

PARTICIPANT WORKBOOK

NATIONAL ARTIFICIAL REEF WORKSHOP

June 9th – 10th, 2016
Alexandria, Virginia



Photo: David Doubilet



NOAA
FISHERIES



NAME: _____



Atlantic States Marine Fisheries Commission

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Douglas E. Grout (NH), Chair

James J. Gilmore, Jr., (NY), Vice-Chair

Robert E. Beal, Executive Director

Vision: Sustainably Managing Atlantic Coastal Fisheries

June 1, 2016

Dear Artificial Reefs Workshop Participant,

The Atlantic States Marine Fisheries Commission (ASMFC) and NOAA Fisheries welcome you to the 2016 National Artificial Reefs Workshop! We look forward to an engaging and productive discussion with you and fellow workshop participants to examine the state of artificial reef science and management. The workshop is an exciting and timely opportunity to learn from past experience and explore key considerations of artificial reefs in U.S. coastal zone and fisheries management.

Your experience and expertise will make the workshop a valuable event and help us reach the proposed objectives to:

- Provide an overview of current science and applied experience (lessons learned) regarding the application of artificial reefs as a tool to support or enhance sustainable fisheries.
- Identify and examine key considerations associated with artificial reefs as a potential management tool to support and/or enhance sustainable fisheries.
- Identify management challenges and associated research needs, knowledge gaps and limitations, and strategies for monitoring, using, and managing artificial reefs.
- Discuss the potential roles of federal, state, and private sector partnerships in resolving artificial reef challenges and achieving objectives.

A steering committee of artificial reef experts, along with key staff from NOAA Fisheries and ASMFC, collaborated to develop the workshop agenda. Seatone Consulting will provide facilitation services at the two-day event. We hope you were able to provide workshop content input through the pre-workshop survey. A summary of survey responses will be shared at outset of the workshop, including how your responses helped shape the agenda. Additional background information is provided in the participant workbook to lay the foundation for presentations and discussion sessions at the workshop. We ask participants to review the materials so that we can hit the ground running on June 9th.

Thank you in advance for your contributions to a successful artificial reef science and management workshop. We look forward to seeing you and working together in Alexandria.

Robert E. Beal

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Executive Director
Atlantic States Marine Fisheries Commission

Russell Dunn

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National Policy Advisor for Recreational Fisheries
NOAA Fisheries

PREPARATIONS FOR THE NATIONAL ARTIFICIAL REEF WORKSHOP

NOAA Fisheries and the Atlantic States Marine Fisheries Commission (ASMFC) are committed to hosting an inclusive, highly interactive and engaging dialogue on artificial reefs in U.S. waters among a wide range of practitioners from around the country. To plan for and convene this gathering, NOAA Fisheries and ASMFC contracted an impartial facilitation team and formed a steering committee comprised of a cross-section of stakeholders who possess extensive knowledge and experience with artificial reefs. The steering committee collaborated closely to identify prospective attendees, develop and conduct a pre-workshop survey, and then utilize survey results to craft an ambitious agenda.

The pre-workshop survey captured perspectives and insights from prospective attendees on a range of artificial reef related topics. Survey results revealed topics of interest, recent advances and outstanding gaps and challenges in artificial reef science and management, and lessons learned from different regions around the country. The survey also helped the steering committee to identify and recruit guest presenters who will frame key topics and issues at the workshop, and collaborate with all participants to share artificial reef experiences, explore the current state of the science and discuss future opportunities and direction of the field. A brief summary of the survey results will be presented at the outset of the workshop.

In addition to facilitating collaborative planning with the workshop steering committee, NOAA Fisheries and ASMFC tasked the workshop facilitation team to conduct a rapid artificial reef science literature review. The literature review was designed to inform workshop planning efforts by building foundational knowledge on the current state of the science, emerging issues surrounding artificial reef development, and recent scientific and technological advancements. The facilitation team compiled and reviewed legal frameworks and policy documents; strategic plans and artificial reef program management plans; recent scientific research; and standards for artificial reef development, among other documents.

Due to the vast amount of artificial reef literature in existence, the research team focused its review on science articles published since 2007, the year the National Artificial Reef Plan was last updated. Moreover, the review effort looked primarily at artificial reef program development and research in U.S. waters in order to align findings with the geographic scope and focus of the workshop. This approach—including review of approximately 90 scientific publications and numerous state and local program management plans—enabled insight on relevant scientific research across a range of topics, technological advances, and program implementation in multiple states and localities across the country.

A **bibliography of identified literature and resources** can be found on the workshop webpage: <http://www.nmfs.noaa.gov/sfa/management/recreational/artificial-reef-workshop.html>

WORKSHOP AGENDA

WORKSHOP OBJECTIVES

- Provide an overview of current science and applied experience (lessons learned) regarding the application of artificial reefs as a tool to support or enhance sustainable fisheries.
- Identify and examine key considerations associated with artificial reefs as a potential management tool to support and/or enhance sustainable fisheries.
- Identify management challenges and associated research needs, knowledge gaps and limitations, and strategies for monitoring, using, and managing artificial reefs.
- Discuss the potential roles of federal, state and private sector partnerships in resolving artificial reef challenges and achieving objectives.

Thursday, June 9th	
8:30 – 8:45 am	<p>Welcome/Opening Remarks <i>Russ Dunn, NOAA Fisheries</i> <i>Pat Campfield, Atlantic States Marine Fisheries Commission</i></p>
8:45 – 9:00	<p>Agenda Review and Guidelines for Discussion <i>Rich Wilson, Seatone Consulting</i></p>
9:00 – 9:30	<p>Summary of Pre-Workshop Survey Findings and Themes <i>Rich Wilson, Seatone Consulting</i></p> <p>Present an overview of survey findings/themes and links to workshop agenda.</p>
9:30 – 10:00	<p>Background and History of Artificial Reefs in U.S. Waters <i>Richard Christian, U.S. Fish and Wildlife Service</i></p> <p>Set the stage for collaborative workshop discussions by presenting a historical perspective of artificial reefs in U.S. waters.</p>
10:00 – 10:15	Break
10:15 – 11:15	<p>Viewing Artificial Reefs Within a Fisheries Management Context</p> <ul style="list-style-type: none"> • Fisheries Management: Principles, Practices and the Connection to Artificial Reefs: <i>Steve Bortone, Gulf of Mexico Fishery Management Council (retired)</i> • NOAA Ecosystem Based Fisheries Management Policy: <i>Kirsten Larsen, NOAA Fisheries Office of Science and Technology</i> <p>Frame the issue of fisheries management, and the connection to artificial reefs as a potential management tool, that will be discussed throughout the workshop.</p>

11:15 – 11:45	<p>Overview of the Artificial Reefs Regulatory Framework <i>Keith Mille, Florida Fish and Wildlife Conservation Commission</i></p> <p>Create common knowledge and understanding on artificial reef governance, permitting requirements and associated regulatory issues.</p>
11:45 – 1:00	<p>Lunch</p>
1:00 – 2:30	<p>Regional Experiences and Lessons Learned in Artificial Reef Application <i>Regional presentations followed by Panel discussion:</i></p> <ul style="list-style-type: none"> • Mid Atlantic: <i>Mark Rousseau, ASMFC Artificial Reef Committee</i> • South Atlantic: <i>Bob Martore, South Carolina Department of Natural Resources</i> • Gulf of Mexico: <i>Dale Shively, Texas Parks and Wildlife Department</i> • West Coast: <i>Michele Culver, Pacific Fishery Management Council</i> • Hawaii: <i>Paul Murakawa, Hawaii Department of Land and Natural Resources</i> <p>Create awareness of common and unique approaches regarding artificial reef program objectives and strategies, applied experiences, and lessons learned on what does or does not work.</p>
2:30 – 2:45	<p>Break</p>
2:45 – 4:45	<p>Regional Experiences and Lessons Learned in Artificial Reef Applications <i>Break out groups – Initial collaboration and solutions-oriented discussions:</i></p> <p>Share regional experiences and lessons learned, and begin developing solutions to common challenges.</p>
4:45– 5:00	<p>Summarize Day 1 Outputs and Preview Day 2 Activities</p>
<p>Friday, June 10th</p>	
8:30 – 8:45 am	<p>Welcome, Recap Day 1 and Review Day 2 Agenda <i>Rich Wilson, Seatone Consulting</i></p>
8:45 – 10:30	<p>The Current State and Potential Future Direction of the Science <i>Presentations followed by Panel discussion:</i></p> <ul style="list-style-type: none"> • Fisheries Management/Reef Function: <i>Bill Lindberg, University of Florida</i> • Design, Siting and Deployment: <i>Bill Gordon, University of Rhode Island</i> • Monitoring Purpose, Objectives and Standards: <i>Greg Stunz, Texas A&M</i> • Socioeconomics of Artificial Reefs: <i>Bill Huth, University of West Florida</i> • Artificial Reefs: The Good, the Bad and the Ugly: <i>Jim Bohnsack, NOAA Fisheries</i> <p>Describe and discuss the scientific basis that informs the application of artificial reefs as a potential management tool to enhance sustainable fisheries.</p>

10:30-10:45	Break
10:45 – 12:30	<p>The Current State and Potential Future Direction of the Science (continued) <i>Breakout groups – Explore outstanding science gaps, partnerships and priorities</i></p> <ul style="list-style-type: none"> • Identify science gaps that need to be addressed to advance the potential for use of artificial reefs as a management tool. • Illustrate key elements of partnerships and/or cooperative arrangements among federal, state, university and other researchers. • Identify short and long-term priorities and discuss how future research might be better focused.
12:30 – 1:45	Lunch
1:45 – 3:45	<p>Fostering Mutual Learning and Advancing the Discussion <i>Break out groups – Important workshop takeaways and future collaboration</i></p> <p>Discuss new knowledge and ideas gained at the workshop, and ways to improve communication, information sharing and collaboration among peers.</p>
3:45 – 4:00	<p>Closing comments <i>Russ Dunn, NOAA Fisheries</i> <i>Pat Campfield, Atlantic States Marine Fisheries Commission</i></p>
4:00	Workshop Adjourns

PRESENTATIONS AND MATERIALS: A number of presentations by artificial reef experts and practitioners will be shared and spur group conversation throughout the course of the workshop. Additional materials to support breakout group discussions will be provided at the workshop. Digital copies of materials will be available for download on the following workshop webpage the week of June 13th:

<http://www.nmfs.noaa.gov/sfa/management/recreational/artificial-reef-workshop.html>

GUIDELINES FOR DISCUSSION

1. **Electronics courtesy** – please silence or turn off all devices that might interrupt us
2. **Common conversational courtesy** – please do not interrupt others, please use appropriate language, and please do not make it hard to hear by having third-party conversations at the table
3. **Be comfortable** – take personal breaks if needed, restrooms and refreshments provided, feel free to stand and stretch
4. **Humor is welcome** – it just should not be at someone else's expense
5. **Share the air** – the facilitator will balance participation by checking in with people who haven't spoken, and asking those with repeated comments to wait until others have joined in the conversation
6. **Treat each other with respect** – people have different backgrounds, expertise, and experience; seek to understand their interests and ideas, not dismiss them
7. **All ideas and points of view have value** – nobody's ideas are more valued than someone else's; if you do not agree with something, propose an alternative that could meet everyone's interests
8. **Avoid editorials** – avoid judging other people's motives or the value of their actions; instead tell us what is important for you to consider this work to be a success
9. **Honor time** – we have a full agenda and need to spend some time with each topic



BACKGROUND AND HISTORY OF ARTIFICIAL REEFS IN U.S. WATERS

*An **artificial reef** may be described as one or more objects of natural or human origin deployed purposefully on the seafloor to influence physical, biological or socioeconomic processes related to living marine organisms. (Seaman and Jensen, 2000)*

Centuries ago, sailors and seafarers recognized that sunken vessels and all sorts of other objects that found their way to the sea floor would soon colonize with life. As early as the 1830s, curious individuals began purposefully building artificial reef structures off the coast of South Carolina using log huts. Over 100 years later, in the 1950s, fishermen began sinking man-made “materials of opportunity” or “secondary use materials” such as railcars, buses, tires, porcelain toilets and a myriad of other objects in an attempt to enrich marine life in local fishing areas. In the ensuing decades, marine resource managers, scientists and fishermen gradually became much more purposeful in artificial reef design, siting, construction and monitoring.



Conference on Artificial Reefs and Related Aquatic Habitats (CARAH)

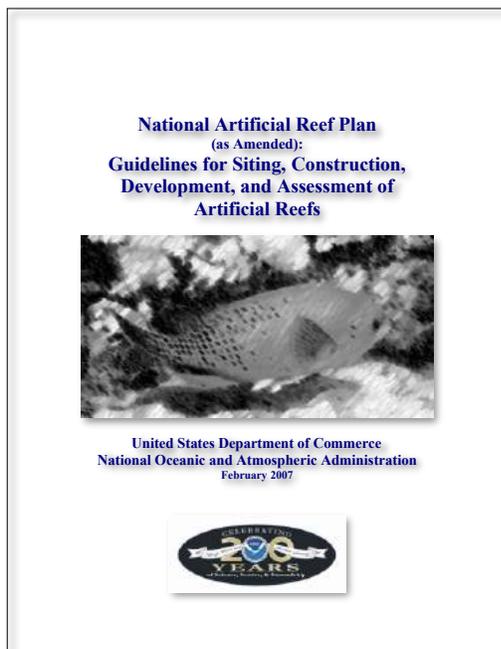
In the spring of 1974, a cohort of 250 international scientists gathered together in Houston, Texas to discuss and deliberate the potential value of artificial reefs. This gathering represented the first international conference of its kind, focused exclusively on artificial reefs, and was designed to bring colleagues of mutual interest together to “...improve the exchange of information among persons interested in artificial reefs and focus international attention on the potential use of artificial reefs in fishery management.” There have been 10 CARAHs convened since the first conference in 1974, with the most recent event held Turkey in 2013. Each of these gatherings have fostered collaboration and further identified key considerations related to the potential role of artificial reefs in fisheries management.

National Artificial Reef Plan

No national oversight of artificial reef development in U.S. waters existed in the early 1980s, even though a growing number of states had programs underway by this time. In recognizing the increased use of artificial reefs, and the need for good practices, the National Fishing Enhancement Act (Act) of 1984 directed the Department of Commerce, and by extension the National Oceanic and Atmospheric Administration (NOAA), to develop a long-term, national plan to guide artificial reef development in U.S. waters.

The purpose of the Act is to “promote and facilitate responsible efforts to establish artificial reefs in the navigable waters of the United States and waters superjacent to the outer continental shelf (as defined in 43 USC, Section 1331) to the extent such waters exist in or are adjacent to any state.” The Act set national standards in place for artificial reef development, specifically noting that artificial reefs in waters covered under the Act, “...shall be sited and constructed, and subsequently monitored and managed in a way that will:

1. Enhance fishery resources to the maximum extent practical;
2. Minimize conflicts among competing uses of waters covered under this title and the resources in such waters;
3. Minimize environmental risks and risks to health and property; and
4. Be consistent with generally accepted principles of international law and shall not create any unreasonable obstruction to navigation.”



Under directive of the Act, a small group of National Marine Fisheries Service scientists crafted the first ever **National Artificial Reef Plan** (National AR Plan, or Plan) in 1985. The Plan is a dynamic, working document, designed to be updated as new information becomes available. Initial revisions to the original document occurred between 1996 and 1998, and a formally revised Plan was completed and re-published by NOAA in 2007. Today approximately half of U.S. coastal states have artificial reef program planning documents or strategic plans based, at least in part, on guidance from the National AR Plan.

The National AR Plan provides state and local artificial reef program managers, policy makers and interested parties with guidelines and resources on siting, construction, development and assessment of

artificial reefs. In addition, the Plan outlines the respective roles of federal, state and local governments in the permitting, oversight and ongoing management of artificial reefs. Despite the Federal government’s broad role, there is currently no federally coordinated program regulating artificial reef activities in U.S. waters. Responsibility for artificial reef permitting and oversight is divided among five federal entities:

- **U.S. Department of the Interior (DOI)** through the U.S. Fish and Wildlife Service provides funding for state artificial projects that enhance recreational fisheries resources.
- **Department of Commerce (DOC)** through NOAA provides a long-term National AR Plan for responsible and effective artificial reef use.
- **Department of Defense (DOD)** through the U.S. Army Corps of Engineers is the lead federal

agency for permitting artificial reefs.

- **Department of Transportation (DOT)** through the Maritime Administration has provided surplus ships for artificial reef construction material.
- **Environmental Protection Agency (EPA)** oversees the placement of fill material or structures used to create artificial reefs.

Link to the National AR Plan here: [PDF – 1 MB](#)

PRESENTATION: A Brief History of Marine Artificial Reef Development in U.S. Waters

PRESENTER: Richard Christian, Tribal Fisheries Liaison, Fish and Aquatic Conservation Program, U.S. Fish and Wildlife Service

The story of artificial reef development in U.S. marine waters starts with, and continues to evolve, around marine sport fishermen, associated organizations, and their desire to enhance recreational fishing opportunities. Commercial applications and large-scale commitment of research and development funds have lagged behind other countries such as Japan. Innovative entrepreneurial activities cropped up in the 1990s that led to establishment of successful businesses catering to the needs and financial capacities of clubs, coastal communities and state agencies. The evolution of artificial reef development has been supported and limited by sustainable sources of appropriate materials and the funds to acquire, transport, and place them, as well to monitor and maintain the reef structures. The earliest recorded history of reef development dates back to the 1800's and reached a peak of development and innovation under significant state and federal government oversight in the mid to late 1980's with passage of the National Fishing Enhancement Act (NEFDA), promotion of the Rigs-to-Reefs initiative by the then Minerals Management Service within the Department of the Interior and expansion of the Federal Aid in Sport Fish Restoration Act under the Wallop-Breaux Amendments. This presentation, takes a brief look at these activities and examines the effects of State and Federal oversight under relevant legislation and policies leading to the heydays of the 1980 and 90s with an overview of current federal policy guidance.

NOTE TAKING SPACE

VIEWING ARTIFICIAL REEFS WITHIN A FISHERIES MANAGEMENT CONTEXT

PRESENTATION: Artificial Reefs in Fisheries Management: Has the Time Come?

PRESENTER: Steve Bortone, Gulf of Mexico Fishery Management Council, *retired*

Artificial reefs (i.e., objects deployed to influence aquatic resources) have many uses, with fisheries management as the presumed paramount use. Practically, however, artificial reefs have not assumed a significant position in the fisheries management “tool box” because, at our current level of understanding, we lack the appropriate information to make the results of their application predictable. To facilitate the usage of artificial reefs in fishery management strategies, several measures must be adopted. Currently there are few standards that allow meaningful comparisons among artificial reef studies. The extraordinarily high variance among variables in the aquatic environment, coupled with inadequate replication of study designs, inhibits adequate testing to determine casual relationships between artificial reef attributes and fishery management objectives. Also, we lack a fundamental understanding of the community’s trophic response resulting from artificial reef deployments. Making artificial reefs a predictable option when addressing fishery management hinges on two independent approaches. Organization is needed overcome the study design issues to facilitate the assessment of artificial reef evaluation studies. Lastly, under the assumption that the addition of artificial reefs to the environment will facilitate fish populations, investigations are needed to identify life history attributes that would be enhanced through the addition of specific artificial reef attributes.

NOTE TAKING SPACE

NOAA ECOSYSTEM BASED FISHERIES MANAGEMENT POLICY AND ROAD MAP

PRESENTATION: NOAA Ecosystem Based Fishery Management Policy

PRESENTER: Kirsten Larsen, National Habitat Science Coordinator, Office of Science and Technology, NOAA Fisheries

The long-term health of our marine fisheries resources depends on our ability to understand and account for the interactions among key species, their environment, and the people who rely upon them for food, recreation, and their livelihood. NOAA's National Marine Fisheries Service (NMFS) is responsible for stewardship of the nation's living marine resources and their habitat, and **ecosystem based fisheries management** (EBFM) is important for achieving these objectives. EBFM is an integrated, science-based approach that includes consideration of the entire ecosystem, including people. We continue to evolve and expand our science-based management capabilities under the framework of the Magnuson-Stevens Act and other federal laws.

NMFS has written two internal documents to codify and guide continued progress toward development and implementation of EBFM approaches: the **EBFM Policy** and **EBFM Road Map**. This new policy codifies NMFS' commitment to ecosystem-based fishery management in the agency's resource management decisions. The EBFM policy establishes a framework of six *guiding principles* to enhance and accelerate the implementation of ecosystem-based fishery management within NOAA Fisheries. These are:

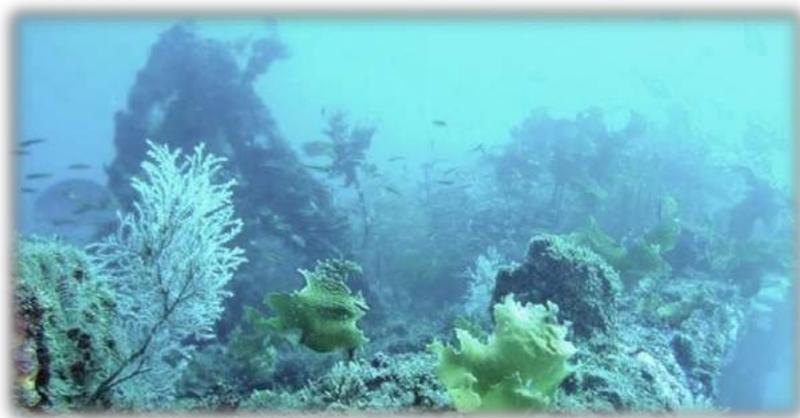
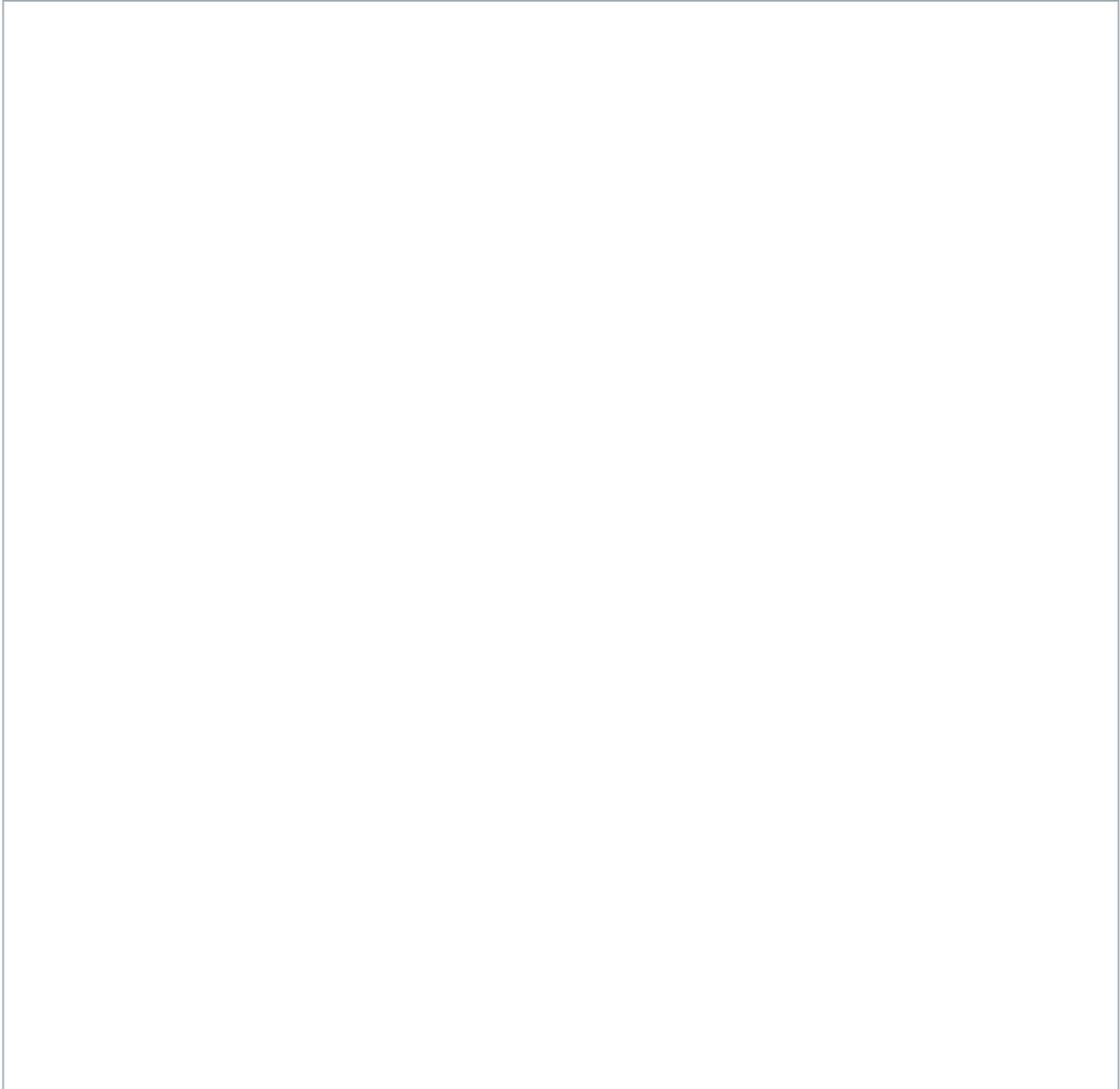
1. Implement ecosystem-level planning
2. Advance understanding of ecosystem processes
3. Assess risks and vulnerabilities
4. Explore trade-offs
5. Incorporate ecosystem considerations into management advice
6. Maintain ecosystem resilience and social well-being

The policy complements existing policies and recognizes the important roles played by Councils, Commissions, Tribes and states in supporting healthy and productive fish populations for the long-term benefit of our oceans and coastal communities.

NMFS and the Fishery Management Councils are already implementing some ecosystem-based fisheries management, but the draft road map outlines the next steps to further implement the EBFM Policy and the six guiding principles over the next five years.

In some areas of the world, artificial reefs have been used to enhance or restore ecosystem services and functions. As NMFS continues to increase and evolve their approach to EBFM, the effects of artificial reefs on fisheries and ecosystems as a whole may be considered.

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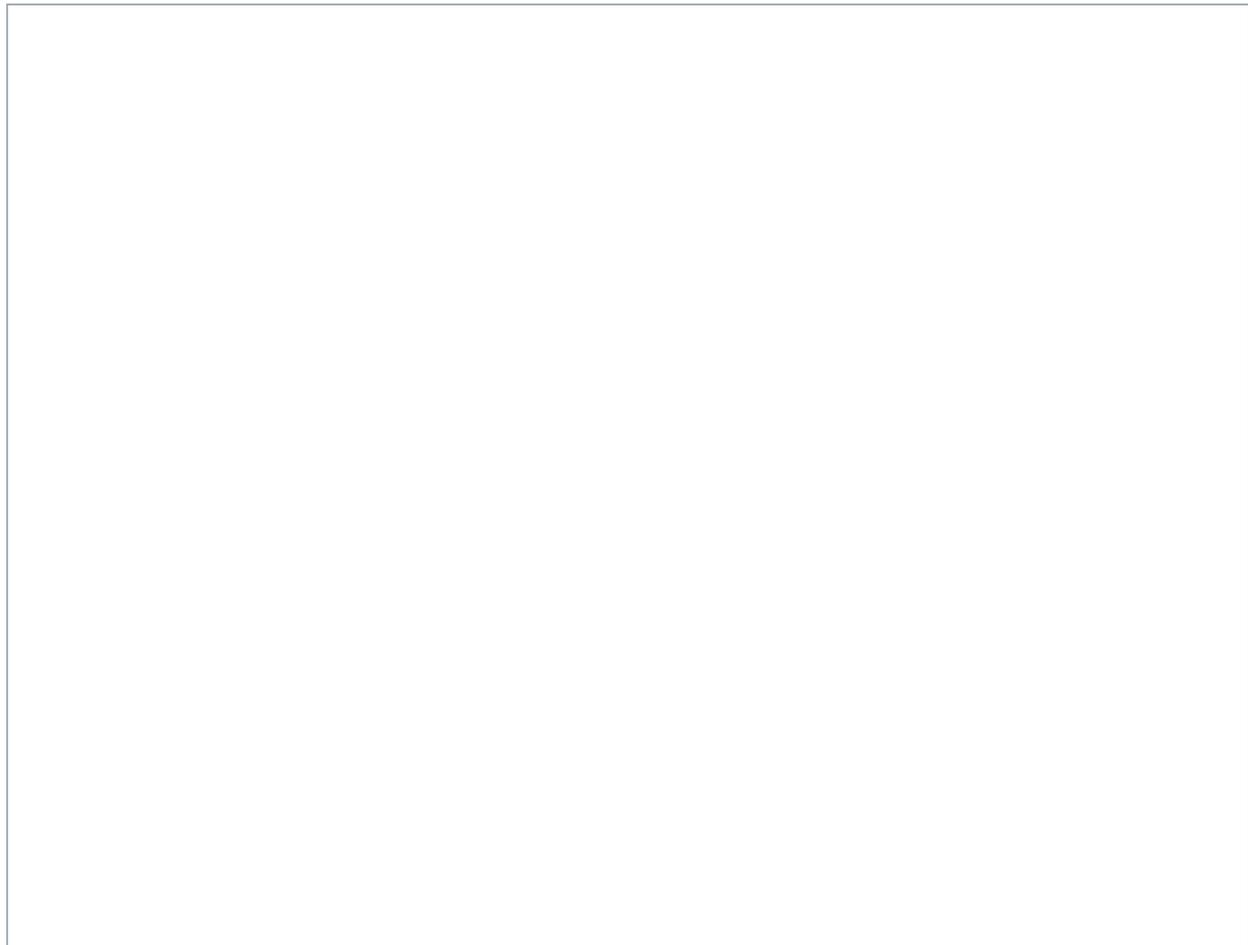
OVERVIEW OF THE ARTIFICIAL REEF REGULATORY ENVIRONMENT

PRESENTATION: Overview of the Artificial Reef Regulatory Environment

PRESENTER: Keith Mille, Florida Fish and Wildlife Conservation Commission

Regulatory requirements for marine artificial reef construction provide the spatial, physical and temporal boundaries within which manmade marine habitats are authorized. This presentation provides a brief overview of the purpose and authority of federal, state and local regulatory requirements for artificial reef development in state and federal waters of the United States. This includes navigational restrictions, material standards, environmental and historical resource requirements, political boundaries and avoiding conflict with other human uses of the seafloor. The regulatory implications of non-permitted activities and past problematic materials are reviewed, and opportunities for improved coordination are discussed. Appreciation and understanding of the regulatory framework is critical for fisheries managers to realize the constraints for future marine artificial reef development.

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REGIONAL EXPERIENCES AND LESSONS LEARNED

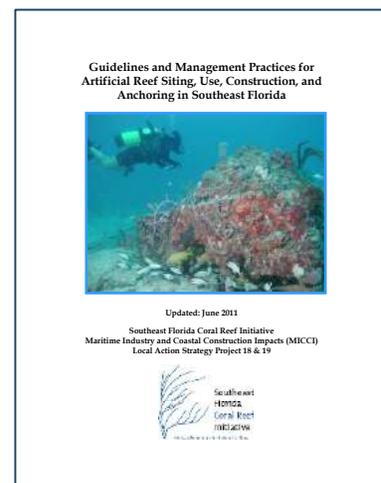
The associated series of presentations, discussions, and breakout group work related to *regional experiences and lessons learned* are intended to create awareness of both common and unique approaches regarding artificial reef program objectives and strategies among workshop participants, and to share applied experiences and lessons learned on what may or may not work.

EVOLUTION OF STATE PROGRAMS AND REGIONAL COLLABORATION

In coastal regions of the United States—most notably the mid-Atlantic, south Atlantic and Gulf of Mexico—state resource management agencies, and in some places local governments, have developed comprehensive strategic and program planning documents to guide artificial reef development in inshore, nearshore and offshore waters. The genesis of this effort lies in the early artificial reef conferences of the 1970s, pioneering efforts to apply artificial reefs as a fishery enhancement tool, and the eventual establishment of the National Artificial Reef Plan for U.S. waters in 1985.

From the late 1980s to the early 2000s, several states made significant strides forward in developing and implementing artificial reef programs, and others have developed since this time. During the same time period, both the Atlantic States Marine Fisheries Commission and the Gulf States Marine Fisheries Commission established formal artificial reef committees as a mechanism to foster collaboration between state programs, and with federal agencies, regulators and scientists. Capitalizing on this collaborative engagement and drawing on the practical experience of multiple states, these interstate marine fisheries commissions played a central role in updating the National AR Plan in 2007.

Several states have continued the process of developing and utilizing comprehensive program planning documents since the 2007 National AR Plan revision. Moreover, nascent artificial reef programs are evolving in Hawaii, California, Oregon and Washington, and other U.S. territories. Most state program planning documents—building on the standards and guidelines in the National AR Plan—outline state level policies and program goals, and describe key considerations on a range of issues including but not limited to permitting, design and siting, monitoring and adaptive management. Many also include useful information for resource users, such as artificial reef site coordinates, maps and contact information of relevant management authorities and permitting agencies.



Many state agencies and interstate marine fisheries commissions now include information about their artificial reef programs on their respective websites. Interested parties are encouraged to learn about different state programs via the hyperlinks below.

[Atlantic States Marine Fisheries Commission](#)
[Gulf States Marine Fisheries Commission](#)
[Alabama](#)
[California](#)
[Delaware](#)
[Florida](#)
[Georgia](#)
[Hawaii](#)
[Louisiana](#)

[Maryland](#)
[Massachusetts](#)
[Mississippi](#)
[New Jersey](#)
[New York](#)
[North Carolina](#)
[Rhode Island](#)
[South Carolina](#)
[Texas](#)
[Virginia](#)

REGIONAL PRESENTATIONS AND PANEL DISCUSSION

REGION: Mid Atlantic

PRESENTER: Mark Rousseau, ASMFC Artificial Reef Committee

REGION: South Atlantic

PRESENTER: Bob Martore, South Carolina Department of Natural Resources

REGION: Gulf of Mexico

PRESENTER: Dale Shively, Texas Parks and Wildlife Department

REGION: West Coast

PRESENTER: Michele Culver, Pacific Fishery Management Council

REGION: Hawaii

PRESENTER: Paul Murakawa, Hawaii Department of Land and Natural Resources



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CURRENT STATE AND POTENTIAL FUTURE DIRECTION OF THE SCIENCE

The associated series of presentations, discussions, and breakout group work related to the *current state and potential future direction of the science* are intended to:

- Describe and subsequently facilitate discussion on the scientific basis that informs the application of artificial reefs as a potential management tool to enhance sustainable fisheries;
- Identify science gaps that need to be addressed to advance the potential for use of artificial reefs as a management tool;
- Illustrate key elements of partnerships and/or cooperative arrangements among federal, state, university and other researchers; and
- Identify short and long-term priorities and discuss how future research might be better focused.

LITERATURE REVIEW AND PRE-WORKSHOP SURVEY FINDINGS/THEMES

Indicative of this workshop's objectives, much more research and attention has been directed to the key considerations of artificial reefs as a potential fisheries management tool over the last decade than ever before. Researchers are conducting investigations through this lens with greater frequency, including building artificial reefs to suit a particular species' needs, or for a given stage of that species' life history, to inform specific management objectives. Artificial reef design and complexity (i.e. rugosity, total volume, number of refugia, vertical structure, etc.)



has also become a prominent focus of both research and management in recent years.

The 2007 National AR Plan emphasizes monitoring as a critically important component of artificial reef management. Monitoring remains a major topic of discussion in the scientific community, as the literature reveals there is no precise agreement among various agencies and individuals on what constitutes acceptable and/or scientifically rigorous monitoring. However, the array of existing state and local program planning documents,

along with a review of the literature, suggests most if not all managers and researchers continue to believe in the importance of establishing a baseline, and conducting ongoing monitoring of artificial reefs, in order to evaluate performance against stated program objectives.

Managers, scientists and others working on artificial reef programs or projects continue to explore the application of new technologies for monitoring (e.g. side scan sonar, multi-beam

water column imagery, isotope ratios, passive acoustic recordings, etc.), as well as new materials and design. Advances in technology have enabled sophisticated methods to become more affordable, the traditional methods of visual observation remain essential to the field.

Not surprisingly, a large body of research has come from the Atlantic and Gulf States, where the majority of the artificial reefs in U.S. waters are established and monitored. A number of studies related to the conversion of rigs-to-reefs have recently been conducted in California. Due to increased interest in evaluating the potential of artificial reefs as fishery management tools, ample research can be found on targeted commercial or recreational fish species, such as red snapper (*Lutjanus spp.*) and gag (*Mycteroperca microlepis*).

EMERGING RESEARCH AND TOPICS FOR FURTHER STUDY

Socioeconomics related to artificial reefs is another emerging topic of investigation. Recent studies look at artificial reef valuation, return on investment, and resultant human-behavior interactions, such as shifting recreational diving and fishing patterns. While socioeconomic impacts vary regionally and often are not well quantified, researchers on this topic have pointed out that an increase in applied research on human dimensions and associated fishery activities may be useful.

In the last decade, researchers have also focused attention on topics such as reef community ecology and community production in an attempt to address the ongoing debate of attraction-versus-production of artificial reefs as compared to natural reef habitat. Several key questions are rising to the top of the discussion among researchers and managers, including:

- Do artificial reefs inadvertently facilitate the establishment or spread of invasive fish populations (e.g. lionfish in the Gulf of Mexico)?
- What is the ability of artificial reefs to act as stepping-stones that facilitate native species dispersal?
- Is there a difference in natural and fishing-related mortalities of fish species on artificial reefs as compared to other natural habitats?
- How do artificial reefs affect disease frequency in fish and invertebrates?
- What are the effects of artificial reefs on living resource production?
- What is the long-term structural integrity of certain reefs?
- What are the cost-benefit relationships among reef types, materials, designs, and deployment methods, and how do these varieties relate to fishery productivity or other factors, such as user accessibility?
- How do artificial reefs contribute to changes to the socioeconomic conditions of adjacent coastal communities?
- How would artificial reefs support the various life stages of estuarine-dependent fishery resources in the highly variable estuarine environment?

Lastly, it is important to bring renewed attention to the topics identified by artificial reef program and fishery managers as areas where more research and information is required. In their 2007 National AR Plan, managers listed the following issues in order of priority:

- Estuarine Applications
- Understanding Reef Community Ecology
- Reef Population Life Histories
- Bioengineering and Design
- Harvest Analysis
- Reef Population Dynamics
- Socioeconomics
- Community Production
- Reef Data Acquisition and Distribution
- Mitigation

PANELIST PRESENTATIONS AND DISCUSSION

PRESENTATION: Ecological Functioning of Artificial Reefs with Fisheries Management Implications

PRESENTER: Bill Lindberg, University of Florida

Protracted debates like the Attraction-Production Question generally involve philosophical as well as scientific differences. Production aspects of this debate have received the most attention, yet habitat selection theory and the process of density-dependent habitat selection (DDHS) might offer greater understanding of the fisheries management implications. As a model system, prior reef experiments established DDHS by gag (*Mycteroperca microlepis*), with shelter taking precedence over growth. A demographic bottleneck was hypothesized for strong year classes crossing the inner continental shelf, with the Steinhatchee Fisheries Management Area created as a test. Results to date corroborate predictions from MacCall's Basin Model about trends in gag abundance as a function of intrinsic habitat quality and stock size, with implications for hyperstability in catch per unit effort (CPUE), spatial redistribution within a region and consequences of spatial perturbations affecting natural mortality and/or emigration. Corresponding effects on effort distribution are expected, but not yet modeled. Issues of scale remain the biggest challenges (e.g. the geographic scale of fisheries stocks versus the localized scale of artificial reef projects; spatial behavior of target species across scales; temporal scales of stochastic drivers), which require spatially explicit data and modeling.

PRESENTATION: Planning Artificial Reefs in the U.S.: Recent Trends and Evolutionary Challenges

PRESENTER: Bill Gordon, University of Rhode Island

Since the early 1970s, there has been an inconsistent use of the terms 'siting' and 'planning' within the U.S. Artificial Reef (AR) community. Siting involves the choice of a specific location for AR deployment, while planning refers to the proactive process leading to the placement of reefs. In the 1950s, California was among the first states to manage and plan reef deployments. It was not until the 1970s and 80s that government agencies and fishing advocates began publishing guides to AR planning. During the 1980s and 90s, reef development involved mostly single placement of "materials of opportunity." With the availability of appropriate materials for reef construction, reef "planners" focused on site specific applications. Considered too much of a reactive process by some, a need was articulated to develop a comprehensive system of planning, based upon regional "needs." Even the National Artificial Reef Plan, and its subsequent updates, have yet to engage in a comprehensive, proactive approach. Arguably, AR planning has been dormant for 20 years. A resurgence is required to determine how AR

development fits within current state CZM/fishery management agendas. Finally, will AR development become an afterthought within the proposed spatial zoning/management of near and offshore bottom lands that are found within Marine Spatial Planning?

PRESENTATION: Science Informing Artificial Reefing Practices: Key Findings, Knowledge Gaps, and Future Directions from the Northwestern Gulf of Mexico

PRESENTER: Greg Stunz, Texas A&M University, Corpus Christi

Artificial structures are the dominant complex marine habitat type along the northwestern Gulf of Mexico shelf. These habitats can consist of a variety of materials, but in this region consist primarily of both active and reefed oil and gas platforms. The dynamics of fish communities inhabiting these structures remain poorly investigated. Thus, there is a need to standardize sampling methodologies across broad basin-scales to better understand the performance of artificial structures and provide the reefing community with 'wise-science' to maximum reefing success. Moreover, projects are often limited in resources (e.g., materials and finances), and by having a solid science foundation, managers can design the most cost-effective programs to accomplish their goals. This presentation will focus on the purpose, objectives and standards we have developed from our research and monitoring program in the northwestern Gulf of Mexico. We have shown these structures are highly valuable supporting diverse communities and abundant fishery species. We recommend a combination of approaches to assess their success such as SCUBA, vertical line, and remotely operated vehicles. Overall, our data indicate that using a variety of methodologies may best capture the entire community assemblage. Additionally, it is important to compare the performance of artificial structures to Gulf of Mexico natural reefs using rigorous experimental designs to fully understand their functionality.

PRESENTATION: Artificial Reef Socioeconomics: Everything but the Kitchen Sink

PRESENTER: Bill Huth, University of West Florida

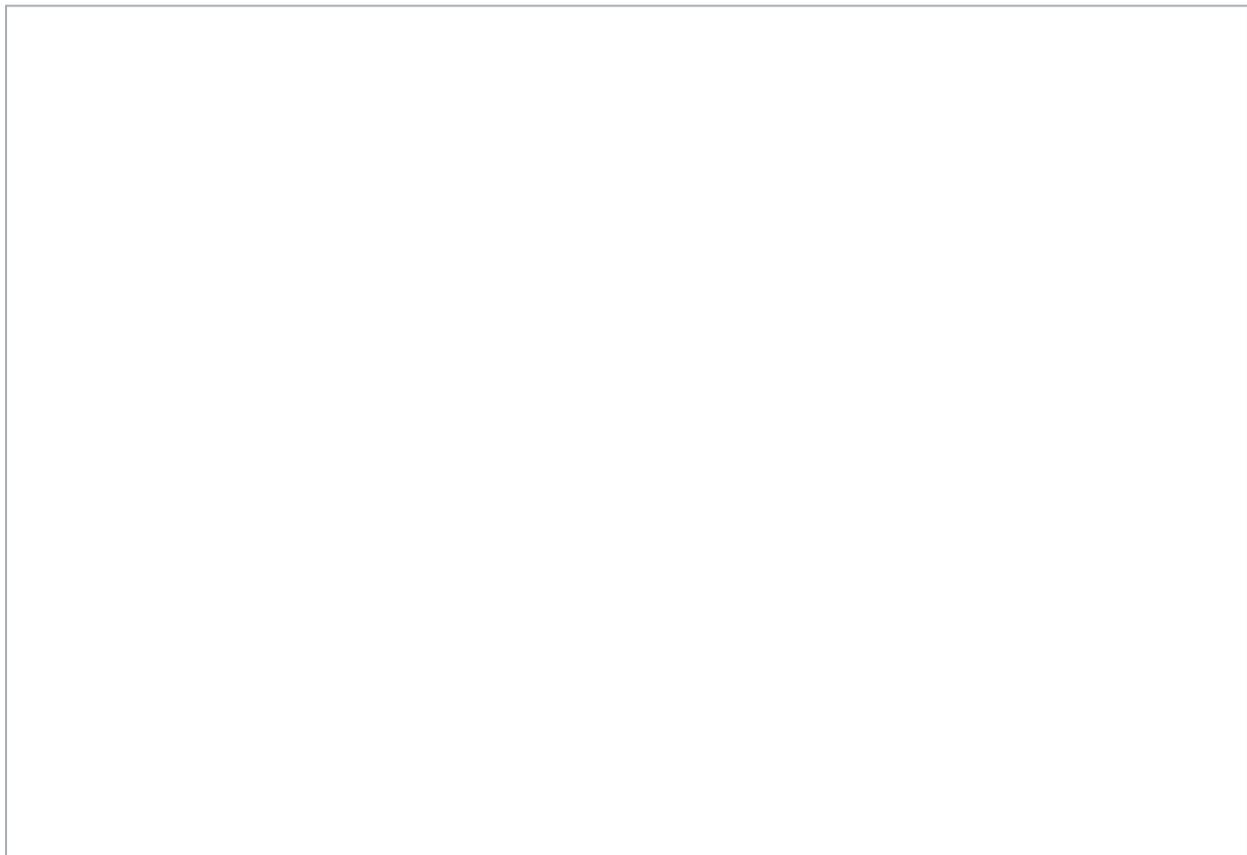
Economics is threaded throughout the fishery management process. The Magnuson-Stevens Fishery Management and Conservation Act requires attention to the environmental, sociological, and economic aspects of fisheries and artificial reefs impact each of those performance elements. Valuing artificial reefs is important in investment decision making where the return on reef investment is often implicit. Valuation includes calculating economic impact and value along with other ecosystem service contributions. Reef stakeholders include those engaged in infrastructure development and reef users; commercial and recreational fishing and diving. Valuation across user groups requires measuring willingness to pay which can be accomplished through contingent valuation of user stated and revealed preferences. Along with preferences, regular assessment of stakeholder attitudes and opinions regarding reefs can be inputs into fishery management decision making. The assessment can be accomplished using state fishing license databases and the National Angler Registry to recruit and manage an online research panel to provide statistically representative sampling using survey instruments designed to address fishery management and artificial reef issues. Finally, socioeconomic issues surrounding the threat on natural and artificial reefs from invasive species (e.g. lionfish) can be addressed by supporting the development of a fishery.

PRESENTATION: Artificial Reefs: The Good, the Bad and the Ugly

PRESENTER: Jim Bohnsack, NOAA Fisheries

Public expectations for artificial reefs (ARs) often are not realistic. The usual assumption is that habitat is limiting and that deploying ARs can increase total fish abundance. ARs function on a gradient between simply aggregating existing fish with little net production (attraction) to increasing the abundance and size of new fish from higher growth and survival (production). New production is most likely for sedentary and obligatory reef species where natural reef occurrence and fishing pressures are low. New net fish production is predicted to be low in areas of high natural reef habitat availability, high fishing pressure, and for highly mobile and non-obligatory reef species (Bohnsack 1989). Fishing for species attracted to ARs is not a problem from a fishery perspective unless the population is overfished. When overfishing occurs, ARs can accelerate population depletion by concentrating remaining fishes and making them easier to exploit. In this case, the amount of reef habitat is not limiting. The limiting factor is the abundance and size of reproductive females and total reproduction, or for some species the availability and suitability of non-reef nursery habitat. Other fisheries management programs may be more important for fishing success than building artificial reefs. This history of artificial reef programs is fraught with many mistakes, failures, and unacceptable practices. It is important to learn from past mistakes and do no harm.

NOTE TAKING SPACE



<< PARTICIPANTS MAY INSERT INDIVIDUAL WORKSHEET (B) HERE>>

FOSTERING MUTUAL LEARNING AND ADVANCING THE DISCUSSION

This workshop's presentation and discussion-based forum afforded the variety of participants in attendance the opportunity to share their experience and expertise with colleagues, and learn from each other as the discussion on artificial reefs in U.S. waters advances. As the field evolves, effective communication, innovative collaboration arrangements, and successful partnerships among federal, state, university and other researchers may prove highly valuable.

As we move into the workshop's last break-out session on fostering mutual learning and advancing the discussion, we hope you will have been able to identify new areas for potential partnerships, opportunities to take advantage of, barriers to your work that can now be anticipated and overcome, expertise or resources you could contribute to a collaborative effort, and key methods for communication that can be implemented in the future.

NOTE TAKING SPACE

Thank you for participating in the National Artificial Reef Workshop. We hope your time spent with colleagues has been meaningful, productive and helps guide your future endeavors!

<< PARTICIPANTS MAY INSERT INDIVIDUAL WORKSHEET (C) HERE >>

PRESENTER BIOGRAPHIES

Biographies are organized here by the order in which presenters were introduced in the workshop agenda.

**RICHARD CHRISTIAN, Tribal Fisheries Liaison
Fish and Aquatic Conservation Program, U.S. Fish and Wildlife Service**

Upon completion of a Bachelor of Science degree at Texas A&M College of Marine Science in Galveston TX in 1979, Richard began his career in fisheries at the National Marine Fisheries Service's Fort Crockett Lab in Galveston, working on the shrimp mark and recapture program. He received a MS in 1986 from Texas A&M in Recreation and Renewable Resources with thesis work on Texas red drum legislation. With a focus on fish politics, he took an internship in Washington DC with the Sport Fishing Institute (now American Sportfishing Association). He has remained in DC working on both saltwater and freshwater fisheries issues interacting with representatives from the fishing industry, state and federal governments, and national policy makers. In addition to early beginnings with NMFS, his career has included stints with private industry conducting research and development on marine artificial reefs, the Sport Fishing Institute, the Atlantic States Marine Fisheries Commission, and the U.S. Fish and Wildlife Service (USFWS). Since coming to work for the USFWS in 2000, he has held positions in the national headquarters as Chief of Budget, Policy and Legislation for the National Fish Hatchery System, Partnership Coordinator for Fish and Aquatic Resources Conservation, and Chief of the Branch of Communications and Partnerships for Fish and Aquatic Conservation (FAC). He is currently the Tribal Fisheries Liaison with FAC.

**STEPHEN BORTONE, Ph.D.
Osprey Aquatic Sciences, LLC**

Stephen A. Bortone retired as Executive Director of the Gulf of Mexico Fishery Management Council and is now a consultant with Osprey Aquatic Sciences, LLC. Formerly, he was Director of Minnesota Sea Grant College and Professor of Biology at the University of Minnesota Duluth. He was Director at: The Sanibel-Captiva Conservation Foundation Marine Laboratory; Environmental Science at the Conservancy of Southwest Florida; and the Institute for Coastal and Estuarine Research while Professor of Biology at the University of West Florida. Dr. Bortone received the B.S. degree (Biology) from Albright College; the M.S. degree (Biological Sciences) from Florida State University, and the Ph.D. (Marine Science) from the University of North Carolina – Chapel Hill. He published 173 articles, chiefly on fisheries and edited five books: Sea Grasses, Biology of the Spotted Sea Trout, Estuarine Indicators, Artificial Reefs in Fisheries Management, and Interrelationships between Corals and Fisheries – all with CRC Press. He was Visiting Scientist at The Johannes Gutenberg University (Mainz, Germany) and was a Mary Ball Washington Scholar at University College Dublin, Ireland. He is a "Fellow" with the American Institute of Fishery Research Biologists, a "Certified Fisheries Professional" by the American Fisheries Society and a "Certified Senior Ecologist" by the Ecological Society of America.

**KIRSTEN LARSEN, National Habitat Science Coordinator
Office of Science and Technology, NOAA Fisheries**

For the last seven years Kirsten has been the Habitat Science Team Lead and Coordinator in the NMFS Office of Science and Technology, working to build a more cohesive and organized habitat science presence within NMFS and across NOAA. This includes developing relationships between habitat scientists and managers across the agency, helping to align science activities to management information needs, and developing and promoting new habitat science budget initiatives as outlined in the new Habitat Blueprint. Prior to this Kirsten worked in the NMFS front office under the Chief Scientist, and was a Knauss Sea Grant Fellow. Before arriving at NOAA, Kirsten was a fisheries researcher at the Gulf Coast Research Laboratory, University of Southern Mississippi (USM) and sailed on NMFS white ships as a contractor. She received her Master's degree in biological and fisheries sciences from USM and her Bachelor's degree at the University of Wisconsin-Eau Claire in Biology and Chemistry.

**KEITH MILLE, Biological Administrator
Florida Artificial Reef Program, Florida Fish and Wildlife Conservation Commission**

Keith Mille is Biological Administrator of Florida's Artificial Reef Program within the Division of Marine Fisheries Management at the Florida Fish and Wildlife Conservation Commission in Tallahassee, Florida. Keith has been with the Artificial Reef Program for 14 years, recently promoted to Administrator in April 2016. The Program currently administers over \$12M state/federal grant funds for statewide artificial reef construction, monitoring and research; provides technical review and regulatory comment on artificial reef development; and coordinates workshops, strategic plans and best management practices to guide and prioritize Florida's artificial reef activities. Prior to joining the Artificial Reef Program, Keith worked with the Florida Department of Environmental Protection conducting statewide environmental regulatory review of coastal construction projects including beach nourishment, inlet maintenance dredging and mitigation artificial reef construction. Keith initially began his career with FWC Fisheries Independent Monitoring Program conducting estuarine fishery sampling along east-central Florida's Indian River Lagoon region. Keith is an experienced scientific and technical SCUBA diver, having logged over 1,000 dives across Florida's Gulf and Atlantic marine habitats during his 22-year tenure with the State of Florida. Keith is originally from Long Island, NY and received his Bachelor's Degree from the University of Rochester.

**MARK ROUSSEAU, Environmental Analyst
Massachusetts Division of Marine Fisheries, Fisheries Habitat Program in Gloucester MA**

Mark's work focuses on coastal aquatic habitat restoration, climate change impacts to fisheries, and artificial reef development. He has worked as DMF Artificial Reef Project Coordinator since 2010 and has served as the Massachusetts representative on the Atlantic States Marine Fisheries Commission (ASMFC) Artificial Reef Committee. He also represents MA DMF as a member of the ASMFC Habitat Committee and the Atlantic Coastal Fisheries Habitat Partnership (ACFHP) Steering Committee. He is currently working on establishing regulations to prohibit commercial fishing at a new artificial reef site in Nantucket Sound. He is also involved

in a NFWF grant to design and plan a shoreline protection project utilizing fabricated structures and to assess beneficial reuse potential of Boston Harbor material dredging. Mark holds a M.S. Degree from the University of New Hampshire and a B.S. from University of Massachusetts.

BOB MARTORE, Wildlife Biologist, Artificial Reef Coordinator
South Carolina Department of Land and Natural Resources

Bob Martore has been a marine biologist with the South Carolina Department of Natural Resources (SCDNR) for more than 30 years. After receiving his Master's Degree in Marine Science from the College of Charleston in 1986, he began working in Environmental Research at the South Carolina Marine Resources Research Institute in Charleston. In 1995 he moved to the field of fisheries management and, in 2000, became program manager of the South Carolina Marine Artificial Reef Program. In addition to overseeing all permitting and construction activities on the state's artificial reefs, Bob is the principal investigator and chief scientist for all artificial reef related research for the Marine Resources Division of SCDNR and serves on the department's Diving Control Board. He was responsible for the establishment of exclusive research reefs off South Carolina and the Southeast's first ever artificial reef Marine Protected Area (MPA). Bob is a past chairman of the ASMFC's Artificial Reef Technical Committee on which he has served for almost 20 years.

J. DALE SHIVELY, Program Leader
Texas Parks and Wildlife Artificial Reef Program

Dale Shively received his Master of Science degree in Oceanography from Old Dominion University, Norfolk, Virginia in 1984. With over 30 years of professional fisheries experience, he has been a marine fisheries biologist with Texas Parks and Wildlife since 1993 and has managed the Artificial Reef Program since 2003. Dale has also worked as an environmental biologist in Virginia, a tribal fisheries biologist with the Great Lakes Indian Fish and Wildlife Commission in Wisconsin, and as a Meteorology and Oceanography Officer in the U.S. Navy Reserves. He has published numerous popular and scientific articles and management reports through venues such as the Gulf States Marine Fisheries Commission and *North American Journal of Fisheries Management*.

MICHELE K. CULVER, Regional Director
Washington Department of Fish and Wildlife

Ms. Culver has worked for the Washington Department of Fish and Wildlife for 23 years and has been in her current position as the Regional Director of the coastal area since 2007. In this capacity, Ms. Culver coordinates with many overlapping tribal, federal, state, and local jurisdictions. She develops and oversees the implementation of policies and management decisions affecting fish, wildlife, and habitats within a diverse region with more than 200 employees deployed in four geographic districts across eight counties. The coastal region includes over 20,000 acres of Department-managed lands, with more than 200 access sites to public waterways, the estuaries of Grays Harbor and Willapa Bay and offshore Pacific Ocean

waters. Ms. Culver has represented the state on the Pacific Fishery Management Council since 2006, and is the Pacific Council's representative on the International Pacific Halibut Commission's Management Strategy Advisory Board and the West Coast Regional Planning Body for Ocean Planning.

PAUL MURAKAWA, Aquatic Biologist
Hawaii Department of Land and Natural Resources

Paul Murakawa is a State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources (DAR) Aquatic Biologist in the Fisheries Program. His major responsibilities include project leader for the State's Artificial Reef Project, co-project leader for the Oahu/Maui Marine Resources Assessment and Monitoring Project, and the Diving Safety Officer (DSO) for DAR. Paul was born and raised on the island of Oahu. He graduated from Castle High School and the University of Hawaii at Manoa with a B.A. in Zoology in 1991. Paul started with DAR as a Fishery Technician in 1991 and worked with rearing freshwater prawns, channel catfish, rainbow trout, striped mullet, and Pacific threadfin at the Anuenue Fisheries Research Center at Sand Island. In 2002, Paul became an Aquatic Biologist responsible for minimizing alien invasive species from entering Hawaii from ballast water and/or hull fouling. In 2005, he became the project leader of the State's artificial reef project. In his spare time, Paul enjoys recreational fishing.

BILL LINDBERG, Associate Director
School of Forest Resources and Conservation at the University of Florida

Bill Lindberg, Associate Director of the School of Forest Resources and Conservation at the University of Florida (UF), leads the Fisheries and Aquatic Sciences Program at UF. He teaches *Scientific Thinking in Ecology* for two graduate programs and *Foundations of Marine Sciences* for the undergraduate marine sciences major. His research addresses habitat selection, essential fish habitat, artificial reef design and spatial dynamics within reef fish populations. In the early 1990's he created the Suwannee Regional Reef System as a large-scale, long-term experiment, which led directly to the Steinhatchee Fisheries Management Area (SFMA). The SFMA is a large-area artificial reef research and demonstration project focused on fisheries conservation objectives. Bill contributed to the Florida Artificial Reef Strategic Plan; served on the Special Reef Fish Scientific and Statistical Committee of the Gulf of Mexico Fishery Management Council; gave the opening keynote for the 9th International Conference on Artificial Reefs and Associated Habitats (9th CARAH, Curitiba, Brazil in 2009) and was a steering committee member for the 10th CARAH (Izmir, Turkey, 2013). As a Florida Sea Grant Extension Specialist, Bill served on steering committees for numerous Florida Artificial Reef Summits and continues to work closely with the State of Florida's Artificial Reef Program.

**WILLIAM R. GORDON, Jr., Ph.D., Professor
University of Rhode Island**

Dr. William Gordon (Bill) is a Professor in the Department of Landscape Architecture at the University of Rhode Island, where he teaches coursework in Environmental Law and Planning. While at URI, he refined a research focus in how traditional planning concepts are implemented in 'non-related' coastal and marine settings. This evolved from his early work with Dr. Robert Ditton at Texas A&M University. It was at A&M, where Bill began a resource management interest in Artificial Aquatic Habitat. While there, Bill developed the early planning frameworks that became key components in the National Artificial Reef Plan (1985), as well as in the Sport Fishing Institute's (1985) Artificial Reef Planning Guide. In 1994, Bill wrote the first east coast Planning Guide for Artificial Reef development for the Atlantic States Marine Fisheries Commission (ASMFC). In recent years, he has served as a planning consultant to various federal and state agencies regarding state artificial reef programs and/or specific deployments (USACE, NMFS and FHA). Bill has written Environmental Impact Statements for proposed/constructed artificial reef complexes, especially with obsolete bridges. His recent research investigates how state artificial reef development initiatives will likely collide with newly proposed Marine Spatial Plans.

**GREGORY W. STUNZ, Ph.D., Director
Harte Research Institute at Texas A&M University, Corpus Christi**

Greg Stunz, Ph.D. is a marine biologist that specializes in fisheries ecology and sport-fisheries. He holds the Endowed Chair of Fisheries and Ocean Health at the Harte Research Institute for Gulf of Mexico Studies and is a Professor of Marine Biology. He also Director of the Center for Sportfish Science and Conservation. He received both his M.S. and Ph.D. in Wildlife and Fisheries Sciences from Texas A&M University (1995, 1999), and a B.S. in Biology from the University of Texas at San Antonio (1990). Dr. Stunz is also heavily involved in fisheries management and serves a member of the Gulf of Mexico Fishery Management Council. The overarching goal of Dr. Stunz's research program is to provide scientific data for sustainable management of our marine fisheries and ocean resources to ensure healthy environments. Dr. Stunz's research program is diverse but currently focuses on migration patterns of marine life using a variety of state-of-the-art electronic tracking devices, diving, and ROV. Much of this work centers on studies of artificial reefs in the Gulf of Mexico to better understand how these structures enhance and promote sustainable fisheries. Dr. Stunz is also engaged with numerous boards, panels, and scientific advisory committees from the local to national levels.

**BILL HUTH, Distinguished Professor
University of West Florida, Department of Marketing and Economics, UWF College of
Business**

Bill is engaged in marine related economic research including the continued development of artificial reefs and their place in fishery management. He is also interested in sea level rise and saltwater intrusion and is currently establishing a salt water intrusion monitoring system in the Floridan aquifer. Bill is a technical diver, an artificial reef economic research specialist, and author of many publications marine resource valuation. He also has research interests and

publications about consumer demand for Gulf of Mexico oysters and was principal investigator of a NOAA, National Sea Grant project to measure consumer response to consumption risk from oysters infected with *Vibrio vulnificus*. He was also the lead investigator on a Florida FWC project that measured Florida artificial reef economic benefits. That report documented saltwater fishing and diving economic value for Florida and each county. His current work examines the lionfish invasion problem and he developed the first measures of consumer willingness to pay for lionfish control through consumption. That paper is currently under review and has been accepted for presentation at the 2016 European Association of Environmental and Resource Economists Conference at the end of June.

JAMES (JIM) BOHNSACK, Ph.D.

Marine Ecologist and Director of the Protected Resources and Biodiversity Division, Southeast Fisheries Science Center (SEFSC)

Adjunct Professor and CIMAS Fellow, University of Miami's Rosenstiel School of Marine and Atmospheric Science

Dr. Jim Bohnsack actively conducted research on artificial reefs for his doctoral dissertation and for 25 years with the National Marine Fishery Service (NMFS). He graduated from Tulane University with a B.S. in biology and has a M.S. and Ph.D. from the University of Miami. Dr. Bohnsack's scientific research focus is to better understand natural processes and the impacts of human activities on marine ecosystems to increase public understanding, appreciation, awareness and wise management of marine ecosystems. His goals are to provide the knowledge and understanding necessary to help sustain and restore coral reef productivity and improve fishery management of marine ecosystems. Dr. Bohnsack's research has led to a better understanding and application of artificial reef technology, improved monitoring of coral reefs, the importance of ocean ethics, and the potential of marine ecological reserves to benefit fisheries and people.

LIST OF WORKSHOP PARTICIPANTS

Names and affiliations of participants who RSVP'ed by June 1, 2016. Asterisk () indicates National Artificial Reef Workshop Steering Committee member.*

First Name	Last Name	Affiliation
Alicia	Nelson	VA Representative; ASMFC Artificial Reef Committee
Alisha	Gray	Florida Fish & Wildlife Conservation Commission
Amy	Comer	NC Artificial Reef Biologist
Bill	Huth	University of West Florida
Bill	Gordon	University of Rhode Island
*Bill	Lindberg	University of Florida
Bob	Martore	South Carolina Department of Natural Resources
*Bob	Williams	NOAA Fisheries
Brian	Nunes-Vais	Anne E Clarke Foundation
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David	Bacon	Fish Reef Project
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Dean	Rewerts	California Ships to Reefs
Ed	Bonner	Philadelphia Army Corp of Engineers
Ed	Parnell	Scripps Institution of Oceanography
Eleanore	Rewerts	California Ships to Reefs
Eric	Wilkins	California Department of Fish and Wildlife
Erik	Zlokovitz	Former MD Representative; ASMFC Artificial Reef Committee
George	Sedberry	NOAA Office of National Marine Sanctuaries
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Kate	Wilke	The Nature Conservancy
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Rick	Elyar	Coastal Conservation Association
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Meagan	Wylie	Seatone Consulting
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