2015 FLORIDA ARTIFICIAL REEF SUMMIT

CLEARWATER BEACH, FL

JANUARY 13–16, 2015

Sea Grant Florida

UF | IFAS Extension UNIVERSITY of FLORIDA

ABSTRACTS & PROGRAM

#FLARSUMMIT2015

Navigating Expectations and Charting Objectives

Welcome to the 2015 Florida Artificial Reef Summit! On behalf of the steering committee, we are excited to welcome back our friends and colleagues from the artificial reef community. We last met in 2010 in Cocoa Beach and this year's Summit marks the 9th time the program has been offered since 1979.

With over 2,900 planned public artificial reefs placed off its 1,357 miles of coastline, Florida manages one of the most diverse and most active artificial reef programs in the United States. The Summit provides a critical opportunity for the Florida Fish and Wildlife Conservation Commission Artificial Reef Program and Florida Sea Grant to disperse high-quality information, experience, and program goals and objectives directly with all of Florida's artificial reef stakeholders.

The Summit steering committee has been working hard over the past year to put together a first rate program for you. We chose the theme *Navigating Expectations and Charting Objectives* to reflect on the diverse perspectives of artificial reef use in Florida as well as discuss what it takes to responsibly plan for, design, manage, and evaluate a comprehensive artificial reef program in the Sunshine State. Throughout the Summit participants will be referred to a series of overarching ***guiding questions*** **(located on the inside back cover of this booklet)** that touch on a number of broad ecological, economic and social concepts associated with Florida's artificial reef program. We hope you find these questions useful when reflecting on the information presented during the Summit.

We thank you for taking time out of your busy schedule to attend this year's Summit. Your participation is what makes this such a great event. We hope you find the presentations, panel discussions, posters, and networking opportunities worthwhile. As always, a special thank you goes out to all of our awesome sponsors who make this event possible. Please make sure to stop by their booths, say hello, and check out what services and/or products they have to offer.

Have a fantastic Summit!

Bryan Fluech & Joy Hazell, Florida Sea Grant
Keith Mille, Florida Fish and Wildlife Conservation Commission

This publication was supported by the National Sea Grant College Program of the United States Department of Commerce's National Oceanic and Atmospheric Administration under NOAA Grant # NA06OAR4170014.
The views expressed herein do not necessarily reflect the views of any of these organizations.

Online copies are available at the Florida Sea Grant website, www.flseagrant.org.

January 2015
TP 212

2015 Florida Artificial Reef Summit Agenda
Clearwater Beach Marriot on Sand Key
Clearwater Beach, Fla.

Tuesday, January 13, 2015

1:00 Afternoon Optional Field Trips
Option 1: Clearwater Marine Aquarium Group Tour (2 hours)
Option 2: Chartered Dive Trips to Pinellas County Artificial Reefs (4 hours)
Steering Committee Planning Meeting

Wednesday, January 14, 2015

10:00 Morning Optional Field Trip
Pinellas County Artificial Reef Staging Area Tour (1 hour)

12:00 Check in and poster set-up

1:00 **Summit Welcoming Remarks**

1:15 **Current Perspectives on Artificial Reefs Session: Invited Speakers**
Moderator: Bryan Fluech, Florida Sea Grant

International and National Perspectives on Artificial Reefs
Steve Bortone, Osprey Aquatic Sciences, Inc.
1:45 Gulf of Mexico Perspectives
Brooke Shipley-Lozano, Texas Parks and Wildlife Department
2:00 South and Mid-Atlantic Perspectives
Erik Zlokovitz, Maryland Department of Natural Resources
2:15 State of Florida Perspectives
Jon Dodrill, FWC Division of Marine Fisheries Management

2:40 BREAK

3:10 **Florida County Perspectives, by Region**
Moderator: Keith Mille, Florida Fish and Wildlife Conservation Commission

- Northeast Florida (Nassau – Volusia), *Joe Nolin, Volusia County*
- East-Central Florida (Brevard – Martin), *James Gray, Indian River County*
- Southeast Florida (Palm Beach – Monroe), *Sara Thanner, Miami-Dade County*
- Southwest Florida (Pinellas – Collier), *Chris D'Arco, Collier County*
- Big Bend of Florida (Franklin – Pasco), *Geoff Wallat, Taylor County*
- Northwest Florida (Escambia – Gulf), *Robert Turpin, Escambia County*

5:00 ADJOURN

5:45 FWC Lionfish Control Program and Demo, *Meaghan Faletti, FWC*
6:00 Poster Session and Evening Networking Social

Thursday, January 15, 2015

8:30am **Welcome and Announcements**

8:35 **Rapporteur Synopsis of Day 1**
Steve Bortone, Osprey Aquatic Sciences, Inc.

8:50 **Human Dimensions Session: Contributing Speakers**
Moderator: Joonghyun "Cheetos" Hwang, FWC-FWRI

Nautical Charting of Artificial Reefs
Paul Gionis, National Oceanic and Atmospheric Administration

9:05 Enhancement of Artificial Reef Management in Tampa Bay
Laura Thorne, Environmental Protection Commission of Hillsborough County

9:20 If You Build It, Will They Come? Publicizing Reefs and Distributing Coordinates in a Digital Age
Travis Griggs, StrikeLines Custom Fishing Charts

9:35 **Human Dimensions Session: Invited Speakers**
Moderator: Chuck Adams, Florida Sea Grant

Artificial Reefs Branding and Marketing: Why and How?
Mike Campbell, Lee County DNR

9:50 BREAK

10:20 Boat Visitation Rates from Acoustic Detections on Paired Artificial-Natural Reefs on the West Florida Shelf
Peter Simard, University of South Florida, College of Marine Science

10:35 Measuring Florida Artificial Reef Economic Benefits: A Synthesis
Bill Huth, University of West Florida

11:00 **Ecological Applications Session: Contributing Speakers**
Moderator: Betty Staugler, Florida Sea Grant

Invasive Lionfish on Panhandle Artificial Reefs: Trends, Effects and Potential Mitigation Measures
Kristen Dahl, University of South Alabama and Dauphin Island Sea Lab

11:15 Comparison of Food Webs Among Limestone Boulder Artificial Reefs, Natural Reefs and Soft Bottom
Amy Hirons, Nova Southeastern University, Oceanographic Center

11:30 Evaluation of Fish Production and Assemblage Similarity Between Artificial and Natural Reefs
Jennifer Granneman, University of South Florida, College of Marine Science

11:45 LUNCH (provided)

1:15 **Ecological Applications Session: Invited Speakers**
Moderator: Pat Quinn, Broward County Environmental Protection & Growth Management

Integrating Basic and Applied Ecology Using Paired Artificial-Natural Reef Systems
Chris Stallings, University of South Florida

1:35 Ecological Function of Northern Gulf of Mexico Artificial Reefs: Comparisons to Natural Reefs
Will Patterson, University of South Alabama and Dauphin Island Sea Lab

1:55 Rationale and Evaluation of an Artificial Reef System Designed for Enhanced Growth and Survival of Juvenile Gag, *Mycteroperca microlepis*
Bill Lindberg, University of Florida, School of Forest Resources and Conservation

2:15 BREAK

2:45 **Panel Discussion of Diverse Perspectives on the Guiding Questions**
Facilitators: Joy Hazell, Bryan Fluech, Holly Abeels, Florida Sea Grant

- Federal & State Fisheries Management Representatives
  Luiz Barbieri, FWC
  Andy Strelcheck, NMFS
- County Reef Managers
  Robert Turpin, Escambia County
  Pat Quinn, Broward County
- Stakeholder Representatives
  Don Roberts, CCA
  Jessica Koelcsh, NWF
- Contractor Representatives
  Dave Walter, Reefmaker and Walter Marine
  Todd Barber, Reef Ball Foundation

5:00 ADJOURN

6:00 Evening Networking: Dinner on your own

Friday, January 16, 2015

8:15	**Welcome and Announcements**
8:20	**Contributed Presentations** *Moderator: Shelly Krueger, Florida Sea Grant*
	Artificial Reef Federal Regulatory Review Process *Beverlee Lawrence, US Army Corps of Engineers*
8:45	Improving State Regulation of Artificial Reefs *Andy May, Florida Department of Environmental Protection*
9:00	If You Build It, Will They Come? Exploring Enhancements to Artificial Structure for Use in Restoration and Mitigation Applications *Kirk Kilfoyle, Nova Southeastern University Oceanographic Center, National Coral Reef Institute*
9:15	The Use of Light Traps to Assess Recruitment of Juvenile Fishes to Artificial and Natural Reefs in Pinellas County, Florida *Monica Lara, St. Petersburg College*
9:30	The Success of Stony Coral Including *Oculina varicosa, Oculina tenella,* and Deepwater Sport Fish Species on Deep Artificial Reefs on the East Coast of Florida *Kerry Dillon, Sea Rover Services & MCAC Reef Fund*
9:45	BREAK
10:15	*Moderator: Libby Carnahan, Florida Sea Grant*
	Mapping and Monitoring Fish and Benthic Recruitment of the Clifton Perry Artificial Reef Complex *Cindy Lott, Florida Department of Environmental Protection*
10:30	Geospatial Analysis of 10 Years of Artificial Reef Monitoring in Martin County *Alexandra Carvalho, CMar Consulting, LLC*
10:45	The State of Florida Artificial Reef Program's Dive Assessment Team: 22 Years of Fish Census Data, 1992 to 2014 *Bill Horn, Florida Fish and Wildlife Conservation Commission (retired)*
11:00	**Rapporteurs' Highlights and Take-Home Messages** *Bill Seaman, Tom Frazer, and Steve Bortone*
11:20	**Audience Conversation with Rapporteurs** *Bill Seaman, Tom Frazer, and Steve Bortone*
12:00	ADJOURN 2015 Florida Artificial Reef Summit

Acronyms

AAUS .....American Academy of Underwater Scientists
ACOE.....Army Corps of Engineers
ADCNR .....Alabama Department of Conservation and Natural Resources
AR.....Artificial Reefs
BC EPCRD .....Broward County Environmental Planning and Community Resilience Division
BOCC.....Board of County Commissioners
CARAHs.....Conferences on Artificial Reefs and Aquatic Habitats
CCA .....Coastal Conservation Association
CSA .....Continental Shelf Associates, Inc.
CSUN.....California State University, Northridge
DNR .....Division of Natural Resources
EPC HC .....Environmental Protection Commission of Hillsborough County
ERP.....Environmental Resource Permitting
FDEP .....Florida Department of Environmental Protection
FDOT .....Florida Department of Transportation
FOS.....Florida Oceanographic Society
FSG.....Florida Sea Grant
FSGE .....Florida Sea Grant Extension
FSU .....Florida State University
FWC.....Florida Fish and Wildlife Conservation Commission
FWC-DMFM.....FWC, Division of Marine Fisheries Management
FWC-FWRI .....FWC, Fish and Wildlife Research Institute
GOM .....Gulf of Mexico
IFAS .....Institute of Food and Agricultural Sciences
JRRT .....Jacksonville Reef Research Team
JOSFC .....Jacksonville Offshore Sport Fishing Club
Lee County DNR ...Division of Natural Resources
MBARA .....Mexico Beach Artificial Reef Association
MCAC Reef Fund ..Martin County Artificial Reef Fund
MCARP .....Martin County Artificial Reef Program
MDC DERM.....Miami-Dade County Department of Environmental Resources Management
NMFS .....National Marine Fisheries Service
NOAA .....National Oceanic Atmospheric Administration
NOAA NMFS.....NOAA National Marine Fisheries Service
NOS .....National Ocean Service
NSU .....Nova Southeastern University
NWF .....National Wildlife Federation
OAR .....Organization for Artificial Reefs
SBEP .....Sarasota Bay Estuary Program
SPC .....St. Petersburg College
SRS .....Sea Rover Services
SWARA .....South Walton Artificial Reef Association
TPWD .....Texas Parks and Wildlife Department
UF .....University of Florida
USA.....University of South Alabama
USACE.....US Army Corps of Engineers
USEPA .....US Environmental Protection Agency
USF .....University of South Florida
UWF.....University of West Florida

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Poster Abstracts

Artificial Reefs: Regional Perspectives

International and National Perspectives on Artificial Reefs

Bortone, S.A.

Osprey Aquatic Sciences, Inc.

In 1974, artificial reef researchers organized the first International Conference on Artificial Reefs on March 20-22, 1974 in Houston, Texas to "…to provide an international forum for the exchange of information, experiences and thoughts among persons involved with or interested in any aspect of artificial reef research, construction or use." (Clark et al., 1974:3). Since that time, and spurred by pioneering programs in Japan, artificial reef efforts in the USA have helped lead the world in virtually all facets of artificial reef activity, including design and placement to further enhance fisheries and the economic development of coastal communities. More recently, and largely owing to the international CARAHs (Conferences on Artificial Reefs and Aquatic Habitats), artificial reef program improvements have become truly integrative and multidisciplinary. This improved perspective has led to an overall increase in the sophistication of programs and projects that have a scientifically rigorous, hypothesis-based approach. Major developments helping to improve international and national artificial reef programs include: the development of goal/objective-specific reef projects, an increase in sophistication in sampling methodology, and a universal appreciation of the role that artificial reefs can play in environmental and fisheries management. Future artificial reef efforts are likely to focus on life-history based, species-specific goals and objectives of fisheries management.

The implementation of international and national data bases of artificial reef projects with clearly defined metadata and the establishment of "reef standards," along with continuing cooperative agency and institutional interactions, will go far toward fully resolving the long-standing issues facing artificial reef programs.

Gulf of Mexico Regional Perspectives

Shipley-Lozano, B.

Texas Parks and Wildlife Department

The Texas Artificial Reef Program is managed by the Texas Parks and Wildlife Department (TPWD). Currently, there are 72 permitted reef sites that cover over 4,550 acres of substrate. Of the 72 permitted reef sites, 52 have water depths conducive to the reefing of oil and gas platforms. Within the Artificial Reef Program there are three programs: Nearshore Reefs, Ships to Reefs, and Rigs to Reefs. The Rigs to Reefs program is the primary source of artificial reef material. To date there are over 143 platform donations, plus other oil and gas components in Texas artificial reef sites. Further, the Rigs to Reefs program has contributed over $24.8 million to the Texas Artificial Reef Fund. Recently, the Rigs to Reefs program has suffered due to Idle Iron and its resulting policies stemming from hurricanes and the Deepwater Horizon catastrophe. However, the Texas Artificial Reef Program continues to work with the oil and gas operators to retain as much relevant structure as possible. One outcome of the recent oil disaster is restoration projects designed to mitigate the adverse effects of the oil spill impact through the Natural Resource Damage Assessment and Restore Act. Three reef sites will receive enhancement and reef materials. In addition, the Texas Artificial Reef Program carries out broad monitoring on its reef sites through visual diver surveys, video surveys, ROVs and ARIS technology surveys, and vertical line sampling.

South and Mid-Atlantic Perspectives

Zlokovitz, E.[1] and Martore, R.M.[2]

[1]Maryland Department of Natural Resources – Fisheries Service

[2]South Carolina Department of Natural Resources – Marine Resources Division

This overview presentation will summarize recent experiences in artificial reef construction, monitoring, and management in the South and Mid-Atlantic regions (New Jersey – Georgia) over the last 5-10 years. The states in this region have deployed offshore, coastal, and estuarine artificial reefs with both large materials (ships, barges, retired subway cars) and smaller materials (reef balls, crushed stone, concrete rubble, and shell). Two large offshore projects completed since 2011 were the sinking of the retired destroyer USS Radford and two vertically enhanced barges sunk off South Carolina. A large multi-agency reef-building effort in Chesapeake Bay has focused mainly on oyster restoration. In the next 5-10 years, offshore wind towers in the Mid-Atlantic region may also act as artificial reefs for recreational fishermen.

Monitoring of artificial reefs in the South and Mid-Atlantic region includes diving, photographic and video surveys, hook-and-line sampling, and volunteer angler/diver surveys. Some states with small one-person programs, such as MD, rely on volunteer angler studies to provide data on the reefs. Funding and staffing for long-term monitoring can be challenging for the smaller states.

Management strategies for artificial reefs in the South Atlantic and Mid-Atlantic regions include standard fishery regulations (size and bag limits), Special Management Zones (SMZs) and Marine Protected Areas (MPAs). A proposal for SMZs on the reefs off Delaware in the EEZ is in the latter stages of the review process with NOAA. These designated reefs would be open only for hook-and-line and hand gear fishing (i.e. rod and reel and spears). South Carolina reefs in federal waters have been classified as SMZs since the mid 1980's, after a request was sent to the South Atlantic Fisheries Management Council (SAFMC). Special regulations have included restricting fishing to hand-held gear only (rod and reel and spears without power heads), and more recently, restricting all catches on artificial reefs to recreational bag and size limits. Type II MPAs forbid bottom fishing but allow mid-water and surface trolling for species like billfish and tuna. Included in these MPAs was an area off South Carolina requested by SCDNR for a first-of-its-kind deep water artificial reef project.

State of Florida Perspectives

Dodrill, J.

Florida Fish and Wildlife Conservation Commission,
Division of Marine Fisheries Management

One definition of "Best Available Science" is science that maximizes the quality, objectivity, and integrity of information, including statistical information; uses peer-reviewed and publicly available data; and clearly documents and communicates risks and uncertainties in the scientific basis for such projects. We discuss from a state perspective the use of Best Available Science and the Best Management Practices in which the former is incorporated, both in concert with and in tension with stakeholder, political and economic issues relating to Florida's artificial reefs. Examples to be touched upon include: FWC funded artificial reef monitoring and research efforts since 2010, a shift in county reef construction activities from federal waters to state waters in response to red snapper management involving state and federal inconsistencies in recreational season length, the management implications of near future placement of 4,000-5,000 reef modules off five western panhandle Counties using $11.4 million in Deepwater Horizon Natural Resource Damage Assessment Funds; the dormancy of the federal Ships-to-Reefs program in Florida since 2009; and the continued five year de facto moratorium of artificial reef development in the Florida Keys, including the ongoing prohibition of the use of lobster casitas. We will discuss to what degree the development of new artificial modular reef designs takes into account best available science, the tension between the demands for more reef construction vs. research and monitoring using appropriate methodology to assess performance of reefs in meeting the objectives for which they were placed. The donation of memorial reefs to supplement local reef programs, as well as manpower provided by volunteer and reef nonprofit organizations in supporting best management practices in county programs will also be touched upon.

Florida County Perspectives

Turpin, R.[1] and Mille, K.[2]

[1]Escambia County Marine Resources Division

[2]Florida Fish and Wildlife Conservation Commission

Since Florida's first state-wide Artificial Reef Summit in 1979, updates and status reports from each county's artificial reef programs have typically consisted of a summary of the number and types of reefs deployed and other (mostly) quantitative information. In accordance with the theme of the 2015 Florida Artificial Reef Summit, Navigating Expectations and Charting Objectives, representatives from each of six coastal regions around Florida were asked to coordinate with county artificial reef managers to present the connectivity of their artificial reef program with each of the multi-dimensional aspects associated with artificial reef planning.

Guiding questions were developed to help each presenter explore the unique aspects of artificial reef planning within their region considering aspects such as ecological, stakeholder and economic objectives. Each county artificial reef program manager will summarize their findings based on the guiding questions, and these will be summarized into Regional perspectives.

Each county's quantitative data will be compiled into a spreadsheet and provided to all Summit attendees.

Human Dimensions Session: Contributing Speakers

Nautical Charting of Artificial Reefs

Gionis, P.* and Roddy, L.
National Oceanic and Atmospheric Administration

The Office of Coast Survey of the National Oceanic and Atmospheric Administration's (NOAA's) National Ocean Service (NOS) is congressionally mandated to produce nautical products for U.S. waters. Our mission is to ensure safe navigation by maintaining approximately 1000 nautical charts. A portion of this mission includes the charting of obstructions, e.g. artificial reefs/fish havens.

Permits issued by the U.S. Corps of Engineers (USACE) are the sole source for classifying obstructions as artificial reefs/fish havens for charting purposes. The NOS treats Artificial Reefs and Fish Havens similarly. Upon receipt of a USACE public notice or permit, cartographers will pre-process the information checking for inaccuracies, completeness, and potential charting conflicts. Essential information is required for NOS to chart artificial reefs including accurate geographic positions (NAD83) and accurate dimensions of the reef (polygon or circular). For each specific reef, NOS policy requires one definitive single numerical clearance in order to chart an authorized minimum clearance to convey available depth to the mariner. In addition to the engineering and biological aspects of an artificial reef, potential effects on maritime navigation and nautical charting must be considered. Accurate information allows NOS to verify that there are no conflicts with other charted items (i.e. safety fairways, anchorages, etc.). NOS charts the artificial reef at the start of construction upon receipt of post-deployment notification, and/or upon receipt of as-built surveys from the permittee. Consideration of NOAA charting requirements during the planning phase will make the permitting and charting phases more efficient for all stakeholders.

Enhancement of Artificial Reef Management in Tampa Bay

Thorne, L.*, Pratt, C. and Ursin, B.

Environmental Protection Commission of Hillsborough County

Artificial reef management is not one-size-fits-all, nor is it a snapshot in time. Our program goal is to enhance recreational fishing opportunity through habitat creation. The EPC Reef Program Team has spent the last year focusing on the purpose of the Reef program and developing a plan to meet the current needs of stakeholders and re-designing the monitoring plan. Since visibility in Tampa Bay most of the year is low, accurate fish assessment while diving is a challenge. We turned the focus to the community and are in the process of developing an interactive map and a mobile and internet app to allow fishermen to tell us what they are catching on the reefs. We started to engage with fishermen and guides on a more routine basis, beginning with a survey and introducing ourselves on popular area fishing forums. Our recently established YouTube channel has received over 4,000 views within the last 4 months, and each spike in views can be attributed to a specific action we've taken. This effort has allowed us to gauge our ability to reach our target audience, as well as allowed us to receive feedback from our stakeholders. A new brochure is being created to incorporate these new features and educational information. Future efforts include a 10-year epifaunal study and additional reef placement evaluations. This presentation would summarize all of our efforts and explain how using certain tools, each program can ensure they are working to achieve their program goals.

If You Build It, Will They Come? Publicizing Reefs and Distributing Coordinates in a Digital Age

Griggs, T.

StrikeLines Custom Fishing Charts

Public reef programs have a "last mile" problem. After months of methodical planning, permitting, and deployment, reef managers often struggle to distribute coordinates in a format that fishermen and other stakeholders can conveniently use.

The challenges to digital distribution are many. Unstandardized GPS hardware. Proprietary data formats. Technologically unsavvy users. Complicated online mapping software. Faced with these difficulties, reef managers often resort to posting lists of coordinates online -- leaving users to painstakingly enter them, one by one, into their GPS systems. But there is a better way. Through experimentation on the online Pensacola Fishing Forum in 2014, we developed a digital distribution method that allows users to transfer thousands of coordinates to GPS units and mobile devices, often with just a few keystrokes and minimum technical knowledge. During a six-month period, our Northwest Florida artificial reef file was downloaded more than 15,000 times by users from as far as Tennessee and Massachusetts. If you post it, they will come.

During a brief, nontechnical presentation, I will demonstrate how reef managers can use Google Fusion Tables and Quantum GIS to convert lists of coordinates into interactive online maps and user-friendly GPS downloads. The best part? The software is free, and the process is dead simple. If you can sort and filter an Excel spreadsheet, you can convert your county's artificial reef coordinates in an afternoon.

Human Dimensions Session: Invited Speakers

Artificial Reefs Branding and Marketing: Why and How?

Campbell, M.*[1], Qurollo, S.[2], and Weatherby, J.[3]

[1]Lee County DNR

[2]Pearl Branding

[3]Artificial Reefs International

Introduces the concept of artificial reef branding and marketing. Marketing of artificial reefs can be implemented for a variety of reasons from public outreach and fundraising to tourism. Strategies implemented (How) will depend on goals set for marketing efforts (Why). Strategies for education and outreach vs. tourism observing efforts in Lee County, Florida.

Boat Visitation Rates from Acoustic Detections on Paired Artificial-Natural Reefs on the West Florida Shelf

Simard, P.*, Wall, K. and Stallings, C.D.
University of South Florida, College of Marine Science

The goals of establishing artificial reefs often include increasing biological habitat, providing recreational opportunities (e.g., fishing, diving) and attracting resource users away from natural habitats. However, assessing the effectiveness of artificial reefs in attaining these goals can be challenging. For example, quantifying the amount of recreational activity on a reef can be hampered by the logistical challenges of surveying different reefs simultaneously using boat- or aircraft-based observers. This study used acoustic recordings to determine the visitation rates of recreational boats on four artificial-natural reef pairs on the West Florida Shelf. Acoustic recordings were collected continuously from April 2013 to October 2014 with autonomous acoustic recorders operating on a 10-second per 10-minute duty cycle. An automatic detection algorithm was developed to identify the sounds produced by boats, and the results from the algorithm were converted to boat visitation rates using several correction factors (e.g., the correct classification rate of the algorithm, the proportion of total boats detected using the duty cycle). In this presentation, the weekly boat visitation rates will be compared for each of the eight reefs over the duration of the 19-month study period. Additional data on boat type and boater activity (from boat-based surveys conducted during acoustic recorder servicing trips) will also be presented. This study not only provides boat visitation estimates for these reefs, but also highlights the advantages of passive acoustic monitoring such as data collection over synoptic spatial and temporal scales and cost-effectiveness for monitoring resource use and biological activity.

Measuring Florida Artificial Reef Economic Benefits: A Synthesis

Huth, W.L.[1], Morgan, O.A.[2], and Burkart, C.[1]

[1]University of West Florida

[2]Appalachian State University

Results from an FWC funded study of the economic value of Florida's complete system of artificial reefs are presented. Economic value was comprehensive and included both economic impacts for Florida, each of its 67 counties, and eight more broadly defined regions and economic use value which is a benefit that flows to artificial reef users from paying less than what they were willing to pay for artificial reef use. Artificial reef use was for both fishing and scuba diving. Saltwater fishing impacts were based on surveys of Florida residents, nonresidents, and charter boat saltwater fishing license holders from the FWC license database. Diving economic impact was from surveys of scuba divers who reported diving Florida's artificial reefs. The surveys were also used to measure artificial reef user characteristics, attitudes, opinions, and preferences about reef related issues. The estimated economic impact from artificial reef related economic activities for Florida as a whole was over $3 billion of annual economic output, over $1 billion of annual personal income for Floridians, over 39,000 jobs, and $250 million in annual state revenue.

Ecological Applications Session: Contributing Speakers

Invasive Lionfish on Panhandle Artificial Reefs: Trends, Effects, and Potential Mitigation Measures

Dahl, K.*[1], Patterson, W.[1] and Snyder, R.[2]

[1]University of South Alabama and Dauphin Island Sea Lab

[2]University of West Florida

Red lionfish were first documented in the northern Gulf of Mexico (nGOM) in summer 2010. Since then, their distribution and density has increased exponentially and they are perceived as a substantial threat to reef ecosystems in the region. A 10-year database of reef fish community and size structure at experimental (n = 27) artificial reef sites in the Escambia East Large Area Artificial Reef Site (EE-LAARS) has enabled us to track the lionfish invasion in this region, as well as perform a series of experiments to examine lionfish ecology, the impact of the species on native fishes, and the effectiveness of lionfish removals to mitigate or reverse negative impacts of lionfish. As of summer 2014, lionfish density on EE-LAARS reefs was two orders of magnitude higher than on nearby natural reefs, and also among the highest throughout the western Atlantic. Stomach content analysis revealed that lionfish sampled at EE-LAARS reefs predominantly forage on non-reef benthic fishes (e.g., lizardfishes, searobins, and flounders) and crustaceans, thus the lack of small demersal reef fishes on artificial reef (AR) sites does not appear to be limiting to lionfish. While few exploited reef fishes have been found in lionfish stomach samples, indirect effects include competing with native fishes for prey resources. As evidence of this, red snapper have been estimated with acoustic telemetry to forage 75 percent farther and 85 percent higher in the water column at AR sites with lionfish present. Results of an ongoing lionfish removal experiment also will be discussed.

Comparison of Food Webs Among Limestone Boulder Artificial Reefs, Natural Reefs and Soft Bottom

Hirons, A.C.*[1], Guerra, J.L.[1], Metallo, A.C, Hays, B.K., Messing, C.G.[1], Banks, K.[1,2], and Quinn, P.[2]

[1]Nova Southeastern University

[2]Broward County, Environmental Planning and Community Resilience Division

South Florida coastal waters, unlike the Gulf of Mexico, are unique by having both natural and artificial reefs closely associated with each other. In an effort to determine how artificial reefs are impacting soft bottom and neritic productivity, the infaunal and fish community of an established, concrete boulder reef was compared to the adjacent natural reefs. Situated between the first and second natural reef track just offshore of Fort Lauderdale, Florida, the FDOT reef was deployed in 2009. Pre-construction sediment cores were taken at approximately three and seven meters from each of the twelve boulders, and samples were chemically preserved for identification of infaunal organisms. Three and one-half years post-construction, repeated sediment cores were collected at four of the twelve boulders for comparison of infaunal communities. Additionally, similar infaunal samples were collected at two nearby rocky outcroppings of the natural inner reef and two nearby rocky outcroppings of the natural, middle reef. Infaunal community composition of the concrete boulder reef show distinct differences pre- and post-construction. Preliminary data indicate soft bottom disturbance alters the invertebrate sediment community from one dominated by arthropods to one dominated by polychaete worms. Trophic relationships between the invertebrates and associated fish species are being assessed to try and determine if the type of invertebrates are influencing the presence of fish, and whether they actually forage at the artificial site or simply use the structure as refuge.

Evaluation of Fish Production and Assemblage Similarity between Artificial and Natural Reefs

Granneman, J.*[1], Stallings, C.D.[1] and Steele, M.A.[2]

[1]University of South Florida, College of Marine Science

[2]California State University, Northridge

The extent to which artificial reefs may be useful for mitigation of environmental impacts, fisheries management, and conservation depends in part upon how well the organisms that live on them fare. Using five pairs of artificial and natural reefs that spanned 225 km in the Southern California Bight, we tested whether fishes living on artificial reefs were in similar condition. Four target species (*Paralabrax clathratus*, *P. nebulifer*, *Semicossyphus pulcher*, and *Embiotoca jacksoni*) were collected at the reefs to measure foraging success, condition, growth, reproductive output, and tissue production. We also evaluated how well assemblages of fishes on artificial reefs mimicked those on natural reefs and which attributes of reefs were linked to assemblage structure. Using underwater visual transects, we quantified fish diversity, density, and size structure as well as substrate structure, kelp density, and invertebrate density. Total fish tissue production tended to be higher on artificial reefs, with some exceptions. Fish species richness was indistinguishable between artificial and natural reefs, but density and biomass tended to be higher on average on artificial reefs, body size was slightly smaller, and assemblage structure differed between the two reef types. Our results indicate that artificial reefs can support similar fish assemblages and fish production as those found on natural reefs indicating that well-designed artificial reefs can be useful tools for mitigation, conservation, and fisheries management. The methods developed in this study will be used to evaluate fish production on paired artificial – natural reefs located in the eastern Gulf of Mexico.

Ecological Applications Session: Invited Speakers

Integrating Basic and Applied Ecology Using Paired Artificial-Natural Reef Systems

Stallings, C.*[1], Wall, K.R.[1], Simard, P.[1], Granneman, J.E.[1], Kingon, K.[2], and Koenig, C.C.[2]

[1]*University of South Florida*

[2]*Florida State University*

Understanding the influence of habitat on populations and communities is a central goal to both ecological studies based on first principles and those that seek to inform resource management. Paired artificial-natural reefs provide a quasi-experimental system in which to integrate the research objectives across these fields. We present a synthesis of our recent and ongoing research on paired artificial-natural reefs in the eastern Gulf of Mexico. Specifically, we will share 1) what we have learned from comparing population dynamics of reef fishes on these habitats, 2) why the types of artificial structures and locations where we place them may be important, 3) how fishing intensity differs between the habitats and whether such patterns are reflected in the densities and size structures of targeted fishes, and 4) next steps we are taking to estimate production of managed species on the two habitats. We will challenge the role of artificial reefs as a management tool by highlighting important gaps in our understanding of how they operate in complex socio-ecological systems and will provide suggestions for how future deployments may be conducted to help address these gaps.

Ecological Function of Northern Gulf of Mexico Artificial Reefs: Comparisons to Natural Reefs

Patterson, W.*[1], Tarnecki, J.[1], Addis, D.[2], Neese, J.[3], and Norberg, M.[2]

[1]University of South Alabama and Dauphin Island Sea Lab

[2]Florida Fish and Wildlife Research Institute

[3]Alabama Department of Conservation

Considerable research focused on the ecology of artificial reefs has occurred in the Gulf of Mexico (GOM) over the past 30 years, but few direct comparisons between the ecology of reef fishes on artificial reefs with the same species on natural reefs have been reported. We conducted such a study in 2009-10, during which we sampled 23 natural (n = 23) and artificial (n = 26) reefs with a micro ROV to examine reef fish community structure. We also collected fish samples to examine species-specific differences in trophic ecology and size at age. A total of 25,065 individuals among 91 taxa was enumerated among ROV video samples. Both habitat type and depth stratum (strata: <30, 30-45, and >45 m) significantly affected reef fish community structure (PERMANOVA, $p \leq 0.002$). Overall, greater diversity was observed among natural reef communities, but some notable exploited species, such as red snapper and gray triggerfish, had higher densities at artificial reefs. No differences were detected in species-specific trophic ecology, which was inferred from stomach samples and muscle stable isotope (d13C, d15N, and d34S) values, or size at age between habitat types. Therefore, while artificial reefs may provide reef fishes with structured habitat in shelf areas lacking reef habitat, they do not appear to convey a growth or trophic advantage to fishes that inhabit them. Interestingly, the species with the highest densities on artificial reefs, tomtate and red snapper, forage away from reefs regardless of habitat type. Implications of these findings for artificial reef management will be discussed.

Rationale and Evaluation of an Artificial Reef System Designed for Enhanced Growth and Survival of Juvenile Gag, *Mycteroperca microlepis*

Lindberg, W.J.

Fisheries and Aquatic Sciences Program, School of Forest Resources and Conservation, University of Florida

The Steinhatchee Fisheries Management Area (SFMA) is a federally permitted, large-area artificial reef system in the northeastern Gulf of Mexico, designed and constructed to test a bottleneck hypothesis for juvenile gag. Gag have a spatially stage-structured life history, with juveniles (ages 1-4) occupying patch reefs on the shallow continental shelf. Prior experiments demonstrated density-dependent habitat selection and growth, with the tension between mortality risk and growth potential favoring available shelter as a primary element of habitat quality. The SFMA is 259 km2 on the shallow shelf, enhanced with 500 “conservation reefs” designed and randomly distributed to improve growth rates and survivorship of juvenile gag. The SFMA is not a “no-take marine protected area.” Instead, locations of small conservation reefs are not publicly known, which in combination with small reef size and wide dispersion is a passive constraint on directed fishing. The evaluation plan involves monitoring reefs offshore that bracket the region, a tagging study and comparisons of gag growth and mortality rates between the SFMA and adjacent, unenhanced shelf areas. Those parameter estimates will be inputs for spatial modeling of habitat effects on gag population dynamics.

Contributed Presentations

Artificial Reef Federal Regulatory Review Process

Lawrence, B.

U.S. Army Corps of Engineers

The Corps authorizes permits to deploy artificial reef material under Section 10 of the Rivers and Harbor Act and Section 404 of the Clean Water Act. Applicants must be a City or County entity due to insurance and liability issues. The Corps encourages pre-application meetings to discuss new reef sites or existing sites with applicants. See our web site at http://www.saj.usace.army.mil/Missions/Regulatory/OfficeLocations.aspx for the appropriate Corps office. Keep in mind, the National Marine Fisheries Services, Protected Species Division, may take up to six months to review the proposed application due to their current backlog. The proposed reef site should be depicted on the most recent NOAA chart and the navigational clearance indicated in the application. New or existing reef site(s) must go through a public notice process. Permits are authorized for ten years, and a valid permit is needed to deploy material. Acceptable reef material needs to be durable and stable such as prefabricated modules of ferrous and/or aluminum-alloy metals, concrete, and rock. Deployed material(s) must not move on the submerged bottom or break up such that there would be a loss of benthic habitat. The Corps also authorize vessel deployment. The permit, if issued, will include special conditions to ensure deployed material does not harm endangered species or existing aquatic resources. Also, pre and post monitoring reports are included as special conditions of the permit. Reports are sent to the Corps and Florida Fish and Wildlife Conservation Commission for compliance review.

Improving State Regulation of Artificial Reefs

May, A.

Florida Department of Environmental Protection

Florida's extensive, natural, shallow-water coral reefs have developed over millennia, and sustain our exceptional fisheries and tourism industries, protect our coastlines, and promote our overall quality of life, yet they have experienced significant stress within just the past few decades. Artificial reefs can provide some of the same functions as natural reefs, but can also lead to severe impacts if designed or installed inappropriately, which is why The Florida Department of Environmental Protection (DEP) regulates these projects under the Environmental Resource Permitting (ERP) program. DEP approves roughly 10 artificial reefs per year, under a 19-year-old ERP General Permit (GP), but the Florida Fish and Wildlife Conservation Commission (FWC), coastal counties and other stakeholders have identified several aspects of the GP that could be improved. DEP will present possible revisions to the existing GP that were explored during the comprehensive Statewide ERP rulemaking during 2012 and 2013, yet which could not be resolved quickly enough to be included with that larger rulemaking effort. Administrative rulemaking is a challenging process that requires stakeholder cooperation and consensus to be successful. DEP is prepared to consider revising the existing GP (Rule 62-330.600, F.A.C.) as a standalone rulemaking effort with participation from FWC, counties and other stakeholders.

If You Build It, Will They Come? Exploring Enhancements to Artificial Structure for Use in Restoration and Mitigation Applications

Kilfoyle, K.A.*[1], Quinn, P.T.[1], Edwards, A.J.[2], Dodge, R.E.[1], and Spieler, R.E.[1]

[1]Nova Southeastern University Oceanographic Center, National Coral Reef Institute

[2]Newcastle University

A study involving standardized artificial reef modules (ReefballsTM) was conducted in Puerto Morelos, Mexico. The purpose was to explore the use of artificial structure in restoration and mitigation projects in a Caribbean coral reef environment similar to South Florida by applying select experimental treatments hypothesized to accelerate their acquisition of a natural coral reef assemblage. Multiple hypotheses on the progression and interaction between artificial structure and the resulting fish, coral, algal, and non-coral invertebrate assemblages were examined. Each of 40 reefball modules received one of 4 treatments (10 modules/treatment): invertebrate substrate pads, coral transplants, settlement plates, or control. Following deployment, monitoring trips were made on a bi-annual basis for 3 years to assess the development of the biotic assemblages, with a final trip made 6 years post-deployment. At each module divers conducted non-destructive visual counts of fishes to obtain data on total abundance, species richness, size classes, and assemblage structure. Other monitoring work included coral recruitment surveys, invertebrate substrate pad collections, and digital imaging of coral transplants and benthic quadrats. Seasonal variation and patterns of succession were observed. In general there were no significant differences between experimental treatments and controls.

The Use of Light Traps to Assess Recruitment of Juvenile Fishes to Artificial and Natural Reefs in Pinellas County, Florida

Lara, M.* and Mathews, H.

St. Petersburg College

In order to determine if artificial reefs are acting as new habitat for recruits and not simply attracting adult organisms from other areas, light traps designed to capture the late larval stages of fishes, crustaceans, cephalopods and other organisms were deployed on artificial reefs in Pinellas County, Florida. Control traps were set simultaneously at natural reef ledges in nearby areas (comparable depth and nearest to location of artificial reef) to compare the diversity and abundance of recruits between the two types of sites. Light traps collect a diversity of late larval stages of many aquatic organisms. The traps used in this study were modified from those designed by D.L. Jones (2006) by fitting them with LED light arrays. Samples have been collected from 10 traps during the nights around the new moon since April 2014. Collection is ongoing but large sample volumes over the summer at both types of sites are already being seen with diversity at artificial reefs comparable to that from nearby natural ledges. Future work includes continuation of monthly sampling and taxonomic identification of the fishes, crustaceans and cephalopods collected for comparison between the two types of sites. Preliminary work indicates that artificial reefs in the Pinellas County area are serving as new habitat for recruits of a number of reef organisms.

The Success of Stony Coral Including *Oculina varicosa*, *Oculina tenella*, and Deepwater Sport Fish Species on Deep Artificial Reefs on the East Coast of Florida

Dillon, K.

Sea Rover Services & MCAC Reef Fund

The deeper artificial reefs of Florida have been sporadically monitored due to expense and lack of qualified divers to successfully monitor the deeper artificial reefs. However, Florida has many artificial reefs in the deeper than 130 foot depth range down to close to 300 feet deep. Many coral species thrive in these depths including *Oculina vericosa*, a threatened and federally protected species, and *Oculina tenella*. Many deeper water species of sport fish occur on the deeper reefs as well, including many on the grouper/snapper complex such as, warsaw grouper, red snapper, black snapper, snowy grouper, speckled hind, and coney. Because of the limitation of traditional recreational scuba depths limits of 130 feet, many of these important species are being under-documented and missed completely with many fish and coral species censuses. I dive and monitor many of these deeper reefs within the FWC artificial reefs inventory, some which were funded utilizing state funds. I propose to present findings of the last 5 years of monitoring on many artificial reefs in the 150 - 270 foot depth range. Last week on a monitoring dive, I witnessed and photographed a White Marlin on a new (4 month old) ship placed in 190 feet of water in April of 2014. These and other interesting deep water treasures will be presented for all interested parties to enjoy.

Mapping and Monitoring Fish and Benthic Recruitment of the Clifton Perry Artificial Reef Complex

Lott, C.[1], Stokes, M.[2] and Dillon, K.*[3]

[1]Florida Department of Environmental Protection

[2] Martin County, Utilities and Solid Waste Department

[3]Sea Rover Services & MCAC Reef Fund

Florida Oceanographic Society (FOS) volunteer science divers received a Florida Protect Our Reefs license plate grant (POR) in 2008 to monitor the artificial reef complex, Clifton Perry, named after founder of FOS. Physical mapping and biological monitoring would be conducted to define the spatial layout of the artificial reef structure itself, followed by assessing the processes of benthic settlement by monitoring percent coverage of basic benthic taxa groups, as well conducting fish identification and size class counts. The site would be characterized as a demonstration of how the adjacent natural coral reef, the St. Lucie Inlet State Preserve, the northernmost living reef of the United States, would recover following a stochastic event, such as a hurricane. Knowledge and documentation of these ecological processes on artificial substrata would provide the science researchers' and resource managers' insights as case studies into the environmental factors that directly affect coral reefs by studying these same processes on artificial reef structures. Training and monitoring activities occurred from January 2008 to October 2009.

Data revealed greater recruitment of epibenthic taxa group species, and fish species abundance and diversity at the center structural areas which provided both vertical relief and spatial/dimensional complexities. Areas lacking vertical relief or spatial/dimensional features, as well as occurring away from the central complex along the structure's edge, showed fewer benthic and fish species presence. These data may implicate faster recovery for epibenthic and fish recruitment onto a natural reef following a stochastic event, provided vertical relief and spatial complexity can be restored.

Geospatial Analysis of 10 Years of Artificial Reef Monitoring in Martin County

Carvalho, A.*[1], Fitzpatrick, K.[2] and Garland, J.[2]

[1]CMar Consulting, LLC

[2] Martin County, Department of Engineering

The Martin County Artificial Reef Program (MCARP) started in the 1970s and includes four offshore active permitted reef sites: Donaldson, Ernst, Sirotkin and South County. To date, the County has deployed over 100 artificial reefs at different depths varying between 50 feet and 200 feet (15 to 61 m). Some of the shallower water reefs are popular fishing and diving spots, some in deeper waters offshore are dedicated to enhance angling opportunities, and others deployed in areas less accessible are designed primarily for fishery enhancement.

To assure the reefs are meeting the MCARP objectives, the County monitors new reef deployments annually for two years and then includes them in the MCARP rotating schedule for subsequent years. Monitored elements consist of structural characteristics (i.e. stability, settling and scouring) and reef biology (i.e. species inventories compiled from fish and invertebrate observations collected along with photographs and video).

To help with visualization and analysis of the monitoring data and to evaluate whether the current monitoring program provides data suitable to assess the performance of the reefs, the County entered 10 years of reef monitoring data into its Coastal GIS. This presentation describes some of the findings from that effort. Specifically, it illustrates how this large amount of information was organized to assist with a long term analysis of the data; provides a timeline of how the fish and invertebrate assemblages evolved over time; and relates the observed changes with the natural characteristics of the reefs sites, types of materials and reef design.

The State of Florida Artificial Reef Program's Dive Assessment Team: 22 Years of Fish Census Data, 1992 to 2014

Horn, B.

Florida Fish and Wildlife Conservation Commission

In 1992 the state of Florida created the artificial reef assessment dive team to monitor artificial reefs deployed off Florida waters. This dive team consists of scientific divers qualified under the American Academy of Underwater Scientists (AAUS) standards and has been performing underwater dive assessments on artificial reefs throughout the state of Florida each year for the last 22 years. Although this dive team is now located within the FWC's Division of Marine Fisheries Management, it was previously located in several other state agencies. But staff members, procedures and methods remained relatively consistent over the years. In addition to basic artificial reef structural observations, photography and video, this team of divers has been performing fish census surveys on hundreds of reefs off Florida. The standard Roving Dive fish census method has been utilized by these divers to gather a large set of relative fish abundance data across many years. In addition to this fish census information, associated information like reef materials type, depth, water temperature, maximum reef profile and reef age was also collected on each assessment dive. This paper will summarize these data and compare species richness and relative abundance to these additional reef attributes as well as document the most common fish species observed by this dive team both statewide and regionally.

Poster Session

Poster #1
Increasing Juvenile Grouper Habitat within Sarasota Bay through Deployment of Targeted Reef Modules

Leverone, J.*[1], Solum, M.[2], Hipp, A.L.[3] and Beggs, L.[4]

[1]Sarasota Bay Estuary Program

[2]Sarasota County

[3]Manatee County

[4]Reef Innovations, Inc.

While most of Florida's artificial reefs are located in coastal and offshore waters, Sarasota Bay has had an ongoing inshore, estuarine artificial reef program since the 1980s. The reefs are popular fishing destinations that are already supported by materials such as rocks and reef balls. In June, 2013, a variety of new reef modules were dropped on three existing reefs in Sarasota Bay. (The same materials are planned for deployment on three additional reefs in Manatee County in 2015). The new modules were specially designed to attract young reef fish, particularly gag grouper, during their estuarine-dependent life stage. The "deep cover" module, in particular, mimics natural ledges and can hold large numbers of fish, offering safety from predators and humans.

In 2015, after two years of "soaking," we will begin monitoring these reefs. We will map the seafloor and reef materials within the permit area using side-scan sonar to create a mosaic map of each region and the natural habitat areas that border them. We will also characterize and compare fish assemblages utilizing baited remote underwater video stations (BRUVS) and underwater visual census (UVC) methods to determine similarities and differences in fish abundance, species richness, and composition within and between habitats (artificial reef vs. seagrass vs. sand bottom). Special attention will be given to longer-resident reef fish species that may be utilizing these habitats, particularly juvenile gag grouper, *Mycteroperca microlepis*, an economically important species.

Poster #2

Reef Fish Sampling, PCB Analysis Results and Visual Monitoring Associated with the Oriskany Reef, a Decommissioned Former Navy Aircraft Carrier Sunk in 2006 as an Artificial Reef in the Northeastern Gulf of Mexico off Pensacola, FL

Mille, K.*[1], Dodrill, J.[1] and Turpin, R.[2]

[1] Florida Artificial Reef Program, Division of Marine Fisheries Management, Florida Fish and Wildlife Conservation Commission

[2] Escambia County Marine Resources Division

The Oriskany Reef, a decommissioned US Navy aircraft carrier, was deployed by the U.S. Navy in May 2006 in the Gulf of Mexico, 23.5 nm southeast of Pensacola, Florida as an economically valuable fishing and diving enhancement. As a cost-saving measure during vessel preparation, the Navy requested and received from the USEPA a risk-based polychlorinated biphenyl (PCB) bulk product waste disposal permit. Supported by extensive modeling studies, the permit authorized an estimated 722 pounds of non-liquid PCBs distributed in wiring, insulation, paint and gaskets to remain onboard the vessel when sunk as an artificial reef. In compliance with the monitoring requirements of the permit, we collected 490 legal size reef fish between December 2006, and April 2014 for skin-on lateral muscle fillet analysis. Initially the mean total PCB level across targeted species collected from the Oriskany Reef within the first two years had combined values exceeding the EPA screening value of 20 ppb. By sample round 5, collected at 2.9 years, the mean total PCB level decreased to below the EPA screening value and remained low through sample round 10, 5.9 years after sinking. The downward trends of red snapper mean total PCB levels to below screening levels and the consistently low vermilion snapper mean PCB levels presently did not result in fish consumption advisory actions. The remaining analyzed species (triggerfish, groupers, porgy) represent too few specimens sampled with too great a PCB variability among individuals of the same species to take any species specific fish consumption advisory action.

Poster #3
Coastal Recovery Utilizing Habitat, Shoal & Mitigation Modules

Backus, J.C.*, Farrell, J., Jr. and Johnston, J.
Resolve Coastal Recovery, Inc.

Natural reefs provide multiple environmental benefits including habitat and shore protection. As climate change and sea level rise occur, the ability for many natural reef systems to adapt, migrate, grow or respond otherwise is hampered due to anthropogenic alterations to the natural system. Habitat loss and decreased efficacy of reefs with regard to shore protection are often the result. Often biota are most threatened by habitat loss rather than changing environment; artificial habitat affords biota more physiologically capable of tolerating climate change habitat for survival. Considering degradation of wave attenuating reefs, coupled to considerations of the monetary and ecological costs associated with beach nourishment, highlights a differing impact of natural reef loss.

Coastal Recovery Modules afford management options to achieve objectives. Constructed of a biofavorable reinforced concrete, controllably buoyant modules can be utilized for wave attenuation and shore protection, and also serve as artificial near shore reef habitat. They may be constructed with a lower profile as artificial hard-bottom habitat which is ideal for mitigation projects. Coastal Recovery Modules may be deployed in deeper water as a cost effective, ecologically favorable alternative to ship reefs, providing significant vertical relief suitable for *Oculina* as well as many fisheries-managed species.

Coastal Recovery Modules are designed and constructed based on site specific considerations. Ideal modules range from 20 feet to 120 feet in length. Modules designed with shore protection have a H:W:L ratio of 1:3:9 while modules designed for hard-bottom equivalency may depart towards a ratio of 1:6:18. Modules remain removable and repositionable for many decades.

Poster #4
Artificial Reefing Efforts in California – Current Projects

Smith, P. and Rewerts, E.
California Ships to Reefs

Awareness of the beneficial aspects of artificial reefing is gaining recognition in California. This poster will present some of the ship placement projects currently in work by California Ships to Reefs. Images of the vessels and brief histories will be displayed along with charts of proposed sink sites. Images and examples of the baseline sampling and site studies carried out in partnership with local colleges and universities at these sink sites will be presented along with what government organizations and issues need to be addressed before ship placement can occur.

Poster #5
Oyster Reefs as Engineered Shoreline Protection on the Gulf Coast

Ortego, T.

Wayfarer Environmental Technologies/ORA Estuaries

Estuaries throughout the world are subject to severe environmental challenges. Coastal wetland loss, water quality impairments, ecological damage and fisheries collapse are common problems. Oysters, a common but often threatened inhabitant of estuaries, have been described as “ecosystem engineers” for their ability to modify their habitat. One of the ways that oysters affect their habitat is by protecting shorelines via the hydrodynamic interactions caused by the reef. Via clever configuration of substrate, these reefs can be designed into living engineered breakwaters. By using the reef building nature of the oyster to create breakwaters, structures can be created with less material, lower foundation pressure and fewer construction impacts. In this presentation, we look at case studies using the OysterBreak Shoreline Protection System™. This presentation will look at the similarities and differences between the different projects, and discuss some of the coastal engineering, as well as ecological aspects of the projects.

Poster #6

Preliminary Results of Experimental Fishing on Artificial Reefs (ARs) in Pozos Colorados Bay, Colombian Caribbean

Delgadillo-Garzón, O.*[1], García, C.B[2] and Toro-Ballesteros, N.[3]

[1]M oAm Monitoreos Ambientales S.A.S.
[2]Universidad Nacional de Colombia
[3] Ecopetrol S.A.

In an inter-institutional integrative process leading by ECOPETROL S.A., six steel pipe artificial reefs (ARs) of 4.5 x 4.5 x 4.5 m were deployed in Pozos Colorados Bay, to ameliorate multiple impacts affecting their natural resources. In order to evaluate the conservation and fishery potential of ARs, from April to July of 2014, experimental fishing with gill nets were conducted on the habitats and three control sites (CS). Gill nets of 57 m long x 7 m wide and 3.5' mesh size were arranged in the four cardinal points to distances of 30 and 150 m from the ARs and CS, during four hours morning and afternoon. Statistical analyses were performed to evaluate differences between sites, in relation with environmental conditions and attraction effects of the ARs. A total of 49 species were recorded, with an abundance of 132 individuals and 53.5 kg. Higher richness and abundance were recorded in CS1 and AR4, while CPUE was superior in CS3 (6.28 $kg*h^{-1}$) and AR4 (2.58 $kg*h^{-1}$). Differences in abundance were found between ARs and CS ($p<0.05$), and within ARs ($p<0.05$), but no relationship was evident with environmental variables, position and distance from the reef. The relevance for conservation objectives is high, supported by the presence of endangered and important commercial species. This approach should be the fate for AR development in the area. Nevertheless, in the potential scenario of fishery exploitation, ARs have to be enhanced in area, volume and structural complexity, along with implementation of management plans for their utilization.

Poster #7

Tunicate Biodiversity and Distribution on Artificial and Natural Reefs off Florida's West Coast

Senokossoff, S.*, Goltz, M.A. and Lara, M.

St. Petersburg College

Due to the lack of data and understanding of the ecological presence of tunicates along the Florida Gulf Coast, a study of the quantity and species of tunicates was undertaken to further understand the nature and productivity of artificial reefs in the Eastern Gulf of Mexico. Tunicates are chordate filter feeders characterized by sac-like bodies and sessile adult lifestyles. Much like plants, they cannot displace themselves to escape harsh conditions, and this makes them effective biological indicators of reef conditions. Furthermore, many tunicates are highly opportunistic colonizers and are potentially invasive in reef habitats. Tunicates appear to be remarkably well-represented on artificial reefs in Pinellas County. By analyzing the species composition and areal extent of tunicates on the reef we can begin to explore questions of succession on artificial reef substrate. Ultimately by studying tunicates that populate both artificial and natural reefs, we can speculate on the relative conditions of the water, organic components, location, substrate attachment, and other elements of reef design and construction that allow these types of organisms to proliferate and/or dominate artificial verses natural reefs. Most significantly we hope to answer questions about the role of tunicates in the relative quality of artificial reefs in terms of providing habitat, food and clean water.

Poster #8

The 'Belzona Wreck Trek' Connection Project, Key Biscayne, FL

Thanner, S.* and Ross, R.

Miami-Dade County, Department of Regulatory and Economic Resources—Division of Environmental Resources Management

Miami Dade County's Artificial Reef program conceptualized a project to engage stakeholders in 'connecting' adjacent artificial reefs by the placement of smaller, intermediate reefs. The goals of this project were to provide enhanced settlement opportunities for benthic organism, to expand foraging and shelter opportunities for fish assemblages, and to create new habitat linkages and navigation trails for recreational divers between existing artificial reefs. During the planning process, stakeholders were involved through the donation of secondary use concrete from an art installation at popular local festival (Art Basel). A local nonprofit, Reef Guard, has also been involved by participating in the planning stages to select the optimal site for the connection reefs. In 2011, with assistance from a FWC construction grant (No. 10162) two such connection reefs were placed utilizing the donated concrete material and limerock boulders. The connection reefs were deployed between three popular reefs (the 'Belcher Barge', the 'Belzona Tug' and the 'HAV Parker III Barge'), creating the 'Belzona Wreck Trek' in the Key Biscayne Artificial Reef Site. Reef Guard has stayed involved with the Belzona Wreck Trek Connection Project by helping to train and organize volunteer divers to assess the fish population on the connection reefs and existing tug and barge reefs. This 'stakeholder' driven project, has been a strong example of the benefits of a public/private partnership, that has provided benefits to the environment as well as enhanced the understanding and appreciation of the role of artificial reefs within the diving community.

Poster #9

A Comparison Between Artificial Reef and Natural Ledge in Respect to Sediment Coarseness and Infaunal Diversity

Mathews, H.*[1] and Trier, G.C.[2]

[1]St. Petersburg College

[2]Reef Monitoring

Sediment samples were collected from local artificial reefs and natural ledges in relatively the same area and similar depths. Samples were taken both at the base of the reef and off the reef or ledge. The sediment samples were preserved in formalin and stained with Rose Bengal and ethanol solution to reveal the organic material. The sediments were then dried and sieved into fractional sizes. Benthic infauna was sorted into various taxa. Artificial reef samples seem to contain coarser sediment than natural ledges both on and off reef samples. Based on preliminary observations benthic populations differ in the two types of samples, and infaunal diversity and sediment coarseness is being compared between artificial reefs and natural ledges, to see if any correlations can be established between sediment coarseness and infaunal diversity or if the correlation is dependent on natural ledges versus artificial reefs.

Poster #10

Artificial Reefs in France: Expanding Applications, Designs and Evaluation

Seaman, W.*[1], Tessier, A.[2], Francour, P.[3], Charbonnel, E.[4], Dalias, N.[2], Pascaline, B.[3] and Lenfant, P.[5]

[1]University of Florida

[2]SEANEO

[3]Université Nice-Sophia Antipolis

[4]Parc Marin de la Côte Bleue

[5]Université Perpignan

Artificial reefs in the coastal waters of France have been deployed for over 45 years. We have examined status and trends concerning them since their review by Barnabe et al. (2000). Advancements of practices and knowledge include: (1) increased number of objectives (and sites) for French artificial reefs (ARs); (2) emphasis of reef design based on life history requirements of given species; (3) exclusive use of fabricated reef structures, particularly concrete modules; (4) evaluation that centers on biological attributes, especially fish assemblage diversity and abundance.

The principal aim of French ARs is to enhance success and continuity of artisanal fishing. Newer purposes include provision of habitat to maintain or restore biodiversity and sites for scuba diving, recreational fishing, and research. Over 60 percent of the volume of material has been deployed since 2000. AR sites in France include nine on the Atlantic coast and 24 along the Mediterranean Sea, including the largest in Europe.

In some cases production of fish biomass on artificial reefs is both correlated with their degree of structural complexity and also comparable to levels at natural areas. The perceptions of stakeholders toward artificial reefs, and use of the structures in Marine Protected Areas are new research topics. Greater construction funding from the European Union has led to increased monitoring. Our recommendations include development of longer-term studies including fishery production, trophic dynamics, recruitment and ecological connectivity of habitats. Economic research needs to be commenced. Greater use of experimental control sites, statistical analyses, and uniform field methods is encouraged.

Poster #11
Mexico Beach Artificial Reef Association Accomplishments

Cox, B.* and Cox, C.
Mexico Beach Artificial Reef Association

The Mexico Beach Artificial Reef Association (MBARA) will provide video and a photo slide show illustrating recent accomplishments and artificial reef performance. The video will be presented on a 60-inch LED TV along with a photo slide show on a 32-inch LCD TV in the poster viewing area.

Poster #12

Evaluation of Sessile and Epifaunal Assemblages of Two Artificial Reefs in the Gulf of Morrosquillo, Colombian Caribbean

Perdomo-Ramos, S.*[1], Delgadillo-Garzón, O.[1], García, C.B.[2] and Delgado-Cuadros, F.[3]

[1] *MoAm Monitoreos Ambientales S.A.S.*

[2] *Universidad Nacional de Colombia*

[3] *Ecopetrol S.A.*

In 2008 after a year of deployment, the biodiversity of sessile and epifaunal assemblages was evaluated in two artificial reefs (ARs) from Program Diáspora in San Antero 16 (SA16) and Coveñas 19 (C19), Gulf of Morrosquillo. Benthic coverage and extraction of epifauna were accomplished through random arrangement of 20 quadrats of 0.25 x 0.25 m in each AR. Statistical analyses were used to compare sites and to establish distribution patterns of the assemblages. Sessile structure was conformed by seven phyla of 12 main categories and 29 secondary components, 25 in SA16 and 22 in C19. Sponges (41 percent), hydroids/filamentous algae (27 percent) and gorgonians (11 percent) dominated the covering. Total epifaunal abundance was 1882 with 66 genera. SA16 presented 1096 individuals and 51 genera, while C19 had 786 individuals and 41 genera. Bryozoans (61.2 percent), cnidarians (13.5 percent) and annelids (8.9 percent) showed the highest abundance. Statistical differences were found for coverage percentage, epifaunal richness and biodiversity, whereas no distribution pattern was evident in the assemblages. Differences in these variables between ARs were related to the influence of estuarine systems and coral reefs close to SA16, compared with C19. However, the assemblages presented the same suite of functional groups and genera, resulting from the relative homogeneity in environmental conditions, which favored colonial and filter feeding organisms. The selection of specific locations for ARs deployment close to natural ecosystems, could be an alternative to boost the secondary production and connectivity, necessary for the artisanal fishing enhancement as expected in this program of ARs.

Poster #13

Coral Reef Restoration Using *In Situ* Coral Nurseries

Ruiz, H.*[1], Scharer, M., Ortiz, A. and Nemeth, M.

HJR Reefscaping

Efforts to restore threatened species of corals include various in-situ coral nurseries seeded with Staghorn (*Acropora cervicornis*) and Elkhorn (*A. palmata*) corals in southwest Puerto Rico. Gulf of Mexico Foundation and the NOAA Restoration Center have supported this project since 2010 for habitat enhancement. The project involved volunteer divers trained to install underwater coral arrays (benthic and floating) that have generated 3,264 colonies (2,686 Staghorn and 578 Elkhorn) in three years. The project includes extensive outplanting of colonies to reefs impacted by vessel groundings to mitigate loss of colonies in grounding sites and enhance habitat for reef fishes. In order to increase survival probabilities of transplanted colonies, species-specific protocols are necessary for outplanting efforts especially for long-distance transport. Measurements were collected of fish and benthic community parameters prior to and at intervals after coral outplantings. Monitoring these sites indicates increased diversity and abundance of fishes, mainly in recruitment pulses of juvenile grunts, snappers and parrotfishes. These results support the idea that coral structure in shallow reef habitats can be realized artificially with these methods. In this particular habitat outplantings provided an increased area for a critical ecological function. This project led to the development of techniques and practices with quantitative data that can be used to measure the increased value of ecosystem level processes.

Poster #14

Patterns and Processes of Benthic Communities on Paired Artificial and Natural Reefs in the Eastern Gulf of Mexico

Wall, K.* and Stallings, C.D.

University of South Florida

Marine benthic communities are shaped by a wide variety of pre- and post-recruitment processes. Understanding the relative influence of these processes, and whether they differ between artificial and natural reefs, can be informative about how these two habitats function. For example, settlement cues for marine larvae (pre-recruitment) and predation vulnerability of recent settlers (post-recruitment) may differ between artificial and natural habitats. We present an ongoing effort to quantify the patterns of benthic community structure across paired artificial-natural reefs in the eastern Gulf of Mexico. We focus on the density and diversity of sessile organisms (e.g., algae, corals, sponges, encrusting organisms) and mobile herbivores, which may have top-down effects on the benthos. In addition, we examine the relative strengths of recruitment processes by measuring settlement rates and short-term succession using a controlled field experiment. Together, our observational and experimental approaches will provide valuable insight on the patterns that shape community structure and how the processes that drive them compare on artificial and natural reefs.

Poster #15

Evaluation of Monitoring Protocols Utilized on Texas Rigs-to-Reefs Structures

Shipley-Lozano, B.* and Shively, D.

Texas Parks and Wildlife Department

The Texas Artificial Reef Program is managed by the Texas Parks and Wildlife Department (TPWD). To date the Texas Artificial Reef Program has 68 permitted reef sites, including 35 placed in the General Permit Area found in High Island. Materials range from donated petroleum platforms, vessels, fly-ash blocks, concrete culverts, reef balls, pyramids, and other materials of opportunity. Additionally, reef sites vary from 33 to over 300 ft in water depth with the majority in water at least 98 ft deep. Due to the variety in depth, material, and water clarity, a range of biological monitoring techniques must be utilized. The initial biological sampling technique involved roving diver surveys, which are still a major part of the current sampling protocols. However, additional methodologies including video camera surveys, utilization of parallel lasers for length estimates, decompression diving allowing for deep-water fish surveys, and vertical longline sampling have been incorporated in recent years. Roughly 560 diver surveys have occurred from 2011 through the summer of 2014. This increased effort and varying survey techniques since the initial survey in 1993, provides a better understanding of the species compositions and abundance at the Texas rigs-to-reefs structures.

Poster #16

The Contribution of Artificial Reef Use to the Coastal Economies of Florida

Adams, C.A.* and Lindberg, W.

University of Florida

Florida reportedly has more permitted artificial reefs that any other state in the US. Artificial reefs have been deployed in state and federal waters all along the Gulf and South Atlantic Coast of Florida. A long history of deployment programs has been met with strong support by local communities who derive significant economic benefit from the use of the reefs by both commercial and recreational user groups.

Some reefs meet local demands, while other artificial reef deployments attract users from around the state and the nation. Some recent large ship deployments are good examples of artificial reef programs that have created a reputation for artificial reefs in Florida as premier dive destinations, while other reefs continue to provide access to local anglers and divers. The users of the reefs create economic activity as they purchase fuel, supplies, lodging and other items necessary for the utilization of the artificial reefs. Many non-residents utilize the reefs, and bring in new dollars to the local economies. Key user groups include both private boaters and the fore-hire sector. The economic contribution of these artificial reef users can be significant to the local economies where the use occurs, as well as the overall economy of Florida. This poster provides an overview of the studies that have been conducted with the goal of quantifying the economic activity and impacts associated with artificial reef use in Florida.

Poster #17

Scientific Diving with Closed-Circuit Rebreathers: Improved Logistics, Efficiency and Safety over Open-Circuit

Gardner, P.G.*, Marcinek, D.M., and Lindberg, W.

University of Florida

Closed-circuit rebreathers (CCRs) have been used in scientific diving since 1970, but by 2011, CCR divers represented only 1.5 percent of AAUS scientific divers. As with any research tool, the adoption of CCRs has significant tradeoffs encompassing training and personnel, financial investment, diving safety, logistics, study design, and CCR unit selection. These tradeoffs are presented within the context of artificial reef surveys along the Florida Big Bend, in which CCRs are used to visually census and collect fish. This work demonstrates CCR logistical efficiencies and physiological advantages for divers. Using CCRs, a two man dive team typically performs 20 minute dives to 70 fsw up to 15 dives per day. At the end of the day, the divers have a B letter group designation. On EAN36 open circuit (OC), the same team can only complete 8 dives with an ending letter group designation L. This difference equates to less inert gas dissolved in tissues and a corresponding decrease in the probability of decompression illness. In addition, the OC operation would require 16-95 cf steel cylinders, substantially increasing diver fatigue and weight in the vessel. While not right for every project because of the tradeoffs, CCRs have the potential to greatly increase bottom times while creating fewer disturbances to the environment and study species. CCRs in scientific diving represent a powerful tool for improving in situ study designs and the efficiency of publicly supported science and reef monitoring.

Poster #18

Jacksonville Reef Research Team: Making Volunteer Research Diving Work

Dacey, J.* and Perkner, J.

Jacksonville Reef Research Team

The Jacksonville Reef Research Team (JRRT) is a non-profit [501(c)(3)], volunteer dive organization established in 1985, that uses SCUBA divers to monitor and assess artificial reefs offshore northeast Florida. There are approximately 151 placements offshore northeast Florida covering Duval, Nassau, Flagler and St. Johns counties. The primary area of focus for the JRRT is the region of 120 deployments off of Duval and St. Johns County. The majority of the diving/fishing artificial reef locations are between ten and twenty nautical miles off of Jacksonville, Florida. As early as the 1960s, secondary use concrete, steel vessels and other permitted materials have been deployed to create habitat for a diversity of species and provide new fishing and diving opportunities to the community. The JRRT is committed to studying the development of these artificial reefs by conducting quarterly fish census and benthic surveys to determine species abundance and biodiversity. There are numerous game fish species including: grouper, red snapper, cobia, an assortment of jacks, several species of mackerel, barracuda, sharks and many other reef fish species that are monitored through JRRT fish counts. The JRRT assists the public and scientific community of northeast Florida by providing data about artificial reef biological communities and by locating and evaluating sites for future artificial reef placement. Finally, the JRRT educates the public concerning the utilization of artificial reefs by maintaining working relationships with the scientific community and other local marine interests.

Poster #19

Incorporating Artificial Reef Habitat Into Long-Term, Fishery Independent Surveys of Reef Fishes in the Eastern Gulf of Mexico: Initial Steps

Keenan, S.*[1], Weather, E.[1], Knapp, A.[2], and Switzer, T.S.[1]

[1]Fish and Wildlife Research Institute, St. Petersburg

[2]Fish and Wildlife Research Institute, Senator George Kirkpatrick Marine Laboratory, Cedar Key

The Fish and Wildlife Research Institute (FWRI) has conducted fishery-independent surveys of reef fishes in the eastern Gulf of Mexico (Gulf) for the past seven years, a collaborative effort with the National Marine Fisheries Service. Utilizing standardized methods and gear types, these complementary surveys have provided valuable abundance and life history data for several reef fish stock assessments. Because funding has been limited, ongoing surveys have been restricted to natural hard-bottom habitats, and so reef fishes associated with artificial reef habitats have been underrepresented. We present a summary of preliminary FWRI efforts, implemented in 2014, to not only expand sampling efforts spatially into the Florida Panhandle, but also incorporate artificial reef habitats into reef fish surveys. Regardless of habitat type sampled (natural or artificial), an essential component of the FWRI reef fish survey is habitat mapping through use of side-scan sonar. Standardized side-scan surveys are used to not only direct sampling efforts, but also identify and classify reef habitats. Within this poster, we will provide an overview of how artificial reef habitats have been incorporated into the FWRI survey design, as well as how data from side-scan sonar surveys and associated underwater imagery intersect to provide insight into the landscape-scale dynamics of reef habitat in Gulf waters. Combined, these efforts will provide a better understanding of the relative importance of various habitat types in supporting reef-fish assemblages in the eastern Gulf.

Poster #20
Federal Regulatory Review of Artificial Reefs

Lawrence, B.

U.S. Army Corps of Engineers

The Corps' presentation is a flow chart of the permitting process. The first step is a pre-application meeting with the Corps that includes inviting local stakeholders, such as representatives from the port, military base, local shrimpers, or any other users of the transit way to the reef and the site. The chart includes the various steps in the process and highlights coordination under Section 7 of the Endangered Species Act. Currently, it is taking the National Marine Fisheries Service, Protected Species Division, up to six months to provide a clearance letter on pending applications. Due to the backlog, the Corps is encouraging applicants to submit their application a year in advance.

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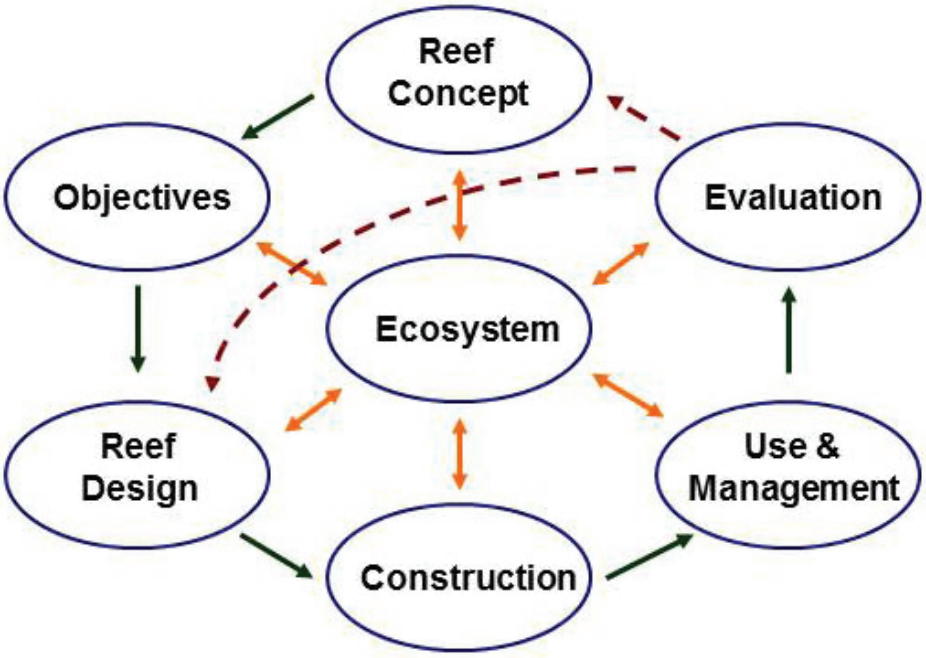
Guiding Questions

1. What is the natural ecosystem in your project area (e.g. depth, natural bottom, biotic community)? How do artificial reefs interact with the existing ecosystem? **(ECOSYSTEM)**

2. Who are the stakeholders of artificial reef programs, i.e. those who impact, are impacted by or have technical knowledge of your reef program? Who are the primary users? **(REEF CONCEPT and USE AND MANAGEMENT)**

3. Why are reefs being built? What are their purposes, what are their aims? **(OBJECTIVES and USE and MANAGEMENT)**



from Lindberg and Seaman 2011, figure 1.3, bit.ly/13WdTVC

4. What led you to the design and construction of your reefs? **(REEF DESIGN and CONSTRUCTION)**

5. How is monitoring and evaluation designed and conducted to ensure you are meeting your program objectives? **(OBJECTIVES and EVALUATION)**

6. How are reefs being used? How is reef performance determined? **(EVALUATION)**

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