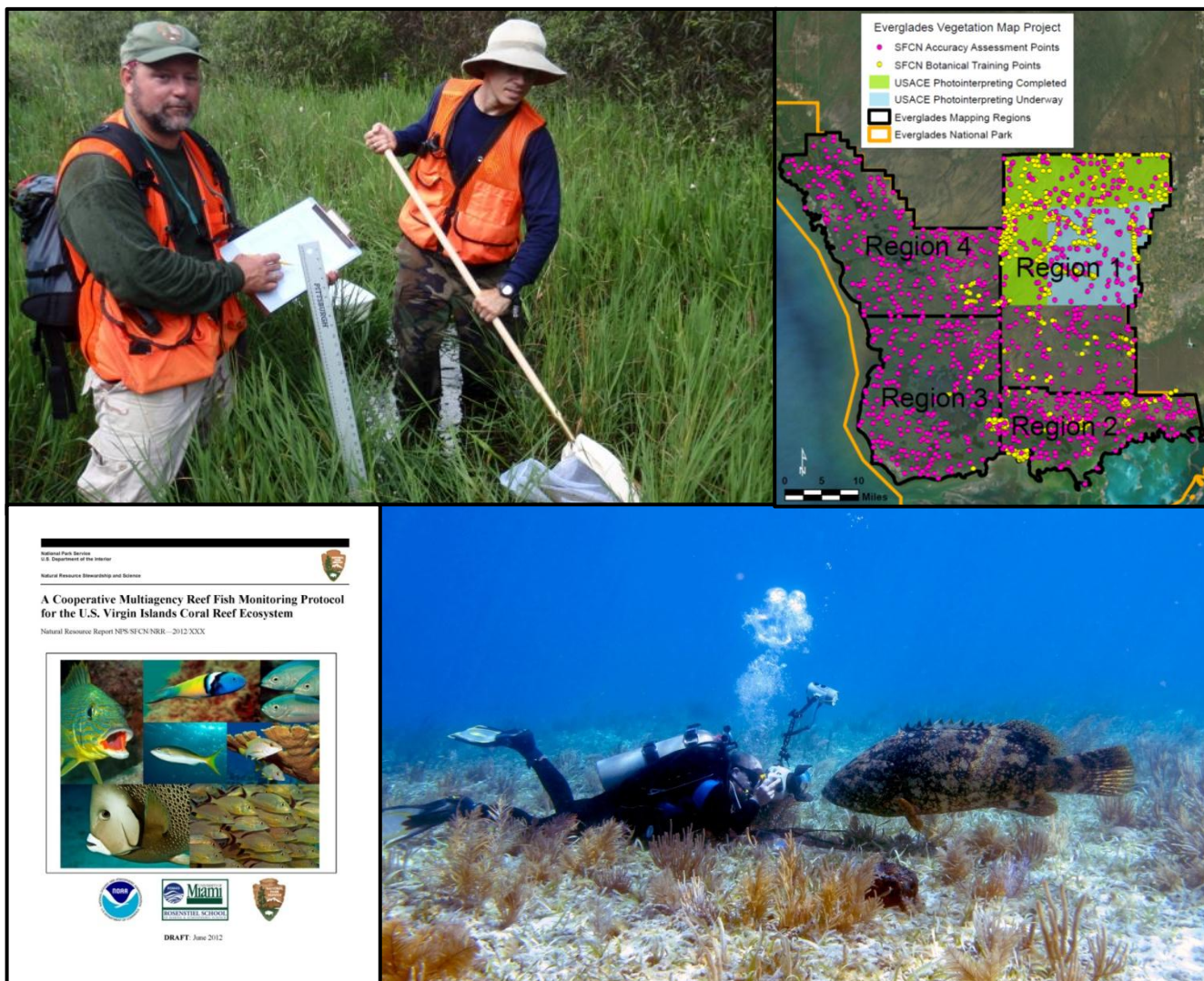




Annual Administrative Report (FY 2012) and Work Plan (FY 2013) for Inventories and Vital Signs Monitoring

South Florida / Caribbean Network

Natural Resource Report NPS/SFCN/NRR—2013/702



ON THE COVER

Clockwise from top left: SFCN community ecologist Kevin Whelan and biological technician Raul Urgelles sample for aquatic invertebrates in East Hinson Marsh, Big Cypress National Preserve (BICY). Map of field and accuracy assessment points supplied by SFCN to USACE for EVER vegetation map project. Front cover of soon to be published reef fish monitoring protocol for the U.S. Virgin Islands. SFCN biological technician Rob Waara face-to-face with a curious Goliath Grouper during a reef fish monitoring survey in Dry Tortugas National Park (photo credit: Tara Dolan, NOAA).

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National Park Service South Florida / Caribbean Network

18001 Old Cutler Rd.
Suite 419
Palmetto Bay, FL 33157

August 2013

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate high-priority, current natural resource management information with managerial application. The series targets a general, diverse audience, and may contain NPS policy considerations or address sensitive issues of management applicability.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

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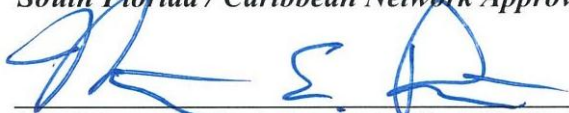
ANNUAL ADMINISTRATIVE REPORT (FY 2012) AND WORK PLAN (FY 2013) FOR INVENTORIES AND VITAL SIGNS MONITORING

FY 2012-FY 2013

South Florida / Caribbean Network

Includes: Biscayne National Park, Big Cypress National Preserve, Buck Island Reef National Monument, Dry Tortugas National Park, Everglades National Park, Salt River Bay National Historical Park and Ecological Preserve, and Virgin Islands National Park.

South Florida / Caribbean Network Approval Signatures



Matt Patterson, Network Coordinator, South Florida / Caribbean Network

11/16/12

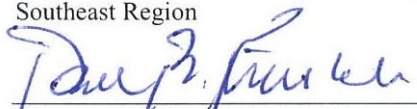
Date



Lisa Garrett, Inventory and Monitoring Branch Chief
Southeast Region

11/16/12

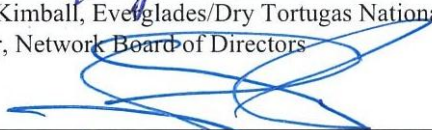
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Date



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11/16/12

Date



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National Historical Site and Ecological Preserve

11/16/12

Date



Acting Superintendent, Virgin Islands National Park / Virgin Islands Coral Reef NM

11/16/12

Date

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Executive Summary

The South Florida/Caribbean Network (SFCN) includes seven national parks with significant natural resources in the southern tip of the state of Florida and the U.S. Virgin Islands of St. Croix and St. John. In FY 2012 the SFCN received \$2,117,355 from the Inventory and Monitoring (I&M) program, the NPS Vegetation Inventory Program (mapping), the NPS Water Resources Division, and from Everglades National Park. Together, these funding sources enabled the SFCN to develop vegetation and benthic habitat maps for several parks, begin development of Natural Resource Condition Assessments for Everglades National Park and Big Cypress National Preserve, and to continue operational monitoring for core vital signs. The SFCN includes Big Cypress National Preserve (BICY), Biscayne National Park (BISC), Buck Island Reef National Monument (BUI), Dry Tortugas National Park (DRTO), Everglades National Park (EVER), Salt River Bay National Historical Park and Ecological Preserve (SARI), and Virgin Islands National Park (VIIS).

SFCN's Vital Signs Monitoring Plan is focused on protocol development and monitoring for the areas that emerged as top priorities in the planning phase of the group's establishment. The network completed its three year startup review in November, 2011. The review panel indicated that the network was indeed on the right track and making satisfactory progress towards vital signs monitoring as planned. Significant efforts were put forward by SFCN on Marine Fish Community monitoring in South Florida and St. Croix, Marine Benthic Community monitoring in all coral reef parks, Colonial Nesting Bird monitoring in South Florida, Coastal Geomorphology monitoring in BISC, Corridors of Invasiveness exotics monitoring in South Florida, Periphyton monitoring in BICY, and Ecotonal Movement monitoring in EVER and BICY. Additional effort has been focused on report development and automation of tasks, as well as continued data management. Considerable effort has taken place to revise our web presence, bringing the site towards compliance with new NPS web content policies. SFCN has successfully expanded our program by hiring a Natural Resource Condition Assessment ecologist and a Marine Research Assistant as well as two Student Conservation Association Interns (SCA's) in FY12. The EVER vegetation map project has completed nearly all of the accuracy assessment field data collection, and nearly 20% of the terrestrial portion of the park has been mapped. Work continues on final reports and DVD bundled data packages for vegetation maps for western BICY, EVER, BISC, and VIIS. All SFCN National Park Service staff completed Operational Leadership training and SFCN Volunteer in Parks (VIPs) logged a total of 3,789.5 hours in FY12.

Sixty nine percent (69% or \$1,456,529) of the FY12 budget was focused on personnel, 10% (\$203,842) on cooperative agreements, 11% (\$226,266) on contracts, 8% (\$165,796) on operations, 2% (\$39,198) on travel, and 1% (\$25,723) on Regional assessments.

The FY13 budget proposes spending \$2,033,955 with the following allocations: 74% (\$1,514,865) on personnel, 5% (\$108,150) on cooperative agreements, 11% (\$227,191) on contracts, 4% (\$88,836) on operations, and 3% (\$54,000) on travel, and 2% (\$42,912) on Regional assessments and loan repayment to Gulf Islands Network (GULN) and Southeast Region Inventory & Monitoring Division office (SER I&M).

Program Accomplishments Summary

Inventories

- Vegetation Maps:
 - SFCN and EVER are collaborating with the U. S. Army Corps of Engineers (USACE) to map Everglades National Park with funding from the Comprehensive Everglades Restoration Plan RECOVER program. SFCN is assisting with field identification of training points and conducting a field accuracy assessment. This year 319 training points and 464 accuracy assessment points were collected bringing the totals to 941 and 988 points respectively. Four week-long botanical training sessions were conducted with the USACE/NPS interagency team. USACE photointerpreters have completed photointerpretation and QA/QC of Region 1 Section 1; photointerpretation of Region 1 Section 2; 74% of photointerpretation of Region 1 Section 3; and 15% of photointerpretation of Region 1 Section 4.
 - The Biscayne National Park vegetation map final project report draft has been completed and all product deliverables are being assembled onto a DVD for final review in FY13.
 - The Virgin Islands National Park (VIIS) vegetation map has been completed. The draft project report and all product deliverables will be finalized and assembled onto a DVD and submitted for review in FY13.
- Benthic Habitat Maps:
 - A revision of the benthic habitat map for offshore Biscayne National Park (BISC) was completed. The associated report will be submitted for publication in FY13.
 - An accuracy evaluation is in progress for the inshore benthic habitat map for BISC. This map will be merged with the revised offshore map and BISC terrestrial map to produce a comprehensive map of BISC natural resources.
- The small and medium sized mammal inventory for Big Cypress National Preserve (BICY) and Everglades National Park (EVER) report, photos, and database are being bundled onto a DVD for final delivery to the parks.
- The bat inventory database has been cleaned up and a final report with maps is in progress.
- The Biscayne BioBlitz 2010 report is under revision from comments and additional species received from participating scientists.

Vital Signs Monitoring

- Marine Benthic Communities:
 - “Eight years of coral reef community monitoring: results from inside and outside the Research Natural Area at Dry Tortugas National Park, and a new benthic map” (Miller et al. 2012) was published in *Implementing the Dry Tortugas National Park RNA Science Plan: The 5-year Report*. This report presents results on interdisciplinary studies focused on the performance efficacy of the no-take RNA.
 - SFCN conducted marine benthic community (coral) monitoring in BISC, DRTO, VIIS, and BUIS and SARI.

- A new marine benthic community monitoring index site was installed in SARI. The marine benthic community extensive site plan was modified in DRTO, with two new index sites installed.
- Marine Fish Communities:
 - In a new larger-scale, multi-agency monitoring effort, SFCN conducted marine fish community monitoring in SARI, BUIS, and the St. Croix shelf in partnership with BUIS park staff, NOAA Southeast Fisheries Science Center (NOAA-SEFSC), University of Miami, NOAA Biogeography Branch (NOAA-BB), University of the Virgin Islands, The Nature Conservancy and the VI Department of Planning and Natural Resources. This represented the first island-wide reef fish survey using the revised sampling design detailed in *The Cooperative Multiagency Reef Fish Monitoring Protocol for the U.S. Virgin Islands Coral Reef Ecosystem* (Bryan et al., *in review*) The protocol has completed the external peer review process.
 - SFCN conducted marine fish monitoring in BISC and DRTO in partnership with BISC National Park staff, NOAA-SEFSC, University of Miami, and the Florida Fish and Wildlife Conservation Commission.
 - Fish monitoring at VIIS index sites was conducted for the 25th consecutive year with collaboration of the University of Hawaii, Hilo.
- Colonial Nesting Birds:
 - SFCN completed its fourth year of data collection to support the development of the monitoring protocol for colonial nesting birds (Great White Heron, Great Egret, and Double-crested Cormorant) in BISC. The protocol and Standard Operating Procedures (SOPs) are mostly complete and a database has been developed.
 - SFCN created SOPs for existing monitoring of colonial nesting birds at BUIS, VIIS, and EVER based upon interviews with park staff and existing documents. Clearly documenting these methods will assist with reporting results across the network. These SOPs have been reviewed by appropriate park staff and are complete.
 - In FY12, one monitoring flight was performed in BICY during which no nesting activity was observed.
- Forest Ecotones and Community Structure, Mangrove-Marsh Ecotone:
 - The Forest Monitoring Protocol is nearly complete but the SFCN post-doc assigned to write the protocol has left for a new job so the final completion has been delayed.
 - SFCN established a 3rd mangrove-marsh ecotone monitoring area in EVER south of the Spreader Canal project in Eastern Taylor Slough
 - Three forest monitoring plots were established in SARI using a restricted stratified random sampling design.
 - Two mangrove forest monitoring plots were established and sampled on Long Key in DRTO.
 - SFCN and Florida International University (FIU) collaborated to locate and re-establish the 12 Hurricane Andrew Recovery Team (HART) vegetation plots in

southern Everglades. This should allow assessment of change 20 years after this severe disturbance event.

- In BISC, all four legacy forest plots on northern Old Rhodes Key were sampled.

Coastal Geomorphology:

- A Soil Elevation Table (SET) monitoring site was established in SARI this year.
- The two sites at BISC were sampled.
- SFCN collaborated with Dr. Marguerite Toscano (Smithsonian Institution) to sample peat cores in BISC.
- SFCN has developed a draft protocol building upon three other protocols: “Monitoring Salt Marsh Elevation: A Protocol for the Coastal Ecosystem Monitoring Program at Cape Cod National Seashore”; the “Standard Operating Procedure for the Louisiana Department of Natural Resources Coastal Restoration Division”; and the draft Northern Coastal Barriers Network protocol “Protocols for Measuring and Understanding Wetland Elevation Change.”
- Invasive/Exotic Plants:
 - SFCN has incorporated edits from external peer reviewers on the SFCN Early Detection Protocol for Invasive Exotic Plants and added in suggested analysis. The protocol will shortly be submitted to the Regional Coordinator. The protocol was implemented in eastern EVER and two new exotic species were identified: Anil de Pasto (*Indigofera suffruticosa*), and Indian laurel (*Ficus microcarpa*).
 - On June 1, 2012, SFCN discovered the presence of an invasive seagrass, *Halophila stipulacea*, at Mennebeck Reef in VIIS. This information was passed along to the Chief of Resource Management for VIIS, Rafe Boulon.
 - SFCN revisited SARI invasive/exotic plant removal efficacy plots. In the future, these plots may be monitored in collaboration with the University of the Virgin Islands.
- Invasive / Exotic Animals:
 - The SFCN conducted a daytime/nighttime electrofishing study in canals along the periphery of Everglades National Park (EVER) to determine optimal sampling time. Overall, the number of fish collected and number of species was greater for night electrofishing.
 - SFCN continued collaborating with Dr. Jennifer Rehage of Florida International University (FIU) by assisting with field support for her extensive canal sampling project to investigate how man-made canals function as habitat for both native and non-native fishes. The results of this 3 year study are assisting the design of the non-native fish in canals monitoring protocol.
- Periphyton: SFCN conducted a fourth round of pilot study sampling in Big Cypress National Preserve to better understand spatial and temporal variability in diatom communities. Results are showing differences in diatom community structure between nutrient impacted and unimpacted basins but also are showing considerable year to year temporal variability.

- Aquatic Invertebrates in Wet Praires and Marshes: The SFCN conducted a pilot study assessing the use of a U.S. Fish and Wildlife Service (USFWS) protocol “Procedure for the Collection of Field Identifiable Freshwater Wetland Macroinvertebrates Using a Time-Limited Qualitative Dip-Net Method.” Results indicate that this rapid assessment method is within the technical skills of SFCN staff for invertebrate identification.
- Butterflies: The South Florida / Caribbean Network (SFCN) worked with the Florida/Caribbean Exotic Plant Management Team and Biscayne National Park on a Schaus Swallowtail Butterfly (*Heraclides aristodemus pnoceanus*) habitat enhancement project in Biscayne National Park (U.S. Fish and Wildlife Service Coastal Program Grant). SFCN enlisted the help of numerous volunteers to help plant 2,332 seedlings – mostly torchwood, *Amyris elemifera*, the larval host plant of the critically endangered Schaus Swallowtail Butterfly.
- Land use change: SFCN acquired 2010 NPScape data (land use, road density, census) and is working jointly with the Natural Resource Condition Assessment ecologist to analyze this data. SFCN also acquired permit data for unincorporated Miami-Dade county and has begun analysis of this data.

Water Quality Monitoring

- Contaminants:
 - SFCN continued the collaboration with Dr. Tim Bargar and David Alvarez of the U.S. Geological Survey (USGS) to assess levels of Emerging Pollutants of Concern (EPOCs) in near shore waters of Biscayne Bay. SFCN assisted with 3 sampling events in October and December 2011 and April 2012. During these events SFCN samples sediment in the Fall and fish in the Spring.
 - SFCN obtained preliminary results for EPOC and contaminants sampling events following the Deep Water Horizon offshore well explosion and subsequent oil spill.
- The Coral Reef Water Temperature Protocol is receiving external peer-review process and recommendations will be addressed prior to submittal for publication in FY13.
- Nutrient Dynamics and Water Chemistry: Dr. Darrell Herbert, Water Quality post-doc, was hired to work with SFCN on the Nutrient Dynamics and Water Chemistry vital signs via a cooperative agreement with Jim Fourqurean at Florida International University.

FY2012 SFCN Field Work Maps

Most of SFCN’s vital sign protocols and reporting strategies with partners are still in development. The following series of maps (Figures 1-7) show work accomplished in each park this year by SFCN or SFCN with partners (i.e., reef fish monitoring, invasive/exotic animals and invasive/exotic plants, were collaborative efforts between SFCN and partner agencies and park staff).

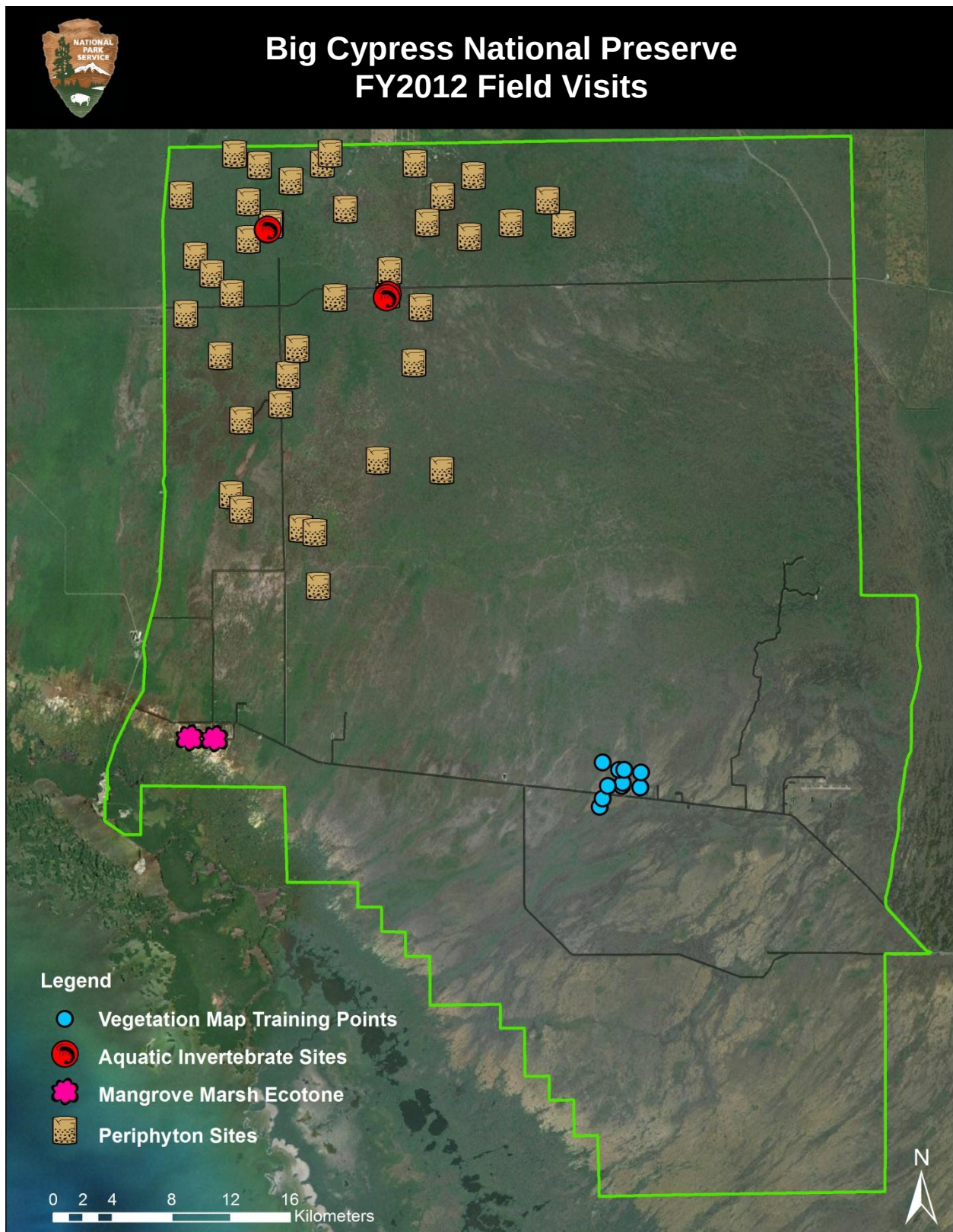


Figure 1. Field visits in FY2012 by SFCN to Big Cypress National Preserve.

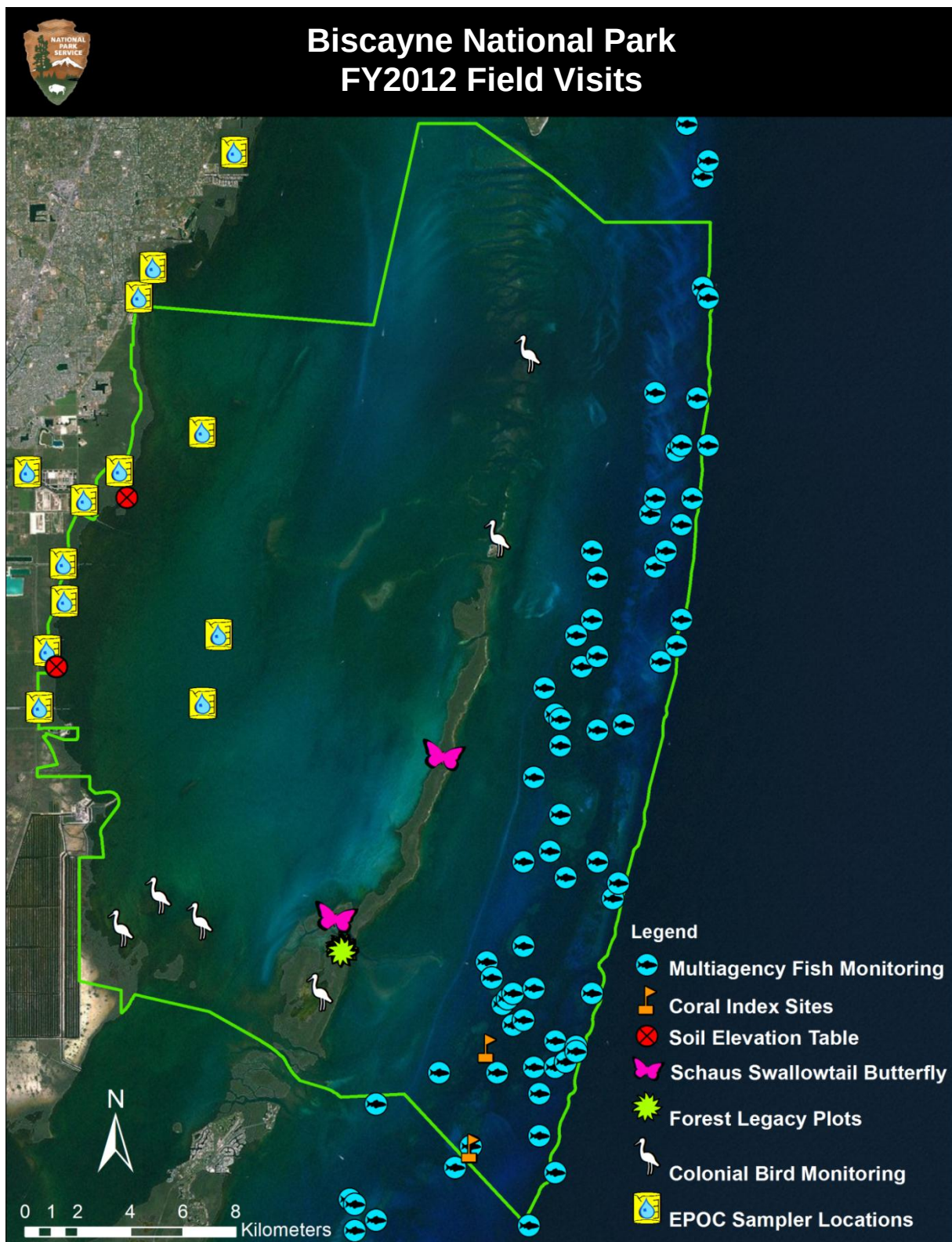


Figure 2. Field visits by SFCN and partners in FY2012 to Biscayne National Park. Fish monitoring sites are part of a Florida Keys multiagency monitoring effort and included many sites monitored by SFCN and BISC staff.

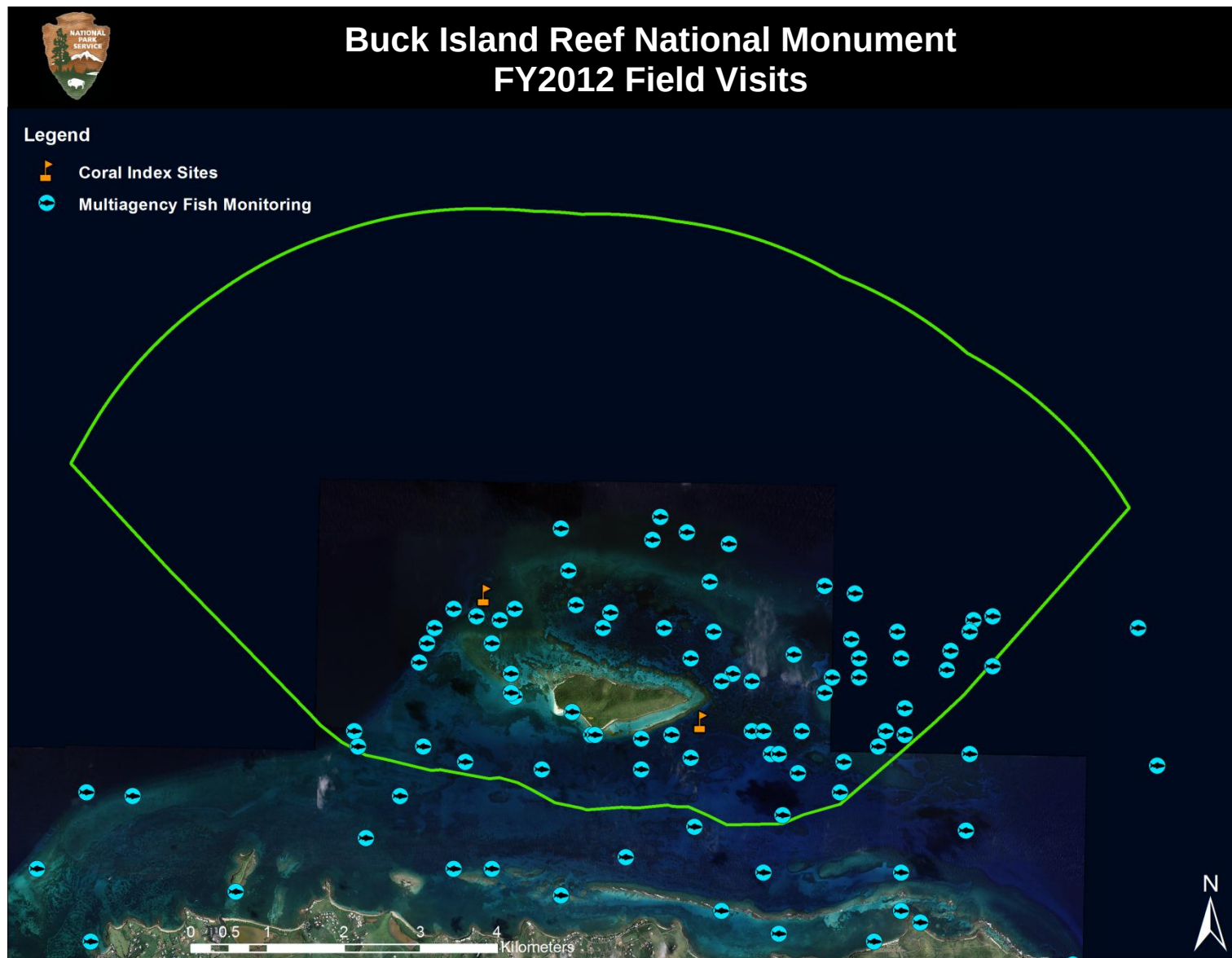


Figure 3. Field visits in FY2012 by SFCN and partners to Buck Island Reef National Monument. Fish monitoring sites are part of a St. Croix-wide multiagency reef fish monitoring effort that included SFCN and BUIS park staff.

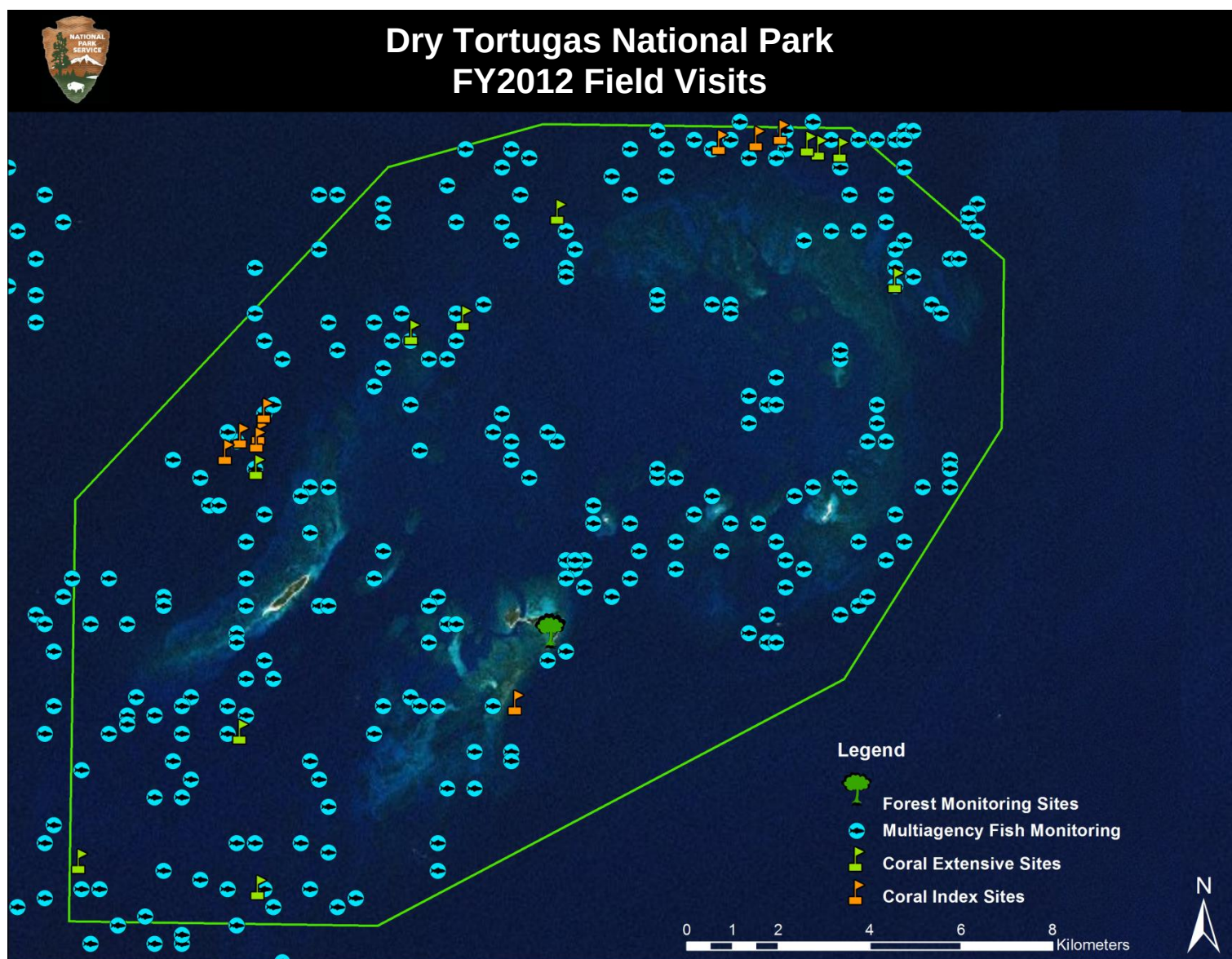


Figure 4. Field visits in FY2012 by SFCN and partners to Dry Tortugas National Park. Fish monitoring sites are part of a Dry Tortugas regional multiagency reef fish monitoring effort that included SFCN staff.

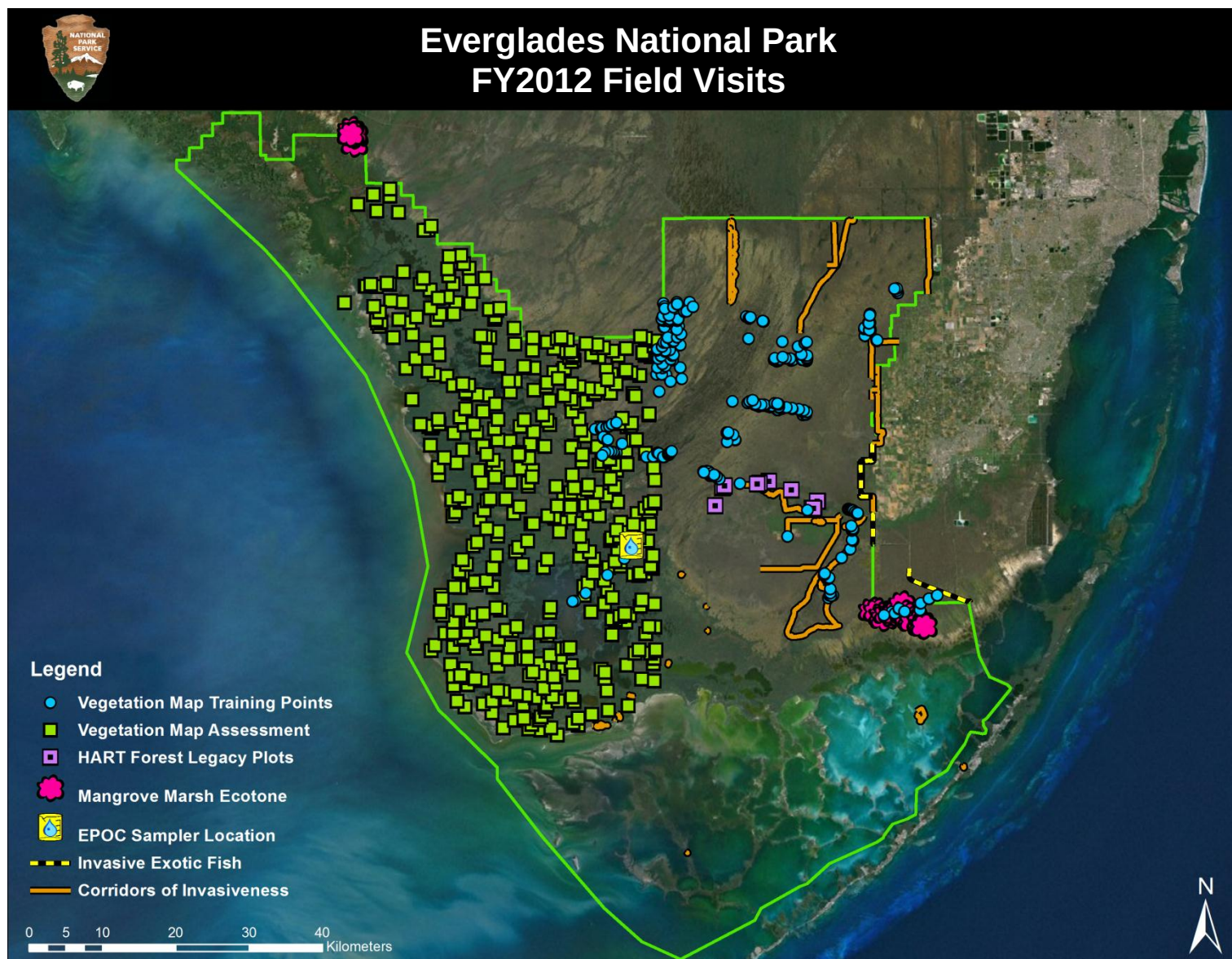


Figure 5. Field visits by SFCN and partners in FY2012 to Everglades National Park. All are joint efforts with partners or partner-funded with the exception of the Mangrove-Marsh Ecotone sites.

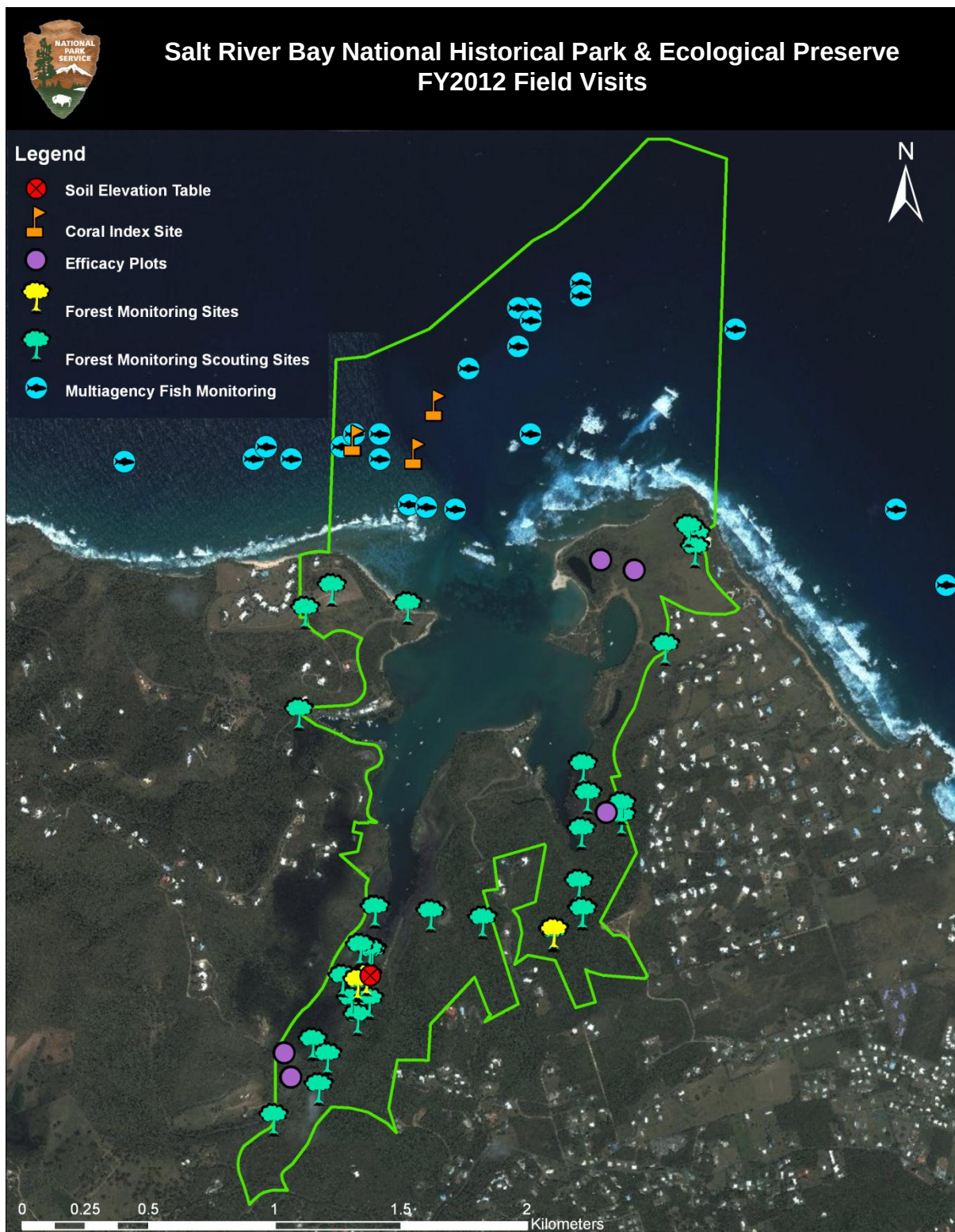


Figure 6. Field visits by SFCN and partners in FY2012 to Salt River Bay National Historical Park and Ecological Preserve. Fish monitoring sites are part of a St. Croix-wide multiagency reef fish monitoring effort that included SFCN and BUIS/SARI staff. BUIS/SARI staff also assisted with terrestrial field work.

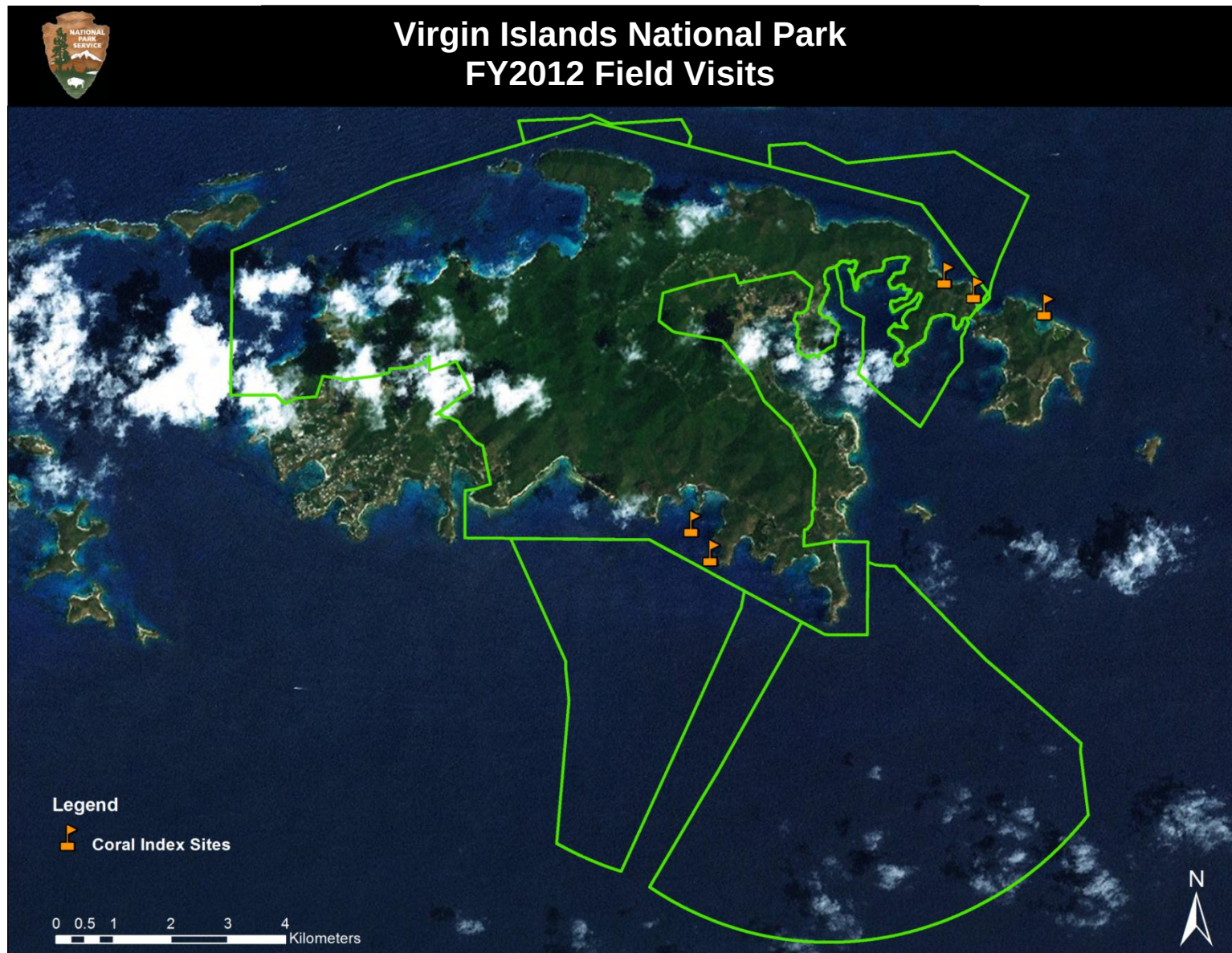


Figure 7. SFCN field visits in FY2012 to Virgin Islands National Park.

Acronyms

AA	Accuracy Assessment
AM	Amanda's Reef (BISC)
BB	Ball Buoy Reef (BISC)
BICY	Big Cypress National Preserve
BISC	Biscayne National Park
BK	Bird Key Reef (DRTO)
BUIS	Buck Island Reef national Monument
C	Carbon
CERP/MAP	Comprehensive Everglades Restoration Plan Monitoring and Assessment Plan
CERP/RECOVER	Comprehensive Everglades Restoration Plan Restoration Coordination & Verification Program
CESI	Critical Ecosystem Studies Initiative
CRCP	NOAA Coral Conservation Research Program
DEP	Florida Department of Environmental Protection
DERM	Florida Department of Environmental Resource Management
DPNR	Virgin Islands Department of Planning and Natural Resources
DRTO	Dry Tortugas National Park
EEMP	East End Marine Park (St. Croix)
EPMT	National Park Service Exotic Plant Management Team
EPOC	Emerging Pollutant of Concern
EVER	Everglades National Park
FCE-LTER	Florida Coastal Everglades Long Term Ecological Research Program
FIA	U.S. Forest Service Forest Inventory and Analysis Program
FIU	Florida International University
FKNMS	Florida Keys National Marine Sanctuary
FWRI	Florida Fish and Wildlife Research Institute
FY	Fiscal Year
GE	Greater Everglades
GIS	Geographic Information System
GMP	General Management Plan
GRTS	Generalized Random Tessellation Stratified
HA	Haulover Reef (VIIS)
HART	Hurricane Andrew Recovery Team
I & M	National Park Service Inventory & Monitoring Program
LH	Loggerhead Reef (DRTO)
LiDAR	Light Detection and Ranging
LTER	Long Term Ecological Research Program in the Florida Coastal Everglades
MB	Mennebeck Reef (VIIS)
N	Nitrogen
NCRMP	NOAA's National Coral Reef Monitoring Program
NF	Newfound Reef (VIIS)
NM	National Monument
NMDS	Non-metric multi-dimensional scaling
NOAA	National Oceanic and Atmospheric Administration

Acronyms (cont.)

NOAA-BB	NOAA Biogeography Branch
NOAA-SEFSC	NOAA Southeast Fisheries Science Center
NP	National Park
NPS	U.S. National Park Service
NRCA	Natural Resource Condition Assessment
P	Phosphorus
PSU	Primary Study Units
QA/QC	Quality Assurance/Quality Control
REMI	Florida International University Resource Management Intern
REU	National Science Foundation Research Experience for Undergraduates
RHA	SFCN Rapid Habitat Assessment
RM	Resource Management
RMSE	Residual Mean Square Error
RNA	Dry Tortugas National Park Research Natural Area
RVC	Reef Fish Visual Census
SARI	Salt River Bay National Historical Park and Ecological Preserve
SCA	Student Conservation Association
SERC	Southeast Environmental Research Center at FIU
SET	Soil Elevation Table
SFCN	South Florida/Caribbean Network
SFERTF	South Florida Ecosystem Restoration Task Force
SFR	South Fore Reef (BUIS)
SFWMD	South Florida Water Management District
SOP	Standard Operating Procedure
SR	SARI reefs
SRS	Shark River Slough
SRV	Submerged rooted vegetation
SV	Santa's Village Reef (DRTO)
TK	Tektite Reef (VIIS)
TNC	The Nature Conservancy
UM	University of Miami
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USVI	U.S. Virgin Islands
UVI	University of the Virgin Islands
VICR	Virgin Islands Coral Reef National Monument
VIIS	Virgin Islands National Park
VIP	Volunteer in the park
WCA	Water Conservation Area
WMA	Water Management Area
WSG	Western Spur & Groove (BUIS)
WY	Water Year
YZ	Yawzi Reef (VIIS)

I. Program Accomplishments

The accomplishments and scheduled activities are under the following four sections:

- I.A Marine Ecology Branch
- I.B Community Ecology Branch
- I.C Data Management, Analysis and Reporting Branch
- I.D Water Quality Monitoring

Each section describes new staff, inventory activities and vital signs monitoring activities that relate to their branch. Water quality accomplishments and scheduled activities are described separately in section I.D.

I.A Marine Ecology Branch



A loggerhead turtle observed during a reef fish visual survey in DRTO (Photo credit: Rob Waara).

Overview

The Marine Ecology Branch made significant progress during FY12 on benthic habitat mapping and “vital sign” resource monitoring in network parks, including expansion of coral community monitoring and reef fish surveys to Salt River Bay National Historical Park and Ecological Reserve (SARI) in St. Croix, VI. In addition, several new staff members joined the division. Dr. Darrell Herbert, a water quality post-doc, was funded to work on the Nutrient Dynamics and Water Quality vital signs via a cooperative agreement with Dr. Jim Fourqurean of Florida International University in February 2012. Mr. Lee Richter renewed his annual Student Conservation Association (SCA) Marine Internship in March 2012. Ms. Elizabeth Witcher (recent Oberlin College graduate, B.A. Geology) joined SFCN as a full-time data management/marine ecology volunteer in August 2012.

The Marine Ecology Branch successfully completed the annual coral monitoring of index sites in South Florida and Caribbean parks. Index sites are specifically selected reefs where randomly placed permanent transects are sampled. There are three index sites in DRTO, two in BISC, five in VIIS, two in BUIS, and one index site in SARI. The Marine Ecology Branch surveyed 15 additional extensive coral monitoring sites throughout DRTO (identified in the DRTO Field

Work Map in the Executive Summary). Reef water temperature data was also downloaded from all monitoring sites in all network parks.

Three new index sites were installed in 2012. In DRTO, two index sites were established while frequency of re-sampling at the Bird Key North site has been reduced. This change allows more sampling to be refocused on the three largest *Montastraea* complex dominated coral reef systems within DRTO. The newly established SARI index site has transects located within the significant spur-and-groove reef system in the west of the park, and on both the east and west walls of the Salt River Canyon. This marks the expansion of the SFCN marine benthic community monitoring program to this park.

The Marine Ecology Branch assisted SFCN partners with survey design and annual reef fish monitoring in DRTO, BUIS, SARI and BISC, including a significant expansion of the survey domain to the entire St. Croix shelf (0-33 m).

SFCN Marine Ecology Branch scientists published four chapters in the *Implementing the Dry Tortugas National Park Research Natural Area Science Plan: The 5-Year Report* and co-authored three peer-reviewed scientific journal articles in 2012 (See Section IV. Reports, Publications, and Presentations). Results from the Tortugas 5-year report were presented at a public meeting of the Florida Fish and Wildlife Conservation Commission in Palm Beach Gardens June 27 – 28, 2012.

The *Cooperative Multiagency Reef Fish Monitoring Protocol for the U.S. Virgin Islands Coral Reef Ecosystem* (Bryan et al., *in review*) completed the external peer review process in FY12. This protocol documents the collaborative interagency (NPS, NOAA's Southeast Fisheries Science Center [NOAA-SEFSC], NOAA's Biogeography Branch [NOAA-BB], University of Miami [UM]) program for the development of a fisheries independent survey design and a reef fish database for the USVI (St. Croix, St. John, St. Thomas). Mike Feeley and Dave Bryan attended the Caribbean Protocol Planning meeting with the Director of NOAA's Coral Conservation Research Program (CRCP) and other agency scientists in Silver Springs, MD in January 2012. Using the revised protocol, the interagency monitoring effort conducted the first St. Croix-wide assessment of reef fish communities in 2012 that is completely independent of fishery harvest data.

A workshop on *Quantitative Methods for Large-Scale Coral Reef Ecosystem Surveys: Statistical Design, Data Management and Analysis* was held at SFCN headquarters April 2012. Lead instructors for the course were Dr. Jerald Ault and Dr. Steven Smith. The goal of the training was to provide an introduction to the quantitative theory of probability based survey sampling design applied to the dynamics of a coral reef ecosystem. The workshop was designed for agency data managers and focused on: survey design principles to support fisheries management, population dynamics and community ecology; development of large-scale monitoring surveys; survey development, data management and estimation of population and community metrics.

Mr. Jeff Miller presented *What two coral bleaching events tell us about reef resilience* at the 12th International Coral Reef Symposium 9-13 July 2012 Cairns, Queensland, Australia. He was also a contributing author on two other presentations given at the meeting, including, *Bioerosion*

of in situ coral colonies: St. John, US Virgin Islands, led and presented by SFCN volunteer, Elizabeth Whitcher.

The SFCN partnered with 78 marine scientists and managers in a regional collaboration to report the status and trends of fish and benthic communities within the Caribbean. Jeff Miller attended a workshop sponsored by the International Union for the Conservation of Nature in April 29-May 5, 2012 in which monitoring design and results were shared and synthesized among the 36 workshop participants, representing 18 countries. The report of this workshop was released in October 2012, titled, *Tropical Americas Coral Reef Resilience, Workshop Final Report*.

Matt Patterson attended a workshop for NOAA's National Coral Reef Monitoring Program (NCRMP) in June 5-6 2012 to discuss the various coral reef monitoring methodologies available to assist NOAA with development of a nationwide monitoring protocol. Participants included NOAA, NPS, USFWS, Florida Atlantic University (FAU), and the U.S. Environmental Protection Agency (EPA).

The SFCN logged 1109 dives working on vital sign projects for network parks, the equivalent of 665 hours or 28 days underwater (Figures 8 & 9).

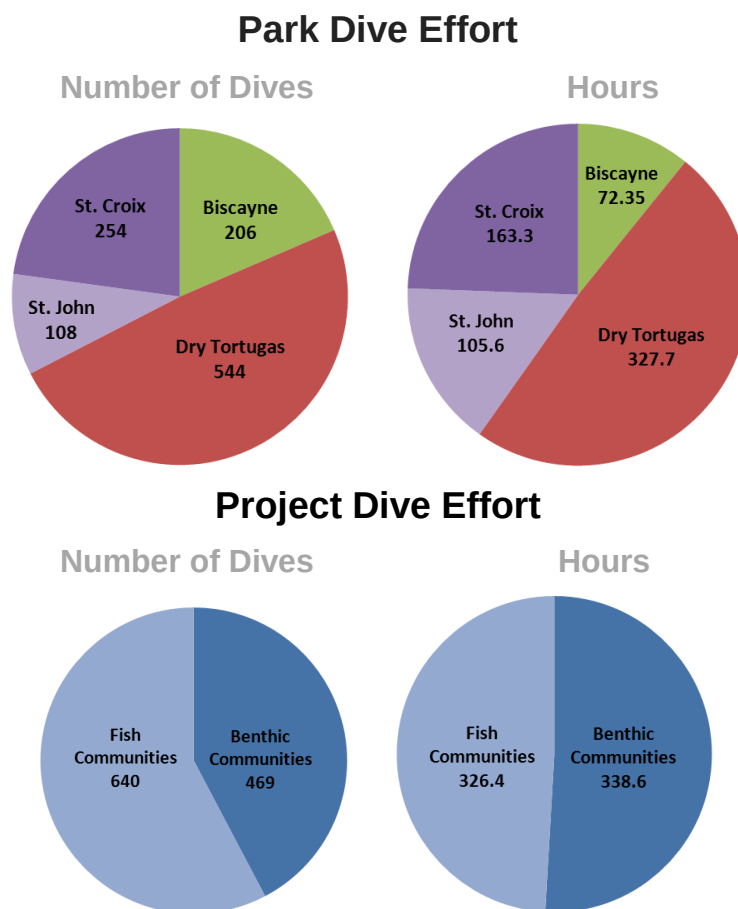


Figure 8. Work effort by the SFCN Marine Ecology Branch in FY12 by park (top) and by projects (bottom) measured in number of dives and total dive hours.

Project	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	
Coral Index - HA	x												VIIS
Coral Index - SFR		x											BUIS
Coral Index - SARI				x									DRTO
Coral Index – NF			x										BISC
Coral Index - WSG				x									VICR
Coral Index – BK						x							SARI
Coral Index – SV						x							
Coral Index – LH						x							
Coral Extensive						x							
Coral Index – BB									x				
Coral Index – AM										x			
Coral Index – YZ									x				
Coral Index – TK										x			
Coral Index – MB											x		
Fish - DRTO						x		x					
Fish – VIIS							x*						
Fish - VICR													
Fish - BISC								x					
Fish - BUIS					x								
Fish - SARI					x								

Figure 9. Timeline of SFCN Marine Ecology field operations completed in FY12. □ indicates a new index coral monitoring site was installed. * =Planned for 2013. HA=Haulover Reef; SFR=South Fore Reef; NF=Newfound Reef; WSG=Western Spur & Groove Reef; BK=Bird Key Reef; SV= Santa's Village Reef; LH=Loggerhead Forest Reef; BB=Ball Buoy Reef; AM=Amanda's Reef; YZ=Yawzi Reef; TK=Tektite Reef; MB=Mennebeck Reef.

New Staff

Darrell Herbert – Water Quality Post-doctoral Research Associate

Dr. Herbert received his Ph.D. in Agriculture and Soil Science in 1995 and his M.Sc. in Botany in 1984, both from University of Hawaii. As a Staff Scientist at the Marine Biological Laboratory, Woods Hole, and currently as a Faculty Research Associate at Florida International University he uses mathematical modeling and empirical approaches to address questions concerning terrestrial and marine ecosystems spanning arctic, temperate, and tropical biomes. His research makes use of statistical and mathematical models and long-term monitoring of biotic and abiotic data to address land and water management goals and decisions. Dr. Herbert is currently developing the SFCN water quality indicators, compiling data and developing models to predict the quality of benthic estuarine and marine habitat on the basis of commonly measured water quality parameters.



Elizabeth Whitcher – Marine Ecology/Data Management Volunteer

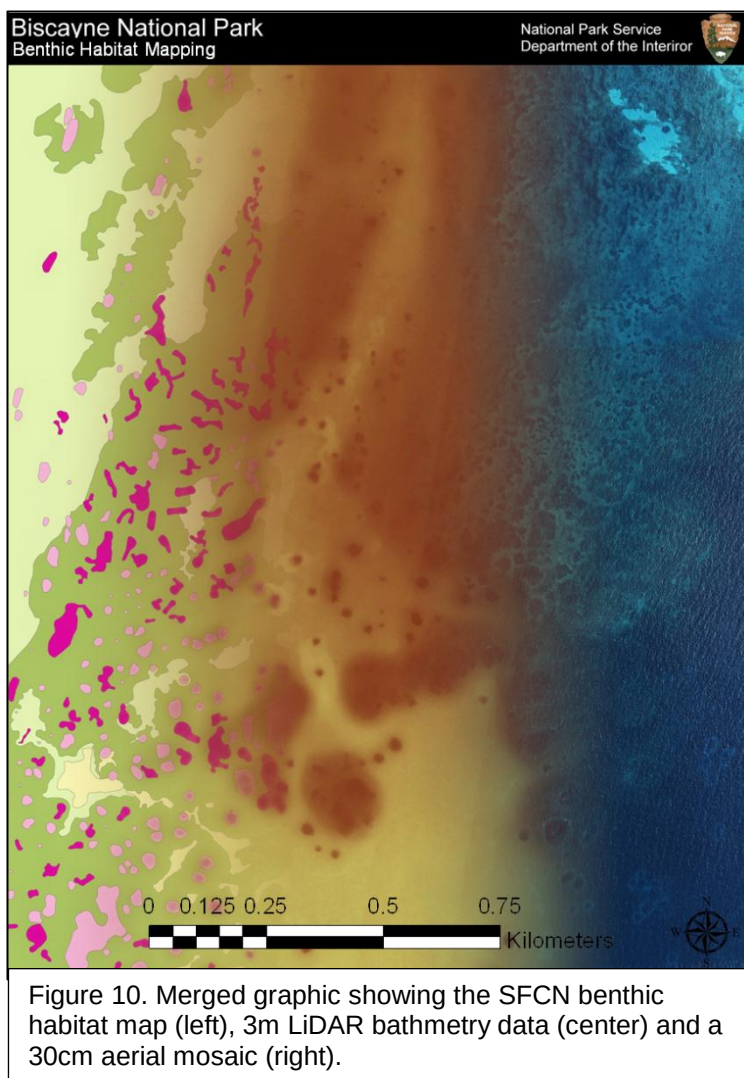
Elizabeth Whitcher began volunteering with the South Florida/Caribbean Network in June 2012, after graduating with a B.A. in Geology from Oberlin College in Oberlin, Ohio. This is her second experience working with the SFCN, following a volunteer position during the summer of 2010. As an undergraduate, Ms. Whitcher participated in field work in the Dominican Republic, China, and most recently in St. John, VI. She has logged 40 hours of underwater data collection using SCUBA. She completed an undergraduate honors thesis on carbonate cycling in St. John reefs, and presented her work at the 12th International Coral Reef Symposium in Cairns, Australia (July 2012). Ms. Whitcher supported various Marine Ecology Branch programs; including data management projects, the Dry Tortugas Benthic Monitoring cruise on the M/V Fort Jefferson (June 2012) and Biscayne Reef Visual Census (RVC) Fish Monitoring (August 2012).



Inventories

Biscayne National Park (BISC) Benthic Habitat Map: Offshore

Project Overview: The SFCN, in partnership with the Florida Fish and Wildlife Research Institute (FWRI), contracted Avineon, Inc. to conduct photo-interpretation of aerial photography (30cm resolution) collected in 2005 for the offshore portion of Biscayne National Park. An initial accuracy assessment of the Avinenon map concluded 33.2% of the accuracy assessment points were an exact match and 80.7% had an acceptable accuracy. Improvements in linework and polygon habitat classifications were made possible by use of the LiDAR bathymetry data (Figure 10) and over 500 field data points collected during the initial accuracy assessment, rapid habitat assessments (RHA), reef fish visual census (RVC), and collection of targeted habitat data at points of interest. Figure 11 displays changes in linework and polygon classifications which took place



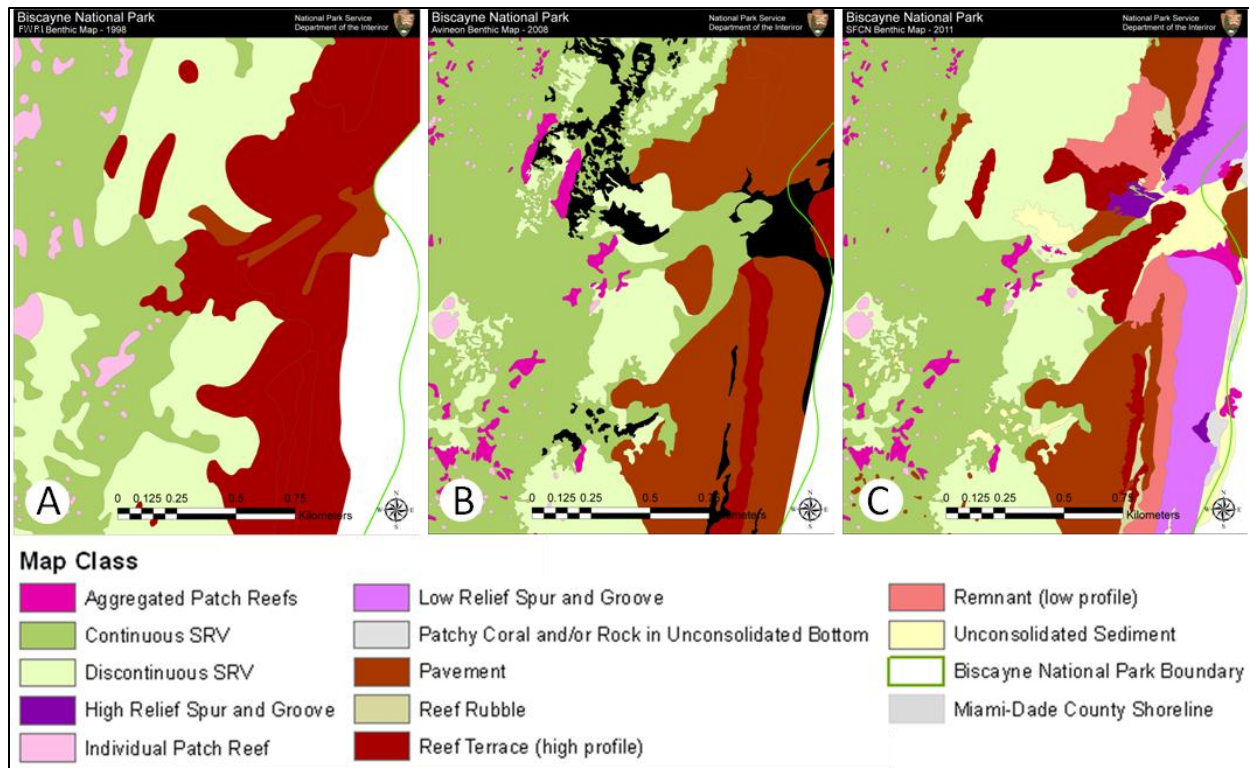


Figure 11. A comparison of A) 1998 FMRI; B) 2008 Avineon Inc. and C) 2011 SFCN benthic habitat maps along the eastern boundary near Pacific Reef.

from the Avineon (B) and SFCN (C) benthic maps. After the first phase of hard bottom revisions, 83 non-random sites were field evaluated to improve characterization of common habitat signatures from remote sensed datasets. The 2011 BISC Habitat Map classification system follows Madley's 2002 "A System for Classification of Habitats in Estuarine and Marine Environments (SCHEME) for Florida". Revisions (1267 modifications) of all hard bottom and soft bottom habitats were completed in 2010 and 2011 respectively. The primary changes from the Avineon map included: a) the addition of low relief spur-and-groove and remnant (low profile) classes; b) the elimination of the unconsolidated unknown map class (the majority was reclassified as unconsolidated sediment) and c) the generalization of the discontinuous SRV (submerged rooted vegetation) class. The Avineon map did not match the SCHEME definition for discontinuous SRV and this has been corrected.

A random accuracy assessment (232 points) was completed on the revised SFCN map in 2011. The 2011 BISC Habitat Map had an exact accuracy of 80.2% and an acceptable accuracy of 94.4%, significantly improving the habitat classifications of the Avineon map. The SFCN map improved the exact identification of individual and aggregated patch reefs along with continuous SRV. Difficulties were most often encountered with the interpretation of pavement, reef rubble, and high relief spur-and-groove habitats. This suggests the use of LiDAR and aerial photography data alone may not adequately define these habitats in BISC and requires confirmation by field data. It also suggests difficulties correctly classifying the difference between high and low relief spur-and-groove areas along the reef tract. Overall, the revised map greatly improved the delineation of the offshore benthic habitats of BISC.

Project Status: The 2011 BISC benthic map is currently complete (Figure 12). Additional offshore benthic mapping products which will be made available in FY13 include: raster data (aerial imagery, Ikonos satellite imagery); LiDAR; geospatial benthic habitat information (benthic graphics, historic benthic habitat files); accuracy assessment files; Arcview shapefiles and the project report.

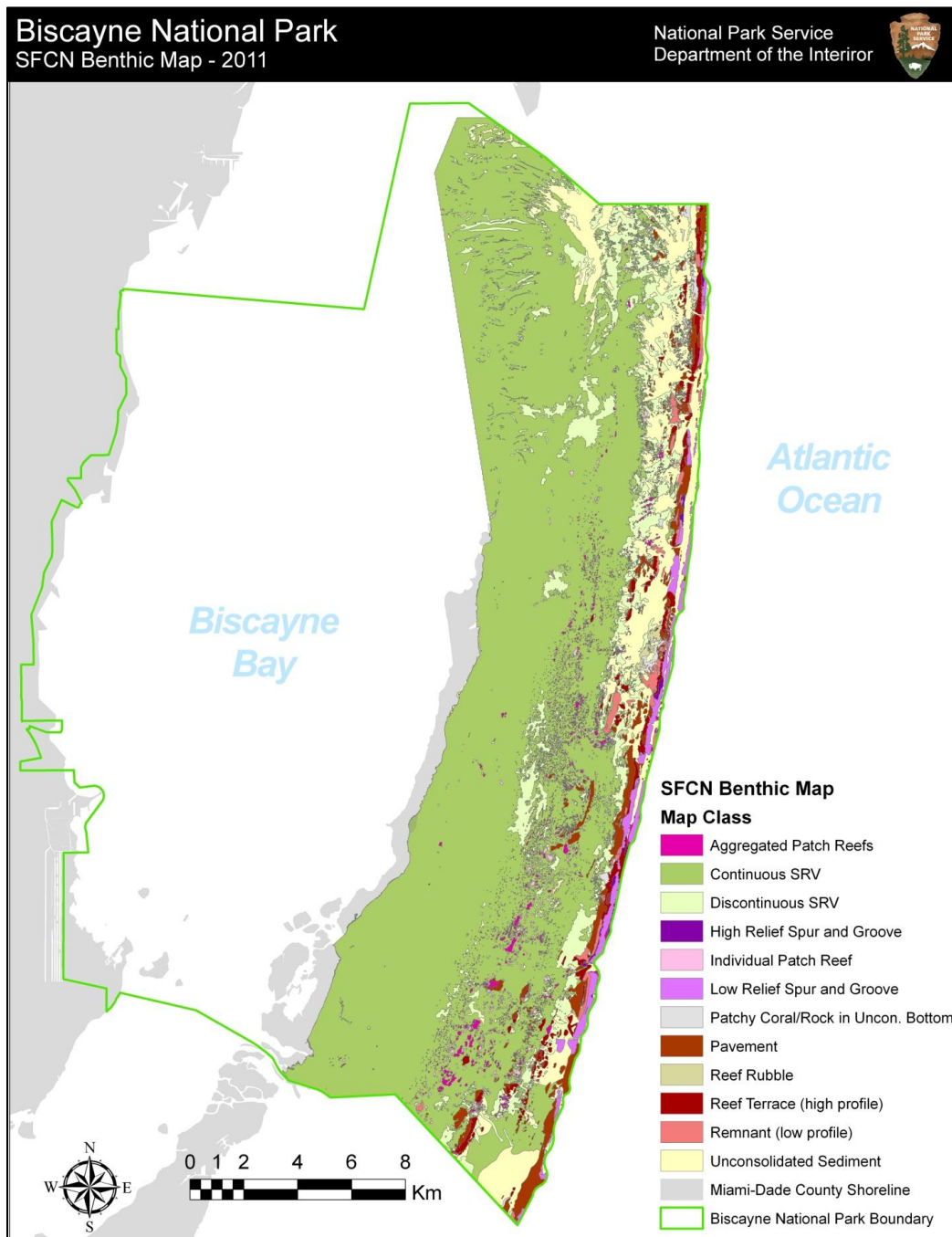


Figure 12. The 2011 SFCN Biscayne National Park offshore benthic habitat map.

Merger of two benthic maps (inshore and offshore) of Biscayne National Park (BISC)

Project Overview: This project will create a single comprehensive benthic habitat map of BISC. An assessment of the benthic habitat map of the inshore portion of Biscayne Bay produced by PhotoScience, Inc. in 2009 will first be completed. The inshore map will then be merged with the offshore map (Estep et al., in prep) to produce a complete map of the marine ecosystems in the park (Figures 13 and 14). A crosswalk technique will be used to merge polygons where different map categories occur using ArcMap. The project will satisfy the requirements of a master's thesis for Andy Davis at Green Mountain College (GMC). Dr. Mike Feeley at SFCN will partner with Dr. John G. Van Hoesen at GMC to serve as Andy Davis' thesis committee. This project will be submitted for publication as a peer-reviewed report under the NPS Natural Resource Technical Report Series format.

Project Status: Dr. Van Hoesen accepted Andy Davis' thesis proposal in September 2012. All field data necessary to evaluate Biscayne Bay habitats was acquired from the University of Miami, the State of Florida, USGS and Miami-Dade County. The acquisition of aerial imagery of the study area is 95% complete. The accuracy evaluation of the Biscayne Bay Habitat Map, the map merger and the thesis will be finalized and submitted to GMC in FY13.

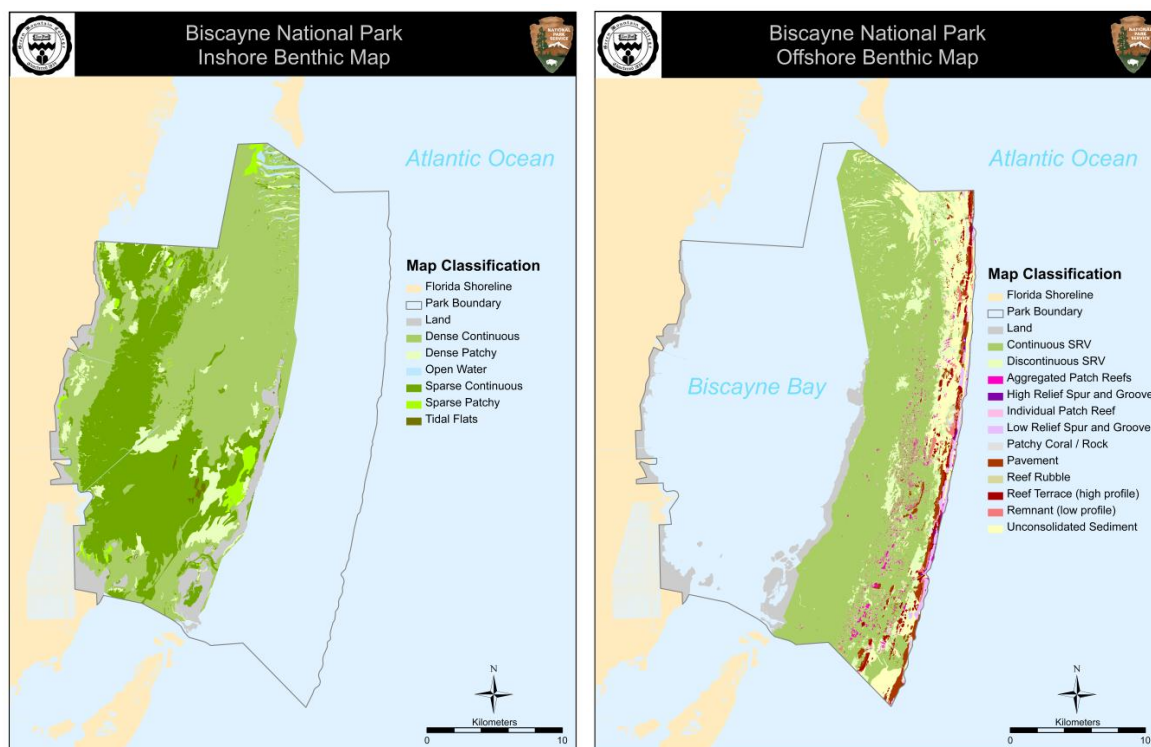


Figure 13. Biscayne National Park offshore and inshore benthic habitat maps.



Figure 14. Enlarged version of the inshore and offshore benthic habitat maps and merge overlap.

Vital Signs Monitoring

Marine Benthic Communities Vital Sign (BISC, BUIS, DRTO, SARI, VIIS)

Coral Reef Monitoring Protocol

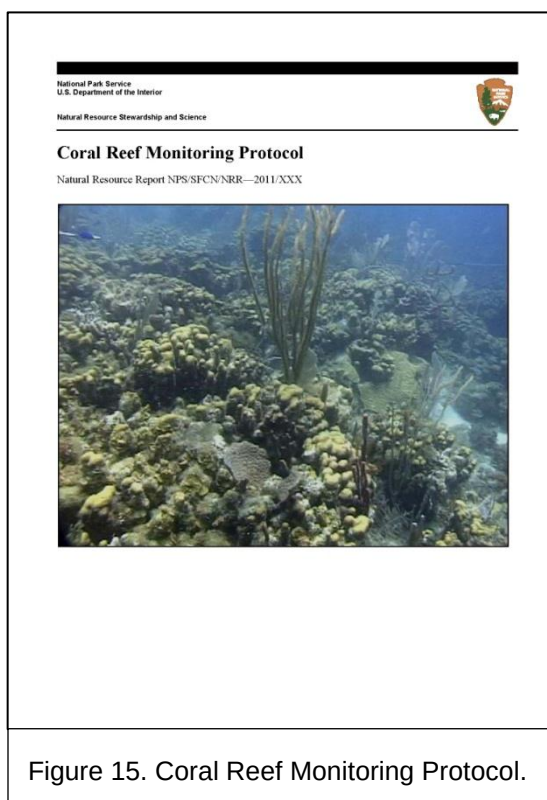
Project overview: The Coral Reef Monitoring Protocol (Figure 15) guides the monitoring of this imperiled community within five national parks of the SFCN: BISC, DRTO, VIIS, SARI and BUIS. Coral reef communities within the SFCN are among the best quality Caribbean and Western Atlantic Coral reefs protected by the National Park Service. These reefs support incredible diversity, including conch, lobster, and endangered sea turtles. Reefs also play a vital role for humans by supporting fisheries, nursery areas, tourism, pharmaceutical bio-prospecting and shoreline protection to name a few. Monitoring coral reefs was identified as a national priority in President Clinton's Executive Order 13089.

The objectives for this protocol include:

- 1) detecting changes over time in percent cover of major taxonomic groups (e.g. coral, algae [turf, calcareous, macroalgae], gorgonians, sponge, substrate), and community-level indicators of habitat condition (e.g. coral species diversity, coral community structure, and rugosity);
- 2) tracking trends and severity in reef-associated covariates such as coral bleaching, coral disease and presence of the herbivorous sea urchin, *Diadema antillarum*; and
- 3) maintaining a video archive of the transects and digital photographic record of disease lesions encountered on the transects to allow for quantification and future analyses of benthic components not identified in this protocol.

Accomplished in FY12: The Coral Reef Monitoring Protocol was revised: Field Standard Operating Procedures (SOPs) continued to be updated. Data management sections were brought up to date, additional QA/QC procedures implemented, queries were developed to facilitate additional types of data exports, and templates were developed to facilitate synergistic reporting (e.g. resource briefs, data summaries, web pages).

Continuation in FY13: The protocol will be finalized and sent out for peer review in 2013. Final revisions will be made to SOPs describing merging of databases, QA/QC procedures, analysis, and report summaries. Descriptions of the SARI, DRTO Loggerhead Forest, and DRTO Santa's Village sites will also be added to the protocol.



Dry Tortugas National Park (DRT0)

Table 1. Dry Tortugas National Park coral community resource condition summary table. Symbol definitions given in Section [“VI. Connect The Dots-Resource Condition Summary Tables.”](#)

Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source
Bird Key Coral Reef Condition	Primary= % live stony coral cover; Secondary= algal, sponge, & soft coral cover, sea urchin density, disease area, disease prevalence and water temperatures.		Live stony coral cover =10.0%(6/12/2012) shows a significant drop in live stony coral cover since SFCN began monitoring the reef in 2004 (24% loss of existing cover). (SFCN data analysis 10/23/2012.) Historical work (Jaap et al. 1989; Dustan, 1985; Wheaton et al., 2007) suggests this reef is much lower in coral cover that in the recent past.	Historical work (Jaap et al. 1989; Dustan, 1985; Wheaton et al., 2007) suggest this reef had much higher coral cover in the recent past (~ 40% in 1975).
Bird Key North Coral Reef Condition			Live stony coral cover = 10.7% (6/3/2011). Monitoring of Bird Key North reef started in 2005 which is after the steepest part of the drop experienced by Bird Key Reef. No significant trend has been detected since 2005. (SFCN data analysis 10/23/2012.) Historical work (Jaap et al., 1989; Dustan, 1985; Wheaton et al., 2007) suggests this reef is much lower in coral cover that in the recent past.	
Logger-head Forest Coral Reef Condition			Average stony coral cover = 26.4%. 3 additional 4-transect sites were added this year to 2 existing sites for a total of 5 sites. (SFCN data analysis 10/23/2012)	To be determined
Santa's Village Coral Reef Condition			3 4-transect sites were established this year. Average stony coral cover = 16.2%. (SFCN data analysis 10/23/2012)	To be determined
Inside Research Natural Area Coral Reef Condition			Average stony coral cover=9.4%. No trend has been detected across the 6 sites monitored since 2008. However site I-50 (in Loggerhead Forest reef) may be showing a decline but is only significant at the p<0.08 level. (SFCN data analysis 10/23/2012)	To be determined
Outside Research Natural Area Coral Reef Condition			Average stony coral cover=5.7%.No trend has been detected across the 6 sites monitored since 2008. (SFCN data analysis 10/23/2012)	To be determined

Albins MA, Hixon MA. 2008. Invasive Indo-Pacific lionfish *Pterois volitans* reduce recruitment of Atlantic coral-reef fishes. Mar Ecol Prog Ser. 367:233–238. <http://dx.doi.org/10.3354/meps07620>

Dustan, P. 1985. Community structure of reef-building corals in the Florida Keys: Carysfort Reef, Key Largo and Long Key Reef, Dry Tortugas. Atoll Research Bulletin No. 288 May 1985.27 Pages.

Jaap, W. C., W. G. Lyons, P. Dustan, and J. C. Halas. 1989. Stony coral (Scleratinia and Milleporina) community structure at Bird Key Reef, Ft. Jefferson National Monument, Dry Tortugas, Florida. Florida Marine Research Publication. No. 46. Florida Marine Research Institute, St. Petersburg, FL.

Wheaton, J., M. Callahan, S. Brooke, C. Beaver, S. Wade, D. Johnson, S. Kupfner, J. Kidney, M. Bertin. 2007. Dry Tortugas National Park (DRT0) Long Term Monitoring and Assessment Project Annual Report: 2005-2006. Technical Report of the Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute. F2454-04-A2. http://myfwc.com/media/201280/CREMP_NPS_Annual_Report_4_23_2007.pdf

Accomplished in FY12 – DRTO RNA Science Plan 5-year Report: Results from Miller et al.’s (2012) “Eight years of coral reef community monitoring: results from inside and outside the Research Natural Area at Dry Tortugas National Park”, and a new benthic map were presented in [*Implementing the Dry Tortugas National Park RNA Science Plan: The 5-year Report*](#) (Figure 16). This report presents results on interdisciplinary studies that focused on the performance efficacy of the no-take Research Natural Area (RNA). Below are summarized the benthic community trends from the Miller et al. (2012) chapter (reference provided in [Section IV. Reports, Presentations, and Publications](#)).

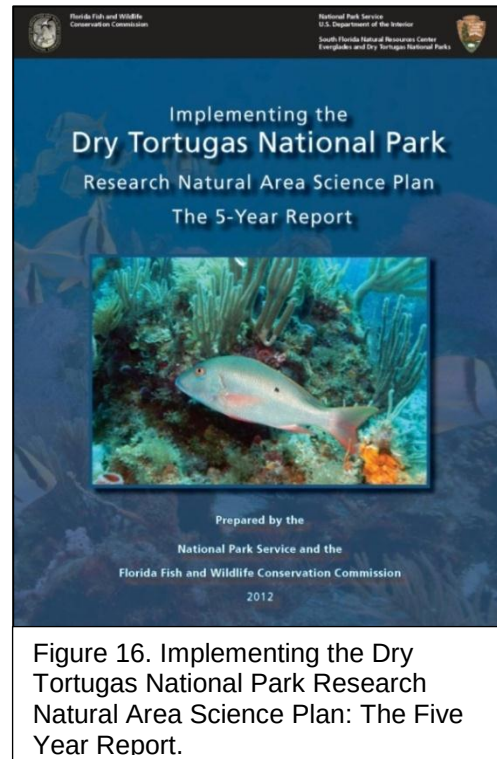


Figure 16. Implementing the Dry Tortugas National Park Research Natural Area Science Plan: The Five Year Report.

Benthic community percent cover data at Bird Key Reef index sites were transformed (square root [$x+1$]) and analyzed with repeated measures analysis of covariance (ANCOVA) using a 1st order Autoregressive Model (in SAS 9.2). Monitoring data from 2004 through 2011 indicated a significant decrease in stony coral cover at the Bird Key site (13.2% to 10.6%; $p < 0.0001$). This decrease primarily occurred from 2004 through 2007 and then appeared to stabilize. Bird Key North, initiated in 2005, did not show a significant overall trend (Figure 17). Octocoral cover (e.g., sea fans, sea plumes, etc.) showed a significant decline between 2005 and 2006 sampling at both Bird Key Reef sites from an average of 20.0% in 2005 to 8.9% cover in 2006 ($p < 0.0001$) followed by an increase through 2011 to 13.5%. This trend is likely the result of four hurricanes passing over DRTO during the extremely active hurricane season in 2005.

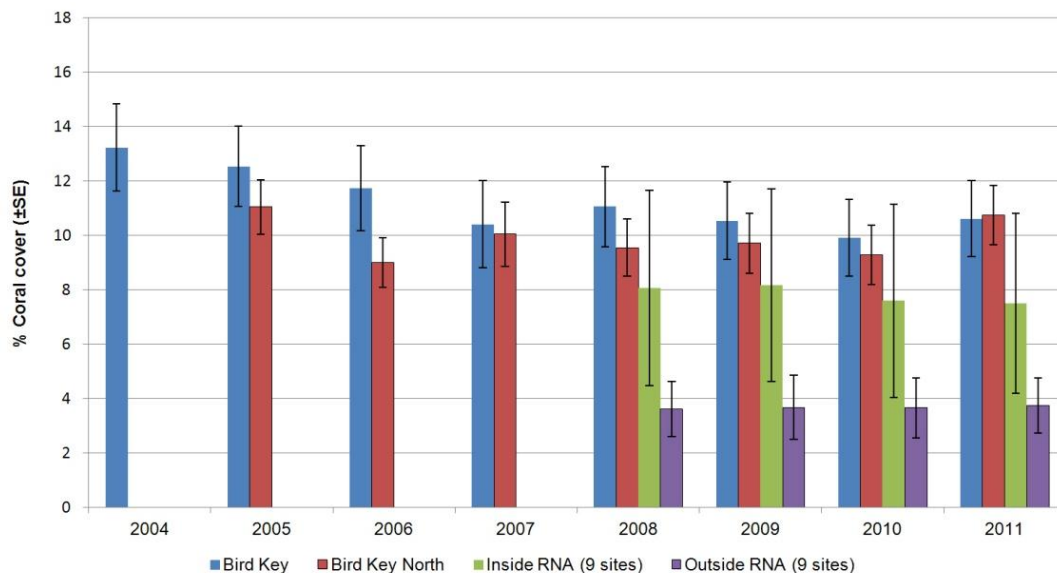


Figure 17. Trends in average percent cover of stony corals ($\pm$ SE) at coral monitoring sites grouped into Bird Key, Bird Key North, Inside and Outside the Research Natural Area (RNA) strata.

Results of annual monitoring at the 18 extensive sites showed stony coral cover had no significant trends at these sites from 2008-2011. Two sites located within the RNA in Loggerhead Forest (I-05, I-50), had exceptionally high stony coral cover (I-5: four year mean=31.0% [SE=0.5]; I-50: four year mean=20.1% [SE=1.3]). In June and July of 2008, SFCN staff observed an outbreak of the coral disease white plague in DRTO, much of it located in the Loggerhead Forest area. (Note: Index sites are 20 transect sites placed in areas of management interest or otherwise of high live stony coral cover. Extensive sites are 4-transect sites placed randomly within an area of interest that is typically much greater than a typical index site. In this case, 9 extensive sites were placed randomly inside and outside the RNA within habitat with an initial estimate of >5% live stony coral cover).

Accomplished in FY12 – Annual monitoring and site installation: SFCN staff monitored marine benthic communities during a 10 day cruise on the *M/V Ft. Jefferson* in June 2012. Data was collected on 13 of 18 extensive sites established for coral reef monitoring. Extensive sites were originally installed in FY08 (nine sites inside and nine outside of the newly established Research Natural Area [RNA]). Five extensive sites were not surveyed due to extremely low percent coral cover recorded in previous years (< 2%) which was below the initial pre-installation site estimate of $\geq 5\%$ and monitoring such low coral cover sites are not the purpose of this protocol. Data was collected using the Coral Reef Monitoring Protocol (which includes the High Definition video for benthic component cover), *Diadema antillarum* abundance, coral disease presence/type and measurements, and reef-depth water temperature co-located at each sample site.

SFCN staff concurrently conducted annual coral reef index site monitoring, (protocols and data collected as listed above) at Bird Key Reef. Analysis of percent live coral data from 2012 is complete and included in this report, representing eight years of data. Coral monitoring was discontinued at the Bird Key North Index site (water temperature data still collected), in part because of its close proximity to the Bird Key Index site. This was also done to allow for an increased monitoring effort in habitat delineated in the 2010 DRTO Benthic Habitat Map; primarily in the northeast and southwest sections of DRTO (e.g., low and high relief spur-and-groove, reef terrace). SFCN revised its extensive site study design in FY12 to include these areas in the survey domain and to allow specific reporting of trends in the high coral cover *Montastraea* complex dominated reefs of Loggerhead Forest and an area named by staff as “Santa’s Village”. In Jeff Miller’s words, these are “special places within special places” and require focused effort.

Field reconnaissance was conducted in March and June 2012 to determine the reef boundaries of Loggerhead Forest and Santa’s Village Reefs using time-referenced photos, underwater video, and observations of benthos and depth with SCUBA. After establishing the geographical domain for each reef, SFCN staff established randomly selected sites within the reef domains (Figure 18). An extensive-style site design (four cardinal transects; N, E, S, W) was chosen for these areas with consideration for the relative large size of these reefs and diving logistics. The Santa’s Village Index site consists of three extensive-style coral monitoring sites (12 transects total). An additional three new extensive-style sites were also established within Loggerhead Forest, which complements the two existing sites previously established there (protocols and data collected as listed above). The new Loggerhead Forest Index site is comprised of five extensive-style sites (20 transects total).

Figure 19 and 20 show the monitoring results for the index sites and individual monitoring sites.

Continuation in FY13: Bird Key, Loggerhead and Santa's Village Index sites will be monitored.

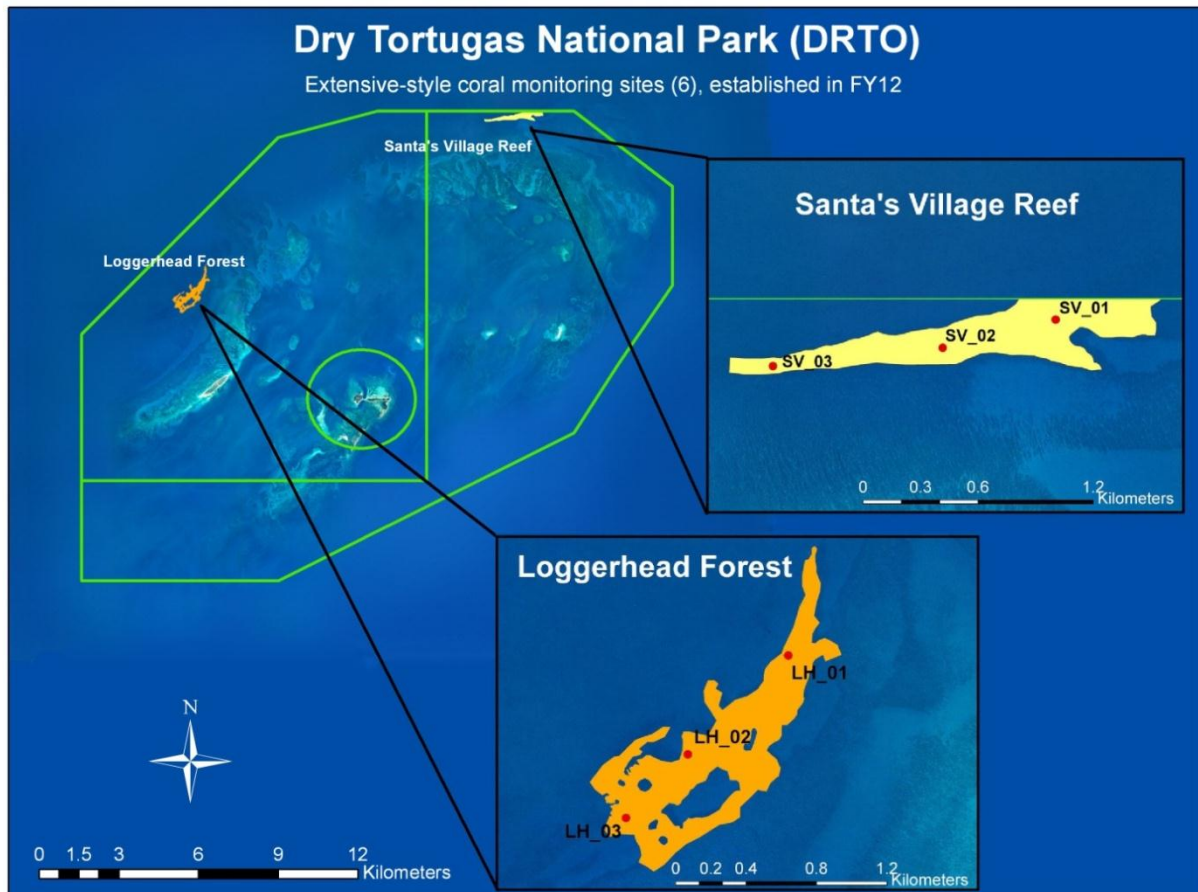


Figure 18. Locations of the newly established extensive-style index coral reef monitoring sites at Santa's Village Reef and Loggerhead Forreest in DRT0. (Loggerhead Forest sites I-5 and I-50 not displayed)



Montastraea dominated reef terrace on the Loggerhead Forest index site (Photo credit: Rob Waara).

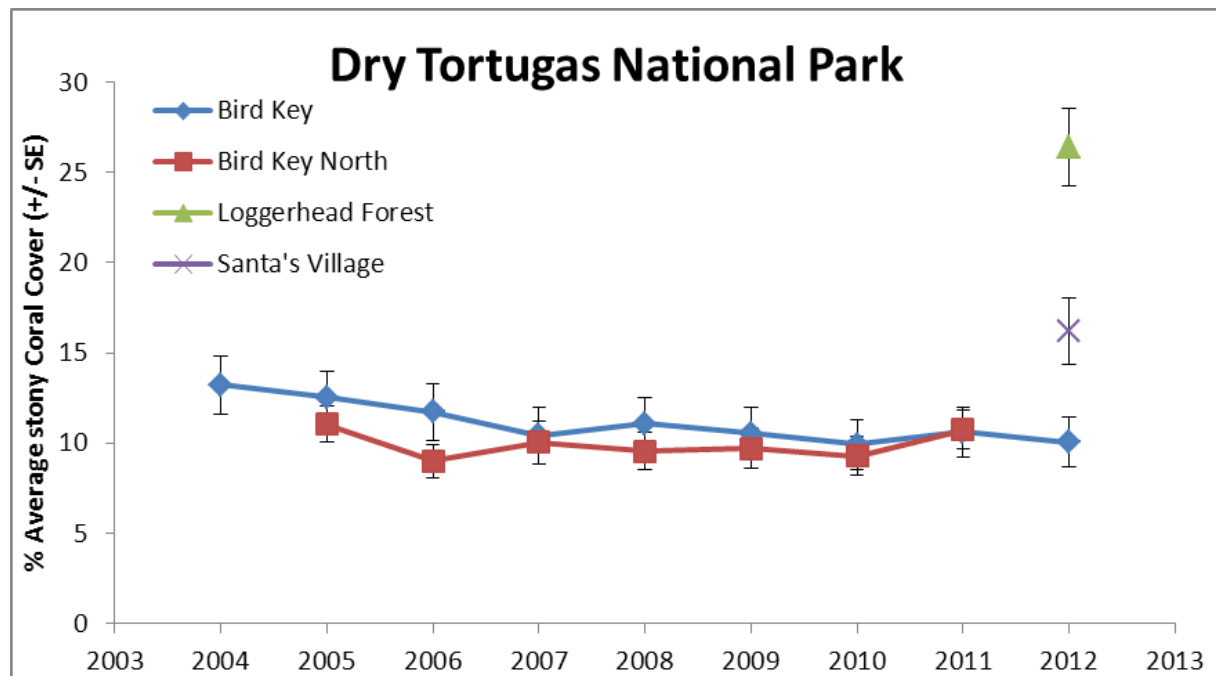


Figure 19. Trends in live stony coral cover at select monitored reefs in DRT0.

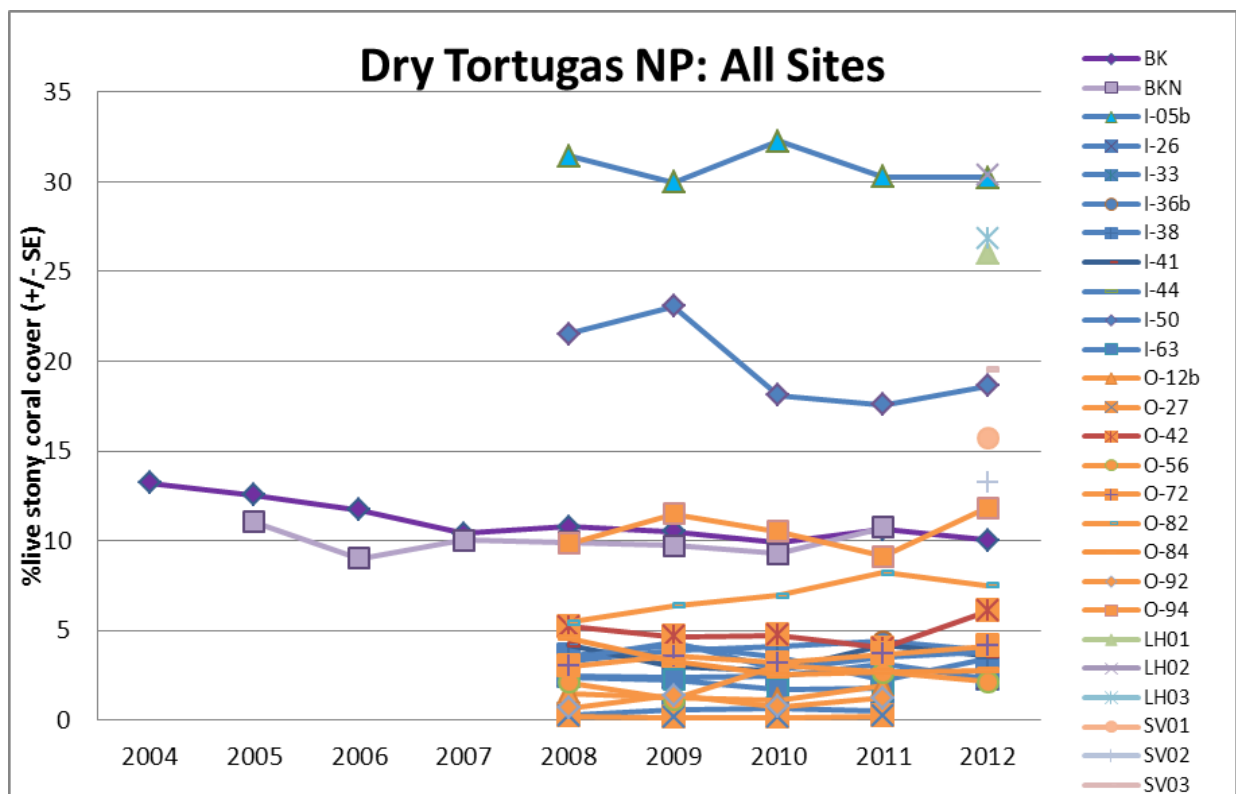


Figure 20. Trends in live stony coral cover at all survey sites in DRT0 including extensive sites and Bird Key and Bird Key North Reefs.

Biscayne National Park BISC

Table 2. Biscayne National Park coral community resource condition summary table. Symbol definitions given in Section [“VI. Connect The Dots-Resource Condition Summary Tables.”](#)

Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source
Ball Buoy Reef	Primary= % live stony coral cover; Secondary= algal, sponge, & soft coral cover, sea urchin density, disease area, disease prevalence and water temperatures.	↔	Live stony coral cover = 6.9% (sampled 8/22/2011) and is not significantly different from 2004 so no trend has been detected. (SFCN data analysis 10/23/2012.)	Reference condition under development by looking at available historical data and reports.
Amanda's Reef		↔	Live stony coral cover is 6.7% (sampled 8/20/2011) and is not significantly different from 2004 so no trend has been detected. (SFCN data analysis 10/23/2012.)	

Accomplished in FY12: SFCN staff conducted annual coral reef community monitoring of index sites at Ball Buoy Reef and Amanda's Reef (Figure 21). These two sites now have 10 years of monitoring data (Figure 21). Data at both sites were collected using the Coral Reef Monitoring Protocol (which includes the HD video for benthic component cover), *Diadema antillarum* abundance, coral disease presence/type and measurements, and reef-depth water temperature co-located at each sample site. The 2012 data is not included in this report since it was collected in October 2012 and was still in the data entry and proofing phase.

Continuation in FY13: SFCN staff will continue to conduct annual coral reef index site monitoring. A BISC park wide marine benthic community assessment schedule is under development. Coral site(s) within the proposed marine reserve zone are also under consideration.

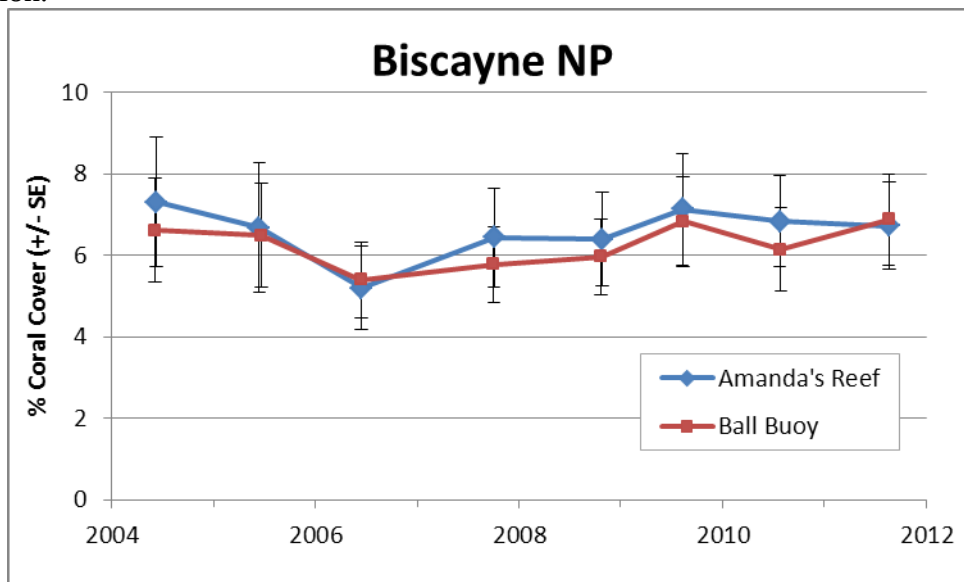


Figure 21. Trends in live stony coral cover at Ball Buoy and Amanda's Reef, BISC.

Virgin Islands National Park (VIIS)

Table 3. Virgin Islands National Park coral community resource condition summary table. Symbol definitions given in Section [“VI. Connect The Dots-Resource Condition Summary Tables.”](#)

Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source
Haulover Coral Reef Condition	Primary= % live stony coral cover; Secondary= algal, sponge, & soft coral cover, sea urchin density, disease area, disease prevalence and water temperatures.		Live stony coral cover = 10.4%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event. No trend has occurred in live stony coral cover since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 22.5% (sampled 1/11/2005; SFCN database)
Mennebeck Coral Reef Condition			Live stony coral cover = 12.4%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event. However a small upward trend has been detected since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 26.7% (sampled 10/19/2004; SFCN database)
Newfound Coral Reef Condition			Live stony coral cover = 5.5%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event and prior decline. No trend has occurred in live stony coral cover since 2007. (SFCN data analysis 10/23/2012.)	3/23/1999 Coral Cover = 18.0%; Pre 2005 bleaching event coral cover = 13.2%. (sampled 3/2/2005; SFCN database)
Tektite Coral Reef Condition			Live stony coral cover = 13.1%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event. However a small upward trend has been detected since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 24.7%(sampled 9/26/2005; SFCN database)
Yawzi Coral Reef Condition			Live stony coral cover = 6.7%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event. However a small upward trend has been detected since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover=8.6%.(sampled 9/14/2004; SFCN database)

Accomplished in FY12: SFCN staff conducted annual coral reef index site monitoring in VIIS (Tektite Reef, Haulover Reef, Yawzi Reef, Mennebeck Reef, and Newfound Reef). Data were collected using the Coral Reef Monitoring Protocol (which includes the High Definition (HD) video for benthic component cover), *Diadema antillarum* abundance, coral disease presence/type and measurements, and reef-depth water temperature co-located at each sample site. The sites in VIIS have between 8-14 years of data (Figure 22).

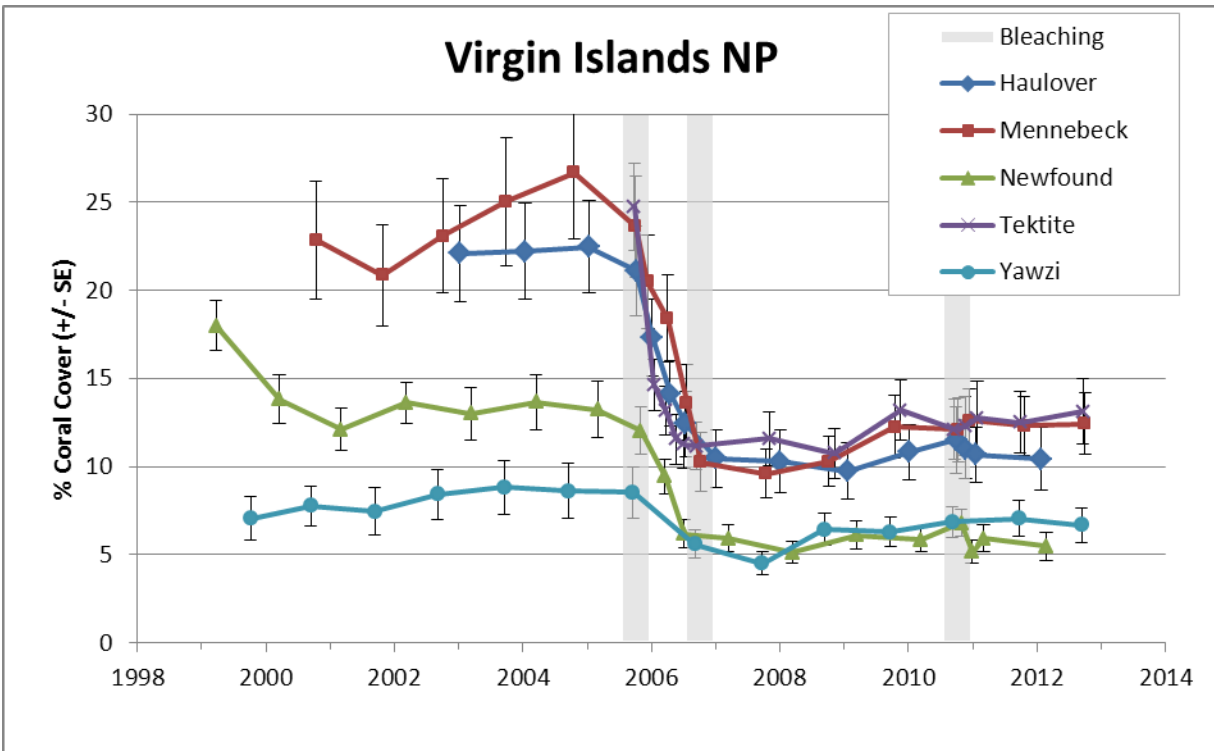


Figure 22. Trends in live stony coral cover at index sites throughout VIIS. Grey bars indicate coral bleaching/disease event of 2005 that continued into 2006 and the coral bleaching event in 2010. (Coral bleaching occurs when coral under stress lose their symbiotic algae and look white or “bleached.”)

Continuation in FY13: SFCN staff will continue to conduct annual coral reef index site monitoring. The VIIS marine benthic monitoring schedule will be reviewed and evaluated.

Buck Island Reef National Monument (BUIS)

Table 4. Buck Island Reef National Monument coral community resource condition summary table. Symbol definitions given in Section [“VI. Connect The Dots-Resource Condition Summary Tables.”](#)

Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source
South Fore Reef Coral Reef Condition	Primary= % live stony coral cover; Secondary= algal, sponge, & soft coral cover, sea urchin density, disease area, disease prevalence and water temperatures		Live stony coral cover =6.5%. Reef still not recovered from the large drop in the devastating 2005 bleaching/disease event. However a small upward trend has been detected since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 19.8% (sampled 2/1/2005; SFCN database)
Western Spur & Groove Coral Reef Condition			Live stony coral cover =3.3%. Reef still not recovered from the large drop in the devastating 2005 bleaching/disease event. However no significant trend has been detected since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 5.1% (sampled 5/23/2005; SFCN database)

Accomplished in FY12: SFCN staff conducted annual coral reef index site monitoring in BUIS (South Fore Reef and Western Spur-and-groove). Data were collected using the Coral Reef Monitoring Protocol (which includes the HD video for benthic component cover), *Diadema antillarum* abundance, coral disease presence/type and measurements, and reef-depth water temperature co-located at each sample site. The BUIS sites have 11 and 13 years of sampling data respectively (Figure 23).

Continuation in FY13: SFCN staff will continue to conduct annual coral reef index site monitoring.

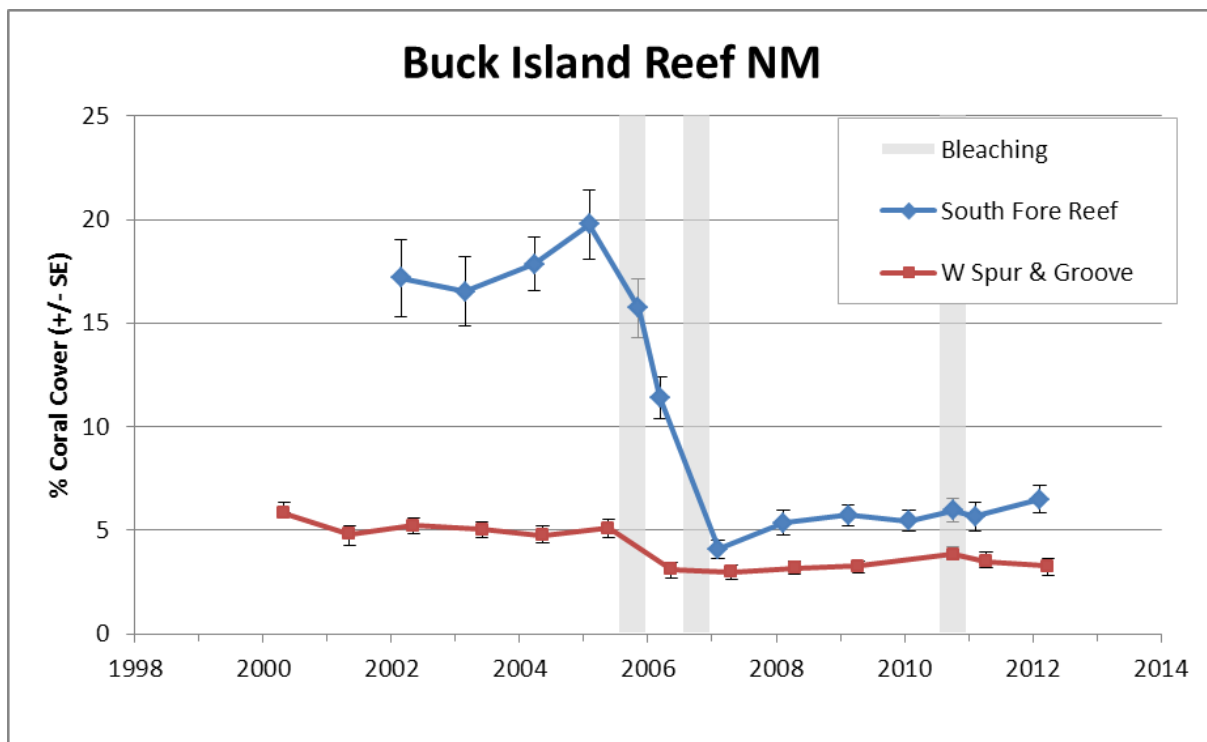


Figure 23. Trends in live stony coral cover at Western Spur-and-groove and South Fore Reefs, BUIS. Grey bars indicate coral bleaching/disease event of 2005 that continued into 2006 and the coral bleaching event in 2010. (Coral bleaching occurs when coral under stress lose their symbiotic algae and look white or “bleached.”)

Virgin Islands coral bleaching

Annual benthic monitoring conducted at VIIS during September and October coincides with annual peak thermal stress. Seawater temperatures again exceeded the theoretical bleaching threshold in mid-September, 2012. Bleaching was observed again during monitoring at VIIS index sites in September and October 2012; the extent of bleaching is summarized in Figure 24. While monitoring revealed that bleaching became more severe through September into October 2012, no corals at any site experienced complete loss of pigment (correlating to severe thermal stress). However, nearly two-thirds of coral cover exhibited some level of bleaching at Mennebeck Reef, the last of the sites to be monitored. (See the water temperature graphs and discussion in the "Water Quality Monitoring section [Marine Benthic Communities – Coral Reef Water Temperature \(page 68\)](#)).

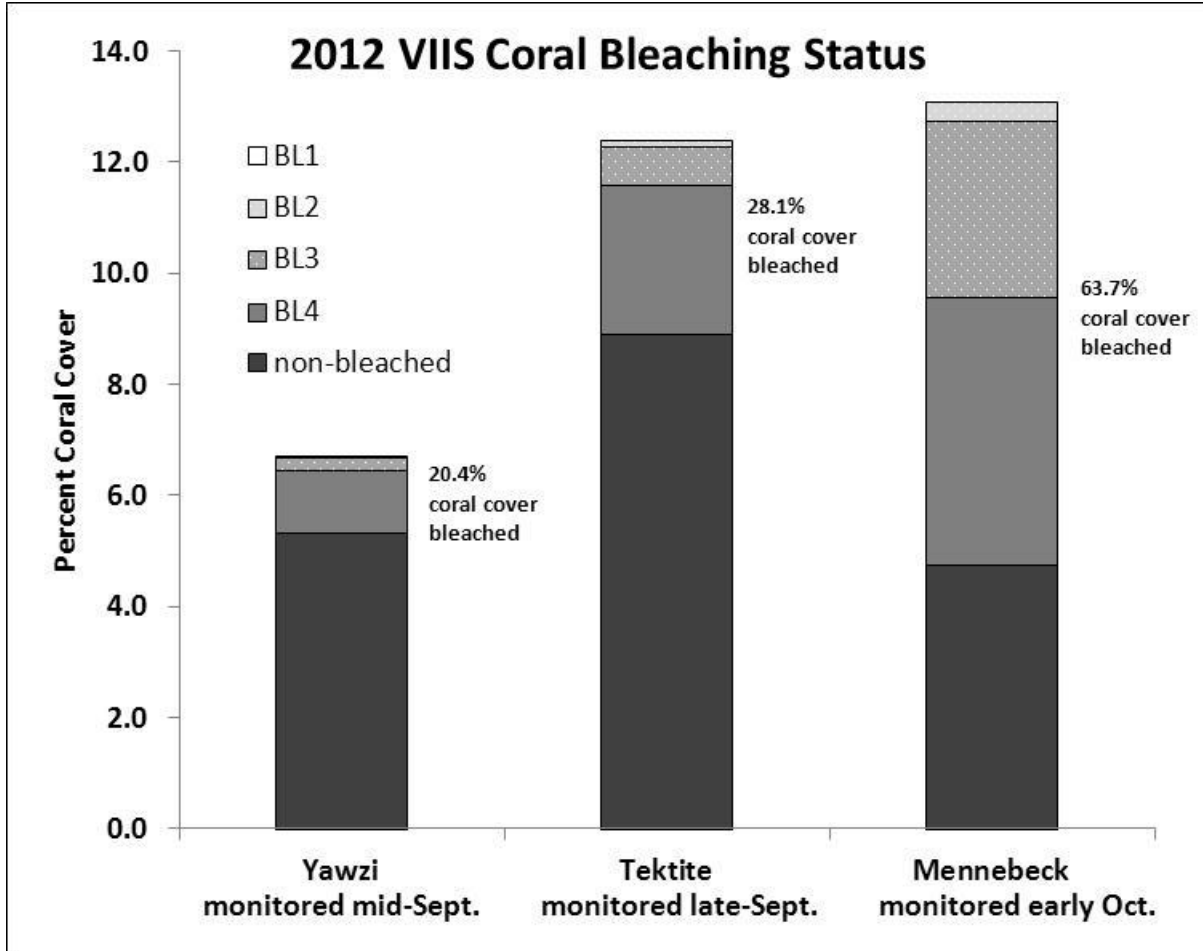


Figure 24. Comparison of bleaching severity (BL1-4) at three index sites monitoring during peak thermal stress in VIIS. BL1=Bleaching Level 1 – complete loss of color signifying significant stress to the coral and significant loss of zooxanthellae. BL4=Bleaching Level 4 – slight loss of color signifying relatively minor stress to coral and minimal loss of zooxanthellae. Non-bleached indicates normal coral pigment.

Salt River Bay National Historical Park and Ecological Preserve (SARI)

Table 5. Salt River Bay National Historical Park and Ecological Preserve coral community resource condition summary table. Symbol definitions given in Section [“VI. Connect The Dots-Resource Condition Summary Tables.”](#)

Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source
Primary= % live stony coral cover; Secondary= algal cover, sponge cover, soft coral cover, sea urchin density, disease area, disease prevalence and water temperatures .		% live stony coral cover = 10.6% (10/23/2012 SFCN data analysis). SFCN established 20 transects in SARI in three areas of relatively high coral cover, diversity and complexity in 2012. Comparing SFCN data to historical accounts shows coral cover on the east wall (~ 12%) may be within the historical range but coral cover on the west wall (~ 12%) is currently lower than values reported from 1979 – 1984 (20 – 33%). No historical data was located for the expansive spur and groove area outside the canyon, however, numerous observations of partial or near complete colony mortality (primarily <i>Montastraea</i> spp.), similar to those observed at other SFCN VI monitoring sites, suggests the area was impacted by bleaching and disease that were pervasive throughout the NE Caribbean from 2005-2007. In addition SFCN saw active signs of white plague (coral disease) during sampling. SFCN's data also shows relatively high macroalgae cover (34.0%); Macroalgae was not listed as a benthic component in any SARI historical report. As a consequence SFCN professional opinion is that the SARI monitoring site warrants an overall rating of degraded.	(Rogers et al. 1984) (Boulon 1978) (Coulston et al. 1990)

Coulston ML, M. Taylor, R. Simms, C. Kesling. 1990. Environmental Monitoring in the Salt River Submarine Canyon, St. Croix 1989-1990. Annual Report Mission 89-3.
 Ralf H. Boulon, Jr. 1978. Final Scientific Report 78-6b, Coral Distributions in the Salt River Submarine Canyon, St. Croix, US Virgin Islands. NULS-I Mission 78-6b 13-28 September 1978
 Rogers C, H Fitz III, M. Gilnack, J. Beets, and J. Hardin 1984. Scleractinian Coral Recruitment Patterns at Salt River Submarine Canyon, St. Croix, US. Virgin Islands. Coral Reef 3:69-76.

Accomplished in FY12: SFCN staff installed an index site consisting of 20 permanent transects for coral reef monitoring in Salt River Bay National Historic Park and Ecological Preserve (SARI) in April 2012 (Figure 25). The transects were randomly distributed in three distinct areas: outer canyon east wall (4 transects), canyon west wall (4 transects), and a spur-and-groove area northwest of the canyon (12 transects). These areas were chosen because of relatively high coral cover, reef complexity, historical significance and were constrained to 33 m depth. Prior to site installation, ecological significance of these areas was confirmed by *in situ* field reconnaissance (time-referenced photos, underwater video, and observations of benthos and depth) by SFCN staff in February 2012.

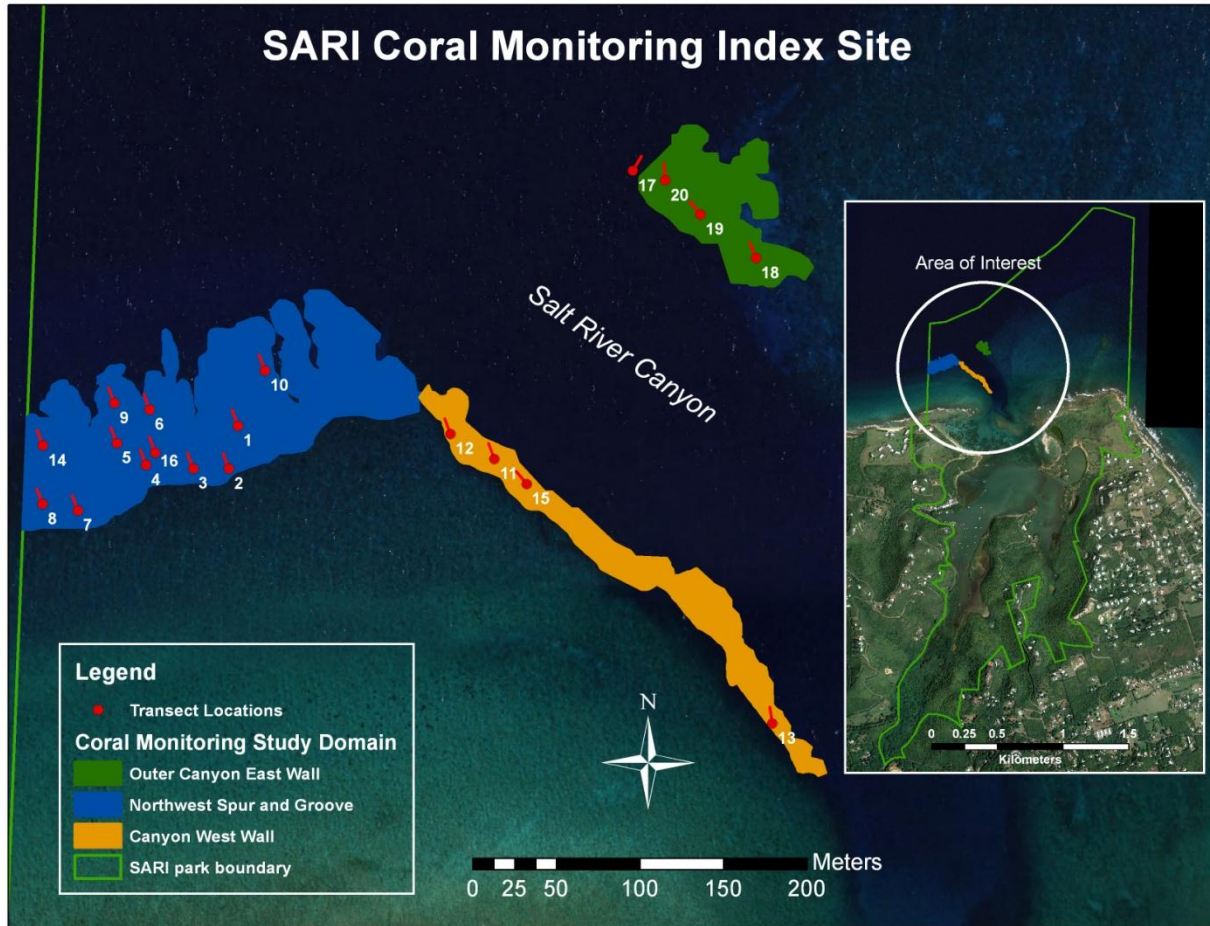


Figure 25. Locations of the 20 transects comprising the SARI coral reef monitoring index site in three areas: outer canyon east wall (green), canyon west wall (orange), and spur-and-groove area northwest of the canyon (blue).

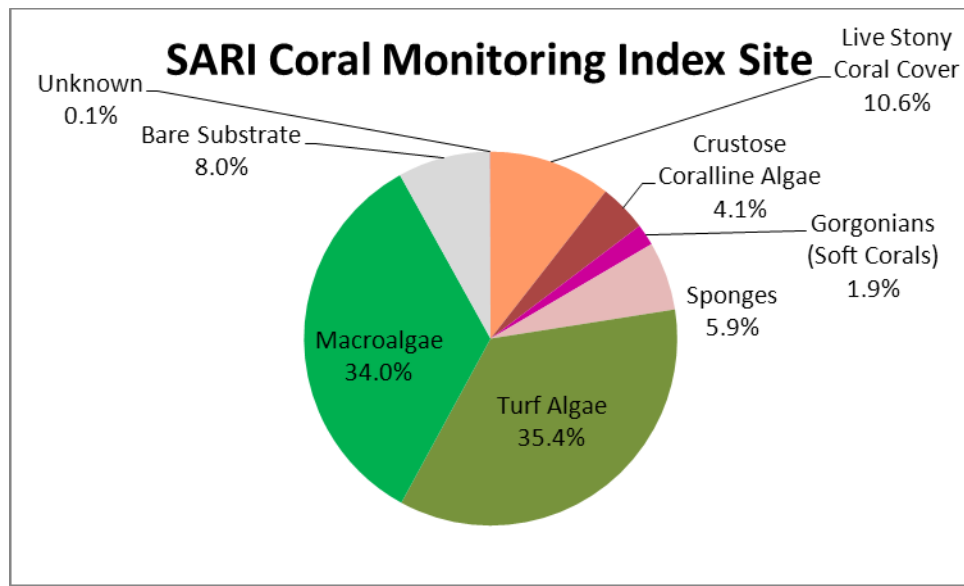


Figure 26. Initial results from SARI coral reef monitoring index site.

This is the first year the SFCN has collected benthic data at the SARI index site (Figure 26). Data will be collected annually using the Coral Reef Monitoring Protocol, which includes the High Definition video for benthic component cover, *Diadema antillarum* abundance, coral disease presence/type and measurements. Reef-depth water temperature data is also collected at two of the 20 transect locations in SARI.

Continuation in FY13: SFCN will conduct annual coral reef monitoring at the SARI index site.

Data Management, Analysis, and Reporting.

Accomplished in FY12: Work continued on development of a comprehensive reporting strategy including refining the coral graphing template and developing the data summary reporting templates for coral monitoring, coral disease monitoring, and water temperatures monitoring. A draft data summary for VIIS was developed and refined.

Continuation in FY12: A comprehensive reporting strategy for coral monitoring index sites and extensive sites will be drafted and implemented. Automated reporting will be completed in the coral database and automated reporting will be developed from the coral disease and *Diadema* database to support these reports. Annual data summaries and resource briefs will be created and delivered to the parks. A multi-park comprehensive analysis report will be initiated (and hopefully completed). QA/QC procedures will be finalized and incorporated into the database.

Marine Benthic Communities – Seagrass and Conch (BISC, BUIS, DRTO, VIIS)

Accomplished in FY12: The evaluation of the historical and current seagrass protocols in use within the network and how these can be used or integrated into network seagrass monitoring continued in FY12. The feasibility of conducting surveys for queen conch (*Strombus gigas*, a species listed under the vital sign “Marine Exploited Invertebrates”) in conjunction with the seagrass monitoring is also being considered.

Continuation in FY13: SFCN will continue to develop a seagrass protocol and will conduct a pilot-scale seagrass survey possibly in BISC or DRTO.

Marine Fish Communities Vital Sign

Marine Fish Monitoring Protocol for the U.S. Virgin Islands Coral Reef Ecosystem (VIIS, VICR, BUIS, SARI)

Accomplished in FY12: We held a follow up meeting to discuss the reef fish Caribbean protocol in January 2012 with the Biogeography Branch at NOAA’s Center for Coastal Monitoring and Assessment in Silver Springs, MD. Research scientists from UM, NOAA-SEFSC, NOAA-BB, CRCP and SFCN attended to develop the cooperative protocol for monitoring reef fish communities in the U.S. Virgin Islands. Topics discussed included the scope of the document, sampling design and domain, available benthic habitat maps, data entry, field methodology, key metrics to be measured and authorship.

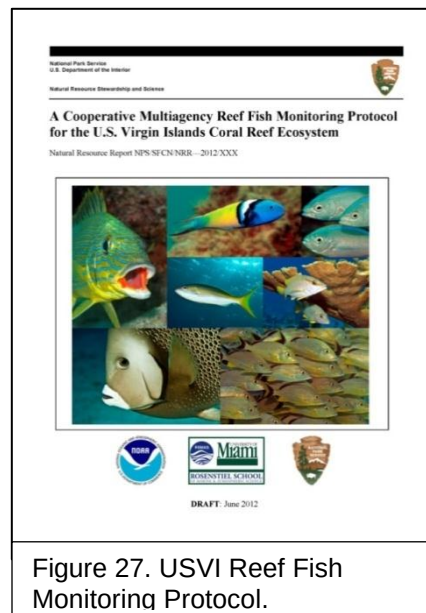


Figure 27. USVI Reef Fish Monitoring Protocol.

The draft of *A Cooperative Multiagency Reef Fish Monitoring Protocol for the U.S. Virgin Islands Coral Reef Ecosystem* is currently in review (Figure 27). The USVI fish protocol external review was completed by Mr. Alex Chester and Mr. Jim Tilmant. Mr. David Bryan, UM/NPS Research Associate, is the first author of the protocol and is advised by Dr. Jerry Ault (UM) Steve Smith (UM); and Dr. Mike Feeley, Matt Patterson and Dr. Andrea Atkinson (SFCN).

Continuation in FY13: The Marine Fish Protocol manuscript is undergoing internal editing and is expected to be submitted to the Regional Coordinator for final review by December 2012.

U. S. Virgin Islands Marine Fish Monitoring Surveys

Accomplished in FY12: SFCN scientists partnered with NOAA-BB, BUIS, NOAA-SEFSC, UM, The Nature Conservancy (TNC), The University of the Virgin Islands (UVI) and Virgin Islands Department of Planning and Natural Resources (DPNR) for two-one week missions designed to monitor fish and benthic communities on the St. Croix shelf, including the managed areas of BUIS, SARI and East End Marine Park (EEMP). The sampling design was allocated on hard bottom habitat only and stratified by management zone and depth. These changes represent a significant redesign of past survey efforts. Survey development is an iterative process that will minimize sample variance and maximize sampling efficiency. The survey design is based on the quantitative methods used in South Florida and described in the USVI Fish Protocol (Bryan et al., *in review*). The 2012 interagency effort surveyed 288 sites on the St. Croix shelf, including 60 sites and 12 sites allocated within BUIS and SARI respectively (Figure 28). Figure 29 illustrates the spatial distribution of the previous 10 years of fish surveys in St. Croix. At each site, the fish assemblage characterizations were co-located with estimates of benthic cover along a 25x2 meter transect. VIIS and VICR were not surveyed in 2012.

SFCN continued the pilot study to co-locate surveys of fish assemblages with the benthic video transects at the index sites at VIIS and BUIS. Coordinated fish/benthic habitat video transects began in January 2007 and occurred at all Virgin Islands index sites sampled through March 2012. Sampling design changed from a fish survey on each video transect on all 20 transects, to surveying only 12 of the 20 transects and extending the length of the fish transect by 15 additional meters (25 m total) in 2009.

SFCN also conducted annual monitoring of adult and juvenile fish at four index sites in VIIS, (HA, YZ, TK, NF) in partnership with University of Hawaii professor, Dr. Jim Beets. This marks the 25th year of collaborative annual sampling for adult fish and 12th year for juvenile fish surveys (Fowler et al. 1992).

References:

Fowler, A. J., P. J. Doherty and D. McB. Williams. 1992, Multi-scale analysis of recruitment of a coral reef fish on the Great Barrier Reef. *Mar. Ecol. Prog. Ser.* 82:131-141.



SCA Marine Intern Lee Richter collects marine benthic community data on a fish survey in St. Croix (Photo credit: Charlie Menza, NOAA-BB).

Continuation in FY13: SFCN will partner with the NOAA-BB and NOAA-SEFSC teams on fish and benthic habitat characterization missions in St. John and St. Thomas, VI. The St. John and St. Thomas shelf (between 0 – 33 m depth) will be surveyed in July 2013. Reef fish and benthic surveys will be conducted from small boats based in St. John and St. Thomas and will involve personnel from the following collaborative agencies: NOAA-BB, NOAA-SEFSC, UVI, TNC, DPNR, BUIS, VIIS and SFCN. A probability based single stage stratified random survey with an emphasis on hard bottom habitat will focus on the managed areas of VIIS and VICR for comparison with surrounding open-use areas. This survey design represents a significant change from past survey efforts. In the future we expect to incorporate recommendations of NOAA's National Coral Reef Monitoring Program (NCRMP) for the collection of benthic metrics. These surveys are planned to continue every other year (biennially). Thus, following the St. John/St. Thomas 2013 surveys, all USVI parks will again be surveyed in 2015.

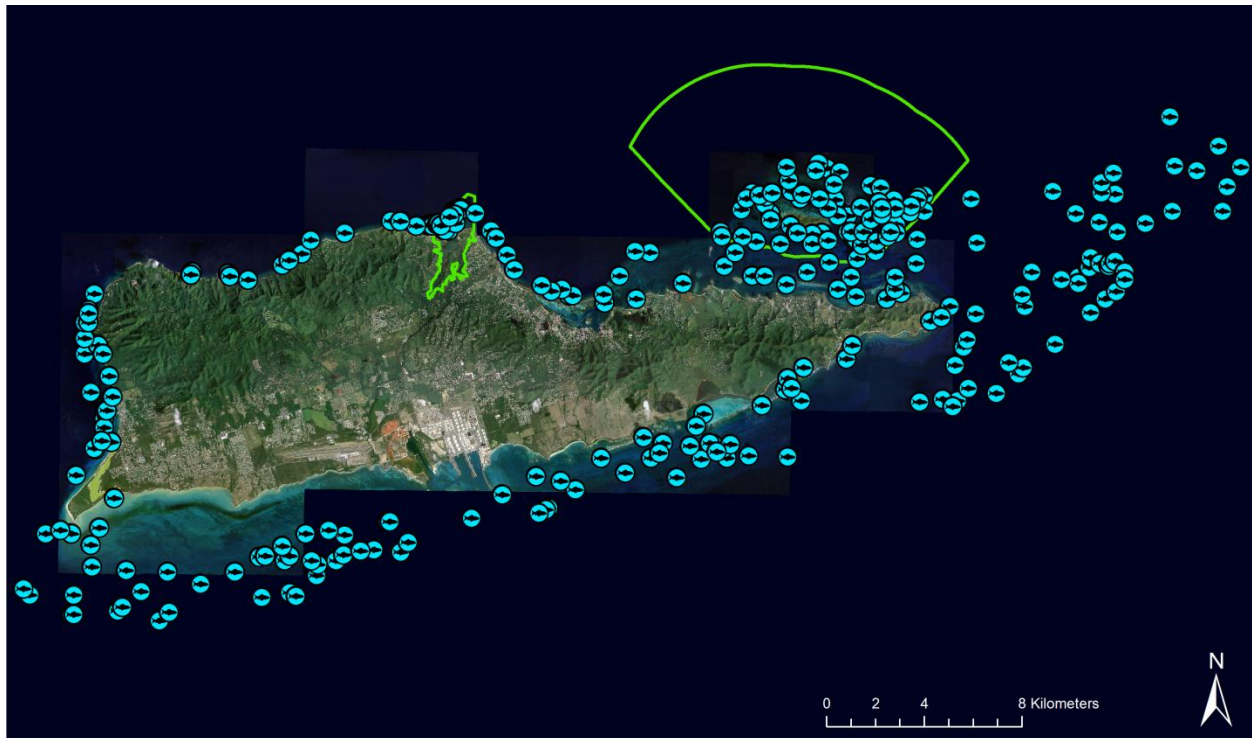


Figure 28. Multiagency fish monitoring sites (288) sampled in 2012 around St. Croix, VI.

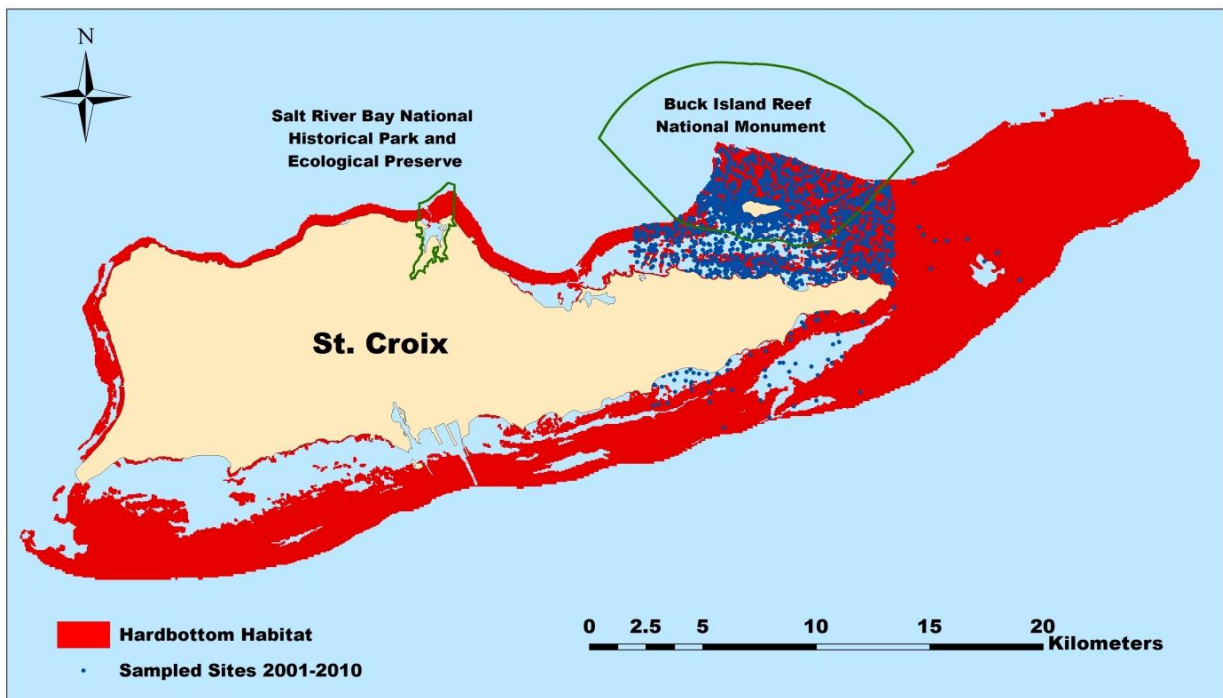


Figure 29. Multiagency fish monitoring sites sampled from 2001 - 2010 around St. Croix, VI (n = 1483 hard bottom surveys).

Dr. Ron Hill (NOAA-Galveston) has funding to compare visual fish survey methodologies (point, transect) in FY12. One outcome of his project will be the creation of conversion factors that can be used to interpret historical data and compare across methods. If these goals are achieved, NPS parks can provide managers precise quantitative estimates of reef fish community health comparable across parks.

Reef fish assemblage data co-located with video benthic surveys will be analyzed and evaluated in FY13 to determine if sampling efforts will be continued.



Commercial fish trap set in the East End Marine Park, St. Croix (Photo credit: Michael Feeley).

South Florida Protocol Development (BISC, DRTO)

Accomplished in FY12: A workshop titled “Quantitative Methods for Large-Scale Coral Reef Ecosystem Surveys: Statistical Design, Data Management and Analysis was held at SFCN headquarters in April 2012.” The lead instructors for the course were Dr. Jerald Ault and Dr. Steven Smith. The goal of the training was to provide an introduction to probability based survey sampling design applied to the dynamics of a coral reef ecosystem. The workshop was designed for agency data managers and focused on: a) Survey design principles to support fisheries management, population dynamics and community ecology; b) Development of large

scale monitoring surveys; c) Data management; and d) Estimation of population and community metrics.

Also in April 2012, the interagency Florida RVC protocol methodology meeting was held at SFCN. In attendance were scientific divers from NOAA-SEFSC, UM, Florida Fish and Wildlife Research Institute (FWRI), Florida International University (FIU), Florida Department of Environmental Resource Management (DERM), Florida Department of Environmental Protection (DEP) and NPS, including research staff from BISC, DRTO and SFCN. Participants at the meeting received training and updates on field methodology and data management for the 2012 season.

Continuation in FY13: The Marine Fish Communities protocol for south Florida will undergo development to incorporate NOAA's National Coral Reef Monitoring Program (NCRMP) criteria for biological monitoring of fish and benthic communities.

South Florida Marine Fish Monitoring Surveys

Accomplished in FY12: SFCN staff collaborated with South Florida research scientists on two 10 day reef fish monitoring cruises in the Tortugas on the M/V Spree, in June and August 2012. The cruises were scheduled and contracted by DRTO and NOAA-SEFSC to meet the DRTO RNA Science Plan performance measures that were due in 2012 for the 5-Year Report on the Implementation of the DRTO no-take Research Natural Area (RNA). Four hundred and seven (407) sites were sampled by two teams of two divers using a two-stage stratified random survey design in the Tortugas region (Figure 30). This survey design targets all hard bottom habitats occurring between 6 - 33 m depth within the sampling domain. In the future, these cruises will survey the Tortugas region every other year and consist of two 10-day cruises in DRTO, the Tortugas Bank and open use areas of the Tortugas. The next survey is scheduled in 2014.

A total of 74 BISC region sites were surveyed in 2012 as part of the South Florida Interagency Keys wide survey (Figure 31). SFCN and BISC staff surveyed 60 inshore sites within and near the BISC region in August, 2012, with assistance from the BISC scientific staff. The data collected will provide fishery metrics (length frequency and relative abundance) to assess the status of important reef fish populations within BISC compared to base line data and data collected throughout the entire South Florida ecosystem.

Continuation in FY13: No domain-wide reef fish visual surveys are planned for 2013 in south Florida. Reef fish surveys will continue on a biennial basis in south Florida, alternating years with USVI reef fish monitoring. The next scheduled surveys for DRTO and BISC will occur in 2014.

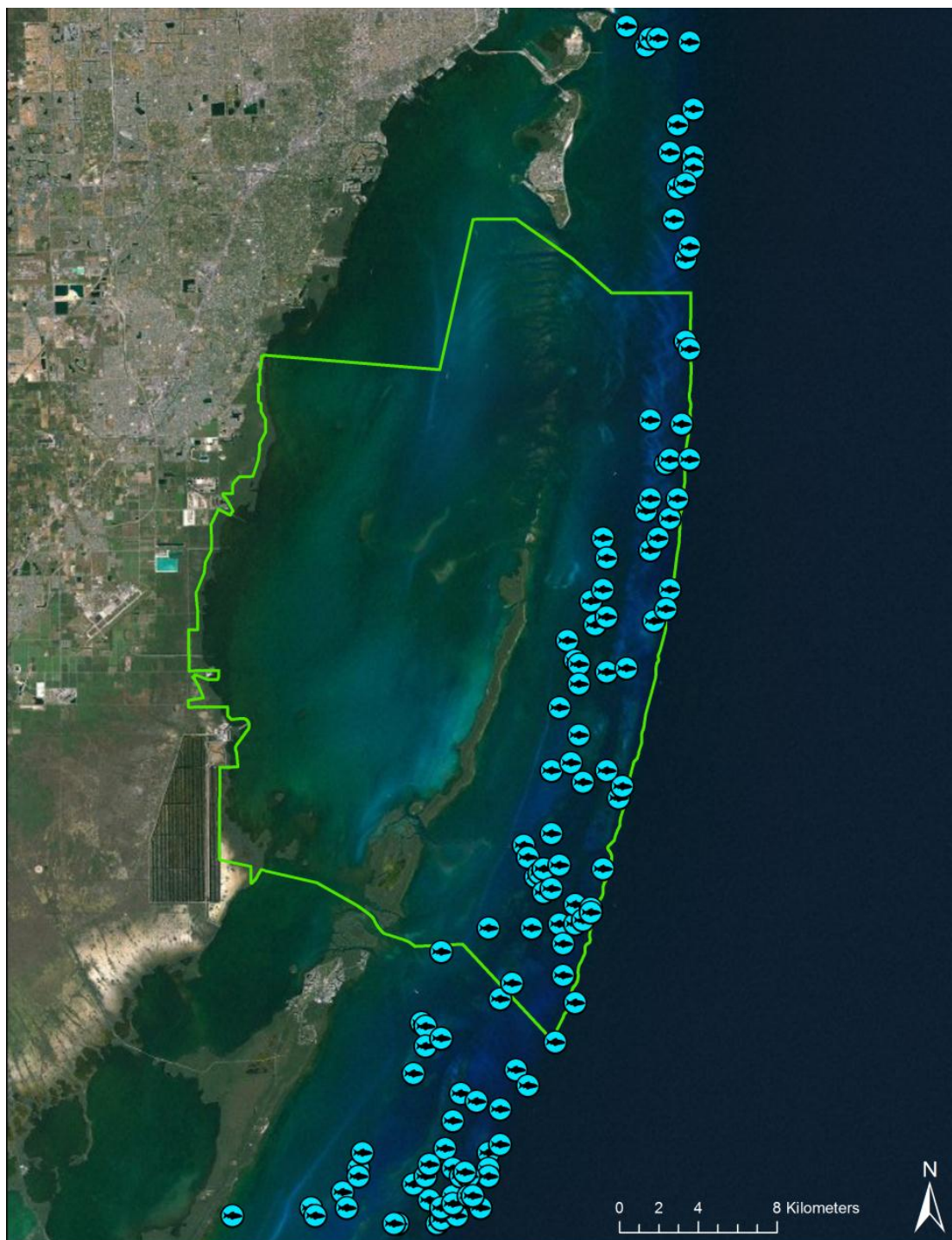


Figure 30. Multiagency Fish Monitoring Sites in BISC region in 2012.
Total Sites monitored: 74; Total sites monitored by SFCN and BISC: 60
(each site consists of 2 sub-sites)

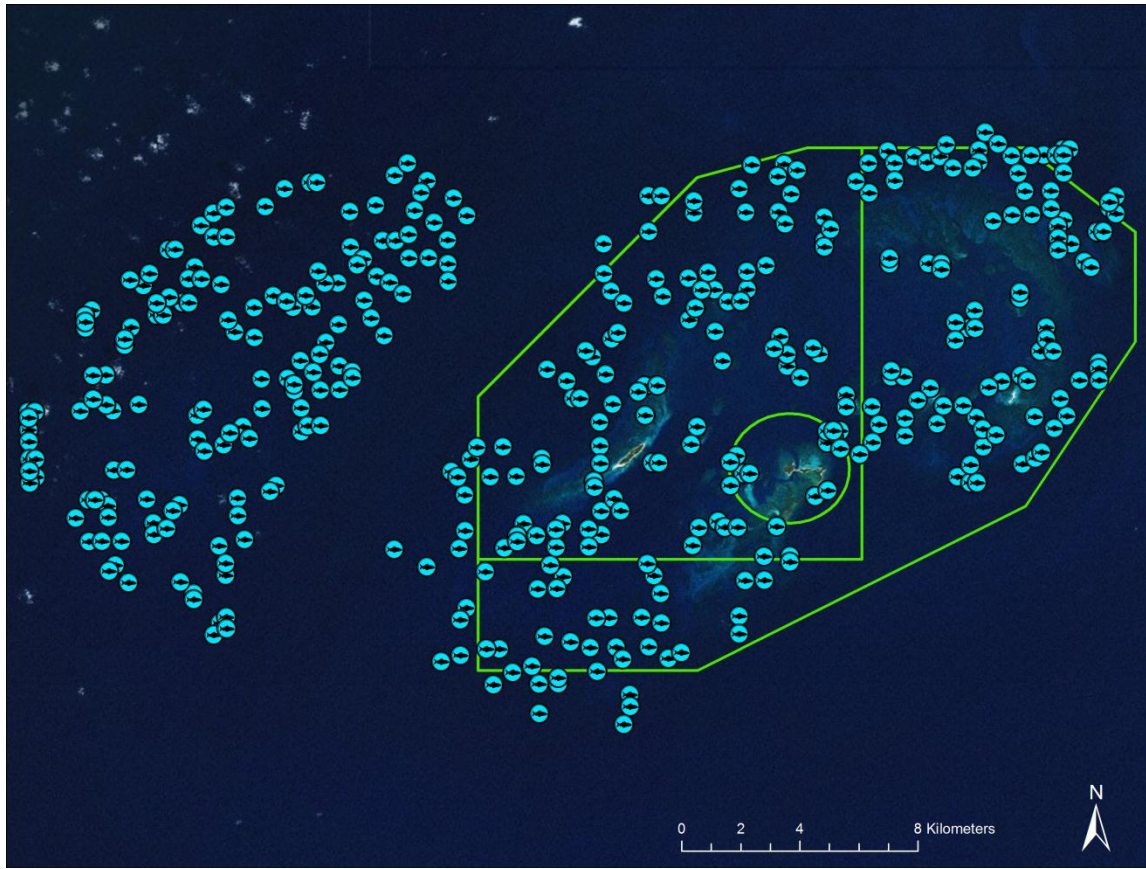


Figure 31. Multiagency Fish Monitoring Sites in and near Dry Tortugas National Park.
Total Sites monitored: 407 (each site consists of 2 sub-sites)

Data Management and Reporting

Development of a comprehensive reporting strategy for reef fish population monitoring was initiated in FY12. Automated reporting of important metrics (occurrence, density, length frequency distribution, etc.) is in development through collaboration with our partners (UM, NOAA-SEFSC, NOAA-BB) for key regional reef fish species in the USVI and south Florida to support timely production of reports. The overall objective is to create annual data summaries and resource briefs that can be delivered to the parks in “quick look” format (Figure 32). Our goal is to deliver a multi-park comprehensive analysis report in FY13.



Figure 32. Sample page from MS Excel graphing template under development with the plan to create similar graphs for key species for St. Croix. Please note that this is made-up data to provide an example of what these “quick look” pages would look like in the data summary report.

I.B Community Ecology Branch

Overview

The Community Ecology Branch made considerable progress on the planned vital signs while still progressing on three vegetation mapping projects. During FY12 the Community Ecology Branch spent 4,393 person hours in the field. The Community Ecology Branch successfully and safely used 83.2 hours of flight time (15.9 hours colonial bird monitoring, 1.4 hours periphyton sampling, and 65.9 hours for vegetation mapping) to overcome remote access issues related to field work in the South Florida Parks. We would like to thank BICY Resource Management (RM) for paying for 1.4 hours flight time for periphyton sampling and to thank both EVER and BICY Flight Following for helping to make sure these missions were safe and successful.

The Community Ecology Branch staff has experienced some changes this year. We had two departures. Dr. Tim Fotinos has left the Vegetation Post-doc position for full time employment with the U. S. Fish and Wildlife Service in the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative Inventory and Monitoring section as the Plant Ecologist. He is stationed at the Red River National Wildlife Refuge. His position is very similar to the type of work he performed here except he is working from Arkansas to the Florida panhandle. Joaquin Alonso, the vegetation map project manager has decided to leave resource management to pursue other interests. We plan to fill both of these positions in the near future. Additionally, this year we were awarded funding for a National Science Foundation Long Term Ecological Research Experience for Undergraduates internship and a George Wright Climate Change Intern through the NPS. Both of these positions were filled by Michelle Prats. She has worked and continues to work out very well in these endeavors. Additionally, we were fortunate to have Craig Perry who worked with us as part of his 400 hour internship for the Florida International University's Parks and Recreation degree and has now been hired as our FIU Resource Management Intern (ReMI).

We continued to pursue work on the Everglades and Big Cypress Vegetation Map with the U.S. Army Corps of Engineers and the NPS National Vegetation Mapping Program. This year Everglades National Park generously helped with additional support for the Everglades Vegetation Mapping project (\$62,400). These funds are being utilized to support a photo-interpretation key development and to build staff knowledge using the DAT/EM CAPTURE and SUMMIT EVOLUTION software (Summit is the digital stereoplotter program and Capture allows polygon creation).

The small and medium-sized mammals inventory project for BICY and EVER report is complete. There was extensive database cleanup associated with this project and the final report, database, and associated photos and files are in the process of being bundled with metadata into a final deliverable DVD.

We have completed one vegetation map report this year (BISC). In addition, there was one vegetation map project generally completed but in final stages of having final reports sent out for review (VIIS). There are two other vegetation mapping projects requiring extensive effort: EVER/BICY and BICY western. EVER/BICY is in its second year of a six year project. This is a collaborative project with the U.S. Army Corp of Engineers (USACE) as part of Everglades Restoration. The National Vegetation Mapping program of the NPS has provided \$180K in funding to help support the EVER/BICY vegetation mapping project. This funding will support

staff time managing the project and conducting the field work that is required to produce an objectively validated map. The western BICY vegetation map report will be completed in FY13.

We are still working on the development of the monitoring protocol for colonial nesting birds (Great White Heron, Great Egret, and Double-crested Cormorant) in BISC. The protocol is mostly complete and all SOPs and a database have been developed. We have begun internal SFCN review.

The Community Ecology group made progress on our Forest Ecotones and Community Structure and Mangrove-Marsh Ecotones vital signs in FY12. We tested the feasibility of the Generalized Random Tessellation Stratified (GRTS) methodology in SARI and determined it had logistical constraints that made it impossible to use this sampling design, so we shifted to a restricted stratified random design in order to attempt to have a spatially balanced random approach. We installed an additional ecotonal monitoring site in EVER and digitized and field evaluated a second ecotonal line. We installed 3 permanent plots in SARI and 2 in DRTO. Additionally, we sampled legacy plots in BISC and EVER. The digitizing of the Long Pine Key vegetation map was begun by Derek S. (a high school student volunteer).

We installed a Soil Elevation Table site in SARI. The corridors of invasiveness protocol is complete and is awaiting its official number. The 2012 summary data report will be completed shortly. We continue to collaborate with Dr. Jen Rehage (FIU) in understanding exotic fishes in canals, a Critical Ecosystem Studies Initiative (CESI) funded project. Additionally, we evaluated differences in nighttime and daytime electrofishing sampling. Once we complete an analysis of the FIU CESI data series and incorporate findings about nighttime sampling we should be able to finish a draft protocol in FY13. The pilot work for periphyton vital signs needed a better temporal understanding so that we can finish this protocol. We were able to evaluate the U.S. Fish and Wildlife Service Macroinvertebrate sampling protocol.

The Community Ecology Branch worked on a U.S. Fish and Wildlife Service Coastal Program Grant to fund the Schaus Swallowtail Butterfly (*Heraclides aristodemus pnoceanus*) habitat enhancement in Biscayne National Park. We helped plant 2,332 seedlings. Most of these were torchwood, *Amyris elemifera*, the larval host plant of the endangered Schaus Swallowtail Butterfly. Additionally, we collaborated with Dr. Marguerite Toscano (Smithsonian Institution) to sample peat cores in BISC to help measure long-term sea level rise rates. Finally, we have mostly completed the field work associated with the National Park Service/USGS Water Quality Partnership Baseline Aquatic Contamination and Endocrine Status in a Resident Fish Species of Biscayne National Park and in the Adjacent Coastal Environment (3 year and \$300K USGS internal funds). This is a collaborative effort with the USGS's Dr. Tim Bargar (Florida Integrated Science Center) and Dr. David Alvarez (Columbia Environmental Research Center).

We successfully competed for funds for the National Park Service/USGS Water Quality Partnership project "A Predictive Model to Manage Seagrass Community Characteristics based on Existing Water-quality and Ecological data" (\$50K), National Science Foundation Long Term Ecological Research Experience for Undergraduates internship program (\$5K), George Wright Climate Change Intern (\$5K), and an Albright Scholarship (\$2.8K).

The Community Ecology Branch has made six presentations of its work this year and led one college course field sampling class, as well as one vegetation map botanical training class, led a field trip for Deputy Associate Director Gayle Hazelwood, and assisted with a climate change field trip for the Society of Environmental Journalist.

New Staff

Michelle Prats – George Melendez Wright Climate Change Intern and previously National Science Foundation Research Experience for Undergrads (REU).

Michelle Prats is currently working with the SFCN as the 2012 George Melendez Wright Climate Change Intern through the National Council for Science and the Environment (NCSE). She is completing her B.S. at Florida International University in Environmental Studies and is particularly interested in terrestrial community ecology and scientific communication. She hopes to find a way to apply her previous B.A. in English to the communication of scientific research for managers, policy makers, and the general public. The project Michelle is currently working on focuses on mangrove-marsh ecotonal movement and soil surface elevation monitoring in mangrove habitats as long term indicators of climate change. Previously, she was serving the SFCN as a FIU National Science Foundation Research Experience for Undergraduates (REU), as part of the Florida Coastal Everglades Long Term Ecological Research Program (FCE-LTER).



Craig Perry – Resource Monitoring Intern

Craig Perry is a student intern with the SFCN through Florida International University. He started with SFCN as a volunteer in February of 2012, and was hired for a resource management internship (ReMI) in May of 2012. His main duties with SFCN are working on a US Fish and Wildlife grant for habitat enhancement to promote the Schaus Swallowtail, an endangered butterfly species endemic to the barrier islands of the upper keys, and Biscayne National Park. However, Craig is also involved in multiple vital sign monitoring projects such as colonial nesting birds, electrofishing, crested goby collection, and sediment elevation tables. He currently holds an associate's degree from Miami Dade College in liberal arts and will graduate in the fall of 2012 with a bachelor's degree in sports and recreation within the park management track, as well as obtaining a certificate of environmental studies. Craig is a born and raised South Florida native who has always enjoyed nature and the outdoors, and is currently thrilled to be working in the environmental field towards conservation.



Inventories

Everglades National Park (EVER) Vegetation Mapping Project – *In progress (year 2 of 6)*

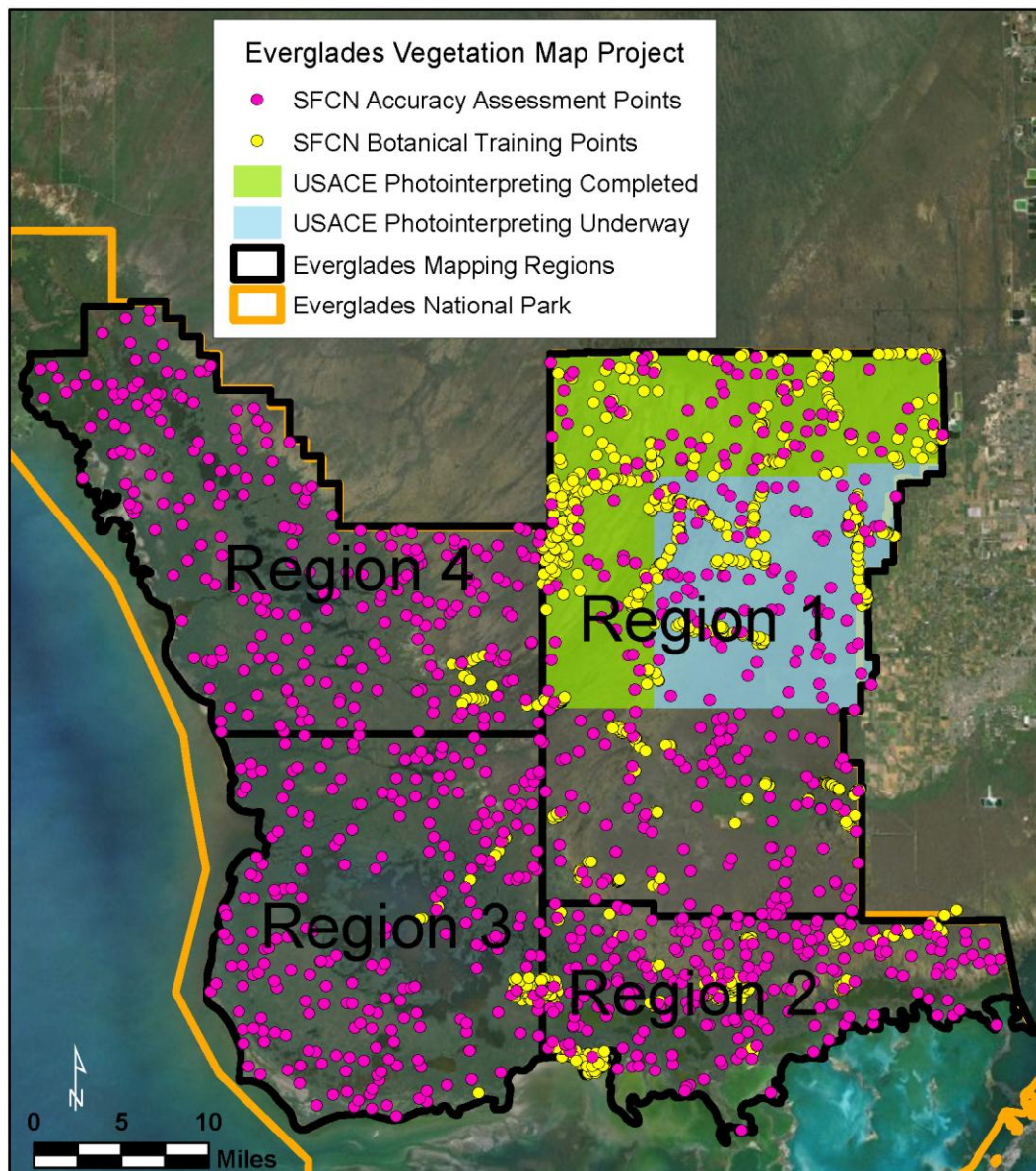


Figure 33. Everglades National Park vegetation map photointerpretation regions, accuracy assessment points, and training points.

Project Overview

The project goal is to create a vegetation map of Everglades National Park (EVER) and Big Cypress National Preserve (BICY). These two parks are the only portions of the greater Everglades Comprehensive Everglades Restoration Plan (CERP) that have not been mapped. This is a joint project between the United States Army Corps of Engineers (USACE) who is performing the photointerpretation and the National Park Service (NPS) who is providing field logistic support, botanical training, and ground truthing (map accuracy assessment) (Figure 33).

The CERP vegetation mapping effort encompasses the entire Greater Everglades (GE) landscape, over 2.4 million acres, that include Corbett Water Management Area (WMA), Pal-Mar WMA, Rotenberger WMA, Holeyland WMA, Loxahatchee National Wildlife Refuge, Water Conservation Area (WCA) 2A, WCA 2B, WCA 3, EVER, BICY, BISC, and SE Dade/C111 wetlands. The entire landscape has been divided into 50m x 50m grid cells as a minimum mapping unit. Photointerpretation of each grid cell is performed by superimposing the two-dimensional grid over three-dimensional stereo imagery. Each distinct vegetation community is designated according to the “Vegetation Classification System for South Florida Natural Areas” (Rutchev et al. v6.15.09) where the dominant vegetation community type within the cell is the driver for the classification. The South Florida Water Management District (SFWMD) acquired the imagery for the majority of this project (April 2009 aerial imagery) at a cost of \$190,000 with RECOVER funds.

The current mapping project will be accomplished by completing all six remaining mapping GE regions within EVER and BICY. Each region is subdivided into four sections. After completion of each section the classification data is then submitted for QA/QC evaluations and the final map accuracy assessments are completed. The completed products will be available as the regions are completed and verified for accuracy.

The field component of this project is being accomplished by the National Park Service’s South Florida/Caribbean Network (SFCN), and is critical to the map’s timely completion and overall accuracy. The SFCN botanical personnel provide the USACE photointerpreters with botanical training each year. Photointerpreters (PI) receive training in basic knowledge of South Florida ecology, botany, and plant identification to enhance their ability to interpret imagery and produce accurate classifications. SFCN also provides training point field data that allows for the creation of a photointerpreter’s key for vegetation annotation. Concurrent accuracy assessment (ground truthing) of the regional maps helps anticipate and mitigate mapping errors. A minimum of 210 randomly selected grid cells are chosen per region for an accurate and detailed field-based ground truthing. SFCN’s work is improving map accuracy by reducing the time lag between initial photo acquisition, interpretation, and ground-truthing. This increases the project’s efficiency and reduces errors due to vegetation changes caused by disturbance events such as hurricanes, freezes, or fires.

This project will produce a highly accurate and spatially complete vegetation map of EVER and BICY with over 80% accuracy and 90% confidence for all field checked attributes. This project will generate over 4,000 spatially explicit training point locations and approximately 1,000 accuracy assessment locations documenting existing vegetation. The field assessment is an essential validation of the accuracy of the final product, ensuring the long-term usefulness of the map.

An accurate vegetation map will provide the essential baseline information to detect and document the changes in the spatial extent, pattern, and proportion of the different plant communities in the ecosystem as they respond to hydrological modifications due to CERP/RECOVER restoration efforts and/or climate change related impacts. Additional ancillary products generated from this mapping project include a landscape level network of spatially

balanced vegetation data that will include species level relative abundance estimates supported by geo-referenced photograph.

Project Status

USACE photointerpreters have completed photointerpretation and QA/QC of Region 1 Section 1. Photointerpretation of Region 1 Section 2 is completed and it is undergoing QA/QC by USACE. Photointerpretation is complete for 74% of Region 1 Section 3 and 15% of Region 1 Section 4. The SFCN will conduct an accuracy assessment of the map once an entire region is completed.

A total of four week-long botanical training sessions have been conducted with USACE personnel as part of their field training over the entire project. This year, we have collected data for 319 training points bringing the project total to 941 training points. Each training point has field collected vegetation data, geo-reference photographs, and is classified to provide support for the photointerpreter's vegetation classification key. The SFCN has spent 770 person hours in the field on this project (with no accidents occurring). Development of a photointerpreter's vegetation classification key began in 2012, in collaboration with USACE and Florida International University (Daniel Gann, Dr. Jenny Richards, and Pablo Ruiz). Field vegetation data has been shared with these partners via DVD.

We collected data for 464 accuracy assessment points in FY12. To date, a total of 988 accuracy assessment points have been visited and classified for Regions 1, 2, 3, and 4. The overall project has a goal of 1,020 accuracy assessment points to check the vegetation map of all of EVER.

Draft vegetation maps and site specific field data has been exchanged with a number of other Everglades' research projects. The Everglades Landscape Vegetation Succession (ELVeS) model developers use the site specific field data to help parameterize their models. Florida International University remote sensing scientists use the site specific field data to help train computer algorithms. The map products are also being utilized by the Natural Resource Condition Assessment (NRCA) for Everglades National Park and are being compared to the Primary Study Units (PSU) intensive site specific vegetation mapping project.

Reference:

Rutchev, K., T.N. Schall, R.F. Doren, A. Atkinson, M.S. Ross, D.T. Jones, M. Madden, L. Vilchek, K.A. Bradley, J.R. Snyder, J.N. Burch, T. Pernas, B. Witcher, M. Pyne, R. White, T.J. Smith, J. Sadle, C.S. Smith, M.E. Patterson, and G.D. Gann, 2006. Vegetation Classification for South Florida Natural Areas. USGS Open File Report 2006-1240, Saint Petersburg, Florida. Version 6.15.09.

Virgin Islands National Park (VIIS) Vegetation Mapping Project – *Report in review*

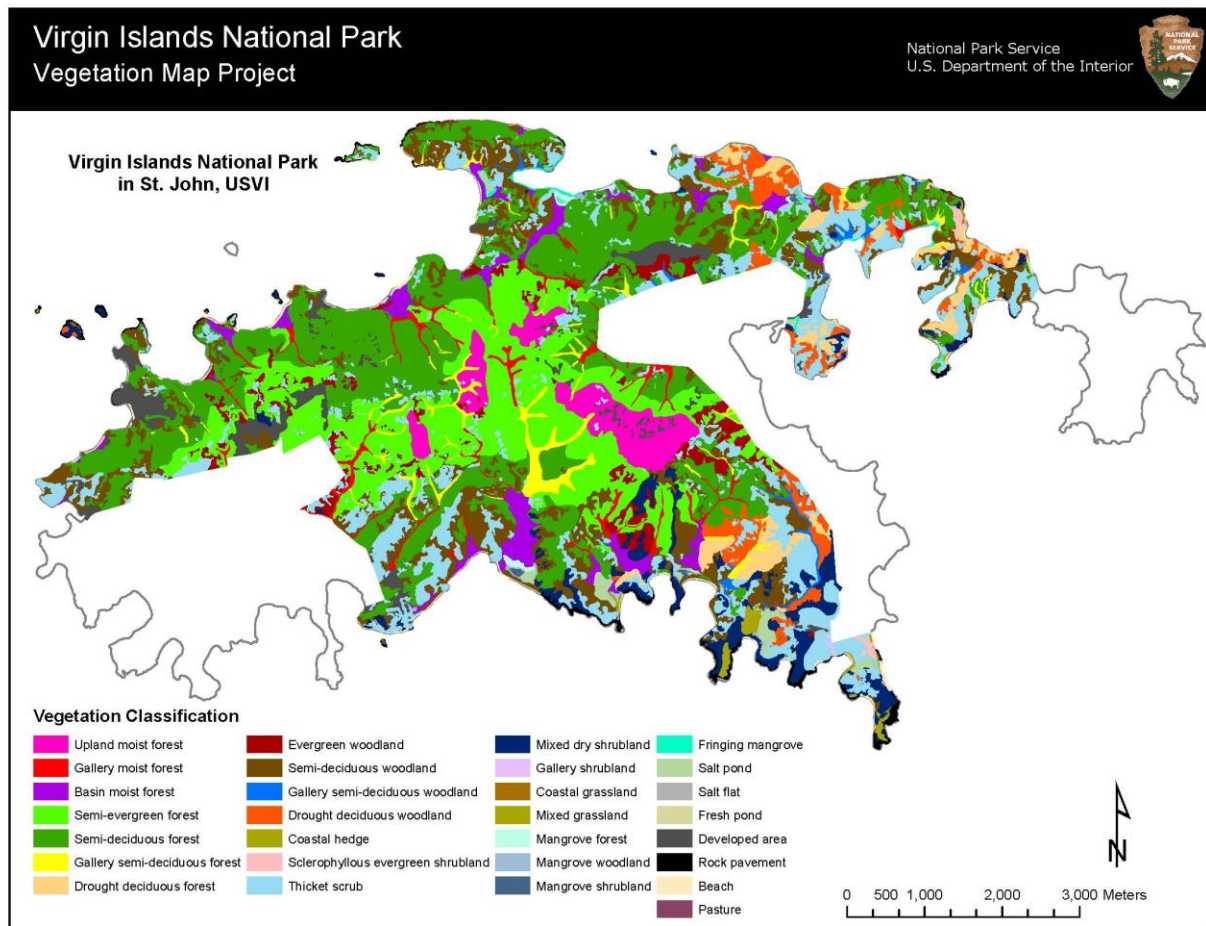


Figure 34. Virgin Islands National Park vegetation mapping project.

Project Overview

A vegetation map of Virgin Islands National Park (VIIS) was produced by the Eastern Caribbean Conservation Data Center in the University of the Virgin Islands (UVI) in 2001. This map classifies vegetation from the shoreline to the highest peak of the park, using 1994 aerial imagery. Anecdotal conversations with park staff that had limited use of the map indicated that the map was relatively accurate; however, there was not a formal accuracy assessment of the product at the time it was created. SFCN assessed the accuracy of the map to determine whether it met NPS Vegetation Mapping Inventory Program requirements by visiting 133 accuracy assessment locations. The result indicated a 40% rate of classification accuracy for this map.

Consequently, SFCN has attempted to correct a number of shortcomings of the UVI vegetation map. This was accomplished by using newer aerial imagery (2007) which included Red, Green, Blue Bands (RGB), Green Red Vegetation Index (GRVI), and Albedo layers. Additionally, manipulation of 3m and 5m Light Detection and Ranging (LiDAR) sensor datasets, that included a Bare Earth and first return LiDAR layer, allowed SFCN to generate elevation, slope, and vegetation wedge (vegetation height) data sets in order to further adjust the map.

Analysis of field data collected to check the UVI map enabled the creation of an error matrix which identified some obvious errors. Refinement of the vegetation classification along with all the above mentioned procedures facilitated photointerpretation and creation of a new map (Figure 34).

Project Status

The map has been completed. A total of 133 locations were visited between May and October of 2009 to assess the original UVI map.

SFCN visited another 108 locations in April of 2011, and also used 22 additional data points from the US Forest Service's Forest Inventory and Analysis (FIA) program to check and assess the newly created NPS vegetation map. These visits revealed that the new map was 83% accurate with a 90% confidence interval.

SFCN has compiled a summary project report which contains the SFCN's accuracy assessment report as well as appendices including a map with the final vegetation classification polygons, an accuracy assessment report, an error matrix between the UVI map and the SFCN map, descriptions and photos of the map's vegetation classes, a photo-interpretation key, and a sample field data sheet. The summary report meets the format required by the National Vegetation Mapping Inventory Program. This document will be submitted for review. The final products will be submitted to the National Vegetation Mapping Inventory Program, as well as the parks and its partners as an interactive DVD.

Terrestrial Vegetation of Biscayne National Park (BISC), derived from aerial photography, NDVI, and LiDAR– *Final map deliverable accepted, final report completed*

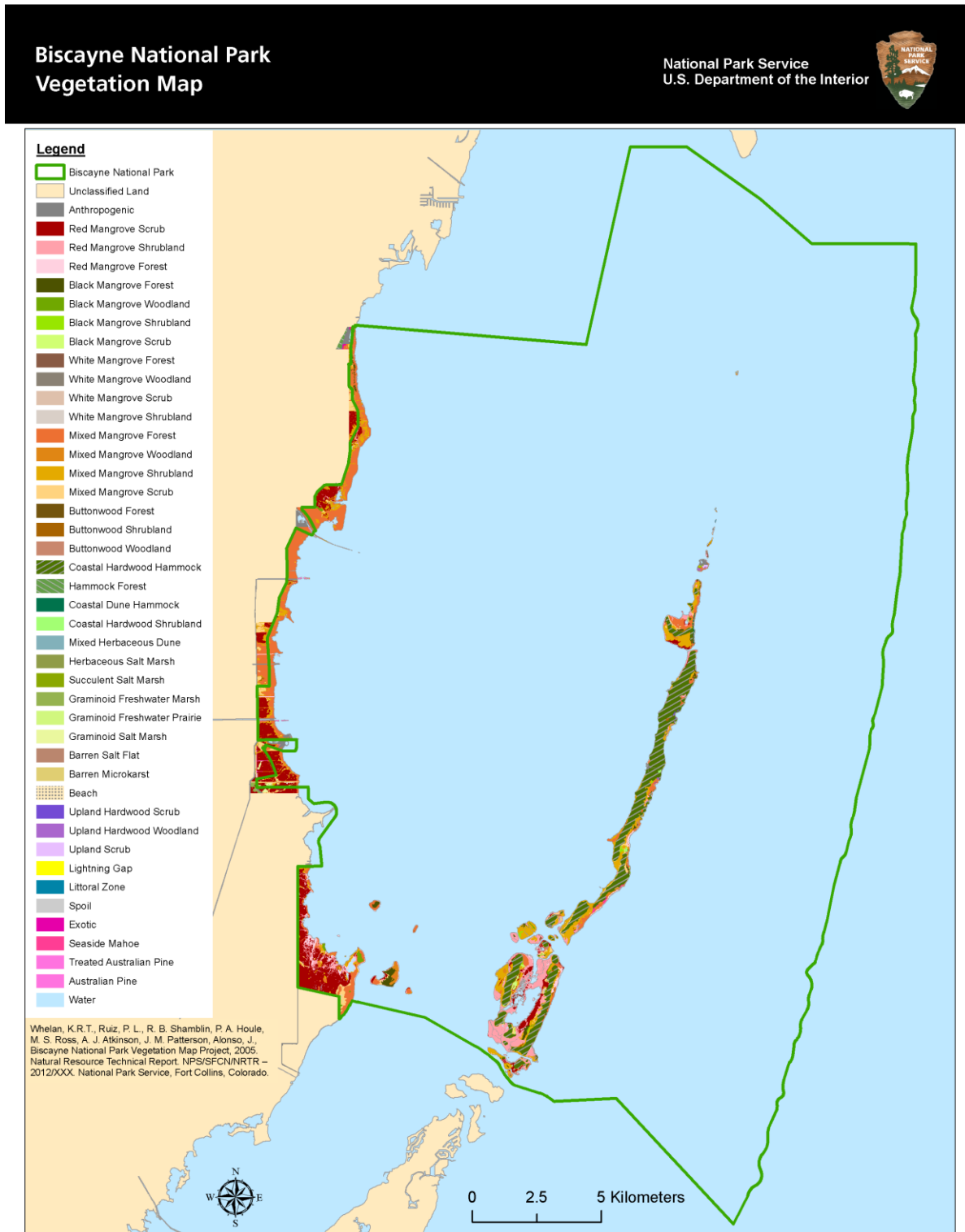


Figure 35. Biscayne National Park vegetation mapping project.

Project Overview

BISC includes 41 mangrove-dominated islands with extensive areas of tropical hardwood hammock, as well as a narrow strip of mangrove-dominated shoreline on the mainland. The vegetation map was created by Pablo L. Ruiz, Patricia A. Houle, and Michael S. Ross of Florida International University with funding from the National Vegetation Mapping Inventory Program. Polygon creation depended primarily upon 2005 aerial imagery (30cm, 5-band), Normalized Difference Vegetation Index (NDVI), and 2002 LiDAR data (mainland only). The vegetation map features a six-level hierarchical vegetation classification system (Rutchev et al. 2006), with all polygons defined to at least the third level.

Map deliverables were received in February, April, May, June, and December 2008, with the latest version covering the entire park. Metadata for the geodatabase has also been completed. The December draft divides 20,913 acres into 4,987 polygons representing 102 vegetation classes. During map creation, 1,081 ground check points were visited by boat, on foot, or helicopter by the FIU and SFCN staff. Pablo Ruiz wrote an accompanying report detailing how the map was created using eCognition software for map generation, and the strengths (shorelines and obvious distinctions) and weaknesses (subtle vegetation distinctions) of the software.

SFCN checked the positional accuracy of the vegetation polygons with field visits to clearly identifiable features including corners of docks, seawalls, sidewalks, and lighthouse and centers of small red mangrove tree islands. A total of 25 points were visited with Trimble ProXR or GeoXT GPS units in January 2009. The average error was 1.3m with an RMSE of 1.4m and maximum detected error of 2.9m.

SFCN checked the horizontal accuracy of the aerial imagery in November 2007 with field visits to 13 ground control points. Using both Trimble ProXR and GeoXT GPS units, the average error was 1.5m, with an RMS error of 1.6m.

SFCN's accuracy assessment of the map classification began in August 2008 and was completed in January 2009. Between 5 to 30 classification accuracy assessment points per vegetation category were randomly selected for a total of 390 accuracy assessment points. Points were 314m² (circle with radius 10m) and randomly chosen from all possible vegetation category area or randomly chosen from possible small polygons. Points closer than 10m to an edge were moved inwards towards center of the polygon. The current 2008 BISC vegetation map's overall accuracy at the most detailed level was assessed to be 83% (326 of 390 points correct) with a lower 90% confidence level of 80.5% accuracy. SFCN has completed its accuracy assessment report.

Project Status

The final map was submitted by the cooperator and the accuracy assessment completed in FY09. The map has been updated with the results of the accuracy assessment (Figure 35). SFCN has compiled a summary project report which contains the FIU report and SFCN's accuracy assessment report as appendices and is putting all the project pieces in the format required by the National Vegetation Mapping Inventory Program. The final products will be submitted to the National Vegetation Mapping Inventory Program, as well as the park and its partners as an interactive DVD in FY13.

Reference:

Rutchev, K., T.N. Schall, R.F. Doren, A. Atkinson, M.S. Ross, D.T. Jones, M. Madden, L. Vilchek, K.A. Bradley, J.R. Snyder, J.N. Burch, T. Pernas, B. Witcher, M. Pyne, R. White, T.J. Smith, J. Sadle, C.S. Smith, M.E. Patterson, and G.D. Gann, 2006. Vegetation Classification for South Florida Natural Areas. USGS Open File Report 2006-1240, Saint Petersburg, Florida.

Terrestrial Vegetation of western Big Cypress National Preserve (BICY), and northwestern Everglades National Park (EVER)– Final deliverable accepted. Final report to be completed in FY13.

Project Status: All deliverables from the contractor have been received and accepted (Figure 36). The SFCN will compile a summary project report document which contains the contractor's report and SFCN's accuracy assessment report as appendices and putting all the project pieces in the format required by the National Vegetation Mapping Inventory Program. The final products will be submitted to the National Vegetation Mapping Inventory Program, as well as the parks and partners as an interactive DVD. The intent is for this map to merge seamlessly with the vegetation mapping project with currently being conducted by the SFCN and USACE for EVER/BICY.

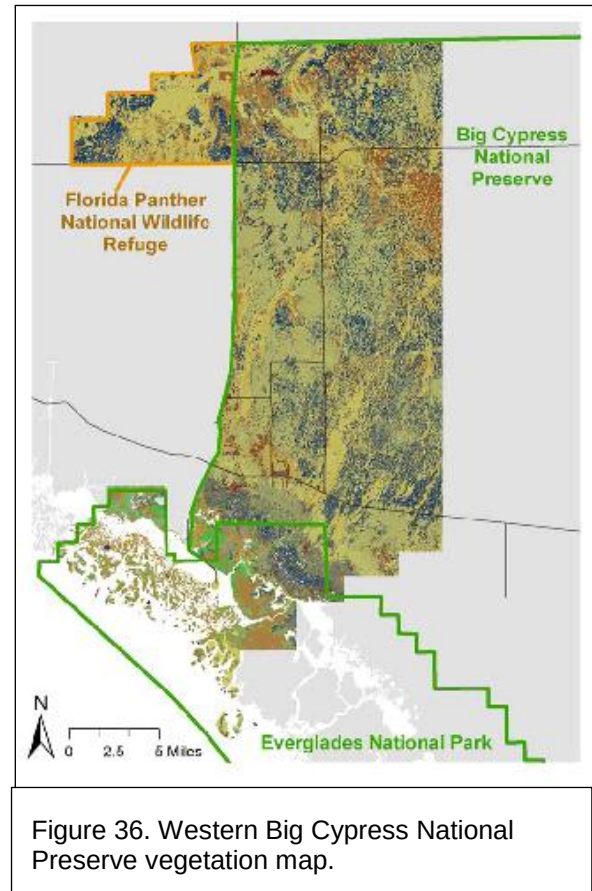


Figure 36. Western Big Cypress National Preserve vegetation map.

Small & Medium Mammals Inventory (BICY, EVER)

Project Status: The University of Florida and U.S. Geological Survey collaborated on the small and medium sized mammal inventory for Everglades National Park and Big Cypress National Preserve. Most of the inventory work was within 500m of a road or trail. A draft report was submitted and reviewed by SFCN and comments were returned. However the cooperators did not choose to make any final changes so the small and medium sized mammals inventory project report is considered complete. There was extensive database cleanup associated with this project and the final report, database, and associated photos and files are in the process of being bundled with metadata into a final deliverable DVD.



Bobcat cub photographed by automated camera station during inventory, BICY.

Vital Signs Monitoring

Colonial Nesting Birds Vital Sign (BISC)

Accomplished in FY12: Colonial nesting birds such as Great Blue Herons, Great Egrets, White Ibis, and Double-crested Cormorants are an important vital sign of the health of many national parks. Monitoring the nesting success of colonial nesting birds provides a measure of the habitat's ability to support foraging and breeding requirements. The acts of selecting mates, building nests, laying eggs and rearing chicks, are energy intensive. If the habitat is insufficient to support these activities, the nesting success will suffer and may indicate a problem in the ecosystem.

The SFCN completed its fourth year of monitoring colonial nesting birds in Biscayne National Park (BISC). The results of monitoring have yielded valuable nesting data (Table 6; Figures 37 and 38) that will allow for the observation of species-specific nesting pattern trends.

The monitoring consists of taking photographs of nesting activities of six island-colonies. Photographs are taken monthly from a helicopter. The photographs are analyzed for active nests and compared sequentially to ensure nests are not double-counted. The nest counts are recorded and entered into a newly developed Microsoft Access database. The new database allows input from observed data (notes from field sheets) and photographs taken (Figure 39). The information will be used to determine long-term trends in nesting populations of colonial birds in BISC.

The collected data (through 2011) has been entered into the Access database and verified for accuracy. The field data sheets and the photo processing data sheets were modified to correspond more closely with each other and the Access database. These modifications provide faster and more accurate data handling and processing. The Colonial Nesting Bird Protocol is in the final stages of development and should be ready for editing and review by the end of 2012.

The species of birds in BISC can be broken down into three functional types based on their feeding behavior: divers, stalk and strike, and tactile. Double-crested Cormorants are divers and the most abundant bird in BISC with 95% of the nests (note the quantities of nests for the Double-crested Cormorants and the selected species on Figure 37 and 38 below). Different nesting seasonality is evident for the various species, as well as for species with similar feeding methods. Roseate Spoonbills and White Ibis are both tactile feeders, yet each species nests during different seasons. These trends provide indicators of conditions in the park that support nesting behavior.

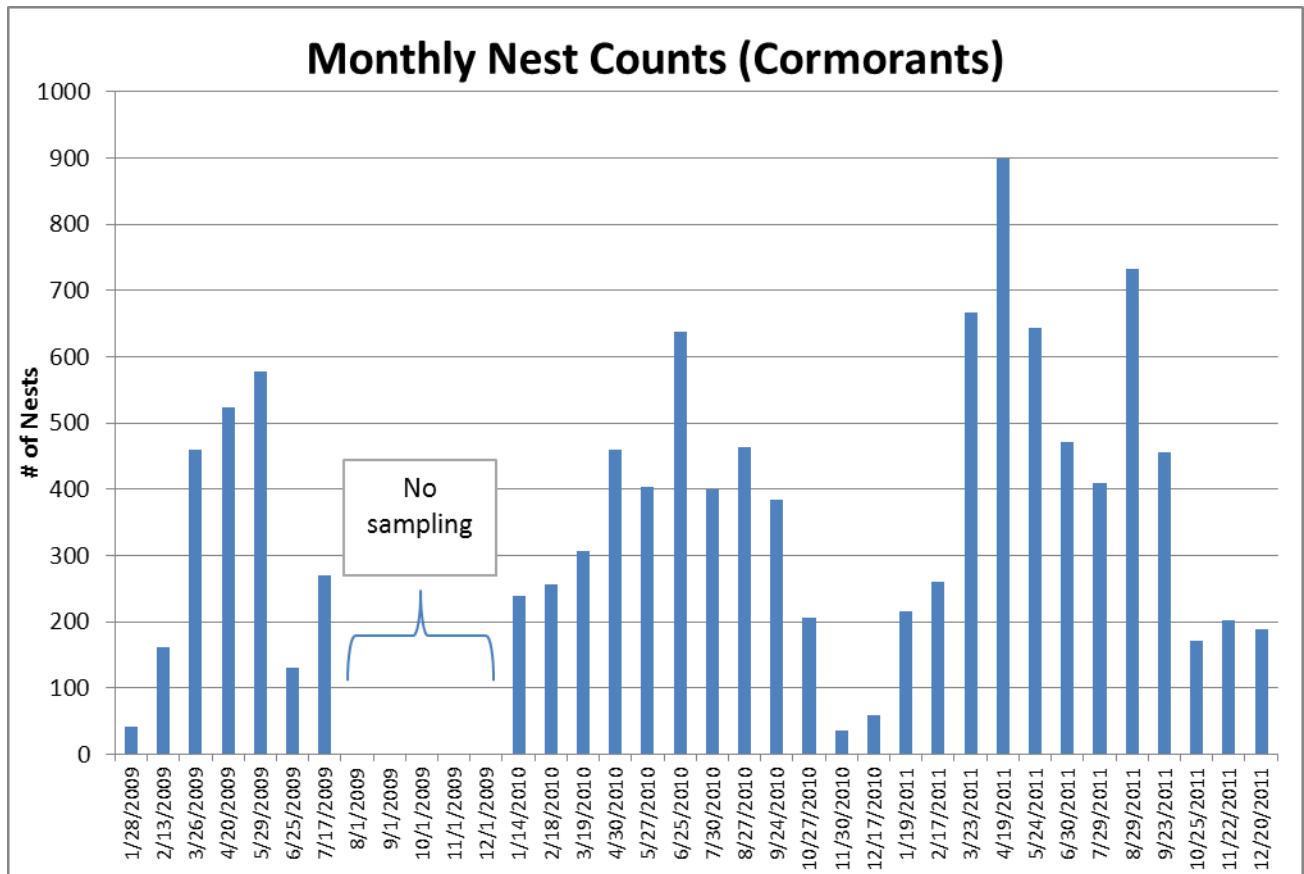


Figure 37. Number of Double-crested Cormorant nests per month, as well as the peak nesting periods.

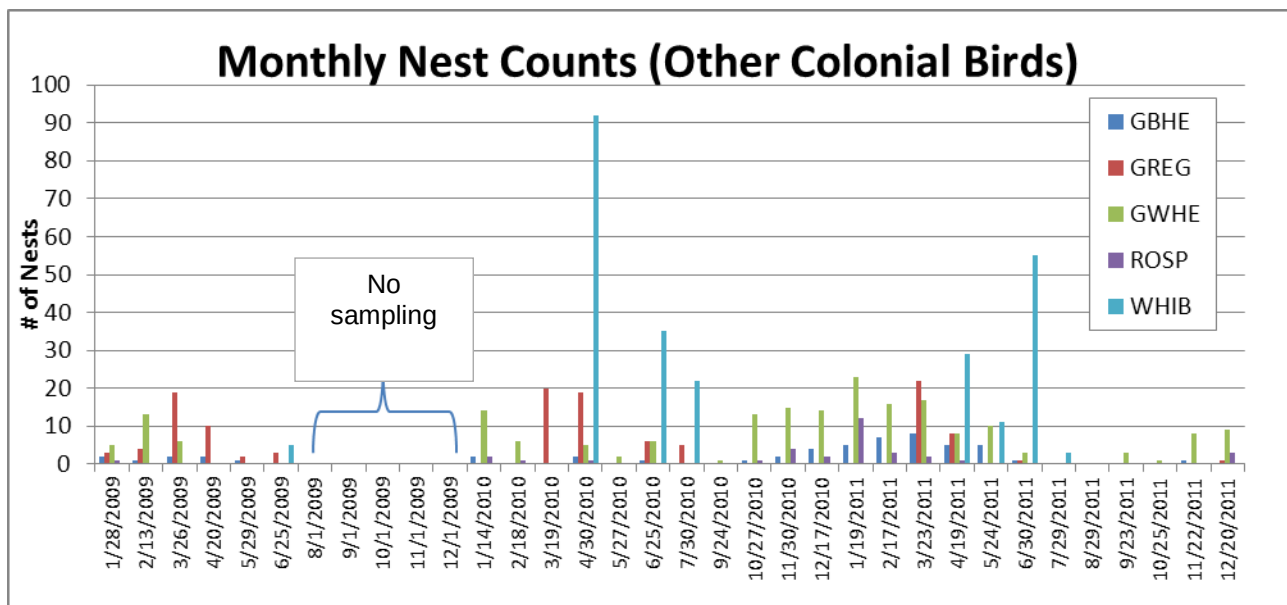


Figure 38. Number of nests of selected species [Great Blue Heron (GBHE), Great Egret (GREG), Great White Heron (GWHE), Roseate Spoonbill (ROSP), and White Ibis (WHIB)]. The seasonality patterns are evident after only three years of data. The no sampling gap occurs between the initial pilot study which assumed that sampling would only occur seasonally and a revised pilot study which attempted to capture year-round variation in nesting as it became clear that coastal nesting patterns differed from inland.

Table 6. Totals of occupied nests counted by species and month for the calendar year 2011. Double-crested Cormorants account for 94.7% of the counted nests. (Note: An occupied nest contains an egg, chick or adults in immediate proximity with signs of occupation. As nesting can take longer than one month, occupied nests may be counted in multiple months.)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Double-crested Cormorant	215	261	666	900	644	471	409	732	455	172	202	188
Great Blue Heron	5	7	8	5	5	1					1	
Great Egret			22	8		1						1
Great White Heron	23	16	17	8	10	3			3	1	8	9
Roseate Spoonbill	12	3	2	1								3
White Ibis				29	11	55	3					
Grand Total	257	287	717	952	670	531	414	732	458	173	213	206

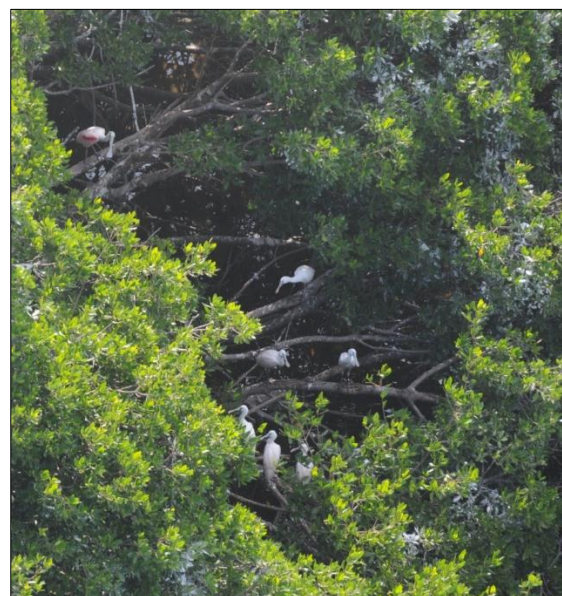


Figure 39. (Left) The SFCN colonial bird monitoring database. (Right) Roseate Spoonbills (*Platalea ajaja*) (an adult and 6 juveniles) on a mangrove island in Biscayne National Park.

For the year 2012, one monitoring flight was performed in BICY. No colonial nesting activity was observed during the flight. Locations of roosting sites have been added to the database to help direct observations in FY13. This information was passed on to BICY resource management and to Dr. Peter Fredrick at University of Florida who conducts monitoring as part of the Comprehensive Everglades Restoration Plan Monitoring and Assessment Plan.

Using input from BUIS, VIIS, and EVER, the SFCN has authored SOPs for colonial bird monitoring in their respective parks. These have been reviewed by appropriate park staff and are complete.

Continuation in FY13: SFCN will continue monthly helicopter flight monitoring in BISC. The Colonial Bird Monitoring Protocol and SOP for data reporting will be completed. In the nesting season of 2013, the SFCN plans one fixed-wing aircraft flight through BICY searching for confirmation of bird colonies. Dr. Peter Frederick's monitoring efforts continue to receive funding from CERP- RECOVER so this colonial monitoring collaboration should continue in FY13.

Forest Ecotones and Community Structure, Mangrove-marsh Ecotone, Wetland Ecotones and Community Structure Vital Signs (BICY, BISC, BUIS, DRTO, EVER, SARI, VIIS)

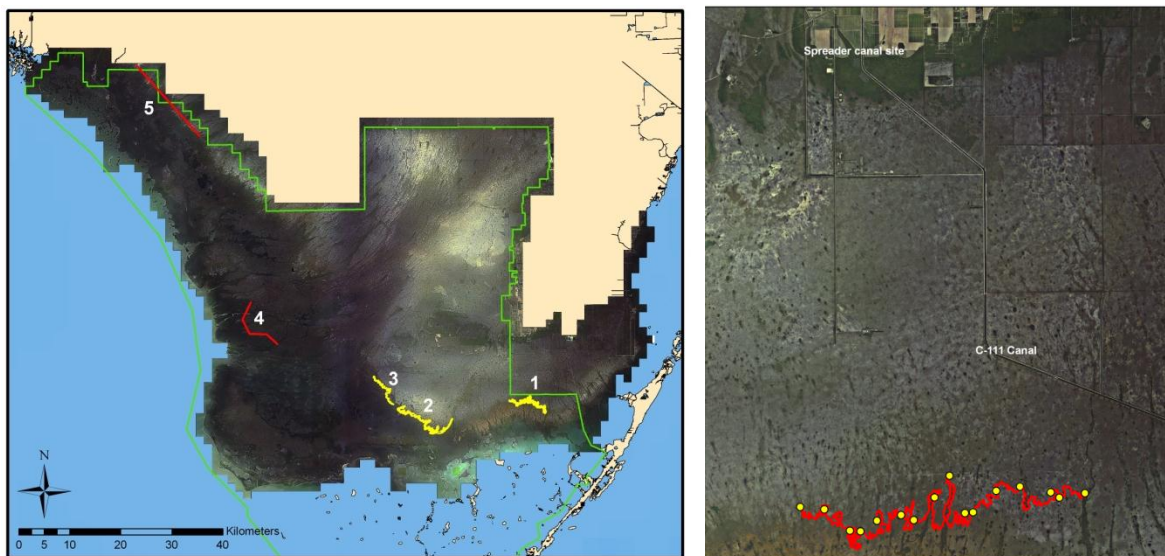


Figure 40. (Left) Installed and proposed mangrove-marsh ecotone sites (left side image). Site 1 is the Spreader Canal area in eastern Taylor Slough. Site 2 is the main Taylor Slough. Site 3 is in the Mahogany Hammock area. Site 4 is in the main Shark Slough area; and site 5 is in the Ochopee area and traverses both EVER and BICY. The sites in yellow (sites 1-3) have been installed and the sites in red (4, 5) are still in the digitizing process. (Right) Mangrove-marsh ecotonal movement monitoring area installed south of the Taylor Slough spreader canal in EVER, showing digitized ecotonal boundary (red line) and ground truth sites (yellow points).

Accomplished in FY12: Implementation of the third mangrove-marsh ecotone monitoring area was completed; south of the C-111 Spreader Canal project in eastern Taylor Slough (Figure 40). A total of 16 witness posts were installed along the ecotone line for the purpose of detecting ecotonal change in the future. A fourth mangrove-marsh ecotone area south of Ochopee in northwest EVER has been digitized and an initial scouting of the digitized line was completed by airboat. The fifth mangrove-marsh ecotone area has been identified in the southern Shark Slough area of EVER. Work on the digitized ecotone line has begun and will continue into FY13. These two areas cover more than 120km of mangrove-marsh ecotone using a method that combines remote monitoring with aerial imagery and on-the-ground field measurements in order to obtain a regional perspective.

SFCN also continued the process of site selection for core forest monitoring plots. An oversample draw of points, using Generalized Random Tessellation Stratified (GRTS) methodology, was performed for SARI. Three permanent forest monitoring plots were

established in SARI, two plots in mangrove habitat and a third in a gallery forest (Figure 41). The two mangrove plots were established and sampled, while the gallery forest plot was established and half the plot sampled. The GRTS sampling methodology was found to be inadequate for a number of reasons. The sampling design for site selection has been changed to restricted stratified random sampling.

The Wetlands Vegetation Monitoring SOP has been suspended due to funding changes and reorganization of existing monitoring in EVER as part of the Comprehensive Everglades Restoration Plan (CERP).

Two mangrove forest plots were established and sampled on Long Key in DRTO. Tim Fotinos, the SFCN post-doc contracted to write the Forest Monitoring protocol left for a new job with the U.S. Fish and Wildlife in April 2012, and his departure has delayed the completion of the Forest Monitoring protocol. The Forest Monitoring protocol is mostly complete. We still need to complete the Ecotonal monitoring digitizing SOP, the tree/sapling/seedling database for core plots, the reporting analysis SOP and have the protocol document reviewed. The SFCN staff spent 529.5 field hours working on this vital sign in FY12.

Continuation in FY13: SFCN will establish the two additional mangrove-marsh ecotone monitoring areas (yielding a total of five areas) and conclude year one baseline data collection for this portion of the Forest Vegetation Monitoring Protocol. SFCN will also continue establishing forest structure plots in network park units and begin collecting data for of the Forest Vegetation Monitoring Protocol. Additionally legacy plot evaluation and monitoring will continue as time permits. Due to the departure of Tim Fotinos, the Forest Vegetation Monitoring Protocol will be finished and submitted for external review during FY13.



Figure 41. SFCN crew established two mangrove forest plots and one gallery forest plot in SARI.

Legacy Vegetation Monitoring: Hurricane Andrew Recovery Team (HART) vegetation plots (EVER)



Figure 42. SFCN crew and volunteers locating dwarf cypress HART vegetation plots at Pahayokee in EVER.

Accomplished in FY12: In a collaborative effort, SFCN and Florida International University (FIU) located and re-established the 12 Hurricane Andrew Recovery Team (HART) vegetation plots in FY12 (Figure 42). The HART project began as a project assessing the damage to non-tidal, upland forest communities in the southern Everglades immediately following Hurricane Andrew. This project assessed damage and short term recovery in 3 plots each of hammock, pineland, bayhead, and cypress dome communities. Communities were assessed for an array of metrics including tree damage, tree recovery, changes in seedling recruitment, and changes in soil nutrient availability, among others. The project was originally headed by Dr. Suzanne Koptur, Dr. Steven Oberbauer, and Dr. Kevin Whelan and was conducted for three years following the hurricane's impact with some additional data collected 10 years post-hurricane.

The sites of the HART project are currently being re-established 20 years after hurricane Andrew in order to determine which communities impacted have lasting discernible effects. The project is now led by FIU doctoral candidate Jeremy May with continuing support from Dr. Steven Oberbauer, Dr. Suzanne Koptur, and Dr. Kevin Whelan under NPS permit number EVER-2012-SCI-0031. The re-establishment of the project will revisit all of the sites and metrics previously studied, however will also include a shade/nutrient manipulation experiment on seedling recruitment conducted on the campus of Florida International University. The combination of past and present aspect of this project will help describe how hurricane damage affects each of these communities and ultimately how they recover over short- and long-term time periods.

Continuation in FY13: In FY13, the SFCN will also assist in the resampling of the HART plots.

Legacy Vegetation Monitoring: Biscayne National Park (BISC) – Locating and resampling of permanent forest plots

Accomplished in FY12: All four long-term forest plots on northern Old Rhodes Key were sampled in BISC in FY12 (Figure 43). Initial analyses of the Old Rhodes Key plots indicated an increase of 47 stems and a basal area increment increase of 6,274.96 cm² for the 1,600 m² sampled. This initial analysis suggests a higher recruitment rate than mortality of trees, and in many cases the trees are becoming larger. Pigeon plum (*Coccoloba diversifolia*) showed the greatest gains in both density and basal area, while White stopper (*Eugenia axillaris*) displayed the greatest decrease in both density and basal area (Table 7). The decrease in White stopper density is not surprising as this tree species is considered a pioneer species and their numbers decrease as the forest matures. Recruitment of an additional tree species (*Simarouba glauca*, Paradise tree) was recorded for the north Old Rhodes plots. In addition, the four long-term monitoring plots on the south end of Old Rhodes Key have been located and are ready for re-sampling in FY13.

Continuation in FY13: SFCN will make the modifications to the Elliott Key plot sampling summary report and prepare it for official submittal. In addition, SFCN will attempt to locate and sample the four long-term monitoring plots located on the south end of Old Rhodes Key.



Figure 43. SFCN crew resampling BISC tree plots on Old Rhodes Key.

Table 7. Total density and basal area of the four plots located on the north end of Old Rhodes Key in BISC. Stem density and basal area both increased since 1998. The four permanent tree plots make up a total area of 1600m².

Species	Density 1998	Density 2011	Basal Area 1998	Basal Area 2011
Amyris elemifera	43	42	821.37	948.54
Ardisia escalionoides	61	72	633.52	756.56
Ateramnus lucida	49	67	676.25	1108.64
Boureria ovata	44	36	1075.83	1159.71
Bursera simaruba	21	22	3914.03	5524.16
Canella winterana	8	10	269.36	326.52
Coccoloba diversifolia	316	479	10919.84	16060.47
Drypetes diversifolia	3	2	79.17	44.35
Drypetes latifolia	20	30	552.84	802.40
Eugenia axillaris	248	146	2392.02	1381.97
Eugenia confusa	3	2	60.77	96.35
Eugenia foetida	43	44	540.72	601.16
Exothea paniculata	2	3	1178.17	1210.69
Ficus aurea	4	3	987.29	860.23
Ficus citrifolia	16	10	1209.34	1044.55
Guapira discolor	29	19	1407.57	1093.11
Guettarda elliptica	4	6	105.24	166.76
Krugiodendron ferreum	18	21	355.94	431.81
Metopium toxiferum	116	93	17193.23	16362.75
Piscidia piscipula	3	5	315.52	547.37
Pithecellobium guadalupense	11	16	319.71	443.78
Schaefferia frutescens	3	3	50.90	50.28
Sideroxylon foetidissimum	3	2	400.55	383.08
Simarouba glauca	0	1	0.00	7.54
Swietenia mahogani	76	57	9078.78	9371.01
Ximenia americana	1	1	29.21	58.35
Total	1145	1192	54567.18	60842.14

Legacy Vegetation Monitoring: Big Cypress National Preserve (BICY) – Locating and resampling of permanent forest plots

Accomplished in FY12: No sampling occurred in FY12.

Continuation in FY13: In FY13, SFCN will attempt to locate, assess, and resample the remaining seven historic vegetation plots in BICY that were established by Gunderson and Loope. These plots will be added to the SFCN Forest Vegetation Monitoring Protocol as part of a set of legacy plots. The work planned for FY13 will conclude our initial resampling of historic plots in BICY.

The return period for revisiting these plots has yet to be determined but most likely will be every 10 years.

Salt River Bay National Historical Park & Ecological Preserve (SARI) – Re-visit of permanent exotic plant removal efficacy vegetation plots.

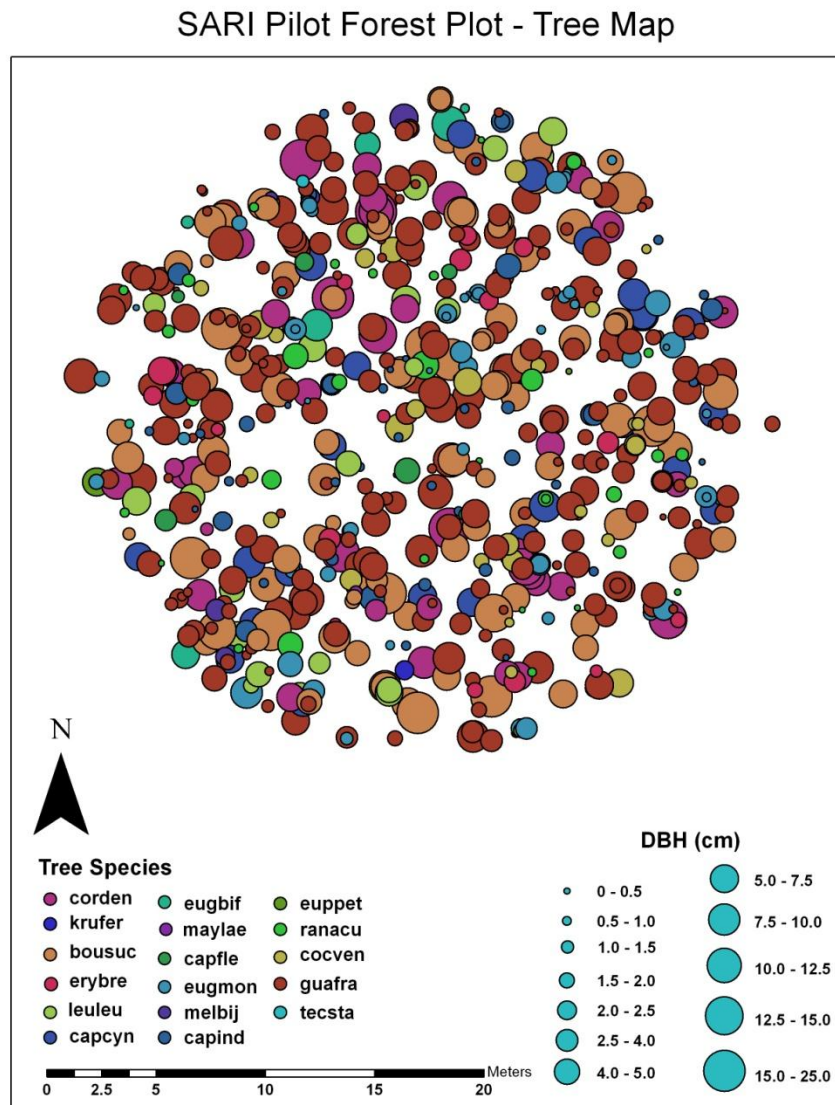


Figure 44. Tree map of permanent exotic plant removal efficacy plot 3 showing size and location of tagged trees in SARI.

Accomplished in FY12: SFCN re-visited the efficacy plots for an update of their condition in January 2012 (Figure 44). The exotic Guinea grass (*Urochloa maxima*) was still dominating the understory of four of the five plots with the presence of 3m tall exotic Tan Tan (*Leucaena leucocephala*) shrubs and dense patches of the native Basket wiss vine (*Serjania polyphylla*). Plots 1 and 2 are located on the eastern region of SARI and the Florida and Caribbean EPMT team has begun a restoration of this area of the park by removing the exotic shrub purple allamanda (*Cryptostegia grandiflora*) and replacing them with many species of native trees and

shrubs. The other plot (Plot 3) is located in a native dry forest which had low exotic plant cover. In this plot, the exotics that were treated (mainly Tan Tan) were still dead with little re-sprouting occurring. Within Plot 3, SFCN completed measuring the trees within the 15m radius circle. A total of 1,013 trees were tagged and measured, with the Black Mampoo (*Guapira fragrans*) as the dominant tree species. In addition, one-quarter of the plot was re-sampled to detect trends in tree growth rate.

Continuation in FY13: The data from Plot 3 is being used in the Forest Vital Sign Monitoring to help determine the proper plot size regarding Forest Structure plots in the Virgin Island parks units. The continuation of the re-census of this plot may be started by groups of students from the University of the Virgin Islands as a teaching exercise in forest monitoring field methods.

Coastal Geomorphology Vital Sign - Soil Elevation Tables (SET)(BISC, SARI, VIIS)



Figure 45. SFCN established a Soil Elevation Table monitoring site in SARI.

Accomplished in FY12: SFCN established a soil elevation monitoring site in SARI (Figure 45). This site selection built upon a scouting trip for potential sites in January 2012. Site selection was constrained by forest tree size, intertidal location, influences from road bed run off and an attempt to minimize vandalism. We have drafted a protocol which builds upon the NPS protocol Monitoring Salt Marsh Elevation Cape Cod National Seashore and the Louisiana Department of Natural Resources Coastal Restoration Division. We sampled the two soil elevation monitoring sites in BISC this year. Additionally, we collaborated with Dr. Marguerite Toscano

(Smithsonian Institution) to sample peat cores in BISC. The SFCN spent 294 person hours in the field working on this vital sign.

Continuation in FY13: We will finish adapting the SFCN SET protocol. We will take initial measurements and establish stage monitoring equipment at the site. We will explore SET establishment in VIIS. We will continue biannual monitoring of the existing SET sites.

References:

Cahoon, D. R., J. C. Lynch, and P. F. Hensel. Monitoring salt marsh elevation: a protocol for the long-term coastal ecosystem monitoring program at Cape Cod National Seashore. U.S. Geological Survey report. Patuxent Wildlife Research Center, BARC-East Bldg 308, 10300 Beltsville Ave., Beltsville, MD 20705. 104 pp.

Folse, T. M. and J. L. West. 2004. A Standard Operating Procedures Manual for the Louisiana Department of Natural Resource's Coastal Restoration Division: Methods for Data Collection, Quality Assurance / Quality Control, Storage, and Products. Louisiana Department of Natural Resources, Baton Rouge, LA. 158 pp.

Lynch, J.C., P. Hensel, and D.R. Cahoon. *DRAFT*. Protocols for measuring and understanding wetland elevation change. Natural Resource Report NPS/NCBN/NRR – 2012/XX. National Park Service, Fort Collins, Colorado.

Invasive/Exotic Plants Vital Sign - Corridors of Invasiveness (BICY, BISC, EVER)

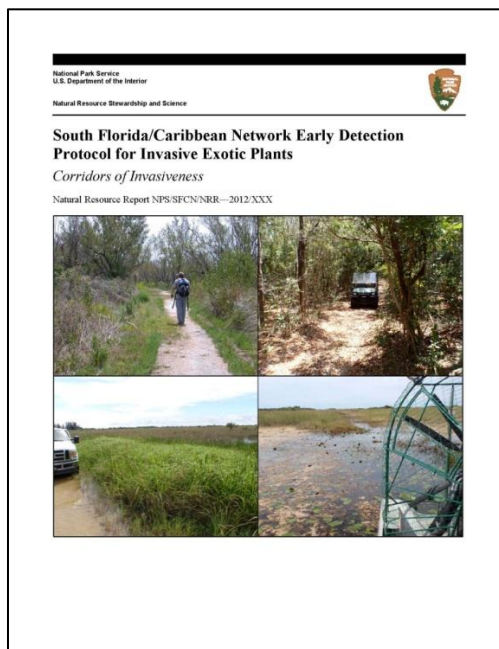


Figure 46. The SFCN Early Detection Protocol for Invasive Exotic Plants is completed and will shortly be sent to the Regional Coordinator for approval.

Accomplished in FY12: The Corridors of Invasiveness Vital Sign monitors for new invasive-exotic plant species establishing along corridors within BICY, BISC, and EVER. Additionally,

our collaboration with the FLACO EPMT allows for early detection and rapid response to these plants. The protocol was completed and sent out for external peer review (Figure 46). The protocol was then returned with suggestions and is now in the final editing stage and due to be sent to the regional office for official submittal early in FY13.

The official second year of field work on this Vital Sign was completed in 2012 in the eastern region of EVER. A total of 317.2 kilometers were surveyed and 52 species of exotic plants found. Of these species, two of them were new to the park exotic plant list although they have been established in the park since the mid-1990's. The new species were the Anil de Pasto (*Indigofera suffruticosa*), and Indian laurel (*Ficus microcarpa*). Small infestations were treated on the spot, while large infestations were reported to the park and to the Exotic Plant Management Team. The SFCN spent 279 person hours in the field working on this vital sign. The summary report for the 2012 surveys in EVER will be completed in early FY13.

Continuation in FY13: Final edits and re-submittal of the protocol will be completed early in FY13. The 2012 summary report for the EVER surveys will be completed and submitted for official acceptance. Implementation of this protocol in BICY will start in spring of 2013 and a summary report for the findings that year will be started.

Invasive/Exotic Animals Vital Sign (EVER, BICY)

Accomplished in FY12: SFCN conducted a daytime/nighttime electrofishing study in canals along the periphery of Everglades National Park (EVER). The goal of this pilot study was to determine the difference between day and night electrofishing based on the following two parameters: number of fish collected and species richness. Our vital sign focuses on the detection of new non-native fish species in canals. Thus, the time of day yielding higher catch rates and greater number of species would prove the most efficient to meet our monitoring needs. Three canals bordering EVER were selected and four pairs of locations within each canal were sampled (12 locations, 24 sites total). Designated day and night location sites were visited during a 24-hour period. Sampling took place in the early to mid-wet season, from June 25 to July 27.

Overall, the number of fish collected and number of species was greater for night electrofishing than for day electrofishing (Figure 47, A and B; Figure 48). A paired Student's *t*-test was used to analyze the paired day and night bouts from the 12 locations and found the differences in both catch and species richness to be significant ($p = 0.024$ and $p = 0.027$, respectively). The eight most abundant species were used to determine any difference in standard length between day and night electrofishing. The species list consisted of four centrarchids (largemouth bass, bluegill, redear, and warmouth) and four cichlids (peacock bass, Mayan cichlid, spotted tilapia, and blue tilapia). A paired Student's *t*-test was again used to analyze the standard length of the eight species collected from the paired sites and found night electrofishing length to be significantly greater ($p = 0.001$) than day electrofishing length (Figure 47, C).

The SFCN continued their collaboration with Dr. Jennifer Rehage of Florida International University (FIU) who conducted the third year of their Critical Ecosystem Studies Initiative (CESI) project, which is investigating how man-made canals function as habitat for both native

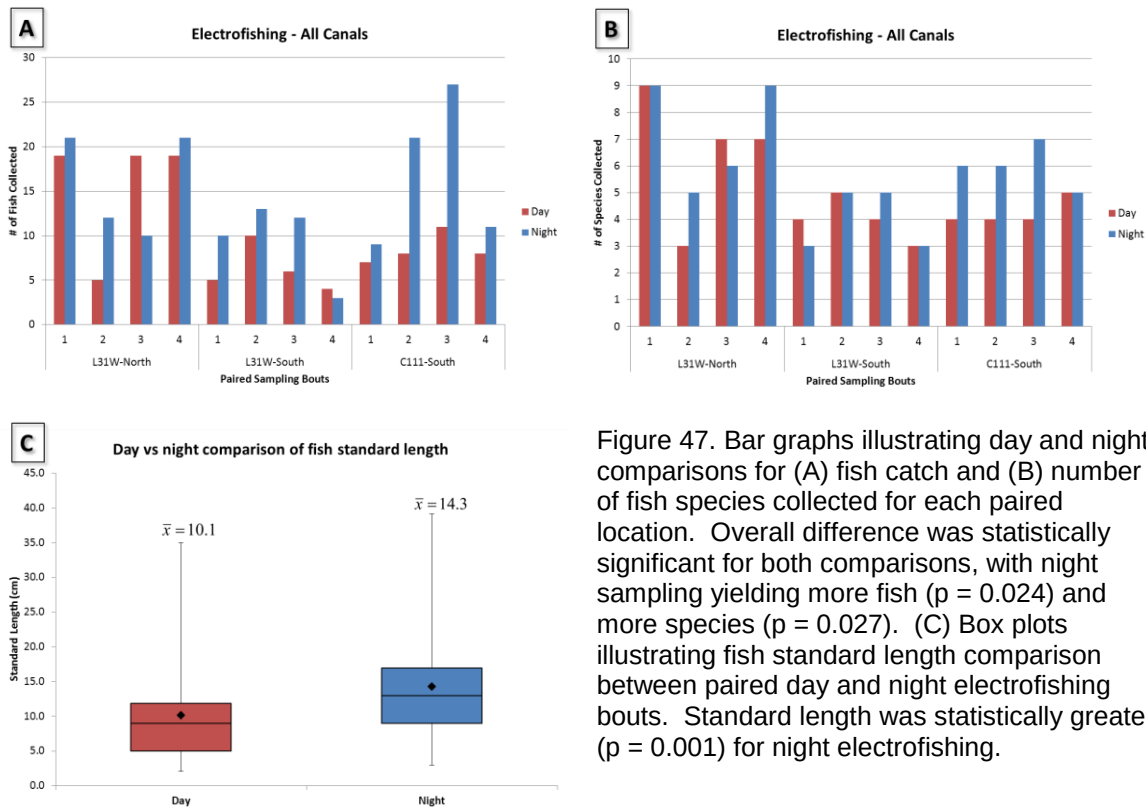


Figure 47. Bar graphs illustrating day and night comparisons for (A) fish catch and (B) number of fish species collected for each paired location. Overall difference was statistically significant for both comparisons, with night sampling yielding more fish ($p = 0.024$) and more species ($p = 0.027$). (C) Box plots illustrating fish standard length comparison between paired day and night electrofishing bouts. Standard length was statistically greater ($p = 0.001$) for night electrofishing.



Figure 48. (A) SFCN intern Craig Perry and biological technician Robert Muxo get ready to collect fish during nighttime electrofishing. (B) SFCN technicians Robert Muxo and Raul Urgelles process the fish caught during one of the nighttime electrofishing bouts. (C) Butterfly Peacock Bass (*Cichla ocellaris*) caught during night electrofishing.

and non-native fishes. SFCN staff participated in extensive canal electrofishing conducted by FIU during the wet and dry seasons. The SFCN will design its Non-Native Fish Monitoring Program in the canals adjacent to EVER based on the outcome of the CESI project. The SFCN staff spent 315.5 field-hours working on this vital sign.

Continuation in FY13: Upon analyzing the FIU CESI data, the SFCN will begin the implementation of a combined daytime/nighttime electrofishing monitoring program in coordination with EVER staff. The final invasive/exotic fish protocol should be in draft form by the end of Summer of 2013.

Periphyton Vital Sign (BICY)

Accomplished in FY12: In January 2012, the SFCN conducted its fourth sampling of periphyton in the Big Cypress National Preserve (BICY). Periphyton sample collection took place later than usual in the 2011-2012 water-year due to high water levels in the month of November, limiting accessibility to most of the sites. The main goal of the fourth-year sampling was to detect any significant temporal shifts in diatom community structure at the collection sites. Also, a seventh basin, Kissimmee Billy East (KBE), was delineated and sampled due to a continuous high total phosphorus signature in the water column, as indicated by the basin's hydrostation. Forty samples were collected: 33 from sites previously sampled in 2009 and 2010, five from the newly added basin, and two from locations proposed by BICY staff for future water-quality monitoring stations (Figure 449). Sites within the basins were once again accessed by helicopter and by all-terrain vehicles (ATVs) (Figure 50). Samples were preserved and sent to Dr. R. Jan Stevenson at Michigan State University for diatom identification.

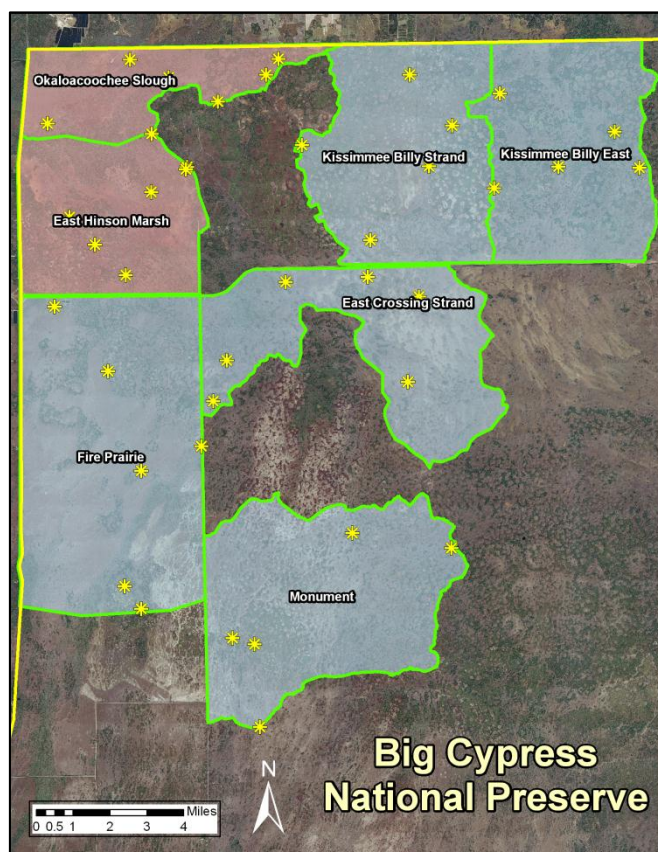


Figure 49 (Left). The 40 sites sampled for periphyton in January 2012. As indicated by community analyses, basins with diatom assemblages characteristic of impacted wetlands are shown in red, those of unimpacted wetlands in blue.

Figure 50 (Above). SFCN botanist Brooke Shamblin records the vegetation description for a sampled site.

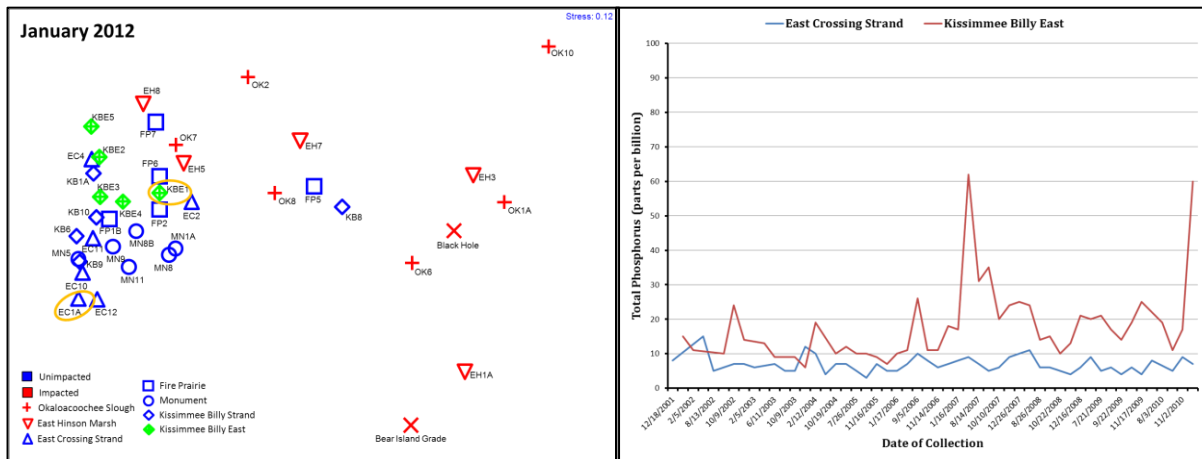


Figure 51. Left: Non-metric multi-dimensional scaling (NMDS) of diatom assemblages found in the January 2012 periphyton samples. Sites with hydrostations for newly added Kissimmee Billy East basin and unimpacted East Crossing Strand basin (for comparison) are circled in orange. Right: Graph showing comparison of total phosphorus signature over time for both hydrostations.

We performed ordination analyses on the January 2012 samples and, once again, found a significant difference between unimpacted and impacted basins (Analysis of Similarity, Global $R = 0.604$). Non-metric multi-dimensional scaling (NMDS), a graphical representation of these analyses, corroborates the results (Figure 51, left). Despite a high water-column total phosphorus signature (Figure 451, right), KBE sites were more similar in diatom community structure to known unimpacted basin sites such as those from Fire Prairie and East Crossing Strand basins (Figure 51, left). The results of the KBE basin were similar to those of the Kissimmee Billy Strand basin, initially selected *a priori* as an impacted basin yet consistently similar throughout the years to unimpacted basins in diatom community structure.

Analysis of Similarity of diatom data for three consecutive water-years (2009-2010, 2010-2011, and 2011-2012) demonstrated a significant difference between the November 2009 and the November 2010 and January 2012 samples (pairwise comparisons, $R = 0.653$ and $R = 0.657$ respectively). Figure 52 illustrates a graphical representation of this difference through NMDS; there is a noticeable separation of the 2009 samples whereas the 2010 and 2012 samples overlap to a great extent.

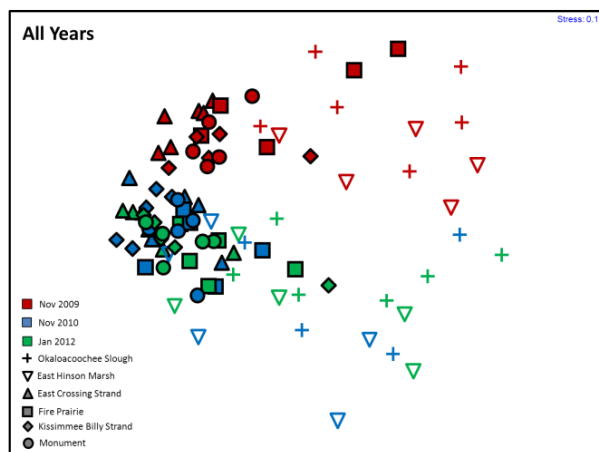


Figure 52. Ordination created by NMDS showing relative abundance of diatom site assemblages for three consecutive water-years (with the exception of two sites in Okaloacoochee Slough which were not sampled in 2010). Analysis of Similarity (ANOSIM) indicates not only a consistently significant difference between impacted and unimpacted basins, but also a significant difference between the November 2009 sampling and the other two collections (November 2010 and January 2012).

Continuation in FY13: The SFCN will continue to sample periphyton from the six hydrological basins delineated within northwest BICY in coordination with BICY staff (hydrologist Robert Sobczak). The goal for the Fall 2012 sampling is to continue the development of the temporal periphyton signal. After this sampling event, the SFCN should be able to produce a BICY Periphyton Protocol in the Spring of 2013.

Freshwater Fish and Large Macro-invertebrates Vital Sign (BICY)

Accomplished in FY12: The SFCN did not conduct any sampling of freshwater fish and large macro-invertebrates due to time constraints. Monitoring for this vital sign initially called for a coordinated sampling effort between this and two other relevant vital signs: Periphyton and Aquatic Invertebrates in Wet Prairies and Marshes. All sampling would take place in the northwest portion of Big Cypress National Preserve (BICY). However, sampling for this vital sign would take place at a time of year not suitable for the collections associated with the other two vital signs, due to accessibility to sites and logistical constraints.

Continuation in FY13: The SFCN will initiate a pilot study to sample fish and macro-invertebrates in the northwest portion of BICY in FY14. Sampling methodology for this vital sign will either be similar to that used to sample forested areas (BICY, Audubon of Florida) or marshes (EVER, Florida International University). The SFCN will determine if sampling sites for this vital sign will be located next to existing periphyton sampling sites or have its own sample frame. This vital sign is also going to be dependent on establishing a strong relationship to water quality impacts.

Aquatic Invertebrates in Wet Prairies and Marshes Vital Sign (BICY)

Accomplished in FY12: The SFCN conducted a pilot study assessing the use of a U.S. Fish and Wildlife Service (USFWS) protocol: “Procedure for the Collection of Field Identifiable Freshwater Wetland Macroinvertebrates Using a Time-Limited Qualitative Dip-Net Method” (Figure 53). The advantage of which is no need for extensive post-sampling invertebrate identification. This qualitative method has been readily used to assess lotic environments such



Figure 53. Left: SFCN community ecologist Kevin Whelan and biological technician Raul Urgelles sample for aquatic invertebrates in East Hinson Marsh, Big Cypress National Preserve (BICY). Right: Representatives of three beetle genera (from left to right: *Hydrocanthus*, *Haliplus*, and *Suphis*) collected from East Hinson Marsh, BICY.

as streams. Metrics have been developed to successfully show a strong relationship between the macro-invertebrate communities and water quality impacts. The goal of this pilot study was to determine the feasibility of this rapid-assessment method for SFCN staff. The SFCN staff has the technical skills for adequate invertebrate identification.

Continuation in FY13: We still need to assess the relationship to water quality impairment. We will accomplish this by continuing to collaborate with the USFWS to establish these relationships and determine the feasibility of full scale monitoring by attempting a pilot study. This pilot study will be limited by logistical constraints and timing will be based on a hydrological clock. The pilot study will build on knowledge gained from current periphyton sampling.

Butterflies Vital Sign (BISC)

Project overview: The SFCN, FLCO-EPMT, and BISC were awarded a competitive grant from the U.S. Fish and Wildlife Coastal Program to fund a project for habitat enhancement for the federally endangered Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*) (Figure 54). The goal of this project is to supplement Schaus host plant populations in two current restoration areas at Elliott Key and at Adam's Key in Biscayne National Park. We collected seeds from native populations of torchwood (*Amyris elemifera*) and wild lime *Zanthoxylum fagara*) and reared them in a contracted nursery. A total of 5,000 torchwood, wild lime, and nectar plants will be planted in the coastal hardwood hammocks at Elliott Key and Adam's Key over fiscal years 2012 and 2013. There is also an educational component of this project meant to



Figure 54. Habitat enhancement project for the federally endangered Schaus Swallowtail butterfly (*Heraclides aristodemus ponceanus*).

increase public awareness of the plight of the Schaus swallowtail and to instill stewardship through interpretive signage and volunteer and outreach programs.

Accomplished in FY12: Two restoration sites which were previously occupied by exotic burma grass (*Neyraudia reynaudiana*) and latherleaf (*Colubrina asiatica*) have been treated for exotics and are now completely filled with native plants, torchwood and wild lime. A total of 2,332 seedlings have been planted this year, including 1,791 torchwood, 445 wild lime, and 96 nectar plants. The restoration at Elliott Key encompasses 1.42 acres and the restoration at Adam's Key encompasses 0.66 acres.

To accomplish this project a large number of partner organizations have been engaged. The Florida Department of Environmental Protection's Division of Recreation and Parks has been instrumental in our acquisition of torchwood and wild lime seeds. We have a permit to collect seeds at Dagny Johnson Key Largo Hammock Botanical State Park and at John Pennekamp State Park, and a permit to collect at the Crocodile Lake National Wildlife Refuge. We have coordinated with the state park manager, the nursery manager, park biologists and a volunteer and have collected hundreds of seeds from state parks and restoration sites. The Florida Keys Electric Cooperative helped us acquire seeds in power line corridors, and Monroe County helped us rescue torchwood plants from properties permitted for clearing. Pennekamp nursery has provided us with torchwood, wild lime, and nectar plants. Fairchild Tropical Botanic Garden has provided nectar and host plants for the restoration as well. Seeds have been germinated and grown at Kelly's Tropicals nursery.

NPS staff, interns, and volunteers spent over 1,649 hours in the field. Most of these were volunteer hours. We have hosted a volunteer workday with the Sierra Club (Figure 54) where many seedlings were planted. Numerous volunteers (many from Florida International University) have participated in this effort. Support for this project has been provided by the BISC resource management staff and their maintenance staff as well, both in work hours and in providing equipment for the project.

Funds from this project have supported a Resource Monitoring Internship (ReMI) position, filled by Craig Perry, who has overseen a vast amount of the field work for this project. Jaeson Clayborn, a Ph.D. student at Florida International University, is also working with us while doing his dissertation research on the Schaus swallowtail. The BISC environmental education division has incorporated this project into their educational presentations, including an educational outreach day with Doral Academy High School.

Continuation in FY13: The SFCN will continue to perform maintenance on the restoration areas. Seeds will be collected and germinated in the nursery, and seedlings will be planted in natural gaps and along trails found throughout Elliott Key and Adam's Key. If we are able to collect enough seeds, we aim to plant an additional 2,668 seedlings this year. Installation of interpretive signs at BISC will highlight the plight of the Schaus swallowtail butterfly.

I.C Data Management, Analysis, and Reporting Branch

Overview

The Data Management, Analysis and Reporting Team worked this year to assist moving protocols to completion by working with the Marine and Community Ecology Branches to develop databases, data entry procedures, QA/QC procedures, reporting and graphing templates, and develop associated SOPs as well as providing overall editorial support, formatting support, and general project support. The team has also focused on cleaning up lingering projects such as the Biscayne National Park vegetation map, the Bat Inventory, and the Small and Medium Sized Mammals project. Updating the SFCN web page was a major effort this year during which all vital signs were transitioned into web pages, their contents are being updated, and the entire SFCN web page is undergoing a transition to the new National Park Service format and look. The team has continued to provide IT support to SFCN, provide information support to the parks, and help on occasion with field work. Jed Redwine made progress on the Natural Resource Condition Assessments for both Everglades National Park and Big Cypress National Preserve.

No new computers were purchased in FY12. Currently there are a total of 26 functioning workstations, 7 laptops, and 1 server in the Florida SFCN office, and 2 workstations, 1 laptop, and 1 server in the St. John SFCN office. A second DOI-T1 circuit was installed at the Florida SFCN office, but final activation is still pending.

Staff fulfilled at least 23 requests for spatial data, reports, and analysis assistance from national parks, universities, NGO's and state/federal agencies. Included among these were a series of requests for coral data for a world-wide coral data analysis funded by the International Union for the Conservation of Nature (IUCN).

In May BISC requested assistance upgrading the park GIS software. A new license was obtained from the national office and was installed on the appropriate BISC server. Individual GIS users in the park were contacted, and a convenient time was scheduled for each so that SFCN could remotely install the software.

New Staff

Craig Booker – Administrative Assistant

Craig Booker joined SFCN in October, 2011 as the new Administrative Assistant. Craig is a native of New Hampshire and a recent transplant to Florida, having relocated from the Seattle area, where he spent several years in the private sector following his career as a Personnelman in the US Navy. He graduated from Florida International University in 2010 with a degree in Psychology. In his spare time, Craig enjoys spending time with his young family, traveling, camping, hiking, and especially river kayaking.



Inventories

Biscayne BioBlitz (BISC)

Project status: Comments on the draft report and additional species updates were received from participating scientists for the 2010 Biscayne BioBlitz.

Continuation in FY13: The additional species will be incorporated into the database and comments incorporated into the report and the report finalized and published. The species new to the park list, digital voucher specimen information, any relevant references, and the record of observation will be uploaded into NPSpecies database (located at <https://irma.nps.gov/App/Species/Welcome>).

Bat Inventory – (BICY, BISC, BUIS, DRTO, EVER, SARI, VIIS)

Accomplished in FY12: The bat inventory project report (2003-2007) is nearly complete. The bat database was cleaned up and slightly updated in preparation for the final report. A brief draft report is in progress. The species list by park has been updated since last year's species list and was harvested from the Anabat software files (Table 8; Figure 55).

Continuation in FY13: We hope to have the final report reviewed and completed by early 2013.



Figure 55. Jamaican Fruit-Eating Bat (*Artibeus jamaicensis*) found in the U.S. Virgin Islands.

Table 8. Bat species detected by park. (Note: *Mormoops blainvillii* and *Stenoderma rufum* have also been detected in VIIS via other efforts (Rafe Boulon, personal communication).

Scientific Name	Common Name	BICY	BISC	BUIS	DRTO	EVER	SARI	VIIS
<i>Artibeus jamaicensis</i>	Jamaican Fruit-eating Bat							X
<i>Brachyphylla cavernarum</i>	Antillean Fruit-eating Bat						X	X
<i>Corynorhinus rafinesquii</i>	Rafinesque's big-eared Bat	X						
<i>Eptesicus fuscus</i>	Big Brown Bat	X	X			X		
<i>Eumops glaucinus</i>	Wagner's Mastiff Bat	X	X			X		
<i>Lasiurus intermedius</i>	Northern Yellow Bat	X	X			X		
<i>Lasiurus seminolus</i>	Seminole Bat	X				X		
<i>Molossus molossus</i>	Cuban House Bat	X	X	X		X	X	X
<i>Myotis austroriparius</i>	Southeastern Myotis	X						
<i>Noctilio leporinus</i>	Fishing Bat						X	X
<i>Nycticeius humeralis</i>	Evening Bat	X	X			X		
<i>Pipistrellus subflavus</i>	Eastern Pipistrelle	X				X		
<i>Tadarida brasiliensis</i>	LeConte's Free-Tailed Bat	X	X	X		X	X	X
Total Species Detected	13	10	6	2	0	8	4	5

Vital Signs Monitoring

Landbirds and Colonial Nesting Birds (DRTO)

Accomplished in FY12: Judd Patterson assisted Sonny Bass and others with the annual DRTO Christmas Bird Count, which included unusual wintering species such as the Worm-eating Warbler. Judd also found time for colony monitoring in late May while installing forest monitoring plots. At that time 19 Roseate Terns and at least 4 Bridled Terns were present on Bush/Long Keys. Both of these species have nested at DRTO in recent years, after an extended absence from the islands.

Continuation in FY13: Judd will again assist the DRTO and BISC monitoring efforts as requested.



Nesting Brown Pelican.

Invasive/Exotic Plants – Digital Aerial Sketch Mapping (BICY, EVER)

Accomplished in FY12: Judd Patterson provided minimal assistance to the NPS-EPMT program on Digital Aerial Sketchmapping, as the EPMT staff were able to implement their SOP successfully.

Continuation in FY13: If needed, SFCN will be providing assistance in post-processing of the digital sketch mapping with the SFCN-SCA contributing 2 weeks of time. Although both NPS-EPMT and SFCN would like to develop a more formal protocol, SFCN needs to postpone this until other SFCN protocols are finalized.

Land use change (BICY, BISC, BUIS, EVER, SARI, VIIS)

Accomplished in FY12: SFCN downloaded permit records for unincorporated Miami-Dade County from the county GIS library webpage. A single shapefile contained all records occurring between 2009 and 2012. A query extracted proposed “new” construction permits from this dataset. GIS was used to calculate the distance of permits from the Miami Dade urban development boundary. The result was displayed on a map (Figure 56) and via a histogram (not shown). Permit data from the US Virgin Islands was not obtained.

SFCN received updated datasets for the landscape dynamics monitoring project from the NPScape team. The NPScape data was confined to the south Florida region, encompassing Dade, Collier, and Monroe counties. Human development in these counties directly affects Everglades National Park, Big Cypress National Preserve, and Biscayne National Park.

Continuation in FY13: Analysis of land use change data will be conducted in collaboration with the Natural Resource Condition Assessment (NRCA) ecologist. The NRCA ecologist and SFCN will use NPScape and county permit information to report land use change for both Everglades National Park and Big Cypress National Preserve. SFCN will continue to search out supporting

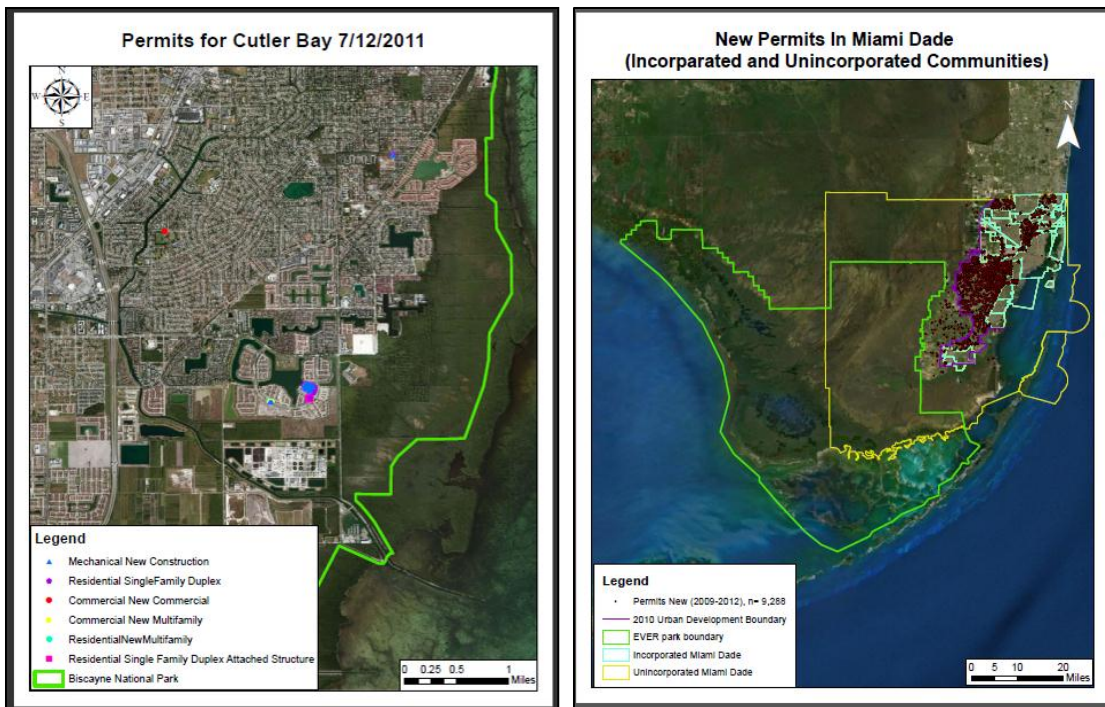


Figure 56. Maps showing addresses of residential and new construction permits that were geocoded in ArcMap. The first map shows permits in the city limits of Cutler Bay from 2011. The second map shows new permits from 2009-2012 in unincorporated Miami Dade county.

information about land use practices from federal and county/local agencies to assist temporal/trend analysis, and devise a strategy for analysis with the NRCA ecologist. SFCN will work to obtain US Virgin Island permit data, and produce a draft of the land use change protocol.

Sea Turtles (BUIS)

Accomplished in FY12: Work was started on developing the additional reporting queries to help better tell the story of sea turtle nesting success at BUIS.

Continuation in FY13: More extensive reporting will be developed to better tell the story of sea turtle nesting success at BUIS. We will also work with BUIS staff to improve documentation of legacy database fields, as well as convert existing location system to UTM coordinates. We will talk with VIIS, BISC, and EVER to see if they are interested in using the database.

Web page reporting for Vital Signs (All parks)

Accomplished in FY12: All our vital sign webpages have been converted from PDF summaries to functional webpages. Whenever possible, the language and content of these were updated with more up-to-date content including summaries, statuses, and trends from last year's FY11 annual report. The I&M Network websites are currently being updated to a new National Park Service Web Content standard and we have been working with the staff in Ft. Collins, CO to migrate our current webpages to the new format.

Continuation in FY13: SFCN will continue to transition its webpages to the new National Park Service Web Content standard. We hope this process will be complete by the end of 2012. We

will also continue to work on providing summaries and reports on our other vital sign web pages with particular focus on the many Category I vital signs with protocols in development. We seek guidance from the parks on the level of reporting effort the network should put towards reports/web pages for vital signs that are monitored by the parks and other organizations. In addition SFCN will generate web page links to existing monitoring program documents. In some cases this may simply involve creating links to the CERP RECOVER System Status Report and/or EVER World Heritage Report.

Reporting Strategies (All parks)

Accomplished in FY12: In an attempt to make reporting results as easy as possible for SFCN staff, our team is working to develop automated reporting, graphing templates and reporting templates where possible to support the protocols. This year we worked to create graphing templates for coral monitoring (Figure 57) and USVI fish monitoring (Figure 58) and reporting templates. Database reporting and the reporting template were updated for the Corridors of Invasiveness protocol to include additional metrics.

The value of this streamlined reporting became apparent when SFCN was able to rapidly respond to requests from USGS for water temperature data and graphs in VIIS and DRTO.

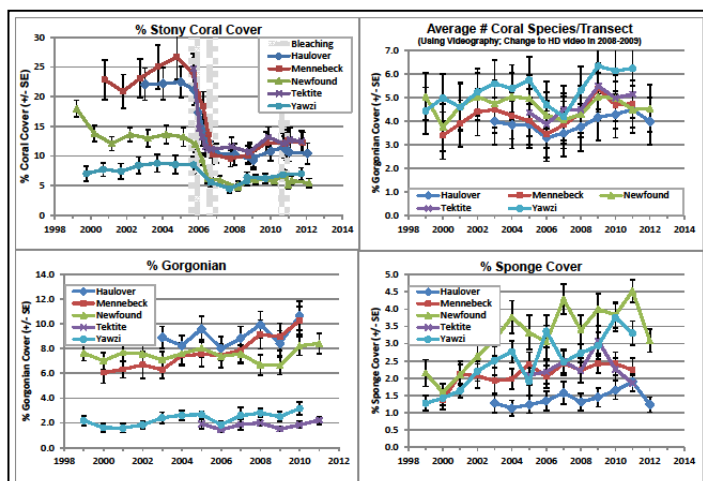


Figure 57. Graphics template page for coral monitoring reporting at VIIS.

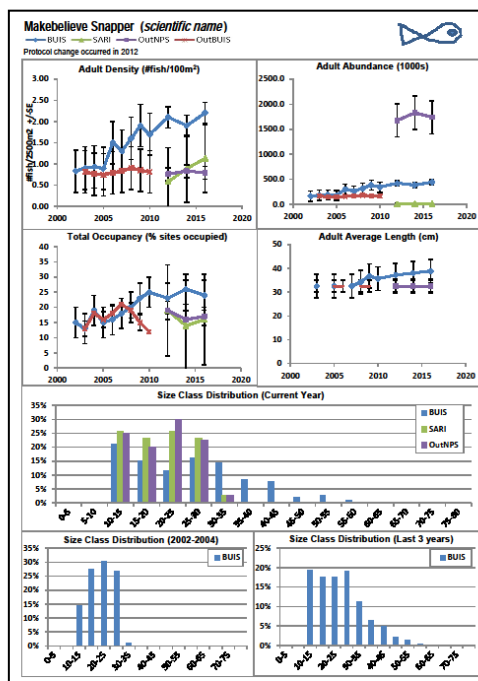


Figure 58. Draft report template and graphics page for marine fish monitoring reporting at St. Croix.

Continuation in FY13: We will continue developing streamlined data analysis and reporting pathways including automated database reports and exports, graphing templates, and reporting templates. Immediate emphasis on USVI fish reporting, S. Florida park fish reporting, and coral monitoring reporting. Making reporting part of protocol development helps bring out critical assumptions, highlights QA/QC procedures that must be included, and identifies legacy data that must be moved into SFCN databases to allow effective reporting. We will be working to make SFCN datasets publically available online once protocols are complete in cooperation with the Marine and Community teams. Implementing annual data archival procedures will occur this year, i.e. an annual static version of a protocol database will be archived together with summary reports and the protocol version used that year.

Natural Resource Condition Assessment - Big Cypress National Preserve (BICY) and Everglades National Park (EVER)

Accomplished in FY12: The Natural Resource Condition Assessments for EVER and BICY are scoped, outlined, and scheduled. Both of these NPS units have unique cultures, historical management processes, staffing levels, and near-term goals. As a result, the scoping processes have been very different, even though the document outlines and natural resources listed for evaluation are ~80% similar. EVER has agreed to a list of 57 natural resource categories for reporting; BICY agreed to 67 categories for reporting. Three of these reporting categories will be written in a section that is likely to be very similar for both parks (regional scale air quality: ozone, wet and dry deposition, and air contaminants); over forty of the reporting categories are focused on the same subjects, but will be written independently due to the subtle differences in the geographic and historical context of EVER and BICY. At least twenty reporting categories are completely unique to either park. Threatened/endangered species and management-focused landscape issues are the key areas where the two reports are distinctly different.

Everglades National Park has a large (>30 person) natural resource management and research staff. Managers at EVER are deeply engaged in the Comprehensive Everglades Restoration Program with a group of 10 state/federal agencies and 2 sovereign tribal nations. The Everglades has received a lot of research focus and at least six system-level reporting processes include the Everglades National Park as a significant aspect of the report. Scoping for the Everglades emphasized a careful comparison of these report processes, with the goal of using the NRCA to enhance the precision and consistency of the existing reporting requirements of EVER staff. The synthesis portion of the EVER NRCA is focused on “going with the flow”, where resource status is linked to combinations of water patterns, fire management, and other human-effects that change together across the five clearly defined river basins.

Big Cypress National Preserve has around ten people in their natural resource management and science staff. Their priorities are framed by striking a balance between resource protection, recreational use, hunting, trapping, subsistence harvests, and cultural uses. The geology and soils of Big Cypress produce a distinctive set of habitats and geographic features with large expanses of upland habitats that have historically hosted a relatively higher abundance of larger mammals including bears and Florida Panthers. Even though water management concerns played a large role in establishing Big Cypress, comprehensive regional-scale planning is not as present in the lives of natural resource managers as it is in EVER. Priorities for synthesis are: developing a comprehensive assessment of resource status that can support environmental

assessments (EA's); clarifying the role of relatively obscure biogeochemical processes in determining landscape conditions over decades-century timescales; and communicating the unique importance of Big Cypress' natural resources in the context of the broader Caribbean region.

Continuation in FY13: The content and goals for the Natural Resource Condition Assessments of EVER and BICY are established. Plans for progress have been reviewed and next steps are in motion. Exotic plant and animal species reporting is a high priority for superintendents and natural resource managers in both NPS units. Coordination efforts with each park are starkly different and are as unique as the communication styles of each individual who participates in the NRCA process. Preliminary results of sections drafted in FY13 should crystallize the distinguishing aspects of each parks management approach and set clear expectations for the final document.

I.D Water Quality Monitoring

Contaminants (BISC, DRTO, EVER)

Baseline Aquatic Contamination and Endocrine Status in a Resident Fish Species of Biscayne National Park and in the Adjacent Coastal Environment

Accomplished in FY12: The SFCN continued its collaboration with USGS to assess levels of emerging pollutants of concern (EPOCs) and wastewater contaminants that enter the near shore waters of Biscayne Bay and Biscayne National Park. The SFCN again worked in conjunction with the U.S. Geological Survey's Dr. Tim Bargar (Florida Integrated Science Center) and Dr. David Alvarez (Columbia Environmental Research Center) to complete the third phase of the project by collecting sediment samples and fish samples.

A component of the Comprehensive Everglades Restoration Plan is rehydration of the coastal wetlands adjacent to Biscayne National Park. Before the planned rehydration of the wetlands begins, it is necessary to understand the threats to the park's resources from existing organic wastewater contaminant (OWC) levels to differentiate them from potential impacts from OWCs introduced by the rehydration. In September of 2009, passive water samplers were deployed for a period of one month where nine different canals enter Biscayne Bay and at three locations within the bay. Based on the total number of detected contaminants, waters in the C-111 canal were the most contaminated, while the least contaminated locations were the central and northern bay locations. Very few wastewater chemicals were detected indicating low wastewater contribution to Biscayne Bay. The C-1 canal, which passes the South Dade Wastewater Treatment Plant, did not have a greater wastewater contaminant load relative to the other canals. Additional sampling is underway to determine: (1) if seasonality plays a role in contaminant introduction into the bay, (2) if OWCs are partitioning into sediments and the biota (fish), and (3) the endocrine status of a

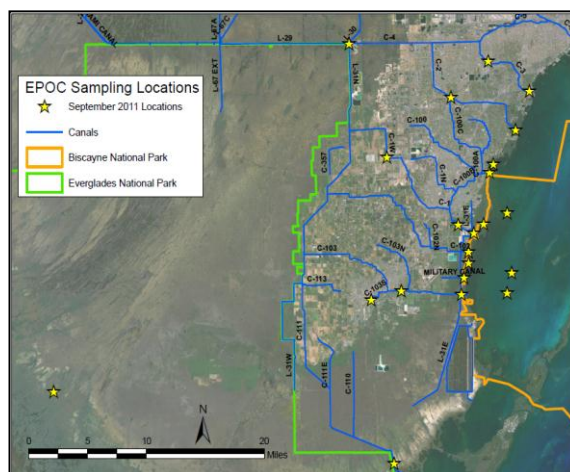


Figure 59. 2012 EPOC sampling locations.



Figure 60. Actual location of POCIS sampler in the Cutler Wetlands, just northeast of Black Point in Biscayne National Park.



Figure 61. SFCN and USGS personnel participate in the collection of sediment core samples and fish at EPOC sites.

resident fish species. POCIS Sampling was completed in May 2011 and September 2011. Sediments were collected in October 2011 and December 2011, while fish were sampled during the wet season of 2012 (Figures 59, 60, and 61). This project took 362 field hours to accomplish the work.

Continuation in FY13: All field work for the contaminants project has been completed. Fish samples are being processed for histological data and contaminant burden. Once this is complete, it will establish data for baseline aquatic contamination and endocrine status in a resident fish species of Biscayne National Park.

SFCN will continue supporting Biscayne National Park staff with negotiations between the park and Miami-Dade Water and Sewer Department's Wastewater Reuse Pilot Project as necessary. The Miami-Dade Water and Sewer Department's proposal for the development of a Wastewater Reuse facility adjacent to the park's western boundary has been suspended at this time. NPS concerns still include the ability for the advanced wastewater treatment to adequately process water to make it clean enough to have no negative impacts to the park ecosystems and adjacent lands. SFCN continues to assist in this project by its collaboration with the USGS investigating EPOCs from canal discharge into the bay. This will ensure any pilot project that goes forward

would be able to produce scientifically defensible results to more fully understand the consequences of treated wastewater entering the park.

Marine Benthic Communities – Coral Reef Water Temperature (BISC, BUIS, DRTO, VIIS)
Accomplished in FY12: Reef temperature data was collected at all coral index sites in VIIS, BUIS, BISC, DRTO, and all coral extensive sites in DRTO (Figures 62-65). All sites show typical seasonal variation in water temperatures, ranging from 17.0°C to 31.7°C at South Florida sites and from 24.7°C to 30.7°C at sites in the Virgin Islands.

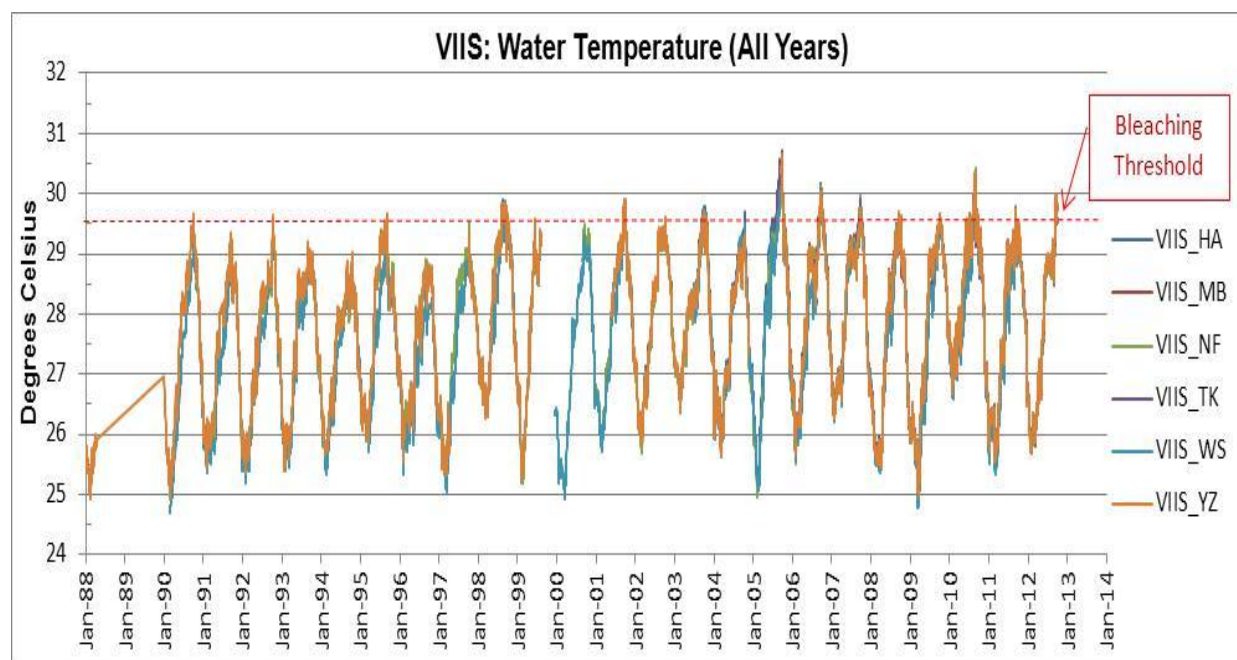


Figure 62. Virgin Islands National Park (VIIS) water temperature summary graph. Graph shows water temperature data from the six sites in VIIS since 1988. The bleaching stress threshold of 29.5 °C is shown.

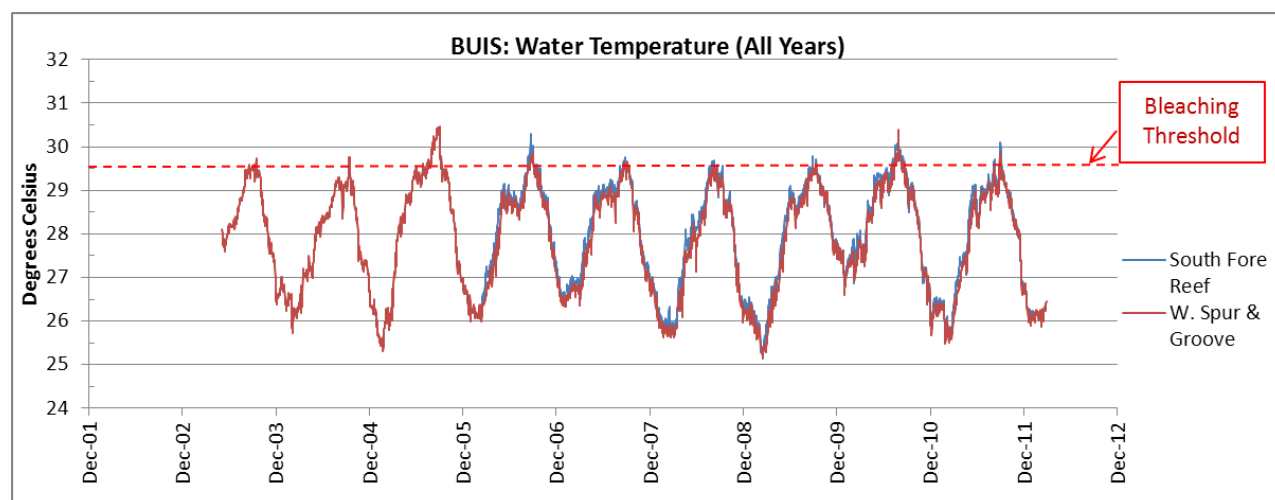


Figure 63. Buck Island Reef National Monument (BUIS) water temperature summary graph. Graph shows water temperature data from the two index sites in BUIS since 2002. The bleaching stress threshold of 29.5 °C is shown.

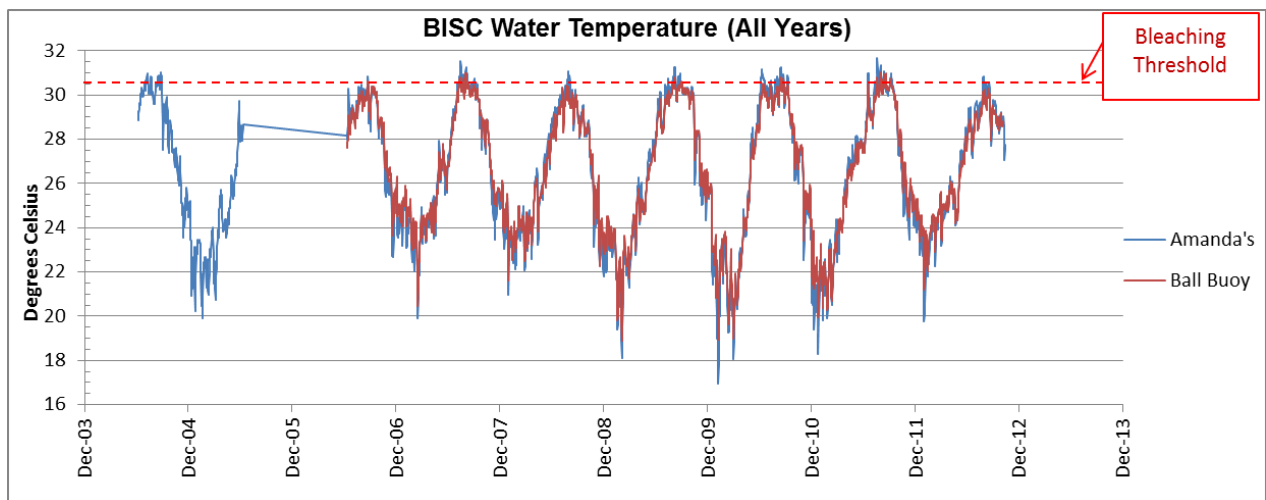


Figure 64. Biscayne National Park (BISC) water temperature summary graph. Graph shows water temperature data from the two index sites in BISC since 2003. The bleaching stress threshold of 30.5 °C is shown.

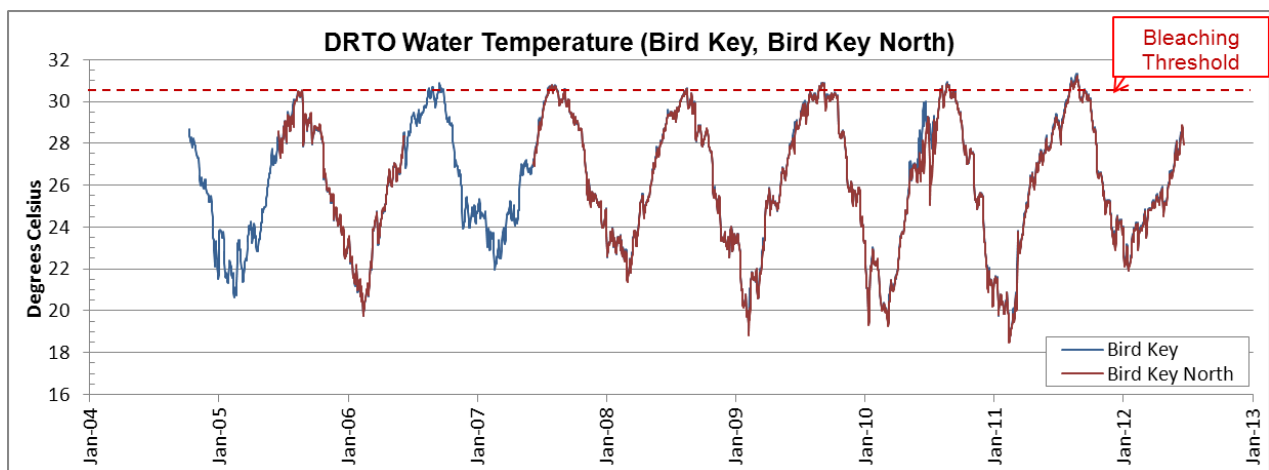


Figure 65. Dry Tortugas National Park (DRTO) water temperature summary graph. Graph shows water temperature data from the two index sites in DRTO since 2004. The bleaching stress threshold of 30.5 °C is shown.

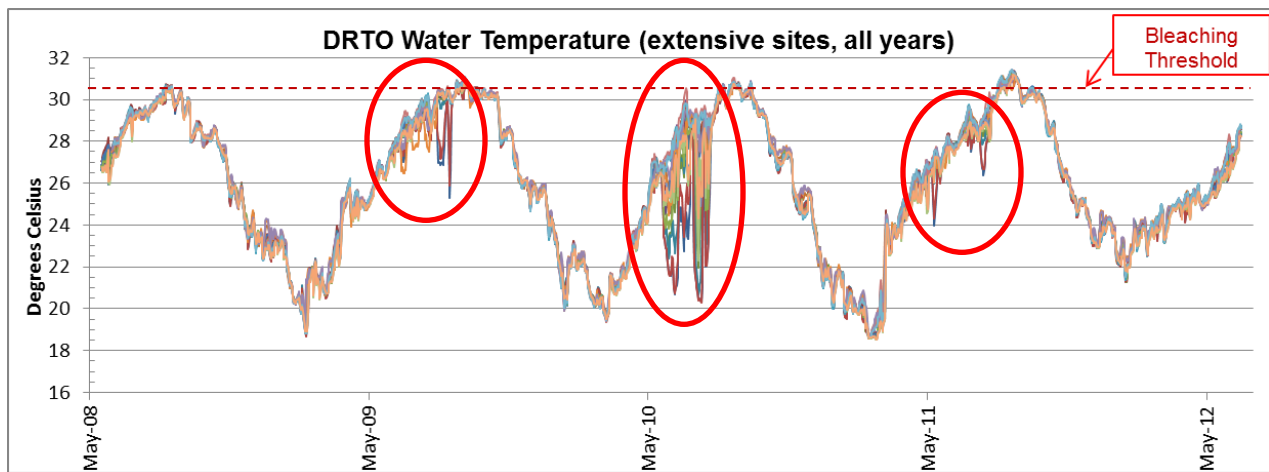


Figure 66. Dry Tortugas National Park water temperature summary graph. Graph shows water temperature data from the 18 index sites in DRT0 since 2008. The bleaching stress threshold of 30.5 °C is shown. The three red circles indicate cold-water events, occurring in late spring through early summer.

Temperature data from the DRT0 index and extensive sites reveal that benthic resources are subject to a wide variance in thermal stress. In particular, temperature records from the extensive sites show cold-water events from the past three years, occurring between late April and early June, designated by red circles in Figure 66. The most severe recorded event occurred in June 2010, where several extensive sites were affected (Figure 66). It is suspected that this cold-water anomaly is from upwelling, influenced by currents off the Tortugas Bank, along the northwestern edge of the park. During the cold-water events, sites I-50, I-05, and I-38 experienced the lowest temperatures, likely due to the proximity to Tortugas Bank and the comparatively deep nature of these three extensive sites.

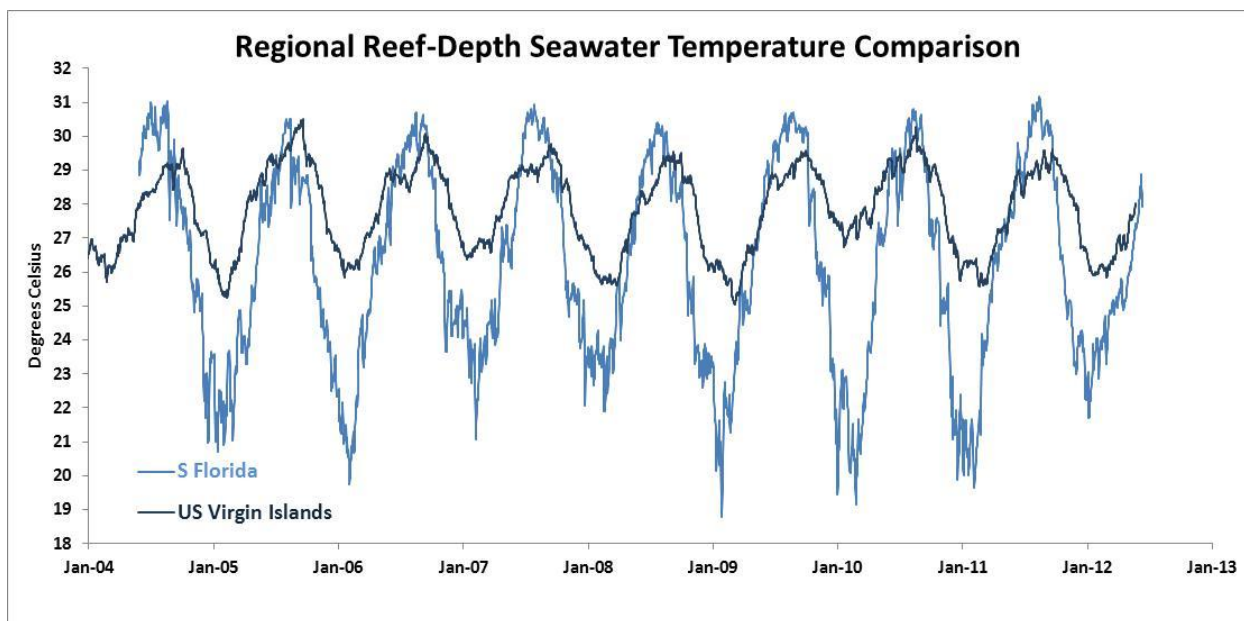


Figure 67. Comparison of mean daily temperatures at SFCN parks by region from summer 2004 through summer 2012. US Virgin Island parks include VIIS and BUIS. S. Florida parks include BISC and DRT0.

A regional summary of *in situ* seawater temperature at SFCN parks reveals a substantially different thermal regime between the South Florida and Caribbean. Corals within the South Florida parks are subject to wide annual temperature variation, often $> \pm 10^{\circ}\text{C}$, and consistent, annual excursions beyond the theoretical coral bleaching threshold ($\sim 30.5^{\circ}\text{C}$). The Virgin Island reefs experience a much smaller temperature range ($\sim \pm 4^{\circ}\text{C}$). Typically, they do not get as warm as the Florida reefs, with the exception of 2005 a year of extreme Caribbean heating, and record-breaking hurricane activity in South Florida. The reefs within the Virgin Islands consistently exceed their theoretical coral bleaching threshold ($\sim 29.5^{\circ}$) (Figure 67; 1998, 2001 and 2003-2012).

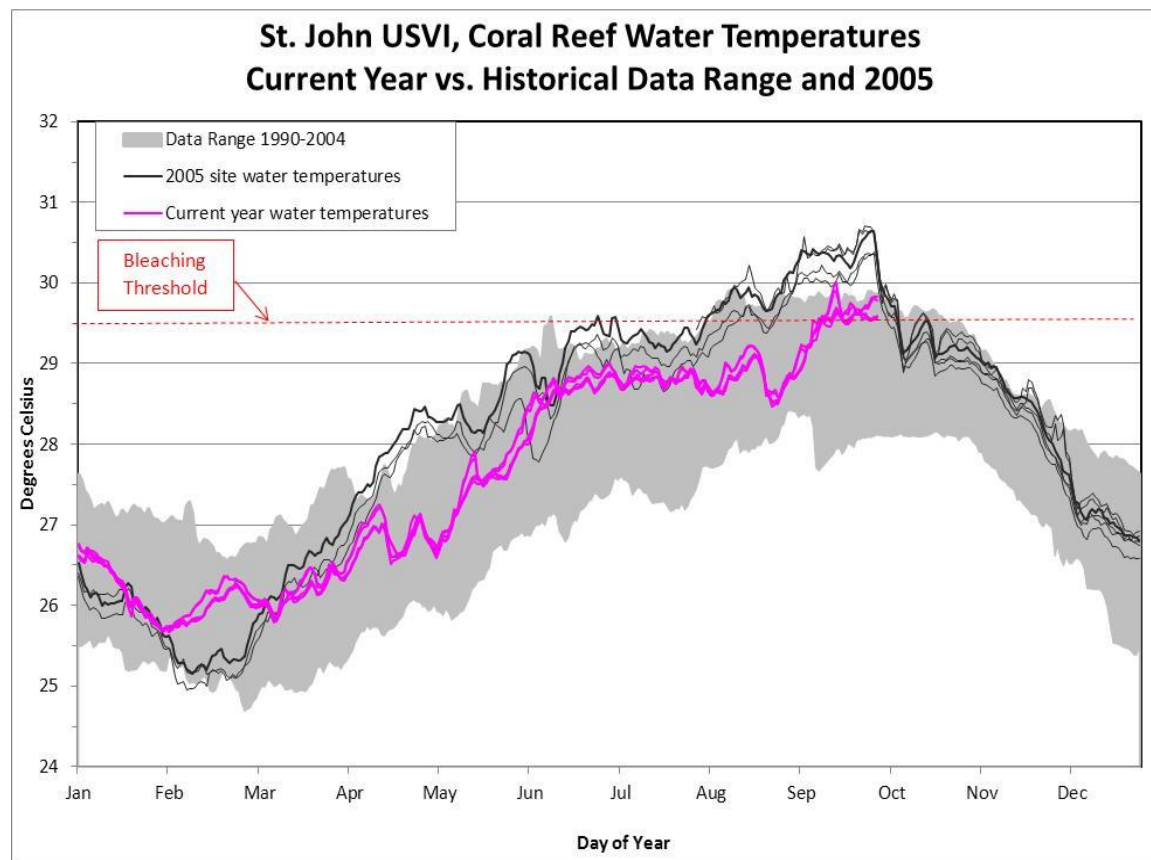


Figure 68. The water temperature in 2012 for Virgin Islands National Park compared with 2005 (a significant bleaching year) and the 1990-2004 range of daily average temperatures for all sites. The bleaching stress threshold of 29.5°C is shown. Tropical Storm Isaac passed approximately 175 miles south of VIIS on August 29-30.

Despite the passing of Tropical Storm Isaac which helped to lower thermal stress, mean daily temperatures exceeded the theoretical bleaching threshold (29.5°) on September 11-13 (Figure 68), and remained above that level for the rest of the month. Coral bleaching was observed at the three VIIS sites monitored in September and October with Mennebeck Reef, sampled in October, showing the most severe bleaching ([see coral monitoring section for more details](#)).

Continuation in FY13: Water temperature data will continue to be collected at all sites in FY13. Exports of data for the SFCN web page and Data ForEVER database at EVER are in development for early FY12. SFCN plans to publish the long-term water temperature data record at VIIS. Analysis of DRT0 water temperatures will continue to evaluate spatial/depth patterns across the park.



Brian Witcher downloads reef temperature data with a HOBO[®] waterproof data shuttle in DRT0 (Photo credit: Rob Waara).

Coral Reef Ecosystem Water Temperature Protocol

Project Overview: The document is a guide for the deployment, maintenance, and data management of SFCN temperature loggers. Water temperature has been historically collected as a basic environmental parameter of water quality monitoring efforts at coral reef sites throughout the world. There are numerous references in scientific literature suggesting a link between water

temperature anomalies and coral colony survivorship. Coral bleaching occurs when the coral host loses zooxanthellae from its tissue due to physiological stress, most-often associated with high water temperatures and/or high incidence of solar radiation. Additionally, unusual cold water temperatures have been found to negatively affect the survivorship of corals and other reef dwelling organisms. The NPS and the United States Geological Survey (USGS) have collected water temperature data around St. John and VIIS since 1990. These loggers are currently deployed as part of a long-term coral reef monitoring program. This effort has been expanded throughout the network, with 40 long-term *in-situ* water temperature monitoring sites managed by SFCN in BISC, BUIS, DRTO, SARI and VIIS.

The database developed with this protocol is a repository for SFCN parks water temperature data. Data collected under this protocol will be useful to NPS efforts outside the network such as the Climate Change Response Program to help address climate change strategies. This data also complements *in situ* seawater temperature data information collected by several partners throughout the Florida reef tract.

Accomplished in FY12: The protocol was sent to three peer review subject experts in 2012 (Figure 69). Two reviews of the manuscript have been received by SFCN. Andy Davis is currently evaluating comments and will make appropriate modifications to the final document.

Continuation in FY13: The *Coral Reef Ecosystem Water Temperature Protocol* manuscript will be submitted for publication to the NPS Natural Resource Technical Report Series in February 2013.

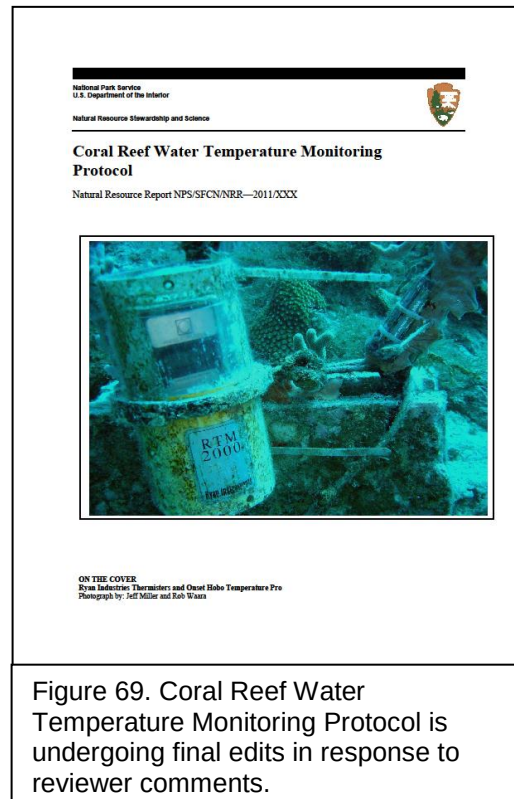


Figure 69. Coral Reef Water Temperature Monitoring Protocol is undergoing final edits in response to reviewer comments.



Rob Waara gets up close and personal with a goliath grouper after a fish survey in DRTO. (Photo credit: Tara Dolan, NOAA)

Nutrient Dynamics and Water Chemistry (BISC, DRTO, EVER, SARI, VIIS)

Accomplished in FY12: Dr. Darrell Herbert was hired to work on the Nutrient Dynamics and Water Chemistry vital signs via a cooperative agreement with Jim Fourqurean at Florida International University. Dr. Herbert is currently developing a statistical model that will predict the quality of benthic estuarine and marine habitat on the basis of commonly measured water quality parameters such as temperature, salinity, turbidity, and the organic and inorganic species of C, N, and P following the methodology of a smaller-scale model that focused on Florida Bay (Fourqurean et al. 2003, Herbert et al. 2011). To this end, geo-referenced water quality and benthic habitat data from multiple public and private sources have been synthesized into a single database spanning a period of more than 20 years beginning in 1991. Data sources include:

Water Quality:

1. SERC SFL Estuaries Water Quality Dataset
2. SERC LTER Water Quality Dataset
3. SERC Florida Keys Sanctuary Water Quality Data
4. SERC Little Venice Water Quality Data
5. NOAA Water Quality Dataset
6. District/Miami-Dade County Department of Environmental Resources Management

Seagrass:

1. LTER Benthic Data
2. FKNMS Benthic Monitoring Permanent Sites
3. FKNMS Benthic Monitoring Seasonal Sites
4. Little Venice Benthic Data
5. District/Miami-Dade County Department of Environmental Resources Management
6. Department of Environmental Protections Fish Habitat Assessment Program
7. Florida Audubon Society
8. University of Miami SwaPs Biscayne Bay

The geographic extent of database coverage includes Biscayne, Everglades, and Dry Tortugas National Parks. The database can be easily queried on any type of habitat, species, or water quality parameter relative to time, seasonal hydro-period, region, or original data source. Spatial interpolation of water quality parameters measured from as many as 600 stations allow for precise estimates of water quality in over 2500 benthic habitat survey locations (e.g., salinity and salinity variability as shown in Figure 70).

The project is now at the stage where statistical analyses can proceed, using water quality geo-referenced to benthic survey stations, to develop a predictive statistical model. There are two steps in current data analyses. Step 1 uses summary statistics, correlation analysis, and principal component analysis to reduce the number of water quality parameters necessary to build statistical relationships between water quality and benthic habitat. Step 2 uses discriminant function analysis to build the statistical relationships between benthic habitat and water quality.

The primary product of the geo-referenced database and statistical analysis is a predictive model that uses water quality data to forecast changes in the benthic habitat characteristics. The model can be used as a management tool to interpret trajectories in previously collected water quality and benthic habitat data from a regional decadal sampling effort and allow a clear determination of predicted outcomes based on past trends and their relationships. This will allow for a move

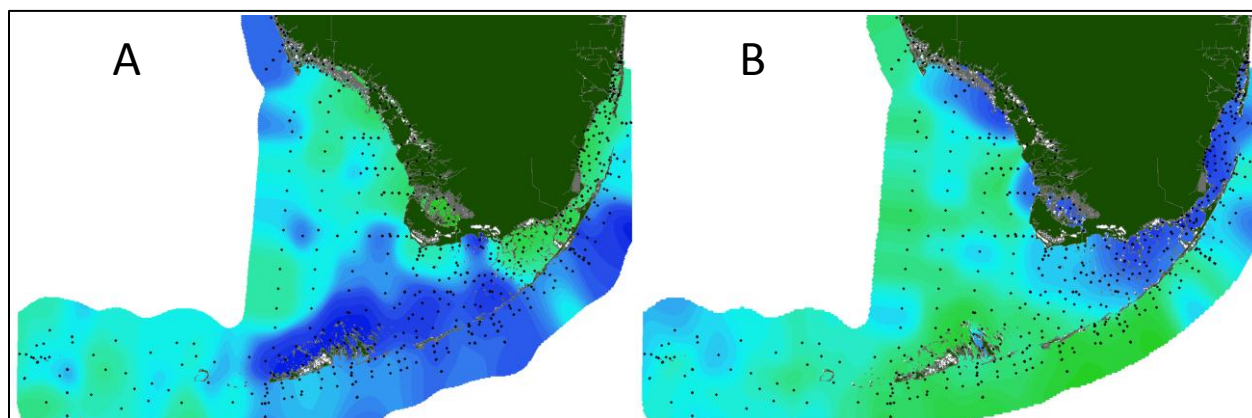


Figure 70. Spatial representation of (A) salinity and (B) salinity variability in South Florida estuarine and marine ecosystems encompassing Everglades, Biscayne, and Dry Tortugas National Parks. Darker shades represent higher salinity and variability, respectively. Unshaded areas indicate no data. Black points indicate water quality sample stations.

from responsive management decisions to forward-thinking, adaptive management actions with a clear tool to communicate the reasons behind the management decision. Additionally, it is envisioned that the model will inform interests and analyses related to habitat suitability and forage availability for a variety of wading and diving seabirds, important game fish and pink shrimp populations in Biscayne, Everglades, and Dry Tortugas National Parks.

References:

Fourqurean, J.W., Boyer, J.N., Durako, M.J., Hefty, L.N. & Peterson, B.J. (2003) Forecasting responses of seagrass distributions to changing water quality using monitoring data. *Ecological Applications*. 13: 474 – 489.

Herbert, DA, Perry, WB, Cosby, BJ, and Fourqurean, JW. (2011). Projected reorganization of Florida Bay seagrass communities in response to increased freshwater inflow with Everglades restoration. *Estuaries and Coasts* 34: 973 - 992.

Continuation in FY13: Dr. Herbert expects to complete his work in 2013.

On a separate note, with EVER's permission, SFCN will work with WRD to migrate DataForEVER to Storet. For VIIS we will be working with the VIIS Data manager to finish their water quality monitoring database.

Estuarine Salinity patterns (BISC, EVER)

Accomplished in FY12: No progress due to other SFCN time constraints.

Continuation in FY13: SFCN Data Management and Reporting Staff will further work with Sarah Bellmund to report this CERP indicator and NPS vital sign on the SFCN web as well as provide links to the CERP RECOVER System Status Report. SFCN will also contact Erik Stabenau for Florida Bay estuarine salinity patterns reports.

Surface water hydrology (BICY, EVER)

Continuation in FY13: For BICY and EVER the SFCN will continue to maintain links to regional hydrology summaries by Bob Sobczak of BICY and EVER; additionally, SFCN will link to EVER's weekly water depth maps based upon the Everglades Depth Estimation Network (EDEN).

Surface water hydrology – Weather stations and Crest Gage (BUIS, SARI)

Accomplished in FY11: SARI and BUIS weather stations were affected by inclement weather early in FY11. The SARI weather station was disassembled at the beginning of FY11 due to severe weather damage and according to park personnel was not possible to reassemble. The BUIS weather stations data collection was affected by hurricane weather, as well as software and hardware problems. This station was also disassembled, but park personnel were able to get it back up and running again. However the last delivery date for data on all loggers and SARI crest gage from park staff to SFCN is 2010.

Continuation in FY12: SFCN needs guidance from BUIS/SARI as to whether they wish these stations to continue and are willing to put park staff time towards their maintenance.

Other water quality related monitoring

A number of other vital signs strongly relate to water quality but are covered under the vital signs monitoring section including periphyton, aquatic invertebrates, freshwater fish and large macro-invertebrates, seagrass, and coral.

II. Public Interest Highlights

Schaus Swallowtail Butterfly Habitat Enhancement Project

The South Florida /Caribbean Network (SFCN) worked with the Florida/Caribbean Exotic Plant Management Team and Biscayne National Park on a Schaus Swallowtail Butterfly (*Heraclides aristodemus pnoceanus*) habitat enhancement project in Biscayne National Park (U.S. Fish and Wildlife Service [USFWS] Coastal Program Grant). SFCN enlisted the help of numerous volunteers (1104.5 hours) to help plant 2,332 seedlings – mostly torchwood, *Amyris elemifera*, the larval host plant of the critically endangered Schaus Swallowtail Butterfly. This project became even more important as only 5 butterflies were detected in 2012 by USFWS surveys. This triggered a joint NPS/USFWS emergency action to allow captive breeding of the butterfly by the University of Florida.

Everglades Vegetation Map

Everglades National Park is being mapped as a joint project between the United States Army Corps of Engineers (USACE) who is performing the photointerpretation and the South Florida/Caribbean Network (SFCN) who is providing field logistic support, botanical knowledge, and ground truthing (accuracy assessment). Photointerpretation has been completed on the first two map sections of Region 1. A total of 941 training points and 988 accuracy assessment points have been completed. An accurate vegetation map will provide the essential baseline information to detect and document the changes in the spatial extent, pattern, and proportion of the different plant communities in the ecosystem as they respond to hydrological modifications due to CERP/RECOVER restoration efforts and/or climate change related impacts that may affect the parks

SFCN's coral data used in regional coral analysis

The South Florida / Caribbean Network (SFCN) partnered with 78 marine scientists and managers in a regional collaboration to report the status and trends of fish and benthic communities within the Caribbean. Jeff Miller attended a workshop sponsored by the International Union for the Conservation of Nature in April 29- May 5, 2012 in which monitoring design and results were shared and synthesized among the 36 workshop participants, representing 18 countries. The report of this workshop was released in October 2012, titled, *Tropical Americas Coral Reef Resilience, Workshop Final Report*.

Multiagency Fish Protocol for the U.S. Virgin Islands nearly complete

The *Cooperative Multiagency Reef Fish Monitoring Protocol for the U.S. Virgin Islands Coral Reef Ecosystem* has received external peer review and comments are being addressed. This protocol documents the collaborative interagency (National Park Service, National Oceanic and Atmospheric Administration, University of Miami) program for the development of survey design and a fisheries independent reef fish database for the US Virgin Islands (St. Croix, St. John, St. Thomas).

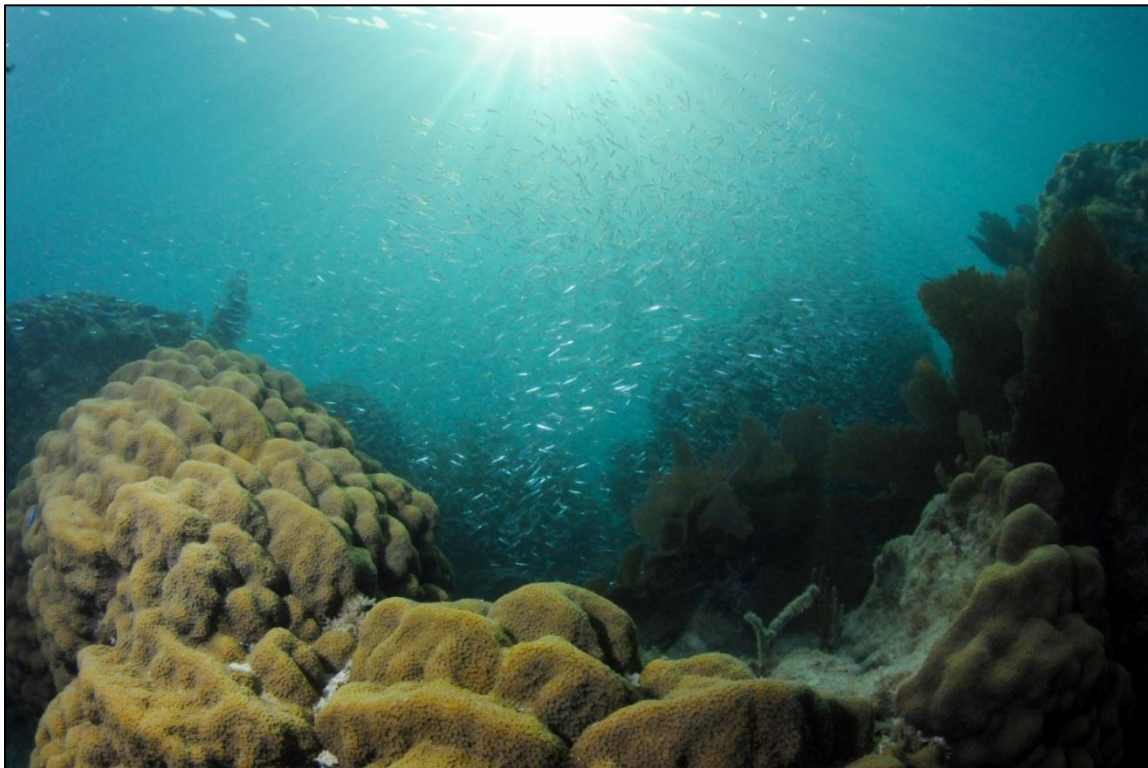
Multiple partner agencies get training in data analysis for reef fish monitoring

A workshop on Quantitative Methods for Large-Scale Coral Reef Ecosystem Surveys: Statistical Design, Data Management and Analysis was held at SFCN headquarters in April 2012. The workshop enabled all partners in the multi-agency reef fish monitoring in South Florida and the

U.S. Virgin Islands to be able to analyze and report the resulting data to meet their respective agency needs. Lead instructors for the course were Dr. Jerald Ault and Dr. Steven Smith of the University of Miami Rosenstiel School of Marine and Atmospheric Science.

SFCN participates in Dry Tortugas Research Natural Area 5 Year Report

The South Florida /Caribbean Network (SFCN) contributed 4 chapters to the *Implementing the Dry Tortugas National Park Research Natural Area Science Plan: The 5-Year Report* which presents the science and monitoring results for the first 5 years of the Dry Tortugas National Park Research Natural Area. Results from the Tortugas 5-year report were presented at a public meeting of the Florida Fish and Wildlife Conservation Commission in Palm Beach Gardens June 27 – 28, 2012.



A school of silversides swims above a *Montastraea faveolata* colony in the Dry Tortugas (Photo credit: David Bryan).

III. Staffing

SFCN Staff, Associated Post-docs, and Interns

Matt Patterson, Network Coordinator
Andrea Atkinson, Quantitative Ecologist
Michael Feeley, Marine Ecologist
Kevin R. T. Whelan, Community Ecologist
Brian Witcher, Data Manager
William “Jeff” Miller, Fisheries Biologist
Judd Patterson, GIS/Data Management Specialist
Rachel Vargas, Data Management/Outreach Technician
Andy Davis, Marine Biological Technician
Andy Estep, Marine Biological Technician
Rob Waara, Marine Biological Technician
Brooke Shamblin, Vegetation Technician
Raul Urgelles, Wildlife Technician
Robert Muxo, Community Technician
Everglades Vegetation Map Technician
Jed Redwine, Natural Resource Condition Assessment Ecologist
David Bryan, Marine Research Assistant
Lee Richter, Student Conservation Association Intern
Mario Londono, Student Conservation Association Intern
Craig Booker, Administrative Assistant
Darrell Herbert, Water Quality Postdoctoral Research Assistant
Michelle Prats, National Science Foundation Research Experience for Undergrads Intern &
George Melendez Wright Climate Change Intern
Craig Perry, Florida International University Resource Monitoring Intern
Jaeson Clayborn, Florida International University Ph.D. student collaborator
Joaquin Alonso, Everglades Vegetation Map Program Manager (accepted job with NPS-EPMT)
Tim Fotinos, Vegetation Postdoctoral Research Assistant (accepted job with USFWS I & M)

Board of Directors

Pedro Ramos, Superintendent, Big Cypress National Preserve
Mark Lewis, Superintendent, Biscayne National Park
Joel Tutein, Superintendent, Buck Island Reef National Monument/ Salt River Bay National
Historical Park and Ecological Preserve/ Christiansted National Historic Site
Dan Kimball, Superintendent, Everglades National Park/ Dry Tortugas National Park
Mark Hardgrove, Superintendent, Virgin Islands National Park / Virgin Islands Coral Reef
National Monument (retired 8/2012)
Mike Anderson, Acting Superintendent, Virgin Islands National Park / Virgin Islands Coral Reef
National Monument
Matt Patterson, Network I&M Coordinator
Lisa Garrett, Regional I&M Division Chief

Science and Technical Committee

Ron Clark, Resource Management Chief, Big Cypress National Preserve
Elsa Alvear, Resource Management Chief, Biscayne National Park

Zandy Hillis-Starr, Resource Management Chief, Buck Island Reef National Monument/ Salt River Bay National Historical Park and Ecological Preserve
Robert Johnson, South Florida Natural Resource Center Director, Everglades National Park / Dry Tortugas National Park
Carol Mitchell, Deputy Director for Science, South Florida Natural Resources Center, Everglades National Park and Dry Tortugas National Park
Rafe Boulon, Resource Management Chief, Virgin Islands National Park / Virgin Islands Coral Reef National Monument
Carol Daniels, South Florida / Caribbean Cooperative Ecosystem Studies Unit Coordinator

Volunteers in the Park (V.I.P.)

Numerous Volunteers in the Park (VIPs) worked with the Community Ecology Branch (3,291.5 hrs), three VIP worked with Marine Ecology Branch (450 hrs) and two VIP worked with the Data Management Branch (48 hrs). The SFCN VIP program logged a total of 3,789.5 volunteer hours in FY12 with an approximate value of \$82,573.21.

The Schaus Butterfly Habitat Enhancement project used numerous volunteers. There were over 1,104.5 field hours volunteered for the project. Some of these hours came from FLC-EMPT, BISC NPS, US FWS and the rest from the outside public. This does not include hours volunteered by some State of Florida agencies that assisted with project.

Michelle Prats (FIU Earth and Environment student) volunteered 500 hrs as a National Science Foundation Long Term Ecological Research Experience for Undergraduates internship program and 480 hrs as a George Wright Climate Change Intern through the NPS. She worked with the community ecology team as part of the Coastal Geomorphology Vital sign and the Ecotonal movement monitoring.

Elizabeth Whitcher (VIP) volunteered 370 hrs working with the Marine Ecology Branch assisting with the Marine Benthic Communities and Marine Fish Community Vital Signs, including data management support for the USVI Reef Fish Monitoring Protocol and field support in BISC and DRTO.

Jaeson Clayborn (FIU Biological Sciences) PhD Student has volunteered 300 hrs of office and fieldwork. He worked on the Schaus Butterfly Habitat Enhancement project which is a chapter in his dissertation.

Craig Perry (FIU Park and Recreation student) has volunteered 250 hrs of office and fieldwork. He worked mostly on the Schaus Butterfly Habitat Enhancement project but he also helped with Colonial Birds vital sign monitoring.

Coral Kelly (FIU Earth and Environment student) has volunteered 110 hrs of office and fieldwork. She worked mostly with the FLC-EPMT entering data and updating GIS files. She additionally assisted with data quality control and Schaus work.

Beatriz Guimaraes (FIU Earth and Environment student) has volunteered 131 hrs of office and fieldwork. She worked mostly on the Corridors of Invasiveness Vital Sign especially on updating track files.

Derek S. (High School Student) has volunteered 100 hrs of office and fieldwork. He mostly worked on digitizing the Long Pine Key vegetation map and did some field work supporting georeferencing on this product.

Timothy Bargar and Carla Wieser each volunteered 59 hrs assisting with contaminant sampling.

Theodore Schall, Becky Maholland, and Cynthia Irvin, all volunteered 40 hrs each on the Everglades Vegetation Mapping project.

Brandon Adams (FIU Earth and Environment student) has volunteered 48 hrs digitizing for the Ecotonal movement monitoring vital sign.

Jeremy May (FIU Biological Sciences) PhD Student has volunteered 50 hrs of office and fieldwork. He worked on the Everglades National Park Legacy Forest Structure sampling by resampling the Hurricane Andrew Research Team (HART) plots. This work is the main focus of his dissertation. Dr. Kevin R. T. Whelan is a member of his dissertation committee.

Elvia Mejia (Artist) volunteered over 40 hrs helping develop and revise the SFCN logo.

Logan Michelle Williams, a student at Eckerd College, and Devon Nemire-Pepe (VIP) each volunteered 40 hours assisting with data management and field work with the Virgin Islands section of the marine group.

Rudy Gadala (FIU Earth and Environment student) has volunteered 32 hrs of fieldwork. He worked mostly on the Schaus Butterfly Habitat Enhancement project.

David Gandy, Monica Isola, Ashley Salvatore, Tal Berman, Samuel Mitchell, Michelle Williams, Josephine Whelan, and Andres Alonso (VIP), all helped with various projects but mostly on the Schaus Butterfly Habitat Enhancement project.

Suresh Subedi (FIU Biological Sciences) PhD Student has volunteered 8 hrs of office time. He is working resampling forest vegetation in Crocodile Lakes National Wildlife Refuge (US. Fish and Wildlife Service). This work is the main focus of his dissertation. Dr. Jed R. Redwine is a member of his dissertation committee.

IV. Reports, Publications and Presentations

Published journal articles, open file reports, reports, resource briefs, presentations

Journal Articles

- Ault, J.S., Smith, S.G., Bohnsack, J.A., Luo, J., Zurcher, N., McClellan D.B., Ziegler, T.A., Hallac, D.E., Patterson, M., Feeley, M.W., Ruttenberg, B.I., Hunt, J., Kimball, D. & Causey, B. *Submitted for publication*. Assessing coral reef fish population and community changes in response to marine reserves in the Dry Tortugas, Florida USA. Fisheries Research.
- Brandt, M.E., B.I. Ruttenberg, R. Waara, J. Miller, B. Witcher, A.J. Estep and M. Patterson. 2012. Dynamics of an acute coral disease outbreak associated with the macroalgae *Dictyota* spp. in Dry Tortugas National Park, Florida, U.S.A. Bull Mar Sci 88(4):000-000. <http://dx.doi.org/10.5343/bms.2011.1104>
- Hart, K.M., Sartain, A.R., Fujisaki, I., Pratt, H.L. Jr, Morley, D., Feeley, M.W. 2012. Home range, habitat-use, and migrations of hawksbill turtles tracked from Dry Tortugas National Park, Florida, USA. Marine Ecology Progress Series. doi: 10.3354/meps09744
- Ruttenberg, B.I., Schofield, P.J., Akins, J.L., Acosta, A., Feeley, M.W., Blondeau, J., Smith, S.G. & Ault, J.S. 2012 Rapid invasion of Indo-Pacific lionfish (*Pterois volitans* and *P. miles*) in the Florida Keys, USA: evidence from multiple pre- and post-invasion datasets. Bulletin of Marine Science 88(4):1051–1059. <http://dx.doi.org/10.5343/bms.2011.1108>

Reports and related products

- Ault, J.S., Smith, S.G., Switzer, T.S., Bohnsack, J.A., Patterson, M., Feeley, M.W., McClellan D.B., Ruttenberg, B.I., Hallac, D.E., Ziegler, T.A., Hunt, J. & Kimball, D. 2012. Status of Tortugas region reef fishery resources from fishery-independent visual and trap survey assessments. In: T.A. Ziegler and J. Hunt (eds), Implementing the Dry Tortugas National Park Research Natural Area Science Plan: The 5-Year Report 2012. South Florida Natural Resources Center, Everglades and Dry Tortugas National Parks, Homestead, FL, and the Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.
- Bryan, D.R., Atkinson, A.J., Ault, J.S., Brandt, M.E., Bohnsack, J.A., Feeley, M.W., Patterson, M.E., Ruttenberg, B.I. & Smith, S.G. *In Review*. A Cooperative Multiagency Reef Fish Monitoring Protocol for the U.S. Virgin Islands Coral Reef Ecosystem. Natural Resource Report NPS/SFCN/NRR—2012/XXX. National Park Service, Fort Collins, Colorado.
- Feeley, M.W., Morley D., Acosta, A., Switzer, T.S., Farmer, N.A. & Ault, J.S. (2012) Spillover of select fish species in and near the Dry Tortugas National Park Research Natural Area. In: T.A. Ziegler and J. Hunt (eds), Implementing the Dry Tortugas National Park Research Natural Area Science Plan: The 5-Year Report 2012. South Florida Natural Resources Center, Everglades and Dry Tortugas National Parks, Homestead, FL, and the Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.
- Feeley, M.W., Morley D., Acosta, A., Switzer, T.S. & Pratt, H.L. (2012) Regional connectivity of fishes within the Tortugas region of Florida. In: T.A. Ziegler and J. Hunt (eds),

- Implementing the Dry Tortugas National Park Research Natural Area Science Plan: The 5-Year Report 2012. South Florida Natural Resources Center, Everglades and Dry Tortugas National Parks, Homestead, FL, and the Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.
- Fotinos, T. and K.R.T. Whelan. In progress. 30 Years of Vegetation Change at Turner River, Big Cypress National Preserve, Florida (Intended Journal Florida Scientist).
- Jackson J., K. Cramer, M. Donovan, A. Friedlander, A. Hooten, and V. Lam. 2012. Tropical Americas Coral Reef Resilience Workshop Final Report. SFCN Marine Group significant contributor to data, and report writing/review.
- Miller, J., Waara R., Patterson, M., Feeley, M.W., Atkinson, A., Davis, A., Estep, A. & Richter, L. 2012. Eight years of coral reef community monitoring: Results from inside and outside the Dry Tortugas National Park Research Natural Area. In: T.A. Ziegler and J. Hunt (eds), Implementing the Dry Tortugas National Park Research Natural Area Science Plan: The 5-Year Report 2012. South Florida Natural Resources Center, Everglades and Dry Tortugas National Parks, Homestead, FL, and the Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.
- Shamblin, R. B., and K.R.T.Whelan. 2013. SFCN Exotic Plant Survey – Corridors of Invasiveness: 2009 Pilot Year Summary Report. Natural Resource Technical Report NPS/SFCN/NRTR—2013/788. National Park Service, Fort Collins, Colorado.
- Shamblin, R.B. and K.R.T. Whelan. 2013. Corridors of Invasiveness Data Summary Report: Biscayne National Park, 2011. Natural Resource Data Series NPS/SFCN/NRDS—2013/526. National Park Service, Fort Collins, Colorado.
- Shamblin, R.B., K.R.T. Whelan, and Rachel M. Vargas. 2013. South Florida/Caribbean Network Early Detection Protocol for Invasive Exotic Plants: Corridors of Invasiveness. Natural Resource Report NPS/SFCN/NRR—2013/675. National Park Service, Fort Collins, Colorado.
- Standard Operating Procedure: Buck Island Seasonal Bird Surveys for Brown Pelicans and Least Terns. 2012. 9 pages.
- Standard Operating Procedure: Methods for Detecting Wading Bird Nesting Colonies in Everglades National Park. 2012. 2 pages.
- Standard Operating Procedure: Virgin Islands Brown Pelican Monitoring Program. 2012. 4 pages.
- Whelan, R. T. K., C. Ariori, T. Thanawastien and J. M. Patterson. *DRAFT*. Digitization of 1981 Vegetation Map of the Coastal Region between Flamingo and Joe Bay of Everglades National Park (East Map). Natural Resource Report NPS/SFCN/NRR—20XX/XXX. National Park Service, Fort Collins, Colorado.

Whelan, R. T. K., C. Ariori, T. Thanawastien and J. M. Patterson. *DRAFT*. Digitization of 1981 Vegetation Map of the Coastal Region between Flamingo and Joe Bay of Everglades National Park (West Map). Natural Resource Report NPS/SFCN/NRR—20XX/XXX. National Park Service, Fort Collins, Colorado.

Whelan, R. T. K., C. Ariori, T. Thanawastien and J. M. Patterson. *DRAFT*. Digitization of 1982 Vegetation Map of Turner River Road Area of Big Cypress National Preserve. Natural Resource Report NPS/SFCN/NRR—20XX/XXX. National Park Service, Fort Collins, Colorado.

Whelan, K.R.T., P. L. Ruiz, R. B. Shamblin, P. A. Houle, M. S. Ross, A. J. Atkinson, J. M. Patterson, J. Alonso. *DRAFT*. Biscayne National Park Vegetation Map Project. Natural Resource Technical Report. NPS/SFCN/NRTR – 20XX/XXX. National Park Service, Fort Collins, Colorado.

Presentations, Posters, and Resource Briefs

Feeley, M. 2012. Overview of SFCN Marine Ecology Monitoring Program. Presentation to Grenada and St. Vincent Visiting Rangers, April 20, 2012. Biscayne National Park, FL.

Fotinos, Timothy and Kevin R. T. Whelan. Resurrecting Past Projects: resampling Gunderson and Loope vegetation plots in Big Cypress National Preserve. Third Annual Big Cypress Research Symposium November 10, 2011 – Big Cypress Welcome Center, Ochopee

Friedlander A., E. DeMartini, E. Brown, J. Beets, J. Miller. 2012. How top-down control by predatory fishes and humans influence reefs. International Coral Reef Symposium. July 9-13, 2012. Cairns, Australia.

Gandy, David A., Jennifer S. Rehage, Jeff Kline, Kevin R. T. Whelan and Raul Urgelles. Non-native fishes in canals of the Florida Everglades: implications for management . Intecol Meeting 2012, Orlando Florida

Miller J. 2011. Reef life within Virgin Islands National Park. Presentation to St. John charter and dive boat operators. November 29, 2011. St. John, VI.

Miller J. 2012. A short history of benthic and fish community monitoring in Virgin Islands National Park. International Union for the Conservation of Nature (IUCN) and Global Coral Reef Monitoring Network (GCRMN) meeting and working group. May 5, 2012. Panama City Republic of Panama.

Miller J. 2012. Documenting the decline – monitoring trends and techniques in Virgin Islands national parks. Workshop on Biological Integrity of Coral Reefs. August 21-23, 2012. La Parguera, Puerto Rico.

Miller J. Weekly Nov 2011 - Feb 2012. Reef Life. Presentation at Maho Bay Ecocamp, St. John VI.

- Miller J., A. Davis, A. Atkinson, J. Herlan, M. Patterson, C. Rogers, J. Patterson, B. Witcher, R. Waara, M. Feeley. 2012. What two coral bleaching events can tell us about resilience. International Coral Reef Symposium. July 9-13, 2012. Cairns, Australia.
- Miller J., A. Estep. 2012. SFCN –Who are we? What are we? What do we do? All-employee meeting at BUIS. February 14, 2012. St. Croix, VI.
- Nestler, Jennifer H., Judd M. Patterson, and Eric W. Wilberg. 2012. Exploring crocodylian diversity in an environmental context: Implications for the fossil record. Society for Vertebrate Paleontology. October 2012. Raleigh, NC.
- Patterson, Matt. 2012. NPS Marine Protected Areas lecture. April 9, 2012. Florida International University Marine Protected Areas Class
- Redwine, Jed and Mario Londono. Assessing the Condition of Exotic Plant Species in the Eastern Addition Lands of Everglades National Park. Intecol Meeting 2012, Orlando Florida.
- Whelan, Kevin R. T., Timothy A. Fotinos, and Robert B. Shamblin. Monitoring Mangrove Ecotonal Movement into Everglades Marshes. Intecol Meeting 2012, Orlando Florida
- Whelan, Kevin R. T. and Michelle C. Prats. Establishment of Long Term Soil Surface Elevation Monitoring Sites in Biscayne National Park. Intecol Meeting 2012, Orlando Florida
- Whelan, Kevin R. T. , Ted Schall, Joaquin Alonso, Clayton A. McCoy, H. C. Giannini, Judd Patterson, and Robert B. Shamblin. Vegetation Map of Everglades National Park and Big Cypress National Preserve. GIS Day/ USACE and NPS poster presentation 2012
- Whitcher E., D. Hubbard, K. Parsons-Hubbard, J. Miller. 2012. Bioerosion of *in situ* coral colonies: St. John, US Virgin Islands. International Coral Reef Symposium. July 9-13, 2012. Cairns, Australia.

V. Protocol Status Summary Table

Name of Protocol	Vital Signs Addressed	Parks	Protocol Status – Dates for Actual/Expected Milestones			Comments on Protocol Status
			Draft Available	Submitted for Review	Approved by Regional Mgr.	
Coral Reef Monitoring Protocol	Marine Benthic Communities ; Marine invertebrates-rare, threatened & endangered	BISC DRTO VIIS BUIS VICR (later) SARI	Yes	New Version Planned March 2013	Ver.1 – June 2002	Original prototype protocol was completed and peer reviewed. Protocol is under revision to add monitoring for coral disease, diadema, rugosity, expanded sampling design, boat operations & safety, and reporting. >12 years of monitoring data has been collected from evolution of this protocol from I&M Prototype program. Protocol data used in numerous presentation, publications and peer-reviewed journal articles.
Coral Reef Water Temperature Protocol	Marine Benthic Communities ; Water Chemistry	BISC DRTO VIIS BUIS VICR (later) SARI	Yes	March 2012		Reviews received from 3 peer reviewers and final edits are being addressed. There was a protocol submitted under the prototype as well, but with the change in logger technology used, SFCN is submitting a new protocol. >21 years temperature data have been collected.
A Cooperative Multiagency Reef Fish Monitoring Protocol for the Florida Keys Coral Reef Ecosystem	Marine Fish Communities	BISC DRTO			September 2009	Published: <u>Brandt, M. E., N. Zurcher, A. Acosta, J. S. Ault, J. A. Bohnsack, M. W. Feeley, D. E. Harper, J. Hunt, T. Kellison, D. B. McClellan, M. E. Patterson, S. G. Smith. (2009) A Cooperative Multi-Agency Reef Fish Monitoring Protocol for the Florida Keys Coral Reef Ecosystem. Natural Resource Report NPS/SFCN/NRR – 2009/150. National Park Service, Fort Collins, Colorado.</u>
A Cooperative Multiagency Reef Fish Monitoring Protocol for the U.S. Virgin Islands Coral Reef Ecosystem	Marine Fish Communities	BUIS VIIS SARI	Yes	July 2012		External Peer Reviews received and final edits being addressed. Expect to be submitted to Regional Mgr. by March 2013.

Name of Protocol	Vital Signs Addressed	Parks	Protocol Status – Dates for Actual/Expected Milestones			Comments on Protocol Status
			Draft Available	Submitted for Review	Approved by Regional Mgr.	
Seagrass	Marine Benthic Communities ; Marine Exploited Invertebrates	BISC DRTO VIIS BUIS SARI	September 2014			Just starting. Have gathered existing protocols. Existing monitoring occurring in EVER, BISC, DRTO and in VIIS. SFCN will be choosing an existing protocol from two being used by partners and develop program to complement existing programs and fill in gaps.
Spiny Lobster	Marine Exploited Invertebrates	BISC, DRTO, EVER, SARI, VIIS, BUIS	September 2014			Not started yet. BUIS will be conducting own monitoring. SFCN will look at methods being used by FWRI.
Corridors of Invasiveness	Invasive/exotic plants	BICY BISC EVER	Spring 2011	Summer 2011		All peer review comments have been addressed. Submitting to regional coordinator (e.g., in late October or November, 2012). Pilot work completed, pilot year report for 2009 and data summary report for 2011 complete and 2012 nearly complete. A new SOP was added to improve spatial component of protocol data collection. The three park EPMT and the FLCOEPMT have indicated that the metrics are useful and have actually used data for early detection and rapid response to address new species found in park unit.
Periphyton	Periphyton	BICY	July 2013			We conducted pilot sampling for periphyton in the northwest portion of BICY in 2008, 2009, 2010, and 2012. Initial objectives were to determine any significant difference between impacted and non-impacted “basins”, selected <i>a priori</i> , and between two habitat-types within each basin (2008). Subsequent sampling was done to determine spatial (2009) and temporal (2010 and 2012) variability for each basin. These determinations are necessary before establishing an effective sampling design for periphyton in the northwest portion of BICY.
Freshwater Fish and Large Macro-invertebrates	Freshwater Fish and Large Macro-invertebrates	BICY	September 2015			Our original plan was to combine this vital sign with the periphyton and aquatic invertebrates in freshwater prairies and marshes vital signs (see below) and simultaneously collect for all three. However, we have now determined that this would not be feasible since sampling for each of these vital signs will most likely occur at different times throughout the year, as well as in potentially different

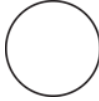
Name of Protocol	Vital Signs Addressed	Parks	Protocol Status – Dates for Actual/Expected Milestones			Comments on Protocol Status
			Draft Available	Submitted for Review	Approved by Regional Mgr.	
						habitats. Pilot sampling for this vital sign is likely to start in late 2013.
Aquatic Invertebrates in Freshwater Prairies and Marshes	Aquatic Invertebrates in Freshwater Prairies and Marshes	BICY	May 2015			Our original plan was to combine this vital sign with the periphyton and freshwater fish and large macro-invertebrates vital signs (see above) and simultaneously collect for all three. However, we have now determined that this would not be feasible since sampling for each of these vital signs will most likely occur at different times throughout the year, as well as in potentially different habitats. We are looking into possibly adopting a USFWS time-limited, qualitative procedure for the collection of field identifiable freshwater wetland macro-invertebrates. Initial pilot assessment of USFWS protocol was accomplished this summer. Pilot protocol sampling for this vital sign is likely to start in Fall 2012.
Invasive/ Exotic Fish in Canals	Invasive/ Exotic Animals	EVER BICY	January 2014			We delayed this protocol because we chose to collaborate with Dr. Jennifer Rehage's lab at Florida International University who was funded by the NPS Critical Ecosystems Studies Initiative (CESI) program to study how exotic fish utilize canal habitat. The Rehage lab is in their second year of sampling south Florida canals and we have been assisting this effort by electrofishing for fish. David Gandy, graduate student of Dr. Rehage, is analyzing the data collected from electrofishing as part of his Master's Thesis and is scheduled to finish in the Jan of 2013. We will model our sampling design, to continue the monitoring of canals for the new exotic fish, based on the project findings.
Biscayne National Park Colonial Nesting Birds	Colonial Nesting Birds	BISC BICY	March 2013			Our original plan was based on regional sampling but after investigation, there needed to be extensive modification for adaptation to estuary-based colonial nesting birds. We have pilot sampling for half of 2009, and all 2010 and 2011. We have determined variation in nest counts and have just begun determining what the annual nesting patterns are. This vital sign is costly due to helicopter expense. BISC has interest in the data due to FPL expansion activities. An SOP will be developed for BICY as per agreement with RECOVER-funded bird monitoring related to Everglades restoration. Staff illness has slowed progress on this vital sign this year but we are back on track.

Name of Protocol	Vital Signs Addressed	Parks	Protocol Status – Dates for Actual/Expected Milestones			Comments on Protocol Status
			Draft Available	Submitted for Review	Approved by Regional Mgr.	
Soil Elevation Table	Coastal Geomorphology	BISC EVER VIIS SARI	October 2013			Adapting from two existing Protocols: Monitoring Salt Marsh Elevation Cahoon et al. 2004 and A Standard operating Procedures manual for the Louisiana Department of Natural Resource's Coastal Restoration Division T. M. Folse and J. L. West 2004. Our protocol is also being tied to a National Park Service Wide SET protocol authored by James Lynch of the National Coastal and Barrier Network, Philippe Hensel (National Geodetic Survey) and Don Cahoon (US Geological Survey). We have installed 2 sites in BISC and 1 site in SARI currently and have begun data collection.
Forest Vegetation Monitoring Protocol	Forest Ecotones and Community Structure; Mangrove-Marsh Ecotones	EVER BICY BISC VIIS SARI BUIS	October 2014			Pilot testing occurred for 1 year. Year 1 of mangrove-marsh ecotone monitoring is underway. Assessment of initial sampling design using GRTS has occurred and been rejected. Reassessment of sampling design has been to use restricted stratified random sampling for plot location. This assessment will occur this fall 2012. Ecotonal monitoring is progressing well. Forest structure plots will start to be installed next year.
Amphibians	Amphibians	EVER BICY VIIS	December 2015			To be started in FY 2013. SFCN will begin pilot work on this vital sign next year.
Land cover and use	Land cover and use	All	November 2013			Zoning and land use data for south Florida parks has been compiled and ways of reporting investigated. Cutler Bay permits, Collier county permits, and unincorporated Miami-Dade permits have been compiled and types of change and ways of reporting are being evaluated.
Weather Station and Rain Gages	Surface Water Hydrology	BUIS SARI BISC	Yes	Yes		Network evaluating whether to proceed with this monitoring or switch to nearby airport data. SARI may have a different type of weather station installed.

VI. Connect the Dots – Resource Condition Summary Tables

Below are Resource Condition Summary Tables for SFCN parks. These tables should be considered an experimental attempt at clearly communicating resource status and trends to a variety of audiences. These represent a combination of results including SFCN monitoring, Air Resources Division (ARD) monitoring, Exotic Plant Management Team (EPMT) monitoring, Comprehensive Everglades Restoration Plan/Monitoring and Assessment Program (CERP/MAP) funded or associated monitoring, park monitoring, and other partner monitoring. Much of the CERP/MAP monitoring has been summarized in the South Florida Ecosystem Restoration Task Force summary report “System-wide Ecological Indicators for Everglades Restoration: 2012 Report” (SFERTF DRAFT) and their symbols were merely converted into the Inventory & Monitoring program framework and text is copied and cited as is and the reader is referred to their report and the soon to be published CERP/RECOVER/MAP System Status Report. Determining how to summarize these vital signs effectively is still a work in progress. The plan is to expand and include additional vital signs as those reports are identified and ways or summarizing status and trend are determined. In addition the upcoming Natural Resource Condition Assessment reports for EVER and BICY should support future versions of these tables.

The Status and Trend symbols used in the summary tables below are summarized in the following key. The background color represents the current condition status, the direction of the arrow summarizes the trend in condition, and the thickness of the outside line represents the degree of confidence in the assessment.

Condition Status		Trend in Condition		Confidence in Assessment	
	Warrants Significant Concern		Condition is Improving		High
	Warrants Moderate Concern		Condition is Unchanging		Medium
	Resource is in Good Condition		Condition is Deteriorating		Low

Big Cypress National Preserve (BICY) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Invasive/ Exotic Plants	Exotics in Corridors of Invasion	Type, number, location and distribution of new exotic species		5 new species were detected in 2009: Stachytarpheta urticifolia, Ludwigia peruviana, Panicum repens, Lantana camara, Sphagneticola trilobata. 8 infestations of other exotics were also reported (Shamblin & Whelan, Draft)	To be determined. But new exotics generally warrant caution rating.	SFCN/ EPMT monitoring
	Casuarina Spp. (Australian Pine)	Canopy acres		23.69 canopy acres. 174.08 gross infested acres (2012 EPMT Digital Aerial Sketchmapping Database; Queried 10/23/2012). The difference from 2010 is within the measurement error of the method. (EPMT Specialist, personal communication, 10/31/2012)	24.08 canopy acres; 170.4 gross infested acres (2010 EPMT Digital Aerial Sketch-mapping database; Queried 10/30/2010)	EPMT Monitoring
	Schinus terebinthifolius (Brazilian Pepper)	Canopy acres		2122.82 canopy acres. 9987.84 gross infested acres (2012 EPMT Digital Aerial Sketchmapping Database; Queried 10/23/2012). The difference from 2010 is within the measurement error of the method. (EPMT Specialist, personal communication, 10/31/2012)	1804.92 canopy acres; 6847.03 gross infested acres (2010 EPMT Digital Aerial Sketchmapping Database; Queried 10/30/2010)	
	Lygodium (Old World Climbing Fern)	Canopy acres		14.8 canopy acres. 158.43 gross infested acres (2012 EPMT Digital Aerial Sketchmapping Database; Queried 10/23/2012). The difference from 2010 is within the measurement error of the method. (EPMT Specialist, personal communication, 10/31/2012) . NOTE: This sampling method may grossly underestimate the acres of Lygodium within the park as this species may be difficult to detect until infestation sizes are large.	60.54 canopy acres; 291.08 gross infested acres (2010 EPMT Digital Aerial Sketch-mapping Database; Queried 10/30/2012)	

Big Cypress National Preserve (BICY) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
	Mealeuca	Canopy acres		386.93 canopy acres. 3024.76 gross infested acres (2012 EPMT Digital Aerial Sketchmapping Database; Queried 10/23/2012). The difference from 2010 is within the measurement error of the method. (EPMT Specialist, personal communication, 10/31/2012)	360.77 canopy acres; 2774.46 gross infested acres (2010 EPMT Digital Aerial Sketch-mapping Database; Queried 10/30/2012)	
Air Quality	Air Quality - Visibility	Haze index in deciviews (dv)		National Park Service, Air Resources Division. 2010. Air quality in national parks: 2009 annual performance and progress report. Natural Resource Report NPS/NRPC/ARD/NRR—2010/266. National Park Service, Denver, Colorado.	(same as left)	Park Monitoring w/ ARD analysis
American Alligator	American Alligator	Relative density, body condition		“Relative density (component score = 0.17) and body condition (component score = 0.33) combined for a location score of 0.25 and so conditions do not meet restoration criteria.” (Brandt et al. 2012)		CERP/MAP/ Partner Monitoring
Visitor Use		Annual Park Visitation		BICY reported its highest level of visitation in 2011 and the pattern since 1988 has been increasing. Nearly all measured factors increased over 2010. https://irma.nps.gov/Stats/SSRSReports/Park Specific Reports/Annual Park Visitation Graph (All Years)?Park=BICY ; https://irma.nps.gov/Stats/SSRSReports/Park Specific Reports/Monthly Public Use?RptDate=12/1/2011&Park=BICY (Accessed 10/19/2012)	To be determined	Park Monitoring

Brandt, L.A., J. Boyer, j. Browder, M. Cherkiss, R.F. Doren, P. Frederick, E. Gaiser, D. Gawlik, S.Geiger, K. Hart, B. Jeffery, C. Kelble, J. Layne, J. Lorenz, C. Madden, F. J. Mazzotti, P. Ortner, M. Parker, M. Roblee, L. Rodgers, A. Rodusky, D. Rudnick, B. Sharfstein, J. Trexler, A. Volety. 2012. System-wide Ecological Indicators for Everglades Restoration: 2012 Report. Unpublished Technical Report of the South Florida Ecosystem Restoration Task Force.

Shamblin, R.B. and K.R.T. Whelan. DRAFT. SFCN Exotic Plant Survey – Corridors of Invasiveness 2009 Pilot Year Summary Report. Natural Resource Technical Report NPS/SFCN/NRTR—2012/XXX. National Park Service, Fort Collins, Colorado.

Biscayne National Park (BISC) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Air Quality	Visibility	Haze index in deciviews (dv)		National Park Service, Air Resources Division. 2010. Air quality in national parks: 2009 annual performance and progress report. Natural Resource Report NPS/NRPC/ARD/NRR—2010/266. National Park Service, Denver, Colorado.		Park Monitoring w/ ARD analysis
	Ozone	Ozone Concentration (ppb)				
Coral Communities	Ball Buoy Reef	Primary= % live stony coral cover; Secondary= algal, sponge, & soft coral cover, sea urchin density, disease prevalence & area, and water temperatures		Live stony coral cover = 6.9% (sampled 8/22/2011) and is not significantly different from 2004 so no trend has been detected. (SFCN data analysis 10/23/2012.)	Reference condition under development by looking at available historical data and reports.	SFCN monitoring
	Amanda's Reef			Live stony coral cover is 6.7% (sampled 8/20/2011) and is not significantly different from 2004 so no trend has been detected. (SFCN data analysis 10/23/2012.)		
Invasive species	Lionfish	Presence & Distribution		Lionfish were first detected in the park 2009. Since the invasion began, park biologists have been routinely visiting known "hotspots" of lionfish settlement to remove individuals, and they are also assessing and removing lionfish from 300 randomly selected coral habitat sites to determine if and how lionfish distribution and density is determined by environmental features To date, over 1600 individuals have been captured and removed by park staff, and park visitors have likely removed countless others as well. When management efforts began, lionfish were fairly uncommon, however they have become increasingly more common (across different sites) and abundant (density at a single site) over time. (Vanessa McDonough, park biologist, personal communication, 1/9/2013)	0 lionfish were detected in 2008 despite extensive sampling (SFCN monitoring)	NPS-BISC monitoring

Big Cypress National Preserve (BICY) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Marine Exploited Invertebrates – Pink Shrimp	Pink Shrimp – North of Black Point	Juvenile pink shrimp density		<i>“This site had a moderate density of shrimp (~3.5/m² in 2005 and ~2.3/m² in 2009. In 2012, it was less than 1.5.” Footnote suggested trend is not significant at the p<0.05 level.” (Brandt et al. 2012)</i>		CERP/MAP/ Partner monitoring
	Pink Shrimp – South of Black Point	Juvenile pink shrimp density		<i>“Density was slightly higher in 2012 (1.0/m²) than in 2010 (~0.5), but the 5 previous years were better (almost 3 in 2006)” (Brandt et al. 2012)</i>		CERP/MAP/ Partner monitoring
Algal Blooms	Algal Blooms - Central Biscayne Bay	Chlorophyll-a concentrations		Current status based upon 2011 data. <i>“Chlorophyll-a concentrations each year since 2002 were higher than typical historic concentrations in this region, indicating a long-term increase. While these concentrations are not considered harmful, they may indicate that there was an increased potential for algal blooms over the past decade.” (Brandt et al. 2012)</i>		CERP/MAP/ Partner monitoring
	Algal Blooms - South Biscayne Bay	Chlorophyll-a concentrations		Current status based upon 2011 data. <i>“Chlorophyll-a concentrations in 2010 and 2011 were higher than typical historical concentrations in this region, indicating a potential for algal blooms.” (Brandt et al. 2012)</i>		CERP/MAP/ Partner monitoring
American Crocodile	American Crocodile	Juvenile Growth and Survival		<i>“Juvenile growth (component score = 0) and survival (component score = 0.3) combined for a location score of 0.3 and so current conditions do not meet restoration criteria.” (Brandt et al. 2012)</i>		CERP/MAP/ Partner monitoring
Invasive/ Exotic Plants	Exotics in Corridors of Invasion	Type, number, location and distribution of new exotic species		3 new species were detected in 2011: <i>Ficus religiosa</i> (treated during survey); <i>Pongamia pinnata</i> (too many to treat during survey); <i>Szygium cumini</i> (treated during survey) (Shamblin & Whelan, 2013)	To be determined. But new exotics generally warrant caution rating.	SFCN/ EPMT monitoring
	Shoebuttan (Ardisia elliptica)	Canopy acres treated		0.03 canopy acres treated (APCAM database query 11/1/2012); Total acreage in park unknown.		EPMT Monitoring
	Australian Pine (Casuarina Sp.)			0.34 canopy acres treated (APCAM database query 11/1/2012); Total acreage in park unknown.		

Big Cypress National Preserve (BICY) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Invasive/ Exotic Plants (cont.)	Madagascar periwinkle (Catharanthus roseus)	Canopy acres treated		0.06 canopy acres treated (APCAM database query 11/1/2012); Total acreage in park unknown.		EPMT monitoring
	Lather Leaf (Colubrina asiatica)			3.26 canopy acres treated (APCAM database query 11/1/2012); Total acreage in park unknown.		
	Sapodilla (Manikara zapota)			2.42 canopy acres treated (APCAM database query 11/1/2012) ; Total acreage unknown.		
	Burma reed (Neyraudia renaudiana)			2.69 canopy acres treated (APCAM database query 11/1/2012) ; Total acreage unknown.		
	Karum Tree (Pongamia pinnata)			0.0003 canopy acres treated (APCAM database query 11/1/2012) ; Total acreage unknown.		
	Castor Bean (Ricinus communis)			0.0003 canopy acres treated (APCAM database query 11/1/2012) ; Total acreage unknown.		
	Beach naupaka (Scaevola sericea)			0.95 canopy acres treated (APCAM database query 11/1/2012) ; Total acreage unknown.		
	Brazilian Pepper (Schinus terebinthifolius)			2.78 canopy acres treated (APCAM database query 11/1/2012) ; Total acreage unknown.		
	Seaside mahoe (Thespesia populnea)			37.54 canopy acres treated (APCAM database query 11/1/2012) ; Total acreage unknown.		
	Yellow alder (Turnera ulmifolia)			0.06 canopy acres treated (APCAM database query 11/1/2012) ; Total acreage unknown.		
	Wedelia (Wedelia trilobata)			0.20 canopy acres treated (APCAM database query 11/1/2012) ; Total acreage unknown.		

Big Cypress National Preserve (BICY) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
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Albins MA, Hixon MA. 2008. Invasive Indo-Pacific lionfish *Pterois volitans* reduce recruitment of Atlantic coral-reef fishes. Mar Ecol Prog Ser. 367:233–238. <http://dx.doi.org/10.3354/meps07620>

Brandt, L.A., J. Boyer, j. Browder, M. Cherkiss, R.F. Doren, P. Frederick, E. Gaiser, D. Gawlik, S.Geiger, K. Hart, B. Jeffery, C. Kelble, j. Layne, J. Lorenz, C. Madden, F. J. Mazzotti, P. Ortner, M. Parker, M. Roblee, L. Rodgers, A. Rodusky, D. Rudnick, B. Sharfstein, J. Trexler, A. Voley. 2012. System-wide Ecological Indicators for Everglades Restoration: 2012 Report. Unpublished Technical Report of the South Florida Ecosystem Restoration Task Force.

Shamblin, R.B. and K.R.T. Whelan. 2013. SFCN Corridors of Invasiveness Data Summary Report: Biscayne National Park, 2011. Natural Resource Data Series NPS/SFCN/NRDS—2013/526. National Park Service, Fort Collins, Colorado.

Buck Island Reef National Monument (BUIS) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coral Communities	South Fore Reef Coral Reef Condition	Primary= % live stony coral cover; Secondary= algal, sponge, & soft coral cover, sea urchin density, disease area, disease prevalence and water temperatures		Live stony coral cover =6.5%. Reef has still not recovered from the large drop in the devastating 2005 bleaching/disease event. However a small upward trend has been detected since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 19.8% (sampled 2/1/2005; SFCN database)	SFCN monitoring
	Western Spur & Groove Coral Reef Condition			Live stony coral cover =3.3%. Reef has still not recovered from the large drop in the devastating 2005 bleaching/disease event. However no significant trend has been detected since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 5.1% (sampled 5/23/2005; SFCN database)	
Invasive/ Exotic Species	Lionfish	Presence & distribution		Lionfish were first detected in the park 2010 (BUIS Resource Mgmt Chief). Lionfish are considered to be invasive predatory fish that may cause damage to reef ecosystems (Albins and Hixon, 2008)	None detected previous to 2010	Partners, Park and SFCN monitoring
Invasive/ Exotic Plants	Rosary pea (Abrus precatorius)	Canopy acres treated		3.78 canopy acres treated (APCAM database query 11/1/2012);		EPMT monitoring
	Pitted Beardgrass (Bothriochloa pertusa)			3.24 canopy acres treated (APCAM database query 11/1/2012)		
	Bellyache bush (Jatropha gossypifolia)			0.55 canopy acres treated (APCAM database query 11/1/2012)		
	Lead tree (Leucaena leucocephala)			1.33 canopy acres treated (APCAM database query 11/1/2012)		
	Guinea grass (Panicum maximum)			35.07 canopy acres treated (APCAM database query 11/1/2012)		
	Beach naupaka (Scaevola sericea)			0.02 canopy acres treated (APCAM database query 11/1/2012)		

Buck Island Reef National Monument (BUIS) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
	Yellow elder/ yellow trumpetbush (Tecoma stans)			0.10 canopy acres treated (APCAM database query 11/1/2012)		

Albins MA, Hixon MA. 2008. Invasive Indo-Pacific lionfish *Pterois volitans* reduce recruitment of Atlantic coral-reef fishes. Mar Ecol Prog Ser. 367:233–238. <http://dx.doi.org/10.3354/meps07620>

Dry Tortugas National Park (DRTN) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coral Communities	Bird Key Coral Reef Condition	Primary= % live stony coral cover; Secondary= algal, sponge, & soft coral cover, sea urchin density, disease area, disease prevalence and water temperatures		Live stony coral cover =10.0%(6/12/2012) shows a significant drop in live stony coral cover since SFCN began monitoring the reef in 2004 (24% loss of existing cover). (SFCN data analysis 10/23/2012.) In addition historical work (Jaap et al. 1989; Dustan, 1985; Wheaton et al., 2007) suggests this reef is much lower in coral cover that in the recent past.	Historical work (Jaap et al. 1989; Dustan, 1985; Wheaton et al., 2007) suggest this reef had much higher coral cover in the recent past (~ 40% in 1975).	SFCN monitoring
	Bird Key North Coral Reef Condition			Live stony coral cover = 10.7% (6/3/2011). Monitoring of Bird Key North reef started in 2005 which is after the steepest part of the drop experienced by Bird Key Reef. No significant trend has been detected since 2005. (SFCN data analysis 10/23/2012.) In addition historical work (Jaap et al., 1989; Dustan, 1985; Wheaton et al., 2007) suggests this reef is much lower in coral cover that in the recent past.		
	Loggerhead Forest Coral Reef Condition			Average stony coral cover = 26.4%. 3 additional 4-transect sites were added this year to 2 existing sites for a total of 5 sites. (SFCN data analysis 10/23/2012)	To be determined	SFCN monitoring
	Santa's Village Coral Reef Condition			3 4-transect sites were established this year. Average stony coral cover = 16.2%. (SFCN data analysis 10/23/2012)	To be determined	SFCN monitoring
	Inside Research Natural Area Coral Reef Condition			Average stony coral cover=9.4%. No trend has been detected across the 6 sites monitored since 2008. However I-50 may be showing a decline but is only significant at the p<0.08 level. 2 sites were dropped from monitoring this year as they had less than 2% live coral cover and such low coral cover sites were not the intent of this protocol. (SFCN data analysis 10/23/2012)	To be determined	SFCN monitoring

Dry Tortugas National Park (DRTN) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
	Outside Research Natural Area Coral Reef Condition			Average stony coral cover=5.7%. No trend has been detected across the 6 sites monitored since 2008. 3 sites were dropped from monitoring this year as they had less than 2% live coral cover and such low coral cover sites were not the intent of this protocol. (SFCN data analysis 10/23/2012)	To be determined	SFCN monitoring
Invasive/ Exotic Species	Lionfish	Lionfish presence, distribution		Lionfish were first detected in the park 2010 (SFCN Lionfish database). Lionfish are considered to be invasive predatory fish that may cause damage to reef ecosystems (Albins and Hixon, 2008)	None detected previous to 2010	Partners, Park and SFCN monitoring
Invasive/ Exotic Plants		Canopy acres treated		No weed control occurred this year. (APCAM database query 11/1/2012); Park staff treatment acres pending.		EPMT monitoring

Albins MA, Hixon MA. 2008. Invasive Indo-Pacific lionfish *Pterois volitans* reduce recruitment of Atlantic coral-reef fishes. Mar Ecol Prog Ser.

367:233–238. <http://dx.doi.org/10.3354/meps07620>

Dustan, P. 1985. Community structure of reef-building corals in the Florida Keys: Carysfort Reef, Key Largo and Long Key Reef, Dry Tortugas. Atoll Research Bulletin No. 288 May 1985. 27 Pages.

Jaap, W. C., W. G. Lyons, P. Dustan, and J. C. Halas. 1989. Stony coral (Scleratinia and Milleporina) community structure at Bird Key Reef, Ft. Jefferson National Monument, Dry Tortugas, Florida. Florida Marine Research Publication. No. 46. Florida Marine Research Institute, St. Petersburg, FL.

Wheaton, J., M. Callahan, S. Brooke, C. Beaver, S. Wade, D. Johnson, S. Kupfner, J. Kidney, M. Bertin. 2007. Dry Tortugas National Park (DRTN) Long Term Monitoring and Assessment Project Annual Report: 2005-2006. Technical Report of the Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute. F2454-04-A2. http://myfwc.com/media/201280/CREMP_NPS_Annual_Report_4_23_2007.pdf

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Air Quality	Visibility	Haze index in deciviews (dv)		National Park Service, Air Resources Division. 2010. Air quality in national parks: 2009 annual performance and progress report. Natural Resource Report NPS/NRPC/ARD/NRR—2010/266. National Park Service, Denver, Colorado.		Park Monitoring w/ ARD analysis
	Nitrogen deposition	Wet deposition (kg/ha/yr)				
	Sulfur deposition	Wet deposition (kg/ha/yr)				
	Mercury deposition	Wet deposition (ng/m2)		The above report does not provide condition assessments for Mercury. However mercury levels in EVER were higher than any other park. EVER just issued a warning regarding eating Everglades bass and some fish species in Florida Bay due to mercury levels. http://www.nps.gov/ever/planyourvisit/mercurywarning.htm (accessed 10/22/2012). However another web page suggest that mercury concentrations in fish in birds are actually down 60-70%. http://www.nps.gov/ever/naturescience/florida_panthiermercury.htm		
Surface Water Hydrology	Water Volume and Distribution	Magnitude and direction of sheetflow		<i>“A large disparity continues to exist in the distribution of flows between WSS and NESRS. Over the long-term, 77% of the total SRS flow distribution was delivered to WSS and 23% to NESRS. In 2011, 78%, or almost double the western SRS target volume, was delivered to WSS and only 22% was delivered to NESRS.”</i> (Mitchell & Johnson 2013). NESRS=Northeast Shark River Slough, WSS=Western Shark Slough, SRS=Shark River Slough	<i>“On an average annual basis, 55% of flows should come through NESRS and 45% of flows should come through WSS.”</i> (Mitchell & Johnson 2013).	Park/ SFWMD/ USGS monitoring

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Surface Water Hydrology (cont.)	Water Volume and Distribution (cont.)	Average annual water volume into Northeast Shark Slough		“Over the period from 1978 to 2011 (33 years), the target was met only 4 times, and only in dry years. In 2011, the amount of water to NESRS was less than half the target amount. During wet years, most water continues to be put on the western marl prairies instead of in the natural center of NESRS.” (Mitchell & Johnson 2013). NESRS= Northeast Shark River Slough	“On average, a total annual volume of water should be delivered to NESRS of 550,000 acre-feet (kac-ft) with a range of 200 to 900 kac-ft during years of below and above average rainfall, respectively. (Mitchell & Johnson 2013).	Park/ SFWMD/ USGS monitoring
	Water pattern and water levels	Water pattern and water levels (timing and spatial distribution of surface water depth hydropattern)		“NESRS water levels are consistently significantly lower than targets. In no year has the average water level in NESRS even reached the lower range of the target (7.5 ft NGVD).” (Mitchell & Johnson 2013). NESRS= Northeast Shark River Slough	“The target is to achieve annual average water levels (stage) in NESRS of approximately 8.0 feet (ft) National Geodetic Vertical Datum 1929 (NGVD) during years of average annual rainfall. During years of below and above average annual rainfall, the average water level in NESRS would be 7.5 and 8.8 ft, respectively.” (Mitchell & Johnson 2013).	Park/ SFWMD/ USGS monitoring
Water Quality	Total Phosphorus	Shark River Slough inflow phosphorus concentration		“Inflow phosphorus concentration is between the long-term limit and phosphorus target.” (Mitchell & Johnson 2013).	“Inflow phosphorus concentrations to Shark River Slough below the target.”	Park/ FIU/ SFWMD/ USGS monitoring
		Shark River Slough interior marsh phosphorus concentration		“Interior marsh phosphorus concentration is below the target.” (Mitchell & Johnson 2013).	“Interior marsh phosphorus concentrations in Shark River Slough below the target.” (Mitchell & Johnson 2013).	Park/ FIU/ SFWMD/ USGS monitoring

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Water Quality (Cont.)	Total Phosphorus (cont.)	Taylor Slough and Coastal Basins inflow phosphorus concentration		<i>“Inflow phosphorus concentration is between the long-term limit and phosphorus target this year, but since October 1992 concentrations have increased.” (Mitchell & Johnson 2013).</i>	<i>“Inflow phosphorus concentrations to Taylor Slough and Coastal Basins below the target.” (Mitchell & Johnson 2013).</i>	Park/ FIU/ SFWMD/ USGS monitoring
		Taylor Slough and Coastal Basins interior marsh phosphorus concentration		<i>“Interior marsh phosphorus concentration is below the target and concentrations have declined since October 1992.” (Mitchell & Johnson 2013).</i>	<i>“Interior marsh phosphorus concentrations in Taylor Slough and Coastal Basins below the target.” (Mitchell & Johnson 2013).</i>	Park/ FIU/ SFWMD/ USGS monitoring
	Periphyton	Shark River Slough periphyton tissue phosphorus content		<i>“More than 25% of monitored stations in Shark River Slough were coded yellow or red for periphyton tissue phosphorus content, exceeding the desired state.” (Mitchell & Johnson 2013).</i>	<i>“25% or less of Shark River Slough stations are coded yellow or red.” (Mitchell & Johnson 2013).</i>	CERP/MAP monitoring, FIU
		Shark River Slough periphyton biomass		<i>“More than 25% of monitored stations in Shark River Slough were coded yellow or red for periphyton biomass phosphorus concentration, exceeding the desired state.” (Mitchell & Johnson 2013).</i>	<i>“25% or less of Shark River Slough stations are coded yellow or red.” (Mitchell & Johnson 2013).</i>	
		Shark River Slough periphyton composition		<i>“The condition was not assessed this year, but last year more than 25% of monitored stations in Shark River Slough were coded yellow or red for periphyton composition and this pattern is expected to continue over the next few years, exceeding the desired state.” (Mitchell & Johnson 2013).</i>	<i>“25% or less of Shark River Slough stations are coded yellow or red.” (Mitchell & Johnson 2013).</i>	
		Taylor Slough and Coastal Basins periphyton tissue phosphorus content		<i>“25% or less of monitored stations in Taylor Slough and Coastal Basins were coded yellow or red for periphyton tissue phosphorus content, but the area is on the cusp of yellow and reductions in hydroperiods, water depth, or increased nutrient loading may lead to declines in the indicator.” (Mitchell & Johnson 2013).</i>	<i>“25% or less of Taylor Slough and Coastal Basins stations are coded yellow or red.” (Mitchell & Johnson 2013).</i>	

Everglades National Park (EVER) "Connect the Dots" Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Water Quality (cont.)	Periphyton (cont.)	Taylor Slough and Coastal Basins periphyton biomass		"25% or less of monitored stations in Taylor Slough and Coastal Basins were coded yellow or red for periphyton biomass phosphorus concentration." (Mitchell & Johnson 2013)	"25% or less of Taylor Slough and Coastal Basins stations are coded yellow or red." (Mitchell & Johnson 2013)	CERP/MAP monitoring, FIU
		Taylor Slough and Coastal Basins periphyton composition		"The condition was not assessed this year, but last year more than 25% of monitored stations in Taylor Slough and Coastal Basins were coded yellow or red for periphyton composition and this condition is expected to continue over the next few years, exceeding desired state." (Mitchell & Johnson 2013)	"25% or less of Taylor Slough and Coastal Basins stations are coded yellow or red." (Mitchell & Johnson 2013)	
Fresh-water Environment: Ridge, Slough, and Marl Prairies	Fresh-water Fish and Large macro-invertebrates	Shark River Slough Abundance and composition		"Fewer fish were present than expected based on rainfall and drought tolerant species were abundant. Represents a decline in condition from previous years." (Mitchell & Johnson 2013)	"Abundance is maximized in a manner that reflects pre-drainage conditions." (Mitchell & Johnson 2013)	CERP/MAP Monitoring
		Taylor Slough Abundance and composition		"Fewer fish were present than expected based on rainfall conditions and drought tolerant species abundant. Represents a decline in condition from previous years." (Mitchell & Johnson 2013)	"Abundance is maximized in a manner that reflects pre-drainage conditions." (Mitchell & Johnson 2013)	CERP/MAP Monitoring
	American Alligator	Nesting effort		"Nesting effort has increased significantly since 1985; recent trends show more stability during poor to moderate conditions and record numbers during favorable conditions." (Mitchell & Johnson 2013)	"Increasing trend in nesting effort throughout all freshwater marshes, particularly peripheral marshes historically believed to support the majority of nesting effort. The target is nesting effort consistent with a restored Everglades ecosystem." (Mitchell & Johnson 2013)	Park monitoring

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Fresh-water Environment: Ridge, Slough, and Marl Prairies (cont.)	American Alligator (cont.)	Nest success		“Nest success continues to be highly erratic due both to extreme natural and managed seasonal hydrologic fluctuation.” (Mitchell & Johnson 2013)	“Increasing trend in nest success and reduced failure due to flooding of egg cavity. The target is nest success levels consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	Park monitoring
		Nest density/ distribution		“Nest density and distribution throughout freshwater hydrologic basins of ENP have demonstrated an increasing trend in recent years.” (Mitchell & Johnson 2013)	“Increasing trend in density of nests across hydrologic basins, particularly within shorter hydro period peripheral marshes. The target is nest density and distribution consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	Park monitoring
		Alligator abundance		“Results of spotlight surveys indicate reduced abundance estimates in all size classes within ENP.” (Mitchell & Johnson 2013)	“Increasing trend in abundance for all size classes of alligators within freshwater wetlands. The target is an abundance of alligators consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	Park monitoring
	Wading Birds: Wood Stork, White Ibis, long-legged wading birds	Number pairs of nesting birds in South Florida		“Absolute size of breeding populations of ibises, storks, and long-legged wading birds declined sharply between the 1930s and 1970s. Since the mid-1980’s, nesting numbers in ENP are trending up. Numbers fluctuate greatly from year to year.” (Mitchell & Johnson 2013)	“Maintain or increase current total numbers of nesting birds in ENP mainland colonies, to a level consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	Park, CERP/MAP monitoring

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Fresh-water Environment: Ridge, Slough, and Marl Prairies (cont.)	Wading Birds: Wood Stork, White Ibis, long-legged wading birds (Cont.)	Month of Wood Stork nest initiation		“Nest success continues to be highly erratic due both to extreme natural and managed seasonal hydrologic fluctuation. Trend is improving slightly, but storks continue to fail because of late nest initiation.” (Mitchell & Johnson 2013)	“Month of Wood Stork nest initiation should be November or December.” (Mitchell & Johnson 2013)	Park, CERP/MAP monitoring
		Proportion of nesting in ENP headwaters		“Recent trends are positive, especially for storks, but distant from the 70% target.” (Mitchell & Johnson 2013)	“At least 70% of all wading bird nests should be located in the headwaters ecotone of the mangrove estuary of Florida Bay and the Gulf of Mexico (ENP).” (Mitchell & Johnson 2013)	
		Mean interval between exceptional White Ibis (<i>Eudocimus albus</i>) nesting years		“The trend is positive and consistent in recent years. This interval now consistently exceeds the target for restoration, and has shown dramatic improvement in last decade.” (Mitchell & Johnson 2013)	“Mean interval between exceptional White Ibis nesting years ($\geq 13,000$ nesting pairs) should be 1-2 years.” (Mitchell & Johnson 2013)	
		Ratio of Wood Stork + White Ibis to Great Egret nests		“Current ratio (2:1) is well below 30:1 that is considered to be representative of healthy nesting conditions. Ratio appears to have stabilized and has not moved much in the last ten years (range ~ 1.5:1 to 4:1).” (Mitchell & Johnson 2013)	“Ratio of the combination of Wood Stork and White Ibis nests to Great Egret nests should be 30:1, which is characteristic of the community composition of predrainage conditions.” (Mitchell & Johnson 2013)	
Coastal and Estuarine Environment: Florida Bay	Salinity patterns in Florida Bay	Amount of time during the year that salinity is in the desired range.		“Salinity conditions overlap with desired conditions only during 2 months at the end of the dry season. Conditions are variable but exhibit no year-to-year trend.” (Mitchell & Johnson 2013)	“Salinity is within the interquartile range of the desired predrainage conditions 50% of the time.” (Mitchell & Johnson 2013)	Park, NOAA, SFWMD monitoring

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coastal and Estuarine Environment: Florida Bay (cont.)	Salinity patterns in Florida Bay (cont.)	Difference between observed mean salinities and desired mean salinities.		<i>“The mean salinity is above desired mean salinity throughout the year. The degree of difference over the period of record is variable but is largely driven by precipitation and shows no year-to-year trend.”</i> (Mitchell & Johnson 2013)	<i>“The mean salinity is within the variability of the mean salinity of desired pre-drainage conditions.”</i> (Mitchell & Johnson 2013)	Park, NOAA, SFWMD monitoring
		Occurrence of extreme high salinity events.		<i>“Salinity exceeds the 90th percentile of the desired conditions much more frequently than desired and shows no year-to-year trend.”</i> (Mitchell & Johnson 2013)	<i>“Salinity does not exceed the 90th percentile defined by the desired conditions more frequently than the 10% of the time.”</i> (Mitchell & Johnson 2013)	
	Algal Blooms in Florida Bay	Central Florida Bay (Whipray Basin) chlorophyll a concentration		<i>“Levels have been below threshold levels throughout 2012. Continuous monitoring methods are still being refined, and elevated levels (up to 23 ppb) have been recorded in previous years.”</i> (Mitchell & Johnson 2013)	<i>“Average monthly concentrations below 1 ppb.”</i> (Mitchell & Johnson 2013)	Park, CERP/MAP monitoring
		Northern Florida Bay (Garfield Bight and Terrapin Bay) chlorophyll a concentration		<i>“Elevated levels were recorded in 2012 at both northern sites, including period of extremely high levels (12 to 21 ppb) for five months Terrapin Bay. Continuous monitoring methods are still being refined, but initial results indicate poor and declining conditions.”</i> (Mitchell & Johnson 2013)	<i>“Average monthly concentrations below 1 ppb.”</i> (Mitchell & Johnson 2013)	
		Western Florida Bay (Buoy Key) chlorophyll a concentration		<i>“Levels have been below threshold levels throughout 2012. Continuous monitoring methods are still being refined, and elevated levels (up to 25 ppb) have been recorded in previous years.”</i> (Mitchell & Johnson 2013)	<i>“Average monthly concentrations below 1 ppb.”</i> (Mitchell & Johnson 2013)	
		Southern Florida Bay (Peterson Key) chlorophyll a concentration		<i>“Levels have been below threshold levels throughout 2012. Continuous monitoring methods are still being refined.”</i> (Mitchell & Johnson 2013)	<i>“Average monthly concentrations below 0.5 ppb.”</i> (Mitchell & Johnson 2013)	

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Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coastal and Estuarine Environment: Florida Bay (cont.)	Seagrasses in Florida Bay	NE Zone – Seagrass Abundance		“Aggregate Abundance Index is in the good range for the NE zone, with signs of recovery from the '05-'08 algal bloom. However, caution is warranted because salinity levels in the area remain high.” (Mitchell & Johnson 2013)	“Abundance of seagrass consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	CERP/MAP monitoring
		NE Zone – Target Species Diversity		“Good measurements of current species mix along with the presence of subdominants (<i>Halodule</i> and <i>Ruppia</i>). Desired mixed species communities have not yet established.” (Mitchell & Johnson 2013)	“Seagrass species diversity and niche diversity consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	
		Transition Zone – Seagrass Abundance		“Aggregate Abundance Index was fair for 2010-2011, since density levels fell in 2006.” (Mitchell & Johnson 2013)	“Abundance of seagrass consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	
		Transition Zone – Target Species Diversity		“A good mix of target species decreased in 2006-2007, and have yet to recover due to dominance of turtle grass.” (Mitchell & Johnson 2013)	“Seagrass species diversity and niche diversity consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	
		Central Zone – Seagrass Abundance		“Aggregate Abundance Index was fair for 2010-2011, since improving from poor in 2008.” (Mitchell & Johnson 2013)	“Abundance of seagrass consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	
		Central Zone – Target Species Diversity		“Reflects the increasing presence of target species of <i>Halodule</i> and <i>Ruppia</i> .” (Mitchell & Johnson 2013)	“Seagrass species diversity and niche diversity consistent with a restored Everglades ecosystem.” (Mitchell & Johnson 2013)	

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coastal and Estuarine Environment: Florida Bay (cont.)	Seagrasses in Florida Bay (cont.)	Southern Zone – Seagrass Abundance		<i>“Poor rating due to reduced and declining densities of seagrass in this area. ” (Mitchell & Johnson 2013)</i>	<i>“Abundance of seagrass consistent with a restored Everglades ecosystem. ” (Mitchell & Johnson 2013)</i>	CERP/MAP monitoring
		Southern Zone – Target Species Diversity		<i>Fair after improving in 2009 from several years in the poor range. Species dominance component improved to fair.</i>	<i>“Seagrass species diversity and niche diversity consistent with a restored Everglades ecosystem. ” (Mitchell & Johnson 2013)</i>	
		Western Zone – Seagrass Abundance		<i>“High scores in the Abundance Index, sustaining improvement from 2008. ” (Mitchell & Johnson 2013)</i>	<i>“Abundance of seagrass consistent with a restored Everglades ecosystem. ” (Mitchell & Johnson 2013)</i>	
		Western Zone – Target Species Diversity		<i>“Reflects good scores because the target species component increased. ” (Mitchell & Johnson 2013)</i>	<i>“Seagrass species diversity and niche diversity consistent with a restored Everglades ecosystem. ” (Mitchell & Johnson 2013)</i>	
	Estuarine fish (Sport fish) and invertebrates	Snook (<i>Centropomus undecimalis</i>) catch-per- unit effort (CPUE)		<i>“Snook populations declined in response to a cold spell kill in 2010. The CPUE has indicated a return to a stable condition, but has not yet indicated recovery. ” (Mitchell & Johnson 2013)</i>	<i>“The target is the CPUE levels from 2007-2009, or at least a stable CPUE trend, indicating sustainable recreational use and environmental conditions. ” (Mitchell & Johnson 2013)</i>	Park monitoring
		Red drum CPUE		<i>“Red drum CPUE has been relatively stable for the period of record (POR), and has increased in recent years. ” (Mitchell & Johnson 2013)</i>	<i>“The target is a stable to increasing trend in CPUE, indicating sustainable recreational use and environmental conditions. ” (Mitchell & Johnson 2013)</i>	Park monitoring

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coastal and Estuarine Environment: Florida Bay (cont.)	Estuarine fish (Sport fish) and invertebrates (cont.)	Spotted seatrout CPUE		“Spotted seatrout CPUE has been relatively stable for the POR, with indications of a slightly increasing trend since 2004. ” (Mitchell & Johnson 2013)	“The target is a stable to increasing trend in CPUE, indicating sustainable recreational use and environmental conditions. ” (Mitchell & Johnson 2013)	Park monitoring
		Gray snapper (<i>Lutjanus griseus</i>) CPUE		“Gray snapper CPUE has been relatively stable for the POR, with indications of an increase in CPUE since 2006. ” (Mitchell & Johnson 2013)	“The target is a stable to increasing trend in CPUE, indicating sustainable recreational use and environmental conditions. ” (Mitchell & Johnson 2013)	Park monitoring
		Pink shrimp density		“Pink shrimp density was generally below baseline levels and showed a declining trend at most sites compared to the pre-restoration baseline. ” (Mitchell & Johnson 2013)	“The target is densities at or above those recorded during the pre-restoration baseline at the majority of sites in Florida Bay and the southwest coast of EVER. Note: restoration projects are not yet complete. ” (Mitchell & Johnson 2013)	CERP/MAP Monitoring, NOAA
	American Crocodile	Total population and distribution		“Total population and distribution has exhibited an increasing trend, historic population is uncertain. ” (Mitchell & Johnson 2013)	“Population is nearing predrainage estimates consistent with a restored Everglades ecosystem. Occupation throughout historic range. ” (Mitchell & Johnson 2013)	Park, CERP/MAP, FPL monitoring

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Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coastal and Estuarine Environment: Florida Bay (cont.)	American Crocodile (cont.)	Nesting effort, distribution, nesting success		“Reproductive effort within some areas of ENP has exhibited an increasing trend and is the best indicator of continued species recovery. ” (Mitchell & Johnson 2013)	“Increasing trend present in nesting effort, distribution and success in ENP, including historical nesting sites in NE Florida Bay. Increasing trend present in growth and survival of juvenile crocodiles, consistent with a restored Everglades ecosystem. ” (Mitchell & Johnson 2013)	Park, CERP/MAP, FPL monitoring
		Hatchling-juvenile growth and survival		“Survival is directly linked to increased hatchling-juvenile growth rates which increase with lower salinities. Hatchlings within ENP consistently exhibit lower growth rates than adjacent nursery sites. ” (Mitchell & Johnson 2013)	“Reduced salinity regimes occur which encourage rapid hatchling growth rates (approaching mass > 200g three-four months posthatching) and allow juveniles to more rapidly reach total length > 75cm. ” (Mitchell & Johnson 2013)	
	Roseate Spoonbill	Number of nests in FL Bay (5-year mean)		“The target number of nests for the whole bay is 1,258. The 5-year mean number of nests for 2010-2012 was 336, 284, and 264 respectively or 30%, 23% and 21% of the target respectively. This indicates that the FL Bay spoonbill population is not recovering... The 5-year trend of the mean declined from 36% to 21%, dropping below the 33% threshold the stoplight from to red. Although nest numbers appear to be increasing in the NE subregion, they continue to fall elsewhere throughout the Bay.” (Brandt et al. 2012)		CERP/MAP Monitoring, Audobon

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coastal and Estuarine Environment: Florida Bay (cont.)	Roseate Spoonbill (cont.)	Nesting location overall		<i>“The overall score for nesting location is the lowest of the three component scores. In this case the number of nests in NE FL Bay is red therefore the over-all score is red...Water mgt operations have resulted in increasing suc-cess in NEFB thereby in-creasing the population. The C-111 spreader canal project is now on-line and may also promote greater success. Both the NE and NW colo-nies are trending toward yellow.”</i> (Brandt et al. 2012)		CERP/MAP Monitoring, Audobon
		Number of nests in NE FL Bay (5-year mean)		<i>The target number of nests is 688. The 5-year mean from 2010 to 2012 was 76, 51 and 67 respectively or 11%, 7% and 10% of target indicating that the NE FL Bay spoonbill population is in jeopardy... Spoonbills have successfully nested 5 of the last 7 yrs in NEFB and these birds are entering into sexually maturity thereby increasing the num-ber of nests in this part of the Bay.”</i> (Brandt et al. 2012)		
		Number of nests in NW FL Bay (5-year mean)		<i>“The target number of nests in NW FL Bay is 210. The 5-year mean from 2010 to 2012 was 205, 166 and 140 respectively. The thresholds for yellow are from 130 to 210 nests... 2010 was the first year in the last 10 where the target was not met and has declined further in the last two years. In 2012, the percent of tar-get was just 1% point above the yellow threshold.”</i> (Brandt et al. 2012)		

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coastal and Estuarine Environment: Florida Bay (cont.)	Roseate Spoonbill (cont.)	Overall Nest Production and Success		<i>“The overall score for nesting success is the lowest score of the four component metrics. From 2010-2012, there were at least two metrics that scored yellow but none were red...The greater sensitivity to the spoonbill nesting cycle by water managers has increased the possibility of nesting success during favorable climatic conditions, however, until the C-111 Spread-er Canal Project is completed, there will still be limitations on maintaining favorable conditions resulting in a prospectus of yellow.” (Brandt et al. 2012)</i>		CERP/MAP Monitoring, Audobon
		Chick Production in NE FL Bay		<i>The 5-year mean of NE production was 1.31, 1.39 and 1.47 [chicks/nest] from 2010-2012. The target of 1.38 [chicks/nest] (based on pre-SDCS conditions) was exceeded for the first time since 1993...Greater sensitivity to the spoon-bill nesting cycle by water managers has resulted in greater nesting success during years with favorable climatic conditions. This sensitivity is expected to continue. Also the C-111 spread-er canal may possibly add productivity. (Brandt et al. 2012)</i>		

Everglades National Park (EVER) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coastal and Estuarine Environment: Florida Bay (cont.)	Roseate Spoonbill (cont.)	Chick Production in NW FL Bay		<i>“5 yr mean nest production was 1.4, 1.3 and 1.2 c/n respectively from 2010-2012. Nest production of >1 [chicks/nest] in NW FL Bay is being maintained (yellow) however productivity dropped below the target of 1.38 [chicks/nest] in 2011 and 2012...It is not clearly understood why nesting success is declining in NWFB but this likely explains the declining nest numbers as well. Potential sources may be in-creased nest predation by crows and adverse affects of the in-creasing impact of unregulated canals on the foraging grounds. The later has been partially fixed but the potential positive effects of the recent plugging of these” (Brandt et al. 2012)</i>		CERP/MAP Monitoring, Audobon
		Percent s Percent successful years in NE FL Bay		<i>“Successful nesting (>1 ‘chicks/nest’) occurred in 5, 6 and 6 of the previous 10 yrs from 2010-2012... In 2012, 6 of the last 7 years were successful. If there is 1 more successful yr out of the next 3, the green condition (7 yrs) will be met.” (Brandt et al. 2012)</i>		
		Percent successful years in NW FL Bay		<i>“In 2011, the number of successful yrs for the prior 10 yrs was 6 dropping below the green threshold of 7... It is not well understood why success has not occurred for the last 3 yrs but there is little reason to believe this trend will reverse unless the plugging of the canals has a profound ef-fect on the productivity of the foraging grounds.” (Brandt et al. 2012)</i>		

Everglades National Park (EVER) "Connect the Dots" Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coastal and Estuarine Environment: Florida Bay (cont.)	Roseate Spoonbill (cont.)	Prey Fish community Structure NE FL Bay	↑	"In 2010 and 2011, freshwater species made up 3.6 and 13.7% of the catch. The target is 40% and the threshold for Red/yellow is >5% (i.e. 2011 was yellow). Data for 2012 not yet available...The C-111 spreader canal, if operated correctly, is expected to increase freshwater flow through Taylor Slough thereby increasing freshwater species as well as prey productivity." (Brandt et al. 2012)		CERP/MAP Monitoring, Audobon
Invasive Exotic Plants	Exotics in Corridors of Invasion	Type, number, location and distribution of new exotic species		New species detected include <i>Indigofera suffruticosa</i> and <i>Ficus microcarpa</i> but these may have been present in the park since at least 1997 but not on the official park list. Exotics. (Shamblin Draft)	To be determined.	SFCN/ EPMT monitoring
	Casuarina Spp. (Australian Pine)	Canopy Acres, Gross infested acres,		76.12 canopy acres 720.29 gross infested acres (2012 EPMT Digital Aerial Sketchmapping Database; Queried 10/23/2012). Although there is a decrease since 2010, the difference in results is within the measurement error of the method. (EPMT specialist, personal communication)	96.78 canopy acres; 795.3 gross infested acres; (2010 EPMT Digital Aerial Sketch-mapping Database; Queried 10/30/2012)	EPMT Monitoring
	Schinus terebinthifolius (Brazilian Pepper)	Canopy Acres, Gross infested acres,		10,861.67 canopy acres 46,546.16 gross infested acres (2012 EPMT Digital Aerial Sketchmapping Database; Queried 10/23/2012). Although there is a decrease since 2010, the difference in results is within the measurement error of the method. (EPMT specialist, personal communication)	12,868.53 canopy acres; 48,476.97 gross infested acres; (2010 EPMT Digital Aerial Sketch-mapping Database; Queried 10/30/2012))	

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Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Invasive Exotic Plants (cont.)	Lygodium (Old World Climbing Fern)	Canopy Acres, Gross infested acres,		462.89 canopy acres 1897.15 gross infested acres (2012 EPMT Digital Aerial Sketchmapping Database; Queried 10/23/2012). Although there is a decrease since 2010, the difference in results is within the measurement error of the method. (EPMT specialist, personal communication). NOTE: This sampling method may grossly underestimate the acres of Lygodium within the park as this species may be difficult to detect until infestation sizes are large. Some estimates have been as high as 10,000 acres	615.88 canopy acres; 2024.37 gross infested acres (2010 EPMT Digital Aerial Sketch-mapping Database; Queried 10/30/2012)	
	Melaleuca quinquenervia	Canopy Acres, Gross infested acres,		272.38 canopy acres 3734.26 gross infested acres (2012 EPMT Digital Aerial Sketchmapping Database; Queried 10/23/2012). Although there is a decrease since 2010, the difference in results is within the measurement error of the method. (EPMT specialist, personal communication)	370.87canopy acres; 3856.98 gross infested acres (2010 EPMT Digital Aerial Sketch-mapping Database; Queried 10/30/2012)	EPMT Monitoring
Invasive Exotic Fish and Wildlife	Freshwater Fish	Rate of new introductions of exotic fish		<i>“Since 2000, 8 new exotic fishes have been observed in ENP, an increase in the rate of introductions. ”</i> (Mitchell & Johnson 2013)	<i>“Rate of new introductions of exotic fishes is decreasing over time. ”</i> (Mitchell & Johnson 2013)	
		Relative abundance of exotic fishes in Shark River Slough		<i>“Exotic species are present, but relative abundance continues to be less than 2% threshold in monitored sites. ”</i> (Mitchell & Johnson 2013)	<i>“Freshwater fish assemblage is dominated by native species and composed of less than a 2% relative abundance of exotic individuals. ”</i> (Mitchell & Johnson 2013)	

Everglades National Park (EVER) "Connect the Dots" Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Invasive Exotic Fish and Wildlife	Freshwater Fish (cont.)	Relative abundance of exotic fishes in Taylor Slough		"Exotic species are present, but relative abundance continues to be less than 2% threshold in monitored sites. " (Mitchell & Johnson 2013)	"Freshwater fish assemblage is dominated by native species and composed of less than a 2% relative abundance of exotic individuals. " (Mitchell & Johnson 2013)	
		Relative abundance of exotic fishes ENP-wide annual sample		"Exotic species are present, but relative abundance has been less than the 2% threshold at monitored sites since the January 2010 cold weather event. However, exotic species were collected at more sites in October 2011 than in 2010 suggesting an undesirable trend."(Mitchell & Johnson 2013)	"Freshwater fish assemblage is dominated by native species and composed of less than a 2% relative abundance of exotic individuals. " (Mitchell & Johnson 2013)	
	Herpetofauna	Rate of new herpetofaunal introductions in and around ENP		"Florida has more established exotic herpetofauna than any other place in the world (Krysko et al. 2011). ENP is at high risk for additional invasions of exotic herpetofauna. " (Mitchell & Johnson 2013)	"Minimize and eliminate new invasive herpetofaunal introductions to ENP. " (Mitchell & Johnson 2013)	
		Containment and control of established populations: Burmese python		"Burmese pythons are now widespread and are having negative impacts on native species. " (Mitchell & Johnson 2013)	"Burmese python population in the park is contained and decreasing" (Mitchell & Johnson 2013)	
		Response efforts to known invasives adjacent to ENP:North African python		"Response to a small and contained population of North African pythons adjacent to ENP demonstrated that removals can be effective for small areas. Full eradication may not be possible. " (Mitchell & Johnson 2013)	"Known invasives adjacent to ENP are eliminated prior to establishment in the park" (Mitchell & Johnson 2013)	
		Response to recent introductions to the park: Argentine tegu		"Tegus have recently moved into ENP but reproduction has not yet been detected. Trapping is possible but resources (staff and funding) are inadequate. The extent of spatial distribution of tegus inside the Park is uncertain. " (Mitchell & Johnson 2013)	"Recent introductions to the Park are effectively addressed and populations of incipient invasives are eliminated. " (Mitchell & Johnson 2013)	

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Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Invasive Exotic Fish and Wildlife	Marine Species	Lionfish Density		<i>“Lionfish density in mangroves and on seagrass beds often exceeds density on reefs (Barbour 2010, Claydon 2010). ” (Mitchell & Johnson 2013)</i>	<i>“Minimize the number of lionfish in Florida Bay. ” (Mitchell & Johnson 2013)</i>	
		Biomass of prey species		<i>“Lionfish will have a large impact on prey species. ” (Mitchell & Johnson 2013)</i>	<i>“Minimize the impact from lionfish on postsettlement native fish and invertebrate populations. ” (Mitchell & Johnson 2013)</i>	
		Lionfish Distribution		<i>“Lionfish are able to invade any habitat type within Florida Bay. ” (Mitchell & Johnson 2013)</i>	<i>“Minimize the spatial distribution of lionfish. ” (Mitchell & Johnson 2013)</i>	

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Salt River Bay National Historical Park and Ecological Preserve (SARI) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coral Communities	Salt River Canyon Site	Primary= % live stony coral cover; Secondary= algal, sponge, & soft coral cover, sea urchin density, disease area, disease prevalence and water temperatures		% live stony coral cover = 10.6% (10/23/2012 SFCN data analysis). SFCN established 20 transects in SARI in three areas of relatively high coral cover, diversity and complexity in 2012. Comparing SFCN data to historical accounts shows coral cover on the east wall (~ 12%) may be within the historical range but coral cover on the west wall (~ 12%) is currently lower than values reported from 1979 – 1984 (20 – 33%). No historical data was located for the expansive spur and groove area outside the canyon, however, numerous observations of partial or near complete colony mortality (primarily <i>Montastraea</i> spp.), similar to those observed at other SFCN VI monitoring sites, suggests the area was impacted by bleaching and disease pervasive throughout the NE Caribbean from 2005-2007. In addition SFCN saw active signs of white plague (coral disease) during sampling. SFCN's data also shows relatively high macroalgae cover (34.0%); Macroalgae was not listed as a benthic component in any SARI historical report. As a consequence SFCN professional opinion is that the SARI monitoring site warrants an overall rating of degraded.	Rogers et al.1984; Boulon 1978; Coulston et al. 1990	SFCN monitoring
Invasive/ Exotic Plants	Coconut palm (Cocos nucifera)	Canopy Acres Treated		0.86 canopy acres treated (APCAM database query 11/1/2012)		EPMT

Salt River Bay National Historical Park and Ecological Preserve (SARI) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
	Lead tree (Leucaena leucocephala)			5.10 canopy acres treated (APCAM database query 11/1/2012)		
	Guinea grass (Panicum maximum)			7.71 canopy acres treated (APCAM database query 11/1/2012)		
	Beach naupaka (Scaevola sericea)			0.08 canopy acres treated (APCAM database query 11/1/2012)		
	Seaside mahoe (Thespesia populnea)			5.03 canopy acres treated (APCAM database query 11/1/2012)		
	Spanish Bayonet (Yucca aloifolia)			0.24 canopy acres treated (APCAM database query 11/1/2012)		

Coulston ML, M. Taylor, R. Simms, C. Kesling. 1990. Environmental Monitoring in the Salt River Submarine Canyon, St. Croix 1989-1990. Annual Report Mission 89-3.

Ralf H. Boulon, Jr. 1978. Final Scientific Report 78-6b, Coral Distributions in the Salt River Submarine Canyon, St. Croix, US Virgin Islands. NULS-I Mission 78-6b 13-28 September 1978

Rogers C, H Fitz III, M. Gilnack, J. Beets, and J. Hardin 1984. Scleractinian Coral Recruitment Patterns at Salt River Submarine Canyon, St. Croix, US. Virgin Islands. Coral Reef 3:69-76.

Virgin Islands National Park (VIIS) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
Coral Communities	Haulover Coral Reef Condition	Primary= % live stony coral cover; Secondary= algal, sponge, & soft coral cover, sea urchin density, disease area, disease prevalence and water temperatures		Current stony coral cover = 10.4%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event. No trend has occurred in live stony coral cover since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 22.5% (sampled 1/11/2005; SFCN database)	SFCN monitoring
	Mennebeck Coral Reef Condition			Current stony coral cover = 12.4%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event. However a small upward trend has been detected since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 26.7% (sampled 10/19/2004; SFCN database)	
	Newfound Coral Reef Condition			Current stony coral cover = 5.5%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event and prior decline. No trend has occurred in live stony coral cover since 2007. (SFCN data analysis 10/23/2012.)	3/23/1999 Coral Cover = 18.0%; Pre 2005 bleaching event coral cover = 13.2%. (sampled 3/2/2005; SFCN database)	
	Tektite Coral Reef Condition			Current stony coral cover = 13.1%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event. However a small upward trend has been detected since 2007. (SFCN data analysis 10/23/2012.)	Pre 2005 bleaching event coral cover= 24.7%(sampled 9/26/2005; SFCN database)	
	Yawzi Coral Reef Condition			Current stony coral cover = 6.7%. Condition is degraded after the decrease in coral cover between 2005-2007 Bleaching/Disease event. However a small upward trend has been detected since 2007. (SFCN data analysis	Pre 2005 bleaching event coral cover=8.6%.(sampled 9/14/2004; SFCN database)	

Virgin Islands National Park (VIIS) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
				10/23/2012.)		
Invasive/ Exotic Species (Marine)	Lionfish	Presence, distribution, density, occupancy		Lionfish were first detected in the park 2010 (VIIS Resource Mgmt Chief). Lionfish are considered to be invasive predatory fish that may cause damage to reef ecosystems (Albins and Hixon, 2008)	None detected previous to 2010	Park and SFCN monitoring
Invasive Exotic Plants (Marine)	Invasive seagrass, <i>Halophila stipulacea</i>	Presence & distribution of new invasive species		On June 1, 2012, SFCN discovered the presence of an invasive seagrass, <i>Halophila stipulacea</i> , at Mennebeck Reef. The presence of this species is considered a concern by SFCN and the Resource Management Chief as it is unclear what affects it may have upon the ecosystem.	Not previously detected to 2012.	SFCN monitoring
Invasive/ Exotic Plants (terrestrial)	(Penguin) (Bromelia penguin)	Canopy acres treated		0.32 canopy acres treated (APCAM database query 11/1/2012)		EPMT monitoring
	Life plant (Kalanchoe pinnata)			0.11 canopy acres treated (APCAM database query 11/1/2012)		
	Lead tree (Leucaena leucocephala)			1.61 canopy acres treated (APCAM database query 11/1/2012)		
	Meliococcus bijugatus			0.30 canopy acres treated (APCAM database query 11/1/2012)		
	Guinea grass (Panicum maximum)			9.94 canopy acres treated (APCAM database query 11/1/2012)		
	Snake plant/ bowstring hemp (Sansevieria trifasciata)			2.84 canopy acres treated (APCAM database query 11/1/2012)		
	Limeberry (Triphasia			0.01 canopy acres treated (APCAM database query 11/1/2012)		

Virgin Islands National Park (VIIS) “Connect the Dots” Resource Condition Summary Table

Priority Resource or Value	Indicator of Condition	Specific Measure	Condition Status/ Trend	Rationale and Data Sources for Resource Condition	Reference Condition and Data Source	Notes
	trifolia)					
Air Quality	Visibility	Haze index in deciviews (dv)		National Park Service, Air Resources Division. 2010. Air quality in national parks: 2009 annual performance and progress report. Natural Resource Report NPS/NRPC/ARD/NRR—2010/266. National Park Service, Denver, Colorado.	National Park Service, Air Resources Division. 2010. Air quality in national parks: 2009 annual performance and progress report. Natural Resource Report NPS/NRPC/ARD/NRR—2010/266. National Park Service, Denver, Colorado.	Park Monitoring w/ ARD analysis
	Nitrogen Deposition	Wet deposition (kg/ha/yr)				
	Sulfur Deposition	Wet deposition (kg/ha/yr)				

Albins MA, Hixon MA. 2008. Invasive Indo-Pacific lionfish *Pterois volitans* reduce recruitment of Atlantic coral-reef fishes. Mar Ecol Prog Ser. 367:233–238.
<http://dx.doi.org/10.3354/meps07620>

VII. Budget Narrative

In FY 2012 the SFCN received \$2,117,355 in funding from the Inventory and Monitoring (I&M) program, the NPS Vegetation Mapping program, the NPS Water Resources Division, and Everglades National Park. This funding enabled the SFCN to conduct monitoring of marine and community resources as the network continues operational monitoring for core vital signs

SFCN continued to implement its Vital Signs Monitoring Plan, focused on protocol development and monitoring. SFCN conducted marine benthic community Vital Sign monitoring in BISC, BUIS, DRTO, SARI, and VIIS. Marine Fish Community monitoring was conducted in BISC, DRTO, BUIS and SARI. SFCN hired a Natural Resource Condition Assessment Ecologist and funded a Marine Research Assistant, a Water Quality Post Doc, and two SCA's in FY12.

I&M funding covered the salary of the network coordinator, quantitative ecologist, community ecologist, marine ecologist, data manager, fisheries biologist, GIS specialist, South Florida marine biological technicians, USVI marine biological technician, botanist, wildlife biologist, community ecology technician, data management/outreach technician, administrative assistant, EVER vegetation map program manager, EVER vegetation map technician, NRCA Ecologist and 1/5 share of the Program Support Specialist for all the Southeast Region Networks. A research assistant was funded to develop a sister protocol for marine fish community monitoring in the US Virgin Islands. In addition, SFCN funds provided for network and park staff travel. SFCN continued to work collaboratively with the Army Corp of Engineers on the vegetation map for Everglades National Park. A Natural Resource Condition Assessment Ecologist has made substantial progress on defining both the EVER and BICY Assessment outlines, and analysis has begun. A mobile periphyton sampling platform was jointly purchased between SFCN and the EPMT program. The SFCN purchased two Hollis Prism 2 closed circuit rebreather units for deep water work.

In FY13 the SFCN anticipates receiving \$2,033,955 in funding from the National Park Service, including \$1,586,300 in funding from the Service-wide Inventory and Monitoring (I&M) program, \$139,100 from the Water Resource Division for Water Quality monitoring as part of Vital Signs Monitoring Plan in network parks, \$180,000 for continuation of ongoing vegetation mapping, and \$128,555 for South Florida Natural Resource Condition Assessment. SFCN will continue operational monitoring, including protocol development, data management and analysis, and report writing efforts.

The FY12 budget was spent primarily on personnel, accounting for 69% (\$1,456,529), 10% (\$203,842) was spent on cooperative agreements, 11% (\$226,266) on contracts, 8% (\$165,796) on operations, 2% (\$39,198) on travel, and 1% (\$25,723) on Regional assessments

The FY13 budget proposes spending \$2,033,955 with the following allocations: 74% (\$1,514,865) on personnel, 5% (\$106,150) on cooperative agreements, 11% (\$227,191) on contracts, 4% (\$88,836) on operations, and 3% (\$54,000) on travel, and 2% (\$42,912) on Regional assessments and loan repayment to GULN and SERO I&M.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 910/122092, August 2013

National Park Service
U.S. Department of the Interior



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