Biological Information for Use in Management Decisions Concerning Offshore Platform Decommissioning

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Project Team

Principal Investigators

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- 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) – Decision Analysis and Project Technical Review
- Dr. Ed Weber (Versar) – Technical Lead, Literature Synthesis

Background

- There are more than 4,000 structures in the GOM.
- They provide one of the largest artificial reef complexes in the world.
- Lease agreements require complete removal when production ends.
- Removals will outpace new construction during the next 10 years.

Background (cont.)

- Some rigs are left in place as part of Rigs-to-Reefs programs.
- MMS would like to know effects of rigs and removals on the northwest GOM ecosystem.

Team Approach

- Compile database of relevant literature.
- Summarize the role of platforms and likely effects of large-scale removal.
- Develop case studies to illustrate assessment approaches.
- Identify gaps in the state of knowledge, and develop potential approaches to addressing such gaps.

Previous Work

Substantial existing literature 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 relevance
- 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
- Literature that team members were aware of based on professional experience and contacts with other researchers

Literature Database

Subject	Number of Reference[1]
Directly related to platforms in the Gulf of Mexico	78
Directly related to platforms elsewhere	38
Related to artificial reefs in the Gulf of Mexico	25
Related to artificial reefs elsewhere	191
Related to natural reefs in the Gulf of Mexico	12
Related to natural reefs elsewhere	519
Total references in bibliography	846

[1]Some papers refer to multiple categories and thus are counted multiple times

Reference Manager 11 - Search

File Edit View References Tools Window Help

Reference List - gulf rig lit Database: Journal Reference ID 207

[01] Ref Type*	Journal
[02] Ref ID*	207
[03] Title	Toppled platform to become artificial reef in Gulf Of Mexico

Search

gulf rig lit — Internet search

Connector	Field	Parameter	Results
	Abstract [25]	red snapper	

742	Aburto-Oropeza,	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

For Help, press F1 NUM

Reference Manager 11 - Reference List - gulf rig lit Database: Report Reference ID 1284

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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	
[37] Image(s)	

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
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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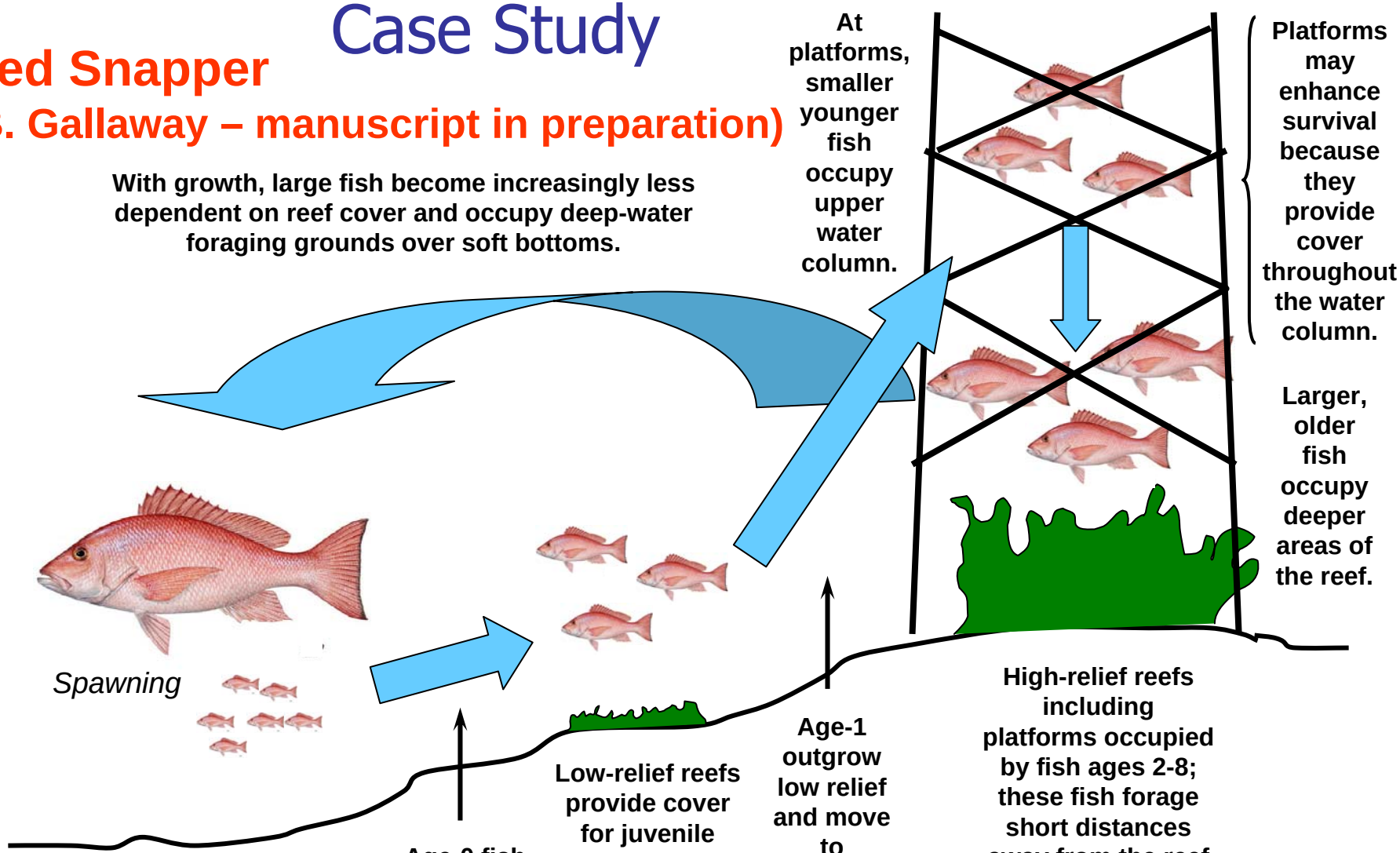
Evaluation Approaches

- Level of evaluation is 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. 1990)
  - Level 3 – semi-quantitative conceptual models (e.g., Powers et al. 2003)
  - Level 4 – quantitative ecosystem and community dynamics models
  - Case studies if feasible (similar to NOAA procedures for EFH identification)

Case Study

Red Snapper
(B. Gallaway – manuscript in preparation)



Evaluation Supported by Compiling Habitat Use Matrix

- By species, reef size/type
  - Presence/absence
  - Seasonal occurrence
    - biomass by time
    - size/age frequency by time
  - Diet
    - by size, season, habitat affinity of prey
  - Vital rates
    - growth
    - mortality
    - production
  - Site fidelity
  - Foraging dynamics
  - Spawning/life history strategy
    - location
    - parental care

Level 1

Level 4

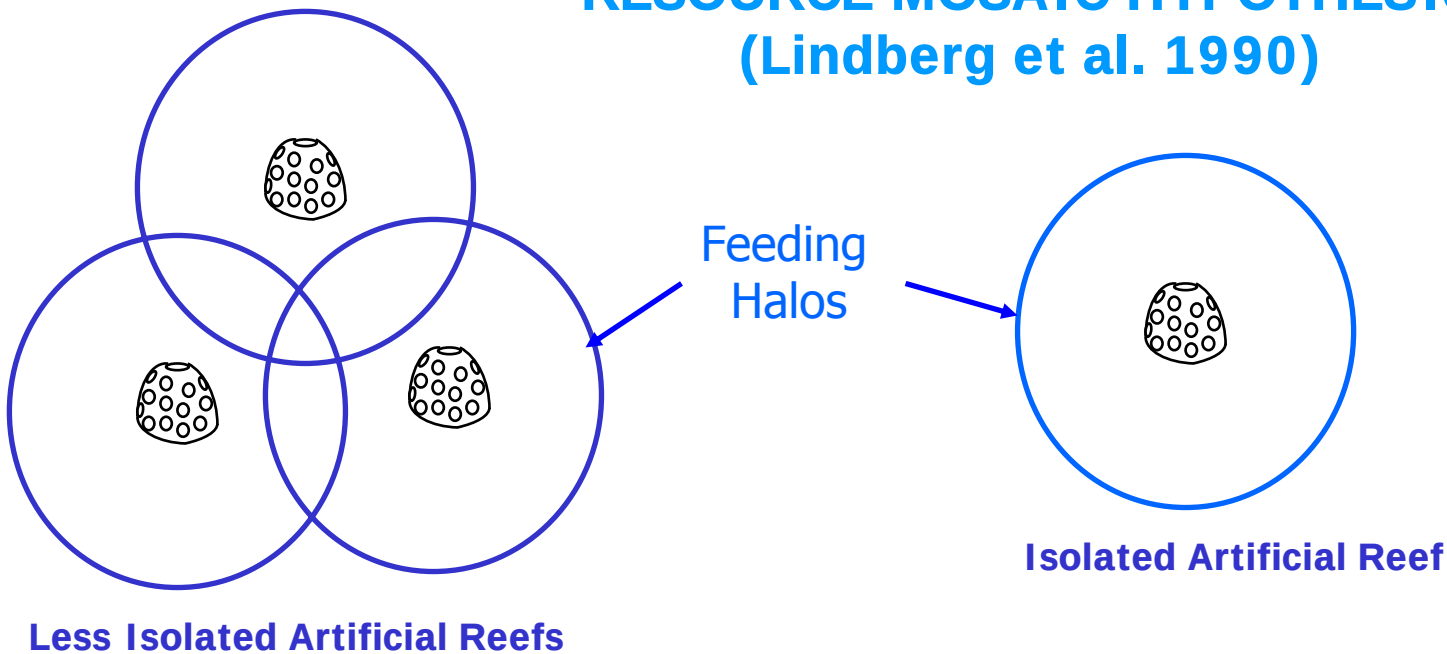
Conceptual Models (Level 2)

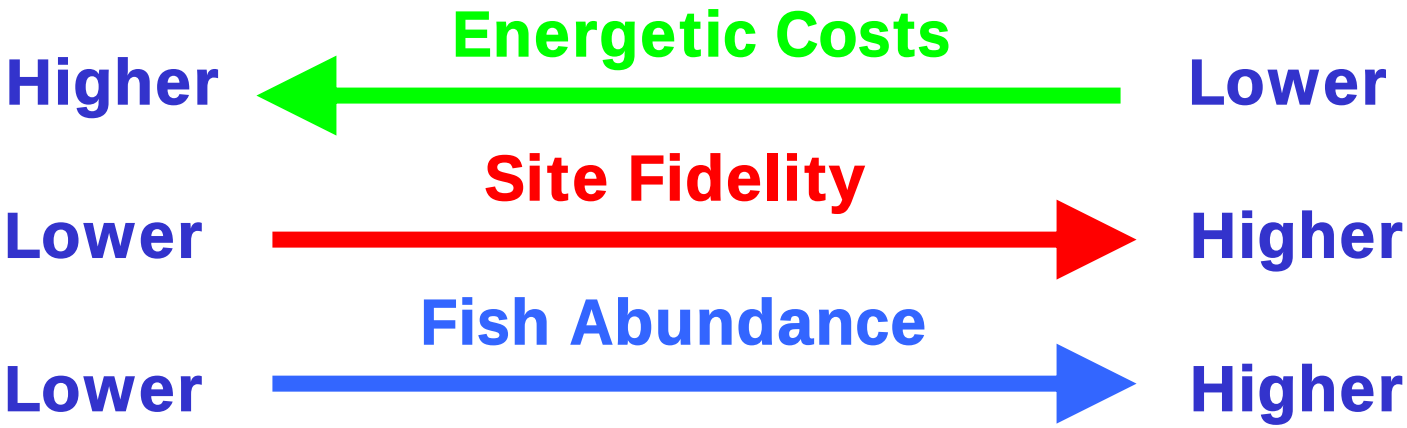
Bohnsack (1989)

Production		Attraction
Obligatory	Reef Dependency	Partial or Opportunistic
Low	Fishing Intensity	High
Low	Reef Availability	High
Habitat limited	Population Control	Recruitment limited
Site Fidelity/Demersal	Behavior	Migratory/midwater

Conceptual Models (Level 2)

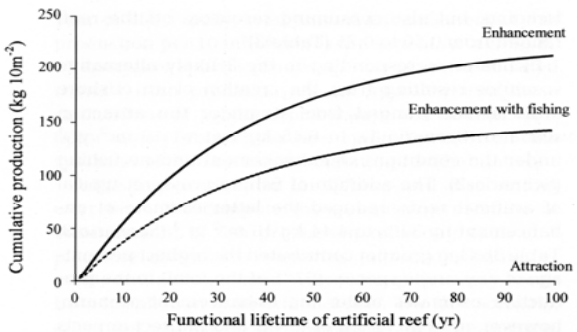
RESOURCE MOSAIC HYPOTHESIS
(Lindberg et al. 1990)





Semi-quantitative Index (Level 3)

- Index of added production (Powers et al. 2003)
- AP = IRE x $\sum (P_i \times N_i)$, where IRE = index of reef exclusivity, based mostly upon diet
  - Some variables are qualitative
  - Describes the relative value of artificial reefs for species under the four scenarios:
    - attraction
    - enhancement
    - enhancement with fishing
    - attraction with fishing

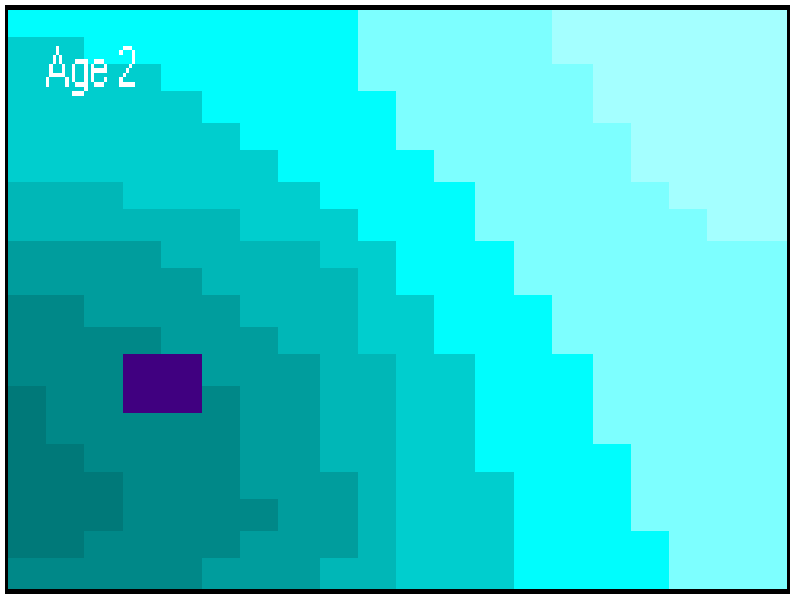


Red snapper foraging dynamics (Level 4)

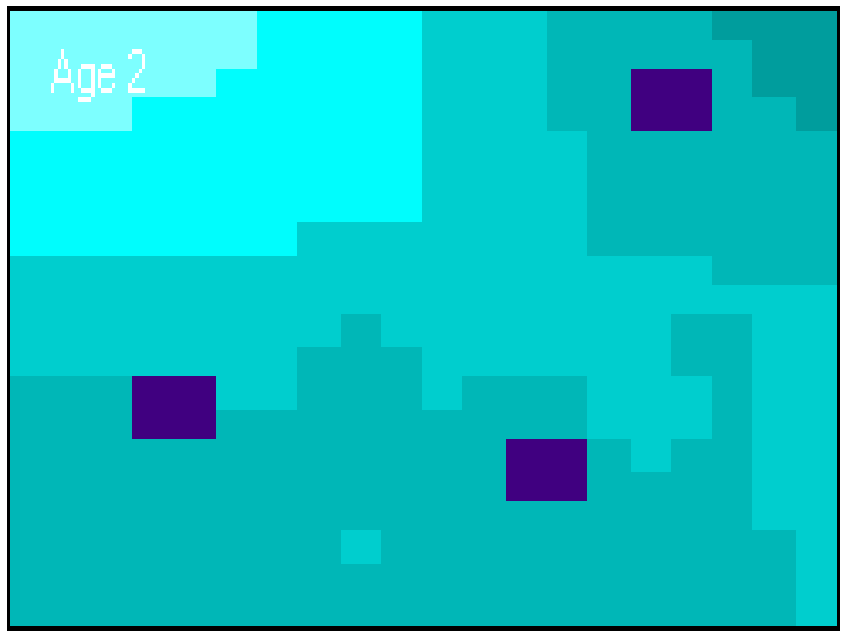
(Shipley, Cowan, Walters and Rose, unpublished)

- Ecopath (mass-balance snapshot from AR)
- Ecosim (simulation over time)
- Ecospace (spatial and temporal simulation)
- Input values from previous research and the Wisconsin Bioen95 model
- Ecospace base map set to be 1 reef km^{-2}
- Calibration model run 20 years, 5 years w/o hurricanes, and 5 years with environmental effects

EwE, Plus Ecospace (Level 4)



Age 2 snapper, 1 reef per km^{-2}



Age 2 snapper, 3 reef per km^{-2}

Dark colors indicate prey depletion

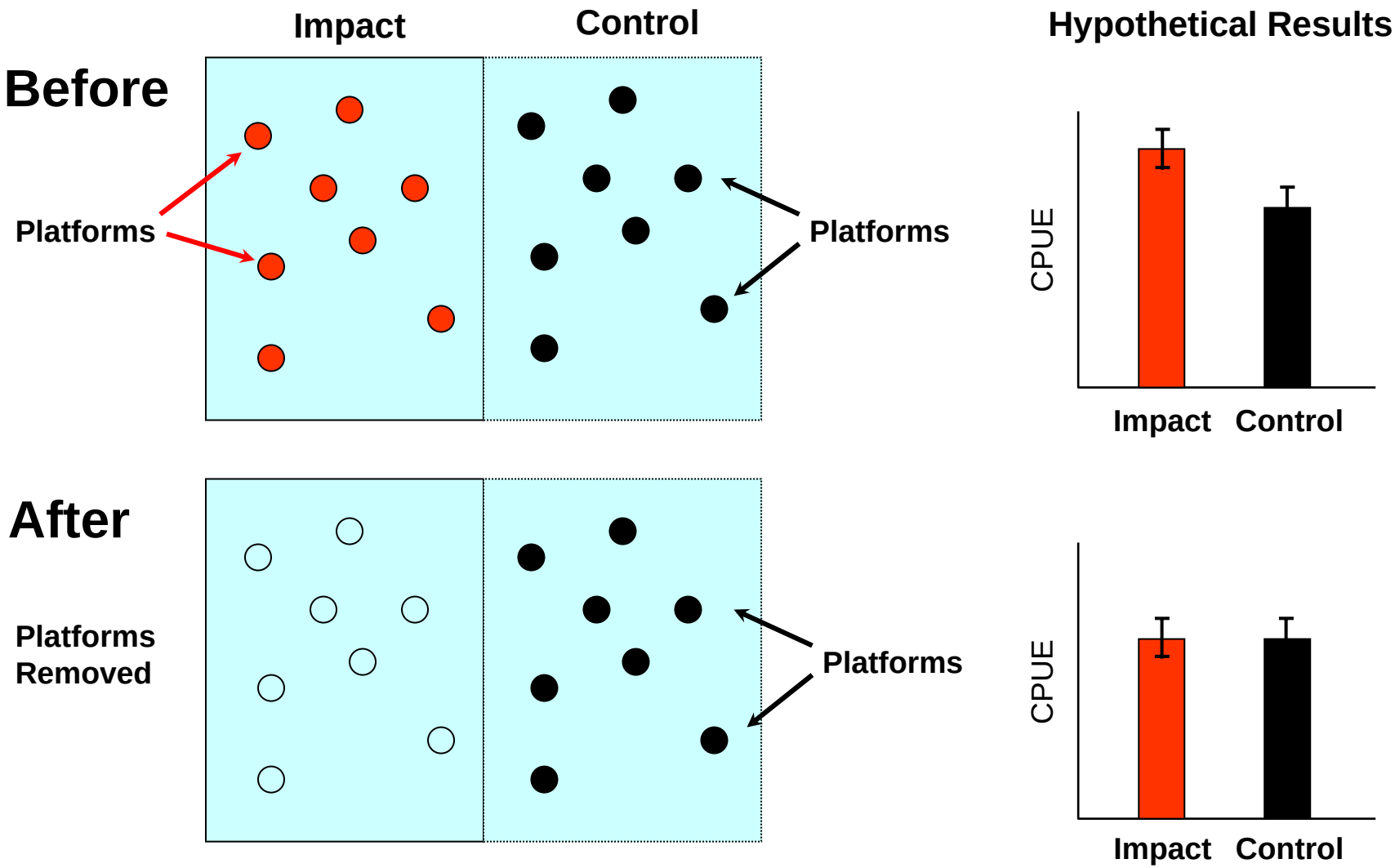
Project Status

- Literature database is nearly complete.
- Project team is assessing the adequacy of data for representative species at each level of evaluation.
- Project team is evaluating approaches to study design and future research to address gaps in the literature.

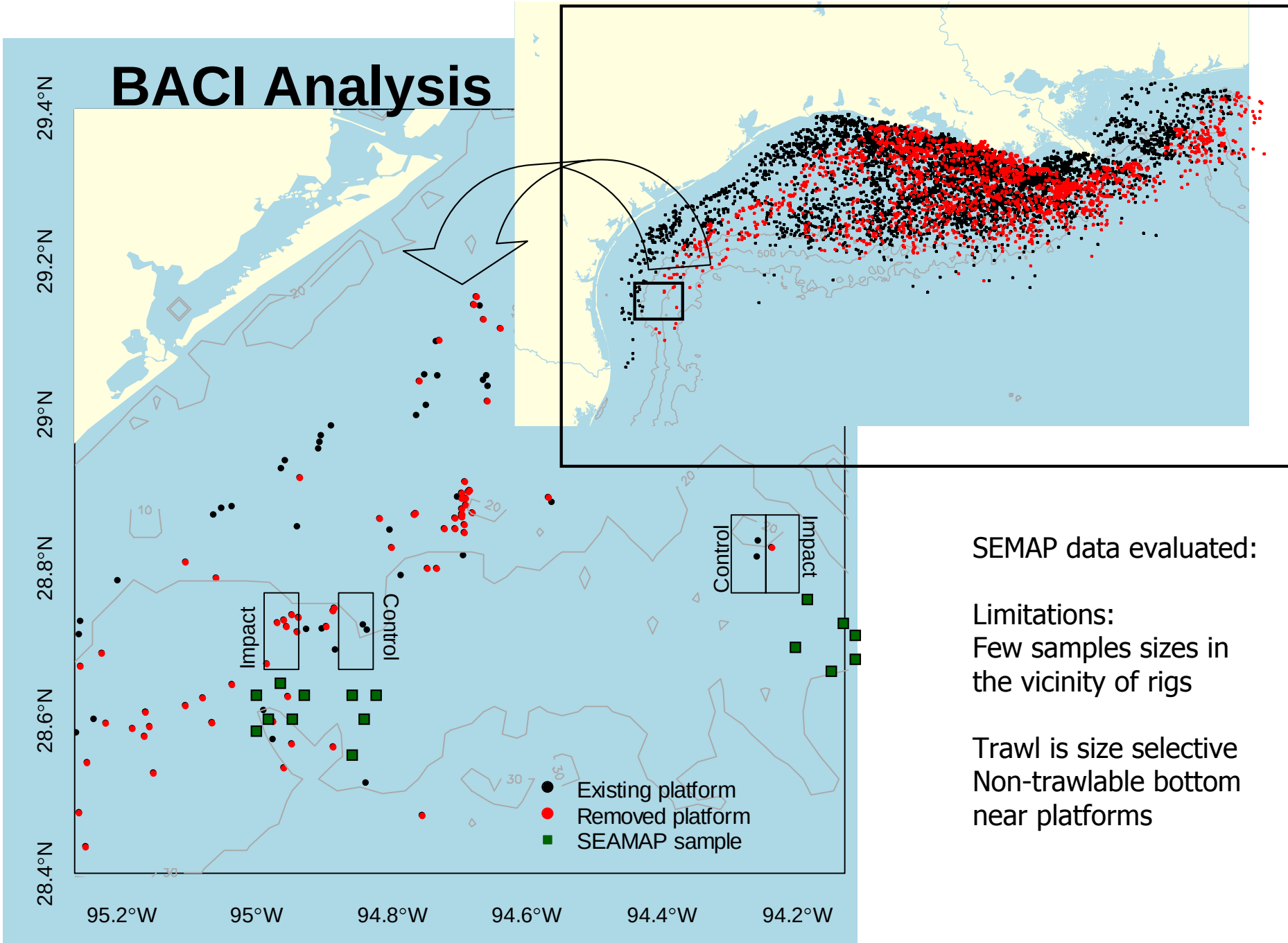
Some Limitations of Existing Information for Evaluating the Ecological Role of Platforms

- Few studies at platforms include control data.
- Ecological studies could be strengthened by applying an experimental design such as 'BACI.'
  - Select study and control sites before platform removals.
  - Collect data before and after removals.
  - Consider available data and decommissioning plans in study design.

Principles of BACI Analysis



BACI Analysis



SEMAP data evaluated:

Limitations:
Few samples sizes in the vicinity of rigs

Trawl is size selective
Non-trawlable bottom near platforms

Acknowledgments

- Ms. Jodi Dew and Beth Franks (Versar) helped compile literature and implemented the Reference Manager Database

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