5th Workshop on Salt Marsh Management & Research

4th Biennial Mosquito Lagoon Conference

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February 15-17, 2005

Holiday Inn Cocoa Beach
Oceanfront Resort

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Subcommittee on Managed Marshes
Florida Coordinating Council on
Mosquito Control

Merritt Island National Wildlife Refuge
U.S. Fish & Wildlife Service

Canaveral National Seashore
National Park Service

ORGANIZING COMMITTEE

Ron Brockmeyer
St. Johns River Water Management District

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Indian River Mosquito Control District

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National Park Service

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Brevard County Environmentally
Endangered Lands Program

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Day 1
Tuesday - February 15, 2005

Planning Session I
Organizer & Moderator - Cheri Ehrhardt
Merritt Island National Wildlife Refuge

Intro, framing for future growth, impacts, boat registrations.
.....Cheri Ehrhardt

Landcover change within the North Indian River Lagoon Watershed.
.....Brean W. Duncan, Paul A. Schmalzer and Vickie L. Larson

Surface Water Improvement Management Plan.
.....Joel Steward

National Estuary Program Overview.
Troy Rice (for Bob Day) .....

Indian River Lagoon North Feasibility Study.
..... Debbie Peterson

NPS inventory and monitoring program.
..... Joe Devivo

Planning Session II
Organizer & Moderator - Cheri Ehrhardt
Merritt Island National Wildlife Refuge

General Management Plan Update.
..... John Stiner

Comprehensive Conservation Plan, Merritt Island National Wildlife Refuge.
.....Cheri Ehrhardt

Contributed Papers:
From "Burning to Boating"
Organizer & Moderator - Doug Scheidt
Dynamac Corp.

"Fire management in the inter-galactic interface" or "Thirty years of fire management on the Merritt Island National Wildlife Refuge".
..... F.W. Adrian.

Florida scrub ecology and management.
Eric Menges.....

Impact of recreational boating on oyster reefs in Mosquito Lagoon.
..... Linda Walters, Loren Coen and Paul Sacks

Mosquito Lagoon creel/exit ramp and aerial surveys: results, trends and management applications.
Karen Holloway-Adkins, Douglas M. Scheidt and Marc B. Epstein .....

Wetlands Initiative

Organizer & Moderator - Ron Brockmeyer
St. Johns River Water Management District

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Day 2
Wednesday - February 16, 2005

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Mosquito Control
Organizer & Moderator - Doug Carlson
Indian River Mosquito Control District

Source reduction for salt marsh mosquito control and natural resource management.
Doug Carlson .....

Progress in wetland management in Saint Lucie County.
James R. David .....

Larviciding: the second best way to control mosquitoes.
Alan Curtis.....

Aerial adulticiding for mosquito control: Recent technological advances to improve efficiency while protecting the environment.
Jane Barber .....

Management of Indian River County spoil islands for mosquito control.
Rich Wilson and Michael Hudon.....

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Habitat Restoration
Organizer & Moderator - D. Scott Taylor
Brevard County Environmentally
Endangered Lands Program

Salt marsh restoration in Volusia County.
Glen-Paul Edson .....

The restoration of tidal marshes at Tomoka State Park (Volusia County) by backfilling dragline ditches with an amphibious excavator.
Charles DuToit.....

An update on the Upper Tampa Bay Park rotary ditching project.
Doug Wassmer.....

Removing the sands (sins?) of our past: Dredge-spoil and saltmarsh restoration along the Indian River Lagoon, Florida.
D. D. Scott Taylor and Thomas W. Workman .....

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Wildlife I

Organizers & Moderators - Marc Epstein
Merritt Island National Wildlife Refuge
John Stiner, Canaveral National Seashore

Aquatics I

Organizer & Moderator - Doug Scheidt

Dynamac Corp.

Larval hatching in the horseshoe crab, *Limulus polyphemus*: facilitation by environmental cues.

Gretchen S. Ehlinger and Richard A. Tankersley.....

***Coccotrypes rhizophorae*, a scolytid beetle that feeds on *Rhizophora* mangle propagules and seedlings**.

Michael Hudon .....

Making a dent in derelict crab traps.

Nicole Adimey and Jessica Koelsch .....

Diet and habitat use of loggerhead turtles nesting in Florida: an assessment using stable isotopes.

Kimberly J. Reich, Karen A. Bjorndal, Alan B. Bolten and Blair E. Witherington .....

Northern coastal basins juvenile fisheries survey.

Michael Turtora .....

The importance of Cape Canaveral Beaches as a winter nursery area for the lemon shark, *Negaprion brevirostris*.

E.A. Reyier, D.H. Adams and D.M. Scheidt.....

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Day 3

Thursday - February 17, 2005

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Wildlife II

Moderator - Marc Epstein

Merritt Island National Wildlife Refuge

Winter survival and temporary emigration of Lesser Scaup in East-Central Florida.

Garth Herring and Jaime Collazo .....

An eighteen-year summary of wading bird populations on the Kennedy Space Center/Merritt Island NWR.

E.D. Stolen, D. R. Breininger, R. B. Smith and D. K. Hunt .....

Seasonal numbers of shorebirds and waterfowl using impoundments at Merritt Island NWR: preliminary results. .....Jaime A. Collazo and Marc B. Epstein

Home range and distribution of bottlenose dolphins in the Mosquito Lagoon.

Marilyn Mazzoil, Steve Mcculloch and R.H. Defran .....

The Indian River Lagoon dolphin health assessment project: A sentinel for emerging marine mammal disease and ecosystem health.

Gregory D. Bossart .....

Long term trends in distribution and abundance of manatees in the Northern Banana River (1977-2004).

J.A. Provancha, R. Cancro, R. Lowers, M. Provancha, D. Scheidt, and E. Reyier.....

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Aquatics II

Moderator - John Stiner

Canaveral National Seashore

An ichthyoplankton survey of the Northern Indian River Lagoon complex with emphasis as to the function of an estuarine no-take fisheries reserve.

E.A. Reyier and J.M. Shenker .....

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Geology, Hydrology, Meteorology

& Water Quality

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Late quaternary subsurface geology of CNS/MINWR.

Randy Parkinson and Ron Schaub.....

The current state of the National Hydrography Dataset for Mosquito, Banana, and Indian River Lagoons.

Ed Carter, David Clapp, Whitney Green and Marc Adkins.....

Spatial rainfall patterns and nutrient deposition in waters surrounding KSC.

John H. Drese and J. R. Barfus.....

Particles in suspense – a mystery in Southern Mosquito Lagoon .

M. A. Lasi, J.H. Trefry, L. J. Morris, J.S. Steward, R. W. Virnstein and W.A. Tweedale.....

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Posters

$ **Forage availability and aquatic bird distribution under various wetland management schemes**.

Garth Herring, Eric Stolen, and Jaime Collazo .....

$ **Unleashing standard desktop applications to ask ecological questions about wading bird foraging habitat use.**

D.K. Hunt1 and E. D. Stolen .....

$ **Is Brazilian pepper a threat to the mangrove ecosystem?**

Melinda Donnelly and Linda Walters.....

$ **Biodiversity of oyster reefs (*Crassostrea virginica*) in Mosquito Lagoon, Florida.**

Jennifer Stiner, Michelle Boudreaux, and Linda Walters .....

$ **The impact of cigarette butts on burrowing bivalves**.

Angie Ashcraft-Cryder and Linda Walters.....

$ **Seasonal distribution of fishes and water chemistry at four Florida sites.**

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The Organizing Committee would like to express our appreciation to all those assisting with this Workshop:

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Contributors

Session organizers and moderators

Brevard County Environmentally Endangered Lands Program

Dynamac Corp

Indian River Mosquito Control District

St. Johns River Water Management District

Speakers

All participants

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Opening comments

On behalf of the Subcommittee on Managed Marshes (SOMM) and in association with the U.S. Fish and Wildlife Service and the National Park Service, the organizing committee would like to thank you for your participation at the joint meeting of the 5th Workshop on Salt Marsh Management & Research and the 4th Biennial Mosquito Lagoon Conference. With a great deal of assistance, the organizing committee was able to put together an interesting and informative 3 day program. Topics ranged from planning - to the Wetlands Initiative - to mosquito control - to habitat restoration - to wildlife and aquatics issues.

For those who were not familiar with the Subcommittee on Managed Marshes (SOMM), you learned that SOMM is an interagency committee under the Florida Coordinating Council on Mosquito Control. Both of these committees were formed in 1983 and are now established in the Florida Statutes. The Subcommittee's role is to provide guidance and review of plans for the management of Florida's salt marshes, taking into account both mosquito control and natural resource interests. SOMM's first workshop was held in 1988, the others have been at 4 year intervals.

Given the tremendous overlap between the information provided at the Biennial Lagoon Conferences and the Salt Marsh Workshops, it seemed only logical to combine these two important meetings into one larger meeting reflected in this abstract collection. Again, thank you for taking the time to attend this meeting.

Ron Brockmeyer *Doug Carlson* *Marc Epstein*

Doug Scheidt *John Stiner* *D. Scott Taylor*

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PINE ISLAND CONSERVATION AREA FIELD TRIP SUMMARY

D. Scott Taylor
Brevard Environmentally Endangered Lands Program
5560 North U.S. Hwy 1
Melbourne, FL 32940

On Feb. 15, 2005 an afternoon field trip to the Pine Island Conservation Area, a Brevard County Environmentally Endangered Lands Program (EEL) Sanctuary site, was conducted by D. Scott Taylor, EEL Land Manager. This site is the location of a marsh restoration project (see abstract herein). About 60 ac. of high saltmarsh were buried under dredge spoil during construction of a navigation canal during a development project in the late 1960's. About 300,000 cu yd of spoil are estimated to be on site. The EEL Program, in conjunction with St. Johns River Water Management District (co-owners of the site) are in the process of removing the spoil and grading the deposition site down to historic marsh elevation (about 1.0-1.3 ft. NGVD). Spoil is being trucked off-site and sold. Attendees viewed the site from a 'stock-piled' mound of spoil (about 40,000 cu yd.) removed from the first phase of the site (~10 ac) that was completed in September, 2003. Another 23 ac. is nearly complete, with only final grading yet to be done. Saltmarsh vegetation recruitment on the completed portion of the site is impressive, with about 18 species present and vegetative cover increasing rapidly.

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Banquet Presentation

Life along the Indian River Lagoon in Titusville during the 1950's, 60's & 70's

Laurilee Thompson

Hi. For those of you who don't know me, I'm Laurilee Thompson and I'd like to welcome you to my family's restaurant. I hope you're having a great time at the conference! I wish it wasn't happening during the busiest time of the year for us – I'd sure like to attend the sessions!

I was surprised when Marc asked me to be your speaker. I was in a quandary trying to figure out what to talk about. So many of you have helped me out anytime I asked -- what could I possibly say that you would find beneficial? So, since you guys are estuary people, and most of you are probably a lot younger than I am, and more than likely you weren't around this estuary in the 1950's and 60's like I was, I decided that my gift to you will be to relate some of my memories of what it was like to grow up on my beloved Indian River Lagoon.

I'm a fifth generation Floridian. My great great grandfather wandered up the St Johns River before the Civil War and settled in the area that is now known as Blue Spring State Park. Our family's ancestral home still stands in the park today.

Before the Space Race really got going, Titusville was a small town of about 5,000 people – it was the kind of community where no one ever locked their doors. The house where I spent my early childhood is right down the street – on the north side of the Titusville causeway – that green concrete block building that the Coast Guard Auxiliary is in now.

It was a fantastic place to live – it was right on the shore of the Indian River lagoon. My dad had a small boat and motor dealership on the ground floor and our family crammed into the small apartment on top. I had a little sister and twin brothers. The four of us, along with various cousins and friends that were actually allowed to play with us, evolved into the Pier Gang. That's because my grandfather operated the Titusville Pier and that's where we hung out.

The Pier Gang ruled because we had a distinct advantage in advanced weaponry – my granddad always gave us the tip ends that he cut off of cane poles before he sold them. I don't know if you've ever been whacked across the back with the skinny end of a cane pole, but believe me – it stings. It's like getting hit with a whip.

The Titusville Pier looked different then. It was actually part of the original wooden bridge that crossed the river. You see … after the Army Corp of Engineers built the new cement bridge and causeway, they tore down the old wooden bridge. My granddad convinced the Titusville City Council to request that a portion of the western span remain. The Army Corps gave it to the city. He leased it, built a baithouse out over the water and created what was billed as the World's Longest Free Fishing Pier.

Fishing was THE major tourist activity in Titusville as it was in many coastal communities. A lot of towns and private entrepreneurs operated fishing piers and they collected a fee for people using them. My granddad didn't charge people to go on the Titusville Pier. He figured he'd make a good enough living off of renting poles and nets and lights. He installed power lines with plug-ins under the railings, which was another thing that made our pier unique. You could use electric lights instead of messing around with temperamental gas lanterns. I wish my granddad was still alive so that he could see the elaborate set ups shrimpers use on the bridge today. It takes them two hours to get set up.

My dad built an L-shaped addition onto the Pier that went all the way to our house. So we kids could actually go from our house out to the baithouse without ever going out on the main highway, which we weren't allowed to get near anyway. The Pier was a big part of Titusville's social life, especially during shrimping season. Springtime shrimp runs were a huge event – on a good run, you could fill up 2 or 3 40-gallon garbage cans with shrimp in a very short time. Locals kept big freezers just so they could fill them up with shrimp. You could never tell when the shrimp would run – usually it was really early in the morning and sometimes they only ran for just a few minutes.

When the shrimp started running, my granddad would call 2 or 3 people on the phone and they'd call the rest of the people in town. Within minutes, the pier would be covered with people, many of whom were still in their pajamas and bedroom shoes – they wouldn't even take the time to get dressed. Dad would have to get out of bed and go out to the baithouse to help my granddad rent shrimp nets and lights. Our job was to race up and down the pier jumping over people's net poles. Any misstep would send a patron's carefully arranged nets and fishing poles flying. We spent a lot of time running from irate grownups in flapping bathrobes. They hated to ear us come thundering down the Pier.

There was a small boat basin with a boat ramp at the west end on the north side of our house. Dad built a finger dock right by the boat ramp where people could tie their boats after they put them in the water. When the wind blew out of the east, big mats of seagrass drifted in, -- then the manatees would come – only we called them sea cows. We could sit on the finger dock and put our feet on the backs of grazing manatees. They did seem to mind. Sometimes they'd nuzzle our bare feet with their soft whiskery faces. The manatees still come into that little basin now when the wind blows the seagrass in.

Dad gave me a small rowboat with restrictions – I was not allowed to go past the entrance to the boat basin. My arms weren't long enough to row the conventional way. I improvised, perched on the bow using one oar, paddling endlessly up and down the boat basin. There were all kinds of things to discover in my small world – sea squirts, barnacles and oysters grew on all of the seawall and pilings.

All kinds of interesting creatures could be found just by turning over rocks. One of our favorite pastimes was collecting what we called bloodworms. There were so many of them in the sand that you could fill up a paper cup in just minutes. We had contests to see who could fill up their cup with bloodworms the fastest. The challenge was to pull the bloodworms from out of the wet sand without breaking them. I found out later when I went to college that the bloodworms were actually polychaetes. My mom was a really good sport because she was always gracious when presented with paper cups full of bloodworms.

In the summer, different kinds of jellyfish showed up. There were times when there would be so many moon jellies that it seemed like you could walk on them – all different sizes – you could see them all the way from the bottom of the river to the surface. Moon jellies were everywhere – and they'd be that thick all up and down the river. Dad showed us how to pick up the moon jellies without getting stung by putting our hands on top of them and forcing them down in the water while flipping them over. We had some spectacular battles using moon jellies as projectiles.

Clouds of comb jellies often floated in to the boat basin. We called them pocketbook jellies because they looked like pocketbooks. You all might not know what a pocketbook is. That's what southern ladies called purses – All southern ladies had a collection of pocketbooks – my grandmother was buried with her favorite pocketbook clutched in her hands. We'd never heard of pocketbooks being called purses until all of the northerners started moving down because of the Space Center.

Pocketbook jellies were special because you could pick them up without getting stung. You could hold them in your hand and see all the colors of the rainbow as fluid moved through them. They were all different sizes – there were comb jellies so small you could barely see them all the way up to jellies the size of my hand. The tiny ones were wonderful to put in jars with river water. When you held them up to the sunlight, it was like holding a container full of prisms.

You could catch all kinds of fish right off of the pier when I was little -- seatrout, redfish, sheephead, black drum, snook, spots, croakers, bluefish, pompano, jacks, ladyfish and my favorite – mangrove snapper. Sometimes if you were lucky, you could even catch a grouper. Back then, the water was much clearer. Sometimes, the water would get so clear, you could go all the way out to the end of the pier and see the bottom. It was over 15 feet deep out there. You could see the fish swimming right up to your bait.

And you can't believe how many blowfish there were. There were so many blowfish, you couldn't get your bait through them to reach the fish you wanted to catch. Frustrated anglers would leave them on the pier to die,

hoping to thin them out. The pier was always covered with dead blowfish. Some of them puffed up before they expired and remained so after their demise. We liked to run up and down the pier and kick them back in the water. You had to be careful not to kick the blowfish in the mouth with your bare toe. They have razor sharp teeth that can inflict a painful injury – even when they're dead.

There must have always been a lot of blowfish. My uncle told me that when he was fishing on the old wooden bridge in the middle of the night, he could tell when a car was coming long before he could see the headlights. He said it sounded like a gun battle coming towards him as the car ran over all of the dead blowfish.

A good method for catching sheephead was to take a straightened out hoe and scrape barnacles off the side of a piling. You could see the barnacles sparkling as they sank in the water – then the sheepheads would blast in. You could toss down a line with a fiddler crab in the middle of the school and catch sheepheads as fast as you could get your fiddler crab down. As soon as the barnacles floated to the bottom, the sheepheads would disappear. You'd have to scrape the piling again to get them to come back.

Back then, you could walk along any shoreline of the river and there would be fiddler crabs as far as you could see. The big ones would all be outside of their burrows waving their claws trying to attract a lady fiddler. As you walked along the shore, they'd run toward their burrows – the motion of all those fiddler crabs looked like waves parting.

Bottle-nosed dolphins fed out side the entrance of the boat basin every evening. Mullet were concentrated there because they were funneled by the relief bridge in the causeway. We could stand on the pier and watch the dolphins tossing mullet in the air and leaping after them. It didn't take long before temptation got the best of me – I *had* to paddle out with dolphins. I'd spend hours out in my little boat, right in the middle of the feeding dolphins. It was better than Marineland because the dolphins were in the wild in their home in the river.

I got a little older and my dad gave me a little 3 HP kicker for my rowboat. Suddenly my world expanded. I could motor up to the Titusville Marina -- only back then we called it the yacht basin. It didn't have an official name. It took awhile, but I could now reach the closest spoil islands and go all the way over to the east shore of the Indian River. I began my career as a tour guide, taking my friends out on the water, always eager to show them my beloved Indian River.

The following summer, my dad announced that it was time for me to start working. My grandpa needed live bait shrimp to sell at the pier. I must have been about 10 or 11 years old. Dad helped me expand the live well in my rowboat and built me a push net so I could catch bait shrimp for the pier. Do you all know what a pushnet is? (describe).

It's hard work, even for a grown-up. I must have looked pretty funny pushing that big net around – but I was in hog heaven

Every morning we'd load the rowboat into the back of Dad's pickup truck and take it up to Haulover Canal where he'd dump me and the boat off. I'd spend the day doing whatever I wanted to do. Of course I had to push the net and catch a few shrimp to justify the trip up to the canal. But I mostly spent my time exploring.

There were beautiful yellow soft corals and colorful seaweeds growing on the rocks in Haulover Canal and the water was so clear you could see sheepheads picking barnacles off the rocks 15 feet down. Dolphins were

always present and every once in a while I'd even see a big sea turtle cruising through the canal. The best place to look for shrimp was in the lush seagrass beds along the west sides of a string of spoil islands that ran north from Haulover Canal. My dad and all of the locals called them the Clinkers.

I loved seeing all of the things that I caught in my pushnet. I'd catch pipefish, sea horses, spider crabs, conchs, little tiny blowfish and porcupine fish and a lot of other kinds of fish. I also caught a lot of shrimp. Sometimes I'd bump my net up against a sting ray that was so big it would knock the handle of the net out of my hands as it leapt off the bottom and flapped away. Dad came back in the afternoon and we'd put the shrimp in a garbage can with an aireator, and we'd load the boat into the back of the truck and head back to town to sell the shrimp at the pier. It truly was a wonderful summer.

The next summer, I got a bigger boat and a 20 HP motor. I could now get to Haulover Canal under my own power. We built some pigfish traps and I added pigfish income to my shrimp money. Surely you all know what a pigfish is. They are the BEST bait for seatrout. I'd run my pigfish traps in the morning. The little pigfish were so thick, sometimes the traps would be half full of them when I pulled them out of the water. Then I'd go in behind the clinkers and push the net around for bait shrimp for a while then go back out to the slough - check the pigfish traps again – then head back to the pier.

The following summer, one of the commercial fishermen asked me why I was selling my pigfish for bait. He said I could make a lot more money if I used them to catch fish. He taught me how to splatterpole for big seatrout. The term splatterpoling comes from what you do with the end of the pole. Every once in a while, you put the end of the pole in the water and thrash it around – it sounds like a school of fish feeding on top of the water.

You hook the pigfish like this – right above its bottom fin…..toss it out and drift in the wind right at the edge of the seagrass where it starts breaking up and getting spotty – that's where the big trout are. You have to keep the line tight… then you kind of bump the bottom of your cane pole and it tumps the pigfish upside down and it grunts and that attracts the trout. It was easy to catch 100 pounds of big trout in a morning of fishing. That old fisherman was right. I made a lot more money using the pigfish for bait. But I always saved some for my granddad to sell at the pier.

Splatterpoling was exciting fishing. Sometimes I'd hook a redfish that was so big, I couldn't snatch it in the boat. The only thing I could do was to throw the fishing pole in the water and chase the fish until it got tired enough to get it in the boat. Even if the fish dragged the pole all the way under, it would eventually pop up somewhere nearby. I spent the next couple of summers content with trapping pigfish and fishing for trout.

Eventually greed set in and I got a bigger boat, a 23-foot crab boat with a 75 HP Evinrude motor. I built 150 crab traps. Every afternoon after school, I'd run my crab traps, spending countless hours on the lagoon, studying its moods. I could now range as far north as New Smyrna, where I discovered a world of beautiful mangrove lined waterways that ran all the way beyond Ponce Inlet.

The following summer, I got my first bank loan and financed enough money to buy 500 yards of gill net, a bigger motor and a bow runner mullet boat. I was 15. I started spending entire nights out on the lagoon, doing my homework under the dim glow of a 15 watt DC light bulb that I hooked up to the battery I used to start my motor. One of my favorite places to fish was Banana Creek. It was eerie, listening to workers on the

Vehicle Assembly Building, especially when it was foggy. You could hear their hammers ringing and their voices carried so well in the fog, it sounded like they were right next to me in the boat.

There were a lot of huge alligators in Banana Creek – when I'd shine my spotlight down the shoreline, it seemed like hundreds of big red eyes shone back at me. Sometimes one would swim right up to my net and grab a fish. When it wouldn't come out, the gator would swim down to the next trout. Oh yeah, they were picky – they didn't go for mullet – the gators definitely preferred trout. The gator would work its way down the net punching holes in the trout – with me madly poling my boat after it. It must have been a pretty comical sight – a 15 year old girl out on the river in the middle of the night -- whacking a 10 foot gator on the head trying to get it to let go of my fish. My poor mother would have had a heart attack if she really knew what I was doing out on the river.

I loved being by myself out on the river at night. On summer nights the bioluminescence was spectacular. Mullet would streak off from the bow showering meteor trails of green light. It was like fireworks underwater. Dolphins made much bigger and more brilliant streaks and manatees burst into huge explosions of ghostly green light deeper down. You could drag your hand through the water and it would sparkle with green specks when you took it out. You could stand on the causeway and look out over a river that was alive with bright green whitecaps.

When the mullet started bunching up later in the fall, I ranged further south, fishing for roe mullet between Eau Gallie and Sebastian Inlet. I kept my boat at a fish house in Melbourne. It was common to see school after school of mullet moving south – huge schools of traveling mullet – acres of mullet -- with their lips out of the water and some would be jumping, but they all jumped in the same direction – south. Pelicans and cormorants would be diving in the schools with dolphins attacking the edges. When I heard a school of roe mullet going by in the dark of night, it sounded like water going over a waterfall.

I'd have to work fast to circle part of the school because the mullet were moving so fast. And I could only cut off a tiny part of the school with just a little bit of net because there were so many fish, my boat couldn't possibly hold them all. It was impossible to clear the net out on the water. I'd have to rope the net on and back the boat up to the shore to clear the net. It was easy to catch 2,000 pounds of roe mullet in one set. Roe mullet fishing was the most exciting fishing I did in the river.

Spring brought on some major challenges to fishing in the lagoon. Spring was horseshoe crab and catfish mating season. It was unbelievable how many horseshoe crabs were in the river back then. They would crawl up on the shore to lay their eggs. The whole shoreline would be covered with horseshoe crabs. Many more would be waiting out in the water. You knew they were there because you could see their tails waving in the air above the surface.

It was truly aggravating when a bunch of horseshoe crabs got into my net. They would hit the lead line and just keep crawling right up into the webbing. They'd sink the corkline and the mullet would escape over the void. Their feet and tails would tangle and they'd just keep crawling. They'd eventually roll the entire net up. I'd have to rope the net onboard and go to shore where it would take hours to clear it out. I couldn't leave it in the water to clear it – the longer it sat, the more horseshoe crabs piled in.

Catfish too were a major pain. They congregate in the spring worse than any other time of the year. Catfish are extremely difficult to get out of a gill net. They can lock their spines when they open them out. You have to either carefully push their spines back down or break them off so you can push the catfish on through the webbing. Meanwhile, more catfish are hitting the net. Catfish carry their eggs in their mouths. They look

like grapes. They'd spit the eggs out when they were dragged into the boat. It was hard to keep your footing as more and more catfish eggs hit the deck and got squashed, turning the deck into a slippery mess.

I graduated from high school in 1971. Determined to stall my efforts to become a full-time commercial fisherman, my parents sent me off to Florida Tech, only back then it was known as Florida Institute of Technology. I studied Oceanographic Technology. I hauled a smaller mullet boat down to Jensen Beach with me and continued my practice of doing homework at night while my nets soaked in the Lagoon.

I discovered that the southern end of the Indian River Lagoon is really quite different than it is up on this end. There were tropical fish – the same colorful fish you see in salt-water aquariums – and banded coral shrimp and arrow crabs and different kinds of seagrass. I caught barracudas in my nets -- I never caught a barracuda up here. I thought catfish had been problem, but they were nothing compared to an angry snapping barracuda with its mouthful of razor sharp teeth!

After college, I set out full-bore on my goal to become a real commercial fisherman. My parents were not happy, but I persisted. They finally caved in, but they told me I could not just hang out at the Port and drink beer with the other fishermen….I had to work. I beat the docks every day, begging for a site. None of the captains would hire me because they knew my parents didn't want me to be a commercial fisherman. They were afraid that my dad wouldn't help them with their boat repairs at his boat plant if they gave me a job.

Speaking of boat repairs -- I did every kind of nasty job they could dream up. I rebuilt most of the fishing boats at the Port while I was scrounging for a job. I scraped bottoms, rebuilt fuel tanks, made new fish boxes and ate more grinding dust than I ever had while working at my dad's boat plant. It took me six months, but I finally got a site on a swordfish longline boat. The meanest captain at the Port took a chance and gave me a job. This guy was so awful no one would work for him. With nothing to lose, he approached my parents, assured them he'd watch out for me and off I went.

Finally I was fishing on the ocean! A whole new universe opened up for me – the Gulfstream became my new playground. I witnessed northern right whales and humpback whales breaching right off of Cape Canaveral with the launch towers in the background. Where else in the world can you see such a sight?

I spent hours on the bow when we were steaming offshore, thrilled to see new species of dolphins riding in my bow waves. I didn't know it then, but I found out later that 27 species of whales, dolphins and porpoises – and even 2 species of seals – are found in the waters off of Florida.

I saw sunfish and huge jellyfish and learned about wide ranging ocean fish – tuna, swordfish, marlin, sailfish and monster sharks. There were new strange looking species of birds -- pelagic birds -- birds that spend their entire lives at sea and only come to land to nest. Birders now spend hundreds of dollars for the opportunity to go out on fishing boats in order to add pelagic species to their life lists – how I wish I'd been a birder then.

It wasn't too long before I started running boats. I finally ended up on a 65-foot longliner that I named the Mary Jean, after my Mom. It's good luck you know to name a boat after your mom – worked for me – I caught a lot of fish -- I was a highliner. I spent 10 years on the ocean, fishing from Cape Hateras, NC to the Texas/Mexican border. In all of my travels on this country's southern oceans and estuaries, I never encountered an area that matched the diversity of habitats and variety of wildlife found right here.

After 10 years of living on the high seas, I was pretty well beaten-up, both mentally and physically. I was looking forward to coming home and working with my family in the restaurant business and I couldn't wait to get back out on my beloved Indian River. When I finally did have an opportunity to get out on the Lagoon, I was appalled at what I found. You couldn't see 6 inches into the water. The beautiful soft corals that grew on the rocks at Haulover Canal were gone – those rocks which had previously had such interesting stuff growing on them were covered with slime. I couldn't find a single blowfish and I had to look really hard to find a horseshoe crab. The beautiful nighttime phosphorus was gone!

I couldn't believe this had happened in such a short time. Geez – I was only gone for 10 years. The bad things that happened to the lagoon were probably already going on when I was a child – I just didn't know it. I realize now that I am one of the lucky ones. I got to see at least a little bit of what the Indian River was like before the development that's happened in our area took its toll. My grandfather always said that as soon as they started building causeways, the river started going downhill.

One way to measure the character of a community is to look at what it protects -- we protect what we value. For several generations my family and many others have depended on a healthy environment to make our living. The economic value of natural lands and unpolluted water through the creation of jobs in the fishing, tourism, recreation and other industries is well documented. Corporations consistently rank quality of life as a key consideration when relocating. It was Florida's natural areas and warm climate that sustained wildlife and brought vacationers long before there were theme parks and sprawling metroplexes. When viewed merely as an economic asset, natural lands clearly pay their way.

Nine years ago, a small group of volunteers sat right here in this restaurant and began the Space Coast Birding & Wildlife Festival. It has grown to become the nation's third largest birding festival, with attendees last year coming from 36 states and 4 foreign countries. The use of science and technology to benefit wildlife has emerged as the festival's central theme.

The list of worthwhile projects featured at our past festivals is long and the collection of presenters and field trip leaders is a virtual who's who within the environmental community. Many of them return every year, volunteering their time because they are passionate about their work and its impact on the future. They understand the value of education and its ability to introduce change.

I am humbly grateful to each and every one of them. The birding festival would not have achieved its status as one of the nation's top environmental events without them. A lot of our past presenters and field trip leaders are participating in the conference you are now attending. I looked through your conference agenda and picked out the names of those who have helped with our festival. I want to recognize you, so if you would, please stand up when I call your names…

Anne Birch, Dave Breininger, Bob Day, Gretchen Ehlinger, Marc Epstein, Ron Hight, Ross Hinkle, Donna Oddy, Jane Provancha, Paul Schmalzer, Rebecca Smith, John Stiner, Eric Stolen, D. Scott Taylor, Blair Witherington and Kim Zarillo

I know that there are probably others here who have helped with the festival who are not presenting at this conference. If there's anyone else in the room who has lent a hand, can you please stand up?

You guys are my heroes! I am so indebted to all of you!

When you all go back to your homes, keep in mind that there's other people out there like me who struggle every year to put together vital educational programs aimed at the general public. Education is the only way we'll be able to save anything. People can't possibly value what they don't know anything about.

So, when you get a call from some groveling program director, if you don't mind dealing with the public, help them out. You'll have a great time. It's very rewarding to see your hard work being appreciated. And I'm always looking for more ideas, speakers and trip leaders for our own event. We don't pay, but you'll get a nice motel room, free festival registration for two and you get to eat at Dixie Crossroads every night. It's like a vacation.

Thank you for coming this evening!

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Planning Session I

Moderator - Cheri Ehrhardt

Merritt Island National Wildlife Refuge

Landcover change within the North Indian River Lagoon Watershed. Brean W. Duncan, Paul A. Schmalzer[1] and Vickie L. Larson[2].

1. Dynamac Corp., Mail Code: DYN-2 Kennedy Space Center, FL 32899.
2. Ecospatial Analysts, Inc., 475 Robin Hood Dr., Merritt Island, FL 32953.

The Indian River Lagoon (IRL) is among North Americas most diverse estuaries. Like many other estuaries, it is surrounded by a rapidly growing human population. Anthropogenic influences such as point and non-point source pollution, impoundment of wetlands, and the general alteration of natural hydrologic processes have become large stressors of the IRL. To quantify changes that have occurred within the watershed, we produced landcover maps representing the northern portion of the Indian River Lagoon watershed for 1920, 1943, and 1990. The 1943 and 1990 maps were generated by photo interpretation and the 1920 map was produced by spatial modeling techniques. All anthropogenic landcover types increased throughout the study period, while all native landcover types decreased with the exception of hammocks. The dominant, terrestrial landcover types in 1920 were flatwoods, scrub, and freshwater marsh. In 1943 flatwoods and scrub types were still dominant, but agriculture was the third most abundant type. In 1990 urban became the dominate landcover with flatwoods second and agriculture third. The remaining natural areas have been highly fragmented by roads, canals, and urban areas. Shoreline composition has changed, with 1% of the IRL study shoreline being urban in 1920 and 26% in 1990. This dataset is useful for identifying changes in functional landcover, which will help improve management of resources within the IRL watershed and support important ecological studies investigating the relationships between natural and anthropogenic influences.

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Surface Water Improvement Management Plan. Joel Steward, St. Johns River Water Management District, P.O. Box 1429, Palatka, FL 32178.

The latest update of the Indian River Lagoon (IRL) Surface Water Improvement and Management (SWIM) Plan will be presented. The presentation will summarize the objectives and strategies for seagrass and coastal wetland restoration and management in IRL basin. Project accomplishments, challenges, and strategies to meet those challenges will also be discussed.

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National Estuary Program Overview. Bob Day, St. Johns River Water Management District, 525 Community College Parkway SE, Palm Bay, FL 32909.

The National Estuary Program was established by Congress as part of the 1987 revisions to the Clean Water Act. As the result of efforts by local interest groups, in 1990 Governor Bob Martinez nominated the Indian River Lagoon for inclusion in the National Estuary Program. A Management Conference was convened in 1991 and a Comprehensive Conservation and Management Plan for the Indian River Lagoon was published in 1996. The Indian River Lagoon Program, which is a combination of the National Estuary Program and the SWIM Program, continues to implement the actions outlined in the IRLCCMP.

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Indian River Lagoon North Feasibility Study. Debbie Peterson, U.S. Army Corps of Engineers, 525 Community College Parkway SE, Palm Bay, FL 32909.

The Comprehensive Everglades Restoration Plan (CERP), authorized as part of the Water Resources Development Act of 2000, recommended the Indian River Lagoon (IRL) Feasibility Study be conducted by the U.S. Army Corps of Engineers to comprehensively evaluate the Indian River Lagoon watershed to determine the types of modifications that are needed to successfully restore habitat, ecological conditions, and water quality of the Lagoon. While there is no physical border, from a hydrological perspective, within the IRL watershed, it is separated by jurisdictional subdivisions of the state of Florida. For that reason, the IRL Feasibility Study was completed for the southern portion of the study area utilizing one non-Federal sponsor, and is underway for the northern portion of the study area utilizing a different non-Federal sponsor. The IRL-South Feasibility study is complete and scheduled to be submitted to the U.S. Congress in 2004. The IRL-North Feasibility Study is underway and currently scheduled to be completed and submitted to the U.S. Congress in 2008. Even though the IRL study area includes separate political jurisdictions, the interagency Project Delivery Team and the NEP Advisory Group endeavor to look beyond their individual needs and concerns to evaluate the needs of the IRL as a whole, from a watershed and ecosystem restoration perspective. This presentation will describe the U. S. Army Corps of Engineers planning process utilized for the IRL Feasibility Study, formulation of alternative plans, restoration targets, and implementation goals.

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NPS inventory and monitoring program. Joe Devivo, National Park Service, SE Regional Office. Atlanta Federal Center, 1924 Building, 100 Alabama St. SW, Atlanta, GA 30303.

The National Park Service Inventory & Monitoring Program is designing a long-term ecological monitoring program to: (a) determine the status and trends in selected indicators of ecosystem condition to allow managers to make better-informed decisions and to work more effectively with other agencies and individuals for the benefit of park resources, (b) provide early warnings of abnormal conditions to help develop effective mitigation measures and reduce costs of management, (c) provide information to better understand the dynamic nature and condition of park ecosystems and to provide reference points for comparisons with other, altered environments, (d) provide data to meet legal and congressional mandates related to natural resource protection and visitor enjoyment, and (e) provide a means of measuring progress toward performance goals. Canaveral National Seashore is one of twenty parks in the Southeast Coast Network. The Network contains seventeen parks in North Carolina, South Carolina, Georgia, Alabama, and Florida that contain similar natural resources but span a wide diversity of missions, including four National Seashores, two National Historic Sites, two National Memorials, seven National Monuments, two national Military Parks, as well as a National Recreation Area, National Battlefield, and Ecological and Historic Preserve. The parks range in size from slightly more than 20 to nearly 60,000 acres, and when considered with non-federal lands jointly managed with SECN parks the Network encompasses more than 253,000 acres. We will be discussing the planning process, preliminary findings, and potential opportunities for collaboration.

Planning Session II

Moderator - Cheri Ehrhardt

Merritt Island National Wildlife Refuge

General Management Plan Update. John Stiner, Canaveral National Seashore, National Park Service, 308 Julia St., Titusville, FL 32796.

Canaveral National Seashore's current General Management Plan was written in 1981, almost 25 years ago. Since that time many changes have occurred. Expansion of the park and the opening of new areas have brought about an increase in visitation and placed greater pressure on functionally obsolete facilities. A significant increase in recreational pursuits such as boating and fishing has resulted in concern for marine wildlife and vegetation.

A new general management plan/environmental impact statement (GMP/EIS) is being prepared which will provide long-term guidance for managing the park over the next 15 - 20 years. The plan will address management zones, carrying capacity, growing and changing visitor use patterns, transportation, appropriate size and type of facilities, evaluation of water quality, management of wildlife populations and threatened and endangered species, commercial services, partnering and relationships with neighboring communities.

The project will be accomplished by an interdisciplinary team consisting of staff from CANA, Southeast Regional Office (SERO) and Denver Service Center. Substantial input from other federal, state, and local agencies and the general public is a vital key to the process. Comments will be solicited through public meetings and newsletters. Planning documents will also be posted on the park website and linked to other NPS planning program websites for review.

First, the range of desired resource conditions, visitor opportunities, and facilities will be defined, in adherence to the park's original purpose and significance. From these, several alternative concepts will be developed. Each will have a different approach or vision on how to achieve the desired visitor experience and resource conditions. Zones will be delineated for various conditions and activities.

These alternatives will be analyzed for their affects on visitor use and natural and cultural resources, as well as cost effectiveness. A preferred alternative will be determined using a Choosing by Advantage (CBA) process. A draft plan and EIS will be prepared, and after internal review, issued for public review. The final plan is due by September, 2006.

The revised plan and environmental impact statement will provide the seashore with long-range guidance for handling increased visitation, developing adequate visitor and administrative facilities, planning interpretive opportunities at newly opened sites and addressing new resource and land protection issues. It will provide direction for appropriate levels of development and recreational use in various areas of the park. Cultural and natural resource protection, visitor experiences and community relationships will be improved through completion and implementation of the GMP.

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Comprehensive Conservation Plan, Merritt Island National Wildlife Refuge. Cheri Ehrhardt, U.S. Fish and Wildlife Service, Merritt Island NWR, P.O. Box 6504, Titusville, FL 32782.

In 1997, Congress passed the National Wildlife Refuge System Improvement Act. This Act outlined the Wildlife First focus of the National Wildlife Refuge System and required the completion of 15-year management plans (Comprehensive Conservation Plans) by 2012 for all units of the Refuge System. In 2001, Merritt Island National Wildlife Refuge informally began the planning process by gathering information and conducting internal reviews, such as the Wildlife and Habitat Management Review. In late 2002 Merritt Island National Wildlife Refuge formally began the process of developing a Comprehensive Conservation Plan (CCP) with intergovernmental coordination, an open house, and subsequent public scoping meetings. The CCP represents the first time in the 40-year life of the Refuge that the public, partners, and other governmental agencies have had the opportunity to comment on any aspect of Refuge management. It also represents the first time in the 40-year life of the Refuge that the public, partners, and other governmental agencies have had the opportunity to help the Refuge, for the first time, develop an overall Refuge management plan. The Draft CCP and Environmental Assessment document for Merritt Island National Wildlife Refuge is anticipated to be available for public review and comment in late 2005, with a final in 2006.

Contributed Papers:

From "Burning to Boating"

Moderator - Doug Scheidt

Dynamac Corp.

"Fire management in the inter-galactic interface" or "Thirty years of fire management on the Merritt Island National Wildlife Refuge". F.W. Adrian, Merritt Island NWR, P.O. Box 6504, Titusville, FL 32782.

Merritt Island National Wildlife Refuge is located on the John F. Kennedy Space Center (KSC) on the central east coast of Florida. Most of the fuels found on the refuge burn with high intensity, and many are important habitat for threatened and endangered species. Little fire management occurred until 1981. That year a severe fire season resulted in two fatalities when over 60,000 acres burned in wildfires. An intensive prescribed burning program was initiated after this with the primary objective of the reduction of hazardous fuels. Large tracts, containing several vegetative types were commonly burned during this period. In 1993, more emphasis was placed on using fire to restore and maintain wildlife habitat. Many of the constraints to prescribed burning on the Refuge are similar to those one encounters elsewhere; increasing urbanization in the vicinity, threatened and endangered species concerns, and impacts on visitors and the general public for example. However, the biggest challenge has proven to be conducting a prescribed burning program in and around a space port. Launches at both the Kennedy Space Center and the adjacent Cape Canaveral Air Force Station and landings of the Space Shuttle are sensitive to smoke impacts. Smoke can also impact many of the payloads while they are in processing facilities. As one would expect, both NASA and the Air force have put restrictions on burning operations. When first put forth, these restrictions would have eliminated effective prescribed burning.

Reducing the limitations to prescribed burning took a combination of education, negotiation, external pressure and a bad fire season to accomplish. Key KSC personnel were briefed on the need for fuels reduction prescribed burning in order to minimize potential wildfire impacts on space operations. Mid level managers were taken out on prescribed burns to observe operations. With the support of these managers, a new notification/approval process was developed. This limited the number of KSC personnel with "no-go" authority from almost anyone with a phone, to seven. KSC dispatch also agreed to field most of the casual questions and only forward significant inquires to fire managers at the refuge. Discussions with Hubble Space Telescope personnel reduced the original limit of prohibiting fires within 25 miles of processing areas to a more reasonable six mile zone. Lines of communication were set up so refuge fire personnel could capitalize on any windows during the payload processing time where burning might be possible inside the 6 mile radius. These precedents were followed for other sensitive payloads. The 1998 fire season, during which clean rooms were smoked in for a week underscored the need for fuels management prescribed burning. The coordination between fire managers on space operation managers is a continuing process. The effort required is great, but it allows the refuge to maintain an active prescribed fire program.

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Florida scrub ecology and management. Eric Menges, Archbold Biological Station, P.O. Box 2057, Lake Placid, FL 33862.

I integrate information from long-term studies, chronosequences, and experiments into life history and population viability analyses (PVA) of Florida scrub plants, to suggest evolutionarily relevant fire regimes (ERFR) for Florida scrub. Resprouting shrubs dominate more frequently burned types of scrub (scrubby flatwoods, hickory scrub) and will probably be resilient to a range of fire return intervals. Intense or frequent fires could affect resprouters. For seeders, time to first reproduction and inter-fire demography of adults and seed banks may constrain fire return intervals. Florida rosemary scrub is dominated by a seeding species (*Ceratiola ericoides*), which can be eliminated by frequent fires (< 10 years) and probably also by fire suppression (> 80 years). Based on current knowledge, we cannot closely specify ERFR based on life hitory information. PVAs provide more precise approaches for key species. One PVA on an herbaceous resprouting species that grows in oak-hickory scrub (*Eriogonum longifolium* var. *gnaphalifolium*) suggests that it can tolerate a range of fire return intervals, but is favored by more frequent fires. On the other hand, a short-lived, seed banking, gap specialist species (*Dicerandra frutescens*) favors 6-12 year fire return intervals of fairly complete, intense fires. PVAs on two rosemary scrub herbs (*Hypericum cumulicola* and *Eryngium cuneifolium*) suggest frequent fires would

promote persistence. Because local extinctions are likely for these two species, patchy burning patterns would facilitate metapopulation viability. We use these demographic analyses to more closely specify ERFR that can be used to manage various types of Florida scrub with prescribed fire. We argue that a moderate amount of pyrodiversity can promote biodiversity while not harming the viability of individual species.

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Impact of recreational boating on oyster reefs in Mosquito Lagoon. Linda Walters[1], Loren Coen [2], Paul Sacks[3].

1. Dept. of Biology, University of Central Florida, Orlando, FL 32816.
2. South Carolina Dept. of Natural Resources, Marine Resources Research Institute, 217 Fort Johnson Road, Charleston, SC 29412.
3. Science Dept., Winter Park High School, 130 Tuskawilla Road, Winter Springs, FL 32708.

We have been examining long-term changes in intertidal oyster reefs in the northern Indian River Lagoon (IRL) and collecting a variety of data to better understand the causes and impacts of these changes. Over the past 60 years, many intertidal reefs in Mosquito Lagoon have developed "dead mounds" on their seaward edges. These mounds are composed of tightly-packed, disarticulated shells that can extend one meter above the high tide line. To determine if wakes created by the ever-increasing levels of recreational boating activity is pushing shells into these configurations, we have run replicated field trials with a variety of hull types and engine configurations. If distance from shore and propeller angle are maximized, then most vessels cause limited impact. When reefs with dead mounds are compared to "pristine" reefs (with no dead mounds), we found significant differences in sediment loads, oyster survival, and damage to new recruits. We did not find differences in settlement or disease loads (MSX, Dermo) between reef types.

Mosquito Lagoon creel/exit ramp and aerial surveys: results, trends and management applications. Karen Holloway-Adkins[1], Douglas M. Scheidt[1] and Marc B. Epstein[2].

1. Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899.
2. Merritt Island NWR, P.O. Box 6504, Titusville FL 32782.

Increased user demand on natural resources can have a profound impact on protected public lands. Resource managers and their staff are required to focus on a sometimes conflicting set of challenges that involve balancing the needs of the public and the protection of fish and wildlife resources. Department of the Interior staff responsible for the management and monitoring of estuarine resources within the boundaries of the Merritt Island National Wildlife Refuge and Canaveral National Seashore sought a study to measure the level and characteristics of boating and fishing in Mosquito Lagoon. In 2002, creel/exit ramp and aerial surveys were initiated to quantify resource utilization patterns within the lagoon. Bi-weekly creel and aerial surveys were conducted one weekend day and one weekday. The creel interview was a 35 question survey that was given to boaters exiting the water for the day. The survey focused on gathering information about the activities, boat types, user opinions and experiences of boaters visiting Mosquito Lagoon. During the aerial survey, researchers recorded the number and types of boats, the number of individuals per boat, boating activity (fishing, clamming, canoeing, or other), their locomotion (anchored, poling, and motoring) and their direction of travel. Aerial surveys revealed that Saturday had the highest use day and early and late weekdays were the lowest. Areas around Georges Bar and Haulover Canal consistently had the highest boat count per survey. In addition, other aerial overflight observations and data (Sargent et al. 1995) have shown increased prop-dredging and scarring in fragile soft bottoms and seagrass communities. The combined data from these studies have provided the refuge valuable information to make informed decisions on meeting its responsibility to provide a balance in resource management, protection and compatible public uses. An example, at recent scoping meetings, the public provided overwhelming support and acceptance of an experimental "poling/trolling only" zone in the Mosquito Lagoon.

Wetlands Initiative

Moderator - Ron Brockmeyer

St. Johns River Water Management District

Wetlands Initiative at Merritt Island National Wildlife Refuge: Project overview, site description and history.
Ronald E. Brockmeyer[1], C. Ross Hinkle[2], Jaime A. Collazo[3], Linda K. Blum[4], Donald R. Cahoon[5], Joseph B. Stewart[1], Mark J. Provancha[2] and Douglas M. Scheidt[2].

1. St. Johns River Water Management District, Palatka, FL.
2. Dynamac Corp., Kennedy Space Center, FL.
3. North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Raleigh, NC.
4. University of Virginia, Charlottesville, VA.
5. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD.

The Merritt Island National Wildlife Refuge (MINWR; Florida), the St. Johns River Water Management District and NASA gathered experts to design and conduct an interdisciplinary research effort, now called the Wetlands Initiative at MINWR, to evaluate ways to optimize wetland management. Momentum was provided by a U.S. Geological Survey-led project to examine shorebirds at selected east coast Refuges, including MINWR. Integrated proposals were prepared by researchers with similar interests resulting in all major components having secured funding within two years. Historical land cover changes, topography, sediment processes, water quality, fish and aquatic invertebrates dynamics, fiddler crabs, shorebirds, wading birds, waterfowl, and nearby seagrass beds were investigated by researchers from over a dozen organizations with principal funding from the Environmental Protection Agency. Project results were utilized to generate comprehensive recommendations for restoring or maintaining optimal ecological functioning and for providing a foundation for sustainable management of Indian River Lagoon wetlands.

For nearly four years, this effort examined open/unmanaged, mosquito control managed, and wildlife managed impoundments as well as natural and restored wetlands. The shoreline impoundments of Black Point Wildlife Drive area were selected as the study site after considering sampling logistics, management priorities, hunting designation, and overall project funding. An extensive collection of historical aerial photography, land use/land cover maps, and vegetation (wetland and seagrass) maps were compiled to provide a context for the study. New high-resolution (1:6000) aerial photography was collected, extensive survey work was done, and new vegetations maps were prepared to establish current conditions. Global Positioning Satellite (GPS) equipment was use to determine the location of all dikes, culverts, instrumentation, and sampling stations. All of this information was integrated into a Geographical Information System (GIS). Analysis of this information revealed extensive changes in the land cover of these impounded wetlands and substantial changes in their substrate elevations.

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Wetlands Initiative at Merritt Island NWR: Marsh surface elevations, exchange volume calculations, water levels and salinity.
Joseph B. Stewart[1], Ronald E. Brockmeyer[1], Mark J. Provancha[2], Joseph E. Beck[1] and Edward E. Carter[1].

1. St. Johns River Water Management District, Palatka, FL.
2. Dynamac Corp. Kennedy Space Center, FL.

The Wetlands Initiative at Merritt Island National Wildlife Refuge (MINWR; Florida) was established to evaluate ways to optimize wetland management. As a part of this effort high-resolution (1:6000) aerial

photography was collected, and extensive survey work using Global Positioning Satellite (GPS) equipment was performed to determine the location of all dikes, culverts, instrumentation, and sampling stations. This information was integrated into a Geographical Information System (GIS). GIS was used with Real-Time Kinematic GPS surveys to generate topographic representations of most of the study impoundments. Continuous water level and salinity data was collected using sensors in each impoundment. Data derived from the topographic representations was combined with water level data to determine exchange volume between a managed marsh and the adjacent Indian River Lagoon (IRL). The surface representations was also analyzed in conjunction with water level data for the duration of the study, revealing substantial changes in substrate elevation within impounded wetlands relative to mean water levels in the area. Salinity data was analyzed and compared to the management goals for each impoundment.

Wetlands Initiative at Merritt Island NWR: Sedimentation and elevation dynamics. Donald R. Cahoon[2], Linda K. Blum[3], Russell H. Lowers[1] and Eric A. Reyier[1].

1. Dynamac Corporation, Kennedy Space Center, FL.
2. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD.
3. University of Virginia, Charlottesville, VA.

Native salt marsh habitats at Merritt Island NWR were isolated from the Indian River Lagoon by the construction of mosquito control impoundments in the 1950s and 1960s. In the 1960s, prolonged flooding was introduced to enhance waterfowl habitat. In the 1970s, tidal exchange was restored to one impoundment by removing the perimeter dike. This project evaluated salt marsh sediment elevation responses to these hydrologic alterations using: a) historic (~40 year) sediment accretion, and b) recent (2-4 year) trends in organic matter accumulation, sediment elevation, and vertical accretion. Recent accretion rates in native and restored marsh were 4-5 mm/yr, which are comparable to historic accretion rates (3-4 mm/yr) and local sea-level rise. In the impounded marshes, however, prolonged flooding has caused the death of marsh plants, reduction of sediment organic matter, and elevation, and conversion of large areas to open water. Unvegetated areas of impounded marsh are continuing to lose elevation at a rate of 2-12 mm/yr, despite accretion rates of 5-15 mm/yr. This loss is attributed to sediment compaction and erosion.

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Wetlands Initiative at Merritt Island NWR: Comparison of water quality, seagrass, vegetation, fiddler crab and ichthyofaunal community structure under three differing water management strategies.

Douglas M. Scheidt[1], Linda K. Blum[2], Gretchen S. Ehlinger[5], Karen Holloway-Adkins[1], Eric A. Reyier[1], Russell H. Lowers[1], Robert W. Virnstein[3], Barbara V. Peterson[1], Mark J. Provancha[1], Julie A. Simpson[1] and Byorn G. Tunberg[4].

1. Dynamac Corp., Kennedy Space Center, FL.
2. University of Virginia, Charlottesville, VA.
3. Divisic
4. Smithsonian Marine Station, Ft. Pierce, FL.
5. Florida Fish and Wildlife Conservation Commission, Jacksonville, FL.

Impounded salt marshes within Merritt Island NWR are managed to address many specific goals including mosquito control, promotion of emergent or submergent vegetation and wildlife accessibility. The majority of impounded marshes are currently managed under three different hydrological protocols (open, rotational impoundment management, wildlife aquatic management) that differ in their degree of connection to adjacent lagoonal habitats. The purpose of this study is to compare ichthyofauna, fiddler crab and seagrass community structure, along with water quality between management types and with a nearby, restored marsh over a 36-month period. For the local ichthyofauna community monthly collections in seven impoundments, beginning January 2001, utilizing cast nets, culvert traps and throw traps have yielded 35

fish species to date. Results show that many transient species are present under all three management schemes and can recruit here as small juveniles despite the microtidal nature of the region and the great distance (30 km) to nearest ocean inlet. Overall species counts are similar (25 open, 26 RIM, 23 WAM) but have decreased steadily in WAM impoundments. For the fiddle crabs (*Uca*) the study revealed that the *Uca* populations at the investigated sites were totally dominated by one species, the sand fiddler *Uca pugilator*. There was no demonstrated impact on seagrass related to impoundment management. Biweekly water samples were collected from impoundments and the lagoon at two sites in each management regime from March 2000 to March 2003. Sixteen water quality parameters were measured at each sampling site. Results indicate no impoundment or water management effect on water quality characteristics within the impoundment or the adjacent lagoon. Principal Components Analysis (PCA) revealed a seasonal trend in water quality and a significant wind effect on bacteria, chlorophyll, color, total suspended solids, and turbidity. Geographic location of the impoundment influenced water quality. Wind driven events suspended sediments and decreased water clarity.

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Wetlands Initiative at Merritt Island NWR: Recommendations for wetland management and restoration.

Ronald E. Brockmeyer[1], C. Ross Hinkle[2], Jaime A. Collazo[3], Linda K. Blum[4], Donald R. Cahoon[5] and Douglas M. Scheidt[2].

1. St. Johns River Water Management District, Palatka, FL.
2. Dynamac Corp., Kennedy Space Center, FL.
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4. University of Virginia, Charlottesville, VA.
5. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD.

The Wetlands Initiative at Merritt Island National Wildlife Refuge (MINWR) was a multi-agency effort established to evaluate wetland processes under various hydrological management scenarios. For over four years, this effort examined a variety of wetland components within pairs of open/unmanaged, mosquito control managed, and wildlife managed impoundments as well as reference natural and restored wetlands. Project results were synthesized and analyzed with other work occurring at MIWNR and with information available in the literature. This compilation of information was used by researchers to generate recommendations for wetland management and restoration. The goal of these recommendations was to provide a foundation for restoring or maintaining optimal ecological functioning and to provide information directed toward sustainable multiple-species management of Indian River Lagoon wetlands. As an example, examination of historical photography and land cover changes, extensive evaluation of sedimentation rates, evaluation of organic matter dynamics, and development of marsh topographic maps demonstrated that loss of vegetation was the major contributing factor to marsh subsidence and should be a consideration in future marsh management strategies. This led to one of the most important recommendations calling for the protection of emergent vegetation to preserve a wetland's capability to maintain its vertical position relative to a rising sea level. Recommendations and complete project results were summarized in a project report and are being summarized and disseminated in peer-reviewed publications.

Day 2

Wednesday - February 16, 2005

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Mosquito Control

Moderator - Doug Carlson

Indian River Mosquito Control District

Source reduction for salt marsh mosquito control and natural resource management.

Doug Carlson, Indian River MCD, P.O. Box 670, Vero Beach, FL 32961.

Mosquito control offices typically employ an Integrated Pest Management (IPM) approach when controlling salt-marsh mosquitoes. Source reduction (=the elimination of breeding sites) is typically the most effective and economical technique. This presentation will provide an overview of impoundment management along the Indian River Lagoon highlighting efforts to control mosquitoes while enhancing the impounded salt marshes. A short video will demonstrate the repair of an island impoundment dike, a difficult project within the Indian River Mosquito Control District made possible through cooperation with the East Volusia Mosquito Control District. A recent rotary ditching project in Indian River County will also be part of the video.

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Progress in wetland management in Saint Lucie County. James R. David. Saint Lucie County Mosquito Control District, 3150 Will Fee Road, Ft. Pierce, FL 34981.

The Saint Lucie County Mosquito Control District's earliest management efforts involved ditching and impoundment construction on private lands. Wetland management in Saint Lucie County has now evolved into an effort to gain public control of the coastal wetlands in order to implement current Best Management Practices in wetland management. This acquisition effort has been integrated into the county-wide effort to purchase environmentally-sensitive lands. As a result, 83 %, or over 3,400 acres of Indian River Lagoon coastal wetlands in Saint Lucie County are now under public/private long-term conservation, and over 54 % of the barrier island is now under public ownership. Our future preservation plans target the mainland coastal wetlands, totaling 258 acres of isolated wetlands. We began focusing on restoration in the early 1980's with the initial work done in response to mitigation requirements. Our earliest restoration efforts involved installation of culverts and solitary 6,000 gpm electric pumps. Monitoring of water quality and wildlife was then initiated, which was also initially tied to mitigation requirements. This work studied the marine exchange benefits of culverts, and made additional contributions in the areas of water quality and wildlife utilization. Areas of study included: marine fishes & macro-crustaceans; zooplankton & phytoplankton; wading birds & wildlife; nutrient loads & hydrology; water quality & sediment chemistry; benthic ecology & mangrove ecology. Research efforts towards BMP development now approach $2 m (both completed and planned work). The current BMP's are based on rotational impoundment management and modified open marsh water management practices, as well as, wetland creation techniques. Following study findings, culvert per acre (1:10-15 ac) and culvert per LF of perimeter dike (1:900 LF) ratios were established, and 7,000 gpm pump per acre ratios (1:80-100 ac) were developed, to achieve boundary condition equivalency during summer pumping seasons. These engineering improvements resulted in modified versions of RIM/Open Marsh Water Management strategies being adopted for impoundments. The range of modified RIM/OMWM impoundment strategies includes: RIM artificial flooding in association with vinyl sheet-pile weir & breaching; RIM artificial flooding in association with season-long open culvert operation; RIM artificial flooding in association with season-long multiple open/partially open culverts; RIM artificial flooding in association with rotary ditching. Current restoration totals are as follows: 3400 ac reconnected; 344 perimeter culverts; 19 A1A culverts; 18 pump & aeration stations; 44 pumps with 66.5 BG annual pumping capacity (reflecting 80 % boundary condition). An estimated $2.5 M has been expended towards restoration activities, in addition to $81.5 M invested in public land acquisition on the barrier island in Saint Lucie County.

Current work includes: 2 dimensional hydrological modeling; water quality monitoring; seagrass monitoring; tarpon tag & release & track program; shrimp life history studies; FAD settlement and refugia study (reef balls). Future work of interest includes: seagrass & wetland inter-relationships; organismal recruitment through open culverts during summer management season by tarpon, snook, shrimp, lobsters, etc.

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Larviciding: The second best way to control mosquitoes. Alan Curtis, Indian River MCD, P.O. Box 670, Vero Beach, FL 32961.

The other important component of an IPM program for salt-marsh mosquito control is the use of chemicals to kill mosquito larvae (=larviciding). Along the Indian River Lagoon, several larvicides are used depending on the particular needs and situation. These chemicals include the bacteria *Bacillus thuringiensis israelensis* (*Bti*), Altosid (an insect growth regulator) and Abate (=the organophosphate temephos). This presentation will describe these materials, the primary means in which they are applied and some of the recent issues involved in their use.

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Aerial adulticiding for mosquito control: Recent technological advances to improve erial adulticiding for mosquito control: Recent technological advances to improve efficiency while protecting the environment. Jane Barber, John A. Mulrennan, Sr., Public Health Entomology Research & Education Center, Florida A&M University, 4000 Frankford Ave., Panama City, FL 32405.

Aerial spray equipment used for mosquito control dating back to the World War II era was actually inherited from agricultural insecticide spraying practices. Many assumptions on application protocols for agriculture are not pertinent for mosquito control needs. Mosquito control aerial spray equipment has been rapidly improving over the past decade. Research conducted in Florida has led to a fresh approach to this discipline by employing equipment which creates droplet sizes which provide better mosquito control benefits with a minimal amount of contamination to non-target organisms. These advancements are being achieved by bringing together some of the best minds on droplet physics and meteorological phenomena. This presentation will describe the history of aerial mosquito control spray technology, explain where we are now in the process of improving spray efficiency and tell where we intend to be in the near future.

Management of Indian River County spoil islands for mosquito control. Rich Wilson and Michael Hudon, Indian River MCD, P.O. Box 670, Vero Beach, FL 32961.

Indian River County (IRC) spoil islands can be prolific producers of the Atlantic salt-marsh mosquito (*Ochlerotatus taeniorhynchus*) and have been routinely inspected by the Indian River Mosquito Control District for the past 20 years. Aerial and ground larviciding remain the typical mosquito control methods on these islands. These spoil islands are becoming increasingly popular as recreation sites thus making effective control of mosquitoes there important. Because these islands are in FDEP Aquatic Preserves, options for chemical treatments are restricted to larviciding with *Bti* and Altosid (methoprene). In cooperation with FDEP, a pilot project employing integrated mosquito control strategies including habitat modification, hydro-period alteration and biological control is underway on Spoil Island #42 in southern IRC.

Habitat Restoration

Moderator - D. Scott Taylor

Brevard County Environmentally

Endangered Lands Program

Salt marsh restoration in Volusia County. Glen-Paul Edson, East Volusia Mosquito Control District, 1600 Aviation Center Parkway, Daytona Beach, FL 32115.

In 2002, Saint John's Water Management District (SJRWMD) and Volusia County Mosquito Control (VCMCD) entered into agreement to begin the restoration of D-12 South. Located in the northern section of Canaveral National Seashore, D-12 South is an impoundment encompassing approximately 278 acres with 6.19 miles of dike. There are also 53.09 acres of dragline-impacted marsh inside of D-12 South. The goal of the project is to remove the dike material to the borrow ditch and bring everything back to marsh elevation allowing for open tidal flow across the marsh. The internal dragline ditches will be restored by leveling the adjacent spoil piles that have allowed the recruitment of exotic upland species to a historical high marsh. The techniques used are the same as those used to remove dragline spoil on both Porkchop and Orange Island. All the work is being done with a Wilco Marsh Buggy. It is a long reach trackhoe mounted on pontoons allowing for a very low (2 pounds per square inch) ground bearing pressure.

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The restoration of tidal marshes at Tomoka State Park (Volusia County) by backfilling dragline ditches with an amphibious excavator. Charles DuToit, Tomoka Basin State Parks, Division of Recreation and Parks, Florida Dept. of Environmental Protection, 2099 North Beach Street, Ormond Beach, FL 32174.

Tomoka State Park in Volusia County is situated at the confluence of the Tomoka River and the Halifax River in the Northern Coastal Basin of east central Florida. The tidal marshes of Tomoka State Park, 465 acres, were extensively altered by dragline ditches in the 1950s. The excavation of parallel cuts for mosquito control, "grid ditching", changed the vegetation and hydrology of the brackish marsh community, dominantly *Spartina bakeri* and *Juncus roemerianus*, which is characterized by irregular tidal flooding and poor surface drainage. The deposition of dredge spoil on the marsh surface created elevated substrate for woody shrubs and trees including red cedar and non-native Brazilian pepper. Tomoka State Park initiated Phase 1 of the Dragline Ditch Project in December 2000 to backfill the dragline ditches by using an amphibious excavator with a long-arm backhoe. Phase 2 was started in November 2003 and by April 2004 the park had backfilled 40 dragline ditches, 35,000 linear feet cumulatively, restoring 250 acres of tidal marsh. The operational objective for the "restoration" of dragline ditches is to remove and grade spoil berms down to the ground level of adjacent natural marsh and to fill-in the ditch channel with the excavated spoil and vegetation debris. In the Phase 1 project, the exposed substrate of graded berms was recolonized by native marsh plants (75-100% ground cover) by the 2nd growing season. In the Phase 2 project, physical changes in restored marshes were investigated by topographic surveys of dragline ditch #23 before and after berm removal and backfilling. Water level data from the USGS tide station on the Tomoka River was used to assess changes in hydroperiod, and its influence on vegetation growth, due to the alteration of marsh habitat.

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An update on the Upper Tampa Bay Park rotary ditching project. Doug Wassmer, Pasco County Mosquito Control District, 2308 Marathon Road, Odessa, FL 33556.

I will discuss the Upper Tampa Bay Project and the past need for it, how it was constructed, when, and what data were collected. Before and after construction photographs will be shown depicting what it looked like in the mid-1980's, and what it looks like today. Since there are no recent scientific data collections available to compare with the original ones from the construction era, there will be no

statistical comparisons. The purpose of this talk is simply to provide updated information on one of the first rotary ditching projects in Florida.

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Removing the sands (sins?) of our past: Dredge-spoil and saltmarsh restoration along the Indian River Lagoon, Florida. D. Scott Taylor[1] and Thomas W. Workman[2].

1. Brevard County Environmentally Endangered Lands Program, 5560 N. US 1, Melbourne, FL 32940.
2. St. Johns River Water Management District, P.O. Box 1429, Palatka, FL 32178.

Estuarine saltmarshes are widely recognized as highly productive and biologically diverse marine systems. The Indian River Lagoon (IRL) is a 256 km long estuary (an "Estuary of National Significance) along Florida's east coast and is known as one of North America's most diverse estuaries. Over 4,300 species are associated with this system, including 35 Threatened and Endangered species. Like most North American estuaries, the IRL is facing a number of problems, among them loss of emergent wetlands. Between 75-90% of the original mangrove and saltmarsh acreage historically bordering the IRL has been lost or impacted, either through direct filling for development or impoundment for mosquito control. This loss has impacted IRL water quality and fisheries, since these once formerly productive nursery habitats are now removed from the estuarine system. Active programs are now underway to 'restore' mosquito impoundments by reconnection with culverts or removal of dikes, but restoration of dredge spoils is more problematic, as many of these sites have been developed. However, where undeveloped spoils are found on public lands, restoration is a possibility. One such site, Pine Island Conservation Area, jointly owned by the Brevard County Environmentally Endangered Lands Program and the St. Johns River Water Management District, contained over 60 acres of dredge spoil originating from 1969, when the property was owned by a private development company. Following public acquisition in 1996, plans were developed to remove the spoil and restore the site to historic conditions, high saltmarsh. Using both mitigation funds and in-kind contributions, we have moved forward with the project and report on the status of this multi-year, multi-agency cooperative project.

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Hydrologic restoration of the North Fork St. Lucie River through oxbow and floodplain wetlands reconnection. Jeff Beal, Fla. Dept. of Environmental Protection, 9737 Gumbo Limbo Lane, Jensen Beach, FL 34957.

A significant portion of the floodplain of the North Fork St. Lucie River (NFSLR) in east-central Florida is completely or partially isolated from the river's main branch because of dredging conducted during the 1920s to facilitate drainage of the watershed. The dredged material was placed along the banks of the river, creating spoil berms that are between 2-18' high and 10-30' wide. As a result, certain natural communities from the historical water course including tidal swamp and forest, floodplain swamp and forest, baygall, and oxbows (black water river, sloughs, and streams) are not fully connected to the main river branch. A significant portion of the river's natural filtration of water-borne nutrients and pollutants is not being utilized to its full capacity. The river suffers from overdrainage, heavy sediment and pollutant loadings, and a constrained flow regime. Pilot projects were conducted in two areas to restore the connectivity and productivity of the floodplain wetland natural communities using breaches (culverts or cuts) through the spoil berm to reconnect an oxbow and to re-hydrate the wetlands. Within weeks of breaching, turbidity in the project areas matched background level. Water volume and residence time increased on the floodplain surface, increasing available habitat for fishes and crustaceans. Fish and crustacean community structure, species richness, and abundance increased within the rehydrated wetlands. Important fishery species (snook, blue crabs, penaeid shrimps) and rare species (slashcheek goby, bigmouth sleeper) utilized newly available habitat.

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Quantifying seagrass meadow prop scar restoration resulting from an internal combustion engine exclusion zone, Tampa Bay, Florida. Roy R. "Robin" Lewis III, Ann B. Hodgson and Marcus Tooze, Lewis Environmental Services, Inc., P.O. Box 5430, Salt Springs, FL 32134.

[ABSTRACT NOT PROVIDED]

Wildlife I

Moderators - Marc Epstein

Merritt Island National Wildlife Refuge

John Stiner, Canaveral National Seashore

Flora and rare plants of Canaveral National Seashore. Paul A. Schmalzer and Tammy. E. Foster, Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899.

We have conducted a floristic survey of selected areas on Canaveral National Seashore from the fall of 2002 through the summer of 2004. We also revisited locations of listed plants identified previously. To date we have identified a flora of 650 taxa within the seashore boundaries based on collections in this study, specimens in the seashore museum, and previous work on Kennedy Space Center/Merritt Island National Wildlife Refuge/Canaveral National Seashore. We have identified 13 taxa considered endangered (SE) or threatened (ST) by the state of Florida. Coastal strand and scrub are important for *Lantana depressa* var. *floridana* (SE), *Glandularia maritima* (SE), *Chamaesyce cumulicola* (SE), *Tephrosia angustissima* var. *curtissii* (SE), *Myrcianthes fragrans* (ST), *Opuntia stricta* (ST), and *Scaevola plumieri* (ST). *Lechea divaricata* (SE) and *Pteroglossaspis ecristata* (ST) occur in oak scrub, particularly areas recently burned. *Ophioglossum palmatum* (SE) is epiphytic on *Sabal palmetto* in a few hammocks. *Tillandsia fasciculata* (SE) and *T. utriculata* (SE) are also epiphytic in hammocks. One population of *Nemastylis floridana* (SE) is known. *Argusia gnaphalodes* (SE) and *Harissia simpsonii* (SE) appear to have been eliminated by freezes in the 1980s. Plants listed by the state of Florida as commercially exploited include *Osmunda cinnamomea*, *O. regalis*, and *Zamia pumila*.

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Value of natural versus created wetlands for maintaining reptile and amphibian biodiversity.

Richard A. Seigel and Rebecca B. Smith, Dept. of Biological Sciences, Towson University. Dept. of Biological Sciences, Towson University, Towson, MD 21252.

Freshwater wetlands are being destroyed at an alarming rate worldwide. Mitigation efforts often take the option of replacing these habitats in order to maintain biodiversity, but the long-term value of created wetlands remains poorly known. At the Kennedy Space Center in Florida, natural freshwater habitats are limited primarily to freshwater swales and mesic hammocks. These habitats are subjected to road construction, alteration in drainage, and disturbances from feral hogs. Created wetlands at this site include roadside ditches and excavated limestone pits. From 1994-2005 we compared the species richness and abundance of reptiles and amphibians between roadside ditches and natural wetlands (swales), primarily using aquatic traps. Data analysis of over 4500 trap nights suggests that species richness and abundance in roadside ditches is surprisingly high. Although ditches are subject to rapid changes in water levels and occasional saltwater intrusion, some amphibian and reptile species are more common in ditches than in swales (e.g., green water snakes). Conversely, some species are restricted to swales (e.g., black swamp snakes, gopher frogs). Our data suggest that resource managers interested in preserving overall biodiversity in an area should focus not only on natural habitats, but should consider created habitats as potentially important sites well.

Florida scrub-jay habitat and population dynamics along Florida's Central Atlantic Coast. D. Breininger, G. Carter, D. Oddy, Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899.

There has been extensive landcover alteration because of habitat loss, fragmentation, and the disruption of natural processes (i.e., fire regimes). We combined long-term data on the recruitment, survival, and dispersal with habitat mapping and population models to quantify Florida scrub-jay demography on Merritt Island and the mainland in Brevard County and Indian River County. We investigate whether several landcover variables can be used to predict whether Florida scrub-jay territories will function as a sources (net exporters with recruitment exceeding mortality) or sinks (net importers with mortality exceeding reproductive success). The arrangement of shrub height had the greatest effect size on demographic performance, although the best-supported models included several landcover variables and their interactions. We use these approaches to describe their utility in developing conservation reserves and adaptively managing scrub, using prescribed fire.

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Current Status of the Southeastern Beach Mouse at Merritt Island National Wildlife Refuge and Canaveral National Seashore. J. Provancha[1], R.B. Smith[1], M. Fernandes[2], J. Stiner[3] and M. Gaines[2].

1. Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899.
2. Dept. of Biology, University of Miami, Coral Gables, FL 33124.
3. Canaveral National Seashore, 308 Julia St. Titusville, FL 32796.

The Southeastern beach mouse (SBM) (*Peromyscus polionotus niveiventris*) once occurred throughout 280 km of Florida's Atlantic coast. Habitat loss and modification have reduced this species distribution to between 50 km to 80 km of the federally protected lands of Canaveral National Seashore (CNS), Kennedy Space Center/Merritt Island National Wildlife Refuge (KSC/MINWR), and Cape Canaveral Air Force Station (CCAFS). The SBM was listed as Threatened in 1989 by the U.S. Fish and Wildlife Service and in 1990 by the Florida Fish and Wildlife Conservation Commission. Sporadic small mammals surveys conducted within the federal lands suggest that SBM abundance is low within CNS, the least disturbed portion of its range, but increases further south within KSC/MINWR and CCAFS. Despite its Threatened status, little is known about this species and statements regarding its natural history are often made without scientific support. Future research will focus on SBM habitat requirements and the development of habitat suitability models.

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The effects of intraguild predation on community structure and sea turtle conservation. Brandon Barton and James Roth, University of Central Florida, Dept. of Biology, 4000 Central Florida Blvd., Orlando, FL 32817.

Raccoon predation is among the highest causes of egg mortality for sea turtles. On some Florida beaches, raccoon removal has been used to successfully decrease nest depredation by raccoons for over 20 years. However, numerous studies have suggested that removing predators can produce cascading effects within the community. We studied the relationship between raccoons and ghost crabs, another common sea turtle egg consumer that is preyed upon by raccoons, at four beaches in east-central Florida. We used track plots to quantify the relative abundance of raccoons and ghost crabs between May—September 2004. The relative abundance of ghost crabs and raccoons was negatively correlated, and beaches where raccoons were removed had more and larger ghost crabs. This relationship between these two predators may be an important factor to consider in planning strategies for sea turtle conservation.

Trends in sea turtle abundance in Mosquito Lagoon and preliminary data from the passive acoustic monitoring network. R. Lowers, J. Provancha, M. Mota, K. Holloway-Adkins, D. Scheidt, and E. Reyier. Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899; Speaker: Russ Lowers.

Biologists at Kennedy Space Center (NASA) have studied the status of the marine turtle population in Mosquito Lagoon since 1976. While capture methods, techniques and locations have been replicated, the ratio of green turtle (*Chelonia mydas*) and loggerhead turtle (*Caretta caretta*) captures have shown distinct changes in the past 29 years. In the 1970's green turtles represented approximately 20% of total net captures. Today, they represent 80% of the total captures in the lagoon. Sex ratio samples suggest a highly female- biased green turtle population. Capture and recapture rates are quite low with only 10% of the animals recaptured over the nine year period. Comparing Mosquito Lagoon capture data to other sites within the Indian River Lagoon (IRL) and other Florida estuaries shows similar population structures (i.e. dominated by juveniles) but indicates a relatively small population in Mosquito Lagoon. Prior to 1980, the prevalence of green turtles with fibropapillomatosis or FP; a potentially debilitating disease, was not observed in Mosquito Lagoon. However, since the 1980's, the ratio of green turtles with FP is on average 50% of total captures. This disease is found in most juvenile green turtle populations and etiological studies have not ruled out the role that environmental cofactors may play in the promotion of FP.

To study the movements of FP turtles and healthy turtles we installed a network of passive acoustic receivers in April 2004 in Mosquito Lagoon and northern Indian River. Our objective is to compare their movements, home range and foraging areas. The passive acoustic network has expanded through collaboration with other universities and institutions in Florida. Although the network is not continuous in coverage, it currently extends from Fort Pierce, Florida to New Smyrna Beach, Florida. This type of passive monitoring is currently being used for many different types of aquatic animals with opportunities to enhance the acoustic network within the IRL.

Aquatics I

Moderator - Doug Scheidt

Dynamac Corp.

Larval hatching in the horseshoe crab, *Limulus polyphemus*: facilitation by environmental cues.

Gretchen S. Ehlinger and Richard A. Tankersley, Florida Fish and Wildlife Conservation Commission, 6134 Authority Ave., Jacksonville, FL 32221.

Female horseshoe crabs, *Limulus polyphemus* (Linnaeus), lay their eggs in nests on sandy beaches near the high water line. Embryos develop within the sand, hatch into trilobite larvae, and enter the water column when the nest is inundated. Given the diversity of tidal and shoreline inundation patterns that populations of *L. polyphemus* experience throughout their range (semi-diurnal and diurnal tides, microtidal, and nontidal), hatching may also be facilitated by environmental triggers that serve to synchronize hatching and larval emergence with periods of high water. The objective of this study was to determine if larval hatching in *L. polyphemus* is triggered or facilitated by environmental cues. Stage 21 embryos were subjected to one of seven different treatments that simulated conditions experienced during inundation: (1) hydration, (2) agitation, (3) hydration and agitation, (4) hydration and agitation with sand, (5) osmotic shock, (6) terrestrial hypoxia, and (7) aquatic hypoxia. Hatching rates increased significantly under all simulated tidal conditions compared to controls and were highest (96 %) for eggs simultaneously exposed to both hydration and agitation with sand. Measurements of the osmolarity of the perivitelline fluid of developing eggs collected from the field indicated that it is hyperosmotic to the ambient seawater and pore water. Thus, when inundated, eggs also experience a hypoosmotic shock, which would likely facilitate hatching by causing the eggs to swell, rupturing the egg membrane, and thereby increasing the likelihood that larvae would hatch and enter the water column during periods of high water.

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***Coccotrypes rhizophorae*, a scolytid beetle that feeds on *Rhizophora mangle* propagules and seedlings**.

Michael Hudon, Indian River MCD, P.O. Box 670, Vero Beach, FL 32961.

Scolytid beetles include the bark beetles, wood-boring bark beetles and ambrosia beetles. *Coccotrypes rhizophorae* is a small dark reddish brown scolytid beetle that is an obligate parasite of red mangroves in the New World. Observed in Florida since 1970, this beetle bores into propagules, seedlings, and prop roots. Infested propagules exhibit high mortality, and those propagules that are in the shaded understory are attacked more frequently than those in light gaps. Collaboration is underway to collect beetle samples from a variety of locations in the New and Old World and using molecular genetics determine whether *Coccotrypes rhizophorae* is a recent introduction to the New World. Indian River Mosquito Control District will be participating in this project by providing infested propagules from our area to aid in this research.

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Making a dent in derelict crab traps. Nicole Adimey and Jessica Koelsch, USFWS, Ecological Services,

6620 Southpoint Dr. South #310, Jacksonville, FL 32216.

The blue crab fishery in Florida is one of the most substantial commercial and recreational fisheries in the State. Unfortunately, each year, thousands of crab traps are lost or abandoned. These derelict crab traps are a source of injury and mortality for many wildlife species: manatees, dolphins, birds, small land animals, marine turtles, fish, invertebrates, and whales. In addition, lost or discarded traps can pose a risk and expense for fishers, boaters, and divers, damage seagrass beds, and deplete the resource if crabs become confined in lost traps. In 1999, the Entanglement Working Group (EWG) was formed with federal, state, county, and non-profit organizations to address the threat of fishing gear to Florida's wildlife.

To assess impacts of derelict crab traps, the EWG conducted four crab trap removals in Mosquito Lagoon and its associated tributaries on the Merritt Island National Wildlife Refuge. Removal efforts were conducted annually from 2001-2004, with a total of over 20 effort hours resulting in the collection of 105 derelict traps. Traps were categorized as either non-working ("non-fishable") or working ("fishable"), with 59 and 46 retrieved respectively. Trap/tag identification was found & legible on 10 traps and two buoys. Poor water visibility and the fact that only 40% of the traps collected (from three removal efforts) had buoys attached made trap location and subsequent retrieval efforts difficult. Impacted aquatic wildlife included various species of fish and crabs, and other invertebrates such as barnacles, oysters, tunicates and algae.

To address derelict crab traps in other parts of Florida, the EWG recommends short-term closures on a rotating basis around the state for derelict crab trap retrieval; a community-based approach to retrieval efforts; a state-wide coordinator to address entanglement; increased funding for research to reduce entanglement; and subsequent derelict crab trap retrievals that focus on areas of high trap density and have a greater potential to impact wildlife.

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Diet and habitat use of loggerhead turtles nesting in Florida: an assessment using stable isotopes.

Kimberly J. Reich[1], Karen A. Bjorndal[1], Alan B. Bolten[1] and Blair E. Witherington[2].

1. Archie Carr Center for Sea Turtle Research and Dept. of Zoology, Box 118525, University of Florida, Gainesville, FL 32611-8525,
2. Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, 1220 Prospect St., Suite 285, Melbourne, FL 32901.

Relative abundances of naturally occurring stable isotopes have been used increasingly to study trophic relationships, diet, habitat use, and movements of animals in both marine and terrestrial systems. In this study, we used stable isotope analysis to investigate the diets and habitats (neritic vs oceanic) of adult female loggerheads prior to migrating to their nesting beaches. Samples were collected from turtles nesting at Canaveral National Seashore and three additional locations on the Atlantic coast of Florida at

the beginning of the 2003 nesting season. Turtles were measured and tagged, and a sample of epidermis was collected for stable isotope analysis. Analyses of stable carbon ratios of the turtles sampled (n = 225) indicate that a significant number of turtles exhibit a stable carbon signature characteristic of an oceanic foraging strategy. Relative abundances of stable nitrogen indicate that turtles exhibiting an oceanic strategy consume a diet spanning more trophic levels than turtles feeding in neritic habitats. Turtles exhibiting an oceanic foraging strategy were significantly smaller than turtles feeding in neritic habitats.

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Northern coastal basins juvenile fisheries survey. Michael Turtora, U. S. Geological Survey, 7920 71St NW, Gainesville, FL 32653.

The United States Geological Survey began conducting a volunteer-supported survey of juvenile fisheries resources in cooperation with the St. John's River Water Management District in November 2001. Active participation in the program has come from the Florida Marine Research Institute (FMRI), the Florida DEP, the University of Florida, and area colleges, agencies, and private citizens. The study area includes the bar built estuaries ranging from just north of St. Augustine, Fl to Ponce de Leon Inlet. Sampling protocols developed by the FMRI for their statewide fisheries independent monitoring program were replicated to allow for comparability with FMRI program results. Samples are collected monthly from randomly selected stations based on a stratified design. Fish are collected using a 21.3 m center-bag seine with a 3 mm mesh and a 6.1 m otter trawl with a 3 mm mesh liner. Total estimated fish and selected invertebrate densities from the first full year of sampling are similar to estimates from FMRI projects in adjacent areas. Preliminary analysis indicates that species distribution patterns appear to be mainly a function of proximity to the three inlets within the study area. The region encompassing Tomoka basin is furthest from an inlet and had the greatest estimated density of juvenile gamefish (e.g. *Sciaenops ocellatus* and *Cynoscion nebulosus*) while samples near inlets had greater estimated densities of marine species (Clupeids, *Trachinotus* spp.).

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The importance of Cape Canaveral Beaches as a winter nursery area for the lemon shark, *Negaprion brevirostris*. E.A. Reyier[1], D.H. Adams[2], D.M. Scheidt[1].

1. Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899.
2. Fla. Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Melbourne, FL 32951.

The lemon shark, *Negaprion brevirostris*, is a large coastal carcharhinid with tropical affinities whose early life history has been extensively studied. Along the east coast of North America, known high-value nurseries for this species consist of quiescent lagoons and shallows of south Florida and the Bahamas. Recently, a significant population of juvenile lemon sharks has been observed along the Atlantic beaches of Cape Canaveral on the central east coast of Florida. These juveniles aggregate in relatively sheltered longshore troughs along an otherwise high-energy coastline, a behavior that facilitates both visual counts and collection. Biweekly visual surveys along a fixed nine kilometer beach transect have demonstrated that lemon sharks are present in the littoral zone year-round but are most common (in groups of up to 338 animals) from November until April. 144 sharks have been captured to date using cast nets and hook and line. Sizes ranged from 48 - 149 cm precaudal length, with estimated ages of 0.5 to 8.7 years. Limited tag returns demonstrate that a portion of this population is migratory, traveling as far as North Carolina (645 km). These aggregations are now largely protected within the Kennedy Space Center no-entry security zone. The local conditions facilitating such large aggregations are unknown but Cape Canaveral is considered a climactic transition zone and possesses the most expansive sub-tidal shoals along the Florida east coast. Given the high number of sharks documented and the small area of suitable habitat surveyed to date, Cape Canaveral beaches may eventually be recognized as one of the most important nursery areas for lemon sharks in the United States.

Day 3

Thursday - February 17, 2005

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Wildlife II

Moderator - Marc Epstein

Merritt Island National Wildlife Refuge

Winter survival and temporary emigration of Lesser Scaup in East-Central Florida. Garth Herring and Jaime Collazo, North Carolina State University, Box 7617, Raleigh, NC 27695.

The North American continental population of lesser scaup (*Aythya affinis*) has been declining since the mid-1980s. Seasonal survival estimates may provide insights about the ecological basis for this decline, but such data are not available. We estimated post-harvest winter survival of lesser scaup in east-central Florida, USA, where 62% of the Atlantic Flyway population winters. The Kaplan-Meier survival estimate from 11 January to 14 March 2002 was 0.95 ± 0.04 (SE) for females and 0.90 ± 0.09 for males. These estimates were not different ($P = 0.64$) and pooled survival was 0.93 ± 0.04. Temporary emigration (movement out of and return to the study area) was exhibited by 25% of the birds during survey periods, but absences were short and were believed to have had little effect on precision of survival estimates. Our findings suggested that natural mortality at Merritt Island National Wildlife Refuge (MINWR) and surrounding estuarine areas was relatively low. Our results also indicate that habitat quality in this portion of east-central Florida was sufficient to meet overwintering requirements and likely contributed to the reported survival rates. Estimating survival during other stages of the annual cycle, as well as an overall winter estimate reflecting harvest mortality, is necessary to determine if low survival rates are responsible for continental population declines.

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An eighteen-year summary of wading bird populations on the Kennedy Space Center/Merritt Island NWR. E.D. Stolen[1], D. R. Breininger[1], R. B. Smith[1] and D. K. Hunt[2].

1. Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899.
2. Matrix Information Systems Inc., 1355 N. Courtney Pkwy., Suite G, Merritt Island, FL 32953.

Continuous long-term ecological monitoring of wading bird populations in the northern Indian River lagoon system has been underway since 1987. Some wading bird species appear to have benefited from changes in habitat resulting from salt marsh impounding. However, use of habitat by wading birds varies greatly between seemingly similar impoundments. The myriad conditions present in this region and the ongoing efforts to reconnect impoundments to the estuary provide a unique opportunity to investigate factors influencing wading bird habitat use under different management scenarios. This talk explores patterns of wading bird habitat use within managed impounded wetland habitat in a subtropical estuary, and the mechanisms controlling those patterns.

Seasonal numbers of shorebirds and waterfowl in impoundments at the Merritt Island NWR: preliminary results. Jaime A. Collazo[1] and Marc B. Epstein[2].

1. North Carolina State University, Box 7617, Raleigh, NC 27695.
2. USFWS, Merritt Island NWR, P.O. Box 6504, Titusville, FL 32782.

Local volunteers and refuge staff conducted avian surveys every 10 days in 17 impoundments and wetlands sectors within the Refuge between 1999 and 2004. Species richness and seasonal numbers (adjusted by area) were determined. Contrasts between T-10-H and C (open) and T-10-D and E (RIM) were of particular interest. Thirty-four species of shorebirds and 17 of species of waterfowl were recorded. Fifty of the shorebirds and seventy percent of waterfowl counted during surveys belonged to 2 and 3 species, respectively. As expected, numbers of both groups were highest during fall (waterfowl) and spring (shorebirds), patterns correlated with patterns of water depth. Seasonal numbers

did not differ between hydrological treatments. These findings, and those of selected resident species, underscore the importance of Merritt Island NWR for migratory and resident aquatic species, and provide insights on the potential benefits of various habitat management schemes.

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Home range and distribution of bottlenose dolphins in the Mosquito Lagoon.

Marilyn Mazzoil, Steve Mcculloch and R.H. Defran, Harbor Branch Oceanographic Institution. Division Of Marine Mammal Research and Conservation, Harbor Branch Oceanographic Institution, 5600 U.S. 1 North, Ft. Pierce, FL 34946.

The Indian River Lagoon (IRL) on Florida's central east coast is a shallow-water body with limited circulation and tidal exchange and is particularly vulnerable to the influx of pollutants and other environmental impacts. Necropsy and photo-identification data on IRL bottlenose dolphins (*Tursiops truncatus*) have shown a high prevalence of infectious and inflammatory diseases of the skin and other organs, suggesting that the population may be in a state of altered immunologic homeostasis. Current analyses were based on IRL photo-identification data collected between 1996 – 2003 and were undertaken to provide an empirical foundation for the collecting and sampling strategies of a planned 5 y health assessment of IRL dolphins. In this research we examined the distribution of dolphins within three geographic areas of interest: (1) Mosquito Lagoon, which has a high degree of geographical isolation within the IRL; (2) South Merritt Island, which was the site of a recent unusual mortality event (UME); and (3) St. Lucie River, which is subject to a high degree of agricultural runoff. Dolphins exhibited a high, relatively high, and moderate level of site fidelity in the Mosquito Lagoon, UME, and in the St. Lucie River areas respectively. However, there was virtually no overlap in range between the dolphins sighted in these three areas. It thus appears that these dolphins may represent separate sub-population units within the IRL, and that these regions should be important sample sites in the planned health study.

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The Indian River Lagoon dolphin health assessment project: A sentinel for emerging marine mammal disease and ecosystem health. Gregory D. Bossart, Director and Head of Pathology, Division Of Marine Mammal Research and Conservation, Harbor Branch Oceanographic Institution, 5600 U.S. 1 North, Ft. Pierce, FL 34946.

Concern for the overall health of the Indian River Lagoon (IRL) ecosystem, an Estuary of National Significance, was first prompted by the rapid increase in development of the IRL area, and the associated alterations of physical and ecological features. Destruction of sea grass habitat, alteration of water flow and declining water quality are upsetting the balance and altering the function of the IRL ecosystem. There is a present concern about the health of the Atlantic bottlenose dolphin population living in the IRL. Dolphins in the IRL consume fish associated with seagrass beds and recent studies of IRL seagrass distribution and abundance suggest that overall seagrass abundance has declined throughout the IRL. Water clarity and quality are major factors controlling seagrass distribution and these factors have changed in the IRL over the past five decades due to significant watershed alteration and land drainage patterns. The major cause of water quality decline is fresh and storm water discharges that alter salinity, water clarity and introduce nutrients and pollutants into the system. For the years 1993-2000, dolphin strandings in the IRL represented approximately 40% of reported strandings along the entire east coast of Florida. In addition, with the exception of 1999, dolphin strandings in the IRL have increased and remained high since 1996. Perhaps even more alarming was the occurrence of an unusual mortality event in the northern portion of the IRL over the summer of 2001, in which at least 30 dolphins died over a 2-month period. Photo-identification data and recently published pathologic research from Harbor Branch Oceanographic Institution document a varied assortment of diseases in IRL dolphins that may have anthropogenic etiologies. Some of the pathologic findings in stranded dolphins also suggest immunologic dysfunction as a component in disease pathogenesis. To date, we have no explanation for these patterns because no recent comprehensive studies have been done to

determine the health status of IRL dolphins. To address this issue, in the summer of 2003, we launched the first comprehensive study focused on defining the health status of IRL dolphins in collaboration with our partners at NOS/NOAA in Charleston, SC and under a permit issued to Harbor Branch Oceanographic Institution by the National Marine Fisheries Service. This presentation will describe the first two years of this 5-year program including the extraordinary logistic planning performed by the Harbor Branch marine mammal staff and the cutting-edge technological examinations and diagnostic testing that were done. Preliminary results will also be presented. Defining the health status of bottlenose dolphins is important for the future management of this species and provides an insight into the health of the IRL ecosystem as a whole.

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Long term trends in distribution and abundance of manatees in the Northern Banana River (1977-2004).

J.A. Provancha, R. Cancro, R. Lowers, M. Provancha, D. Scheidt, and E. Reyier, Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899**.**

The northern Banana River is surrounded by the high technology and industrial operations of Kennedy Space Center (KSC) and Cape Canaveral Air Force Station. The river also provides excellent, protected habitat for the Florida Manatee. KSC biologists have been using aerial surveys to monitor distribution and abundance of manatees since 1977. The most continuously used platform for surveys is the helicopter with 2 observers and a Loran/GPS/computer operator.

The northern most portion of the river has been closed to boating and any public access since 1963. Trends tracked from 1977 though 1986 indicated that this section of the river was being utilized by increasing numbers of manatees and lead to additional questions about habitat use. The actual peak counts each spring at KSC were remarkable resulting in management discussions between the Marine Mammal Commission and the US Fish and Wildlife Service. In 1990, USFWS designated an additional section of river as a sanctuary, which prohibited the entry of motorized watercraft.

We will present the highlights in trends in this long-term dataset and make some short-term comparisons in use of the old and new sanctuary. The major trends include a continuing use of this site by very large numbers of manatees but a relative plateau during the mid-1990s to the present. Although we observed unprecedented numbers in the spring of 2003, the multi-year summer season data do not show consistent trends in new sanctuary use that were evident in the early 1990s.

Aquatics II

Moderator - John Stiner

Canaveral National Seashore

An ichthyoplankton survey of the Northern Indian River Lagoon complex with emphasis as to the function

of an estuarine no-take fisheries reserve. E.A. Reyier[1] and J.M. Shenker[2].

1. Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899.
2. Dept. of Biological Sciences, Florida Institute of Technology, 150 West University Boulevard, Melbourne, FL 32901.

One of the anticipated benefits of no-take fisheries reserves is a local increase in the production of eggs and larvae of exploited species, an assumption difficult to examine directly in most open coastal settings. The shallow estuarine waters surrounding Kennedy Space Center, east-central Florida, are microtidal and largely divided by earthen causeways. These features dampen hydrologic exchange between management areas and offer a unique opportunity to quantify ichthyoplankton production across a reserve boundary. From August 2002 to July 2004, fish larvae were collected with a neuston net from each of eight sub-basins of the Indian River Lagoon complex whose management includes both fished and unfished areas. A total of 592,000 larvae representing at least 56 taxa were retained in

1713 plankton tows. Estuarine-spawned sportfish larvae, 3% of total catch, were dominated by preflexion spotted seatrout, *Cynoscion nebulosus*, southern kingfish, *Menticirrhus americanus*, and red drum, *Sciaenops ocellatus*. Averaged across spawning seasons, these three species were 11.8, 7.7 and 13.6 times more abundant respectively in fished vs. unfished habitats, suggesting that fishing pressure at it current level is not the main determinant in structuring larval densities for these taxa. This distribution also held true for most species without fisheries value. Although causal relationships between ichthyoplankton abundance and measured habitat characteristics cannot be made, fished areas in this study were characterized by relatively high turbidity which may be indicative of high primary production and/or low predation rates, factors that may reduce larval fish mortality outside reserve waters.

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Geology, Hydrology, Meteorology & Water Quality

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Late quaternary subsurface geology of CNS/MINWR. Randy Parkinson[1] and Ron Schaub[2].

1. Coastal Tech, 715 North Dr., Melbourne, FL 32934.
2. Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899.

The principle goal of this investigation was to characterize the distinct geologic resources of the Canaveral National Seashore (CNS) and surrounding region using newly established Coastal Geology Mapping (CGM) Protocols developed by the National Park Service (NPS). This mapping exercise was conducted in association with the NPS Geologic Resources Inventory Program (GRI), initiated to document the sedimentology, geomorphology, and stratigraphy of the coastal parks it manages.

As the NPS initiated the GRI, it became immediately evident the standard methods used to map national parks in Americas' hinterland (i.e., Glacier National Park) were not applicable to coastal terrains. Distinctions include: (1) relatively young age (<5 my), (2) low relief (<100 m), and (3) predominance of sediments and sedimentary rocks. This investigation is one of the first to utilize the newly established CGM Protocols.

The geologic data acquired during this investigation include: (1) 14 Geoprobe^{TM} cores and (2) 84 surface samples. Cores penetrated to an average depth of 35 ft and were obtained along two east-to-west transects at the northern and southern limits of the study area. Surface samples, acquired by CNS staff, were obtained throughout the study area.

Core results document the presence of an ancestral Indian River Lagoon and associated shore parallel coastal ridge, analogous to the Atlantic Coastal Ridge. New landscape features (i.e., lowland step) were also identified and characterized using surface samples and associated land cover maps.

Using the NPS Geology-Geographic Information System Data Model, the information acquired during this investigation will ultimately be incorporated into a centralized database. This database will soon be available through the WWW to facilitate access and informed resource management.

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The current state of the National Hydrography Dataset for Mosquito, Banana, and Indian River Lagoons.

Ed Carter, David Clapp, Whitney Green, Marc Adkins, St. Johns River Water Management District, P.O. Box 1429, Palatka, FL 32178.

The National Hydrography Dataset (NHD) is a comprehensive set of digital spatial data that contains information about surface water features. The features combine to form reaches and the reaches form a drainage network that allow water features to be ordered in an upstream and downstream order. The medium resolution (1:100,000) and now the high resolution (1:24,000) data sets are "completed" for the lagoon area. NHDinArc has now been converted to the NHDinGEO format. Numerous errors are

evident in this potentially very useful data. The St. Johns River Water Management District is investing $120,000 this year to improve and participate in potential stewardship of this data. Attendant's local knowledge and feedback are critical to this effort and will be solicited.

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Spatial rainfall patterns and nutrient deposition in waters surrounding KSC. John H. Drese and J. R. Barfus, Dynamac Corp. Mail Code: DYN-2, Kennedy Space Center, FL 32899.

A pilot study was begun as a SHARP student project to understand the spatial variability of nutrients and metals found in precipitation and dry deposition at KSC and CCAFS. The study was conducted during the summer of 1999 and continued for eighteen weeks (6-15-99 to 11-02-99). Continuously open 2-liter soda bottles, set on 1-meter high poles at 16 sites, were used to collect 'total' (wet and dry deposition). Samples were collected weekly on Tuesday (same as NADP samples) and the collectors were cleaned and re-deployed. The samples were submitted to a chemistry lab for analysis of NO2+NO3-N, NH4N, PO4P, Cl, and metals. The data in mg/L was converted into loading rates (mg / m2). The NO2+NO3-N ranged from <0.068 to 30.366 mg / m2 and the 18-week total ranged from 31.46 to 72.17 mg / m2 and the mean total across the domain was 53.02 mg / m2. The NH4-N ranged from <0.068 to 79.752 mg / m2 and the 18-week total ranged from 12.748 to 99.963 mg / m2 and the mean total across the domain was 50.043 mg / m2. The PO4-P ranged from <0.068 to 26.83 mg / m2 and the 18-week total ranged from 5.127 to 35.225 mg / m2 and the mean total across the domain was 17.908 mg / m2. The following metals Ag, Al, Cd, Ni, and Zn were found above detection limits.

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Particles in suspense – a mystery in Southern Mosquito Lagoon . M. A. Lasi[1], J.H. Trefry[2], L. J. Morris[1], J.S. Steward[1], R. W. Virnstein[1] and W.A. Tweedale[1.]

1. St. Johns River Water Management District, 4049 Reid St., Palatka, FL 32177.
2. Dept. of Marine and Environmental Systems, Florida Institute of Technology, 150 West University Boulevard, Melbourne, FL 32901.

The Mosquito Lagoon (ML) contains one of the more extensive seagrass coverages in the IRL system, approximately 732 acres per linear mile of lagoon (185 ha per linear km). Most of this seagrass is confined to the vast shallow flats of the southern ML, where watershed development is minimal and seagrass coverage has remained relatively stable over time (1992-2003 coverages show only 8 to 12% loss since 1943). Despite such apparently favorable conditions, seagrass in the southern ML falls short of attaining its established seagrass deep-edge depth target of 1.3 m, and receives only a fair rating based on seagrass condition metrics. Although water quality in the southern ML is generally good from the standpoint of chlorophyll, color, and nutrients (1990-2004 medians: 5 :g/L chlorophyll_*a*, 15 cpu color, 0.028 mg/L total phosphorus, and 1.3 mg/L total nitrogen), water clarity conditions tend not to be as favorable (1990-2004 medians: 5 ntu turbidity, 1 m Secchi depth). Elevated light attenuation associated with high levels of suspended, non-algal matter appears to be an important, if not the major factor limiting the depth distribution of grass beds in the southern ML (maximum deep-edge depths range from 0.8 to 1.1 m). In an attempt to elucidate the causes for elevated turbidity and restricted depth distribution of grass beds in the ML, preliminary results will be presented from an ongoing study to identify the types and sources of suspended matter in the lagoon. Other potential factors related to bottom substrate stability, bottom topography and hydrodynamics will also be discussed.

Posters

$ **Forage availability and aquatic bird distribution under various wetland management schemes**. Garth Herring, Eric Stolen, and Jaime Collazo, North Carolina State University, Box 7617, Raleigh, NC 27695.

Merritt Island National Wildlife Refuge and the St. Johns River Water Management District sponsored a multi-year project aimed at evaluating responses of prey base and aquatic bird use in Open, Rotational Impoundment Management (RIM), Wildlife Aquatic Managed (WAM), and Restored wetlands. The goal is to develop wetland management strategies within the framework of multi-species management. Findings suggest that forage needs may be best met for wintering shorebirds and waterfowl using WAM and RIM treatments. Wading birds benefited from a variety of wetland types and hydrologic conditions being available throughout the year. Increased accessibility for aquatic organisms (fishes and invertebrates) could be gained by improving water flow controls, without reducing the quality of foraging habitat for waterbird species. Ultimately, management of these impounded wetlands needs to balance the needs of waterbirds, fish fauna, invertebrate species, and maintaining sufficient aquatic macrophyte beds, such that levels of sediment accretion are able to uphold current elevations and prevent further loss of habitat for all species.

$ **Unleashing standard desktop applications to ask ecological questions about wading bird foraging habitat use.** D.K. Hunt[1] and E. D. Stolen[2].

1. Matrix Information Systems Inc., 1355 N. Courtney Pkwy., Suite G, Merritt Island, FL 32953.
2. Dynamac Corp., Mail Code: DYN-2, Kennedy Space Center, FL 32899.

Long-term ecological data is highly valued by natural resource managers and scientists. However, collecting such information is usually expensive and requires organizations with sufficient resources to handle the logistics of measuring, storing and analyzing vast amounts of data. The way data is collected and stored can influence the types of analyses that can realistically be performed. Since beginning data collection in April 1987, we have recorded nearly 27,000 observations of wading bird foraging habitat use during systematic monthly surveys on the Merritt Island National Wildlife Center. To come to terms with this volume of data, we have developed processes and tools, including the use of Microsoft Excel and Access XP. The resulting effort has promoted highly efficient data transcription, quality control, screening and preparation for statistical analysis of this data. This approach could be readily adapted to a variety of ecological data.

$ **Is Brazilian pepper a threat to the mangrove ecosystem?** Melinda Donnelly and Linda Walters, Dept. of Biology, University of Central Florida, Orlando, FL 32816.

Mangrove ecosystems are critical to Florida, providing economic resources to humans, and untold ecological resources to estuarine organisms. Invasive *Schinus terebinthifolius* (Brazilian pepper) is hypothesized to disrupt mangrove productivity and be detrimental to the numerous species that rely on the mangrove ecosystem's functions. *Schinus terebinthifolius* is currently found growing within the intertidal region of Mosquito Lagoon alongside three native species of mangroves, *Rhizophora mangle*, *Avicennia germinans* and *Laguncularia racemosa.* The purpose of this study is to better understand some of the important life-history characteristics of *S. terebinthifolius*. This will help us to determine if and how Brazilian pepper outcompetes or inhibits germination/growth of three native species of mangroves in the Indian River Lagoon system. Manipulative experiments began in May 2004 to determine the ability of *S. terebinthifolius* to*:* 1) invade coastal habitats by dispersing seeds in the water, 2) tolerate conditions within the mangrove canopy, and 3) alter species richness and abundance of the flora when present in a mangrove system.

$ **Biodiversity of oyster reefs (*Crassostrea virginica*) in Mosquito Lagoon, Florida.** Jennifer Stiner, Michelle Boudreaux, and Linda Walters, Dept. of Biology, University of Central Florida, 4000 Central Florida Blvd., Orlando, FL 32816.

Populations of *Crassostrea virginica* within Mosquito Lagoon, Florida have recently undergone significant die-offs, which are the subject of major concern. Restoration efforts within Mosquito Lagoon are focusing on reconstructing the three-dimensional reef habitats. Before effective protocol can be established, however, important questions about the sources of juvenile and adult oyster mortality must be answered. Potential causes of *C. virginica* mortality in the Indian River Lagoon System include sediment loads, competition, predation, and disease. Lift Nets have been deployed within Mosquito Lagoon in order to address oyster competitor and predator species. We are collecting species inventory data at six sites to determine the sessile invertebrate species (competitors) and motile predators present on oyster reefs. These species may affect the

settlement, growth, and survival of *Crassostrea virginica.* The nets are deployed intertidally, just above mean low water, on living oyster reefs. One and a half liters of live and dead oysters are placed within the nets upon deployment. The nets are picked up monthly and surveyed for all fauna. Upon retrieval, all oysters within each net are brought back to the lab where we identify the organisms immediately and return the oysters to the lagoon. Permanent temperature monitors are deployed at each site to record daily temperature and salinity is measured monthly during net collection. Sediment traps have also been deployed at each site to record sediment loads. This experiment began May 2004 and will continue for the duration of a year.

$ **The impact of cigarette butts on burrowing bivalves**. Angie Ashcraft-Cryder, Linda Walters, Dept. of Biology, University of Central Florida, Orlando, FL 32816.

Cigarette butts are among the most commonly found litter in coastal areas in Florida. To date, the potential impacts of this type of debris on intertidal organisms have not been well studied. To address this issue, we first conducted beach surveys to determine the numbers of butts on the beach. Adjacent to the pier in Cocoa Beach, an average of 244 butts/m^2 were collected. To determine any impact of cigarette butts on the abundant, burrowing coquina clam *Donax variabilis*, replicated trials were run with 0, 1 or 3 butts that were either new or old (collected from the beach) and either contained tobacco or did not. Interesting results were found; most clams died, were narcotized (but recovered within 24 hr), or delayed burrowing in response to the cigarette butts. Both short- and long-term delays in burrowing may significantly increase the probability these clams will be consumed by shore birds or other predators. These results provide new information on the wide-ranging negative impacts of cigarettes in our environment.

$ **Seasonal distribution of fishes and water chemistry at four Florida sites.** Rebecca Hale, Dept. of Zoology, University of Florida, 223 Bartram Hall, Gainesville, FL 32611.

Species distributed across a broad geographic range necessarily experience a range of ecological conditions that can influence local adaptation. Because ecological variables covary over space, identifying selective pressures driving local adaptation can be difficult. My doctoral research is focused on understanding how ecological variables influence the evolution of reproductive investment in the flagfish (Jordanella floridae), a pupfish native to Florida. Flagfish are found across a range of salinities and have been observed spawning in both freshwater and brackish habitats. Laboratory studies of embryo development suggest that post-fertilization investment (i.e., parental care) may be more important for offspring survival in freshwater habitats than in brackish ones. However, parents providing care in freshwater habitats may incur higher metabolic costs than those in brackish habitats. I have been examining the effects of salinity on reproductive investment in four flagfish populations. Although the salinities experienced by these four populations are known to differ, the amount of variation in salinity and other water chemistry variables as well as in species composition has not been described. Here, I describe the water chemistry and species composition at these four sites measured during a bimonthly survey conducted between May 2003 and July 2004.

$ **Modeled effects of causeway removal and an analysis of seagrass bed morphology near causeways in Indian River Lagoon, FL.** David Christian, Joseph Beck and Jan Miller, St. Johns River Water Management District and Jones, Edmunds and Associates, 4049 Reid St., Palatka, FL 32177.

There are 13 causeways traversing the Indian River Lagoon (IRL) system from the NASA Railroad Bridge, just north of Titusville in the north IRL to Wabasso causeway just north of Vero Beach in the south IRL. It has been surmised that these causeways have an effect on seagrass coverages, in terms of their physical footprint and also through changes in circulation patterns caused by their presence. Eight of the 13 causeways were actually present in 1943.

Seagrass acreages were calculated for each of four quadrants around each of the causeways from maps made in 1943, 1986, 1989, 1992, 1994, 1996, 1999, 2001, and 2003. Since the data did not follow a normal distribution (Shapiro-Wilks tests were performed) Wilcoxon matched-pairs signed-ranks tests were used to compare coverages in 1943 in each quadrant around each causeway with coverages in the same quadrant in other years. There was no clear pattern of difference in seagrass coverage where causeways were present or not yet present in 1943 leading to the conclusion that causeways are not responsible for either declines or increases in seagrass coverage.

A modeling study was done to examine the effects on water quality of completely or partially removing Pineda, Eau Gallie, and Melbourne Causeways. Comparisons were made between a base case, with all of the causeways included, and cases with the causeways removed for the year 1998. Parameters analyzed were salinity at the bottom of the lagoon, surface velocities, flow through lagoon cross-sections, total suspended solids (TSS), percent of incident light at the bottom (PILB), and flushing of lagoon segments adjacent to the causeways. The effects of any differences were analyzed with respect to their effect on seagrass.

The model results showed only minimal changes for water quality parameters affecting seagrass, even with all three causeways removed together. An increase in fetch caused by the causeway removal actually caused an increase in TSS and a decrease in PILB, both of which may be detrimental to seagrass growth.

$ **Dispersal and recruitment of red, black and white mangroves in the Indian River Lagoon.** Sarah Johnson, Heidi Deutsche and Linda Walters, Dept. of Biology, University of Central Florida, Orlando, FL 32816.

To better understand the dispersal and recruitment potential of three mangrove species in Mosquito Lagoon (the red mangrove *Rhizophora mangle*, the black mangrove *Avicennia germinans*, and the white mangrove *Laguncularia racemosa*), we measured: 1) short-term (10 minute) dispersal of pre-weighed seeds, 2) long-term (1 week) dispersal of marked red mangrove seeds, and 3) 5-week recruitment and germination of seeds of all three mangrove species deployed on pristine as well as disturbed intertidal oyster reefs. Pristine oyster reefs are completely submerged at high tide, while disturbed reefs have mounds of disarticulated shells on their seaward edges that extend up to one meter above the high tide line. Many of these disturbed reefs are the result of intense boating activity. The shell mounds associated with disturbed reefs create small islands that may quickly increase in all dimensions and may significantly alter estuarine habitat complexity if salt-tolerant species, such as mangroves, are able to colonize them. Seed dispersal was driven by wind conditions and thus varied greatly between trials. No seeds remained on pristine oyster reefs. However, many red, as well as a few black and white mangrove seeds, were retained on the disturbed oyster reefs, with a few producing roots during our 5-week trial. This documents the potential for long-term retention of all three mangrove species on oyster reefs altered by human activities.

$ **Environmentally Endangered Lands Acquisition and Conservation Program in Brevard County, Florida**. C. Ross Hinkle, Dave Breininger, Mark Bush, Ron Hight, Randy Parkinson, Paul Schmalzer and Kim Zarillo, Dynamac Corp. Mail Code: DYN-1, KSC, FL 32899.

In 1990 Brevard County voters approved an ad valorem tax to collect up to $55M for the acquisition and management of conservation lands to protect biodiversity. A scientific advisory committee was established to select the lands and to develop management plans for the conservation areas. After 14 years approximately 8000 ha of environmentally endangered lands have been protected. These areas were targeted for acquisition and management to sustain biological diversity of the Central Florida habitats. The successful long-term survival of protected species such as the Florida scrub jay (*Aphelocoma coerulescens*), eastern indigo snake (*Drymarchon corias couperi*) and plant endemics such as the scrub mint (*Dicerandra thinicola*) depend upon these publicly owned conservation areas. A long term management and educational outreach program has been established. One of four centers for environmental education has been in place for one year and another is in the design process. Management plans for several of the sites have been established. A robust citizens volunteer program is in place to assist the land managers for the sites and it has successfully contributed to the program from educational and cost savings perspectives. In November 2004 the voters approved an additional $60 M for land acquisition and management. The advisory committee and county staff are currently working with the Brevard County Commission to plan for the additional acquisition afforded by this new authorization.

$ **Nutrient cycling in salt marsh impoundments under different management regimes**. Cassondra Thomas, National Research Council/NASA, Mail Code: DYN-2, Kennedy Space Center, FL 32899.

The salt marshes of the Indian River Lagoon have been heavily impacted by management techniques. In the 1950s and 1960s over 75% of the wetlands were impounded for mosquito control. In the early 1990s, the marshes of the Merritt Island National Wildlife Refuge (MINWR) had culverts installed into the earthen dikes

to reintroduce lagoon water flow in a controlled manner. Four management protocols are currently employed; Wildlife/Aquatic Management (WAM) impoundments are continually flooded to encourage migratory bird usage; Rotational Impoundment Management (RIM) impoundments are flooded during mosquito breeding season and open to the lagoon the remainder of the year; Open Impoundments are connected to the lagoon year round through culverts; and Restored impoundments are connects to the lagoon year round through tidal creeks.
The differing hydroperiods for these marshes create different sediment conditions that greatly influence nutrient cycling. The nutrient cycles of these marshes was analyzed with Ecological Network Analysis (ENA). Ecological network analysis is a tool for evaluating the network and assessing ecosystem level functioning using a collection of algorithms to evaluate flow and cycling of energy or material through ecosystem networks and index the 'structure' of the networks. A model template composed of 51 compartments representing the plant, animal, and abiotic components of the marsh/lagoon ecosystem was used to create carbon, nitrogen, and phosphorus cycling models for the different impoundment types.

Nutrient cycling differs between marsh types and nutrient types. Nitrogen cycling in very high in all marsh types (FCI is 70-90%) which is atypical for Atlantic coast salt marshes. Phosphorus cycling is much higher in the WAM impoundments than the other impoundment types. Overall, WAM has higher nutrient cycling than the other marshes, which is consistent with its isolation from the lagoon. Organic matter accumulation only occurs in the WAM and Open impoundments. A significant portion of the nitrogen and phosphorus sequestered in organic matter in the Open impoundments originated from lagoonal sources. A negligible amount of nutrients is brought into the marshes or removed from the marshes by migratory birds. Fiddler crabs play in increasingly important role in providing nitrogen to emergent vegetation as the impoundments get progressively drier. These results suggest that the management protocols employed at the MINWR are impacting how nutrients are cycling through the impoundments. This affects the structure and function of these marshes and their ability to handle perturbations.

$ **Mosquito magnets as barrier treatments against salt marsh mosquitoes around residential houses in marsh area.** Rui-De Xue[1], Dan Kline[2] and Alan Grant[3]
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In recent years, more residential homes have been built around the marsh areas located on the Intra-Coastal Waterway (ICW) and resulting in more complaints about marsh mosquitoes. Many homeowner associations have created policies and regulations that forbid the spraying of pesticides. The new challenge has forced our mosquito control district to look for alternative strategies and methods to control marsh mosquitoes. The ABC Mosquito Magnet Traps as barrier treatments have been evaluated around residential houses in Marsh Creek (624 houses) in Anastasia Island, St. Augustine, Florida. The residential neighborhood was divided into north and south subdivisions. We used one side for treatment and the other side for control and rotated every week. The effectiveness of barrier treatments was conducted by monitoring mosquito populations via 2 pickle jar traps with dry ice as an attractant in center of each subdivision and 1- minute landing rate counts near each trap site and at the center of the site. The mosquito magnets have caught more than 91,000 mosquitoes in 18 species and more than 2 million sand flies, and significantly reduced landing rate counts in the treated subdivision, compared to the control subdivision during the last 4 week experiments. The experiment will be continued in the area for more weeks.

$ **Population genetics of the Southeastern Beach Mouse at Cape Canaveral Air Force Station**. Jacob F. Degner, I. Jack Stout, James D. Roth and Christopher L. Parkinson, Dept. of Biology, University of Central Florida, Orlando, FL 32816.

The southeastern beach mouse (*Peromyscus polionotus niveiventris*) is native to coastal habitats in east Florida and was once abundant over about 280 km of coastline. Due to extensive coastal development, it is now restricted to 64 km of coastline in east-central Florida and is currently listed under both state and federal law as threatened. One of the few intact populations of this subspecies inhabits the Cape Canaveral Air Force Station in east-central Florida. Because the persistence of this population is critical for the sustained survival of the subspecies, we are documenting the genetic diversity, genetic structure, effective population size, and

breeding patterns of this population. We used nine polymorphic microsatellite loci to estimate the genetic diversity and genetic structure within this population, and estimated gene flow between mice along the beach and groups living inland from traditional dune settings. This information will be critical for any reintroductions, translocations or other management efforts implemented in the future to promote the recovery of this subspecies.

$ ***Mytella charruana*: a new, invasive bivalve in Mosquito Lagoon**. M. Boudreaux[1], A. Benson[2], J. Stiner[1], K. Borrowman[1], H. Deutsche[1], M. Donnelly[1], S. Johnson[1], S. Shipee[1], S. Weiss[1], K. Yeargain[1] and L. Walters[1].

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Mytella charruana d'Orbigny 1846, a mussel species indigenous to South American coasts, was found for the first time in Mosquito Lagoon in August 2004. The only previous record of this species in Florida was in 1986, when *M. charruana* was found in the brackish water intake pipes of a power plant on the St. Johns River, northeast of Jacksonville. Locally, it created a significant biofouling problem by clogging intake pipe filters. The 1986 introduction was attributed to ballast water from oil tankers from Venezuela. Since 1986, *M. charruana* had not been recorded in this location nor any other in Florida until our August 2004 finding by M. Boudreaux. She found this invasive attached to live oysters and disarticulated oyster shells on intertidal reefs. If permanently established in Mosquito Lagoon, this species could become a significant competitor with native organisms, including the eastern oyster *Crassostrea virginica*, for food and habitat. Investigations are currently underway to determine the mussel's distribution within Mosquito Lagoon, its growth rate, settlement substrate preferences, an approximate age of the current population (determined by size), environmental tolerances (temperature, salinity), and its competitors and predators. This work will help us to begin to understand in the dynamics of *Mytella charruana* populations within Mosquito Lagoon; this information is needed by Resource Managers to monitor the spread of this invasive species and develop an appropriate eradication strategy, if warranted.

$ **Forty years of isolation: Restoring estuarine connectivity in mosquito impoundments along east central Florida's Indian River Lagoon**. D. Scott Taylor, Brevard County Environmentally Endangered Lands (EEL) Program, 5560 N. U.S. 1, Melbourne, FL 32940.

About 90% of the remaining saltmarsh/mangrove swamp bordering the Indian River Lagoon, FL was impounded during the 1950's-60's to control salt marsh mosquitoes (*Ochlerotatus taeniorhynchus* and *Oc. sollicitans*). Ultimately, over 16,000 ha. of impoundments were constructed. Impoundment was effective in controlling mosquito populations and certainly enhanced the quality of life in this part of coastal Florida. However, impoundment has adverse environmental effects on both the marsh systems and the adjacent estuary. As a result, a variety of 'restoration' efforts have recently been undertaken, from installation of culverts which are seasonally opened to outright removal of dikes. In many cases, modern water management techniques allow effective mosquito control through source reduction, while some natural marsh functions are retained.

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