

VINEYARD NORTHEAST

CONSTRUCTION AND OPERATIONS PLAN VOLUME II APPENDIX

MARCH 2024

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VINEYARD



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Appendix II-B1 Figures

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March 2024

Revision	Date	Description
0	July 2022	Initial submission.
1	October 2022	Updated to include additional data collected in 2022.
2	May 2023	Updated to include all data collected in 2022.
3	November 2023	Removed the potential New York Offshore Export Cable Corridor (OECC) figures. Removed onshore facilities from figures.
3	March 2024	Resubmitted without revisions.

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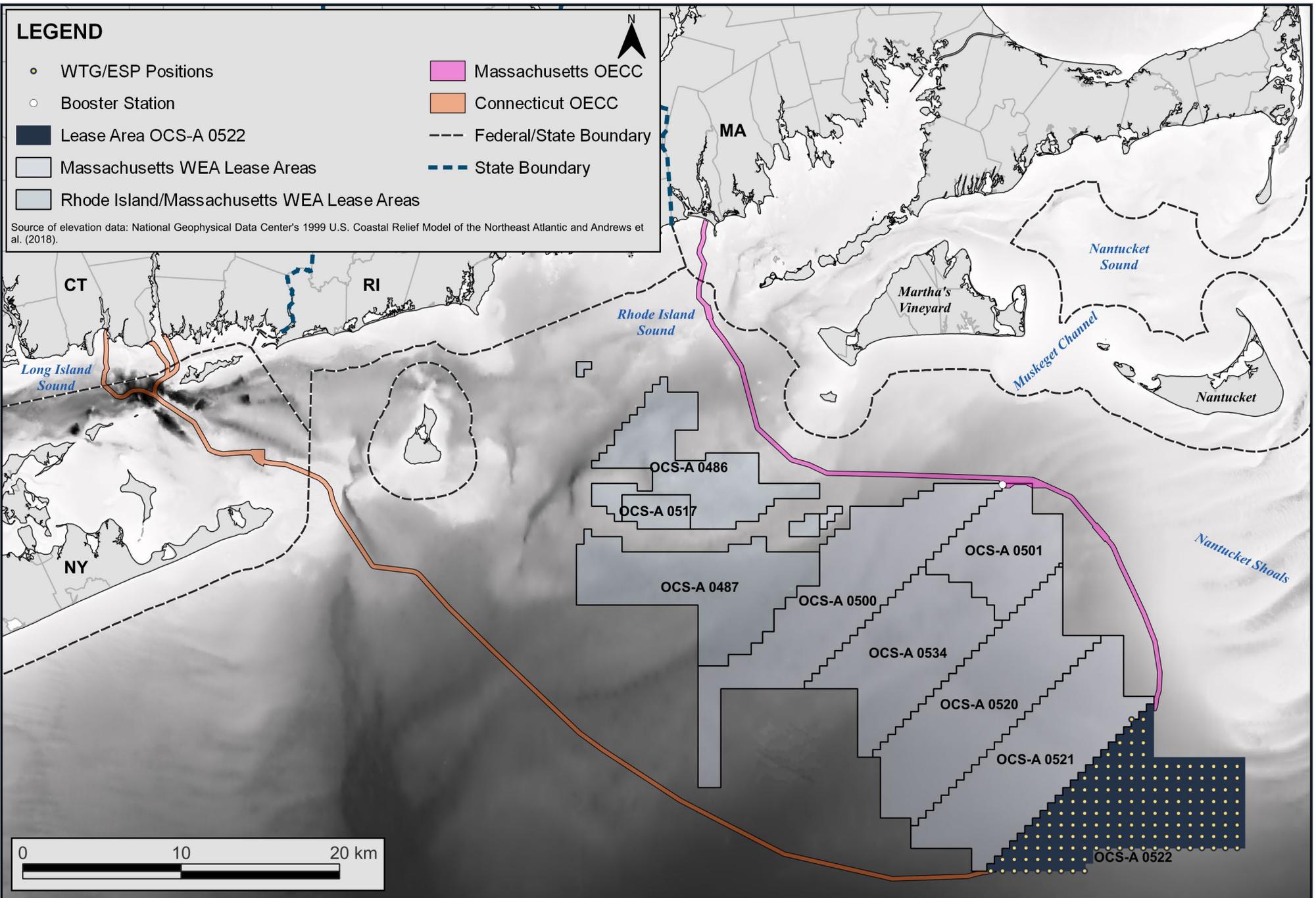


Figure 1.1-1
 Overview of Vineyard Northeast Offshore Development Area

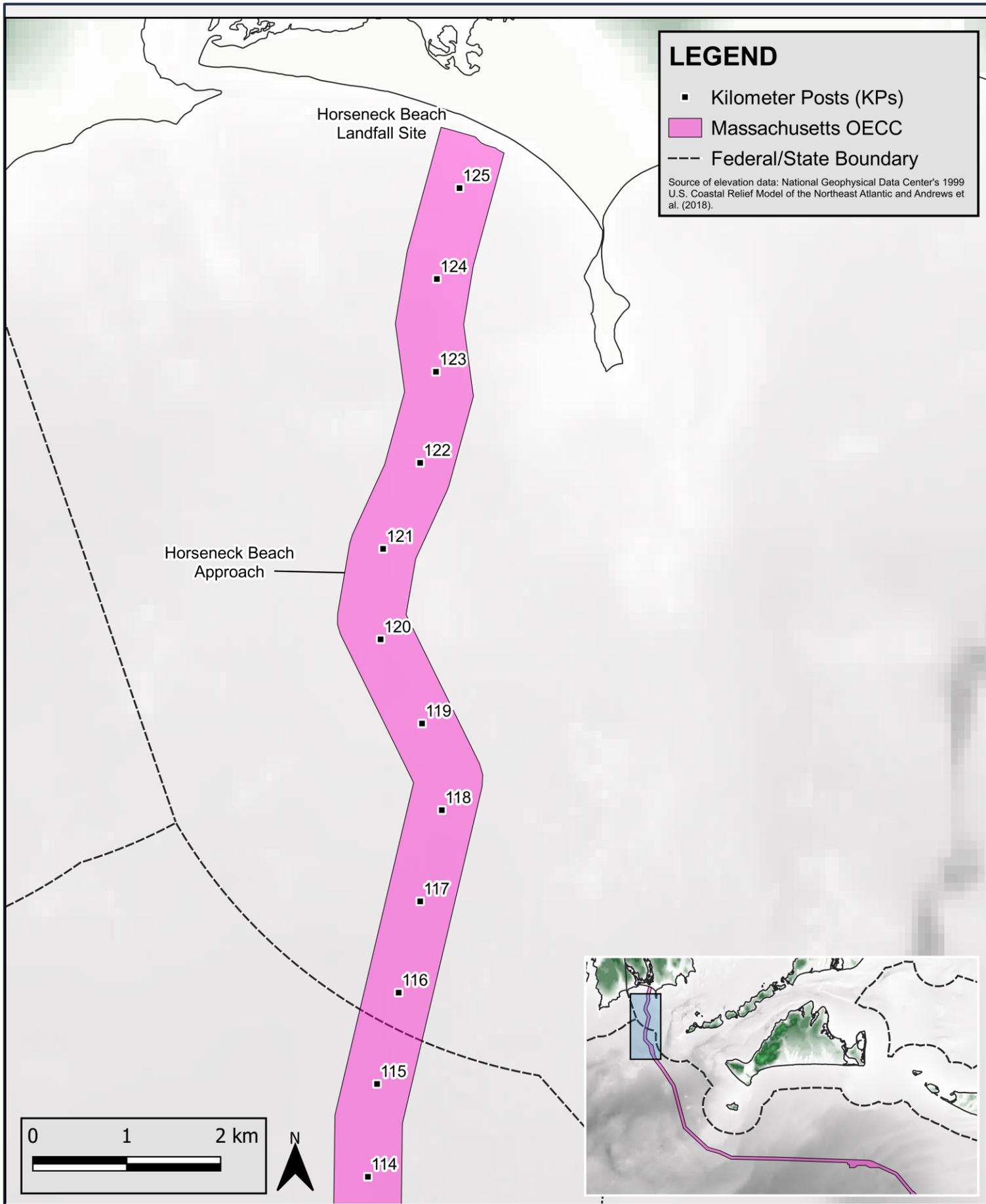


Figure 1.1-2
Massachusetts OECC Landfall Site

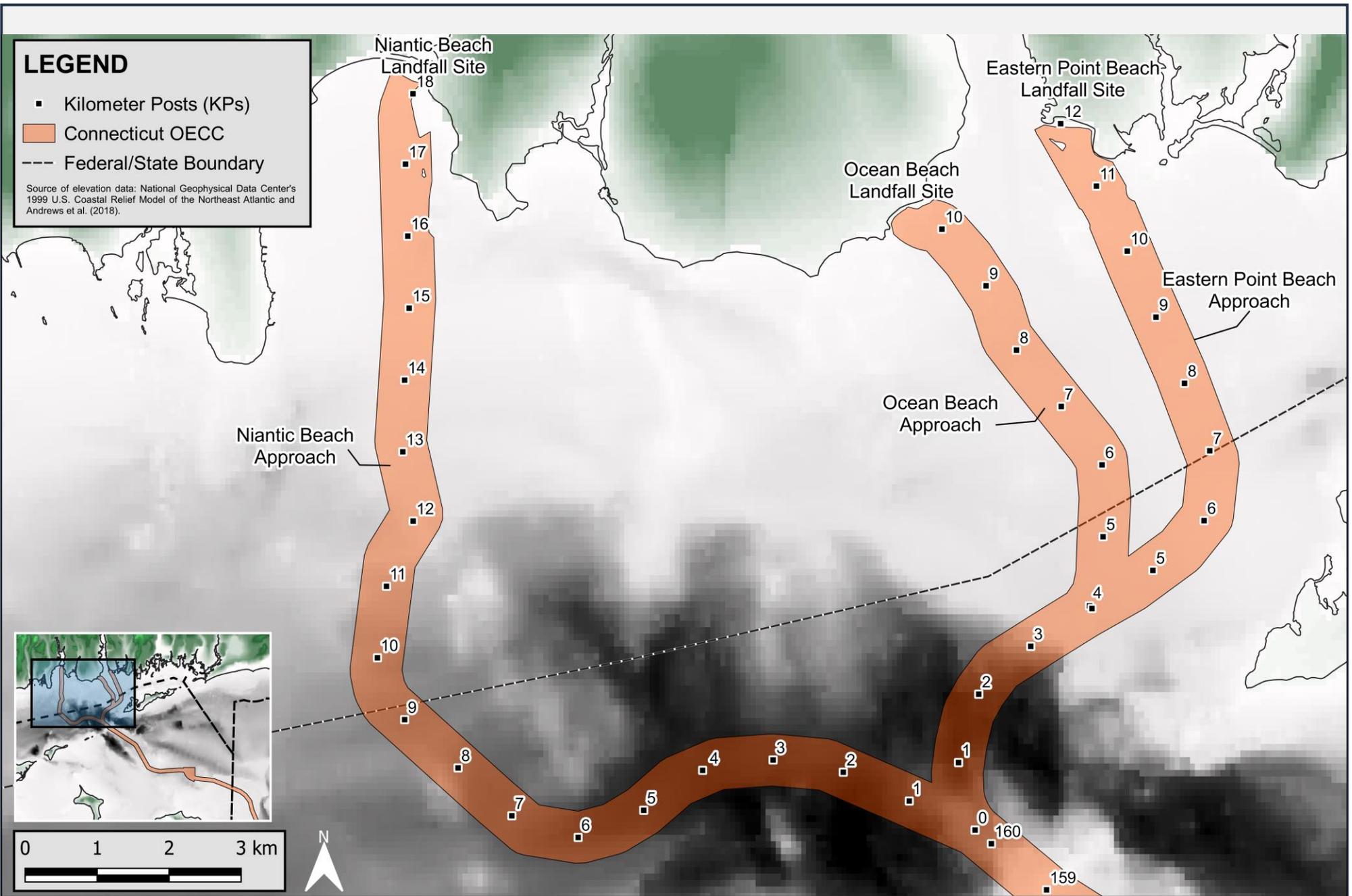


Figure 1.1-3
 Connecticut OECC Landfall Sites

LEGEND

- 2019 Benthic Grab Samples
- 2019 Underwater Video Transects
- Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al (2018).

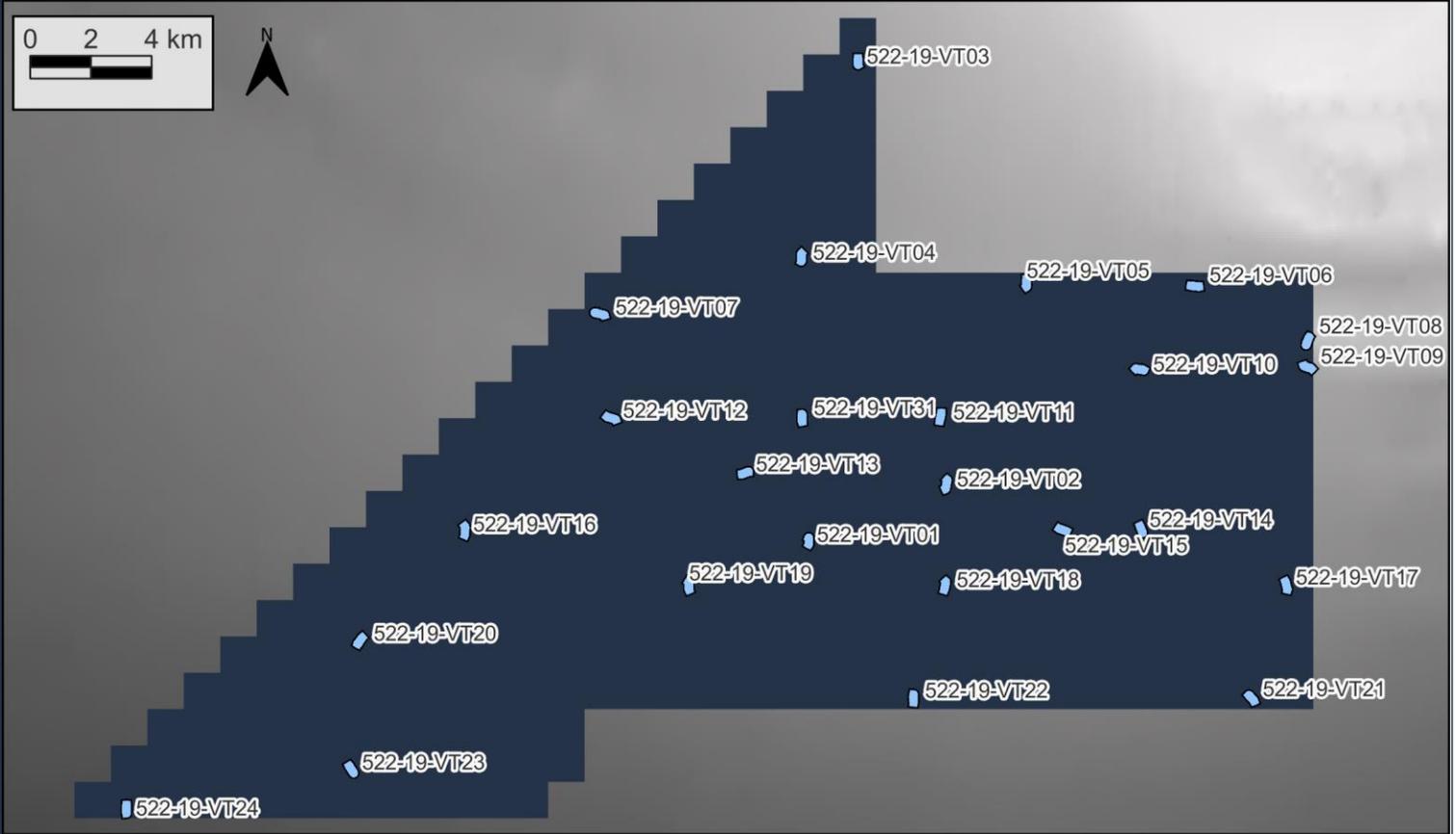
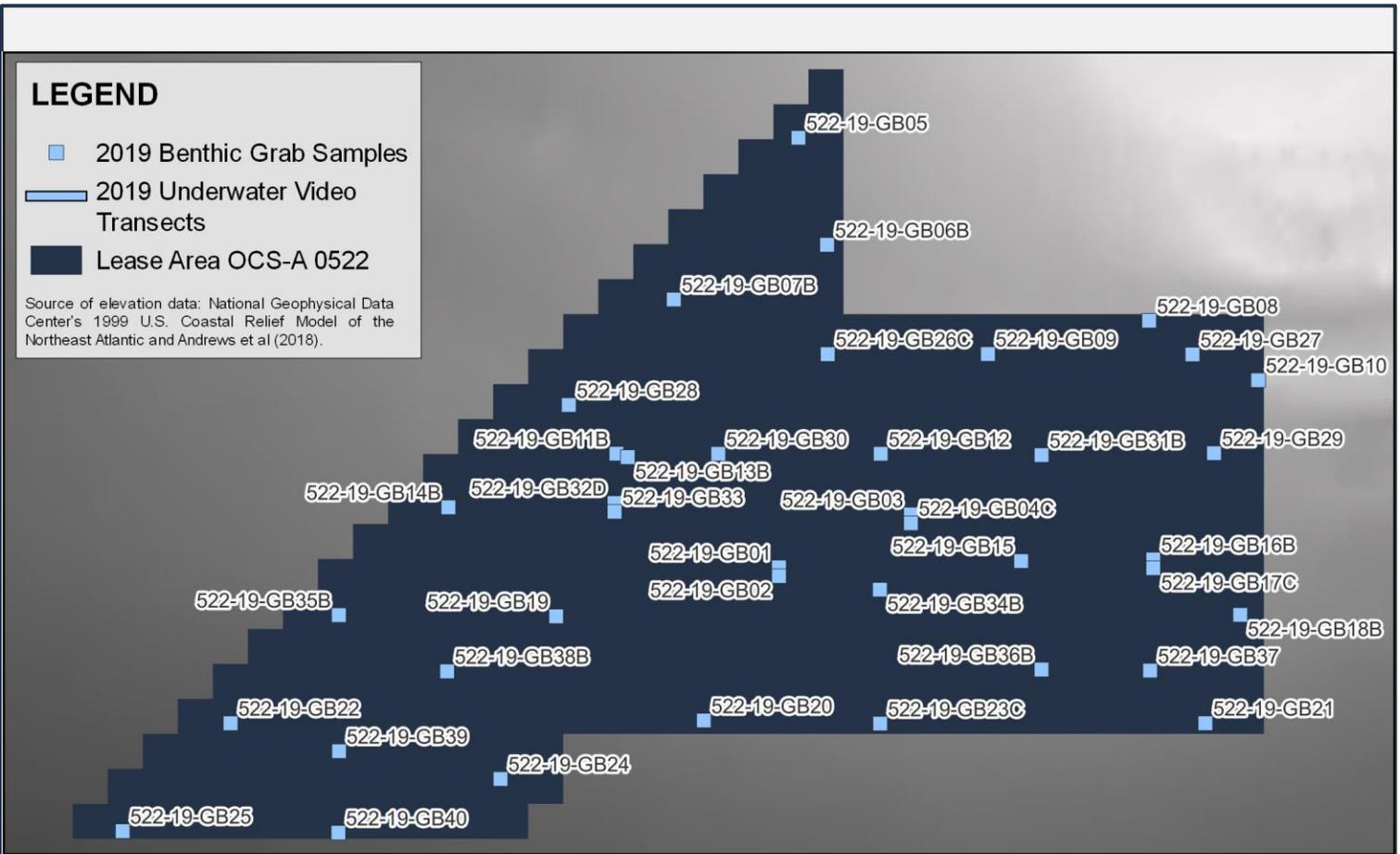


Figure 1.3-4

2019 Benthic Grab Sample Locations and Underwater Video Transects, Lease Area



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LEGEND

2022 Benthic Grab Stations

- Grain Size Analysis and Infauna
- Grain Size Analysis Only
- Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al. (2018).

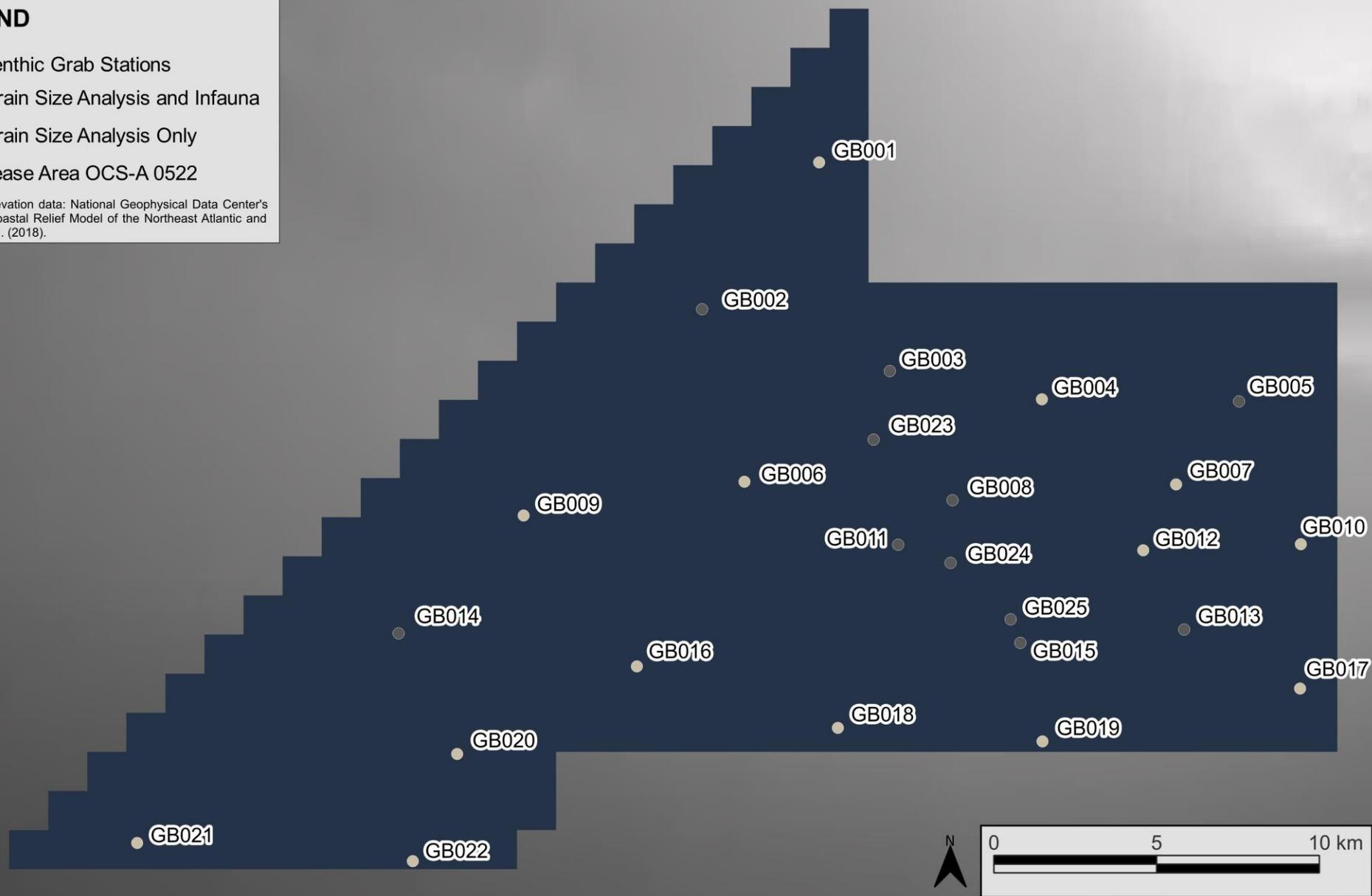


Figure 1.3-7

2022 Benthic Grab Sample Locations, Lease Area

LEGEND

— 2022 Underwater Video Transects

■ Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al. (2018).

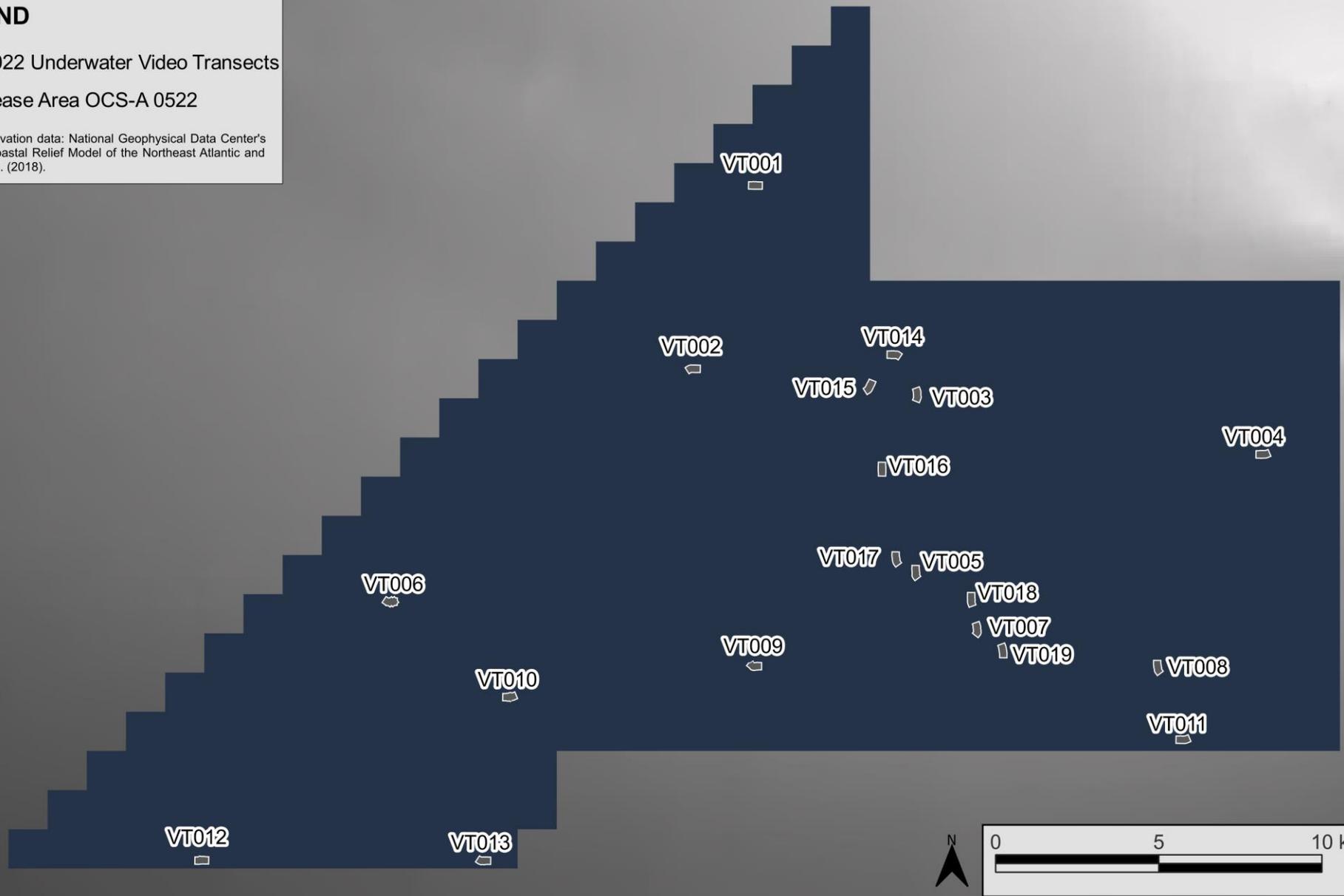


Figure 1.3-8

2022 Underwater Video Transect Locations, Lease Area

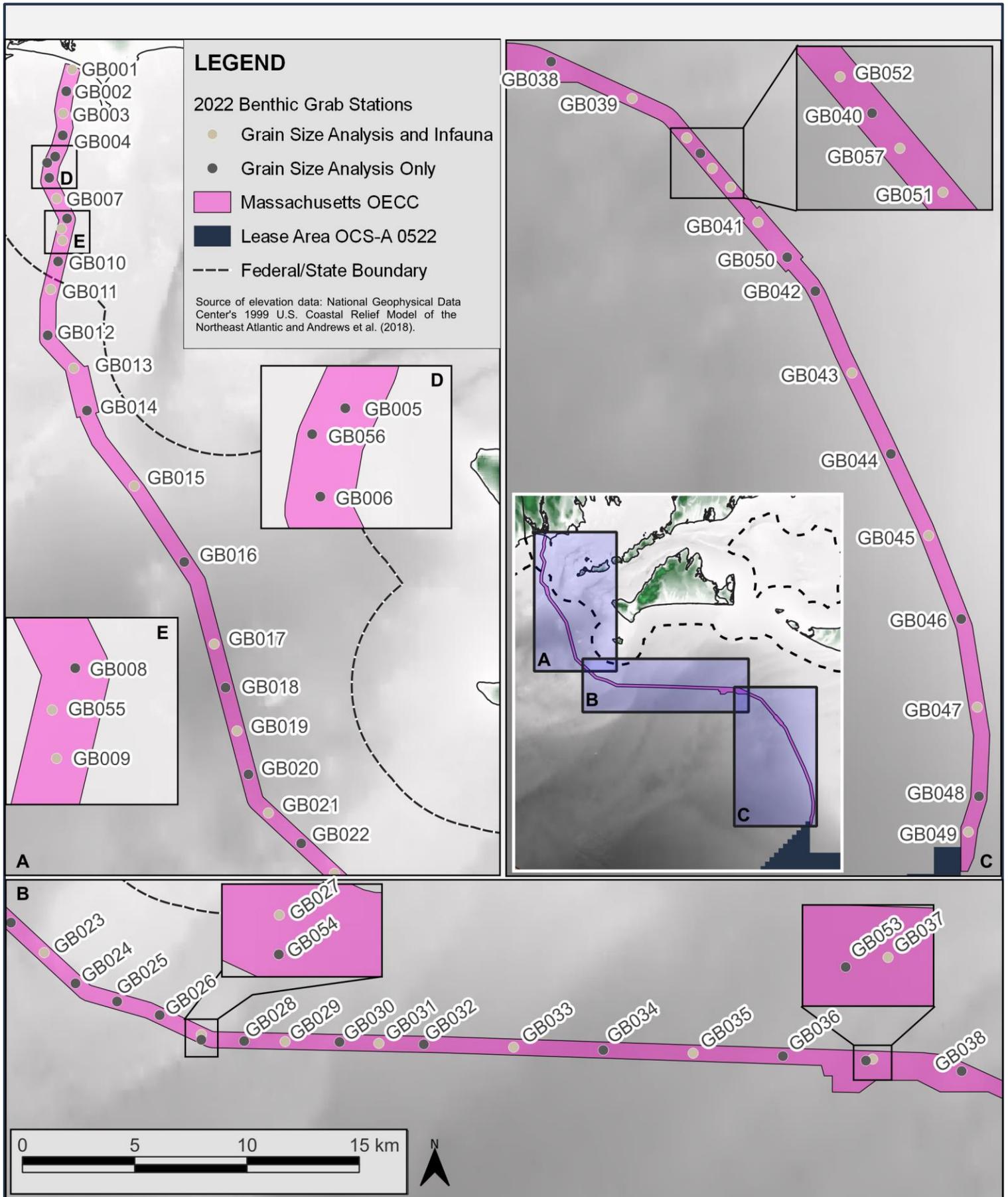


Figure 1.3-12

2022 Benthic Grab Sample Locations, Massachusetts OECC



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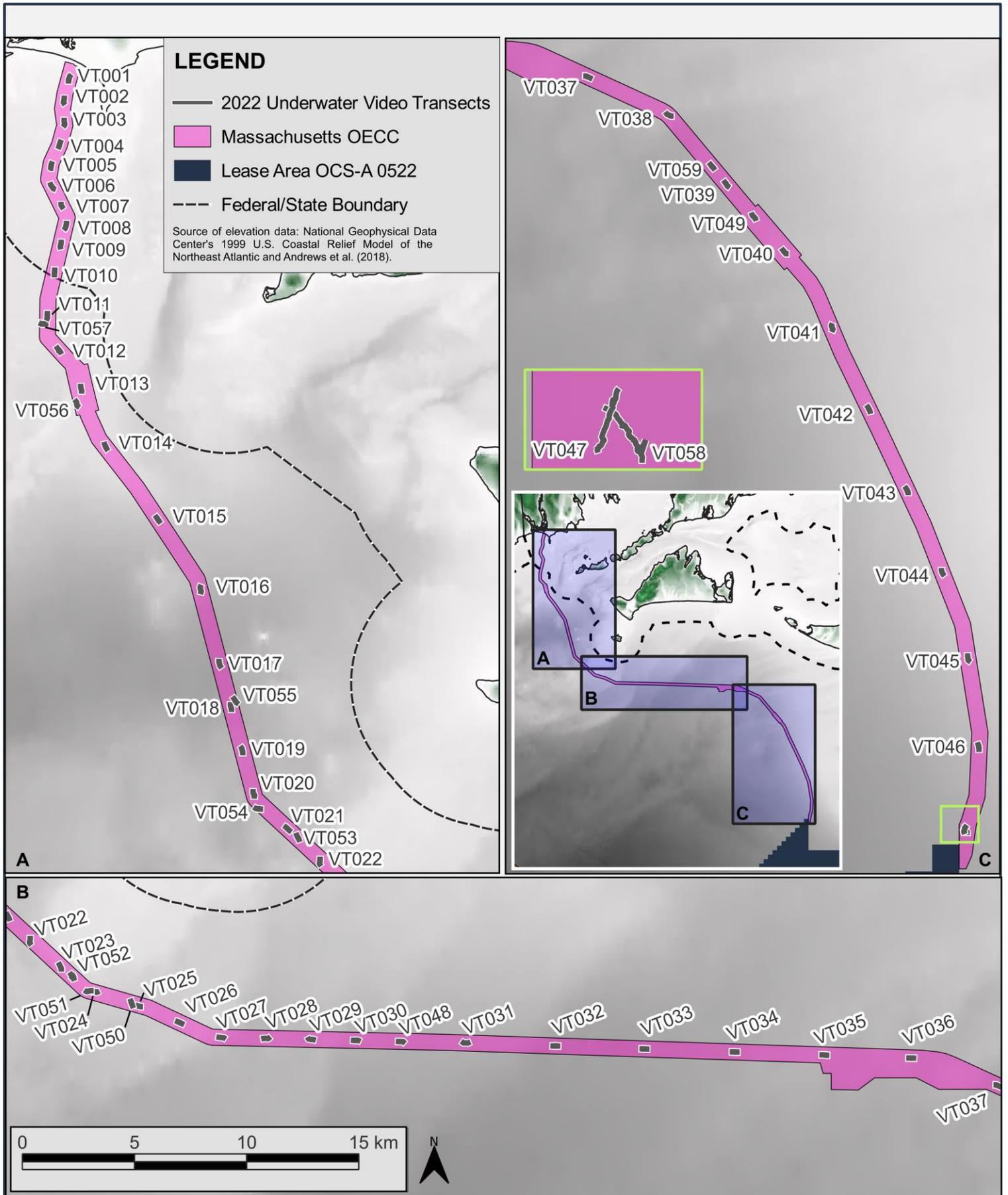


Figure 1.3-13

2022 Underwater Video Transect Locations, Massachusetts OECC



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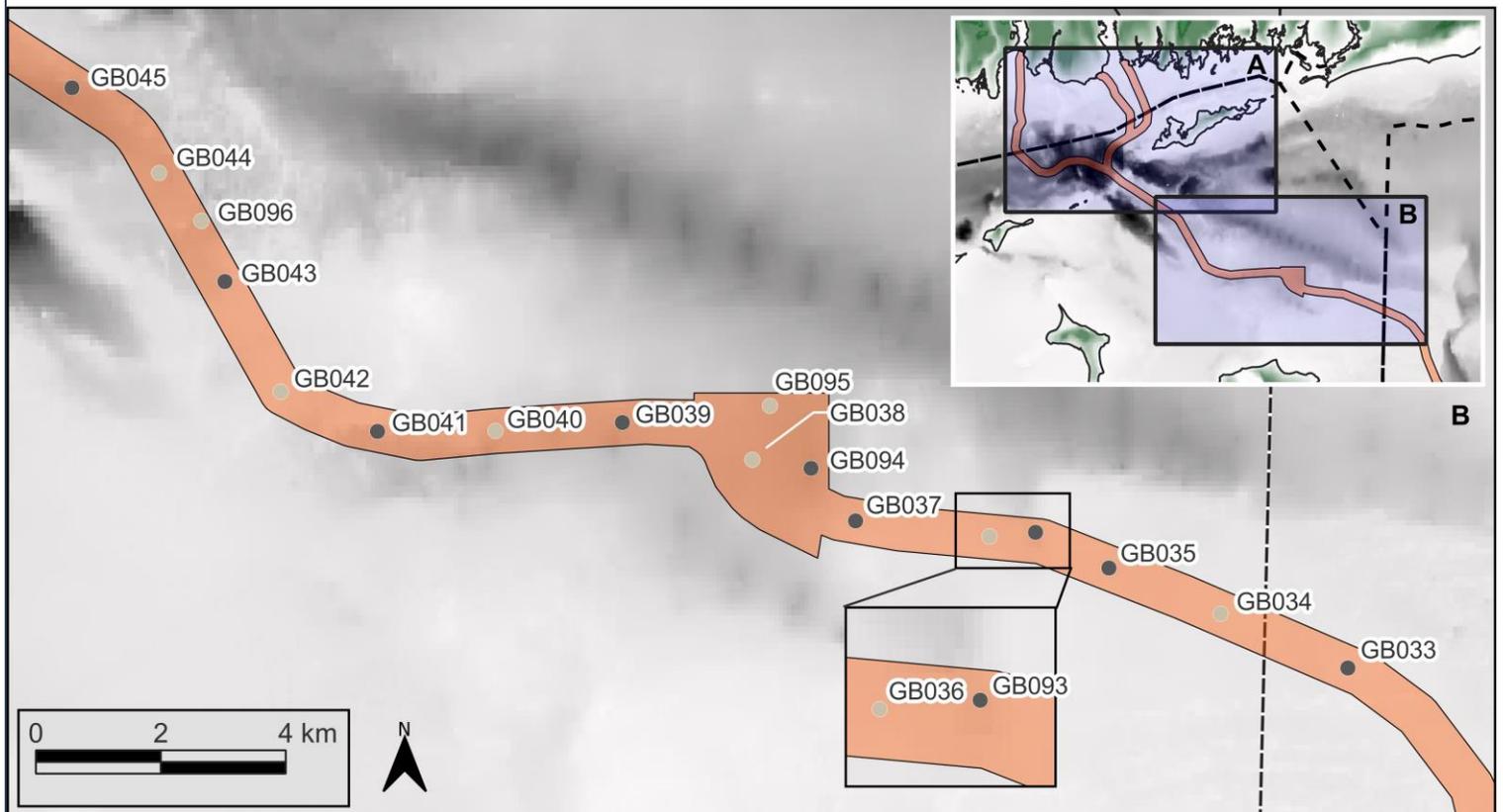
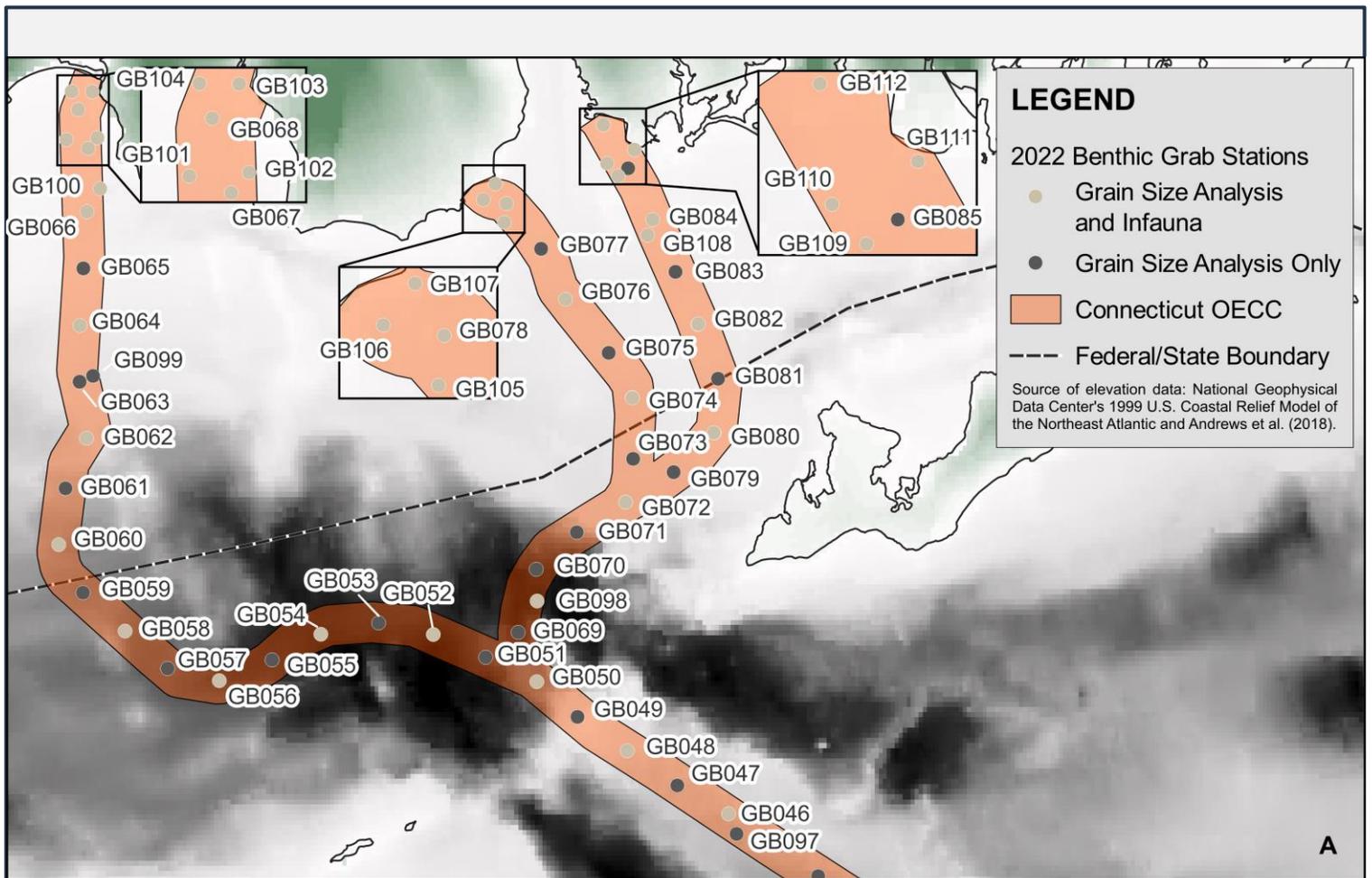


Figure 1.3-22

2022 Benthic Grab Sample Locations, Connecticut OECC Nearshore



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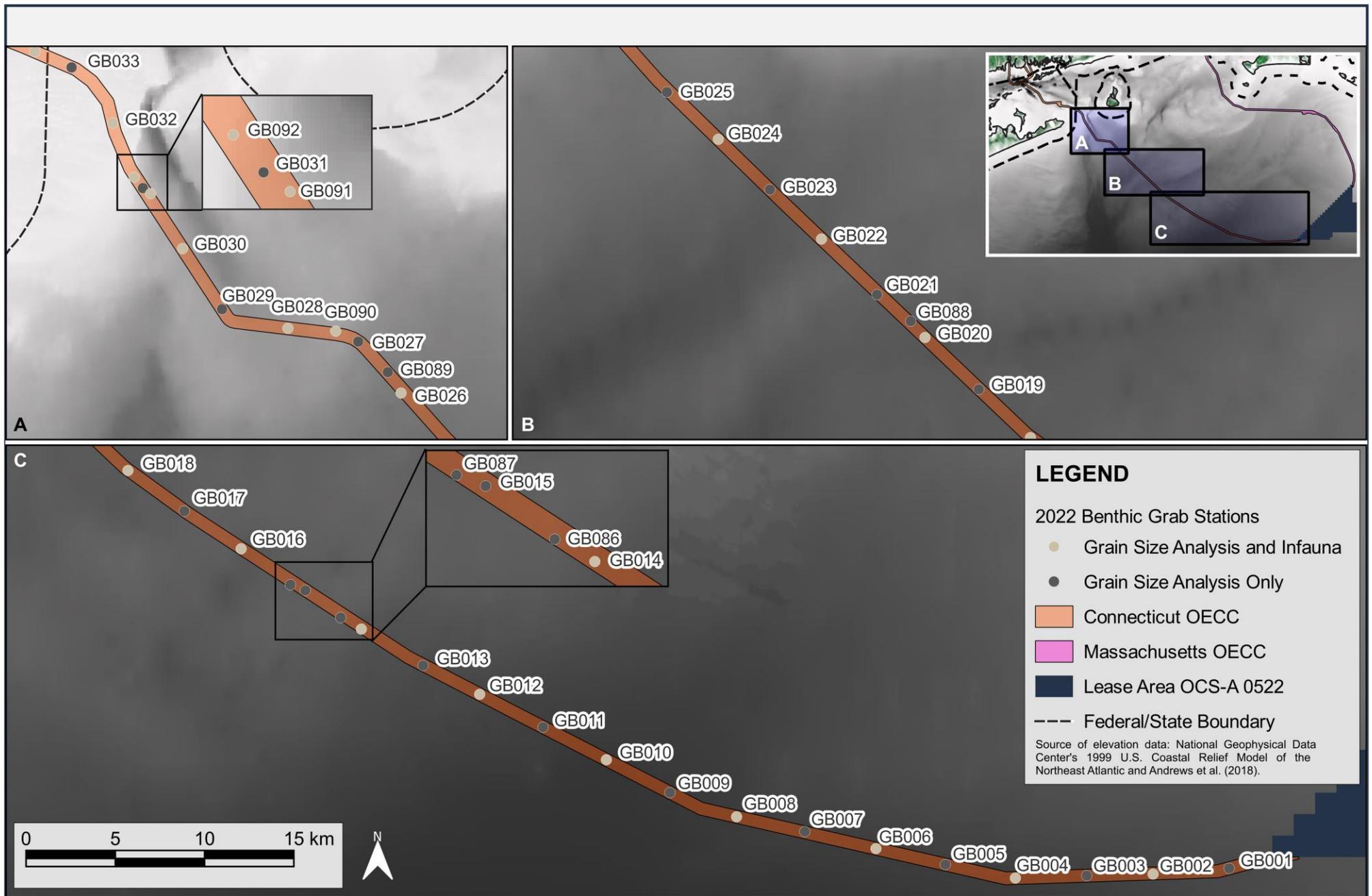


Figure 1.3-23
2022 Benthic Grab Sample Locations, Connecticut OECC Offshore

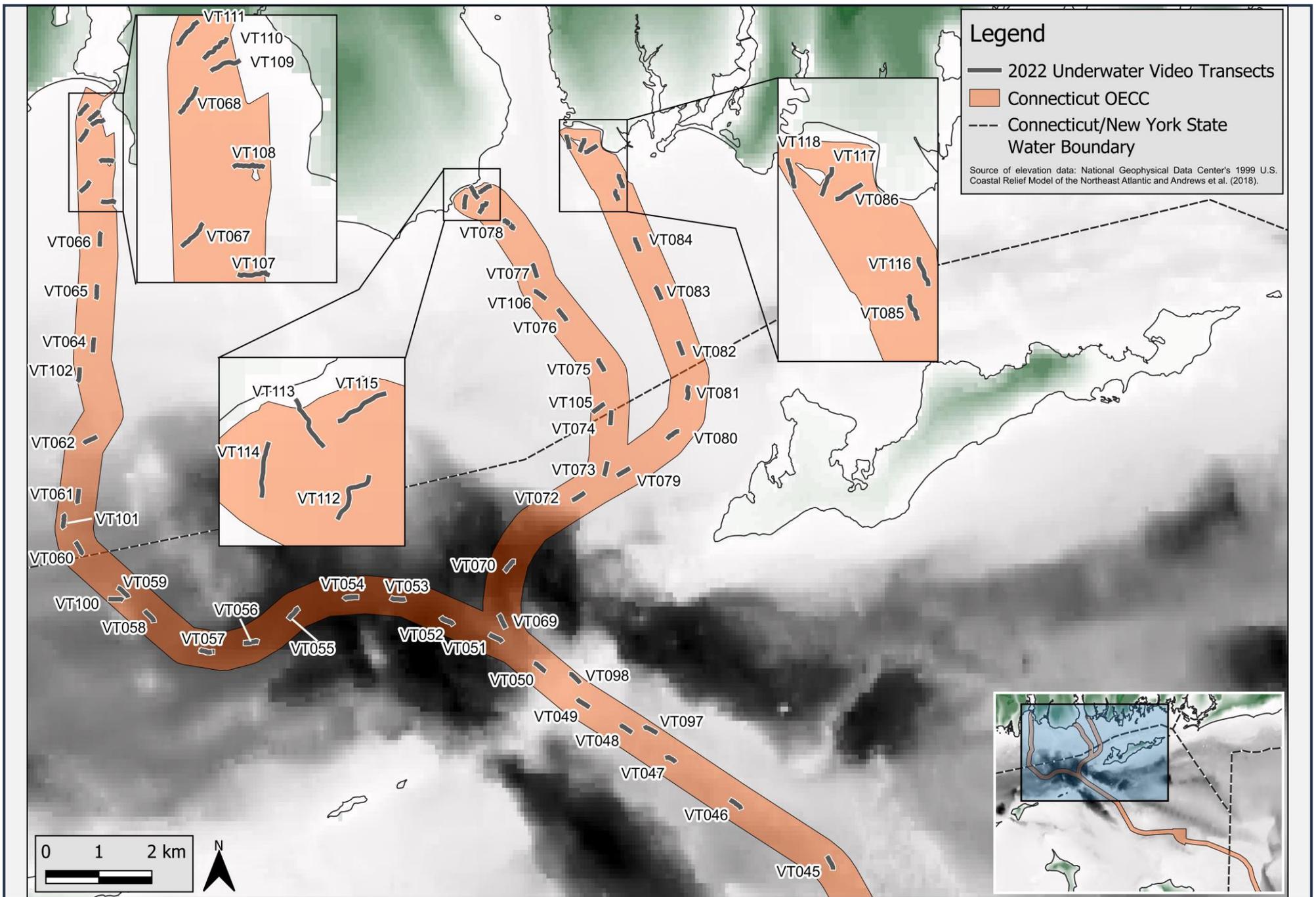


Figure 1.3-24
2022 Underwater Video Transect Locations, Connecticut OECC Landfall

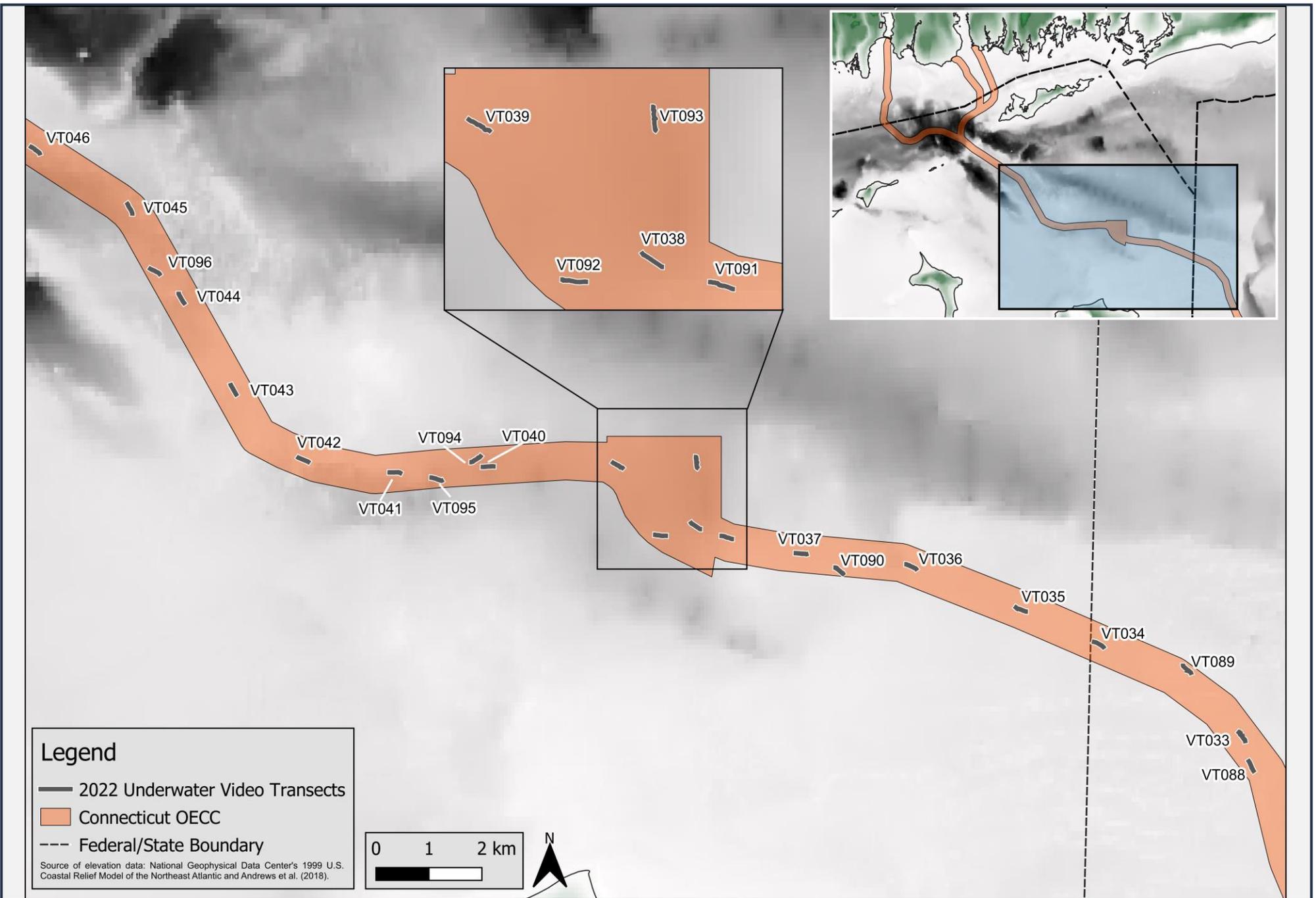


Figure 1.3-25
2022 Underwater Video Transect Locations, Connecticut OECC Nearshore

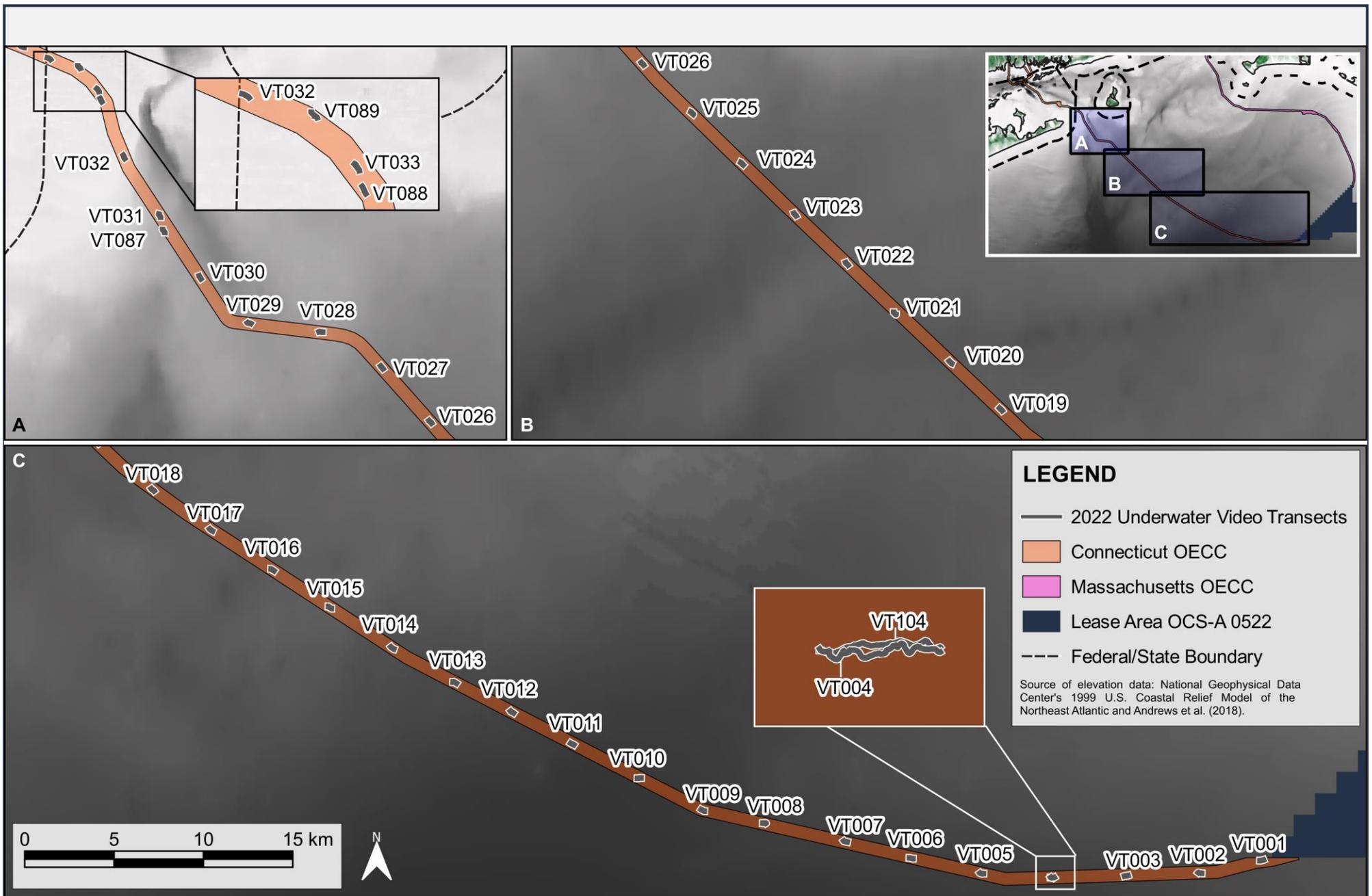


Figure 1.3-26
2022 Underwater Video Transect Locations, Connecticut OECC Offshore

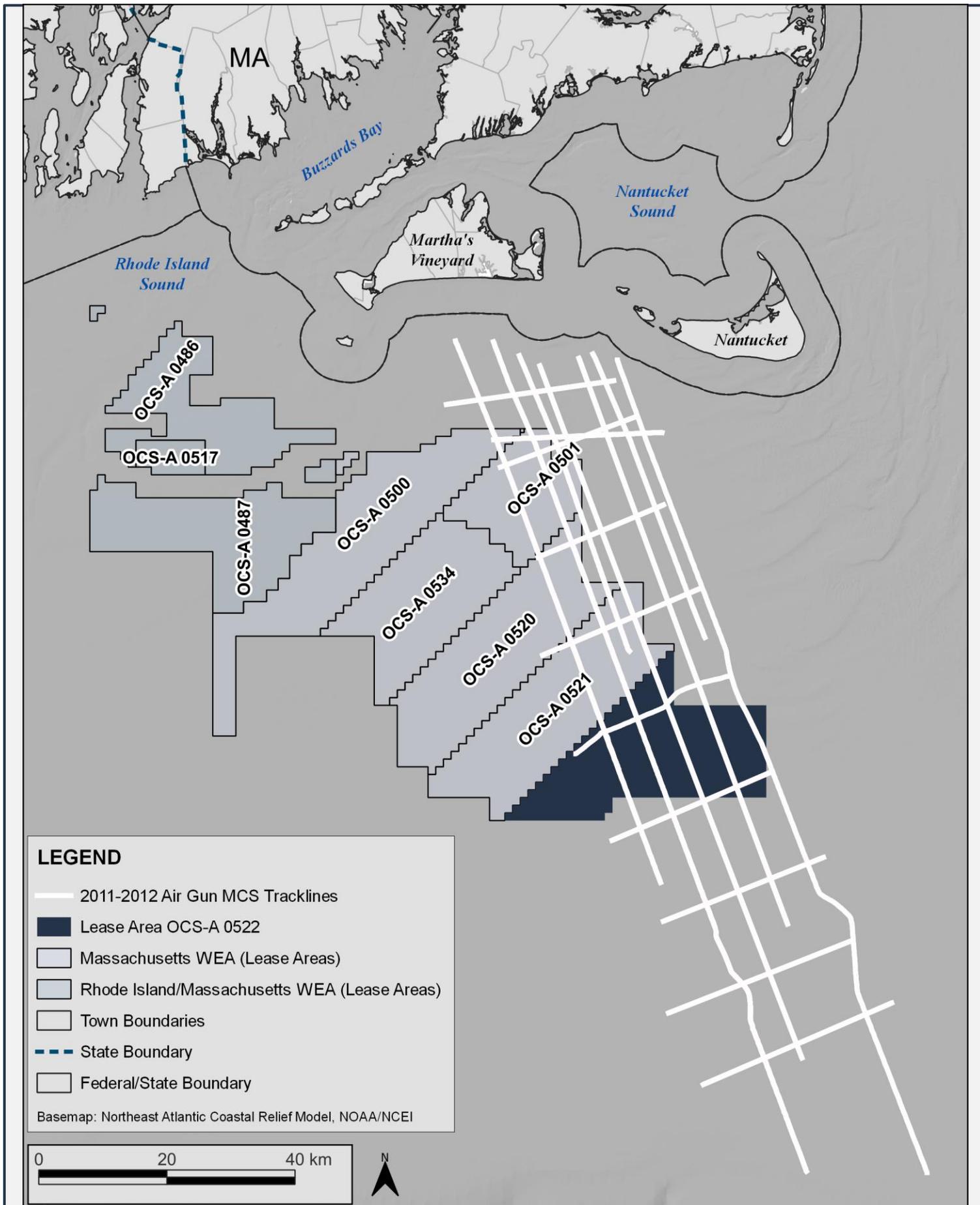


Figure 1.4-1
 MCS Tracks from Air Gun Seismic Collected on the OCS (Siegel et al. 2012)

LEGEND

NMFS-Modified CMECS Classification

White Border = Soft Bottom Station

Black Border = Complex Station

■ Muddy Sand

■ Sandy Mud

■ Fine/Very Fine Sand

■ Medium Sand

■ Very Coarse/Coarse Sand

■ Shell Rubble

■ Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al (2018).

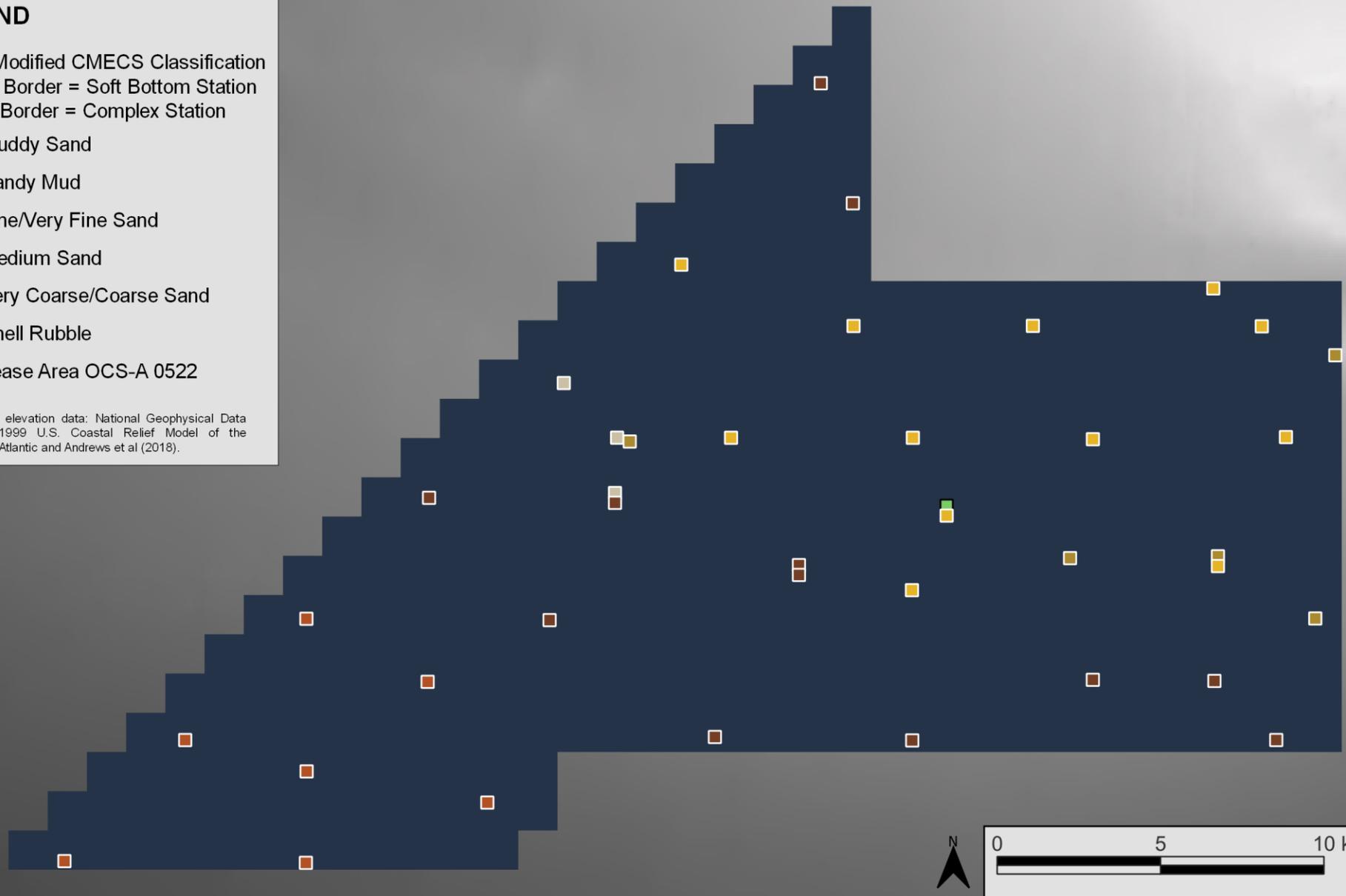


Figure 5.1-1

2019 Lease Area Benthic Grabs CMECS

LEGEND

NMFS-Modified CMECS Classification

White Border = Soft Bottom Station

Black Border = Complex Station

■ Fine/Very Fine Sand

■ Medium Sand

■ Muddy Sand

■ Sandy Mud

■ Very Coarse/Coarse Sand

■ Boulder

■ Cobble

■ Gravel Pavement

■ Gravelly Muddy Sand

■ Gravelly Sand

■ Muddy Sandy Gravel

■ Pebble/Granule

■ Sandy Gravel

■ Shell

■ Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al. (2018).

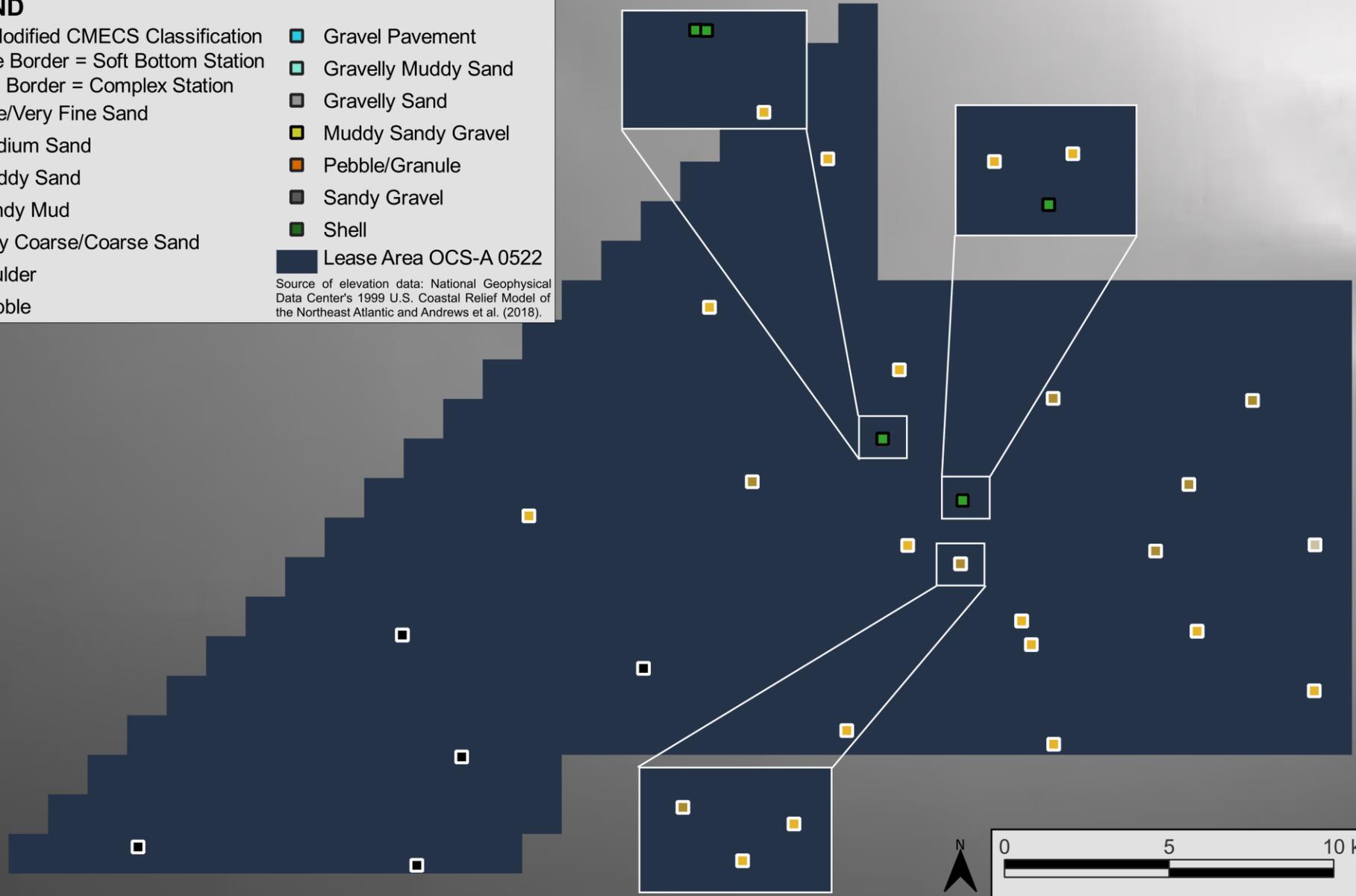


Figure 5.1-2

2022 Lease Area Benthic Grabs CMECS

LEGEND

-  Complex Mix Station
-  Soft Bottom Station
-  Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al (2018).

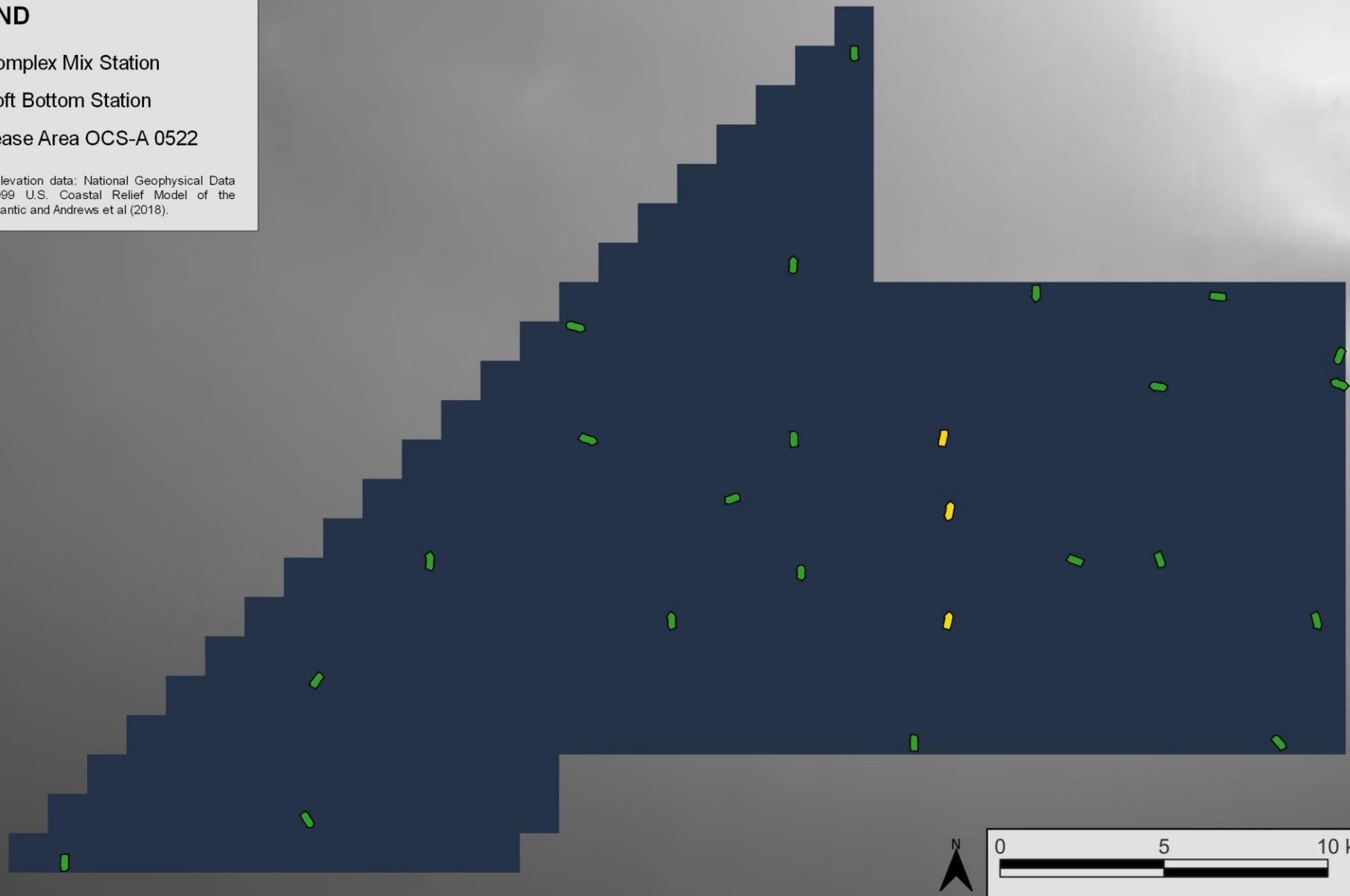


Figure 5.1-3

2019 Lease Area Video Transects NMFS Classifications

LEGEND

- Soft Bottom Station
- Complex Mix Station
- Complex Station
- Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al. (2018).

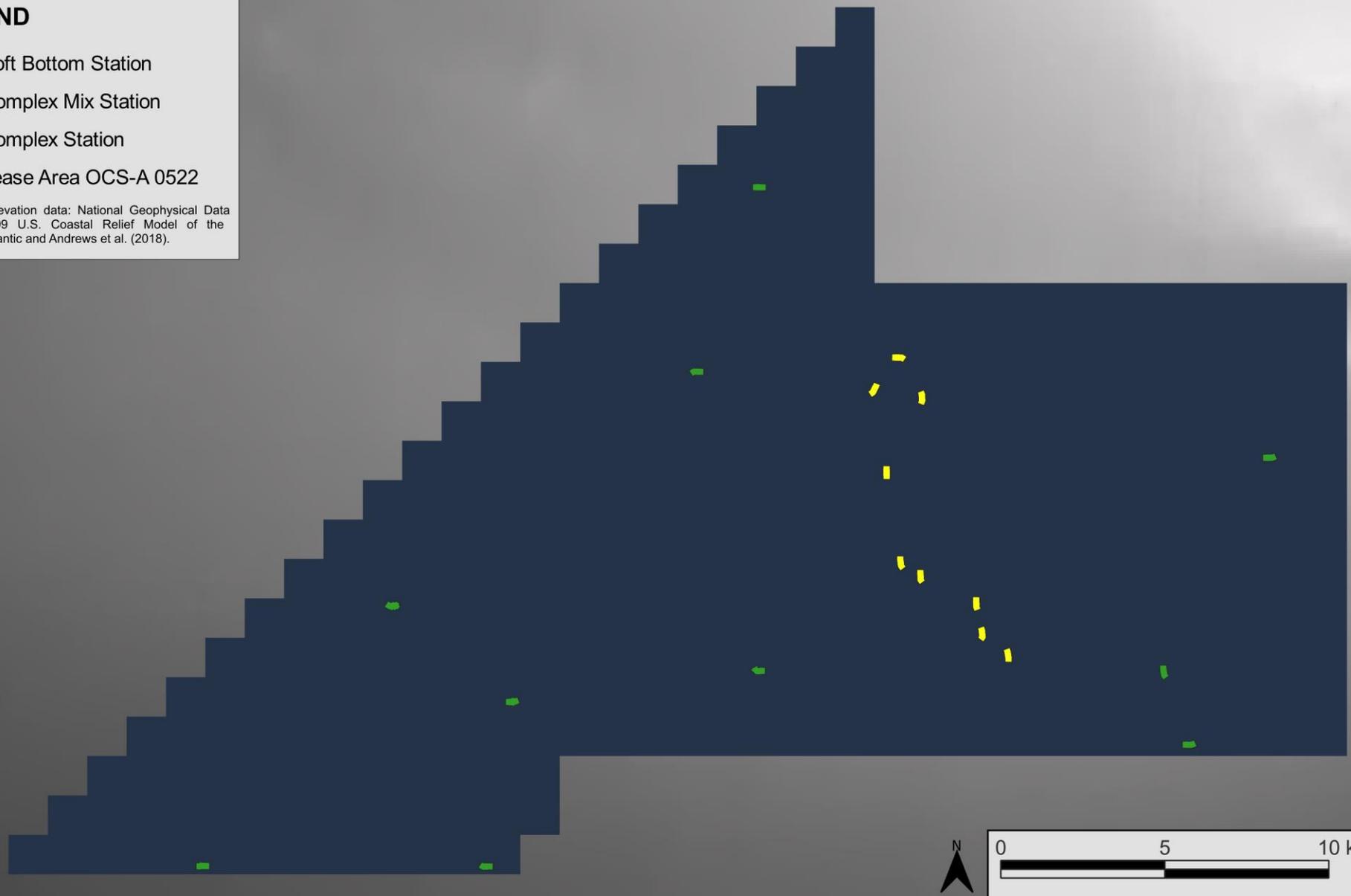


Figure 5.1-4
2022 Lease Area Video Transects NMFS Classifications

LEGEND

usSEABED Classification
(Folk 1954)

- Gravel
- Sandy Gravel
- Muddy Sandy Gravel
- Muddy Gravel
- Gravelly Sand
- Gravelly Muddy Sand
- Gravelly Mud
- Slightly Gravelly Sand
- Slightly Gravelly Sandy Mud
- Slightly Gravelly Muddy Sand
- Slightly Gravelly Mud
- Sand
- Muddy Sand
- Sandy Mud
- Mud

■ Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al. (2018).

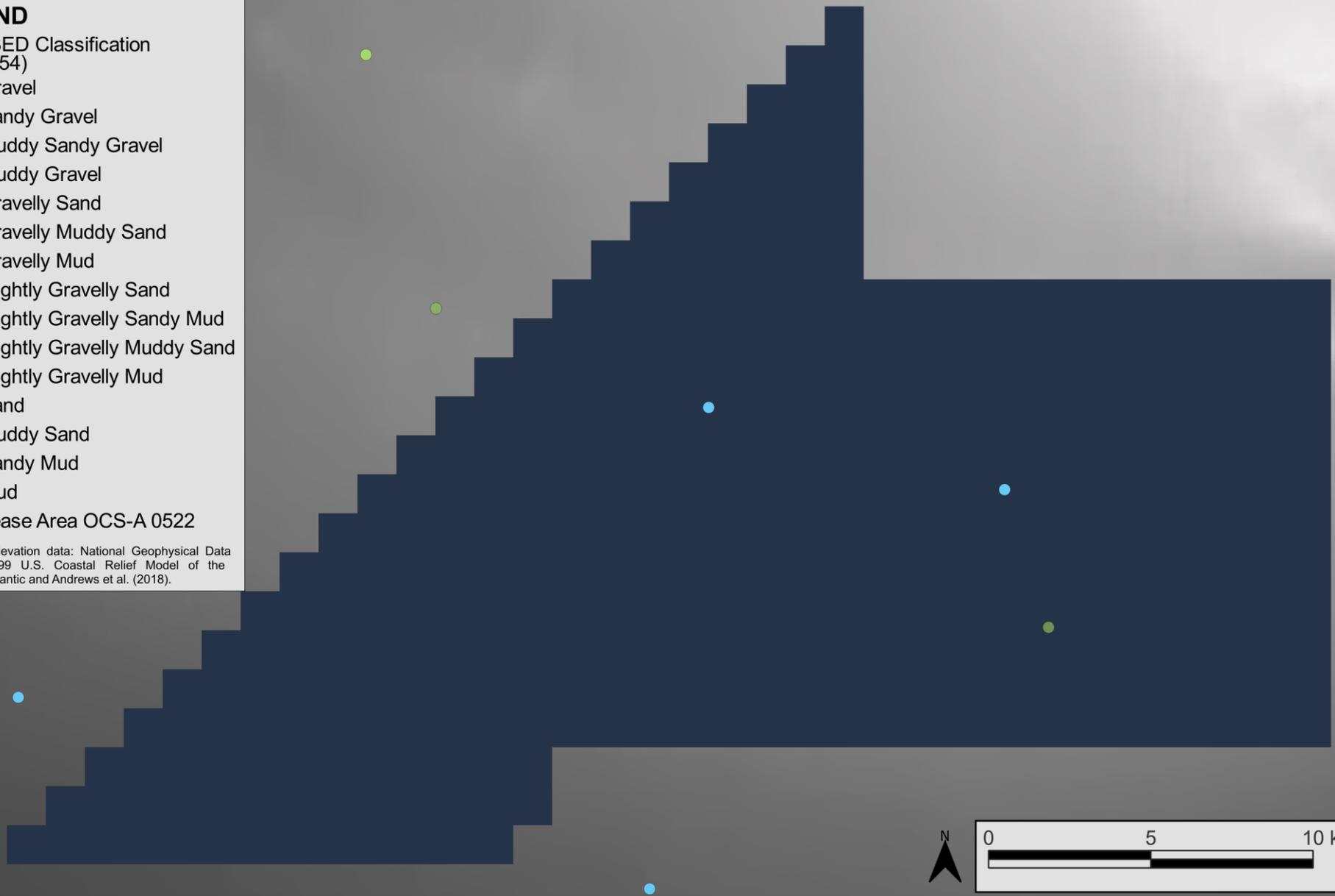


Figure 5.1-5

usSEABED Classification Within the Lease Area

LEGEND

USGS Sediment Texture Database
Classification (Shepard 1954)

- Bedrock
- Boulders
- Gravel
- Gravelly Sediment
- Sand
- Silty Sand
- Sandy Silt
- Clayey Silt
- Sand Silt Clay
- Silty Clay
- Silt

■ Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al. (2018).

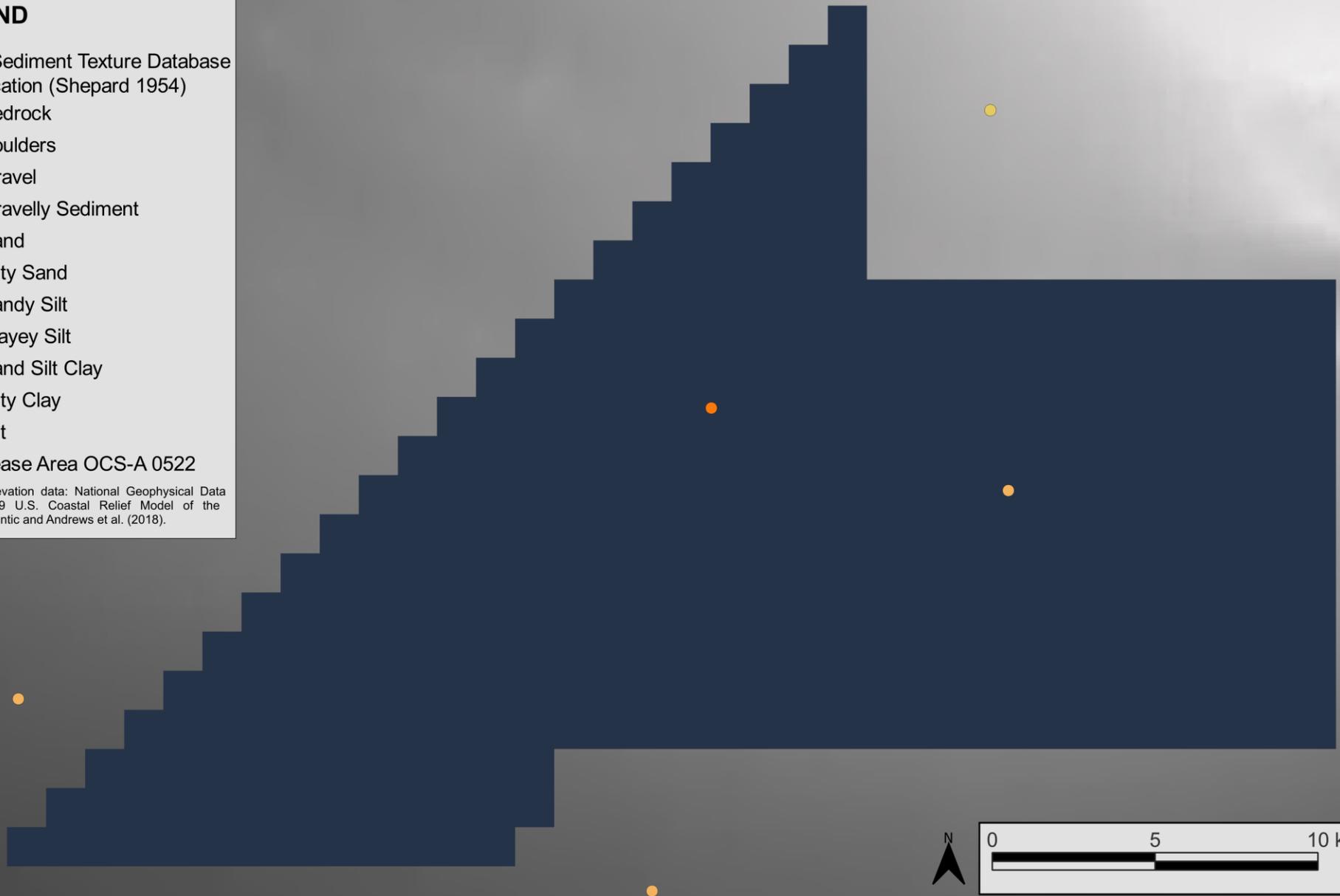


Figure 5.1-6

USGS Sediment Texture Within the Lease Area

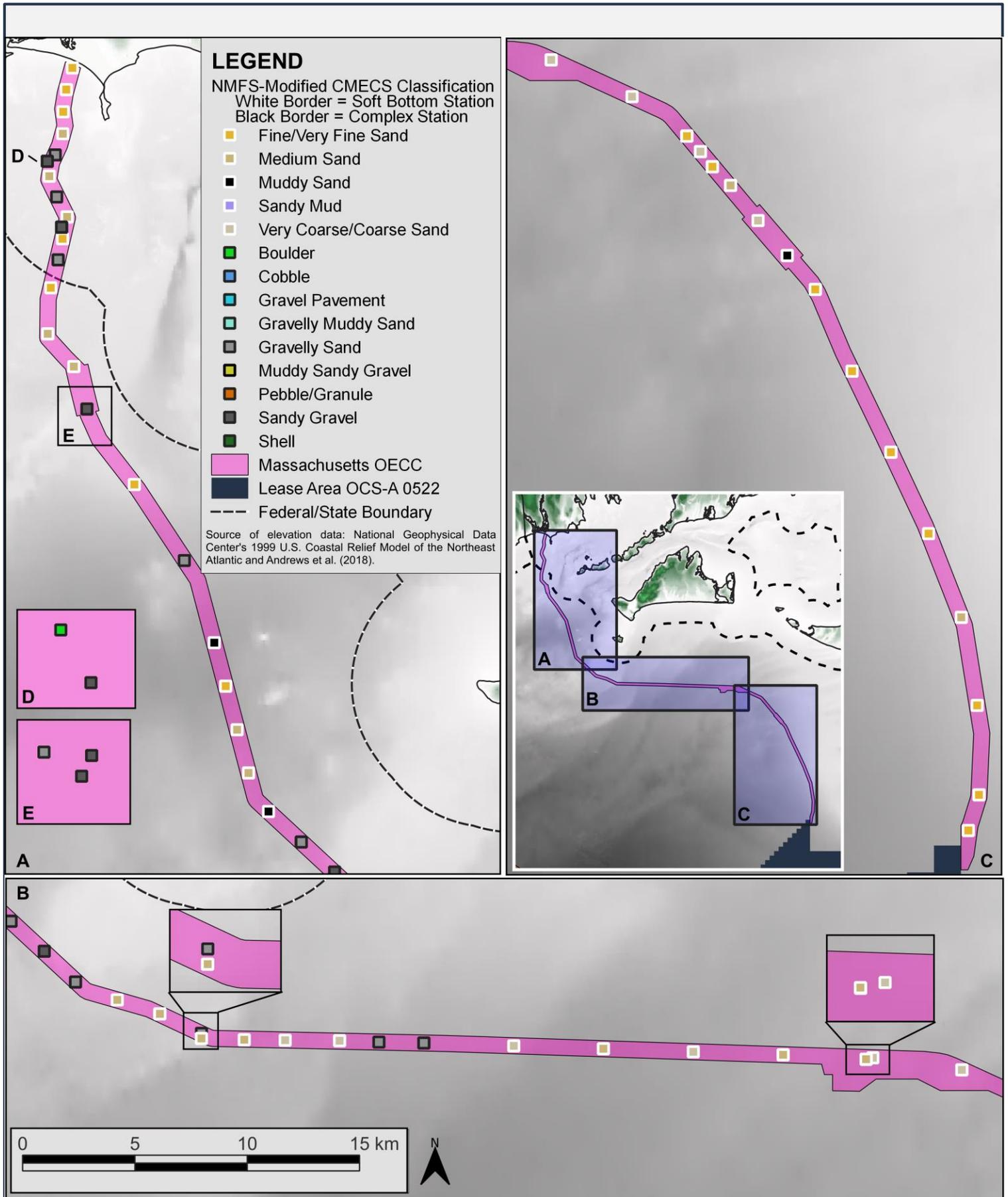


Figure 5.1-7
 2022 Massachusetts OECC Benthic Grabs CMECS

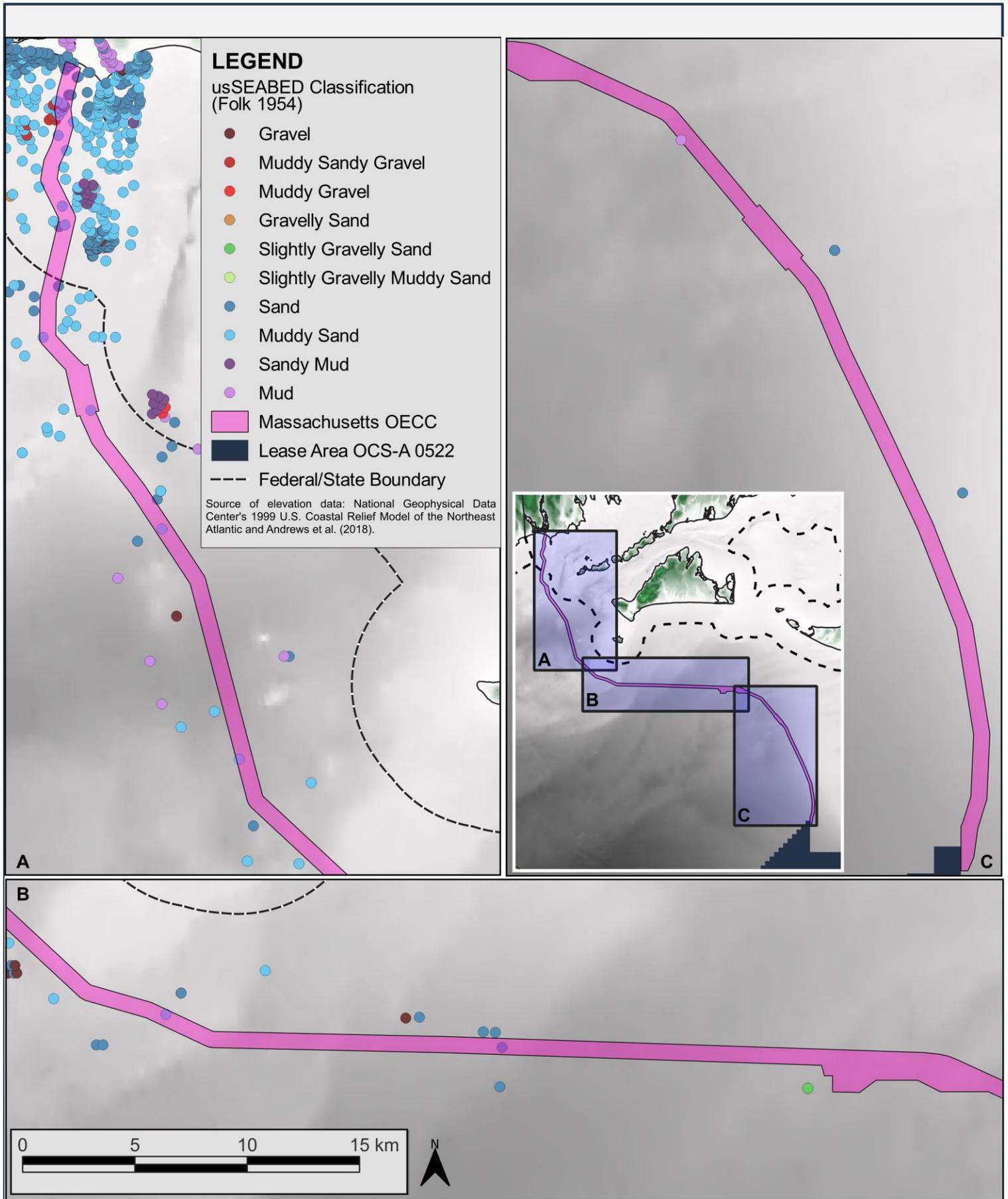


Figure 5.1-8
usSEABED Classification Along Massachusetts OECC

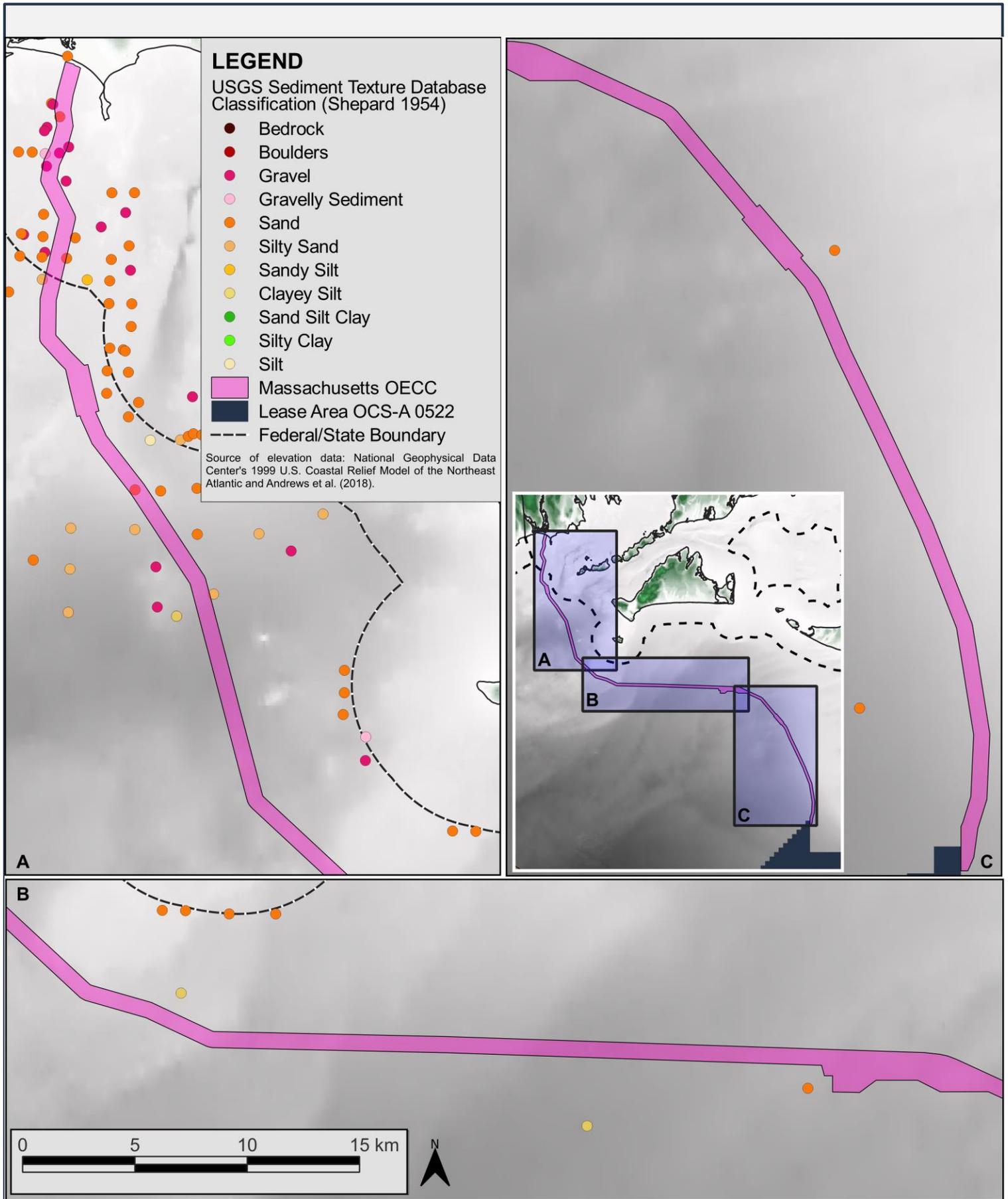


Figure 5.1-9
 USGS Sediment Texture Along Massachusetts OECC

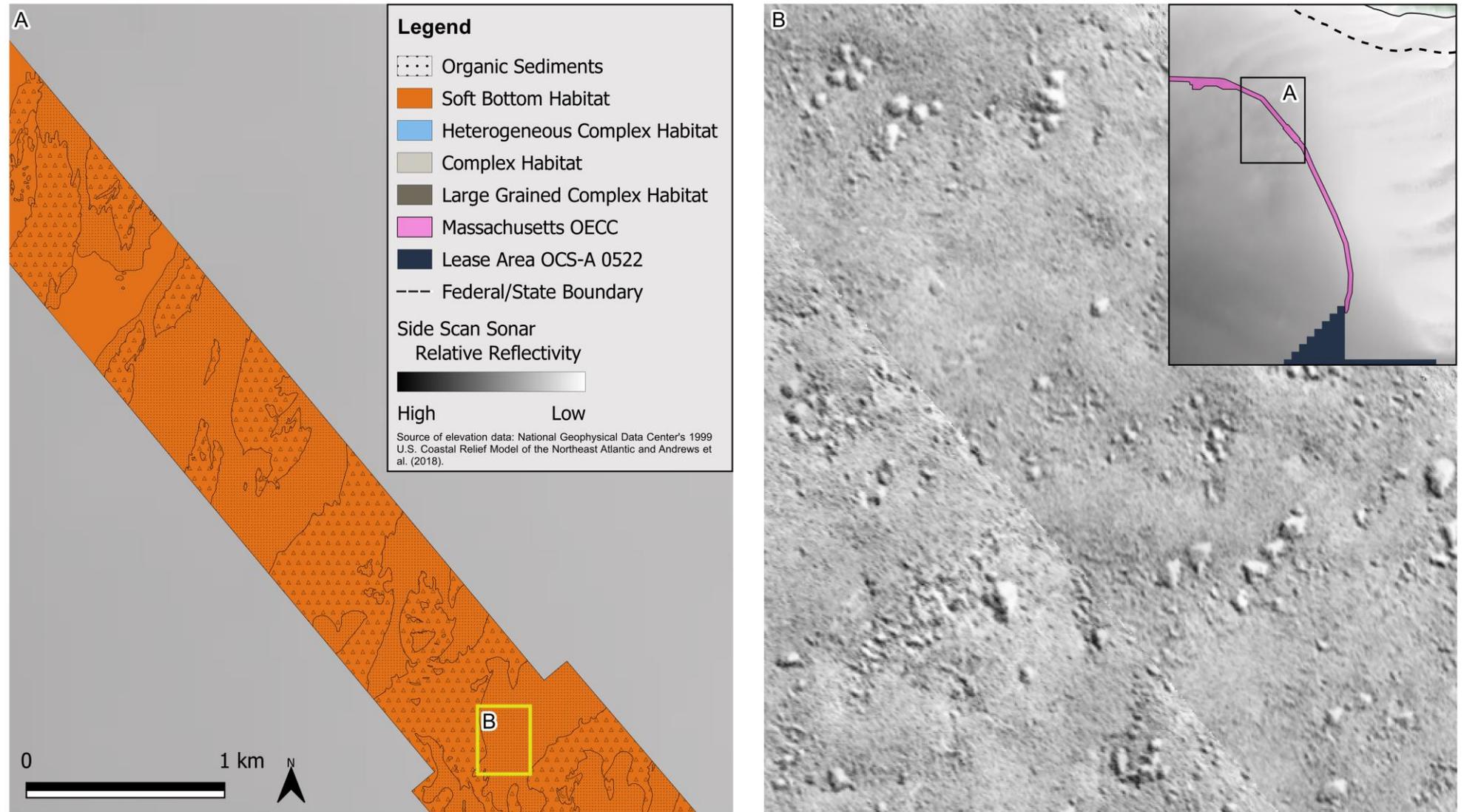


Figure 5.1-10
Organic Mounds in Massachusetts OECC

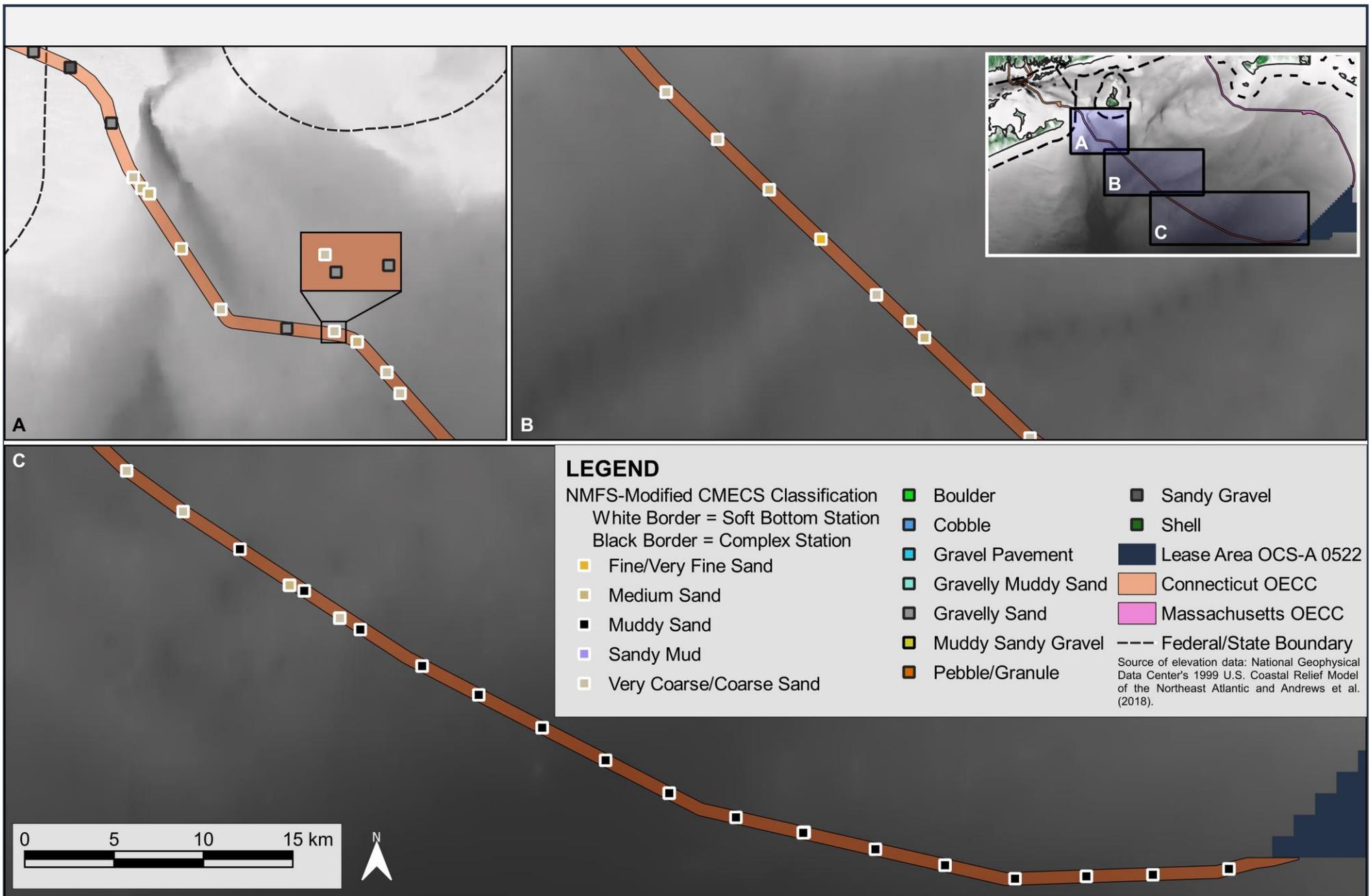


Figure 5.1-11a
 2022 Connecticut OECC Offshore Benthic Grabs CMECS

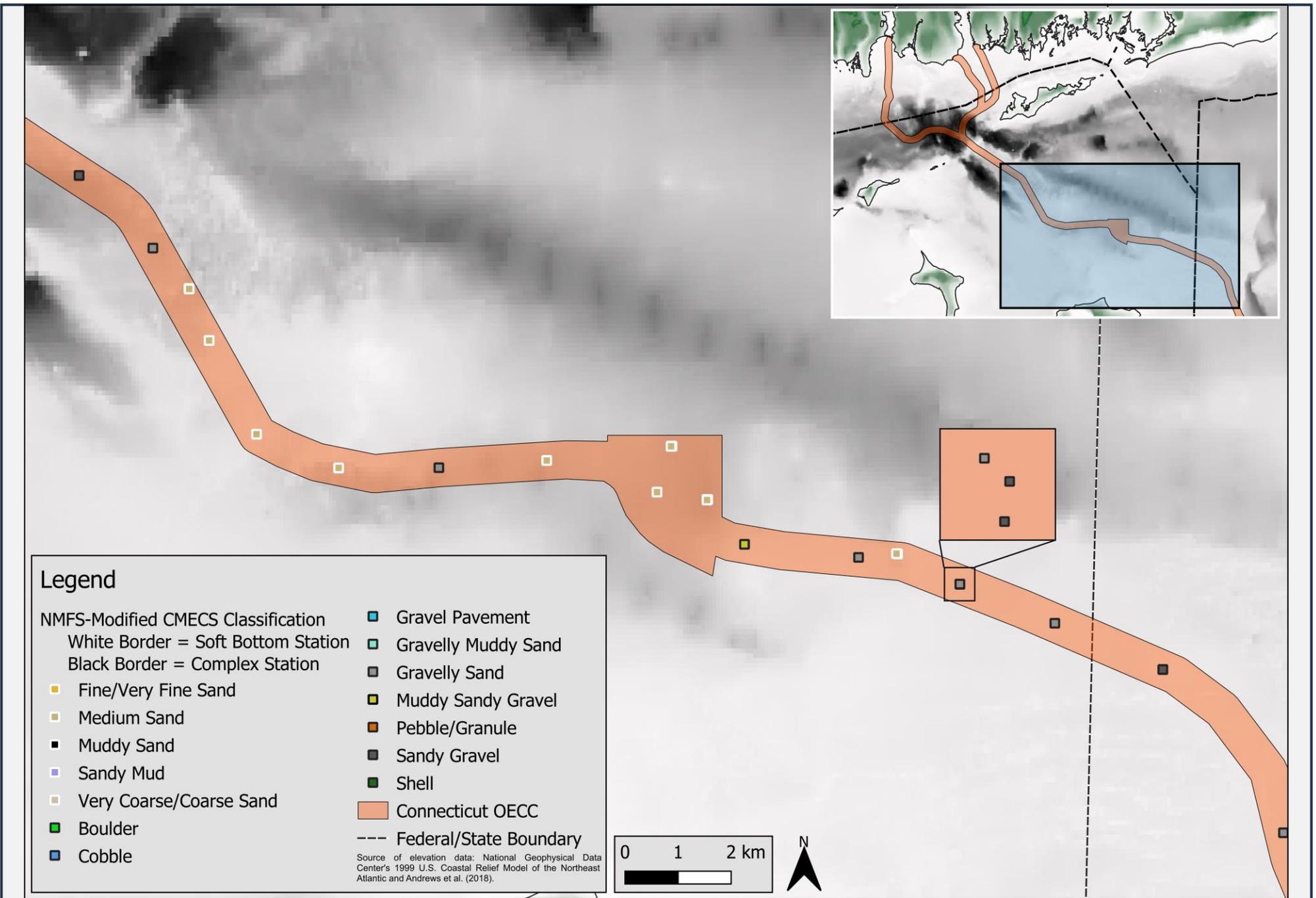


Figure 5.1-11b

2022 Connecticut OECC Nearshore Benthic Grabs CMECS

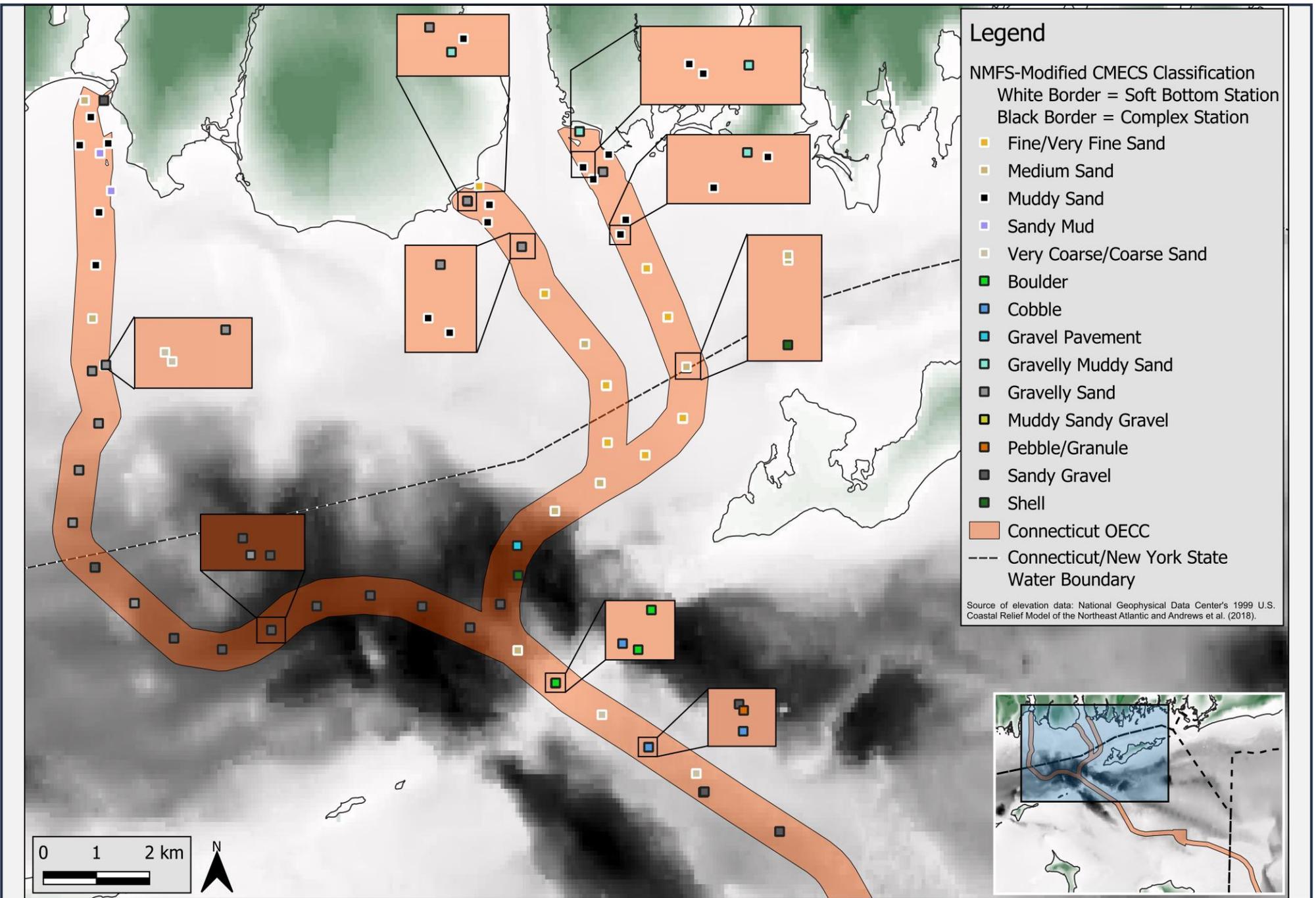


Figure 5.1-11c
2022 Connecticut OECC Landfall Benthic Grabs CMECS

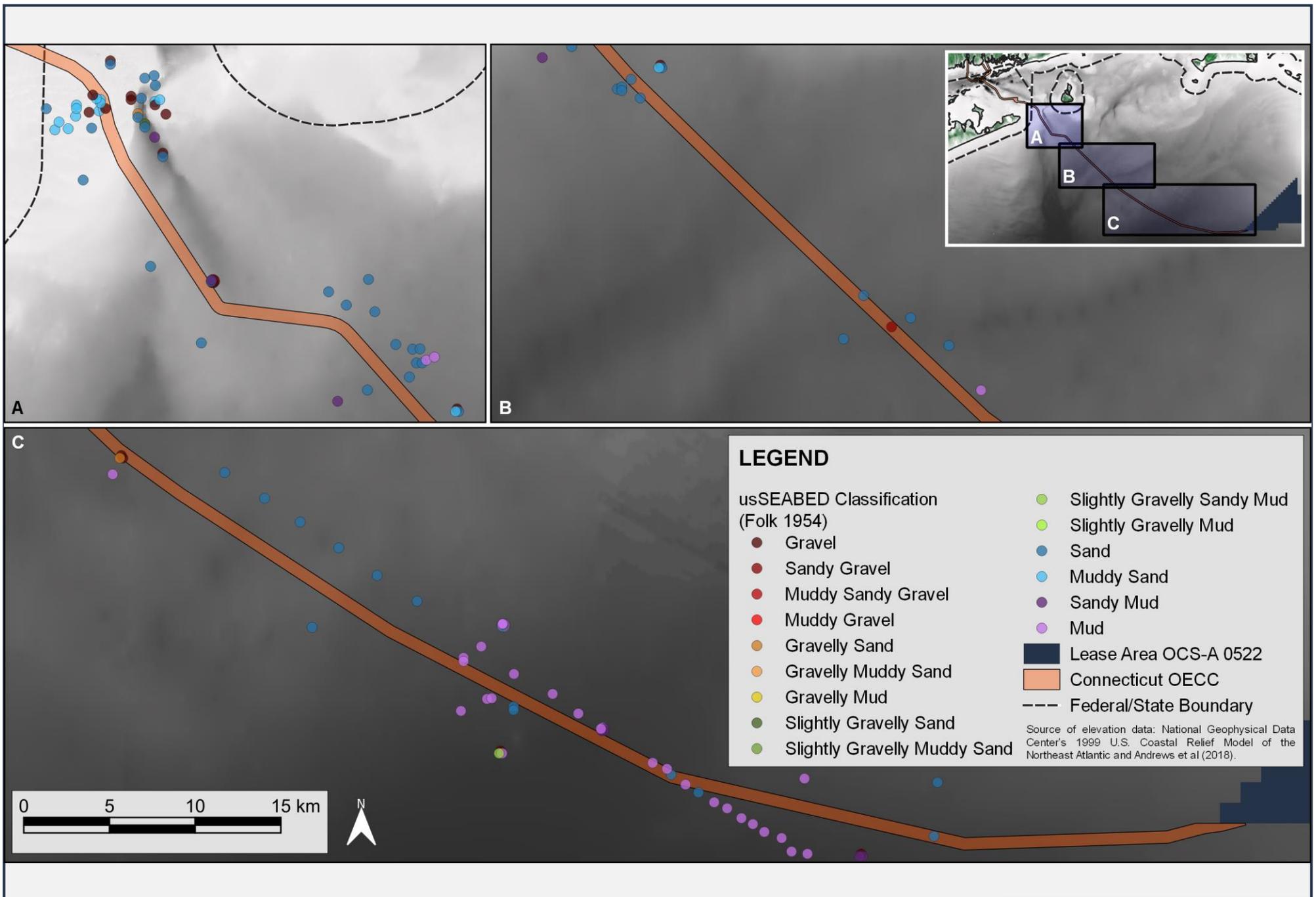


Figure 5.1-12a

usSEABED Classification Along Connecticut OECC Offshore

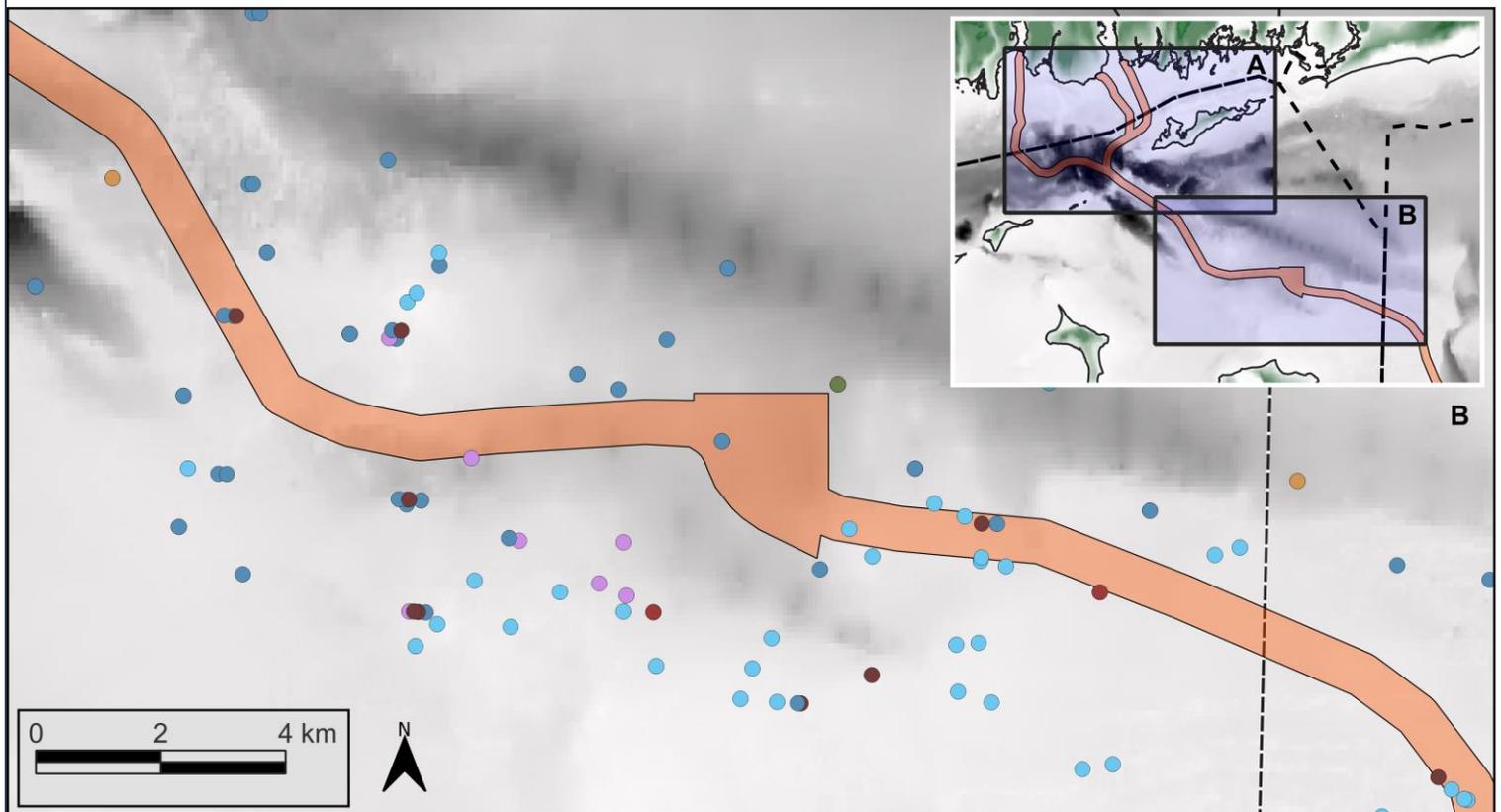
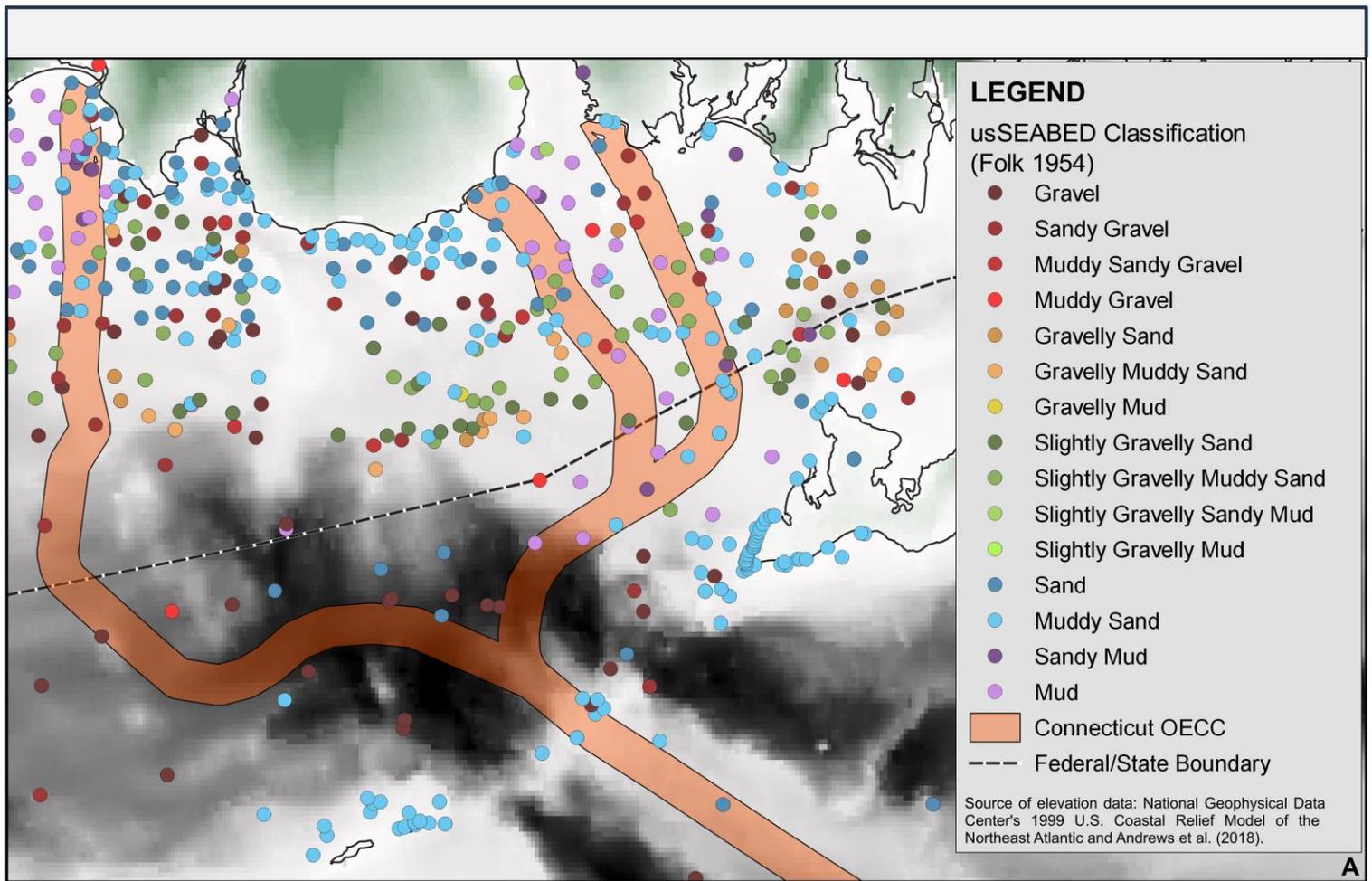


Figure 5.1-12b
usSEABED Classification Along Connecticut OECC Nearshore

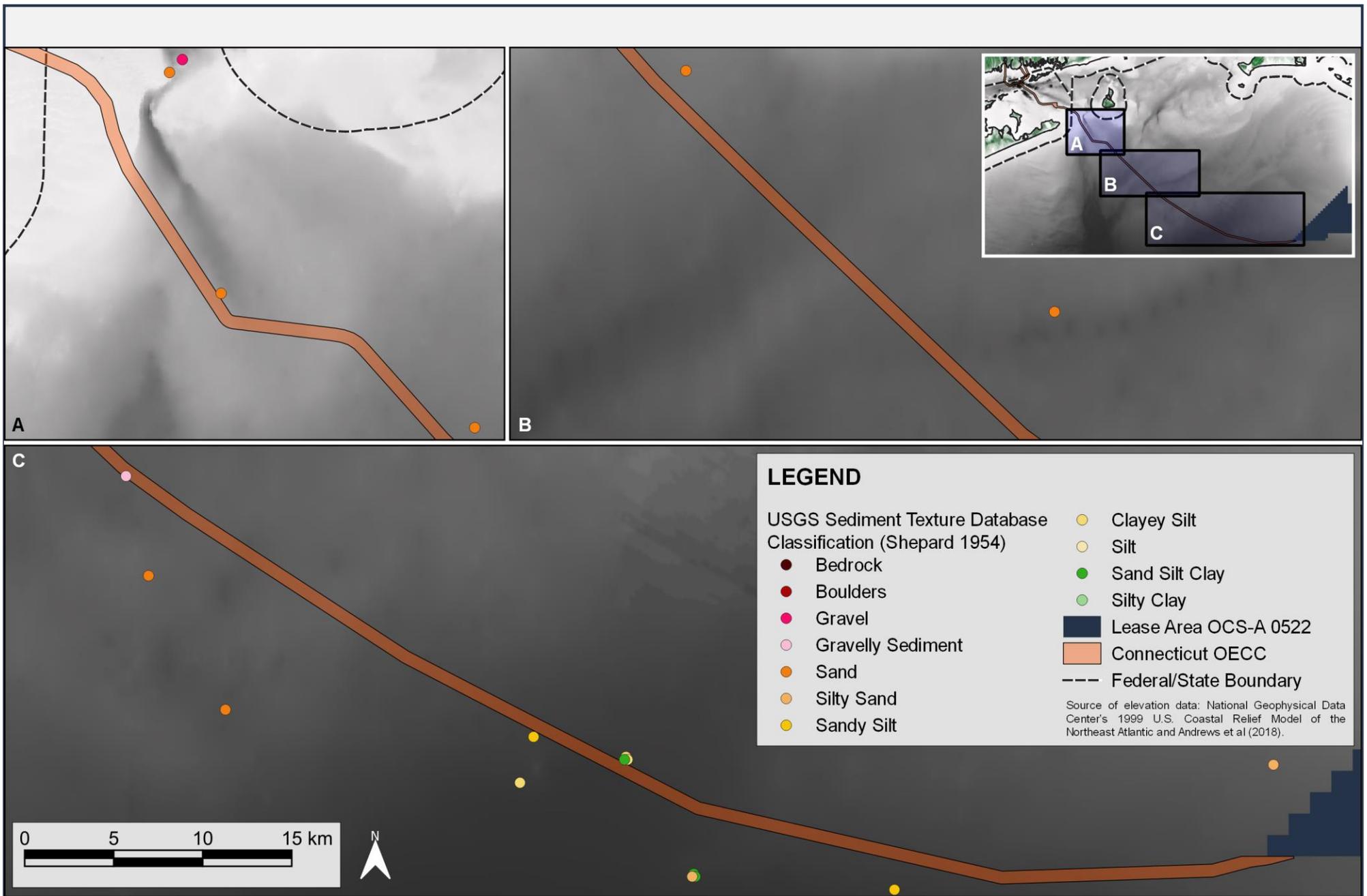


Figure 5.1-13a

USGS Sediment Texture Along Connecticut OECC Offshore

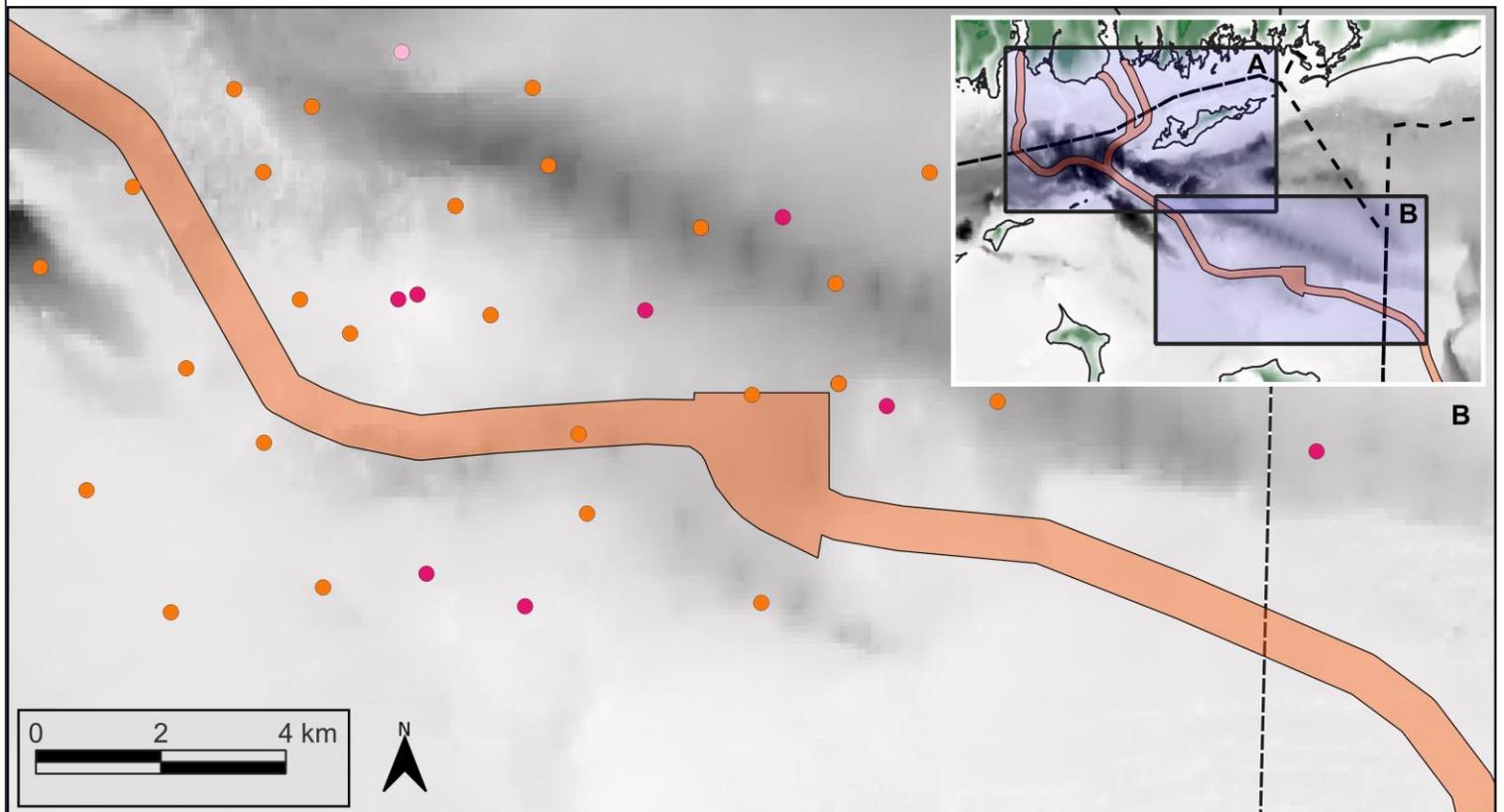
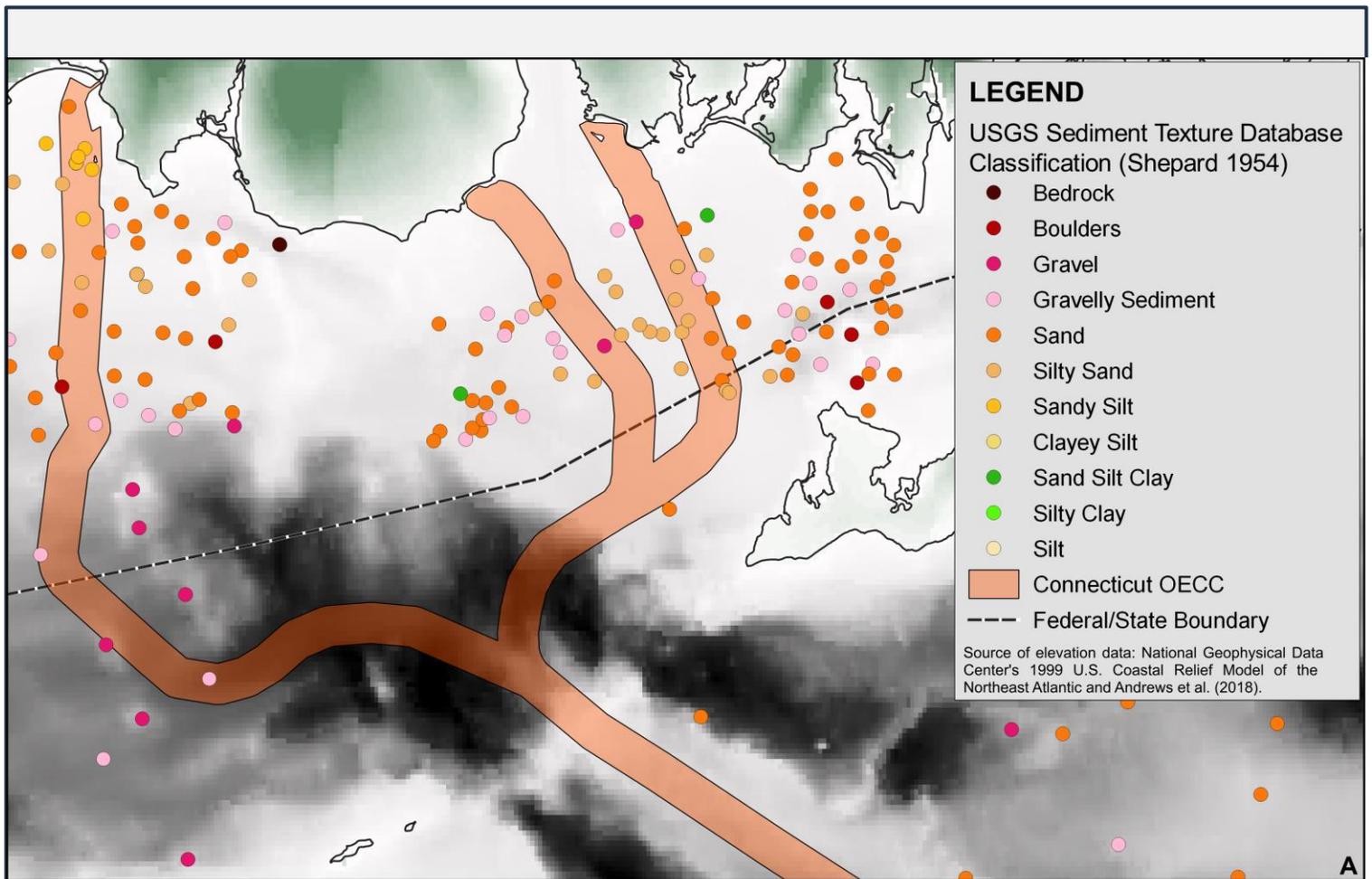


Figure 5.1-13b
USGS Sediment Texture Along Connecticut OECC Nearshore

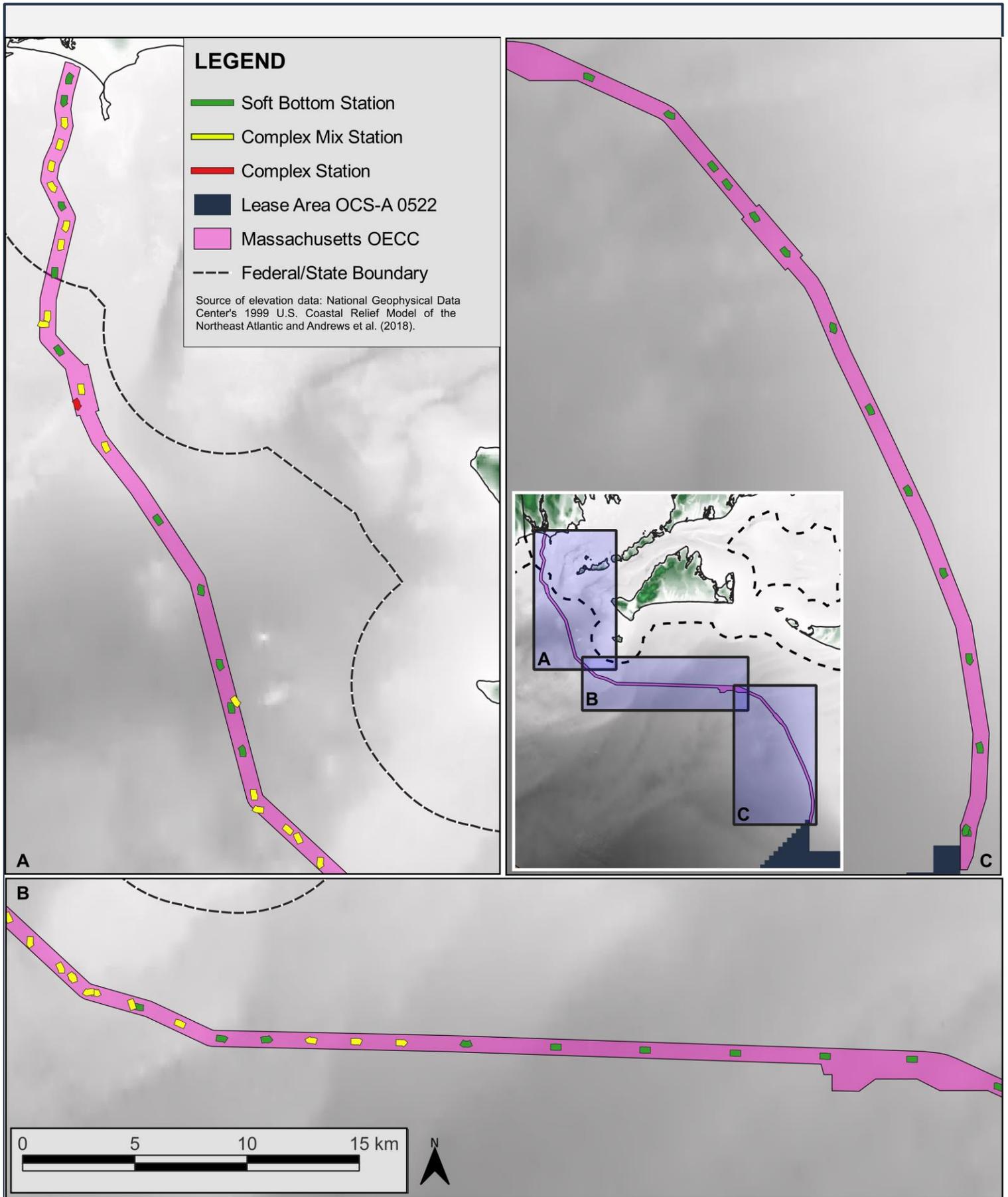


Figure 5.1-14

2022 Massachusetts OECC Video Transects NMFS Classifications



**VINEYARD
NORTHEAST**

VINEYARD OFFSHORE

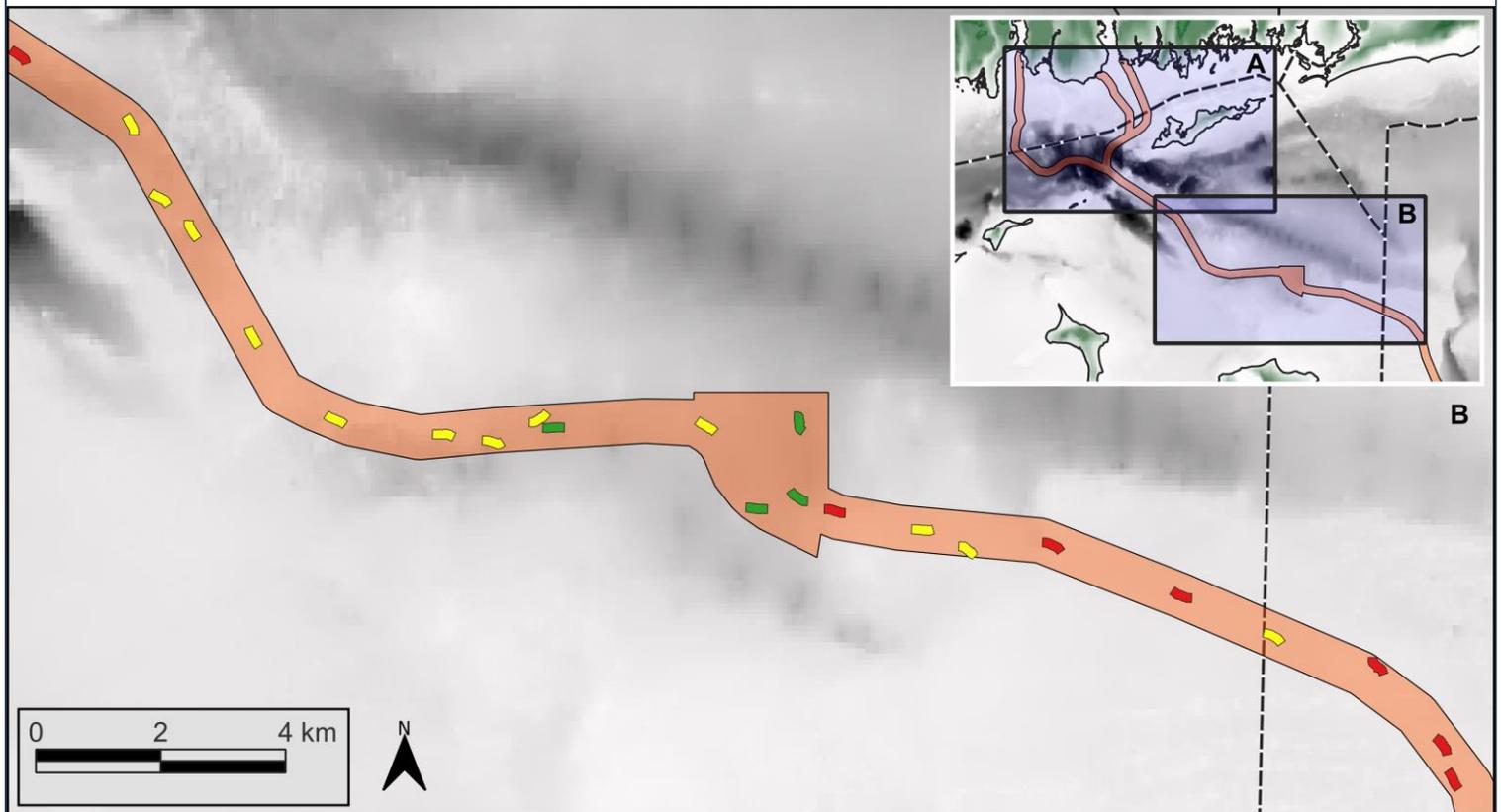
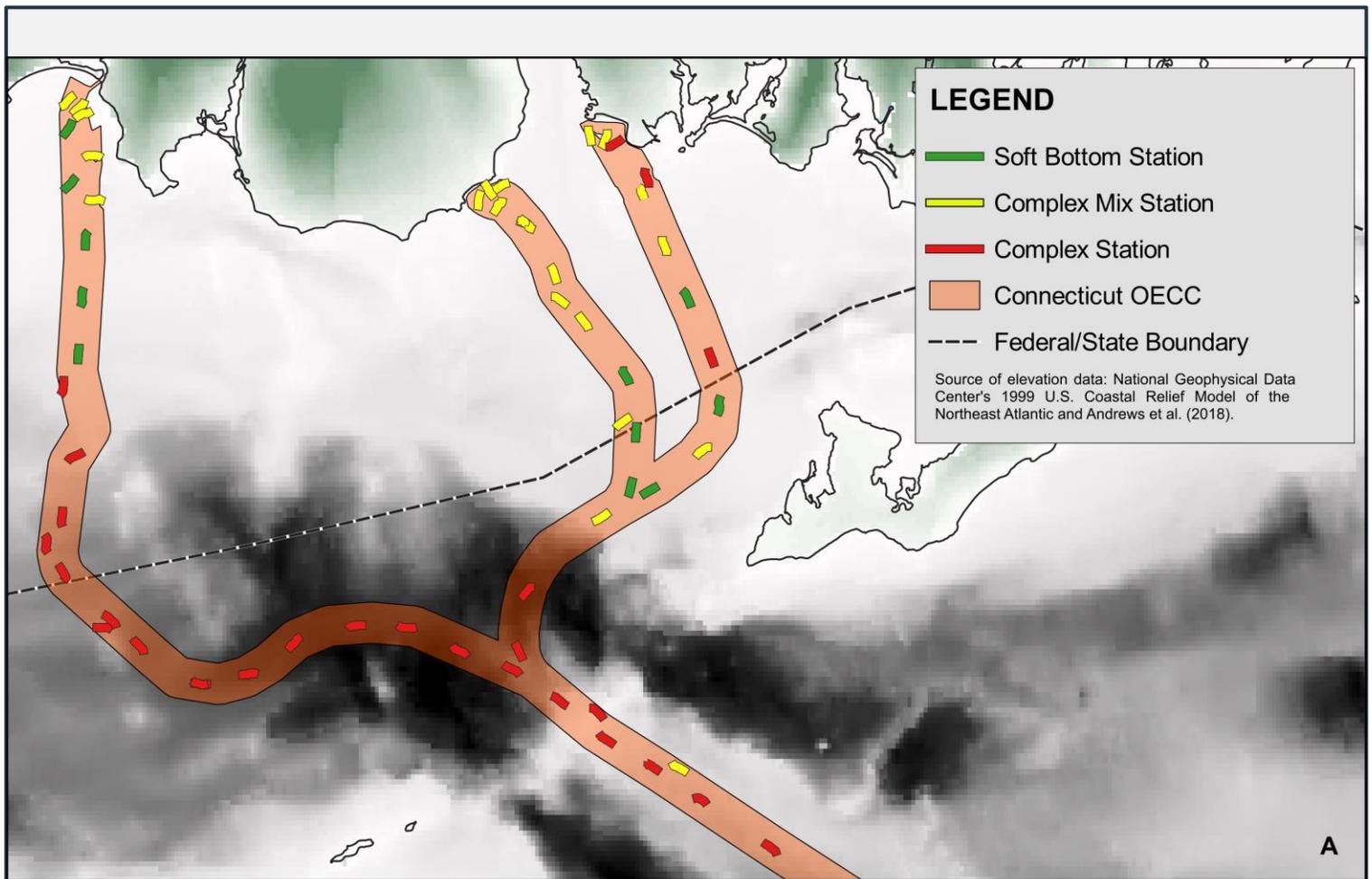


Figure 5.1-15a

2022 Connecticut OECC Nearshore Video Transects NMFS Classifications



**VINEYARD
NORTHEAST**

VINEYARD OFFSHORE

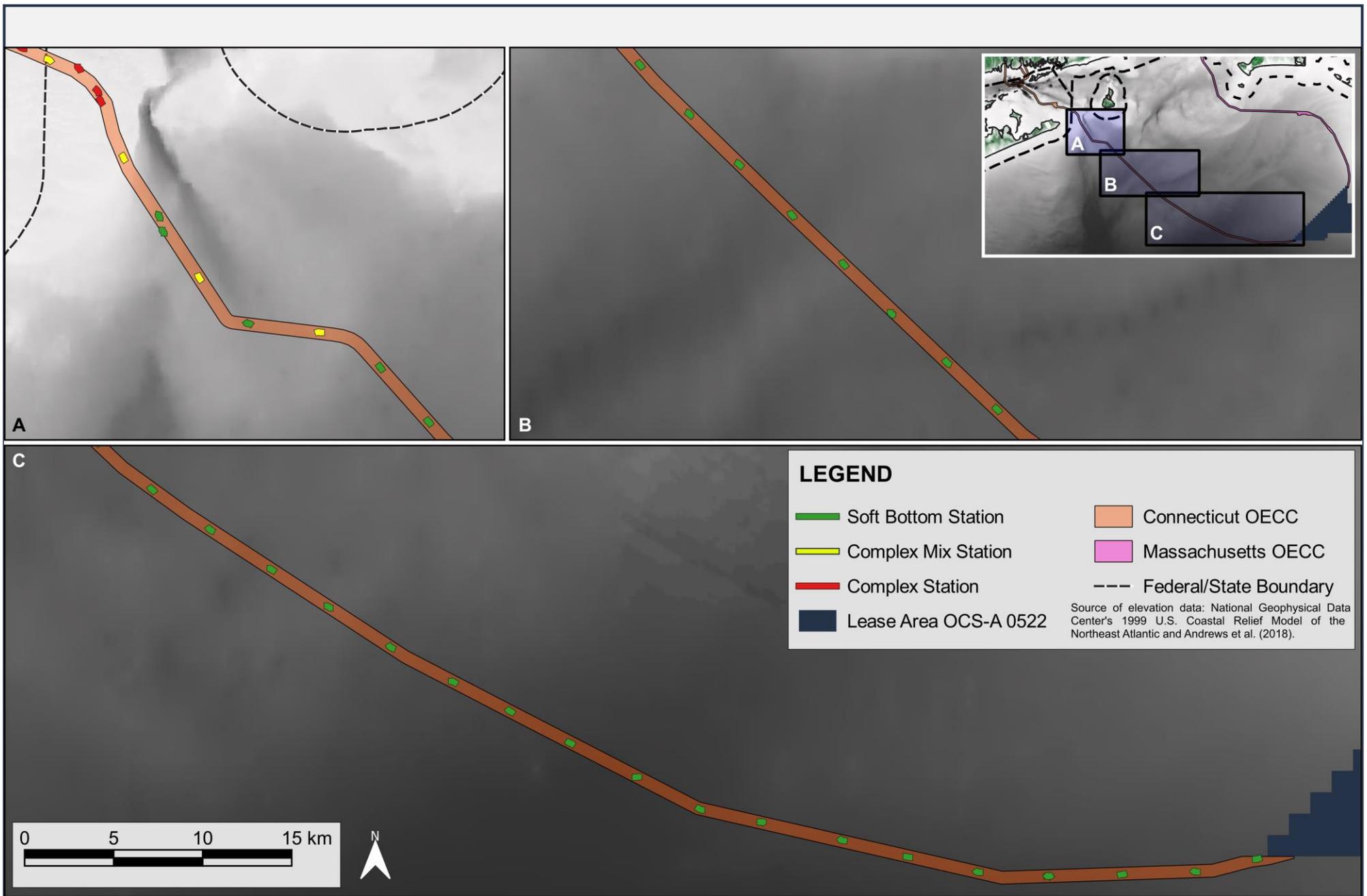
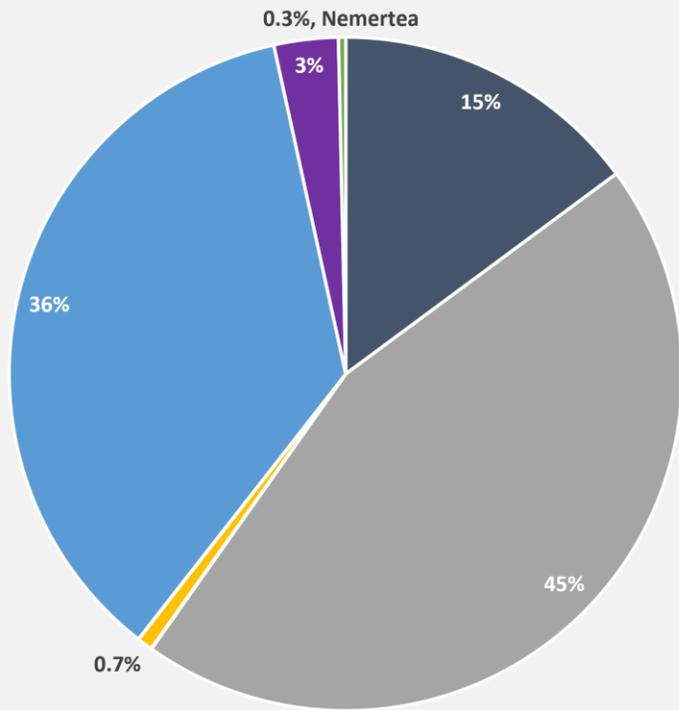


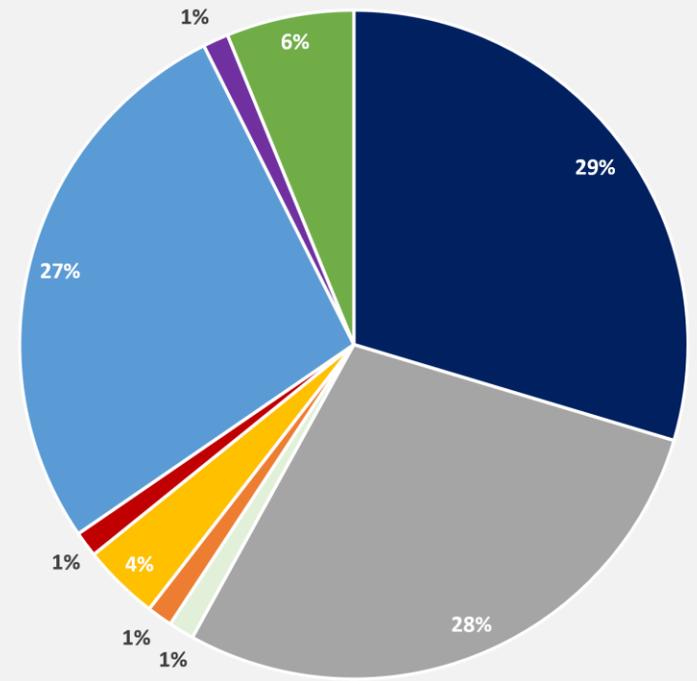
Figure 5.1-15b

2022 Connecticut OECC Offshore Video Transects NMFS Classifications

Proportional Abundance



Proportion of Taxa



*Cnidaria, chordata, and ectoprocta are each responsible for 0.01% of total abundance

Figure 5.1-16a

Inf fauna Proportional Abundance by Phylum in Lease Area 2019

Lease Area 2019 Infauna Community Summary

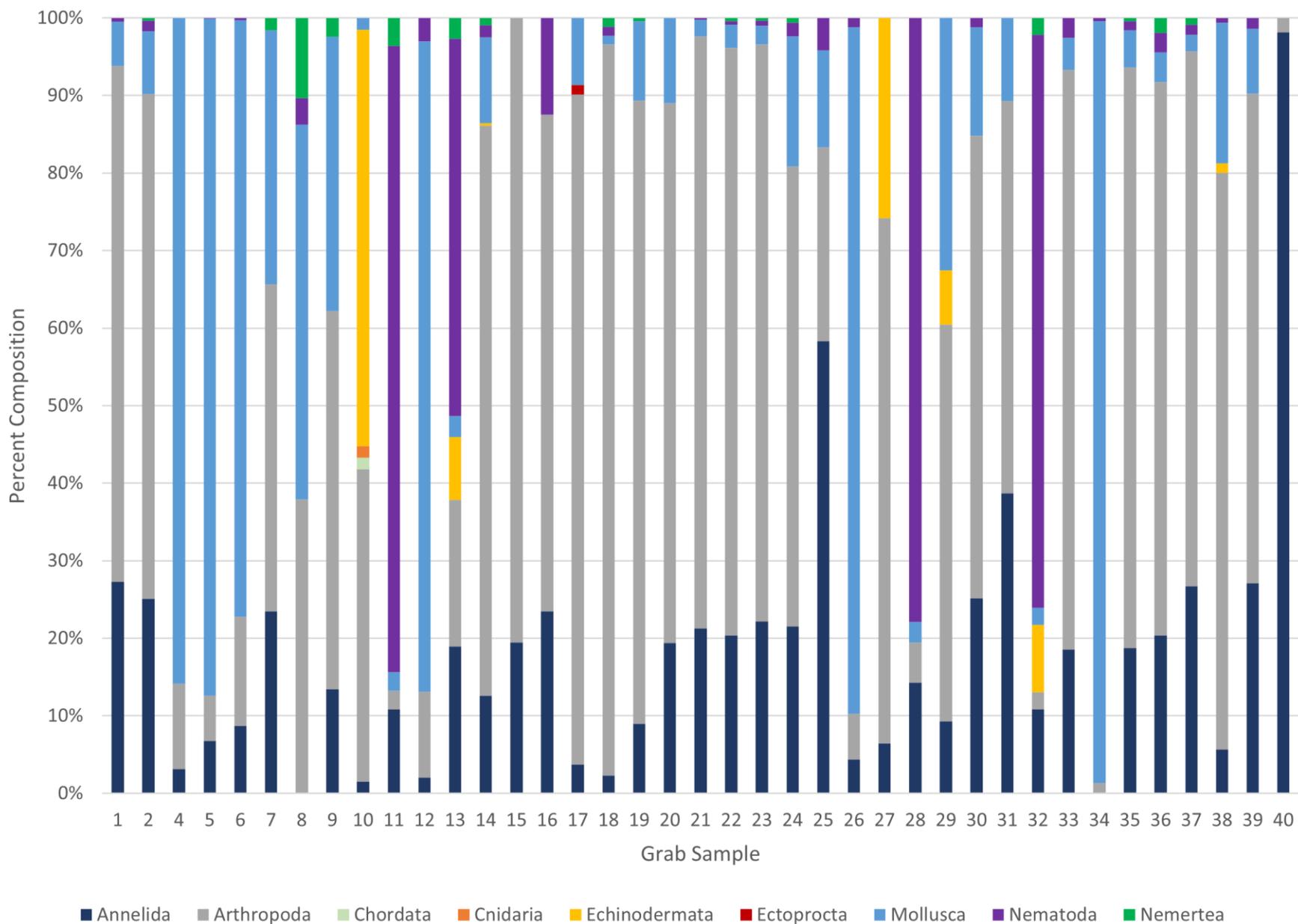


Figure 5.1-16b

Lease Area 2019 Infauna Community Summary

Lease Area 2019 Infauna Density

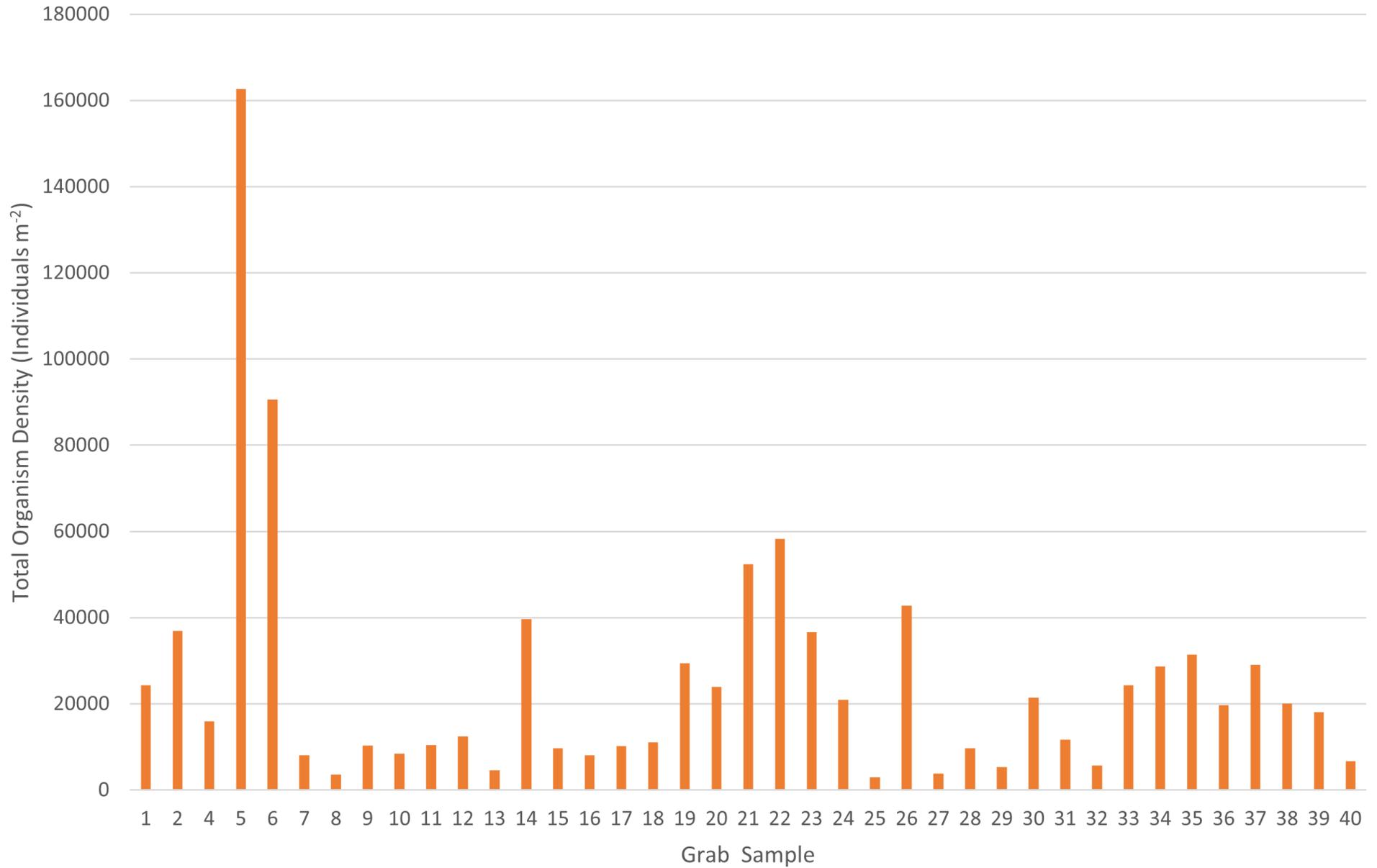


Figure 5.1-16c
Lease Area 2019 Infauna Density

Lease Area 2019 Infauna Diversity

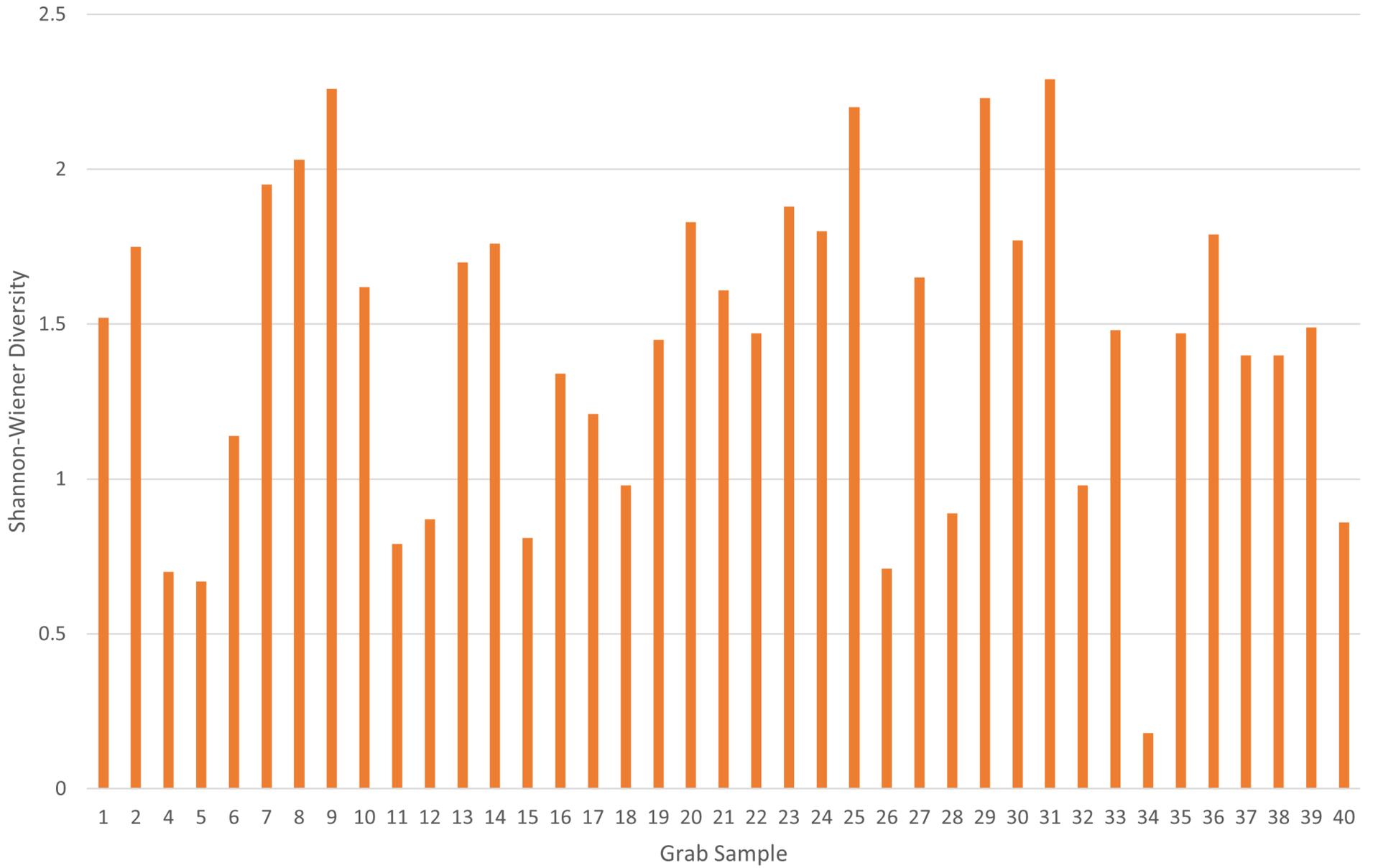


Figure 5.1-16d
Lease Area 2019 Infauna Diversity

Lease Area 2019 Infauna Evenness

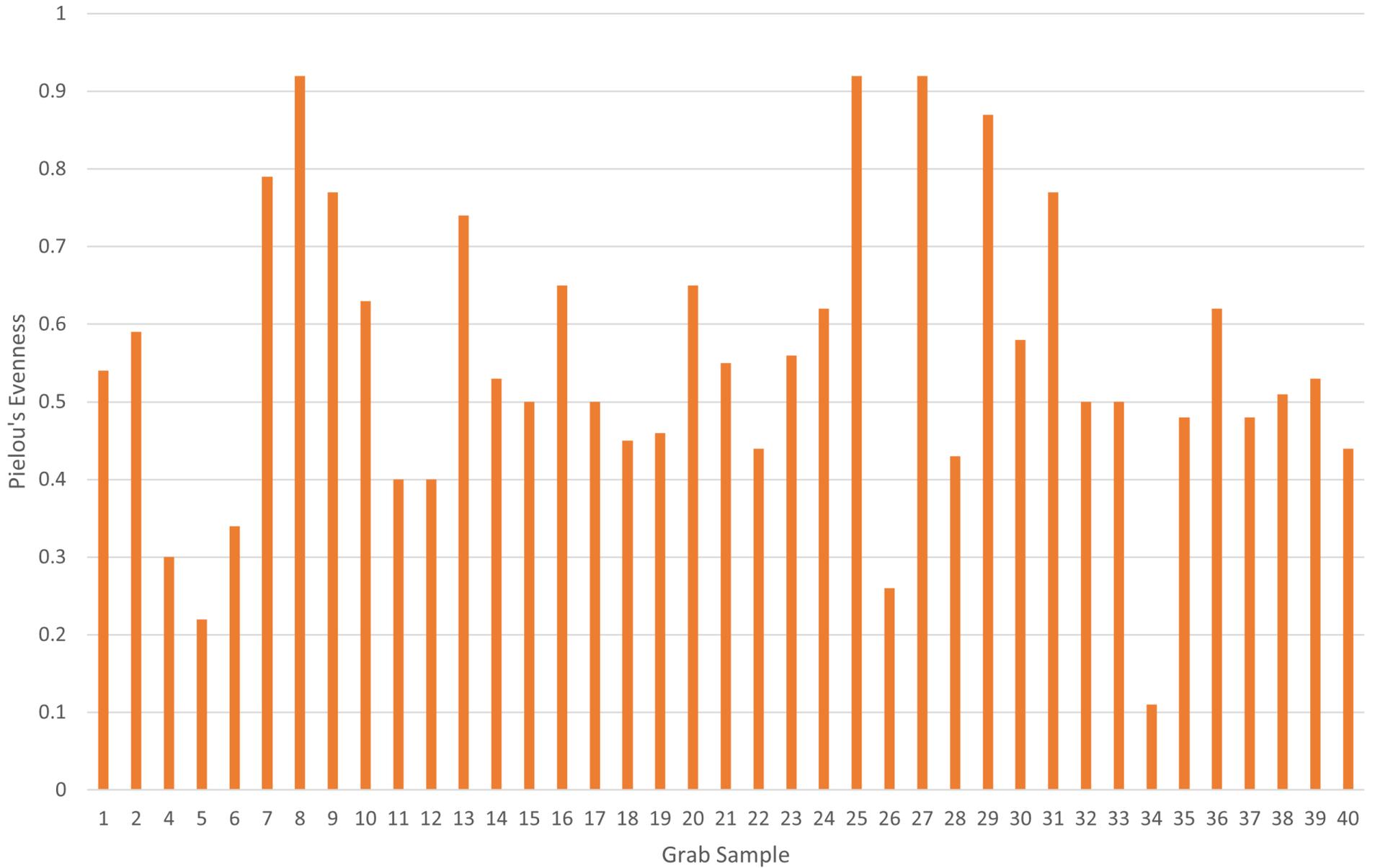


Figure 5.1-16e
Lease Area 2019 Infauna Evenness

Lease Area 2019 Infauna Taxonomic Richness

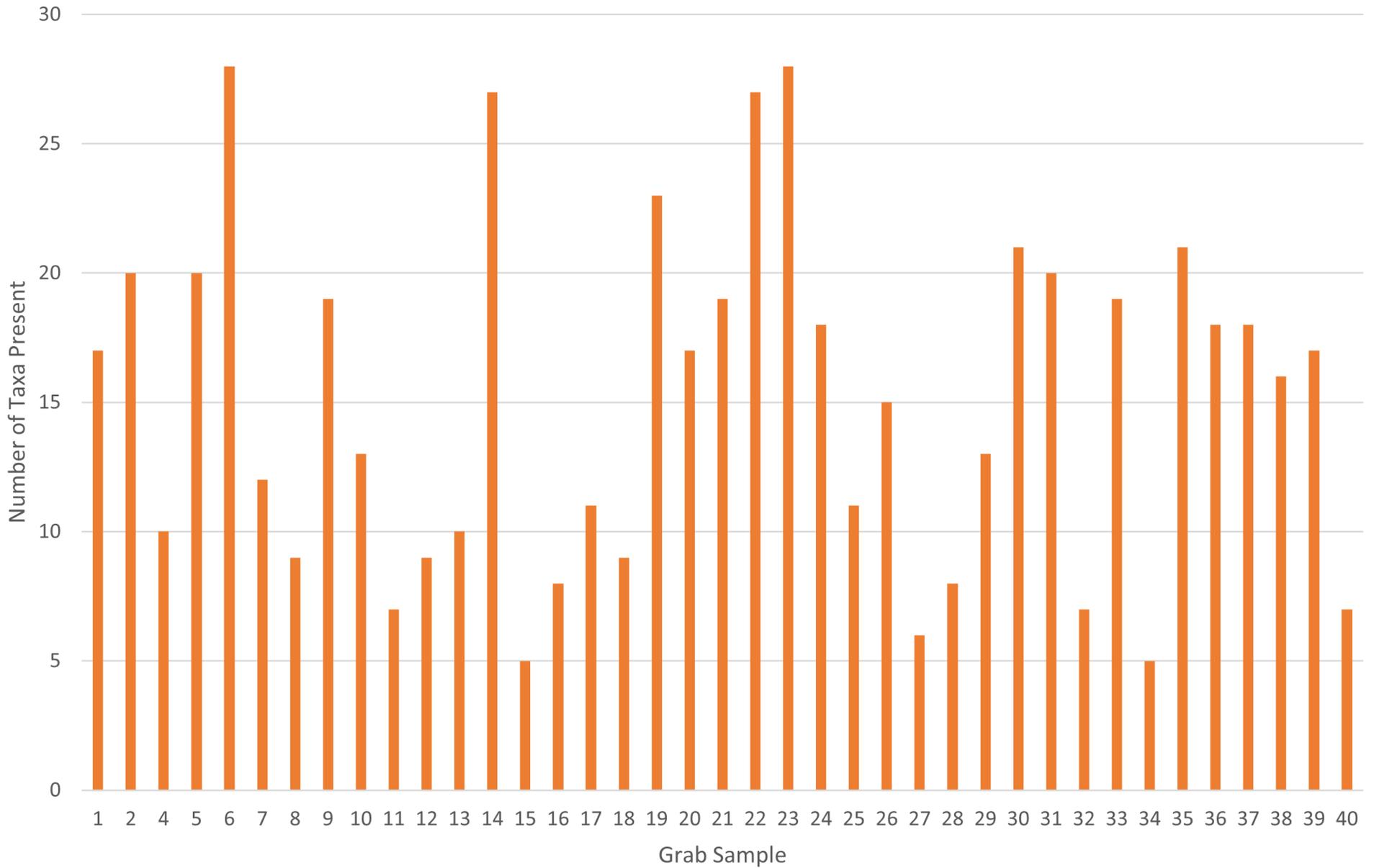
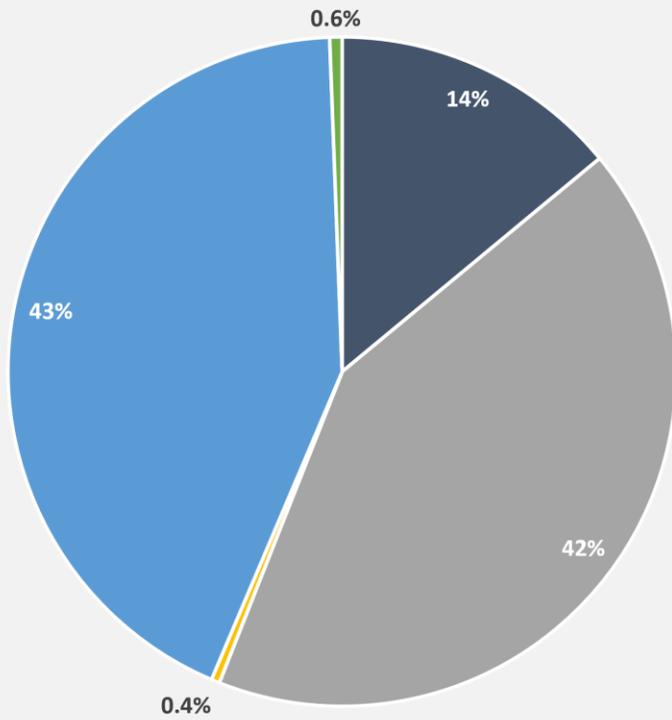


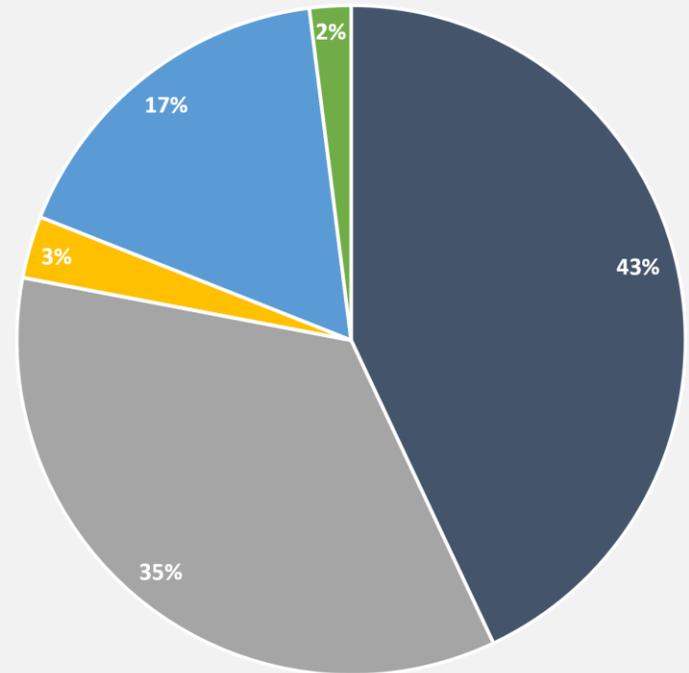
Figure 5.1-16f

Lease Area 2019 Infauna Taxonomic Richness

Proportional Abundance



Proportion of Taxa



- Annelida
- Arthropoda
- Chordata
- Cnidaria
- Echinodermata
- Mollusca
- Nemertea

Figure 5.1-17a

Inf fauna Proportional Abundance by Phylum in Lease Area 2022

Lease Area 2022 Infauna Community Summary

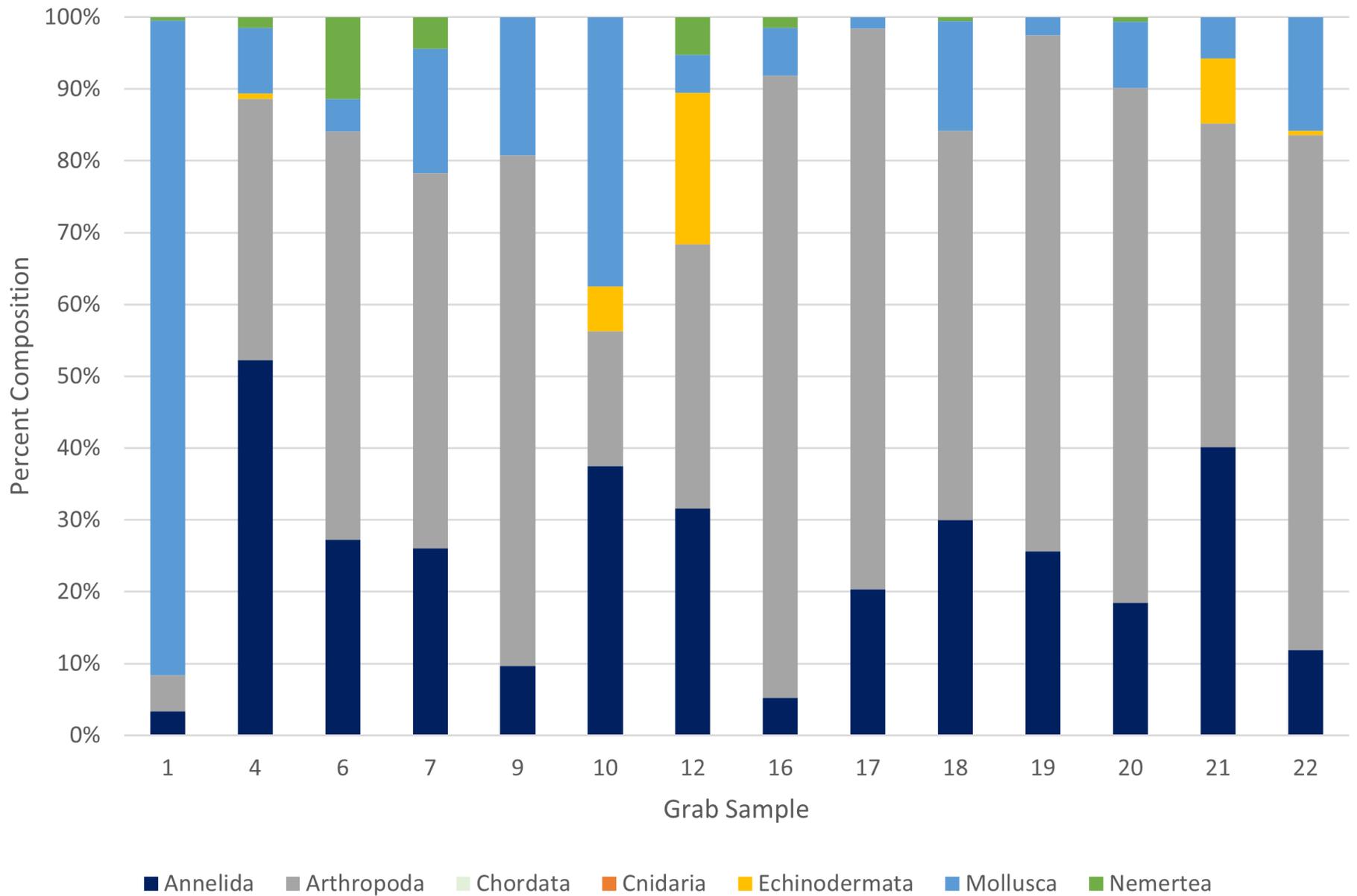
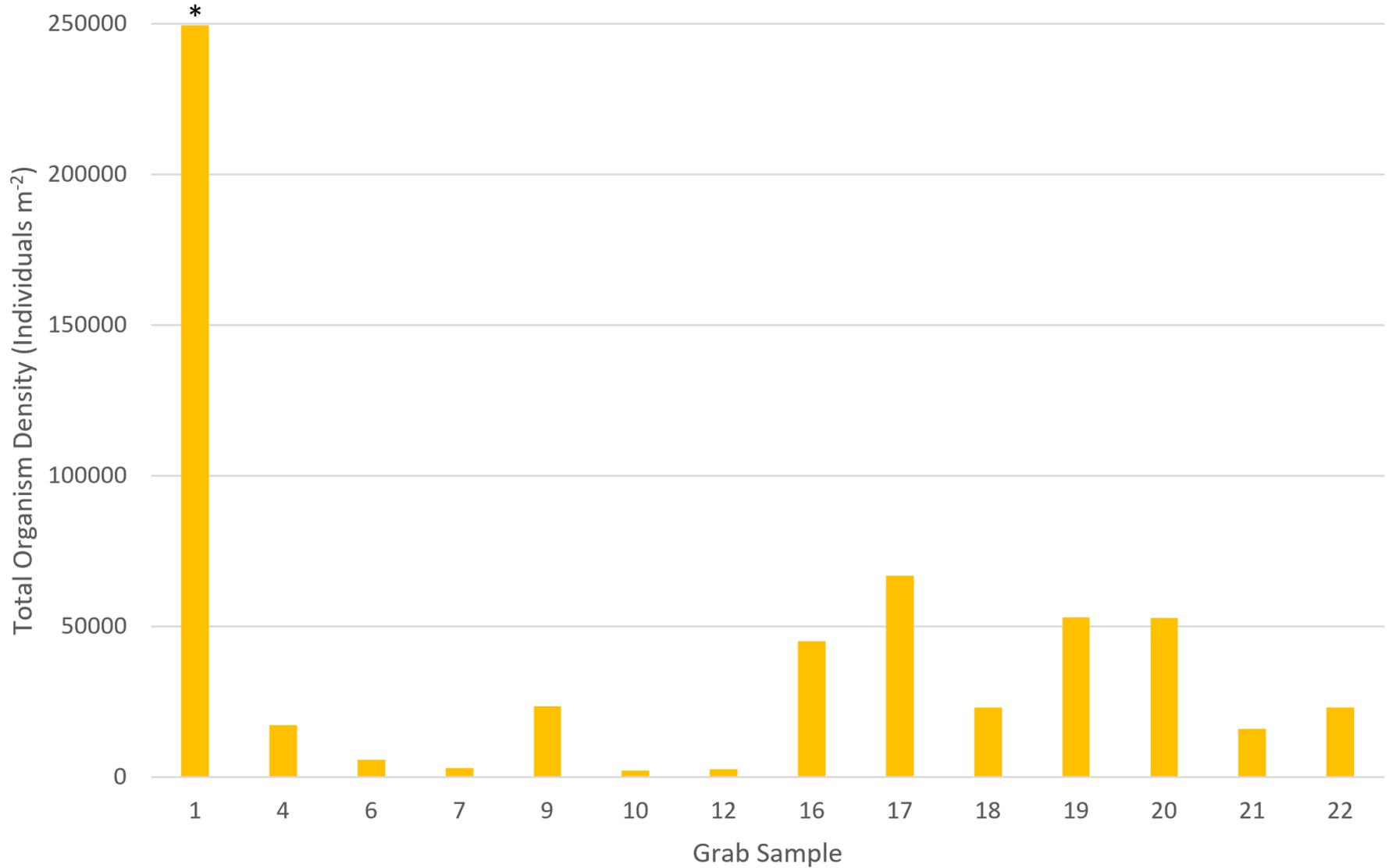


Figure 5.1-17b

Lease Area 2022 Infauna Community Summary

Lease Area 2022 Infauna Density



* Sample 522LA22-001 was a positive outlier due to a small field sample size of 9.58 cm², which likely overinflated the relative density when converted to individuals m⁻².

Figure 5.1-17c

Lease Area 2022 Infauna Density

Lease Area 2022 Infauna Diversity

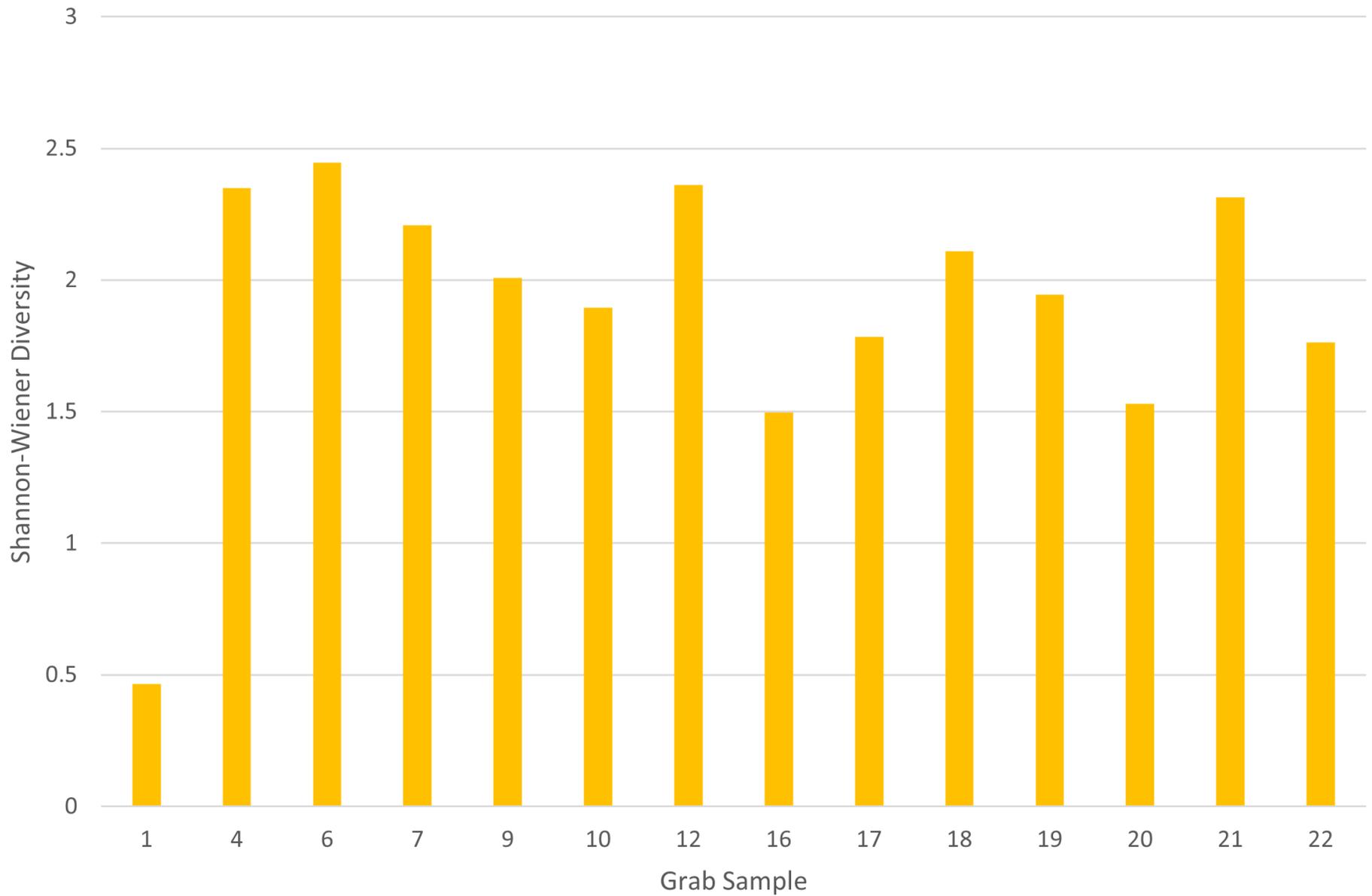


Figure 5.1-17d
Lease Area 2022 Infauna Diversity

Lease Area 2022 Infauna Evenness

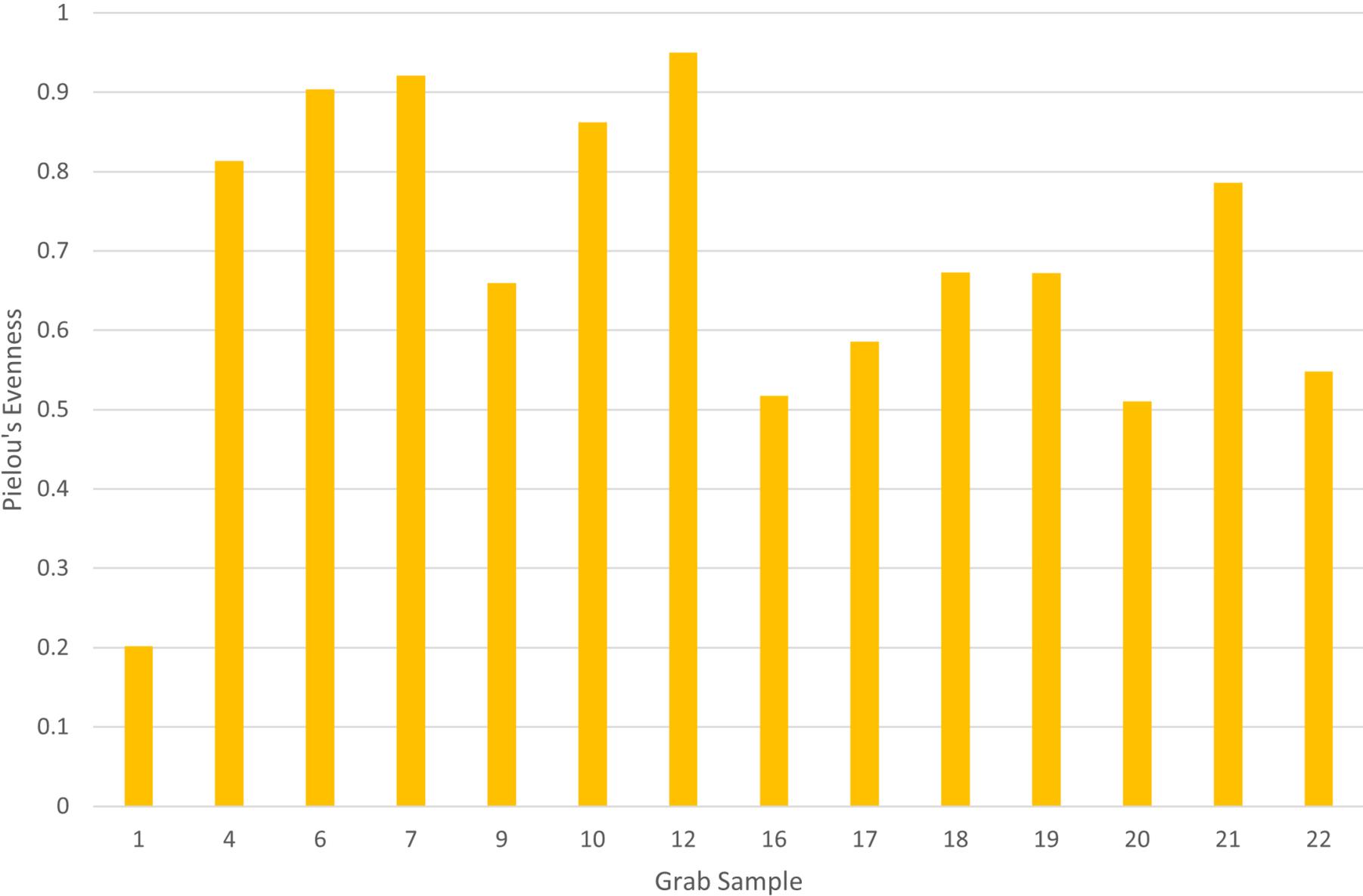


Figure 5.1-17e
Lease Area 2022 Infauna Evenness

Lease Area 2022 Infauna Taxonomic Richness

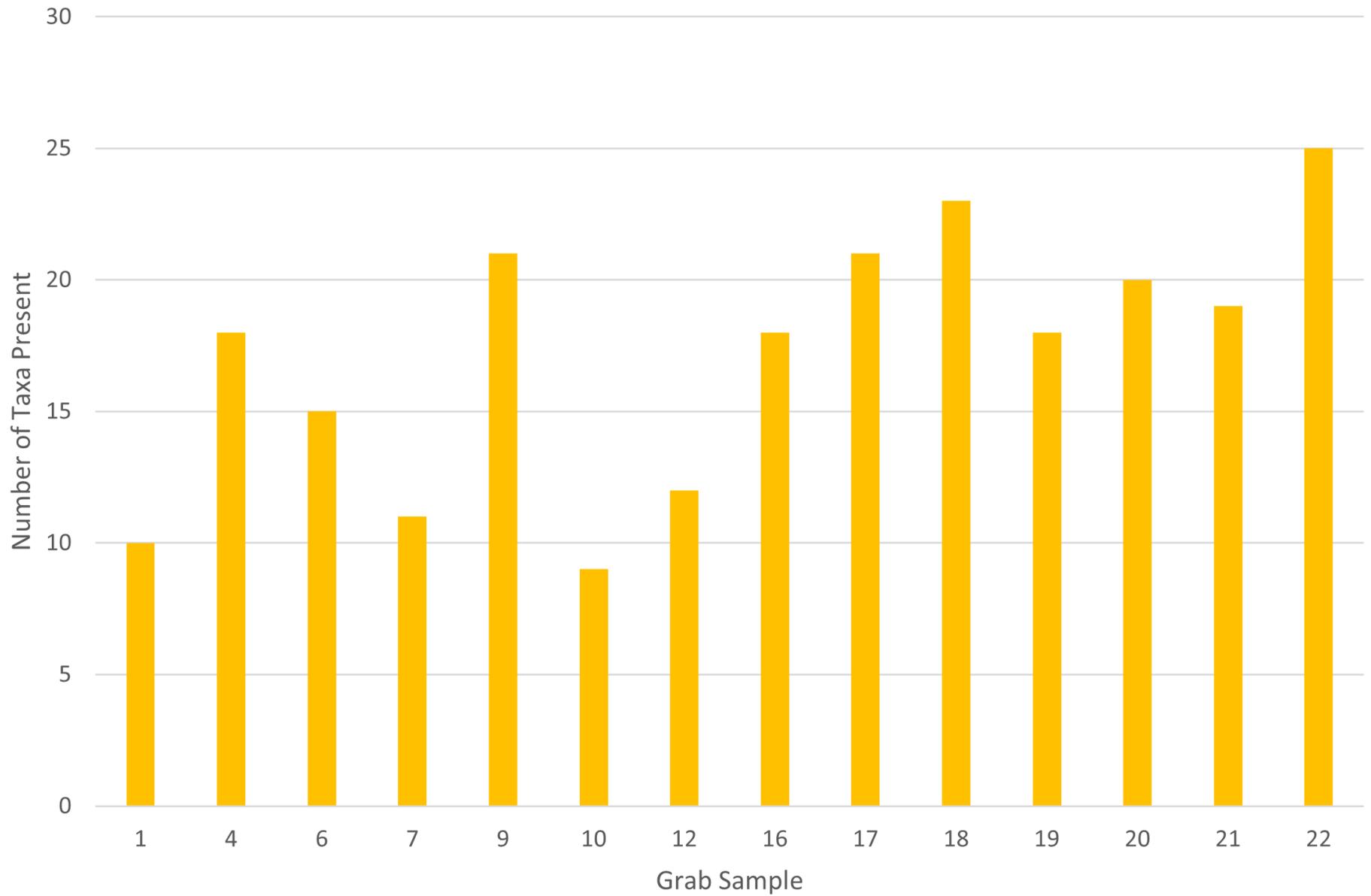


Figure 5.1-17f

Lease Area 2022 Infauna Taxonomic Richness



**VINEYARD
NORTHEAST**

VINEYARD OFFSHORE

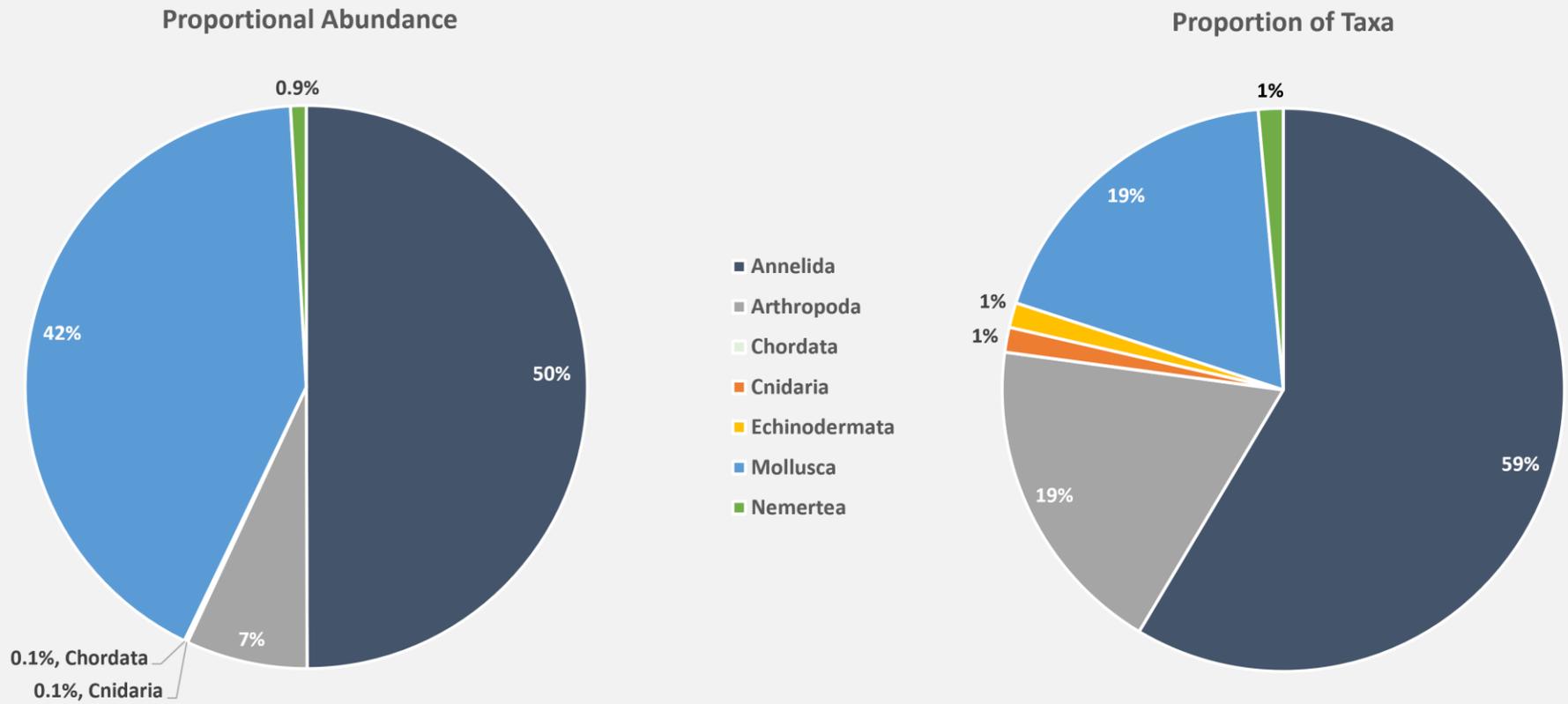


Figure 5.1-18a

Inf fauna Proportional Abundance by Phylum in Massachusetts OECC

Massachusetts OECC Infauna Community Summary

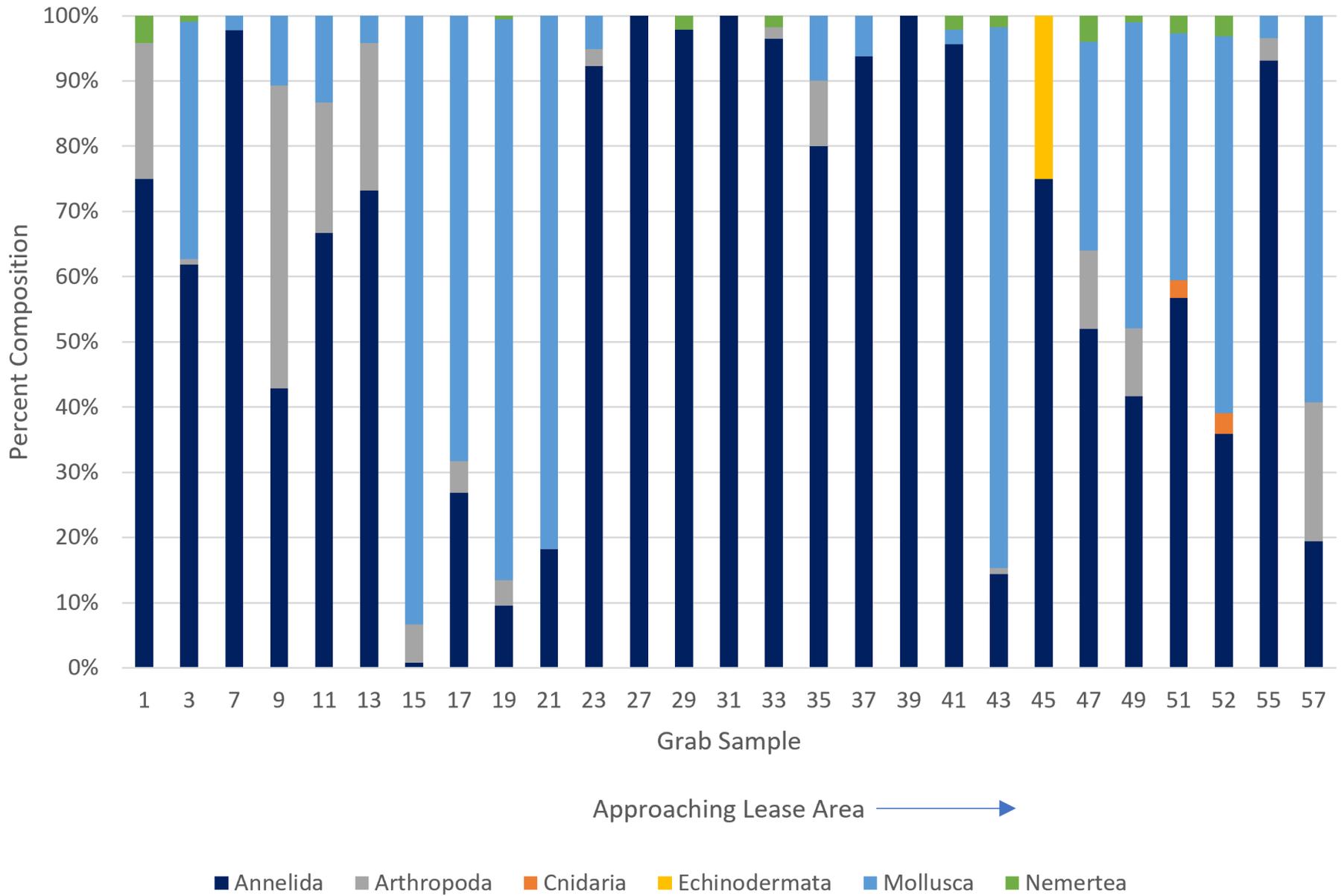


Figure 5.1-18b
Massachusetts OECC Infauna Community Summary

Massachusetts OECC Infauna Density

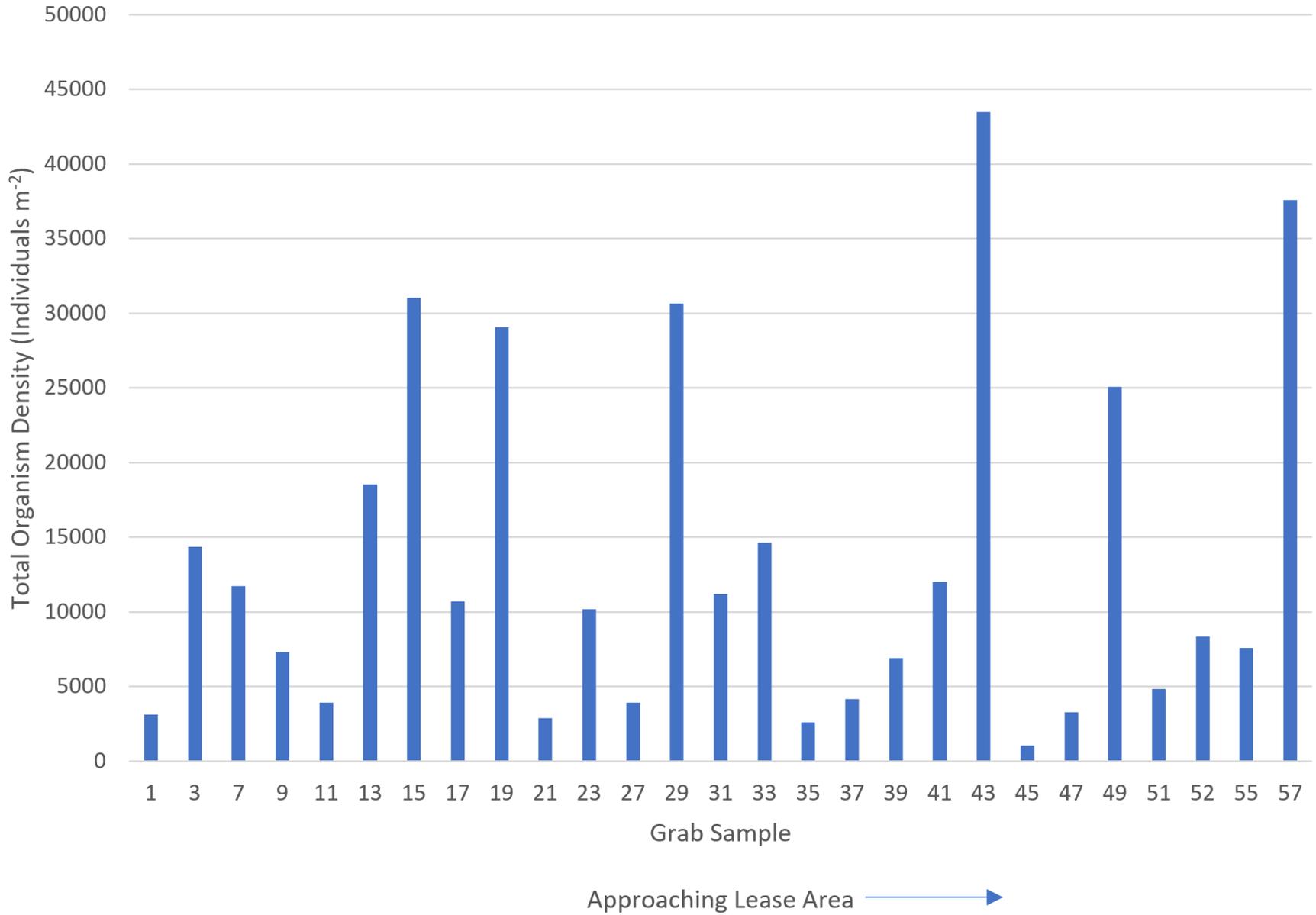


Figure 5.1-18c
Massachusetts OECC Infauna Density

Massachusetts OECC Infauna Taxonomic Richness

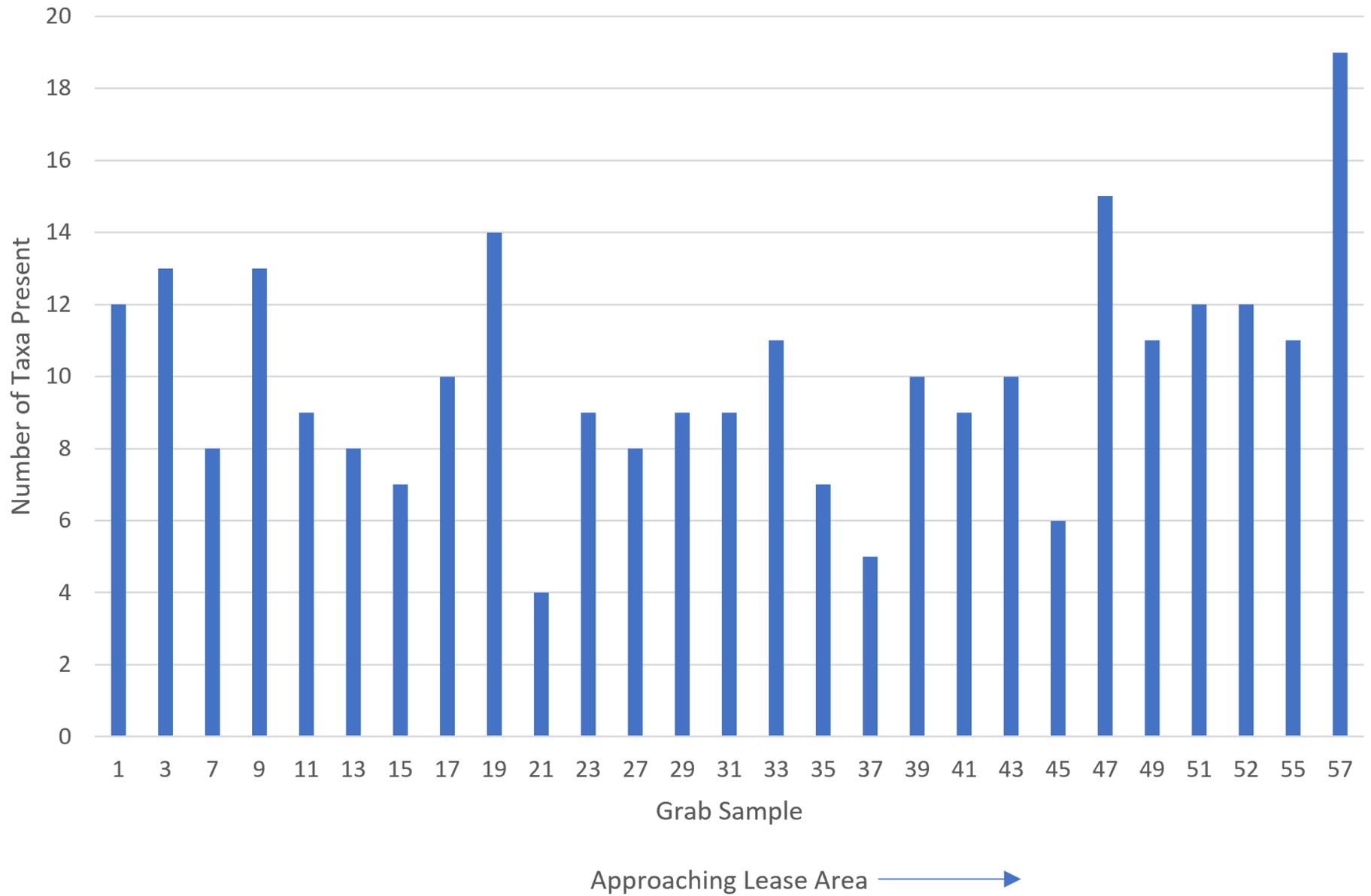


Figure 5.1-18d

Massachusetts OECC Infauna Taxonomic Richness

Massachusetts OECC Infauna Diversity

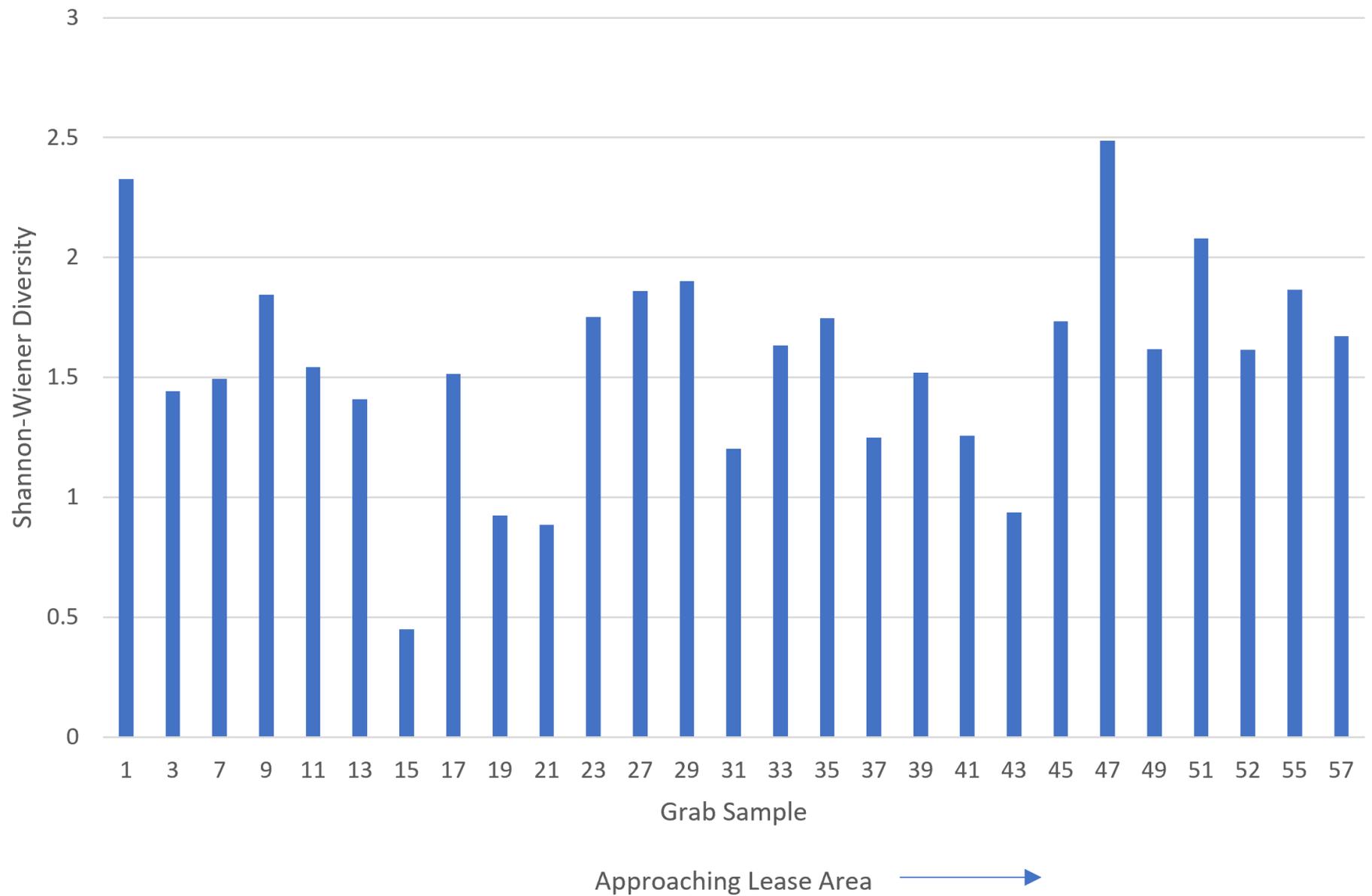


Figure 5.1-18e
Massachusetts OECC Infauna Diversity

Massachusetts OECC Infauna Evenness

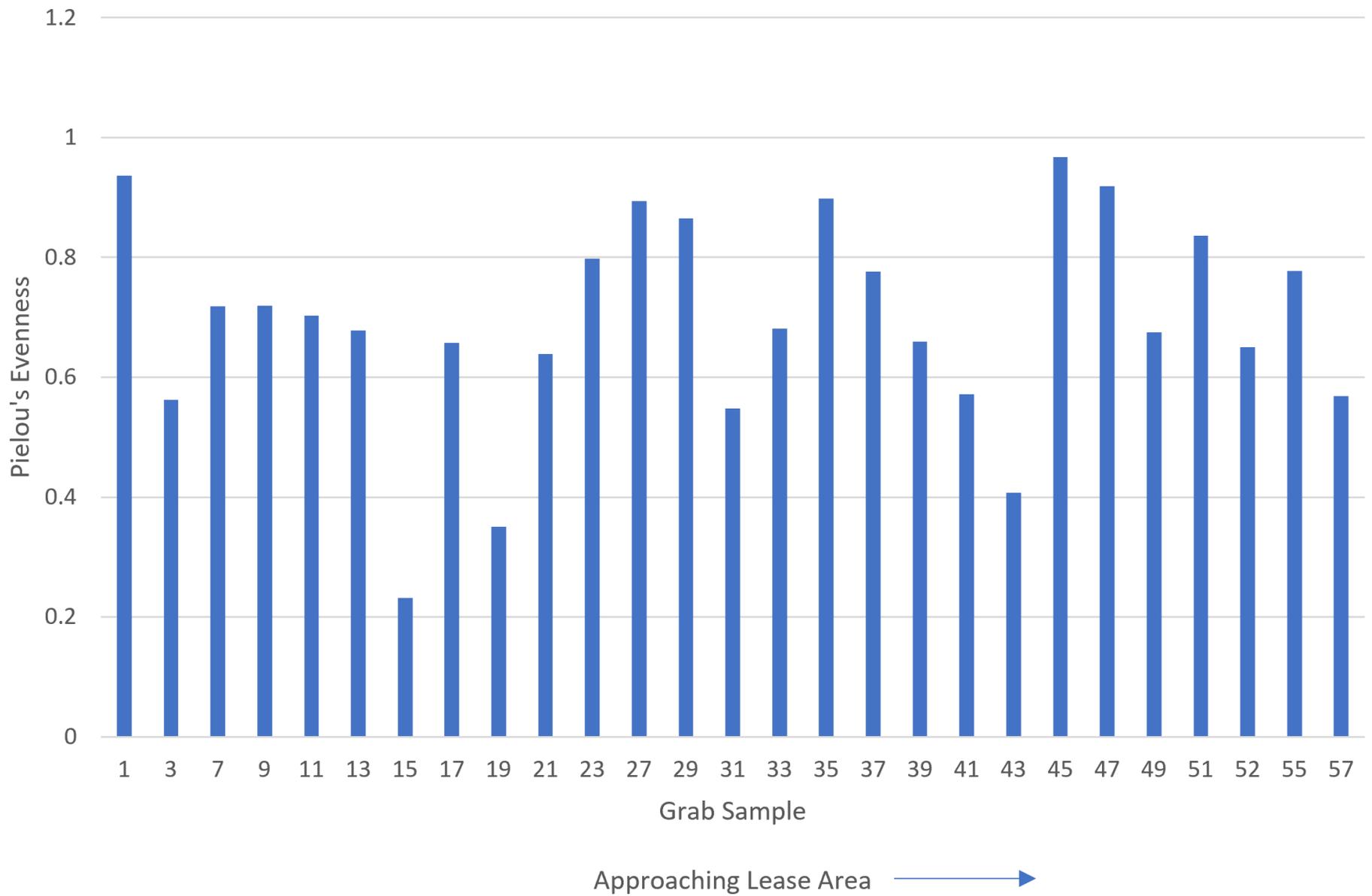
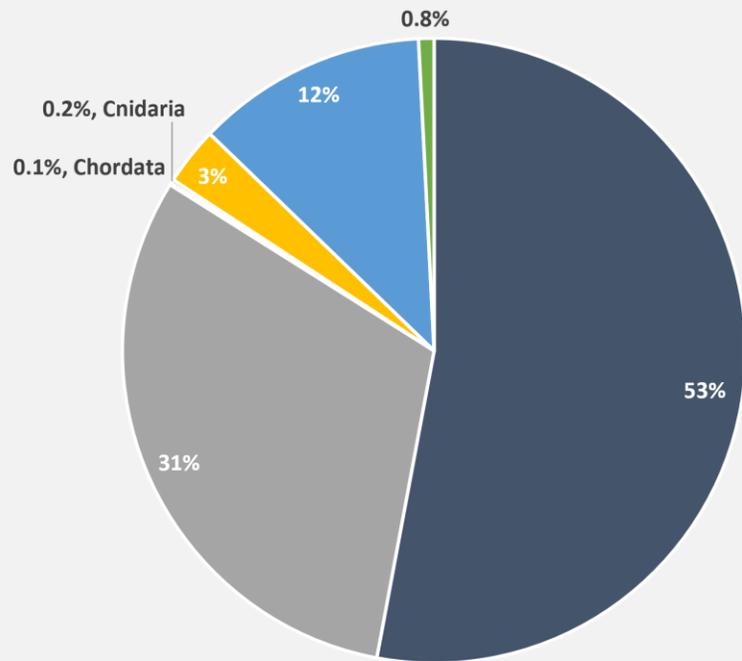


Figure 5.1-18f
Massachusetts OECC Infauna Evenness

Proportional Abundance



Proportion of Taxa

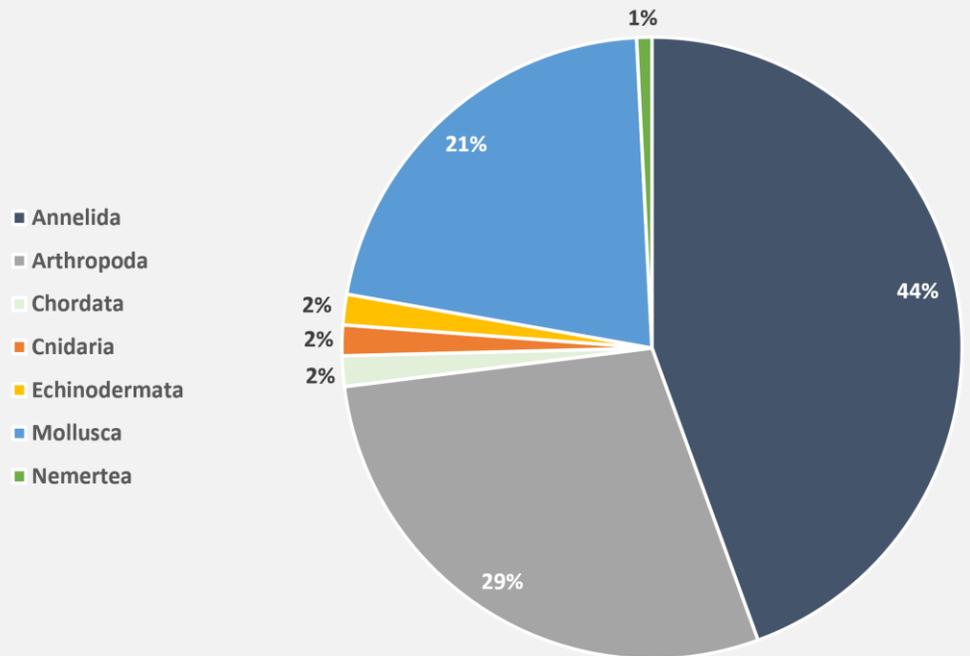


Figure 5.1-19a

Inf fauna Proportional Abundance by Phylum in Connecticut OECC

Connecticut OECC Infauna Community Summary

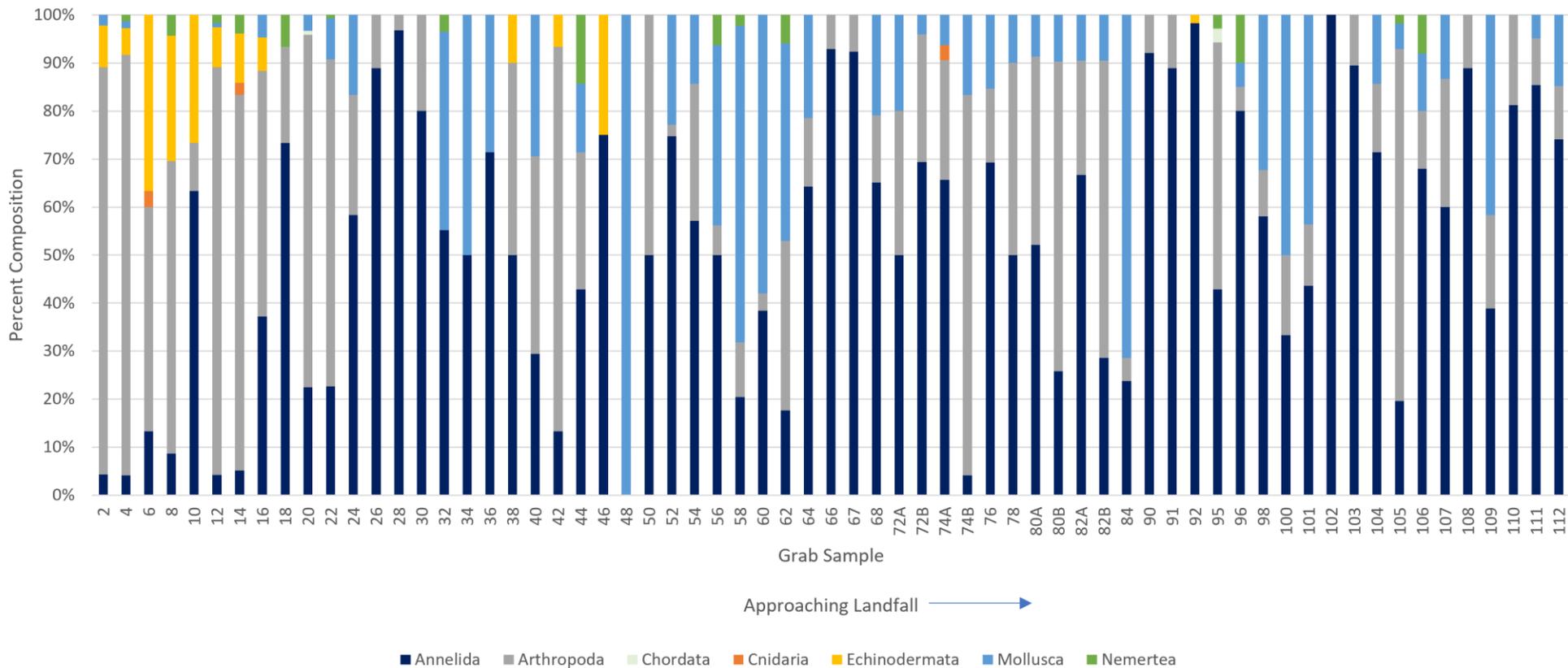
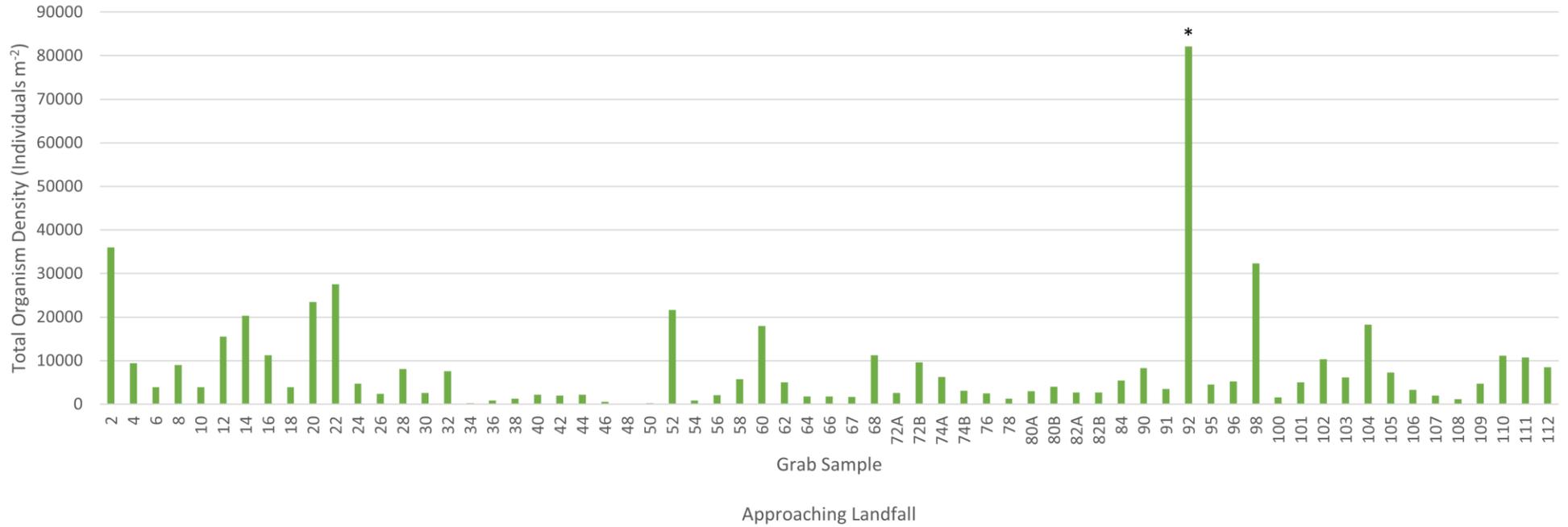


Figure 5.1-19b
Connecticut OECC Infauna Community Summary

Connecticut OECC Infauna Density



* Sample 522CT22-092 was a positive outlier due to a small field sample size of 7.18 cm², which likely overinflated the relative density when converted to individuals m⁻².

Figure 5.1-19c
Connecticut OECC Infauna Density

Connecticut OECC Infauna Taxonomic Richness

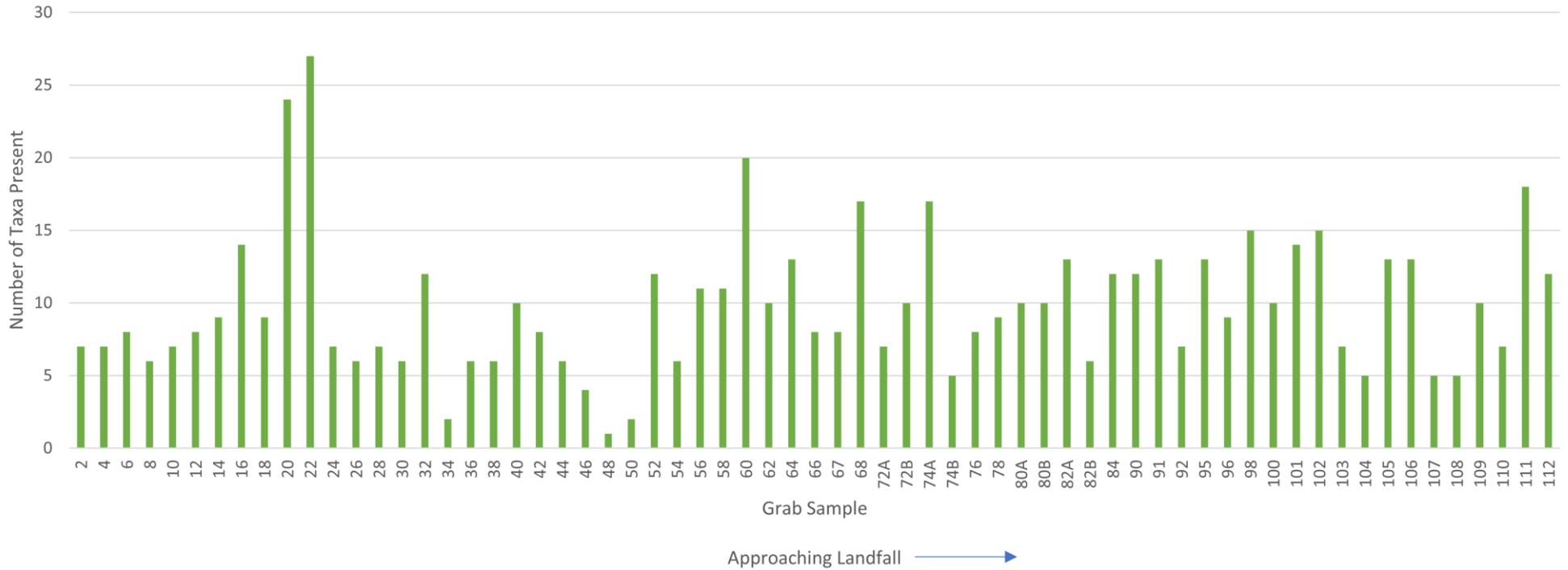


Figure 5.1-19d
Connecticut OECC Infauna Taxonomic Richness

Connecticut OECC Infauna Diversity

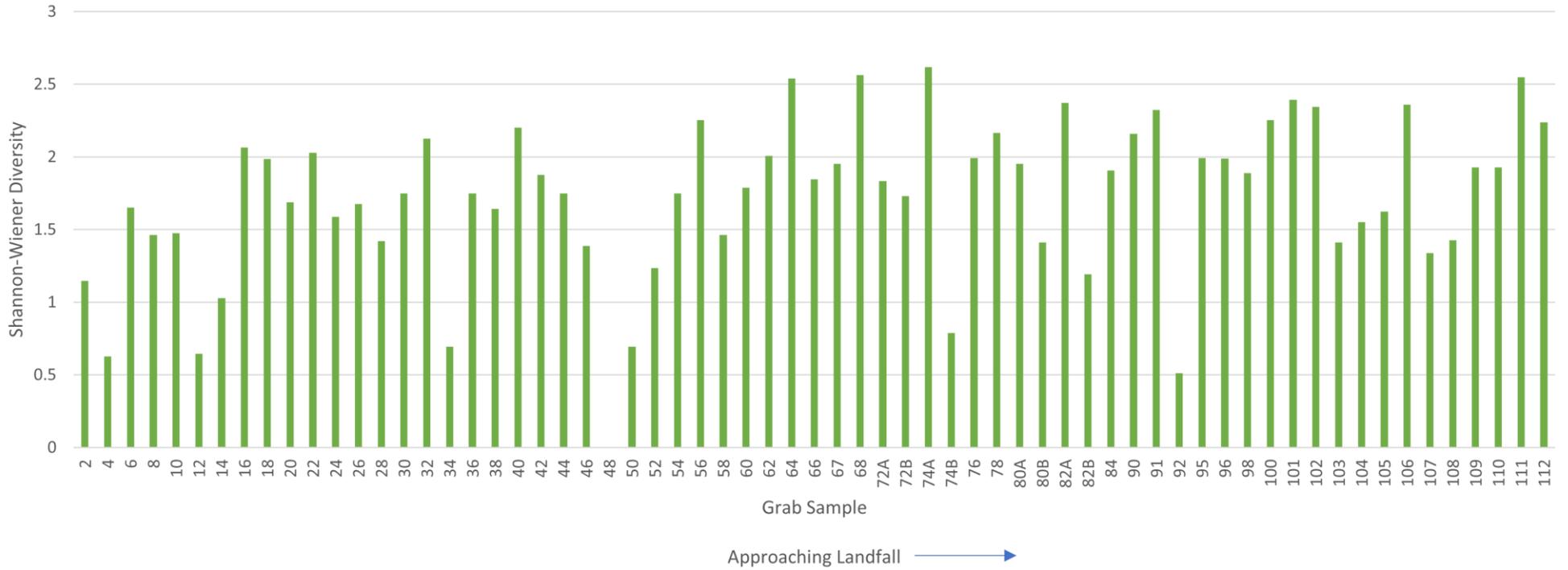


Figure 5.1-19e
Connecticut OECC Infauna Diversity

Connecticut OECC Infauna Evenness

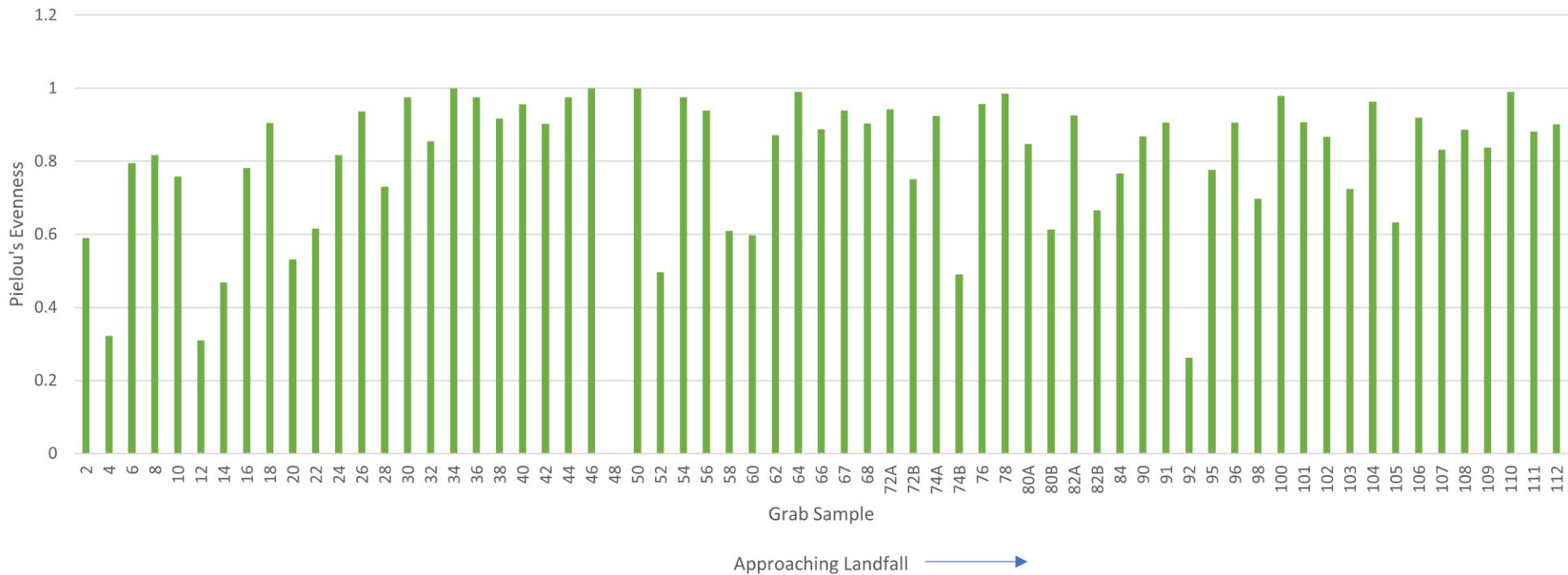


Figure 5.1-19f
Connecticut OECC Infauna Evenness

Infauna Community Comparison

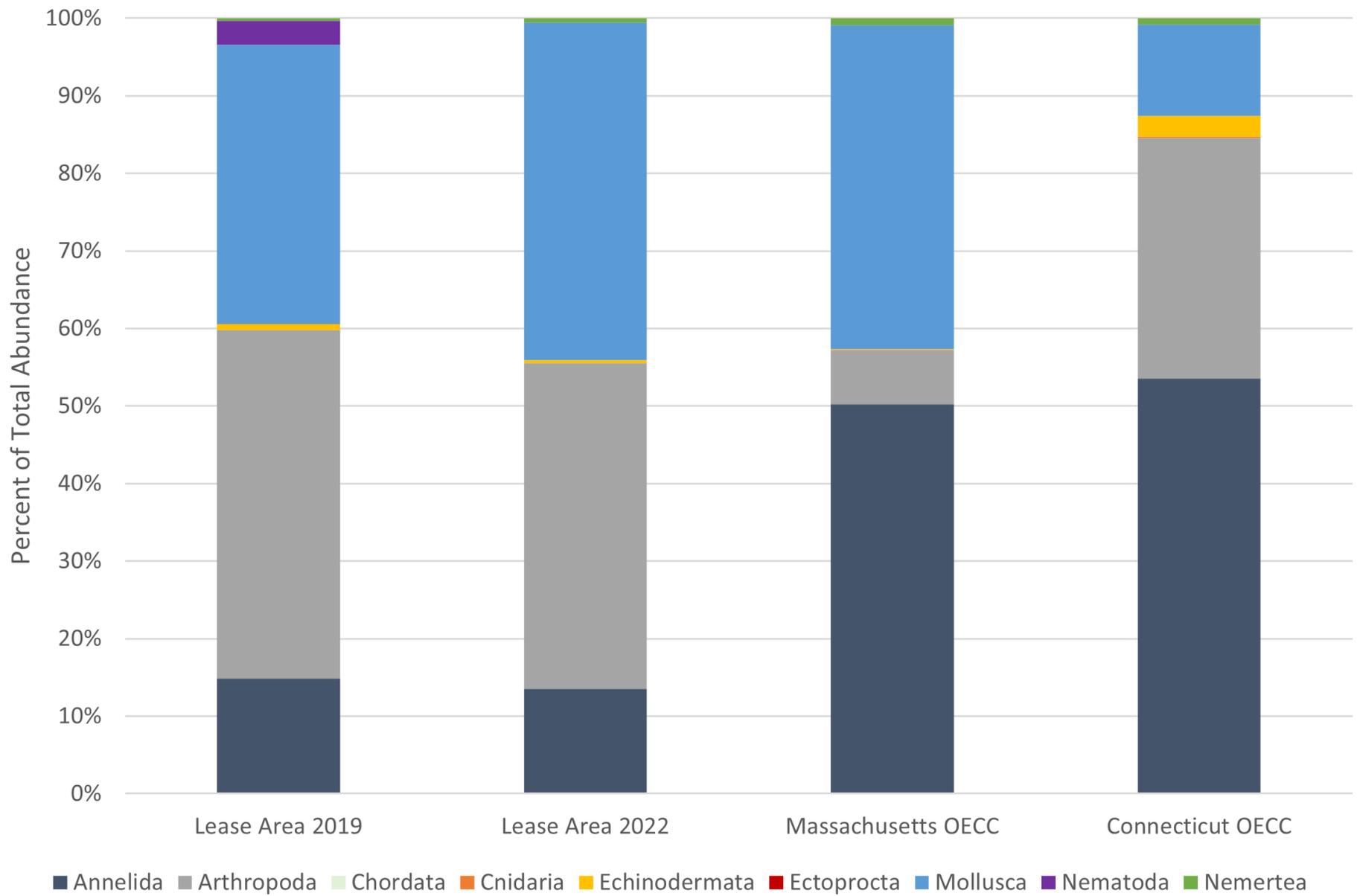


Figure 5.1-20
Vineyard Northeast Infauna Community Comparison

Non-metric MDS

Transform: Fourth root
Resemblance: S17 Bray-Curtis similarity

2D Stress: 0.25

Project Area

- ▲ Connecticut
- ▼ Lease Area
- Massachusetts

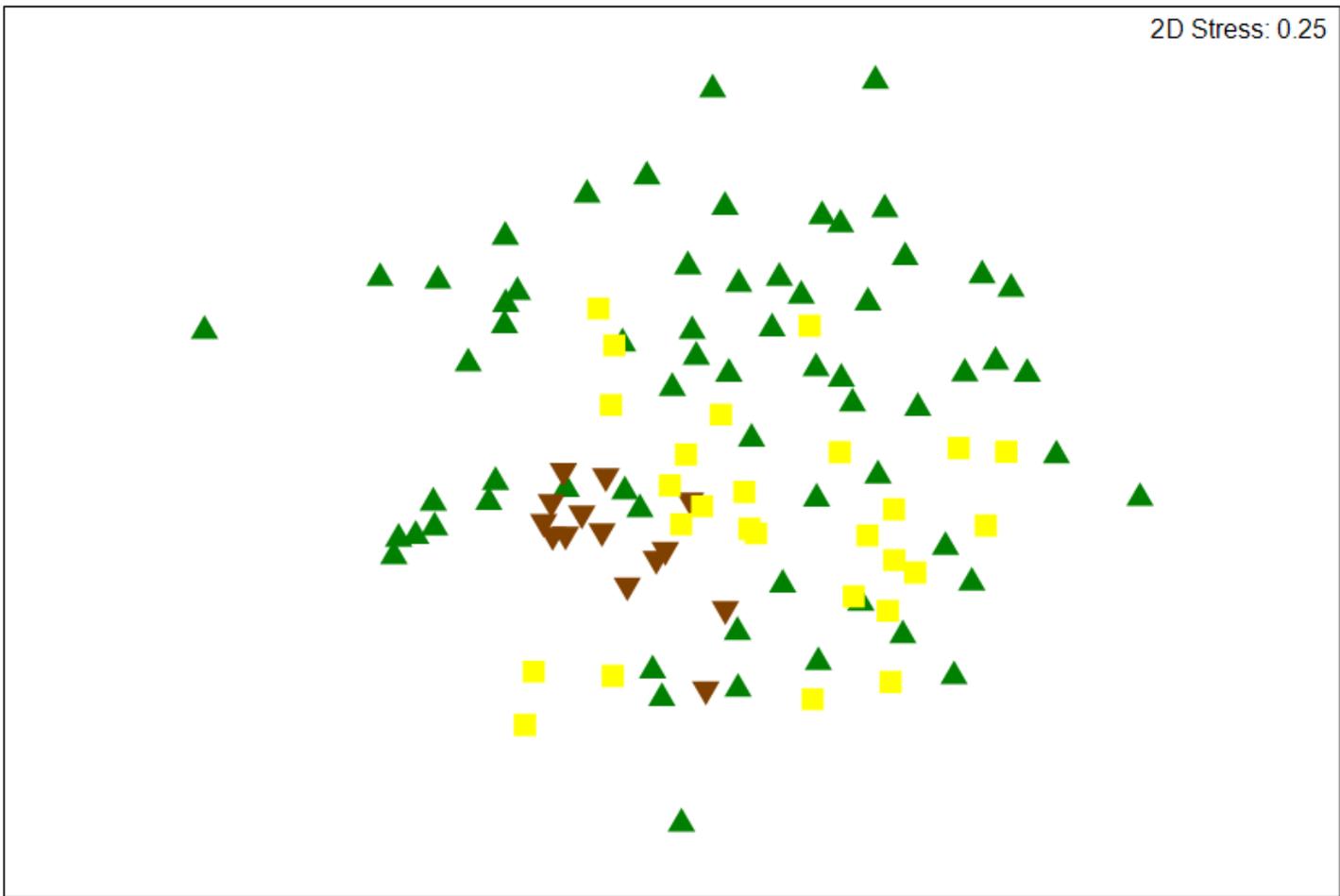


Figure 5.1-21

NMDS Ordination of Community Composition in Benthic Infauna Samples by Project Area

Non-metric MDS

Transform: Fourth root
Resemblance: S17 Bray-Curtis similarity

2D Stress: 0.25

CMECS Substrate Group

- Sandy Mud
- ▲ Muddy Sand
- ▼ Sand
- Gravelly
- ◆ Gravel Mixes

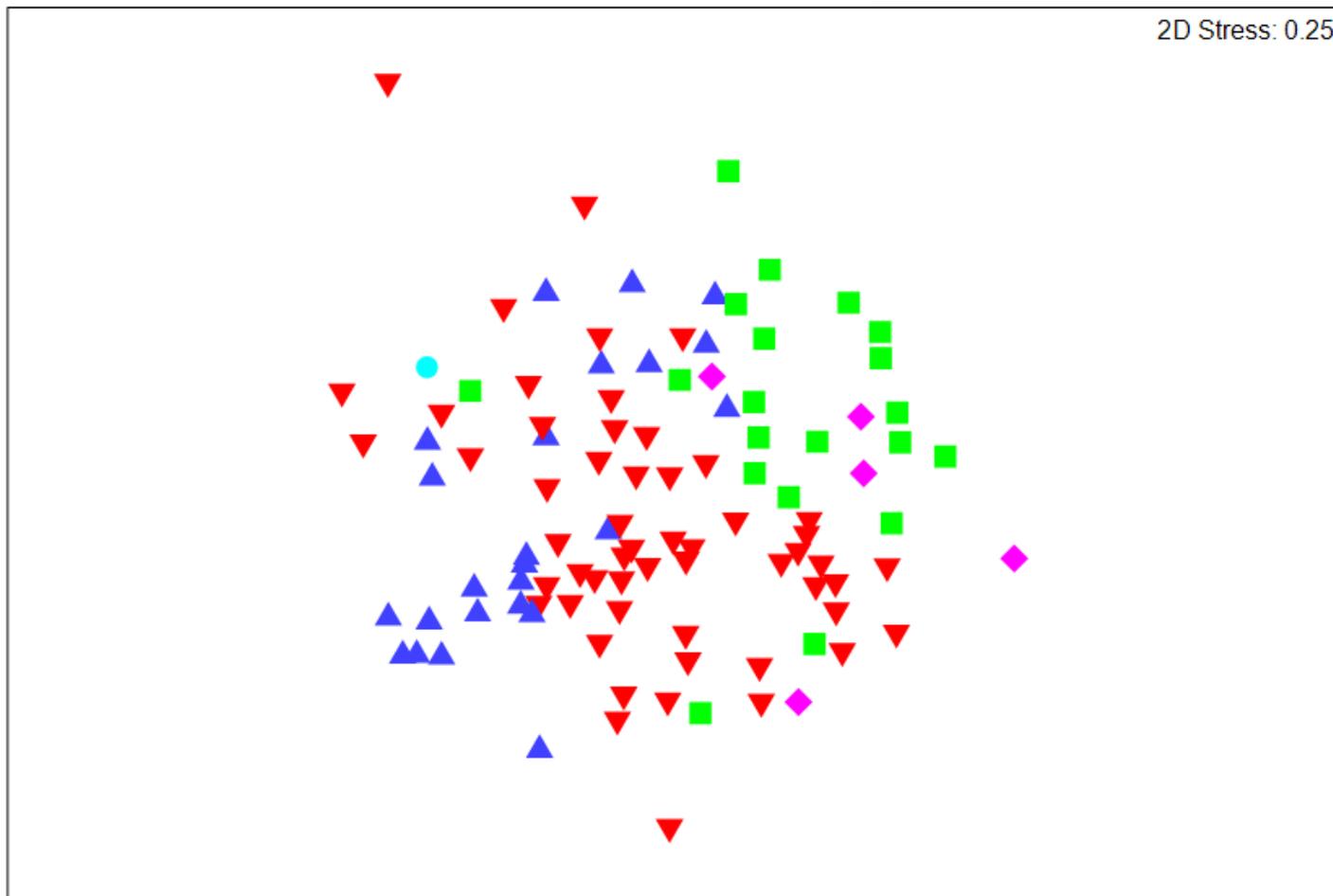


Figure 5.1-22

NMDS Ordination of Community Composition in Benthic Infauna Samples by CMECS Sediment Group



VINEYARD
NORTHEAST

VINEYARD OFFSHORE

Non-metric MDS

Transform: Fourth root
Resemblance: S17 Bray-Curtis similarity

2D Stress: 0.25

NMFS
▲ Soft
▼ Complex

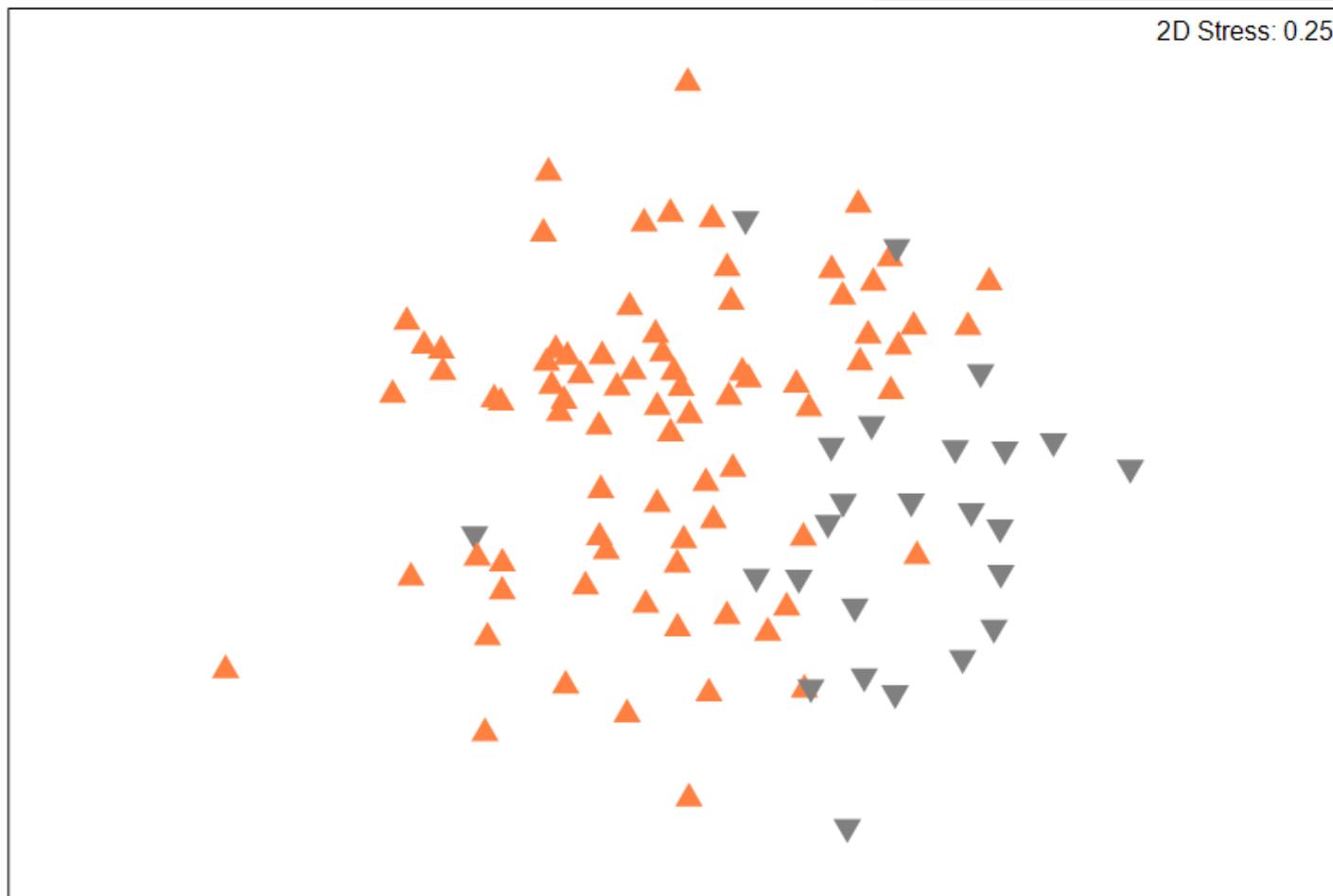


Figure 5.1-23

NMDS Ordination of Community Composition in Benthic Infauna Samples by NMFS Classification

Non-metric MDS

Transform: Fourth root
Resemblance: S17 Bray-Curtis similarity

2D Stress: 0.26

Nearshore/Offshore

▲ Offshore

▼ Nearshore

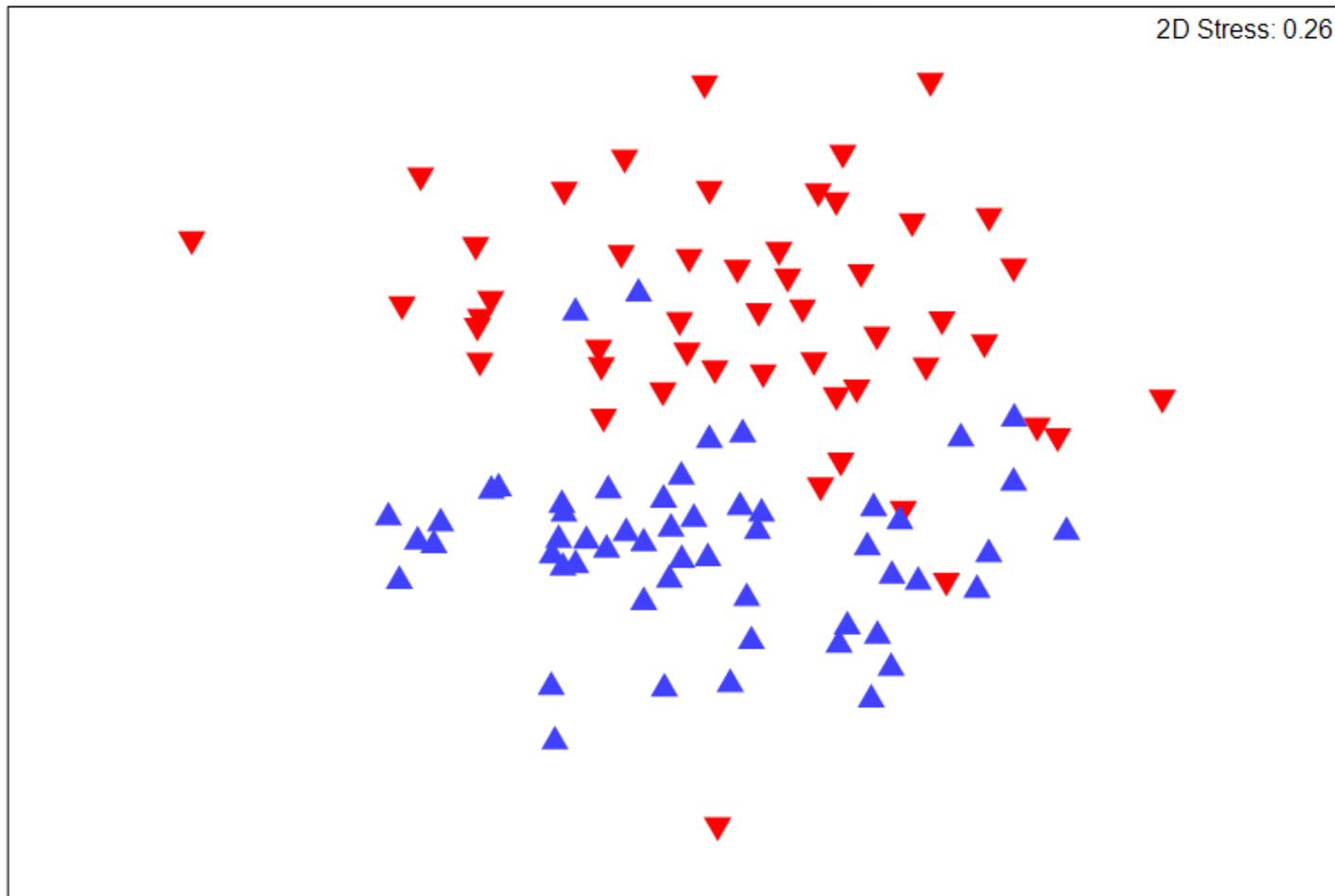


Figure 5.1-24

NMDS Ordination of Community Composition in Benthic Infauna Samples Comparing Nearshore and Offshore Waters



VINEYARD
NORTHEAST

VINEYARD OFFSHORE

LEGEND

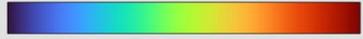
Video Stills CMECS Classification

- Biogenic Shell Rubble w/ Co-occurring Sand
- Fine Sand Mud w/ Sparse Shell Rubble
- Fine Sand Mud w/ Sparse Shell Hash
- Fine Sand Mud

Video Transect Trackline (522-19-VT02)

- Complex Mix Station

Bathymetry (meters)



-45.26 -44.68

- Lease Area OCS-A 522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al (2018).

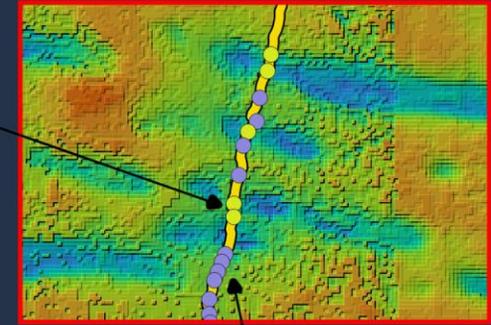
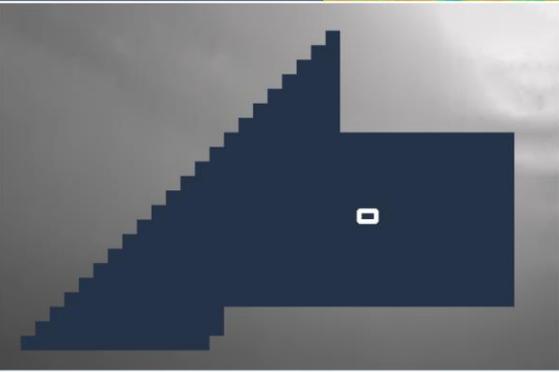


Figure 5.2-1

Shell Furrows Within Lease Area (MBES and Video Stills)

LEGEND

-  Soft Bottom Habitat
-  Heterogeneous Complex Habitat
-  Complex Habitat
-  Large Grained Complex Habitat
-  Ripples
-  Megaripples
-  Pitted Seabed
-  Organic Mounds
-  Shell Furrows - More Dense
-  Shell Furrows - Less Dense
-  Lease Area OCS-A 0522

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al. (2018).

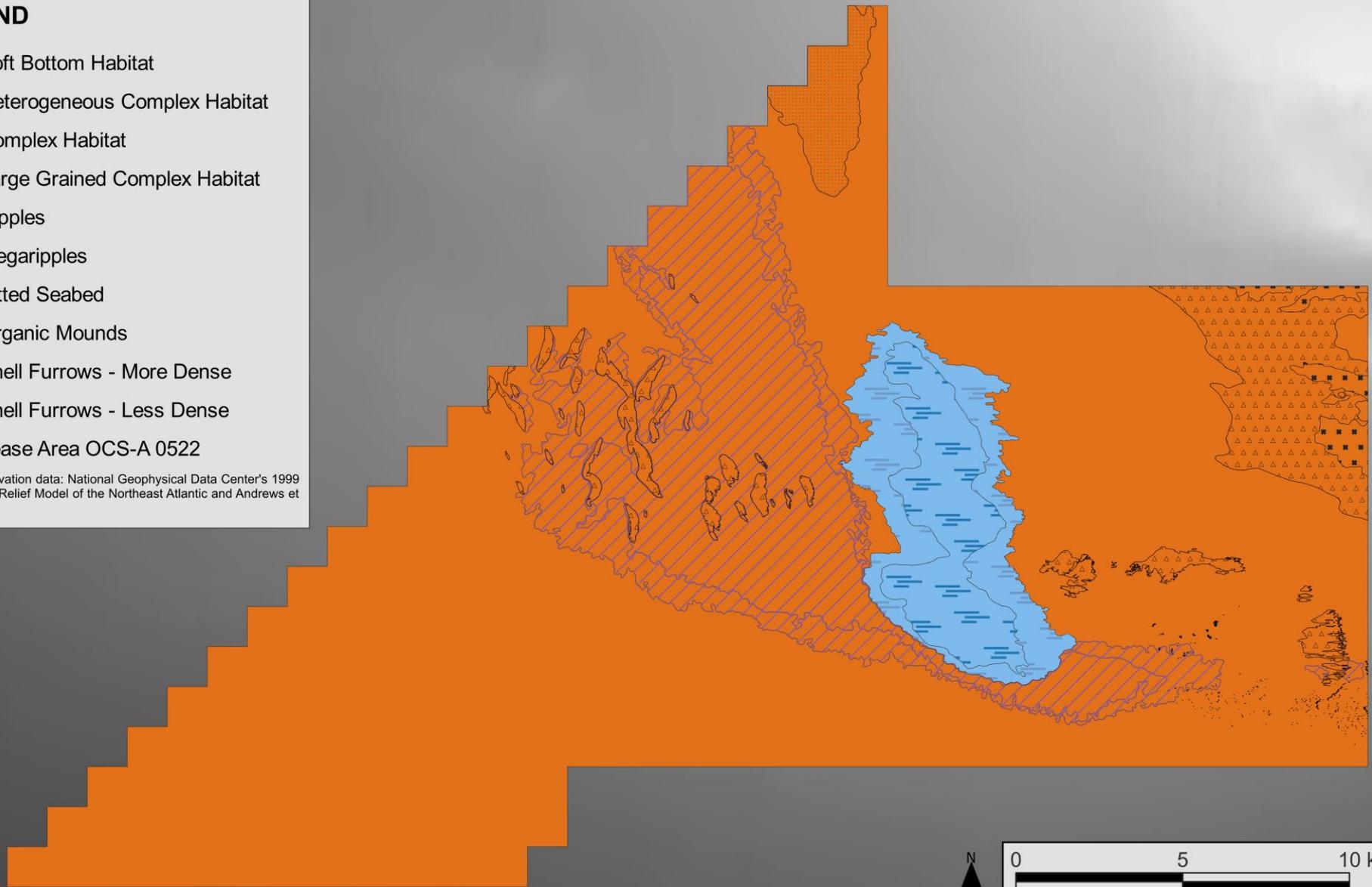


Figure 5.2-2
NMFS Habitat Mapping Lease Area

LEGEND

- Pitted Seabed
- Organic Mounds
- Shell Furrows - More Dense
- Shell Furrows - Less Dense
- Soft Bottom Habitat
- Heterogeneous Complex Habitat
- Complex Habitat
- Large Grained Complex Habitat
- Ripples
- Megaripples
- Lease Area OCS-A 0522

Side Scan Sonar
Relative Reflectivity



Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al. (2018).

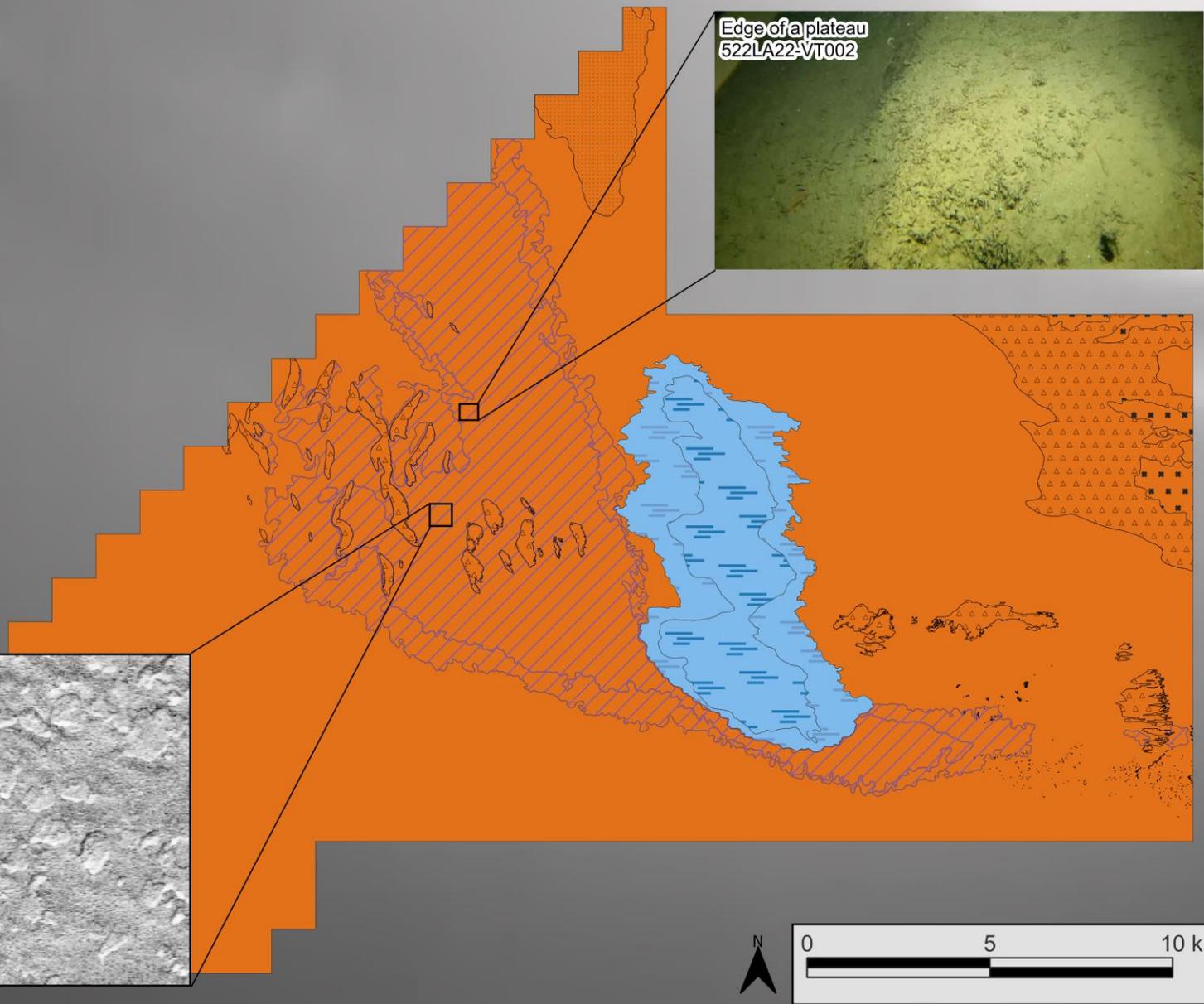


Figure 5.2-3

Pitted Seafloor Feature in the Lease Area

LEGEND

-  Organic Mounds
 -  Pitted Seabed
 -  Shell Furrows - More Dense
 -  Shell Furrows - Less Dense
 -  Soft Bottom Habitat
 -  Heterogeneous Complex Habitat
 -  Complex Habitat
 -  Large Grained Complex Habitat
 -  Ripples
 -  Megaripples
 -  Massachusetts OECC
 -  Lease Area OCS-A 0522
- Side Scan Sonar
Relative Reflectivity
- 
- High Low

Source of elevation data: National Geophysical Data Center's 1999 U.S. Coastal Relief Model of the Northeast Atlantic and Andrews et al. (2018).

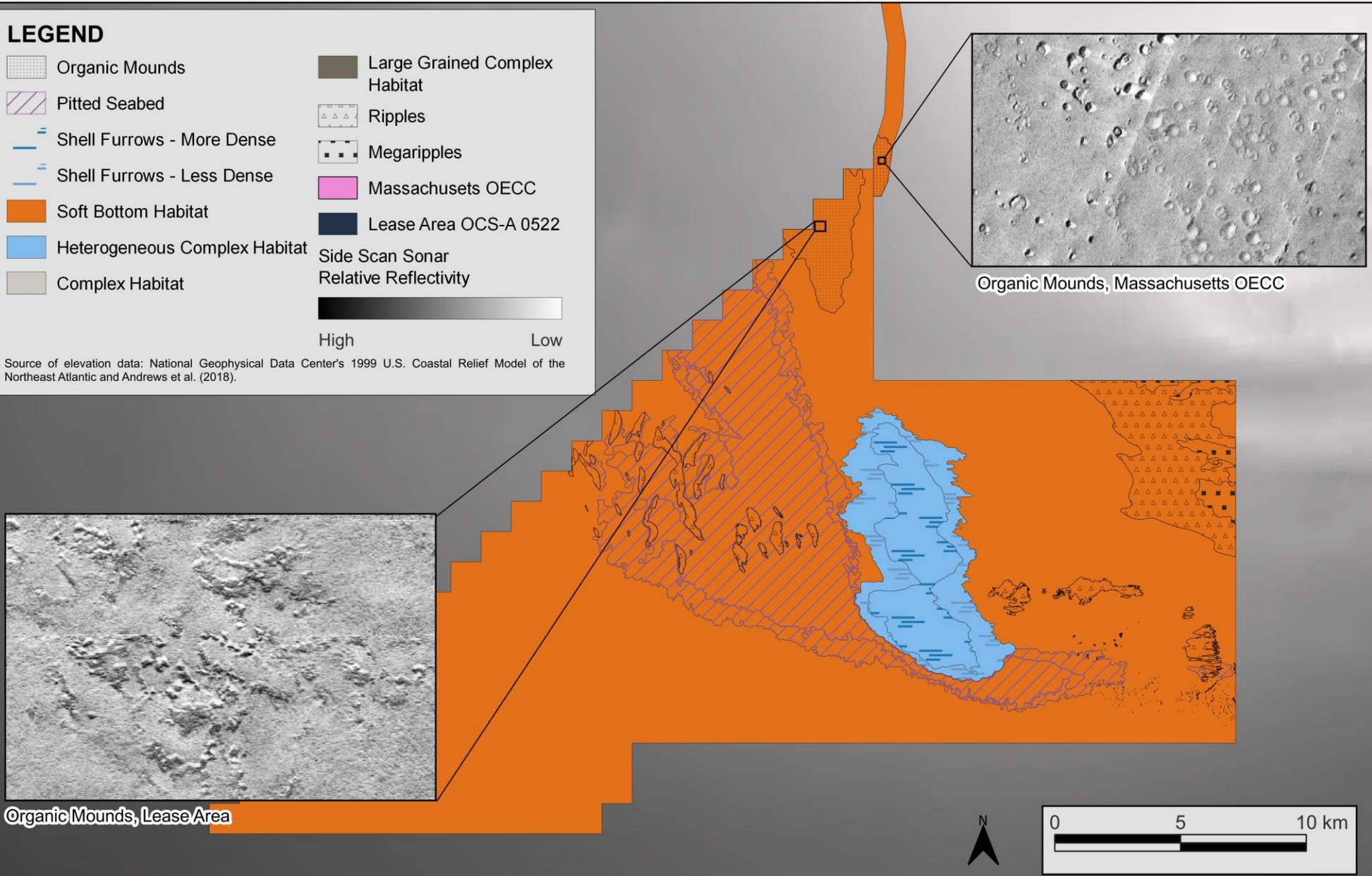


Figure 5.2-4
Organic Mounds in the Lease Area Compared to Massachusetts OECC

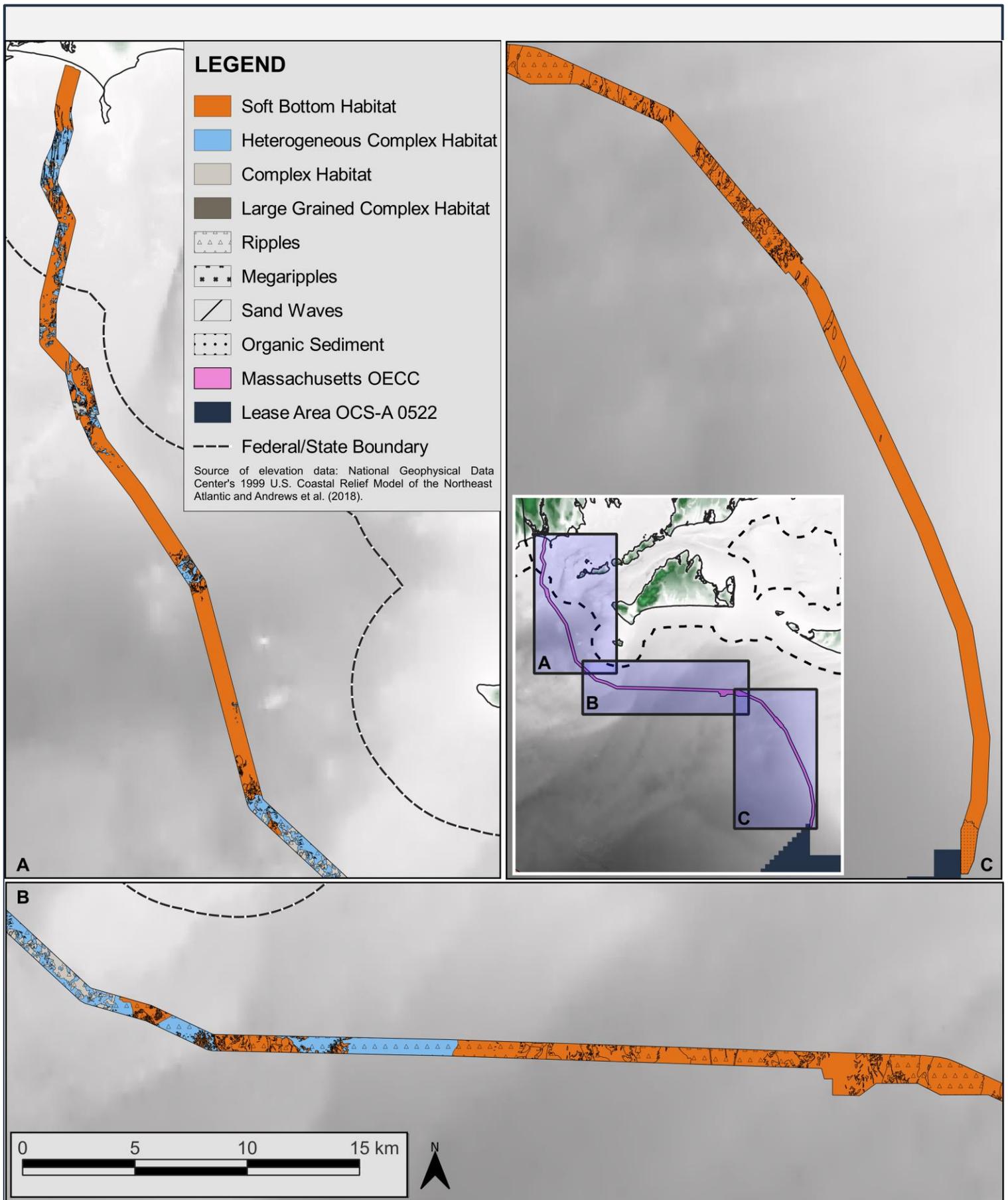


Figure 5.2-5
 NMFS Habitat Mapping Massachusetts OECC

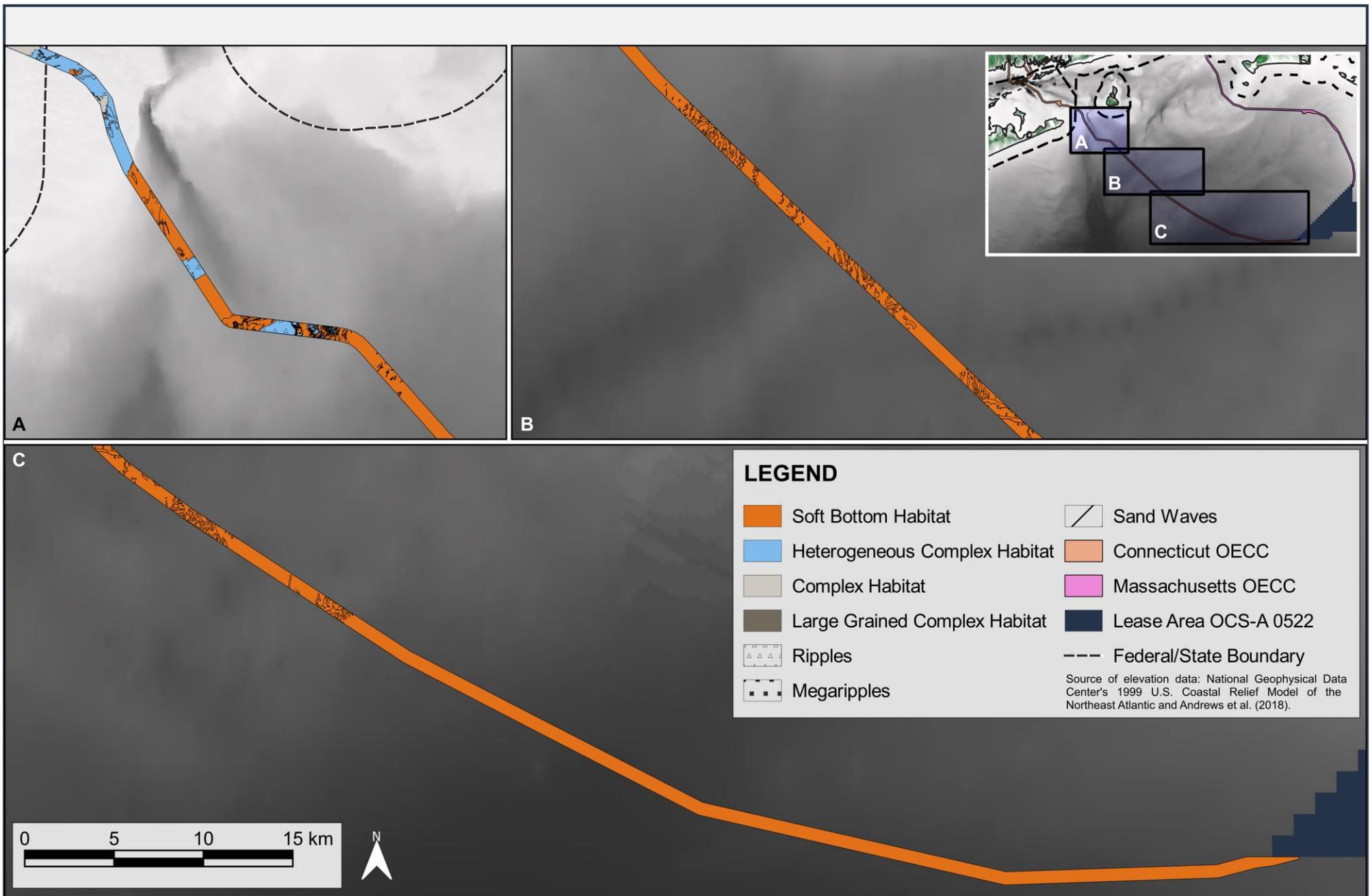


Figure 5.2-6a
 NMFS Habitat Mapping Connecticut OECC Offshore

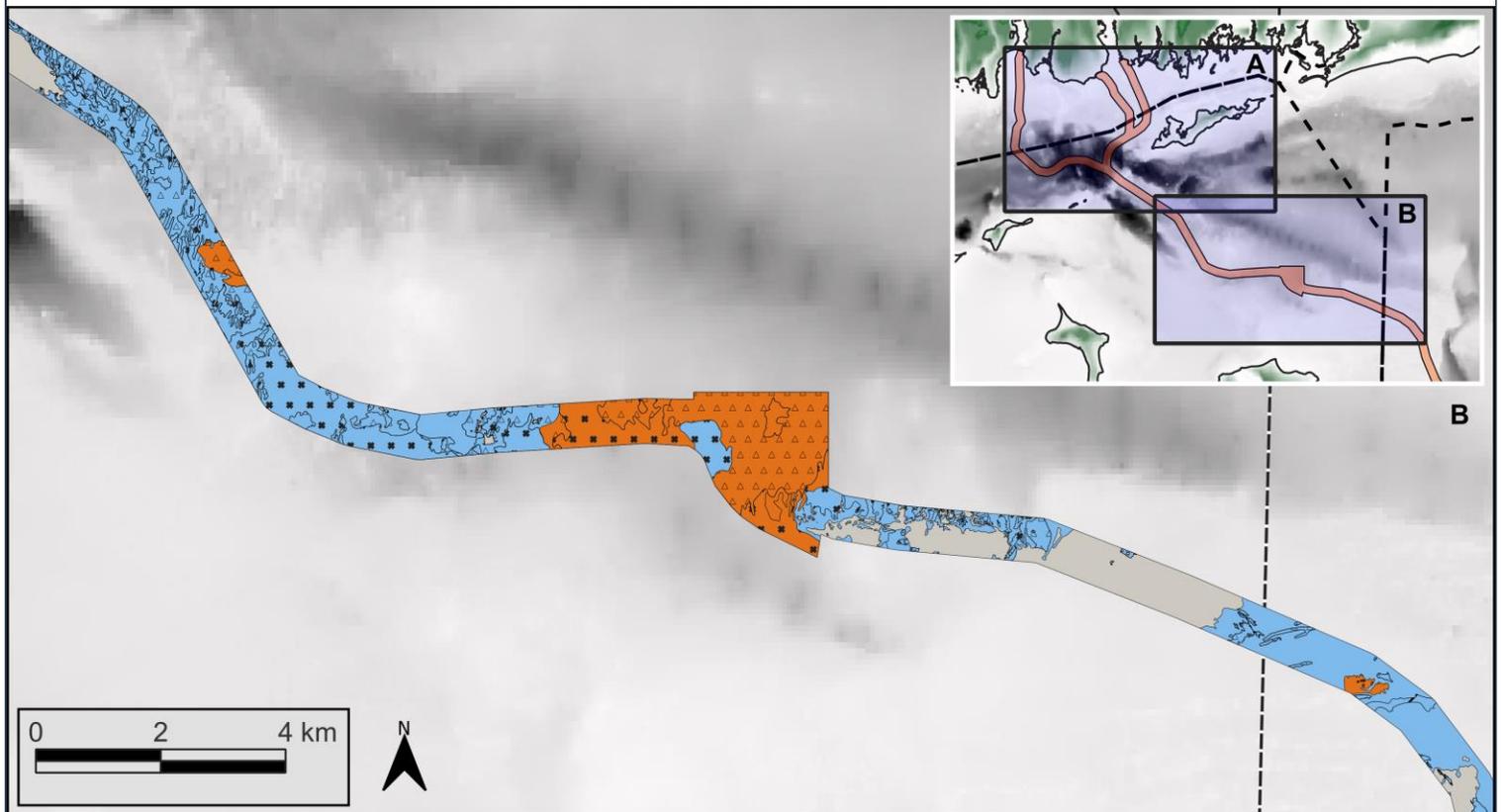
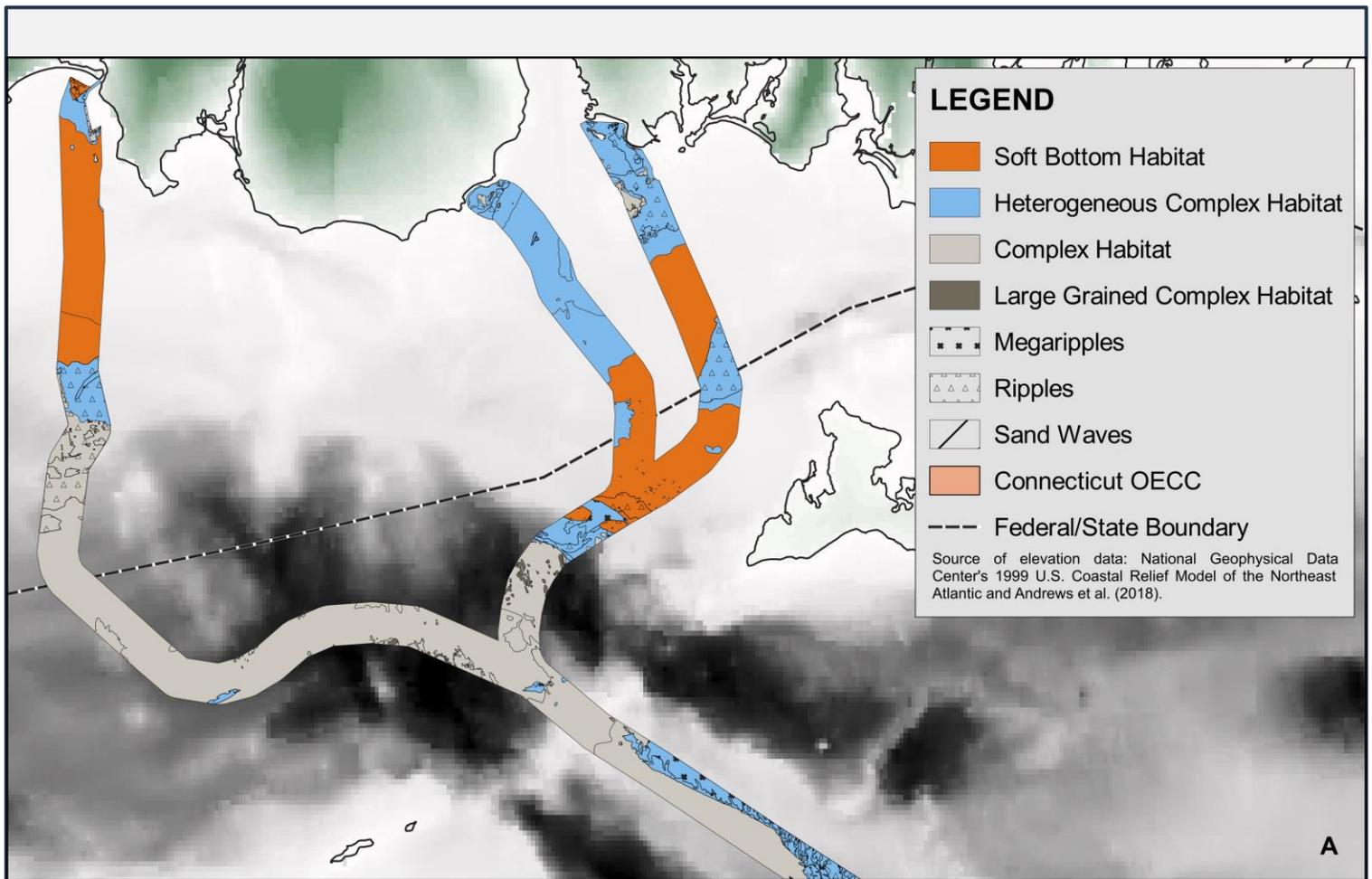


Figure 5.2-6b
 NMFS Habitat Mapping Connecticut OECC Nearshore

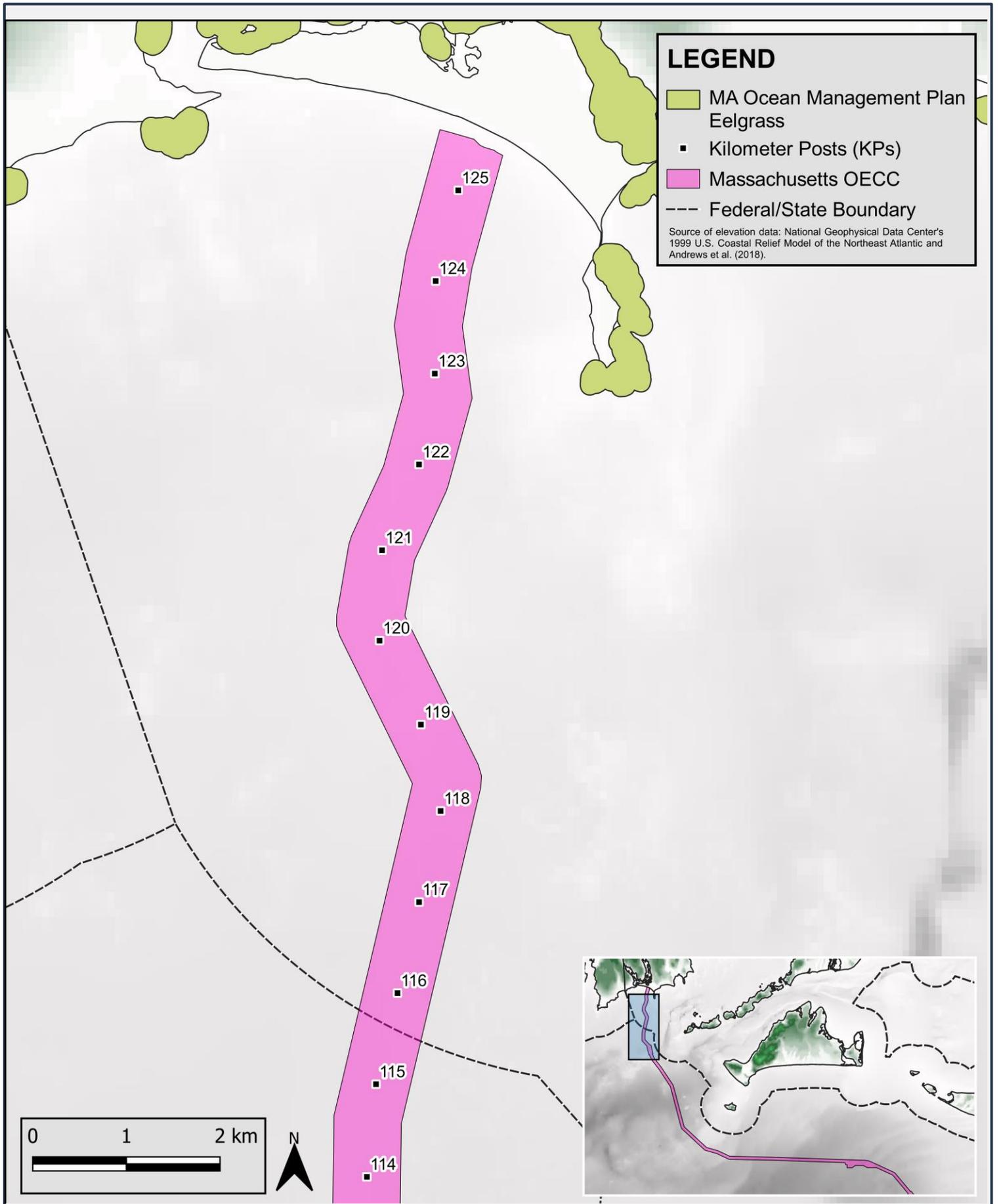


Figure 5.2-7

Massachusetts State Water SSUs Submerged Aquatic Vegetation



**VINEYARD
NORTHEAST**

VINEYARD OFFSHORE

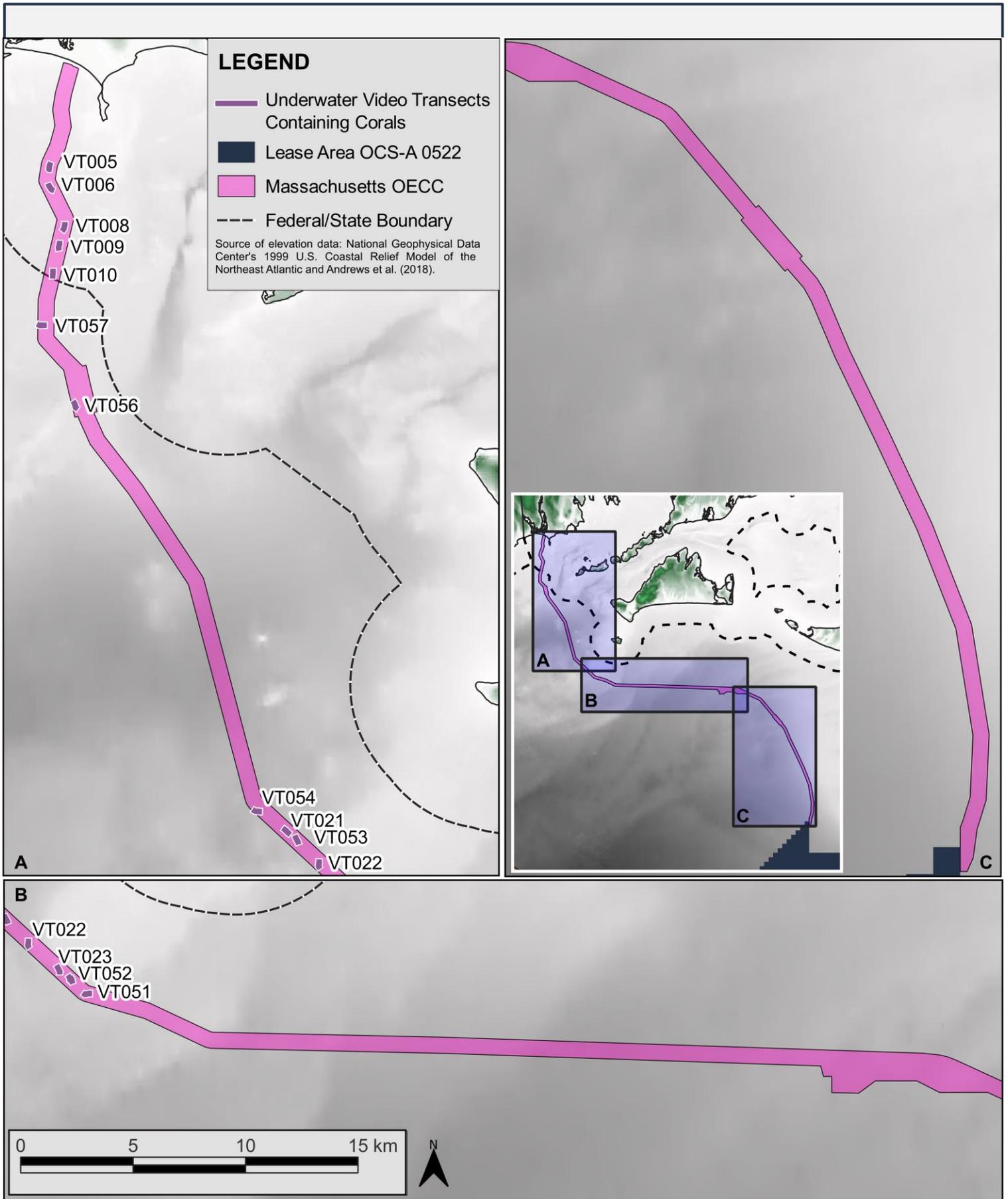


Figure 5.2-8

Massachusetts OECC Corals Detected in 2022 Field Survey



**VINEYARD
NORTHEAST**

VINEYARD OFFSHORE

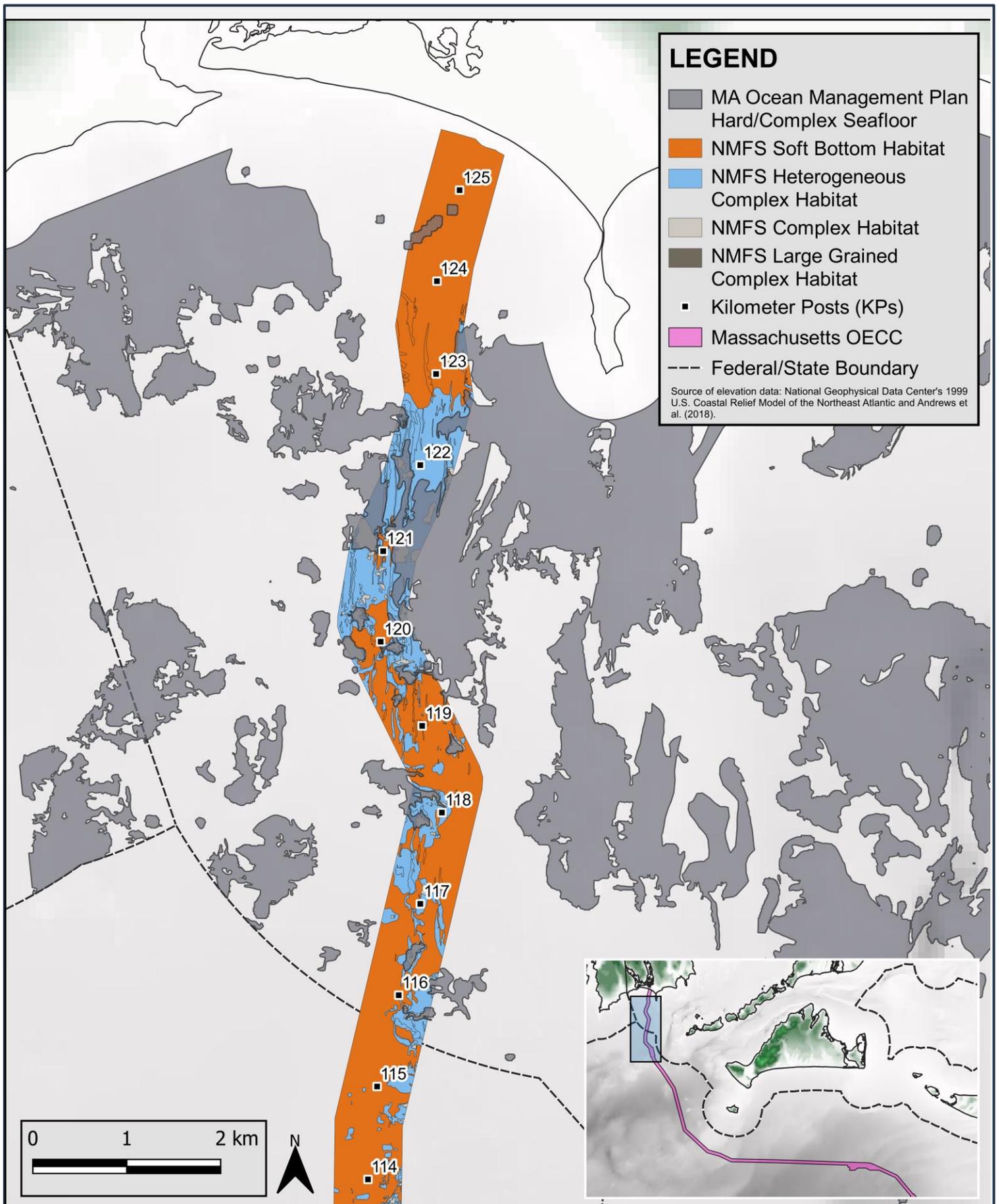


Figure 5.2-9

Massachusetts State Water SSUs Hard Bottom Compared to NMFS Habitat Classifications



**VINEYARD
NORTHEAST**

VINEYARD OFFSHORE

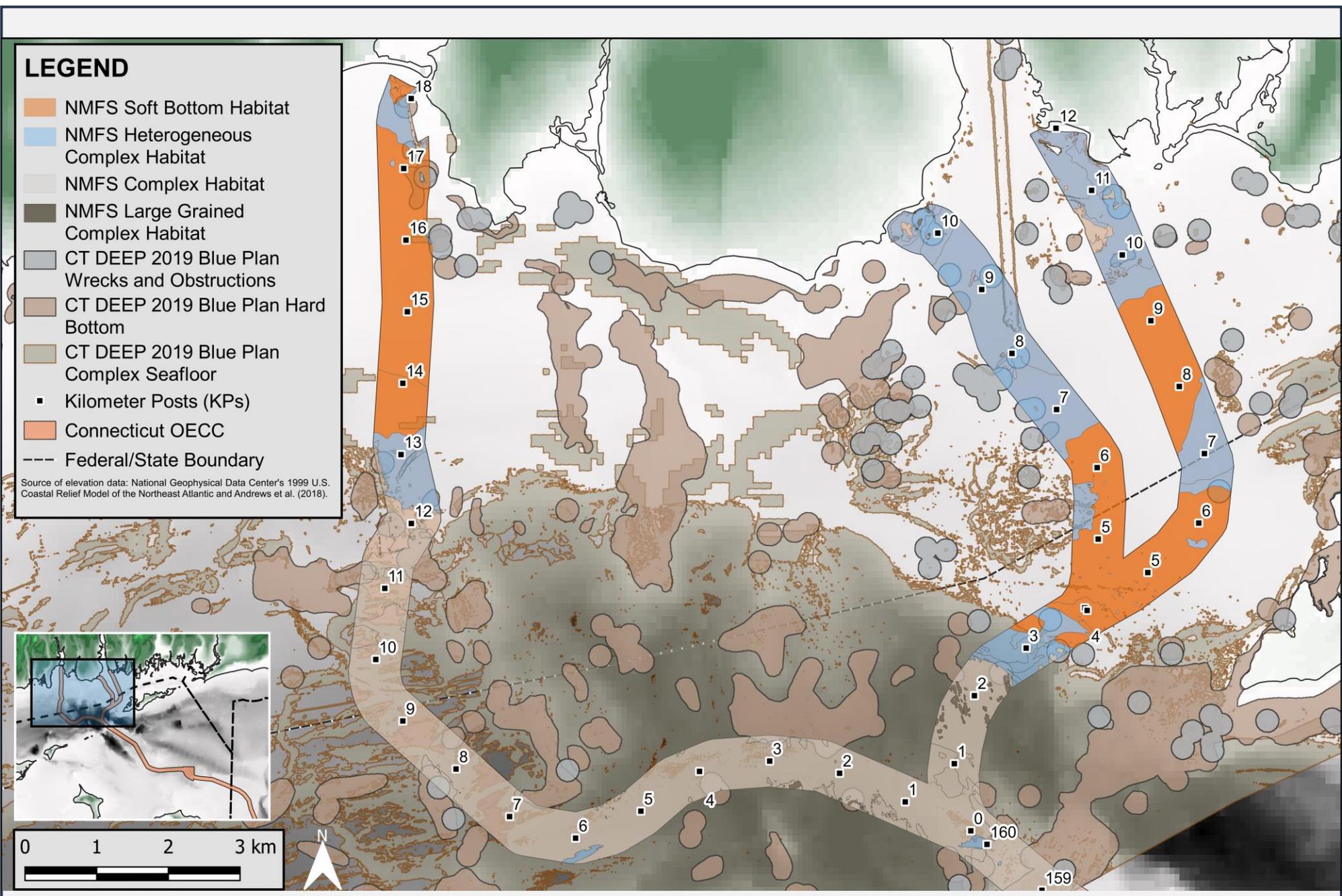


Figure 5.2-10

Connecticut State Water ESAs Hard Bottom, Complex Seafloor, and Wrecks Compared to NMFS Habitat Classification

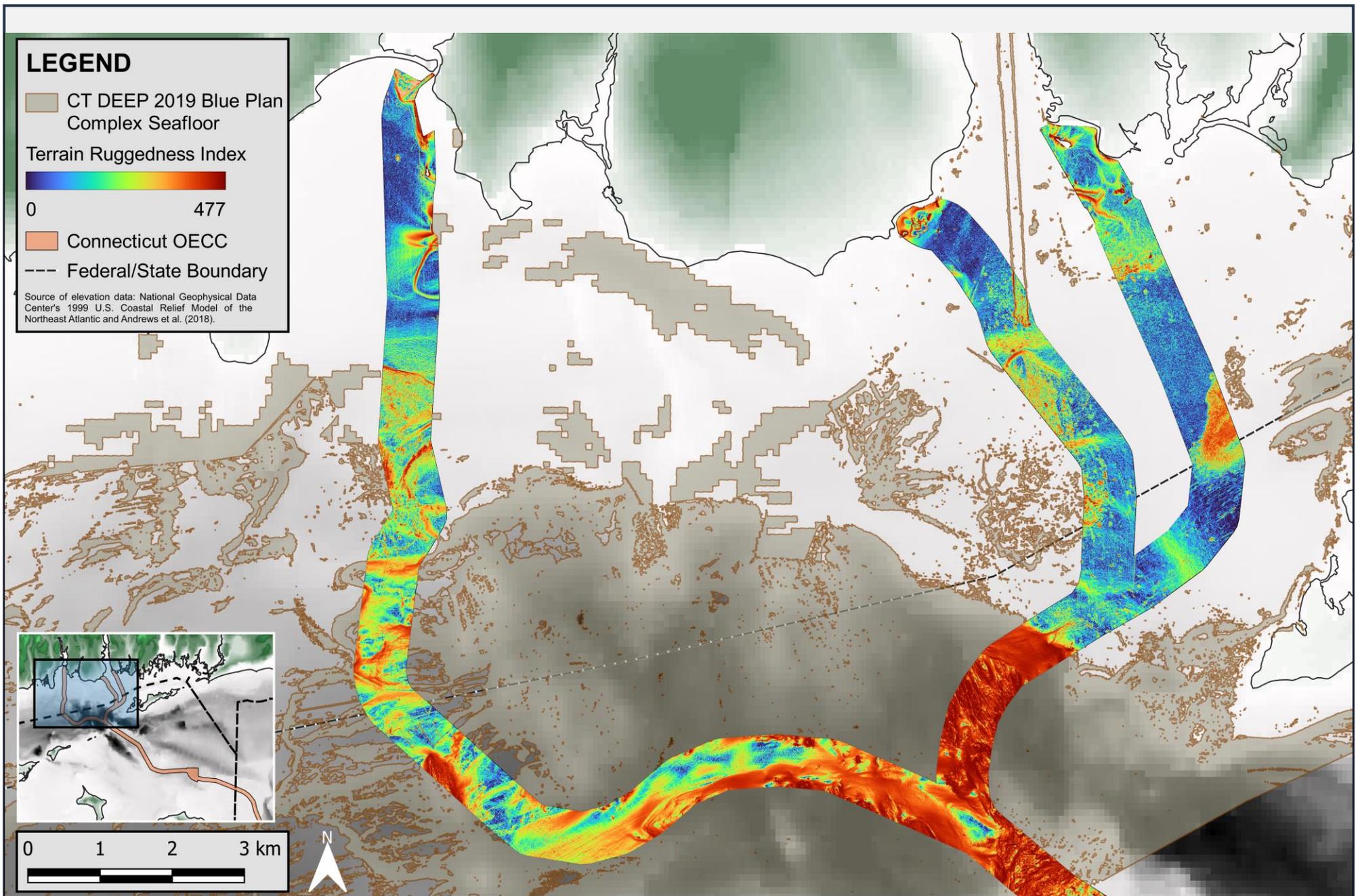


Figure 5.2-11

Connecticut State Water ESAs Complex Seafloor Compared to Terrain Ruggedness Index

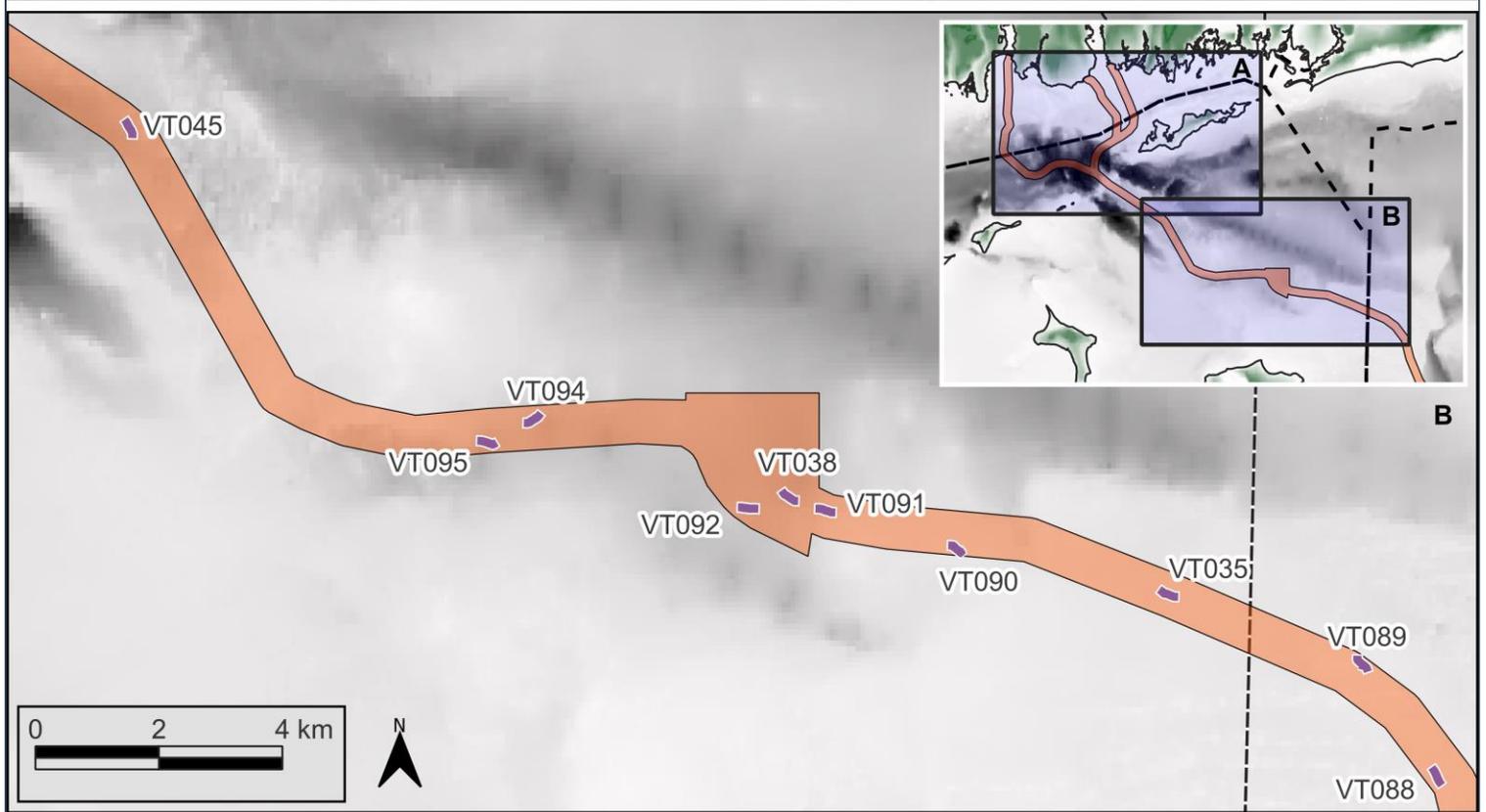
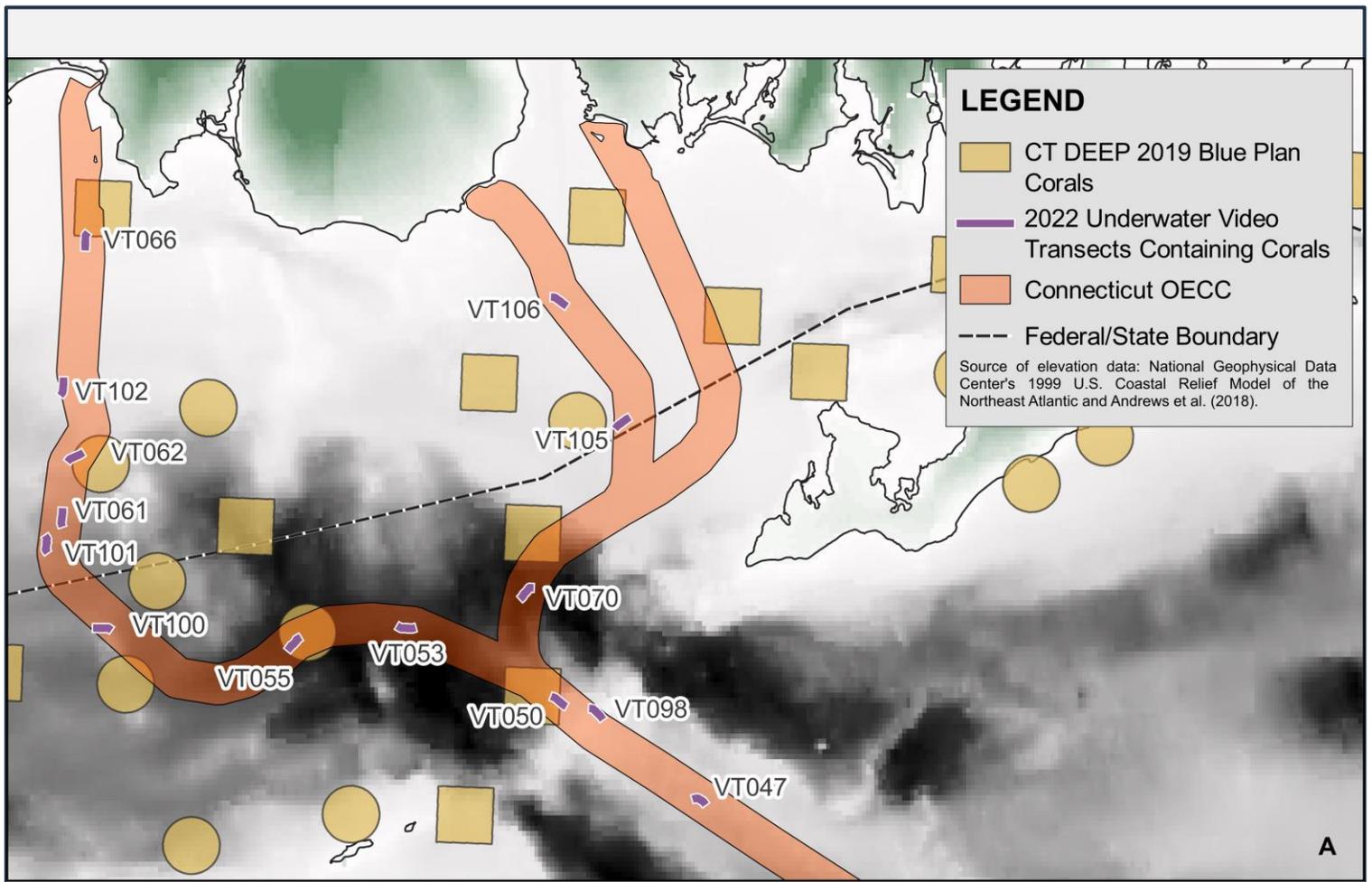


Figure 5.2-12
 Connecticut State Water ESAs Corals Compared to Corals Detected in 2022 Field Survey

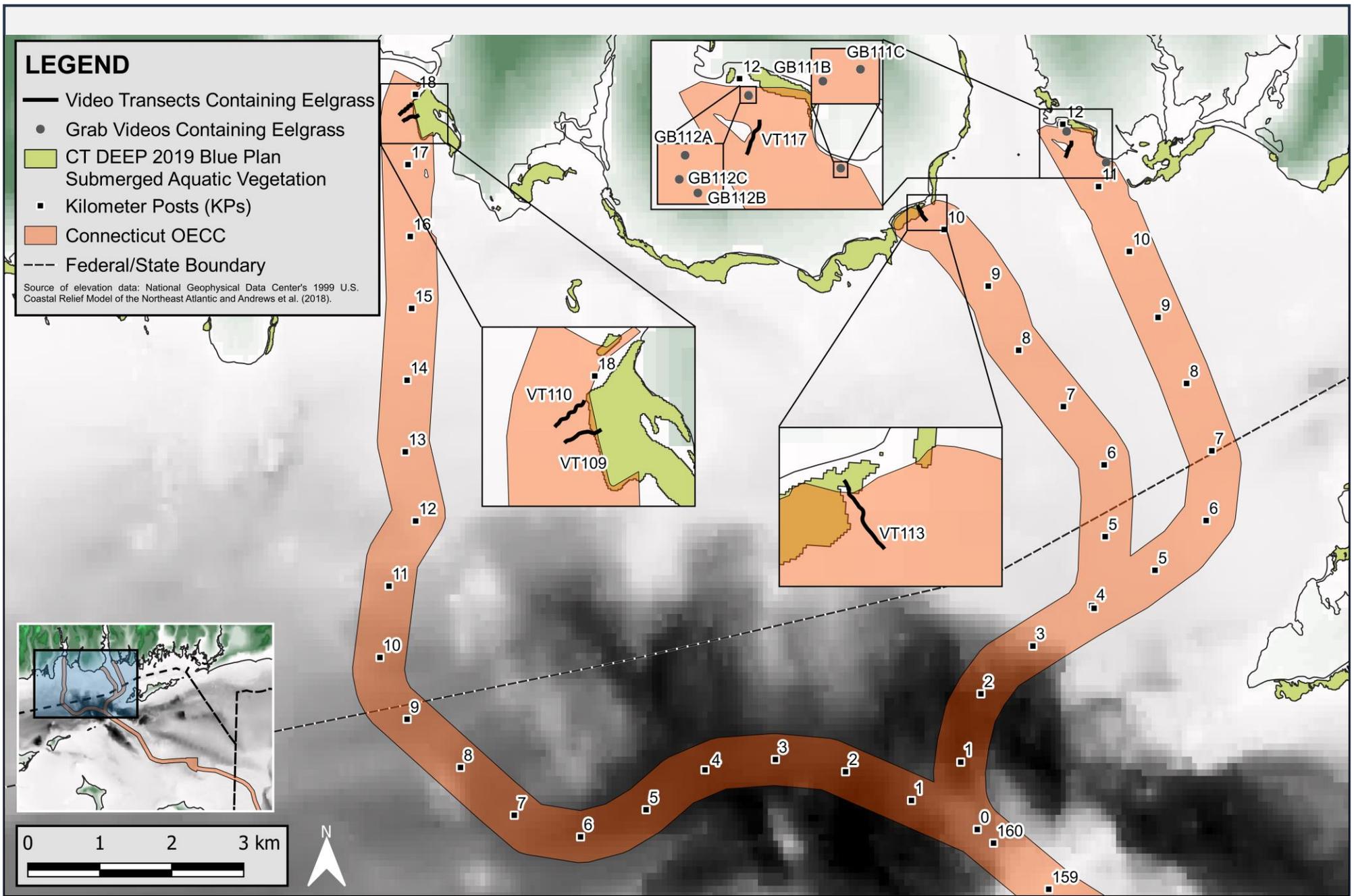


Figure 5.2-13

Connecticut State Water ESAs Submerged Aquatic Vegetation Compared to Eelgrass Detected in 2022 Field Survey

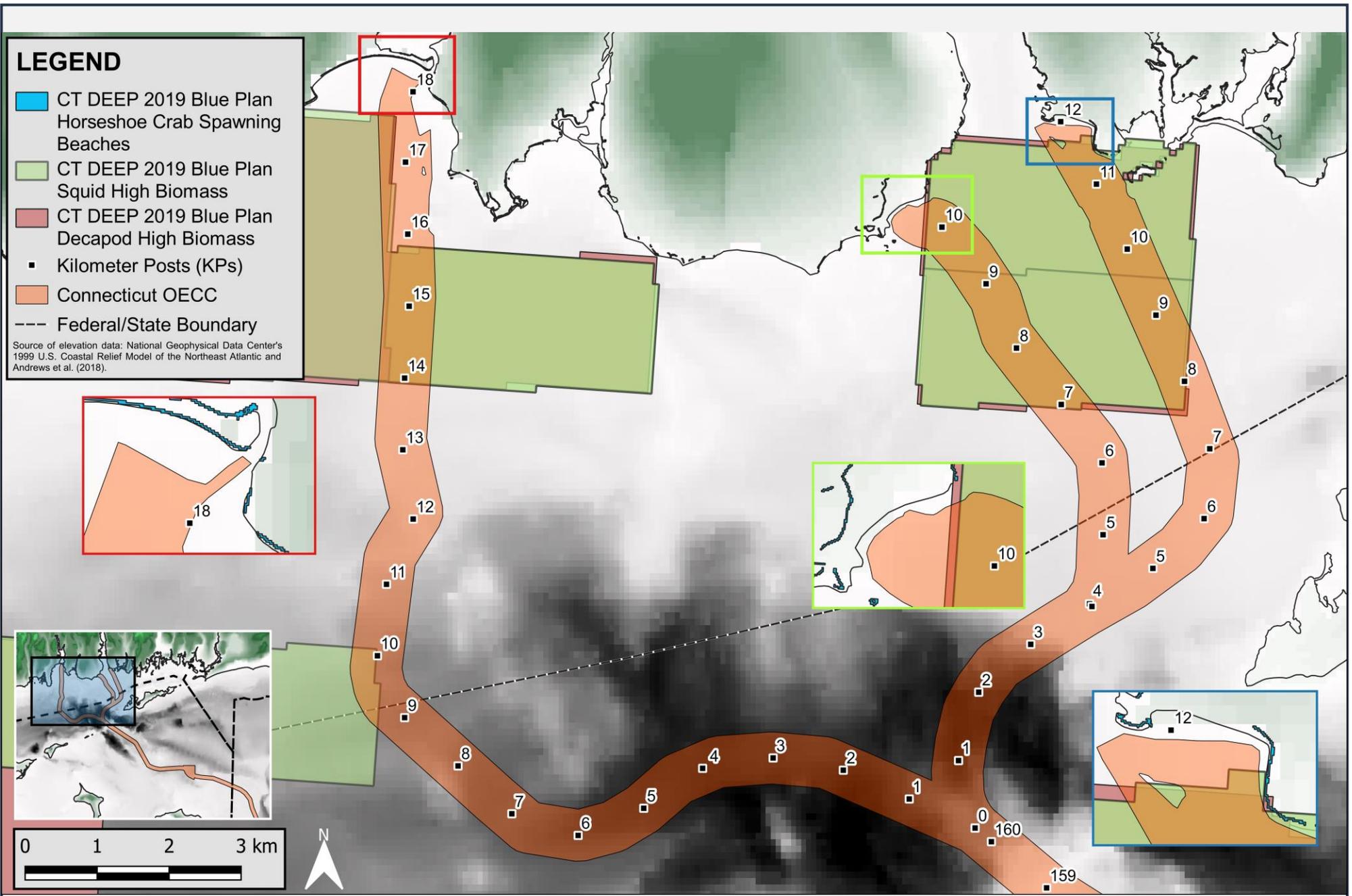


Figure 5.2-14
Connecticut State Water ESAs Mobile Invertebrates

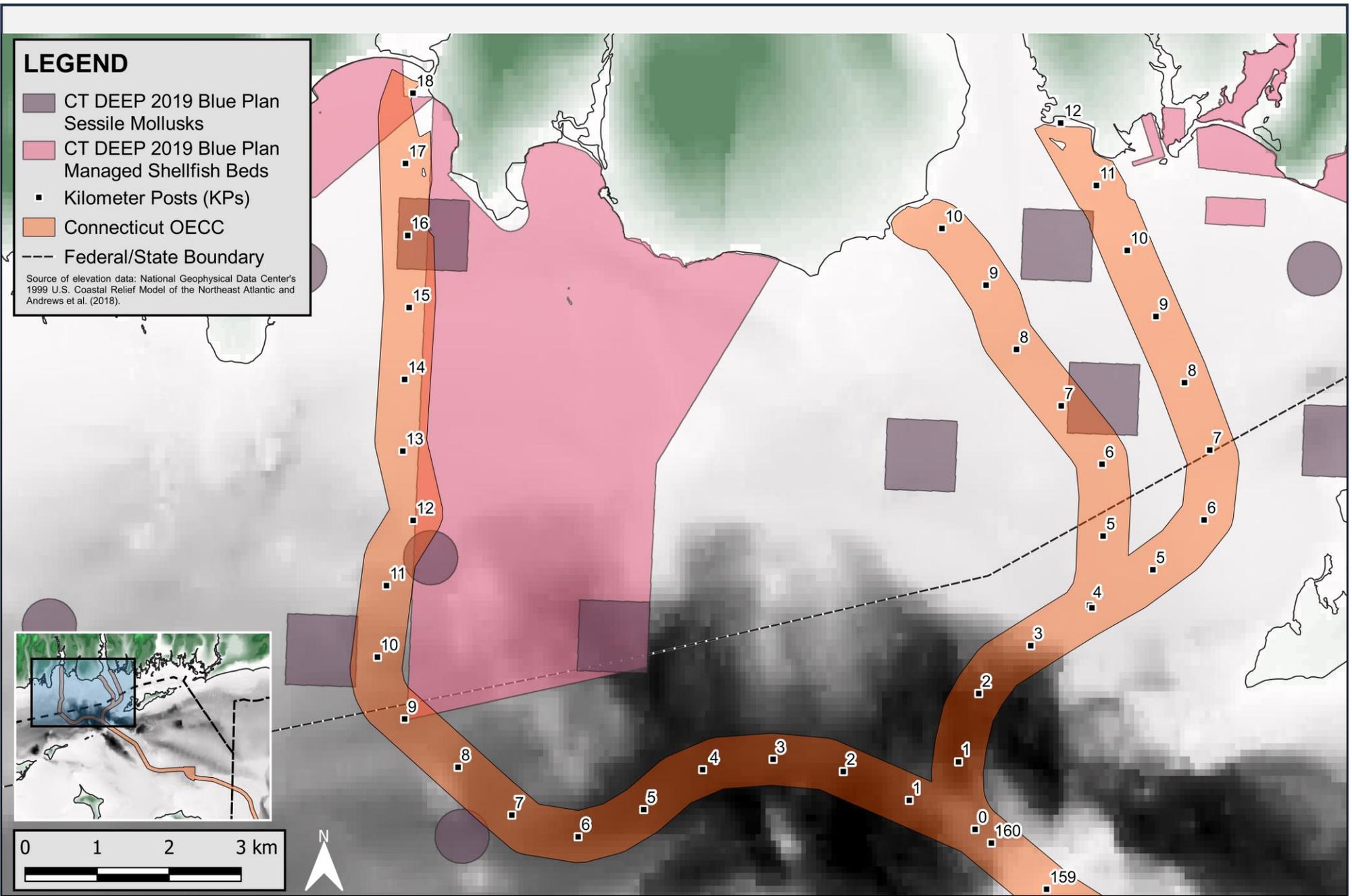


Figure 5.2-15
Connecticut State Water ESAs Mollusks Shellfish

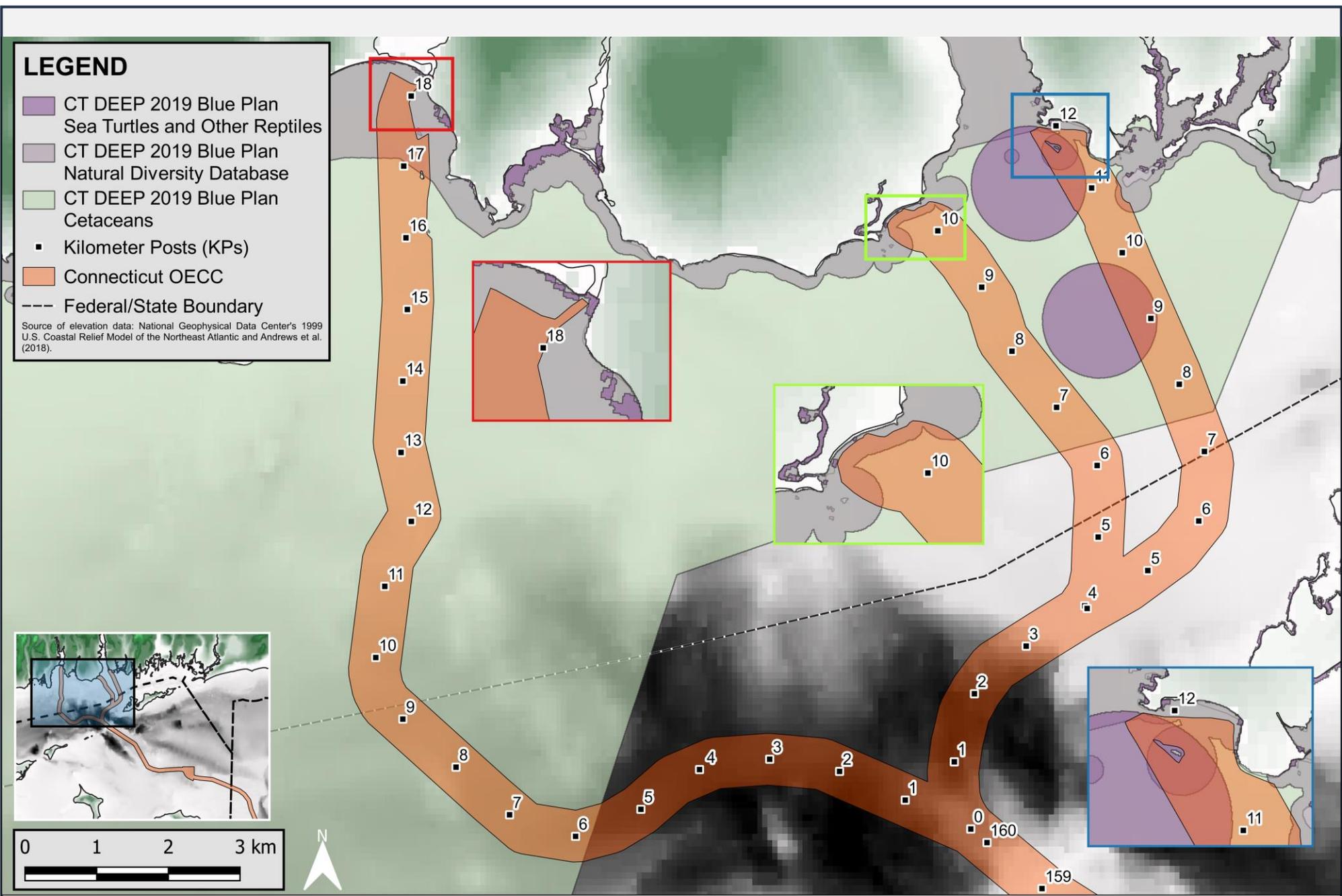


Figure 5.2-16
Connecticut State Water ESAs Cetaceans, Turtles, and Natural Diversity