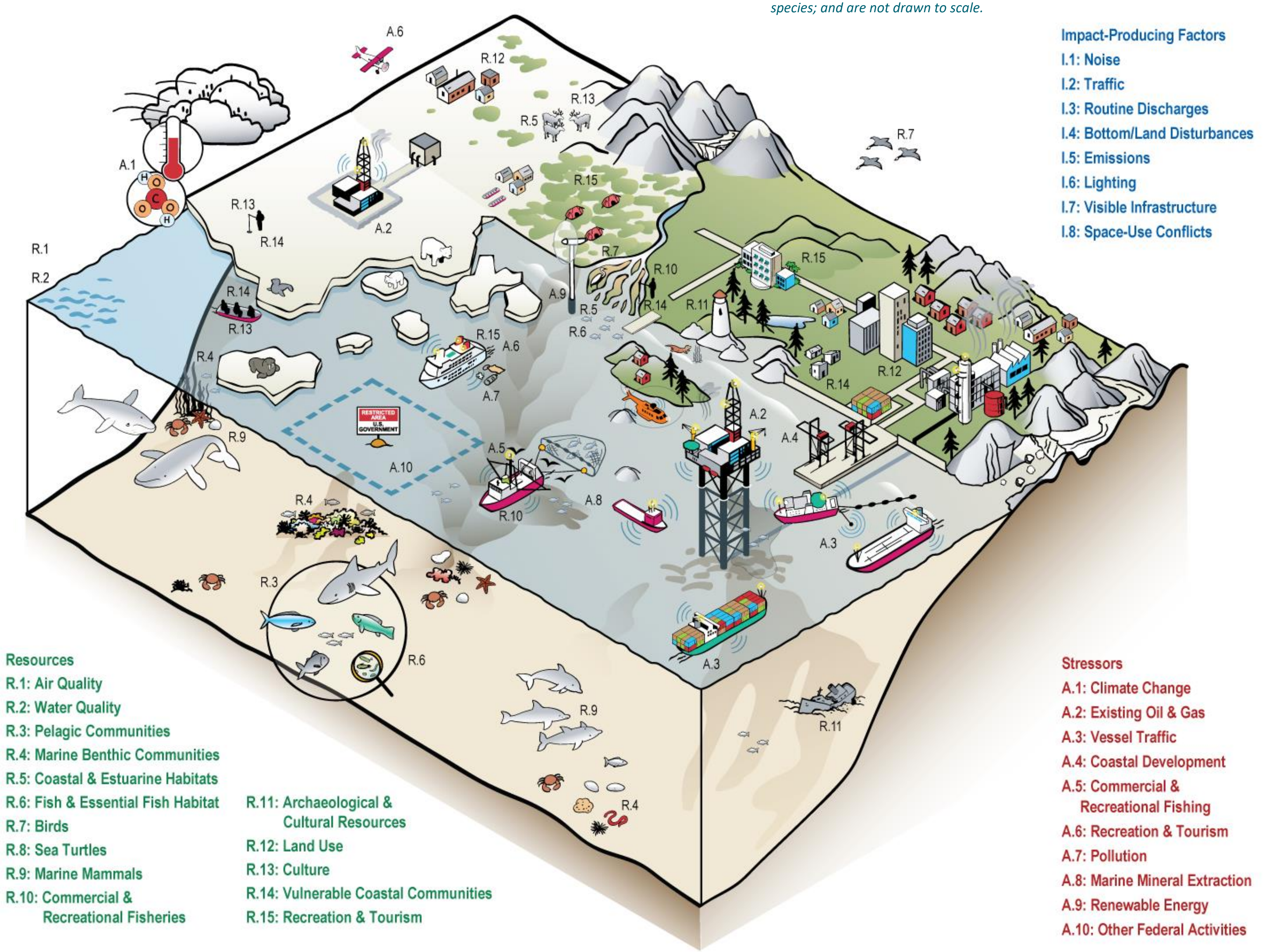


Figure 3-5. Alaska Region—Potential Impacts Associated with New Leasing Under the 2024–2029 Program

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.1** for additional discussion.*

IPFs may impact Alaskan resources in unique ways because of the region's remoteness and limited development. For example, subsistence (**R.13, R.14**) food sources are vital to many parts of the Alaska Region. Sound sources associated with oil and gas (**I.1**) may disturb fish (**R.6**) and marine mammals (**R.9**). Increased noise (**I.1**) may displace bowhead whales (**R.9**) or other mammals (e.g., caribou [**R.5**]) central to subsistence hunts, changing harvest patterns and success and adversely affecting food security, sense of well-being, and cultural identity of Alaska Native peoples (**R.13, R.14**). Noise (**I.1**) and visible infrastructure (**I.7**) associated with offshore and onshore construction may also impact culture (**R.13**), vulnerable coastal communities (**R.14**), and tourism and recreation (**R.15**). Some localized routine discharges, such as drilling muds and cuttings (**I.3**), may degrade benthic communities (**R.4**) and impact key feeding grounds for certain birds and marine mammal species (such as walrus) (**R.9**) that feed on benthic organisms. Disturbance (**I.4**) from pipeline laying, anchoring, offshore construction, and other activities may degrade or destroy sensitive benthic communities (**R.4**). Onshore construction may permanently alter wetlands and other coastal habitats (**R.5**), displacing birds (**R.7**) and other animals (e.g., caribou). Lighting (**I.6**) on new infrastructure may disorient migrating birds (**R.7**). Waves from increased vessel traffic (**I.2**), especially near industrial areas such as ports, may increase shoreline (**R.5**) erosion. Land use (**R.12**) in remote areas may be intensified dramatically by onshore industry-support construction and traffic (**I.2**) because of limited existing highway and road systems. Oil and gas activities may also cause space-use conflicts (**I.8**) with the Alaska fishing industry (**R.10**), subsistence users (**R.13, R.14**), or other Federal activities (**A.10**), such as NASA launch operations.

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

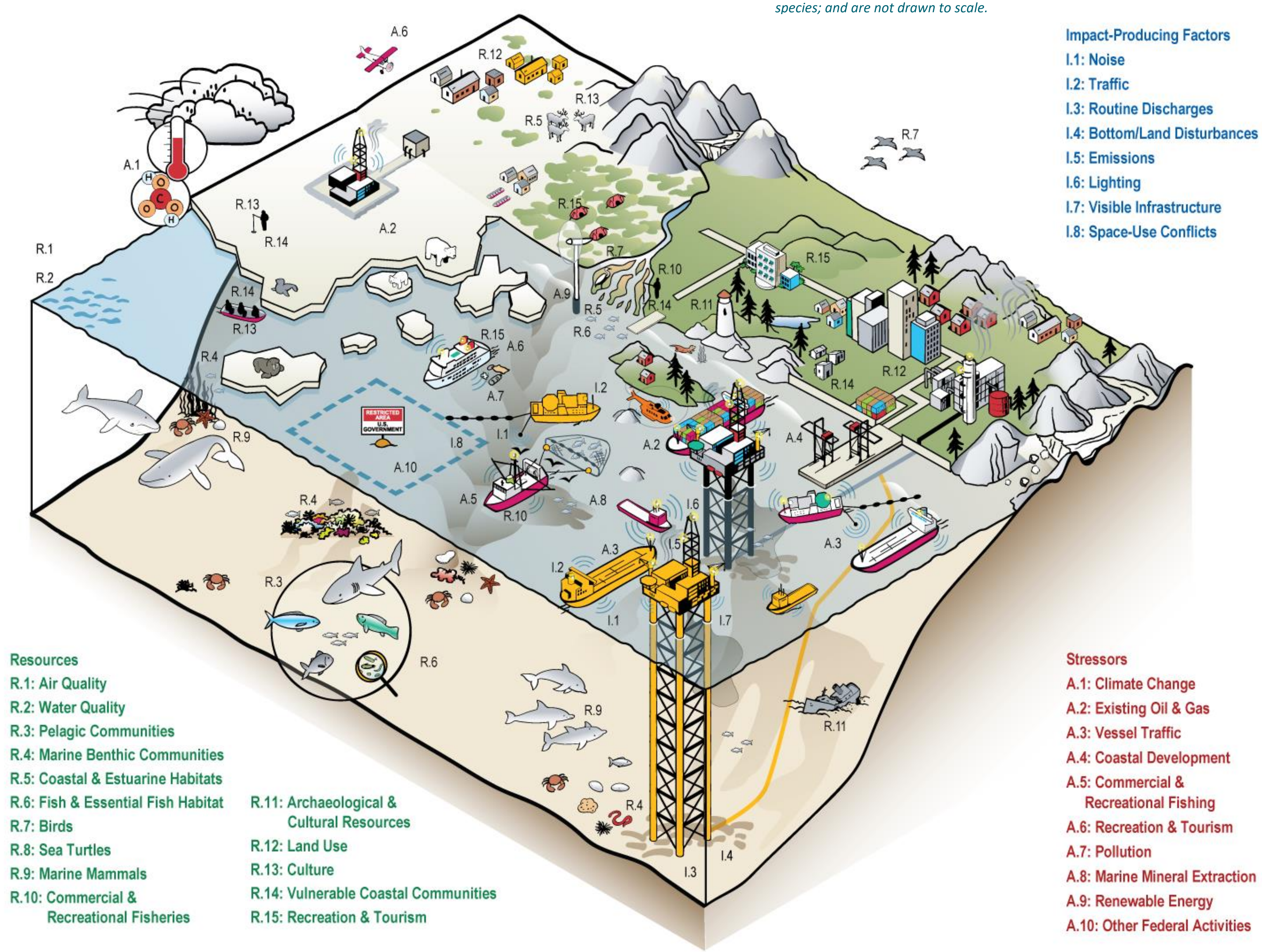


Figure 3-6. Pacific Region—Current Environmental Conditions

*See **Figure 3-1** for the master key to icons and **Chapter 2** for label definitions and additional discussion.*

At 3–25 mi (5–40 km) wide, the Pacific Region continental shelf is narrower than in other OCS regions and has a steep slope and seasonal upwelling that brings cool, nutrient-rich water to the surface. Water quality (**R.2**) in this region currently is rated as good overall. Pelagic communities (**R.3**) vary in space and time with upwelling strength, including the distribution and abundance of forage fish (**R.6**) and their predators (**R.7, R.9**), which are critical for fishing (**R.10**) and central to subsistence, food security, livelihood, sense of well-being, and cultural identity of Native American and other vulnerable communities with ties to the ocean or coast (**R.13, R.14**). Over 30 species of marine mammals (**R.9**) occur in the Pacific Region, including resident and migratory species. Ten marine mammals and four species of sea turtles (**R.8**) in this region are protected under the ESA. Monterey Canyon in the Central California Planning Area and other submarine canyons attract diverse sea life (**R.6**) and are popular for fishing (**R.10**). Fisheries (**R.10**) target crabs, squid, and various fishes (**R.6**). Rocky subtidal habitats and kelp forests (**R.4**) provide habitats for rockfish (**R.6**), marine mammals (**R.9**), and many other species. Soft bottom habitats (**R.4**) are common along the entire Pacific Coast, which also has deepwater corals. The shoreline supports high bird diversity (**R.7**) and includes island outcroppings, rocky shores, beaches, tidal flats, estuaries, wetlands, and marshes (**R.5**). The Southern California Planning Area has important port and industrial centers (**R.12**) that support ongoing offshore oil and gas activities. The Pacific Coast supports recreation and tourism on land (e.g., hiking, camping) and water (e.g., beach-going, kayaking, surfing) (**R.15**). Thousands of shipwrecks and many other archaeological and cultural resources (**R.11**) occur in the Pacific Region. Air quality (**R.1**) may be significantly degraded in the highly populated coastal areas of southern California.

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

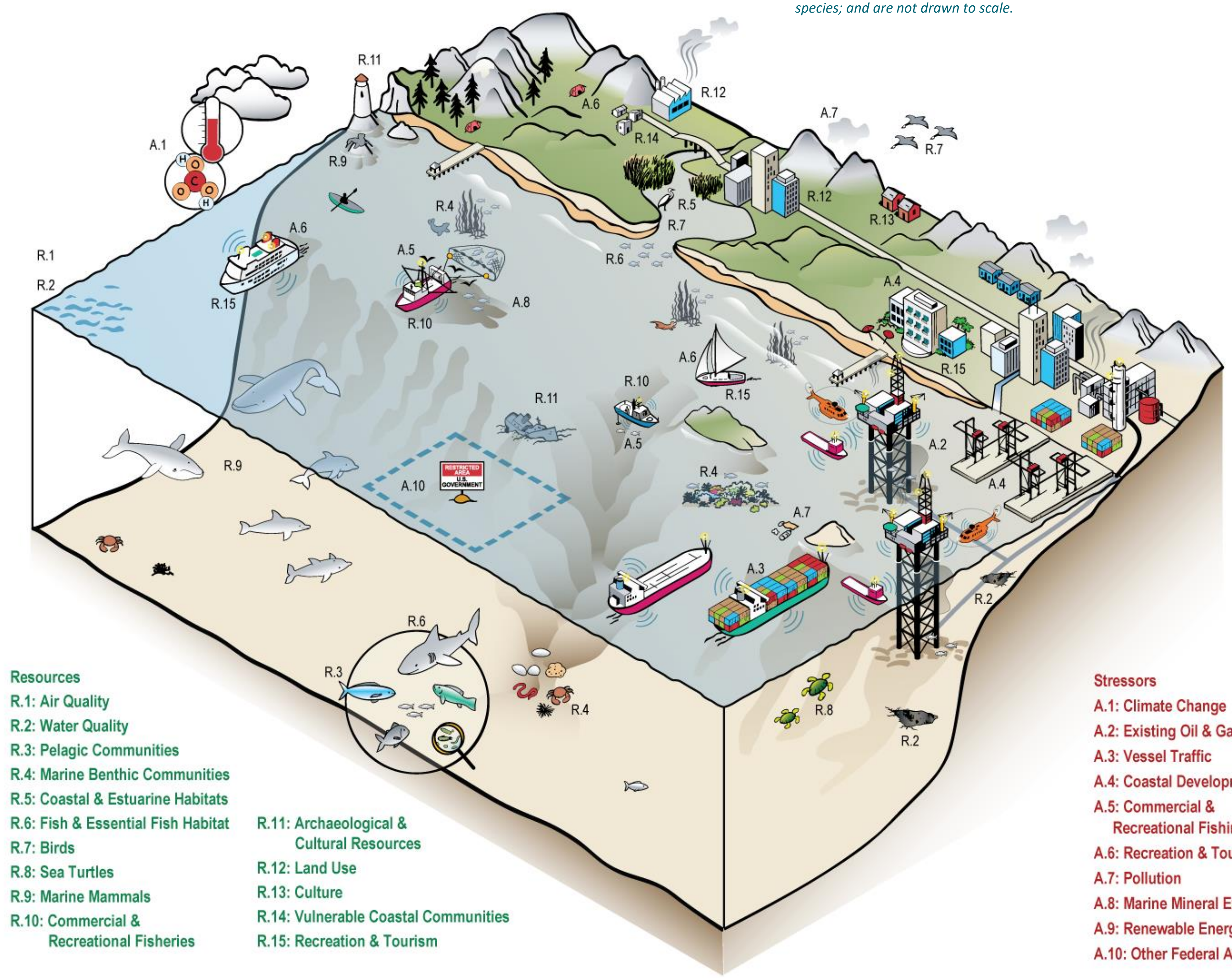


Figure 3-7. Pacific Region—Future Baseline Conditions (40 to 70 years)

*See **Figure 3-1** for the master key to icons and **Chapter 2** for label definitions and additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Climate change (**A.1**), fishing pressure (**A.5**), increased vessel traffic (**A.3**), and port expansions (**A.3, A.4**) would likely pose environmental challenges for fish (**R.6**), marine mammals (**R.9**), and pelagic and benthic communities (**R.3, R.4**). Ocean acidification (**A.1**) may impact marine species and fisheries (**R.10**) and archaeological and cultural resources (**R.11**). Sea level rise (**A.1**) and net sediment loss (**A.4**) may continue to threaten coastal and estuarine habitats (**R.5**) and archaeological and cultural resources (**R.11**). Demand for sand via dredging (**A.8**) to replenish beaches may increase, impacting benthic communities (**R.4**). Decommissioning existing oil and gas platforms (**A.2**) and construction of offshore wind farms (**A.9**) may locally impact the marine environment. Due to greater water depth in the Pacific Region, floating wind turbines (**A.9**) are more likely to be used than fixed-foundation turbines and may have an impact on the marine benthic (**R.4**) and pelagic communities (**R.3**). Human population levels are expected to increase in some areas (**A.4**), and air quality (**R.1**) is expected to remain degraded in heavily settled coastal areas but improve elsewhere in the region.

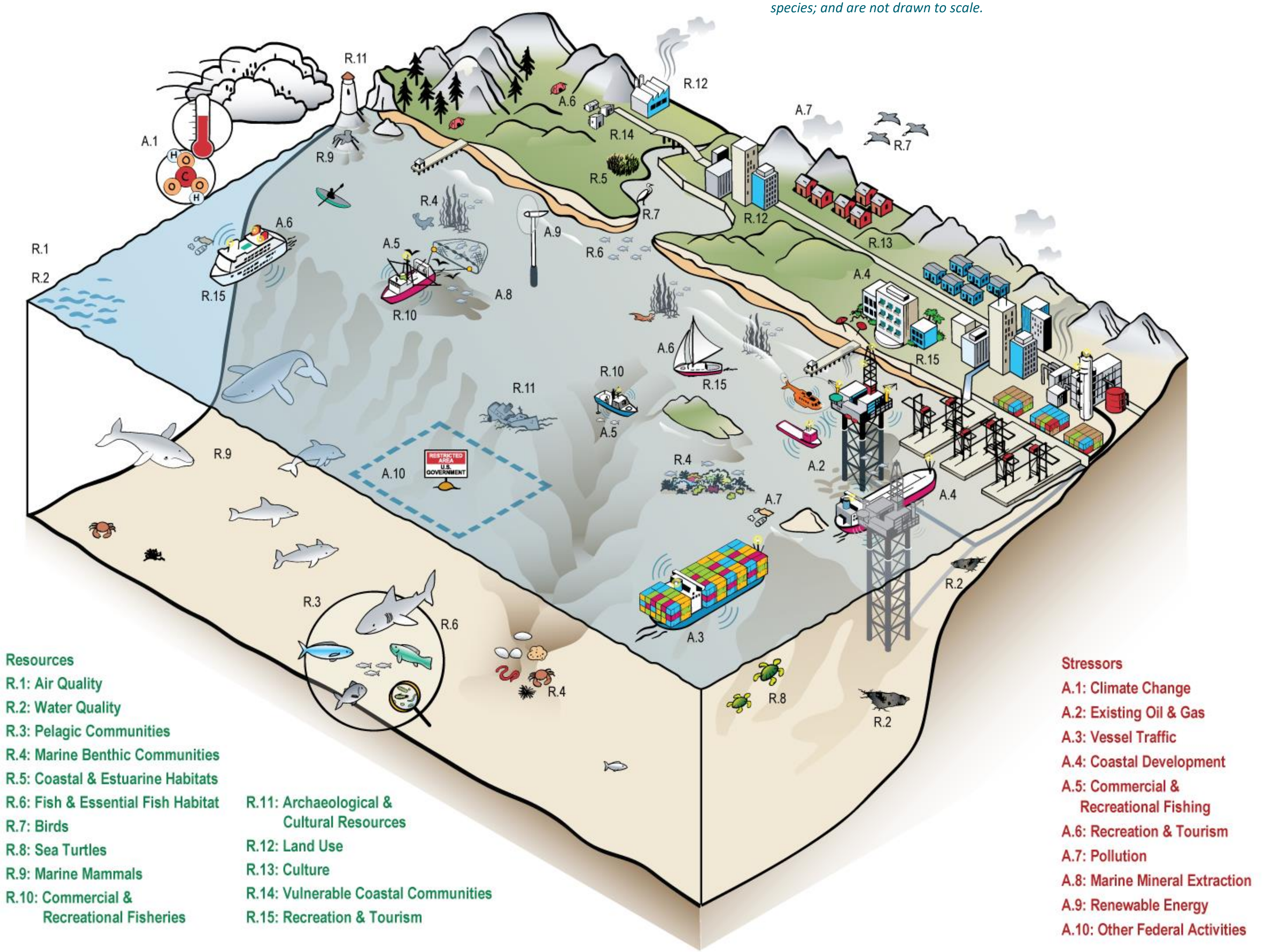


Figure 3-8. Pacific Region—Potential Impacts of Alternative A—No Action Alternative (No Leasing)

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.2.1** for additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Oil tankering (**A.3**) may increase if current energy consumption patterns continue and, if so, likely would be the most notable change, impacting fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**), particularly due to discharges and vessel noise. Vessel strikes (**A.3**) to mammals (**R.9**) and sea turtles (**R.8**) may also increase. Dredging to support new or expanded routes for tanker traffic may damage marine benthic communities (**R.4**) and injure or kill sea turtles (**R.8**). Oil spills from tankers may have long-term and population-level effects on marine resources (**R.2–R.10**), as well as culture (**R.13**), vulnerable coastal communities (**R.14**), and recreation and tourism (**R.15**).

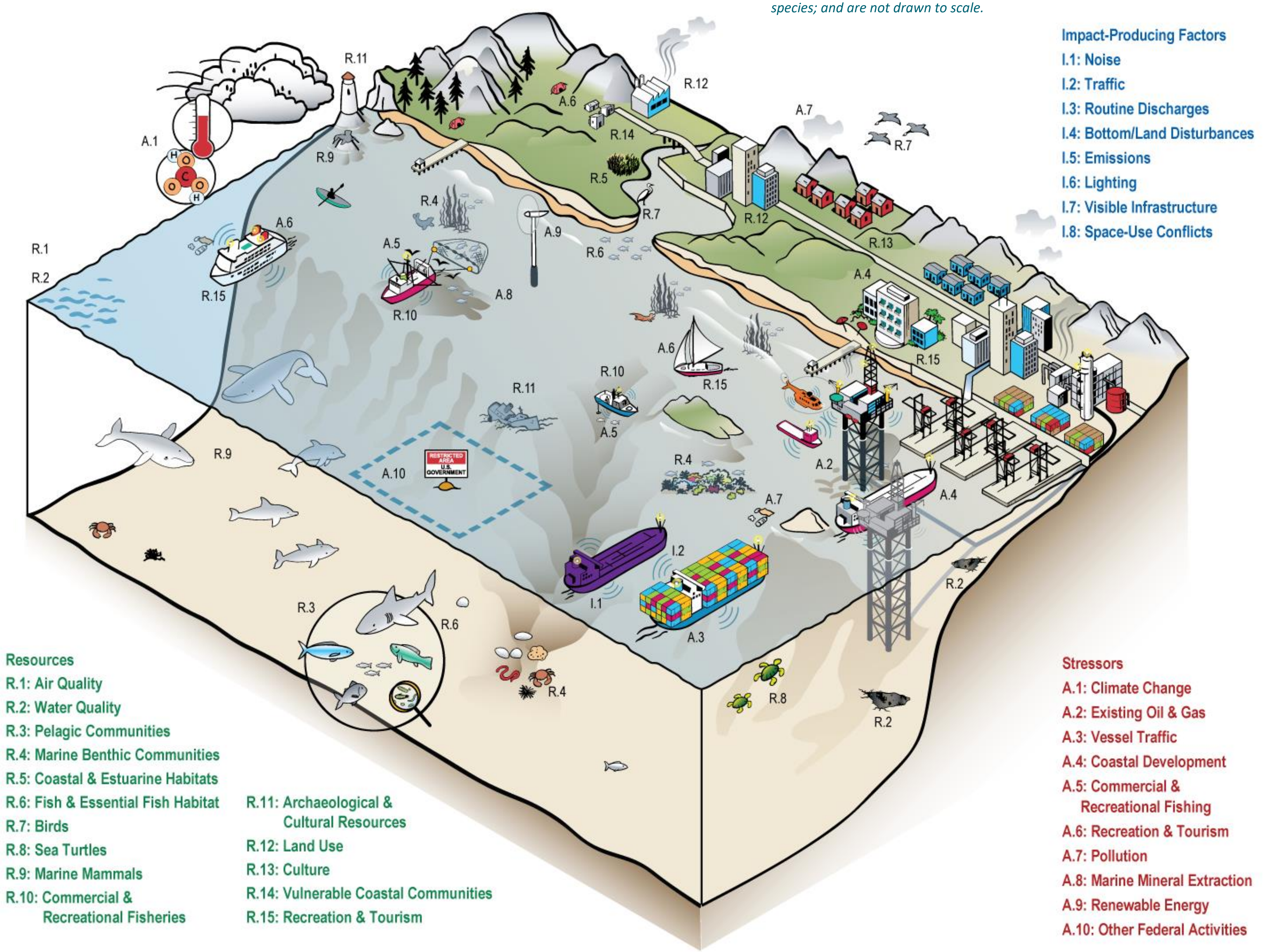


Figure 3-9. Pacific Region—Potential Impacts Associated with New Leasing Under the 2024–2029 Program

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.1** for additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Noise (**I.1**) may injure or disturb fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**). Some communities (**R.14**) may be disrupted by visible infrastructure (**I.7**) or noise (**I.1**) from onshore facilities. New industrial facilities may be required and influence land use (**R.12**). Vessel traffic (**I.2**) may make waves and increase erosion; onshore construction (**I.4**) may degrade coastal and estuarine habitats (**R.5**). Localized drilling muds, cuttings, and debris (**I.3**) may reduce water quality (**R.2**) and smother, alter, or remove benthic communities (**R.4**), which is a particular concern for sensitive areas such as cold-water coral reefs and kelp beds. In areas characterized by relatively undeveloped seascapes and coastlines, visible infrastructure (**I.7**), noise (**I.1**), and lighting (**I.6**) may impact recreation and tourism (**R.15**) and cultural practices (**R.13**) dependent upon wilderness characteristics. Increased vessel traffic (**I.2**) and emissions (**I.5**) from new facilities may contribute to existing exceedances of the NAAQS in southern California (**R.1**) and potentially affect vulnerable coastal communities (**R.14**). Oil and gas activities may cause space-use conflicts (**I.8**) with other human uses of the OCS, including commercial and recreational fishing (**R.10, A.5**) or other Federal activities (**A.10**), such as military operations or offshore renewable energy development (**A.9**).

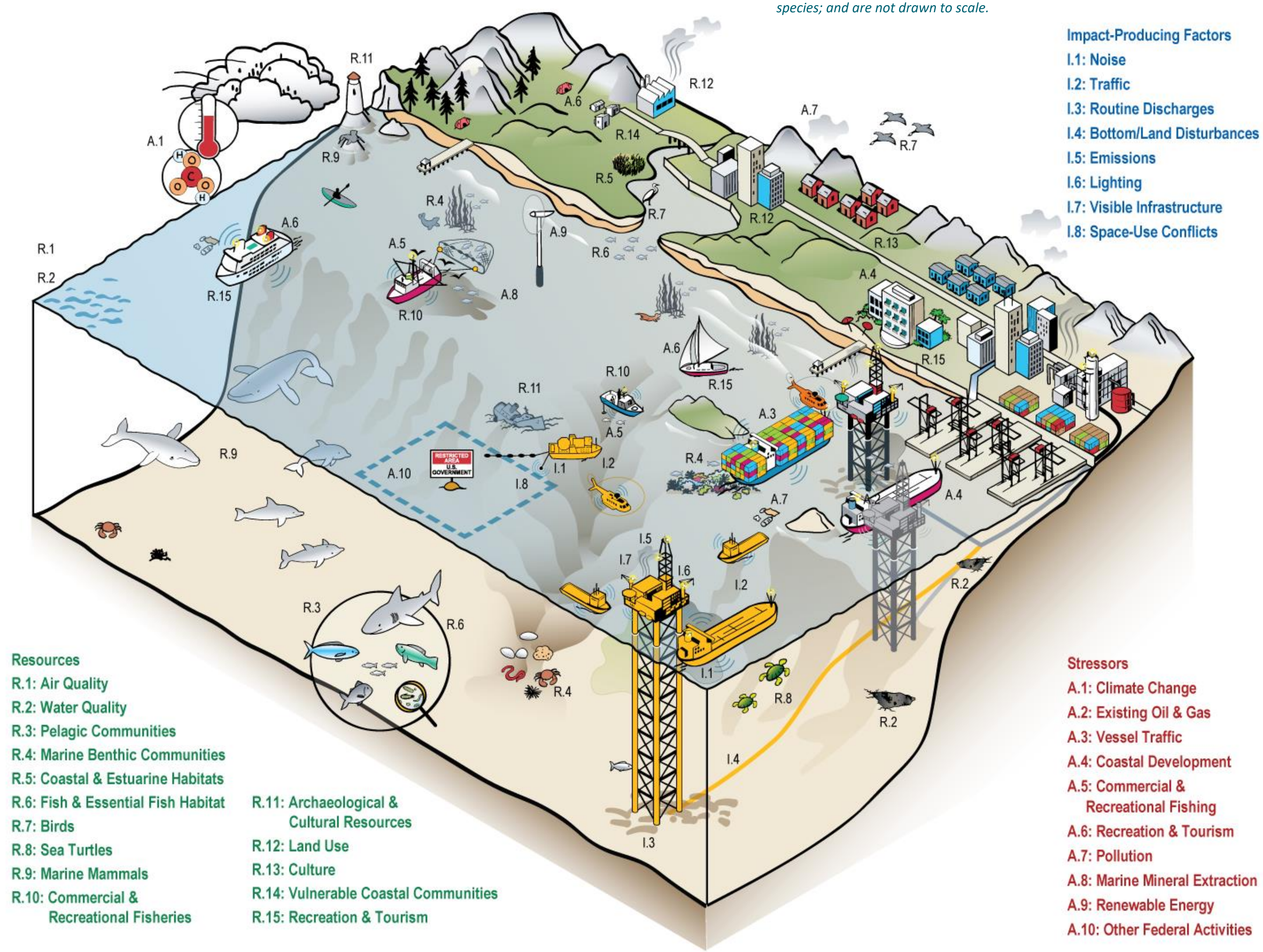


Figure 3-10. Gulf of Mexico Region—Current Environmental Conditions

*See **Figure 3-1** for the master key to icons and **Chapter 2** for label definitions and additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

The GOM coastline totals over 47,000 mi (75,639 km) and comprises bays, barrier islands, estuaries, and wetlands (**R.5**) providing habitat for many species of birds (**R.7**). Coastal land loss is a major issue in the region. Mud and sand make up most of the northern GOM seafloor. Hard bottom areas are also present in the GOM and include shallow and deepwater corals, pinnacles, banks, artificial reefs, and chemosynthetic communities (**R.4**). Of the 22 species of marine mammals (**R.9**) and 5 species of sea turtles (**R.8**) that occur in the GOM, six species are endangered. GOM beaches provide nesting habitat for several sea turtle species. In addition, EFH (**R.6**) has been designated for fish species across the entire region, from coastal to offshore areas. Local industries include oil and gas production (**A.2**), tourism and recreation (**A.6, R.15**), shipping (**A.3**), and fisheries (**A.5, R.10**). Thousands of operational and decommissioned oil and gas platforms (**A.2**) attract fish (**R.6**) and other marine life (**R.4**) around and on submerged legs. In some cases, decommissioned platforms may be toppled and left in place to serve as habitat for marine species. Several major industrial centers (**R.12**), primarily in the Western and Central GOM Planning Areas, support ongoing offshore oil and gas activities (**A.2**). Commercial shipping (**A.3**) is heavy, with many large ports along the coast. Air quality (**R.1**) mostly meets NAAQS requirement, though ozone (O_3) is in nonattainment in parts of Texas, and sulfur dioxide (SO_2) is in nonattainment in parts of Texas, Louisiana, and Florida. The USEPA generally rates marine water quality (**R.2**) in the GOM Region as fair.

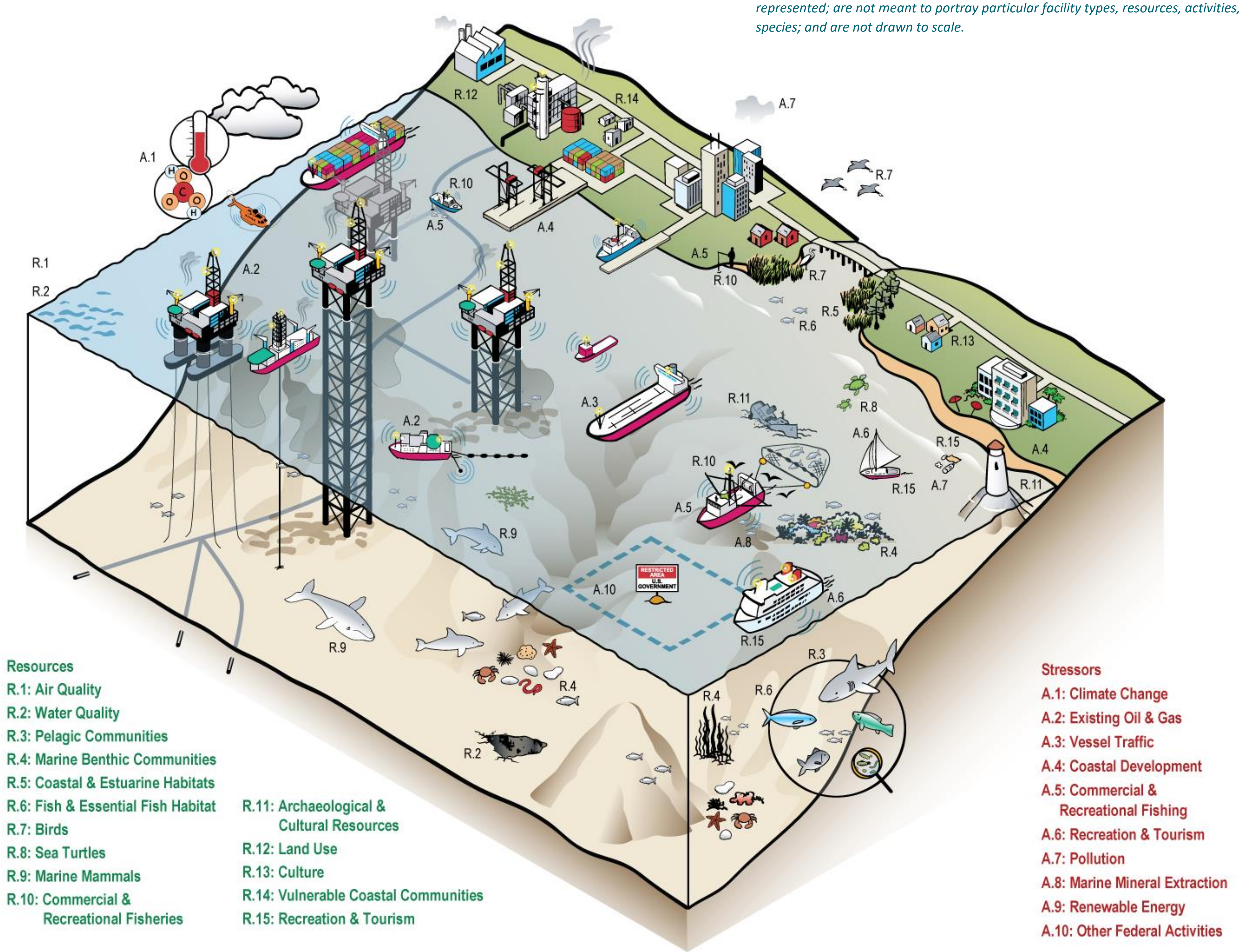


Figure 3-11. Gulf of Mexico Region—Future Baseline Conditions (40 to 70 years)

*See **Figure 3-1** for the master key to icons and **Chapter 2** for label definitions and additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Multiple stressors are likely to affect resources in the coming decades, including invasive species, marine traffic (**A.3**), military and other Federal activities (**A.10**), climate change (**A.1**), and oil and gas activities (**A.2**). For example, noise from deep-penetration seismic surveys or decommissioning may disturb or injure marine mammals (**R.9**), sea turtles (**R.8**), and fish (**R.6**). Increased ocean temperature (**A.1**) and acidity may challenge many marine and estuarine communities, including coral reefs and other hard rock marine benthic communities (**R.4**). Commercial and recreational fishing (**A.5**) may impact some benthic communities (**R.4**), levels of harvested fish species (**R.3, R.6, R.10**), and bycatch. Rising demand for sand and increased dredging (**A.8**) may degrade benthic communities (**R.4**) and may disturb, injure, or kill sea turtles (**R.8**). Coastal and estuarine habitats (**R.5**) along the Gulf Coast may be subjected to runoff and pollution (**A.7**), which may degrade water quality (**R.2**). Increases in vessel traffic (**A.3**), coastal development (**A.4**), and sea level rise (**A.1**) may influence coastal erosion. Wetlands (**R.5**) are threatened by subsidence, sediment starvation, and sea level rise (**A.1**). The coastal populations of the GOM Region are projected to increase slowly but steadily (**A.4**), with the highest rates in Texas and Florida. Tourism (**A.6**) is expected to continue to be important.

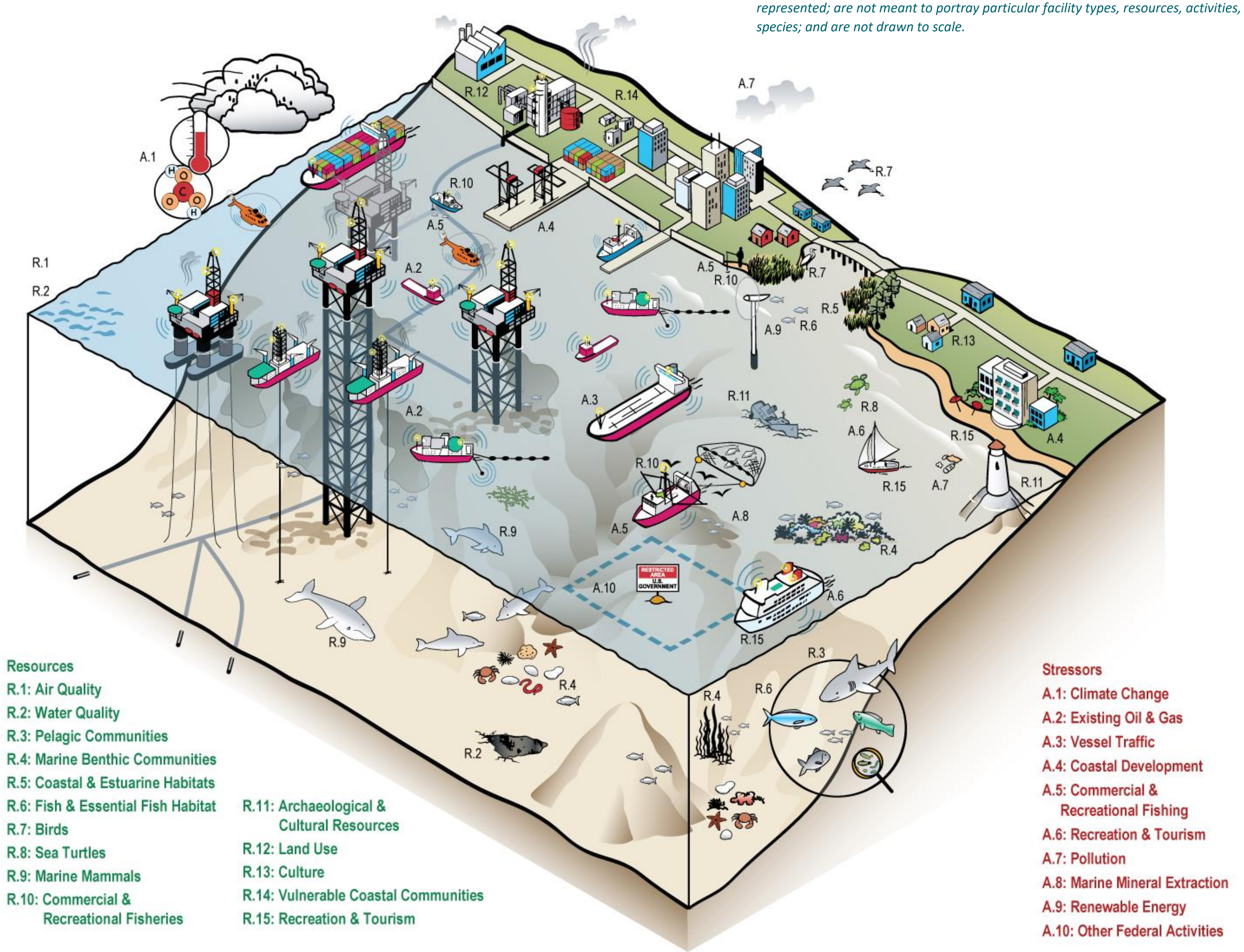


Figure 3-12. Gulf of Mexico Region—Potential Impacts of Alternative A—No Action Alternative (No Leasing)

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.2.1** for additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Oil tankering (**A.3**) may increase if current energy consumption patterns continue and, if so, likely would be the most notable change, impacting fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**), particularly due to discharges and vessel noise. Vessel strikes (**A.3**) to mammals (**R.9**) and sea turtles (**R.8**) may also increase. Dredging to support new or expanded routes for tanker traffic may damage marine benthic communities (**R.4**) and injure or kill sea turtles (**R.8**). Oil spills from tankers may have significant long-term and population-level effects on marine resources (**R.2–R.10**), as well as culture (**R.13**), vulnerable coastal communities (**R.14**), and recreation and tourism (**R.15**). The economic impacts of no leasing would create losses associated with employment, income, and revenues, which could also have impacts on culture (**R.13**) and vulnerable coastal communities (**R.14**).

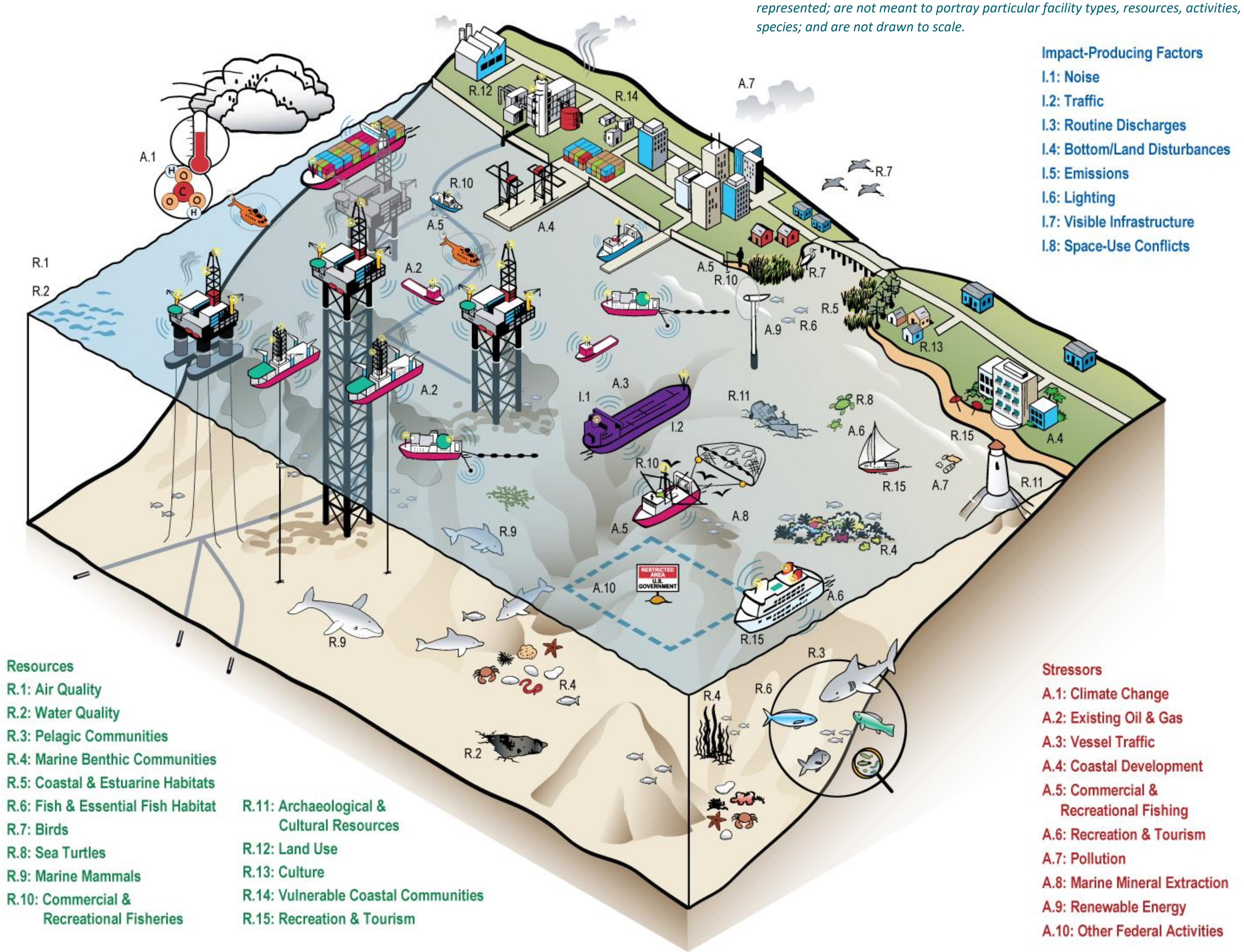


Figure 3-13. Gulf of Mexico Region—Potential Impacts Associated with New Leasing Under the 2024–2029 Program

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.1** for additional discussion.*

Oil and gas activities are expected to continue at existing levels in shallow and deeper waters. Fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**) may be injured or disturbed by noise (**I.1**) associated with oil and gas development. Vessel activity (**I.2**) (such as tanker and barge transport, survey vessel trips, and support vessels) may impact sea turtles (**R.8**), marine mammals (**R.9**), and coastal and estuarine habitats (**R.5**). Drilling mud and cutting discharges (**I.3**) may smother local marine benthic communities (**R.4**), which may also be impacted by pipeline laying, anchoring, and platform construction (**I.4**). Port infrastructure may need to be expanded (**I.4**) in undeveloped areas to accommodate increased offshore oil and gas development and associated support activities. Loss of coastal habitats (**I.4**) may impact migratory and coastal bird species (**R.7**) that use these areas for nesting, foraging, and migration. Lighting (**I.6**) on structures and vessels may impact birds (**R.7**). Water and land traffic (**I.2**) may increase to support OCS development and onshore support infrastructure. Culture (**R.13**) and vulnerable communities (**R.14**) may experience long-term impacts from traffic (**I.2**), visible infrastructure (**I.7**), and noise (**I.1**), especially in the Eastern GOM Planning Area. Increased vessel and offshore emissions (**I.5**) may further degrade air quality (**R.1**) for O_3 in nonattainment areas and Class I areas. Oil and gas activities may cause space-use conflicts (**I.8**) with other human uses of the OCS, including commercial and recreational fishing (**R.10, A.5**) or other Federal activities (**A.10**), such as military operations or marine mineral extraction (**A.8**).

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

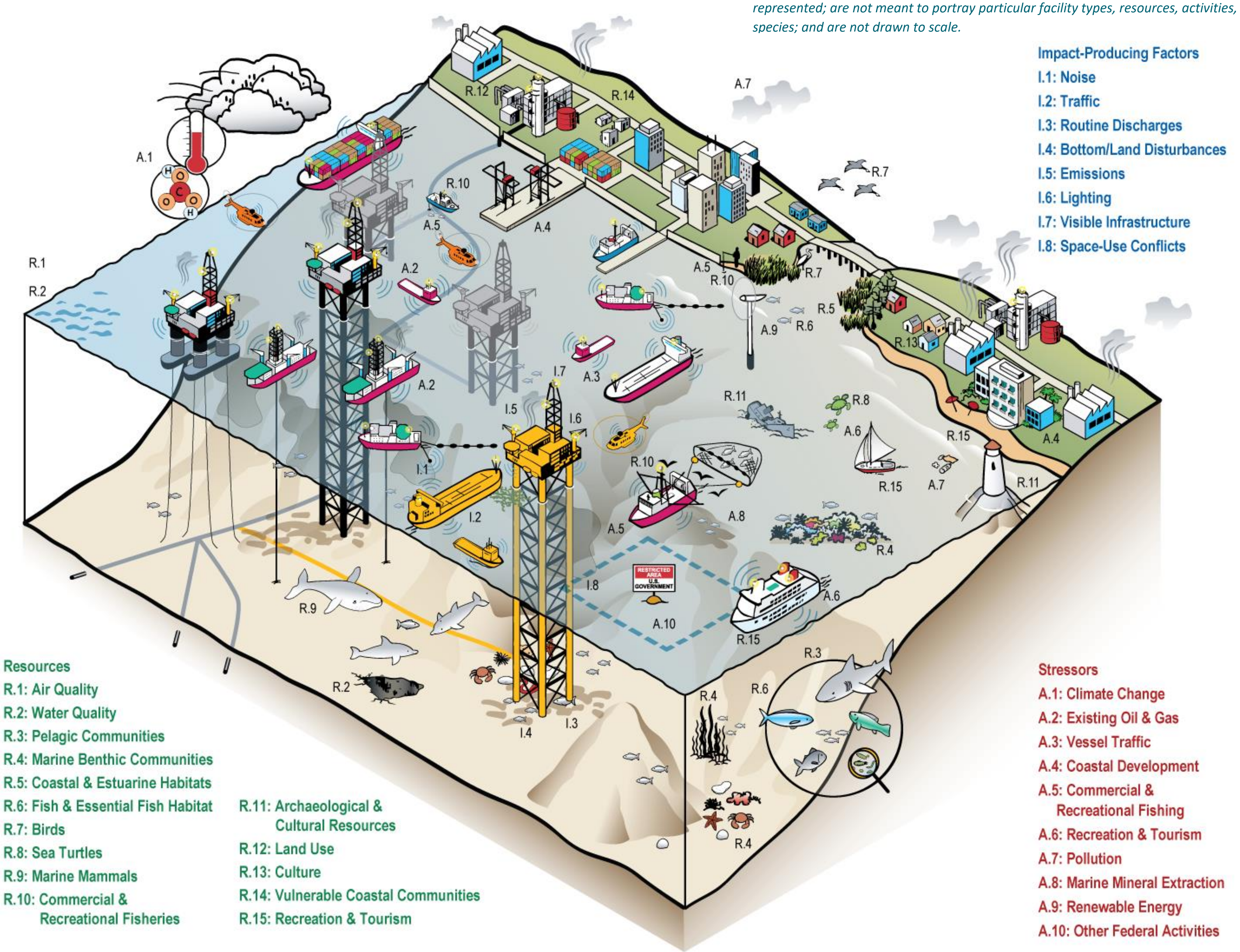


Figure 3-14. Atlantic Region—Current Environmental Conditions

*See **Figure 3-1** for the master key to icons and **Chapter 2** for label definitions and additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

The Atlantic Region comprises 2,069 mi (3,330 km) of coastline from Maine to southern Florida and has a continental shelf that is relatively broad and shallow, especially in the Mid- and North Atlantic Planning Areas. Benthic communities (**R.4**) include patchy hard bottom features (e.g., coral reefs) and sandy sediments. Canyons provide refuge for fishes (**R.6**) and substrate for marine benthic communities (**R.4**) and serve as key foraging areas for marine mammals (**R.9**) and seabirds (**R.7**). Seven baleen whale species and 27 toothed whale species (**R.9**) occur in the region, along with thousands of shipwrecks and many other archaeological and cultural resources (**R.11**). Commercial fisheries (**R.10**) include hook and line fishing, longlining, bottom fishing, and bottom trawling. Bycatch and entanglement in fishing gear (**A.5**) is an ongoing problem for large pelagic species. Recreational fisheries (**R.10**) are an important activity supporting employment and income for thousands. Coastal habitats (**R.5**) include sandy beaches, rocky shores, wetlands, and SAV. A wide variety of birds (**R.7**) use coastal habitats and migrate along the coast from the Caribbean to the Arctic. The southeast coastal beaches are breeding grounds for sea turtles (**R.8**). Coastal development (**A.4**) is extensive, mixing highly developed urban areas, suburban sprawl, recreational areas, and agricultural lands (**R.12, R.13, R.14**). Population is concentrated in urban areas, including several major ports and industrial centers. Air quality (**R.1**) exceeds the NAAQS for O_3 in some Mid-Atlantic cities, with smaller SO_2 and PM nonattainment areas in Florida, the Mid-Atlantic, and New England. The overall condition of the water quality (**R.2**) is rated as fair according to the USEPA. The sandy beaches of the Atlantic Coast are popular destinations (**R.15**) for swimming, surfing, and sunbathing. Some beaches need sand for coastal restoration, and marine mineral extraction (**A.8**) occurs in state and Federal waters. Many cruise ships (**R.15**) depart from Atlantic ports.

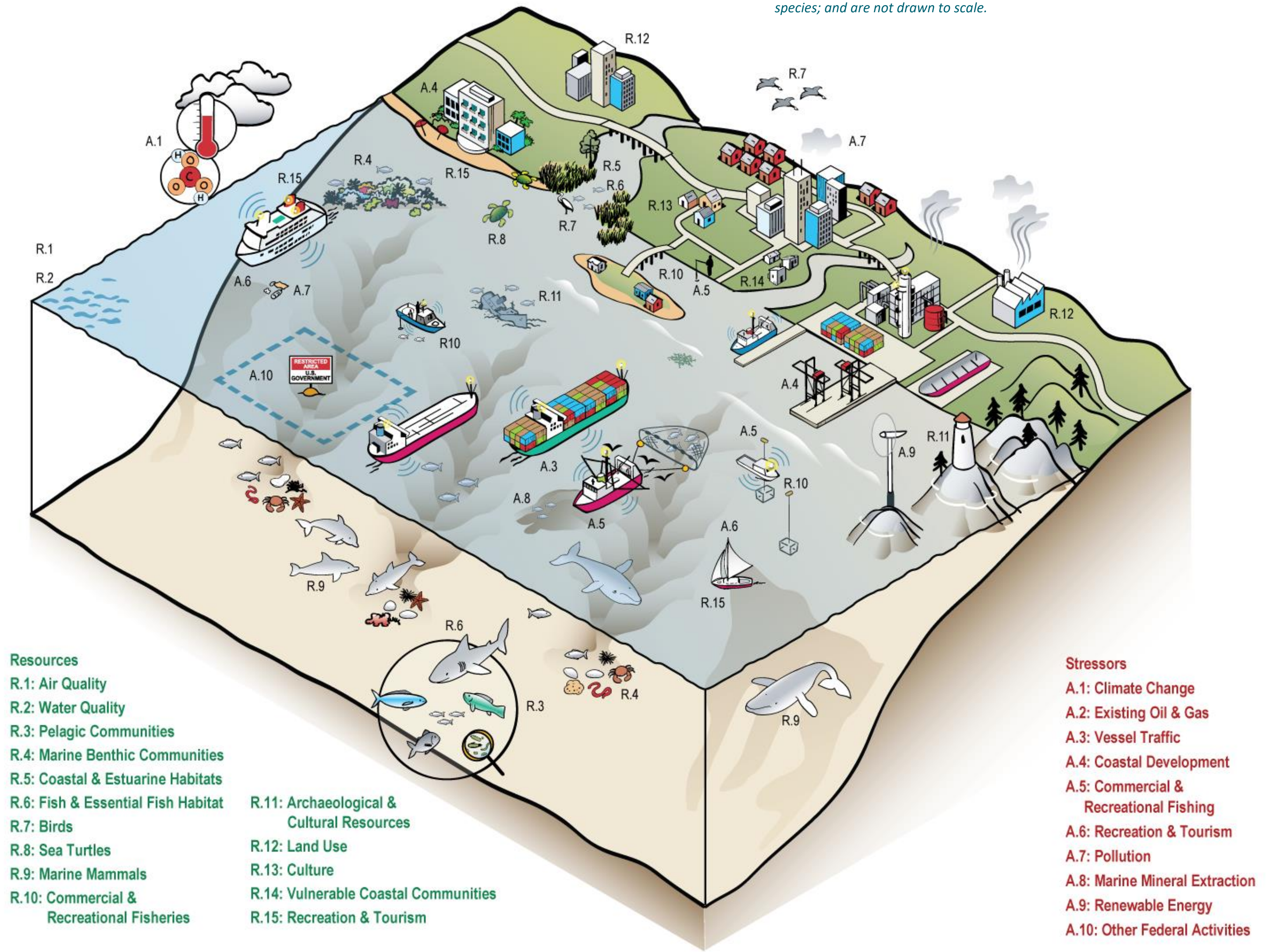


Figure 3-15. Atlantic Region—Future Baseline Conditions (40 to 70 years)

*See **Figure 3-1** for the master key to icons and **Chapter 2** for label definitions and additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Various stressors may pressure resources in the Atlantic Region in future decades. The northeast Atlantic Region is warming rapidly (**A.1**), and some marine species may expand their range northward, which may shift or disrupt marine food webs. Bycatch and entanglement in fishing gear (**A.5**) is likely to continue to stress large pelagic species (**R.5**) like sharks, sea turtles (**R.8**), and baleen whales (**R.9**). Several ports are expected to expand (**A.3**) to accommodate larger ships and offshore wind fabrication and staging facilities, increasing coastal traffic (**A.4**) and erosion. Increasing sea level and storm severity caused by climate change (**A.1**) may threaten vulnerable coastal communities (**R.14**) and coastal species, such as birds (**R.7**) and nesting turtles (**R.8**), and may result in submerged barrier islands and hardening of shorelines. Offshore renewable energy (**A.9**), especially wind, is a growing industry in the Atlantic Region. Human population levels for most coastal states are projected to rise, and demand for housing is likely to increase, especially in suburban and urban areas (**A.4**).

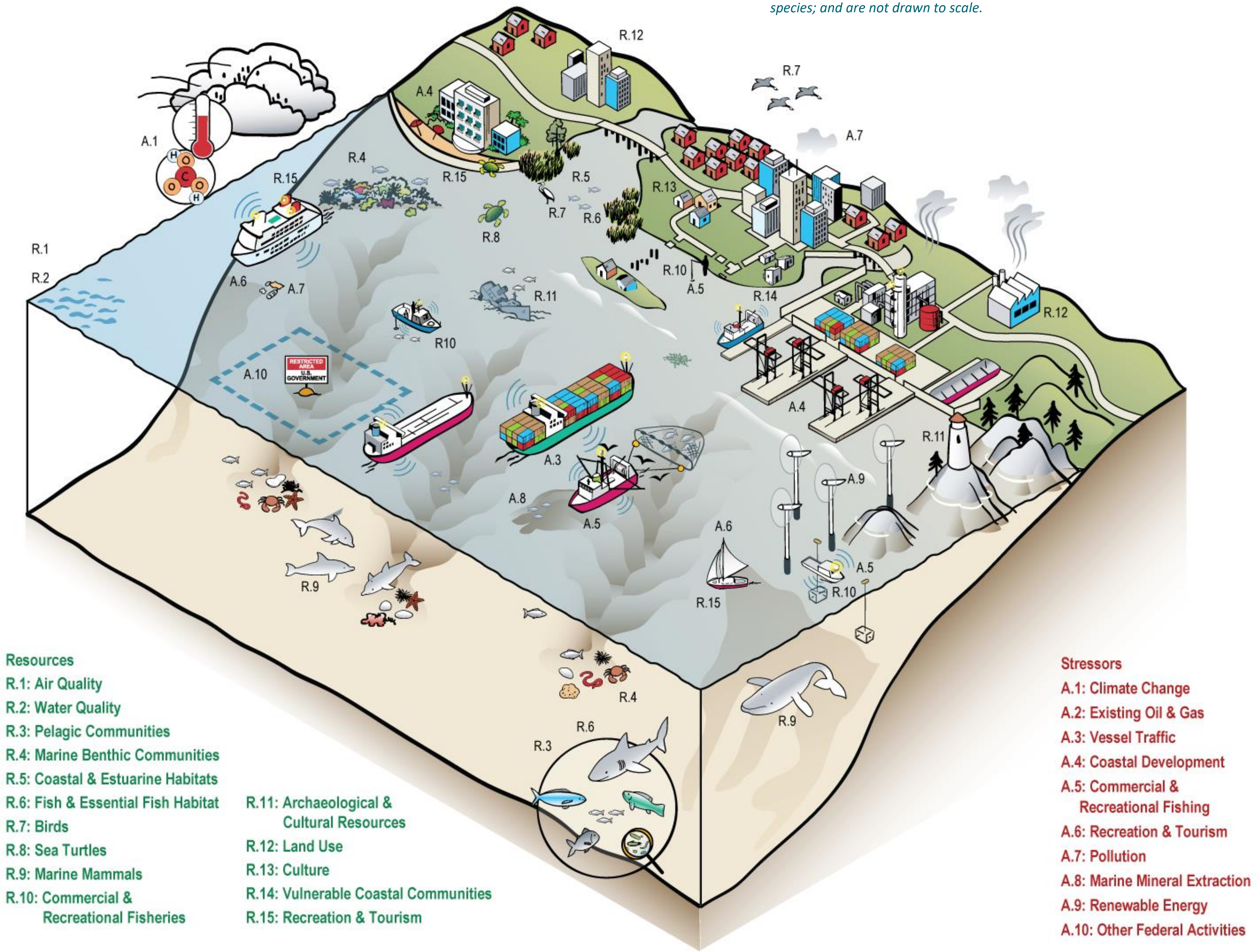


Figure 3-16. Atlantic Region—Potential Impacts of Alternative A—No Action Alternative (No Leasing)

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.2.1** for additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Oil tankering (**A.3**) may increase if current energy consumption patterns continue and, if so, likely would be the most notable change, impacting fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**), particularly due to discharges and vessel noise. Vessel strikes (**A.3**) to mammals (**R.9**) and sea turtles (**R.8**) may also increase. Dredging to support new or expanded routes for tanker traffic may damage marine benthic communities (**R.4**) and injure or kill sea turtles (**R.8**). Oil spills from tankers may have significant long-term and population-level effects on marine resources (**R.2–R.10**), as well as culture (**R.13**), vulnerable coastal communities (**R.14**), and recreation and tourism (**R.15**).

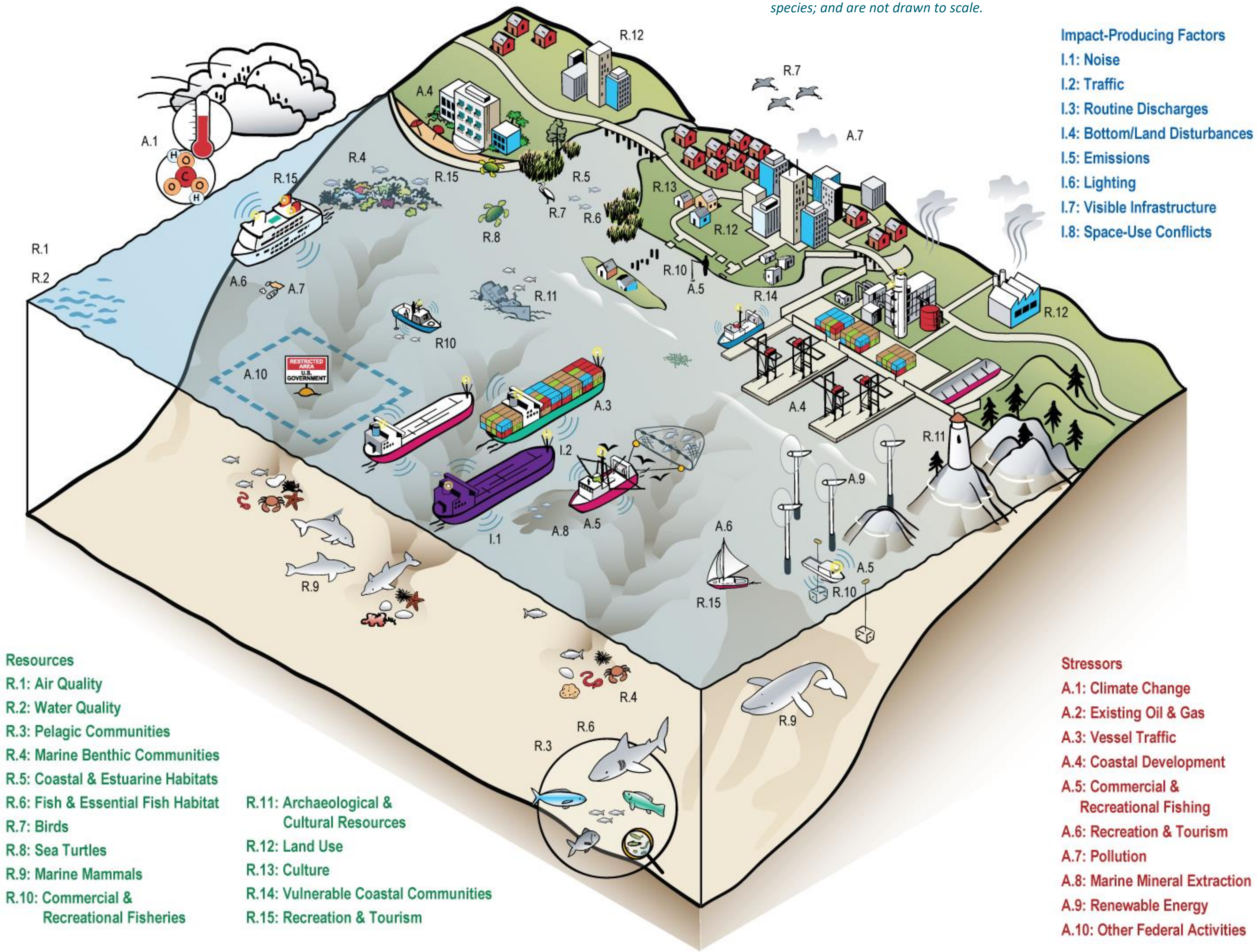
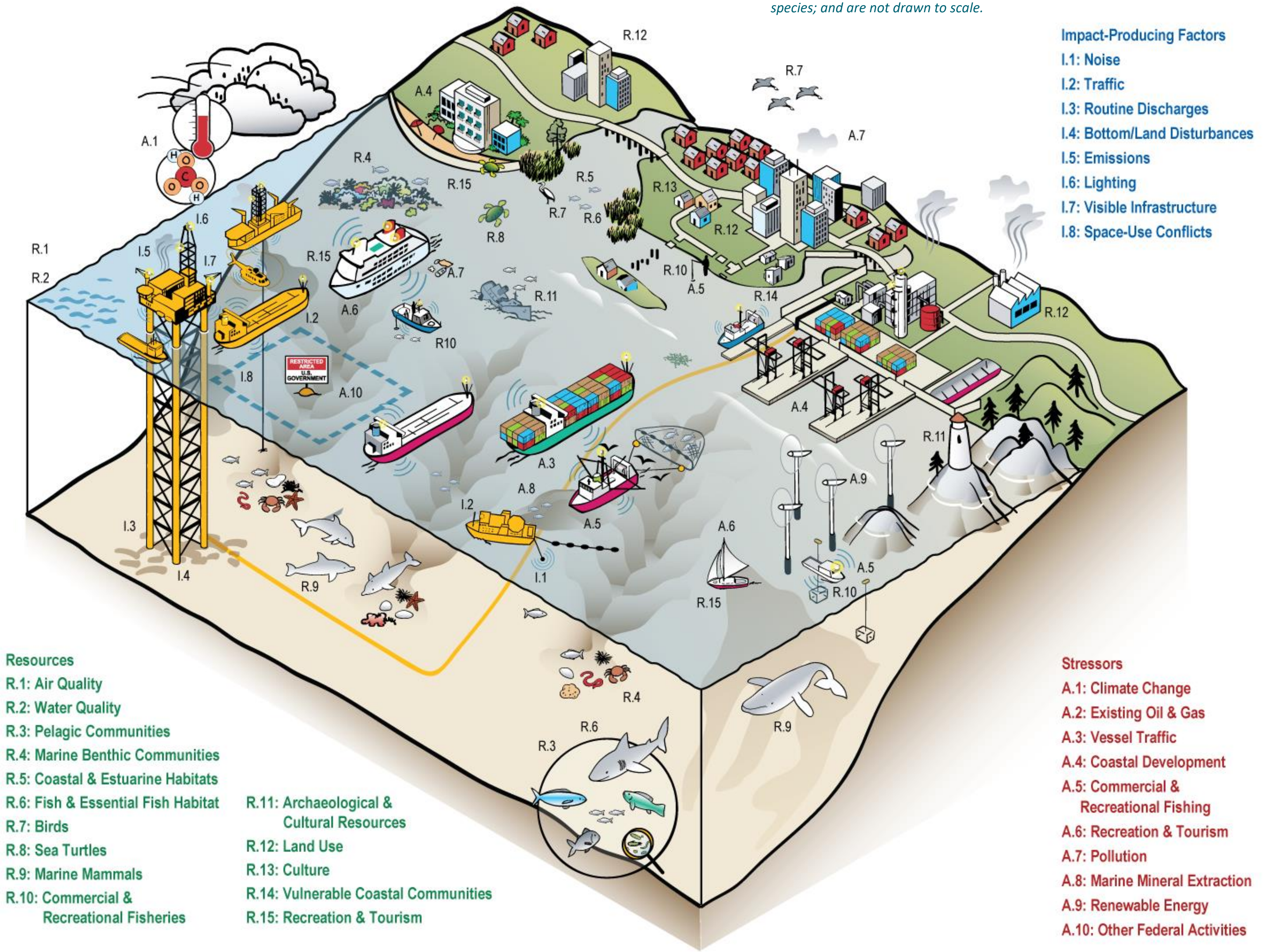


Figure 3-17. Atlantic Region—Potential Impacts Associated with New Leasing Under the 2024–2029 Program

*See **Figure 3-1** for the master key to icons, **Chapter 2** for label definitions, and **Section 4.1** for additional discussion.*

The illustrations depict broad scientific concepts relevant to the environments represented; are not meant to portray particular facility types, resources, activities, or species; and are not drawn to scale.

Noise (**I.1**) associated with oil and gas activities may injure or disturb the behavior of fish (**R.6**), sea turtles (**R.8**), and marine mammals (**R.9**). Noise (**I.1**) from new construction to support offshore oil and gas development may also be noticeable to coastal residents living nearby (**R.14**). The barrier islands and beaches (**R.5**) in the southeast may be particularly susceptible to increased erosion caused by vessel activity (**I.2**), which may also impact recreation and tourism (**R.15**) if beaches become inaccessible or change in character. Additional vessel traffic (**I.2**) may increase strikes of sea turtles (**R.8**) and whales (**R.9**), such as the ESA-listed North Atlantic right whale. Although localized, drilling muds and cuttings (**I.3**) may degrade benthic communities (**R.4**), such as those in the northeast canyons or hard bottom areas along the southeast Atlantic Coast. Disturbance (**I.4**) from pipeline laying, anchoring, offshore construction, and other activities may stress benthic communities (**R.4**) and coastal and estuarine habitats (**R.5**). To accommodate offshore development, land use (**R.12**) may change through expansion of existing oil and gas support infrastructure (e.g., ports, shipyards, support vessels). Construction (**I.4**), lighting (**I.6**), and physical presence (**I.7**) of these facilities may impact coastal and estuarine habitats (**R.5**), which in turn may affect coastal and migratory birds (**R.7**), estuarine fish (**R.6**), and nesting sea turtles (**R.8**). Visible infrastructure (**I.7**) could impact people's use or enjoyment of coastal views (**R.13, R.14, R.15**). Increased construction may augment congestion on local roadways (**R.12**). Oil and gas activities may cause space-use conflicts (**I.8**) with the Atlantic fishing industry (**R.10, A.5**), offshore renewable energy development (**A.9**), and Federal activities (**A.10**), such as military training, NASA launch operations, and marine mineral extraction (**A.8**).



Chapter 4:

Environmental Consequences

4.1 IMPACTS ASSOCIATED WITH LEASING UNDER THE 2024–2029 PROGRAM

This chapter describes the impacts that may result from oil and gas activities associated with leases issued under the 2024–2029 Program (**Figure 4-1**). BOEM determined which potential impacts to analyze in detail by evaluating whether IPFs associated with oil and gas activities (defined in **Section 2.4.3**) could impact the 15 different resource areas, and, if so, whether impacts could be potentially significant. Direct and indirect impacts that are not expected to be significant are discussed in **Appendix A**. This chapter also includes an analysis of alternatives for the 2024–2029 Program.

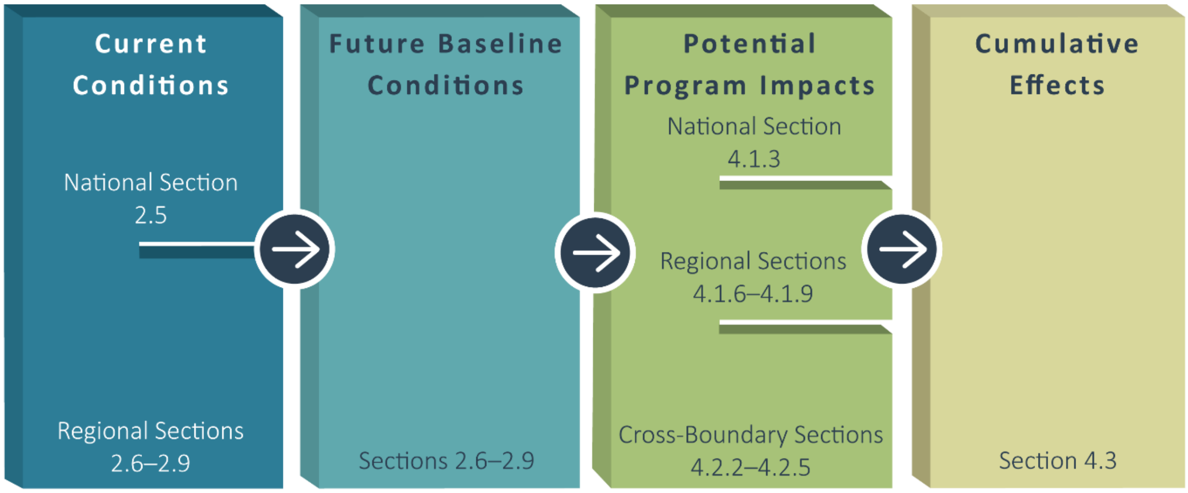


Figure 4-1. Organization of the affected environment and environmental consequences

This Final Programmatic EIS is consistent with CEQ guidance on programmatic reviews (Boots 2014) and provides a level of detail appropriate for the decision at hand. More detailed impact analyses incorporating additional information would occur in NEPA documents prepared at the lease sale and subsequent stages, such as exploration and development plans. Those site-specific reviews will assess potential impacts at a finer spatial and temporal scale, incorporate new information as necessary, analyze appropriate mitigation measures, and update scientific information as warranted.

4.1.1 Approach to Characterizing Impacts

This Final Programmatic EIS informs the Secretary's decision on the size, timing, and location of new OCS lease sales proposed under the 2024–2029 Program. The decision requires consideration of environmental context, resource location, and potential impacts. For example, **R.7 BIRDS** (a resource) migrate through the GOM Region (context and location) and may be disoriented by **I.6 LIGHTING** from offshore platforms (impact).

Impacts are analyzed differently in this Final Programmatic EIS than in previous programmatic analyses, which used four intensity-based impact levels: negligible, minor, moderate, and major. In past documents, impact was determined based on measurability, resource recoverability, impact reversibility, and whether impacts could be mitigated by measures at the lease sale stage or later.

This Final Programmatic EIS, however, addresses a larger spatial scale than those previous programmatic analyses, resulting in greater variation in activities and IPFs. The increased scale and complexity introduce greater uncertainty, making it more difficult to analyze environmental effects using the four impact levels previously used. BOEM determined that, for this programmatic stage, the most important context is where activities might occur. That is, if activity occurs in an area, certain impacts may occur. Analysis of the impact severity (e.g., negligible, minor, moderate, or severe) is more appropriate at subsequent stages, when site-specific information (including activity levels) is available and decisions on specific mitigation measures can be made.

> In this Final Programmatic EIS, the impact of an IPF on a resource is simply determined to be either ***potentially significant*** or ***not expected to be significant***. This document describes the conditions leading to these determinations. When an IPF ***does not interact*** with a resource, impacts do not occur and therefore are not analyzed.

This Final Programmatic EIS addresses the full spectrum of oil and gas development activities that may occur in a given planning area if leases are issued there. However, the likelihood of these activities occurring within a given planning area is dependent on many factors, including subsequent government review and authorization. This Final Programmatic EIS classifies each of the 25 planning areas included in the alternatives as ***mature***, ***intermediate***, or ***frontier*** based on resource potential, existing infrastructure, and leasing history, and considers the likelihood and scale of reasonably foreseeable oil and gas activities that may result from leasing under the 2024–2029 Program. Based on existing patterns of exploration and development, this Final Programmatic EIS assumes that development is more likely in areas with more hydrocarbon resources, infrastructure, and history of development; in these areas, impacts also may be more likely to occur.

> **Mature:** areas with high potential for oil and gas resource development, access to existing infrastructure, and existing leases or established patterns of leasing
>
> **Intermediate:** areas with oil and gas resource potential, but variation in existing infrastructure, leasing patterns, and operational barriers, such as water depth
>
> **Frontier:** areas with oil and gas resource potential that is highly uncertain or considerably lower than other areas, limited infrastructure in place, and highly uncertain leasing patterns

Southern California, Cook Inlet, Western GOM, Central GOM, and Eastern GOM Planning Areas are considered **mature**. These areas have high potential for oil and gas resource development under existing leases or leases issued under the 2024–2029 Program. Southern California was the site of the first offshore oil development and production in the western hemisphere, dating back to 1896. Although no lease sales have been held in the last few decades, offshore production in state and OCS waters from existing leases off southern California has continued without interruption to the present day. State production is ongoing in Cook Inlet, AK, where 14 OCS leases were issued in 2017. The GOM Region has a 67-year history of OCS leasing, exploration, and development, and generates about 97% of all OCS oil and gas production, primarily in the Western and Central GOM Planning Areas. The GOM Region has fully developed infrastructure, including ports, heliports, road systems, support services, and housing in adjacent coastal areas, with oil- and gas-specific services concentrated in the Western and Central GOM Planning Areas. Development is reasonably foreseeable at low, mid, and high modeled activity levels (BOEM 2022c).

The following OCS planning areas are considered **frontier** areas: Hope Basin, Norton Basin, Navarin Basin, St. Matthew-Hall, Aleutian Basin, Bowers Basin, St. George Basin, Aleutian Arc, Shumagin, and Kodiak (in the Alaska Region), and the Straits of Florida (in the Atlantic Region). Due to the lack of supporting infrastructure, frontier areas could require more extensive development to support OCS oil and gas activities and, therefore, have an increased potential for significant impacts. The oil and gas resource potential in these areas is limited, and existing resource estimates are highly uncertain or considerably lower than in mature areas. Aleutian Arc, Aleutian Basin, Bowers Basin, and St. Matthew-Hall Planning Areas are considered to have negligible petroleum potential based on BOEM's 2016 *Assessment of Undiscovered Oil and Gas Resources of the Nation's Outer Continental Shelf* (BOEM 2017a). Difficult and expensive operating environments and lack of supporting infrastructure present technological and financial disincentives for prospective leasing, exploration, and development, especially given the volatility of oil and gas prices. If leases are issued, geophysical exploration or exploration drilling is reasonably foreseeable, but development and production activities at economically sustainable levels are more speculative.

The Final Programmatic EIS analyzes the potential impacts from development and production in frontier areas, despite the low likelihood of these activities.

The remaining planning areas (Beaufort Sea, Chukchi Sea, Gulf of Alaska, Washington/Oregon, Northern California, Central California, South Atlantic, Mid-Atlantic, and North Atlantic) do not fit into either the mature or frontier categories. These planning areas are considered **intermediate** areas. They vary considerably in oil and gas resource potential, supporting infrastructure, and general difficulty or expense in operations.

4.1.2 Life Cycle of Oil and Gas Activities

The typical life cycle of oil and gas activities includes five sequential phases (**Figure 4-2**): geophysical exploration (**A**), exploratory drilling (**B**), development (**C**), production (**D**), and decommissioning (**E**). **Figure 4-2** also depicts the primary IPFs expected under each phase. Specific IPFs could be relevant at some or all phases of the OCS oil and gas development process. Potential effects from accidental spills are discussed in **Section 4.6**.

Although these five phases happen in sequence as a geologic structure is explored and developed, they may occur simultaneously within a single lease block. For example, additional exploratory wells may be drilled while existing wells are in the production phase, and marine seismic surveys could occur during any of the phases throughout the life cycle of the project.

Geophysical exploration (A) includes marine seismic surveys, which use acoustic signals to look for oil and gas beneath the seabed. Geologic hazard surveys, which may use submersibles or other equipment at the seafloor, also may occur during this phase to investigate special benthic or archaeological features. The primary IPFs that occur during this phase are **I.1 NOISE**, **I.2 TRAFFIC**, **I.4 BOTTOM/LAND DISTURBANCE**, and **I.6 LIGHTING**.

Next, during the **exploratory drilling phase (B)**, mobile drilling units are used to drill exploration wells to confirm the presence of extractable hydrocarbons. The primary IPFs during this phase are **I.1 NOISE**, **I.2 TRAFFIC**, **I.3 ROUTINE DISCHARGES**, **I.4 BOTTOM/LAND DISTURBANCE**, **I.5 EMISSIONS**, **I.6 LIGHTING**, and **I.8 SPACE-USE CONFLICTS**.

The **development phase (C)** uses more equipment than in other phases to build production platforms (either floating or attached to the seafloor), drill production and injection wells, lay pipelines, and construct onshore infrastructure. With **production (D)**, many of the IPFs diminish in severity over time as the drilling and construction process is completed and the well is producing. All IPFs may occur during development and production: **I.1 NOISE**, **I.2 TRAFFIC**, **I.3 ROUTINE DISCHARGES**, **I.4 BOTTOM/LAND DISTURBANCE**, **I.5 EMISSIONS**, **I.6 LIGHTING**, **I.7 VISIBLE INFRASTRUCTURE**, and **I.8 SPACE-USE CONFLICTS**.

Finally, the **decommissioning process (E)** begins when an oil field is no longer producing. The grayed-out platform in **Figure 4-2** depicts a decommissioned structure (toppled, partially removed, or fully removed). Operators are required to remove structures to below the mudline, typically by using explosives or cutting the structure, followed by cleanup using trawlers. Operators may submit a request to BSEE to leave some infrastructure, such as pipelines, in place. In some cases, platforms may be toppled and left in place to serve as habitat for marine species through the Rigs to Reef Program (www.bsee.gov/what-we-do/environmental-focuses/rigs-to-reefs). The primary IPFs during this phase are **I.1 NOISE**, **I.2 TRAFFIC**, **I.4 BOTTOM/LAND DISTURBANCE**, **I.5 EMISSIONS**, **I.6 LIGHTING**, and **I.8 SPACE-USE CONFLICTS**.

Although the life cycle phases are analyzed in this document, the development of a schedule of proposed lease sales does not authorize any action to be taken on the OCS. BOEM's oil and gas leasing, exploration, and development process involves many stages prior to the final step of allowing the full development of a lease (**Figure 1-1**).

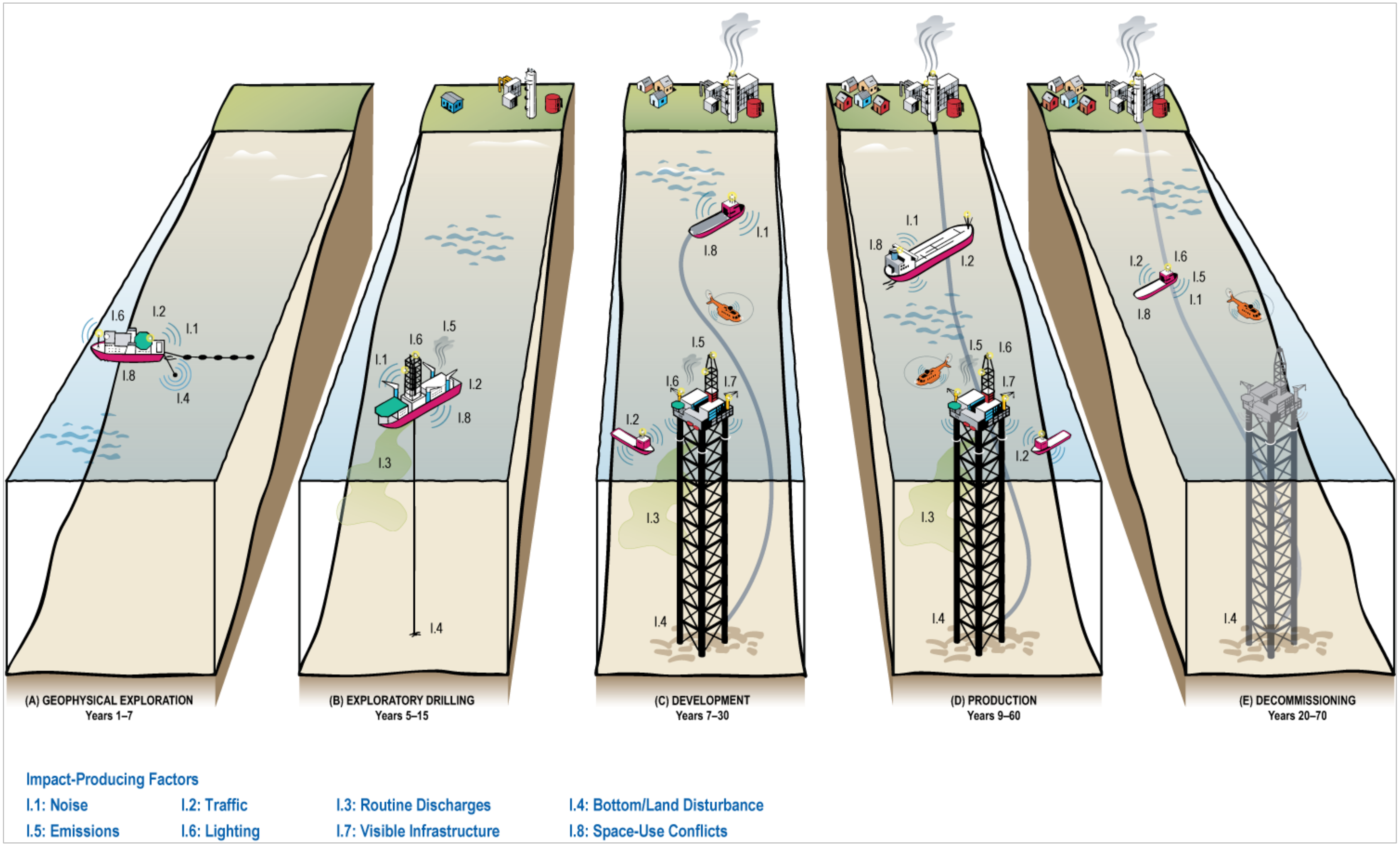


Figure 4-2. Life cycle of a typical OCS lease

Each panel indicates a representative time frame within which each phase occurs during the life cycle. These panels depict common activities representative of each stage, but there are differences associated with various location and environmental factors.

4.1.3 National Overview of Impacts of OCS Oil and Gas Activity

This section describes the effects associated with OCS oil and gas activities (summarized in **Figure 4-3**).

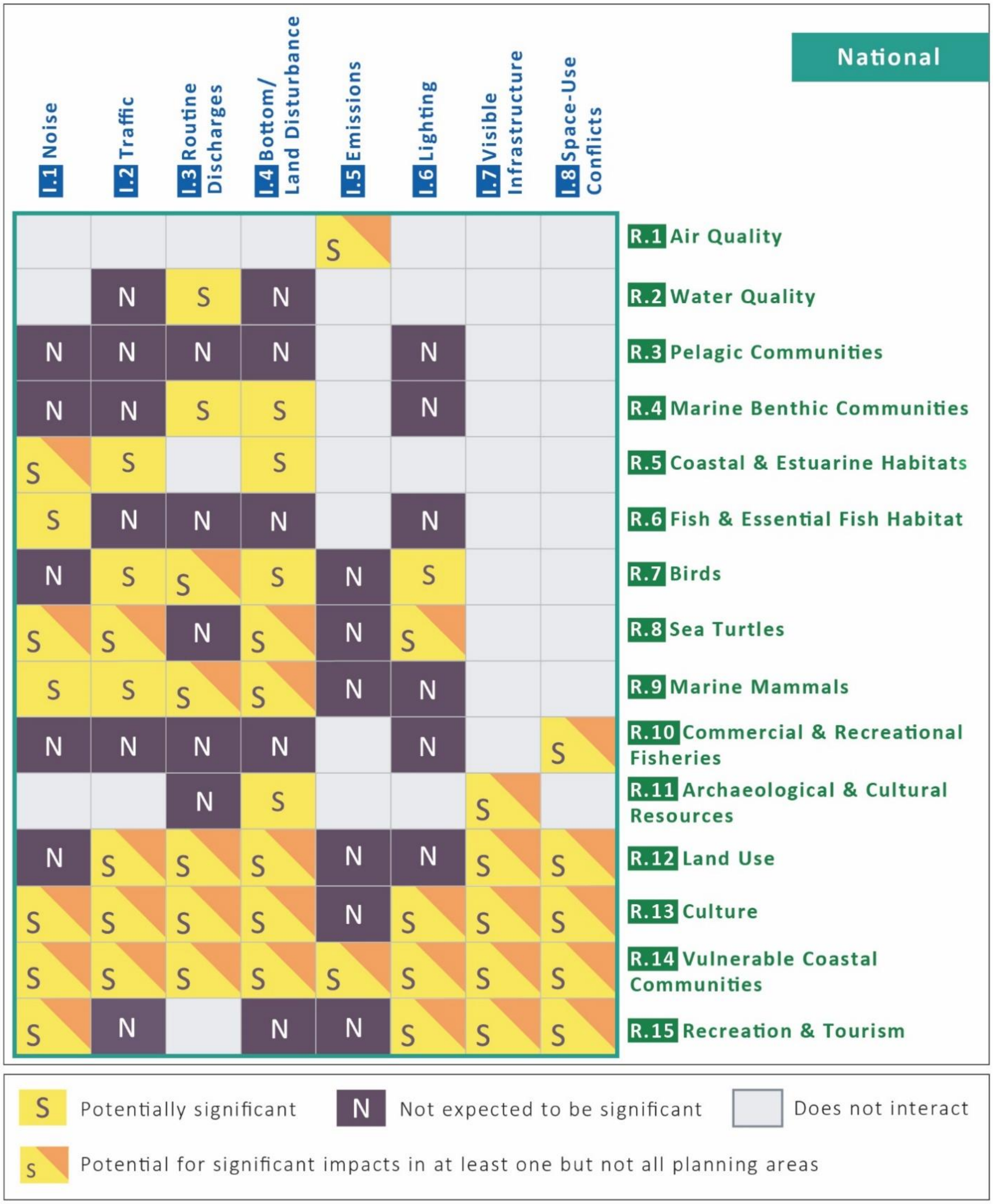


Figure 4-3. Interaction between oil and gas IPFs and marine resources (national overview)

This figure shows BOEM's assessment of potential impacts of IPFs (blue labels) on physical, biological, or sociocultural resources (green labels). See **Figures 4-5 to 4-8** for region-specific impacts.

For the analysis in this Final Programmatic EIS, the effects of IPFs on specific resources are categorized according to the definitions in **Table 4-1**. The terms "effects" and "impacts" are used interchangeably in this discussion.

Table 4-1. Definitions and examples of direct and indirect effects of IPFs on resources

Impact	Icon	Definition	Example	Refer to
Potentially significant	S	An IPF may affect the particular resource in question and is generally considered to be unavoidable. This category includes impacts that are potentially irreversible but may be removed or reduced through mitigation, regulation, or remedial action. This assessment considers impacts on individual animals (ESA-listed species), as well as populations, as appropriate.	I.1 NOISE and R.9 MARINE MAMMALS	**Sections 4.1.3 and 4.1.6–4.1.9**
Not expected to be significant	N	An IPF interacts with a resource but is not expected to affect the particular resource in question, or, if impacts do occur, the resource would most likely recover without mitigation after the impacting factor is removed.	I.1 NOISE and R.4 MARINE BENTHIC COMMUNITIES	**Appendix A**
Does not interact		An IPF does not interact with a specific resource.	I.1 NOISE and R.1 AIR QUALITY	N/A

This section describes the potentially significant impacts of IPFs on resources at the national level for the 25 planning areas[15] included in the DPP (**Figure 1-5**). **Sections 4.1.6 to 4.1.9** then provides detail on regional differences. When impacts are discussed at the region or BOEM ecoregion level, the impacts apply to all the planning areas within that larger area. Impacts are characterized using descriptive language to highlight the context and intensity considerations (Boots 2014). **Appendix A** describes and explains BOEM-identified impacts that are *not* expected to be significant, noted as N in **Figures 4-3 and 4-5 to 4-8**. **Appendix F** describes typical mitigation measures for reducing impacts. Mitigation measures can be applied at the programmatic level but are usually applied as lease stipulations or conditions of plans or permits. **Section 4.6** addresses accidental spill events, which could significantly impact all resources.

[15] In this section, the term in "all planning areas" refers to the 25 analyzed planning areas.

I.1 NOISE

Noise is a complex issue, and additional background information on noise in the marine environment is provided in **Appendix B**.

R.5 **COASTAL & ESTUARINE HABITATS:** The impact of noise on coastal and estuarine habitats is potentially significant in some Alaska planning areas. Aircraft and helicopter noise may startle caribou, causing them to flee the area and expend excessive energy. Caribou may be separated from their calves or be reluctant to return to important foraging grounds or insect relief areas (Calef et al. 1976; Maier et al. 1998; Stinchcomb et al. 2020). Although this noise is likely to be short term, significant effects on caribou are possible. Noise is not expected to be significant for coastal and estuarine habitats in the Pacific, GOM, or Atlantic Regions. Impacts of noise on marine mammals, birds, fish, and sea turtles are discussed separately.

R.6 **FISH & ESSENTIAL FISH HABITAT:** The impacts of noise on fish are potentially significant in all planning areas. Impacts on fish from seismic surveys, decommissioning, and vessel noise are typically short term and relatively localized because of fish mobility. Impacts are likely to be permanent in only a few instances. For example, fish with swim bladders are susceptible to tissue damage and auditory injury caused by sudden changes in pressure, also called barotrauma. This injury could occur if fish are in very close proximity (i.e., tens to hundreds of meters) to high-intensity sources like airguns, explosives, and pile-driving operations (Casper et al. 2013; McCauley et al. 2003; Popper et al. 2005). Behavioral disturbance could occur over a larger spatial scale than auditory injury, but evidence thus far shows that exposure to seismic airguns yields subtle and variable effects in fishes (Davidsen et al. 2019; Hassel et al. 2004; McCauley et al. 2008; van der Knaap et al. 2021). Communication in several fish species can be masked by vessel noise (Codarin et al. 2009; Pyć et al. 2021; Vasconcelos et al. 2007), which could reduce their effective communication range (Putland et al. 2018; Stanley et al. 2017). Many fish species gather in large groups and use acoustic signals to coordinate the timing of spawning. In such instances, the presence of masking noise could have population-level effects. For additional information about fish hearing, see **Appendix B** and Appendix J of the GOM G&G EIS (BOEM 2017d).

R.8 **SEA TURTLES:** Noise from marine seismic surveys and explosives may impact sea turtles in the Pacific, GOM, and Atlantic Regions (Nelms et al. 2016). Sea turtles are rare to Alaskan waters, especially outside of the Gulf of Alaska Planning Area, where encounters are more likely than other Alaska planning areas but still uncommon. Therefore, it is unlikely that they will be exposed to seismic survey noise; however, if they are exposed, impacts are expected. It is generally accepted that sea turtles can detect sounds between 100 Hz and 2 kHz, though there is relatively little data on hearing sensitivity (Bartol and Musick 2003; Martin et al. 2012; Popper et al. 2014). Results from the limited behavioral studies that have been conducted on sea turtles have yielded mixed results (Nelms et al. 2016). DeRuiter and Larbi Doukara (2012) observed some avoidance behaviors in turtles in response to seismic airguns, while Moein et al. (1994) showed that sea turtles initially avoided airgun sounds and later became habituated. It is reasonable to assume that sea turtles would attempt to avoid approaching seismic vessels, which means the potential risk of auditory injury resulting in hearing loss (temporary threshold shift [TTS] or permanent threshold shift [PTS]) would be highly localized and limited to individuals that are too close to the source to swim away. Behavioral disturbance or masking of important acoustic cues could be more widespread, but little is known about noise levels that induce such changes in sea turtles (McCauley et al. 2000; Moein et al. 1994).

R.9 **MARINE MAMMALS:** The impact of noise on marine mammals is potentially significant in all planning areas. Marine mammals are particularly sensitive to sound and rely on acoustic cues for many basic life functions; for more information, see Appendix H of the 2017 GOM G&G EIS (BOEM 2017d), NMFS (2018a), Richardson et al. (1995), and Southall et al. (2021). In general, baleen whales communicate in lower frequencies and are more susceptible to noise-related impacts than toothed whales because their hearing ranges overlap in frequency with several sound sources from oil and gas activities. The most severe impacts would be expected from seismic surveys using airguns due to the low-frequency, high-intensity nature of the sounds and the large geographic scope of surveys. Use of explosives during decommissioning presents a high risk due to the intensity of the sounds, but these activities would be short term, usually occurring in a single day. Although it is possible that marine mammals could experience mortality, PTS, or TTS due to exposure to either of these noise types, the likelihood is low; mitigation measures (**Appendix F**) and avoidance behavior on the part of the animals is expected to make it unlikely that the animals would be very close to the noise source (Dolman et al. 2009).

Behavioral changes and stress responses are expected to be more pervasive than auditory injury, but these specific responses are not as well understood because these less acute effects may be caused by lower noise levels and could occur over larger areas (Southall et al. 2021). Auditory masking, stress, or behavioral responses may result from distant seismic surveys or decommissioning activities, as well as from vessel, aircraft, construction, and drilling noises.

Anthropogenic sounds may lead to various behavioral reactions in marine mammals. Some documented responses include the following: North Atlantic right whales changing diving behavior (Nowacek et al. 2004), beaked whales rapidly swimming away (DeRuiter et al. 2013), humpback whales changing migration speed or direction (Dunlop et al. 2016; Malme et al. 1984), sperm whales reducing foraging activity (Miller et al. 2009), and walrus stampeding at haulouts (Udevitz et al. 2013). Some of these reactions may lead to increased energy expenditures; depending on the duration of the activity and the life history of the species, these disturbances could have population-level effects (Pirotta et al. 2018). Some marine mammals avoid acoustic masking by changing their vocalization rates, e.g., bowhead whale (Blackwell et al. 2013), blue whale (Di Iorio and Clark 2010), humpback whale (Cerchio et al. 2014); increasing call amplitude, e.g., killer whale (Holt et al. 2009), bearded seals (Fournet et al. 2021); or shifting dominant frequencies of their calls, e.g., right whale (Lesage et al. 1999; Parks et al. 2007). Other species may lose the ability to locate and communicate with other individuals. Marine mammals have strong social bonds and can transmit knowledge through acoustic communication; increased noise may reduce a population's capacity for social learning, especially in species whose numbers are limited (Whitehead et al. 2004).

A few studies have examined changes in stress levels in response to noise, and these impacts may be more widespread than is currently known. For example, exposure to low-frequency ship noise in heavy traffic areas may be associated with chronic stress in the ESA-listed North Atlantic right whale and other baleen whales (Hunt et al. 2014; Rolland et al. 2012; Trumble et al. 2018; Wright et al. 2007).

R.13 **CULTURE:** In the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area, onshore and offshore noise from oil and gas activities may interfere significantly with cultural (including traditional ties to recreational fishing), religious, and subsistence hunting and fishing activities. Increases in noise, particularly near sacred cultural sites, may impact traditions and cultural experiences tied to land, water, and natural resources. Subsistence serves a vital role in nutrition for many communities and fulfills traditions of sharing, kinship, and passing knowledge to younger generations. Noises affecting highly valued hunting, gathering, or fishing grounds also may impact a community's ability to access traditional foods, their cultural identity, and their sense of place (Kofinas et al. 2015). The degree of impact would depend on existing levels of industrialization and the proximity and degree of cultural, religious, and subsistence hunting and fishing practices.

R.14 **VULNERABLE COASTAL COMMUNITIES:** In the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area, onshore and offshore noise from oil and gas activities may have a disproportionately high impact on vulnerable coastal communities. Impacts within various planning areas would depend on existing levels of industrialization and the proximity of vulnerable coastal communities to noise sources. Coastal areas that are less developed may experience more pronounced impacts from noise. Conversely, these noise impacts could also be less noticeable in areas where there is an active industrial baseline. High densities of low-income communities and minority populations have historically lived near ports and other industrialized areas and may, therefore, be disproportionately impacted from increased noise from construction, port staging, drayage trucks, and vessel traffic (Maantay et al. 2010; USEPA 2018e). OCS oil and gas leasing may contribute to a continuation of noise-related impacts for communities already by noise in industrialized areas. The Tribal communities and others who participate in subsistence fishing may observe a difference in fish behavior depending on the nature and regularity of the noise (Bureau of Indian Affairs 2018; Popper and Hastings 2009). Noise impacts on subsistence food resources may reduce food security, nutrition, well-being, and community resilience, and may potentially result in disproportionate impacts on Native American, Alaska Native, minority, and low-income communities (Kofinas et al. 2015).

R.15 **RECREATION & TOURISM:** In the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area, noise from OCS oil and gas activities may significantly impact nature-based tourism activities (e.g., camping, hiking, beach visitation, and watersports) because of visitor expectations for undeveloped wilderness and ocean destinations with quieter surroundings (Buxton et al. 2019; Garcia et al. 2012; Li 2009). However, the significance of noise would vary within planning areas, and impacts on coastal recreation areas would probably decrease with distance from sources. For example, noise from construction near more urban or industrial areas may be less noticeable than in an area known for nature-based tourism. Noise from geophysical surveys, drilling operations, pipeline trenching, construction, and platform removal would be intermittent and have defined short-term impacts, while noise from vessel traffic or aircraft may be ongoing and may impact recreation and tourist activities over the life of a project. In general, noise may contribute to decreased levels of recreation or tourism or diminish the quality of the experience for those activities.

I.2 TRAFFIC

R.5 COASTAL & ESTUARINE HABITATS: Traffic is potentially significant for coastal and estuarine habitats in all planning areas. Vessel traffic within estuaries may result in habitat loss or degradation and environmental contamination (Robb 2014). Coastal organisms and vegetation may be impacted by increased turbidity from the wake from vessels such as tankers, barges, survey vessels, and support vessels. In addition, increased OCS vessel traffic may increase shoreline erosion of coastal and estuarine habitats from wave activity, which could lead to loss or degradation of habitat in these areas. Onshore traffic aiding construction of supporting infrastructure (such as roads, facilities, and pipelines) could also disturb or destroy coastal and estuarine habitats. The many nesting and foraging coastal animals, including some ESA-listed bird and sea turtle species, may experience negative habitat impacts.

R.7 BIRDS: Traffic impacts on birds are expected to be short term but potentially significant in all planning areas. Vessel or aircraft traffic may locally disturb and temporarily displace resting or foraging birds. Some diving bird species are sensitive to marine traffic and avoid or leave areas with high shipping intensity; high displacement has been reported for loons, sea ducks, cormorants, and grebes (Natural Power 2018). The distance from marine traffic that causes flight (flushing distance) may increase with increased flock size, and flushing disturbance may reduce critical feeding and resting opportunities (Guillemette et al. 1992; Schwemmer et al. 2011). Air traffic may also cause parent birds to flee when incubating eggs or brooding chicks, in turn exposing eggs and chicks to harm from intense sun, wind, rain, pecking by neighboring birds, predation or other impacts. Site-specific mitigations, such as careful selection of vessel and flight routes to avoid key nesting and roosting areas, could minimize the impacts.

R.8 SEA TURTLES: Vessel traffic may impact sea turtles in the Pacific, GOM, and Atlantic Regions. Sea turtles are rare in Alaskan waters, especially outside of the Gulf of Alaska Planning Area, where encounters are more likely than other Alaska planning areas but still uncommon. Therefore, it is unlikely that they will be exposed to vessel traffic; however, if they are exposed, impacts are expected. Sea turtles spend at least 20 to 30% of their time at the surface for breathing, basking, feeding, orientation, and mating (Dodge et al. 2014; Lutcavage et al. 1997), which makes them vulnerable to collisions with moving vessels. Any vessel strike with a sea turtle is expected to cause the animal’s injury or death. Sea turtles are also known to startle at the approach of boats and ships, causing additional metabolic expenditure. Onshore traffic, including construction of roads and vehicle traffic, may affect nesting sea turtles.

R.9 MARINE MAMMALS: Vessel and air traffic may impact marine mammals in all planning areas. Vessel traffic may disturb or displace marine mammals, and direct collisions with vessels could cause injury or death. Impacts from vessel traffic are expected to be most pronounced where marine mammal abundance is highest. For example, recent work suggests that some species, such as beaked whales (Pirotta et al. 2012) and harbor porpoise (Wisniewska et al. 2018), may alter their foraging behavior in the presence of vessels. Although the probability of occurrence is low, vessel strikes may injure or kill marine mammals and may have population-level effects for small populations like the North Atlantic right whale. Most reports of vessel collisions with marine mammals involve large whales, but collisions with smaller species also occur (Schoeman et al. 2020; Van Waerebeek et al. 2007). Most severe and lethal whale injuries involve large ships (> 262 ft [80 m]) at higher speeds (Laist et al. 2001). Ship strike records show that 89% of the vessels were moving at > 14 kn (26 km/hr) (Laist et al. 2001). Seismic operations generally are conducted at relatively slow speeds of 4 to 6 kn (7.4 to 11 km/hr), with a maximum speed < 8 kn (14.8 km/hr) (BOEM 2014; van der Hoop et al. 2015), but small crew change or support vessels move faster.

Aircraft traffic also may cause short-term disturbance of semi-aquatic marine mammals (e.g., walrus scared off a beach by aircraft). Stampeding may crush calves and yearlings and further reduce particularly small or vulnerable populations (Udevitz et al. 2013).

R.12 **LAND USE:** Impacts may occur in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Level of impact may depend on existing traffic patterns and level of industrialization. For example, southern California and Cook Inlet have some existing oil and gas infrastructure, and impacts may be less in these areas than in areas where new infrastructure may be required. Additional ship and road traffic due to the creation of new infrastructure, as well as changes to existing infrastructure, zoning, road systems, traffic patterns, public services, and vessel port activity, may impact land use (Tyler and Ward 2011; World Port Source 2018a). These impacts are expected to occur over decades due to the life cycle of a lease and expected longevity of infrastructure.

R.13 **CULTURE:** In the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area, traffic volume and patterns may impact culture, especially if there is an increase of aircraft, vessels, or onshore traffic in a particularly remote area where cultural traditions are practiced. Impacts may be especially evident on coastal communities that have cultural practices (e.g., kinship and sharing) related to subsistence because traffic may alter animal behavior (Stephen R. Braund & Associates 2017). Traffic may introduce noise that may interfere with cultural subsistence practices or traditional life (Park et al. 1994; Širović and Demer 2009; Wall et al. 2014; Wilson et al. 2004). The level of impact may depend on the proximity of activities to culturally important areas, existing traffic patterns, and level of industrialization.

R.14 **VULNERABLE COASTAL COMMUNITIES:** In the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area, vulnerable coastal communities may experience long-term, adverse, and disproportionate impacts from increased traffic, because these communities tend to be located closer to industrial areas (such as ports) that may serve as staging areas for oil and gas activities. Increased traffic can cause diesel PM emissions from drayage trucks, harbor vessels, and ocean-going vessels. A change in traffic volume and patterns may impact vulnerable coastal communities that rely on traditional subsistence (e.g., fishing and hunting) for nutrition. Animals may be disturbed by traffic, making it more difficult to harvest subsistence resources (Stephen R. Braund & Associates 2017). Impacts on food resources may potentially cause adverse impacts on food security, nutrition, sense of well-being, community resilience, and cultural identity, and potentially result in disproportionate impacts on Native American, Alaska Native, minority, and low-income communities (Kofinas et al. 2015). Impacts may depend on existing traffic patterns and level of industrialization. The degree of onshore traffic impacts would depend on the proximity of onshore support activity, port activity, and program-related traffic to coastal communities. Traffic impacts in already industrialized areas would likely represent a continuation of existing conditions and associated ongoing impacts, including ongoing impacts on human health. Traffic impacts may be more severe on communities with less industrialization because traffic patterns may be adjusted to accommodate oil and gas development (Geotab 2018).

I.3 ROUTINE DISCHARGES

R.2 **WATER QUALITY:** Routine discharges are potentially significant for water quality in all planning areas. Common discharges vary depending on the well and include drilling muds, cuttings, and produced water. These discharges may release trace metals, hydrocarbons, and suspended materials around the drilling location. Impacts on water quality from discharged muds and cuttings are often localized because of settling, mixing, and dilution (Neff 2005).

SBMs were developed as an alternative to oil-based muds when drilling activities began moving into deeper waters. Discharge of untreated SBM is prohibited, but SBM-wetted cuttings may be discharged after the majority of the SBM has been removed. Removal of SBMs is required because they can accumulate in higher concentrations and adversely affect benthic communities (Neff et al. 2000). Produced water may degrade water and sediment quality in the immediate vicinity of the discharge by increasing concentrations of salts, petroleum hydrocarbons, metals, and technologically enhanced, naturally occurring radioactive materials, some of which are toxic and persist in the marine environment. Overall, impacts from drilling muds, cuttings, and produced water may affect water quality locally. These discharges are regulated by the USEPA and can only be discharged upon authorization and compliance with an NPDES permit.

R.4 **MARINE BENTHIC COMMUNITIES:** Routine discharges are potentially significant for marine benthic communities in all planning areas. Mud and cuttings discharged close to the seafloor settle relatively quickly and deposit in thick, concentrated layers close to drilling or facility operations (Neff 2005). Organisms may be smothered or lose access to food because of the muds and cuttings. Sessile organisms (e.g., corals, sponges, algae, barnacles, bivalves) may be severely impacted because they cannot avoid the impacted area.

A typical cuttings pile footprint is less than 165 ft (50 m) in diameter and occupies less than 6,500 ft^2 (2,000 m^2) of sea floor (Neff et al. 2000). Drilling muds and cuttings may spread out in a thin veneer over a wider area when discharges are released near the surface (Continental Shelf Associates Inc. 2004). Ellis et al. (2012) observed reduced species diversity and increased abundance of opportunistic species within 984 ft (300 m) of a drill site. Benthic organisms may also exhibit reduced reproductive fitness, altered populations, and acute toxicity. The recovery time of marine benthic communities is not well understood; the few documented studies indicate recovery times ranging from 1–3 years following the end of drilling (Ellis et al. 2012; Gates and Jones 2012). These impacts may be long term and persistent for slow-growing and particularly sensitive benthic species. Although these impacts are potentially significant, mitigation measures such as those associated with USEPA NPDES restrictions and requiring avoidance of sensitive live bottom communities may minimize potential impacts on these ecosystems (**Appendix F**).

R.7 **BIRDS:** Routine discharges are potentially significant for birds in the Alaska Region because of the important populations of benthic-feeding sea ducks, including eiders. If not reinjected or otherwise disposed of, drilling muds and cuttings may locally degrade the quality of benthic habitats and prey and, in turn, may affect food resources for diving sea ducks. Water depth, species sensitivity, amount of muds and cuttings, and the extent of area covered determine the degree and duration of impact. The impact on most marine birds would be temporary, because the area available for foraging is large in comparison to the amount of habitat that could be lost. However, the impact may be more severe if key foraging areas are disturbed. Mitigations developed through ESA consultation and USEPA NPDES permit restrictions typically eliminate or minimize the potential for impacts through activity timing restrictions, constraints on infrastructure siting, and minimizing the release of contaminants.

R.9 **MARINE MAMMALS:** Drilling muds and cuttings may impact benthic-feeding marine mammals in all Alaska planning areas. If not reinjected or otherwise disposed of, drilling muds and cuttings may locally degrade the quality of benthic habitats and prey and, in turn, may affect food resources for marine mammals. Water depth, species sensitivity, volume of muds and cuttings, and the extent of area covered determine the degree and duration of impact. Mitigations developed through MMPA authorization, ESA consultation, and USEPA NPDES permit restrictions typically eliminate or minimize the potential for impacts through activity timing restrictions (e.g., prohibiting vessel discharges and restricting vessel entry into the Chukchi Sea from the Bering Strait until after the spring bowhead whale migration (USEPA 2015)) and constraints on infrastructure siting.

R.12 **LAND USE:** Routine discharges may impact land use in the Eastern GOM Planning Area, Pacific Region (except for the Southern California Planning Area), Alaska Region (except for the Beaufort Sea and Cook Inlet Planning Areas), and Atlantic Region. In these areas, offshore oil and gas activity does not already occur, and open land areas may be converted or modified to make way for new waste processing or storage facilities (Zender Environmental Health and Research Group 2015). Waste that cannot be diluted or reinjected offshore must be processed onshore and land farmed, recycled, or landfilled in designated containment areas (Dismukes 2011). Waste disposal is regulated by the USEPA under the Resources Conservation and Recovery Act and by state and local governments.

R.13 **CULTURE** and R.14 **VULNERABLE COASTAL COMMUNITIES:** Routine discharges, such as drilling muds and cuttings, may impact culture and vulnerable coastal communities in the Alaska Region and all planning areas in the Pacific Region except the Southern California Planning Area. Native American and Alaska Native peoples in the Washington/Oregon Ecoregion and Northern and Central California Planning Areas rely on marine resources, such as salmon or crabs, which are dependent on healthy and uncontaminated benthic environments. Impacts from routine discharges on marine benthic communities (including treaty-reserved resources) may impact commercial, traditional, subsistence-harvest, and cultural practices, thereby disproportionately impacting Tribes and, in some cases, treaty rights. Impacts on food resources may cause adverse impacts on food security, nutrition, sense of well-being, community resilience, and cultural identity and potentially result in disproportionate impacts on Native American, Alaska Native, minority, and low-income communities (Kofinas et al. 2015).

I.4 BOTTOM/LAND DISTURBANCE

R.4 MARINE BENTHIC COMMUNITIES: Bottom disturbance is potentially significant for marine benthic communities in all planning areas. Pipeline laying, anchoring, or offshore construction may smother (via settlement of resuspended solids) or crush benthic organisms and diminish or eliminate habitat value. Sensitive benthic communities, such as live hard bottom and deepwater coral, may be particularly affected. Mitigation measures to avoid distinctive and localized communities (e.g., coral reefs) may minimize potential impacts. Impacts on soft bottom communities from anchors and structure installation (e.g., crushed organisms, sediment resuspension) would be limited to the construction and decommissioning phases and typically affect only a small portion of the communities' geographic area.

R.5 COASTAL & ESTUARINE HABITATS: Bottom/land disturbance may permanently alter coastal and estuarine habitats and is potentially significant in all planning areas. Installing pipelines and roads in or near these habitats may cause hydrologic alteration, disturbance, fragmentation, or loss of wetlands, which serve as a buffer against flooding (Ko and Day 2004). Wetlands may be particularly vulnerable because development and infilling may remove or modify the wetlands, which in turn may change or eliminate ecosystem functions. Impacts may be long term and may affect the ecological functions of these habitats (e.g., nesting and feeding). Dust may have indirect impacts, especially from unpaved roads. Recovery from winter construction compaction would probably vary with the scale of construction and affected vegetation type. Seasonal or avoidance mitigation measures could reduce impacts.

R.7 BIRDS: Bottom/land disturbance is potentially significant for birds in all planning areas. Construction of new onshore facilities may lead to irreparable loss of estuarine and wetland areas and permanently displace birds that use this habitat to forage and breed. Suspended sediment and reduced water quality may diminish the quantity and quality of bird prey and make prey harder to hunt, especially in coastal habitats. Conversely, birds may also use oil and gas infrastructure (e.g., for rest).

R.8 SEA TURTLES: Land disturbance is potentially significant in all the planning areas in which sea turtles nest (GOM Region; Straits of Florida, South Atlantic, and Mid-Atlantic Planning Areas). Construction of onshore infrastructure may affect important nesting beaches for sea turtles. Careful timing of activities and siting of onshore infrastructure could decrease the likelihood of these impacts.

R.9 MARINE MAMMALS: Bottom/land disturbance may impact marine mammals in the Alaska and Atlantic Regions. Bottom disturbance from placing or removing structures may temporarily displace benthic-feeding marine mammals (e.g., walrus, gray whales, bearded seals) from foraging areas in the Alaska Region and could interfere with the reproductive success of sand lance, which is an important forage fish for many marine mammals in the Atlantic Region (Staudinger et al. 2020). Construction of onshore infrastructure may affect polar bear denning and key haul-out areas for semi-aquatic mammals. These impacts are expected to be short term, as animals would probably revisit the areas after construction finished, but extensive habitat alteration may prevent future use by the animals. Careful timing of activities and siting of onshore and OCS infrastructure, particularly regarding ESA-listed species, could decrease the likelihood or severity of potential impacts.

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES:** Bottom/land disturbance may impact archaeological resources on the OCS in all planning areas. Resources currently located on the OCS could be associated with past human occupation or culturally important Tribal sites from a time when these areas were not underwater. Drilling, OCS infrastructure emplacement, anchoring, pipeline trenching, routine maintenance, and structure removal may disturb the seafloor and potentially impact marine resources. For example, permanent loss of historical or cultural information may occur if an anchor or anchor cable severely damages a shipwreck or impacts site conditions or the state of artifacts (Coastal Environments Inc. 1977; ICF International et al. 2013; TRC Environmental Corporation 2012). Onshore construction may also disturb land-based archaeological and cultural resources. Physical disturbance underwater and onshore may cause rapid and unexpected changes to the site. Information from shipwrecks, for example, may be lost if environmental conditions that help preserve a site are disturbed (Damour et al. 2015). Physically altering a site in a way that makes it more vulnerable to weather may damage onshore resources. Potential archaeological resources can be located using high-resolution surveys and through consultations; mitigation measures may reduce or eliminate potential impacts to these resources.

R.12 **LAND USE:** Bottom/land disturbance may impact land use in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Expansion or new construction of onshore oil and gas facilities may require new or different land uses, resulting in potential zoning changes that could change or constrain future land uses within the area (Bahr and Lanier 1981; Tyler and Ward 2011).

R.13 **CULTURE:** Bottom/land disturbance affects environmental continuity important for subsistence and cultural traditions and may impact culture in all planning areas except Southern California and the Western and Central GOM. Many of the subsistence species that coastal communities rely on for cultural practices and livelihood feed on the benthos (e.g., crab species), and their feeding may be negatively impacted by bottom disturbance activities. Land disturbance caused by onshore construction also may affect subsistence species and the communities that subsist on them by changing their natural patterns of behavior. Impacts on subsistence may cause adverse impacts on sense of well-being, community resilience, and cultural identity (Kofinas et al. 2015).

R.14 **VULNERABLE COASTAL COMMUNITIES:** Bottom/land disturbance is potentially significant for vulnerable coastal communities in all planning areas except Southern California and the Western and Central GOM. Onshore construction may affect vulnerable communities by altering habitats or animal behavior (e.g., caribou) and possibly reducing levels of hunting success or requiring hunters to change hunting areas. Onshore and nearshore areas may be impacted by onshore construction or pipeline trenching. Vulnerable coastal communities may be particularly affected if fish harvested for subsistence and livelihood (e.g., salmon, herring, halibut, shellfish) are impacted. Regions with an established network of onshore oil- and gas-related infrastructure and associated land uses may experience less change from existing conditions. Offshore activities such as drilling, OCS infrastructure emplacement, anchoring, pipeline trenching, routine maintenance, and structural removal may impact subsistence resources farther offshore (e.g., whales). Impacts on food resources may cause adverse impacts on food security, nutrition, sense of well-being, community resilience, and cultural identity, and potentially result in disproportionate impacts on Native American, Alaska Native, minority, and low-income communities (Kofinas et al. 2015).

I.5 EMISSIONS

R.1 **AIR QUALITY:** Emissions from new or expanded onshore facilities, offshore facilities, and mobile sources may impact air quality in the onshore areas near the Central GOM and Southern California Planning Areas. These emissions are significant because, when added to existing sources, they may impact air quality, including contributing pollutants to onshore nonattainment areas, Class I areas, and other nationally designated protected areas. This degradation of air quality could negatively impact people, plants, and animals. Emissions from oil and gas operations may reduce visibility, including in nearby Class I areas and other nationally designated protected areas. Other parts of the OCS may experience fewer impacts due to lower onshore concentrations of criteria pollutants or prevailing winds, which may disperse emissions before reaching shore or direct offshore emissions away from shore.

> The criteria pollutants released by OCS oil and gas operations and associated vessels include CO, NO_2, PM_{10}, $PM_{2.5}$, and SO_2. NO_X and VOCs released by OCS operations are precursor pollutants for O_3, which is formed through photochemical reactions in the atmosphere (Wilson et al. 2017).

OCS oil and gas development may degrade air quality via emissions from offshore and mobile sources, such as helicopters, vessels, stationary engines (e.g., generators), venting, flaring, and equipment leaks. Additionally, the expansion or modification of existing port facilities may increase onshore sources contributing to ambient concentrations of criteria or precursor pollutants. See **Appendix C** for expected emission totals. As additional information becomes available at each stage of the leasing process—such as the likely place within a planning area for new leasing—more detailed information on possible impacts will be provided.

Oil and gas produced offshore is brought onshore for processing, distribution, and consumption, releasing criteria and percussor pollutants onshore. Due to uncertainty of where these activities take place, it is not possible to analyze these emissions; however, Federal and state air regulations analyze these activities before they are authorized regardless of decisions on OCS oil and gas leasing.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Emissions may impact vulnerable coastal communities near the Southern California Planning Area, where some studies have shown disproportionate impacts on low-income and racial and ethnic minorities (Marshall et al. 2011; Morello-Frosch et al. 2002). Historically marginalized communities are likely to live in close proximity to industrialized areas, which may expand onshore in support of new offshore development (Maantay 2002a). The current industrialized areas adjacent to the Southern California Planning Area already have degraded air quality for multiple pollutants (USEPA 2018c).

Similar disproportionate impacts on low-income and racial and ethnic minorities are possible in other regions as OCS oil and gas products are processed, distributed, and consumed. Emissions-related impacts in already industrialized areas may represent a continuation of existing conditions and associated ongoing impacts, including potential ongoing impacts on human health.

I.6 LIGHTING

R.7 BIRDS: Lighting may impact birds in all planning areas. Lighting on offshore platforms, onshore infrastructure, and vessels may attract seabirds and migrating birds and result in repeated circling or collisions, which may cause fatigue, injury, or mortality (Hamer et al. 2014; Ronconi et al. 2015). Poor visibility due to fog, precipitation, and low cloud cover increases the attraction of birds to lighting, especially at dusk or at night (Ronconi et al. 2015). In addition, artificial lighting may attract large aggregations of nocturnal birds, altering their migratory behavior and causing them to circle the light source and expend undue energy (Van Doren et al. 2017). For species with small populations, such as ESA-listed species, these impacts may be especially severe, affecting entire populations. Mitigation measures that limit light pollution, such as installing shields, could minimize some of these impacts.

R.8 SEA TURTLES: Lighting adjacent to sea turtle nesting sites may impact sea turtles in all planning areas of the GOM Region and in the Straits of Florida, South Atlantic, and Mid-Atlantic Planning Areas. Upon hatching, sea turtles use natural light cues to orient themselves and advance toward the ocean (Witherington and Martin 1996). Additional onshore lighting may confuse hatchling turtles when they emerge from their nests. Rather than crawling straight to the ocean, they travel in circuitous paths, increasing the time that they are exposed to predators (Silva et al. 2017). Similarly, additional lighting in nearshore waters may delay transit of hatchlings offshore, which also may increase their risk of predation in that environment (Thums et al. 2016). Therefore, lighting added to an area that is adjacent to an important nesting zone may have population-level effects. Mitigation measures that limit light pollution could minimize these impacts. Offshore lighting is not expected to affect sea turtles in the water and would be located too far away to disorient hatchlings.

R.13 CULTURE and **R.14 VULNERABLE COASTAL COMMUNITIES:** Lighting may impact culture and vulnerable coastal communities in the Alaska Region (except Cook Inlet Planning Area), Pacific Region (except for the Southern California Planning Area), and Atlantic Region. Introducing nighttime lighting systems where they currently do not exist may interfere with traditional or ceremonial practices, potentially impacting the cultural identity of Native American and Alaska Native peoples, and coastal communities.

R.15 RECREATION & TOURISM: In the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area, lighting is potentially significant. Within planning areas, impacts may vary widely depending on existing light pollution sources. These impacts may be greater in less developed areas or preservation areas that are actively managed to lessen the effects of light pollution, because any measurable increase in light pollution may change wilderness and aesthetic experience and alter character, use, and valuation (Rajkhowa 2014). The National Park Service recognizes night skies as natural, cultural, and economic resources (NPS 2018b). Cape Cod National Seashore, Fire Island National Seashore, Gateway National Recreation Area, Assateague National Seashore, and Acadia National Park have goals to protect night sky visibility (National Park Foundation 2018; NPS 2015). Lighting impacts are very similar to those discussed for **I.7 VISIBLE INFRASTRUCTURE**. The following regional descriptions provide detail specific to night-based recreation and tourism impacted by lighting. However, descriptions of the impact of visible infrastructure on tourism and recreation may also include impacts due to lighting that overlap with visible infrastructure, such as on visitor experience.

I.7 VISIBLE INFRASTRUCTURE

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES:** Visible infrastructure may impact archaeological and cultural resources in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Visible offshore infrastructure may impact onshore historic properties (including historic standing structures, onshore archaeological sites, and Traditional Cultural Properties), depending on whether oil and gas infrastructure is visible from the property and whether an unobstructed and unaltered historic viewshed contributes to the property's *National Register* eligibility (NPS 1997). BOEM evaluates the effects of visible infrastructure on historic properties through the NHPA Section 106 process (36 CFR Part 800) at lease sale and later OCS development stages, when more detailed information regarding any potential effects is available. For less developed planning areas, visible infrastructure may cause an affected resource to lose its significance under the NHPA and become ineligible for listing on the *National Register*. These effects would be evaluated carefully at the project scale. National Historic Landmarks, National Natural Landmarks, and underwater battlefields are identified through programs administered by the National Park Service and could also be impacted.

R.12 **LAND USE:** Visible infrastructure may impact land use in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. The expansion or addition of new oil and gas infrastructure may introduce visual elements that are out of character with existing land use, potentially leading to land conversion and property devaluation (Cordera et al. 2018; Tyler and Ward 2011). Impacts on land use would probably vary due to diversity in zoning and use, but impacts may be greater in undeveloped areas, where new oil and gas infrastructure may alter current uses.

R.13 **CULTURE:** Visible infrastructure may impact culture in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. New visible infrastructure may affect the character, use, and valuation of rural areas and undermine local and regional cultural identities (Stephen R. Braund & Associates 2009). An unobstructed view of the ocean is sometimes an important aspect of religious and cultural practices. New visual elements may be at odds with the existing natural land and seascapes. The extent and intensity of these potential impacts would depend on the degree to which the landscape and viewshed are changed and the cultural significance they hold.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Visible infrastructure may impact vulnerable coastal communities in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. New onshore facilities may be constructed near vulnerable coastal communities that have been historically underserved, which may cause disproportionate impacts (Maantay 2002a). However, the degree of impact would probably depend on the nature and exact location of the infrastructure. An obstructed view of the ocean may be at odds with the existing natural land and seascapes and interfere with the traditional, religious, or cultural practices of Native American and Alaska Native peoples and certain racial or ethnic minorities. The extent and intensity of these potential impacts would depend on the degree to which the landscape and viewshed are changed and the cultural significance of those amenities. Furthermore, the addition of visible infrastructure may affect property values or the visual aspects of environmental quality surrounding existing public services, such as community recreation facilities.

R.15 **RECREATION & TOURISM:** Visible infrastructure may impact recreation and tourism in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Impacts may be higher in areas where visitors are drawn to the unique wilderness character, undisturbed ocean views, and low level of industrial infrastructure and activity (Dean Runyan Associates 2017a; Dussault 2016; Outdoor Industry Association 2017; Washington Tourism Alliance 2017). Natural ocean views that draw beachgoers and recreationists may be impacted by industrialization (BOEM 2018a; Li 2009). Visible infrastructure, or the perception of industrial activity, could degrade the quality of the recreational experience and adversely affect recreation or nature-based tourism (Brody et al. 2006). Overall, an industrialized viewshed from oil and gas activities onshore and nearshore may affect visitor experience (Li 2009; Visit Florida 2018). Visible infrastructure impacts may be greater in locations where people recreate more often, in popular tourist destinations, or in areas dependent on recreation and tourism revenues.

I.8 SPACE-USE CONFLICTS

R.10 **COMMERCIAL & RECREATIONAL FISHERIES:** Space-use conflicts are potentially significant for commercial and recreational fisheries in all planning areas where offshore facilities and activities could limit access to fishing grounds, either temporarily or for the life of a platform (Arbo and Thủy 2016; Arne 2012). These areas include the Alaska Region (except the Beaufort Sea and Chukchi Sea Planning Areas), Pacific Region, GOM Region, and Atlantic Region. Many commercial and recreational fishermen rely on specific offshore areas important to catch target species (Island Institute 2012). Exclusion from a highly productive area may decrease landings or cause longer trips (Arbo and Thủy 2016), resulting in decreased revenue. The extent of the impact from space-use conflicts would depend on the timing and location of activities. Areas with existing oil and gas activity have more experience coordinating with fishing industries and may be able to decrease space-use conflicts more effectively than areas with less experience.

R.12 **LAND USE:** Space-use conflicts may impact land use in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Uses of the OCS (e.g., military, subsistence, or renewable energy development) may be impacted by spatial or temporal conflicts among users (GSA 2018; Mid-Atlantic Regional Council on the Ocean 2020a; Northeast Regional Ocean Council 2018). For example, OCS oil and gas activities may affect Federal uses of the OCS, such as offshore military exercises or space launch activities. Potential conflicts may also arise with overlapping onshore uses, such as new onshore construction operations and land use plan changes. In some cases, conflicts may be avoided or minimized through mitigation measures, such as coordination and time or area closures.

R.13 **CULTURE:** Space-use conflicts are potentially significant for culture in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Space-use conflicts may impact the culture of small, coastal fishing communities, as well as Tribal communities, because their cultural identity is strongly linked to fishing. Vessel traffic or oil and gas facilities may impact the culture of those communities by interfering with the sustainable harvest, transport, sale, processing, or storage of fish, or threatening fisheries sustainability. The arrival of field crews and oil workers conducting related land-based operations may interfere with subsistence hunting and fishing activities (Stephen R. Braund & Associates 2010; 2017), which may impact these important cultural practices. Impacts on food resources may cause adverse impacts on nutrition, sense of well-being, community resilience, and cultural identity (Kofinas et al. 2015).

R.14 **VULNERABLE COASTAL COMMUNITIES:** Space-use conflicts are potentially significant for vulnerable coastal communities in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Space-use conflicts nearshore and offshore may have adverse or disproportionate impacts on community subsistence and other non-industrial uses (Sandlos and Keeling 2016). Leasing may adversely impact food security, nutrition, sense of well-being, community resilience, and cultural identity, and may disproportionately impact Native American, Alaska Native, minority, and low-income communities (Kofinas et al. 2015). New onshore facilities may be situated near or within communities that have been historically underserved and live in closest proximity to industrial zones (Maantay 2002b). Low-income communities may be particularly subject to further industrialization, which may create space-use conflicts.

R.15 **RECREATION & TOURISM:** Space-use conflicts may impact recreation and tourism in the Alaska, Pacific, and Atlantic Regions and in the Eastern GOM Planning Area. Space-use conflicts may occur, particularly in remote wilderness areas, where recreational activities rely on undeveloped natural land and seascapes (Brody et al. 2006; Li 2009). The occurrence of onshore and offshore OCS oil and gas activities may adversely affect the quality of visitor experiences and ultimately deter tourism (Klenosky et al. 2007). Recreation and tourism industry declines may have a negative effect on state GDP (Harcombe 1999).

4.1.4 Employment and Income

This section discusses impacts from OCS oil and gas activities on employment and income from a national perspective; **Section 4.1.5** discusses leasing revenues and highlights some unique regional differences. These impacts are not tied to a specific IPF but rather are the net influence of OCS leasing on employment and income.

Oil and gas activities could beneficially impact national or regional employment and income as a result of industry expenditures, government revenues, corporate profits, and other market impacts. Some of these impacts are expected to be concentrated along immediately adjacent coasts, while others may be widely distributed across the U.S. See Chapter 9 of the PFP for a more detailed discussion.

Figure 4-2 depicts the general pattern of life cycle oil and gas activities associated with the projects that may result from a lease sale, and **Figure 4-4** depicts the general employment pattern typically associated with industry spending on a single illustrative offshore oil and gas project following a lease sale.

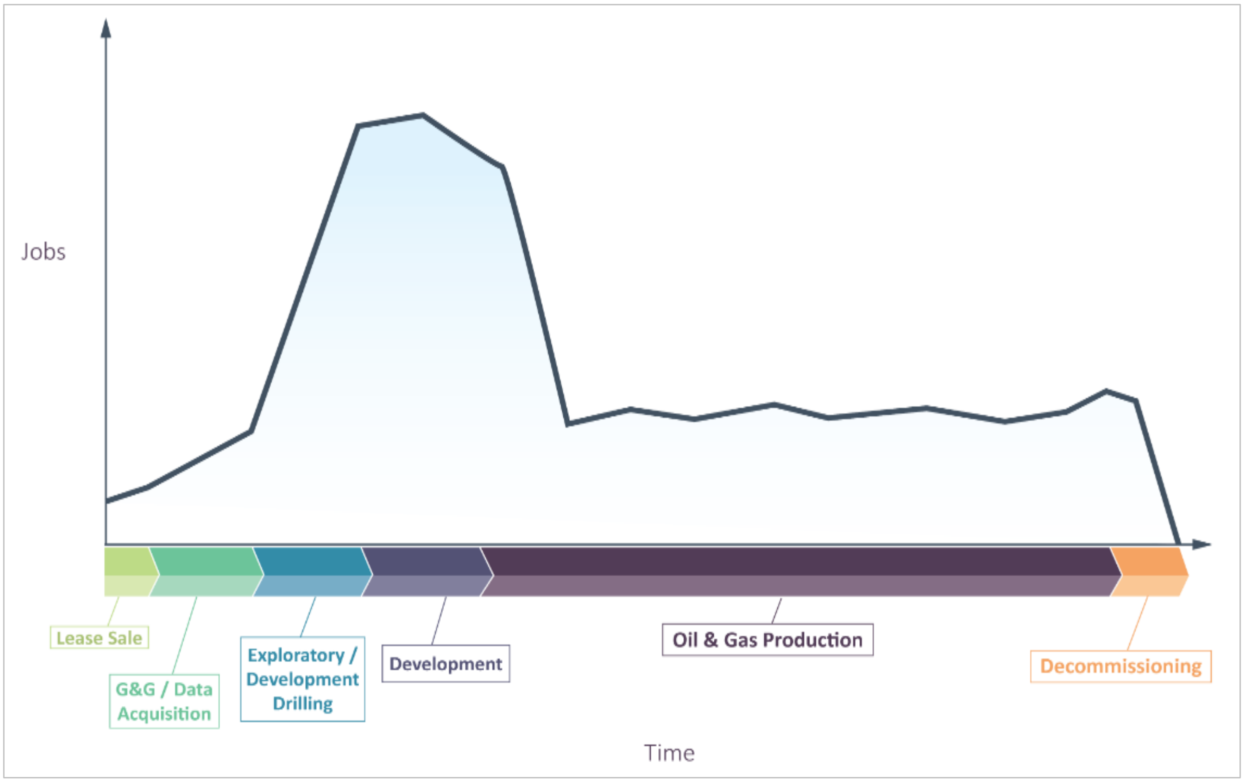


Figure 4-4. Illustrative offshore oil and gas project employment pattern

This figure shows an example employment pattern for one project. The information presented here is based on historical output from BOEM's regional economic models, MAG-PLAN GOM and MAG-PLAN Alaska.

Employment increases shortly after a lease sale, during the data acquisition and analysis phase (typically years 1 to 7 after a lease sale and lasting for 2 to 5 years in duration). Employment increases more rapidly during exploration and development and peaks during design, fabrication, and installation, but these levels are short term, lasting several years. Employment then declines and flattens out during long-term production, which may last from year 7 to year 60 after a lease sale (15 to 35 years in duration is most typical), depending on the size of the oil and gas reserves. Employment initially increases at the beginning of the decommissioning phase before tapering off. The timing of the different development phases varies by individual project, with the pre-production phases likely to be shorter in mature areas and longer in frontier areas. Multiple projects in a lease sale area tend to be staggered, resulting in smoother employment patterns over time as employees work on one project and then move to another.

The direct changes in employment, income, and expenditures resulting from a project would initiate subsequent rounds of income creation, spending, and re-spending. Third-party contractors, vendors, and manufacturers receiving payment for goods and services required by the project would, in turn, be able to pay others who support their businesses. In addition, persons directly and indirectly employed because of a project would generate additional jobs and income in the economy as they purchase goods and services. These indirect and induced effects are sometimes referred to as "multiplier effects."

Offshore oil and gas development requires an extensive network of onshore support facilities and services that generate many of the indirect and induced employment opportunities. Port facilities, fabrication facilities, oil and gas processing facilities, pipelines, and waste management facilities are among those that provide support to offshore oil and gas projects. Transportation, lodging, food, legal, architectural, and other services also employ many workers that provide project-related support.

Regional employment impacts vary considerably because of the nature of offshore and onshore support activities. Offshore worker schedules (e.g., 2 weeks on and 2 weeks off) allow for very long-distance commuting. New leasing for OCS oil and gas activities in mature areas is expected to maintain current levels of offshore-related employment in the adjacent states (as workers cycle from one project to the next) rather than create significant levels of new employment. In the short- to medium-term, a substantial portion of the supplies and services needed to support development in frontier and intermediate areas would probably come from onshore regions that already support OCS oil and gas operations, lessening the initial impact of new employment in these areas.

Annual labor income patterns over time are expected to be similar to those of employment. The contribution of total labor income over the life of a project can be substantial. Offshore oil and gas workers typically earn higher-than-average incomes.

Overall, assessing impacts on employment and income greatly depends on the specific characteristics of a location or community including an area's population size, employment rate, and income level. For example, additional employment opportunities in a large city with low unemployment rates would not have as large of an impact on the population as it would in a small community with few employment options. Impacts will be evaluated in more detail during subsequent environmental reviews.

4.1.5 Leasing Revenues

A reduction or increase in revenues associated with OCS oil and gas activities may impact government budgets and any programs that receive these funds. Changes in revenues collected by the Federal

Government would impact the funds distributed to the U.S. Department of the Treasury general fund, as well as several programs whose support by these revenues is mandated by legislation. GOMESA specifies certain percentages of revenues be shared with Texas, Louisiana, Mississippi, and Alabama, and counties and parishes within those states. Section 8(g) of the OCS Lands Act directs sharing of revenues from oil and gas occurring within the first 3 mi (4.8 km) of Federal waters (the 8(g) zone) with those states bordering the Federal waters concerned. Additional legislation governs the sharing of revenues with both the Historic Preservation Fund (HPF) and Land and Water Conservation Fund (LWCF). All 50 states and various other entities receive funding from the HPF and LWCF, and benefit from the inflows to the general fund of the U.S. Treasury. The funds that these organizations depend on to operate could be affected by an increase or decrease in leasing revenues.

Impacts may also occur related to an increase or decrease in revenues from property taxes related to onshore support infrastructure and state corporate and personal income taxes. Impacts generated by these revenues would be localized, and the level of impact would depend on where and how the revenues are used.

Other factors uniquely impact Alaska. Oil produced from an OCS lease sale could help maintain flow capacity in TAPS and reduce the pipeline tariff, a situation that could increase revenue to the state from royalties and production tax (i.e., the TAPS effect). OCS oil- and gas-related activities could also contribute taxes to government revenues from economic activities (such as taxes on profits and dividends), which may be particularly important to remote areas where oil and gas production is the only or top industrial activity. Annual North Slope Borough (NSB) revenues associated with new oil and gas activities would directly support wages for NSB residents and indirectly support local services. The combination of these factors would probably translate to more noticeable positive effects on the NSB economy as compared to other local economic effects from OCS oil and gas activities. Specifically, the NSB would receive annual property tax revenues (passed through from the state) associated with onshore infrastructure to support OCS development; however, the Chukchi Sea and Beaufort Sea Planning Areas have been withdrawn from consideration for oil and gas leasing under Section 12(a) of the OCS Lands Act and are not included in the PFP. Property tax payments by North Slope oil producers are the main source of revenue for the NSB (accounting for approximately 90% of the NSB operating budget in 2015), and these revenues directly support wages for NSB government jobs held by borough residents. In addition, under the state's Community Revenue Sharing, the NSB also receives revenues, which may increase slightly as a result of the larger number of oil and gas workers in the NSB. The workers would be counted as permanent residents for purposes of calculating revenue sharing per capita payments to the NSB. Revenues would be used to provide services and funding to NSB communities, such as education, public safety, and health and social services.

In addition to environmental consequences common across OCS regions, each region may be uniquely affected by OCS oil and gas activities. The following sections present the potentially significant IPF/resource combinations in each region. If an IPF/resource combination is not expected to be significant for that region, the rationale is presented in **Appendix A**. Discussion of impacts from accidental spills is provided in **Section 4.6**.

4.1.6 Potentially Significant Impacts in the Alaska Region

IPFs may impact Alaskan resources in unique ways because of the region's remoteness and limited development. Potentially significant impacts in the Alaska Region are shown in **Figure 4-5** and explained below. If an IPF is not expected to have a significant impact on a particular resource, the interaction is not listed in this section but is discussed in **Appendix A**. See **Sections 2.4.3** and **4.1.3** for a general discussion of IPFs and national impacts.

Alaska Region

Alaska Region	I.1 Noise	I.2 Traffic	I.3 Routine Discharges	I.4 Bottom/ Land Disturbance	I.5 Emissions	I.6 Lighting	I.7 Visible Infrastructure	I.8 Space-Use Conflicts
R.1 Air Quality					N			
R.2 Water Quality		N	S	N				
R.3 Pelagic Communities	N	N	N	N		N		
R.4 Marine Benthic Communities	N	N	S	S		N		
R.5 Coastal & Estuarine Habitats	S (partial)	S		S				
R.6 Fish & Essential Fish Habitat	S	N	N	N		N		
R.7 Birds	N	S	S	S	N	S		
R.8 Sea Turtles	S (partial)	S (partial)	N	N	N	N		
R.9 Marine Mammals	S	S	S	S	N	N		
R.10 Commercial & Recreational Fisheries	N	N	N	N		N		S (partial)
R.11 Archaeological & Cultural Resources			N	S			S	
R.12 Land Use	N	S	S (partial)	S	N	N	S	S
R.13 Culture	S	S	S	S	N	S (partial)	S	S
R.14 Vulnerable Coastal Communities	S	S	S	S	N	S (partial)	S	S
R.15 Recreation & Tourism	S	N		N	N	S	S	S

S Potentially significant; N Not expected to be significant; (empty) Does not interact

S (partial): Potential for significant impacts in at least one but not all planning areas

Figure 4-5. Interaction between oil and gas IPFs and marine resources (Alaska Region)

I.1 NOISE—See **Appendix B** for a general description of the impacts of noise.

R.5 COASTAL & ESTUARINE HABITATS: Noise effects on caribou are potentially significant for coastal and estuarine habitats in some Alaska planning areas. These areas include Beaufort Sea, Chukchi Sea, Hope Basin, Norton Basin, Shumagin, St. George Basin, and Aleutian Arc Planning Areas. Effects from vehicle traffic noise are unlikely because caribou tend to avoid transportation corridors (Dau and Cameron 1986; Douglas et al. 2002; National Research Council 2003a). However, caribou response to helicopters and fixed-wing aircraft varies greatly (Calef et al. 1976; Maier et al. 1998; Wolfe et al. 2000). Although impacts are likely to be short term, some studies show that aircraft noise causes caribou to expend excess energy by fleeing the area. As a result, the caribou may become separated from their calves or temporarily avoid returning to important foraging or insect relief areas (Calef et al. 1976; Maier et al. 1998; Stinchcomb et al. 2020). Impacts from noise on marine mammals, fish, sea turtles, and birds are analyzed separately.

R.6 FISH & ESSENTIAL FISH HABITAT: Noise is potentially significant for fish and EFH in all Alaska planning areas. Low-frequency noise from seismic surveys, vessel traffic, or decommissioning activities may disturb acoustically sensitive Alaskan fish, including walleye pollock, rockfish, and herring. For example, Pacific herring may use acoustic signals to maintain cohesion of schools, and additional noise may lead to avoidance or startle responses (Schwarz and Greer 1984). Herring have a wider frequency range for both sound production and detection than most other fishes, which means they may be disturbed by high-frequency sources (e.g., side-scan sonars), though the impacts are likely to be localized and temporary. Chinook salmon experience auditory injury when exposed to high-intensity impulsive sounds (e.g., pile driving), but recovery may be possible (Casper et al. 2012). Finally, recent evidence shows that Arctic cod also produce low-frequency sounds (Riera et al. 2018) and may be disturbed by anthropogenic noise in a similar manner as Atlantic cod (**Section 4.1.9**).

R.8 SEA TURTLES: Sea turtles are rare to uncommon in Alaska; however, when they do occur, it is in the Gulf of Alaska Planning Area via the Japan and North Pacific Current (Harrison et al. 2018; Hodge and Wing 2000). If a sea turtle were exposed to an impact-producing activity, potentially significant impacts may occur as discussed in **Section 4.1.3**.

R.9 MARINE MAMMALS: Noise is potentially significant for marine mammals in all Alaska planning areas. The severity of physiological and behavioral impacts from noise on marine mammals would likely depend on behavioral context and amplitude of received sounds (BOEM 2016c). Low-frequency noise sources may adversely affect baleen whales (e.g., bowhead, minke, fin, humpback, and North Pacific right whale). For example, migrating bowhead whales exposed to seismic airguns first increased, then decreased, their calling rate depending on amplitude of the noise (Thode et al. 2020), indicating that more than one type of behavioral response is possible; reactions could occur at distances up to 62 mi (100 km) (Blackwell et al. 2015). Other studies found that the response to noise varies among individuals: some bowheads move away from the sound source, some cease feeding, and some change their diving behavior (Richardson et al. 1990). These studies suggest that noise from oil and gas activities may affect the location or behavior of whales during their annual migration. Beluga whales appear to be very sensitive to approaching vessels (Finley 1990) and may experience elevated heart rates, other stress responses, or acoustic masking (Castellote et al. 2019; Lesage et al. 1999). Masking may be more likely for the eastern stock of the North Pacific right whale (Shelden et al. 2005). This species uses low-frequency signals to communicate over long distances, but only intermittently, presumably because individuals are so scarce (Munger et al. 2008). If additional noise prevents the approximately 30 individual whales of this species from finding each other, population-level effects are possible (Muto et al. 2020a). Noise from aircraft or construction may temporarily disturb ice-associated mammals like seals, walrus, and polar bears. Low-altitude flights may startle them and cause them to flee; sea lion pups, northern fur seal pups, and walrus calves are at risk of being trampled during these incidents (Udevitz et al. 2013). Female and offspring polar bears in dens may be more sensitive to noise than non-denning bears (Armstrup and Gardner 1994), but snow acts as an effective insulator and limits attenuation into dens (Amstrup 1993).

R.13 **CULTURE** and R.14 **VULNERABLE COASTAL COMMUNITIES:** Noise, both onshore and offshore, is potentially significant for culture and vulnerable coastal communities, such as Alaska Native Tribes, in all Alaska planning areas. Noise could impact subsistence hunting and fishing success, which could impact kinship and bartering practices. In Cook Inlet, where fishing is an important subsistence activity, dispersal of fish away from waters near noisy activities could delay subsistence fishers in the immediate vicinity and result in potential short-term missed harvest. Bowhead whales are particularly sensitive to low-frequency noise; changing their normal migration paths may make subsistence hunting in the Chukchi and Beaufort Seas and the East Bering Sea Ecoregions more difficult or dangerous, or even impossible. In the Shumagin, Kodiak, and Gulf of Alaska Planning Areas, several species of Alaskan fish (including salmon, walleye pollock, rockfish, and herring) are known to be acoustically sensitive and may be disturbed by low-frequency noise, such as vessel traffic (Park et al. 1994; Širović and Demer 2009; Wall et al. 2014; Wilson et al. 2004). Onshore, caribou are an important food source and may be sensitive to noise from aircraft. Noise may displace caribou, forcing hunters to traverse longer distances at greater risk and expense (Efroymson and Suter II 2001). This impact could disproportionately affect communities located in the Beaufort and Chukchi Seas Ecoregion, the East Bering Sea Ecoregion, and parts of the Cook Inlet Planning Area (Alaska Department of Fish and Game 2018b; Efroymson and Suter II 2001).

R.15 **RECREATION & TOURISM:** Noise is potentially significant for recreation and tourism in all Alaska planning areas. Noise associated with onshore and offshore construction and operations may impact visitor experience of nature-based tourism activities (e.g., camping, backpacking, recreational fishing) because of the natural and remote experiences tourists typically seek in Alaska. Therefore, noise may reduce recreation and tourism activity (Harbrow et al. 2011; McDowell Group 2018). The Gulf of Alaska Ecoregion is especially dependent on tourism, which accounted for 23% of employment in 2017 in Southeast Alaska (McDowell Group 2018). Noise impacts from onshore construction are expected to be temporary in nature, normally lasting for a period of months. However, activities are likely to overlap in the summer months, when visitor season is at its peak and oil- and gas-related construction is most likely to take place. Noise from drilling operations would probably be intermittent, while noise from support activities, such as helicopters or vessels, may be ongoing and negatively impact recreation and tourist activities throughout the production life of the oil and gas development when in close proximity to recreational activities in the water and nearshore (Radtke et al. 2017). However, mitigation measures could potentially reduce or avoid impacts, depending on the timing, location, and nature of development activities. The magnitude of the noise impact would probably decrease with distance from popular coastal areas and may be greatest in nature-based recreational areas.

I.2 TRAFFIC

R.5 **COASTAL & ESTUARINE HABITATS:** Traffic is potentially significant for coastal and estuarine habitats in all Alaska planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.7 **BIRDS:** Traffic is potentially significant for birds in all Alaska planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.8 **SEA TURTLES:** Sea turtles are rare to uncommon in Alaska; however, when they do occur, it is in the Gulf of Alaska Planning Area via the Japan and North Pacific Current (Harrison et al. 2018; Hodge and Wing 2000). If a sea turtle were exposed to an impact-producing activity, potentially significant impacts may occur as discussed in **Section 4.1.3**.

R.9 **MARINE MAMMALS:** Vessel traffic is potentially significant for marine mammals in all Alaska planning areas. Gray whales, bowhead whales, bearded seals, or walrus may change their normal migration patterns to avoid vessel traffic, which may lead to short-term metabolic changes. Additionally, Finley (1990) observed that approaching ships triggered a fleeing response in beluga whales at distances up to 31 mi (50 km) away and that whales were generally slow to return to their original location. Vessel strikes may lead to injury or death (Martin et al. 2016) and may have population-level effects for particularly vulnerable species like the North Pacific right whale. Mitigation measures, such as protected species observers, could potentially reduce or avoid impacts.

R.12 **LAND USE:** Traffic impacts may be significant for land use in all Alaska planning areas. However, impacts in the Cook Inlet Planning Area may differ due to the existing baseline of land use patterns (e.g., tourism, shipping, oil and gas, and fishing). For Cook Inlet, a small amount of additional oil and gas activity may not have a noticeable impact if the existing onshore facilities support OCS activities. However, if additional ship or road traffic requires changes in zoning, road systems, traffic patterns, public services, or port activity, then impacts may occur. For example, if industry-support traffic increased substantially, traffic patterns could change, or road expansion may be required. For all Alaska, increased traffic may impact other uses of lands and waters. For example, increased traffic could potentially overlap with activities associated with NASA's Poker Flat Research Range launch areas in the Beaufort Sea. In most planning areas in Alaska, there is little to no onshore oil and gas infrastructure, and land use may be impacted by any increase in onshore industry-support traffic, especially because of the limited existing highway and road systems to and within these areas (Alaska Department of Transportation and Public Facilities 2022). The East Bering Sea Ecoregion would probably experience more impacts compared to the Chukchi and Beaufort Seas Ecoregion, which has some existing infrastructure, including TAPS, onshore activities around Prudhoe Bay, and offshore development in state waters.

R.13 **CULTURE** and R.14 **VULNERABLE COASTAL COMMUNITIES:** Traffic, both offshore and onshore, is potentially significant for culture and vulnerable coastal communities adjacent to all Alaska planning areas. Increased offshore vessel traffic may cause subsistence species (e.g., bowhead whales, beluga whales, bearded seals, and walrus) to change their normal movement patterns or behaviors, which may make hunting them more difficult (Huntington 2013; Richardson et al. 1990). In Cook Inlet, short-term and localized conflicts may arise between subsistence fishing vessels and vessels supporting seismic and site clearance surveys, drilling, and construction activities (e.g., platform and pipeline installation); in these instances, harvesters may need to temporarily alter their harvest locations, timing, or levels of effort. Vessel or land-based traffic may result in changes to subsistence-harvest patterns, hunting, and fishing success, which may adversely affect food security, nutrition, sense of well-being, community resilience, and cultural identity of Alaska Native peoples and disproportionately impact other vulnerable coastal communities, such as minority and low-income communities. Communities currently threatened by sea level rise and coastal erosion may be more susceptible to erosion from traffic-related impacts. The U.S. Army Corps of Engineers has identified 178 Alaska communities with erosion problems, including 20 coastal Alaska Native villages (USACE 2009).

I.3 ROUTINE DISCHARGES

R.2 **WATER QUALITY:** Routine discharges are potentially significant for water quality in all Alaska planning areas because the area is relatively pristine. The effects of produced water, drilling muds, and cuttings in the Alaska Region would most likely be localized but persistent (Neff 2010; Neff and Durell 2011). These discharges are expected to disperse faster in higher-energy environments, such as the tidally active lower Cook Inlet. Compliance with NPDES permit requirements and current USCG regulations could reduce or minimize impacts on receiving waters from discharges from normal operations, but significant local impacts on water quality may still occur.

R.4 **MARINE BENTHIC COMMUNITIES:** Routine discharges are potentially significant for marine benthic communities in all Alaska planning areas. Some routine discharges, such as drilling muds and cuttings, may smother, alter, or remove benthic habitats and may be particularly harmful to unique or sensitive habitats like the Boulder Patch area, Herald and Hannah Shoals, and Barrow Canyon. Impacts on these areas from drilling muds or cuttings may be both acute and long term due to smothering and loss of habitat. Although such impacts are expected to be localized, they may be long term and could extend recovery times for slow-growing species, such as cold-water corals. These impacts could be minimized by not allowing open-water disposal of drilling waste.

R.7 **BIRDS:** Routine discharges are potentially significant for birds in all Alaska planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.9 **MARINE MAMMALS:** Routine discharges are potentially significant for marine mammals in all Alaska planning areas. Walrus, bearded seal, and gray whale prey may be affected by drilling muds and cuttings. These mammals may be displaced temporarily from foraging areas if drilling debris covers benthic habitat, or they may have difficulty locating fish or invertebrate prey if water quality and visibility is compromised. Without appropriate mitigation, some habitat loss, alteration, or restriction of access to a preferred habitat may occur in the Alaska planning areas. The impact on marine mammals in most cases would probably be temporary, because the area available for foraging is very large in comparison to the amount of habitat that could be lost. However, the impact may be more severe if key foraging areas, such as Hanna Shoal, were disturbed (Kaplan et al. 2010).

> Gray whales are unique among the baleen whales because they use suction feeding to feed on animals living in the mud. Therefore, they depend on healthy benthic habitats to meet their caloric needs, especially when they reach the end of their annual migration in Alaskan waters (Kaplan et al. 2010).

R.12 **LAND USE:** Routine discharges are not expected to be significant for land use in the Beaufort Sea and Cook Inlet Planning Areas, where there is existing oil and gas activity, and the addition of discharges from new leasing is unlikely to have a noticeable impact on the current baseline. In all other planning areas in the Alaska Region, impacts are potentially significant on land use. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.13 **CULTURE** and R.14 **VULNERABLE COASTAL COMMUNITIES:** Routine discharges are potentially significant for culture and vulnerable coastal communities in all Alaska planning areas. Routine discharges, such as drilling muds or cuttings, may affect the foraging behavior of whales, thereby affecting Alaska Native peoples who rely on whales for subsistence and to share with kin outside of their communities (Stephen R. Braund & Associates 2009). Real or perceived contamination from routine discharges may distress people relying on these resources. For example, in Cook Inlet, participants in a study shared concern about the effects of discharges on resources in Cook Inlet, and some study participants from a community on the western side of Cook Inlet reported observations of onshore odors following permitted discharges and concerns about effects on fish and marine mammals (Holen 2019). Impacts on resources and subsistence patterns may impact entire communities because there are few nutritional substitutes for these foods in the region. These changes may adversely affect food security, nutrition, sense of well-being, community resilience, and cultural identity; they also may disproportionately impact vulnerable coastal communities, such as Alaska Native peoples and minority and low-income communities (Kofinas et al. 2015).

I.4 BOTTOM/LAND DISTURBANCE

R.4 **MARINE BENTHIC COMMUNITIES:** Bottom/land disturbance is potentially significant for marine benthic communities in all Alaska planning areas. Pipeline laying, anchoring, offshore construction, and other activities may cause mortality and loss of sensitive benthic communities, such as the Boulder Patch area, Herald and Hannah Shoals, and Barrow Canyon. In the Arctic, the need to bury pipelines to provide protection from ice gouging may lead to increased short-term and localized disturbance of benthic habitats. Regular movements of anchors and chains or lines may lead to chronic local seafloor disturbance (physical compaction and sediment resuspension). Although these impacts are expected to be localized, they may be long term and lead to lengthy recovery times for slow-growing species, such as cold-water corals. Impacts on benthic communities could be reduced by excluding biologically important areas from OCS oil and gas activities (**Section 4.5**) or, at later stages, by applying avoidance measures to sensitive areas, such as hard bottom benthic habitat.

R.5 **COASTAL & ESTUARINE HABITATS:** Bottom/land disturbance is potentially significant for coastal and estuarine habitats in all Alaska planning areas. Construction of onshore bases, temporary and permanent roads, and pipelines, as well as the expansion and development of fill material sources, may lead to fragmentation and damage to the extensive wetlands in the Arctic Coastal Plain. Most of these impacts may be longer term, potentially lasting longer than the specific activity generating the impacts or the length of oil and gas activity in the area (e.g., impacts from permanent infrastructure). Indirect impacts may occur from dust associated with onshore construction and be long term where roads are not paved; recovery from compaction as a result of winter construction probably would vary depending on size and intensity of the impact and on vegetation type. The U.S. Army Corps of Engineers has jurisdiction over construction in nearshore and onshore water bodies and wetlands through Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act (**Appendix H**). Any new pipelines in the National Petroleum Reserve-Alaska would be subject to the authority of the Bureau of Land Management. These agencies are expected to require regulatory controls and mitigation.

Caribou may be impacted by bottom/land disturbance in Alaska planning areas that overlap with their range, as described in I.1 **NOISE**. Caribou may avoid construction areas or even abandon preferred habitat areas where a new onshore pipeline is installed (National Research Council 2003a), which may affect daily or seasonal movements of individuals or herds to potentially suboptimal areas. These effects could be especially important if insect relief areas, calving grounds, or foraging areas were destroyed or blocked by onshore pipelines or other onshore construction. Caribou may experience reduced foraging efficiency and increased physiological stress if relief areas are not accessible during peak insect harassment (Hagemoen and Reimers 2002).

R.7 **BIRDS:** Bottom/land disturbance is potentially significant for birds in all Alaska planning areas. For example, enormous flocks of migrating and molting waterbirds, including shorebirds and waterfowl, gather in coastal wetlands and bays during spring and fall. Onshore construction may permanently alter coastal habitats like wetlands, displacing migratory birds that utilize these habitats.

> Many bird species' entire populations congregate at specific breeding colonies along Alaska's extensive shoreline and many small islands (Smith et al. 2017b). Disturbing key breeding or wintering habitats may have population-level effects.

R.9 **MARINE MAMMALS:** Bottom/land disturbance is potentially significant for marine mammals in all Alaska planning areas. Destruction of benthic areas may affect walrus, gray whales, and bearded seals due to their bottom-feeding behaviors (see above in I.3 **ROUTINE DISCHARGES**). Certain benthic features, such as Hanna Shoal and Barrow Canyon, are particularly sensitive due to their high levels of benthic biodiversity and their role as critical feeding areas for marine mammals. Excluding oil and gas activities from these areas could minimize potential impacts (**Section 4.5**). Polar bears may be affected by disturbance to denning areas and interactions with onshore facilities and personnel (Amstrup 1993; Smith et al. 2007).

R.11 ARCHAEOLOGICAL & CULTURAL RESOURCES: Bottom/land disturbance is potentially significant for archaeological and cultural resources in all Alaska planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.12 LAND USE: Bottom/land disturbance may impact land use in all planning areas in the Alaska Region. However, there may be differences between planning areas due to current levels of industrialization. For example, the Cook Inlet and Beaufort Sea Planning Areas have some existing oil and gas infrastructure, and land use needs may be accommodated within an existing industrial or port area. In especially remote areas of the other planning areas in Alaska, onshore oil and gas support facilities and pipeline infrastructure may be the first industrial development. This change in land use may alter wilderness environments to oil and gas industry-support environments. Offshore, nearshore, and onshore oil and gas activities may change the physical composition of the landscape most noticeably in the less developed portions of the Alaska Region, potentially limiting the current and future use of an area by local users and wildlife (Stephen R. Braund & Associates 2013). Onshore construction and infrastructure (such as pipelines, ice roads, and bridges) may have considerable impacts in and around lands used for subsistence activities. These impacts may, for example, include hunters avoiding industrialized areas or the deflection of caribou; however, some hunters continue to harvest in areas near man-made infrastructure (Stephen R. Braund & Associates 2017).

R.13 CULTURE and **R.14 VULNERABLE COASTAL COMMUNITIES:** Bottom/land disturbance is potentially significant for culture and vulnerable coastal communities in all Alaska planning areas. Coastal habitat disturbance, including of estuaries and rivers, from construction of new pipelines or shore facilities may affect subsistence resources such as caribou, marine mammals, and fish. In the Arctic, road traffic and elevated pipelines (< 7 ft [2.1 m]) with snow buildup may deflect caribou from their normal migration routes (Stephen R. Braund & Associates 2009; 2013). In Cook Inlet, localized disturbance in nearshore harvest areas may be associated with pipeline landfalls, depending on the landfall location. Changes in habitat and displacement of marine or terrestrial animals may impact subsistence-harvest patterns and the availability of subsistence resources. These changes may adversely affect food security, sense of well-being, community resilience, and cultural identity of Alaska Native peoples in vulnerable coastal communities (Kofinas et al. 2015).

I.6 LIGHTING

R.7 BIRDS: Lighting is potentially significant for birds in all Alaska planning areas. Alaska has a particularly high diversity of migrating birds, so additional lighting may impact more species than in other OCS regions. The small populations of ESA-listed spectacled and Steller's eiders may be particularly susceptible to artificial lighting in the Chukchi and Beaufort Seas Ecoregion as they pass through this area during their annual migrations; lighting from any new facilities may disrupt their migrations (Smith et al. 2017b).

R.13 CULTURE and **R.14 VULNERABLE COASTAL COMMUNITIES:** Lighting is potentially significant for culture and vulnerable coastal communities in all Alaska planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.15 RECREATION & TOURISM: Lighting is potentially significant for recreation and tourism in all Alaska planning areas because of the tourism industry's dependence on nature-based activities. When daylight is limited, the effect of light pollution may be more intense and interfere with unique tourism experiences, such as viewing the Northern Lights (Dussault 2016). Artificial lighting may affect popular tours such as polar bear viewing in Kaktovik (Beaufort Sea Planning Area) or cultural tours in Utqiaġvik, Kotzebue, and Nome (Beaufort Sea, Hope Basin, and Norton Basin Planning Areas). These potential impacts of lighting on night-based tourism may be especially noticeable in the high-latitude planning areas during the winter months when daylight is limited.

I.7 VISIBLE INFRASTRUCTURE

R.11 ARCHAEOLOGICAL & CULTURAL RESOURCES: Visible infrastructure is potentially significant for archaeological and cultural resources in all Alaska planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.12 LAND USE: Impacts from visible infrastructure are expected to be significant in all Alaska planning areas. However, impacts may vary depending on existing infrastructure. For example, the Cook Inlet Planning Area may not be as affected due to existing oil and gas infrastructure supporting activities in state waters. New infrastructure in this area may be accommodated within existing industrial areas; however, if infrastructure expansion requires new zoning or modification of land use, then there is a potential for impacts to be significant (BOEM 2018a). In all Alaska planning areas, land use may be affected by the addition of onshore support infrastructure near coastal communities. If there is an increase in OCS activity in either the Beaufort or Chukchi Planning Areas, additional roads, construction traffic, pipelines, and worker housing may be developed on open tundra (North Slope Borough 2018).

R.13 CULTURE and **R.14 VULNERABLE COASTAL COMMUNITIES:** Impacts from visible infrastructure are potentially significant in all Alaska planning areas, depending on the local sociocultural environment. New infrastructure emplacement where there has been no previous activity may affect the character, use, and valuation of non-industrialized areas and undermine local and regional cultural identities (Stephen R. Braund & Associates 2009). These impacts may be long term and disproportionately impact communities that are closest to the infrastructure (Dussias 2014; Garcia-Martin et al. 2017).

R.15 RECREATION & TOURISM: Impacts on recreation and tourism are potentially significant in all Alaska planning areas. Impacts may be more noticeable in areas with little to no existing oil and gas activity. New visible infrastructure may alter the unique wilderness character and natural landscapes. The Gulf of Alaska Ecoregion may be the most affected by impacts from visible infrastructure or lighting on visitor experience, as this area leads the state in tourism-related employment, labor income, and visitor spending and is highly dependent on cruise ship operations (McDowell Group 2018).

I.8 SPACE-USE CONFLICTS

R.10 COMMERCIAL & RECREATIONAL FISHERIES: Space-use conflicts are potentially significant for commercial and recreational fisheries in all Alaska planning areas except the Beaufort Sea and Chukchi

Sea Planning Areas. The North Pacific Fishery Management Council approved, and NMFS implemented, a Fishery Management Plan for Fish Resources of the Arctic Management Area (Arctic FMP) in 2009. Currently, all Federal waters of the U.S. Arctic are closed to commercial fishing for any species of finfish, mollusks, crustaceans, and all other forms of marine animal and plant life; however, harvest of marine mammals and birds is not regulated by the Arctic FMP. The Arctic FMP does not regulate subsistence or recreational fishing or State of Alaska-managed fisheries in the Arctic (North Pacific Fishery Management Council 2020). There is insufficient information available to predict whether fishing activity will be allowed in the Beaufort and Chukchi Seas Ecoregion within the next 40 to 70 years, and, if it is allowed, it would be difficult to predict the rate and scale of capacity building that may take place. Space-use conflicts for commercial and recreational fisheries are not likely to occur in the Beaufort Sea and Chukchi Sea Planning Areas, because there is currently no commercial fishing allowed, and recreational fishing is limited in the area. In other Alaskan planning areas, space-use conflicts with oil- and gas-related activities may disrupt access to fishing grounds and have substantial impacts, because the fishing industry generates a large number of jobs and is an integral part of many communities (NMFS 2018d; 2021b).

R.12 **LAND USE:** Space-use conflicts are potentially significant for land use in all Alaska planning areas. Land and habitat conversion to oil and gas purposes may affect how others use the land. Ports and other industrial areas used for fishing, cargo vessels, shipyards, pipeline landfalls, and tourism may need to be expanded to accommodate oil and gas activity (Thesing et al. 2006; World Port Source 2018a). Port expansions may introduce additional land use conflicts by reducing the amount of land available for other uses. Road development may occur in all planning areas and would probably be most noticeable in the East Bering Sea Ecoregion and Beaufort and Chukchi Sea Ecoregion, where there are fewer road systems and greater ecological risks from road maintenance in the tundra environment (Alaska Industrial Development and Export Authority 2017; National Research Council 2003a). Throughout all the planning areas, habitat loss because of port expansion, construction of new roads, or other industrial development needed for increased oil and gas activities may affect the quality or quantity of land available for subsistence hunting, fishing, and gathering. Other Federal uses of the OCS, such as military activity, could be impacted by space-use conflicts. For example, NASA launch activities from the Poker Flat Research Range are a unique space-use consideration for the Beaufort Sea Planning Area, and impacts would depend on the degree and location of oil and gas development offshore, as well as the effectiveness of mitigation measures (BOEM 2018a). For many space-use conflicts, the application of mitigation measures could minimize the potential for onshore and offshore conflicts.

R.13 **CULTURE** and R.14 **VULNERABLE COASTAL COMMUNITIES:** Space-use conflicts are potentially significant for culture and vulnerable coastal communities in all Alaska planning areas, primarily due to emplacement of new facilities and activities (Maantay et al. 2010). Impacts on subsistence activities and harvest patterns by Alaska Native peoples and other vulnerable coastal communities may impact food security, health, cultural practices, and community well-being. Space-use conflicts may result from activities that overlap in time and space with subsistence activities, which could prevent or limit harvesters' access to subsistence use areas and resources. In Cook Inlet, construction and ongoing presence of offshore platforms and onshore pipelines has the potential to cause space-use conflicts with some subsistence users. Land-based operations may disproportionately impact communities shoreward of the Beaufort Sea and Chukchi Sea Planning Areas, where subsistence hunting of terrestrial mammals (e.g., caribou and polar bears) and marine mammals (e.g., bowhead and ringed seal) currently takes place (George and Suydam 2018; Kofinas et al. 2015; Stephen R. Braund & Associates 2009; 2010; 2013; 2017; Wolfe 2004). In the East Bering Sea Ecoregion, culture and vulnerable coastal communities may experience disproportionate impacts from space-use conflicts with subsistence harvesting of seal, caribou, harbor seal, and various species of fish and vegetation (Alaska Department of Fish and Game 2018a; 2018d; 2018e; 2018f; Muto et al. 2020b; USFS 2015). Similar impacts on traditional harvests (e.g., fish, seal, shrimp, birds, and vegetation) may occur in and near the Shumagin, Cook Inlet, Kodiak, and Gulf of Alaska Planning Areas (Alaska Department of Fish and Game 2018a; 2018d; 2018e; 2018f; George and Suydam 2018; Kofinas et al. 2015; Muto et al. 2020b; Stephen R. Braund & Associates 2009; 2010; 2013; 2017; Wolfe 2004). These onshore and offshore impacts may be long term (40 to 70 years), and the intensity may vary with the life cycle of the offshore leases based on the phase of development (BOEM 2018a).

R.15 **RECREATION & TOURISM:** Space-use conflicts are potentially significant in all Alaska planning areas. The recreation and tourism industries may experience impacts if oil and gas activities overlap with recreation and tourism uses of coastal or offshore areas and alter visitor experience. A substantial decrease in tourism may adversely impact the state economy (Cerveny 2005; Cruise Line International Association Alaska 2018; Crystal Cruises 2016; McDowell Group 2018), particularly in Gulf of Alaska Ecoregion, which depends more heavily on the tourist industry for employment and GDP than other areas of Alaska.

4.1.7 Potentially Significant Impacts in the Pacific Region

Potentially significant impacts in the Pacific Region are shown in **Figure 4-6** and explained below. If an IPF is not expected to have a significant impact on a particular resource, the interaction is not listed in this section but is discussed in **Appendix A**. See **Sections 2.4.3** and **4.1.3** for a general discussion of IPFs and national impacts.

Pacific Region

	I.1 Noise	I.2 Traffic	I.3 Routine Discharges	I.4 Bottom/ Land Disturbance	I.5 Emissions	I.6 Lighting	I.7 Visible Infrastructure	I.8 Space-Use Conflicts
R.1 Air Quality					S (partial)			
R.2 Water Quality		N	S	N				
R.3 Pelagic Communities	N	N	N	N		N		
R.4 Marine Benthic Communities	N	N	S	S		N		
R.5 Coastal & Estuarine Habitats	N	S		S				
R.6 Fish & Essential Fish Habitat	S	N	N	N		N		
R.7 Birds	N	S	N	S	N	S		
R.8 Sea Turtles	S	S	N	N	N	N		
R.9 Marine Mammals	S	S	N	N	N	N		
R.10 Commercial & Recreational Fisheries	N	N	N	N		N		S
R.11 Archaeological & Cultural Resources			N	S			S	
R.12 Land Use	N	S	S (partial)	S	N	N	S	S
R.13 Culture	S	S	S (partial)	S (partial)	N	S (partial)	S	S
R.14 Vulnerable Coastal Communities	S	S	S (partial)	S (partial)	S (partial)	S (partial)	S	S
R.15 Recreation & Tourism	S	N		N	N	S	S	S

S = Potentially significant; N = Not expected to be significant; blank = Does not interact

S (partial) = Potential for significant impacts in at least one but not all planning areas

Figure 4-6. Interaction between oil and gas IPFs and marine resources (Pacific Region)

I.1 NOISE—See **Appendix B** for a general description of the impacts of noise.

R.6 FISH & ESSENTIAL FISH HABITAT: Noise is potentially significant for fish and EFH in all Pacific planning areas. Throughout the Pacific Region, fish with swim bladders—such as salmon, kelp bass, and rockfish—may experience physical or auditory injury when close to a sound source. Recent research has shown that physical injuries occur when juvenile Chinook salmon are exposed to high-intensity impulsive sounds (Halvorsen et al. 2012), though follow-up work showed recovery several days after sound exposure (Casper et al. 2012). The fish in the Pacific Region with the best known hearing capabilities are species like sardines and herring (Hastings and Popper 2005; Higgs 2004); they can detect very high-frequency sounds and may experience physiological or behavioral impacts from a wider range of sound sources or at a greater distance than other fishes (Schwarz and Greer 1984). Other commercially and recreationally important species that are known to produce sounds—such as giant sea bass (Clark and Allen 2018), white sea bass (Aalbers 2008), and rockfish (Širović and Demer 2009)—may experience temporary behavioral disruptions (Pearson et al. 1992) or acoustic masking from low-frequency sound sources. In some cases, behavioral changes may impact catch rates; Skalski et al. (1992) showed a > 50% decrease in rockfish catch-per-unit-effort immediately after an area in central California was exposed to airgun sounds. Intermittent noise may also temporarily increase stress in some fish species in the Pacific Region, as has been observed in the giant kelpfish (Nichols et al. 2015).

R.8 SEA TURTLES: Noise is potentially significant for sea turtles in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.9 MARINE MAMMALS: Noise is potentially significant for marine mammals in all Pacific planning areas. Blue, gray, humpback, and fin whales are abundant in the California Current Ecoregion (Barlow and Forney 2007) and may experience physiological harm or behavioral disturbance from noise, particularly from deep-penetration seismic surveys. There is evidence that gray whales can adapt their acoustic repertoire when exposed to some types of anthropogenic noise, but this phenomenon is not well-studied for most marine mammals (Dahlheim and Castellote 2016). The presence of busy shipping ports in southern California means that vessel noise is already a challenge for baleen whales (which use low-frequency signals to communicate); additional noise from OCS oil and gas activities may make it more difficult for them to communicate and may increase stress levels (Redfern et al. 2017). Some of these impacts may be avoided for migratory species if seismic surveys are carefully timed to match seasonal lows in abundance. Toothed whales (e.g., sperm, beaked, dolphins) that reside in the Pacific Region may be impacted by noise associated with oil and gas activities. Pinnipeds such as California sea lions, northern elephant seals, and sea otters are less sensitive to OCS sound sources than most cetaceans (Ghoul and Reichmuth 2014; NMFS 2018a) and are not expected to experience significant physiological impacts but may experience behavioral disruption from vessel, aircraft, or construction noise.

R.13 CULTURE and **R.14 VULNERABLE COASTAL COMMUNITIES:** Noise is potentially significant for culture and vulnerable coastal communities in all Pacific planning areas, because onshore and offshore construction, operations, and decommissioning may impact regional sacred traditional practices and vulnerable communities in rural, Tribal, or less developed areas along the coast. Significant impacts from noise to fish and marine mammals may subsequently significantly impact Tribal treaty rights and rights to trust resources. Tribes who are heavily dependent on marine fisheries and resources for their economies, subsistence, ceremonies, culture, and identity may be disproportionately impacted by significant impacts from noise to fish and marine mammals. Noise associated with oil and gas activities (e.g., construction, port staging, and vessel traffic) may alter the Pacific Region's natural and cultural character.

R.15 **RECREATION & TOURISM:** Noise is potentially significant for recreation and tourism in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

I.2 TRAFFIC

R.5 **COASTAL & ESTUARINE HABITATS:** Traffic is potentially significant for coastal and estuarine habitats in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.7 **BIRDS:** Traffic is potentially significant for birds in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.8 **SEA TURTLES:** Traffic is potentially significant for sea turtles in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.9 **MARINE MAMMALS:** Vessel traffic is potentially significant for marine mammals in all Pacific planning areas. Large cetaceans like blue whales are particularly vulnerable to vessel strikes (McKenna et al. 2015), and resulting injury and mortality is an ongoing issue (Rockwood et al. 2017). Additional vessel traffic associated with oil and gas development may increase risk for these protected species, though impacts may be limited to areas where feeding hotspots and shipping lanes overlap (Rockwood et al. 2017). Traffic impacts could be mitigated by avoiding these areas or reducing vessel speeds.

R.12 **LAND USE:** Traffic is potentially significant for land use in all Pacific planning areas because onshore road systems, ports, and other traffic-related infrastructure are needed to accommodate support industries and construction operations. The development of new infrastructure or expansion of existing infrastructure may require changes to zoning, road systems, traffic patterns, and vessel activity (Tyler and Ward 2011), particularly in and around ports and nearby industrial zones (Geotab 2018; INRIX 2018). Ports in Washington and Oregon are smaller than those in California (World Port Source 2018b; 2018d; 2018e), and the most noticeable traffic impacts on land use may occur in the Washington/Oregon Planning Area, where there are limited oil and gas support activities and infrastructure. Traffic-related infrastructure may need to be developed in these areas, while the Southern California Planning Area, for example, may be able to accommodate increased activity.

R.13 **CULTURE:** Traffic is potentially significant for culture in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.14 VULNERABLE COASTAL COMMUNITIES: Traffic is potentially significant for vulnerable coastal communities in all Pacific planning areas. An increase of aircraft, vessels, or onshore traffic in relatively undeveloped or rural areas where offshore oil and gas activities have not occurred may require the construction of new infrastructure, strain transportation services, or alter traffic patterns. In areas where there is a history of oil and gas activity, increased traffic may strain transportation services and infrastructure or exacerbate traffic congestion (e.g., Los Angeles, CA) (Geotab 2018; INRIX 2018). These impacts may be long term (40 to 70 years), and the intensity would probably vary with the life cycle of the offshore leases based on the phase of development. Increased onshore traffic at port staging areas (e.g., Ocean Park, WA; Coos Bay, OR; and Los Angeles, CA) may increase commute times and cause adverse health impacts from pollutants, thereby disproportionately impacting vulnerable coastal communities (USEPA 2018b; World Port Source 2018d; 2018e). Traffic-related impacts on marine mammals, including treaty-reserved resources, may impact traditional, cultural, and subsistence practices, thereby disproportionately impacting Tribes and legally defined treaty rights (Tyler 2018).

I.3 ROUTINE DISCHARGES

R.2 WATER QUALITY: Routine discharges are potentially significant for water quality in all Pacific planning areas. This region has a particularly large number of protected areas that may be adversely affected by degraded water quality. Compliance with NPDES and other regulations could help minimize these impacts.

R.4 MARINE BENTHIC COMMUNITIES: Routine discharges are potentially significant for marine benthic communities in all Pacific planning areas. Drilling muds may impact extensive kelp beds that span the coastline and provide habitat for a range of species. Although impacts on benthic communities are expected to be localized, they may be long term, and some slow-growing species may have long recovery times. Mitigation in the form of avoidance could minimize potential impacts.

R.12 LAND USE: Routine discharges are potentially significant for land use in all Pacific planning areas except the Southern California Planning Area. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.13 CULTURE and **R.14 VULNERABLE COASTAL COMMUNITIES:** Routine discharges are potentially significant for culture and vulnerable coastal communities in all Pacific planning areas, except the Southern California Planning Area, because impacts on marine benthic communities could impact resources protected under treaty rights and fish and sessile organism harvests central to Tribal cultural practices along the Pacific Coast.

I.4 BOTTOM/LAND DISTURBANCE

R.4 MARINE BENTHIC COMMUNITIES: Bottom/land disturbance is potentially significant for marine benthic communities in all Pacific planning areas. Disturbance from pipeline laying, anchoring, offshore construction, and other activities associated with oil and gas activities may lead to mortality and loss of sensitive benthic communities, such as live hard bottom or deepwater corals. Bivalves often form reefs, creating unique habitat along the base of Pacific oil and gas platforms, which serve as hard substrate on the otherwise soft bottom seafloor. Fish use the more complex shell mound habitat for feeding and shelter. Decommissioning activities may lead to the reduction or displacement of fish and bivalve biomass and production. Although these impacts are expected to be localized, slow-growing species may have long recovery times. Mitigation and avoidance could minimize potential impacts.

R.5 **COASTAL & ESTUARINE HABITATS:** Bottom/land disturbance is potentially significant for coastal and estuarine habitats in all Pacific planning areas. Disturbance or loss of coastal habitats, such as kelp beds, may affect species that depend upon them for refuge or for food resources. These losses would probably be localized but may lead to long-term ecological impacts and shoreline loss due to the role of kelp beds and other coastal and estuarine habitats in attenuating waves and providing habitat for a diverse assemblage of Pacific species.

> In the Pacific Region, the high human population density and presence of large ports, particularly in the areas adjacent to Central and Southern California Planning Areas, are already placing pressure on coastal and estuarine habitats. The addition of roads, onshore support bases, and pipelines to distribution points may add further stress to these habitats. In addition, bottom/land disturbance may exacerbate the impacts of sea level rise and sediment shortages on coastal and estuarine habitats.

R.7 **BIRDS:** Bottom/land disturbance is potentially significant for resident and migratory birds in all Pacific planning areas because of habitat degradation and disturbance to food sources. Impacts on birds may have population-level effects for some species. Some ESA-listed species in the Pacific Region—including marbled murrelets, snowy plovers, Ridgway's rails, and least terns—may be especially impacted by disturbances to their habitats because of their small population sizes. Potential mitigation measures such as time or area closures may reduce or avoid these impacts on birds.

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES:** Bottom/land disturbance is potentially significant for archaeological and cultural resources in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.12 **LAND USE:** Bottom/land disturbance is potentially significant for land use in all Pacific planning areas. However, there are important distinctions between the planning areas, because oil and gas activities already occur in the Southern California Planning Area. If existing infrastructure in this area cannot absorb increased production, then onshore construction may create potential impacts. Due to decommissioning trends in the Pacific Region, impacts would depend on various factors, including the number of leases issued and existing state laws. OCS oil and gas activities may constitute an entirely new use of the ocean and impact onshore zoning by expanding industrial areas, particularly ports (Tyler and Ward 2011).

R.13 **CULTURE:** Impacts on culture from bottom/land disturbance is potentially significant in all planning areas of the Pacific Region except Southern California. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Impacts on vulnerable coastal communities from bottom/land disturbance is potentially significant in all Pacific planning areas except Southern California. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

I.5 EMISSIONS

R.1 **AIR QUALITY:** Emissions are potentially significant for air quality in the Southern California Planning Area, because new offshore facilities and offshore mobile sources emit additional criteria and precursor pollutants, which could affect onshore $PM_{2.5}$ and O_3 nonattainment areas. New OCS oil and gas activity here may exacerbate already degraded air quality in coastal areas, particularly in the Ventura County Air Pollution Control District and South Coast Air Quality Management Districts, which include much of the Los Angeles Metropolitan Area. Emissions may also impact San Gabriel, Cucamonga, San Jacinto, and Agua Tibia Wilderness Areas and Joshua Tree National Park, which are designated as Class I areas. See **Appendix C** for expected OCS emissions.

The existing facilities in Federal and state waters are regulated by the onshore air regulations of local air agencies that have been delegated air quality authority by USEPA. Some of the existing OCS facilities currently located off southern California are powered via the onshore electric grid. However, construction of new facilities operating on natural gas could contribute to the already elevated $PM_{2.5}$ and O_3 concentrations onshore. These effects may be recurring but localized to the Southern California Planning Area. See **Appendix C** for expected OCS emissions.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Emissions are potentially significant for vulnerable coastal communities in the Southern California Planning Area because of reasons explained above in air quality**.**

I.6 LIGHTING

R.7 **BIRDS:** Lighting is potentially significant for birds in all Pacific planning areas. Several pelagic species—including the ESA-listed short-tailed albatross and Hawaiian petrel, as well as the globally rare ashy storm-petrel and Scripps's murrelet—are especially vulnerable due to their small population sizes. These species are susceptible to disorientation and collision from lighting on offshore vessels and structures.

R.13 **CULTURE:** Lighting is potentially significant for culture in all Pacific planning areas except Southern California. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Lighting is potentially significant for vulnerable coastal communities in all Pacific planning areas except Southern California. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.15 **RECREATION & TOURISM:** Lighting is potentially significant for recreation and tourism in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

I.7 VISIBLE INFRASTRUCTURE

R.11 ARCHAEOLOGICAL & CULTURAL RESOURCES: Visible infrastructure is potentially significant for archaeological and cultural resources in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.12 LAND USE: Visible infrastructure is potentially significant for land use in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.13 CULTURE: Visible infrastructure is potentially significant for culture in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3.**

R.14 VULNERABLE COASTAL COMMUNITIES: Visible infrastructure is potentially significant for vulnerable coastal communities in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3.**

R.15 RECREATION & TOURISM: Visible infrastructure is potentially significant for recreation and tourism in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

I.8 SPACE-USE CONFLICTS

R.10 COMMERCIAL & RECREATIONAL FISHERIES: Space-use conflicts are potentially significant for commercial and recreational fisheries in all Pacific planning areas. Space-use conflicts with OCS oil and gas activities may disrupt access to fishing grounds and may have substantial impacts, because the fishing industry generates a large number of jobs in this region and is an integral part of many communities (NMFS 2021b). However, mitigation measures could potentially reduce or avoid impacts, depending on the timing, location, and nature of development activities.

R.12 LAND USE: Space-use conflicts are potentially significant for land use in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.13 CULTURE: Space-use conflicts are potentially significant for culture in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.14 VULNERABLE COASTAL COMMUNITIES: Space-use conflicts are potentially significant for vulnerable coastal communities in all Pacific planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.15 RECREATION & TOURISM: Space-use conflicts are potentially significant for recreation and tourism in all Pacific planning areas. Negative perception related to increased industrialization may impact the tourism industry along the Pacific Coast and divert interest to other natural areas as substitutes (Klenosky et al. 2007). OCS oil and gas activities that overlap with tourism uses or recreational activities may have long-term effects on this industry, which depends on wilderness land and seascapes.

4.1.8 Potentially Significant Impacts in the GOM Region

Potentially significant impacts in the GOM Region are shown in **Figure 4-7** and explained below. If an IPF is not expected to have a significant impact on a particular resource, the interaction is not listed in this section but is discussed in **Appendix A**. See **Sections 2.4.3** and **4.1.3** for a general discussion of IPFs and national impacts.

Gulf of Mexico Region

	I.1 Noise	I.2 Traffic	I.3 Routine Discharges	I.4 Bottom/ Land Disturbance	I.5 Emissions	I.6 Lighting	I.7 Visible Infrastructure	I.8 Space-Use Conflicts
R.1 Air Quality					S*			
R.2 Water Quality		N	S	N				
R.3 Pelagic Communities	N	N	N	N		N		
R.4 Marine Benthic Communities	N	N	S	S		N		
R.5 Coastal & Estuarine Habitats	N	S		S				
R.6 Fish & Essential Fish Habitat	S	N	N	N		N		
R.7 Birds	N	S	N	S	N	S		
R.8 Sea Turtles	S	S	N	S	N	S		
R.9 Marine Mammals	S	S	N	N	N	N		
R.10 Commercial & Recreational Fisheries	N	N	N	N		N		S
R.11 Archaeological & Cultural Resources			N	S			S*	
R.12 Land Use	N	S*	S*	S*	N	N	S*	S*
R.13 Culture	S*	S*	N	S*	N	N	S*	S*
R.14 Vulnerable Coastal Communities	S*	S*	N	S*	N	N	S*	S*
R.15 Recreation & Tourism	S*	N		N	N	S*	S*	S*

- S* = half-yellow, half-orange "S" cell in the figure (potential for significant impacts in at least one but not all planning areas); empty cell = does not interact
- S: Potentially significant
- N: Not expected to be significant
- (grey): Does not interact
- S (yellow/orange): Potential for significant impacts in at least one but not all planning areas

Figure 4-7. Interaction between oil and gas IPFs and marine resources (GOM Region)

I.1 NOISE—See **Appendix B** for a general description of the impacts of noise.

R.6 **FISH & ESSENTIAL FISH HABITAT:** Noise is potentially significant for fish and EFH in all GOM planning areas. Fish with swim bladders—such as snappers, jacks, groupers, cobia, and tunas—may be susceptible to injury when close to high-energy sources like seismic airguns or explosive decommissioning. Behavioral impacts from noise are more likely than injury or mortality and may also be more widespread. An in situ study on Atlantic bluefin tuna showed that vessel noise may disorient fish and change schooling dynamics (Sarà et al. 2007). Therefore, noise may temporarily disrupt normal behaviors in this species, which spawns throughout the GOM Region (Teo et al. 2007). Several sound-producing fishes inhabit parts of the GOM (Wall et al. 2013), including commercially important species such as red drum, red snapper, and grouper. Most of these species are sensitive to low-frequency sound and use acoustic signals to coordinate spawning (Locascio and Burton 2015; Mann et al. 2009; Montie et al. 2016; Nelson et al. 2011). Noise may cause masking or disruption of important behaviors; however, impacts are dependent upon proximity to the sound source, signal characteristics, and whether the noise co-occurs with reproductive activity.

R.8 **SEA TURTLES:** Noise is potentially significant for sea turtles in all GOM planning areas. Seismic activity may impact both breeding and hatchling Kemp's ridley sea turtles, which occur in all GOM planning areas. Soon after hatching, Kemps' ridley sea turtles swim into the open ocean and drift with floating *Sargassum* patches (FWS 2015). Although adult turtles would probably swim away from approaching seismic vessels and only experience behavioral disturbance (DeRuiter and Larbi Doukara 2012), younger and slower turtles may struggle with avoidance (BOEM 2014).

R.9 **MARINE MAMMALS:** Noise is potentially significant for marine mammals in all GOM planning areas. Disturbance from noise in the Eastern GOM Planning Area has the potential for greater impacts than in other GOM planning areas because of the lack of existing oil and gas activity there. Populations of sperm whales and beaked whales are expected to be most susceptible to auditory injury or behavioral disturbance from deep-penetration seismic surveys (BOEM 2017d; Farmer et al. 2018). As described in **Section 2.8**, the Rice's whale population is found in the Eastern GOM Planning Area and may be impacted by increased noise from vessels or seismic airguns in this area (Estabrook et al. 2016; Putland et al. 2018). Manatees spend most of their time near coastlines and have greatest hearing sensitivity in higher frequencies (Gaspard III et al. 2012), so they may be less affected by airgun noise. Several distinct populations of resident bottlenose dolphins live along the western and northern coasts of Florida (Van Parijs 2015) and may experience behavioral disturbance from noise when they venture farther from the coast.

> Several species of baleen and toothed whales in all GOM planning areas may experience behavioral disturbance from noise, particularly noise generated by seismic airguns or vessels. When in very close proximity to airguns, it is possible that auditory injury could also occur. For a detailed analysis of potential impacts, see the GOM G&G Programmatic EIS (BOEM 2017d).

R.13 CULTURE and **R.14 VULNERABLE COASTAL COMMUNITIES:** Noise is potentially significant for culture and vulnerable coastal communities in the Eastern GOM Planning Area because, in contrast to the well-developed Western and Central GOM Planning Areas, new development may be required if the necessary facilities do not yet exist. High densities of low-income communities and minority populations are more prevalent near ports (i.e., industrialized areas) within these planning areas. Increased noise from construction, port staging, and increased vessel traffic may disproportionately impact these vulnerable coastal communities near industrial zones in the Eastern GOM Planning Area (Maantay et al. 2010; USEPA 2018e). Onshore noise at ports and other facilities that serve the Western and Central GOM Planning Areas, or facilities near the Western and Central GOM Planning Areas used as a base for activity in the Eastern GOM Planning Area, may extend existing noise-related impacts on nearby communities but would likely represent a continuation of baseline noise levels.

R.15 RECREATION & TOURISM: Noise is potentially significant for recreation and tourism in the Eastern GOM Planning Area. The difference in existing industrialization and oil and gas activity between the Western and Central GOM and the Eastern GOM Ecoregions drives many of the differences in potential impacts on recreation and tourism. Because Florida is so reliant on its recreation and tourism industry, any negative impacts (e.g., nearshore and onshore noise from oil and gas support industry vessels, shipyards) associated with OCS oil and gas activities may deter visitors and negatively affect Florida’s economy.

I.2 TRAFFIC

R.5 COASTAL & ESTUARINE HABITATS: Traffic is potentially significant for coastal and estuarine habitats in all GOM planning areas. Vessel traffic (e.g., tankers, barges, support vessels, and seismic survey vessels) associated with oil and gas activities and pipeline installation may increase wave erosion and habitat disturbance.

> In all the GOM planning areas, stressors such as sea level rise, land loss, and subsidence are already placing pressure on coastal and estuarine habitats. The addition of increased vessel traffic from OCS oil and gas activities may exacerbate coastal and estuarine habitat loss.

R.7 BIRDS: Traffic is potentially significant for birds in all GOM planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.8 SEA TURTLES: Traffic is potentially significant for sea turtles in all GOM planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.9 MARINE MAMMALS: Traffic is potentially significant for marine mammals in all GOM planning areas. Rice’s whales spend 90% of their time within 39 ft (12 m) of the ocean’s surface (Constantine et al. 2015), which makes them vulnerable to collisions with large ships. Manatees are slow moving and are often struck by smaller boats (FWS 2001). Increased vessel activity along the coast may put both species at risk, especially in the Eastern GOM Planning Area, where Rice’s whales reside and where manatees are concentrated. Manatees undertake seasonal movements along the Gulf Coast during the summer and fall.

R.12 **LAND USE:** Traffic is potentially significant for land use in the Eastern GOM Planning Area. Existing infrastructure in the GOM Region may need to expand to accommodate additional needs, and new onshore infrastructure may need to be built in Florida. It is uncertain how much onshore infrastructure would be needed in this area to support development, as it depends on several factors (e.g., industry interest in leasing and exploration, oil prices, economic feasibility of development, proximity of activities to existing infrastructure, and ability for existing infrastructure in the Western and Central GOM to accommodate additional activities in the Eastern GOM). Although unlikely, if development occurs at such a level that causes aircraft, vessels, and onshore traffic to increase, then traffic patterns or infrastructure needs may change. Additional traffic from industrial activities, waste management, and roadway expansions, particularly in port areas that may be used for staging oil and gas activities (e.g., Tampa Bay, Panama City, and Pensacola), may impact land use (BOEM 2018a; Bulleri and Chapman 2010; Dismukes 2011; World Port Source 2018c).

R.13 **CULTURE:** Traffic is potentially significant for culture in the Eastern GOM Planning Area due to the potential impacts on Tribal communities located along Florida's Gulf Coast. The impacts may vary if existing infrastructure in the GOM Region cannot accommodate additional needs and new onshore infrastructure is built in Florida.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Traffic is potentially significant for vulnerable coastal communities in the Eastern GOM Planning Area if new onshore support facilities were to be developed in coastal areas bordering the Eastern GOM Planning Area. Existing infrastructure in the GOM Region may need to expand to accommodate additional needs, and new onshore infrastructure may need to be built in Florida, creating new vessel and aircraft traffic patterns. Use of existing ports, shipping channels, or onshore transportation infrastructure in communities bordering the Western and Central GOM Planning Areas may contribute to extending existing traffic-related impacts in those areas, including any existing impacts disproportionately born by vulnerable communities due to proximity to transportation infrastructure.

I.3 ROUTINE DISCHARGES

R.2 **WATER QUALITY:** Routine discharges are potentially significant for water quality in all GOM planning areas. Protected areas and sensitive habitats (such as areas with the shallow and deepwater coral reefs that are common throughout the region) may be particularly impacted by degraded water quality. These impacts can be minimized through compliance with NPDES and other regulatory requirements; however, they are still expected to be significant.

R.4 **MARINE BENTHIC COMMUNITIES:** Routine discharges are potentially significant for marine benthic communities in all GOM planning areas. Discharges of drilling muds and cuttings may cover and smother hard bottom communities. In the Eastern GOM Planning Area, these discharges may be of particular concern on the West Florida Slope, an area that supports more complex reef habitat than elsewhere on the GOM slope (Ross et al. 2017). Although these impacts are expected to be localized, they may be long term and lead to additional recovery time in some benthic ecosystems, such as areas with coral reefs. The implementation of mitigation measures that require avoidance of sensitive live bottom communities may reduce potential impacts on these ecosystems.

R.12 **LAND USE:** Routine discharges are potentially significant for land use in the Eastern GOM Planning Area. Existing infrastructure in the GOM Region may need to expand to accommodate additional needs, and new onshore infrastructure may need to be built in Florida. The lack of existing onshore waste disposal sites may require the expansion of industrial areas (most likely near port areas that may be used for staging oil and gas activities, such as Tampa Bay, Panama City Beach, and Pensacola, FL).

I.4 BOTTOM/LAND DISTURBANCE

R.4 **MARINE BENTHIC COMMUNITIES:** Bottom/land disturbance is potentially significant for marine benthic communities in all GOM planning areas. Disturbance from pipeline laying, anchoring, offshore construction, and other OCS activities may lead to mortality and loss of sensitive benthic ecosystems, such as live hard bottom and deepwater coral communities. As noted in I.3 **ROUTINE DISCHARGES**, these impacts are expected to be localized, but may cause long recovery times, especially for slow-growing species like corals. The Eastern GOM Planning Area contains more complex reef habitat than elsewhere on the GOM slope and may be particularly susceptible to bottom disturbance (Ross et al. 2017). Application of mitigation measures requiring avoidance of sensitive marine benthic ecosystems may reduce or eliminate potential impacts on these habitats.

R.5 **COASTAL & ESTUARINE HABITATS:** Bottom/land disturbance is potentially significant for coastal and estuarine habitats in all GOM planning areas. Ongoing stressors such as subsidence, sea level rise, eutrophication, and ocean acidification are already challenging these habitats along the entire Gulf Coast (**Sections 2.5.4** and **2.8.4**). The addition of roads, onshore support bases, and pipelines to distribution points may further stress these coastal and estuarine habitats, leading to erosion and subsequent land loss. These impacts would be expected mainly in the Eastern GOM Planning Area, where additional infrastructure may be required.

R.7 **BIRDS:** Bottom/land disturbance is potentially significant for birds in all GOM planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.8 **SEA TURTLES:** Bottom/land disturbance is potentially significant for sea turtles in all GOM planning areas. Coastal development that leads to permanent alteration of nesting habitats, or even short-term disturbance during nesting periods, may impact sea turtles. Bottom/land disturbance may also destroy SAV habitat that sea turtles depend on for feeding and breeding.

> Sea turtles are slow to reach sexual maturity, and any coastal construction disrupting egg-laying may have population-level effects.

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES:** Bottom/land disturbance is potentially significant for archaeological and cultural resources in all GOM planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.12 **LAND USE:** Bottom/land disturbance is potentially significant for land use in the Eastern GOM Planning Area. Existing infrastructure in the GOM Region may need to expand to accommodate additional activities, and new onshore infrastructure may need to be built in Florida.

R.13 **CULTURE:** Bottom/land disturbance is potentially significant for culture in the Eastern GOM Planning Area due to the presence of Native American peoples and coastal communities with historical ties to recreational fishing located along Florida's Gulf Coast and the coasts of Alabama, Mississippi, and Louisiana.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Bottom/land disturbance is potentially significant for vulnerable coastal communities in the Eastern GOM Planning Area. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

I.5 EMISSIONS

R.1 **AIR QUALITY:** Emissions from new offshore facilities and offshore mobile sources are potentially significant for the onshore areas adjacent to the Central GOM Planning Area. Results of a Wilson et al. (2019) study of future impacts of oil and gas development on the GOM Region suggest that future OCS sources may contribute to onshore criteria pollutant concentration, visibility reduction, and acid deposition. The study showed that new activity may result in elevated O_3 concentrations along portions of the central Louisiana Coast, and visibility and nitrogen deposition impacts at Breton NWR, a Class I Area (**Figure 2-6**). No other onshore emissions impacts from new leasing were found in the study area. Like all new facilities near Class I areas, new OCS facilities near Breton NWR will receive additional scrutiny by the Federal land manager (in this case, by FWS). See **Appendix C** for expected OCS emissions. While destructive, hurricanes do not meaningfully affect air emissions, although facilities do get shut down when they are threatened by storms, resulting in a brief reduction of emissions. Shutting down and restarting operations on a facility may result in a very brief period of higher-than-normal emissions, but those emissions still would be required to remain within all approved air quality plans and air quality permits.

I.6 LIGHTING

R.7 **BIRDS:** Lighting is potentially significant for birds in all GOM planning areas. Russell (2005) estimated that approximately 200,000 migratory birds die annually from collisions with the existing platforms in the GOM, particularly during the fall migration, when these birds travel primarily at night and are attracted to lights on offshore infrastructure. Using special types of lighting (e.g., green wavelengths) (Poot et al. 2008) on new platforms could reduce some of these impacts.

R.8 **SEA TURTLES:** Lighting is potentially significant for sea turtles in all GOM planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.15 **RECREATION & TOURISM:** In the Eastern GOM Planning Area, lighting has the potential to significantly impact recreation and tourism. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

I.7 VISIBLE INFRASTRUCTURE

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES:** Visible infrastructure is potentially significant for archaeological and cultural resources in the Eastern GOM Planning Area. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.12 **LAND USE:** Visible infrastructure is potentially significant for land use in the Eastern GOM Planning Area. OCS oil and gas activities may alter current land use practices because industrial zones and port areas used for staging oil and gas activities may need to expand to support a new industry. Visual effects of industrialization may influence how Florida counties utilize industrial zones and neighboring residential areas (Fainstein 2018; Industrial Economics Inc. 2014).

R.13 **CULTURE:** Visible infrastructure is potentially significant for culture in the Eastern GOM Planning Area. Visible infrastructure nearshore and onshore may have long-term impacts on culture due to the presence of Native American peoples and coastal communities with historical ties to recreational fishing along Florida's Gulf Coast.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Visible infrastructure is potentially significant for vulnerable coastal communities, including Tribal communities, in the Eastern GOM Planning Area. Construction of fixed infrastructure onshore may be necessary to support activity in this planning area. Vulnerable coastal communities are more likely to live near industrial zones and may experience long-term impacts from new visible infrastructure onshore (Dismukes 2011; Dismukes 2014; Maantay 2002b).

R.15 **RECREATION & TOURISM:** Visible infrastructure is potentially significant for recreation and tourism in the Eastern GOM Planning Area. New onshore or offshore development may alter the current landscape and viewshed of the region, as there is currently little industrial activity. The Eastern GOM Planning Area is well known for its scenery and ocean views, attracting tourists and residents to vacation in this area. This influx of visitors contributes significantly to state and local economies, and a change in visitor experience could decrease the number or visitors and therefore decrease revenues.

I.8 SPACE-USE CONFLICTS

R.10 **COMMERCIAL & RECREATIONAL FISHERIES:** Space-use conflicts are potentially significant for commercial and recreational fisheries in all GOM planning areas. In the Western and Central GOM Planning Areas, commercial and recreational fisheries coexist with ongoing oil and gas activities. However, additional activity may worsen existing or create new space-use conflicts. There is relatively little oil and gas activity in the Eastern GOM Planning Area, and the fishing industry may experience new space-use conflicts with oil and gas activities, including loss of fishing ground access and revenue.

R.12 **LAND USE:** Space-use conflicts are potentially significant for land use in the Eastern GOM Planning Area. Existing infrastructure in the GOM Region may need to expand to accommodate additional needs, and new onshore infrastructure may need to be built in Florida. The Eastern GOM Planning Area currently has only one large port (Tampa, FL) and several smaller ports. If new leasing occurs, port infrastructure and road systems may need to be expanded to accommodate a new industry (Tyler and Ward 2011; World Port Source 2018c). Any new onshore support infrastructure may compete for limited available coastal land onshore of the Eastern GOM Planning Area, where land is in high demand for tourism and real estate (Bulleri and Chapman 2010). Nearshore or offshore space-use conflicts may also occur. For example, military infrastructure and associated air or vessel traffic may overlap with OCS oil and gas activities or land uses. However, mitigation measures could potentially reduce or avoid impacts, depending on the timing, location, and nature of development activities.

R.13 **CULTURE:** Space-use conflicts are potentially significant for culture in the Eastern GOM Planning Area due to the potential impact on Native American peoples' cultural connections with the ocean and coast, and on coastal communities with historical ties to recreational fishing along Florida's Gulf Coast.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Space-use conflicts are potentially significant for vulnerable coastal communities in the Eastern GOM Planning Area due to the presence of Native American peoples and coastal communities with historical ties to recreational fishing along Florida's Gulf Coast and low-income coastal towns, especially along the Florida panhandle. Existing impacts from space-use conflicts related to offshore oil and gas in the Western and Central GOM Planning Areas may continue.

R.15 **RECREATION & TOURISM:** Space-use conflicts are potentially significant for recreation and tourism in the Eastern GOM Planning Area. Oil and gas activities that overlap with recreational activities or popular tourist destinations could impact a visitor's experience and, in turn, affect the number of residents and visitors that come to this area, particularly in Key West, Siesta Key, Clearwater, and Sanibel, which are ranked among Florida's top beaches to visit (Auvil 2018).

4.1.9 Potentially Significant Impacts in the Atlantic Region

Potentially significant impacts in the Atlantic Region are shown in **Figure 4-8** and explained below. If an IPF is not expected to have a significant impact on a particular resource, the interaction is not listed in this section but is discussed in **Appendix A**. See **Sections 2.4.3** and **4.1.3** for a general discussion of IPFs and national impacts.

Atlantic Region

	I.1 Noise	I.2 Traffic	I.3 Routine Discharges	I.4 Bottom/ Land Disturbance	I.5 Emissions	I.6 Lighting	I.7 Visible Infrastructure	I.8 Space-Use Conflicts
R.1 Air Quality					N			
R.2 Water Quality		N	S	N				
R.3 Pelagic Communities	N	N	N	N		N		
R.4 Marine Benthic Communities	N	N	S	S		N		
R.5 Coastal & Estuarine Habitats	N	S		S				
R.6 Fish & Essential Fish Habitat	S	N	N	N		N		
R.7 Birds	N	S	N	S	N	S		
R.8 Sea Turtles	S	S	N	S	N	S		
R.9 Marine Mammals	S	S	N	S	N	N		
R.10 Commercial & Recreational Fisheries	N	N	N	N		N		S
R.11 Archaeological & Cultural Resources			N	S			S	
R.12 Land Use	N	S	S	S	N	N	S	S
R.13 Culture	S	S	N	S	N	S	S	S
R.14 Vulnerable Coastal Communities	S	S	N	S	N	S	S	S
R.15 Recreation & Tourism	S	N		N	N	S	S	S

S Potentially significant; N Not expected to be significant; (blank) Does not interact

S (with orange corner) Not expected to be significant in the North Atlantic Planning Area

Figure 4-8. Interaction between oil and gas IPFs and marine resources (Atlantic Region)

I.1 NOISE (See **Appendix B** for a general description of the impacts of noise)

R.6 **FISH & ESSENTIAL FISH HABITAT:** Noise is expected to have potentially significant impacts in all Atlantic planning areas. Fish with swim bladders—such as herring, tuna, and billfish—may be susceptible to injury when within a few hundred meters of high-intensity sound sources like seismic airguns or explosive removals. Atlantic cod are able to detect acoustic pressure and are sensitive to a wider range of acoustic frequencies than most fish, so they may be more susceptible to noise impacts than other species (Astrup and Møhl 1993; Hawkins and Popper 2020). There is evidence that noise exposure can negatively affect growth in cod larvae (Nedelec et al. 2015) and decrease egg production in adults, presumably due to heightened stress levels (Sierra-Flores et al. 2015). However, more recent work with tagged Atlantic cod showed only subtle changes in behavior when exposed to sounds of seismic airguns (Hubert et al. 2020; van der Knaap et al. 2021). Behavioral impacts may occur in other acoustically sensitive fishes—such as haddock and ESA-listed Atlantic salmon (Gulf of Maine DPS), which are ecologically and economically important species. Cod (Rowe and Hutchings 2006), sciaenid fishes (e.g., drum, Atlantic croaker, and spot) (Ramcharitar et al. 2006), and groupers (Sanchez et al. 2017) form large aggregations and use acoustic signals to coordinate spawning. The presence of noise from oil and gas activities during spawning may reduce their “communication space” and limit their ability to successfully reproduce (Stanley et al. 2017).

R.8 **SEA TURTLES:** Noise impacts on turtles are potentially significant in all Atlantic planning areas. Depending on timing and spatial overlap, seismic activity may impact both breeding adults and young hatchling loggerhead and green sea turtles, which occur in the Mid-Atlantic, South Atlantic, and Straits of Florida Planning Areas. Adult turtles would probably swim away from approaching seismic vessels and only experience behavioral disturbance (Lenhardt 1994), but avoidance may be more difficult for younger and slower turtles. Additional stress is also likely to exacerbate occurrences of cold-stunning in juveniles, which has been an increasing issue due to changing sea surface temperatures, especially for Kemp’s ridley sea turtles in the northwest Atlantic (Griffin et al. 2019).

R.9 **MARINE MAMMALS:** Impacts from noise on marine mammals are potentially significant in all Atlantic planning areas. Bottlenose dolphins, short-beaked common dolphins, Atlantic spotted dolphins, short-finned pilot whales, and striped dolphins constitute the majority of individuals that may be disturbed by potential seismic airgun activities because of their relatively high abundance and high spatial overlap with potential activity (BOEM 2014). Five ESA-listed species (North Atlantic right whale, fin, blue, sei, and sperm whales) may also be disturbed by seismic airgun noise (BOEM 2014). Recent evidence shows that North Atlantic right whale mother-calf pairs communicate using low-amplitude sounds, which may be highly susceptible to acoustic masking from vessel and seismic airgun noise (Parks et al. 2019); previous work showed that North Atlantic right whales exhibit elevated stress in the presence of vessel noise (Rolland et al. 2012). A large proportion of North Atlantic right whales, especially lactating females, currently exhibit declining body condition due to varying sources of energetic stress (Pettis et al. 2017). Additional stress on these animals may affect reproduction. This population is already declining, and the lost reproductive potential of just one individual may have population-level effects. Mitigation measures, such as exclusion zones, temporal closures, and protected species observers, may help to avoid or minimize some of these acoustic impacts (**Appendix F**).

> Several species of baleen and toothed whales in all Atlantic planning areas may experience physical or behavioral disturbance from noise, particularly from seismic airguns or vessels. For a detailed analysis of potential impacts, see the Atlantic G&G EIS (BOEM 2014).

R.13 **CULTURE:** Noise impacts are potentially significant for culture in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Noise impacts are potentially significant for vulnerable coastal communities in all Atlantic planning areas. Industrial noise unrelated to offshore oil and gas development is present throughout the Atlantic Region (i.e., shipping, port activity, fishing and fish processing, and ocean-view housing developments) and may reduce the noticeability of oil and gas-related noise.

R.15 **RECREATION & TOURISM:** Noise impacts are potentially significant for recreation and tourism in all Atlantic planning areas. Impacts may be greatest in areas with low preexisting development and noise levels, such as Acadia National Park in Maine, Cape Cod National Seashore in Massachusetts, Assateague Island National Seashore in Maryland, Cape Hatteras National Seashore in North Carolina, Hilton Head Island in South Carolina, and Canaveral National Seashore in Florida. Noise occurring near more urban or industrial areas likely would be less significant than in an area known for nature-based tourism.

I.2 TRAFFIC

R.5 **COASTAL & ESTUARINE HABITATS:** Impacts from traffic on coastal and estuarine habitats are potentially significant in all Atlantic planning areas. Depending on existing levels of vessel activity, additional vessel traffic (such as from pipeline installation, tankering, survey, and support vessels) may lead to increased wave activity and erosion of coastal and estuarine habitats, particularly along low-energy shorelines. If development is planned in areas with high levels of existing activity (e.g., Norfolk, VA), the additional vessel traffic may not have as much of an impact on wave activity and subsequent erosion. These near- and long-term impacts may be compounded with sea level rise, which has accelerated over the past few decades in the coastal areas of the Mid-Atlantic and South Atlantic Planning Areas (Valle-Levinson et al. 2017).

R.7 **BIRDS:** Traffic is potentially significant for birds in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.8 **SEA TURTLES:** Impacts on sea turtles from vessel traffic are expected to be potentially significant in all Atlantic planning areas. Onshore traffic, including construction of roads and vehicle traffic, may affect nesting sea turtles, particularly in the SECS Ecoregion.

R.9 **MARINE MAMMALS:** Impacts on marine mammals from traffic are potentially significant in all Atlantic planning areas. Cetacean species that migrate through all Atlantic planning areas (such as humpback, minke, and fin whales) may be at risk of collisions with vessels that could result in injury or death. North Atlantic right whales have historically suffered from a high rate of vessel strikes (Knowlton and Kraus 2001). These whales appear to hear approaching ships but do not avoid them (Nowacek et al. 2004), putting them at high risk of injury or mortality. North Atlantic right whale collisions have been decreasing within seasonal management areas that cover 20-nmi (37-km) arcs around U.S. Atlantic ports, but ship strikes outside these areas increased from 1990–2012 (van der Hoop et al. 2015) and still pose a substantial threat to this species. Regulations (50 CFR § 224.105) now require ships to limit their speed to 10 kn (18.5 km/hr) in North Atlantic right whale feeding areas and migratory corridors to minimize mortalities (Laist et al. 2014; van der Hoop et al. 2015). Traffic associated with OCS oil and gas activities may have population-level effects considering the small number of North Atlantic right whale individuals left.

R.12 **LAND USE:** Traffic impacts on land use are potentially significant in all Atlantic planning areas. Impacts may be more noticeable where alternate road routes are limited or substantial increases in traffic occur near major cities where traffic congestion already exists (Bulleri and Chapman 2010; Geotab 2018; INRIX 2018). Increased vessel or ship traffic at busy ports in the Atlantic planning areas may also impact land use if existing infrastructure cannot accommodate the additional traffic. Other Federal uses in the Atlantic planning areas may be impacted by increased traffic, both onshore and offshore. For example, additional vessel traffic could potentially overlap with NASA's launch area from the Wallops Flight Facility on the Eastern Shore of Virginia.

R.13 **CULTURE** and R.14 **VULNERABLE COASTAL COMMUNITIES:** Traffic impacts are potentially significant for culture and vulnerable coastal communities in all Atlantic planning areas. An influx of temporary and permanent workers and construction traffic may be introduced to relatively undeveloped or rural areas (where offshore oil and gas activities have not previously occurred) or may strain existing facilities and public services where traffic is already high. The areas that may be impacted include Tribal communities and fishing villages that rely on the ocean's resources for subsistence, areas valued for their maritime heritage, popular beach communities that rely mainly on tourism, and many other places that contribute to the culture of the areas adjacent to the Atlantic planning areas. Vessel traffic may also interfere with Native American use of coastal waterways to convey knowledge of traditional navigation routes to younger generations and to foster connections with neighboring coastal Tribes in the region (Mid-Atlantic Regional Council on the Ocean 2020b). Low-income and minority communities residing in close proximity to onshore support activity may be disproportionately adversely affected by onshore and offshore traffic, especially near areas used for subsistence fishing such as Tangier Island, VA, and the area used by the Gullah/Geechee of the Sea Islands (Worrall 2018; Yale University 2018).

I.3 ROUTINE DISCHARGES

R.2 **WATER QUALITY:** Impacts from routine discharges are potentially significant for water quality in all Atlantic planning areas. Routine discharges, such as produced water and drilling muds or cuttings, would be fairly new to most of the Atlantic Region. These discharges may be localized but unavoidable, though compliance with NPDES permit requirements and current USCG regulations may reduce or minimize impacts on receiving waters caused by discharges from normal operations.

R.4 **MARINE BENTHIC COMMUNITIES:** Impacts of routine discharges are potentially significant for marine benthic organisms in all Atlantic planning areas. Drilling muds and cuttings may smother, alter, or remove benthic organisms and communities. Although generally localized, these impacts may be particularly detrimental to unique or sensitive habitats, such as scattered live bottom or deeper cold-water corals of the Atlantic that are slow growing and have longer recovery times. Mitigation measures that require avoidance of sensitive live bottom communities may reduce potential impacts on these ecosystems (**Appendix F**). Regional impacts are expected throughout the Atlantic planning areas due to the varied benthic communities in each of the planning areas and the importance of each of these benthic communities.

R.12 **LAND USE:** Routine discharges are potentially significant for land use in all Atlantic planning areas, particularly in industrial areas near major ports where new waste processing facilities may be needed (e.g., Boston, MA; New York, NY; Norfolk, VA; Charleston, SC). There are a few oil field waste disposal facilities in the Atlantic, and most have been developed to support onshore drilling activities in Appalachia; however, offshore development likely would require expanded waste processing and disposal capacity for routine discharges taken to shore (Dismukes 2014).

I.4 BOTTOM/LAND DISTURBANCE

R.4 **MARINE BENTHIC COMMUNITIES:** Bottom/land disturbance is potentially significant for marine benthic communities in all Atlantic planning areas. Pipeline laying, anchoring, offshore construction, and other activities associated with oil and gas activities may disturb or destroy sensitive benthic communities, such as live hard bottom areas in the South Atlantic Planning Area or deepwater corals associated with canyons in the Mid-Atlantic Planning Area. Although these impacts are expected to be localized, slow-growing species may take longer to recover. Mitigation and avoidance could minimize potential impacts (**Appendix F**).

R.5 **COASTAL & ESTUARINE HABITATS:** Bottom/land disturbance is potentially significant for coastal and estuarine habitats in all Atlantic planning areas. Coastal and estuarine habitats are already stressed by sea level rise, high human population density, and the presence of large ports along the Atlantic Coast. Adding roads, onshore support bases, and pipelines may further stress these compromised habitats. Atlantic salt marshes are key habitats for the Eastern oyster, a historically ecologically and commercially important species that creates reef habitat for hundreds of associated marine species (Bahr and Lanier 1981). Disturbance and degraded water quality may significantly impact this species and the communities that these reefs support. Submerged coastal habitats like seagrass beds serve as nursery areas for many commercially important fish species and are a key food source for sea turtles and manatees. Bottom/land disturbance may disrupt or destroy not only these coastal habitats, but also the species that depend upon them. These losses would probably be localized but may lead to long-term impacts and shoreline loss.

R.7 **BIRDS:** Impacts from bottom/land disturbance are potentially significant for birds in all Atlantic planning areas. Birds migrating through the Atlantic Flyway depend on coastal habitats in all Atlantic planning areas (Rappole 1995), and many areas along the Atlantic Coast have been designated as Important Bird Areas for resident species (National Audubon Society 2018). Destruction or degradation of coastal and estuarine habitats in all Atlantic planning areas may displace birds from their normal stopover areas, where they feed to build critical migratory and pre-breeding fat reserves (Placyk Jr. and Harrington 2004).

R.8 **SEA TURTLES:** Impacts from bottom/land disturbance on sea turtles are potentially significant in the Atlantic planning areas where turtles nest: Straits of Florida, South Atlantic, and Mid-Atlantic Planning Areas. These areas are particularly important for the ESA-listed loggerhead sea turtle, which has critical reproductive habitat along the coast of the SECS Ecoregion (NOAA 2017d), and green turtles, which also nest regularly in the southeast U.S. (NOAA 2018).

R.9 **MARINE MAMMALS:** Impacts from bottom/land disturbance on marine mammals are potentially significant in all Atlantic planning areas. Several deep-diving toothed whale species feed at the banks and canyons along the edge of the continental shelf in the North and Mid-Atlantic Planning Areas, where prey is abundant (Schick et al. 2011; Stanistreet et al. 2017). Dolphins in the South Atlantic and Straits of Florida Planning Areas feed around reefs and hard bottom habitats. Disturbing such benthic areas may have cascading effects through the food chain, ultimately affecting these predators. Rocky shorelines and beaches of the North and Mid-Atlantic Planning Areas are important haul-out areas for gray and harbor seals, and permanently altering these habitats may have long-term consequences.

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES:** Bottom/land disturbance is potentially significant for archaeological and cultural resources in all Atlantic planning areas. For example, historic underwater battlefields are located along the Atlantic Coast. Mitigation measures may potentially reduce or avoid impacts, depending on the timing, location, and nature of development activities.

R.12 **LAND USE:** Bottom/land disturbance is potentially significant for land use in all Atlantic planning areas. Ports and industrial areas may expand and impact surrounding areas, particularly where there is little industrial development (e.g., the Boston Harbor Islands, Assateague Islands National Seashore, and Everglades National Park). Bottom/land disturbance from OCS oil and gas activities could also impact the growing offshore wind energy in the Atlantic Region.

R.13 **CULTURE:** Bottom/land disturbance is potentially significant for culture in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented **in Section 4.1.3**.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Bottom/land disturbance is potentially significant for vulnerable coastal communities in all Atlantic planning areas but may vary depending on the level of onshore and offshore development. There are no regionally distinct components to the impact analysis presented **in Section 4.1.3**.

I.6 LIGHTING

R.7 BIRDS: Impacts on birds from lighting are potentially significant in all Atlantic planning areas. Increased onshore lighting may affect coastal and pelagic species (Ronconi et al. 2015). Birds migrating through the Atlantic Flyway and other resident birds may alter their behavior, expend excess energy, or deviate from migration patterns. ESA-listed species in this region are especially vulnerable due to smaller population sizes, including the Bermuda petrel, piping plover, red knot, roseate tern, and wood stork. Pelagic species, such as the ESA-listed black-capped petrel, may become disoriented from lighting on offshore structures and vessels.

R.8 SEA TURTLES: Impacts from lighting are potentially significant in the Atlantic planning areas where sea turtles nest: Straits of Florida, South Atlantic, and Mid-Atlantic Planning Areas. Sea turtle hatchlings may be disoriented by onshore lighting during nesting season and nearshore lighting during transit offshore, increasing chances of predation (Thums et al. 2016). These impacts may be particularly detrimental for loggerhead and green sea turtles, which nest regularly in the southeastern U.S.

R.13 CULTURE: Lighting is potentially significant for culture in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.14 VULNERABLE COASTAL COMMUNITIES: Lighting is potentially significant for vulnerable coastal communities in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.15 RECREATION & TOURISM: Lighting is potentially significant for recreation and tourism in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

I.7 VISIBLE INFRASTRUCTURE

R.11 ARCHAEOLOGICAL & CULTURAL RESOURCES: Visible infrastructure is potentially significant for archaeological and cultural resources in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.12 LAND USE: Visible infrastructure is potentially significant for land use in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.13 CULTURE: Visible infrastructure is potentially significant for culture in all Atlantic planning areas. Impacts may vary depending on the extent that new onshore and offshore infrastructure related to oil and gas alters the current landscape and ocean views of the region (Bureau of Transportation Statistics 2018).

R.14 VULNERABLE COASTAL COMMUNITIES: Visible infrastructure is potentially significant for vulnerable coastal communities in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3.**

R.15 **RECREATION & TOURISM:** Visible infrastructure is potentially significant for recreation and tourism in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

I.8 SPACE-USE CONFLICTS

R.10 **COMMERCIAL & RECREATIONAL FISHERIES:** Impacts from space-use conflicts on commercial and recreational fisheries are potentially significant in all Atlantic planning areas. Fishing activity is high, and associated fishing communities are dense along the U.S. East Coast (NMFS 2021b); overlap with oil and gas activities is likely. Oil and gas activities may impact access to economically important areas for fishing, which may affect landings and revenue.

R.12 **LAND USE:** Space-use conflicts are potentially significant for land use in all Atlantic planning areas. The impacts are expected to vary with location depending on whether oil and gas development would require new or expanded onshore infrastructure (e.g., roads, ports, shipyards) (Mid-Atlantic Regional Council on the Ocean 2014; Northeast Regional Ocean Council 2018; The Louis Berger Group Inc. 2004). OCS oil and gas activities may affect Federal activities, such as offshore military uses and space launch activities from NASA’s Wallops Flight Facility on the Eastern Shore of Virginia, and the growing offshore wind energy industry.

R.13 **CULTURE:** Space-use conflicts are potentially significant for culture in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Space-use conflicts are potentially significant for vulnerable coastal communities in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

R.15 **RECREATION & TOURISM:** Space-use conflicts are potentially significant for recreation and tourism in all Atlantic planning areas. There are no regionally distinct components to the impact analysis presented in **Section 4.1.3**.

4.2 ALTERNATIVES ANALYSIS

The Final Programmatic EIS presents Alternatives A–D in order of increasing geographic area. Alternative A includes no new OCS oil and gas leasing, and Alternative D considers the full scope of the Draft Proposal lease sale schedule, which includes 25 planning areas (BOEM 2018a). The alternative analyses include for each alternative a summary of the potentially significant impacts by resource and planning area.

The analysis in this section builds on the discussions covered in **Chapter 2 and Section 4.1**. The affected environment described in **Chapter 2** includes the future baseline conditions that are a result of current and future stressors for each resource. These future baseline conditions would occur *regardless of whether* new leasing takes place under the 2024–2029 Program; they provide context for the analysis of all four alternatives, because the impacts of each alternative are additive to the future baseline conditions. Each alternative refers to the environmental impacts described in **Sections 4.1.3 and 4.1.6–4.1.9** rather than repeat the impacts analysis under each alternative.

The alternatives analysis also builds up incrementally starting with the discussion of Alternative A. Alternative A assumes no new leasing under the 2024–2029 Program. The analysis of Alternative A considers the incremental impacts that result *because* there is no new leasing. These impacts result from energy substitutions and, in some OCS regions, include impacts on employment and income.

For each action alternative (Alternatives B–D), this document analyzes the incremental impact of new leasing in specific planning areas (**Figure 1-5**).

In addition to impacts within the planning areas where oil and gas activities take place, these activities may affect resources outside of the planning area where the activities occur. These "cross-boundary" impacts may occur across the OCS, including in planning areas not included in the 2024–2029 Program.

> ***What are cross-boundary impacts?*** Cross-boundary impacts are impacts from activities in one planning area that affect resources in other planning areas. Cross-boundary impacts occur in two ways: (1) an IPF (such as noise or spilled oil) may spread into an adjacent planning area and affect the species and habitats there (**Figure 4-9**), or (2) migratory species may experience effects from oil and gas activities occurring in a particular planning area and be impacted as they migrate through the affected planning area to another area.

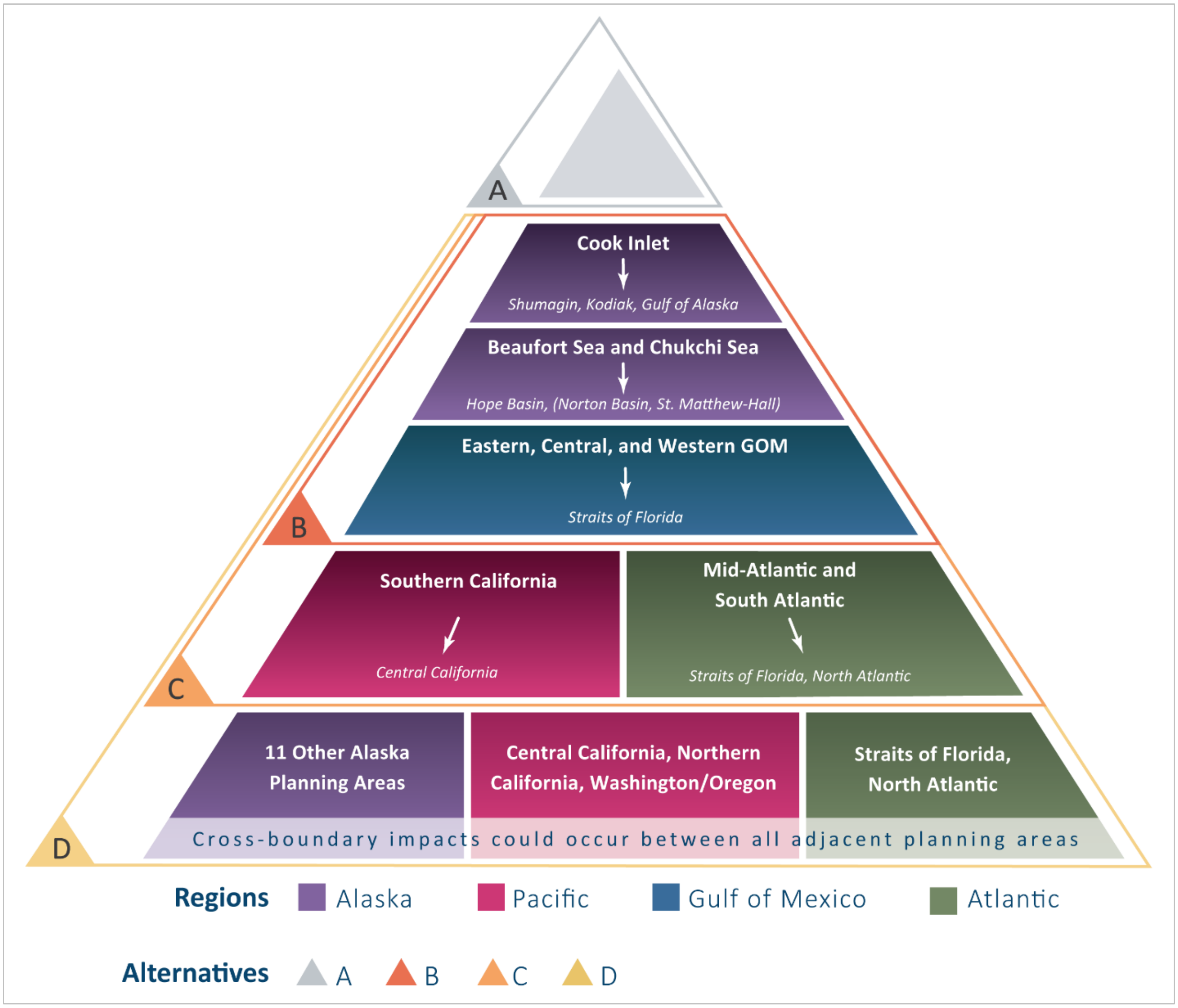


Figure 4-9. Planning areas that could be directly affected (bold white) or are most likely to be indirectly affected by leasing under Alternatives B–D via cross-boundary impacts (italicized white)
Planning areas listed in parentheses are farther away from areas of activity but could still be affected by cross-boundary impacts.

Figure 4-9 shows geographic adjacency of planning areas that may have cross-boundary impacts. For example, oil and gas activity in the Cook Inlet Planning Area could affect the adjacent Shumagin, Kodiak, or Gulf of Alaska Planning Areas if sound were to propagate or an oil spill were to spread out of the Cook Inlet Planning Area. Also, species that move from one planning area to another could experience another type of cross-boundary impact. For example, many birds and marine mammals described in **Chapter 2** spend summers in Alaska and migrate south for the winter, passing through or staying in planning areas in the Pacific, GOM, or Atlantic Regions. A marine mammal that summers in Alaska could experience impacts that continue to affect them as they move south. Similarly, a bird that migrates to the GOM from Alaska could experience impacts in both regions. Each alternative analysis section below includes additional discussion of cross-boundary impacts. Alternative A does not include leasing in any planning area and therefore does not have any cross-boundary impacts.

4.2.1 Alternative A: No Action Alternative (No Leasing)

Under Alternative A, no new leases would be issued under the 2024–2029 Program. The effects analysis focuses on the (1) impacts from energy substitutes and (2) impacts on employment, income, and revenues. The future baseline conditions described in **Chapter 2** apply to all alternatives, including Alternative A.

Alternative A assumes approval of the 2024–2029 Program with no lease sales, and under this alternative no new leases would be issued for the duration of the program in any of the four OCS regions. All potential OCS energy production from new leases would be forgone. BOEM estimates that 0.7 to 4.6 BBOE of OCS energy production may be forgone under Alternative A relative to a five GOM lease sale scenario, with an estimated 2.97 BBOE of forgone OCS energy production under the mid activity scenario. This estimate is based on the analysis for five lease sales. **Table 4-2** presents the estimated proportions of substitute energy sources (calculated at the mid activity level).

4.2.1.1 Energy Substitution

Estimates for Alternative A, which use as a baseline the Energy Information Administration's *2023 Annual Energy Outlook* (EIA 2023a), indicate that foreign oil production would replace between 55% and 57% of the OCS oil and gas production estimated in five GOM lease sales. Increased domestic oil and gas production would replace between 23–24% (**Table 4-2**). Approximately 10–11% of the production from five GOM lease sales would not be replaced. Other energy substitutes, mostly natural gas plant liquids, but also biofuels, coal, renewable energy, nuclear energy, and gas imports would replace the remaining 10%. However, BOEM recognizes that as future energy policies change to meet national GHG emissions reduction commitments, future energy market patterns may differ from what is projected in the baseline. Estimates of necessary energy substitutes are similarly uncertain.

For over a decade, BOEM has used the energy market simulation model MarketSim (Industrial Economics Inc. 2023a) to estimate energy substitutions that would replace forgone OCS production. The MarketSim model shows only limited change in the domestic demand for energy between the different alternatives. Forgone OCS production from Alternative A, the alternative with the largest amount of forgone production, would likely lead to increased energy prices, causing a marginal decrease in energy consumption.

MarketSim does not show significant changes in offshore wind energy in response to National OCS Program decisions. State energy policies, rather than market forces, are likely to be the major driver of offshore wind energy development for the foreseeable future. Furthermore, wind energy cannot substitute for oil and natural gas for all energy needs. The Proposed Program and PFP provide more details on energy substitutions.

MarketSim is calibrated to a special run of the EIA's National Energy Modeling System (NEMS). The NEMS baseline is modified to include no new OCS leasing after the start date of the program (i.e., the No

Action Alternative). Removing the EIA's production expectation from new OCS leasing allows BOEM to use MarketSim to investigate alternative new OCS leasing scenarios within the EIA's broad energy market projections. For the PFP analysis, BOEM requested and used a modified version of the EIA's *2023 Annual Energy Outlook* reference case, which includes no new OCS lease sales starting in 2023.[16] MarketSim makes no assumptions about future technology or policy changes other than those reflected in the EIA NEMS forecast (Industrial Economics Inc. 2023a). Chapter 1 of the Final EAM provides a detailed description of the MarketSim as well as updates made to it. BOEM recognizes and emphasizes the significant uncertainty about what controlling policies and actual practices will be in place concerning GHG emissions in the U.S. and abroad over the next decades. The model does not attempt to quantify how demand for OCS oil and gas and substitute energy sources would change with significant market changes that would be required to reach net-zero domestic GHG emissions by 2050, the objective agreed to by President Biden and the parties to the Paris Agreement.

As described in the Proposed Program, BOEM asked for public comments and input to assist the Bureau in improving its net-zero analysis. Based on comments received, BOEM, in conjunction with its contractor, performed the sensitivity tests to determine impacts of different net-zero scenarios on modeling results. Chapter 4 of the Final EAM includes a discussion on future changes in energy laws and policies as the U.S. progresses towards its climate goals for a net-zero emissions economy. In addition, the chapter provides a qualitative discussion of the different domestic net-zero pathways and summarizes sensitivity analyses for the impacts on BOEM's net-zero and GHG analyses, assuming changes to U.S. laws and policies will be implemented.

Table 4-2. Anticipated energy substitution under Alternative A as compared to five GOM lease sales assuming current energy consumption patterns continue

Energy Sector	Substitution Percentage (%)
Domestic onshore oil and gas	23–24
Existing OCS oil and gas, and oil gas in state waters	< 1
Oil imports	55–57
Gas imports	1
Coal	< 1
Electricity from sources other than coal, oil, or gas (e.g., hydropower, solar, renewable*)	1
Other energy sources**	7
Conservation or reduced demand	10–11

* Although renewable energy production (including production from offshore wind energy projects) is expected to increase over the next several decades, it is not likely to be a substitute for OCS oil and gas production under Alternative A.
**The 'Other Energy Sources' substitution category includes biofuels, other natural gas, and other oil. Other oil is by far the largest component and is comprised of refinery processing gain, product stock withdrawal, natural gas plant liquids, and liquids from coal. Roughly 80% of the other oil category are natural gas plant liquids.

[16] The modified NEMS data used in MarketSim's baseline (and calibrated to the AEO 2023) was provided to BOEM on April 7, 2023 (EIA 2023c).

Energy substitutes would have their own environmental impacts. The analysis for Alternative A considers these potential impacts over a period of 40 to 70 years, which is the timeline associated with 2024–2029 Program activities. BOEM uses the OECM to estimate environmental and social costs that result from different energy sectors and potential energy substitutions (Industrial Economics Inc. 2018) (**Section 1.6**). OECM documentation describes the impacts from different energy sectors at a high level. The Alternative A analysis focuses on impacts resulting from these substitutes on the OCS or adjacent coastal areas commensurate with the scope of analysis for the other alternatives.

It is difficult to evaluate and definitively characterize the impacts of energy substitution (e.g., onshore oil spills, pollution from coal mining, air emissions from burning biomass energy sources) because of uncertainty about how, when, and where energy substitutes would be produced and supplied and because of uncertainty about whether current energy consumption patterns will continue in the face of the 2030 and net-zero 2050 national GHG emissions reduction targets. Therefore, this Final Programmatic EIS does not specify the planning areas in which the substitution impacts may occur. Most substitutes would not be produced within BOEM OCS planning areas, though they may travel through them as in the case of additional imports, and the variable location and distance must be considered when evaluating impacts and implications on OCS planning areas.

In general, energy substitution impacts are anticipated to be similar across the Atlantic, GOM, and Pacific Regions. Most energy sources that substitute for forgone OCS production in the Alaska Region would be produced outside Alaska, so impacts from energy substitutes are not expected there for any resources (BOEM 2018a) (**Figure 3-4**). No additional tankering is expected because Alaska already imports almost all its refined oil and gas resources by tanker, barge, or train.

Energy substitution in the Pacific, GOM, and Atlantic Regions (**Figures 3-8, 3-12, and 3-16**) may impact resources by increasing noise, vessel traffic, routine discharges, bottom/land disturbance, lighting, or accidental spills. Tankering across the Pacific, GOM, or Atlantic Regions may increase substantially due to an expected increase in foreign oil imports. Increased tankering and port expansion may also require more dredging to maintain or create channels for tanker traffic. Oil and gas activities could also increase in state waters, on existing Federal leases, and onshore (BOEM 2022b; Industrial Economics Inc. 2023a). These activities may increase air emissions and routine discharges. Accidental oil spills from tankers and other sources may increase.

4.2.1.2 Resources Impacted Under Alternative A

This section discusses impacts under Alternative A, as well as the socioeconomic implications of not issuing new leases in OCS areas where leasing regularly occurs. **Figures 3-4, 3-8, 3-12, and 3-16** illustrate potential impacts on resources in each region if no new leasing occurs under the 2024–2029 Program. The Alternative A analysis is based on the potential impact of a no action decision. Impacts are not analyzed relative to any other alternative, and information on aspects of another alternative (i.e., Alternative D) are provided only for reference. Implementing a program with no new leasing would avoid generating emissions directly from lease activity. Baseline conditions likely would not change if there is no new leasing under the 2024–2029 Program. BOEM acknowledges that leasing (particularly in the GOM) beyond the 2024–2029 Program could occur and therefore may be reasonably foreseeable.

R.1 AIR QUALITY: The production and transportation of substitute energy sources in the U.S. and elsewhere may emit criteria and precursor air pollutants. Import of oil via tankers may increase shipping traffic to U.S. ports and in shipping lanes; these mobile sources would release air pollutants. Emissions from substituted energy sources are not expected to have a measurable impact on air quality in any OCS areas. However, emissions from the exploration, development, production, and decommissioning of substitute energy sources may occur in state waters, onshore, or in other countries, such that a net increase in emissions is expected. This increase is due in part to longer vessel trips required for bringing in the imported oil and to imports produced in countries with less stringent air regulatory programs. **Appendix C** provides estimated emissions totals.

R.2 WATER QUALITY: Producing and transporting substitute energy sources via tankers or barges may produce relatively small volumes of discharges. These discharges may include fuel, waste, invasive species, and other material, and may occur on the OCS and elsewhere. An oil spill associated with energy substitution or increased energy imports may also have short- and long-term impacts on water quality, depending on the volume of discharge.

R.3 PELAGIC COMMUNITIES: Increased tanker or barge discharges may affect the health of pelagic communities. An oil spill associated with energy substitution or increased energy imports may have widespread and both short- and long-term impacts on pelagic communities.

R.4 MARINE BENTHIC COMMUNITIES: Impacts on marine benthic communities from energy substitutes may result from grounding of tankers importing foreign oil, increased dredging to support channels for tanker traffic, and oil spills from oil and gas activities in state waters or originating onshore. Impacts from vessel noise are expected to be localized to shipping areas but may be chronic and long term. An oil spill associated with energy substitution or increased energy imports may have widespread and both short- and long-term impacts on marine benthic communities.

R.5 COASTAL & ESTUARINE HABITATS: Coastal and estuarine habitats may be impacted by energy substitutions, including impacts from noise, vessel traffic, routine discharges, bottom/land disturbance, facility lighting, and accidental spills. To support the increase in tanker traffic, there may be an increase in the frequency and quantity of dredging conducted to create and maintain navigation channels. Ports may need to be expanded to accommodate additional oil imports, which may increase disturbance to nearshore and onshore coastal habitat. An oil spill in nearshore waters or the grounding of a tanker may have short- and long-term impacts on coastal and estuarine ecosystems. A large oil spill associated with increased energy imports may have population-level effects.

R.6 FISH & ESSENTIAL FISH HABITAT: Routine discharges or vessel noise from increased tankering may affect managed and ESA-listed fish species and EFH. An oil spill in nearshore waters or the grounding of a tanker may have long- and short-term impacts on fish and EFH. A large oil spill associated with increased energy imports may have population-level effects.

R.7 BIRDS: Lighting, collisions with tankers, and noise may impact birds. Coastal bird populations may also be impacted by habitat loss from onshore development related to energy substitutions. These impacts may be localized and small in magnitude, but impacts from larger oil spills associated with increased energy imports may have population-level effects.

R.8 **SEA TURTLES:** Noise, vessel strikes, routine discharges, bottom/land disturbance, facility lighting, and accidental spills related to energy substitutes may impact sea turtles. Turtles may be killed or injured by vessel strikes or entrainment by dredging conducted to maintain navigation channels. Dredging or placing sand on nesting beaches may impact nearshore or onshore habitat. A large oil spill associated with increased energy imports may have population-level effects.

R.9 **MARINE MAMMALS:** Tanker noise and vessel strikes are particular concerns for marine mammals. These impacts would likely occur primarily in shipping lanes and are unlikely to have population-level effects on most marine mammals. However, marine mammal species with few individuals (e.g., North Atlantic right whale) may experience population-level effects. A large oil spill associated with increased energy imports may have population-level effects as well.

R.10 **COMMERCIAL & RECREATIONAL FISHERIES:** Space-use conflicts may arise from vessel traffic associated with increased energy imports in fishing areas, though the increased traffic is unlikely to measurably affect fishing effort or landings. A large oil spill associated with increased energy imports may reduce landings.

R.11 **ARCHAEOLOGICAL & CULTURAL RESOURCES:** Increased dredging, groundings, or activities related to onshore or offshore energy development that may be required for energy substitution may cause localized bottom/land disturbance and affect these sites. A large oil spill associated with increased energy imports may also have effects on both onshore and offshore resources.

R.12 **LAND USE:** Infrastructure development to accommodate increased traffic associated with increased energy imports and to support onshore or offshore oil and gas activities, such as port expansion, may impact other uses of land or water (e.g., subsistence, military, NASA launch areas, renewable energy).

R.13 **CULTURE:** In areas where the oil and gas industry is woven into the cultural heritage of people (e.g., Western and Central GOM Planning Areas) (Louisiana State University 2017), the importance of this industry goes beyond employment and economics. The oil and gas industry in this area has provided the cultural basis for generations of families who are generally supportive of and dependent upon ongoing development of this industry. The lack of new leasing may impact people who identify with that culture if they become disassociated from the oil and gas industry because of a loss of employment or income. Onshore construction associated with port expansion or an increase in traffic or oil spills associated with increased energy imports may also impact culture, especially if these things occur near an area used for cultural practices.

R.14 **VULNERABLE COASTAL COMMUNITIES:** Effects related to employment and income may affect the tax base for vulnerable coastal communities, which could impact household income and the ability of local governments to provide services. Individuals from these communities rely on current or prospective income from offshore oil- and gas-related employment in certain areas. The lack of new leasing under Alternative A may affect vulnerable coastal communities in the Western and Central GOM

Planning Areas because the status quo of leasing would be disrupted. Existing impacts from refineries and petrochemical facilities may continue as those facilities continue to process oil and gas from sources other than the OCS. In other areas, like the Alaska Region, current conditions would not be impacted, but potential positive economic effects of leasing may be forgone. Onshore development of substitute energy sources near vulnerable coastal communities may occur. Infrastructure expansion, traffic, and oil spills associated with increased energy imports could impact health, economy, and the environment in these communities, which are more likely to be located near oil and gas infrastructure.

R.15 **RECREATION & TOURISM:** The impacts related to energy substitution may have little effect on recreation and tourism, though an increase in energy-related activities on land or nearshore may make some areas less attractive for recreation and tourism. A large oil spill associated with increased energy imports may have more serious impacts, depending on proximity to popular tourist or recreation areas.

Employment, Income, and Revenues

Under Alternative A, there may be a noticeable impact on employment, income, and revenue for the Western and Central GOM Planning Areas. An expansive OCS oil and gas industry has developed in the Western and Central GOM Planning Areas in response to decades of lease sales and is an important source of employment and income in GOM OCS coastal areas (Louisiana State University 2017). A pause on lease sales under the 2024–2029 Program may disrupt the industry and may cause loss of jobs, income, revenues, and profits. In the absence of new GOM leasing, OCS revenues would likely decline in the short term due to the lack of bonuses and rents, and royalty revenues from new leases would be forgone. As such, revenues available for sharing under GOMESA may be reduced if no new leasing occurs under the 2024–2029 Program. Furthermore, disruption of activity in the GOM may affect future investments in the region. The overall negative economic impacts would depend on the market share of OCS oil and gas supplies relative to other sources, as well as the overall conditions of oil and gas markets at the time.

The Western and Central GOM Planning Areas would experience most of the employment, income, or revenue losses due to a pause of lease sales. However, the economic impacts of GOM activity go beyond the five states in the GOM (**Figure 2-8**). The existing oil and gas industry has influenced land use and population in the GOM over decades. Alternative A may cause impacts on local infrastructure and populations, potentially resulting in some out-migration, reduction in public services, and associated social impacts. Areas in the Alaska, Pacific, and Atlantic Regions that do not already have OCS development would not experience employment, income, or revenue losses but would lose any opportunities that could have resulted from the 2024–2029 Program.

> Alternative A could cause impacts on employment, income, or revenues, particularly in areas that are highly dependent on OCS oil and gas activities, such as the Western and Central GOM Planning Areas.

4.2.2 Alternative B: 6 Planning Areas

Under Alternative B, the 2024–2029 Program would include the planning areas in the Alaska Region where recent leasing has occurred since 2007 (Chukchi Sea, Beaufort Sea, and Cook Inlet Planning Areas) and the GOM Region (Western, Central, and Eastern GOM Planning Areas) (**Figure 1-5**). **Table 4-3** shows where to find the analysis for the planning areas considered under Alternative B, and **Figure 4-10** shows potentially significant impacts under Alternative B.

BOEM estimates that, with five GOM lease sales, there would be approximately 2.97 BBOE of potential production, or 22.1% of the estimated 13.4 BBOE possible with Alternative D (Draft Proposal). Energy substitutes may be required to offset any reduction in energy production in proportions similar to those presented in **Table 4-2**.

The types of impacts from the energy substitutes may be similar to impacts described for Alternative A (**Section 4.2.1**). There likely would be no impact on employment and labor income in the GOM Region.

Table 4-3. Where to find the analysis for planning areas considered under Alternative B

Region	Planning Area(s)	Affected Environment & Future Baseline Conditions	Environmental Consequences
All	All	**Section 2.5**—Overview of Affected Environment and Associated Resources	**Section 4.1.3**—National Overview of Direct and Indirect Impacts of OCS Oil and Gas Activity
Alaska	Cook Inlet Beaufort Sea Chukchi Sea	**Section 2.6**—Alaska Region Affected Environment	**Section 4.1.6**—Potentially Significant Impacts in the Alaska Region
GOM	Western GOM Central GOM Eastern GOM	**Section 2.8**—GOM Region Affected Environment	**Section 4.1.8**—Potentially Significant Impacts in the GOM Region

Alternative B: 6 Planning Areas

Alaska

Cook Inlet

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S	S	S		S		
R.8								
R.9	S	S	S	S				
R.10								S
R.11				S			S	
R.12		S		S			S	S
R.13	S	S	S	S			S	S
R.14	S	S	S	S			S	S
R.15	S					S	S	S

Beaufort Sea

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5	S	S		S				
R.6	S							
R.7		S	S	S		S		
R.8								
R.9	S	S	S	S				
R.10								
R.11				S			S	
R.12		S		S			S	S
R.13	S	S	S	S		S	S	S
R.14	S	S	S	S		S	S	S
R.15	S					S	S	S

Chukchi Sea

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5	S	S		S				
R.6	S							
R.7		S	S	S		S		
R.8								
R.9	S	S	S	S				
R.10								
R.11				S			S	
R.12		S	S	S			S	S
R.13	S	S	S	S		S	S	S
R.14	S	S	S	S		S	S	S
R.15	S					S	S	S

Gulf of Mexico

Eastern GOM

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S		S		S		
R.8	S	S		S		S		
R.9	S	S						
R.10								S
R.11				S			S	
R.12		S	S	S			S	S
R.13	S	S		S			S	S
R.14	S	S		S			S	S
R.15	S					S	S	S

Central GOM

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1					S			
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S		S		S		
R.8	S	S		S		S		
R.9	S	S						
R.10								S
R.11				S				
R.12								
R.13								
R.14								
R.15								

Western GOM

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S		S		S		
R.8	S	S		S		S		
R.9	S	S						
R.10								S
R.11				S				
R.12								
R.13								
R.14								
R.15								

S Potentially significant

⊕ Denotes addition to previous alternative

Impact-Producing Factors

- I.1 Noise
- I.2 Traffic
- I.3 Routine Discharges
- I.4 Bottom/ Land Disturbance
- I.5 Emissions
- I.6 Lighting
- I.7 Visible Infrastructure
- I.8 Space-Use Conflicts

Resources

- R.1 Air Quality
- R.2 Water Quality
- R.3 Pelagic Communities
- R.4 Marine Benthic Communities
- R.5 Coastal & Estuarine Habitats
- R.6 Fish & Essential Fish Habitat
- R.7 Birds
- R.8 Sea Turtles
- R.9 Marine Mammals
- R.10 Commercial & Recreational Fisheries
- R.11 Archaeological & Cultural Resources
- R.12 Land Use
- R.13 Culture
- R.14 Vulnerable Coastal Communities
- R.15 Recreation & Tourism

Figure 4-10. Potentially significant impacts under Alternative B

Alternative B(a): Proposed Action (4 Planning Areas)

As discussed in **Section 1.2.3**, Alternative B(a) includes new leasing in the GOM Program Area (which contains the Western GOM Planning Area, most of the Central GOM Planning Area, and a small portion of the Eastern GOM Planning Area not withdrawn from consideration for leasing under Section 12(a) of the OCS Lands Act) (**Figure 1-2**). Existing infrastructure likely would be able to accommodate additional activities resulting from the 2024–2029 Program. People living adjacent to the GOM Program Area have experienced OCS oil and gas activity for nearly three-quarters of a century. Existing significant impacts may be prolonged by any activities authorized under the 2024–2029 Program, but additional impacts for many resources are not expected. Within the GOM Program Area, there has been enough oil and gas development that sales scheduled under the 2024–2029 Program would not introduce new significant effects but would instead prolong significant impacts that already exist.

4.2.2.1 Cross-Boundary Impacts

Alternative B includes the potential for cross-boundary impacts on the many migratory species that take advantage of high levels of productivity during summer in the Chukchi and Beaufort Seas Ecoregion, as well as on some species that pass through the Eastern GOM and into the Atlantic Ocean. R.9 **MARINE MAMMALS** (e.g., bowhead, humpback, and gray whales) travel north through the Bering Strait each summer to feed on massive blooms of plankton, forage fish, and benthic fauna. Other ice-associated mammals (e.g., ice seals, polar bears, and walrus) traverse the boundary between the East Bering Sea and the Chukchi and Beaufort Seas Ecoregions following seasonal changes in ice extent.

IPFs in the Chukchi and Beaufort Seas Ecoregion may have consequences for migratory species. For example, the eastern north Pacific stock of gray whale travels over 10,000 mi (16,000 km) without feeding during its annual migration along the Pacific Coast. When these whales reach the Chukchi Sea, they feed voraciously on benthic prey (Caraveo-Patiño et al. 2009; Smith et al. 2017b). Oil and gas activities occurring in the Chukchi Sea Planning Area may degrade benthic habitats and diminish this prey resource. Failing to acquire adequate summer nutrition may diminish migration success or even reduce calving rates for gray whales later in the year as Kraus et al. (2007) and Wasser et al. (2017) have described for other whale species. This reduction may impact Washington/Oregon Planning Area R.14 **VULNERABLE COASTAL COMMUNITIES**, which depend upon gray and humpback whales for subsistence-harvest and cultural practices (Tyler 2018).

Subsistence harvests for caribou may also be affected by oil and gas activities in the Chukchi and Beaufort Seas Ecoregion. The range of many caribou herds in Alaska is expansive and even extends into Canada (Alaska Department of Fish and Game 2020). Noise and bottom/land disturbance may affect their migration routes or temporarily displace them from important foraging or breeding grounds, which may make hunting more difficult or costly (Calef et al. 1976; Maier et al. 1998; National Research Council 2003a).

Many migratory R.7 **BIRDS** that forage in the Chukchi and Beaufort Seas Ecoregion breed in coastal habitats elsewhere, including the East Bering Sea Ecoregion. Important populations of birds, including ESA-listed eiders, breed in the Chukchi and Beaufort Seas Ecoregions but winter in the East Bering Sea or Gulf of Alaska Ecoregions. Impacts on pelagic food sources in the Chukchi and Beaufort Seas Ecoregion from noise, routine discharges, accidental spills, or other IPFs may affect these bird species. Lighting or onshore construction may adversely impact the reproductive success of birds that have breeding colonies in the tundra and coastal wetlands of the Chukchi and Beaufort Seas Ecoregion, especially when there are long-term impacts from these stressors. R.2 **WATER QUALITY** degradation during coastal construction may also decrease the foraging success of adult birds, in turn reducing growth rates and energy stores of fledgling chicks (Kitaysky et al. 2006). Some species, such as the black-bellied plover and the long-billed dowitcher (Kaufman 2018b; 2018f), leave their breeding grounds in the Chukchi and

Beaufort Seas Ecoregion to spend the winter along the GOM Coast; these species may be affected by OCS activities in both areas (Kitaysky et al. 2006).

Many R.8 **SEA TURTLES** and large pelagic R.6 **FISHES** travel between and within the GOM and Atlantic Regions. Atlantic bluefin tuna spawn in the Western and Central GOM Planning Areas (Richardson et al. 2016) and move through the Eastern GOM Planning Area into Atlantic waters. Similarly, Atlantic sailfish are known to aggregate near the Yucatan peninsula but later disperse into the Western and Central GOM Planning Areas, as well as parts of the SECS Ecoregion (Lam et al. 2016). Some turtles (e.g., green) spend part of their lives in the GOM Region and part in the Atlantic Region (NOAA 2018). Large marine predators also travel from the GOM Region (through the Straits of Florida Planning Area) into the Gulf Stream, aggregating in areas of high productivity. Sharks utilize these areas to prey upon whale calves, turtles, fishes, and even birds (Calich et al. 2018; Gallagher et al. 2011). These far-ranging animals (Hammerschlag et al. 2012; Quieroz et al. 2015) may pass between the GOM and Atlantic Regions and have the potential to be affected by noise, traffic, and other IPFs in both regions.

Alternative B(a) Cross-Boundary Impacts

The GOM Program Area is relatively isolated from a geographic and oceanographic perspective. However, it is possible that activities could produce impacts in adjacent areas where leasing is not proposed as described above. Oil and gas activities carry a risk of oil spills that can affect surrounding area as occurred during the *Deepwater Horizon* oil spill in the GOM. An oil spill in the GOM Program Area could affect the Eastern GOM Planning Area, Mexican waters, or even portions of the Atlantic planning areas. Numerous species of fishes, sea turtles, and marine mammals in the GOM move among planning areas within the GOM and into the Atlantic Ocean. Individuals may be affected by oil and gas IPFs such that reproductive success or overall fitness are affected, and these impacts may persist even after an animal has moved out of the area where oil and gas activities occur. Of particular relevance in the GOM is the potential for cross-boundary impacts from high-intensity sound sources, such as deep-penetration seismic surveys. The sound produced by these sources in the GOM Program Area could affect animals, such as Rice's whale, that occur almost exclusively in the Eastern GOM Planning Area.

4.2.3 Alternative C: 9 Planning Areas

This alternative considers all planning areas in Alternative B *plus* the Mid-Atlantic, South Atlantic, and Southern California Planning Areas.

Estimated production for the areas included in Alternative C is roughly 11.9 BBOE of OCS energy production more than Alternative A, amounting to about 88.8% of the estimated 13.4 BBOE possible under Alternative D (Draft Proposal). Energy substitutes may be required to offset any reduction in energy production or lag in production if consumption increases. The types of impacts of energy substitutes would be similar to impacts described for Alternative A (**Section 4.2.1**), but at substantially reduced levels because there may be an additional increase in OCS energy production under this alternative. There likely would be no impact on employment and labor income in the GOM Region.

Table 4-4 shows where to find the analysis for the planning areas considered under Alternative C, and **Figure 4-11** shows potentially significant impacts under Alternative C.

Table 4-4. Where to find the analysis for planning areas considered under Alternative C

Region	Planning Area(s)	Affected Environment & Future Baseline Conditions	Environmental Consequences
All	All	**Section 2.5**—Overview of Affected Environment and Associated Resources	**Section 4.1.3**—National Overview of Direct and Indirect Impacts of OCS Oil and Gas Activity
Alaska	Cook Inlet Beaufort Sea Chukchi Sea	**Section 2.6**—Alaska Region Affected Environment	**Section 4.1.6**—Potentially Significant Impacts in the Alaska Region
Pacific	Southern California	**Section 2.7**—Pacific Region Affected Environment	**Section 4.1.7**—Potentially Significant Impacts in the Pacific Region
GOM	Western GOM Central GOM Eastern GOM	**Section 2.8**—GOM Region Affected Environment	**Section 4.1.8**—Potentially Significant Impacts in the GOM Region
Atlantic	Mid-Atlantic South Atlantic	**Section 2.9**—Atlantic Region Affected Environment	**Section 4.1.9**—Potentially Significant Impacts in the Atlantic Region

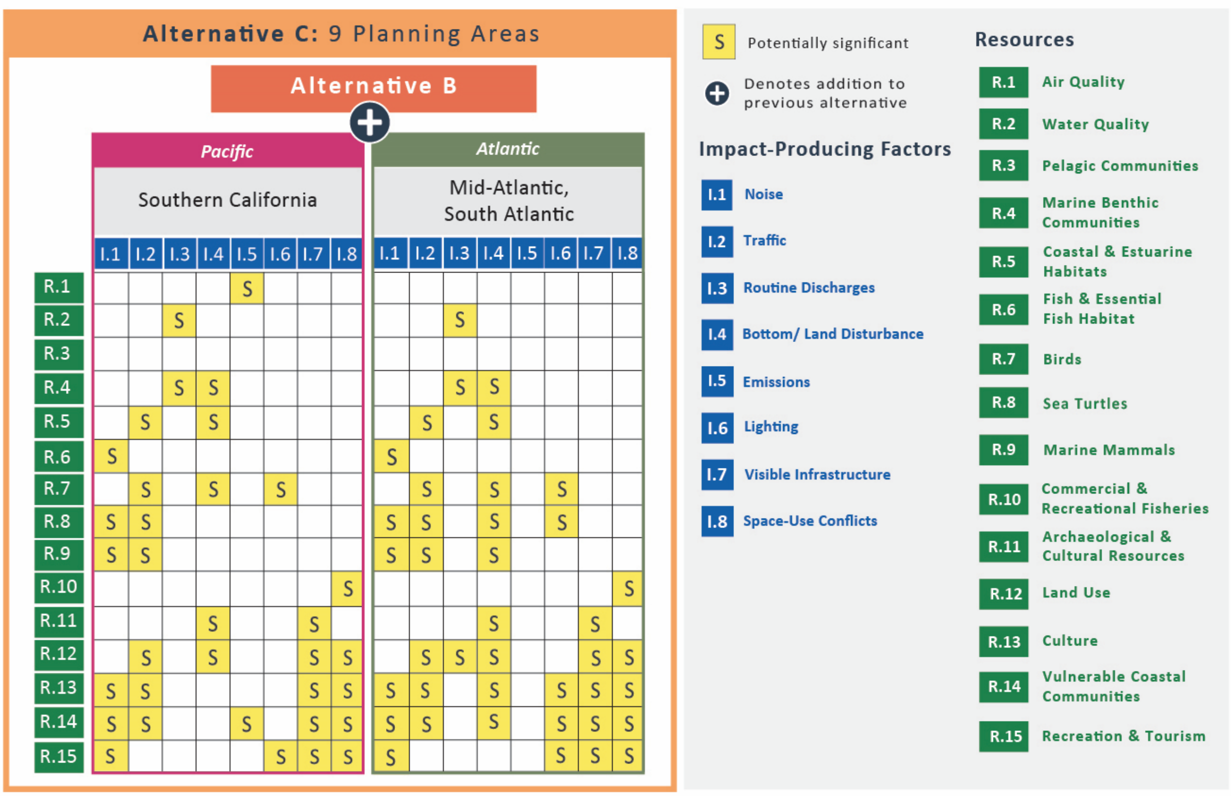


Figure 4-11. Potentially significant impacts under Alternative C

4.2.3.1 Cross-Boundary Impacts

Cross-boundary impacts are expected to occur under Alternative C, in addition to those expected under Alternative B, due to the addition of the Mid-Atlantic, South Atlantic, and Southern California Planning

Areas. A notable **R.9 MARINE MAMMAL** species of concern in the Atlantic Region is the North Atlantic right whale, which migrates annually along the Atlantic coastline (Van Parijs 2015). Calving and nursing typically take place in the South Atlantic Planning Area, and feeding is most frequent in the North Atlantic Planning Area. Additional stress from vessel traffic or noise while in the Mid-Atlantic Planning Area may impact overall health and subsequent calving success (Kraus et al. 2007). Other baleen whales (e.g., minke, blue, sei, humpback) travel along the Atlantic Coast throughout the year and may be similarly impacted from activities occurring in the South and Mid-Atlantic Planning Areas (Van Parijs 2015). In the Pacific Region, blue, humpback, fin, and gray whales occur along the coast; IPFs in the Southern California Planning Area may impact the migratory pathways, overall health, and reproductive success of these species. Impacts on these species, under this alternative, may subsequently impact **R.14 VULNERABLE COASTAL COMMUNITIES** that rely on them for subsistence uses and cultural practices elsewhere along whale migration routes along the Pacific and Alaska Coasts (Braund and Kruse 2009; Tyler 2018).

R.6 FISH and **R.8 SEA TURTLES** may experience similar effects. For example, loggerhead sea turtles that hatch in the Straits of Florida or South Atlantic Planning Areas typically follow the Gulf Stream into the Mid-Atlantic Planning Area before veering east into the open ocean. Many migratory fishes (e.g., sharks, marlin, and tuna) follow similar patterns, pursuing food resources in the rich Gulf Stream eddies. These animals may experience carryover effects from oil and gas activities occurring in the South and Mid-Atlantic Planning Areas. In the Pacific Region, leatherback sea turtles that forage along the coast between the Southern and Central California Planning Areas may also experience cross-boundary impacts.

R.7 BIRDS that migrate through the Southern California, South Atlantic, or Mid-Atlantic Planning Areas may experience cross-boundary impacts from oil and gas activities. For example, the ESA-listed California least tern winters in Mexico but breeds on beaches along the California Coast. This species may be impacted by lighting, land disturbance, or traffic as it passes through the Southern California Planning Area to points further north (Kaufman 2018e). San Diego Bay’s salt ponds, eelgrass beds, and shallow mudflats serve as key feeding areas for many migratory birds. Coastal construction to support OCS activities may disturb these areas, affecting the feeding ecology of species such as the black brant, which migrates between the Chukchi and Beaufort Seas Ecoregion and California (Kaufman 2018c). The ESA-listed red knot nests on shorelines of the Arctic and winters in the Atlantic Region (Kaufman 2018h); this species may experience impacts in both parts of its range under Alternative C. The presence of oil and gas activities near Cape Hatteras may affect a number of pelagic bird species, including the black-capped petrel (a proposed-listed ESA species), because they congregate to feed in Gulf Stream eddies (Haney 1986; Nisbet et al. 2013). Shearwaters and storm-petrels are also common in these areas (Kaufman 2018d) and may be affected by offshore lighting or vessel traffic while passing through the Mid-Atlantic Planning Area during their annual migration.

4.2.4 Alternative D: 25 Planning Areas

This alternative considers all the areas included in the Draft Proposal. Alternative D is estimated to produce roughly 13.4 BBOE, the most of any alternative.

Table 4-5 shows where to find the analysis for the planning areas considered under Alternative D, and **Figure 4-12** shows potentially significant impacts under Alternative D.

Table 4-5. Where to find the analysis for planning areas considered under Alternative D

Region	Planning Area(s)	Affected Environment & Future Baseline Conditions	Environmental Consequences
All	All	**Section 2.5**—Overview of Affected Environment and Associated Resources	**Section 4.1.3**—National Overview of Direct and Indirect Impacts of OCS Oil and Gas Activity
Alaska	Beaufort Sea Chukchi Sea Hope Basin Norton Basin St. Matthew-Hall Navarin Basin Aleutian Basin Bowers Basin St. George Basin Aleutian Arc Shumagin Kodiak Cook Inlet Gulf of Alaska	**Section 2.6**—Alaska Region Affected Environment	**Section 4.1.6**—Potentially Significant Impacts in the Alaska Region
Pacific	Washington/Oregon Northern California Central California Southern California	**Section 2.7**—Pacific Region Affected Environment	**Section 4.1.7**—Potentially Significant Impacts in the Pacific Region
GOM	Western GOM Central GOM Eastern GOM	**Section 2.8**—GOM Region Affected Environment	**Section 4.1.8**—Potentially Significant Impacts in the GOM Region
Atlantic	North Atlantic Mid-Atlantic South Atlantic Straits of Florida	**Section 2.9**—Atlantic Region Affected Environment	**Section 4.1.9**—Potentially Significant Impacts in the Atlantic Region

Alternative D: 25 Planning Areas

Alternative B + Alternative C +

Atlantic — Straits of Florida

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S		S		S		
R.8	S	S		S		S		
R.9	S	S		S				
R.10								S
R.11				S			S	
R.12		S	S	S			S	S
R.13	S	S		S		S	S	S
R.14	S	S		S		S	S	S
R.15	S					S	S	S

Atlantic — North Atlantic

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S		S		S		
R.8	S	S						
R.9	S	S		S				
R.10								S
R.11				S			S	
R.12		S	S	S			S	S
R.13	S	S		S		S	S	S
R.14	S	S		S		S	S	S
R.15	S					S	S	S

Pacific — Washington/Oregon, Northern California, Central California

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S		S		S		
R.8	S	S						
R.9	S	S						
R.10								S
R.11				S			S	
R.12		S	S	S			S	S
R.13	S	S	S	S		S	S	S
R.14	S	S	S	S		S	S	S
R.15	S					S	S	S

Alaska — St. Matthew-Hall, Navarin, Aleutian Basin, Bowers Basin, Kodiak

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S	S	S		S		
R.8								
R.9	S	S	S	S				
R.10								S
R.11				S			S	
R.12		S	S	S			S	S
R.13	S	S	S	S		S	S	S
R.14	S	S	S	S		S	S	S
R.15	S					S	S	S

Alaska — Gulf of Alaska

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5		S		S				
R.6	S							
R.7		S	S	S		S		
R.8	S	S						
R.9	S	S	S	S				
R.10								S
R.11				S			S	
R.12		S	S	S			S	S
R.13	S	S	S	S		S	S	S
R.14	S	S	S	S		S	S	S
R.15	S					S	S	S

Alaska — Hope Basin, Norton Basin, St. George Basin, Aleutian Arc, Shumagin

	I.1	I.2	I.3	I.4	I.5	I.6	I.7	I.8
R.1								
R.2			S					
R.3								
R.4			S	S				
R.5	S	S		S				
R.6	S							
R.7		S	S	S		S		
R.8								
R.9	S	S	S	S				
R.10								S
R.11				S			S	
R.12		S	S	S			S	S
R.13	S	S	S	S		S	S	S
R.14	S	S	S	S		S	S	S
R.15	S					S	S	S

S Potentially significant

+ Denotes addition to previous alternative

Impact-Producing Factors

- I.1 Noise
- I.2 Traffic
- I.3 Routine Discharges
- I.4 Bottom/ Land Disturbance
- I.5 Emissions
- I.6 Lighting
- I.7 Visible Infrastructure
- I.8 Space-Use Conflicts

Resources

- R.1 Air Quality
- R.2 Water Quality
- R.3 Pelagic Communities
- R.4 Marine Benthic Communities
- R.5 Coastal & Estuarine Habitats
- R.6 Fish & Essential Fish Habitat
- R.7 Birds
- R.8 Sea Turtles
- R.9 Marine Mammals
- R.10 Commercial & Recreational Fisheries
- R.11 Archaeological & Cultural Resources
- R.12 Land Use
- R.13 Culture
- R.14 Vulnerable Coastal Communities
- R.15 Recreation & Tourism

Figure 4-12. Potentially significant impacts under Alternative D

4.2.4.1 Cross-Boundary Impacts

Alternative D includes the cross-boundary impacts described for Alternatives B and C, plus potential additional impacts from the other planning areas added in the Atlantic, Pacific, and Alaska Regions (**Table 4-5**). Although excluded from this alternative, the North Aleutian Basin Planning Area may still experience impacts from oil and gas activities occurring in adjacent planning areas (St. George Basin, St. Matthew-Hall, and Shumagin). Given the large geographic scope of this alternative and high degree of connectivity between planning areas, cross-boundary impacts are likely for migratory or wide-ranging species of R.6 **FISH**, R.7 **BIRDS**, R.8 **SEA TURTLES**, and R.9 **MARINE MAMMALS** in multiple planning areas or BOEM ecoregions.

Several species of R.9 **MARINE MAMMALS** travel along the Atlantic Coast throughout the year. For example, minke whales spend winters in low latitudes, where they are thought to breed, and travel to Stellwagen Bank NMS in the North Atlantic Planning Area during the summer to feed on plankton blooms (Risch et al. 2014). Humpback whales follow a similar pattern (Stellwagen Bank National Marine Sanctuary 2011). Although North Atlantic right whales may be expanding their range father north into Canadian waters to follow shifting food webs (Davis et al. 2017), individuals of this species are also generally found year-round along the Atlantic Coast of the U.S., including females with newborn calves (Davis et al. 2017). These species may be impacted by noise, traffic, or other IPFs occurring in any of the Atlantic planning areas and may experience lingering behavioral or physiological effects after they move on to other areas. Cross-boundary impacts on these species may be of particular concern.

Migratory R.7 **BIRDS** may be affected by OCS oil and gas activities in different Atlantic planning areas. Recent efforts to survey marine bird distribution throughout the Atlantic Region has generated predictive models for their abundance (Halpin et al. 2018). For example, some shorebirds move between the North Atlantic and Mid-Atlantic Planning Areas throughout the year (Winship et al. 2018). Atlantic puffins commonly breed on the Atlantic Coast of Canada but may visit pelagic areas of the North Atlantic and Mid-Atlantic Planning Areas in the winter (Kaufman 2018a; Winship et al. 2018). In addition, the ESA-listed piping plover nests on beaches, particularly in the North Atlantic Planning Area (Kaufman 2018g), then migrates south in the winter to the GOM shorelines. Bottom/land disturbance occurring in either region may have impacts on nesting areas, and lighting or traffic associated with offshore structures may disorient or displace birds from their usual migration pathways. Expending additional energy may decrease migrating birds’ ability to return successfully to Canada or other OCS planning areas.

As described in **Section 4.2.3.1**, several migratory species of R.6 **FISH** and R.8 **SEA TURTLES** pass between the GOM and Atlantic Regions and may be affected by OCS activity occurring in either of these areas.

Some R.6 **FISH** and invertebrate species that support important R.10 **COMMERCIAL FISHERIES** regularly migrate within and between Alaska planning areas. For example, red king crabs mate in the nearshore waters of Bristol Bay and afterwards move into deeper waters off the Bering Sea shelf or the Aleutian Islands. Pacific cod, predators of red king crab, also use different parts of the East Bering Sea Ecoregion, migrating between shallow and deep waters at different times of year. Pacific herring spawn in nearshore waters of the Chukchi Sea in the spring but move into the East Bering Sea Ecoregion in the fall and winter to stay in deeper waters off the Bering Sea shelf. Pacific halibut spawn in both the East Bering Sea and Gulf of Alaska Ecoregions, and juveniles often traverse the Unimak Pass. Several salmon species spawn in Alaskan rivers and migrate out into the ocean, where they may pass through several Alaska planning areas (Smith et al. 2017b).

Many marine **R.7 BIRDS** visit foraging hotspots along the Bering Sea shelf break, Aleutian Islands, and Bering Strait. These animals may travel from their colonies to these hotspots at different times of year and may be affected by offshore lighting or traffic during their migration (National Research Council 1996). Other species, like eiders, move between the East Bering Sea and the Chukchi and Beaufort Seas Ecoregions during their annual migrations between breeding, molting, and foraging areas (Smith et al. 2017b).

Some **R.9 MARINE MAMMALS** travel between Alaska planning areas or between the Alaska and Pacific Regions and may be affected by traffic and noise during their migration. For example, following annual sea-ice formation, the ranges of walrus, ice seals, and polar bears regularly span from the Chukchi and Beaufort Seas Ecoregion into Norton Basin and St. Matthew-Hall Planning Areas (Smith et al. 2017a). Bowhead whales follow a similar pattern. Some stocks of beluga whales move between the North Aleutian Basin, St. George Basin, and St. Matthew-Hall Planning Areas. Northern fur seals migrate annually from the California Current Ecoregion to specific island rookeries in the East Bering Sea Ecoregion (Dohl 1983). Certain marine mammals may also be affected by bottom/land disturbance and routine discharges, especially those that are benthic feeders. For example, gray whales feed on crustaceans when they reach Alaskan waters at the end of their annual migration from the California Current Ecoregion. Bottom/land disturbance and noise from oil and gas activity may also impact terrestrial mammals (such as caribou) that travel through coastal environments across Alaska (Calef et al. 1976; Maier et al. 1998; National Research Council 2003a). Impacts on marine mammals and caribou may have carryover effects once they have left an area with OCS oil and gas activity, which may in turn impact **R.14 VULNERABLE COASTAL COMMUNITIES** in other planning areas relying on these resources for subsistence and cultural uses (Braund and Kruse 2009; Tyler 2018).

Point Reyes National Seashore and the Farallon Islands NWR (both in the Central California Planning Area) contain major nesting grounds for various species of marine **R.7 BIRDS** (e.g., murres, auklets, storm-petrels) (Dohl 1983). Although these coastal areas are protected, the birds that inhabit them may forage in OCS waters and be impacted by lighting, traffic, or bottom disturbance. OCS activity may affect wintering birds (e.g., grebes, shearwaters, and gulls) and have downstream implications for these species during other times of the year when they have left the Pacific Region or moved on to other planning areas.

Some **R.6 FISH** and **R.9 MARINE MAMMALS** species utilize Pacific planning areas and their adjacent coastal areas. Northern elephant seals maintain rookeries along the coast of the Northern and Central California Planning Areas but forage in deepwater areas far off the continental shelf (Dohl 1983). White sharks follow a similar pattern, venturing as far as the Hawaiian archipelago (Jorgensen et al. 2009). California sea lions migrate from the Southern California Planning Area (where they breed) into the waters of the Central and Northern California Planning Areas in the fall (Dohl 1983). Impacts from oil and gas activities (such as noise and traffic) in active leasing areas may increase stress levels, which may have lasting effects on these species even after they have moved into other planning areas.

Some species found in the Pacific Region travel into international waters for part of the year and may experience cross-boundary impacts. For example, the ESA-listed blue whale migrates from the California Coast to the waters off Costa Rica or Canada (Carretta et al. 2018). Pacific bluefin tuna spawn in Asia, migrate to the Pacific Region to feed, and later return to their spawning grounds (Fujioka et al. 2018). The movements of Humboldt squid are a bit less predictable than those of other species, because they seem to respond to regular climatological cycles (e.g., ENSO) as well as larger-scale climatological shifts (Zeidberg and Robison 2007). Nonetheless, they may move between Pacific planning areas and Mexican waters and may experience cross-boundary effects.

4.2.5 Effects Comparison of Alternatives

The impacts associated with the alternatives presented in this document include the impacts of OCS oil and gas activities, and potential impacts from energy substitutions. These impacts are summarized below:

- The potential impacts of Alternative B(a) (the Proposed Action) are the most similar to present day conditions (i.e., most OCS oil and gas production occurs in the GOM).
- The potential for OCS impacts increases with increasing number of planning areas and lease sales. Therefore, Alternative D is expected to have the overall greatest number of potential impacts.
- The two planning areas with the highest potential for significant impact interactions are the Chukchi Sea and Beaufort Sea Planning Areas, which are both included under Alternatives B–D.
- The potential environmental effects of increasing OCS production in action alternatives (Alternatives B–D) should be contrasted with the potential environmental effects from energy substitutes that may occur under the No Action Alternative (Alternative A).
- For Alternative A, oil imports and onshore oil and natural gas substitutes would largely replace forgone OCS oil and gas. Energy demand may be reduced slightly because of increasing costs or longer production cycles. Under different future climate policies as the U.S. makes the transition to a net-zero energy economy, OCS substitutes may change, and there could be a larger reduction in energy demand or renewable energy production under Alternative A.
- Impacts on the OCS from energy substitutions likely would be limited to the Pacific, GOM, and Atlantic Regions, where increased tankering of imported oil is anticipated to occur (**Section 4.2.1**).
- In the Alaska Region under Alternative A, there would be no new oil and gas exploration and development associated with the 2024–2029 Program and therefore no associated impacts. Potentially significant impacts related to oil and gas energy substitutions are also unlikely to occur, unless major new oil fields are discovered and developed in the state waters along or on land in the North Slope in Alaska. Therefore, limited impacts in the Alaska Region are expected under Alternative A; this level of impact represents a critically important difference compared to

Alternatives B–D, which may result in potentially significant impacts in the Alaska Region because of new OCS oil and gas activities.

- Under Alternative A, employment, income, and related revenues may be temporarily impacted in the Western and Central GOM Planning Areas if no new leasing were to occur, given the longstanding history and well-established oil and gas industries and economies that have developed there. Any economic benefits associated with OCS activities in the other regions also may be forgone.
- Under Alternative A, there may be the potential for cross-boundary effects related to oil tankering, especially if oil spills occurred in different OCS regions (**Section 4.6**). The potential for cross-boundary effects related to OCS activities generally increases from Alternatives B–D.

The primary difference in the number of impacts among planning areas and alternatives arises from the differing potential for impacts on the human environment in areas with existing oil and gas activities. Differences in impacts on air and water quality drive the differences in physical impacts across planning areas; in only a few planning areas, oil and gas activities are proximate to large urban areas, coastal populations, or designated areas susceptible to deteriorated air quality. The impact findings related to biological resources complement the *Relative Environmental Sensitivity Analysis* provided in the Proposed Program and PFP and show that all planning areas are sensitive and likely to be impacted.

Compared to frontier areas in the alternatives, a fewer potentially significant impacts occur in the Western and Central GOM Planning Areas, largely because existing infrastructure likely would be able to accommodate additional activities resulting from the 2024–2029 Program. Furthermore, people in this area have experienced OCS oil and gas activity for nearly three-quarters of a century. Existing significant impacts may be prolonged by any activities authorized under the 2024–2029 Program, but additional impacts are not expected.

Noise, bottom/land disturbance, and traffic have the potential to impact the greatest number of resources across all planning areas.

4.3 CUMULATIVE EFFECTS ANALYSIS

This section of the Final Programmatic EIS integrates information from previous sections to provide the cumulative effects analysis (**Figure 4-13**).

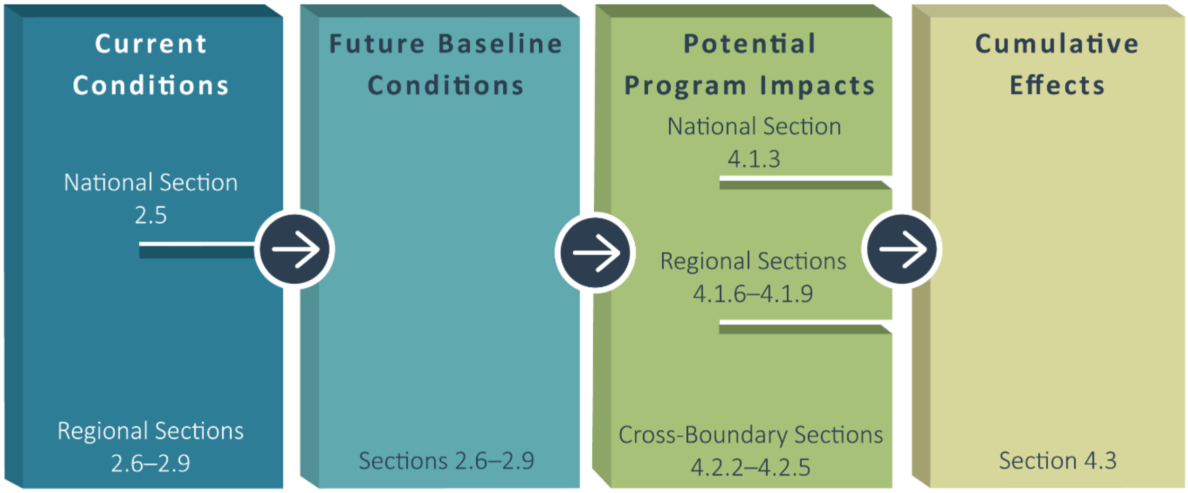


Figure 4-13. Organization of the affected environment and environmental consequences

Previous sections present the building blocks of the cumulative effects analysis. First, **Section 2.4.2** explains ongoing stressors. **Sections 2.6–2.9** discuss the future baseline conditions for each region, i.e., the current status of the resource, how the current conditions may evolve under the influence of the stressors identified in **Section 2.4.2**, and the expected future condition of the resource. **Chapter 4** describes the potential impacts of leasing on physical resources, biological resources, and the human environment at a national and regional scale. The cumulative effects on the marine and coastal environment comprise all these pieces together—and the potential synergistic or additive interactions between them.

This cumulative effects analysis does not include an analysis of accidental oil spills. Accidental spills are non-routine events—with uncertain frequency and size—that may occur through activities under the 2024–2029 Program or otherwise (e.g., existing OCS or state submerged lands oil and gas activities). Assessing the impact of accidental spills could mask the clear description and subsequent understanding of the incremental contribution of other OCS and non-OCS routine activities this cumulative analysis seeks to provide. However, accidental oil spills are a potentially significant concern; therefore, **Section 4.6** discusses potential impacts of oil spills from 2024–2029 Program activities.

4.3.1 Presentation of Cumulative Effects

> The cumulative effects discussion describes the incremental impact of the alternatives when added to ongoing stressors and expected future baseline conditions. The discussion begins with Alternative D, the action alternative with the greatest potential impacts, followed by a brief comparison with other alternatives.

BOEM analyzed the incremental contribution of the 2024–2029 Program to the reasonably foreseeable future actions in each BOEM ecoregion to determine the cumulative impact of program activities. Reasonably foreseeable future actions are described in the qualitative discussion of stressors in **Section 2.4.2** (**Table 2-10**), as well as the expected future baseline conditions described in **Sections 2.6–2.9**. BOEM's approach considers ongoing stressors that are not related to the National OCS Program (referred to as the "stressor index" [**Section 2.4.2**]) and expected 2024–2029 Program impacts (referred to as the "index of potentially significant impacts from the 2024–2029 Program"). The latter was developed by comparing the number of potentially significant interactions between IPFs and resources presented in **Section 4.2.4** (under Alternative D, as presented in **Table 4-5** and **Figure 4-12**). To depict this number as a dimensionless index, this sum was divided by the total number of possible IPF-resource interactions. This Final Programmatic EIS refers to the results as the index of potentially significant impacts from the 2024–2029 Program.

The cumulative analysis considers all areas that were included in the DPP. Cumulative effects are presented beginning with Alternative D because it is the most geographically expansive. Under Alternative D, there would be cumulative impacts in every OCS region; Alternatives C and B have decreasing geographic scope, and thus the cumulative impacts of these alternatives can be viewed relative to Alternative D. For example, Alternative C removes numerous parts of the Alaska OCS compared to Alternative D and therefore would have no incremental contribution to impacts in that area, resulting in no cumulative effects. The cumulative effects of the Proposed Action are described in **Section 4.3.4**.

4.3.2 Cumulative Effects Expected Under Alternative D

4.3.2.1 Alternative D in the Alaska Region

The incremental contribution of Alternative D to cumulative effects in the Alaska Region is expected to be higher than in any other OCS region due to a combination of ongoing stressors, predictions of future change, and greater number of potential impacts expected under this alternative. For the Alaska Region, tourism and coastal development are expected to increase in future years, but population is expected to grow slightly (Howell et al. 2020). Sea surface temperatures are already changing, and ocean acidification and sea level rise are a concern in some areas (Halpern et al. 2015). Climate models predict that this area may warm by 1.2–1.8°C by 2050 (Dorn et al. 2018). Other changes to ocean circulation and ocean chemistry (e.g., the amount of freshwater input from rivers or glacial melt) may contribute to effects on primary productivity and marine food webs. The different levels of existing oil and gas activity in different parts of Alaska drives the variability in cumulative effects between its BOEM ecoregions.

In both the East Bering Sea and the Chukchi and Beaufort Seas Ecoregions, cumulative effects likely would be high. Reasonably foreseeable non-program impacts from climate change may act synergistically with impacts under Alternative D to put additional pressure on certain resources. For example, changes in climate may lead to range shifts of many species. Additional R.14 **VULNERABLE COASTAL COMMUNITIES** may need to relocate further inland due to erosion and sea level rise. Relocation and range shifts may introduce new obstacles for communities to continue subsistence hunting and cultural practices, potentially making hunting more dangerous or costly. Furthermore, if OCS activities cause R.9 **MARINE MAMMALS** to relocate or change their migration routes (e.g., due to noise), it may become even more difficult to hunt these animals. The potential increase in traffic from vessels servicing OCS activities may have additional effects on biological resources, R.12 **LAND USE**, R.13 **CULTURE**, and R.15 **RECREATION & TOURISM**.

The strong cultural interdependencies that Alaska Native peoples have with the natural resources in the East Bering Sea and the Chukchi and Beaufort Seas Ecoregions make them vulnerable to impacts on R.12 **LAND USE** and R.13 **CULTURE** that could result under Alternative D. Animals such as caribou and bowhead whales may be affected by noise, traffic, bottom/land disturbance, or routine discharges from OCS activities. Changes in their distribution or behavior have the potential to affect subsistence hunts, which are critical food sources and central to the cultural identity of Alaska Native peoples in these areas. In addition, lighting and noise from new onshore infrastructure may act synergistically and add stress to both cultural practices and R.14 **VULNERABLE COASTAL COMMUNITIES** by creating negative impacts in remote villages. R.15 **RECREATION & TOURISM** may be similarly affected because additional noise, lighting, and visible infrastructure may significantly decrease a visitor's experience of nature-based activities. Therefore, the incremental impact from new oil and gas leasing is expected to be relatively high in these BOEM ecoregions.

The Chukchi and Beaufort Seas Ecoregion has the lowest stressor index due to relatively low levels of ongoing shipping traffic, invasive species, coastal development, pollution, and fishing activity (Halpern et al. 2015). However, this area is currently facing challenges from climate change, which are expected to accelerate in the future (Intergovernmental Panel on Climate Change 2018) (**Section 2.6**). Current observations indicate that sea surface temperatures have increased (Timmermans and Labe 2021), and the extent of sea ice has decreased rapidly (Meier et al. 2021; Wood et al. 2015). The thickness of winter sea ice in 2020–2021 was the thinnest on record for the past decade, and there is evidence of thinning of the thickest sea-ice region in the Arctic (Meier et al. 2021; Wood et al. 2015). If temperatures increase between 1.5–2.0°C, there is at least a 50% chance that Arctic oceans are completely ice-free at the end of summer (Intergovernmental Panel on Climate Change 2018), which may have serious implications for R.9 **MARINE MAMMALS** that depend on the sea ice, such as polar bears, walrus, and pinnipeds. As the Arctic open-water season lengthens, new areas may open to shipping and tourism, which may provide new pathways for invasive species (Cheung et al. 2009). Vessel traffic earlier in spring and later in fall may also have lighting implications for R.7 **BIRDS**. Lighting from vessels in transit is more noticeable during the months with less sunlight, which may cause birds to become disoriented and collide with vessels (Ronconi et al. 2015). Warming water temperatures are expected to exacerbate ocean acidification in Arctic areas (Arctic Monitoring and Assessment Programme 2013; Cross et al. 2021; Mathis et al. 2015; Mathis et al. 2011). All these expected changes may threaten this ecoregion's delicate marine ecosystems—and the humans that depend on them. Additionally, oil and gas activities under Alternative D may exacerbate these environmental impacts from climate change.

In the East Bering Sea Ecoregion, fishing intensity is currently high, which is the primary factor driving the stressor index (Halpern et al. 2015). Other stressors like coastal development, shipping, and pollution are relatively low in this area (Halpern et al. 2015). In the Bering Strait, climate change has contributed to an increase in sea surface temperatures and an increase in northward water flow (Wood et al. 2015). Many species (e.g., a variety of marine mammals) depend upon the dynamics of sea ice in the Bering Strait for their annual patterns of migration, feeding, and reproduction. As ice dynamics change, these species may have more difficulty finding food or appropriate breeding or molting areas (Smith et al. 2017b). In addition, ocean acidification is expected to worsen throughout the East Bering Sea Ecoregion and may continue to affect fisheries, calcifying organisms, and predators (such as R.6 **FISH** and R.7 **BIRDS**) of calcifying organisms (Mathis et al. 2015).

Coastal development and shipping traffic are higher in the Gulf of Alaska Ecoregion than in other parts of Alaska, but fishing activity is lower in the Gulf of Alaska Ecoregion than in the East Bering Sea Ecoregion, which explains why the stressor index puts the Gulf of Alaska Ecoregion in the mid-range for Alaska (Halpern et al. 2015). For the Gulf of Alaska Ecoregion outside the Cook Inlet Planning Area, the incremental impact of Alternative D is comparable to the level of impact in other areas without existing oil and gas, such as the Pacific Region. Overall, cumulative effects in the Gulf of Alaska Ecoregion are expected to be slightly lower than in the other Alaskan ecoregions and comparable to the Pacific Region if development occurs.

4.3.2.2 Alternative D in the Pacific Region

If development occurs in the Pacific Region, the incremental contribution of Alternative D to cumulative effects is expected to be lower than in parts of Alaska, but higher than in the GOM Region.

Cumulative effects are expected to be very similar in the two Pacific ecoregions. The stressor index for Washington/Oregon Ecoregion and the California Current Ecoregion is similar to that of the Gulf of Alaska Ecoregion, but for different reasons. Compared to Alaska, the Pacific Region currently shows relatively higher stress from ocean acidification but lower stress from sea surface temperature (Halpern et al. 2015). Climate change may impact the ENSO, which are phases of higher- or lower-than-average sea surface temperature in the Pacific Ocean, and may subsequently change upwelling intensity (Hoegh-Guldberg et al. 2014). As a result, primary productivity and marine food webs may shift in future years, posing additional challenges for marine resources such as R.6 **FISH**, R.7 **BIRDS**, and R.9 **MARINE MAMMALS**, as well as the R.14 **VULNERABLE COASTAL COMMUNITIES** that depend on them. The compounding effects of ocean acidification, bottom-contact fisheries, and future dredging may create additional stress for R.3 **PELAGIC COMMUNITIES** and R.4 **MARINE BENTHIC COMMUNITIES** (**Section 2.7**).

Currently, pollution and invasive species are largely concentrated in areas with high coastal development in the major metropolitan areas of Los Angeles, San Francisco Bay, and Seattle (Halpern et al. 2015). Shipping traffic is relatively high throughout the entire Pacific Region, with concentrated hubs near San Francisco and Los Angeles. Given that ships are getting larger (Merk et al. 2015) and global trade is continually growing, the risks of vessel strike, increased noise, and invasive species are expected to intensify in future years (Sardain 2017). Only the Southern California Planning Area has existing oil and gas activities. As operations supported by existing facilities decrease, decommissioning activities will be planned and, depending on the proposed activities and methods, may result in temporary increases to noise and localized bottom/land disturbance. The U.S. Navy has a number of training facilities in southern California, and certain Navy activities (e.g., the use of sonars) may cause stress to marine resources (e.g., whales and dolphins) (Southall et al. 2016). California has a strong public interest in protecting marine resources and access to natural areas, as well as an active coastal R.15 **RECREATION & TOURISM** industry (Crossett et al. 2013).

The incremental impact of Alternative D is expected to be nearly equal in the Washington/Oregon and California Current Ecoregions despite differing levels of existing industrial activity. In the Southern California Planning Area, when compared to the rest of the Pacific Region, impacts from lighting, routine discharges, and bottom/land disturbance may have less of an impact on resources such as R.12 **LAND USE** (because of existing industrialization) and R.13 **CULTURE** (because there are fewer Tribes in this area). However, emissions in this planning area may have significant impacts on R.1 **AIR QUALITY** and R.14 **VULNERABLE COASTAL COMMUNITIES**, as this area faces the most complex air quality challenge in the country. Additional traffic around or in the vicinity of ports that are already extremely busy may disproportionately affect vulnerable coastal communities near these industrialized areas. In the Pacific Region, vulnerable coastal communities that depend on subsistence food sources (e.g., shellfish), may be disproportionately affected by routine discharges or bottom/land disturbance if subsistence sources are impacted in a way that create human health effects or require communities to purchase replacement foods that are more expensive and less nutritious. Impacts on R.15 **RECREATION & TOURISM** (from noise and lighting) likely would be most pronounced in areas with more wilderness areas and nature-based recreation activities (e.g., Washington).

Certain stressors and IPFs may have synergistic impacts on particular resources. For example, ocean acidification along with routine discharges from OCS activity may decrease the quality or quantity of shellfish and crab, which are important food resources for certain Tribes in the Pacific Region. Noise from OCS activities, together with noise from existing vessel traffic and Navy activities, may act together to increase stress or alter the behavior of R.8 **SEA TURTLES** or R.9 **MARINE MAMMALS** in certain areas (Maxwell et al. 2013).

4.3.2.3 Alternative D in the GOM Region

> The disparate level of existing oil and gas activity in different parts of the GOM Region drives the major discrepancy in cumulative effects between the Eastern GOM and the Western and Central GOM Ecoregions.

Throughout the GOM Region, R.10 **COMMERCIAL & RECREATIONAL FISHERIES** pressure is relatively high compared to some other regions (Halpern et al. 2015). Commercial fishing intensity is higher in the Western and Central GOM Ecoregion compared to the Eastern GOM Ecoregion, with the shrimp industry bringing in the biggest revenue (NMFS 2021b). Commercial fishing intensity is expected to persist in future years, which would continue to strain R.4 **MARINE BENTHIC COMMUNITIES** and create entanglement risks for animals in R.3 **PELAGIC COMMUNITIES** (**Section 2.8**). Several of the largest North American ports support GOM commercial fisheries and an active shipping industry in the GOM (Bureau of Transportation Statistics 2018). The expansion of the Panama Canal has increased shipping activity and initiated port expansions in this area. The GOM is experiencing lingering effects from the *Deepwater Horizon* oil spill as well (Joye et al. 2016). Together, these stressors may continue to deteriorate coastal habitats, which may challenge coastal residents and industries and displace associated fauna (e.g., R.7 **BIRDS** and R.8 **SEA TURTLES**). Bottom-contact fisheries and marine mineral dredging in the GOM may cause an increase in turbidity and habitat alterations, which may smother or remove sensitive R.4 **MARINE BENTHIC COMMUNITIES**.

The Eastern GOM Ecoregion has a moderate stressor index and is expected to experience a greater number of potential impacts from leasing under Alternative D. This ecoregion is experiencing similar stress from ocean acidification as the Western and Central GOM Ecoregion but has lower levels of pollution from commercial vessels and ports, and lower nutrient runoff because it is farther from the Mississippi River. The major shipping lanes in the GOM bypass much of the Eastern GOM Ecoregion, except for Tampa and the Florida Keys. Coastal development and R.15 **RECREATION & TOURISM** in the Eastern GOM Ecoregion (particularly on the western coast of Florida) is higher than in the rest of the Gulf Coast (Halpern et al. 2015; NOAA and Office for Coastal Management 2019b). Population is expected to grow at a faster rate in Florida than in the other Gulf states (Weldon Cooper Center for Public Service 2017). Certain counties within this ecoregion have poverty rates that exceed both state and national averages (e.g., Levy County, FL) (U.S. Census Bureau 2016a; 2016b; 2016c). Fishing is an important industry that is likely to remain a stressor to marine life in this area. R.4 **MARINE BENTHIC COMMUNITIES** may continue to be impacted by marine minerals dredging for coastal restoration projects aiming to address chronic and increasing erosion problems.

Although the Eastern GOM Ecoregion has similar biological resources as the Western and Central GOM Ecoregion, the incremental impact of Alternative D in the Eastern GOM Ecoregion is expected to be greater due to the impacts on sociocultural resources (**Section 4.1.8**). New onshore infrastructure may need to be developed to support new OCS activity, which may affect R.12 **LAND USE**; it may also cause additional traffic and noise, which may affect R.13 **CULTURE**, R.14 **VULNERABLE COASTAL COMMUNITIES**, and R.15 **RECREATION & TOURISM**. Florida's economy is very closely tied to tourism (including recreational fishing), which means that visible infrastructure and space-use conflicts from new offshore structures may affect the area's culture and recreation and tourism, including fishing. Noise, lighting, and bottom disturbance from new offshore infrastructure may also affect resources such as R.7 **BIRDS**, R.8 **SEA TURTLES**, and R.9 **MARINE MAMMALS**. Some resources, like R.6 **FISH**, sea turtles, and marine mammals, may also be affected by cross-boundary effects (e.g., noise coming from the Central GOM Planning Area, see **Sections 4.2.2.1**, **4.2.3.1**, and **4.2.4.1**). If development occurs, cumulative effects in the Eastern GOM Ecoregion are expected to be similar to other areas with no existing oil and gas activities and equivalent levels of anthropogenic pressures (e.g., Atlantic Region).

Under future National OCS Programs beyond the 2024–2029 Program, oil and gas exploration and development is not reasonably foreseeable in the Eastern GOM Ecoregion (**Section 2.4.2**).

4.3.2.4 Alternative D in the Atlantic Region

Cumulative effects in the Atlantic Region are expected to be high, second only to Alaska. The dense human population, existing fishing activity, and future projections of climate change explains the relatively high stressor index. However, despite some industrialization along the coast, new infrastructure likely would be required to accommodate a new offshore oil and gas industry. If development occurs, impacts under Alternative D are expected to be high, comparable to other areas with no existing OCS oil and gas activities.

Cumulative effects in the NECS and the SECS Ecoregions are expected to be similar. Despite the lack of existing oil and gas development, the SECS Ecoregion has the highest stressor index of any BOEM ecoregion. Ocean acidification is the major driver of this high index, though sea surface temperatures and sea level rise are also increasing in this region (Halpern et al. 2015). The presence of coral reefs, as well as other sensitive R.4 **MARINE BENTHIC COMMUNITIES** and habitats, makes this ecoregion particularly vulnerable to increases in water temperature and acidity. The NECS Ecoregion has been less affected by ocean acidification (largely due to the influence of the Labrador Current), but sea level rise and sea surface temperature are major drivers of the stressor index for this area (Halpern et al. 2015). In fact, ocean heat content in the northeast Atlantic has risen more drastically than in many other parts of the ocean (Intergovernmental Panel on Climate Change 2014). As a result, climate-related range shifts are already occurring for a variety of species throughout the Atlantic Region (Meyer-Gutbrod et al. 2018; Nye et al. 2009).

Shipping traffic, invasive species, coastal development, and pollution are concentrated in the major ports and cities along the North and Mid-Atlantic Planning Areas (Halpern et al. 2015). Compared to the Pacific Region, these stressors are slightly more widespread due to the large number of coastal ports. As the human population continues to grow, many of the associated stressors may intensify (**Section 2.9**). Furthermore, there are more offshore Federal activities along the Atlantic than in any other region. For example, NASA has a launch range in this region. Also, the U.S. Navy has more training areas on the Atlantic Coast than in any of the other OCS regions, and Navy activities are expected to continue (DOD 2015; 2017). Offshore wind farms will be constructed in the coming years along the coast of the North and Mid-Atlantic Planning Areas, which may affect a variety of biological and sociocultural resources. In addition, the demand for OCS sand probably would continue to increase as sea level rises and coastal storms intensify. High levels of nutrient runoff continue to affect R.2 **WATER QUALITY**, especially near the Delaware and Chesapeake Bays. Warming temperatures and ocean acidification may exacerbate water quality issues in Atlantic estuaries, causing potential adverse consequences for various species (Keppel et al. 2016; Miller et al. 2016).

Throughout the Atlantic Region, R.10 **COMMERCIAL & RECREATIONAL FISHERIES** pressure is relatively high compared to other regions (Halpern et al. 2015). Many species of R.6 **FISH**, R.7 **BIRDS**, R.8 **SEA TURTLES**, and R.9 **MARINE MAMMALS** take advantage of high-productivity areas where the Gulf Stream and Labrador Current mix. However, these areas overlap with fishing, vessel traffic, military presence, renewable energy development, minerals dredging, and other human activities, putting these animals at risk. These stressors, combined with ecological shifts due to climate change, may present major challenges for marine resources throughout this region.

In the Atlantic Region, the incremental impact of Alternative D is expected to be similar to that of the Eastern GOM Ecoregion. Impacts on most physical, biological, and sociocultural resources may be the same in the two Atlantic ecoregions. The only difference in impacts is for R.8 **SEA TURTLES**. These animals typically do not nest in the NECS Ecoregion, and they would not be significantly affected by lighting or bottom/land disturbance in this area. **R.13 CULTURE**, **R.14 VULNERABLE COASTAL COMMUNITIES**, and **R.15 RECREATION & TOURISM** in the less-industrialized parts of the Atlantic Region may be affected by the addition of noise or traffic, and vulnerable coastal communities residing near existing industrialized areas (unrelated to oil and gas) may experience disproportionate adverse impacts from the new industry. Despite the high density of ports along the Atlantic Coast, construction of new onshore waste disposal sites may be required near existing ports, which may affect **R.12 LAND USE**. The NECS Ecoregion coastline is already densely populated; competing needs for real estate may create space-use conflicts between recreation and tourism and the oil and gas industry. Visitor experience for tourists in both Atlantic ecoregions may also be affected by visible infrastructure and lighting. There is a high density of activity from **R.10 COMMERCIAL & RECREATIONAL FISHERIES** along the U.S. East Coast (NMFS 2018d), so overlap with oil and gas activities is likely. In some cases, IPFs may act additively or synergistically with stressors. For example, the combination of noise and traffic, along with shifting food webs and entanglements, may present untenable challenges for the ESA-listed North Atlantic right whale. Historical overfishing of Atlantic cod has already threatened the persistence of this species; the addition of noise at specific spawning locations may exacerbate this problem.

Under future National OCS Programs beyond the 2024–2029 Program, oil and gas exploration and development is not reasonably foreseeable in the Atlantic Region (**Section 2.4.2**).

4.3.3 Cumulative Effects Expected Under Alternative C

The incremental contribution of program activities to ongoing and future impacts in each region or planning area included in Alternative C remains the same as described under Alternative D. However, considered as a whole, cumulative effects that may occur under Alternative C are expected to be less than those expected under Alternative D due to the reduced geographic scope and number of lease sales.

4.3.3.1 Alternative C in the Alaska Region

If no OCS activity were to occur in the East Bering Sea Ecoregion, it would eliminate any potential synergistic effects of ocean acidification and fishing intensity with oil and gas development in this area. Similarly, eliminating leasing in most of the Gulf of Alaska Ecoregion would decrease the potential for compounding effects from a growing coastal population, climate change, and new oil and gas activity. As described in **Section 4.1.6**, the incremental impact of new activities from lease sales in the Cook Inlet Planning Area may be relatively small because operators can take advantage of existing infrastructure (e.g., onshore facilities). The effects of climate change are occurring across all the Alaska Region, but the most extreme effects are expected in the Chukchi and Beaufort Seas Ecoregion. In this area, cumulative effects on **R.9 MARINE MAMMALS**, **R.13 CULTURE**, **R.14 VULNERABLE COASTAL COMMUNITIES**, and other resources are expected to occur similarly as described in **Section 4.3.2.1**. The incremental impact from new oil and gas leasing is expected to be relatively high in the Chukchi and Beaufort Seas Ecoregion due to ongoing stressors such as climate change, as well as strong cultural interdependencies that Alaska Native peoples have with natural resources. Limiting OCS activity to only three planning areas within the Alaska Region may avoid some cross-boundary impacts (e.g., for **R.6 FISH**, **R.7 BIRDS**, or invertebrates that migrate between planning areas within the East Bering Sea Ecoregion; **Section**

4.2.4.1). However, larger migratory species like marine mammals, which pass from the Chukchi and Beaufort Seas Ecoregion into waters further south, may still experience carryover cumulative effects during other parts of their migration.

4.3.3.2 Alternative C in the Pacific Region

Within the Pacific Region, limiting new OCS activity to the Southern California Planning Area would avoid incremental program-related impacts on some resources in the Washington/Oregon Ecoregion and northern reaches of the California Current Ecoregion. However, there is potential for incremental cumulative effects to R.1 **AIR QUALITY**, R.9 **MARINE MAMMALS**, and R.14 **VULNERABLE COASTAL COMMUNITIES** in the Southern California Planning Area, because emissions and traffic from OCS activity may act synergistically with existing stressors (see **Section 4.3.2.2**). Furthermore, some migratory species (e.g., gray whales) may be impacted while in the Southern California Planning Area by both stressors and the incremental impacts of the 2024–2029 Program and may experience carryover effects once they have migrated further north.

4.3.3.3 Alternative C in the GOM Region

Under Alternative C, cumulative effects in the GOM Region are expected to match those described in **Section 4.3.2.3** because the level of activity would be the same.

4.3.3.4 Alternative C in the Atlantic Region

Including only the South and Mid-Atlantic Planning Areas—rather than the entire Atlantic Region—would likely reduce some cumulative effects in Alternative C as compared to Alternative D because of the smaller geographic scope and reduced activity levels. However, these two planning areas host a relatively high degree of anthropogenic activity, such as shipping, military exercises, and commercial fishing; they also serve as important biological areas for many local and migratory species. The mixing of currents, concentration of prey in eddies, and presence of canyons on the shelf result in high levels of biodiversity. In 2018, scientists discovered a large deepwater coral reef in the South Atlantic Planning Area, suggesting that there may be even more biodiversity here than previously assumed (Cordes 2018). This region also provides critical habitat for several ESA-listed species, such as the loggerhead R.8 **SEA TURTLE** and North Atlantic right whale, which use these areas for nesting and calving, respectively. Therefore, the addition of oil and gas activity to this dynamic area may have lasting impacts on resources, and cumulative and cross-boundary effects are expected to be relatively high (as described in **Section 4.3.2.4**). If development occurs, impacts under Alternative C on the Atlantic Region are expected to be high, comparable to other areas with no existing oil and gas, because of a relatively high stressor index and the likelihood of building infrastructure needed to support new OCS activities.

4.3.4 Cumulative Effects Expected Under Alternative B

Alternative B includes the areas included in the Proposed Action—the Cook Inlet Program Area and GOM Program Area. The cumulative impacts for these areas are disclosed in **Section 4.3.2** as part of the discussion of Alternative D, which comprises planning areas in all OCS regions and addresses the full suite of cumulative impacts that could occur under a scenario that includes leasing in all these areas.

The Cook Inlet and GOM Program Area cumulative effects are also discussed here because the effects of the Proposed Action are the same as those described in Alternative B, except for the Beaufort Sea, Chukchi Sea, and Eastern GOM Planning Areas.

4.3.4.1 Alternative B in the Alaska Region

Under Alternative B, cumulative effects in the Alaska Region would match those described in **Section 4.3.3.1** because the level of activity would be the same.

4.3.4.2 Alternative B in the Pacific Region

In the Pacific Region, fewer cumulative effects would likely occur under Alternative B than Alternative C. Although there would be no new leases anywhere in this region, ongoing stressors would continue to put pressure on resources. In addition, impacts resulting from activities related to leasing under the Alternative B in other regions (e.g., Alaska) may affect resources in the Pacific Region. For example, activities in Alaska may impact gray whales; these impacts may remain as the whales migrate through Alaskan waters into the Pacific Region (**Sections 4.2.2.1** and **4.2.4.1**).

4.3.4.3 Alternative B in the GOM Region

Under Alternative B, cumulative effects in the GOM Region are expected to match those described in **Section 4.3.2.3** because the level of activity would be the same.

Alternative B(a): GOM Program Area

The GOM Program Area is included in the Final Proposal and is analyzed as the Western and Central GOM Ecoregion with respect to cumulative impacts in this section. The Western and Central GOM Ecoregion stands out as having one of the highest levels of stressors and lowest levels of 2024–2029 Program impacts, which leads to the lowest cumulative effects compared to any other ecoregion.

The large stressor index in the Western and Central GOM Ecoregion can be attributed to nutrient runoff from the Mississippi River Delta (mainly from agriculture), ocean acidification, and pollution derived from commercial vessels and ports (Halpern et al. 2015). The area is also impacted by sea level rise and increased sea surface temperatures; wetlands have been lost at higher rates here than elsewhere in the U.S. (Couvillion et al. 2017). The combination of higher sea surface temperatures, ongoing sea level rise and coastal erosion, and risk of increased storm intensity is expected to strain coastal ecosystems in future years (Intergovernmental Panel on Climate Change 2018). The hypoxic zone near the mouth of the Mississippi River has persisted for years and is expected to continue (Rabalais and Turner 2019). Existing oil and gas development is highest in the Western and Central GOM Ecoregion compared to any of the others (Halpern et al. 2015), which contributes to the relatively high stressor index. In general, BOEM expects fewer new facilities across the GOM shelf and deepwater environment in future National OCS Programs compared to previous programs; deepwater facilities would yield most of the oil production. The presence of a well-developed oil and gas industry means that the incremental impact of Alternative D is expected to be less significant in this ecoregion compared to anywhere else. Utilizing existing infrastructure may lessen the impacts of bottom/land disturbance, lighting, and routine discharges on various resources. Impacts from additional noise, traffic, and visible infrastructure are not expected to be noticeable (by humans) above baseline conditions. In fact, new leasing is not expected to have significant impacts on most sociocultural resources in the Western and Central GOM Ecoregion, including **R.11 ARCHAEOLOGICAL & CULTURAL RESOURCES**, **R.12 LAND USE**, **R.13 CULTURE**, **R.14 VULNERABLE COASTAL COMMUNITIES**, and **R.15 RECREATION & TOURISM**.

4.3.4.4 Alternative B in the Atlantic Region

With no new leasing occurring in the Atlantic Region under Alternative B, there likely would be fewer cumulative effects than expected under Alternative C (**Section 4.3.3.4**). Under Alternative B, program activities may contribute to cumulative effects through cross-boundary impact. For example, a species (e.g., Atlantic bluefin tuna) that experiences impacts in the GOM Region may continue to experience effects related to that impact after moving out of the GOM Region and into the Atlantic Region. These species may encounter stressors (e.g., climate change, fishing) in both regions.

4.3.5 Cumulative Effects Expected Under Alternative A

If no new leasing were to occur anywhere in the OCS, there would be no new incremental impacts from the 2024–2029 Program. However, with increased tankering due to likely increases in imported oil and gas, some resources (e.g., **R.8 SEA TURTLES** and **R.9 MARINE MAMMALS**) may experience additional stress from noise and traffic. In the GOM Region, effects on biological and physical resources may decrease if activity reduces measurably. Also, in the GOM Region, decreases in employment, income, and revenues may have effects on the economy and local populations. Increased energy imports or substitution activities could potentially impact all human environment resources (**Section 4.2.1.2**). Although the intensity of stressors such as climate change is expected to continue over time, the lack of new OCS activity would remove the potential for compounding or synergistic effects.

4.4 WITHDRAWALS

Restrictions on OCS leasing can originate outside the National OCS Program development process. Section 12(a) of the OCS Lands Act, 43 U.S.C. § 1341(a), authorizes the President to "withdraw from disposition any of the unleased lands of the outer Continental Shelf." Areas withdrawn under Section 12(a) are not available for leasing and do not require Section 18 analysis. Numerous Section 12(a) withdrawals are in place (**Figure 4-14**). Areas can also be withdrawn or otherwise made unavailable for leasing by the President under the Antiquities Act or by Congress under statutes such as GOMESA. For example, the Northeast Canyons and Seamounts Marine National Monument in the North Atlantic Planning Area was established on September 15, 2016, under the Antiquities Act (54 U.S.C. § 320301). Exploring for, developing, or producing oil and gas or minerals, or undertaking any other energy exploration or development activities within the monument is prohibited.

This Final Programmatic EIS analyzes the full suite of areas included in the DPP, including consideration of both full planning areas and portions of planning areas that have since been withdrawn from consideration for leasing.

This section discusses OCS areas that are currently unavailable for leasing (withdrawn) and describes how each withdrawal may change the impact analyses associated with leasing under the 2024–2029 Program (**Section 4.1**). The withdrawals are discussed below by region, and differences in potential impacts, if any, are relative to the analyses provided in **Section 4.1**.

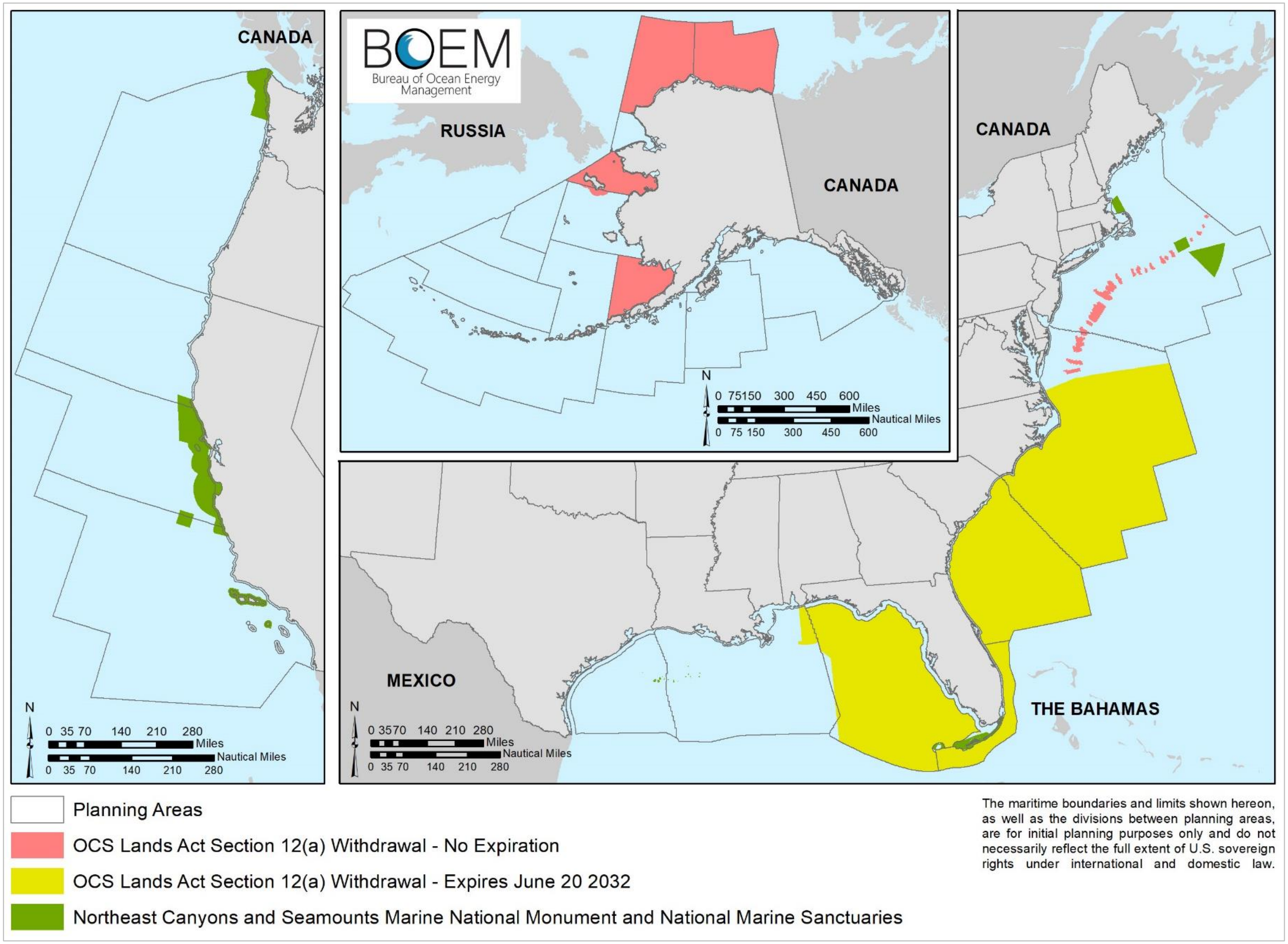


Figure 4-14. Areas currently subject to withdrawal

4.4.1 Alaska Region

Section 12(a) withdrawal areas in the Alaska Region include the North Aleutian Basin Planning Area, Arctic OCS (all of the Chukchi Sea and Beaufort Sea Planning Areas), and Northern Bering Sea Climate Resilience Area (Norton Basin Planning Area and a very small portion of St. Matthew-Hall Planning Area) (**Figure 4-14**). Under the 2024–2029 Program, there would be no new leasing in the Section 12(a) withdrawal areas, and potential impacts would be the same as those described in Alternative A (No Action Alternative) (**Table 4-6**).

The impacts discussion in **Sections 4.1.3** and **4.1.6** apply to the withdrawal of St. Matthew-Hall Planning Area OCS lease blocks within 25 nm of St. Lawrence Island. Withdrawal of these blocks may lessen potential impacts to resources on and around St. Lawrence Island, but do not appreciably change the effects analysis for the portion of the St. Matthew-Hall Planning Area still available for leasing.

Table 4-6. Where to find the analysis relevant to Section 12(a) withdrawals in the Alaska Region

Withdrawal Area	Planning Area-level Affected Environment & Environmental Consequences	Impact of Section 12(a) Withdrawal	Cross-Boundary Analysis	Cumulative Impacts Analysis
Chukchi Sea Planning Area	**Section 2.5**—Overview of the Affected Environment **Section 2.6**—Alaska Region Affected Environment **Section 4.1.3**—National Overview of Impacts **Section 4.1.6**—Potentially Significant Impacts in the Alaska Region	**Section 4.2.1**—Alternative A: No Action Alternative (No Leasing)	**Section 4.2.2.1**—Alternative B Cross-Boundary Impacts	**Section 4.3.5**—Cumulative Effects Expected Under Alternative A
Beaufort Sea Planning Area	Same as above	**Section 4.2.2**—Alternative B: 6 Planning Areas	**Section 4.2.2.1**—Alternative B Cross-Boundary Impacts	**Section 4.3.2.1**—Cumulative Effects Expected Under Alternative D in the Alaska Region
North Aleutian Basin Planning Area	Same as above	**Section 4.2.1**—Alternative A: No Action Alternative (No Leasing)	**Section 4.2.4.1**—Alternative D Cross-Boundary Impacts	**Section 4.3.5**—Cumulative Effects Expected Under Alternative A
Northern Bering Sea Climate Resilience Area (Norton Basin Planning Area and portions of St. Matthew-Hall Planning Area)	Same as above	**Section 4.2.1**—Alternative A: No Action Alternative (No Leasing)	**Section 4.2.4.1**—Alternative D Cross-Boundary Impacts	**Section 4.3.5**—Cumulative Effects Expected Under Alternative A

4.4.2 Pacific Region

There are five 12(a) withdrawal areas in the Pacific Region: Olympic Coast NMS in the Washington/Oregon Planning Area; Greater Farallones, Cordell Bank, and Monterey Bay NMSs, which fall almost entirely inside the Central California Planning Area; and Channel Islands NMS in the Southern California Planning Area (**Figure 4-14**). These areas are withdrawn according to the boundaries in place as of 2008. Since then, the Greater Farallones (formerly Gulf of the Farallones NMS) and Cordell Bank NMSs have expanded their boundaries. While not explicitly withdrawn under Section 12(a), these areas of expansion prohibit oil and gas activities within the expanded boundaries through regulation.

There will be no new leasing under the 2024–2029 Program in withdrawn areas. Because the programmatic analyses consider resources occurring within planning areas and do not anticipate the location or intensity of potential activities, the withdrawal of the NMSs in this region would not necessarily result in notably different impacts than if the entire area were included (**Table 4-7**). Resources within a planning area could still be impacted by oil and gas activities even if portions of the planning area are unavailable for leasing. In the Central California Planning Area, NMSs run the entirety of the coastline and extend offshore to varying degrees but do not encompass the entire planning area. However, the narrow continental shelf in this area means that most of the available hydrocarbon resources are also relatively nearshore. If withdrawal of the NMSs in this area resulted in no new leasing in the entire planning areas in which they are located, impacts in those planning areas could be reduced to those presented under Alternative A (No Action Alternative).

Table 4-7. Where to find the analysis relevant to Section 12(a) withdrawals in the Pacific Region

Withdrawal Area	Planning Area-level Affected Environment & Environmental Consequences	Impacts if Withdrawn	Cross-Boundary Analysis	Cumulative Impacts Analysis
National Marine Sanctuaries (Portions of all Pacific Planning Areas)	**Section 2.5**—Overview of the Affected Environment **Section 2.7**—Pacific Region Affected Environment **Section 4.1.3**—National Overview of Impacts **Section 4.1.7**—Potentially Significant Impacts in the Pacific Region	**Section 4.2.1**—Alternative A: No Action Alternative (No Leasing) (Central California) **Section 4.2.3**—Alternative C: 9 Planning Areas (Southern California) **Section 4.2.4**—Alternative D: 25 Planning Areas (Northern California, Washington/Oregon)	**Section 4.2.3.1**—Alternative C Cross-Boundary Impacts **Section 4.2.4.1**—Alternative D Cross-Boundary Impacts	**Section 4.3.2.2**—Cumulative Effects Expected Under Alternative D in the Pacific Region (Washington/Oregon, Northern California, Southern California) **Section 4.3.5**—Cumulative Effects Expected Under Alternative A (Central California)

4.4.3 GOM Region

There are three 12(a) withdrawal areas in the GOM Region (**Figure 4-14**). Two of these are NMSs—Florida Keys and Flower Garden Banks. The 12(a) withdrawal of the NMSs applies to the boundaries as they were in 2008; the Flower Garden Banks NMS has since been expanded. Leasing is not precluded within the expanded area, though oil and gas activities may be restricted by sanctuary regulations. The third 12(a) withdrawal area is the portion of the GOM OCS designated by Section 104(a) of GOMESA of 2006, Public Law 109-432 (September 2020 GOM withdrawal); this withdrawal is in place until June 2032 and encompasses the vast majority of the Eastern GOM Planning Area, leaving a small portion off the coast of Florida available. It also includes a very small portion of the Central GOM Planning Area (**Figure 4-14**). For the analyses in this document, potential impacts within this Section 12(a) GOM withdrawal are the same as those discussed for the Eastern GOM Planning Area.

There will be no new leasing under the 2024–2029 Program in withdrawn areas. For the September 2020 GOM withdrawal, the potential impacts would be the same as those described in Alternative A (No Action Alternative) for the Eastern GOM Planning Area (**Table 4-8**). Because the programmatic analyses consider resources occurring within planning areas and do not anticipate the location or intensity of potential activities, the withdrawal of the NMSs in the Western and Central GOM would not result in substantively different impacts than if the entire area was included. Resources within a planning area could still be impacted by oil and gas activities even if portions of the planning area are unavailable for leasing. If the Florida Keys NMS were the only withdrawn part of the Eastern GOM Planning Area, that would not reduce impacts appreciably from those described in **Sections 4.1.3 and 4.1.8.**

Table 4-8. Where to find the analysis relevant to Section 12(a) withdrawals in the GOM Region

Withdrawal Area	Planning Area-level Affected Environment & Environmental Consequences	Impacts if Withdrawn	Cross-Boundary Analysis	Cumulative Impacts Analysis
Portions of the GOM as defined by Section 104 of GOMESA (vast majority of the Eastern GOM Planning Area and a small portion of the Central GOM Planning Area)	**Section 2.5**—Overview of the Affected Environment **Section 2.8**—GOM Region Affected Environment **Section 4.1.3**—National Overview of Impacts **Section 4.1.8**—Potentially Significant Impacts in the GOM Region	**Section 4.2.1**—Alternative A: No Action Alternative (No Leasing)	**Section 4.2.2.1**—Alternative B Cross-Boundary Impacts	**Section 4.3.5**—Cumulative Effects Expected Under Alternative A (Eastern GOM)
National Marine Sanctuaries (Florida Keys and Flower Garden Banks)	Same as above	**Section 4.2.2**—Alternative B: 6 Planning Areas (Western GOM) **Section 4.2.4**—Alternative D: 25 Planning Areas (Straits of Florida)	**Section 4.2.2.1**—Alternative B Cross-Boundary Impacts **Section 4.2.4.1**—Alternative D Cross-Boundary Impacts	**Section 4.3.2.3**—Cumulative Effects Expected Under Alternative D in the GOM Region (Western GOM, Straits of Florida)

4.4.4 Atlantic Region

There are six 12(a) withdrawal areas in the Atlantic Region (**Figure 4-14**), three of which are NMSs (Stellwagen, Gray's Reef, and Monitor NMSs). The 12(a) withdrawal of the NMSs applies to the boundaries as they stood in 2008; as of publication of this document, none of the NMSs in the Atlantic in place since 2008 have expanded their boundaries. On December 20, 2016, President Obama withdrew 26 canyons and canyon complexes in the North Atlantic and Mid-Atlantic Planning Areas from future oil and gas leasing consideration. In September 2020, President Trump withdrew the Straits of Florida and South Atlantic Planning Areas, as well as portions of the Mid-Atlantic Planning Area offshore North Carolina. The Northeast Canyons and Seamounts Marine National Monument also was withdrawn in 2016 pursuant to the Antiquities Act.

There will be no new leasing under the 2024–2029 Program in withdrawn areas. For the Straits of Florida and South Atlantic Planning Areas, the potential impacts would be the same as those described in Alternative A (No Action Alternative) (**Table 4-9**). In the Mid-Atlantic Planning Area, oil and gas activities will not occur in the withdrawn areas. Oil and gas activities could occur within the areas that are not withdrawn, and resources in withdrawn areas of the planning area may experience fewer impacts than if those areas were not withdrawn. However, anywhere activities may affect environmental resources, the impacts discussion in **Sections 4.1.3 and 4.1.9** apply (**Table 4-9**). As a result, there is no change expected from the impacts described in **Section 4.1** for the Mid-Atlantic Planning Area.

Because the programmatic analyses consider resources occurring within planning areas and do not anticipate the location or intensity of potential activities, the withdrawal of the Northeast Canyons and Seamounts Marine National Monument (the existing Section 12(a) Atlantic canyons withdrawal) or any of the NMSs would not result in substantively different impacts than if the entire area was included. Resources within a planning area could still be impacted by oil and gas activities even if portions of the planning area are unavailable for leasing (**Table 4-9**). **Section 4.5.4.3** provides additional information on the ecological importance of the Atlantic canyons.

Table 4-9. Where to find the analysis relevant to Section 12(a) withdrawals in the Atlantic Region

Withdrawal Area	Planning Area-level Affected Environment & Environmental Consequences	Impacts if Withdrawn	Cross-Boundary Analysis	Cumulative Impacts Analysis
Straits of Florida and South Atlantic Planning Areas	**Section 2.5**—Overview of the Affected Environment **Section 2.9**—Atlantic Region Affected Environment **Section 4.1.3**—National Overview of Impacts **Section 4.1.9**—Potentially Significant Impacts in the Atlantic Region	**Section 4.2.1**—Alternative A: No Action Alternative (No Leasing)	**Section 4.2.3.1**—Alternative C Cross-Boundary Impacts **Section 4.2.4.1**—Alternative D Cross-Boundary Impacts	**Section 4.3.5**—Cumulative Effects Expected Under Alternative A
Portions of Mid-Atlantic Planning Area	Same as above	**Section 4.2.2**—Alternative B: 6 Planning Areas	**Section 4.2.2.1**—Alternative B Cross-Boundary Impacts	**Section 4.3.2.4**—Cumulative Effects Expected Under Alternative D in the Atlantic Region
National Marine Sanctuaries and Northeast Canyon and Seamounts Marine National Monument (North, Mid-, and South Atlantic Planning Areas)	Same as above	**Section 4.2.3**—Alternative C: 9 Planning Areas (South Atlantic) **Section 4.2.4**—Alternative D: 25 Planning Areas (North Atlantic)	**Section 4.2.3.1**—Alternative C Cross-Boundary Impacts **Section 4.2.4.1**—Alternative D Cross-Boundary Impacts	**Section 4.3.2.4**—Cumulative Effects Expected Under Alternative D in the Atlantic Region

4.5 POTENTIAL EXCLUSIONS

Excluding certain areas that are smaller than planning areas from leasing under the 2024–2029 Program may avoid or minimize potential impacts on sensitive or unique resources. This section discusses areas that were (1) identified in the DPP for potential exclusion or (2) nominated for exclusion based on environmental importance or sensitivity, as well as the potential to mitigate or avoid impacts.

During the public comment period for the DPP, BOEM solicited nominations for areas to be included or excluded in a National OCS Program as required by Section 18(f) of the OCS Lands Act. Nominations for exclusions included entire regions (e.g., Alaska), individual planning areas (e.g., Chukchi Sea Planning Area in Alaska), and areas smaller than a planning area (e.g., Hanna Shoal Exclusion in the Chukchi Sea Planning Area). BOEM received over 70 discrete nominations for exclusion of areas smaller than a planning area based on environmental and human-use considerations. BOEM considered all these nominations to determine whether the areas warranted additional analysis as potential mitigation measures. A team of BOEM scientists and policy experts evaluated each nomination and considered various factors including environmental importance, available information, geographic scale, potential for alternative protection measures, and degree to which a nominated area reduced the available leasing acreage.

In addition to the nominated exclusions carried forward by BOEM subject matter experts, the Secretary identified in the DPP specific subarea options (exclusions) for analysis (**Table 4-10**). BOEM evaluated these additional areas in the Draft Programmatic EIS to determine what, if any, environmental protections they may afford to inform the Secretary's decision on whether to carry them forward into the Proposed Program. Exclusion of these areas addresses environmental concerns or other considerations, such as potential conflict with other uses of the OCS (e.g., military activities, renewable energy) or a request by a state governor.

The Secretary's Proposed Program removed much of the area under consideration for leasing; in the remaining area, the Secretary maintained consideration of a subarea option for a 15-mile no leasing buffer offshore of Baldwin County, AL. She also identified consideration of targeted leasing in the Proposed Program. A targeted leasing approach would remove acreage that has not recently had extensive bidding activity, actively pursued geologic plays, areas of recent seismic acquisition and processing, or exploration and development activity, as well as remove biologically sensitive areas and areas of potential conflict with other uses and users of the marine environment. This approach would offer lease sales in areas with high resource potential while appropriately weighing environmental protection, subsistence use needs, and other considerations, consistent with the policy of the OCS Lands Act to make OCS oil and gas resources available for expeditious and orderly development while considering safeguards for the human, marine, and coastal environments.

In the PFP, the Secretary deferred decisions on exclusions to subsequent stages of the leasing process; she identified three subarea options to be carried forward for further analysis at the lease sale stage: (1) a 15-mile no leasing buffer offshore Baldwin County, Alabama, (2) DOD proposed exclusion areas, and (3) a targeted leasing approach in the GOM Program Area.

This Final Programmatic EIS analyzes all planning areas and potential exclusions identified in the DPP and Proposed Program. Many of the potential exclusions included in the DPP (**Table 4-10**) were within areas later withdrawn under Section 12(a) of the OCS Lands Act (43 U.S.C. § 1341(a)). The analysis of potential exclusions that fall within withdrawn areas can be found in **Appendix I**. **Table 4-10** lists the exclusions and subarea options analyzed within this Final Programmatic EIS and the location of the relevant analysis. Nominations for exclusions that were not identified by the Secretary in the PFP may be considered at subsequent leasing stages, if appropriate.

Table 4-10. Areas analyzed as potential exclusions in this Final Programmatic EIS

Region	Area	Included in a Withdrawal*	DPP Subarea Option	Where to Find Analysis
Alaska	Chukchi Sea Subsistence Use Area	✔	✔	Appendix I
Alaska	15-mi Chukchi Sea coastal buffer	✔	-	Appendix I
Alaska	25-mi Chukchi Sea coastal buffer	✔	✔	Appendix I
Alaska	50-mi Chukchi Sea coastal buffer	✔	-	Appendix I
Alaska	Hanna Shoal	✔	✔	Appendix I
Alaska	Expanded Hanna Shoal	✔	-	Appendix I
Alaska	Barrow Whaling Area	✔	✔	Appendix I
Alaska	Expanded Barrow Whaling Area	✔	-	Appendix I
Alaska	Barrow Canyon Biologically Focused Area (BFA)	✔	-	Appendix I
Alaska	Harrison Bay BFA	✔	-	Appendix I
Alaska	Cross Island BFA	-	-	Appendix I
Alaska	Camden Bay BFA	✔	-	Appendix I
Alaska	Kaktovik Whaling Area	✔	✔	Appendix I
Alaska	Kaktovik Bowhead Whaling Area	✔	-	Appendix I
Alaska	Kaktovik BFA	✔	-	Appendix I
GOM	Topographic Features and Pinnacle Trend Stipulations	-	-	Section 4.5
GOM	Baldwin County buffer	-	✔	Section 4.5
GOM	50-, 75-, 100-, and 125-mi Eastern GOM coastal buffers	✔	✔	Appendix I
Atlantic	25-nmi Coastal Buffer	Partial	✔	Section 4.5
Atlantic	Biodiversity Strip	Partial	-	Section 4.5
Atlantic	Gulf of Maine	-	-	Section 4.5
Atlantic	Georges Bank	-	-	Section 4.5
Atlantic	Atlantic canyons	-	✔	Section 4.5

* Areas included in a withdrawn area are not available for leasing.
Note: Areas that fall completely within a withdrawn portion of the OCS are analyzed in **Appendix I**.

4.5.1 Potential Exclusions in the Alaska Region

Potential exclusions considered in the Alaska Region include multiple areas in the Chukchi Sea and Beaufort Sea Planning Areas (**Table 4-10**) based on ecological importance, human use, and precedent for exclusion or deferral from previous oil and gas leasing programs. Some of these areas were identified for further analysis in the DPP (**Table 4-11**). All potential exclusion areas in the Alaska Region are now in areas withdrawn from consideration from oil and gas leasing under Section 12(a). The analysis for these areas can be found in **Appendix I**.

4.5.2 Potential Exclusions in the Pacific Region

Nominations for potential exclusion areas in the Pacific Region included suggestions for generally excluding the waters off California, Oregon, and Washington, as well as nominations for discrete areas, such as the Santa Barbara Channel. Based on the process described at the beginning of **Section 4.5**, none of these areas were considered appropriate for analysis at the programmatic stage because they did not meet the appropriate criteria. However, all NMSs (as they existed and were configured in July 2008) were withdrawn from leasing in 2008 under Section 12(a) of the OCS Lands Act, including all the NMSs in the Pacific Region (**Figure 4-14**).

4.5.3 Potential Exclusions in the GOM Region

Areas for potential exclusion in the GOM Region (**Table 4-10, Table 4-12, Figure 4-15**) include areas subject to Topographic Features and Live Bottom lease stipulations (which were selected as programmatic mitigation measures by the Secretary in the PFP), a Baldwin County buffer, and an Eastern GOM coastal buffer. The Eastern GOM buffer falls within a withdrawn portion of the OCS and is analyzed in **Appendix I** (**Figure 4-14**).

Table 4-12. Potential exclusions that overlay geologic plays in the GOM Region

Exclusion	Exclusion Size (Million Acres)	Planning Area Acreage (Million Acres)	Percent Planning Area Acreage (Size/Planning Area Acreage)	Number of Geologic Plays Overlapping Exclusion
Baldwin County buffer*	0.3	159.3	0.2%	8

* DPP, Proposed Program, and PFP Subarea Option

Note: Exclusion areas associated with topographic and Pinnacle Trend features are shown in **Figure 4-15**. Because these areas are relatively small and distributed throughout the Western and Central GOM Planning Areas, they are not included in this table.

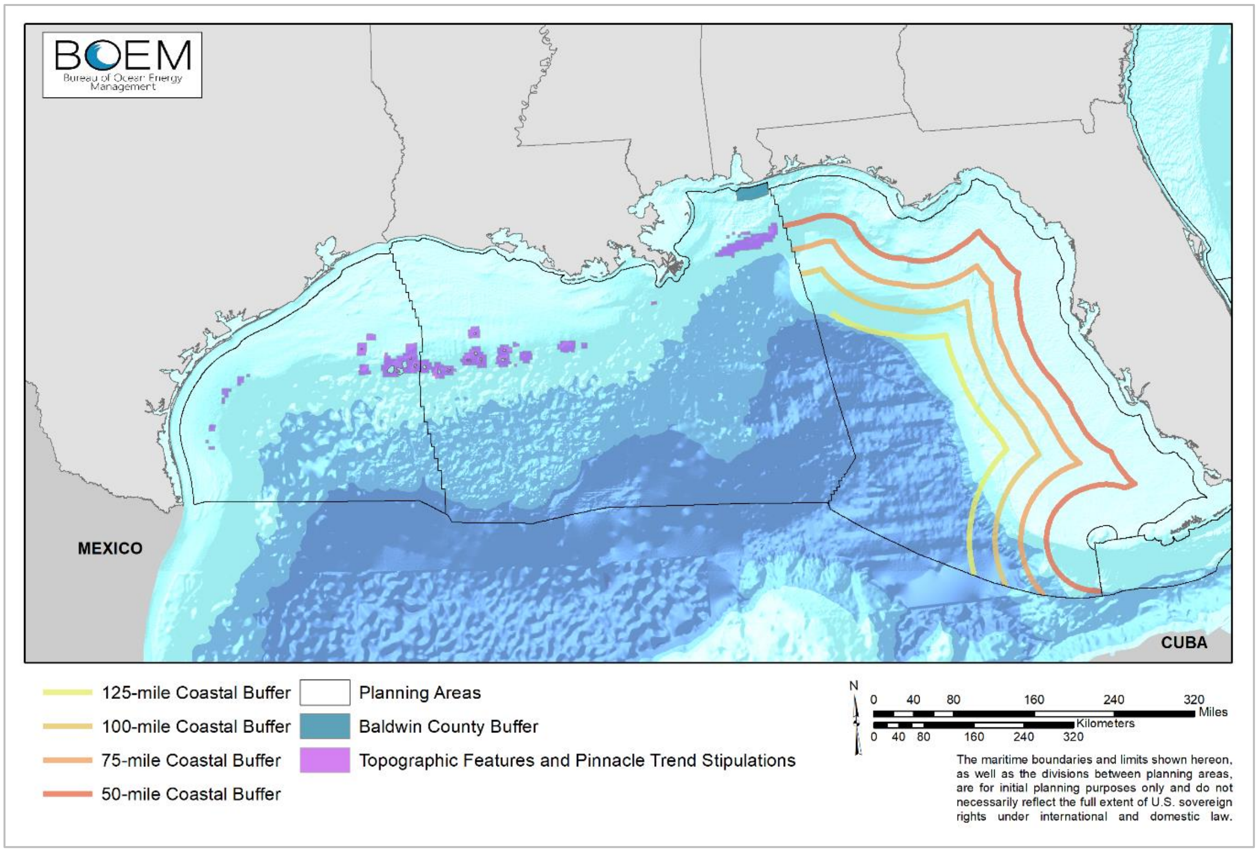


Figure 4-15. Locations of potential exclusions in the GOM Region

Topographic Features and Pinnacle Trend Stipulations

BOEM currently incorporates Topographic Features and Live Bottom (Pinnacle Trend) stipulations, specific measures imposed upon a lease as a condition of sale, in all leases issued under the 2017–2022 Program. BOEM and its predecessor agencies have required avoidance of sensitive bottom habitats in the GOM for decades. The topographic features stipulation was first applied in 1974 and has been used consistently since April 1996. These stipulations are designed to avoid or minimize harm from seafloor-disturbing activities to these sensitive and unique underwater features (**Figure 4-15**). The Secretary chose to continue this programmatic requirement for all leases issued under the 2024–2029 Program in the GOM Program Area.

The existing topographic features stipulations exclude all bottom-disturbing activity in the most sensitive biological areas defined via bathymetric contours (generally 85 m [279 ft]), also known as a "No Activity Zone." The stipulation currently covers 38 topographic banks. A progression of buffer distances around all banks (e.g., 1 mi [1.6 km], 3 mi [4.8 km], and 4 mi [7.4 km]) establishes different levels of protection.

The Live Bottom (Pinnacle Trend) stipulation currently applies to 74 blocks in the northeastern portion of the Central GOM Planning Area (**Figure 4-15**). Under the 2024–2029 Program, a lessee with a block subject to application of this stipulation would be required to assess live bottom habitat in the block and undertake measures to protect the live bottom features. These measures could include relocation of operations, shunting of fluids and cuttings, and monitoring to assess the impact of the activity on the live bottom areas.

The programmatic application of these stipulations is consistent with current practice and would continue the effective protection of these biologically sensitive areas. There would be no appreciable impact to the availability of resources or access to geologic plays because these small (< one lease block) No Activity Zones have been in place for decades.

Impacts from activities in adjacent areas (e.g., spills) may still affect these features. The nature and magnitude of impacts on benthic communities of these topographic features would depend on the location, size, and duration of any occurrences in adjacent areas. It is possible, but not likely, that increased turbidity may affect hard bottom habitat if bottom disturbance occurred near the boundary of a No Activity Zone. The shunting requirements should minimize potential adverse effects of discharged drilling muds and cuttings. Low-relief banks in shallower water may be impacted to some degree.

Baldwin County Buffer (DPP, Proposed Program, and PFP Subarea Option)

The DPP included a subarea option for a 15-mi coastal buffer south of Baldwin County, AL, as requested by the Governor of Alabama, implicating seven geologic plays (**Table 4-12**). The environmental analysis of the GOM Region (**Section 4.1.8**) encompasses this option. There is not a separate analysis for this option, because the area covered is a very small part of the Central GOM Planning Area. In addition, the area traditionally has been subject to a no-surface occupancy lease sale stipulation that minimizes visual impacts from development operations within 15 mi (24 km) of Baldwin County. As a result, the Baldwin County buffer is not expected to afford environmental protection at a scale appropriate for adoption at the programmatic stage; however, in the PFP, the Secretary identified this subarea option to be carried forward for further analysis at the lease sale stage.

4.5.4 Potential Exclusions in the Atlantic Region

4.5.4.1 All Atlantic Planning Areas

The Straits of Florida and South Atlantic Planning Areas, as well as portions of the Mid-Atlantic Planning Area offshore North Carolina are withdrawn from consideration for oil and gas leasing under Section 12(a) of the OCS Lands Act through June 30, 2032. Several of the exclusions analyzed in this section fall partially within the withdrawn areas; however, the analysis provided is relevant to areas that are not withdrawn. Potential exclusions considered in the Atlantic Region include a 25-nmi coastal buffer, Biodiversity Strip, Gulf of Maine, Georges Bank, and Atlantic canyons (**Table 4-10, Table 4-13**). The continental margin of the eastern U.S. has dozens of submarine canyons (CSA Ocean Sciences Inc et al. 2019) (**Figure 4-16**).

Table 4-13. Potential exclusions that overlay geologic plays in the Atlantic Region

Exclusions	Exclusion Size (Million Acres)	Planning Area Acreage (Million Acres)	Percent Planning Area Acreage (Size/Planning Area Acreage)	Number of Geologic Plays Overlapping Exclusion
North Atlantic Planning Area	33			
25-nmi coastal buffer*	13.4	92.3	14.5%	0
Biodiversity Strip	4.74	92.3	5.1%	6
Gulf of Maine	12.0	92.3	13.0%	0
Georges Bank	6.6	92.3	7.0%	3
Atlantic canyons*	2.76	92.3	3.0%	4
Mid-Atlantic Planning Area				
25-nmi coastal buffer*	8.8	112.8	7.8%	4
Biodiversity Strip	5.0	112.8	4.4%	7
Atlantic canyons*	1.07	112.8	1.0%	4
South Atlantic Planning Area				
25-nmi coastal buffer*	8.4	54.34	15.5%	0
Biodiversity Strip	3.6	54.34	6.7%	1
Straits of Florida Planning Area				
25-nmi coastal buffer*	7.16	9.64	74.2%	0

*DPP Subarea Option

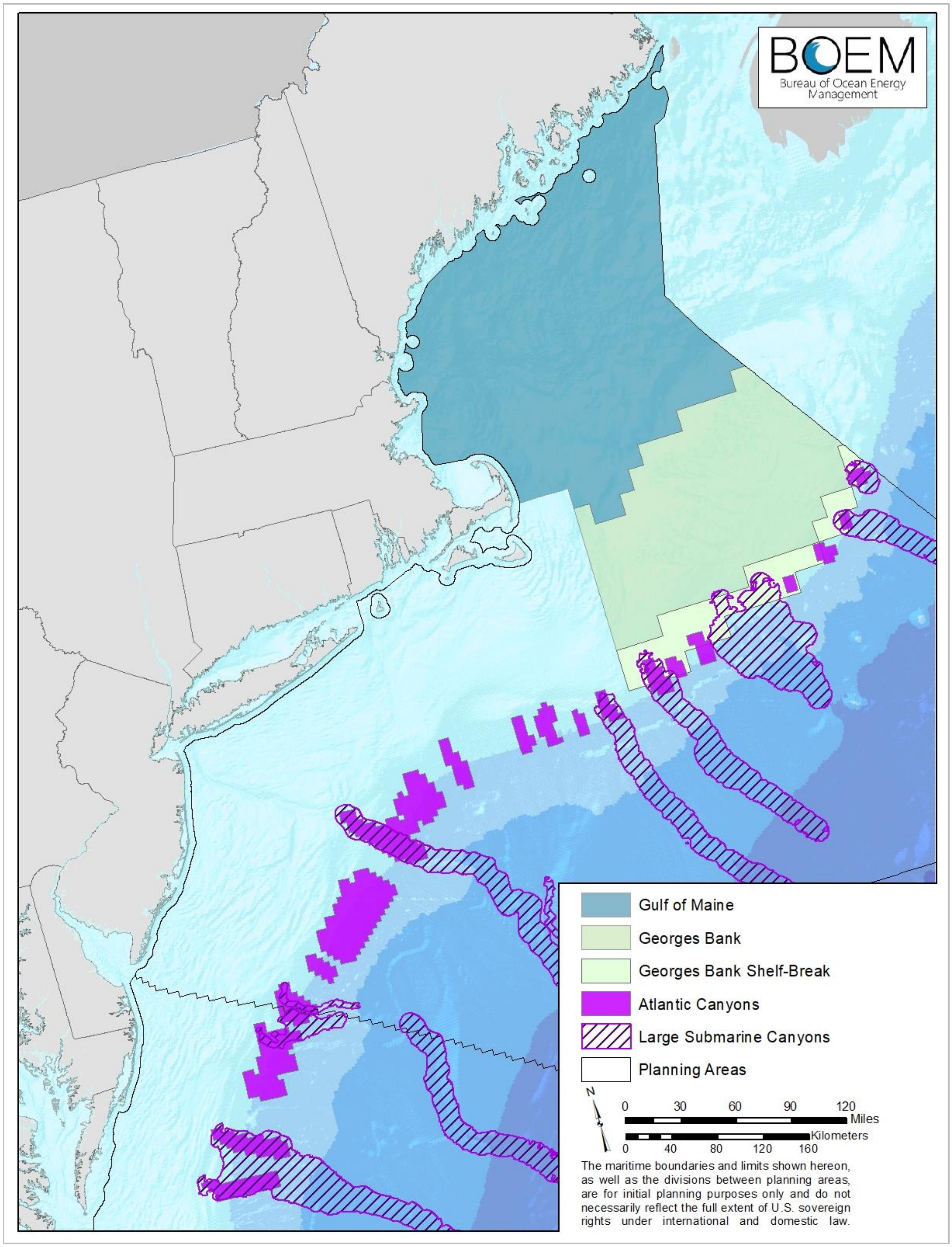


Figure 4-16. Locations of the Gulf of Maine, Georges Bank, and Atlantic canyons exclusion areas in the North Atlantic Planning Area

25-nmi Coastal Buffer (DPP Subarea Option)

This section analyzes a coastal buffer of 25-nmi that was identified in the DPP. Bound at its northernmost extent by the Canadian border and the Florida Strait to the south, an Atlantic 25-nmi coastal buffer includes cultural, historical, and ecological resources, including ESA-listed species and natural heritage sites. Capes, such as Hatteras, extend into the Atlantic and serve as important fisheries areas because of highly migratory fish species aggregating in these productive waters. The Atlantic Coast contains four NMSs (Stellwagen Bank, Mallows Bay-Potomac River, Monitor, and Gray's Reef), 7 national seashores, 2 national parks, 2 national recreation areas, 10 national monuments, 8 national historical sites and parks, 1 national memorial, and the Timucuan Ecological and Historic Preserve (in Florida). The Atlantic Coast also hosts a NASA launch range and variety of military activities.

The coastal buffer includes critical habitat for ESA-listed species, including the North Atlantic right whale, loggerhead sea turtle, smalltooth sawfish, elkhorn, and staghorn corals. It also overlaps the range of ESA-listed fin whales, sei whales, and giant manta ray. Thirty-nine marine mammal species occur in the region. Approximately 5% of total modeled ESA-listed cetacean populations (Roberts et al. 2016) would fall within the coastal buffer, as would the Gray's Reef, Monitor, and Florida Keys NMSs. A 25-nmi coastal buffer would eliminate leasing within most of the North Atlantic right whale critical habitat, except for the Gulf of Maine and a small area of the South Atlantic Bight. HAPCs and a subset of EFHs are located along throughout the Atlantic Coast and are key areas for fish spawning and breeding. Economically important fish species and forage fishes that support commercial fisheries are also prevalent around the coastal buffer. Several HAPCs within the coastal buffer support early life-history stages of various fish species that may be impacted by oil and gas activities.

Oil and gas activities adjacent to the North Atlantic right whale's critical habitat, some of which is within the buffer, may impact calving and foraging behaviors and consequently reduce fitness (NMFS 2018e). Vessel traffic would still be expected to cross the buffer from offshore lease areas to the coast and, as a result, risk of injury or death to marine mammals could potentially occur. Recreation, such as whale watching offshore from Maine through Virginia, may also be impacted if humpback whales and other marine mammals alter their migration routes in response to oil and gas disturbance. The coastal buffer would provide protection of important habitat from bottom disturbance, which may protect sensitive benthic habitat and marine archaeological resources. The buffer would also reduce space-use conflict with the Atlantic commercial fishing industry, which is very active in the coastal buffer area and generated over $2 billion in revenue in 2015 (NMFS 2018b).

BOEM analyzed a range of buffer options from 5 to 50 nmi (9 to 93 km) using correlated economic value of fisheries and density of cetaceans, especially including fisheries data from Kirkpatrick et al. (2017) and cetacean data from Roberts et al. (2016). Resource protection generally increases with distance out to about 30 nmi (56 km) (**Figure 4-17**). For example, the percentage of protected cetacean species increases the further eastward a buffer boundary is designated. Similarly, increasing the protected area also increases the amount of protection for fisheries.

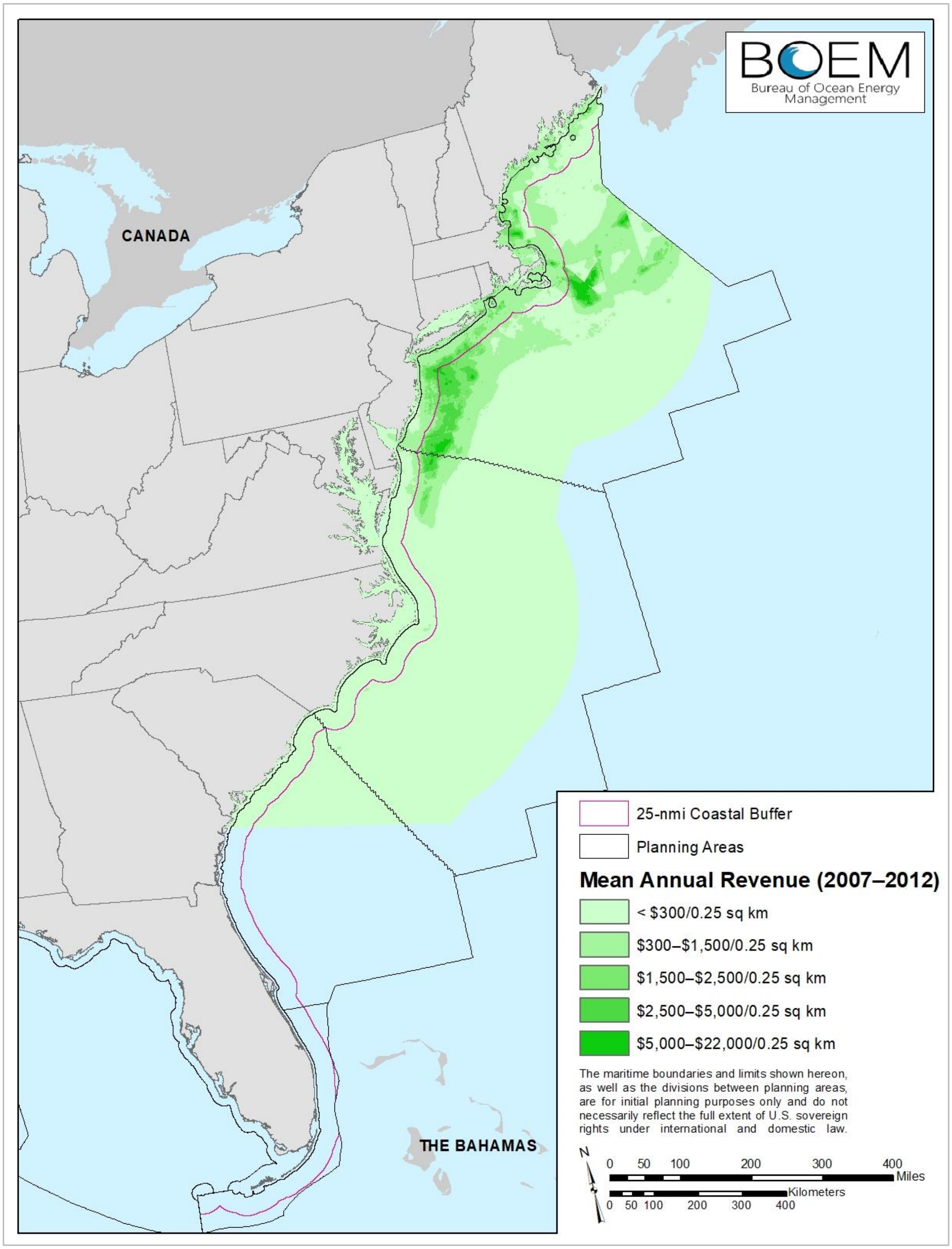


Figure 4-17. Mean annual commercial fishing revenue relative to a 25-nmi coastal buffer in the Atlantic OCS

A 25-nmi coastal buffer would exclude leasing and provide protection for sensitive resources within the buffer area. However, this buffer would not necessarily limit other activities (such as vessel traffic, support activities, and shore-based infrastructure) from occurring outside the buffer; these activities could still affect the resources within the buffer. **Table 4-13** shows the percentage of each planning area occupied by a 25-nmi coastal buffer. This coastal buffer overlaps with four geologic plays in the Mid-Atlantic Planning Area and does not implicate any known plays in the other Atlantic planning areas.

Biodiversity Strip

The northeast shelf off the Atlantic Coast is one of the most productive ecosystems in the world (Aquarone and Adams 2017). Beginning at about the 100-m isobath and running parallel to the Atlantic Coast are biologically rich areas with diverse assemblages of fishes, whales, deep-sea corals, and deepwater canyon habitats. Both options for the Biodiversity Strip exclusion (**Figure 4-18**) would exclude a portion of the Atlantic shelf break. The Biodiversity Strip could begin at either the 100-m or the 150-m isobath, with both options extending seaward for 30 nmi (56 km) toward the shelf break.

The biologically unique habitats within the Biodiversity Strip support some of the most productive recreational and commercial fisheries in the U.S. (Kaplan 2011). Several commercially important fishes rely heavily on this ecosystem. Pelagic species such as tuna and swordfish have been associated with canyons in the area, particularly Hudson, Baltimore, and Norfolk Canyons. Deepwater assemblages of hard corals are particularly important because they create complex habitat and have been observed in most of the canyons where hard substrate is exposed (Baird et al. 2017; CSA Ocean Sciences Inc et al. 2019). Although significant colonies of well-known corals (such as *Lophelia*) are rare within canyons, some types of corals (including black corals and sea fans) add significant community structure and support high community diversity (Baird et al. 2017). Cold-water corals are long-lived and slow-growing species; therefore, they are more susceptible to disturbance. Cold-water corals also serve as important habitat for deepwater fishes.

Deep-diving species, such as ESA-listed sperm whales, are found in greatest densities eastward of 100-m isobaths (Roberts et al. 2016). The ESA-listed fin and sei whales, as well as various beaked whales, also occur throughout the water column. Many marine mammals found in this high-density area are sensitive to mid- to low-frequency sounds (Southall et al. 2019). Some of the larger species of fish and marine mammals live many years, have low reproductive rates, grow slowly, and may be more vulnerable to impacts from oil and gas and other activities.

Both Biodiversity Strip options would provide protection to both pelagic and benthic resources, such as highly migratory fishes and deep-sea corals, from routine oil and gas impacts. Excluding the Biodiversity Strip from oil and gas activities would offer protection for important habitats and species of the Atlantic canyons and other unique features found throughout the area. The 150-m isobath is the smaller of the two options and protects the areas of highest year-round marine mammal density. The 100-m isobath option covers a larger area and includes more ESA-listed species core density area than the 150-m isobath option.

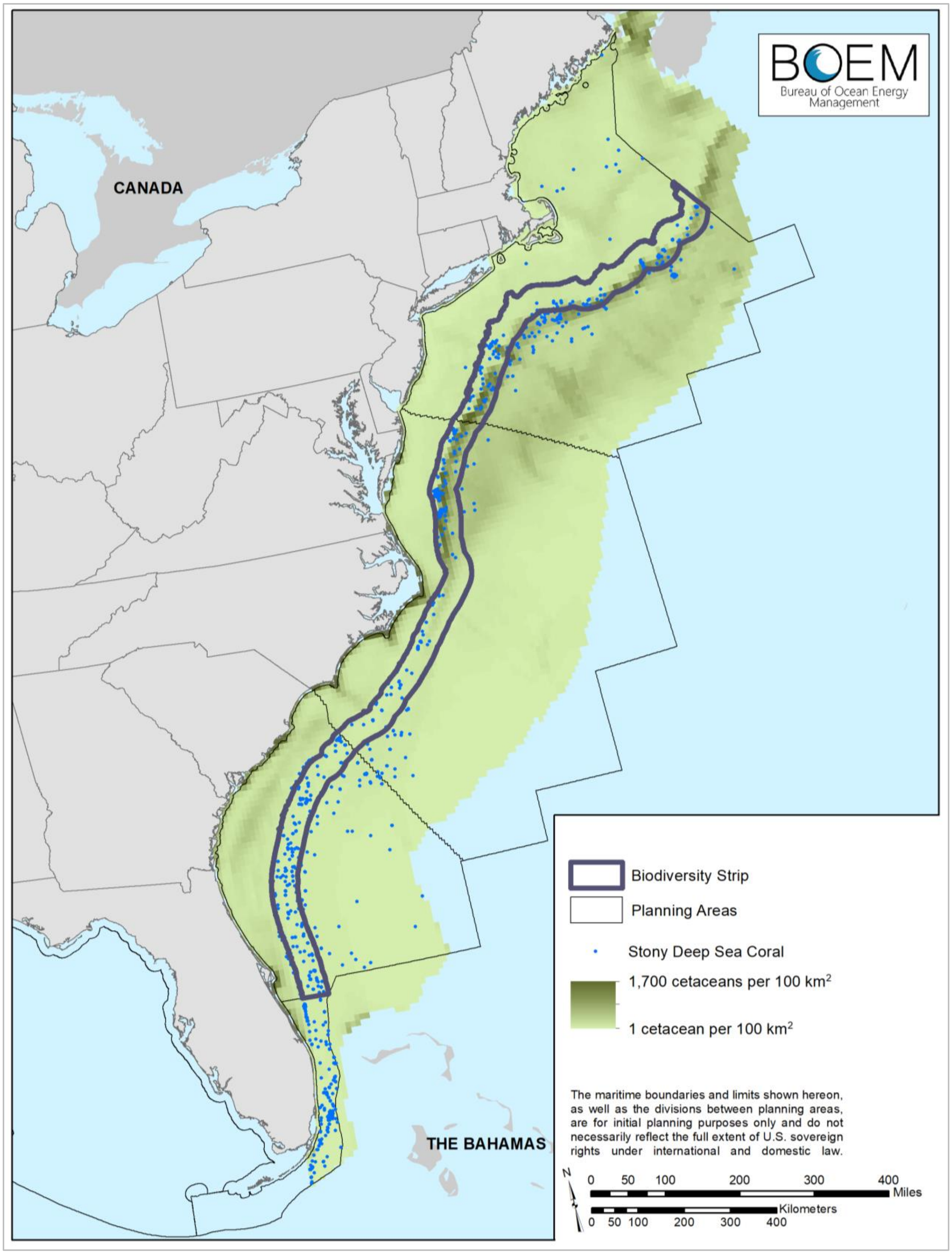


Figure 4-18. Cetacean density in the Atlantic Region relative to the Biodiversity Strip (100-m isobath option shown)

The selection of both a 25-nmi coastal buffer and a Biodiversity Strip captures overall cetacean abundance for ESA-listed species more effectively than a continuous coastal exclusion extended to the shelf break. The area between a 25-nmi coastal buffer and a Biodiversity Strip exclusion would remain available for resource extraction. The area beyond the Biodiversity Strip would also remain open for resource extraction. **Table 4-13** shows the percentage of each planning area occupied by the full-length Biodiversity Strip.

Additionally, a Biodiversity Strip could end just south of Cape Hatteras and not impact resource extraction off the southern half of North Carolina, South Carolina, Georgia, and Florida. This potential exclusion overlaps multiple geologic plays in the North and Mid-Atlantic Planning Areas but only one in the South Atlantic Planning Area.

4.5.4.2 North Atlantic Planning Area

Gulf of Maine

This area is a semi-enclosed sea bounded by Georges and Browns Banks, New England shorelines, and two Canadian provinces (Nova Scotia and New Brunswick) (**Figure 4-16**). It is among the most diverse, productive, and complex temperate marine areas in the world (Sherman and Skjoldal 2002).

The Gulf of Maine has unique bathymetric and physical properties, including topographic features like Wilkinson Basin and Jeffreys Ledge. These features promote high biodiversity, including concentrations of fish (such as herrings, tunas, sharks), marine mammals (such as whales), and seabirds (Winship et al. 2018). Zooplankton species play an important role in the Gulf of Maine ecosystem and serve as prey for herring, sand lance, and North Atlantic right whales (Bigelow 1924; Johnson et al. 2011; Pendleton et al. 2009). Harbor porpoise and the endangered North Atlantic right whale function as significant indicator species of the Gulf of Maine, where they persistently occur in high densities (White 2020a). There is designated critical habitat for the North Atlantic right whale throughout the Gulf of Maine, including in the Great South Channel and Georges Bank. Furthermore, a wide variety of marine birds serve as significant indicators species of the Gulf of Maine, where seasonal persistent aggregations endure (White 2020a). These birds include species highly susceptible to oil spills, such as the red-throated loon, long-tailed duck, Arctic tern, and the ESA-listed roseate tern (White 2020a). This area also includes a deep, cold-water kelp forest, and deep-sea coral.

Stellwagen Bank NMS, designated due to its long history of human use and its high productivity, is located in the Gulf of Maine (**Figure 4-16**). This NMS supports benthic and pelagic species and provides feeding and nursery grounds for over a dozen cetacean species, including the humpback, North Atlantic right whale, sei, and fin whales. It also supports foraging activity of seabirds, such as loons, cormorants, terns, and others. The Stellwagen Bank NMS supports diverse uses throughout the year, including fisheries, recreational, scientific, and educational activities (NOAA 2010). Fisheries are also culturally and economically important in the Gulf of Maine region, which supports high-value fisheries such as lobster and sea scallop (Thompson 2010). **Table 4-13** provides more detail on this subarea option, including the percent area occupied.

Georges Bank

Georges Bank is a large, shallow, sediment-covered plateau (**Figure 4-16**) located at the seaward edge of the Gulf of Maine. It is characterized by strong tidal and wind-driven currents, which generate significant upwelling (Backus and Bourne 1987; Quinn 2018). The Georges Bank exclusion area also includes the Georges Bank shelf break, which features numerous submarine canyons (**Figure 4-16**). Georges Bank is among the most productive continental shelf ecosystems because its shallow depth, vertical mixing, and circulation patterns promote high primary productivity (Loder et al. 1992). This productivity attracts a diversity of ecologically and commercially important species (Boudreau 1998). Oceanographer Canyon at the southern edge of Georges Bank is rich in deep-sea corals, sponges, and other important species of invertebrates and fish (Auster et al. 2020; Clarke 2018; CSA Ocean Sciences Inc et al. 2019).

Over two dozen whale and four seal species occur on Georges Bank, including sperm whales, Risso's dolphins, and the ESA-listed North Atlantic right whale. North Atlantic right whales transit across Georges Bank to and from wintering and summer feeding areas (Boudreau 1998). Georges Bank was designated as critical habitat for the North Atlantic right whale in 2016, along with the rest of the Gulf of Maine. Other important marine mammal species include the humpback whale, minke whale, and Atlantic white-sided dolphin (White 2020a). Many seabird species persist on Georges Bank in high densities. Important seabird species in this area include great shearwater, Cory's shearwater, northern fulmar, and south polar skua (White 2020a).

Georges Bank hosts many commercially important species, including scallop, lobsters, haddock, cod, Atlantic pollock, yellowtail flounder, herring, mackerel, tunas, swordfish, and sharks (Clarke 2018). It is a world-renowned fishery resource area that is key to maintaining productive fish stocks in the region. In 2018, closed fishing areas on the edge of Georges Bank and new protected areas in the Great South Channel between Georges Bank and Cape Cod afforded more spawning protection for an Atlantic cod stock. NMFS also established a new dedicated habitat research area on Georges Bank (Clarke 2018). Eastern Georges Bank is particularly important for lobster and groundfish. It also serves as a primary fishing area for the Atlantic sea scallop, which generates nearly half a billion dollars in annual revenue (Quinn 2018). Recreational fishing also occurs in the area but to a lesser degree. **Table 4-13** provides more detail on this subarea option, including the percent area and associated geologic plays implicated in the North Atlantic Planning Area.

4.5.4.3 North and Mid-Atlantic Planning Areas

Atlantic Canyons (DPP Subarea Option)

The continental margin of the eastern U.S. has dozens of submarine canyons, from Heezen Canyon offshore Cape Cod to Norfolk Canyon off the mouth of the Chesapeake Bay (CSA Ocean Sciences Inc et al. 2019) (**Figure 4-16**). Several canyons, such as Hudson and Norfolk Canyons, occupy an extensive geographic area. The Northeast Canyons and Seamounts Marine National Monument is also located in this area. Canyons and seamounts are hotspots of biodiversity, hosting many different species of fishes, squid, octopus, and invertebrates (e.g., sea stars, sea urchins, and sea cucumbers). They are also important habitats for many deepwater coral species, which have been found in nearly every canyon (Baird et al. 2017; Packer et al. 2007). Dense, localized patches of solitary stony corals and massive colonies of gorgonians occur in Baltimore and Norfolk Canyons (Packer et al. 2007). A chemosynthetic community associated with a methane hydrate site has also been identified on the Blake Ridge (Van Dover et al. 2003).

The Atlantic canyons are ecologically and economically valuable for fisheries. Studies have shown that the high diversity of canyon habitat concentrates benthic species more than at similar depths outside of canyons (Bachman et al. 2012; Hecker et al. 1980; Vetter et al. 2010). Studies also indicate that the canyons build up fishery harvest by concentrating organic matter, enhancing local productivity, providing habitat and prey species, and concentrating species in particular areas (Brodeur 2001; Flexas et al. 2008; Tudela et al. 2003; Yoklavich et al. 2000). The canyons support recreational and commercial fisheries, including tilefish, lobsters, red crab, tunas, and swordfish. Washington and Norfolk Canyons are notably important to tilefish and pelagic fisheries (BOEM 2016d).

The Atlantic canyons also serve as important habitat for many species of dolphins, beaked whales, and pilot whales, as well as protected sperm, fin, and sei whales (Lesage et al. 2017; Roberts et al. 2016; White 2020b). From Canada to the Mid-Atlantic Bight, blue whales use seamounts and other deep ocean structures along the Atlantic Coast as feeding and possibly breeding habitat (Lesage et al. 2017). The canyons also are persistently frequented by a variety of bird species, including the dovekie, red-necked phalarope, Audubon's shearwater, and several species of petrels (White 2020a).

Oil and gas activities may impact the resources found in the Atlantic canyons through IPFs such as noise, vessel strikes, and habitat alterations. **Table 4-13** provides more detail on this subarea option, including the percent area and overlapping geologic plays in the North and Mid-Atlantic Planning Areas. There is an existing withdrawal under Section 12(a) for portions of the Atlantic canyons complex (**Figure 4-14)**. Exclusion associated with the Atlantic canyons could address areas other than those already withdrawn (**Figure 4-16**).

4.6 POTENTIAL IMPACTS OF OIL SPILLS

Oil spills can cause significant and severe impacts on OCS resources, surrounding waters, and coastlines. Industry practices and government regulations are designed to minimize the risk of oil spills and ensure that responsible parties and Federal and state agencies are prepared to respond to spills when they occur (**Appendix H**). BOEM analyzes the potential for, and environmental impacts of, spills on the spectrum of resources and alternatives considered in this Final Programmatic EIS. General estimates of expected numbers and sizes of small and large oil spills are presented in **Appendix G**.

It is difficult to predict possible impacts from an accidental event at the programmatic level. More information is known at the lease sale stage about the timing and location of proposed activities, spill risk from those activities, and specific environmental resources that could be affected. BOEM's oil spill risk analysis modeling is conducted at that stage to estimate spill risk, spill trajectories, and probability of contact with an environmental resource. BOEM uses the modeling results to ascertain potential risk to specific environmental resources and determine how to further mitigate risk.

For additional information on oil spill modeling, visit BOEM's Oil Spill Modeling Program web page (www.boem.gov/Oil-Spill-Modeling-Program/).

> Oil spills can occur at the surface, in the water column, or at the seafloor, and can comprise both liquid oil and natural gas. Crude oil is a complex mixture of thousands of chemical compounds that result in different oil types having different properties, including density, toxicity, viscosity, and volatility. This variability could lead to differences in how spilled oil would react in the environment and differences in impacts.

After spilled oil is released into the environment, the oil is transformed by a variety of natural processes, collectively known as weathering, which change its chemical and physical properties, including its toxicity. **Figure 4-19** indicates the weathering processes of spilled oils in several environments and includes all the resources analyzed within the Final Programmatic EIS. For more detailed information about oil types and definitions of weathering processes, see NOAA's Office of Response and Restoration web page (response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/oil-types.html). For satellite-based reports of oil in the marine environment, see NOAA's Office of Satellite Product and Operations web page (www.ospo.noaa.gov/Products/ocean/marinepollution/). For a summary of the *Transport and Fate of Oil in the Arctic*, see the Arctic Oil Spill Response Technology Joint Industry Programme web page (neba.arcticresponsetechnology.org/report).

The *Deepwater Horizon* explosion, oil spill, and response in April 2010 impacted many facets of the GOM ecosystem and human environment. In February 2016, the Federal and state natural resource trustee agencies (Trustees) issued the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016). This document considers programmatic alternatives to restore natural resources, ecological services, and recreational use services injured or lost as a result of the *Deepwater Horizon* oil spill. The Trustees concluded that the *Deepwater Horizon* oil spill affected a wide array of linked resources over a large area, and that the effects must be described as an ecosystem-level injury. Therefore, the document included a comprehensive, integrated ecosystem restoration plan with a portfolio of restoration types to address the diverse suite of injuries that occurred at both regional and local scales. Since the spill, a large number of peer-reviewed papers and books have been published documenting spill impacts and critical data gaps (Murawski et al. 2020). BOEM will continue to assess new information regarding potential impacts from spills and consider this information in future analyses.

For additional information on regulatory safeguards for spill prevention, visit BSEE's Offshore Regulatory Programs web page (www.bsee.gov/what-we-do/offshore-regulatory-programs/regulations-standards).

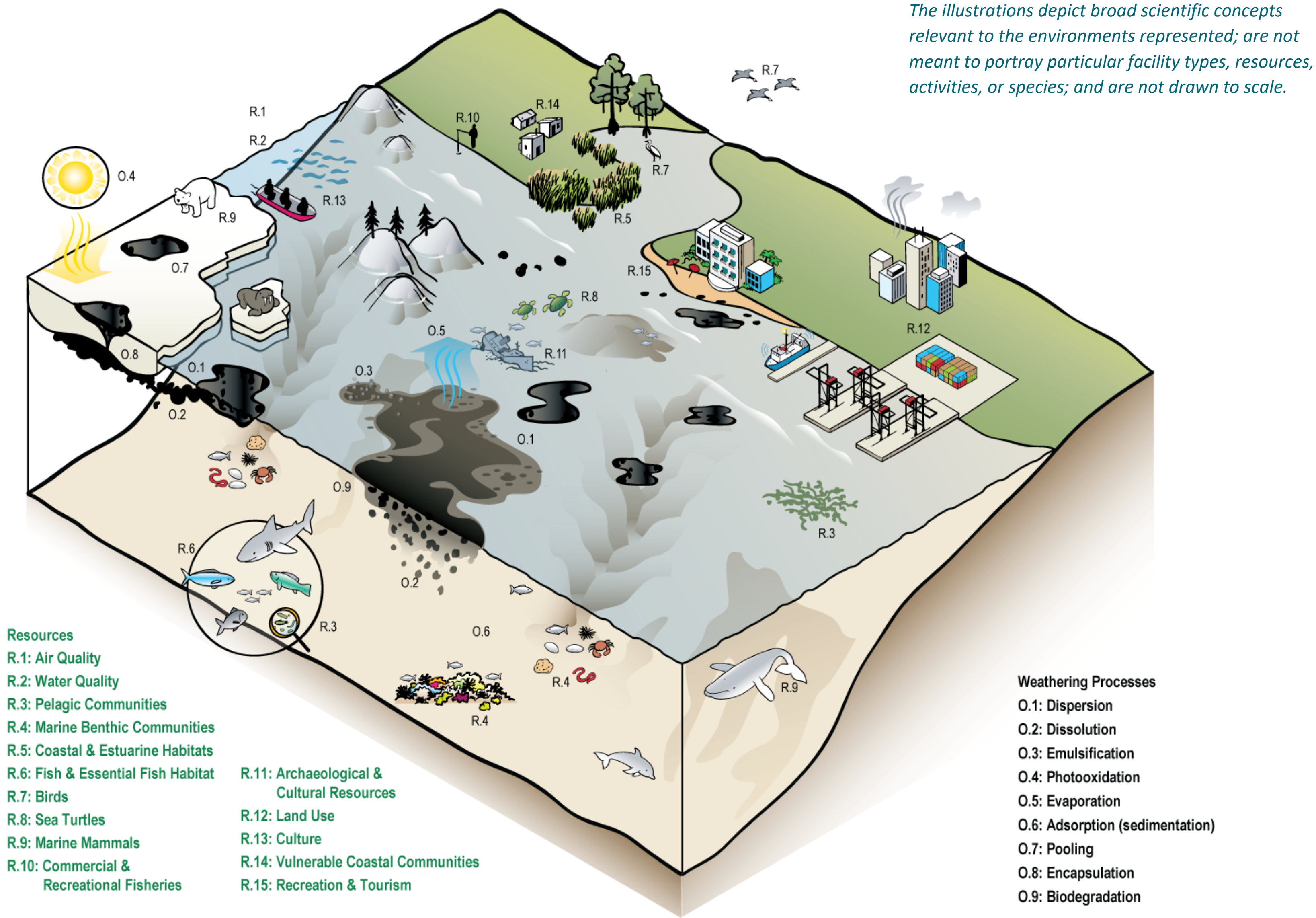


Figure 4-19. Oil spill weathering processes and impacted resources

4.6.1 Potential Impacts Per Resource

Spills may impact resources in all planning areas. The degree and severity of impacts from a spill on resources depends on the spill location, size, composition, depth, duration, environmental conditions, and effectiveness of response activities (Barron et al. 2020). These factors may affect weathering processes, such as evaporation, emulsification, dispersion, dissolution, microbial degradation, oxidation, and transport of the spilled products (**Figure 4-19**). Spills may have cascading effects on populations and ecosystems (BOEM 2017d). For example, cascading effects may include impacts on terrestrial coastal species that would otherwise experience minimal impacts, such as those living in refuges or other protected areas not directly impacted by oil and gas development (Perez-Umphrey et al. 2018). Spills may also destroy coastal or marine habitats and contaminate or deplete food in those environments, and these indirect impacts on marine organisms and resources may persist for months to years (Esler et al. 2018). Further analyses of potential impacts on ecosystems are completed at the lease sale stage.

Resources may be affected by different exposure pathways: directly (e.g., contact with oil or eating oil-contaminated food) or indirectly (e.g., disruption in prey availability, fouling of habitat caused by the spill). Direct oil exposure pathways for affected animals include breathing (through exposure to respiratory surfaces), physical contact including grooming of fur or feathers, drinking of contaminated water, and eating of contaminated food—all of which may have short- and long-term health impacts (BOEM 2017c; 2017d). Oil spill response activities, such as surface and subsea dispersant application or burning of oil, also may impact resources. Affected resources may be exposed to oil spills at the sea surface, in the water column, on the shoreline, in sediments and through the air.

R.1 **AIR QUALITY** likely would be highly impacted by VOC concentrations—and may exceed the NAAQS for criteria pollutants—in the immediate vicinity of a spill; however, concentrations may decrease quickly as the spill and VOCs are dispersed by winds, waves, and currents. In situ burning of spilled oil as a response activity would generate a plume of smoke; release NO_2, SO_2, CO, PM_{10}, and $PM_{2.5}$; and temporarily degrade air quality. Some oil and gas reservoirs contain H_2S, a toxic gas that is heavier than air. An accidental release of H_2S in the atmosphere at or near a platform may present serious health risks, including death, to platform workers and others nearby.

R.2 **WATER QUALITY** may be impacted by dissolved or dispersed petroleum constituents throughout the water column (including the surface) and by response activities (e.g., vessel discharges or use of dispersants). A spill may release gas into the water column, and microbial degradation of the gas may reduce dissolved oxygen levels and potentially create hypoxic or "dead zones," though studies have shown this is not likely (Camilli et al. 2010; Kessler et al. 2011). A spill in Alaskan waters may entrain in ice, with potential long-term effects. To an extent, natural processes would physically, chemically, and biologically degrade oil (National Research Council 2003c). A large spill in coastal or marine waters may cause sustained exceedance of state and Federal water and sediment quality criteria. A large spill at depth, with chemically or mechanically dispersed and suspended oil droplets, may create a plume (Reddy et al. 2011; Valentine et al. 2014) of dissolved and toxic compounds in the water column and cause large patches of sheen or oil on the sea surface.

R.3 **PELAGIC COMMUNITIES** may experience cascading effects from direct contact with oil at the surface, dissolved in the water column, or entrained in sinking detritus. The *Deepwater Horizon* oil spill in the GOM was followed by loss and then recovery of *Sargassum* mats and other biological communities at the sea surface (Powers et al. 2013). A crude oil release from a wellhead (subsurface release, blowout) or from a drilling rig (surface release) may impact phytoplankton and zooplankton within an affected area. Zooplankton are especially vulnerable to acute crude oil pollution, showing increased mortality and sublethal changes in physiological activities (e.g., egg production) (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016; Moore and Dwyer 1974; Suchanek 1993). Additionally, oil spills may be treated with dispersants to help prevent onshore contamination; however, these treatments may have their own varying effects, such as increased oil toxicity to phytoplankton (Bretherton et al. 2019) and changes in microbial community composition (Doyle et al. 2018). Reef-building corals release reproductive bundles that rise through the water column to the surface during very limited, specific time periods and are fertilized. Surface spills may impact coral spawning events if a spill occurs near a reef where spawning is occurring.

R.4 **MARINE BENTHIC COMMUNITIES** may be impacted on the seabed and along the shore. Impacts on deepwater benthic organisms are expected to be largely sublethal and may include reduced feeding and reproduction, physical tissue damage, and altered behavior. Impacts on deepwater communities may include reduced recruitment success, growth, and biological cover as a result of impaired recruitment (Kushmaro et al. 1997; Rogers 1990). Laboratory tests by DeLeo et al. (2016) on the relative effects of oil, chemical dispersants, and chemically dispersed oil mixtures on three species of northern GOM deepwater corals found much greater health declines in response to chemical dispersants and oil-dispersant mixtures than to oil-only treatments, which did not result in mortality. Some spilled oils are heavier than seawater and will sink, while other lighter oils may eventually settle on the seafloor through a binding process with suspended sediment particles (adsorption) or after aggregation, as marine snow (BOEM 2016b; Passow et al. 2012). Deepwater benthic habitats may be smothered by the sinking oil or particles and experience long-term exposure to hydrocarbons (Fisher et al. 2014; Hsing et al. 2013; Valentine and Benfield 2013). In situ burning of oil as a response activity may also introduce burn residue, which may sink to the seafloor and expose benthic organisms and communities to further oil contaminants (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016).

R.5 **COASTAL & ESTUARINE HABITATS** are especially sensitive to spilled oil. Potential impacts are complex and depend on the multiple factors listed above, including oil type, time of year in which a spill occurs, and specific habitat characteristics such as porosity. Wetlands, sheltered tidal flats, and sheltered rocky shores are particularly sensitive to oiling (Whitney 1994), with some areas remaining impacted for decades (Li and Boufadel 2010; Neff et al. 2011). Coastal wetlands may be significantly affected by toxic hydrocarbon and non-hydrocarbon spill components. Vegetated wetlands and semipermeable substrates sheltered from wave energy and strong tidal currents are the most vulnerable intertidal habitats (Hayes et al. 1992; NOAA 2017b). As volatile components are lost, oil on beaches thickens and forms tar balls, pavements, and aggregations that incorporate sand, shell, and other materials. Oil on wetlands or vegetated submerged habitats such as seagrass meadows may kill biota and cause degradation or permanent loss of habitat; plants could also recover by regenerating new shoots (Kenworthy et al. 2017; Pezeshki and DeLaune 2015). Animals that use the habitat, especially benthic organisms that reside in the sediments and are an important component of the food web, may be impacted in turn by this habitat loss. Habitat degradation may persist and have long-term residual impacts on the community ecology, habitat structure, and function. In addition, loss of vegetation along coastal salt marshes may accelerate erosion and retreat of shorelines (Silliman et al. 2012). Lastly, shoreline cleanup efforts after a spill often can mitigate impacts from a spill but may sometimes cause additional negative impacts on the affected habitat if done improperly (Zengel et al. 2015).

R.6 **FISH & ESSENTIAL FISH HABITAT** may both be affected by exposure to spilled oil. A large spill in open waters of the OCS would likely have sublethal and indirect effects on adult fish, which can detect and avoid adverse conditions, metabolize hydrocarbons, and excrete metabolites and parent compounds. However, long-term exposure to contaminants may cause chronic sublethal effects (Baguley et al. 2015; Millemann et al. 2015; Murawski et al. 2014; Snyder et al. 2015), which could affect fish populations. Oil floating on the surface may directly contact ichthyoplankton found at or near the surface, coating eggs and larvae and exposing them to dissolved toxic compounds. Most ichthyoplankton likely would be unable to avoid spills, and affected individuals may be at risk of death, delayed development, abnormalities, endocrine disruption, or other effects resulting in decreased fitness and reduced survival rates (Brown-Peterson et al. 2015; Incardona et al. 2014; Mager et al. 2014; Snyder et al. 2015). Spills reaching nursery habitat or overlapping spatiotemporally with a spawning event have the greatest potential for affecting the early life stages of fish and invertebrates.

R.7 **BIRDS** are vulnerable to oil spills in the water and on the shoreline. Oil spills may adversely impact birds by direct contact, fouling their habitat, and contaminating their food. Eating or inhaling oil during feeding and grooming may lead to tissue and organ damage. Oil may also interfere with finding food, predator avoidance, homing by migratory species, disease resistance, growth rates, reproduction, and respiration. Oiled birds may quickly become hypothermic, lose buoyancy and ability to fly, or die from oil toxicity. Eggs, young, or adult birds exposed to oil or food contaminated with oil may experience various lethal and sublethal effects. Birds may leave fouled habitats for areas that were less suitable for them before a spill. Even a small spill may have serious impacts on ESA-listed species.

R.8 **SEA TURTLES** are affected by oil spills through pathways that include direct contact, inhalation of oil and its volatile components, and ingestion of fouled prey (Wallace et al. 2020). Oil can adhere to sea turtle skin and shells, and contact with spilled oil may decrease health, reproductive fitness, and longevity and increase vulnerability to disease and contamination of prey. Sea turtles surfacing within or near an oil spill likely would inhale petroleum vapors, causing respiratory stress. Ingested oil, particularly the lighter fractions, can be acutely toxic to sea turtles. In addition, several aspects of sea turtle biology and behavior place them at risk, including lack of avoidance behavior, indiscriminate feeding in convergence zones, inhalation of large volumes of air before dives (Milton et al. 2010), and affinity to the *Sargassum* community, where oil can be concentrated, for food and cover (Witherington et al. 2012). Although sea turtles could nest on oiled beaches, it is likely that nesting females would abandon nesting attempts. If nesting occurs, the nesting female, hatchlings, and eggs may get oiled.

R.9 MARINE MAMMALS are expected to be affected primarily by larger spills. Marine mammals may be affected through pathways including direct surface contact with oil, inhalation of oil or its volatile components, direct ingestion, or ingestion of contaminated prey. These pathways may lead to decreased health, reproductive fitness, and longevity, as well as increased vulnerability to disease. An oil spill may lead to the localized reduction, disappearance, or contamination of prey species. Benthic-feeding marine mammals, including walrus and other species that feed on clams and polychaete worms, are most likely to eat oil-contaminated prey, as these benthic animals tend to concentrate petroleum hydrocarbons (Fukuyama et al. 2000; Würsig 1988). The risk is reduced for plankton-feeding baleen whales and is lowest for fish-eating marine mammals, as most petroleum hydrocarbons are not biomagnified in the food web (Würsig 1988). Protected bays and estuaries present particular risks where oil may concentrate and lead to long-term exposure (Schwacke et al. 2014). In addition, any loss of fitness, reproduction, or health may be significant in some very vulnerable species, such as the North Atlantic right whale or Rice's whale.

Cetaceans (including bowhead and beluga whales) concentrate in ice leads during spring migration (BOEM 2012b). In the Alaska Region, an oil spill during periods of restricted open water due to ice cover may have severe effects, as animals are limited in their ability to avoid the oil. Impacts on marine mammal calving grounds may lead to population-level effects. Pinnipeds and polar bears may be exposed when coming ashore onto oiled beaches. Sea otters and polar bears may be particularly vulnerable because they rely on fur to maintain body heat. Once oiled, sea otters (which also inhabit the Pacific Region) quickly become hypothermic, and both species may ingest oil while grooming, which may have lethal impacts on organs. Polar bears may also ingest oil while feeding upon oiled seals or scavenging oiled carcasses.

R.10 COMMERCIAL & RECREATIONAL FISHERIES may experience impacts from oil spills. Fish species and life stages residing in the upper water column are the most likely to contact spilled oil, particularly pelagic species and filter feeders that forage at the water's surface, such as menhaden. Depending on the location and duration of a spill, commercial fishing opportunities may be lost, and commercial fisheries revenue may temporarily decline. State or Federal agencies may close affected areas to fishing until the threat of contamination is over. Fishers moving to unaffected fishing grounds may experience additional costs, including increased competition and additional stress on targeted fish species. Larger spills may contaminate target species, causing potentially large-scale and long-term fishery closures, resulting in loss of revenue. Public perception of seafood quality and safety following a large spill may affect revenues far into the future. A minimum loss of $247 million was estimated from the fishery closures associated with the *Deepwater Horizon* oil spill (McCrea-Strub et al. 2011). Recreational fishing opportunities may be lost, and recreational anglers may turn to other forms of recreation.

R.11 ARCHAEOLOGICAL & CULTURAL RESOURCES may be impacted if oil or contaminated material reaches an archaeological site and alters its ecological, chemical, or physical status. Spills reaching areas closer to shore may affect shallow-water shipwrecks, historical or pre-contact period sites, and Traditional Cultural Properties.

If land or facilities are contaminated, closures or limits on use in areas such as beaches or ports may occur during clean up, and R.12 **LAND USE** may be impacted by spill response infrastructure such as staging areas, as well as transportation of workers and materials. Recovered oil and waste generated from the cleanup may impact capacity at waste disposal sites.

The R.13 **CULTURE** of coastal communities may be impacted by oil spills. Coastal communities form a collective social unity with livelihoods and cultural identity built around fishing; recreation and tourism; and a shared maritime history, economy, and traditions unique to their geographic area. Traditions of Native American and Alaska Native peoples depending on subsistence hunting and gathering of wild coastal and nearshore resources for food security (BOEM 2016d) may be impacted by oil spills. Bowhead whale hunting, for example, may be impacted by any spills or responses to spills in the vicinity, which may have deep and long-term impacts on the communities for whom hunting and sharing in the food is a cultural heritage. Food contamination is a particular concern for Alaska Native communities on the North Slope. Loss or contamination of food may diminish physical and mental well-being.

R.14 **VULNERABLE COASTAL COMMUNITIES** and populations may be disproportionately affected by a large spill, especially if impacted by cleanup operations or disruptions in social fabric and order. Historically marginalized communities have specific concerns related to their psychosocial welfare. Potential effects could include increased levels of depression, generalized anxiety disorder, post-traumatic stress disorder, and other psychological problems, which may result in intrapersonal consequences like violence and childhood trauma (Palinkas 2012). In addition, marginalized communities may be temporarily employed with oil spill cleanup, and there are potential human health risks associated with cleanup activities, such as decreased liver function due to exposure to oil (D'Andrea and Reddy 2014). These impacts could occur in any planning area impacted by oil spills. The food security of vulnerable coastal communities dependent on the harvest of wild food resources may be impacted by oil spills if spills affect the quality or availability of subsistence resources. Subsistence harvesters may also be impacted by increased costs associated with subsistence activities if they need to travel longer distances to access alternate harvest areas after an oil spill. These impacts on individual harvesters could result in community-wide impacts in subsistence communities that are dependent on the sharing of resources brought in by a small number of harvesters, as has been documented in some communities in the Gulf of Alaska and Cook Inlet (Keating et al. 2020).

R.15 **RECREATION & TOURISM** may be affected in areas impacted by oil spills. Ocean-based activities (such as beach visitation, watersports, or fishing) may be affected by a spill and subsequent cleanup efforts. Reduced tourism, due to either real or perceived impacts of a spill, may decrease earnings and impact coastal communities and states dependent on tourism-related income and revenue. Spills may reduce employment, income, and property values; increase public service costs; and cause shortages in commodities or services (Austin et al. 2014; Nadeau et al. 2014).

4.7 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

CEQ regulations for implementing NEPA require discussion of "any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented" (40 CFR 1502.16). The U.S. Court of Appeals for the District of Columbia ruled that, at the National OCS Program stage, no irreversible and irretrievable commitment of resources is made that would adversely affect the environment.[17] Therefore, consideration of irreversible and irretrievable commitment of resources is not necessary in this Final Programmatic EIS; BOEM will consider and disclose any irreversible and irretrievable commitment of resources at subsequent OCS Lands Act stages. The opinions cited above observed that discussion is relevant at the lease sale and subsequent stages when a decision is made that authorizes a course of action or an activity with the potential for impact.

Each of the OCS regions has unique characteristics that influence the potential for unavoidable adverse effects from oil and gas activities to physical and biological resources and the human environment (**Sections 4.1.3 and 4.1.6–4.1.9**). Numerous adverse effects on resources could be avoided or minimized by adherence to regulations, guidance, and conventions; use of best management practices and industry standards; and implementation of mitigation measures. NEPA analyses conducted at the lease sale and subsequent stages will address unavoidable adverse effects on long-term productivity.

Unavoidable adverse effects at later stages may vary in context, intensity, duration, and spatial extent across planning areas; however, none will occur at the National OCS Program stage. The effects will occur only if leases are issued under the 2024–2029 Program and activities result. Many of the adverse effects of routine operations arise during the exploration, development, and early production phases of oil and gas activity. In less developed areas, much of the resulting onshore infrastructure, such as roads and dwellings, likely would remain after leases expire. By adopting mitigation measures for OCS operations, BOEM may minimize short- and long-term adverse effects and maintain the productivity of marine areas where oil and gas exploration and development occur. The coastal and marine environment affected by routine operations is expected to remain at or return to its anticipated long-term productivity levels when activities cease. Use of the oil or gas extracted may have economic, political, and social benefits—in particular, providing energy and reducing the need for oil imports or onshore oil and gas production. However, extracting and consuming OCS oil and gas would deplete these nonrenewable resources.

[17] *Center for Biological Diversity v. Department of the Interior*, 563 F.3d 466 (D.C. Cir. 2009); *Center for Sustainable Economy v. Jewell*, 779 F.3d 588 (D.C. Cir. 2015)

Chapter 5:

Consultation and Coordination

5.1 INTRODUCTION

Input from the public, sovereign Tribal governments, and potentially affected states informed the development of the 2024–2029 Program and Programmatic EIS. **Figure 5-1** outlines the relationship between NEPA and the OCS Lands Act and highlights opportunities for public input during the National OCS Program development processes.

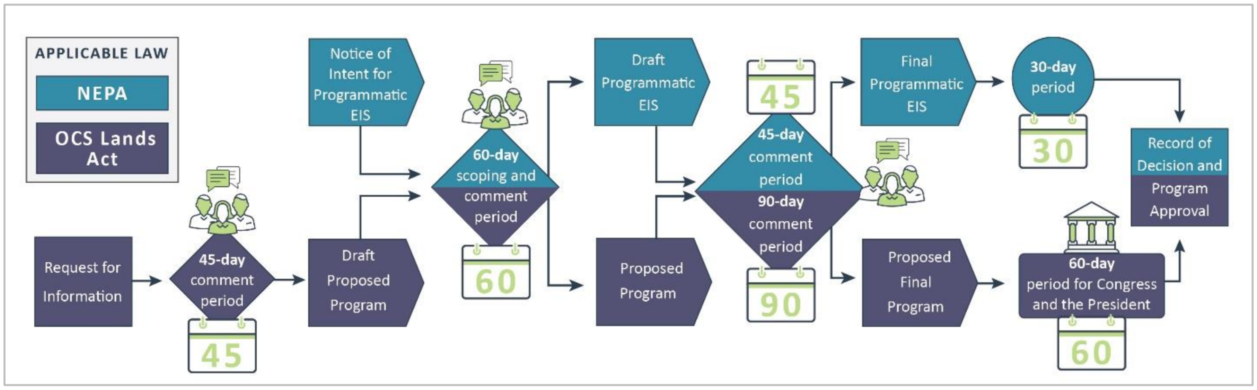


Figure 5-1. Relationship between NEPA and OCS Lands Act processes for the National OCS Program
Timelines for developing the Programmatic EIS match the OCS Lands Act process for the 2024–2029 Program.

5.2 PROCESS FOR PREPARATION OF THE DRAFT PROGRAMMATIC EIS

5.2.1 Scoping for the Draft Programmatic EIS and Commenting on the DPP

BOEM solicited input from Federal and state agencies, federally recognized Tribes, ANCSA corporations, local governments and communities, and other stakeholders over a 60-day period from January 8 through March 9, 2018. BOEM held 23 public meetings, one in each potentially affected coastal state, to facilitate engagement, discuss NEPA and OCS Lands Act processes, and receive comments. BOEM staff solicited comments on the DPP and conducted scoping for the Draft Programmatic EIS. Comments provided the Secretary with information regarding resource and impact issues, possible mitigation measures, nominations for exclusions, and suggested alternatives. Public meeting participation varied across the regions, with approximately 2,700 registered participants in total. BOEM received more than 2 million written comments during the public comment period, approximately 24,000 of which were unique letters (i.e., not form letters). Comments were accepted online, via mail, and in person. A report summarizing the public scoping comments was provided as Appendix A of the Proposed Program.

5.2.2 Cooperating Agencies

Pursuant to 43 CFR 46.225, BOEM is required to invite eligible government entities to participate as cooperating agencies during the development of an EIS. As defined by CEQ regulations (40 CFR 1508.5), a cooperating agency may be any Federal or non-Federal agency that has jurisdiction by law or special expertise with respect to environmental impacts resulting from a proposed activity. The Notice of Intent to Prepare an EIS, published on January 8, 2018, invited other Federal agencies, as well as state, Tribal, and local governments, to become cooperating agencies in the preparation of the Programmatic EIS.

BOEM established cooperating agency status with NASA's Office of Strategic Infrastructure (via a formalized Memorandum of Understanding for their special expertise on launch paths and debris fields) and with the National Park Service (under USDOI internal procedures, for their special expertise on their managed areas).

5.3 PUBLICATION OF THE DRAFT PROGRAMMATIC EIS AND PROPOSED PROGRAM

5.3.1 Notification and Distribution of the Draft Programmatic EIS and Proposed Program

BOEM performed the following tasks to inform affected states, federally recognized Tribes, and the public of the availability of the Draft Programmatic EIS and to solicit public input during the public comment period:

- Published a joint Notice of Availability (NOA) in the *Federal Register* inviting public comment on for the Draft Programmatic EIS and Proposed Program
- Informed government agencies, federally recognized Tribes, and stakeholders of the availability of the Draft Programmatic EIS and Proposed Program and how to comment (**Sections 5.3.2 and 5.3.3**)
- Posted on BOEM's website (www.boem.gov/National-OCS-Program/) the Draft Programmatic EIS and other information announcing all public meeting dates and times and how and when to comment
- Mailed letters to the governors of all states
- Provided notification of document availability to and coordinated with federally recognized Tribes, Alaska Native governments, and regional and village ANCSA corporations that may have an interest in the proposed leasing activities and/or providing input on the Proposed Program or Draft Programmatic EIS, in accordance with USDOI's and BOEM's policies on consultation with Indian and Alaska Native Tribes, and Alaska Native Corporations.

5.3.2 Agencies, Tribes, and Organizations Notified

BOEM's Office of Communications (OOC) maintains a robust database of more than 11,500 media and stakeholder contacts to notify for announcements, events, and services provided by BOEM. Contacts are added to the database by request and as a result of involvement in an issue. Because the development of the 2024–2029 Program and Programmatic EIS is of interest to many individuals in BOEM OOC's database, BOEM sent notifications about availability of the Draft Programmatic EIS to all contacts on those lists in the database.

In addition, BOEM notified interested Federal agencies, state and local governments, industry, nongovernmental organizations, and members of the public. Potentially affected Tribes and Tribal organizations were also notified; more detailed information on Tribal outreach was available in Section 10.4 of the Proposed Program.

5.3.3 Comments Received on the Draft Programmatic EIS

A summary of numbers and types of comments on the Draft Programmatic EIS is provided in **Appendix K**. All comments received during the public comment period were considered by BOEM. Comments were received from state and local officials; Federal, state, and local agencies; environmental organizations and NGOs; the oil and gas energy sector; and individuals. BOEM received approximately 762,859 comments on the Draft Programmatic EIS and Proposed Program; the vast majority of these were statements of either support or opposition to the Proposed Action with no substantive information related to the Draft Programmatic EIS. BOEM identified 184 substantive comments related specifically to the Draft Programmatic EIS. Although the comments covered a wide range of topics, most of the comments centered on climate change, the NEPA process and analysis, oil spills and catastrophic discharge events (CDEs), alternatives, marine mammals, and sociocultural systems. **Appendix K** provides responses to substantive comments.

5.3.4 Notification and Distribution of the Final Programmatic EIS

After reviewing comments on the Draft Programmatic EIS and conducting additional analyses, BOEM prepared a Final Programmatic EIS. Under CEQ regulations, there is a required minimum 30-day waiting period from the release of a Final Programmatic EIS before a Record of Decision can be signed. As part of the notification of availability of the Final Programmatic EIS, BOEM plans to perform the following tasks:

- Publish an NOA for the Final Programmatic EIS in the *Federal Register*
- Post the Final Programmatic EIS and other information on BOEM's website (www.boem.gov/National-OCS-Program/)
- Mail letters to the governors of all states
- Provide notification of document availability to federally recognized Tribes, Alaska Native governments, and regional and village ANCSA corporations that may have an interest in the proposed leasing activities, in accordance with USDOI's and BOEM's policies on consultation with Indian and Alaska Native Tribes, and Alaska Native Corporations.

U.S. Department of the Interior

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management

The mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way. The bureau promotes energy independence, environmental protection, and economic development through responsible management of these offshore resources based on the best available science.