

## **Recent Accomplishments in Research and Monitoring Objectives in the Oculina Evaluation Plan.**

- Recent publications:
  - Eytan, R. I., M. Hayes, P. Arbour-Reilly, M. Miller and M. E. Hellberg. In press. Nuclear sequences reveal mid-range isolation of an imperilled deep-water coral population. *Molecular Ecology*.
  - Harter, S. L., M.M. Ribera, A. N. Shepard and J. K. Reed. 2009. Assessment of fish populations and habitat on *Oculina* Bank, a deep-sea coral marine protected area off eastern Florida. *Fishery Bulletin* 107: 195-206.
  - Reed, J. K., C. C. Koenig, and A. N. Shepard. 2007. Impact of bottom trawling on a deep-water *Oculina* coral ecosystem off Florida. *Bulletin of Marine Science* 81: 481–496.
  - Brooke S, C.C. Koenig and A. N. Shepard. 2006. *Oculina* banks restoration project: description and preliminary assessment. *Proceedings of the 57th Gulf and Caribbean Fisheries Institute*: 607-620.

## **Status of Research and Monitoring Projects in Oculina Evaluation Plan**

Cooperative Institute Proposal, if funded, will address many of the objectives below. The proposed work will:

- Year 1: conduct AUV sonar surveys of the *Oculina* HAPC, use NOAA tech divers and submersibles to ground-truth sonar maps and experiments, and initiate coral monitoring sites, coral health assessment studies, and coral recruitment studies.
- Year 2: test the use of *BlueFin* AUV using 3D laser imaging sensor for coral health assessment and deploy monitoring station for fish assessments and coral ecosystem studies.
- Year 3: initiate coral acidification studies and continue monitoring and health assessment studies
- Year 4: continue monitoring sites, health assessment, and acidifications studies.
- Year 5: assess fish populations within and outside OECA and OHAPC, determine effectiveness of management plan and enforcement, and make a final assessment of coral health.

## **Oculina Evaluation Plan Objectives and Status**

**Objective 1:** Characterize major fishery species within the OECA compared to reference sites.

*Status: Harter et al. 2009: O. varicosa was found to be functionally equivalent to other hardbottom habitats. Even though fish assemblages were not different among management areas, biodiversity and grouper densities were higher inside the MPA compared to outside. The percentage of intact coral was also higher inside the MPA. These results provide initial evidence demonstrating effectiveness of the MPA for restoring reef fish and their habitat. This is the first study to compare reef fish populations on O. varicosa with other structure-forming reef habitats and also the first to examine the effectiveness of the MPA for restoring fish populations and live reef cover.*

*SEADESC dive summaries are being created for 2003-2005 dives and pdfs were added to SAFMC's habitat MIS/GIS. However it appears that none of SEADESC dives tookplace in the Oculina Bank.*

*2001 Islands in Stream cruise used JSL subs to census snapper/grouper at Jeff's and Chapman's Reefs (see Koenig et al. 2002).*

**Objective 2:** Characterize fish communities, inside and outside the OECA, including habitat utilization patterns, trophic interactions, ontogenetic changes, predator-prey relationships, etc.

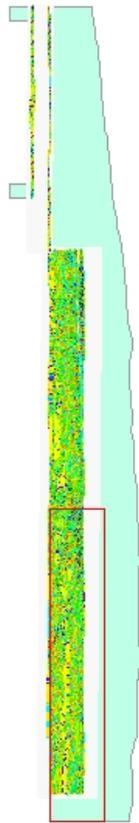
*Status: Harter et al. study above. No data have been collected on trophic interactions, ontogenetic habitat use changes, or predator-prey relationships.*

**Objective 3:** Connectivity to the broader seascape (larval sources and sinks, spill-over effects)

*Status: Not addressed.*

**Describe major habitat types and their locations within the OECA, OHAPC and adjacent hardbottom areas**

*High resolution multibeam bathymetry maps 100% completed for OECA and 95% completed for coral habitat area of entire OHAPC. Previous mapping data, including acoustic maps, video transects, and dive records have been integrated into an Oculina Decision Support System (Web pages and GIS) with access via DVD and Web portals ([www.uncw.edu/oculina](http://www.uncw.edu/oculina) and <http://www.safmc.net/HabitatManagement/DeepwaterCorals/Oculina/tabid/246/Default.aspx>)*



*Status: Harter et al.:*

*Highest percentage of live coral habitat in the OECA than in the OHAPC and areas open to all fishing.*

*More standing dead coral in the OECA than in areas open to all fishing.*

**Determine whether *Oculina* habitat will recover throughout the OECA without human intervention. Determine time frame for significant recovery and whether it will be necessary to introduce artificial substrate to serve as an initial settlement surface.**

**Objective 1:** Identify coral/fish recruitment pathways and compare settlement, growth, and survival rates on artificial substrate relative to nearby unconsolidated coral rubble.

*Status: Ongoing: a total of 225 large concrete ‘reefballs’ were deployed in 2000 and 2001 in various experimental configurations to measure coral settlement, growth and survival on this artificial substrate, and fish response to substrate. Cruise took place in April 2008 and the following conclusions were drawn:*

*Use of technical divers was not the most appropriate method of surveying the recruitment modules.*

*The reefballs that were located at Sebastian Pinnacles did not support enhanced coral or fish populations, but definitive conclusions cannot be drawn because of the small sample size and suboptimal location of those that were observed.*

*Chapman's Reef, while still considered a 'live' habitat, appears to have been impacted (possibly by trawling); coral and reef fish populations were not as prolific as reported in 2001 and recruitment blocks were completely destroyed. There was also a considerable amount of heavy fishing line observed in this area.*

**Objective 2:** Model physical and chemical characters. Previous studies have shown the benthic environment of the *Oculina* reefs to be very dynamic and widely fluctuating due to upwelling events and meandering of the Florida Current.

*Status: No projects on the table, no potential funding opportunities.*

### **Determine and monitor the effect of the *Oculina* Experimental Closed Area on fish distribution**

**Objective 1:** Assess spawning aggregations of fishery species.

*Status: Partly addressed?*

**Objective 2:** Track fish movement

*Status: Has not been addressed.*

**Objective 3:** Identify *Oculina* Experimental Closed Area fish population demographics

*Status: Partly addressed?*

**Objective 4:** Determine pre-closure distribution of dominant harvested species in and outside the reserve areas, in order to provide historical context for subsequent assessments. Review landings for spill-over effects. *NOTE: OET felt that this objective was not worthwhile, because it is well-established that the fisheries were once there. Objective could be met through fishermen interviews, however.*

**Objective 5:** Determine age distribution, nursery grounds, migratory patterns, and mortality rates for dominant harvested fish stocks.

*Status: Gag use seagrasses in Indian River Lagoon as nursery areas, scamp use mid-shelf rock habitat, therefore the nursery grounds for two species of grouper are isolated. If fish are not returning to OHAPC, inshore water quality or recreational harvest on artificial reefs may be contributing factors.*

### **Determine coral population structure**

**Objective 1:** Define the population structure of *O. varicosa*

*Eytan et al. In press. Oculina coral on the Oculina Bank is genetically isolated. Genetic isolation of the Oculina Banks population suggests that focused efforts will be needed to conserve the foundation species of these monotypic reefs.*

**Objectives 2 and 3:** Identify cross-shelf relationships between shallow and deep *Oculina varicosa* populations and describe biogeography of different populations

*Status: Eytan et al. In press: Study suggests that depth may play a role in isolating marine populations and perhaps facilitating initial steps towards speciation.*

### **Define the stressors affecting the *Oculina* Experimental Closed Area habitats**

**Objective 1:** Identify natural and anthropogenic stressors (i.e., disease, gear impacts, poaching, enforcement)

*Status: Ongoing - Except for disease.*

*Researchers have not observed obvious lesions or pathogenic infections on coral collections, although disease has been observed in fragments maintained in the*

*laboratory (Brooke pers. obs.). Addressing this objective would require considerable collections and moderately high funding.*

### **Conduct research on coral feeding activity**

Objective 1: define coral feeding dynamics

*Status: Partially addressed (Brooke unpub.).*

### **List of remaining projects**

These projects have not been addressed because funding and time limitations have dictated that the higher priority and logistically tractable objectives were completed first. These projects are still all considered to be important research needs, to be addressed when resources become available.

### **Define the magnitude and causes of changes in habitat structure and functionality over time**

Objective 1: Determine causes and timing of coral death

Objective 2: Origin and functional characterization of rubble zone

### **Describe how oceanographic conditions and episodic events affect production, coral condition, reproduction and growth**

Objective 1: Quantify the extent, intensity and frequency of episodic events

Objective 2: Assess the impact of episodic events (upwelling, storms, etc)

Objective 3: Optimize design of restoration efforts

Objective 4: Characterize impacts from anthropogenic sources of pollution (nutrients/sedimentation).

### **Define the key trophodynamic functional groups**

Objective 1: Identify food web structures and dynamics

### **Develop an index of physical and chemical parameters that characterize a healthy *Oculina* coral ecosystem**

Objectives 1 and 2: develop indices for coral and community health

Objective 3: Determine indicator species that are intimately tied with *Oculina*

*Status: Description of fauna associated with live *Oculina* colonies has been studied and status of current knowledge was published by Reed et al. (2005 review paper). However the other habitats in the OECA and HAPC have not been studied.*

Objectives 4-6: What is the age of coral substrate and geological formations, are these data associated with past climate and oceanographic conditions and are there data from elsewhere that could give perspective on *Oculina* growth.

*Status: Information on bioherm age was determined using a single core of an *Oculina* mound (Reed, 2002). Further information is needed through carbon dating of bedrock and core samples.*

### **OET Recommendations for Priority Research Projects:**

1. Complete characterization of major fishery species within the OECA and OHAPC

- Ongoing. Need more funding.*
2. Complete multibeam and habitat maps of OHAPC and adjacent areas  
*Almost complete*
  3. Complete assessment of restoration experimental modules  
*Ongoing. Need more funding.*
  4. Model physical-chemical characteristics of OHAPC  
*Not yet begun.*
  5. Determine the magnitude and causes of changes in coral habitat structure  
*Not yet begun.*
  6. Determine the population structure and genetics of the deep-water *Oculina*  
*Ongoing.*