Proceedings of the 2004 Florida Artificial Reef Summit

April 27-28, 2004 • Sarasota, Florida

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Proceedings of the 2004 Florida Artificial Reef Summit

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John Stevely, Editor
Florida Sea Grant

Contents

2004 FLORIDA ARTIFICIAL REEF SUMMIT DISCUSSION SESSIONS REPORT

Discussion Group Process

The Reef Summit participants were organized into four geographic groups: Northeast Florida, Southeast Florida, Peninsular West Coast Florida and Northwest Florida. No formal geographic boundaries for these regions were established; participants were allowed to choose at their own discretion which group they felt most accurately reflected their interests. Each group was given a list of six questions/issues to discuss (see below).

Each group began by prioritizing the questions/issues for discussion purposes. This was done to make sure that there was ample discussion time to address the most important topics. It was assumed that different regions might have different priorities.

The discussion moderator and reporter then recorded points that were brought out during the discussion sessions. Finally, in order to demonstrate the relative importance of the issues on a regional basis, discussants participated in a "sticky dot" exercise. Each person was given five dots to "vote" with for each point. They could use these dots however they decided: one dot for each of five points or more than one (up to all five) for a point. If a participant felt an issue was of paramount importance, they could use all of their dots (votes) for one issue.

It is important to note that the different regions diverged considerably in the priorities that were established after the initial prioritization and voting process. In the following presentation, the issues are presented in the order established by each group. Also, in some instances, the regional groups modified the original questions/issues to make them more meaningful and understandable to that particular discussion group.

Discussion Topics Presented to Regional Breakout Discussion Sessions

1. Issues concerning estuarine reefs:
    - research and information needs;
    - permitting requirements;
    - clarification of jurisdictional issues.

2. Issues concerning offshore large area permits.
    - research and information needs;

- permitting requirements;
- clarification of jurisdictional issues.

3. Issues concerning mitigation reefs:
   - research and information needs;
   - permitting requirements;
   - clarification of jurisdictional issues.

4. Recommendations for improving consistency in how county programs store and
   manage data.

5. Recommendations for enhancing outreach efforts.

6. Interest and informational needs regarding use of naval vessels for artificial reef
   programs.

Northeast Florida Coast Discussion Session

Initial Prioritization of Discussion Session: There was some confusion regarding the initial prioritization process. The following prioritization was based on total number of dots at the end of the discussion session.

1. Recommendations for enhancing outreach efforts (9 dots).
2. Interest and information needs regarding use of NAVAL vessels for artificial reef programs (9 dots).
3. Mitigation reef issues (7 dots).
4. Recommendations for improving consistency in how county programs store and manage data (3 dots).
5. Issues concerning offshore large area permit (2 dots).
6. Issues concerning estuarine reefs (0 dots).

Discussion After Prioritization

1. Recommendations for enhancing outreach efforts (9 dots). The following suggestions were made:

   1.1 Bureaucratic (i.e., local government) education should be a priority.

   1.1.1 Without understanding of artificial reefs there is no private sector support.

1.1.2 Without economic impact information there is no public support.
1.1.3 Liability and legal issues need to be explained to governmental entities on issues like:
1.1.3.a Navigation
1.1.3.b Diving
1.1.3.c Contracting
1.1.3.d Material transportation
1.1.3.e Environmental regulations

1.2 Public outreach needs to include non-reef users.
1.2.1 No apologies for artificial reefs from the fishing and diving communities.

1.3 Outreach should be required for every reef system and reef plan.

1.4 There needs to be interagency, intercommunity and interregional communication, education and resource sharing.

1.5 Outreach should mean a local collaboration and regional cooperative partnership.

2. Interest and informational needs regarding use of naval vessel for reefs (9 dots).

2.1 Space is available in NE Florida.

2.2 Economic information about the fishing, diving and ship cleanup jobs benefits needed to get community support.

2.3 Need Federal legislation to fix and find the MARAD ship to reefs program.

2.4 Can MARAD or Navy get reef permits directly?

2.5 Need simplified permit process.

2.6 Vessel transfer Program needs to be simplified.

2.7 Ask Canadians for help.

3. Mitigation Reef Issues (7 dots).

3.1 Is mitigation funding available for reef construction?

3.2 Could artificial reefs serve as part of a mitigation bank?

3.3 Could mitigation reefs provide data to serve research purposes?

3.4 Encourage and allow innovative and divers mitigation reefs opportunities.

3.5 Can mitigation reefs serve upland or non-reef associated impacted site like surfing reefs, deep offshore reefs or Oculina Banks reefs?

4. Recommendations for improving consistency in how county programs store and manage data (3 dots).

    4.1 Standardized data base is important.
    4.2 Central location for data storage (state level).
    4.3 Data should be aimed toward Fisheries Management.
    4.4 Web based online forms for data entry and retrieval.

5. Issues concerning offshore large area permits (2 dots).

    5.1 Data reliability questions (correct coordinates).
    5.2 Does the sunshine law apply to coordinates?
    5.3 Does it serve the public good (permit criteria).
    5.4 There is potential for user conflicts due to spatial limits and public reefs.

6. Issues concerning estuarine reefs (0 dots).

    6.1 There was little discussion on estuarine reefs. There was a perception that there was no need for estuarine reefs in the area. Most of the productive inshore area already has good oyster reefs and there was no need for enhancement.
    6.2 Navigational issues are more important for the limited deep waterway space than artificial reefs.

Southeast Florida Region Discussion Session

Initial Prioritization of Discussion Session: There was some confusion concerning the initial prioritization process. The following prioritization was based on total number of dots at the end of the discussion session.

1. Issues concerning streamlining permit process (23 dots). Note: Discussants changed wording from original format. The original wording of this issue was: Issues concerning offshore large area permits.
2. Issues concerning mitigation reefs (19 dots).
3. Interest and informational needs regarding use of naval vessels for artificial reef programs (15 dots).
4. Issues concerning estuarine reefs (8 dots).
5. Recommendations for enhancing outreach efforts (5 dots).
6. Recommendations for improving consistency in how county programs store and manage data.

Discussion After Prioritization

1. Issues concerning streamlining permit processes (23 dots).
   Note: Discussants changed wording from original format (see above).

   1.1 Research and information needs.
      1.1.1 Issuance of permits should not be contingent upon monitoring.
      1.1.2 Required research should be limited to monitoring.
      1.1.3 Monitoring requirements should be reasonable – post-construction & 5 yrs. (vs. indefinite annual).
      1.1.4 Southeast Florida Action Strategy Team (SEFAST) monitoring methods should be standardized.
      1.1.5 (SEFAST) Need consistency in requiring BMP's.
      1.1.6 Essential Fish Habitat.
   1.2 Permitting requirements.
      1.2.1 Consistent (regional or area blanket) specific conditions (2 dots).
      1.2.2 Distinguish renewal of expiring permits from original applications.
      1.2.3 Communicate policy changes and new requirements to applicants.
      1.2.4 Standardize application and reporting forms.
      1.2.5 Establish application guidelines (4 dots).
         1.2.5a Use FWC as resource.
         1.2.5b NW ´FL RAI as example.
         1.2.5c Consistency with National & FL artificial reef plans.
         1.2.5d Hold training workshop.
      1.2.6 FKNMS (Florida Keys National Marine Sanctuary) – Navigation/marker buoys.
      1.2.7 SEFAST – review of existing regs.
   1.3 Clarification of jurisdictional issues.
      1.3.1 FKNMS – agencies are aware, but public may not understand complex state/fed boundaries.
      1.3.2 TRUE "Joint" ERP application process.

2. Issues concerning mitigation reefs: (19 dots).

   2.1 Research and information needs:

2.1.1 Establish appropriate success criteria.
2.1.2 High cost of monitoring.
2.1.3 Impacts to system and function of natural system need to be understood.
2.1.4 Funds should go to new research to answer global questions vs. additional monitoring on "like" mitigation.

2.2 Permitting requirements.

2.3 Clarification of jurisdictional issues.

2.3.1 Need consistency between ACOE and DEP in mitigation requirements.

3. Interest and informational needs regarding use of naval vessels for artificial reef programs: (15 dots).

3.1 Need EPA to finalize BMPs.
3.2 Suitability of vessels vs. other more traditional artificial reef materials (cost/benefit analysis per unit area).
3.3 Vessel accessibility and availability.
3.4 Need clarification of and consistency in prioritization and ranking by State (FWC).
3.5 Updated and accurate list of available vessels.
3.6 More info on Navy's small vessel" program (transfer title to States only?).

4. Issues concerning estuarine reefs (8 dots).

4.1 Research and information needs:
4.1.1 Understanding of community; impacts from introduction of artificial reefs (hard substrate) (8 dots total).
4.1.2 Site or species specific objectives.

4.2 Permitting requirements:
4.2.1 Endangered species (e.g., H. johnsonii).
4.2.2 Essential Fish Habitat (EFH).
4.2.3 Live-rock issues.

4.3 Clarification of jurisdictional issues.

4.3.1 FKNMS (Florida Keys National Marine Sanctuary) concerns.

5. Recommendations for enhancing outreach efforts: (5 dots).

5.1 Increase appreciation of existing natural habitat and function.
5.2 Communicate funding needs to legislators/lobby.

6. Recommendations for improving consistency in how county programs store and manage data.

6.1 Standardize formats.
6.2 Improve public access.
6.3 Increase online functionality.
6.4 Adapt new technology.

Florida Peninsular West Coast Discussion Session

Initial Prioritization of Discussion Session

1. Issues concerning estuarine reefs (11 votes).
2. Interest and informational needs regarding use of naval vessels for artificial reef programs (10 votes).
3. Issues concerning mitigation reefs (9 votes).
4. Recommendations for improving consistency in how county programs store and manage data (4 votes).
5. Recommendations for enhancing outreach efforts (3 votes).
6. Issues concerning offshore large area permits (0 votes). NOTE: There was confusion regarding the definition of "offshore large area permits." Several of the votes reflected the belief that these permits were needed for naval vessels. Once this issue was clarified, this question was not considered as a priority.

Discussion After Prioritization

1. Issues concerning estuarine reefs (50 dots).
   1.1 Research and information needs (25 dots).
      1.1.1 Understanding habitat needs for different life stages.
      1.1.2 Understanding impacts of green mussels.
      1.1.3 Shoreline enhancement (there are bay systems in southwest Florida where 50% of shoreline has been altered).
      1.1.4 Liability for placing materials under docks.
      1.1.5 Stability analysis of placing enhancement materials in canals (will storms wash material into canal and impede navigation?).
   1.2 Permitting requirement (15 dots).

1.2.1 Inconsistency in permitting process.
1.2.2 Use of MPR's (Material Placement Reports).

1.3 Clarification of jurisdictional issues (10 dots).
1.3.1 Confusion regarding permitting process for seawall enhancement, oyster reef restoration, and erosion protection. Where do they fit?

2. Interest and informational needs regarding use of naval vessel for artificial reef programs (26 dots).

2.1 Provide template on how counties can apply.
2.2 Regional workshops to provide information, training and gauging local support.
2.3 Can we develop regional applications for multiple ships?
2.4 Need smaller vessels for west coast.

3. Recommendation for improving consistency in how county programs store and manage data (15 dots). Note: After full discussion this was determined to be a higher priority than determined in the initial prioritization.

3.1 Establish clearing house.
3.2 MPR (Material Placement Report) data base.
3.3 Monitoring standards.
3.4 Try to use questions being asked in recreational fishing surveys to obtain information on use of artificial reefs. A participant indicated that there are questions on use of artificial reefs. Need to find a way to use this information.

4. Issues concerning mitigation Reefs (9 dots).

4.1 Need communication between regulators and reef programs. Apparently there have been cases where mitigation reefs (used to compensate for loss of hard bottom due to beach renourishment) were planned without consultation with reef program managers.
4.2 There is some interest in "capitalizing on other peoples mistakes." Research on mitigation projects should be held to a high standard and perhaps used to answer basic questions.

5. Recommendations for enhancing outreach efforts (6 dots).

    5.1 Develop county web sites with links to useful reef info.
    5.2 Distribute reef info with fishing license.
    5.3 Generate media coverage.
    5.4 Include reef info with boater registration renewal.
    5.5 Use cable/community access TV.
    5.6 Brochures in dive shops, bait and tackle etc.
    5.7 Develop links from state web site to county sites.
    5.8 Link projects in schools with volunteer research dive teams.
    5.9 Establish local advisory committees.

6. Issues concerning offshore large area permits (4 dots). Again there was confusion regarding term and "premature" voting during lunch. Interest linked to naval vessel reefing.

Northwest Florida Coast Discussion Session

NW Florida was represented by a diverse group of researchers, coordinators, a public official, citizens and artificial reef advocates. Spirited discussion was held and the topics were ranked as follows:

Initial Prioritization of Discussion Sessions

1. Recommendations for enhancing outreach efforts (24 dots).
2. Issues concerning offshore large area permits (23 dots).
3. Issues concerning estuarine reefs (15 dots).
4. Interest and informational needs regarding use of naval vessels for artificial reef programs (13 dots).
5. Issues concerning mitigation reefs (6 dots).
6. Recommendations for improving consistency in how county programs store and manage data (4 dots).

Discussion After Prioritization

1. Recommendations for enhancing outreach efforts (24 dots).

    1.1 Identify audience and provide appropriate message:
        1.1.1 Users/stakeholders - what is being done, address FAQ's, reef functions, locations of reefs, promote but not create artificial expectations of artificial reefs, GET FEEDBACK.

1.1.2 Legislators/local officials - economic benefits, cost recovery, what is being done, functions, what could be done, funding needs.
1.1.3 Civic organizations- what is being done, economic benefits, functions, opportunities for involvement.
1.1.4 Business community/philanthropist - economic benefit, cost recovery, functions, opportunities for involvement, funding needs.
1.1.5 Potential adversaries - benefits of artificial reefs for all.
1.1.6 Train the trainers, informal and formal educators - artificial reefs curriculum that integrates disciplines such as math, science, language arts, and technical skills if possible.

1.2 Coordinate committee between FWC and Fl. Sea Grant, artificial reef coordinators to produce ***consistent, quality artificial reef information***.

1.3 Create a brochure and utilize websites.

1.4 Utilize educational mechanisms already in place, COSEE, SEA COOS, etc.

2. Issues concerning offshore large area permits (23 dots):
*Defined as offshore Large Area Artificial Reef Sites (LAARS) for permitted public and private deployments.

2.1 Research and Information needs:
2.1.1 Research and monitoring should focus on measuring goals and objectives.
2.1.2 Processes of permitting, implementation and management need to be identified and described. This could be accomplished through regional workshops and a website.
Process: Plan →construct→evaluate (research, monitor, QA/QC).
2.1.3 Plan with users/stakeholders define purpose, goals and objectives.
2.1.4 Evaluate reef/materials for biological, physical and socioeconomic performance categories.
2.1.5 Develop Best Management Practices for planning, implementation, evaluation and monitoring.

2.2 Permitting Requirements:
2.2.1 Goals adequately justified, clearly stated and quantifiable.
2.2.2 Excluded areas, natural reefs, SAVs, endangered species,

conflicts-military exercise areas, sand borrow sites, pipelines, fiber optics, commercial trawling grounds, navigation channels, acreages, oil and gas leases.

2.3 Clarification of jurisdictional issues:
- 2.3.1 Federal-ACOE, other federal agencies plus public interest review.
- 2.3.2 State-Sovereign Submerged lands and CZMA Consistency Review.

3. Issues concerning estuarine reefs (15 dots):

3.1 Research and information needs:
- 3.1.1 Artificial reef habitat suitability to specific estuary conditions.
- 3.1.2. Plan with purpose, goals and objectives in mind, objectives must be clearly defined and measurable, "plan to evaluate."
- 3.1.3. Critical review to ensure no harm or unintended consequences via risk assessment.
- 3.1.4 Reef design should be consistent with purpose, goals and objectives.
- 3.1.5 Proceed with caution when introducing alien habitat.
- 3.1.6 Reef objectives should be consistent with fisheries management.
- 3.1.7 All estuaries not identical.
- 3.1.8 Consider precedence set.

3.2 Permitting requirements:
- 3.2.1 Goals adequately justified, clearly stated and quantifiable.
- 3.2.2 Excluded areas, natural reefs, SAVs, endangered species, conflicts-military exercise areas, Gulf Islands National Seashore, Aquatic Preserves; shellfish harvest areas, pipelines, fiber optics, shrimping, navigation channels, and acreages.

3.3 Clarification of jurisdiction issues:
- 3.3.1 Federal- ACOE, Public interest review.
- 3.3.2 State- FDEP, DOACS.
- 3.3.3 Gulf Islands National Seashore, Military security zones.

4. Interest and informational needs regarding use of naval vessels for artificial reef programs (13 dots):

4.1. Economics – should have a business plan, including cost/benefits analysis, cost recovery/return of investment, marketing plan, base information for Oriskany on 1998 Rand study.
4.2 Planning and Acquisition.
4.3 Vessel Preparation, determine needs of vessel preparation based on environmental studies by the feds and state.
4.4 Consider user modifications and maintenance costs.

5. Issues Concerning Mitigation Reefs (6 dots):

5.1 Research and information needs:
5.1.1 Create a regional Mitigation Plan, have artificial reef interests represented on development, technical and review committee.
5.1.2 Ecological aspects of mitigation project.
5.1.3 Ecosystem definition for impacts / mitigation.
5.1.4 Increase notification process for public comment.

*Not very applicable in NW Florida.

6. Recommendations for improving consistency in how county programs store and manage data (4 dots):

6.1 Data stored in a way consistent with FWC.
6.2 Compatibility w/ agencies, groups and commissions within and outside of Florida.
6.3 Use a web-based interface.
6.4 Access must be user driven.
6.5 Read only files in PDF based format.

Summary Ranking of Issues by Region

Region	Estuarine Reefs	Large Area Permits	Mitigation Reefs	Data Management	Outreach	Use of Vessels
NE	6	5	3	4	1*	1*
SE	4	1**	2	6	5	3
PW	1	6***	4****	3****	5	2
NW	3	2	5	6	1	4

* Equal number of votes (tie).

** There was considerable confusion regarding this topic. Southeast Florida region discussants changed this issue to streamlining the permitting process. Therefore, it is misleading to have large area permits as a top priority for the southeast region.

*** The Peninsular West Florida group confused this issue with permitting sites for naval vessels. After this was clarified, issues regarding large area permits were not considered a priority.

**** Priority changed after full discussion of issues.

NE = Northeast Florida
SE = Southeast Florida
PW = Peninsular West Florida
NW = Northwest Florida (Panhandle)

ARTIFICIAL REEF ECONOMIC ASSESSMENT STUDIES

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Artificial reefs represent an important component of the marine resource utilization industry in many of Florida's coastal counties. Aside from the biological aspects of artificial reefs, many would argue that the primary purpose of reefs are to provide benefits to human users, such as commercial fishers, recreational fishers, and sport divers. However, to measure those benefits, data is needed to describe the direct / indirect uses of the reefs, economic or social impacts, social preferences for reef characteristics, and reasons for those preferences. Such information is needed to determine if artificial reefs are serving the public as intended, to justify previous and future public expenditures on reefs, and to assist in adaptive management efforts by state and federal resource management agencies. Thus, economic assessment of artificial reef utilization is vitally important in determining the economic benefits associated with expenditures of scarce public funds on the design, placement, and monitoring of artificial reefs. Economic analysis of reefs can be conducted as an economic impact analysis, cost effectiveness analysis or cost/benefit analysis. Such studies will assist in determining if artificial reefs are providing a net economic benefit to the local economy, are being implemented at a "reasonable" cost, and if the benefits exceed those costs. Only a few studies have been conducted recently in Florida that are designed to assess the economic consequences associated with artificial reef deployment. However, these studies have shown the following regarding artificial reefs in Florida: 1) economic activity associated with artificial reefs is increased in the local community, by both residents and non-residents, 2) artificial reefs may not generate as much economic activity as natural reefs, 3) artificial reefs are valued by both users and non-users alike, 4) artificial reefs may be an effective management tool for re-directing use away from natural reefs, 5) artificial reefs are a source of economic value that can justify additional deployment, even when taking into account the opportunity cost of scarce public dollars, and 6) artificial reefs appear to provide, in general, for positive benefit/cost ratios.

Keywords: Economics, artificial reefs, valuation, expenditures, research

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AN INTRODUCTION TO ESTUARINE AND REEF FISH ECOLOGY

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Essential to the eventual application of artificial reefs to fisheries management is an understanding of the ecological and biological features of both the fish assemblage and the physical features of the reef. Initially, it may seem important to distinguish between fishes that comprise assemblages in both estuarine and marine environments; however, artificial reef fish assemblages in Florida are nearly identical under both conditions. The similarity is because estuarine reefs in Florida are most often placed in the deeper, higher salinity portions of estuaries. Consequently, fish species with hard-bottom affinities are often similar at both offshore and inshore artificial reefs.

Conceptually, an artificial reef is merely an additional structure to an already functioning ecosystem. To some degree, the addition of an artificial reef in an area alters the natural processes that take place in the pre-existing ecosystem. Florida, despite its rather aggressive reef-building activities during the past several decades, has a total compliment of artificial reefs that is estimated to comprise less than 0.02% of the total shelf substrate. Realistically, the total amount of added reef material is proportionally minor compared to the total amount of natural substrate available. Consequently, the ecological impact that artificial reefs have had on the shelf ecosystem is presumably minor.

Ecologically, an artificial reef can be described by its abiotic (non-living) factors that consist of both environmental and reef–specific attributes. Environmental attributes (things that cannot be controlled by the reef builder) include: aquatic features such as temperature, salinity, current conditions, and substrate; and non-aquatic features such as weather conditions. Reef attributes (things a reef builder can control) include: reef materials, dimensions, orientation, and location. Biotic (living) factors of a reef include attributes of individual fish and their species-specific populations as well as the entire assemblage of organisms (fish and non-fish) present on or near the reef. Researchers have spent considerable effort assessing the relationships between the environmental/reef attributes and the abiotic/biotic factors. To date, little consistent predictability in the outcome of artificial reef deployments relative to the biotic features has been realized. The possibility remains that these relationships are highly complex and inherently variable. With such caveats, these relationships may also be irresolvable because of the lack of determinism that inevitably disallows predictability.

Biologically, the fish species that are associated with artificial reefs often have features that will allow some resolution to the problem of being able to direct reef deployments to attain pre-determined fisheries management goals or the specific objectives needed to achieve these goals. While fishes often associate with structure to gain an advantage in orientation, they nevertheless, occupy very specific tophic niches or feeding guilds that are limited in number. Understanding these guilds, the species that comprise them and their role interaction in the dynamics of artificial reefs within the coastal ecosystem has potential for achieving some of the objectives of an artificial reef development program. While the species may vary by type and relative abundance among sites and specific reef designs, the trophic groups to which the species belong may be less variable, allow better predictability and, consequently, permit a solution to the relationship between the environment and the biological goals desired in a reef program.

Physically, the artificial reef offers a reference or orientation point, away from which foraging activity by fishes occurs. The consequences of this orientation should have a direct and significant influence on artificial reef designs and deployments, especially with regard to site location, orientation and configuration. For example, reef deployments could be designed to optimize the standing biomass of the associated reef-fish assemblage in light of the accessibility of fish to forage areas that are uncontested by other reef-associated species. Thus, reef size, spacing and proximity to areas of higher substrate productivity become paramount factors when considering artificial reef design.

Artificial reef fish assemblages are comprised of species belonging to specific ecological types, each dependent to varying degrees on the ability of the reef to attract fishes and the attributes of the reef that enable higher production. Some species are merely attracted to the reef (either in the water column above the reef or on the substrate adjacent to the reef). Reefs may also provide other species with a habitat feature that, when absent, limits their abundance and frequency of occurrence in the natural environment. Interestingly, those species that are most often the ‘target’ of marine recreational and commercial fisheries in Florida gain some benefit from both attraction and habitat-limiting features of the reef. Fishes such as groupers, snappers, and grunts are examples of fishes in this target group.

The future application of artificial reefs toward solving fisheries management problems lies in our ability to take into consideration the species-specific, innate features of the inclusive fishery resources and aligning them with the artificial reef attributes that we can control. More specifically, reefs should be designed to enhance certain life-history attributes of target species by overcoming life-history ‘bottlenecks’, by reducing total mortality (the result of both natural and fishing

mortality) or by increasing fitness. For example, artificial reefs deliberately designed with enhanced current shadows created by the reef profile may facilitate attraction and retention of certain species. The Caribbean spiny lobster fishery may provide the best example of how the deployment of the 'casita' (literally – small house) can demonstrably increase survivability of the juvenile life stage that has an inherently high natural mortality. Similarly, artificial reefs, when combined with designs that take advantage of innate species responses, can be used to directionally move species from one area to another by facilitating migration from inshore nurseries to offshore adult habitats. Also, artificial reef deployments can be used to reduce fishing pressure on natural habitats that are stressed from a variety of activities and actions. Innovative applications of artificial reefs can include deployments within Marine Protected Areas or by adopting restrictions that temporally and spatially rotate fishing activities on the artificial reef. The consequences including artificial reefs in fisheries management strategies can lead to lower fishing pressure and, in turn, enhance stock survivability.

Future artificial reef designs and deployment configurations should take into consideration the natural responses of dispersing species at all life stages. Taking the natural response of the organisms into consideration, a resource manager could increase the probability of the reefs being found by dispersing larvae, juveniles, and adults of target species. Similarly, reef designs should optimize retention of target species once attracted to a structure. To be included as part of a larger, agency-oriented management strategy, artificial reefs should be directed toward species with biological features that allow them to take advantage of the reef design and configuration. When directed toward readily dispersing fish species that are more easily retained on the reef, there can be an increase in the colonization rate, an increase in growth, and a reduction in mortality. Additionally, artificial reefs should be designed, placed, and oriented to accommodate the innate responses of target species. Simply, artificial reefs need to enhance the life-history features of fishes that are pre-adapted to artificial reefs. To be considered as part of their management directive, agencies should focus on artificial reef efforts that are directed toward species that have specific niche requirements, disperse readily, and are in need of intervention. Features of reefs that can be controlled (other than the choice of site) include orientation, location, and construction design. The exact specifications for the design of these reefs are locally dependent on a variety of factors. However, the specific ways each of these influences each specific fish attribute are poorly understood at present.

Keywords: estuaries, ecology, habitat, management, bottlenecks

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FEDERAL AGENCY ARTIFICIAL REEF PROGRAM INITIATIVES

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The Department of Transportation, Maritime Administration and the Department of Defense, United States Navy both have legislative authority for transferring obsolete vessels to States, Commonwealths, Territories, and Possessions of the United States for use as artificial reefs. (MARAD - PL 92-402 of 1971 (16 USC 1220), Navy - FY04 National Defense Authorization bill (HR 1588 Sec 1013). The Maritime Administration has additional legislative authority to transfer vessels to Foreign Governments for use as artificial reefs. While the Maritime Administration has had reefing authority since 1972 and has participated with States in the reefing of 48 vessels, 2004 is the first year that Navy has artificial reefing legislative authority. The Navy has oversight for the reefing of military vessels while the Maritime Administration has oversight for the reefing of non-combatant and merchant vessels. The Maritime Administration and the Navy signed a Memorandum of Agreement with the Maritime Administration, due to previous experiences in artificial reefing, being the lead agency to provide one point of contact for the Joint Artificial Reef Program.

U.S. Maritime Administration (MARAD) and U.S. Environmental Protection Agency (EPA) legislative requirements are defined in Public Law 108-316, Div.C, Title XXXV, Section 3516, November 24, 2003, (117 STAT. 1795) amending PL 107-314, Div. C, Title XXXV, Section 3504(b)(1) and (5), December 2, 2002, (116 STAT. 2754); 16 U.S.C. which requires:

Environmental Best Management Practices for Preparing Vessels for Use as Artificial Reefs:

"(1) Not later than March 31, 2004, the Secretary of Transportation, acting through the Maritime Administration, and the Administrator of the Environmental Protection Agency shall jointly develop guidance recommending environmental best management practices to be used in the preparation of vessels for use as artificial reefs.

Applications for Preparation of Vessels as Reefs:

(5) Not later than March 31, 2004, the Secretary of Transportation, acting through the Maritime Administration, and the Administrator of the Environmental

Protection Agency shall jointly establish an application process for governments of States, commonwealths, and United States territories and possessions, and foreign governments, for the preparation of vessels for use as artificial reefs, including documentation and certification requirements for that application process."

EPA formed a Best Management Practices Working Group in July 2002 to develop the requirements of (b)(1). EPA will be publishing the document in the Federal Register for a 60 day comment period in April 2004. The Federal Agencies participating in the Working Group include NOAA, USCG, USACOE, EPA, Navy and MARAD.

In August 2002, MARAD formed the Artificial Reef Team (ART) with members nominated by NOAA (2 Offices), USCG, USACOE, FWS, EPA, OSHA, Navy and MARAD. This team was to develop and review the Streamlined Application Process in accordance with section (5) above. MARAD's existing application process served as the basis for this effort. The language is designed to modify MARAD's artificial reefing authority (with some overlap with Navy.)

While there is a Joint MARAD/Navy Program there are programmatic differences in the way in which the agencies perform basic functions such as title transfer and cost sharing. MARAD and Navy will continue to work with Federal Agency partners to identify existing resources that can be made available to States, Commonwealths, Territories and Possessions of the United States to enhance the existing ability to acquire obsolete vessels for artificial reefs.

Keywords: Navy, MARAD, Best Management Practices

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SUMMARY AND SYNTHESIS OF REEF MONITORING PROJECTS IN FLORIDA'S ARTIFICIAL REEF PROGRAM

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The Florida Fish and Wildlife Conservation Commission has been managing grants-in-aid for the Florida Artificial Reef Program since 1980 through various state reorganizations (DNR, DER, DEP and now FWC). One of the main responsibilities of the FWC artificial reef program at the state level is to provide funding for the construction and monitoring of artificial reefs statewide. Since 1980,more than $15,446,100 in grants has been issued to local governments, non-profits and universities in Florida. In 1996, a legislative change to Chapter 370.25 F.S. authorized the program to distribute a portion of its grants for artificial reef monitoring directly in addition to reef construction. Monitoring was performed prior to 1996 but it was associated with construction projects. Overall 82 completed monitoring projects have been funded, using $3,741,432. This accounts for 24.2% of all grant funding since 1980.

The first monitoring/research project went to the University of West Florida in 1988. There are 14 active on-going monitoring/research projects as of March 2004. The monitoring portion of this funding has gone to 17 local governments, 8 non-profit organizations and 6 universities. Most of this funding involves direct in-water monitoring of artificial reefs mainly dealing with fish census events on local artificial reefs. The FWC has also funded 3 side scan sonar monitoring, 5 soci-economic studies, 3 planning projects, 1 materials stability program and 34 research grants.

Of the in-water monitoring grants there are 27 completed grant projects of which 22 were based on fish census events and another 3 were mapping. The remaining 2 grants were a combination of fish census and mapping. The fish census database has rapidly expanded over the years and now includes 526 data sets in FWC Excel Spreadsheet format from contracted entities.

This Excel spreadsheet was developed to provide a single format for all fish census data collected by either the FWC or it's contractors. This Excel data format utilizes 26 fields of data associated with an individual species of fish observed on the reef. This allows the physical parameters of the reef as well as the water and dive data to "follow" each species through data reductions. This format

also allows all of the major fish census methods to be logged. It is also very easy to transform these data into GIS files by quickly modifying the latitude and longitude coordinates into Decimal Degrees needed for Arcview software. It is hoped that one-day online mapping capabilities will exist for a user to visually find a reef on a map and list species observed there with a click of the mouse.

The FWC looks forward to partnering with Florida artificial reefs community in the future and will continue to provide assistance to be better understanding the function of artificial reefs.

This paper provides an overview of the current Fish and Wildlife Conservation Commission artificial reef-monitoring program as of 2004.

Keywords: Florida Artificial Reef Program overview, diversity, regional differences.

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FWC OUTREACH EFFORTS AND PLANS FOR FLORIDA'S ARTIFICIAL REEF PROGRAM

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The Florida Fish and Wildlife Conservation Commission (FWC) is extremely fortunate to have a dedicated Outreach and Education section within the Division of Marine Fisheries. These professionals are responsible for reaching out to the public and educating them on all the activities of the Division, including marine fisheries regulations, management, biology, and general recreational fishing stewardship. Education the public on the artificial reef program is also an important component of marine fisheries outreach efforts.

FWC outreach is accomplished through multiple medias and many venues. On paper the section publishes the *Fishing Lines Magazine* as well as the *Fishing Lines Newsletter*. The newsletter is published twice yearly with about 800,000 copies and provides updated information about the rules for recreational harvest as well as the latest artificial reef coordinates for the previous six months period. The Fishing Lines Magazines is a full color, glossy publication that is a great summary of marine fisheries activities including artificial reefs. In its second edition, over 60,000 copies were distributed last year free of charge to the public.

Much is this information is also available online with the Division's web site; http://myfwc.com/marine/. This site includes copies of the *Fishing Lines Newsletter*, pictures of many of the fish species and the full listing of the states artificial reef deployments by county. You also can get many of the artificial reef program documents like past Summit Proceedings and copies of various planning documents on the Division's web site.

The FWC Marine Fisheries Outreach section also participates in many direct interactive activities with the public throughout the state. Staff provides displays and has personnel available to answer questions booths and interactive touch tanks at about 12 fishing shows per year. They also hosted 19 fishing clinics last year, 14 for the kids and 5 for the ladies. The FWC also maintains a permanent display at the St. Pete Pier Aquarium that includes pictures and models of artificial reefs. Over 700,000 people saw this display last year.

Just last year the Outreach Section helped the artificial reef staff put together an artificial reef video entitled, *"Creating Marine Habitat-The artificial reef*". This video produced by Mark Sosin's Saltwater Journal and funded by Federal Sport Fish restoration grants, is an excellent overview of the issues surrounding artificial reefs in Florida.

Future outreach efforts will include continuing all the efforts above and the production of a new reef program brochure that will clearly and briefly describes Florida's artificial reef program. The artificial reef program also plans to dramatically increase the use of our web site to get needed information out to the public about the artificial reef program program.

This paper provides an overview of the current Fish and Wildlife Conservation Commission's Division of Marine Fisheries outreach and education program as of 2004.

Keywords: Florida Marine Fisheries Outreach and Education, outreach, education

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LEE COUNTY PUBLIC OUTREACH EFFORTS

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Lee County has had an active artificial reef program for the last 14 years. We have always strived to keep our constituents informed of our activities. The County has a Board appointed Advisory Committee called the Waterways Advisory Committee. This Committee advises the County Commissioners on issues that relate to the County waterways. While artificial reefs are not one of their priority issues, they still advise staff when warranted. In the mid 1990's, staff felt that they needed closer ties to the County fishing community regarding reef issues. Staff formed the Artificial Reef Advisory Committee, ARAC, to directly inform and assist staff in the guidance of the reef program. The ARAC is made up of citizens from the various user groups of artificial reefs; diving clubs, fishing clubs, charter fishing and diving captains.

The County also maintains an extensive website devoted to the artificial reef program. This page contains information such as coordinates, maps, pictures, quarterly updates and the County Reef Plan. Most of this data is available for download via PDF format. The county also has a link to a search engine that queries all the data collected from surveys of the reef deployments. Citizens can query the extensive database for information about which type of fish inhabits which site in Lee County waters.

In conclusion, Lee County has always attempted to maintain a close link with the public it is serving. Feedback from the public has been an invaluable asset in bringing forward the reef program into the 21st Century.

Keywords: Lee, Artificial Reef Advisory Committee, Lee County Artificial Reef Plan, www.lee-county.com, Lee County Waterways Advisory Committee

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PROCESSES IMPORTANT TO ARTIFICIAL REEFS FOR CONSERVATION AND FISHERIES MANAGEMENT: DENSITY-DEPENDENT HABITAT SELECTION, TROPHIC COUPLING AND INDIVIDUAL GROWTH DYNAMICS

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Reef fish are vulnerable to over-fishing because fish concentrate over patchy habitats, which can make traditional fishery statistics misleading. How and why large reef fish use patchy habitat, and the potential consequences on demographic parameters, must be known for spatially explicit population dynamics modeling, for discriminating Essential Fish Habitat (EFH) and for effectively planning conservation measures (e.g. marine protected areas, stock enhancement and artificial reefs). Gag, *Mycteroperca microlepis,* is an ecologically and economically important warm-temperate reef dwelling grouper in the southeastern USA, with behavioral and life history traits amenable to large-scale field experiments. Our results over the past decade substantiate that density-dependent habitat selection (DDHS) for shelter, trophic coupling between habitat types and individual growth dynamics are interdependent ecological processes that help to explain how patchy reef habitat sustains gag production. Moreover, gag select reef habitat on the basis of shelter at the expense of maximizing growth. Thus, motile reef fishes could experience significant density-dependent effects on growth, survival, and/or reproduction (i.e. demographic parameters) despite reduced stock sizes as a consequence of fishing. We therefore hypothesize that natural hard-bottom habitat in the northeastern Gulf of Mexico represents a demographic bottleneck for juvenile-to-adult gag during their transition from inshore nursery grounds to offshore spawning aggregations. This hypothesis is to be tested by a 100-square mile fisheries management area (FMA) being developed with artificial reefs designed for conservation goals.

Keywords: gag, shelter, habitat patchiness, density-dependent growth, demographic bottleneck

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GOAL B OF FLORIDA'S STRATEGIC PLAN: TO USE ARTIFICIAL REEFS IN SCIENTIFIC RESEARCH

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The Florida Artificial Reef Strategic Plan adopted by the Florida Fish and Wildlife Conservation Commission states in Goal B that artificial reefs will be used "…*in scientific research to obtain a mechanistic and predictive understanding of how artificial reefs function ecologically and physically across spatial and temporal scales*." Achieving an increase in basic understanding is essential to achieving other strategic goals, particularly assuring long-term benefits (Goal A) and using artificial reefs in fisheries management (Goal C). To accomplish Goal B, it is important that local reef programs understand the nature of research and how science supports natural resource management. It is also important for local programs and research scientists to cultivate mutually supportive working relationships.

Scientific research is driven by questions. For artificial reefs, I suggest there are four types questions, which differ by the scale of effort required and the breadth of application resulting from their answers:

1. What can we learn *about* natural systems to make the application of artificial reef technology more effective in terms of long-term benefits and improved fisheries management?
2. What can we learn *from* artificial reefs to make the management of natural systems more effective?
3. What can we learn about artificial reefs *per se*?
4. What can we learn about this particular artificial reef or set of reefs?

Researchers typically seek to build answers to questions 1 and 2 through repeated, replicated and interrelated studies that encompass questions 3 and 4. At the risk of over generalizing or offending, local artificial reef programs typically stop with answers to questions 3 and 4. That gap has to be bridged through continuing education and communication if Goal B, and therefore Goals A and C, are to be truly achieved.

One step toward bridging the gap is an agreed understanding of how science supports natural resource management. I suggest a view that includes five types of studies:

- Inventories – snapshots of what's there at a given point in time
- Baselines – quantitative descriptions of changes over a period of time
- Process Studies – testing cause-and-effect relationships
- Prediction – modeling expected system changes in response to an event or action, by synthesizing inventories, baselines and process studies
- Monitoring – assessment, accountability and the basis for adaptation in relation to predicted and unexpected changes

Strategic allocation of effort across a portfolio of these studies is essential, and proper monitoring with feedback is necessary to assess and adapt allocations and management actions. By "proper" we mean monitoring based on an agreed understanding of outcomes expected from reef development and management. In general, better understanding will yield less costly ongoing monitoring, and require greater up-front investment in inventories, baselines and process studies. This approach has not been applied well, and most "monitoring" of artificial reefs actually consists of inventories and baselines.

Within Florida's scientific community, four programs presently use artifical reefs in research, and these are primarily process-oriented programs working toward predictive capabilities. At Florida Tech, Dr. Lee Harris has been studying the structural integrity and stability of reef units. At Mote Marine Lab, Dr. Ken Leber and co-workers have been using artificial reefs in experiments testing factors potentially affecting fish stocking success. At Nova Southeastern, Dr. Richard Spieler and his students have been using artificial reefs to manipulate primarily small-scale habitat complexity to test effects on coral reef fish community structure. And at the University of Florida, several collaborators and I have been manipulating larger scale habitat patchiness and shelter availability to confirm the basis for habitat selection by a large mobile fisheries species, and other habitat-related processes underlying population and community dynamics. Opportunities exit for local artificial reef programs to engage other researchers, but that will require working relationships that advance questions 1 and 2, above.

All of this discussion bears on the question frequently asked by artificial reef constituents, "Do artificial reefs attract fish or produce them?" This well-worn Attraction-Production Question is too often thought of as an either-or dichotomy. When posed as a dichotomy, the most appropriate answer is "Yes", which makes the question trivial. For the research community and fisheries managers, the issue

is moving beyond a focus on single factors that limit populations to recognizing the roles and interactions of more factors, including habitat quality, quantity and distribution, habitat effects on fecundity and productivity, and stochastic variation. The challenge is for researchers is to work across a range of temporal and spatial scales (e.g., weeks, seasons, generations, habitat patches, landscapes and ecosystems) and quantitatively integrate the processes operating at different scales across levels of biological organization (e.g., individuals, populations, communities and ecosystems). Thus, Goal B requires the Florida artificial reef community to facilitate the needed research through coordinated multi-county, regional and statewide projects based on rigorous scientific study designs and artificial reef designs.

Acknowledgements: The explanation of science in support of management was borrowed directly from Dr. Chuck Jacoby, with thanks for that and his review of this summary. Drs. Harris, Leber and Spieler generously shared a great deal of information and materials about their programs, and have my sincere thanks. I am also grateful to many colleagues and fellow reef coordinators for honing my thinking about reefs; they deserve credit for anything constructive, while I am responsible for any flaws in my perspective.

Keywords: scientific questions, study types, research portfolio, spatial-temporal scales, monitoring

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CURRENT DIVERSITY OF FLORIDA'S ARTIFICIAL REEF PROGRAM

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Among the 14 Gulf and Atlantic states involved with artificial reef development, Florida boasts one of the most diverse and active artificial reef programs in the nation. Florida's coastline is spread along 8,426 miles of tidal coastline (1,200 miles fronting the Gulf of Mexico and Atlantic Ocean). Of the 35 coastal counties in Florida, 34 counties contain artificial reefs in their marine waters.

Because of the extent of coastline and statewide involvement in reef activities, management of Florida's artificial reef program continues as a cooperative partnership among state and local coastal governments, and non-profit organizations.

The current artificial reef diversity across the state is influenced by variability between different geographical habitats, and regional differences in artificial reef material availability, financial resources, administrative support, monitoring initiatives, and regional program goals and objectives.

This paper provides an overview of the current diversity of Florida's artificial reef program as of 2004.

Keywords: Florida Artificial Reef Program overview, diversity, regional differences.

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COASTAL ARTIFICIAL REEF HABITAT TECHNOLOGY AND THE FLORIDA SEA GRANT EXTENSION PROGRAM

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Overview

Extending science-based information to improve artificial reef technology applications in Florida's coastal waters is a priority subject for the Florida Sea Grant Extension Program (FSGEP). Its very first marine extension agent assisted local fishing interests on the Gulf coast, while its first program leader initiated statewide communication via conferences and publications to enhance reef performance. By 1987, Florida Sea Grant had established the reef summit series. Today, most of its coastal county-based field extension agents are engaged in some activity related to artificial reefs. The work of this faculty is backed by the rigorous research component of the Florida Sea Grant College Program.

Digest of Activity

The emphasis of Florida Sea Grant Extension effort focused on artificial reefs is at the county-level through close and active engagement with citizens and organizations. Of 13 field faculty deployed statewide in key coastal locations, at least nine devote from one to three days' effort per month to artificial reefs. Another serves a county lacking an active reef program, but is engaged in discussion of possible ways to revive reef activity. These individuals address (1) planning, (2) siting, (3) deployment, (4) monitoring and (5) education for artificial reef decision-making. This may be done, for example, through organizing the annual West Coast Reef Coordinators conference and field trip, hands-on assistance to secure and deploy reef materials in Charlotte Harbor, advice on reef enhancements under docks in the Keys, assisting various county applications for reef grants, or advising volunteers in underwater monitoring off the Panhandle.

Complementary to the widespread work of the FSGEP field faculty is the effort of both "statewide extension specialists" and also research faculty based on a university campus. For example, the FSGEP marine economist assists in valuation

studies concerning economic impact of reefs. The former waterways and boating specialist advised on the application of Geographic Information System (GIS) methods to management of reef monitoring data. The communications office of Sea Grant has assisted development of publications and website materials. As needed, individual research faculty may be drawn into FSGEP activity. They develop and synthesize new information about artificial reefs, in part to address questions raised by county stakeholders and extension agents alike, such as determining the effects of human-made reefs on natural reefs or of artificial structures under docks, or extending scientific knowledge of fish assemblages on reefs. Part of the information storehouse comes from 15 major research projects sponsored over time by Florida Sea Grant.

Outlook

The Florida Sea Grant Extension Program will continue to be proactive and responsive to the widespread Florida reef-building community. As additional counties expand reef programs---both construction and monitoring---field and campus-based faculty will develop annual Plans of Work accordingly. Examples of new efforts being considered are the organization of a workshop to offer training in GIS application to reef data management, and writing Extension publications on reef planning and design. The authors of this paper also are involved in reef technology transfer in-state, nationally and internationally (e.g., reefs session at 2004 World Fisheries Congress) and administration of the Florida Sea Grant Extension Program, respectively.

Keywords: Extension, outreach, reefs, Sea Grant, technology

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INTERNATIONAL PERSPECTIVE ON FLORIDA'S ARTIFICIAL REEF STRATEGIC PLAN: SPECULATIONS, GUESSES AND ADVICE FROM THE GALAXY

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Purpose

This paper reconciles some of the major aspects of the Florida artificial reef plan (FWC, 2003) with the approach and efforts of reef-related activities in other countries. This opportunity to make comparisons provides a basis for applying lessons from other areas to the content and the implementation of Florida's plan.

Approach and Information Sources

There are two approaches to obtaining the perspective of artificial reef experts from other countries on the "State of Florida Artificial Reef Plan." One, not chosen, is to send the document overseas and solicit comments from few or perhaps a broad selection of experts in science, policy, planning and evaluation. The other, taken here, is to speculate on what foreign experts might say by drawing upon their technical writings as they relate to the Plan (and vice versa). The elements of the Florida plan are wide-ranging. The method taken for this paper was first to survey the principles (7), goals (6), objectives (32) and tactics (76) of the plan, in order to identify principal trends and categories of information. This digest then was matched against known capabilities of reef experts and planning practices in overseas laboratories and reef programs, as characterized by the literature they produced. National efforts to deploy artificial reefs exist in Japan, Korea, France, Spain and Italy, among other places. Meanwhile, localized in-country efforts to build reefs at given sites in places as diverse as South Pacific Islands, Canada, Mexico, England, Scotland, India and a score of other nations complement the centrally planned efforts in affording a large database of experience. Reports of these activities include 56 papers of the Seventh International Conference on Artificial Reefs and Related Aquatic Habitats (ICES, 2002), and 29 papers on European reefs (Jensen et al., 2000).

Findings on Florida Plan Content and Implementation

Comments on the overall Florida reef plan might be as succinct as "Bravo!"

Nations already having formal reef plans, perhaps for some time as in Japan, or more recently as in Canada, welcome Florida's far-sighted document.

Concerning content of the Plan, a European reviewer might pointedly ask why the diversity of Florida reefs does not include "research" as an objective, while a Korean reader might ask generally why a more holistic approach is not taken, in order to integrate stocking of juvenile fishes into an overall "marine ranching" experimental reserve. Scientists in Hong Kong and Canada, meanwhile, would encourage use of ecological modeling in the ecosystem approach that is identified.

Concerning implementation of the Plan, the proposed "objectives-driven" impact studies are endorsed. The European Artificial Reef Research Network offers guidance on both the standardization of research protocols and the definition of research priorities. Meanwhile, the application of ecological knowledge to Florida reef planning would benefit from examination of Korea's design of the Box Reef, whose physical structure meets life history requirements for two species of marine fish. Finally, FWC staff seeking information sharing are readily invited to the 2004 World Fisheries Congress and the European Marine Biology Symposium for sessions on reefs; a word from FWC leadership is encouraged to "make it so!"

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Keywords: Artificial reefs, international reefs, research, objectives, ecosystems

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FISH COLONIZATION OF A NEWLY DEPLOYED VESSEL-REEF OFF SOUTHEAST FLORIDA: PRELIMINARY RESULTS

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Fish colonization on the *Ebenezer II,* a 25.5m merchant marine vessel, was studied from May 2002 – July 2003. The ship was scuttled in May 2002 off Broward County, Florida at a depth of 21m and was censused 10 times during the study period using a modified Bohnsack and Bannerot visual census method. Adjacent natural reefs and the *Mcallister*, a nearby, 30m tugboat deployed in June 1998, were censused during the same period.

Distinct changes in the fish assemblage on the *Ebenezer II* were observed throughout the sample period. A pioneer assemblage was observed during the first three months, characterized by the settlement of juvenile fishes (<5 cm). Subsequently, numbers of juveniles decreased either through emigration, predation or growth. Resident species made up 52.5% of the total abundance, but transient fish species made up 78% of the total fish biomass during the study period.

Surprisingly, attraction of adult fish from both natural reefs and the *Mcallister* was not a major factor in assemblage formation. The primary adult fishes attracted to the *Ebenezer II* were herbivores. These fishes steadily increased in abundance throughout the study period, presumably due to increased food availability as benthic algal communities developed. A similar trend of increasing herbivores with increasing soak time was observed on the *Spiegel Grove*, a 153m vessel-reef sunk off Key Largo in May 2002.

The artificial reef fish assemblages were more similar to each other than to natural reefs. Vessel-reefs had sixty species in common, while the *Ebenezer II* only had thirty-nine species in common with natural reefs. Several species common to vessel-reefs were absent or rare on nearby natural reefs. This may indicate that vessel-reefs are providing early juvenile and adult habitat that is not available on natural reefs.

Keywords: Fish Colonization, Artificial Reef, Shipwreck

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EFFECTS OF STOCKING DENSITY ON HATCHERY-BASED STOCK ENHANCEMENT OF RED SNAPPER, *Lutjanus campechanus*, OFF THE COAST OF SARASOTA, FL, USA.

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The American Red Snapper, *Lutjanus campechanus,* is a commercially and recreationally a important fish species throughout the Eastern United States. In response to declining red snapper stocks, the Gulf of Mexico Stock Enhancement Consortium was formed to develop protocols necessary for responsible stock enhancement of the species. This program was implemented to determine the feasibility of large-scale enhancement of native red snapper populations in the Gulf of Mexico.

Since the spring of 2002 approximately 2,000 hatchery reared red snapper have been released off the coast of Sarasota, FL USA. Site fidelity and retention of released fish are strongly influenced by release strategies such as stocking density, acclimation, and season of release on artificial reef habitats. Experiments investigating the influence of stocking density and acclimation of naïve hatchery fish were conducted during the spring and fall of 2002. Initial observations suggest that stocking density can influence the overall abundance of hatchery fish on a given system (i.e. following acclimation). Lower stocking densities tended to show increased abundances during both seasons. Loss rates following release appeared to operate independent of stocking densities with high loss rates observed at high and low fish densities immediately following release regardless of season.

The results of these experiments were dependant on accurate diver assessment. Diver accountably can be severely restricted by movement patterns of the fish following release. Movement between sites was relatively low with an emergent pattern suggesting that once fish leave the release site they are generally lost from the system. Beginning in 2004 a portion of each release group will be tagged with acoustic tags to measure diver accountability and movement patterns. The ability to monitor individual fish will allow us to determine relative contribution of mortality and dispersal in our loss rate of released fish. Releases planned for spring 2004 began to assess the influence of predator and competition factors on the release habitats by conducting predation rate assessments, and acoustic tracking of released fish throughout the experimental area. These experiments will

specifically target the first 14 days following release when dramatic losses have been observed.

Keywords: Red Snapper, Stocking Density, Artificial Reef

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MONITORING REEF FISH ASSEMBLAGES ON VESSEL REEFS IN DEPTHS GREATER THAN 60M WITH A REMOTELY OPERATED VEHICLE (ROV): A STUDY IN PROGRESS

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Below conventional SCUBA diving depths exists a region relatively unexplored by research scientists. This region, from approximately 60-150m, is characterized by a unique mixture of economically important shallow and deep-water fishes. Offshore of Broward County, Florida, numerous vessel reefs have been created within this zone with the goal of increasing habitat and enhancing recreational fishing. We are using a remotely operated vehicle (ROV) and digital video to investigate the fish assemblages on four separate vessel reefs over the course of one year. Qualitative data from preliminary technical trimix dives to vessel reefs in depths greater than 60m in Broward County suggest a different reef fish assemblage than on vessel reefs in shallower waters. However, restricted bottom times limited the area covered in these surveys. Through the use of an ROV, this limitation can be avoided. The ROV survey combines two separate types of visual fish counts. A timed swim (approximately one hour total) is used to cover the entire vessel reef. A series of six timed stationary counts are opportunistically conducted, which allow for the detection of cryptic species and those that may avoid a moving ROV. Currently, data are insufficient to fully evaluate the ability of an ROV to monitor reef fish assemblages at depths greater than 60m. However, a preliminary test of this methodology on shallower vessel reefs shows similar species richness and relative abundance when compared with SCUBA diver point count surveys.

Keywords: OV survey, Trimix, Vessel Reef, Broward County, Reef Fish

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IF YOU SINK IT….THEY WILL COME. AN INVASIVE MUSSEL (*Perna viridis*) IN FLORIDA, WITH AN AFFINITY FOR ARTIFICIAL SUBSTRATE

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The first report of *Perna viridis* in North America came from Tampa Bay in 1999, when it was found clogging the intake pipes of a Tampa Electric Co. power plant. Since that time the mussels have spread south along the west coast of Florida and established new populations along the northeast coast of Florida and into Georgia. *P. viridis* reaches high densities and large size in a short period of time while out-competing native fouling organisms on most artificial substrates. Tolerance studies have demonstrated *P. viridis'* ability to tolerate almost the full range of Florida's coastal habitats with regard to temperature and salinity. Additionally, native *Crassostrea virginica* reefs appear to be negatively affected by *P. viridis* settlement. The mussel's high ammonia output may provide enough nutrients to Tampa Bay's waters, that phytoplankton communities experience no net loss from the increased grazing. High densities combined with high clearance rates may lead to an increase in benthic sediment around artificial substrate. Pilings, buoys, bridges, piers, jetties and bottom debris appear to recruit *P. viridis* to an area first. Near-shore artificial reefs may be the mussel's next target.

Keywords: Perna, Florida, artificial, reef, invasive

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A REVIEW OF FISH ASSEMBLAGES ON ARTIFICIAL REEFS IN PALM BEACH COUNTY, FL

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Since the establishment in 1968 of the "East Palm Beach Reef," Palm Beach County has had an ambitious artificial reef program. This program is directed by the Palm Beach County Artificial Reef Committee, and administered by the county's Department of Environmental Resources Management. To date, more than 50 artificial reefs have been created by the county. To conduct monitoring on these reefs, the Palm Beach County Reef Research Team (PBCRRT) was formed in 1991, under the auspices of the Florida Oceanographic Society. Since 1996, the PBCRRT has conducted this monitoring under grants from Florida Department of Environmental Protection and later the Florida Fish and Wildlife Conservation Commission. This review is a summary of the monitoring conducted by PBCRRT between 1997 and 2003. Statistical analyses were conducted on fish population data collected by PBCRRT in order to uncover any patterns in fish assemblages in relation to reef structure, location, depth, age, and time of year. Distinct differences were found between shallow reefs (depth <30 feet) and deeper reefs (depth >60 feet), particularly when comparing adult to juvenile populations. The structural material of the reefs was also found to be an important variable in the formation of fish assemblages, with artificial reefs in general displaying higher overall numbers, but lower species diversity than natural reefs, and ships providing less appropriate habitat for juvenile fish than lime-rock or concrete rubble. This review reinforces the conclusions of previous studies, which determined that the construction of artificial reefs should be dictated by the role these reefs are expected to play in fisheries ecology.

Keywords: Artificial Reefs, Fish Assemblages, Palm Beach County, Reef Research Team

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2003 MONITORING OF MARTIN COUNTY'S ARTIFICIAL REEFS

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Martin County has an active artificial reef program that has been established for several years. The artificial reef sites consist of (in chronological order of development):

1. offshore reef sites in water depths of 40 to 200 feet,
2. nearshore reef sites in water depths of 10 to 20 feet, and
3. estuarine reef sites in the Indian River lagoon.

The offshore reef sites include the Donaldson, Ernst and Sirotkin Reef Sites. Each of these three permitted reef areas contain several artificial reefs which have been deployed over the past several years, and additional reef materials continue to be added to these areas. In 1993 new materials were added to the Sirotkin Reef Site, including a ship (the *Wickstrom*) a barge (*High Queen* salvaged tugboat remnants on *Zeppo* barge), and concrete railroad ties. In 1992 additions to the Sirotkin Reef Site included concrete tetrahedrons and a barge (the Tree barge); and rocks from the dredging of the St. Lucie Inlet were added to the Donaldson Reef Site.

Martin County's nearshore reef sites are located in the Atlantic Ocean between the Stuart and Jensen Public Beach Parks. These three artificial reef sites were established in 2000, in order to provide mitigation for potential impacts to the nearshore reefs from the Hutchinson Island Beach Renourishment Project. The material used for the nearshore reefs was the concrete debris from the removal of the Evans Crary Bridge, which was replaced with a high-rise bridge crossing the St. Lucie River between Stuart and Sewalls Point. This material consisted of concrete bridge pieces, predominantly pilings, with some deck span pieces. Deployment of the material within the permitted areas was performed by pushing them off of a barge with a piece of heavy equipment, and allowing them to stack upon previously deployed concrete material.

The newest reef sites for Martin County are the estuarine reef sites in the Indian River lagoon that were established in 2002. In 2003, Reef Ball artificial reef units were constructed by Martin County school groups for deployment at a later date under the pier at the Martin County Indian Riverside Park.

During the summer of 2003, investigations of Martin County's artificial reef sites were performed to verify reef locations, document biological activity (benthic and pelagic communities), and evaluate engineering performance (stability and condition of the reef materials, scour and settlement, etc.). This work was performed by divers using visual, still and video underwater photography of the reef areas. The results of this work including reef deployments and underwater photographs will be presented for this poster.

Keywords: artificial reefs, reef monitoring, mitigation reefs, Martin County, Railroad ties, concrete tetrahedrons, bridge rubble

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WARSHIPS, VESSELS AND MODULES AS ARTIFICIAL REEFS

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Resolve Marine Group, having sunk more vessels for artificial reefs than any other company, has been involved in Florida's Artificial Reef Program for many years with the sinking/placement of vessels and artificial reef modules. Highlights of major reef work include but are not limited to:

Ex-*Oriskany* - Currently the company is under contract with the U.S. Navy for the preparation of the aircraft carrier ex-*Oriskany* for sinking off the coast of Pensacola. The ex-*Oriskany* (950' loa) is the first U.S. warship to be sunk intentionally as an artificial reef. Preparation for sinking work includes preparation for tow and tow to the work-site, removal of hazardous and regulated materials and the eventual towing to the sink-site. Additional work may include preparation for sinking for proper flooding and stabilized sinking of the vessel and assisting the U.S. Navy with the actual sinking.

Spiegel Grove - Successfully completed the sinking of the 510' *Spiegel Grove* as an artificial reef off the Florida Keys when initial attempts by local divers were unsuccessful. The addition of this artificial reef has resulted in a significant increase in divers visiting the Florida Keys and has provided a habitat for fish and other aquatic organisms.

Artificial Reef Modules and Derelict Vessels - Deployed hundreds of artificial reef modules and sank numerous derelict vessels off the Atlantic and Gulf coasts.

Keywords: Reefing Vessels, Salvage, Emergency Response, Environmental Remediation, Investment in the Future

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MONITORING ARTIFICIAL REEFS IN PALM BEACH COUNTY: 2000–2003

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The Palm Beach county Reef Research Team, a group of volunteer sport divers, monitors a handful of the over 50 artificial reefs in Palm Beach county. These artificial reefs vary in substrate, depth and age. Eight of the artificial reefs along the shores of Palm Beach County have been monitored from 2000 to the present to gain a more complete understanding of the long-term stability and associated communities of each reef type as well as the community succession that occurs over time. The PBCRRT collects the following data during each of its monitoring dives: detailed maps, DGPS positioning data, shore line-up photos, physical condition, average and maximum relief, photos and video representative views, stationary and roving fish counts, and macro-invertebrate species lists and qualitative descriptions. The relative percent cover of invertebrates and fish species richness at reefs of various ages (1-9), substrates (ship, concrete, or lime-rock) and depth (20 – 110 ft) are presented here to provide an overview of the varying reef communities in Palm Beach County.

Keywords: Monitoring, artificial reefs, community succession, species richness, and percent cover

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CORAL RESCUE AND PROPAGATION ON A SUBMERGED ARTIFICIAL REEF BREAKWATER IN ANTIGUA, WEST INDIES

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Under contract to The Stanford Development Company, the Reef Ball Foundation recently (November 2003) constructed a breakwater offshore of the windward side of Maiden Island located on the northeast coast of Antigua. Over 5,000 coral transplants and 17.5 tons of corals damaged by Hurricane Luis were placed on the Reef Ball modules by a large group of volunteers. Scientific studies are underway to document the growth of the coral transplants and a survey undertaken in late March 2004 showed that the transplanted corals are thriving, having completely based out over the cement plugs. The poster will describe the techniques used in the transplanting process as well as the use of submerged artificial reefs as breakwaters to control beach erosion. More information can be found at the website: http://www.reefbeach.com.

Keywords: oral; transplants; Antigua; Reef Ball Foundations, breakwaters

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MULTIVARIATE HYPOTHESES-BASED CORAL REEF RESTORATION STUDY USING ARTIFICIAL REEFS WITH VARYING CORAL TRANSPLANTS AND FISH REFUGES

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Although artificial reefs have been used in coral reef restoration, most of this work has been of a 'best guess' approach; little research has examined the methodology best suited for restoration structure. This multivariate project examined the use of potential coral attractants to increase coral recruitment to, and survival on, restoration substrates and the interaction between varying fish assemblages and the attraction/recruitment/mortality dynamic. One hundred-sixty small (1.13 m) Reef Balls™ were organized into 40, 4-module reef units (quads), each in a square configuration with 3-m sides. The central void space of each Reef Ball was filled with one of four treatments of different structural complexity (empty, small cage, large block, mixed cage and block) that yielded differently sized fish refuges. Ten quads (40 Reef Balls) received each treatment. Additionally, each Reef Ball of a quad had two standardized settlement plates, both incorporating one of four coral attractant treatments: iron, limestone, coral transplants or plain concrete (control). Different complexities generated different fish assemblages, however an understanding of the potential interaction of these differing assemblages with coral recruitment and mortality awaits analysis of the settlement plates. Coral transplants consisted of 10-cm sized colonies of *Montastrea cavernosa* and *Meandrina meandrites*. All of the *M. cavernosa* and 27.5% of the *M. meandrites* transplants maintained or increased their tissue surface area. The remaining 72.5% of the *M. meandrites* transplants showed degrees of tissue mortality. These species-specific differences in transplant growth and mortality indicate that species selection must be considered in reef restoration efforts with artificial reefs.

Keywords: artificial reef, restoration, coral transplant, fish assemblages, coral recruitment

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SARASOTA COUNTY ARTIFICIAL REEF PROGRAM

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The Sarasota County artificial reef system consists of 34 individual sites, each with multiple deployments. The sites start within Sarasota Bay and reach out to 28 nautical miles offshore and cover the coast from north to south. Diverse materials have been used over the years such as barges, boxcars, culverts, Army tanks, bridges and Reef Balls.

Recent changes to the program include less dependence on questionable materials of opportunity and a focus on designed reef modules, substantial concrete materials, tanks and large vessels.

Innovations include microhabitats such as channel marker reefs (a reef ball with a piling through it), soft bottom restoration, combining diverse materials onto the sites and planning dive trails.

Key words: Tanks, reef balls, bay reefs, channel marker reefs, Ringling Causeway Reef

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A HISTORICAL PERSPECTIVE FOR DETERMINING CHANGES IN THE DISTRIBUTION OF OYSTER HABITATS IN SOUTHWEST FLORIDA USING ARCHIVED MAPS AND CHARTS OF FEDERAL AGENCIES

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A key issue in oyster bar restoration is to establish a historical baseline showing pre-development location and extent of this hard-bottom habitat within a bay system. Our paper discusses the utility of using U.S. Army Corps of Engineers waterway surveys and U.S. Coast & Geodetic Survey H (hydrographic) and T (topographic) Smooth Sheets as source documents for delineating antecedent oyster bars. Summary maps accompany the Annual Report of the Army Engineers to Congress in the form of House and Senate Documents. These reports provide a basis for locating detailed survey maps in the National Archives. A generalized map of southwest Florida shows the distribution of Army Engineers survey maps for the period 1880-1939. H- and T-Sheets are available as 210mm negatives from the NOAA Data Control Division, Silver Spring, MD. Generalized maps have been compiled for southwest Florida showing the distribution of H- and T-sheets for the period 1855-1976. Both the Army Engineers maps and the Coast Survey smooth sheets depict oyster bars as polygons using specific symbology. Our methodology includes scanning the source maps, identifying and digitizing the oyster polygons, and creating GIS coverages. Examples of the historical source maps and GIS coverage are shown for Little Sarasota Bay. This historical information is compared with contemporary conditions, derived from interpretation of 1999 color aerial photography, to create a change analysis oyster bar map. The methodology is in the development phase, but we hope that this effort will be useful in evaluating oyster habitat restoration in other areas of southwest Florida.

Keywords: oyster restoration, oyster mapping, oyster historical distribution

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RELEASING FISH WITH RUPTURED SWIMBLADDERS

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Proper release of marine fishes has become increasingly important to anglers. The use of fisheries management tools such as size limits, bag limits and closed seasons, as well as stronger conservation ethics, has resulted in more and more fish being released. In order to maintain healthy fish populations, each angler is responsible for fishing legally, carefully handling fish that are hooked, and releasing fish that are not harvested so they can spawn or perhaps be caught again.

Controlled studies have shown that survival of marine fishes released after hook and line capture is high, validating catch and release as a marine conservation tool. It is the responsibility of every angler to strive for 100% survival of fish that are released.

Recent research on the venting of recreationally caught fish has documented the value of properly venting certain species, especially grouper and sea bass, before release. Many marine fish have a gas filled organ called a swimbladder, which controls buoyancy and allows the fish to maintain a certain depth in the water column. The gas in the swimbladder can over expand when fish are brought quickly to the surface from depth by hook and line. This can result in serious injury to the fish. If released in this buoyant condition, the fish may float away and die from exposure to the elements or become an easy target for predators. This defeats the purpose of fishery management laws and discourages compliance, when the simple technique of venting could save the fish.

Venting is a very simple technique, which can reduce mortality in recreationally released fish. With a little education and an inexpensive venting tool, every angler that targets or catches and releases certain fish species can practice this conservation technique.

This will be a multi media poster display to demonstrate venting with additional information presented on a laptop computer with a power point presentation and a "how-to" brochure available.

Keywords: venting, fish release, fisheries management

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TAMPA BAY WATCH'S
COMMUNITY OYSTER REEF ENHANCEMENT IN TAMPA BAY

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The Oyster Reef and Oyster Dome Programs are designed to promote the growth of oysters along residential canals and shorelines of Tampa Bay. Once established, the oyster communities will improve water quality through biological filtration, provide habitat for small organisms, promote storm surge protection, and create foraging areas and sanctuary for many species of fish and wildlife.

To create these oyster habitats, Tampa Bay Watch utilizes the help from thousands of community volunteers including local schools, corporate teams, and scout troops. Tampa Bay Watch takes its Oyster Dome program from school to school to build approximately 300 reef units per year and to educate students on the importance of oysters and bay restoration. These reef units are half-round in shape and are made from marine friendly concrete, using a fiberglass mold manufactured by Reef Innovations, Inc., of Sarasota. In total, approximately 1000 reef balls are deployed each year by hundreds of community volunteers along seawalls or along shorelines void of habitat.

The Oyster Reef Program creates natural oyster bars using fossilized oyster shell mined in Sarasota. Each year about 40 tons of clean washed oyster shell is placed in mesh bags and placed in permitted areas along the bay bottom in rows. The shell bags attract oyster larvae settlement, which in turn solidifies the shell material into new oyster bars. This is the most demanding project for our volunteers, but also the most rewarding.

Keywords: CORE, oyster dome, oyster bar, habitat restoration, Tampa Bay Watch

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TOYOTA TAPESTRY AND FLORIDA LEARN AND SERVE GRANTS ENVIRONMENTAL CONCERN AND COMMUNITY INTERACTION MONITORING NEW ARTIFICIAL REEFS

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This undertaking is a student made set of six artificial reef modules that will provide realistic field study examples for classrooms for years to come. Oak Park Principal, Jan Komara says; "The construction of the artificial reef was a cross curriculum project to give students an additional opportunity to study and have a hands on experience to do something about an environmental concern." Our County Reef Agents are some of the many area professionals supporting this $10,000 Toyota Tapestry Grant done in conjunction with the National Science Foundation. The Science "Thinking Outside the Box" grant was designed to network three counties, Sarasota, Collier and Manatee to deploy the same two sets of three modules and have students compare results over the internet. Volunteer divers would go out each month and deliver videos for students to identify fish and do fish counts for data required to monitor how life cycles are developing on new reefs. Experts will be invited to the classroom to instruct students on proper field research techniques and validating data. The Sarasota reefs have been placed 1.9 miles offshore off New Pass. The Collier site is nine miles off Marco Island while the Manatee County site is two miles offshore. All are in thirty feet of water with different bottom conditions. We know that comparisons are invalid for the aforementioned and many other reasons. Even statements about one location are invalid because two sets of the modules are not enough of a sampling to validate anything. But students are no longer "bean counters" and have the opportunity to participate in actual "field studies."

These reefs are unique by design because they are very different than the reef balls that have been placed around the county. These have feet that sink into the sand bottom and anchor the reef. These modules can be stacked so the unique"vertical architecture" might include fish other than the usual species found within four feet of the bottom. These reefs will also have fish incubators that can be moved should the students decide to test them under different conditions. Tranquility Reef, Vice President- T.J. Volpe says: "studies have documented that artificial reefs can be designed to attract specific species so this type of experimentation is extremely valuable. These students are "bio-pioneers" with an untested product in a field as new as space." Partner Ron McCarthy says: "Service

projects which bring out this much interaction between students, field experts and community business people are just the type of projects grant givers support."

We are deeply grateful to those who placed us in such a healthy financial position enabling us to move forward. Those funds will allow additional participation in the second phase of the grant gathering video supported data. This structured activity will be using math while gathering data in the classroom on realistic research as practiced in career settings. An Eagle Scout, David Cohen built three rolling carts as his community project to allow us to bring fish samples (Hart's Landing), maps, GPS equipment, presentation CDs, hands on projects, and lesson plans related to water activities to those who will use them.

Keywords: artificial reef, education, fund raising, grants, reef construction

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REDSTART: A COMMUNITY-BASED APPROACH TO FISHERIES ENHANCEMENT

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Red drum (*Sciaenops ocellatus*) supports an important recreational fishery in Florida, USA (commercial harvest was banned in the early 1990's). Significant public funds, particularly in Texas and Florida, have been directed towards stock enhancement based on release of hatchery-reared fish. REDstart represents an innovative, community-based approach to utilize citizen volunteers to assist researchers and resource managers in developing a red drum stock enhancement program in southwest Florida. REDstart is a fisheries enhancement program consisting of biologists, sport anglers, and local volunteers concerned with the sustainability of local fisheries. REDstart is a way of enhancing game fish stocks by releasing hatchery-reared fish. Genetically compatible fry will be raised in captivity to 20-25 cm and tagged before release. Project success will also be evaluated using genetic tagging protocols developed by the Florida Fish and Wildlife Commission. The program was developed under the auspices of the Florida Sea Grant Extension Program, with technical guidance provided by a Science Advisory Board.

Although there are a number of important public resource management and research partners (South Florida Water Management District, U. S. Fish and Wildlife Service, Sanibel-Captiva Conservation Foundation, Florida Fish and Wildlife Commission, Mote Marine Laboratory, City of Sanibel, Lee County Parts and Recreation Department), the program is driven by volunteers. A total of 35 volunteers have contributed a total of 4,250 documented hours for fund-raising, facility construction, maintenance, and operation. Funding form volunteer efforts (e.g. fishing tournaments) has totaled $42,118. The Facilities located on Sanibel Island in southwest Florida include tow tans with a capacity of 98,410 liters with appropriate life support systems. The current potential production is 25,000 fish grown to a cumulative weight of 27,500 kg. The facility is a grow-out facility, Phase I juveniles (2.5-5.0 cm) have been provided by the Florida Fish and Wildlife Commission. To date, the volunteer workforce (under the direction of the local Sea Grant Extension Agent) has proven to be highly motivated and proficient. Detailed water quality and fish health assurance

protocols have been established. Water quality data and progress reports will be posted on a future web site. Progress and success to date suggest that community-based public/private partnerships may be able to significantly augment public stock enhancement programs.

Keywords: fisheries, enhancement, community-based, red drum, aquaculture

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