Florida Oyster Reef Restoration Workshop

Agenda and Abstracts

March 14 & 15, 2007
Fish & Wildlife Research Institute
St. Petersburg, Florida

Florida Oyster Reef Restoration Workshop

March 14 & 15, 2007, Fish & Wildlife Research Institute,
100 8th Avenue SE, St. Petersburg, Florida

Provisional Agenda

Wednesday, March 14

9:30 – 10:00 AM	**Hospitality / Mixer**
10:00 – 10:20 AM	**Welcome & Opening Comments** – Laura Geselbracht, Bill Arnold
10:20 – 10:50 AM	**Plenary Speaker** - Loren Coen
10:50–11:50 AM	**Setting the Stage** • Early History of the Oyster Industry – Paul Zajicek • Current Status of Oyster Reefs in Florida – Bill Arnold • Mapping Strategies and Results – Kathleen O'Keife
11:50 -12:10 PM	**Funding Opportunities** • NOAA - Leslie Craig
12:10 -12:55 PM	**Lunch** – to be provided
12:55 – 1:35 PM	**Ecological Value** • Ecological Value - Greg Tolley • Seston removal - Ray Grizzle
1:35-2:15 PM	**Achieving Ecological Restoration** • Ecological restoration objectives – Rob Brumbaugh • Achieving ecological restoration – Aswani Volety
2:15-3:35 PM	**Restoration Project Planning** • Hatchery Issues – John Scarpa • Genetics - Mike Tringali • Health – Roy Yanong and Denise Petty • Disease – Bruce Barber
3:35-3:50 PM	**Break**
3:50 – 5:10 PM	**Project Construction & Permitting** • Construction – Mark Berrigan • Permitting: Lisa Gregg, FWC; Ann Lazar, FDEP; Mary Saunders, USACOE
5:10 – 5:20 PM	**Day's wrap up**

Day 2 agenda on following page

Thursday, March 15

8:30-9:00 AM	**Breakfast hospitality**
9:00 – 11:00 AM	**Project Case Studies** • Tampa Bay – Peter Clark • Tampa Bay – Ian Dow • St. Petersburg – Jim Anderson • Sarasota Bay – Michael Jones • Sarasota Bay – Jay Leverone • Naples Bay and Southwest Florida – Michael Savarese
11:00 - 11:15 AM	**Break**
11:15 – 12:15 PM	**Project Case Studies, continued** • St. Lucie Estuary – Heather Hitt • Panhandle – Mark Berrigan • MacDill AFB – Jason Kirkpatrick
12:15 – 1:00 PM	**Lunch** – to be provided
1:00 – 1:40 PM	**Project Case Studies, continued** • Indian River Lagoon – Anne Birch • Pelican Island - Liberta Scotto
1:40 PM–2:10 PM	**Vision for Florida's Oyster Reef Future** A proposal and group discussion
2:10 – 2:20 PM	**Next Steps/Wrap Up**

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An Overview of Restoration Efforts for the Eastern Oyster, *Crassostrea virginica* Gmelin: Some Successes and A Lot of Lessons Learned

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Prior to the 1990s, resource agencies focused almost exclusively on the enhancement/restoration of *Crassostrea virginica* as a resource, despite basic research that suggested additional 'ecosystem services'. More recently, these same agencies and numerous researchers have begun to broaden their view and invest significantly more dollars and energy on restoration for these other 'services' also. For example, in the southeast, intertidal reefs also serve critical roles for many bird and mammal species, and our work in SC suggests that they also protect fringing *Spartina alterniflora* marshes from erosion caused by both natural and anthropogenic processes.

One hurdle we face, despite *C. virginica*'s extensive literature, is that there are relatively few 'reference' datasets for natural reefs prior to their decline, hampering our ability to gauge restoration progress and ultimately 'success'. Also critical are explicit goals and appropriate metrics for reef assessment. In 2004, a group of us met to discuss and share their restoration efforts and approaches. More recently, I solicited feedback from the *C. virginica* research community on success and failures, and gaps in our knowledge. Although some ecologically-derived restoration benefits are evident immediately after material ('cultch') is planted, many benefits come <u>only</u> after oyster populations are well-established with oysters at or near their 'natural' densities. Additionally, some have suggested that some of these services (filtering) have been adequately demonstrated (Pomeroy et al. 2006). Currently, longer-term reef restoration projects are only just reaching potential maturity at 5-10 years of age, with many larger-scale ecosystem benefits yet to be assessed in any rigorous manner (see Grizzle et al. paper here). All are discussed here in this timely workshop.

A Brief History of Early Florida Cultch Planting Efforts

Paul Zajicek
Biological Administrator
Division of Aquaculture
Florida Department of Agriculture and Consumer Services

Apalachicola oyster canneries began planting cultch in the Bay during the late 1880s. During 1913 a Shell Fish Division was legislatively created in the Florida Department of Agriculture to "…encourage, protect, regulate and develop the Shell Fish Industry…." Within 18 months, the Shell Fish Division bought and put into service *Sea Foam*, *Roamer*, *Myerdale* and an unnamed vessel; planted 15,000 barrels of cultch, leased 6,059 acres for clam and oyster culture, and collected receipts of $19,487. The Division reported that "raw houses and canning plants have used 980,204 bushels of oysters and clams [since] the shell fish law has been in effect." The Shell Fish Division was with the Department of Agriculture until about 1932 when it was merged into a newly created State Board of Conservation. The Board arranged with the University of Miami's Marine Laborator, led by F. G. Walton Smith, to carryout marine research for the state. An Oyster Division was authorized by the Board in 1947 but was not organized until 1949 with Dr. Smith as Division Director. Smith named a former Miami student, then working with oysters in Louisiana, as his assistant director in charge of field operations: Robert Ingle. Mr. Ingle's initial activities included creating and equipping a marine lab in Apalachicola, purchasing and converting a 34-foot shrimp boat into a floating laboratory, and by March 1950 jointly operating a seafood safety lab with the State Board of Health. Because of lack of available cultch, metal scrap was planted during the summer of 1949. The metal scrap was a failure as cultch and in June 1950 oyster cultch was purchased and barged from Alabama to the Bay for planting.

Current status of oyster reefs in Florida waters: Knowledge and gaps.

William S. Arnold, Florida FWCC Fish and Wildlife Research Institute, 100 Eighth Avenue SE, St. Petersburg, Florida 33701(bill.arnold@myfwc.com)

The Eastern Oyster (*Crassostrea virginica*) has been a culturally and economically important contributor to the Florida lifestyle even before European invasion of North America. Oyster shell is the dominant component of Native American middens throughout the state, and historically significant structures such as the Kingsley Plantation in Jacksonville were constructed from oyster shell. More recently, oysters have supported important fisheries on both the eastern and Gulf of Mexico coasts of Florida. As will be described in several other talks within this workshop, oysters also contribute significantly to Florida's coastal ecosystems. Within that context, it is remarkable how little information is available on the distribution of oysters throughout the state. Based upon the information that I have been able to obtain, I will present a summary of the known distribution of oyster reefs throughout coastal Florida. Of equal importance, I will attempt to identify gaps in our knowledge of oyster reef distribution, thereby providing a map to guide future assessment efforts. I will focus on oyster reefs in their most classical sense, to the exclusion of oyster populations growing on seawalls, mangrove roots, rocks, and other substrates. However, it will be noted that these populations also contribute to ecosystem health although our understanding of the degree and distinctiveness of those contributions is poorly understood.

Tampa Bay Oyster Bar Mapping and Assessment

Kathleen O’Keife, Florida FWCC Fish and Wildlife Research Institute, 100 Eighth Avenue SE, St. Petersburg, Florida 33701(kathleen.okeife@myfwc.com)

The objectives of this mapping exercise were to establish a baseline map layer for the current extent of oysters within Tampa Bay, to assess the accuracy of the mapping effort, and to develop an historic map layer derived from scanned USGS post-1927 T-sheets. These efforts will provide the base data for future mapping projects and enable trend analyses to be performed that will aid scientists in monitoring changes to oyster resources in Tampa Bay.

In addition to identifying oysters within the Bay, there was a desire to ascertain if the mapping of this resource is something that can be automated. Currently, maps are most often produced using ground surveys and manual interpretation of aerial photographs. These techniques are time-consuming and labor intensive. An integrated automated mapping method that incorporates high resolution sources (spectral and spatial) at a lower cost would be a useful tool for resource managers in Tampa Bay as well as may other areas. If a remote sensing method can be proven to secure reliable results, it will enable mapping of oysters on a large geographic scale. This would be efficient as well as economical. To this end, two separate semi-automated feature extraction approaches were employed as well as traditional photointerpretation methods.

Staff at the Fish& Wildlife Research Institute (FWRI) performed mapping, field verification and quality assurance on all products. For this effort, hyperspectral imagery collected by the Galileo-Group, Inc.(Galileo) and 2004 digital orthophoto quarter quadrangles (DOQQs) were used. Extensive field reconnaissance was performed to provide training sets as well as to identify errors of commission and omission. This presentation will describe this project as well as the outcome and future direction of this research.

Oyster reef restoration funding opportunities.

Leslie Craig, National Oceanic and Atmospheric Administration, Southeast Regional Office, St. Petersburg, Florida (Leslie.Craig@noaa.gov).

The National Oceanic and Atmospheric Administration (NOAA) Community-based Restoration Program (CRP) began in 1996 to catalyze local efforts to conduct meaningful, on-the-ground restoration of marine, estuarine and riparian habitat. Since 1996, the CRP has funded more than 1,000 on-the-ground restoration projects. The CRP has contributed $37 million to grassroots restoration projects, often generating 3-5 times that in cash and in-kind contributions.

A model program for community collaboration, partnership building, and interagency cooperation, the CRP partners with grassroots organizations to encourage hands-on citizen participation in restoration projects. The CRP awards millions of dollars to national and regional partners and local grassroots organizations every year. Restoration project funding may be given directly from NOAA as an individual project grant or through subawards from our national and regional partners. The CRP conducts an annual solicitation for individual project grants. Alternatively, NOAA has established national and regional partnership grants which are multi-year cooperative agreements. These long-term agreements allow for subawards to restoration projects which are jointly reviewed and selected by NOAA and partners. Each funding partner fulfills a unique niche – representing unique geographic ranges or habitat focus.

Whether funded directly or through partners, each project proposal is subject to a competitive review process through which successful projects are selected for funding based on technical merit, level of community involvement, and ecological benefits. Technical staff from 16 NOAA offices around the country are available to aid in project identification, design and implementation as well as proposal development.

Proposal solicitations, as well as contact information, are available at www.nmfs.noaa.gov/habitat/restoration.

OYSTER REEFS AS HABITAT: UNDERSTANDING THE ROLE OF FRESHWATER INFLOW IN SHAPING REEF COMMUNITIES

Tolley, S. Gregory, Aswani K. Volety, Michael Savarese, Laura D. Walls, Christi Linardich & Edwin Everham III.—Coastal Watershed Institute, Florida Gulf Coast University, 10501 FGCU Blvd S, Fort Myers, FL 33965-6565

ABSTRACT: Thoughts of oyster-reef restoration in Florida can be traced back to the end of the 19th century, and significant effort was expended beginning in the 1940s to construct and rehabilitate reefs to enhance oyster production. Contemporary projects often focus on restoring ecosystem function lost as a result of the decline of oysters rather than on rebuilding the commercial fishery. One such function is the creation of habitat for commensal organisms, many of which serve as forage for commercially and recreationally important species. Because freshwater inflow is highly variable in Southwest Florida, it is important to understand the influence of salinity on oyster-reef communities when assessing reef habitat. Is community structure comparable along the salinity gradient of an estuary or among tidal tributaries experiencing different levels of freshwater inflow? Do oyster-reef communities vary seasonally in response to changing freshwater inflow? To address these questions, multivariate techniques were employed to examine abundances of decapods and fishes collected from the Caloosahatchee estuary, Estero Bay and Faka Union Bay. Analysis of similarities suggested differences among stations located along the salinity gradients of all three estuaries; community structure also varied among stations located near the mouths of Estero Bay tidal tributaries. Multidimensional scaling identified community structure present at upper stations as distinct from that downstream and at high-flow tributaries as distinct from that near low-flow tributaries. Stations upstream and near high-flow tributaries were typified by *Eurypanopeus depressus* and gobiid fishes; stations downstream and near low-flow tributaries were typified by *E. depressus* and *Petrolisthes armatus*. Dissimilarity was greatest when upper and lower stations were compared along the salinity gradient or when low salinity and high-salinity sites were compared among tributaries. Multivariate dispersion tended to be higher upstream or in association with high-flow tributaries, suggesting that high levels of freshwater inflow may act to disturb oyster-reef communities.

Using *in situ* fluorometry to characterize and quantify the effects of natural and restored oyster reefs on water quality

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Loren D. Coen, South Carolina Department of Natural Resources, Marine Resources Research Institute, 217 Fort Johnson Road, Charleston, SC 29412

Suspension-feeding bivalves such as oysters remove substantial amounts of suspended particles (seston) as they feed, but only a few studies have quantitatively characterized the process in the field. This presentation will describe a newly developing protocol involving *in situ* fluorometers placed upstream and downstream of an oyster reef to characterize short-term (<2 hr) variations in chlorophyll *a*. Recent studies over natural and restored intertidal reefs in South Carolina in June 2006 found total seston uptake (removal) rates expressed as "% of the water column cleared of seston" ranged from <0% to >30%, with rates largely determined by the mean densities (ranging from 0 to ~500/m^2) of oysters relative to water flow speed and cross-sectional area of the overlying water column. *In situ* fluorometry represents a rapid and effective method for quantifying seston removal rates by restored oyster reefs, and is a first step in understanding how oyster reefs influence long-term water quality changes in ecosystems.

Ecological Restoration Objectives: An Ecosystem Services Approach

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Bivalve shellfish are ‘ecosystem engineers’ - organisms that physically, biologically or chemically modify the environment around them in ways that influence the health of other organisms. The biogenic nature of temperate oyster reefs as habitat for other species was described beginning in the 19th century, and their controlling influence on ambient water quality and nutrient cycling was at least estimated if not directly measured in various studies beginning in the mid 20th century. The capacity of suspension feeding bivalves to suppress harmful algal blooms and stimulate the growth of beneficial seagrasses has been inferred from mesocosm studies and mathematical models, and recent field studies have directly measured removal of seston from the water column. The ecosystem services that these ecosystem engineers produce or influence can be broadly categorized as ‘regulating’ (e.g., erosion control), ‘provisioning’ (e.g., fisheries), ‘culturally significant’ (e.g., tourism), and ‘supporting’ (e.g., nutrient cycling), and are increasingly invoked as a desired outcome of habitat restoration. However, many restoration projects are conducted on an ad-hoc basis with limited effort to determine *a priori* the contribution of the project to overall ecosystem function. The Nature Conservancy and partners are developing a nationwide network of shellfish restoration sites where quantitative approaches are used to monitor these projects for ecosystem services outcomes. The intent of this network is to develop collaborative projects, develop and share new tools for monitoring, provide opportunities to compare results at different locations and geographic scales, and to advance the restoration of shellfish for ecosystem services in general. The shift in emphasis toward ecosystem services as well as some ‘better practices’ for restoration are described in a recently published practitioners’ guide that will be highlighted in this presentation.

Achieving Ecological Restoration: Consideration of factors influencing the success or failure of restoration efforts.

Aswani K. Volety, S. Gregory Tolley, Michael Savarese. Coastal Watershed Institute, Florida Gulf Coast University, 10501 FGCU Blvd, Fort Myers, Florida 33965; Peter H. Doering, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, FL 33406.

Ecosystem restoration and management seek to repair or improve a suite of desired environmental conditions for a specific ecosystem. However, it is critical to understand factors influencing the ecological resource prior to engaging in ecosystem restoration and/or management. For example, in the Caloosahatchee estuary, where oyster abundances have declined precipitously from historic values, altered hydrology including unnatural high and low water deliveries to the estuary have been identified as few of the stressors. However, several other factors including larval supply and recruitment, disease incidence of *Perkinsus marinus*, predators, availability of suitable substrate, food availability and contaminants can also contribute to the declines in oyster populations. This project investigated the influence of the above factors on oysters at various locations in the Caloosahatchee estuary along a salinity gradient. Results suggest that timing, quantity and duration of freshwater releases negatively impact oyster populations at the upstream end while lack of suitable substrate are limiting factors at the mid stream and downstream locations. We are engaged in a two-pronged approach in restoring oyster populations in the estuary: working with resource managers in an adaptive management strategy in regulating the freshwater releases into the estuary, as well as substrate enhancement for greater larval recruitment at the mid and lower reaches of the estuary. This project is showing great success to date and illustrates a collaborative approach between resource managers and scientists in regulating water quality conditions that sustain and enhance oyster reefs and reef-resident organisms in the Caloosahatchee estuary.

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Hatchery issues for shellfish restoration

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Restoration techniques encompass many methods for increasing the number of target species. Bivalve restoration has utilized substrate enhancement (e.g., shell replacement, oyster balls), stock preserves (i.e., areas off limits to harvesting) and direct stocking. Direct stocking usually entails placing oysters that are of sufficient size to resist certain predators (e.g., crabs), thereby increasing survivorship. However, direct stocking involves culture techniques that may have unintended consequences. Genetic research has indicated oyster populations within a region may have genetic differences, although the oysters are not different enough to be considered subspecies. Therefore, hatchery and stock restoration personnel must be aware of stock genetic identity and potential genetic diversity within a stock. Genetic identity may be easily maintained by utilizing oysters from the area to be restored. Genetic diversity may be maintained by using enough breeders. The larger the number of parents that contribute to the offspring the greater the probability that genetic diversity will be maintained, but care must be taken when performing the crosses to ensure parental contribution. Understanding the model of Effective Parental Number (N_e) will assist hatchery personnel in maintaining genetic diversity. Although genetic identity and diversity are important, placing infected organisms back into the environment does little for restoration efforts. Production techniques to exclude and limit pathogen introduction and transfer within a facility must be implemented. Quarantine of wild brood stock, water disinfection by ultra-violet light, hygienic hatchery protocols, and pathogen testing will assist in biosecurity efforts to produce specific pathogen free (SPF) organisms for restoration.

Genetic Dynamics of Natural Stocks of *Crassostrea virginica* in Florida Waters: Implications for the Genetic Management of Cultured Oysters

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All activities involving the relocation of wild aquatic organisms or release of cultured aquatic organisms shall be undertaken with full consideration of their impact on natural biological diversity and in ways that do not threaten the state's natural biological heritage. This statement applies to activities involving the intentional or unintentional release of cultured aquatic organisms or their gametes into state waters and where authorization is required for the importation of live aquatic organisms into Florida (FL). Cultured organisms are defined as those that have spent any portion of their life cycle in captivity or that have been transported > 25 km from their site of capture. If cultured individuals of the Eastern oyster *Crassostrea virginica* are not reproductively isolated from wild Eastern oysters in FL, then a potential for genetic impact exists. Therefore, FWC will assess and manage all applicable release/relocation activities.

Genetically distinct Gulf and Atlantic populations of the Eastern oyster interbreed freely and seemingly randomly along the FL Atlantic coast despite a sharp step cline (hybrid zone) in coastal waters of Volusia and Brevard counties. This hybrid zone is characterized by non-assortative reproduction, absence of single-locus and multilocus disequilibria at the zone center, and the lack of intrinsic post-zygotic barriers to gene flow. Breeding and transplant studies are currently in progress by others to investigate environmental barriers to introgression and/or dispersal in Eastern oysters. These results will help guide future assessments. Until then, a precautionary approach will be adopted for activities that could disrupt natural hybrid zone dynamics.

Health Considerations for Oyster Restoration Programs

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Denise Petty, Department of Fisheries and Aquatic Sciences, University of Florida, 7922 NW 71st St., Gainesville, FL 32653 (pettyd@ufl.edu)

Animal health considerations are an important component of any successful aquatic animal restoration or stock enhancement program. Major goals are that animals used for restoration are at optimal health when stocked and do not carry or spread exotic disease agents into their new surroundings. Life stage, population locale, endemic diseases, water body of origin or destination, and water quality parameters (e.g., salinity) will have different levels of importance based on the restoration scheme.

A science-based, pragmatic approach includes: a)agreement among stakeholders on what is “normal” and “acceptable” health for restoration/enhancement, including state and federal regulations, if any exist; b)current understanding of etiology, epidemiology, and relative importance of diseases found in cultured and wild stocks; c) baseline information on “normal” health status for given populations; d) a sound protocol for health assessment; e) methods for mitigation of risk for diseases, to fit the specific type of restoration undertaken; and f) methods for follow-up after release.

A number of diseases and disease pathogens have been identified in different oyster life stages, each with different levels of associated health implications and risk. Diseases of concern (e.g., MSX) should be distinguished from common, opportunistic diseases (e.g., vibriosis). Based on relative importance and level of endemic disease, risk mitigation will vary from one scenario to another. A number of diseases of concern that can cause significant mortalities in the eastern oyster (*Crassostrea virginica*) include MSX, Perkinsosis (Dermo), and SSO. Potential differences in strains or presence or absence of these or other emerging diseases in given areas will result in different biosecurity approaches.

Impacts of diseases on oyster (*Crassostrea virginica*) populations and restoration efforts

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Decisions regarding the restoration of oyster reef habitat in Florida should be guided by an understanding of: 1) the factors that have lead to the decline of natural systems, and; 2) the factors potentially limiting the success of restoration efforts. Two parasitic diseases of oysters, MSX (*Haplosporidium nelsoni*) and Dermo (*Perkinsus marinus*) are responsible for major declines in oyster populations along the east coast of the United States beginning in the late 1950's. MSX is found primarily in the Mid-Atlantic region, while Dermo (probably several species) ranges from Maine to Texas. Initial management efforts focused on the commercial value of the resource. More recently, however, the ecological importance of oysters has been recognized. This has resulted in significant interest (and effort) in reconstructing and repopulating oyster habitat. Even with the incorporation of hatchery-produced, selectively bred oysters, diseases remain a serious impediment to restoration efforts. Attempts to restore oyster populations in Florida should not be undertaken without: 1) current knowledge of disease dynamics in the region(s) of interest, and; 2) post-project disease monitoring to evaluate success.

Construction of oyster reefs as a resource management practice in Florida.

Mark Berrigan, Florida Department of Agriculture and Consumer Services, Division of Aquaculture, 1203 Governor's Square Blvd., Tallahassee, Florida 32301 (berrigm@doacs.state.fl.us)

The benefits derived from replanting processed oyster shell and other alternative cultch materials have been understood for decades, and replacing these materials on depleted or damaged oyster reefs has become common practice for maintaining and restoring oyster reef habitat on private leaseholds and state-owned submerged lands. Shell planting on Florida's public reefs to stimulate oyster production was reported as early as 1914, and the state has maintained an effective shell planting program since 1949. Constructing new reefs or restoring depleted reefs offers resource managers a unique opportunity to mitigate resource losses, contribute direct economic benefit to fishery-dependent communities, and restore critical ecological functions. Successful oyster reef construction requires a multidimensional approach to ensure that all critical components are considered, including: biological, environmental, hydrological, and physical parameters. Oyster reefs should be designed and constructed to be compatible with specific estuarine systems, support self-sustaining oyster populations, and perform ecological services. This presentation will provide an overview of reef construction parameters and discuss their application in current oyster reef restoration projects.

Authorizations required for oyster reef restoration projects: State and federal.

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There are numerous activities encompassed by the term "restoration". With regards to oyster reef restoration, activities may include the following: 1) placement of material to create oyster habitat for aquaculture, non-aquaculture or mitigation purposes; 2) relocation of larvae, spat, juvenile or adult animals; and 3) introduction of cultured animals.

Our presentation will be focusing on the various state and federal licenses or permits required to conduct oyster reef restoration projects, based on the activities necessary for such projects.

Authorizations Required for Oyster Reef Restoration Projects

	DACS	DEP	ACOE	FWC
Material placement for aquaculture purposes	XXX		XXX	
Material placement for non-aquaculture purposes		XXX	XXX	
Material placement for mitigation purposes		XXX	XXX	
Introduction, reintroduction or relocation of animals (wild or cultured) in any life stage				XXX

For purposes of oyster reef restoration, activities designed to improve, enlarge or protect oyster reefs in an open shellfish harvesting area are considered aquaculture.

Contact Information

Licensing and Permitting Contacts (any location statewide):
Department of Agriculture and Consumer Services (DACS), Division of Aquaculture
1203 Governors Square Boulevard, Fifth Floor, Tallahassee, FL 32301
(850) 488-5471
http://www.floridaaquaculture.com/

Florida Fish and Wildlife Conservation Commission (FWC), Division of Marine Fisheries Management, Special Activity License Program
620 South Meridian Street, Mailbox 4B3
Tallahassee, FL 32399-1600
http://myfwc.com/marine/recreational/sal.htm

Permitting Contacts (based on project location):
Department of Environmental Protection (DEP), District Office, Environmental Resource Permitting (ERP) Program for all of Florida except the Panhandle area; Wetland Resource Permitting (WRP) Program for the Panhandle area. DEP District Office information may be found at: http://dep.state.fl.us/secretary/dist/

Army Corps of Engineers (ACOE), Regulatory Offices. Regulatory Office information may be found at: http://www.saj.usace.army.mil/permit/offices/geographic_alignment.htm

Community Oyster Reef Enhancement in Tampa Baywatch

Peter Clark, Executive Director, Tampa Bay Watch (pclark@tampabaywatch.org)

Tampa Bay Watch's Community Oyster Reef Enhancement program creates oyster bars on spoil islands and natural shorelines within Tampa Bay. Oyster communities help stabilize shorelines, provide hard bottom habitats for fish and wildlife resources and promote water quality improvements in the Tampa Bay ecosystem. Local oyster populations have suffered from degraded water quality and habitat loss and fragmentation. The lack of suitable hard-bottom habitat has become a major concern for bay researchers and managers.

The Community Oyster Reed Enhancement (CORE) program creates fossilized oyster shell reefs constructed similar in structure to natural oyster communities found along shoreline areas throughout Tampa Bay. One of the main sites for Tampa Bay Watch's CORE program is MacDill Airforce Base. Since 2004, Tampa Bay Watch has placed 3,725 feet of oyster reef at MacDill. These oyster reefs benefit Tampa Bay by promoting water quality improvements through biological filtering of the water, providing habitat for small organisms, preventing further erosion, and creating foraging areas and sanctuary for many species of fish and wildlife. The project also benefits the community by promoting environmental awareness and offering hands on experience in habitat restoration.

A newly established oyster reef in Boca Ciega Bay, St Petersburg, Florida: A success story?

Ian Dow, College of Marine Science, University of South Florida, St. Petersburg, Florida (dowim@marine.usf.edu).

In an effort to restore some the recreational resources lost due to the 1993 Tampa Bay Oil Spill, a 600ft oyster reef was constructed in October 2005 90m off the shore of War Veteran's Memorial Park in Boca Ciega Bay in Tampa Bay, Florida. The construction of the reef was intended to revitalize the naturally occurring oyster population, while improving the local water conditions, promoting growth of the local seagrass beds, enhancing shoreline accretion, and bolstering the invertebrate and recreational fish populations often associated with oyster reefs. The leeward face of the reef was half covered with a veneer of fresh oyster valves and half with fossilized shell material, and capped with limestone boulders. Oyster recruitment, living density and growth were measured over a period of 12 months. The fresh shell proved to be a better substrate for larval settlement and was more stable than the fossilized material. Partial degradation of the fossilized material over time resulted in a decline of suitable settlement area and reduced oyster density. Comparatively, the fresh oyster valves showed significant increases in oyster density and size. Although the reef appears to have succeeded in natural oyster settlement, some of the other intended services have not yet been realized. An increased sediment loading may be occurring along the outer edge of the seagrass bed and the leeward side of the reef. This may be resulting in decreased water clarity and may eventually lead to a decline in the seagrass density.

US Coast Guard Lassing Park mitigation project:

Jim Anderson, Seagrass Recovery, LLC, 4331 Cockroach Bay Rd, Ruskin, Florida, 33570 (jim@seagrassrecovery.com)

I will be presenting on the creation of an oyster reef built in conjunction with a seagrass bed as part of the mitigation project done by the US Coast Guard. The project built an oyster reef (breakwater) to protect the seagrass transplants. The reef was designed using the concrete rubble from the old boat ramp at the St Petersburg base. No seeding was done and oysters have started to colonize the concrete rubble. The seagrass and oyster reef have produced a large habitat of essential fish habitat.

Oysters as an Environmental Indicator for Sarasota County

M.S. Jones P.W.S., Sarasota Florida

Florida coastal watershed drainage has been altered for development and agriculture. These alterations have often increased freshwater discharge to estuaries resulting in altered salinity regimes. Oysters have specific environmental requirements and are susceptible to fluctuations in the environment. Salinity is a primary factor that affects oyster status. Research has shown that optimal salinity range for oysters is 14-28 ppt. The relationship in freshwater discharge and salinity levels to the number of live and the ratio of live to dead oysters was investigated for Dona and Robert's Bay in Venice, Florida. The numbers of live and dead oysters were counted twice a year from October 2003 through October 2006 within three randomly chosen 0.25m x 0.25m quadrats in six different bay segments of the study area. Available salinity and discharge data was compiled for the same period of record. During seasons with high precipitation and discharge resulting in prolonged decreases in salinity, oyster mortality and the ratio of dead to live oysters were higher than wet seasons with less precipitation. Dead to live oyster ratios were highest in bay segments with the lowest average salinities and lowest in bay segments with a more stable salinity regime. The observed response suggests that oysters are a good indicator of the ecological potential of managing freshwater discharge to estuarine environments. As a result of the Dona Bay monitoring Sarasota County has expanded the monitoring program to include examples from each of its four coastal watersheds and developed a scoring system to track oyster health as an indicator of watershed status.

Establishing an Oyster Habitat Restoration Program for Sarasota Bay

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The Sarasota Bay Estuary Program (SBEP) has been creating, enhancing, and restoring estuarine habitats since its inception in 1989. Oyster habitat restoration has garnered increased attention recently and, in 2003, the SBEP initiated a study to evaluate the current status of oyster habitat and the potential for restoration within the bay. A subcommittee of the SBEP Technical Advisory Committee was formed and tasked to: map the historical presence of oysters, evaluate conditions of existing oyster habitat, select potential restoration sites, design and construct new habitat, and monitor the ecological functioning of newly created habitat.

A survey of historical and existing oyster habitat in the region drew attention to several potential enhancement sites within Little Sarasota Bay. A ten-year water quality database was reviewed to ensure that suitable conditions for oysters were available. White Beach (subtidal) and Turtle Beach (intertidal) were selected as candidate enhancement sites and oyster beds near the mouth of North Creek were selected as a reference site. Preliminary site assessments included detailed surveys and bathymetric profiles. We also evaluated substrate composition, presence of SAV, percent live oysters, spat abundance, disease prevalence and predators.

Oyster habitats were created in August, 2005. Each habitat consisted of various arrays of bagged fossil shell. Year one monitoring revealed spat settlement at both enhancement sites in late summer and early autumn. Artificial settlement plates, however, did not mimic natural recruitment of oyster spat. This year, the design of settlement collectors was modified. Plans are also underway to supplement each habitat with additional shell material.

Is Water Quality Suitable for Oyster Reef Development in Naples Bay? A Reef Restoration Demonstration Project

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Naples Bay suffers from a variety of water quality impairments caused by freshwater inundation due to water management, by pollutants borne from storm water runoff and boat use, and from high rates of sedimentation. Prior to human development, Naples Bay supported prolific oyster reefs. These have been subsequently lost due to elimination of nearshore and intertidal habitat. The question remains as to whether Naples Bay may have adequate water quality to support reef development, yet merely lack appropriate substrate. To test this hypothesis, reef foundations, composed of shell cultch, were constructed at two sites within the bay: at an upstream, lower salinity site near Naples Landing; and at a downstream, higher salinity site near the Winstar development just north of Gordon Pass. Both substrates were monitored quarterly for 18 months for oyster recruitment and growth. The upstream site received few recruits; cultch bags maintained on average < 15 living oysters throughout the study interval (oyster densities ~ 80 oysters / m^2). The downstream site recruited and maintained a larger population size, ranging up to 60-100 individuals per bag (densities from 300-600 oysters / m^2). These densities are far below those found on healthy oyster reefs elsewhere in Southwest Florida. Oysters recruiting to the upstream site experienced smothering due to deposition of muddy sediment. Cultch bags at the downstream site were commonly disturbed by boat wakes and experienced sand deposition. (This site is located outside of the slow speed zone.) Results suggest that oysters are viable along the length of Naples Bay, though water quality conditions are far from ideal to support healthy, highly productive reefs.

St. Lucie Estuary Oyster Gardening and Restoration Project

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The Florida Oceanographic Society started an Oyster Gardening and Restoration Project in the St. Lucie Estuary (SLE) in June of 2006. Several dock owners along the SLE volunteered the use of their docks for growing oysters in cages for three months at a time before being dispersed onto natural oyster reefs. The adult native oysters are collected from the SLE and spawned at the Research Aquaculture facility located at Florida Oceanographic Coastal Center. The seed oysters are given to the dock owners at a size range of 3 mm to 5 mm shell length and the dock owners, or oyster gardeners, measure the salinity, temperature, and Secchi depth of the water each week and rinse the oyster cages. After three months the oysters range from 2 to 5 cm in shell length and are then scattered over six oyster reefs in the SLE. Since the project began, the density of oysters on the six oyster reefs has increased by an average of 79 oysters/m^2 and shell length has increased by an average of 2 cm. Future plans for oyster restoration in the SLE include expanding the Oyster Gardening Project as well as deploying recycled oyster shell in suitable locations for starting a new oyster reef and seeding with eyed larvae inside containment booms.

Restoring Public Oyster Reefs in Florida's Panhandle

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The Division is involved in a comprehensive multi-county project to restore oyster reefs that were damaged by Hurricane Ivan. These projects are designed to rejuvenate fishery habitat, enhance oyster production, and facilitate recovery of the oyster-dependent businesses. Florida, along with the other Gulf States, is sharing federal funds to restore damaged oyster reefs along the Gulf Coast. The Department of Agriculture and Consumer Services was awarded a $1.7 million grant from the National Oceanic and Atmospheric Administration (NOAA) to restore oyster reefs damaged by Hurricane Ivan (2004) and was the recipient of a $3.8 million subaward from the Gulf States Marine Fisheries Commission / NOAA to restore oyster reefs damaged by hurricanes in 2005.

Restoring oyster reef habitat will provide numerous fishery and ecological benefits. These projects promotes the development of self-sustaining reef communities, which in turn, perform ecological services which contribute to fisheries habitat, ecosystem stability, nutrient cycling, and improved water quality. Functioning oyster reefs are recognized as an essential component in stabilizing and sustaining ecological relationships in almost all Gulf estuarine ecosystems.

Constructing Oyster Reefs for Shoreline Stabilization and Restoration at MacDill AFB

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The oyster reef shoreline stabilization project is a five-year, five-phase project initiated by the Air Force and supported by Federal and local partners including the USFWS, NOAA, Tampa Baywatch, Hillsborough County EPC and community volunteers. MacDill's eastern shoreline has experienced rapid erosion over the past decade. While MacDill's northeastern shoreline is being stabilized using a traditional limestone revetment, the less developed southeastern shoreline is being stabilized using an innovative approach that is also ecologically beneficial. Placement of oyster domes in the nearshore waters encourages the establishment of oyster and mussel colonies, which filter the water and provide valuable habitat for fish and other aquatic resources. The oyster reefs reduce wave energy and encourage the accumulation of sediment behind the reefs. The accumulation of sediment creates ideal conditions for the establishment of marsh grasses and eventually mangroves, both of which are excellent natural coastline stabilizer. Two phases of shoreline stabilization using concrete oyster domes and oyster shell bags have been completed already and a third phase is partially complete. With the completion of Phase III in FY07 nearly 1/2-mile of shoreline will be stabilized. The remaining two phases aim to stabilize an additional 1/2-mile of shoreline. The project relies on civilian and military volunteers to install the oyster domes and oyster shell bags and volunteer support on the first two phases has been fantastic.

Conditions at the site in January 05, approximately one year after oyster domes were installed at the Phase I site (looking north)

Conditions at the site in September 06, approximately 2.5 years after installing oyster domes at the Phase I site (looking south). Oyster dome reefs are visible in left hand side of photograph. Marsh grasses were planed by students in July 06.

Restoration of Intertidal Oyster Reefs Affected by Intense Boating Activity in Mosquito Lagoon, Florida

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In recent years, intertidal reefs of the oyster *Crassostrea virginica* in central Florida's coastal areas have suffered extensive losses due to wakes from recreational boats. The creation and enforcement of "no wake" zones in the area are unlikely. Thus there is an urgent need for an alternative restoration strategy to prevent further decline of the remaining healthy, viable oyster reefs in the Indian River Lagoon system. The goal of this project is to implement a scientifically-based restoration technique that minimizes wake damage from recreational vessels on intertidal reefs in Canaveral National Seashore (CANA). To accomplish this, we will test a range of restoration measures to determine the optimal design that best increases: 1) the numbers of oysters, 2) 3-D structure of our intertidal reefs, and 3) biodiversity and abundances of sessile and motile species on reefs. These restoration measures will include all combinations of leveling piles of disarticulated shells on reefs, placing seagrass seaward of reefs, and deploying miniature, mobile oyster reefs (restoration mats) to provide substrate for oyster recruitment and survival. Our restoration mat design includes affixing 36 drilled oyster shells to 0.4 x 0.4 m^2 pieces of black mesh. After completing this experimental objective, the majority of our effort will be to implement our optimal design to increase reef dimensions to historical levels within the bounds of CANA. Our goal is to restore 15 - 20% of the 400 reefs (60 – 80 reefs) in the project area that have been damaged by wakes from recreational vessels.

Pelican Island National Wildlife Refuge Restoration

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A shoreline restoration project was performed at Pelican Island National Wildlife Refuge (NWR), located on Florida's east coast in the Indian River Lagoon. Since its establishment as the nations first NWR in 1903, Pelican Island has decreased in size by 60% due to severe erosion. Fossilized shell breakwaters were constructed in 2000, 2001, and 2006. Smooth cordgrass and mangroves were planted behind the breakwaters to protect the existing shoreline from further erosion. It was anticipated that the breakwater would provide habitat for the establishment of oysters, which would further act to prevent erosion. Occasional site visits revealed few live spat and most juvenile oysters dead and gaping. Funding was not available for condition index, dermo analysis, or gonadal index, however, oyster spat recruitment and water quality data collection began in March 2006. Shell hangers were deployed monthly to verify recruitment and water quality data was collected weekly with a Hydrolab. The median salinity for this drought-year was 32 ppt. Recruitment peaks were noted in spring and late summer, both with a mean of 6 spat per shell. To determine if predation is contributing to the lack of spat in this high salinity system, a predator exclusion bag filled with breakwater shell was deployed in October 2006. To date, restoration efforts have expanded the island by 0.40 acres; however, the biological success of this project will require further investigation.