Biological Information for Use in Management Decisions Concerning Offshore Platform Decommissioning

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VERSAR

Project Team

Principal Investigators

- Dr. Jon H. Vølstad (Versar) Project Manager (now at Institute of Marine Research, Bergen, Norway)
- Dr. Bill Richkus (Versar) Senior Review
- Dr. Gerald Ault (U. of Miami) Technical Lead – GOM Natural Reefs
- Dr. James Cowan (LSU) – Technical Lead – GOM Artificial Reefs
- Dr. Benny Gallaway (LGL) – Technical Lead – GOM Ecosystem
- Dr. Kenneth Rose (LSU) – Technical Lead – Fisheries Population Dynamics
- Dr. Milton Love (UCSB) – Project Technical Review
- Dr. Daniel Sheehy (Aquabio) – Non-Indigenous Species and Project Technical Review
- Dr. Ed Weber (Versar) Technical Lead, Literature Synthesis (now at Southwest Fisheries Science Center, NOAA, La Jolla, California)

Background

- More than 4,000 structures in the GOM
- Provide one of the largest artificial reef complexes in the world
- Lease agreements require complete removal when production ends
- Removals will outpace new construction in the coming decades

Background

- Some rigs are left in place as part of Rigs-to-Reefs programs.
- Objective was to indentify and synthesize information that may contribute to understanding the potential consequences to the GOM ecosystem of removal of structures.

Team Approach

- Compile database of relevant literature.
- Summarize the ecology of platforms from prior synthesis documents and new literature
- Review information to assess feasibility of alternative approaches for evaluating ecological consequences of structure removal
- Review issues relating to non-indigenous species and GOM structures
- Identify gaps in the state of knowledge, and identify research needed to address such gaps.

Previous Work

Substantial existing literature synthesis base, e.g.,

- Sonnier et al. 1976
- Gallaway et al. 1981
- Continental Shelf Associates 1982
- Stanley and Wilson 1997
- Stanley and Scarborough-Bull 2003 – AFS Symposium

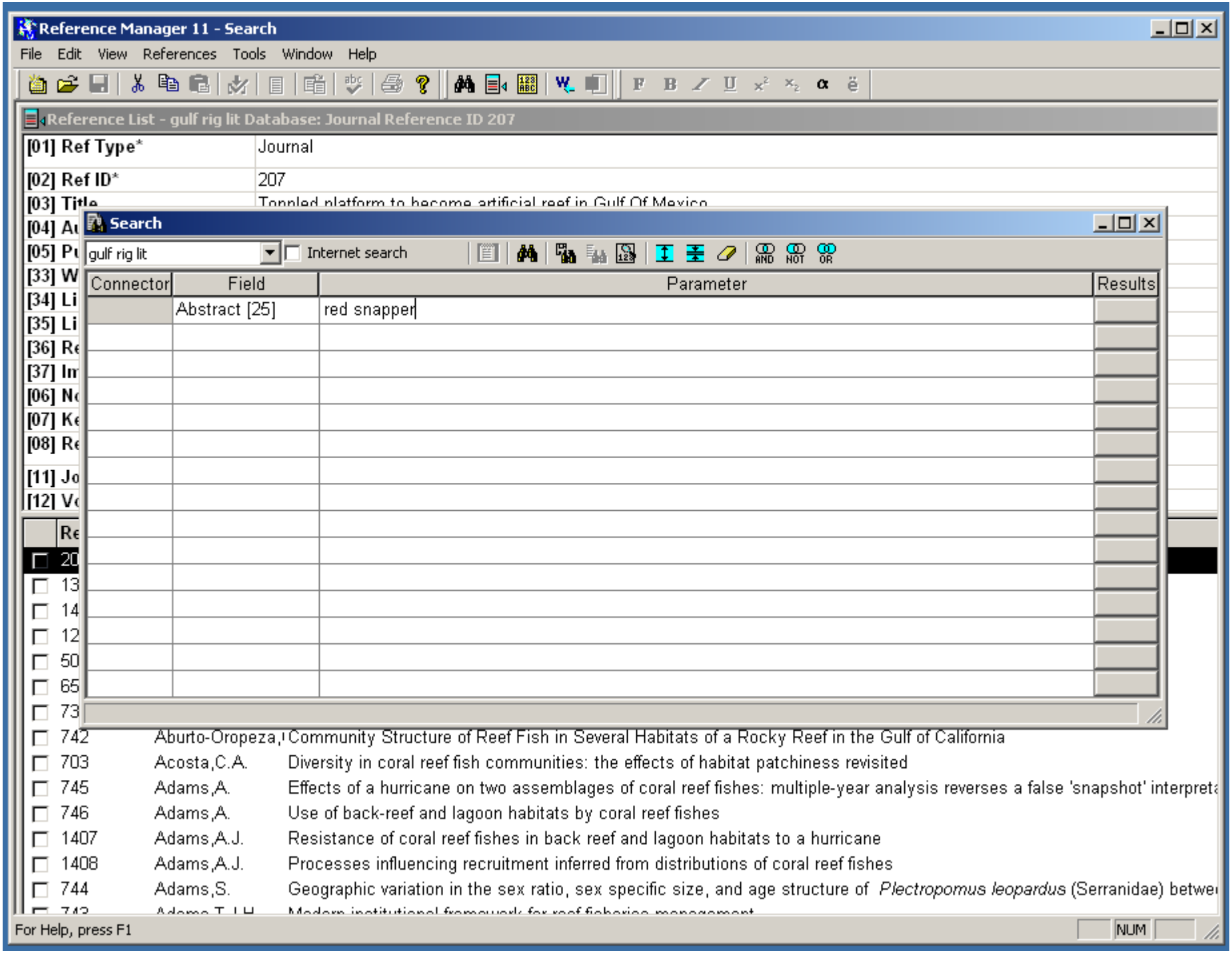
Literature Database – Sources

- ISI Web of Science® keyword searches on “artificial reef”, “reef”, “oil platform”, “gas platform”, “petroleum platform”, “rig”, and “Gulf of Mexico.” Results were screened for relevancy
- MMS Environmental Studies Program Information System web page (http://www.gomr.mms.gov/homepg/espis/espisfront.asp), and various NOAA web sites.
- Thesis and dissertation searches at Auburn University, Georgia Institute of Technology, Louisiana State University, Texas Agricultural and Mechanical University, the University of Houston, the University of Louisiana at Lafayette, and the University of Southern Alabama.
- Extensive literature library at Louisiana State University
- Literature that team members were aware of based on professional experience and networking with other researchers

Literature Database

Subject	Number of References*
Directly related to platforms in the Gulf of Mexico	87
Directly related to platforms elsewhere	46
Related to artificial reefs in the Gulf of Mexico	35
Related to artificial reefs elsewhere	197
Related to natural reefs in the Gulf of Mexico	13
Related to natural reefs elsewhere	522
Total references in bibliography able to review	877
Total references in bibliography	1177

*Some papers refer to multiple categories and thus are counted multiple times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[02] Ref ID* 207
[03] Title Toppled platform to become artificial reef in Gulf Of Mexico
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Abstract [25] red snapper
742 Aburto-Oropeza,I Community Structure of Reef Fish in Several Habitats of a Rocky Reef in the Gulf of California
703 Acosta,C.A. Diversity in coral reef fish communities: the effects of habitat patchiness revisited
745 Adams,A. Effects of a hurricane on two assemblages of coral reef fishes: multiple-year analysis reverses a false 'snapshot' interpreta
746 Adams,A. Use of back-reef and lagoon habitats by coral reef fishes
1407 Adams,A.J. Resistance of coral reef fishes in back reef and lagoon habitats to a hurricane
1408 Adams,A.J. Processes influencing recruitment inferred from distributions of coral reef fishes
744 Adams,S. Geographic variation in the sex ratio, sex specific size, and age structure of Plectropomus leopardus (Serranidae) betwe
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Reference List - gulf rig lit Database: Report Reference ID 1284

[01] Ref Type*	Report
[02] Ref ID*	1284
[03] Title	Ecological Effects of Energy Development on Reef Fish of the Flower Garden Banks.
[04] Authors	Boland,G.S.; Gallaway,B.J.; Baker,J.J.; Lewbel,G.S.;
[05] Pub Date*	/ /1983 **Other**
[33] Web/URL	http://www.esm.versar.com/esm/Gulf_Rigs_Papers/LGL_Report_1983.pdf
[34] Link To PDF	
[35] Link to Full-text	
[36] Related Links	

Ref ID	Authors	Title
1284	Boland,G.S.	Ecological Effects of Energy Development on Reef Fish of the Flower Garden Banks.
1038	Bortone,S.A.	Factors associated with artificial-reef assemblages
1534	Continental Shelf	Study of the Effect of Oil and Gas Activities on Reef Fish Populations in the Gulf of Me
1064	Culbertson,J.C.	Development of tagging techniques for monitoring fish populations at Texas artificial reefs
8	Fischer,A.J.	Red snapper (*Lutjanus campechanus*) demographic structure in the northern Gulf of Mexico based on spatial patterns in g
1238	Gallaway,B.J.	Delineation of essential habitat for juvenile red snapper in the northwestern Gulf of Mexico
1489	Gallaway,B.J.	Pelagic, reef and demersal fishes, and macro-crustaceans/biofouling communities: Volume II
1456	Gitschlag,G.R.	Estimation of fisheries impacts due to underwater explosives used to sever and salvage oil and gas platforms in the U.S.
1280	McKay,M.J.	Proceedings: Gulf of Mexico fish and fisheries: bringing together new and recent research, October 2000.
1262	Nowling,L.K.	Platform Recruited Reef Fish, Phase I; Do Platforms Provide Habitat that
310	Ouzts,A.C.	Diel feeding patterns of red snapper on artificial reefs in the north-central Gulf of Mexico
84	Patterson,W.F.	Age and growth of red snapper, *Lutjanus campechanus*, from an artificial reef area off Alabama in the northern Gulf of Mex
89	Patterson,W.F.	Movement of tagged red snapper in the northern Gulf of Mexico
1268	Peabody,M.B.	Fidelity of Red Snapper (*Lutjanus campechanus*) to Petroleum Platforms and Artificial Reefs in the Northern Gulf of Mexic
1260	Peabody,M.B.	The Fidelity of Red Snapper (*Lutjanus campechanus*) to Petroleum Paltforms and Artificial Reefs in the Northern Gulf of Mexico
1336	Render,J.H.	Hook-and-line mortality of caught and released red snapper around oil and gas platform structural habitat
1431	Render,J.H.	The life history (age, growth, and reproduction) of red snapper (*Lutjanus campechanus*) and its affinity for oil and gas platf
15	Stanley,D.R.	Effect of hypoxia on the distribution of fishes associated with a petroleum platform off coastal Louisiana
1494	Strelcheck,A.J.	Influence of reef location on artificial-reef fish assemblages in the northcentral Gulf of Mexico
17	Szedlmayer,S.T.	Diet shifts of juvenile red snapper (*Lutjanus compechanus*) with changes in habitat and fish size

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Evaluation Focused on Fish

- Fouling communities would not be present in the absence of structures
- Fish are highest trophic levels potentially affected
- Fish are of greatest social and economic interest

Evaluation Approaches

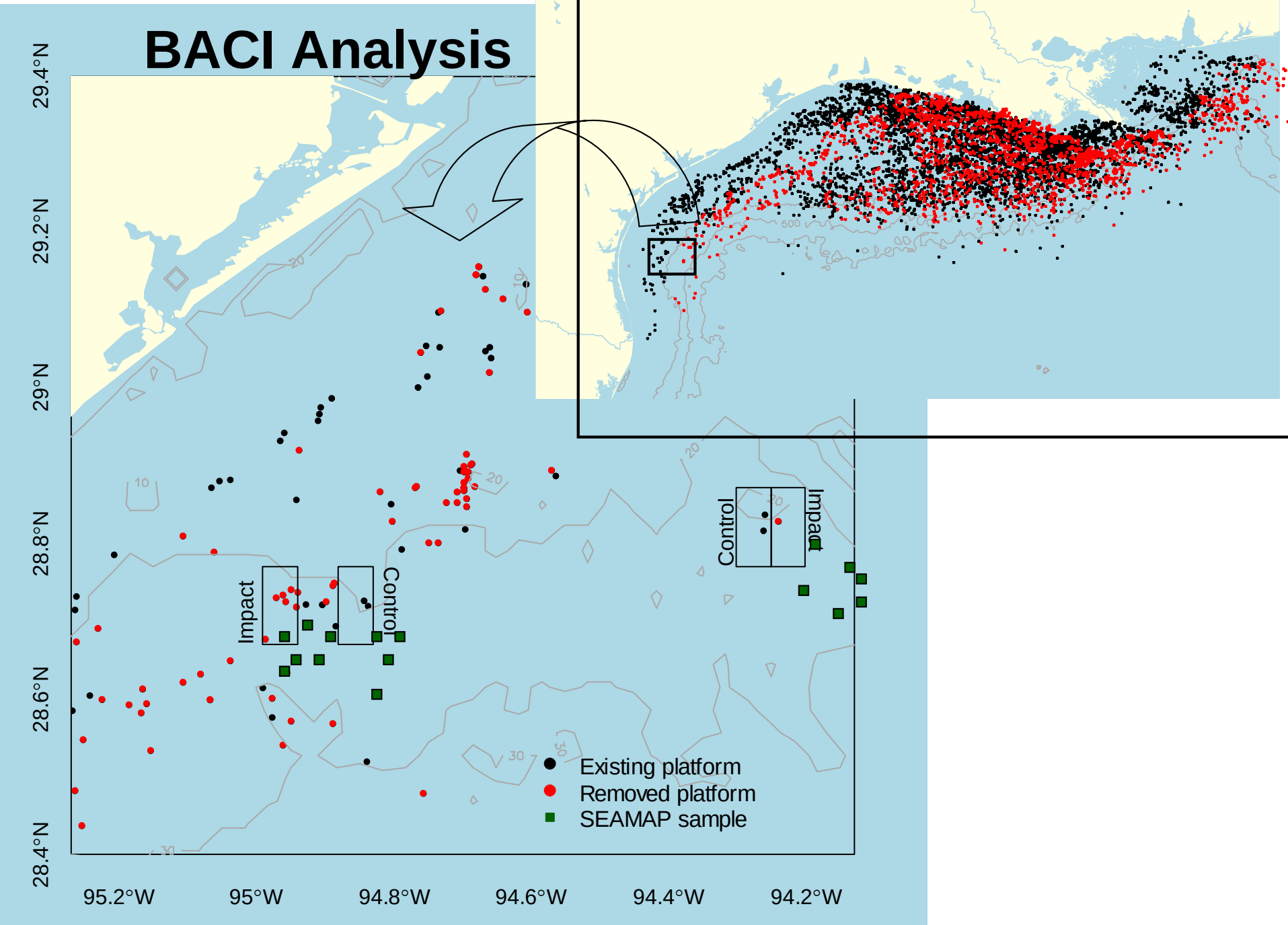
- Assess utility of existing data bases for conducting large scale analyses
- Characterize levels of evaluation that may be possible based on the type of information that is available in the literature

Limitations of Existing Data for Evaluating the Ecological Role of Platforms

- Numerous studies at individual structures or structure groups but generally site- or species-specific
- Few studies at platforms that include valid control data
- No studies specifically designed to evaluate consequences of removal at large scale or on specific species stocks

Potentially Useful Analytical Investigation

- SEMAP program provided a large spatial scale, multi-year data set on fish
- Data spanned locations and periods with and without structures present
- Structured analysis as Before-After-Control-Impact (BACI)


BACI Analysis
29.4°N
29.2°N
29°N
28.8°N
28.6°N
28.4°N
95.2°W
95°W
94.8°W
94.6°W
94.4°W
94.2°W
Impact
Control
Control
Impact
Existing platform
Removed platform
SEAMAP sample

Analysis Was Unsuccessful

- Samples sizes in the vicinity of rigs very small
- Trawl is species- and size-selective
- Non-trawlable bottom near platforms
- Spatial extent of structure effects not known
- No other potentially useful large-scale data sets

Literature Evaluation Approach, Focusing on Fish

Level of evaluation dependent on adequacy of information in the literature

- Level 1 – presence/absence
- Level 2 – process oriented conceptual models (e.g., Bohnsack 1989, Lindberg et al. 2006)
- Level 3 – semi-quantitative conceptual models

  (e.g., Powers et al. 2003)
- Level 4 – quantitative ecosystem and community dynamics models
- **Results of this project element presented at this meeting by Jim Cowan, LSU**

Non-Indigenous Species (NIS) and GOM Structures

- Artificial structures can play a role in establishment and range expansion of NIS
- 15 NIS marine species have been documented in the GOM
- NIS issues could constrain options for use of decommissioned structures

Major Research Needs Identified Through Literature Synthesis

- Platform Ecology and Trophodynamics
  - Diets of structure-oriented fish
  - Influences of structures on primary production
  - Magnitude of passive concentration of plankton and nutrients

Major Research Needs Identified Through Literature Synthesis (cont.)

- Population Vital Rates
  - Recruitment, growth and survival of populations affected and not affected by structures
- Monitoring
  - Statistically sound designs for BACI-type studies for areas in which structure removal is planned

Major Research Needs Identified Through Literature Synthesis (cont.)

- NIS
  - Monitoring for presence of NIS
  - Characterizing vectors of establishment or range expansion
  - Methods of prevention or control
  - NIS risk assessments when considering structure removal and re-use

Project Status

- MMS review comments on draft report received in December
- Project team is in the process of making appropriate revisions
- Final report to be completed early 2009

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Bohnsack, J.A. 1989. Are high densities of fishes at artificial reefs the result of habitat limitation or behavioral preference? Bulletin of Marine Science 44:631–645.

Continental Shelf Associates, Inc. 1982. Study of the effect of oil and gas activities on reef fish populations in the Gulf of Mexico OCS area. Bureau of Land Management Gulf of Mexico OCS Office, New Orleans, LA. OCS Report MMS 1982-36.

Gallaway, B.J., L.R. Martin, R.L. Howard, G.S. Boland, and G.D. Dennis. 1981. Effects on artificial reef and demersal fish and macrocrustacean. In: Middleditch B.S. Environmental Effects of Offshore Oil Production: The Buccaneer Gas and Oil Field Study. New York: Plenum Press. Pp. 237–299.

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Powers, S.P., J.H. Grabowski, C.H. Peterson, and W.J. Lindberg. 2003. Estimating enhancement of fish production by offshore artificial reefs: Uncertainty exhibited by divergent scenarios. Marine Ecology-Progress Series 264:265–277.

Sonnier, F., J. Teerling, and H.D. Hoese. 1976. Observations on the offshore reef and platform fish fauna of Louisiana. Copeia 1:105–111.

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Stanley, D.R. and A. Scarborough-Bull. 2003. Fisheries, reefs, and offshore development. American Fisheries Society Symposium 36. Bethesda, Maryland, U.S.A.

Stanley, D.R. and C.A. Wilson. 1997. Variation in the density and species composition of fishes associated with three petroleum platforms. Coastal Fisheries Institute, Center for Coastal Energy and Environmental Resources, Louisiana State University.