

116961

Project Title: Monitoring Coral Reef Ecosystem Health, Impacts and Disease Propagation at Biscayne National Park

Applicant Organization: University of Tennessee, Knoxville, Tennessee

Project Contact: Dr. Paul D. Ayers, Professor, University of Tennessee

Contact Information:

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Program Category: General Coral Reef Conservation

Geographic Location: Biscayne National Park, Homestead, Florida, USA

Amount of grant funds requested: \$37,000

Amount of matching funds provided: \$54,350

Project Summary:

The coral reefs in Biscayne National Park are subjected to disease, tourism and boat damage, and pollution. Monitoring the conditions and threats to the coral reef ecosystem health is needed. Previously surveyed coral reefs will be reevaluated to determine coral reef ecosystem health condition and changes. These changes include coral distribution and black band disease propagation. Sensitive areas (boat impact areas and mooring buoys) will be mapped using underwater video mapping equipment. Areas of intense damage will be identified so that public awareness and reef restoration activities can be initiated.

This project supports the defined Coral Reef Conservation Project goal 4) "develop sound scientific information on the condition of coral reef ecosystems and the threats to such ecosystem" as stated in Federal Register Vol.69, No. 125, page 39420 for "General Coral Reef Conservation." The project addresses the categories identified by the U.S. Coral Reef Task Force – "monitoring and assessment activities." The goal defined by the National Action Plan to Conserve Coral Reefs that this project supports is A. II. "Assess and Monitor Coral Reef Health." This project will be conducted with coordination with existing NOAA mapping, and Biscayne National Park Service coral reef activities.

Project Summary

This project involves the use modern technology (GPS, GIS and underwater imagery) to initiate a system to identify, monitor and prevent tourism and boating impacts, and monitor long-term coral health condition changes and disease propagation. The system will be used to generate GIS map of coral reef ecosystem health and provide needed information to initiate coral reef restoration efforts. Underwater video mapping equipment, previously used for benthic habitat mapping, will be used to locate and quantify the degree of tourism and boating impact, and coral health change and disease propagation.

This equipment consists of an underwater video camera and Global Positioning System (GPS) combination that provides georeferenced underwater images. Areas in Biscayne National Park, known to be subjected to boating and tourism impacts, will undergo an extensive underwater video mapping survey. Specific areas and locations of tourism and boating impacts will be determined by reviewing the video footage. Areas previously surveyed in 2001 will be resurveyed to evaluate coral health and disease propagation. A geographic information system (GIS) will be utilized to present and analyze the impact locations and changing coral health. The underwater video mapping system can be used to monitor rates of boating and tourism impacts, and the progress of the restoration efforts. By evaluating the coral reef ecosystem recovery and the time from the recent grounding, an indication of natural recovery can be determined.

This project brings the underwater video mapping capabilities of the University of Tennessee, the local scientific (reef restoration) expertise of Biscayne National Park together in an important Coral Reef Conservation project to address an immediate and growing need. The approach employed at Biscayne National Park can be used to address the coral reef ecosystem health at other coral reefs.

The products of this project include 1) Underwater video of the area previously surveyed in 2001 and selected mooring buoy locations, 2) a GIS map of Biscayne National Park showing location of boating and tourism impacts, and changes in coral health and disease propagation, 3) evaluation of boating and tourism impacts near mooring buoys and 4) a map to initiate coral reef restoration efforts

Project need and previous work

On June 11, 1998, President William Jefferson Clinton announced Executive Order 13089, "Coral Reef Protection," to conserve and protect U.S. coral reef ecosystems and those species, habitats, and other natural resources associated with coral reefs and other natural resources associated with coral reefs in all maritime areas and zones in U.S. jurisdiction. The Task Forces duties are organized into four thematic areas: 1) coral reef mapping and monitoring, 2) research, 3) conservation, mitigation and restoration, and 4) international cooperation.

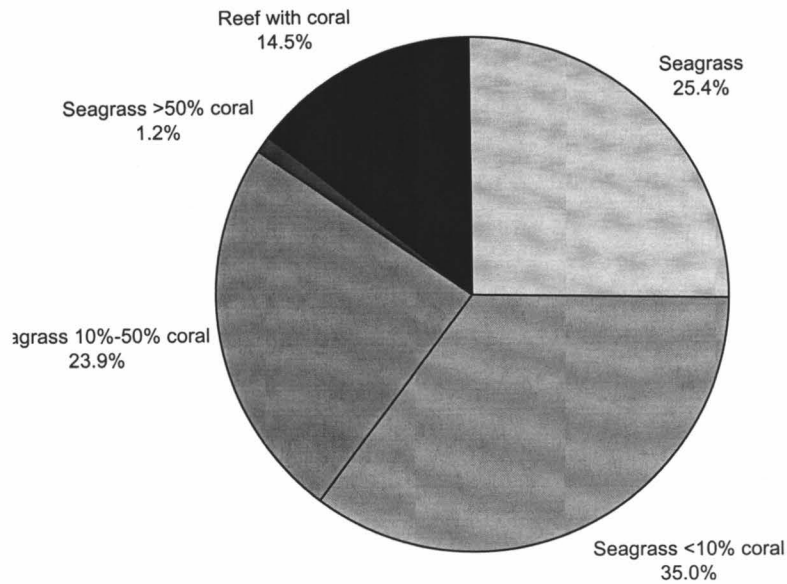
One of the goals of the Coral Reef Conservation Act of 2002 is to develop sound scientific information on the condition of coral reef ecosystems and the threats to such ecosystems. Monitoring the impacts of disease and boat impacts on coral reef ecosystem health is essential to maintain this resource.

Biscayne National Park (BISC) is in Biscayne Bay and the offshore waters along the Atlantic coast south of Miami in Miami-Dade County, Florida. The park encompasses almost 173,000 acres and has relatively pristine estuarine and marine environments. Nearly 165,000 acres are water, containing about 72,000 acres of coral reefs. To conserve the health of the coral reef ecosystem monitoring is needed to evaluate conditions and threats.

There has become an increased need for utilizing georeferenced underwater video to monitor coral reef ecosystem health. Georeferenced underwater video produces a permanent record of coral locations, damage, disease and health. It can be used to map where coral reefs are located, and monitor how they are changing over time.

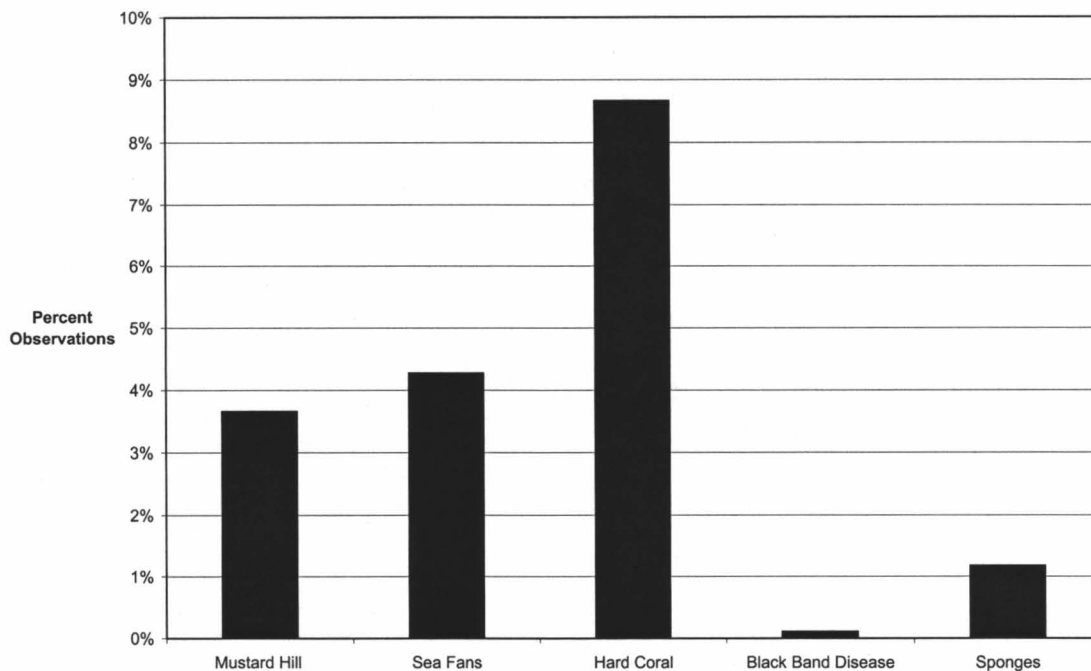
Initial coral reef ecosystem monitoring survey was conducted in January 11-13 2001 by the project officer (Dr. Paul Ayers), with the assistance of Brenda Lanzendorf, Maritime Archeologist BISC, using underwater video. Using an Underwater Video Mapping System (UVMS), ten videotapes of data with 503 minutes of underwater georeferenced video were recorded near Pacific Reef. This video documents the coral reef ecosystem health at that time. The video provides information on coral health, distribution, damage and disease.

The videos were visually separated into five substrate classifications: sea grass, sea grass with less than ten percent coral, sea grass with between ten and fifty percent coral, sea grass with greater than fifty percent coral, and reef with coral. These classifications were expanded from the classifications the Department of Environmental Protection and NOAA used to develop "Benthic Habitats of the Florida Keys". The percentages of the substrate classification can be seen below.



Underwater organisms were identified and recorded using the parallel swathing technique. These include mustard hill coral, sea fans, hard/stony coral, sponges and black band disease. The parallel swathing study site is approximately 0.7 km by 0.35 km. The substrate classifications and disease locations were recorded in ArcGIS maps. A

Species Observations



245,000m² underwater habitat map was generated for a portion of Biscayne National Park using a 20 m swath width.

Black band disease was also be mapped in the same manner. The UVMS is very useful for monitoring disease. Black band disease is a black or dark brown algae that kills coral polyps. It attacks several species of shallow-water corals, and eventually kills the entire colony. Research indicates it is a natural phenomenon and not the result of pollution. The underwater videotape is a permanent record of the health of the coral at the 8 observed locations. The location of black band disease is stored in ArcGIS. In the future the UVMS can return to the sites and see if the disease has progressed or infected nearby coral.

One threat to the health of the underwater ecosystem in Biscayne National Park is damage caused by grounded vessels. Due to its ease of access, natural protection and abundance of coral reefs, Biscayne National Park is a popular site for boaters, snorkelers and divers. The large boat rental business results in a large number of inexperienced boaters accessing the coral reefs. Unaware of tide schedules, navigation and proper anchoring, these boaters continue to degrade the Park's coral reefs. The Park is also adjacent to major shipping lanes. Major ship groundings, some resulting in over one mile in coral reef destruction, occur too frequently. National Park Service personnel attribute boating impacts as the major cause for the decline in coral reef health.

Park staff has recorded over 700 vessel groundings since 1995 and this number comprises only an estimated 10-20% of all groundings in the park. In 1996 Biscayne National Park published a 28 page report titled "Vessel Grounding Response: Policies & Procedures" address the boat grounding problems. Public awareness of this problem and areas of frequent groundings are needed. Anchor scars, trash, nets, fishing equipment, traps, rope and other products from boating exist on the coral reefs and need to be identified.

Mooring buoys help preserve the fragile coral reef ecosystem by preventing anchors from striking the coral and anchor ropes or chains from chafing or breaking coral. They also provide a convenient way to secure your boat. Mooring buoys are located adjacent to some of the more popular reefs in the park. The effectiveness of these mooring buoys in alleviating pressure on the coral reefs needs to be evaluated. Mooring buoys may concentrate anchorages in a given area increasing anchor damage.

A main shipping lane just east of Biscayne National Park and too frequently a large freighter or tanker grounds on the coral reefs. In November of 1996, the Igloo Moon, a 6600 ton tanker grounded on the coral reefs at the north end of the Park. The damage to the coral reefs in the area was immense. The effectiveness of restoration techniques is a major focus of the Park. Coral nurseries can be used to reconstruct and revitalize damaged coral reefs. The rate of natural and artificially induced coral restoration needs investigation.

Long term monitoring and mapping of the boating impact areas and areas of restoration is needed for a comprehensive coral reef management plan. Geographic

information systems (GIS) provide the spatial analysis techniques necessary to implement a coral reef conservation plan.

Objectives

The specific objectives of the project include:

- 1) Resurvey the previously surveyed area in BISC to evaluate changing coral reef ecosystem health, species distribution, boat damage, and disease propagation.
- 2) Conducting underwater video mapping surveys in Biscayne National Park at areas of popular coral reefs, areas of previous boat groundings and areas near mooring buoys to evaluate tapes to determine boating and tourism impacts.
- 3) Developing a GIS map to determine locations and intensities of boating and tourism impacts and possible restoration efforts.
- 4) Documenting recovery of grounding sites and rehabilitation areas.

Methodology

Underwater Video Mapping Equipment and Software

The project utilizes an underwater video mapping system developed by the Project Officer that provides underwater georeferenced images. The Underwater Video Mapping System was designed to examine underwater ecosystems and record their location using a Differentially Corrected Global Positioning System (DGPS). The UVMS incorporates a Splash Cam II underwater camera, a Trimble AgGPS 132 Receiver, a VMS 200 (Video Mapping System 200), a Sony digital video camera DCR-TRV310, a Lowrance LMS-350A sonar depth sounder, and a Pocket PC. These components work together to georeference all the digital images by recording the DGPS position on each frame.

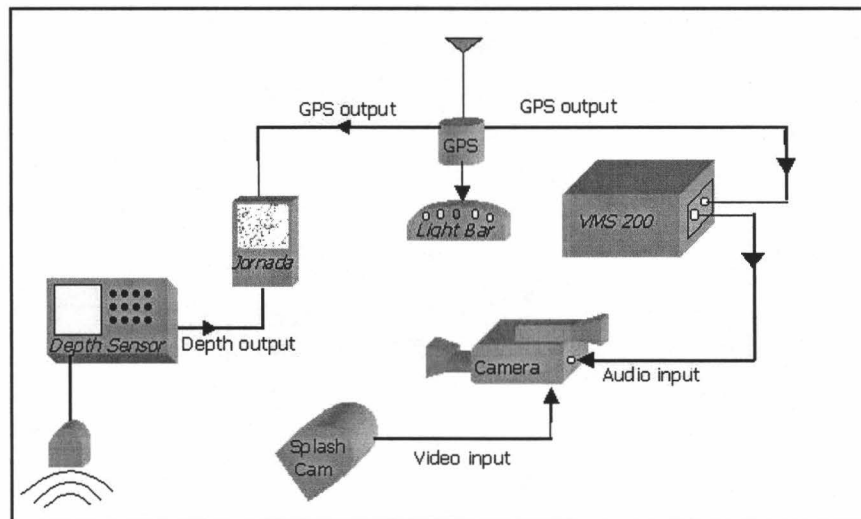
The Splash-Cam II is a compact color underwater video camera. The camera is rated to 0.3 lux, and a lighting pod is available for dark conditions. An adjustable strain relief allows the operator to adjust for viewing at any angle. The underwater camera also has a stabilizer fin to keep the camera oriented forward. It has a cable length of 60 m (200 ft) and a cable breaking strength of 3114 N (700 pounds). A motorized reel stores the cable and is used to raise and lower the camera to the desired height above the substrate. A slip ring was incorporated to allow power and video signal to flow in and out to the camera respectively, in order to accommodate the rotating reel. A LCD color screen allows the operator on the boat to see the underwater images, and adjust the camera height.

The VMS 200 is a spatial multimedia system: a tool that creates "video maps," and interactively displays pictures or video footage of the mapped locations. The system includes hardware that embeds GPS data on the left channel of the videotape and software that automatically builds maps using the videotaped data. The VMS 200 can be used with an external camera. The VMS 200 records the GPS position on each frame of the digital videotape, thus georeferencing images.

The Trimble AgGPS 132 is a 12 channel, high performance sub-meter GPS receiver. It has a combination of a GPS receiver, a Coast Guard Beacon and a satellite differential correction receiver in the same housing. The user can program which NMEA (National Marine Electronics Association) 0183 strings are output. The Trimble receiver is programmed to output the \$GPGGA and \$GPRMC strings. The \$GPGGA string contains time, latitude, longitude, GPS quality (2D/3D fix, and differential correction), number of satellites, horizontal dilution of precision (HDOP), altitude, geoidal separation, age of differential correction, and the differential reference station ID. The \$GPRMC string has time, latitude, longitude, speed over ground, course over ground, date, and magnetic variation. Position accuracies of less than one meter are attained. The parallel swathing option allows the boat operator to drive in straight lines that are equally spaced. The option includes a light bar to guide the boat driver by providing parallel boat swaths. Lights on either the right or left light up if the driver is off course. Each light represents a preset distance. The keypad allows the operator to set initial points, pause the swathing, and return to the pause location.

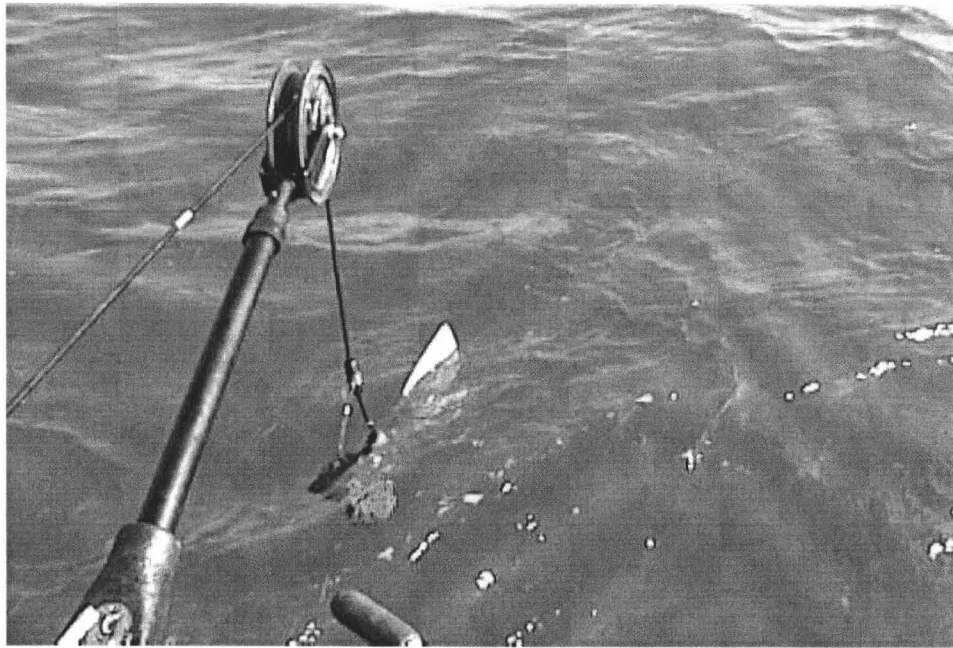
The Sony digital video camera records the underwater image and the GPS data using the audio input RCA jack instead of the microphone. The Pocket PC records the depth measurement from the Lowrance depth sensor, and a counter from the reel motor, defining the camera depth.

A diagram of the equipment setup for data collection can be seen below.

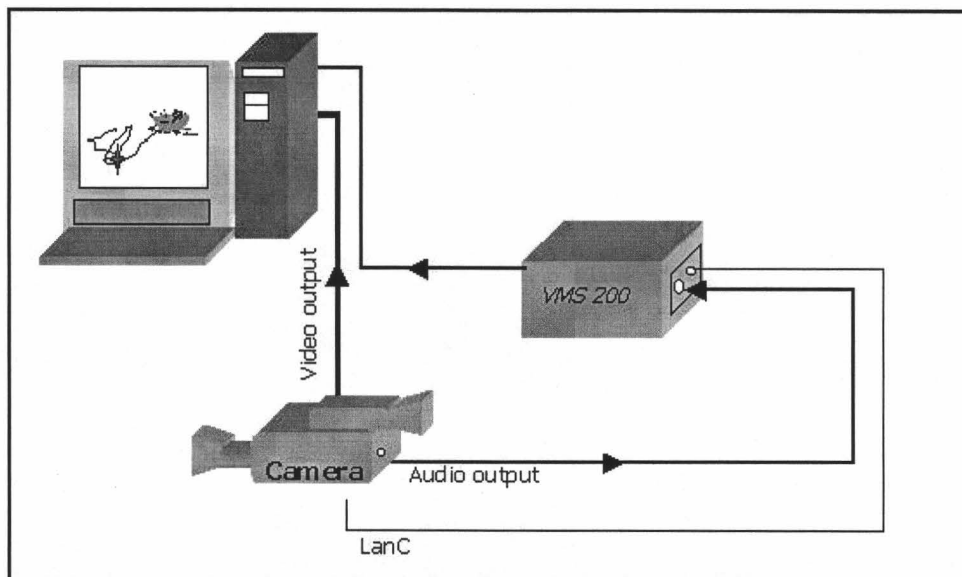


The camera can either be controlled by the reel system, or mounted on a pole that is fixed to the side of the boat. The reel system incorporates a reel with the camera cord wrapped around it and is controlled by the reel motor. A pulley is attached to the edge of the boat to guide the camera off the boat. On the reel, the camera height can be adjusted, it can be close and get more detail of the substrate, or it can be farther away and record a larger area. With the pole mount the camera is in a fixed position, and the receiver can be mounted on or near the camera pole. The pole is 3.05 m (10 ft) long, so this type of

mapping can only be done in shallow water with good visibility. The camera mount using the reel system is shown below.



After filming, the videotapes were analyzed using the software for the VMS 200. To begin the analysis, the hardware was connected as shown below.



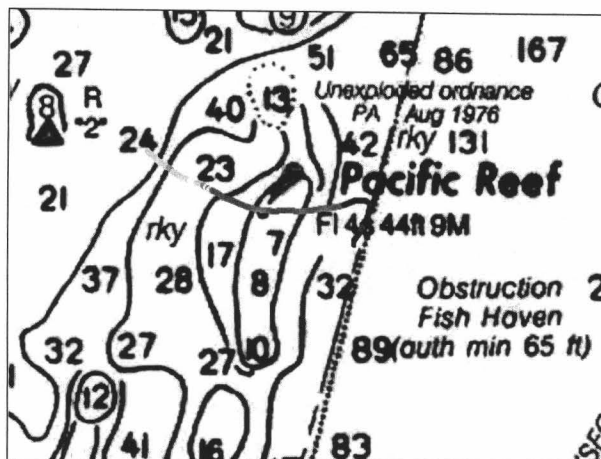
A LanC cable was connected from the camera to the VMS 200; this allows the computer to control the video camera. A video cable was connected from the video output on the camera to the capture card; this allows the computer to capture and save the

images stored on the videotape. Another cable was connected from the audio output on the video camera to the audio input on the VMS 200; this transfers the GPS information stored on the tapes to the VMS 200. The VMS 200 is connected to the serial port on the computer; this transfers the GPS data to the computer. Georeferenced images are selected (as shown below) and mapped.



Underwater video mapping surveys were conducted in Biscayne National Park in January of 2001. The purpose of the surveys was to conduct benthic habitat mapping. An example of a transect is shown below.

Biscayne National Park Transect Over Pacific Reef Overlayed on NOAA Chart



Map created October 7, 2001
by Sarah Legoza

Universal Transverse Mercator

Data collected in Biscayne National Park
January 10th -13th 2001 by Dr. Paul Ayers,
Sarah Legoza, Liv Haugen and Galen Rhodes.

0 0.4 0.8 1.2 Kilometers

Legend

Transect

- Sand
- Dense seagrass
- Sparse seagrass
- Reef with rock patches
- Spur and groove
- Bottom unknown

During the surveys, evidence of tourism and boating impacts (propeller scarring, broken coral, anchor scrapes, lobster traps, discarded ropes, etc.) was obvious. Using the VMS software black band disease was identified and located.

Biscayne National Park Underwater Surveys

Underwater surveys will be conducted in the areas of the 2001 surveys. Parallel swathing and transects over Pacific Reef will be conducted using the similar procedures. This will provide 210,000 m² of visual footage to be compared to the 2001 condition.

Based on discussion with National Park Service personnel, areas subjected to boat and other public damage will be surveyed. Possible reef areas to be monitored and mapped include: Fowy Rocks, Brewster Reef, Ledbury Reef, Star Reef, Triumph Reef, Long Reef, Ajax Reef, Pacific Reef, Anniversary Reef, Elkhorn Reef, Rocky Reef and Ball Buoy Reef

Areas with mooring buoys to be mapped include the following sites:

Name / No. of Buoys	Depth (ft)	Latitude	Longitude	Remarks
Anniversary / 2	8 – 12	25 23.331 N	80 09.859 W	Thick finger Coral

Bache Shoal / 5 coral, brain coral	5 – 15	25 29.150 N	80 09.939 W	Head corals: boulder
Ball Buoy / 5	8 – 18	25 19.097 N	80 11.059 W	Elkhorn
Elkhorn / 2 Coral	6 – 13	25 21.789 N	80 09.948 W	Elkhorn, thick finger
Lugano / 3	20 – 30	25 26.668 N	80 07.184 W	Wreck debris
Pacific / 1	17	25 22.216 N	80 08.342 W	Hard bottom
Rocky / 3	20 – 24	25 20.049 N	80 09.641 W	U-shaped patch reef
Schooner / 2 pile)	6 – 12	25 24.000 N	80 09.700 W	Wreck debris (ballast
Shark / 2	10 – 20	25 20.360 N	80 09.950 W	
The Drop / 2 sponges, mini wall	45 – 80	25 21.955 N	80 08.252 W	Spur & groove,
Triumph / 1	20	25 28.325 N	80 06.715 W	Hard bottom

Areas of previous boat groundings and restoration sites determined by National Park Service personnel will also be mapped. A request to extend the previously approved permit to conduct underwater video mapping surveys in Biscayne National Park will be made for this project.

GIS Coral Health Map Generation

Based on the visual images of the substrate, the substrate classifications, coral distributions, disease levels, the degree and frequency of boating impacts and restoration levels will be determined. A GIS map using ESRI ArcGIS will be generated to provide a spatial description of the impact and survey area. Changes in substrate classification, coral distribution, disease propagation will be developed in the previously surveyed area. Areas of frequent boating impacts will be identified. Coral reef diseases such as Algal Galls, Aspergillosis, Bacterial bleaching, Black band disease, Dark Spots disease, White Plague, White Band Disease, White Pox and Yellow Band disease will be identified and positions recorded. This disease list was taken from the NOAA Coral Health and Monitoring Program (CHAMP). As appropriate, this data will be provided to the CHAMP database.

The level of boating impact around mooring buoys will be determined and compared to impact at sites without mooring buoys. Restoration levels at previous major

boat groundings will be evaluated to determine the effectiveness of restoration techniques (natural and human intervention).



Based on the GIS maps of boater impact areas of high impact will be identified. Pictures of damaged coral reefs will be made available for public awareness efforts at BISC. The underwater video at Fowey Rocks Reef will provide some baseline coral health data that can be used for a long-term coral health monitoring effort utilizing the Sustained Ecological Research related to Management of Florida Keys Seascape (SEAKEYS)

Timeline

9/05 to 12/05 – Prepare equipment and consult with National Park Service personnel regarding survey locations

12/05 to 3/06 – Conduct underwater surveys

3/06 to 6/06 – Analyze underwater videotapes and generate GIS maps

6/06 to 9/06 – Generate evaluations of substrate changes, coral distribution, disease propagation, boating impact locations, mooring buoy effects and restoration technologies, prepare final report

Coordination and Permits

Coordination of the project between the University of Tennessee and Biscayne National Park will be conducted with the Project Contacts (Dr. Paul Ayers and Richard Curry, Science Coordinator, BISC). The results of this project will be disseminated in the Biscayne National Park newsletter, on the Biscayne National Park website, and at appropriate coral reef conservation symposium.

Permits to conduct monitoring surveys in Biscayne National Park have been obtained for previous activities (Permit No. BISC-00-022). Permits to conduct the proposed survey will be requested prior to submission of the final application.

PROJECT BUDGET

Salaries:

Staff Hourly Support - \$22,000 (2200 hours at \$10/hour)

Travel: Domestic travel to Biscayne National Park to conduct underwater video mapping activities and meet with Park personnel (includes transportation, boat rental, lodging and meals)

\$9,000

Equipment: None

Supplies: Supplies include videotapes, computer disks and cartridges, batteries, voltage converters, notepads, camera mounting hardware, electrical components, cables, chargers, weights, etc.

\$6,000

Matching Funds/Services:

Usage of underwater video mapping equipment, GPS receivers, computers, GIS software, printers (provided by the University of Tennessee)

\$15,000

Two months of project officer salary and fringe benefits (provided by the University of Tennessee)

\$18,000

Overhead/Indirect Costs: Indirect costs associated with direct costs and contributed goods/services at standard 30.5% (provided by the University of Tennessee)

Budget Summary

Budget Category	Total per category	Funds Requested	Matching Funds
Salary	\$40,000	\$22,000	\$18,000
Travel	9,000	9,000	
Supplies	6,000	6,000	
Equip Contrib	15,000		15,000
Indirect Costs	21,350		21,350

TOTALS

Expenses: \$91,350

Funds Requested: \$37,000

Matching Funds: \$54,350

Qualifications

PAUL D. AYERS

Professor

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EDUCATION

Ph.D. Department of Biological and Agricultural Engineering, North Carolina State University, Raleigh, North Carolina, 1984.

M.S. Agricultural Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1980.

B.S. Agricultural Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1978.

PROFESSIONAL EXPERIENCE

1/02- Professor, University of Tennessee, Knoxville, Tennessee

7/95-- 1/02 Professor, Bioresource Engineering, Colorado State University, Fort Collins, Colorado

7/90-7/95 Associate Professor, Bioresource Engineering, Colorado State University, Fort Collins, Colorado

8/84-7/90 Assistant Professor, Bioresource Engineering, Colorado State University, Fort Collins, Colorado

TEACHING ACTIVITIES (University Courses Taught)

Advanced Engineering using GIS and GPS
Global Positioning Systems, Principles and Applications
Agricultural and Environmental Measurements
Introduction to Engineering Design
Engineering Design

PROFESSIONAL AFFILIATIONS

Professional Engineer (1986-2004)

RELATED PAPERS/POSTERS

Legoza, S. M. and P. D. Ayers. 2004. Applications of the Underwater Video Mapping System (UVMS) for Coral Reef Ecosystem Mapping. Submitted to Coral Reefs.

Fiscor, A., and P. Ayers. 2004. Mussel Habitat Mapping in the Big South Fork National River and Recreation Area (BISO). Presented at the 15th Annual SAMAB Conference, Gatlinburg, TN.

Fiscor, A., T. Cheung and P. Ayers. 2003. Underwater video mapping system and distribution of habitat for the Hiwassee River. Poster presented at the 2003 National Park Service Spatial Odyssey Conference, Orlando, FL.

Ayers, P., J. Conger, A. Fiscor and K. Christian. 2003. Natural resource inventory at National Parks with video mapping. Poster presented at the 2003 National Park Service Spatial Odyssey Conference, Orlando, FL.

Fiscor, A., P. Ayers and T. Cheung. 2003. GPS-based mapping of natural resources using georeferenced video. Presented at the 14th Annual SAMAB Conference, Asheville, NC.

Legoza, S. M. and P. D. Ayers. 2002. GPS-based Underwater Video Mapping System of Coral Reef Ecosystems in Moloka'i. Summary report submitted to USGS Pacific Science Center.

Ayers, P.D., S.M. Legoza, M.P. Peel, M.E. Field, S.A. Cochran and B.L. Lanzendorf. 2002. Underwater Video Mapping System (UVMS) for coral reef ecosystem mapping and species distribution analysis. Proceedings of the Seventh International Conference on Remote Sensing for Marine and Coastal Environments, Miami, FL.

Ayers, P. D., J. Liu, L. Haugen and S. Legoza. 2000. Mapping natural resources using georeferenced video. Proceedings of the First Annual VMS 200 User's Conference: Beyond the GIS Horizon, Trends in Multimedia Mapping, Estes Park, Colorado.

Ayers, P. D. L. Haugen, L. M. Vance and A. Anderson. 2000. Using GPS for vehicle tracking and dynamic property monitoring. ASAE Paper No. 00-1071. ASAE, St. Joseph MI 49085

Haugen, L., P. D. Ayers, M. Vance, and A. Anderson. 2000. Using GPS for off-road vehicle tracking and environmental impacts. Presented at the 8th European Conference of ISTVS. Umea, Sweden.

Ayers, P. D. and S. Legoza. 2000. DGPS-based underwater mapping for monitoring and managing coastal ecosystems. Proceedings of the Sixth International Conference on Remote Sensing for Marine and Coastal Environments, Charleston, SC.

Ayers, P.D., J. Liu, J. Hocheder, L. Haugen and S. Legoza. 2000. GPS-based video mapping for natural resource management. Proceeding of the Second International Conference on Geospatial Information in Agriculture and Forestry, Lake Buena Vista, FL.

Ayers, P. D. and S. Legoza. 1999. GPS-based underwater video mapping and application for coral reef management. Proceeding of the 1999 South Pacific Applied Geoscience Commission Meeting, Nadi, Fiji.

Ayers, P. D. 1994. Using GPS for productivity and environmental monitoring of off-road vehicles. Proceedings of the 4th International GPS/GIS Conference, Washington D.C.

Ayers, P. D. 1994. Teaching GPS in the University curriculum. Proceedings of the 4th International GPS/GIS Conference, Washington D.C.



Paul Ayers
<ayers@utk.edu>

12/08/2004 03:19 PM
EST

To: Richard Curry <BISC_Science@nps.gov>
cc:
Subject: Re: NOAA preposal

Richard,

I noticed in the first draft I sent you earlier Shay had made some commitment to initiate restoration activities in areas identified. Attached is the revised proposal. I have taken that part out of the proposal and added your name as Science coordinator. Hope you don't feel I am overstepping my bounds. If you do not want to be involved in the project let me know and I will withdraw.

Paul

Paul Ayers wrote:

> Richard,
>
> To follow up on my voice mail, I am looking to send in a pre-proposal
> to NOAA Coral Reef Conservation RFP.
>
> I revised a proposal (Boat and Mooring buoy impacts) developed with
> Shay Viehman. This is just a pre-proposal so changes can be made for
> the final proposal.
>
> If you get a chance, look it over and see if you feel it is a
> worthwhile effort. I combined Shay's proposal with one I put together
> with Brenda Lanzendorf (PMIS 58002). Any word on that?
>
> So if you have input, great. There is no request for matching from
> your agency on this one. I can provide the matching.
>
> If it is approved for full submission in March we can work out the
> details.
>
> Hope BNP is still interested in this work.
>
> Paul
>

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