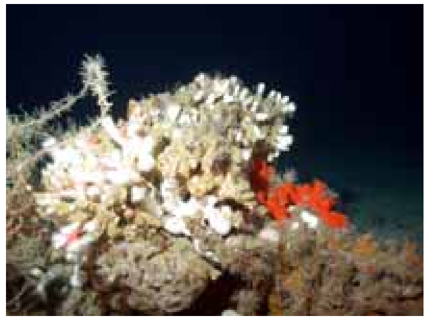
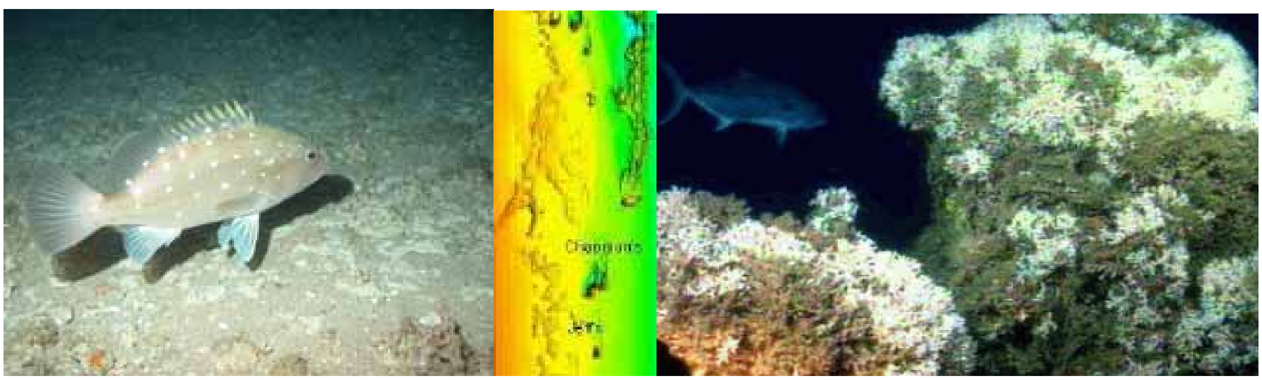


Final
Oculina Evaluation Team Report

(*Oculina* Experimental Closed Area)



February 2007

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Oculina Evaluation Team

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Executive Summary

The Council established the Oculina Evaluation Team (OET) as part of its Evaluation Plan for the Oculina Experimental Closed Area (OECA). The team -- comprising law enforcement representatives, research scientists, resource managers, commercial fishermen, recreational fishermen, outreach experts, and non-governmental organization representatives -- was charged with reviewing and providing recommendations for the ongoing research and monitoring, outreach, and law enforcement components of the Evaluation Plan. These recommendations will assist the Council in completing a required 3-year size and configuration evaluation and a 10-year complete evaluation of the OECA.

The OET convened for the first time August 21-23, 2006 in Port Canaveral, Florida to address the following topics and questions:
(1) What has been accomplished so far on research and monitoring, information and education projects, and law enforcement strategies and timelines?
(2) What has been the effectiveness of research and monitoring, outreach, and law enforcement efforts and how do these need to be improved before the Council's deadline to make a decision on whether or not to continue the regulations in their 10-year review (2014)?
(3) Review and evaluate the current size and configuration of the OECA and provide recommendations to the Council.
(4) Provide recommendations to assist the Council in their 10-year evaluation of research and monitoring, law enforcement and outreach efforts supporting fishing regulations. The OECA review is scheduled for 2014.

This Oculina Evaluation Team Report is based on discussions and recommendations obtained during the August 2006 meeting. Members of the Team received presentations and updates on research and monitoring activities, outreach projects, and law enforcement efforts. Following the presentations, break-out sessions were held for each of the three components of the OECA Evaluation Plan: 1) research and monitoring, 2) law enforcement, and 3) outreach and education, to develop the respective sections of this report. The report, approved by the Team by consensus on August 23, 2006, is provided to support the South Atlantic Council's review of the size and configuration of the Oculina Experimental Closed Area in March 2007. **The overall recommendation from the Oculina Evaluation Team regarding the size and configuration of the OECA is that no changes be made at this time.**

1.0 Introduction

In April 2004, regulations were implemented through Amendment 13A to the South Atlantic Snapper Grouper Fishery Management Plan that extended the fishing restrictions for the designated 92-square mile *Oculina* Experimental Closed Area (OECA) for an indefinite period. The amendment was developed by the South Atlantic Fishery Management Council to address the 10-year sunset provision for the closure of the area to snapper/grouper fishing. Located off the coast of Ft. Pierce, Florida, the area is part of the larger *Oculina* Habitat Area of Particular Concern (HAPC), a 300 square mile area designed to protect the *Oculina* coral found there. In addition to extending the closure, the amendment requires that the size and configuration of the Experimental Closed Area be reviewed within three years of the implementation date of Amendment 13A, and that a 10-year re-evaluation be conducted for the area. The Council also stipulated that an Evaluation Plan be developed within one year of implementation of the extended closure (April 26, 2004) to address needed monitoring and research, outreach, and enforcement efforts. Note: The Oculina Evaluation Plan contains only summary background information on the science and management relating to the *Oculina* Bank HAPC and Closed Area. For more information, please refer to Amendment 13A to the Snapper Grouper Fishery Management Plan.

Oculina Evaluation Plan

Public perception is often that closed areas are created and then left un-enforced, un-monitored and un-questioned. Clearly the Council intends to change this perception by reviewing and re-evaluating the measures in place within the closed area as outlined in the Evaluation Plan. As an additional way to gain public confidence the Council has created an *Oculina* Evaluation Team. The purpose is to bring together a group of individuals knowledgeable about the *Oculina* Experimental Closed Area who will be presented with and review the most recent information on the effectiveness of the closed area. This group will make recommendations to the Council anytime during the fishery management process, but especially before the Council takes significant action concerning the closed area (i.e., before the 3 year and 10 year re-evaluation periods).

Oculina Evaluation Team

The Council established the Oculina Evaluation Team as part of its Evaluation Plan for the OECA. The team is charged with reviewing and providing recommendations for the ongoing research and monitoring, outreach, and law enforcement components of the Evaluation Plan. These recommendations will assist the Council in completing a required 3-year size and configuration evaluation and a 10-year complete evaluation of the OECA.

The Team has representatives from the following groups who are knowledgeable of the *Oculina* Experimental Closed Area: law enforcement, research scientists, commercial fishermen, recreational fishermen, outreach experts, non-governmental organizations and Council staff. A report, written by the team will be presented to all relevant Council Advisory Panels (Habitat, Coral, Snapper Grouper, Information and Education, Law Enforcement, and Marine Protected Areas Advisory Panels) and the Council’s Scientific and Statistical Committee. Those groups will be asked to forward their recommendation to the Council. The Evaluation Team will deliver its first report to the Council by the March 2007 Council meeting in order for the Council to make its determination on whether or not it is necessary to change the size and configuration of the Closed Area. The Team will submit its second report by March 2014 in order for the Council to re-evaluate all regulations within *Oculina* Experimental Closed Area.

Oculina Evaluation Team Meeting August 21-23, 2006

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(1) What has been accomplished so far on research and monitoring, information and education projects, and law enforcement strategies and timelines?

(2) What has been the effectiveness of research and monitoring, outreach, and law enforcement efforts and how do these need to be improved before the Council's deadline to make a decision on whether or not to continue the regulations in their 10-year review (2014)?

(3) Review and evaluate the current size and configuration of the OECA and provide recommendations to the Council.

(4) Provide recommendations to assist the Council in their 10-year evaluation of research and monitoring, law enforcement and outreach efforts supporting fishing regulations. The OECA review is scheduled for 2014.

This Oculina Evaluation Team Report is based on discussions and recommendations obtained during the August 21-23, 2006 meeting. Members of the Team received presentations and updates on research and monitoring activities, outreach projects, and law enforcement efforts. Following the presentations, break-out sessions were held for each of the three components of the OECA Evaluation Plan: 1) research and monitoring, 2) law enforcement, and 3) outreach and education, to develop the respective sections of this report. The report, approved by the Team by consensus on August 23, 2006, is provided to support the South Atlantic Council's review of the size and configuration of the Oculina Experimental Closed Area in March 2007.

2.0 Outreach Breakout Group Report

2.1 Status, Effectiveness, and Recommendations of Outreach Projects in Evaluation Plan and Recommendations

With the understanding that outreach activities would not have a direct influence on the Council's decision regarding the size and configuration of the Oculina Experimental Closed Area, Team members involved in outreach efforts focused on the list of outreach projects outlined in the Evaluation Plan and their current status. This list of projects resulted from constituent meetings held in 2004, with review by advisory panels and the Council. The projects represent both efforts initiated by Council staff as well as those resulting from partnerships with a number of agencies. Additional information regarding outreach efforts is included in Appendix A.

(Council Initiated Projects)

Objective 1:
Assist in development of the *Oculina* Experimental Closed Area Evaluation Plan.

Project 1: **Develop an outreach strategy for the *Oculina* Bank area.**
Status: Completed, 2005. Recommend modifying document to update activities and clarify components.

Objective 2.
Develop a focused campaign targeting recreational/commercial fishermen in the central eastern Florida area.

Project 1. Provide SAFMC regulation brochures to area fishermen (40,000 copies)
Status: Regulation brochures were re-printed in May 2005. Re-print as needed (likely January 2007). Distribute to state and federal agencies and others as requested.
Recommendations: The Team agreed that this is an effective tool for distributing regulation information on the OECA and is used widely by law enforcement officers during boardings in the area.

Project 2. Work with fishing chart manufacturers and or vendors to improve available information for the *Oculina* Experimental Closed Area.
Status: Contacts were made in 2005.
Recommendations: Pursue this objective as a priority in 2006 - 2007. The OHAPC and OECA are poorly represented on paper charts, and information on fishing restrictions is incomplete. Contact manufacturers regarding re-print schedules and possible edits. Create transparent stickers to modify existing paper charts and make available through retail outlets. Include a note in updated regulations brochure regarding sticker availability if timing allows. Check for legal issues regarding the use of stickers with NOAA General Counsel. Contact <u>electronic</u> chart manufacturers 2007 and investigate available information and possible updates .

Project 3. Work with Florida Fish and Wildlife Conservation Commission (FWC) to provide written information regarding the *Oculina* Experimental Closed Area in (a) their publications targeting both recreational and commercial fishermen and in (b) mailings for fishing licenses and permits.
Status: An article regarding the OECA and graphics were submitted to FWC for recreational regulations brochure in April 2005. The article will run in January 2007 (900,000 copies total). Copies will be available in both English and Spanish.
Recommendations: Follow up with the FWC's commercial permits office for mailing of rack cards with commercial permits in January 2007. Continue to supply FWC outreach staff with updated information as it becomes available.

Project 4. Develop and distribute news releases to focus on law enforcement activities, research and monitoring projects, and the ecological importance of the area.
Status: Ongoing
Recommendations: Continue to work directly with state and federal law enforcement agencies to highlight activities. Post recent news releases from NOAA Office for Law Enforcement on the Council's Oculina web site page and continue to highlight law enforcement activities in *South Atlantic Update* Newsletter.

Project 5. Develop a Powerpoint presentation about the *Oculina* Experimental Closed Area, distribute on CD, post at Web site, and present to fishing clubs, environmental groups, local governments etc.
Status: Initial planning completed.
Recommendations: This is not a high priority. Prepare draft for review and complete in 2007. Contact local educational institutions regarding use and distribution *(Note: Grant Gilmore offered to help with identifying these sources).*

Project 6. Develop and distribute posters and rack cards/brochures at area bait and tackles shops, marinas, fish houses, boating stores, fishing tournaments, boat shows, etc.
Status: Printing of rack cards and posters was completed in August 2006. 5,000 rack cards and 1,100 posters to be distributed throughout the Treasure Coast both in person and through the mail.
Recommendations: Continue printing of materials for distribution as needed. Work closely with fishing tournament organizers in local areas to include Oculina rack cards in tournament packets. Contact FWC Law Enforcement Officers regarding possibility of talking briefly about regulations and rack cards at tournament captain's meetings.

(PARTNERSHIP PROJECTS)

These projects are the result of funding opportunities and partnerships involving NOAA's Coral Reef Conservation Program, NOAA Fisheries, NOAA's Undersea Research Program, and the Smithsonian Marine Station, in cooperation with Florida Fish and Wildlife Conservation Commission, NOAA Office for Law Enforcement, Florida Space Port Authority, U.S. Coast Guard, and Harbor Branch Oceanographic Institution.

Objective 3:
Coordinate a broader media campaign with partners to reach central Florida residents and visitors using newspaper, radio, TV, Internet, and existing environmental education network (e.g. environmental centers, schools, academia, area businesses).

Project 1: Develop an *Oculina* Web site or work within the existing site to establish a comprehensive web-based outlet to include access to useful education and outreach products. Publicize availability of information from new site by having links posted on other fishing/Non-Governmental Organizations/tourism related web sites
Status: Oculina information was incorporated into SAFMC ecosystem Web site in 2005-2006. Harbor Branch Oceanographic Institution's www.@Sea.org Web site hosted the 2005 research cruise daily log reports and other information. The development of SAFMC site for Oculina information is ongoing.
Recommendations: Continue to incorporate information as it becomes available. Investigate possibility of incorporating daily cruise logs into SAFMC Ecosystem site. Add relevant press releases regarding law enforcement activities to the Web site.

Project 2: Develop education products for teachers (K-12) and informal educators, post on Web site, and develop packet for distribution to science teachers.
Status: A 2005 Teacher Workshop was completed in conjunction with research and monitoring cruise. Future workshops are contingent on funding.
Recommendations: Continue workshops in conjunctions research and monitoring activities, building on 2005 workshop materials and recommendations. There is strong support for this outreach effort. The NOAA Fisheries Habitat Conservation Division expects funding from the NOAA Office of Education to continue teachers' and excursion workshop activities in 2007.

Project 3: Create media packet targeting ecological importance of area; packet should include popular news items about *Oculina* Experimental Closed Area.
Status: Completed for 2005 research and monitoring cruise through contract with HBOI. Future media packets and materials are dependent upon funding.
Recommendations: Utilize currently available materials (photos, B-roll) in future media releases.

Project 4: Develop a traveling portable exhibit that can be displayed at fishing tournaments, tradeshows, seafood/maritime festivals, aquariums, science museums, libraries, government centers, etc.
Status: Incomplete. Note: A portable deep water coral outreach exhibit is currently available through Smithsonian Marine Ecosystems Exhibit.
Recommendations: Creating a new exhibit is a lower priority, contingent funding and staff availability. Network with local educational institutions for possible display of exhibit.

Project 5: Offer media excursions to the *Oculina* Experimental Closed Area and HAPC/ tours and interviews regarding enforcement activities onboard the *CT Randall* law enforcement vessel.
Status: A media cruise was coordinated with FWC and NOAA OLE in conjunction with 2005 research and monitoring cruise. Weather prohibited media cruise. Staff coordinated use of *C.T. Randall* into 2005 Port Day activities.
Recommendations: Continue to coordinate efforts in conjunction with research and monitoring cruises dependent upon funding.

Project 6: Develop TV documentaries working with environmental TV outlets (e.g., Discovery Channel, Public TV.
Status: A documentary film producer accompanied the 2005 research and monitoring cruise. Film is currently under development.
Recommendations: Continue activities as funding allows.

Project 7: Work within existing program to deploy a real time data buoy in the *Oculina* Bank area to provide weather and sea-state information for boaters and fishermen and integrate information into web site.
Status: No activity
Recommendations: The team recommends removal of this project from Evaluation Plan as it is cost prohibitive. It was suggested that staff work with existing NOAA data buoy web site and investigate possibility of linking web sites with the Council's current site.

Project 8: Assist with the continued development of an interpretive *Oculina* coral display at the Smithsonian Marine Station in Ft. Pierce, Florida.

Status: The world's only Oculina interpretive exhibit was completed in July, 2006. CRCP funds paid for signage. The professionally created exhibit has been well received and outreach materials, including rack cards are being distributed through the Marine Station.
Recommendations: Promote and utilize this exhibit more fully. Add a link from SAFMC Web site to the Smithsonian Marine Station. Highlight article in newsletter about grand opening/5th year anniversary of Smithsonian Exhibit this year. Assure continued contact and representation of Smithsonian in future Evaluation Team efforts. Provide additional video footage for display and make teacher materials available on SMSFP Web site.

Objective 4:
Evaluation

Project 1: Develop a survey tool to assess the effectiveness of the campaign and widely distribute before, during and after majority of activities underway.
Status: 2004 survey developed in cooperation with FL Sea Grant had limited distribution.
Recommendations: The current survey should be re-evaluated. Explore new sources for survey distribution through the Florida Fish and Wildlife Conservation Commission's

Fisheries-Dependent Monitoring Program (check with Michelle Owen) or as a graduate student project (check with local colleges: FIT, FAU, BCC).

Project 2: Continue to receive input from local constituents (through the database established from the June 2004 outreach meetings) regarding the development of materials and level of community awareness.
Status: Ongoing
Recommendations: The group recommends continued outreach efforts with local stakeholder groups on an annual basis. Also, staff should attend local fishing group meetings, including Cape Canaveral Charter Boat Captain's Association, Florida Sportfishing Association, and others. Network with local educational institutions.

2.2 Recommendations Regarding the Current Size and Configuration of OECA
The group deferred to Research and Monitoring and Law Enforcement recommendations.

2.3 Recommendations to Assist in 10-Year Re-evaluation of Fishing Regulations
The group deferred to Research and Monitoring and Law Enforcement recommendations.

3.0 Law Enforcement Breakout Group Report
3.1 Status of Law Enforcement Projects in Evaluation Plan
The Law Enforcement Evaluation Plan for the OECA included a request to NOAA General Counsel to enhance penalties for violations of the OECA regulations and a five point LE strategy.

Status – Penalties

In June of 2003 a revised penalty schedule was published.

Status – LE Strategy

Enforcement Principle 1 – VMS

- Continued monitoring of VMS data by NOAA OLE and alerts sent.
- USCG real time VMS monitoring on vessels not complete. Technology issues have delayed progress. Remains in long term plan.
- FWC direct access to VMS – The reauthorization of the Magnuson-Stevens Act has language which provides VMS access for states participating in a Joint Enforcement Agreement (JEA) with NOAA OLE.

Enforcement Principle 2 – Cooperative Enforcement

- The partnership between NOAA OLE, USCG and FWC is well established and functioning well.

Enforcement Principle 3 – Increased enforcement presence

- Coordinated pulse LE operations.
- Dedicated patrols by FWC and USCG in conjunction with NOAA OLE.
- NOAA OLE will have a 24' RIB available locally.

Enforcement Principle 4 – OHAPC Enforcement Reports

- Data collected and reports created by Special Agent Chesler for quarterly presentation to the Council.
- These reports have reflected an increase in enforcement presence in the OECA.

Enforcement Principle 5 – Outreach and Education

- Distribute OHAPC brochures and Council regulations during patrols and boardings.
- NOAA OLE is providing press releases regarding cases.
- LE partners coordinated with Outreach staff during media event in 2005 and planning to participate in the 2006 event.

3.2 Effectiveness Evaluation of Projects Completed to Date in Meeting OECA Objectives

Overall the implementation of the Law Enforcement strategy has been successful. The following are recommendations for improvement:

- Report patrol days along with patrol hours.
- Work toward reporting hours dedicated to Oculina patrol as compared to hours available.
- Increase participation at fishing tournament Captain meetings prior to the tournament. Specifically in Sebastian and Fort Pierce.
- Provide the quarterly enforcement reports on SAFMC website. To be handled by SAFMC staff.
- Continue to move toward reporting locations of boardings and violations.
- Consider expanding the use of VMS for other commercial fishers.
- Use plain clothes operations.

3.3 Recommendations Regarding the Current Size and Configuration of OECA

No changes recommended.

Though there are no changes recommended the discussions included the following potential changes should they be supported by research and monitoring.

- Decreased the size and change to Type I.
- Move OECA north.
- Make eastern boundary a straight line.

3.4 Recommendations to Assist in 10-Year Re-evaluation of Fishing Regulations.

The current levels of enforcement are at capacity. Should an increase in patrols be desired additional funding and assets would be necessary.

4.0 Oculina Evaluation Team Research and Monitoring Breakout Group Report

The following is the Research and Monitoring break-out group report. Appendix B provides a summary of research and monitoring conducted to date in the Oculina Bank HAPC and Oculina Experimental Closed Area.

4.1 Research and Monitoring Accomplishments that Demonstrate Value of 1994 Oculina MPA Designation and Subsequent Management Actions

- High resolution multibeam bathymetry maps 100% completed for OECA and 95% completed for coral habitat area of entire OHAPC.

- Visual surveys (photographic and video ROV and submersible dives) completed over ~0.5 nm^2 of bottom within OHAPC in order to ground truth the multibeam maps (~0.2% of OHAPC).

- Visual surveys provided evidence that two high-relief *Oculina* bioherms (Jeff's Reef, Chapman's Reef complex) remain healthy and undamaged from trawling within the OECA. These are the last known living deep-water *Oculina* bioherms in the world!

- Visual surveys provided new data showing extensive areas of various habitat types within the OHAPC including the following:
  1) high-relief *Oculina* bioherms with standing coral thickets
  2) high-relief *Oculina* bioherms with coral rubble and sparse intact standing coral
  3) isolated *Oculina* coral thickets on low relief bottom, especially along scour zones
  4) plains of low relief coral rubble
  5) extensive areas of low (<3 ft) to moderate relief (3-10 ft) relief, live-bottom limestone pavement
  6) moderate relief, limestone ledges are especially prevalent at the north base of the *Oculina* bioherms
  7) Tilefish habitat is likely to occur in the deeper regions of the OECA and HAPC.

- Thirty-four publications regarding deep-water *Oculina* reefs since 1995 and including 10 publications since the reauthorization of the OECA in 2004.

- Discovery of 75 high-relief *Oculina* bioherms from recent multibeam surveys that are just west and outside of current OHAPC; estimated number may exceed 100.

- Visual surveys provided quantitative proof that populations of large grouper species are intimately correlated to intact coral habitat; fewer gag and scamp grouper are found associated with dead rubble habitat.

- Recent visual surveys show juvenile speckled hind grouper within OECA for first time since mid-1980s.

- Recent visual surveys show black sea bass within OECA for first time since mid-1980s.

- Recent visual surveys show red grouper, scamp and gag associated with hard bottom, ledge areas near bases of high-relief, coral rubble bioherms.

- Recent quantitative analyses of coral cover comparing photographic transects from 1977 to present show the percent cover of living coral at Jeff's Reef decreased between 1977 and 1995. However, the living coral cover increased between 1995 and 2003, after the area was closed to bottom hook and line fishing.

- 220 concrete reef balls, 50 concrete blocks, and 900 concrete paving stones (reef discs) deployed within the OECA in clusters of various configurations for assessing coral recruitment and new structure for fish habitat.

- Visual surveys show evidence of fishing line, long line and trawl nets impacting coral habitat within the OHAPC and OECA.

4.2 Publications Regarding the Deep-water Oculina Reefs Since 1995

<u>(in descending order by year)</u>

1) Reed, J.K., D. Weaver, S.A. Pomponi. 2006. Habitat and fauna of deep-water *Lophelia pertusa* coral reefs off the Southeastern USA: Blake Plateau, Straits of Florida, and Gulf of Mexico. Bulletin of Marine Science 78(2): 343-375. (includes *Oculina* fish sp. list and comparison to *Lophelia* reefs)

2) Reed, J.K., C. Koenig, A. Shepard. 2006 (in review). Effects of bottom trawling on a deep-water *Oculina* coral ecosystem. Proceeding of 3rd International Deep Sea Coral Symposium, Bulletin of Marine Science. (quantitative point count analysis of photo transects between 1975 and 2005)

3) George, R., T. Okey, J. Reed, M. Sissenwine, R. Stone. 2006 (in review). Ecosystem-based management for biogenic marine habitats: models for deep sea coral reefs and seamounts in US waters. Proceeding of 3rd International Deep Sea Coral Symposium. Bulletin of Marine Science. (*Oculina* food web and trophic structure)

4) Harter, S.L. and A.N. Shepard. 2006 (in review). Deep sea coral ecosystem monitroing: Case study of the *Oculina* Bank. Proceeding of 3rd International Deep Sea Coral Symposium. Bulletin of Marine Science. (discussion of deep coral assessment methods, and fish census and habitat cover data from 2003-2005 ROV dives).

5) Brooke, S. and C.M. Young. 2005. Embryogenesis and larval biology of the ahermatypic scleractinian *Oculina varicosa*. Marine Biology 146(4): 665-675.

6) Koenig, C.C., A.N. Shepard, J.K. Reed, F.C. Coleman, S.D. Brooke, J. Brusher, and K.M. Scanlon. 2005. Habitat and fish populations in the deep-sea *Oculina* coral

Ecosystem of the western Atlantic. American Fisheries Society Symposium 41: 795-805. (fish populations related to coral habitat- living vs dead)

7) Reed, J., C. Koenig, A. Shepard. 2005. Effects of bottom trawling on a deep-water coral reef. 3rd International Symposium on Deep-Sea Corals Science and Management, Miami, Florida, Abstract Book, p. 240. (quantitative point count analysis of photo transects between 1975 and 2005)

8) George, R., T. Okey, J. Reed, R. Stone. 2005. Ecosystem based fisheries management: Food chain models for a northeast Pacific gorgonian forest, the mid-Atlantic Corner Rise Seamount, and the Florida Oculina reefs. 3rd International Symposium on Deep-Sea Corals Science and Management, Miami, Florida, Abstract Book, p. 139.

9) Reed, J.K., A. Shepard, C. Koenig, K. Scanlon, and G. Gilmore. 2005. Mapping, habitat characterization, and fish surveys of the deep-water *Oculina* coral reef Marine Protected Area: a review of historical and current research. Pp. 443-465, In (A. Freiwald, J. Roberts, Ed.), Cold-water Corals and Ecosystems, Proceedings of Second International Symposium on Deep Sea Corals, Sept. 9-12, 2003, Erlanger, Germany, Springer-Verlag, Berlin Heidelberg. (summary of research from 1970 to present on Oculina reefs)

10) Brooke S, C.C. Koenig, and A.N. Shepard. 2005. *Oculina* banks restoration project: description and preliminary assessment. Proceedings of the 57th Gulf and Caribbean Fisheries Institute p. 607-620. (artificial reef balls and concrete blocks placed in different configurations on *Oculina* rubble areas to assess coral recruitment and use for fish habitat)

11) Manning, CB. 2003. *Oculina* Bank Geographic Information System. Masters Thesis, University of North Carolina at Wilmington, Wilmington, NC. 120 pp.

12) Reed, J.K. 2003. Deep-water coral reefs off Southeastern USA. National Geographic Society, Classroom Exploration of the Oceans, 2003, Keynote presentation, [http://www.coexploration.org/ceo]. (online website with description of deep reefs, lots of photos)

13) Shepard, A. and J.K. Reed. 2003. OCULINA BANKS 2003: Characterization of Benthic Habitat and Fish Populations in the *Oculina* Habitat Area of Particular Concern (OHAPC), Mission Summary Report. NOAA/ NURC and South Atlantic Fishery Management Council. 14 pp.

14) Brooke, S. and C.M. Young. 2003. Reproductive ecology of a deep-water scleractinian coral, *Oculina varicosa*, from the southeast Florida shelf. Continental

Shelf Res. 23: 847-858. (reproduction and larval development of deep and shallow Oculina)

15) Reed, J. K. 2002. Deep-water *Oculina* coral reefs of Florida: biology, impacts, and management. Hydrobiologia 471: 43-55. (review of research, trawling impacts, and history of management of Oculina reefs)

16) Reed, J. K. 2002. Comparison of deep-water coral reefs and lithoherms off southeastern U.S.A. Hydrobiologia 471: 57-69. (comparison and contrast of Oculina and *Lophelia* reefs)

17) Reed, J. K. 2002. Florida's *Oculina* Reefs, NOAA/ HBOI Cruise. The Slate, American Academy of Underwater Sciences.

18) Reed, J. K. 2002. Deep-water *Oculina* coral banks of Florida: an assessment of status, impacts, and management. Pp. 200, In: Proceedings of the First International Symposium on Deep-Sea Corals, July 30- August 3, 2000, Ecology Action Center, Dalhousie University, Halifax, Nova Scotia. (abstract of Hydrobiologia 2002 paper)

19) Reed, J. K. 2002. Comparison of deep-water *Oculina* and *Lophelia* coral banks and lithoherms off southeastern Florida. Pp. 201, In: Proceedings of the First International Symposium on Deep-Sea Corals, July 30- August 3, 2000, Ecology Action Center, Dalhousie University, Halifax, Nova Scotia. (abstract of Hydrobiologia 2002 paper)

20) Koenig, C. C., A. N. Shepard, J. K. Reed, R. G. Gilmore, F. C. Coleman, S. Brooke, J. Brusher, M. Barnette, A. W. David, K. Scanlon. 2002. Florida *Oculina* Banks Marine Protected Area: habitat, fish populations, restoration, and enforcement. National Undersea Research Program, 2nd Quarter Milestone. (survey of fish populations in relation to live/dead Oculina habitat and reef ball restoration)

21) Shepard, A., P. Orlando, J. Reed, … 2001. Islands in the Stream Expedition: *Oculina* Habitat Area of Particular Concern, expedition summary report, 10 September 2001. NOAA Ocean Exploration Program, 7 pp.

22) NOAA. 2000. Final rule, Amendment 4 to the Fishery Management Plan for Coral, Coral Reefs, and Live/Hard Bottom Habitats of the South Atlantic Regions (Coral FMP). Federal Register, Vol. 65, No. 115, June 14, 2000.

23) Reed, J. K. 2000. Oculina coral banks of Florida: conservation and management of a deep-water reserve. Pp. 2-4, In: Proceedings of the American Academy of Underwater Sciences 20th Annual Scientific Diving Symposium, Oct. 11-15, 2000, St. Petersburg, Florida. HBOI Contribution Number 1378.

24) Koenig, C. C., F. C. Coleman, C. Grimes, G. Fitzhugh, K. Scanlon, C. Gledhill, and M. Grace. 2000. Protection of fish spawning habitat for the conservation of warm-temperate reef-fish fisheries of shelf-edge reefs of Florida. Bulletin of Marine Science 66: 593-616.

25) Brooke, S. D. 1998. Reproduction and larval biology of the ivory tree coral *Oculina varicosa*. American Zoologist 38:100a.

26) Child, C. A. 1998. *Nymphon torulum*, new species and other Pycnogonida associated with the coral *Oculina varicosa* on the east coast of Florida. Bulletin of Marine Science (63):595-604.

27) NOAA, South Atlantic Fisheries Management Commission. 1998. *Oculina* bank HAPC expanded northward, South Atlantic Update, The South Atlantic Fishery Management Council, 1998. (Oculina HAPC expanded from 92 nm^2 to 300 nm^2)

28) Reed, J. K. 1998. The Gulf Stream. Florida Naturalist 71(2): 10-13.

29) Reed, J. K. 1998. An assessment of Florida's deep-water *Oculina* coral banks. Abstract and poster. Atlantic and Gulf Reef Assessment Workshop, June 2-6, 1998, University of Miami, Florida. HBOI DBMR Miscellaneous Publications #31.

30) Reed, J. K. 1998. Bioerosion and sediment production on Florida's deep-water *Oculina* coral Banks. Abstract. 2nd International Bioerosion Workshop, Fort Pierce, Florida. (bioerosion of Oculina by mollusks, sipunculans, and sponges and production of sediment as result)

31) Perkins, T.H., ..., G. Gilmore,…, J.K. Reed...1997. Distribution of Hard-Bottom Habitats on the Continental Shelf off the Northern and Central East Coast of Florida. Southeast Area Monitoring and Assessment Program, National Marine Fisheries Service.

32) Reed, J. K. and S. Pomponi. 1997. Final Cruise Report. Submersible and scuba collections in the coastal waters of the Bahama Islands and Florida's *Oculina* coral banks: Biomedical and biodiversity research of the benthic communities with emphasis on the Porifera and Gorgonacea. (cruise report- few misc. collections of macroinvertebrates for chemical and biological analyses)

33) Reed, J. K. 1996. Preliminary survey of mud deposits on the mid-shelf reefs off Fort Pierce, St. Lucie County, Florida. Unsolicited report submitted to the U.S. Corps of Engineers, E.P.A., Florida Department of Environmental Protection, National

Marine Fisheries, and St. Lucie County Port and Airport Authority, 37 pp. (comparison of sediments and foraminifera from Oculina reefs and mid to inner shelf areas)

34) Virden, W. T., T. L. Berggren, T. A. Niichel, and T. L. Holcombe. 1996. Bathymetry of the shelf-edge banks, Florida east coast, National Oceanographic and Atmospheric Administration, National Geophysical Data Center, National Marine Fisheries Service, Beaufort, North Carolina: 1. (poster of *Oculina* reefs and low resolution bathymetry)

4.3 Status of Research and Monitoring Projects in Oculina Evaluation Plan

a. List of on-going and completed projects with brief statement of status and timeline

Determine the effect of management measures in the OECA on the status of fishery stocks

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

- **Ongoing:** Reef fish characterization from 2003-2005 ROV surveys is ~80 percent complete (Harter et al.); 2005 transect data were collected at four stations in the OECA, four stations in the OHAPC and 4 stations outside (inshore) of the closed areas; paper to be complete by Dec 2006, and will provide a reef fish community assessment and percent cover from digital photos; SEADESC dive summaries are being created for 2003-2005 dives and pdfs will be added to SAFMC's habitat MIS/GIS (target date- Jan 2007).
- **Proposed**: 2001 Islands in Stream cruise used JSL subs to census snapper/grouper at Jeff's and Chapman's Reefs (see Koenig et al. 2002); although subs may be preferred method, they are prohibitively expensive at $25K/day. Cheaper ROV transects are not ideal method for assessing larger commercial reef fisheries (e.g., gag and scamp).
  - Determine most effective methods for deep reef assessment: Synoptic gear comparison is needed to compare efficacy and accuracy of various affordable data collection methods at long-term sampling sites (2007-2014). Methods should include: 1) ROV transects, 2) drop cameras (cost effective, but difficult for fish identification, especially smaller near bottom species), 3) observatory with video, Didson sonar, and passive acoustics (cost $100K per observatory), 4) and technical diving ($60K). Technical diving is severely limited by bottom time, but is best control for accuracy of other methods. Sites should include: 1) shallow reef (e.g., Horseshoe reef) where scuba can be used as control; 2) restoration/artificial habitat (reefballs), 3) coral rubble on bioherms, and 4) intact *Oculina* reef on bioherms. Other treatments should include seasons (Mar, Aug, Oct) and day-night comparisons.

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

- **Ongoing:** See objective 1 for more information on ROV dive transects inside and out of the OECA and OHAPC. These are not ideal for habitat utilization assessment for commercial fish, but are best option to assess most reef fish by habitat type. Transects also are not optimal for assessing how and why fish are using habitat, which requires stealthy, longer-term observations. No visual or imaging methods are ideal for sampling juveniles.
- **Proposed**: No data have been collected on trophic interactions, ontogenetic habitat use changes, or predator-prey relationships. No studies have attempted to show how commercial species use the closed areas on daily and seasonal basis, or answer question of how OECA may be providing fish to surrounding open areas.
    - <u>Assess daily and seasonal use of OECA and OHAPC by adult of commercial species:</u> work with commercial fishermen, and use historical data and known habitat areas to identify 6 proximate spawning sites (3 sites inside OECA and 3 outside). Tag male gags and identify multi-species use of the habitat. Cost would be approximately $50K (vessel, tags), timeframe 3 years, identify movement patterns, age, spill over, size.
    - <u>Monitor intact reefs for fishing activity and spawning aggregations:</u> See related work in Objective 1-- Deploy video/acoustic observatory at Jeff's Reef ($30K) to identify boating activity, fishing activity, vessel monitoring. Timeframe of 2 years, with total estimated cost of $200K.
    - <u>Increase sampling size of reef fish observations throughout closed and open areas:</u> Reef fish community surveys (snapper/grouper and prey species surveys) Using best approaches defined by synoptic sampling experiment (objective 1). As a rough budget estimate, use of drop cameras at 6 sites would cost ~$80K per year including camera and ship-time, and analyses—need to do annually for at least 3 years. Partial funding may be available through secured NOAA vessel time, but additional project resource needs include ROV and sonar.
    - Sample smaller life history stages: need to conduct plankton tows and light trap collections at long-term stations to begin to understand how juveniles may use the reserve.

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

- This objective has not been addressed specifically. Some of this information could be extracted from the research proposed for the previous objective; for example, spill-over effects and movement of juvenile fish between habitats.

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

Objectives 1 and 2: Complete 1) high definition bathymetric mapping and 2) habitat characterization

Habitat mapping of OECA has been critical for management and likely saved the last remaining known live bioherms (Jeff's and Chapman's reefs) from destruction, in addition to low-lying areas with live coral such as scour areas down-stream from bioherms that also have been shown to support gag grouper, juvenile speckled hind, and juvenile black seabass.

- **Ongoing:** 2002 and 2005 multi-beam surveys covered about 95% of the *Oculina* habitat in the OECA/OHAPC and about 10 km^2 outside the reserve. This area is less than half of the whole OHAPC/OECA; most of the rest of which is deeper soft substrate typical of upper slope, with tile fish burrow habitat. QTC multiview habitat maps will be applied to 2005 survey date (Chapmans Reef area and *Oculina* habitat between satellite areas at north end of OHAPC) by Dec 2006; this habitat map is important baseline characterization for evaluation of habitat changes over time and habitat condition inside and outside OHAPC.
- **Proposed:** We need to finish mapping OECA/OHAPC and target more bottom outside reserve. Target areas for mapping in order of priority include:
  1. All of OECA
  2. Coral areas outside OHAPC, e.g., suspected and known hard coral areas north and south of the OHAPC, specifically north and west from Cape Canaveral to St. Augustine, and St. Lucie mound and Jupiter Inlet to the south
  3. OHAPC within coral zone 50-100 m
  4. Soft bottom habitat east of the coral zone within the OHAPC down to 600 fms

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.

- **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. Assessment of this experiment will address all components of the objective except coral/fish recruitment pathways. During the NURP AUV cruise in October 2006, the coral/fish recruitment experiment will be located and GPS coordinates will be taken for future dedicated survey using technical divers or ROV.
- **Proposed:** A proposal was submitted to NURP (Keonig et al) in 2004 to use technical divers to survey the recruitment experiment. This has been approved, conditional on sufficient funding, but possible cost-share options with NOAA vessel is being explored.
- **Proposed:** Recommendation to remove this component of the objective, since sufficient resources are not available.

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.

- No projects on the table, no potential funding opportunities. University of Miami modeling efforts by Chris Mooers and Jerome Fiechter on basic lower trophic level characterizations and lagrangian (particle-tracking) descriptions may be used to assess characters on the gross scale but higher resolution needed to address this objective

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

Objective 1: Assess spawning aggregations of fishery species.

- These objectives were addressed in previous sections

Objective 2: Track fish movement

- These objectives were addressed in previous sections

Objective 3: Identify Oculina Experimental Closed Area fish population demographics

- These objectives were addressed in previous sections

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

- General group consensus is that this objective may not be worth while, because it is well-established that the fisheries were once there; however, objective could be met through fishermen interviews.

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

- 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 may be the cause. Important question from fisheries perspective, may not have direct implications for OHAPC
- Determination of OHAPC as a nursery area for speckled hind could be partly addressed through previous section.

b. List of remaining projects and reasons why they have not been undertaken, with recommendations for re-prioritization

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

No funding has been made available to accomplish this task and in retrospect this would take considerably more than 20K would involve drilling a coral mound. It is a low priority until habitat and fisheries assessment work is complete.

Objective 2: Origin and functional characterization of rubble zone

- Important, but low priority. Possible collaboration with other DWC coring efforts.

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 (upwelling, storms, etc)

- **Proposed:** Permanent monitoring locations with CTD and other environmental sensor packages are needed to answer questions on episodic events. This would be a long-term proposal (6-10 years away) with NSF IOOS funding entities. Monitoring is also needed at key areas to detect for climate change signals.

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

- **Project:** link oceanographic monitoring with fish tag studies and data collection station with time lapse camera ($50K), CTD etc. to observe animal behavior simultaneously with environmental changes.

Objective 3: Optimize design of restoration efforts

- **Proposed:** A summary (literature review) of oceanographic characters unique to Cape Canaveral and OHAPC
- **Proposed:** An array of inverted echosounders (CPIEs) can provide continuous measurements of the Gulf Stream's current fluctuations and vertical structure (contact Randy Watts, URI for details). Fixed buoys with bottom mounted ADCPs at Jeff's Reef (contact IOOS/OCEAN.US for long term strategies) could be used to increase resolution of modeling efforts at the University of Miami by C. Mooers and J. Fiechter. A proposal to NOAA's ECOFORE program that would have considered exchanges of the Gulf Stream with shelf regions in collaboration with SEACOOS assets was not recommended for funding.

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

- This is not logistically tractable at the moment, therefore was placed at low priority

Determine coral population structure

Objective 1: Define the population structure of O. varicosa

- Population level work is also needed, multiple samples are needed. Information would determine if large scale recovery is possible. May be cost prohibitive to complete the work, especially using microsatellites.

- Taxonomic work has been started and group recommends completing this work to determine eligibility of ESA. Sandra will research cost of completing taxonomic work.
- Samples could be collected opportunistically on other cruises.

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

- This could be addressed using similar methods to previous section. A range of shallow *O. varicosa* samples would be needed also.

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

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

- **Ongoing:** Except for disease, we are collecting this information and completing this objective.
- There has been no research on naturally occurring diseases of deepwater *O. varicosa*. 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.
- The research and assessment group recognized that disease or decreased coral health may be an emerging problem and downstream pollution sources should be considered
- Monitoring for pollution could include water samples to examine nutrient load and bacterial sources and if evidence of blue green algae is observed, sampling should be initiated.
- Low priority considering other research needs

Define the key trophodynamic functional groups

Objective 1: Identify food web structures and dynamics

- This objective has not been addressed completely. George et al (2006) created a rudimentary model, but further information is needed, e.g. gut contents of commercial species, stable isotope analysis etc.

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

- Assessment of coral health is a challenging research objective that requires an understanding of the factors that define a healthy *Oculina* habitat. These might include percent live coral, skeletal density, energetic criteria such as tissue lipid content and fecundity. This research would require intensive sampling, repeated at predetermined intervals, and therefore is currently prohibitively expensive and logistically unfeasible.
- Assessment of community health: These indices may include biodiversity of associated fauna, presence of species that are sensitive to habitat disturbance, etc

or have particular habitat requirements (e.g., anthiid density). This objective has the same restrictions as coral health objective.

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

- 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.

- Information on bioherm age was determined using a single core of an *Oculina* mound (Reed, 2002). Further information is needed through carbon dating (e.g., techniques from McGee, USF thesis) of bedrock and core samples. The other objectives have not been addressed and are currently not considered high priority

Conduct research on coral feeding activity

Objective 1: define coral feeding dynamics

- This objective has been partially addressed (Brooke unpub.) but field sampling (coral fragments for temporal changes in lipid content, diel and seasonal plankton tows above the reef to define food supply) and lab experiments (starvation/feeding regimes, food selectivity study) are need to complete this objective. Currently considered low priority.

4.4 Recommendations for Priority Research Projects

- **Complete characterization of major fishery species within the OECA and OHAPC**
  Conduct surveys with various gear types including drop cameras (cost effective, but difficult for fish identification), Didson PAMS observatory (cost $100K per system), technical diving (bottom time limitation), ROV and submersible dives, at three long-term sites within the OECA (2007-2014). Sites would include artificial habitat (reefballs), coral rubble habitat, and intact high-relief reef, with 3 deployments per year and a comparison outside the OHAPC (e.g., Horseshoe reef).

- **Complete multibeam and habitat maps of OHAPC and adjacent areas**
  Multibeam maps to be completed by 2006. Additional maps of high-relief Oculina habitat outside the OHAPC to the west and north are recommended. Additional visual surveys are recommended to complete habitat ground truth of multibeam maps. Visual surveys (photographic and video ROV and submersible dives) to ground truth the multibeam maps have been completed for only ~0.2% of the OHAPC. This is inadequate to assess fully the status and quantity of coral habitat as well as fish stocks.

- **Complete assessment of restoration experimental modules**

Determine efficacy of restoration module types and configurations for coral recruitment and as new structure for fish habitat. Various module types and configurations have been deployed and there is some evidence of coral recruitment and fish usage of habitat; however, strong currents have prevented detailed surveys. Submersibles would allow for site-specific surveys that have not been possible with ROVs.

- **Model physical-chemical characteristics of OHAPC**
  Deploy fixed moorings at Jeff's Reef and additional sites as funding is available: 1) to monitor oceanic conditions and episodic events (such as upwelling and hurricanes), 2) to monitor and characterize impacts from anthropogenic sources of pollution (nutrients), 3) acoustic recorder to monitor fish spawning activities and illegal fishing and trawling activities.

- **Determine the magnitude and causes of changes in coral habitat structure**
  Determine the age of the dead coral and determine the origin and functional characterization of rubble zone. It is important to determine when and why the coral has died. We have evidence that trawling has certainly been a factor in the past 30 years or so; but are the vast acres of dead coral all due to trawling or are other factors involved.

- **Determine the population structure and genetics of the deep-water Oculina**
  Identify cross-shelf relationships between shallow and deep *Oculina varicosa* populations to determine whether the deep-water morph of *Oculina* is a separate species or sub-species and available for protection under the Endangered Species Act.

4.5 Effectiveness Evaluation of Projects Completed to Date in Meeting the OECA Objectives

Almost without exception, the projects completed to date have addressed the highest priority research objectives and therefore have been effective at meeting those objectives.

4.6 Recommendations Regarding the Current Size and Configuration of the OECA and the 10 Year Evaluation of Fishing Regulations

Based on the best available scientific data and the research and monitoring accomplishments listed above, the Research and Monitoring Panel recommends that no changes be made to the size, configuration or fishing regulations within the current OECA. The current OECA contains all the various habitat types that are found within the entire OHAPC. Current restrictions on bottom fishing have been beneficial to both coral habitat and fish populations within the OECA.

Appendix A. Overview of Oculina Outreach Activities

Partnering has played a major role in recent outreach efforts associated with the Oculina Bank Experimental Closed Area and the Oculina Habitat Area of Particular Concern. As part of a larger outreach initiative focusing on Deepwater Corals through NOAA's Coral Reef Conservation Program (CRCP), partners from Harbor Branch Oceanographic Institution, SAFMC, The Smithsonian, NASA, and NOAA-National Undersea Research Center, joined NOAA Fisheries-Southeast Fishery Science Center in implementing a broad outreach and education initiative, using the Oculina HAPC and Experimental Closed Area as a focus. Beginning in 2004, CRCP provided funding for a series of local constituent meetings that proved valuable to the development of the Outreach component of the Evaluation Plan for the Oculina Experimental Closed Area. Details are included in the Evaluation Plan.

In October 2005, the cooperative efforts capitalized on event-based outreach and education activities associated with the NOAA CRCP sponsored research expedition to the Oculina Bank. Details regarding these activities are listed below.

Partnerships through the CRCP project have increased awareness of and involvement with deep water coral resources of the Southeast region by producing a teacher workshop, daily web-logs during the Oculina research and monitoring cruise, a port day for students and teachers, multi-media resources for news media and educators, posters and rack cards, and web-based resources. The Council's Ecosystem web site now features an entire section on deepwater corals, including information specifically developed cooperatively with NOAA/NURC regarding *Oculina varicosa* and the Oculina Bank HAPC and Experimental Closed Area. http://www.safmc.net/HabitatManagement/DeepwaterCorals/tabid/229/Default.aspx

Additionally, the SAFMC has produced over 40,000 copies of its 2005 Fishing Regulations for the U.S. South Atlantic that includes an entire page on regulatory information for the Oculina Bank HAPC and Experimental Closed Area. These popular regulations brochures have been distributed to state and federal law enforcement agencies as well as to the general public. In addition, the South Atlantic Update, a quarterly publication of the SAFMC, has featured numerous articles regarding the Oculina Bank *(Attachment 5b)*. Copies of both the SAFMC Regulations Brochures and *South Atlantic Update* are also available online at www.safmc.net.

Cooperative project accomplishments are highlighted below:

Teacher Workshop

On 9/17/05; NOAA, SAFMC, and HBOI sponsored a one-day teacher workshop entitled *"Treasures of the Deep – Deep Water Corals of the South Atlantic and Oculina Bank: A Local Resource Workshop for Teachers."* 21 secondary school educators from 3 counties along the central eastern coast of Florida attended the workshop. Participants learned about DSC ecosystems, the OHAPC, research and monitoring efforts, resource management, and received educational materials for classroom use. Participants received new curriculum and multi-media educational resources, conducted activities related to oceanographic exploration, and gained further understanding of the importance of this unique deep water habitat.

Port Day
On 10/12/05, prior to the departure of the NASA M/V *Liberty Star*, ~90 students from 3 Brevard County schools joined expedition scientists and crew at the Port for an educational event. Students rotated among 6 stations learning about *O. varicosa* and deep water reefs, the OHAPC, science and research, enforcement, and management.

Daily Web Logs
Through HBOI's @Sea website (www.at-sea.org), researchers posted daily research journal entries, photographs, and data logs (e.g., ROV temperature, depth, and geographic position) during the Expedition. Regional students posed questions for the scientists and crew, which were answered in the daily journal entries.

Press Kits & News Releases
Media were invited to participate in port day and excursion activities and to receive press kits containing background information, high-resolution images, b-roll film footage, and other materials for developing news stories. The resulting media coverage included several print and on-line articles in local, regional, and national news outlets.

Selected News Stories:
http://www.sciencedaily.com/releases/2005/10/051012081527.htm
http://www.news-journalonline.com/NewsJournalOnline/News/Local/03AreaEAST03ENV101805.htm
http://newswire.ascribe.org/cgi-bin/behold.pl?ascribeid=20050928.134206&time=14%2019%20PDT&year=2005&public=0
"Saving the Sea: Oculina Bank off Brevard's coast is worthy of marine sanctuary protection," Florida Today, 11/7/05.
http://www.floridatoday.com/apps/pbcs.dll/article?AID=/20051018/NEWS01/510180328/1006

(Note: If you are unable to open the direct links to these news stories, please visit www.at-sea.org and view the web log for the 2005 Oculina Mission. There, you will find a list of reference materials for the Oculina cruise, including news reports.)

Media Excursions
On 10/14 &15/05 the FWC Law Enforcement vessel, the *C.T. Randall*, was scheduled to shuttle media and teachers to the M/V Liberty Star for a day-at-sea experience. A tropical depression caused unsafe sea conditions on both excursion days. Despite the weather issues, several news services picked up the story.

Posters & Rack Cards
An educational poster and rack cards were produced in July 2006 and provide information about the regulations and importance of the OHAPC/OECA. The posters and rack cards will be distributed to a variety of recipients including partner organizations, bait and tackle shops, marinas, charter boat captains, fishers, restaurants, and educators.

Other Outreach

Other outreach activities included presenting a poster at the Deep Water Coral Symposium 11/05, attending constituent meetings along the Treasure Coast, development of web based information, presenting at the Space Coast Birding Festival, and interfacing with regional fishers/boaters at fishing tournaments.

Appendix B. Deep-water Oculina Reefs off Florida: Summary of the State of Knowledge of the Habitat, Fauna, Geology and Physical Processes of the Ecosystem (Reed, 2006).

DEEP-WATER *OCULINA* REEFS OF FLORIDA: SUMMARY OF THE STATE OF KNOWLEDGE OF THE HABITAT, FAUNA, GEOLOGY, AND PHYSICAL PROCESSES OF THE ECOSYSTEM

A Report to the South Atlantic Fishery Management Council
Oculina Evaluation Team Workshop
August 21-23, 2006
Port Canaveral, Florida

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August 18, 2006

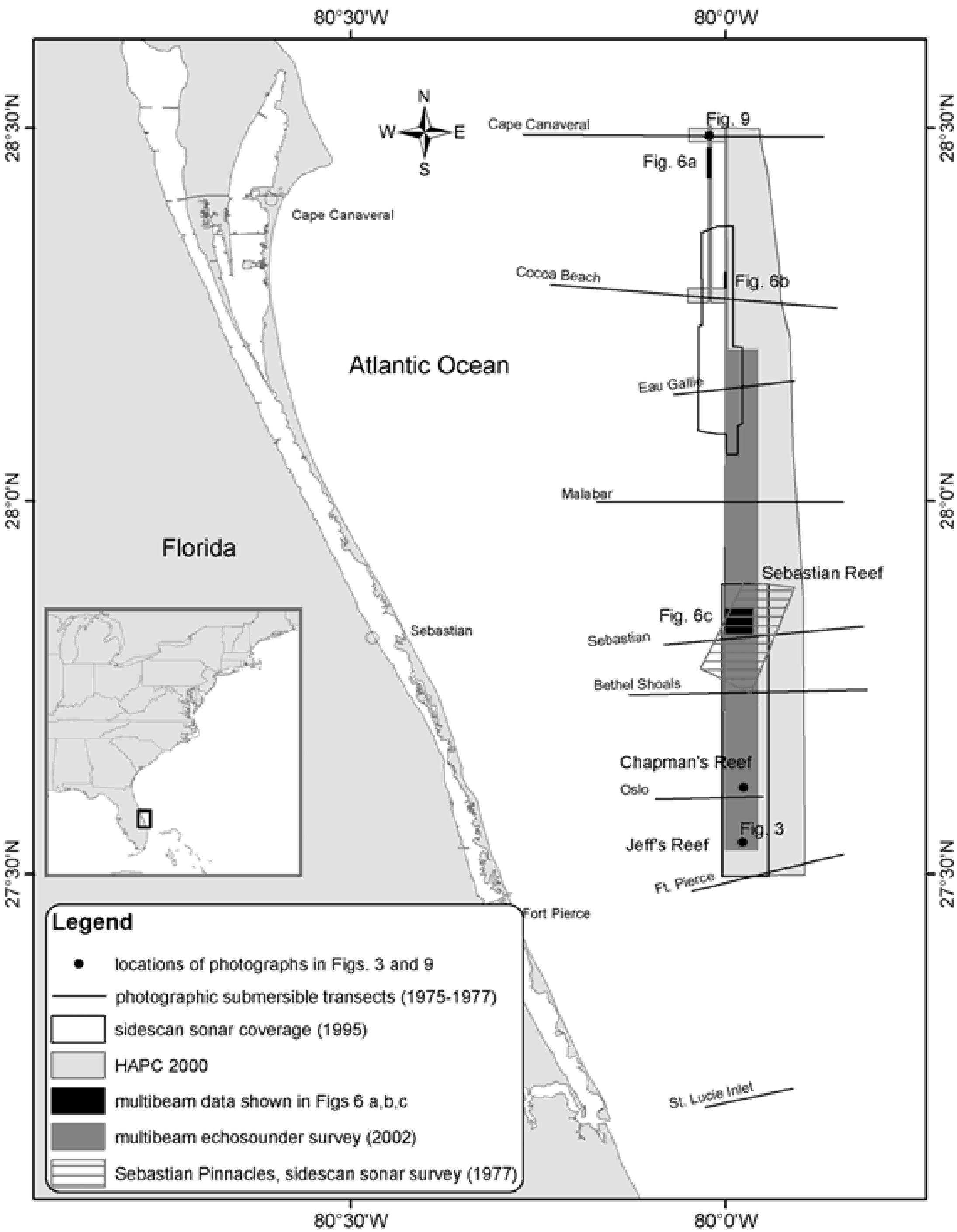

Fig. 1. Light shaded area: 1029 km^2 (300 nm^2) deep-water *Oculina* Marine Protected Area (MPA) off eastern Florida. The original 315 km^2 (92 nm^2) *Oculina* Habitat of Particular Concern (OHAPC) that was designated in 1984 (also known as the Experimental Oculina Research Reserve) is indicated by the boxed area (1995 sidescan sonar coverage) that extends from the Sebastian Reef area to the south at the Ft. Pierce transect line. (from Reed et al., 2005)

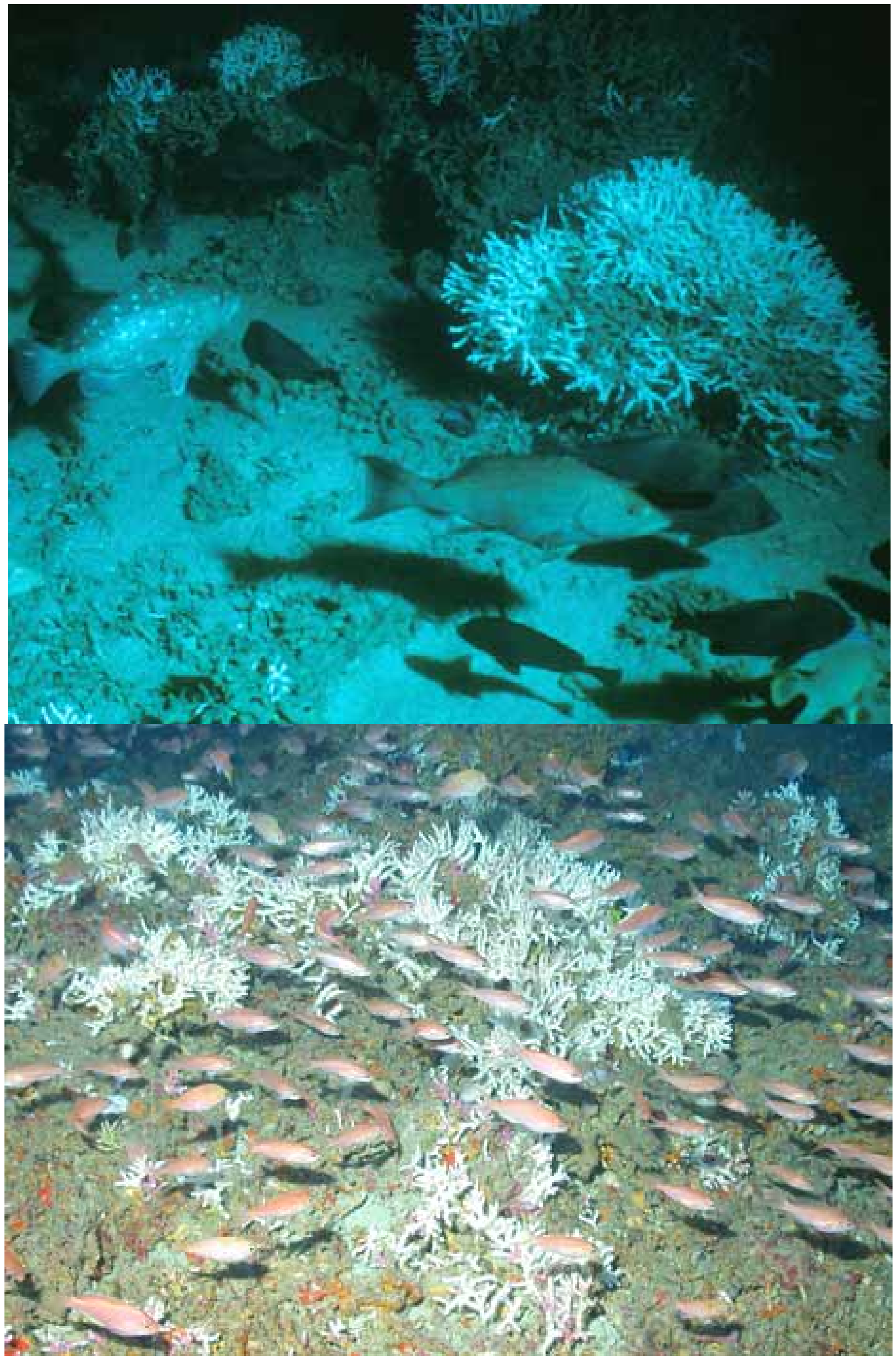

Fig. 2. a. Schools of scamp and gag grouper were abundant on deep-water *Oculina* reefs in 1970s and 1980s (Jeff's Reef, 70-m depth); b. Healthy *Oculina varicosa* coral colony with associated schools of anthiid fish in 2003 (Sebastian Pinnacles, 80-m depth). (from Reed et al., 2005)

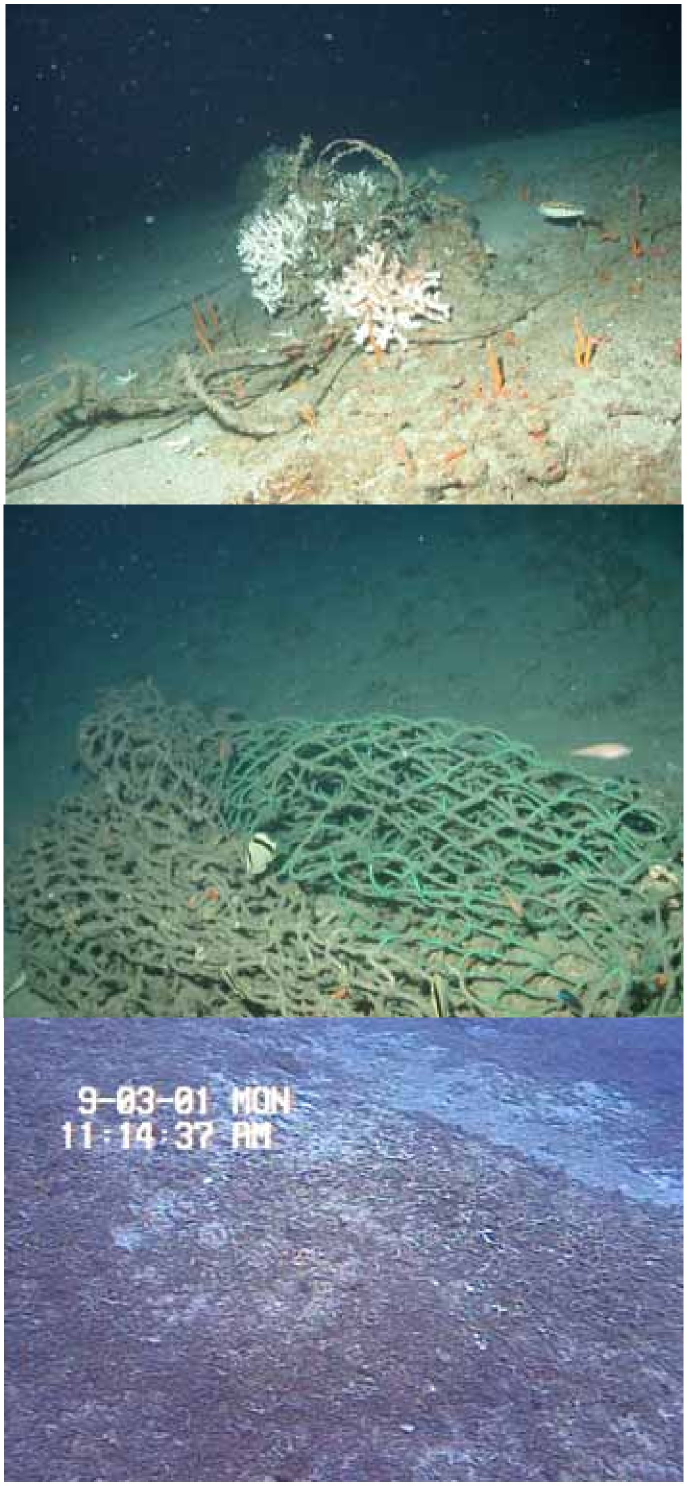

Fig. 3. Damage from fishing gear within *Oculina* MPA: a. longline fishing gear wrapped around colony of *Oculina varicosa* (Sebastian Pinnacles, 80-m depth); b. discarded shrimp trawl net (Sebastian Pinnacles, 80-m depth); *c*. apparent trawl track at Cape Canaveral Pinnacle site (67-m depth). (from Reed et al., 2005)

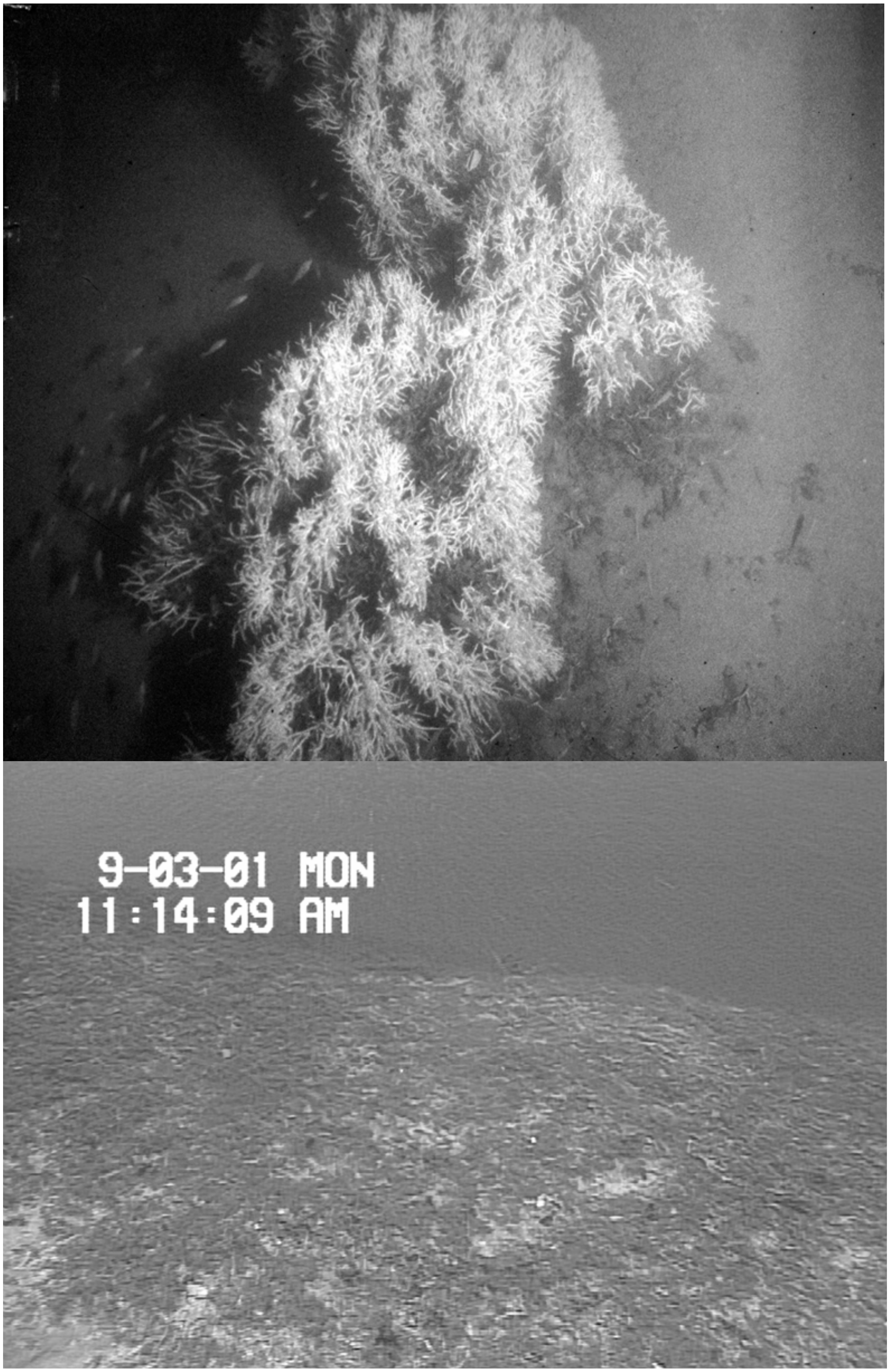

Fig. 4. Peak of 20-m high *Oculina* reef at Cape Canaveral Pinnacle site (67-m depth; 28^{o} 29.8'N, 80^{o} 01.27'W): a. historical photo (*JSL* II-63) from June 8, 1976; b. same site (*Clelia* 616) on Sept. 3, 2001, reduced to rubble from apparent trawling. (from Reed et al., 2005)

This report is a review and summary of the state of knowledge regarding the deep-water *Oculina* reefs off eastern Florida since their discovery in the 1970s to the present. A compilation of all known publications (with annotations) about the Florida *Oculina* reefs is listed in the appendix. These references are categorized into the following categories described below:

Historical Habitat and Bathymetric Surveys

1960s Dredge and Commercial Fish Surveys:

Moe (1963) first described some of the shelf-edge features off eastern Florida based on interviews with commercial fishermen. Macintyre and Milliman (1970) surveyed the physiographic features of the shelf-edge break (80-110 m) from Cape Hatteras, North Carolina (35oN) to Ft. Lauderdale, Florida (26oN) using echosounder profiles, rock dredge, sediment samples, and bottom photographs. Information on coral distribution was also summarized from 57 dredge and trawl records from the R/V Gosnold and R/V Aquarius between 1973 and 1977 (Reed 1980).

1977 Sidescan Sonar Survey:

The Sebastian Pinnacle site (110 km2), within the region now designated as the *Oculina* MPA, was mapped in 1977-78 using a Klein Series 400 sidescan sonar and echosounder (fathometer) tracings (Thompson et al. 1978; Thompson and Gulliland 1980). LORAN C was used for positioning which had navigational accuracy in this region of +-36 m in the east-west direction and +-850 m north-south. The fathometer had a vertical resolution of 0.25- 1.0 m. Bathymetric maps were plotted with 1-m isobath contours.

1975-1983 Submersible and ROV Surveys:

Between 1975 and 1983, data were compiled in the region of the deep-water *Oculina* banks using Harbor Branch Oceanographic Institution's (HBOI, Harbor Branch Foundation) *Johnson-*

Sea-Link (JSL) I and II submersibles and CORD Remotely Operated Vehicle (ROV). These data included photographs, videotapes, cruise reports, logs, dive transcripts, hydrographic data, and collections by lockout dives from the submersibles.

From 1975 to 1977, a benthic survey consisting of 12 east-west photographic transects was made with the JSL submersibles at the shelf-edge break within the region that is now designated as the *Oculina* MPA (Avent et al. 1976; Avent and Stanton 1979). The transects were spaced approximately 19 km apart, extended to 300-m depth, and consisted of 55 submersible dives covering 298 km. It was during this survey that the live deep-water *Oculina* banks were first observed and described in detail (Avent et al. 1977). Navigation used LORAN-A which in this region had an accuracy of +-150-300 m. Photographs were taken every 1-2 minutes during each transect and analyzed using a microfilm reader with a grid overlay for estimating percent cover. Photographic data along with hydrographic and navigation information were entered into a computer database (unfortunately the computer tapes are obsolete, but hard copies and photos are archived at HBOI).

JSL dives and echosounder recordings were also conducted from 1979 to 1983 for biological and geological studies within the area of the *Oculina* MPA (C. Hoskin, J. Reed, pers. observations; Reed, 2002). In addition, a time-lapse camera was deployed to document the reef community over several 48-hour periods. Extensive surveys of the fish populations and fish behavior were made concurrently between 1975 and 1983 (G. Gilmore, pers. comm.; Gilmore and Jones, 1992).

Tethered, mixed-gas dives (lockout) were made with the JSL submersibles from 1976 to 1983 on the deep-water *Oculina* banks for studies on biodiversity of animals associated with the coral, coral growth rates, and geology (Reed, 2002). The scientist-lockout diver used a Kirby-Morgan band mask attached to a 30-m umbilical hose which supplied the gas mix (10% oxygen/ 90% helium) and voice communications from the submersible.

Videotape and Photographic Archives:

Some of the original videotapes (3/4” and ½” open reel) and 30-m rolls of 35-mm Ektachrome film have been recently restored and archived. Unfortunately videotapes of that age are prone to hydrolysis problems. The restoration process stabilizes the polymers of the tape coating. Once stabilized the tapes will be restored and archived onto Beta SP videotapes and copied to digital video disk (DVD) for analyses. The 35-mm photographs were also recently digitized with a Nikon LS-2000 scanner and copied to DVD. These original photographs were recently analyzed for comparison with recent mapping and habitat characterization surveys (Reed et al., 2006).

Recent Habitat and Bathymetric Surveys

Most of the recent surveys (1995 to present) of the *Oculina* HAPC are a series of continuing research projects to characterize the condition of the coral habitat and fish populations. These surveys have been sponsored largely by NOAA’s National Marine Fisheries Service (NMFS), NOAA’s National Undersea Research Center at the University of North Carolina at Wilmington (NURC/UNCW), and NOAA’s Ocean Service (NOS).

1995 Sidescan Sonar Survey:

In 1995, the U.S. Geological Survey, using the NOAA ship R/V Chapman, conducted a 100-kHz sidescan sonar survey covering 206 km2, and approximately 20% of the Oculina MPA

(Scanlon et al. 1999). The goal was to provide reconnaissance geologic maps of the Experimental Oculina Research Reserve (EORR; equivalent to the original 315 km2 *Oculina* MPA) and an unprotected Control Area north of the reserve (now part of the current 1029 km2 *Oculina* MPA) to support NMFS studies of grouper populations.

2002-2006 Multi-beam Echosounder Surveys:
Several multi-beam echosounder surveys primarily from NASA's M/V *Liberty Star* and *Freedom Star*, provided the first high-resolution (1.5-3.0 m) bathymetric map of the coral habitat in the *Oculina* HAPC. Surveys in 2006 will provide additional information within the HAPC but outside the Oculina zone (potential tilefish habitat) and also on recently discovered Oculina reef areas outside the currently protected OHAPC. Seafloor Systems Inc., Oregon, performed the survey using a 240-kHz RESON 8101 multi-beam echosounder system integrated with the ship's Differential Global Positioning System (GPS) unit, a DMSO 5 TSS motion sensor (quantifies heave, pitch, and roll), a SG Brown gyrocompass (yaw), and HYPACK navigation. All data were compiled in real-time using an ISIS Shipboard Data Acquisition and Image Processing System. Conductivity, temperature and density (CTD) casts were made every six hours. Raw data were post-processed in CARIS software to remove outliers and correct for sound velocity and tidal stage.

1995-2006 ROV, Submersible, and AUV Surveys:
NOAA/NURC's Phantom S4 ROV and Spectrum II ROV, and HBOI's Clelia submersible were used for habitat and fish surveys in 1995, 2001, 2003, and 2005. These surveys covered approximately 1.13 km2, or 0.11% of the *Oculina* MPA. The ROVs and submersible were equipped with digital still cameras and color video cameras with parallel lasers to indicate scale in the images. Objectives included: (1) survey high-, moderate- and low-relief areas to document the various habitats including live coral thickets, dead coral rubble, and hard bottom, and (2) revisit historical sites identified in the 1970s to document any changes in habitat. In 2003, the position of the ship and ROV were overlaid on the 2002 multi-beam map which allowed precise targeting of specific features for exploration during the dives. Photographic and video data from the 2001-2003 ROV surveys have been analyzed for habitat cover and associated fish census (Harter and Shepard, in review). In 2006 a new NOAA NURP AUV will be deployed to complete the multibeam mapping.

Oculina Geographic Information System (OGIS):
A multi-media geographic information system (GIS) has been developed to allow access and comparison of past and present data in the Oculina HAPC (NOAA NURC at UNCW; Manning, 2003). Portions of OGIS are available via the internet for use by resource managers and stakeholders (http://www.uncw.edu/oculina). Georeferenced digital photographs and logs from submersible dives complete the multi-media component of OGIS.

Physical Environment

Bottom temperatures averaged 16.2^{o}C and ranged from 7.4 to 26.7^{o}C at the 80-m *Oculina* reef site during a long-term survey (Reed, 1981). Upwelling of bottom water from the Florida Straits produces episodic intrusions of cold water throughout the year at the shelf edge in this region which causes temperatures to drop below 10^{o}C (Smith, 1981; Reed, 1983). During these upwelling periods, levels of nutrients and chlorophyll increase nearly an order of magnitude:

nitrates increased from <2 uM during non-upwelling to 9-18 uM during upwelling; phosphate from <0.25 to 0.5-2.0 uM; and chlorophyll-a from <1 to 1-9 mg m-3 (Reed, 1983). Salinity on the deep reef averages 36.0. The clear, warm water of the northerly flowing Florida Current in the region of the *Oculina* reefs typically only extends down to a depth of 50-60 m. Seldom does this water mass extend to the bottom and the reefs are often inundated with a turbid, bottom nephloid layer. Bottom currents averaged 8.6 cm s-1 but may exceed 50 cm s-1 (1 kn); currents of 50-100 cm sec-1 due to the Florida Current may affect the peaks of the higher *Oculina* pinnacles and may be strong enough to break the coral branch tips (Reed, 1981; Hoskin et al., 1983).

Long-term light measurements with Lambda quantum meters recorded an average of 0.33% transmittance of surface light which usually does not support macroalgae on the deep-water *Oculina* reefs or zooxanthellae within the coral (Reed, 1981). Sedimentation on the reefs averaged 53 mg cm-2 day-1, ranging from 15 to 78 (Reed, 1981). This is slightly higher than typical sedimentation rates for shallow-water coral reefs which average 1-10 mg cm-2 day-1 (Rogers, 1999).

<u>Coral Morphology and Distribution</u>

An extensive area of unique deep-water *Oculina* coral reefs stretches over 167 km (90 nmi) along the shelf edge off eastern Florida, at depths of 70-100 m, and ranging from 32 to 68 km offshore (Reed, 1980; Thompson and Gilliland, 1980; Virden et al., 1996; Koenig et al., 2000). These extend from 27^{o}32'N to 28^{o}59'N latitude, in a 2-6 km wide zone, paralleling the 80^{o}W meridian along the western edge of the Gulf Stream (Florida Current). Deep-water *Oculina* reefs are found exclusively here and are not known anywhere else on earth. A single species of a branching scleractinian coral, *Oculina varicosa* Lesueur, 1820, grows on these reefs. The reef system consists of numerous individual coral pinnacles, mounds, and ridges that are high relief structures, ranging from 3 to 35 m in height and up to 100-300 m in width (Figure 2; Reed, 1980). Each pinnacle is actually a veneer of living coral overlying a mound of sand and mud sediment, coral debris, and oolitic limestone base formed during the Holocene transgression (Macintyre & Milliman, 1970; Reed, 1980).

The deep-water growth form of *O. varicosa* has been found in depths of 49-152 m (Reed, 1980), ranging from Florida to North Carolina of the southeastern United States. The high relief *Oculina* banks, however, are only known off central eastern Florida. Colonies are arborescent with highly anastomosed, irregular, dendritic branches which average 6 mm in diameter. Cross sections of the branches show dense, concentric layers of aragonite. Corallites are distributed spirally around the branches, and calyces are generally 2-3 mm in diameter with three cycles (24) of septa. The core of the colony is strengthened by the anastomosed structure while the tapered tips, which are several centimeters in length, are extremely fragile. Living colonies are pure white in color and microscopic examinations have shown that they lack zooxanthellae.

The deep-water form of *O. varicosa* can be divided into three colony types (Reed, 1980). Individual colonies up to 2 m in diameter grow as discrete, branched, spherical heads. These are either unattached on the sand-rubble substrate or attached to limestone pavement. Of these, colonies less than 25 cm in diameter are often 100% alive. Larger colonies are dead in the center, possibly from water stagnation due to the dense branching framework, with only the outer 10-30 cm alive. Some large colonies over 2 m in diameter are broken in half, probably due to their weight and bioerosion, exposing the dead inner branches. The second deep-water colony type is a linear form which is 1-2 m in height and width and attains a length of 3-4 m. Finally, colonies may form massive thickets of contiguous colonies nearly 2 m in height (Reed, 1980). Extensive banks of this form generally have a steep slope of 30-45 degrees, especially on the south side which faces into the Florida Current. The north slopes are generally less steep and have a greater percentage of dead coral rubble or barren areas. Between 27°45'N and 27°52'N where the prominences reach their maximum density, *Oculina* was mostly found as dead rubble during mapping studies in 1976-1985 (Reed, 1980; Thompson & Gulliland, 1980). Some of these prominences have scattered <1 m live colonies covering up to 10% of the bottom while other banks in this region are 100% dead coral. Usually the dead fragments are <10 cm in length but in some places standing dead colonies <0.5 m in diameter are present (Reed, 1980; Hoskin et al., 1987).

<u>Benthic Communities</u>

Quantitative surveys of the macro-invertebrate fauna associated with the *Oculina* coral discovered that the *Oculina* coral habitat supports very dense and diverse communities of associated invertebrates (Reed et al., 1982; Reed & Mikkelsen, 1987). Live *Oculina* coral colonies of shallow and deep-water growth forms were sampled by placing a Nytex bag with 0.5-mm mesh over each colony. Thus all the macrofauna on and within the coral were collected. In the laboratory, each coral colony was photographed and measured for colony weight, height, diameter, total volume displacement, outer surface area, and branch surface area. Each colony was then broken into live and dead fractions and then further fragmented into 1-2 mm chips to remove all boring, free-living, and epizoic fauna that were retained on a 0.5-mm mesh screen. These studies found over 20,000 individual invertebrates living among and within the branches of 42 small *Oculina* colonies, yielding 230 species of mollusks, 50 species of decapods, 47 species of amphipods, 21 species of echinoderms, 15 species of pycnogonids, 23 families of polychaetes, and numerous other taxa, e.g., sipunculids, nemertines, isopods, tanaids, ostracods, and copepods (Reed et al., 1982; Reed & Hoskin, 1987; Reed & Mikkelsen, 1987; Miller & Pawson, 1979; Child, 1998).

The 42 quantitative *Oculina* coral samples yielded 2,300 decapod crustaceans in 15 families, 35 genera and 50 species (Reed et al., 1982). The community was species rich in xanthid and majid crabs and alpheid shrimp. Numerically it was dominated by hermit crabs (*Pagurus carolinensis, P. piercei*), a porcellanid crab (*Megalobrachium soriatum*), and a galatheid crab (*Galathea rostrata*). Densities of most dominant decapod species were positively correlated with the size of the dead, rather than the live, portion of the coral. However, densities of the obligate commensals *Domecia acanthophora* and *Troglocarcinus corallicola* were independent of coral size.

For the molluscan community, the quantitative coral samples yielded 5,132 individuals and 230 species-level taxa in 74 families and 111 genera, including 155 species of gastropods, 68 bivalves, 1 scaphopod, 5 polyplacophorans, and 1 cephalopod (Reed & Mikkelsen, 1987). An additional 32 species were identified from qualitative samples of *Oculina*. Of these taxa, 47% were free living (motile), 32% symbiotic (parasitic or commensal), 18% epilithic (fouling), and 3% endolithic (boring). The pyramidellid gastropods were the most species rich (23 sp.), followed by Cerithiopsidae (15 sp.), Fissurellidae (15 sp.), and Triphoridae (14 sp.). A total of 177 species were numerically rare consisting of less than 10 individuals, 42 species were common, and 11 species were abundant. Three gastropods (*Parviturboides interruptus, Costoanachis lafresnayi, Metaxia rugulosa*) and three bivalves (*Lithophaga bisulcata, Diplothyra smithii, Barbatia candida*) comprised 51.5% of the individuals collected. Analysis of the trophic structure of the molluscan community showed that 29% of the species were filter feeders (including suspension feeders and mucoid entrappers), 23.9% parasitic carnivores, 16.8% non-parasitic carnivores, 15.5% herbivores, 6.7% detritivores, 4.2% scavengers, and 3.8% corallivores (coral eating carnivores). The corallivore genera included *Latiaxis*, *Coralliophila*, *Calliostoma, and Heliacus*. The cool bottom temperatures and upwelling may account for the greater numbers of eurythermic tropical, temperate, and boreal species that were found on the 80-m reef site.

<u>Fish Communities</u>

The dense invertebrate community helps support the diverse fish populations (>70 species). The deep-water *Oculina* reefs form impressive breeding grounds for commercially important populations of gag (*Mycteroperca microlepis*) and scamp (*M. phenax*) grouper; nursery grounds for juvenile snowy grouper (*Epinephelus niveatus*); and feeding grounds for these and other fish including black sea bass (*Centropristes striata*), red grouper (*E. morio*), speckled hind (*E. drummondhayi*), warsaw grouper (*E. nigritus*), goliath grouper (*E. itajara*), almaco jack (*Seriola rivoliana*), greater amberjack (*S. dumerili*), red porgy (*Pagrus pagrus*), red snapper (*Lutjanus campechanus*), gray snapper (*L. griseus*), little tunny (*Euthynnus alletteratus*), giant ocean sunfish (*Mola mola*), Atlantic manta ray (*Manta birostris*), tiger shark (*Galeocerdo cuvieri*), and scalloped hammerhead shark (*Sphyrna lewini)* (G. Gilmore, pers. comm.; NOAA, 1982; Reed & Gilmore, 1982; Gilmore & Jones, 1992; Koenig et al., 2000, 2005; Reed et al., 2006). This shelf-edge structure also may form part of the migration pathway for king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*S. maculatus*), and wahoo (*Acanthocymbium solandri*). The spiny tail stingray *Dasyatis centroura* use the deep-water *Oculina* reefs region for courtship and mating (Reed & Gilmore, 1981), and large populations of the commercially important squid *Illex oxygonius* have been observed spawning on the banks (Reed & Gilmore, 1982).

Dense schools of thousands of small antheids *Hemanthias vivanus* often cover the coral, darting into the recesses of the branches for protection and for feeding on the invertebrates living within. These in turn help support the large populations of larger fish (Reed, 1985; Reed & Hoskin, 1987). Dense populations of gag and scamp grouper were associated with the *Oculina* reefs in the 1970s and early 1980s. Scamp are seasonally abundant (fall to spring) reaching densities of several hundred individuals per hectare (Gilmore & Jones, 1992). Groups of 5-50 individuals of both scamp and gag grouper school 1-20 m above bottom. The deep-water *Oculina* reefs are temporary habitats for gag and scamp since they also occur at shallower reef sites on the shelf. However, spawning aggregations of hundreds of individuals of scamp and gag appear to prefer the shelf-edge coral formations at depths greater than 70 m. These spawning aggregations avoid the reefs when temperatures drop below 10^{o}C during periods of upwelling (Gilmore & Jones, 1992). Unfortunately these large aggregations made perfect targets for both commercial and recreational fishermen, and the populations dropped drastically by the early 1990s.

The abundance and biomass of the economically important reef fish was much higher 30 years ago, and spawning aggregations of gag and scamp grouper have been greatly reduced in size (Koenig et al., 2000, 2005). Surveys of population densities for the dominant fish species were highly correlated with habitat type when comparing healthy intact coral habitat versus dead coral habitat (Koenig et al., 2006). This was true for the serranid basses (e.g., roughtongue bass and red barbier); serranid groupers (e.g., gag, scamp, and speckled hind); and pelagics like greater amberjack and almaco jack. Few economically important species occurred in coral rubble (Koenig et al., 2006). Juvenile (yellow phase) speckled hind associated with intact habitat at average densities of three to five per hectare. Male gag occurred only on Jeff's Reef and on Sebastian Reef near reefball clusters. Intact coral thickets within the EORR (relative to sites outside of the EORR) clearly contribute to improved abundances of gag and scamp, including males of both species on intact reef sites. These areas also appear to serve as juvenile habitat, based on the observation of juvenile speckled hind in association with the *Oculina* thickets of Jeff's and Chapman's Reefs (Koenig et al., 2006). This is a significant finding because the SAFMC considers speckled hind a threatened species (Coleman et al. 2000). Photographic and video data from the 2001-2003 ROV surveys have been analyzed for habitat cover and associated fish census (Harter and Shepard, in review).

Artificial Habitat Modules

In 2000, the first large-scale restoration of *Oculina* reefs on the high-relief features of Sebastian Reef, an area covered with coral rubble and almost completely devoid of intact coral colonies, was initiated (Brooke et al., 2005; Koenig et al., 2005). Reefballs (Reefball Foundation, www.reefball.org), which are perforated dome-like concrete structures one-meter in diameter and 0.7 m high, were deployed to simulate the overall size and aspect of *Oculina* coral colonies. Clusters of reefballs are expected to serve as attachment sites for coral transplants, centers for *Oculina* thicket restoration as the attached coral grows, and structure replacement for reef fish. One hundred and five reefballs were distributed among nine different 500 m^2 areas in clusters of varying density— 5, 10, or 20 reefballs. Thus, there were three replicates of each cluster size arranged in a randomized block design to determine the most efficient cluster size (density) for attracting fish. Each reefball was affixed with a wooden cross on the top attached with a length of jute (both substances being biodegradable), thus providing sufficient drag to ensure that the reefballs would land upright when reaching the bottom. Clusters deployed from the ship platform fell freely to the seafloor. The same fish survey measures used for natural habitat were used for determining fish abundance on these habitat modules.

Koenig (Koenig et al., 2005) surveyed reefballs in September 2002, thirteen months after their original deployment, to record the reef fish populations. The mean species richness and abundance of economically important fish were greater for reefball densities of 10 reefballs per cluster than for five, but did not increase further at densities of 20 per cluster.

Coral Reproduction and Larval Biology

The effect of temperature on embyogenesis, larval survival, and larval swimming speed were examined in the laboratory (Brooke, 1998; Brooke and Young, 2003, 2005). Separate sexes freely spawn gametes during the summer months. The small 120 micron eggs are fertilized externally and develop into swimming lecithothrophic planulae within 6 hours. Larvae swim actively for at least 22 days before initiating settlement. Embryogenesis ceased at 10^{o}C and was inhibited at 17^{o}C, but progressed normally at 25 and 30^{o}C (Brooke and Young, 2005). Newly ciliated larvae swam to the water surface and remained there for ~18 hr, after which they swam throughout the water column, then became demersal. At 14 and 23 days larvae exhibited negative phototactic behavior (Brooke, 1998; Brooke and Young, 2005).

Coral Growth

Long-term growth experiments were conducted on the deep-water *Oculina* coral (80 m depth) using lockout diving from the *Johnson-Sea-Link* research submersibles (Reed, 1981). The growth rates of the deep-water *Oculina* lacking zooxanthellae were compared to the growth of the shallow-water form of *Oculina* (6 m depth) which had zooxanthellae. Plastic tie wraps were attached to three branch tips on each of 44 coral colonies, and linear growth beyond the bands was measured with calipers every 2-4 months for one year. Additional colonies were stained with alizarin dye and all the branch tips were measured for new growth after a year to determine the variability of intracolony branch growth. Calcification rates were not measured. Control colonies were studied for three years to determine variability of inter-year growth. Additional colonies were transplanted between the 80-m and 6-m reef sites. Analysis of variance was used to compare growth rates within and between stations and stepwise regression analysis to determine the relationship of growth rate and various physical factors such as water temperature, cloud cover, sedimentation rates, light transmittance, and current velocity.

The growth rate of the deep-water *Oculina* coral at 80 m averaged 16.1 mm yr-1 and was significantly greater compared to the growth at 6 m (11.3 mm yr-1; Reed, 1981). Growth rate was significantly positively correlated with water temperature at both sites, but paradoxically the coral growth was faster in deep water where it lacks zooxanthellae. Corals transplanted from 6 m to 80 m lost their zooxanthellae within four months. By the end of one year the morphology of their branch tips became more similar to the deep-water *Oculina* growth form. Typically the deep-water *Oculina* has thinner branches, lower polyp density, but denser skeleta than the shallow-water morph (Reed, 1983). Although environmental factors such as greater sedimentation and sand abrasion from wave surge on the shallow *Oculina* reefs may reduce growth rate, physiological controls resulting from ecotypic variations or differing colony structure may also be factors. The growth rate of the deep-water *Oculina* is comparable to other deep-water ahermatypic scleractinia. Growth rates of 6-15 mm yr-1 have been estimated for colonies of *Lophelia pertusa* collected from deep-water cables (Teichert, 1958; Wilson, 1979). Studies using stable isotopes have estimated the linear growth rates of Lophelia from 5.5 to 20 mm yr-1 (Freiwald et al., 1997; Mortensen & Rapp, 1998).

Coral Growth and Reef Age

The deep-water *Oculina* reefs, based on a growth rate of 1.6 cm yr-1 and maximum height of 25 m, may be estimated at a minimum age of 1,526 years. A 6-cm diameter sediment core was taken by the author during a lockout dive half way up the flank of one 16-m high *Oculina* bank. The core consisted of dead coral branch fragments and mud sediment but only penetrated 22 cm; a piece of *Oculina* branch within the core had a radiocarbon age of 480+/-70 yr B.P. (Hoskin et al., 1987). Using the radiocarbon date yields an estimate of 980 years for the development of this *Oculina* bank. Considering that the base of these *Oculina* reefs would have been exposed ~15,000 years ago during the low water stand (–80 m) at the height of the Wisconsin glacial period, these deep-water *Oculina* reefs maybe relatively young.

Deep-water Coral Reef Sediments

Sediments from deep-water coral reefs and nearby inter-reef areas have been analyzed from both *Oculina* and *Lophelia* reefs (Stetson et al., 1962; Mullins et al., 1981; Hoskin et al., 1987; Freiwald et al., 1997; Paull et al., 2000). Each of these studies reported a greater percentage of mud (silt + clay) in the reef sediments than the non-reef sediments, indicating that the reef structure was trapping the finer sediments. The percentage of gravel, mainly from coral debris, was also generally greater at the reef sites. As the coral dies and erodes, the gravel-size branch fragments remain to form the bank structure.

In addition to the fine sediments produced by bioeroders, the resulting coral rubble is also subject to physical abrasion resulting in the production of gravel-, sand-, and mud-size particles. Broken *Oculina* coral branches were observed tumbling on the sea floor in 75 cm s-1 currents. Coral fragments tested in a mechanical tumbler at intervals of 1 to 1000 minutes produced 2-4 mm gravel-size particles and 0.2 mm sand-size (Hoskin et al., 1983). Coral septal fragments comprised the majority of sand-size particles. This abrasion experiment also produced carbonate muds that were 20% of the abrasion products. Natural sediments on the *Oculina* reefs are similarly dominated by mud (17% on the reefs but only 4% in surrounding non-reef shelf areas), gravel-size coral debris (24%), and sand particles (60%) which are primarily fragments of coral, forams, mollusks, barnacles, pellets, and quartz (Hoskin et al., 1987). The mud, which is primarily the product of bioerosion and physical abrasion, is trapped by the baffling effect of the coral and reef structure.

Hoskin et al. (1987) found the sediment components of the deep-water *Oculina* reefs to be more similar to shallow, hermatypic reefs than to other deep-water reefs. Sediments of both deep-water *Oculina* reefs and shallow tropical reefs have a greater percentage of mollusk components whereas the Lophelia reefs have higher percentages of planktonic sand components such as foraminifera and pteropods (Paull et al., 2000). The *Oculina* reef sediments, however, lack sand components from calcareous green algae that are abundant on shallow tropical reefs.

Deep-water Coral Reef Geomorphology and Development

The internal structure of deep-water coral reefs is not well documented. Attempts were made on a deep-water *Oculina* reef to determine whether live coral capped a mound of unconsolidated sediment or lithified rock. Using a JSL submersible, the author made a lockout dive at a depth of 71 m in a small flat sand area on the flank and midway between the top and base of the 16-m high *Oculina* reef. A 1.3-cm diameter steel rod was used to probe to a depth of 4 m into the mound without hitting bedrock. Rock outcrops are not apparent on the coral reef itself although rock pavement occurs on the flat sandy bottom areas surrounding the bank. A 6-cm diameter aluminum tube was used to core the flank of the reef. The cores consisted of coral branch fragments and mud sediment but only penetrated 22 cm.

The above results support the hypothesis that deep-water coral reefs are accumulations of coral debris and sediment that are initially built upon a hard substrate. The formation of a deep-water reef may progress through the following hypothetical sequence as proposed in part by Squires (1964) and Mullins et al. (1981): 1) coral larvae initially settle and develop into isolated colonies on rock pavement or outcrops; 2) a coral thicket forms as other colonies grow nearby either by sexual reproduction or by branch fragmentation and regrowth; 3) a coppice stage or mound develops from trapped sediment and coral debris; 4) and finally the coppice develops into a coral bank which is a large structure of unconsolidated coral debris and sediment and is capped with live coral. A final mature phase may result in which the mantle of living coral is relatively negligible to the large volume of dead coral (Newton et al., 1987). This may explain the high frequency of extinct, relict deep-water coral mounds that are common in the Atlantic and Gulf of Mexico. Newton et al. (1987) suggest that a paleoclimatic model may also be a factor for many of these senescent reefs.

Deep-water Coral Reef Senescence and Bioerosion

Extensive areas of dead coral on the *Oculina* reefs as well as their *Lophelia* counterparts (Freiwald et al., 1997) may be due to a combination of events including the natural evolution of the mound as described above along with degradation through bioerosion, hydrodynamic stress from currents (Wilson, 1979b; Reed 1998), and in some regions from dredging and trawling activities by fishermen (and scientists). Bioerosion of *Lophelia* coral is the result of sponges, foraminifera, bryozoans, polychaetes, sipunculids, mollusks, and various microborers (Newton et al., 1987; Jensen & Frederiksen, 1992; Freiwald & Schönfeld, 1996; Freiwald et al., 1997; Krutschinna & Freiwald, 1998; Rogers, 1999). Sponges such as *Cliona vastifica*, *Entobia* spp., *Aka labyrinthica*, and *Alectona millar*, and polychaetes such as the sabellid *Perkinsiana socialis* and Paraonidae are the primary borers causing degradation of these deep-water reefs in the eastern Atlantic (Jensen & Frederiksen, 1992). Newton et al. (1987) found large scale borings by lithophagid (?) bivalves, polychaetes, clionid sponges and bryozoans in the Gulf of Mexico's Lophelia banks.

For unknown reasons, in the central region of the deep-water *Oculina* reef system, between 27°45'N and 27°52'N, where the *Oculina* pinnacles reach their maximum density, extensive areas of dead *Oculina* rubble were found when the reefs were first discovered in the 1970s. Generally the coral fragments are <10 cm in length and well encrusted with various fouling species. Several unproved hypotheses exist including human damage and natural processes such as bioerosion, physical abrasion, chemical solution, and episodic coral die-off. Our experiments on limestone substrates show that bioerosion is 20 times more intense than either chemical or physical abrasion processes (Hoskin et al., 1986). Bioeroders of *Oculina* in shallow and deep water are dominated by clionid sponges, mollusks, eunicid polychaetes, sipunculids, and boring barnacles. In a detailed survey of mollusks associated with *Oculina* on the deep and shallow reefs, 41 colonies of coral yielded 5,132 individual mollusks and 230 species (Reed & Mikkelsen, 1987). Of these, 47% of the species are free-living on the surface of the coral, 32% symbiotic (parasitic or commensal), 18% epilithic (fouling), and 3% endolithic (boring). The borers comprised 13.1% of all individuals collected. The endolithic bivalve *Lithophaga bisulcata* is the most frequently occurring molluscan species overall. Other endolithic species include *L. aristata*, *Gastrochaena hians*, *Diplothyra smithii*, *Gregariella coralliophaga*, *Rupellaria typica*, and *Rocellaria ovata*. Density of endolithic mollusks decreases from shallow to deep (4.9, 2.6 and 0.9 [N/100-g dry coral wt] at the 6-m, 27-m and 80-m reef sites, respectively). The corallum of *Oculina* is denser and thinner at 80 m than at the 6-m site, possibly accounting for the fewer numbers and species of boring mollusks at 80 m. Significant correlations ($p<0.05$) exist between the amount of dead coral on the colonies and the endolithic species (*L. bisulcata*, $r = 0.792$; *L. aristata*, $r = 0.573$) but not with the live portion of the colonies.

Weakened by bioerosion the coral becomes susceptible to breakage by peak currents. In our tow tank tests, fresh *Oculina* branches of the deep growth form fractured at current speeds of 140 cm s-1. The Gulf Stream that may exceed 5 knots (250 cm s-1) sometimes impinges upon the peaks of the pinnacles, possibly causing coral breakage. However, maximum current at the base of the banks is only 58 cm s-1 and averages 8.6 cm s-1. On the lithoherms in the Straits of Florida, Messing et al. (1990) also found peak currents in excess of 100 cm s-1 on the eastern side of the Straits and Paull et al. (2000) recorded currents of 25-100 cm s-1 on the western side, which may contribute to the areas of Lophelia rubble on these lithoherms. Large 1-2 m *Oculina* and *Lophelia* colonies also occasionally may shear in half possibly due to the weight of the framework structure weakened by bioerosion.

Human Impacts

The exact cause(s) of the extensive areas of dead coral rubble on modern deep-water reefs, including *Oculina* and *Lophelia*, is yet unknown. Bottom trawling and dredging certainly can cause severe mechanical damage as shown on deep-water *Lophelia* reefs in the northeast Atlantic (Rogers, 1999; Fosså et al., 2000a,b), hard bottom habitats off the southeastern United States (Van Dolah et al., 1987), and deep-water seamounts off New Zealand and Tasmania (Jones, 1992; Koslow et al., 2000; Richer de Forges et al., 2000). Trawling may also cause increased sedimentation on deep reefs which can smother the coral and prevent larval settlement (Rogers, 1990). In addition, most deep-water fish stocks are overfished or depleted. Since most benthic fisheries focus on apex predators such as groupers, snappers, and sharks, removal of these apex predators and other ecologically important species may have severe long-term repercussions (Koenig et al., 2000: Koslow et al., 2000). Natural episodic coral die-off, such as occurs with the shallow-water *Acropora* species also may be an unknown factor on the deep-water coral reefs. We do not yet know whether fungi and other pathogens that attack shallow-water reef corals also affect deep-water ahermatypic coral species. Bioeroders are also an integral component of both *Oculina* and *Lophelia* reefs and are a major producer of sediments. Other hypotheses may account for some of the dead *Oculina* reef areas. One is that German submersibles were known to hide among high relief structures in this region during reconnaissance missions along eastern Florida during World War II (Cremer, 1986). Navy SEAL teams trained here too and the shelf region was bombed extensively as a result. Extensive areas of dead coral on deep-water *Oculina* and *Lophelia* reefs may be the result of a combination of factors: 1) fishing activities and human activities, 2) pathogens, 3) bioerosion, 4) hydrodynamic stress, 5) natural evolution of coral bank development, and 6) paleoclimatic factors.

Apparently commercial fishermen are capable of trawling at these great depths in areas of high relief pinnacles, and shrimp trawlers have been caught and fined for fishing within the *Oculina* Coral Bank Habitat Area of Particular Concern. In the late 1970s roller trawl fishery gear was being used off Georgia and the Carolinas of the southeastern United States and was being considered for fishing off Florida. This type of bottom trawl incorporates wheels along the bottom tickler chain which allows the trawl to be used in rougher bottom topography than the standard bottom trawl. Certainly it would decimate fragile corals like *Oculina*. Other impacts on the *Oculina* reefs are from anchoring, bottom hook and line fishing, and longline fishing. Anchors dropped or dragged through reef areas would certainly destroy coral colonies. From submersible observations we have frequently observed fishing lines draped over some of the deep-water *Oculina* reefs. Since this coral reef system lies within the Gulf Stream and is over 60 m deep, large fishing weights are required for bottom fishing for grouper and snapper. Bottom traps if placed on the reefs would also damage fragile branching coral.

The benthic fisheries that have operated in the region of the deep-water *Oculina* reefs include trawl and dredge fishery for calico scallop (*Argopecten gibbus*), trawl fishery for rock shrimp (*Sicyonia brevirostris*) and penaeid shrimp (*Penaeus* spp.), and hook and line fishery for grouper (*Mycteroperca phenax*, *M. microlepis*), red snapper (*Lutjanus campechanus*), porgy (*Pagrus pagrus*), greater amberjack (*Seriola dumerili*), and various sharks (Koenig et al., 2000). Pelagic fish common to waters above the reefs and in the Gulf Stream include tunas (Scombridae), dolphin (*Coryphaena hippurus*), sailfish (*Istiophorus platypterus*), wahoo (*Acanthocymbium solandri*), king mackerel (*Scomberomorus cavalla*), and barracuda (*Sphyraena barracuda*). Sport fisheries for these pelagic species are fished in the upper 30 m or so and typically do not impact the reefs or the coral. Early in the 1970s bottom fishing activity was sparse and the deep-water *Oculina* reefs had large populations of red and grey snapper, and various grouper species including scamp, gag, snowy, speckled hind, and warsaw grouper. By the late 1980s both commercial and recreational fisheries had taken a toll on the fish populations, especially grouper and snapper (Koenig et al., 2000).

<u>Effects of Trawling</u>

Historical photographic records from the 1970s provide evidence of the status and health of the reefs prior to heavy fishing and trawling activities of the 1980s and 1990s (Avent et al., 1977; Avent and Stanton, 1979; Reed, 1980; Reed et al., 2006 in press). Over 50,000 35-mm photographs were taken during these early submersible transects. Portions of these transects that were over reefs were compared to video transects of the same areas made 25 years later in 2001. Random photographic images from both surveys were quantitatively analyzed by point count to determine changes in percent cover of live *Oculina* coral, standing dead coral and coral rubble. This study has resulted in the restoration, protection and archiving of these rare and invaluable photographic images and data, and also will provide marine managers and scientists a quantitative assessment of the health and percent cover of live coral in the 1970s, prior to intense trawling, compared to the same sites today.

By 2001, only two high-relief bioherm sites (Chapman's Reef and Jeff's Reef) had extensive amounts of live coral remaining (Reed et al., 2006 in press). Except for these two reefs, all 2001 transect sites had less than 0.1% live coral remaining for all *Oculina* habitat types including high relief bioherms, and individual colonies and thickets on moderate to low relief limestone ledges and sand mounds. Overall the loss of mean live coral cover at each transect site was dramatic and statistically significant, varying from 3% to 26%. In addition, the percent loss of live coral was nearly 100% (range 98.4%-100%) for each individual transect site except Chapman's Reef and Jeff's Reef (46.2, 66.4%, respectively). Concurrently, four of the seven transects showed decrease in standing dead coral, and all showed an increase in percent cover of unconsolidated dead coral rubble. Significant declines in both standing live coral and standing dead coral with the concurrent increase of coral rubble suggest that mechanical disruption was the cause of the decline.

Habitat Loss- Effects on the Ecosystem:

The *Oculina* biogenic refuge consists primarily of standing live and dead coral habitat. As long as the coral is standing, the living space within the colony branches supports dense and diverse communities of associated invertebrates (Reed et al., 1982; Reed and Mikkelsen, 1987; Reed et al., 2002 a,b; Reed et al., 2006 in press). However, once reduced to unconsolidated coral rubble, little living space is left except for the boring infauna (Reed, 1998). When the standing coral habitat is lost due to mechanical damage or natural causes, the effects on the ecosystem are dramatic. The decline in fish populations, primarily gag and scamp grouper, on the *Oculina* reefs over that past 20 years is evident (Gilmore and Jones, 1992; Koenig et al., 2000, 2005). This may be attributed to both habitat loss and overfishing. However, population densities of the dominant basses (roughtongue bass *Holanthias martinicensis* and red barbier *Hemanthias vivanus*), dominant groupers (scamp, gag, and speckled hind *Epinephelus drummondhayi*), and pelagic species (greater amberjack and almaco jack *Seriola rivoliana*) all showed positive association with intact coral habitat (either sparse or dense live coral) compared to unconsolidated coral rubble habitat (Koenig et al., 2005). Scamp grouper density in intact coral habitat was significantly greater ($p = 0.05$) than other habitats (sparse live coral or rubble). Only one commercially important species (snapper *Lutjanus* spp.) was primarily associated with the coral rubble habitat.

A hypothetical trophic model of the *Oculina* coral ecosystem shows the plausible interactions of the various invertebrate and fish species that are associated with the coral habitat (George et al., 2006 in press). Standing live and dead coral provide refuge within the branches for diverse invertebrate communities including polychaete worms, mollusks, crustaceans, sponges and octocorals. These consist of various suspension feeders, detritivores, carnivores and corallivores (Reed, 2002a), which are prey for smaller reef fish and up the food chain to larger benthic and pelagic fish. The economically important grouper complex including gag and scamp grouper and speckled hind are closely associated with the standing intact coral habitat (Gilmore and Jones, 1992; Koenig et al., 2005). The whole system in turn is also linked to physical factors such as food, nutrients, and plankton from the Florida Current (Gulf Stream) and upwelling events which provide influx of cold nutrient rich water (Reed, 1983). Therefore significant loss of habitat, in particular intact live and dead standing coral, will bring dramatic and possibly catastrophic shifts in the ecosystem. As seen with the grouper complex that is associated with the intact coral, the loss of standing coral habitat could result in the loss of several commercially important species that use the *Oculina* ecosystem as spawning and feeding grounds. Several species such as gag grouper also utilize inshore mangrove and grassbed habitat as juveniles then move to the deeper high relief reefs once they are sexually mature (Gilmore and Jones, 1992). Also the effects of overfishing is unknown for the *Oculina* ecosystem. Even if the *Oculina* coral is kept intact, how will the lack of top predators affect the whole reef system? Such a loss could cause dramatic shifts in the entire community structure of smaller food prey and ultimately affect the coral itself.

CONCLUSIONS

The recent ROV ground-truthing of the multi-beam map provided new information, including: 1) discoveries of isolated thickets of live *Oculina* that exist within the newly expanded Oculina MPA; 2) numerous high-relief *Oculina* bioherms that were previously unknown exist outside the Oculina MPA; and 3) extensive areas of live-bottom habitat (primarily hard-bottom, rock pavement and ledges) and *Oculina* thickets occur within the low-relief areas. However, ROV surveys are extremely difficult to conduct on these high-current, high-relief reefs and are limited to drifting with the current in most cases. Human-occupied submersibles have consistently proved to be of greater value in surveying the fish populations and mapping the deep-water *Oculina* reefs.

Large gaps still exist in our knowledge of these deep-water *Oculina* reefs. Priorities for habitat mapping and characterization include: 1) complete multi-beam maps of the *Oculina* HAPC and adjacent areas that may contain *Oculina* bioherms; 2) ground-truth these maps with submersible and ROV dives to characterize and document the extent and distribution of the *Oculina* reefs and other habitats; 3) document the extent of damage from recent trawling, both by direct mechanical damage and by indirect damage from resuspension of sediments and smothering of coral; 4) document other potential causes of coral death such as possible temperature changes from global warming, increased nutrient loading, or disease; 5) document the recovery of the fish populations and relationships with artificial reefball structures.

We have little data on when or how the coral rubble was formed, especially the vast areas that were rubble in the 1970s. It is important to know how much of this is from natural causes and how much is man-made. However, the age of dead coral, whether due to trawling versus WWII depth charges, is too young for radiocarbon dating. Also little is known about the rubble ecosystem. For example, what role does it play as habitat for shrimp and other benthic fauna?

Characterization should continue and experimental research is needed to quantify the value of coral thicket habitat (live and dead of various sizes) versus the alternate rubble state.

Certainly, trawling continues to be the primary threat to the ecosystem as evident from recent photographs of trawl nets found on the bottom, destroyed reefball modules, and the documented destruction of the Cape Canaveral Pinnacle reef in the past 25 years (Fig. 4). Since 2000, illegal trawling has been documented within the *Oculina* HAPC, and several poachers have been intercepted by the U.S. Coast Guard. Surveillance and enforcement remain the greatest tasks in protecting the Oculina MPA, as well as any deep-water coral reserve. We remain hopeful that the recently mandated use of a vessel monitoring system for the shrimp fishery in this region along with additional enforcement vessels will aid in the long-term protection of the *Oculina* MPA. In addition, proposed projects are envisioned to use surface buoys with satellite relay to monitor the reefs with acoustic devices which could relay real-time data on sounds of boat traffic and illegal trawlers. These could also be used by scientists studying the fish population patterns, and perhaps include arrays of thermographs, current meters, cameras, and other equipment to help understand this remote yet valuable resource.

ACKNOWLEDGMENTS

This manuscript is dedicated to the memory of Robert Avent who first described these magnificent deep-water *Oculina* reefs using the *Johnson-Sea-Link* submersibles. Appreciation goes to all the individuals in the early years at Harbor Branch Foundation, especially submersible pilots Jeff Prentice and Tim Askew who first discovered Jeff's Reef, and the more recent investigators who have spent countless hours studying various aspects of these reefs. Special thanks goes to Charles 'Skip' Hoskin who provided years of enthusiastic collaboration and leadership. Frank Stanton, John Miller, David Mook, Lee Edmiston, Nat Eisman, Robert Jones, and Mary Rice were also active participants. We gratefully acknowledge Harbor Branch Oceanographic Institution for support of this project. Recent surveys have been sponsored largely by the National Oceanic and Atmospheric Administration (NOAA), including NOAA's National Marine Fisheries, NOAA's Undersea Research Center at the University of North Carolina at Wilmington, and NOAA's Ocean Service. NASA and the United Space Alliance co-funded portions of the shiptime for recent mapping and ROV surveys. We thank the crews of the R/V *Johnson*, R/V *Sea Diver*, R/V *Seward Johnson* I and II, M/V *Liberty Star*, M/V *Freedom Star*, *Johnson-Sea-Link* I and II and *Clelia* submersibles, and ROV pilots Lance Horn and Glenn Taylor for their exceptional operational support. This is contribution no. 260 from Harbor Branch Oceanographic Institution, Biomedical Marine Research Program.

PUBLICATIONS with ANNOTATIONS
OCULINA CORAL REEFS- 1970- PRESENT
Compiled by John K. Reed

(in descending order by year)

35) Reed, J.K., D. Weaver, S.A. Pomponi. 2006. Habitat and fauna of deep-water *Lophelia pertusa* coral reefs off the Southeastern USA: Blake Plateau, Straits of Florida, and Gulf of Mexico. Bulletin of Marine Science 78(2): 343-375. (includes *Oculina* fish sp. list and comparison to *Lophelia* reefs)

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Appendix C. Members of the Oculina Evaluation Team

Oculina Evaluation Team –Research and Monitoring Representatives

Member	Expertise	Association	Address/Phone	email
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Oculina Evaluation Team –Commercial Representatives

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Oculina Evaluation Team –Outreach Representatives

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Oculina Evaluation Team –Conservation Organization Representatives

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Appendix D. Results from the review of the *Oculina* Evaluation Report

Subsequent to the meeting of the *Oculina* Evaluation Team, the draft report was sent for review to the Council's Habitat Advisory Panel, the Coral Advisory Panel, the Marine Protected Advisory Panel, and the Information and Education Advisory Panel. The Council's Scientific and Statistical Committee (SSC), Snapper Grouper Advisory Panel, and the Law Enforcement Panel were all able to review the document at their meetings in December of 2006.

The SSC, Snapper Grouper AP, and the Law Enforcement AP all stated their support for the continuation of the current size and configuration of the *Oculina* Experimental Closed Area and had nothing to edit or add with regard to the Report.

The Habitat Advisory Panel, the Coral Advisory Panel, the Marine Protected Advisory Panel, and the Information and Education Advisory Panel were all sent the draft report either by mail or e-mail and asked to send any comments to the Council office. Only two responses contained any comments. One was items editorial in nature and those changes have been made and the other had recommendation relating to research projects and priorities and that letter will be forwarded to Team members and presented with this report to the Council.

In summary, all parties asked to review the report were either in favor of continuing the current size and configuration of the *Oculina* Experimental Closed Area or did not comment.

At their March 4-9, 2007 meeting in Jekyll Island, Georgia the Council reviewed the recommendations of the *Oculina* Evaluation Team as well as the input from the SSC and the Advisory Panels and agreed with the conclusion and made a motion that the size and configuration of the *Oculina* Experimental Closed Area should not be changed.

The Council will next evaluate the regulations in the Oculina Experimental Closed Area in 2014.