Barber, Alicia W

From: William Marcy <wpmarcymtb@yahoo.com>
Sent: Thursday, November 30, 2017 1:31 PM
To: FLStateParkPlanning; FLStateParkPlanning; Thomason, Mickey; William Marcy
Subject: Cross Florida greenway

Hello,

I want to provide some comments, feedback and suggestions related to the new 15 mile section of paved trail that runs from Santos trial head to Rt. 200. First, the trail is beautiful and has been a real pleasure to ride, and I believe it will become a popular recreational destination. I specifically want to address to article "10-tear greenway management plan up for discussion" that was published on Ocala.com.

The article discussed several different topics;

1. Trail safety, etiquette, etc. - I agree, it is a multi-use trail, cycling, walkers, runners and horses, and we all have to respect each other. I will also say the trails rules or guidelines shouldn't detract from any one user group - or at least be minimized.
    1. Safety and motorized vehicles - in the dozen times I've been on the trail I've seen motorcycles and ATV's on several occasions (4 times).
    2. Dogs off leash - I've seen several dogs off leash. I was chased off the trail by an aggressive ~9 month old german shepherd and it didn't seem to phase the owner. I could have crashed and had to defend myself from being bitten. I will note I slowed down to pass the owner and dog. Same as i do with all users especially horses.
    3. Etiquette - the horse users need to clean up the poop from their horses and respect the other users. I'm surprised as to how much I see on the trail. I always have my dog on a leash and clean up after him. It's a common courtesy other users.
    4. One other comment about the horses - I understand horse can be somewhat nervous and skittish. Here is my analogy and experience with my dog. If my dogs gets nervous and spooked at the dog park by other dogs and people. I wouldn't take my dog to the dog park. I would expect new rules for me that would diminish the experience for other dog people.
2. Concerns of the Horse community - In the meeting it was discussed putting speed pumps on the trail as a safety concern to slow cycling so the horses don't get spooked from a passing cyclist. I believe the main concern is near the bridge underpasses. I'm not sure speed bumps would be a good or effective solution. One reason is many of the more experienced cyclist could just jump over them without slowing (its called a bunny hop). Also, if they are too many speed bumps it would severely detract from the user experience as a cyclist. I think rumble strips could be a better solution, but I believe they would only be needed near the blind underpasses. The 475 underpass is the worst due to poor visibility because the trail so close the the wall of the unpass. The SW 16th Ave and 484 underpasses have a tight turn, but the visibility is fair because of the way the trail approaches the underpass. Suggestion could you widen the trail at the 475 underpass as this would significantly improve the trail safety? I understand the cost concerns would need to be reviewed.

3. Traveling west right after the land bridge there are two or three sharper turns that create blind spots. Suggestion - could you cut or thin out the brush so it would open up visibility? This would be a relatively low cost solution.

I want to voice my opinion and share some ideas.
Thank you,
-Bill Marcy
Ocala, FL

PH-48

Barber, Alicia W

From: Sandra Kokernoot <s_kokernoot@hotmail.com>
Sent: Friday, December 01, 2017 4:38 PM
To: Cutshaw, Steven; FLStateParkPlanning; Alsentzer, Daniel
Subject: Comments on 2017 CFG 10-year plan
Attachments: Sandra Kokernoot's comments - 2017 CFG 10-year plan.docx

Please see my attached comments.

Thank you,
Sandra Kokernoot

On Nov 28, 2017, at 4:13 PM, Cutshaw, Steven <Steven.Cutshaw@dep.state.fl.us> wrote:

Good afternoon Ms. Kokernoot,

My name is Steve Cutshaw and I am happy to hear you are interested in commenting on the Cross Florida Greenway. Daniel Alsentzer is the Park Planner in charge of the CFG and he will be happy to assist you. You may submit comments in many ways, by phone to the planner, by email to us directly or to FLStateParkPlanning@dep.state.fl.us. Daniels number is 850-245-3073 and his email is Daniel.alsentzer@dep.state.fl.us. We just want to get your comments.

My contact information is listed below and please do not hesitate to contact me anytime,.

Thank you for your support of the trail and Florida State Parks!

Sincerely,

Steve

Steven A. Cutshaw, Chief
Office of Park Planning
ision of Recreation and Parks
rida Department of Environmental Protection
Steven.cutshaw@dep.state.fl.us
Office: 850.245.3084
Cell: 850.528.9135

Barber, Alicia W

From: Vaughn, Greg A
Sent: Tuesday, December 05, 2017 8:34 AM
To: Barber, Alicia W
Subject: FW: My comments
Attachments: Kokernoot comments - CFG 10-year plan.docx

Please confirm we already have this comment. Thanks!

Greg Vaughn
ATKINS
greg.vaughn@atkinsglobal.com
850-580-7907

-----Original Message-----
From: Thomason, Mickey [mailto:Mickey.Thomason@dep.state.fl.us]
Sent: Monday, December 4, 2017 4:23 PM
To: Gene Stillman <gstillman@thinkf4.com>; Vaughn, Greg A <Greg.Vaughn@atkinsglobal.com>
Subject: FW: My comments

FYI

Mickey Thomason
Florida Park Service
Cross Florida Greenway Manager
Ph# (352) 236-7143
Fax#(352) 236-7121
8282 SE Hwy 314 Ocala, FL 34470

-----Original Message-----
From: Sandra Kokernoot [mailto:s_kokernoot@hotmail.com]
Sent: Monday, December 04, 2017 3:44 PM
To: Thomason, Mickey <Mickey.Thomason@dep.state.fl.us>; Mills, Adele <Adele.Mills@dep.state.fl.us>
Subject: My comments

Dear Mickey and Adele,

Attached please find a copy of the comments I sent to DEP regarding the draft 10-year management plan for the CFG. They include the map of the Etonaih/CFG land acquisition project of which I spoke at the public hearing at Ravine Gardens State Park.

Thank you for your consideration,

Sandy Kokernoot

[Dep Customer Survey]<https://urldefense.proofpoint.com/v2/url?u=http-3A__survey.dep.state.fl.us_-3Frefemail-3DMickey.Thomason-40dep.state.fl.us&d=DwIFAg&c=cUkzcZGZt-E3UgRE832-4A&r=m0FCgpvouLjN-

wHOzkZ3p0C_WvWkbmtB2dkmmeaYVA4&m=HJ-TcoTwMgKUMfa1NDlgFI7AovBT-zluc_zPTSh5bsU&s=zROrl-wTCEhh0zfjEVb2IVTtfhI0uNI3qpr4LSORqaI&e=>

Comments from Sandra Kokernoot on the 2017 CFG 10-year plan

The Florida Comprehensive Planning Act calls for a management plan to include how natural resources will be protected. Therefore it is first necessary to determine how they are being adversely impacted. That information should be included in a data section.

This plan needs to explain:

1. The significant decline in the size and number of fish in Rodman Pool.

2. The failure of drawdowns, water level increases, and herbicides to control vegetation in Rodman Reservoir.

   On Page 110 the draft plan states that drawdowns dry the shallow areas and kill the invasive aquatic plants. That is not true. The soils of the pool do not dry out completely and vegetation recovers quickly after the pool is refilled.

3. The continuing death of cypress trees upstream of Rodman Dam from holding the reservoir waters at higher levels in an attempt to kill hydrilla.

4. The caving in of gopher tortoise burrows and destruction of trees by heavy equipment on the berms in Putnam County.

The Draft Conceptual Land Use Plan includes laudable objectives, but those objectives need policies with deadlines to accomplish those goals.

On Page 216, under Goals C-G you have included objectives about working with others to create multi-use, hiking, biking, equestrian, and paddling trails, which is commendable.

Under Goals C and D here is a need for policies to create quality hiking trails and multi-use trails in natural areas of the CFG in Putnam County that are not located on torn up fire breaks. The trails north and south of Buckman Lock and the Florida Trail on the east side of Rodman Campground are not enjoyable to walk because they are torn up firebreaks. Those trails have discouraged prospective hikers and turned many ankles. The firebreaks need to be flattened after clearing/disking or the trails need to be relocated off of the firebreaks.

The 1992 Cross Florida Greenbelt Plan called for developing multi-purpose and interpretive trails in Putnam County west of Buckman Lock. You should include a policy to have State biologists explore that option.

On Pages 220-221, under "Proposed Facilities – Facilities Development" the plan proposes no new facilities and very few improvements to existing facilities in Putnam County, despite the need. It calls for paving the road into Kenwood and "evaluating the feasibility" of a paddling trail. You need to add:

1. A functioning visitors center at Buckman Lock. The Buckman Lock Visitors Center should be reopened to the public with a self-guided exhibit explaining the environmental and economic benefits of restoration.
2. Three small parking areas at: Canal Road at CR 310, Berm Road at Dam Road, and the base of the SR 19/Barge Canal Bridge on the north side of the canal to improve public access to the north and south berms in Putnam County.

Objective H4 on Page 218 that calls for evaluating "the opportunity to develop a Guided Historical Interpretive Boat Tour along the greenway canal and lock system" needs to be modified.

Are you talking about a brochure for boaters or a guided tour?

Such a tour of just the man-made part of the greenway could be used, depending on the tour guide, to convince visitors to save Rodman Reservoir and prevent restoration. Rodman Reservoir supporters were found to work as volunteers at the Buckman Lock Visitors Center when it was open and promoted keeping the dam.

If you want to evaluate an interpretive boat tour, evaluate one that goes from the lock to the St. Johns River to the Ocklawaha River to the dam and back, explaining the history, but also explaining how the canal and dam damaged the environment and how Partial Restoration will benefit the economy and environment. Show them the natural river, not just the man-made alterations and structures. That tour could be used before and after Partial Restoration and be expanded to include the restoration area.

Under General Management Measures the plan states, "During all management activities, every effort should be made to minimize detrimental effects to the gopher tortoise population (and its burrows)", however, there are no policies to address how minimizing those detrimental effects will be accomplished. As I explained previously, heavy equipment operators are collapsing gopher tortoise burrows and damaging trees on the berms in Putnam County.

On Pages 209 and 210, under Current Recreation Use and Visitor Programs, the language is biased and misleading and sounds like a promotion for keeping the dam in place. It states:

"Ramps at Kenwood and Rodman Campground provide water access to the Rodman area, which is nationally known for its fishing." You need to drop "nationally known for its fishing" or say "Ramps at Kenwood and Rodman Campground provide water access to the Rodman area and excellent fishing in the Ocklawaha River." Rodman Reservoir is not as highly rated for bass fishing any longer. The best fishing is now in the riverine section upstream of the reservoir and the river below the dam. That's where the current is.

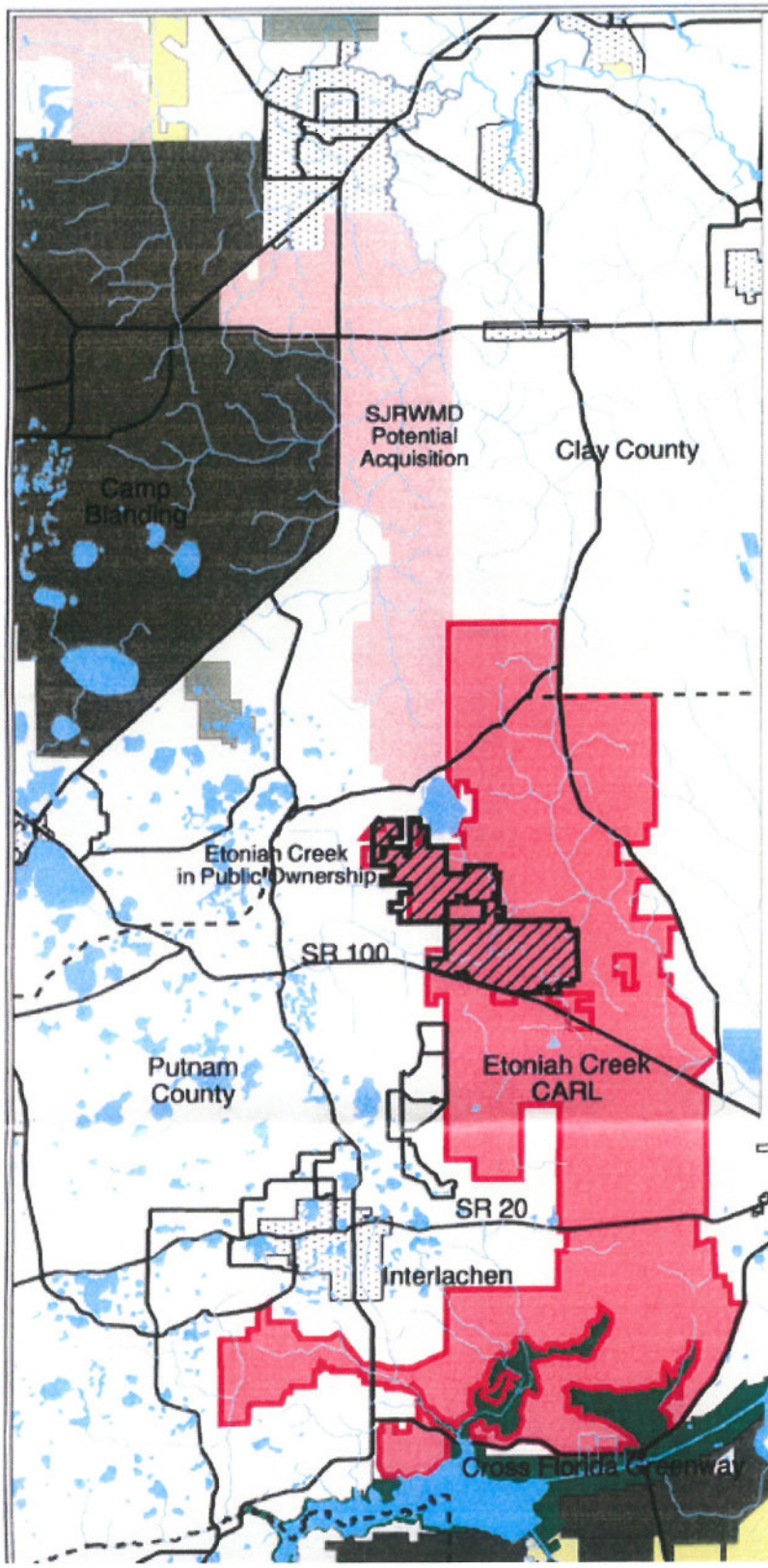
"The moving water flowing through the spillway and down past the fishing piers provides excellent freshwater fishing opportunities," failing to explain that these fish are coming up the Ocklawaha River and are blocked by the dam. Fishermen actually believe the fish are coming out of the reservoir through the dam. You need to say "The fishing piers in the spillway provide excellent freshwater fishing opportunities, because the fish moving up the Ocklawaha toward the current that comes out of the reservoir are blocked by the dam."

"The upstream reservoir side of the earthen dam, adjacent to the spillway, provides excellent additional bank fishing opportunities dependent upon the season, weather patterns, and vegetation." The truth is the reservoir side of the dam does not provide excellent bank fishing and is very rarely used by fishermen. The shoreline is usually filled with dead cypress trunks, water lettuce, water hyacinths, and hydrilla that grows to the pool's surface.

"The Rodman Reservoir provides a diverse and extensive habitat for not only trophy fish..." You need to say, "The Rodman Complex provides a diverse and extensive habitat..." There is nothing diverse about Rodman Reservoir and fishing there has significantly declined. During tournaments held at Kenwood many fishermen lock out of the reservoir or go upstream into the river to catch their trophy fish.

"Many endangered and threatened species of wading birds, waterfowl, Bald Eagles, and others use the reservoir, particularly during the cooler months." It should read, "particularly during drawdowns." Bald eagles are in smaller numbers at Rodman Reservoir than bodies of equivalent size. They prefer the nearby St. Johns River. Some eagles sit atop dead cypress trees during drawdowns when the fish are more concentrated in the historic river channel.

The Optimum Boundary of the Cross Florida Greenway in Putnam County needs to include all of the Etoniah/Cross Florida Greenway land acquisition project (http://floridawildlifecorridor.org/missing-links-2/etoniahcross-florida-greenway/) and the Barak property next to the Buckman Lock area (OGT objected to a land use change that would allow for residential development on the Barak Property. The county granted the land use change, but the property has not been developed to date.). These properties are part of the Ocala to Osceola Wildlife Corridor, considered part of the most important wildlife corridor in the SE US. I have attached a map that was developed by the Putnam County Chamber of Commerce Ecotourism Committee promoting that greenway.



Etoniah
Cross Florida

The Etoniah/Cross Florida Gr
is under consideration for pur
Conservation and Recreation
The project provides the follo
Putnam County:

* Expands Nature-based Tou
  Hiking, Fishing, Camping, a
* Serves as a Greenway for H
* Links the New Rail Trail to tl
* Preserves the Heart of Putn
  Future Generations
* Protects Critical Habitat for
  Including the Florida Black
* Provides Timber Jobs in the
* Enhances Adjacent Propert
* Buffers Important Surface W
* Protects 8 Archaeological S
* Promotes Compact Urban D
  Reduces Public Facility and
* Retains County Revenue th
  Acquisition and Payment in

This project is ranked 18th ou
meetings are scheduled, one
Marjorie Stoneman Douglas
while the other is on Nov. 17,
Voulsia County Council's Offi
Letters of support should be
Greg Brock, Office of Environ
3900 Commonwealth Blvd.,
Tallahassee, Fl. 32399

PH-49

Barber, Alicia W

From: Vaughn, Greg A
Sent: Monday, December 04, 2017 11:59 AM
To: Barber, Alicia W
Subject: Fwd: Comments on 2017 CFG 10-year plan
Attachments: Sandra Kokernoot's comments - 2017 CFG 10-year plan.docx; Fish Study Lewis revision 1 21 FEB 2015 Complete.pdf

CFG comments

Sent from my Verizon, Samsung Galaxy smartphone

-------- Original message --------
From: "Alsentzer, Daniel" <Daniel.Alsentzer@dep.state.fl.us>
Date: 12/4/17 11:52 AM (GMT-05:00)
To: Gene Stillman <gstillman@thinkf4.com>, "Vaughn, Greg A" <Greg.Vaughn@atkinsglobal.com>
Subject: FW: Comments on 2017 CFG 10-year plan

FYI

From: lesrrl3@aol.com [mailto:lesrrl3@aol.com]
Sent: Monday, December 04, 2017 11:31 AM
To: s_kokernoot@hotmail.com; Cutshaw, Steven <Steven.Cutshaw@dep.state.fl.us>; FLStateParkPlanning <FLStateParkPlanning@dep.state.fl.us>; Alsentzer, Daniel <Daniel.Alsentzer@dep.state.fl.us>
Cc: cjs32656@aol.com; noscapr@hotmail.com; j-cmacdonald@comcast.net; karenchadwick95@yahoo.com; keyser@ks.legal; piantanida@windstream.net; sharbaugh@ks.legal; svetlika@msn.com; ktripp@savethemanatee.org; mary.alford@sustainabledesigngroup.com
Subject: Re: Comments on 2017 CFG 10-year plan

Mr. Cutshaw:

The members of Save Our Big Scrub, Inc., would like to formally endorse the comments provided by Mrs. Kokernoot. The updated CFG plan should not be a document written in a biased manner to promote keeping the Rodman Pool instead of restoring the Ocklawaha River, but should be factual and science based, and support the long-standing position of the FDEP that the Ocklawaha River should be restored.

As Mrs. Kokernoot correctly points out, the document is replete with casual, biased and unscientific comments clearly inserted to promote keeping the Rodman Pool. Please remove these statements and comments and insert only science based, and scientifically supported statements and comments.

As an example of the latter, see the attached report which documents the decline of fish populations above the Kirkpatrick Dam, and the likely outcome of increased fish populations in a restored Ocklawaha River and in Silver Springs with restoration of the historical migratory routes of many fish species who historically moved through the St. Johns River and up the original Ocklawaha River into Silver Springs and further south.

R

Roy R. "Robin" Lewis III, Professional Wetland Scientist Emeritus #725
President, Save Our Big Scrub, Inc.
Board Member, Putnam County Environmental Council, Inc.

P.O. Box 5430
Salt Springs, Florida USA 32134
Office. 1.352.546.4842
Mobile 1.813.505.3999
Fax 1.352.546.3224
Email: lesrrl3@aol,com, lesrrl3@gmail.com Please send to both

In a message dated 12/1/2017 4:37:56 PM Eastern Standard Time, s_kokernoot@hotmail.com writes:

Please see my attached comments.

Thank you,
Sandra Kokernoot

On Nov 28, 2017, at 4:13 PM, Cutshaw, Steven <Steven.Cutshaw@dep.state.fl.us> wrote:

Good afternoon Ms. Kokernoot,

My name is Steve Cutshaw and I am happy to hear you are interested in commenting on the Cross Florida Greenway. Daniel Alsentzer is the Park Planner in charge of the CFG and he will be happy to assist you. You may submit comments in many ways, by phone to the planner, by email to us directly or to FLStateParkPlanning@dep.state.fl.us. Daniels number is 850-245-3073 and his email is Daniel.alsentzer@dep.state.fl.us. We just want to get your comments.

My contact information is listed below and please do not hesitate to contact me anytime,.

Thank you for your support of the trail and Florida State Parks!

Sincerely,

Steve

Steven A. Cutshaw, Chief
Office of Park Planning
ision of Recreation and Parks
rida Department of Environmental Protection
Steven.cutshaw@dep.state.fl.us
Office: 850.245.3084
Cell: 850.528.9135

Comments from Sandra Kokernoot on the 2017 CFG 10-year plan

The Florida Comprehensive Planning Act calls for a management plan to include how natural resources will be protected. Therefore it is first necessary to determine how they are being adversely impacted. That information should be included in a data section.

This plan needs to explain:

1. The significant decline in the size and number of fish in Rodman Pool.

2. The failure of drawdowns, water level increases, and herbicides to control vegetation in Rodman Reservoir.

   On Page 110 the draft plan states that drawdowns dry the shallow areas and kill the invasive aquatic plants. That is not true. The soils of the pool do not dry out completely and vegetation recovers quickly after the pool is refilled.

3. The continuing death of cypress trees upstream of Rodman Dam from holding the reservoir waters at higher levels in an attempt to kill hydrilla.

4. The caving in of gopher tortoise burrows and destruction of trees by heavy equipment on the berms in Putnam County.

The Draft Conceptual Land Use Plan includes laudable objectives, but those objectives need policies with deadlines to accomplish those goals.

On Page 216, under Goals C-G you have included objectives about working with others to create multi-use, hiking, biking, equestrian, and paddling trails, which is commendable.

Under Goals C and D here is a need for policies to create quality hiking trails and multi-use trails in natural areas of the CFG in Putnam County that are not located on torn up fire breaks. The trails north and south of Buckman Lock and the Florida Trail on the east side of Rodman Campground are not enjoyable to walk because they are torn up firebreaks. Those trails have discouraged prospective hikers and turned many ankles. The firebreaks need to be flattened after clearing/disking or the trails need to be relocated off of the firebreaks.

The 1992 Cross Florida Greenbelt Plan called for developing multi-purpose and interpretive trails in Putnam County west of Buckman Lock. You should include a policy to have State biologists explore that option.

On Pages 220-221, under "Proposed Facilities – Facilities Development" the plan proposes no new facilities and very few improvements to existing facilities in Putnam County, despite the need. It calls for paving the road into Kenwood and "evaluating the feasibility" of a paddling trail. You need to add:

1. A functioning visitors center at Buckman Lock. The Buckman Lock Visitors Center should be reopened to the public with a self-guided exhibit explaining the environmental and economic benefits of restoration.
2. Three small parking areas at: Canal Road at CR 310, Berm Road at Dam Road, and the base of the SR 19/Barge Canal Bridge on the north side of the canal to improve public access to the north and south berms in Putnam County.

Objective H4 on Page 218 that calls for evaluating "the opportunity to develop a Guided Historical Interpretive Boat Tour along the greenway canal and lock system" needs to be modified.

Are you talking about a brochure for boaters or a guided tour?

Such a tour of just the man-made part of the greenway could be used, depending on the tour guide, to convince visitors to save Rodman Reservoir and prevent restoration. Rodman Reservoir supporters were found to work as volunteers at the Buckman Lock Visitors Center when it was open and promoted keeping the dam.

If you want to evaluate an interpretive boat tour, evaluate one that goes from the lock to the St. Johns River to the Ocklawaha River to the dam and back, explaining the history, but also explaining how the canal and dam damaged the environment and how Partial Restoration will benefit the economy and environment. Show them the natural river, not just the man-made alterations and structures. That tour could be used before and after Partial Restoration and be expanded to include the restoration area.

Under General Management Measures the plan states, "During all management activities, every effort should be made to minimize detrimental effects to the gopher tortoise population (and its burrows)", however, there are no policies to address how minimizing those detrimental effects will be accomplished. As I explained previously, heavy equipment operators are collapsing gopher tortoise burrows and damaging trees on the berms in Putnam County.

On Pages 209 and 210, under Current Recreation Use and Visitor Programs, the language is biased and misleading and sounds like a promotion for keeping the dam in place. It states:

"Ramps at Kenwood and Rodman Campground provide water access to the Rodman area, which is nationally known for its fishing." You need to drop "nationally known for its fishing" or say "Ramps at Kenwood and Rodman Campground provide water access to the Rodman area and excellent fishing in the Ocklawaha River." Rodman Reservoir is not as highly rated for bass fishing any longer. The best fishing is now in the riverine section upstream of the reservoir and the river below the dam. That's where the current is.

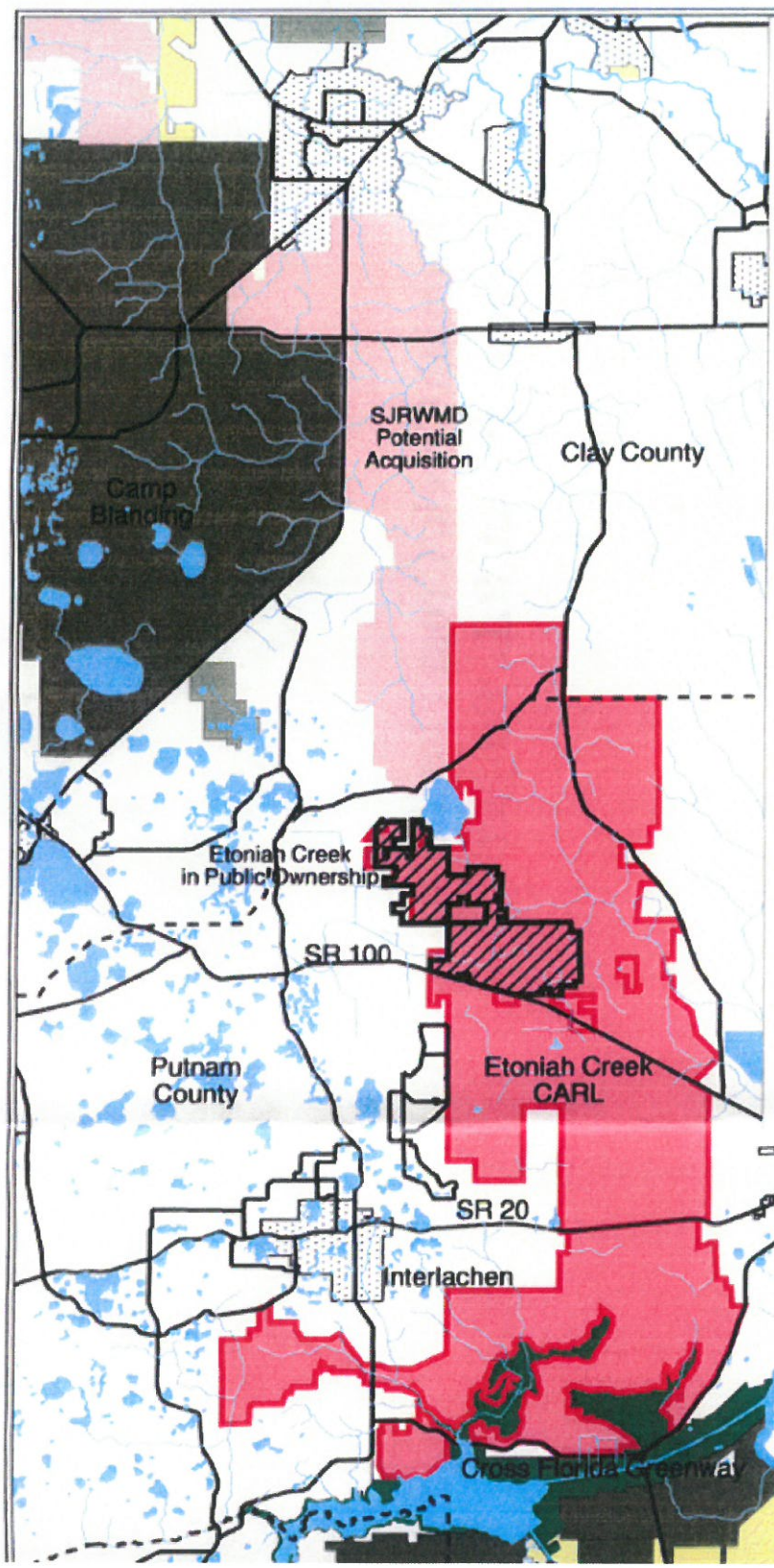
"The moving water flowing through the spillway and down past the fishing piers provides excellent freshwater fishing opportunities," failing to explain that these fish are coming up the Ocklawaha River and are blocked by the dam. Fishermen actually believe the fish are coming out of the reservoir through the dam. You need to say "The fishing piers in the spillway provide excellent freshwater fishing opportunities, because the fish moving up the Ocklawaha toward the current that comes out of the reservoir are blocked by the dam."

"The upstream reservoir side of the earthen dam, adjacent to the spillway, provides excellent additional bank fishing opportunities dependent upon the season, weather patterns, and vegetation." The truth is the reservoir side of the dam does not provide excellent bank fishing and is very rarely used by fishermen. The shoreline is usually filled with dead cypress trunks, water lettuce, water hyacinths, and hydrilla that grows to the pool's surface.

"The Rodman Reservoir provides a diverse and extensive habitat for not only trophy fish..." You need to say, "The Rodman Complex provides a diverse and extensive habitat..." There is nothing diverse about Rodman Reservoir and fishing there has significantly declined. During tournaments held at Kenwood many fishermen lock out of the reservoir or go upstream into the river to catch their trophy fish.

"Many endangered and threatened species of wading birds, waterfowl, Bald Eagles, and others use the reservoir, particularly during the cooler months." It should read, "particularly during drawdowns." Bald eagles are in smaller numbers at Rodman Reservoir than bodies of equivalent size. They prefer the nearby St. Johns River. Some eagles sit atop dead cypress trees during drawdowns when the fish are more concentrated in the historic river channel.

The Optimum Boundary of the Cross Florida Greenway in Putnam County needs to include all of the Etoniah/Cross Florida Greenway land acquisition project (http://floridawildlifecorridor.org/missing-links-2/etoniahcross-florida-greenway/) and the Barak property next to the Buckman Lock area (OGT objected to a land use change that would allow for residential development on the Barak Property. The county granted the land use change, but the property has not been developed to date.). These properties are part of the Ocala to Osceola Wildlife Corridor, considered part of the most important wildlife corridor in the SE US. I have attached a map that was developed by the Putnam County Chamber of Commerce Ecotourism Committee promoting that greenway.



Etoniah
Cross Florida

The Etoniah/Cross Florida Gr
is under consideration for pur
Conservation and Recreation
The project provides the follo
Putnam County:

* Expands Nature-based Tou
  Hiking, Fishing, Camping, a
* Serves as a Greenway for H
* Links the New Rail Trail to t
* Preserves the Heart of Putn
  Future Generations
* Protects Critical Habitat for
  Including the Florida Black
* Provides Timber Jobs in the
* Enhances Adjacent Propert
* Buffers Important Surface V
* Protects 8 Archaeological S
* Promotes Compact Urban D
  Reduces Public Facility and
* Retains County Revenue th
  Acquisition and Payment in

This project is ranked 18th ou
meetings are scheduled, one
Marjorie Stoneman Douglas
while the other is on Nov. 17,
Voulsia County Council's Offi
Letters of support should be
Greg Brock, Office of Environ
3900 Commonwealth Blvd., M
Tallahassee, Fl. 32399

Putnam County Environmental Council

Management and Restoration of the Fish Populations of Silver Springs and the Middle and Lower Ocklawaha River, Florida, USA

Roy R. Lewis III, M.A., P.W.S.

MANAGEMENT AND RESTORATION OF THE FISH POPULATIONS OF SILVER SPRINGS AND THE MIDDLE AND LOWER OCKLAWAHA RIVER, FLORIDA, USA

A Special Report for
The Putnam County Environmental Council
Funded by a Grant from the Felburn Foundation
By
Roy R. "Robin" Lewis III, M.A.
Certified Professional Wetland Scientist and Certified Senior Ecologist
Revised Version 1. February 21, 2015

Cover photograph: Longnose Gar, *Lepisosteus osseus*, in Silver Springs, Underwater Photograph by Peter Butt, KARST Environmental

ACKNOWLEDGEMENTS

THE AUTHOR WISHES TO THANK ALL THOSE WHO REVIEWED AND COMMENTED ON THE NUMEROUS DRAFTS OF THIS DOCUMENT, INCLUDING PAUL NOSCA, MICHAEL WOODWARD, CURTIS KRUER AND SANDY KOKERNOOT. ROBERT KNIGHT SPECIFICALLY OFFERED COMMENTS ON THE USE OF FISH BIOMASS DATA FROM SILVER SPRINGS. ALL CONCLUSIONS, HOWEVER, REMAIN THE RESPONSIBILITY OF THE AUTHOR.

CITATION

THE SUGGESTED CITATION FOR THIS REPORT IS:

LEWIS, RR. 2015. MANAGEMENT AND RESTORATION OF THE FISH POPULATIONS OF SILVER SPRINGS AND THE MIDDLE AND LOWER OCKLAWAHA RIVER, FLORIDA, USA. Revised Version 1. Putnam County Environmental Council, Interlachen, Florida. 30 p + append.

Additional copies of this document can be downloaded from the PCEC website at groupspaces.com/pcecweb.

EXECUTIVE SUMMARY

Sixty-nine (69) species of native fish have been documented to have utilized Silver Springs, Silver River and the Upper, Middle and Lower Ocklawaha River for the period of record. Fifty-nine of these are freshwater fish species and ten are native migratory species using marine, estuarine and freshwater habitats during their life history. These include striped bass, American eel, American shad, hickory shad, hogchoker, striped mullet, channel and white catfish, needlefish and southern flounder. Most of these ten migratory species are currently either rare or absent from the Ocklawaha River above the Kirkpatrick Dam, where historically they were seasonally common to abundant.

The key questions to be answered from this updated review are: (1) how have fish populations changed since impoundment of the Lower Ocklawaha River in 1968, and (2) what is likely to happen to these populations after breaching of the Kirkpatrick Dam, and restoration of flows in the river, thus reestablishing both of the historical migratory routes of fish to and from the St. Johns River, and restoring more normal seasonal inundation of the floodplain habitats of these rivers?

It is obvious from the data and reports reviewed previously by Clugston (2002), and updated here, that significant changes have occurred to the fish populations of Silver Springs, Silver River and the Ocklawaha River over the last 50 years. These changes have accelerated since the construction of a portion of the Cross Florida Barge Canal and closure of the Kirkpatrick (formerly Rodman) Dam. The documented decline of 92% in the biomass of all fish species in the Silver River, and essentially the complete loss of striped mullet, channel and white catfish and shad from the Silver River, and a 60% decline in biomass of largemouth bass, are the clearest indicator of significant problems with fisheries management within this ecosystem. Other historically common species within both the Ocklawaha River and the St. Johns River ecosystems like striped bass and the American eel are now absent as self maintaining native populations due largely to blockage of essential migratory pathways and habitats.

Scientific reports are listed and discussed, and it is noted that they repeatedly recommend breaching of the Kirkpatrick Dam and restoration of flows within the Ocklawaha River to facilitate a likely increase in diversity of fish and wildlife within these north Florida river ecosystems. In addition, the breaching will most likely increase the forage fish food base for many larger fish, wading and seabirds, reptiles and mammals.

It is concluded that there is no credible scientific basis to predict any permanent decline in fish resources following restoration, nor a specific decline in sports fishing opportunities over the short or long term. The species mix may change, but fish biomass within the restored channels, wetlands and floodplains (both above and below the existing Kirkpatrick Dam) will likely remain the same or increase over time after the Rodman Pool is drained and migratory fish populations return. In specific areas such as the Silver River, the reconnected springs, and spring runs, a significant increase in fish populations can be expected.

Certain fish species now absent from these water bodies will return to former abundances, and overall ecological function will increase. Sport fishing opportunities for species like the striped bass will increase with restoration, and a viable riverine largemouth bass fishery will persist.

INTRODUCTION

Damming of the lower Ocklawaha River and the creation of Rodman Reservoir (hereafter referred to as the Pool) were completed in 1968 as part of the Cross Florida Barge Canal Project. The project was deauthorized by the U.S. Congress in 1991, and in 1993, the Florida legislature required environmental studies to assist in determining the future of the dam and Pool. The Florida Department of Environmental Regulation (now Florida Department of Environmental Protection (FDEP)) applied for a permit to breach the Kirkpatrick (formerly Rodman) Dam in 1997. This permit application was submitted to the St. Johns River Water Management District (SJRWMD). Processing of that permit is currently on hold. The future of the Pool and dam is caught up in an ongoing dispute among sport fishermen, who generally wish to preserve the Kirkpatrick Dam and the Pool, water quality experts at the SJRWMD and FDEP, wildlife and fishery scientists, the U.S. Forest Service which owns the land where breaching of the Kirkpatrick Dam would occur, and environmental advocates who support habitat restoration both above and below the existing Kirkpatrick Dam (Clugston 2002).

As previously stated by Clugston (2002) recreational fishermen cite excellent largemouth bass fishing and economic benefits with the Pool in place. Environmental activists emphasize the importance of a free-flowing river without the Pool in place for the benefit of all flora and fauna, some of which are listed by the State of Florida as endangered, threatened, rare or species of special concern. Between these two perspectives, scientists continue to disagree about the specific science in support of one view or another. This report specifically addresses and updates the issue of fish population management and restoration in Silver Springs, Silver River and the Middle and Lower Ocklawaha River, Florida, USA, based upon the most recent scientific reports and review of data by Roy R. Lewis III, a Certified Professional Wetland Scientist (by the Society of Wetland Scientists) and a Certified Senior Ecologist (by the Ecological Society of America).

GEOGRAPHIC SETTING

The Ocklawaha River basin covers 2,769 square miles in central and north Florida. A complete description of the basin setting, history, hydrology, ecology, socioeconomic and management background is provided in FDEP (2000) (pages 29-82). Figures 1 and 2 show the overall settings of Silver Springs, the Silver River and the Upper, Middle and Lower Ocklawaha River (UOR, MOR, LOR). This report discusses issues related to management and restoration of fish populations in just the MOR and LOR. The UOR is essentially totally isolated from any hydrologic connection with the MOR and LOR by the Moss Bluff Lock and Dam (MBLD) which in recent years has been closed to any downstream flows as water is held behind the dam to maintain lake levels in the Harris Chain-of-Lakes. Only heavy storm induced rains produce any flow over the dam. Since its construction in 1925 the MBLD has also blocked upstream movements of fish. The UOR is an important ecological system and includes the Harris Chain of Lakes and Lake Apopka. The UOR deserves its own separate discussion and is not part of this report.

The classification of the segments of the Ocklawaha River in Figure 2 is a revised classification. The author was not satisfied that the previous classifications covered all portions of the examined ecosystem, and thus allowed for discussion of various elements of the ecosystem that are in fact very distinct from one another. For example, the two most recent and comprehensive documents describing the hydrology, water quality and biology of the Ocklawaha River basin are the "Basin Status Report - Ocklawaha" (Florida Department of Environmental Protection [FDEP] 2001) and the "Water Quality Assessment Report - Ocklawaha" (FDEP 2003) both contain extensive maps and descriptions of the various "hydrologic units," "water body identification units," and "planning units" for the Ocklawaha River basin. Few of these have coincidental boundaries. In addition, within each of these categories, various place names are provided. Particularly as it relates to hydrologic and ecological boundaries, there appears to be no consistent designation system, and thus we proposed this new classification.

With particular reference to more recent water quality issues, PBSJ-Atkins, a consultant to the FDEP, has provided another set of maps with further designations in several reports (PBSJ 2008, PBSJ 2010). These reports focusing on water quality issues related to potential breaching of the Kirkpatrick Dam, divide the reach of the Ocklawaha River between Eureka and the Eureka Lock and Dam (ELD) and the Kirkpatrick Dam into three sections based in part on the hydrology and vegetation: riverine, transition, and lacustrine. These designations were also previously noted and defined in CSA (1994) (Figure 3). No specific designations are given to the Ocklawaha River above (south) of Eureka that connects to the Silver River and Silver Springs, nor the Ocklawaha River below (east) the Kirkpatrick Dam that connects the Ocklawaha River basin with the St. Johns River (SJR). Both of these reaches are distinctly different from the three designated reaches, and from each other, and both play important and distinct roles in the hydrology and ecology of the Ocklawaha River. Since they have remained unnamed they are often ignored when water quality and ecological issues are discussed. The author resolves this issue by designating them in turn the "Middle Ocklawaha River – MOR" from the confluence of the Silver River with the Ocklawaha River north to the ELD, and the "Lower Ocklawaha River

Below the Kirkpatrick Dam – LORBKD." This still leaves the short reach of the Ocklawaha River between the Silver River and south (upstream) to the MBLD. This reach is designated as the "Ocklawaha Farms Reach – OFR." This produces a total of six (6) sub basins for the entire Ocklawaha River, and five for just the MOR and LOR (Table 1, Figure 2).

Table 1. Designated sub-basins of the Ocklawaha River (this review).

1. Upper Ocklawaha River (UOR)
2. Ocklawaha Farms Reach (OFR)
3. Middle Ocklawaha River (MOR)
4. Orange Creek (OC)
5. Lower Ocklawaha River (LOR)
6. Lower Ocklawaha River Below Kirkpatrick Dam (LORBKD)

Figure 1. Geopolitical map of the Ocklawaha River basin (from FDEP 2001).

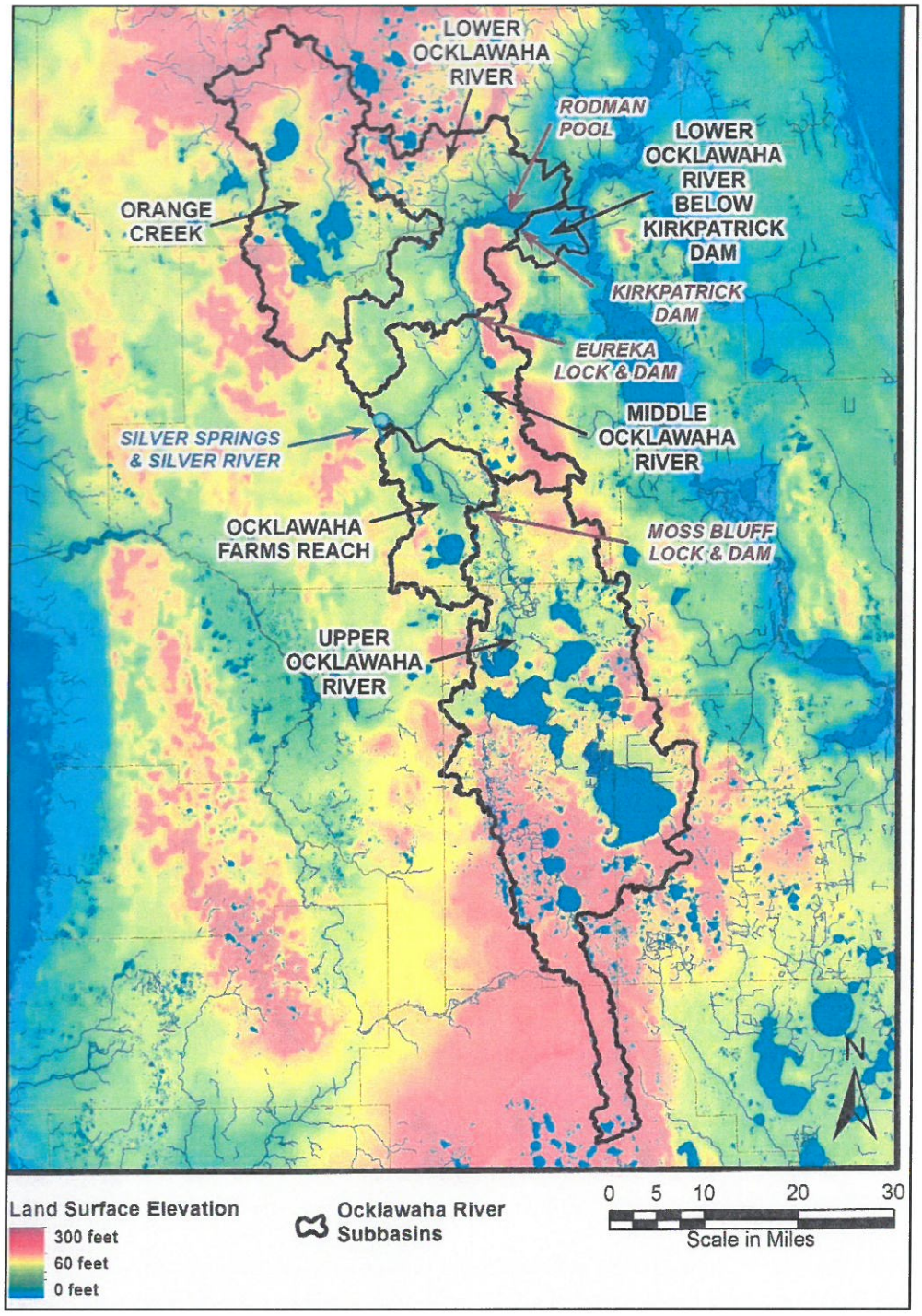


Figure 2. Revised map of the subbasins of the Ocklawaha River.

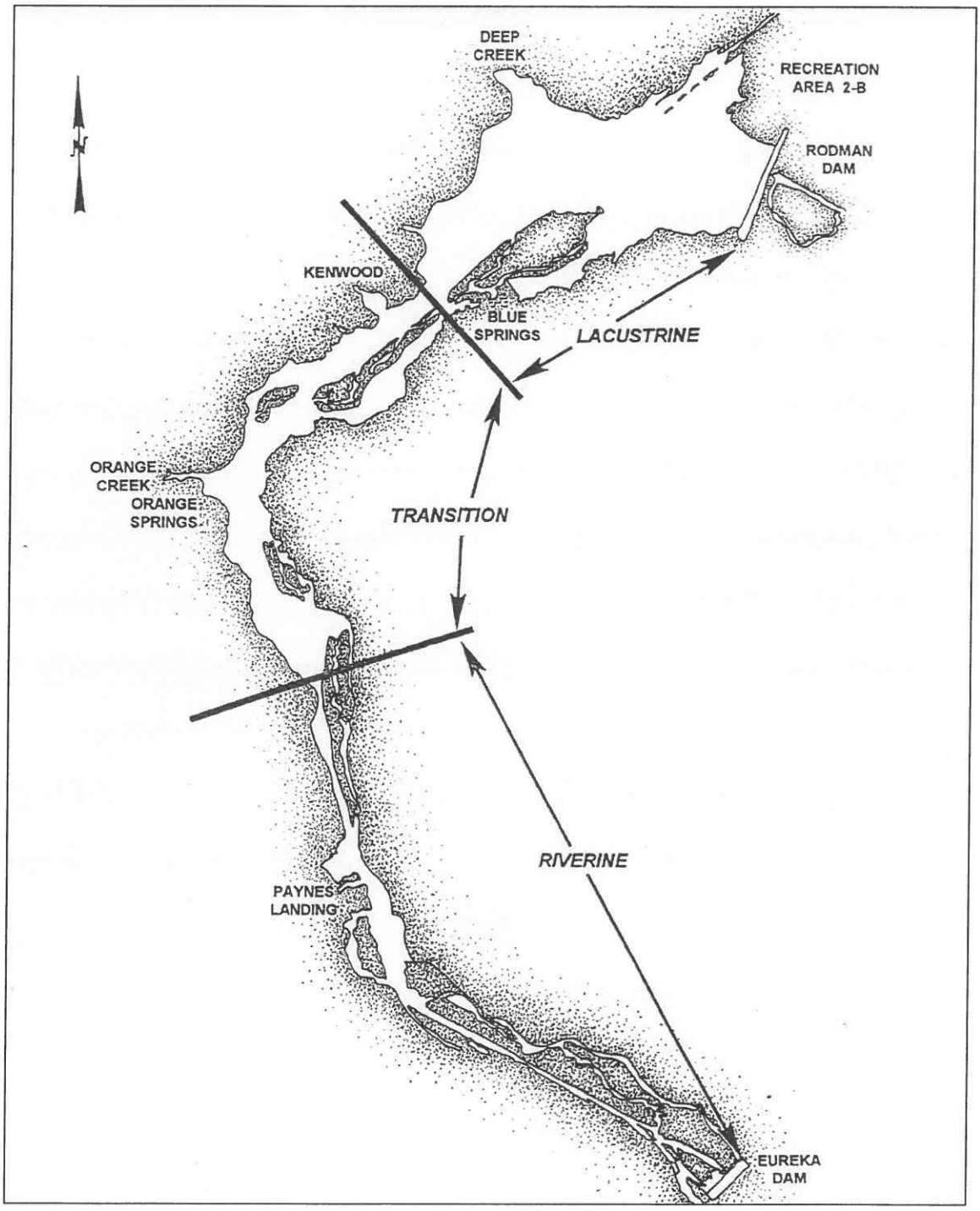


Figure 3. Lacustrine, transition and riverine zones of the Rodman Pool (from CSA 1994).

HYDROGRAPHIC SETTING

Figure 4 graphically summarizes the major sources of water flows in the entire Ocklawaha River basin. Specific flows are discussed in a number of sources including FDEP (2000, 2003) and (Hall 2005). Recent declines in flows through 2009 are discussed in SDI (2010). They concluded that "[F]or the decade since 1999, the average flow of the Ocklawaha River has declined to 1,049 cubic feet per second (cfs), which is 36.3 percent lower than the long-term average stream flow (1,647 cfs)..." These declines have a major impact on fish use and populations in the MOR, LOR and the LORBKD, as important fishery-related floodplain habitats are less frequently inundated on a seasonal basis (Rogers and Allen 2004).

In addition, although not noted in Figure 4, some of the indicated blockages in the system (dams, locks and weirs) represent major impediments to the movement and normal reproduction of migratory fish species and other species such as the endangered Florida manatee (*Trichechus manatus latirostris*). Kirkpatrick Dam and the Moss Bluff Lock and Dam are major impediments. The Eureka Lock and Dam are not, as the dam itself was never completed. It is likely still an impediment to some fish and wildlife use and should be removed, but other projects will likely have higher priority, such as the breaching of the Kirkpatrick Dam.

FISH HABITATS

Available area and quality of specific habitats is an important factor in limiting fish population sizes. Fish go through a number of different forms and sizes as they mature, from eggs to larvae to juveniles to adults. Each of these stages typically requires different habitats. For example eggs may survive best if they are in pelagic (open water) or demersal habitats (associated with bottom sediments or vegetation). Some eggs such as those of the striped bass require long stretches of cool flowing water to allow enough time to hatch and seek good feeding and protective shoreline habitats with slower water velocities and cover provided by aquatic plants or woody debris.

Smaller adult and juvenile fish (forage fish) are subject to predation by larger fish, wading birds, reptiles and mammals, and thus refuge habitat in the form of shallow water with vegetation or debris like downed trees becomes important habitat (Cathey et al. undated). Larger fish may be subject to the same predation by even larger organisms such as adult alligators.

For this reason all fish thrive in a specific mosaic of habitats (Lewis et al. 1985), not typically just a single habitat. The habitat type that is least available relative to the amount necessary to maintain an existing population then can become a controlling point for the ultimate survival of the entire population (bottleneck).

For example, if a shallow water forested floodplain stream or pond is an important nursery habitat for a species, declining water flows that keep these areas dry and not available for fish use can limit the ultimate population of adult fish of that species within that watershed. Rogers and Allen (2004) reviewed long term FFWCC data from several Florida rivers, including the Ocklawaha River, to evaluate trends in fish abundance and fish communities and related

those trends to historical river levels. They concluded "...that lower river levels negatively affect fish communities by reducing fish abundance" and recommended that regulations such as Minimum Flows and Levels (MFLs) should be set to reduce the periodicity of low flow events in order to prevent sequential years of adverse effects on fish populations.

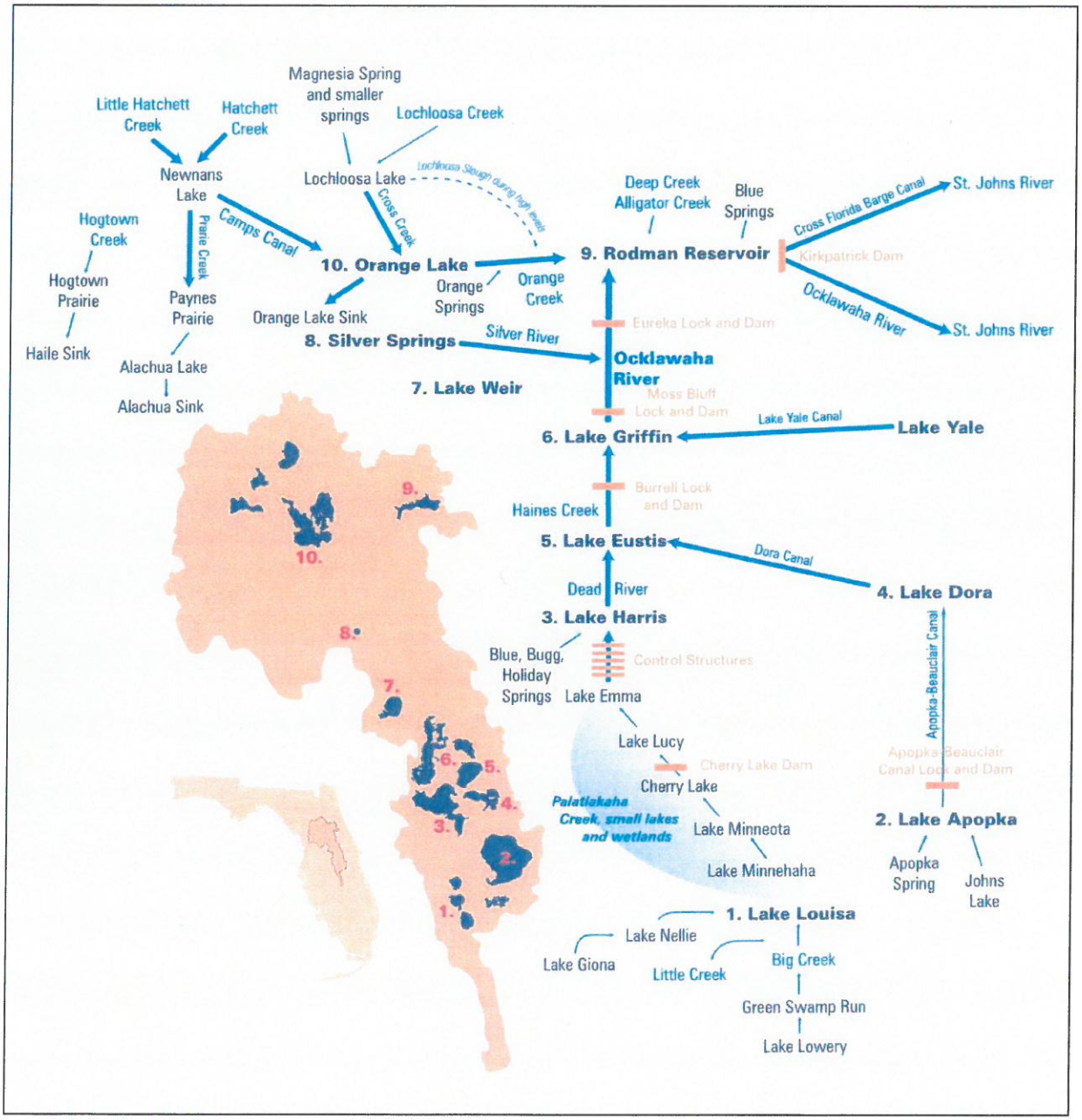


Figure 4. Schematic of water movement in the Ocklawaha River basin (from FDEP 2001).

Leitman et al (1991) documented the fish utilizing the forested floodplain of the Ochlockonee River, Florida, and noted that "[I]nundated vegetative structure, both live and dead, provides important substrate, refuge, or food for any invertebrates and fish...Stumps, logs or clumps of vegetation provide shelter for nests of several species of sunfishes and catfishes...Vegetative cover as protection against predation is an important survival factor for young bluegill...the amount of flooded vegetation and the duration that it was flooded significantly influenced survival of young largemouth bass during the first 3 months of life" (page 22).

Hill and Cichra (2002a, 2002b) have published a literature review and summary of the effects of water levels on fish populations particularly as it relates to floodplain inundation frequencies and the setting of MFLs by the SJRWMD Bureau of Water Supply. They note that "[W]ater level fluctuations have numerous management implications...For systems where flow or water level manipulations is a possibility, water management can be used for fisheries management purposes...given the past history of hydrology alteration for water management and the present and future demands for ground and surface water resources in Florida, fisheries implications can be an important consideration for water management projects and policies" (page 7).

Fish may be resident or transient in a specific habitat, and for some species that move longer distances we use the term migratory. If this migratory portion of their life history takes them between marine, estuarine and fresh waters, depending on the specific pattern, these life histories may be described as anadromous, catadromous, or simply diadromous which is catch-all term for these kinds of life history movements.

Diadromous refers to a species, fish or invertebrate, that exhibit regular migrations at defined life history stages between freshwater and the sea. It can be subdivided into:

Anadromous refers to a fish species that spawns in freshwater, but primarily spends its juvenile and adult life in salt water. Various species of salmon are the most familiar of these species, returning to their natal streams to spawn and die as part of their life cycle. In north Florida the striped bass (*Morone saxitilis*) and several species of shad (*Alosa* spp) exhibit this life history (McBride 2000).

Catadromous refers to the reverse, where adult spawning takes place in salt water, with the juveniles seeking freshwater as their nursery habitat. The American eel (*Anguilla rostrata*) is a typical species occurring in north Florida and the LOR that exhibits this life history pattern.

These life history patterns may be obligatory or facultative. If obligatory, the life stage that is moving between habitats must make a successful migration on time or it dies breaking the cycle of recruitment of the species for a certain area. The striped bass is an obligatory anadromous species in north Florida, and since its spawning habitat in the LOR was blocked in 1968 with the closure of the Kirkpatrick Dam, the native population disappeared. The current population, primarily in the St. Johns River and in the LORBKD, is a combination of a stocked population from inland South Carolina and captured stocked adults in the SJR. The SJR must be regularly restocked as it is not self maintaining through natural reproduction. The striped

mullet (*Mugil cephalus*), on the other hand is a facultative catadromous species (Blaber 2009), and can survive in both salt and fresh portions of the SJR, and is occasional found in the MOR and LOR above the Kirkpatrick Dam after passing through the Buckman Lock. Its biomass within the Silver River has been reduced by 99%, (Munch et al. 2007) and the similar reductions are likely in the MOR and LOR. Thus this species is not totally absent as a self-maintaining population, just drastically reduced in population size.

GENERAL FISH TERMINOLOGY

Several other terms are loosely applied to various species of fish. Some fish are "sportfish" and some are "rough" or "trash" fish. Obviously sportfish are those prized by sport fisherman, like largemouth bass, or speckled perch (black crappie), and can be eaten. "Rough" or "trash" fish are not typically the target of either sport or commercial fisherman and are derogatorily referred to with these terms. None of these terms are scientific terms, and technically all native fish species are part of the ecosystem and likely play a role in that ecosystem, and are likely a source of food for other larger organisms.

The term "forage fish" is a scientific term defined here as "small fish that feed on plants, detritus and small organisms and are in turn consumed as forage [food] by larger predators, such as larger fish species, birds, reptiles [alligators] and mammals [otters, bobcats]". A recent worldwide review of forage fish management issues has been released by the Lenfest Ocean Program and the Institute for Ocean Conservation Science (Pikitch et al. 2012).

Gizzard shad (*Dorosoma cepedianum*), for example, are generally thought of by sports fisherman as "trash fish." However, when a careful examination of the feeding habits of many of the prized species is made, interesting information is derived. For example, young gizzard shad are described by McLane (1955) (p. 49) as a "...very valuable forage fish, being eaten in considerable quantities by black bass, ten pounders, needle fish, flounders, garfishes, and the black crappie..." Gizzard shad are also likely an important food item for stocked striped bass in the St. Johns River. Juvenile, young adult and adult striped mullet are also important forage fish for a number of larger predators. Their overall population and that of the various species of other forage fish species such as shad (*Alosa*), menhaden (*Brevoortia*), various silversides, mosquitofish, sailfin mollies, true minnows and suckers are impacted by habitat loss, such as the blockage to movements by the Kirkpatrick Dam. The loss of this forage for larger organisms (bass, gar, alligators, otters, wading birds, ospreys) in turn reduces these species' populations. Thus any successful fisheries (and ecological) management program must address not just the availability of prized sport fish or commercial fish to humans, but also the food of these targeted species, the habitat requirements of important forage fish consumed by these species and other wildlife, and thus the availability and quality of all fish habitats within a given ecosystem.

Finally, we have "non-native invasive species" or exotic species of fish that compete with native species for habitat and food. Two of the most common of these in the Ocklawaha River are the suckermouth armored catfish (*Hypostomus plecostomus*) and the vermiculated sailfin catfish (*Pterygoplichthys disjunctivus*) (Nico et al. 2009). Another is the blue tilapia (*Tilapia aurea*). Little scientific study of the impact of these species on river habitats or fish

populations has been done, but excavation of depressions and burrows, and loss of benthic vegetation caused by these species are common observations by those who frequent the river (Nico et al. 2009, Lewis pers. obs). They are also commonly observed as dead specimens after cold weather events reflecting their lack of resistance to normal weather conditions (Lewis pers. obs).

FISH POPULATIONS IN SILVER SPRINGS AND THE MIDDLE AND LOWER OCKLAWAHA RIVER – REVIEW AND DISCUSSION

The following thirteen paragraphs repeat important literature excerpts with only minor updates from the excellent summary found in the Clugston 2002 review. Direct quotations are appropriately marked. Following these excepts is the author's discussion .

"The major objective of recent studies was to examine past and present fish populations in the Ocklawaha River system, including Silver Springs, to provide some insight in the possible effects dam removal might have on fishes now present in these systems and in the St. Johns River. Background data prior to the 1993 legislative mandate for additional studies are available from Hubbs and Allen (1943), the Florida Game and Fresh Water Fish Commission (now Fish and Wildlife Conservation Commission - FFWCC) and the University of Florida (Bass and Guillory 1976; Canfield et al. 1993; Duchrow and Starling 1972; Estes et al. 1989; Haller and Shireman 1984; Holcomb 1973; McKinney et al. 1986; Owen 1998) (Clugston 2002). McLane (1955) an unpublished Ph.D. dissertation entitled "The Fishes of the St. Johns River System" is the only extensive study of the fishes in the Ocklawaha River prior to dam construction." A second series of studies concentrating on Silver Springs and Silver River are contained in Hubbs and Allen (1943), Odum (1957), Knight (1980), and Munch et al. (2007) which contains a summary of all of these documents and points to large declines in fish populations over that period of time.

"A review by Continental Shelf Associates, Inc. (1994) summarizes much of the fishery data through 1993. Despite the reports available related to the Pool and the fish communities found throughout the river system, it remains somewhat unclear specifically how the fish community in the Ocklawaha River has been altered by dam construction. Some uncertainties exist because sampling locations and techniques have changed over the past 40 years, and the data are not directly comparable. Establishing cause and effect of some long-term changes in aquatic communities is difficult unless studies are well-planned and initiated long before the environment is purposely altered." Absent such studies, the "weight of evidence" approach looking at all data available and having experts evaluate it, can be used to make "science based" judgments as to likely changes over time and further make management recommendations.

"It has been suggested that a number of fish species have been lost from the Ocklawaha River system because of the construction of the Kirkpatrick Dam. However, the numbers of species present prior to dam construction, the species believed to be lost or displaced following construction, and their identities vary among reports. In order to clarify the effects of the dam and Pool on various fish species." Clugston (2002) did an initial review based primarily on literature sources dated prior to 1994. This review reexamines many of these past studies in relation to habitats required by specific species and the actual habitat sampled, and updates that information based upon data and reports through 2012.

"McLane (1955) reports collecting 118 species representing 36 families in the St. Johns River system. His record included 62 marine species from 27 families. He said the number of marine species 'could be increased considerably if species only collected at the river mouth were included.' He further stated that all the primary freshwater species he found in the St. Johns River proper were also found in the Ocklawaha River drainage. However, he found five species in the Ocklawaha River drainage to be absent from the rest of the St. Johns River basin: dusky shiner (*Notropis cummingsae*), southern tessellated darter (*Etheostoma oimstedi*), mud sunfish (*Acantharchus pomotis*), banded pygmy sunfish (*Elassoma zonatum*), and blackbanded sunfish (*Enneacanthus chaetodon*). Three of these—blackbanded sunfish, banded pygmy sunfish, and mud sunfish—plus the pugnose minnow (*Opsopoeodus emilliae*) were found only in the headwater lakes of the Ocklawaha River (upstream of the Moss Bluff Dam – river mile 64) and from the Alexander Springs Creek and Juniper Springs Creek, both of which flow directly into the St. Johns River. McLane (1955) also stated that the bluenose shiner was extremely rare in the St. Johns River drainage system. He collected this species at two sites in the Ocklawaha River (7 and 25 miles upstream from the mouth of the Ocklawaha River) and also again from Alexander Springs Creek and Juniper Springs Creek..."

"Reid (1970) said "Approximately 110 species of fishes are known from this (Ocklawaha River) drainage system...". However, he did not identify most of these species. He did note that dusky shiner, bluenose shiner, southern tessellated darter and snail bullhead (*Ameiurus brunneus*) were rare and exist as disjunct colonies and that their habitat should be preserved to prevent their extinction."

"Continental Shelf Associates, Inc. [CSA] (1994) provides a table (See modified version as Table 2) that lists native fish species collected from the Ocklawaha River system by 14 sources. Included are those identified by McLane (1955) and those identified and preserved as official records at the Florida Museum of Natural History, Gainesville, Florida. Although the table shows 1993 as the year for museum records (source number 11, Table 2), the data represent specimens collected as far back as the 1940's. The table is subdivided into those species collected from the Pool and those from the river and watershed. Their summary shows a total of 69 species. This listing can be broken down further into 59 freshwater species, 7 brackish and/or saltwater species, and 3 species whose life requirements include some time in both fresh and salt water (anadromous and catadromous)."

"Further examination of the table provided by Continental Shelf Associates, Inc. (1994) shows that 24 species found in the river and watershed were not found in the Pool. Three species are saltwater invaders and one is an anadromous species. The southern flounder (*Paralichthys lethostigma*) and hogchoker (*Trinectes maculates*) are benthic dwellers and upstream movement was possibly stopped by the Kirkpatrick Dam. The white mullet (*Mugil curema*) was collected in the river in 1993 (Continental Shelf Associates, Inc. 1994)." Hubbs and Allen (1943) also note one specimen collected in Silver Springs. "The anadromous American shad (*Alosa sapidissima*) was documented only in the river by a single specimen collected by McLane (1955). A relatively recent study designed to evaluate the use of the lower Ocklawaha River by migratory fishes during spring spawning season did not collect American shad (Jordan 1994a). However, commercial fishermen were interviewed and indicated that American shad or hickory shad (*Alosa mediocris*), were seen at Silver Springs prior to construction of Kirkpatrick Dam" (J. M. Barkuloo, retired U.S. Fish and Wildlife

service, personal communications to J. Clugston in Clugston 2002). Large schools of threadfin shad (*Dorosoma petenensis*) have been reported to have historically occurred in Silver Springs (Hubbs and Allen 1943). McBride (2000) notes that with reference to the Kirkpatrick Dam "...[R]emoving this dam would be the first step towards restoring a shad run to this area..." (page 10).

"The table of native fishes in the Ocklawaha River system provided by Continental Shelf Associates, Inc. (1994) indicates that striped bass were rarely caught in the river and Pool after dam construction. However, there is little doubt that they were seasonally common in the unaltered river system." The junction of Silver River and the Ocklawaha River was a popular fishing location for striped bass prior to dam closure (see website link below) and they were commonly caught near the mouth of the Lower Ocklawaha River Below Kirkpatrick Dam in Little Lake George (Figure 5). More recently, however, Jordan (1994a) failed to collect striped bass between January and June, 1994, in the Pool and river, but he did collect them from the barge canal downstream of the Buckman lock. He states based upon interviews and his knowledge that "...the striped bass was historically common to abundant in the Ocklawaha River up to Moss Bluff Dam, and "the Ocklawaha River was probably an important spawning area." Clugston (2002) notes that "every spring to date since the completion of the dam, local newspapers have reported excellent striped bass fishing in the Ocklawaha River at the base of Kirkpatrick Dam" (in the LORBKD)(see also accounts at http://sites.google.com/site/ocklawahaman/striped-bass-of-the-ocklawaha-river). "The presence of striped bass carcasses in the reservoir during two fish kills in the late 1980's indicate that some passed into the Pool via the Buckman Lock (Florida Department of Environmental Protection 1997). None were seen in a September 2000 fish kill (R. W. Hujik, FL Fish and Wildlife Conservation Commission, personal communication to J. Clugston). There is no doubt that the Kirkpatrick Dam stops upstream migration of striped bass in the Ocklawaha River and likely prevents reproduction" and establishment of a self-maintaining population.

"Two saltwater species, Atlantic needlefish (*Strongylura marina*) and striped mullet, were reported both in the river and the Pool by most sources (CSA 1994). These two species commonly migrate well upstream in the St. Johns River. Two other saltwater species, ladyfish (*Elops saurus*) and menhaden (*Brevoortia* sp.) were reported only from the Pool. However, Continental Shelf Associates, Inc. (1994) indicates specimens of these fishes were not available for confirmation of identification. Jordan (1994a) collected one ladyfish in the Cross Florida barge canal leading to the Buckman Lock in 1994."

"Adult American eel, a catadromous species, was found in the Pool and river by many sources (Continental Shelf Associates, Inc. 1994). Hubbs and Allen (1943) also report it from Silver Springs. Jordan (1994a) did not collect any adult eels during the six-month study in 1994, but did collect one elver (larval eel) below the spillway of Rodman Dam. The Kirkpatrick Dam spillway has served as an elver collecting point for an eel aquaculturist for many years (Dugan Whiteside, comments at Public Hearing on Interstate Fishery Management Plan for American Eel, Palatka, FL, 1999" in Clugston 2002). Bonvechio and Johnson (2007) report routine collections of eels below the Kirkpatrick Dam. Therefore there is no doubt that the dam is blocking movement of juvenile eels upstream and likely impacting populations in the SJR.

Clugston (2002) notes that "the absence of the 20 freshwater fish species that were collected from the Ocklawaha River and watershed from the Pool does not necessarily indicate that those species were lost from the system because of the Pool construction. The watershed includes many headwater lakes, small tributaries to these lakes, ponds, swamps and springs that were not

Figure 5. Roy R. Lewis, Jr., circa 1960, with two native St. Johns River striped bass caught in Little Lake George near the mouth of the Lower Ocklawaha River Below Kirkpatrick Dam.

affected by the construction of the Pool. Fourteen of these freshwater species were collected only from the upstream habitats and probably were not present in the area now inundated by the Pool. To our knowledge, no one recently has sampled the upstream habitats using appropriate collecting methods to determine if these species are present or absent."

"Jordan (1994b) recently collected the pugnose minnow and southern tessellated darter from Orange Creek, a tributary to Rodman Pool. McLane (1955) found the pugnose minnow to be '[V]ery rarely found in the Ocklawaha' and that it was 'a sluggish river and large lake dweller...' In 1992-94 it was also electrofished downstream of the Kirkpatrick Dam (in the LORBKD) by the Florida Game and Fresh Water Fish Commission (Continental Shelf Associates, Inc. 1994). McLane (1955) found the southern tessellated darter in the same vicinity prior to dam construction. Based on early and recent collection sites and knowledge of preferred habitat, these two species were probably present in the area of the Pool but are now restricted to its tributaries and the river."

"The remaining four freshwater species were collected by McLane (1955) prior to Pool construction in the main body of the Ocklawaha River and its tributaries. The most recent collections of bluenose shiner and dusky shiner appear to be 1948 and 1949 respectively (Museum records, University of Florida) from an area about seven miles upstream from the Ocklawaha River mouth" (in the LORBKD). "Jordan (1994b) made an unsuccessful effort to find bluenose shiner in 1994. The sailfin shiner and brown darter appear to have been most recently collected from tributaries of the Ocklawaha River well upstream of the Pool in 1976 (Museum records, University of Florida). The absence of these four species from the recent collections in areas near the Pool or areas now inundated suggests that they are very rare or have been eliminated from the Ocklawaha River proper and its tributaries."

"An additional species, the snail bullhead, was collected in the Pool in 1971" and more recently above the Kirkpatrick Dam at two locations (Evert and Gilbert 2006). "During the mid-1970's, the snail bullhead was collected both well upstream of the Pool and below the Kirkpatrick Dam (Museum records, University of Florida reported in Clugston 2002; Bass and Guillory 1976). Six other species of the catfish family have been collected by researchers from the river and the Pool during the 1990's." This concludes the major repeated sections from Clugston (2002).

Author Discussion

Largemouth bass (*Micropterus salmoides*) is an iconic sport fishing species common in lakes and rivers in Florida. Much of the argument about whether to restore the Ocklawaha River revolves around the populations of this species in the artificial impoundment which is the Rodman Pool, versus what might be the population and fishing opportunities in the Middle and Lower Ocklawaha River, and the St. Johns River, once the dam were breached. It is important to note that largemouth bass are also a common species in the Middle Ocklawaha River outside the Pool (https://sites.google.com/site/ocklawahaman/largemouth-bass-of-the-ocklawaha-river) and while population biomass is documented to have declined by 60% in Silver Springs (Munch et al. 2007) they are still routinely caught outside of the Pool (see Figure 6). One of the largest largemouth bass ever caught in Florida was in fact caught in the Ocklawaha River. The above referenced web site at page 26 of 43 (accessed on April 11, 2012) describes with a newspaper picture a 21 pound 3 ounce bass reportedly caught in the Ocklawaha River near Moss Bluff (south of the Rodman Pool) in 1975.

There is also data and reports that seriously question the claims of some that the Pool supports many more bass, and larger bass, than adjacent lakes and the SJR. As early as 1993 Canfield et al. stated, based upon their examination of catch data and their own sampling that "...largemouth bass fishing is declining in Rodman Reservoir" (p. 25), and that "fishing is substantially better in the Ocklawaha River" [outside the Pool] (p. 24). More recently, the 2014 ratings of best bass lakes in the USA (www.bassmasters.com) rated five Florida lakes in their top 100: Lake Okeechobee was #6, the Kissimmee Chain of Lakes was #21, Stick Marsh #42, SJR # 47 and Rodman Pool was #55.

Livingston (2004) [http://www.fladefenders.org/publications/FishingTournamentStudy.pdf]

reviewed fishing tournament results published in the Palatka Daily News between February 2001 and August 2004, notably looking at two of the area's major fishing tournaments, the

Wolfson Children's Hospital benefit (which begins on the St. John's River) and the Save Rodman Reservoir benefit. Livingston (2004) examined the total weight of catches on the SJR and the Pool. Both tournaments have a seven-fish limit. He repots that "the average winning creel weight of river fish caught at the Wolfson was 31.16 pounds while the Save Rodman Reservoir tournament average winning creel is only 23.51 pounds of reservoir fish (25% less weight). The average big fish for the four years studied was two pounds heavier in the Wolfson tournament than in the Save Rodman Reservoir tournament."

The presence of large amounts of large woody debris in the Pool left over from the partially cleared floodplain forest that was created from the construction of the Cross Florida Barge Canal no doubt contributes to optimum habitat for lake dwelling bass. However this habitat is disappearing over time and will not be replaced because there is no extensive live forest growing in the Pool to replace the decaying large woody debris. Floating and submerged aquatic vegetation in the Pool also contribute to bass habitat and habitat for forage fish and invertebrates. These areas will decline in some areas of the drained Rodman Pool after restoration, but other areas will open up for these types of vegetation. In particular, the 20 drowned natural springs under the Pool (Abbott 1971, see also http://sites.google.com/site/ocklawahaman/the-springs-of-the-ocklawaha-river-florida-from-rodman-dam-upstream-to-eureka-dam) will resume clear water flows and will naturally support very diverse submerged aquatic vegetation communities. Although it is reasonable to anticipate a decline in largemouth bass catches in former Pool areas with restoration, other sport fish species such as stocked and naturally reproducing striped bass will increase. Nursery habitat for largemouth bass below the existing dam within the now largely dry floodplain of the LORBKD should increase with more frequent inundation, and lead to increased bass populations in that reach of the river. Overall, there is no scientific support for the projection of any permanent major loss of sport fishing opportunities within the Middle or Lower Ocklawaha River ecosystem after restoration. Once the system stabilizes after the dam is breached, and floodplain ecosystems both above and below the dam are in the process of revegetation and rehydration (expected time frame 3-5 years), any temporary decline in fish populations should show a significant rebound. Expected increases in forage fish populations will soon offset any temporary decline in food for larger predators, not just including largemouth bass and striped bass, but wading birds, reptiles and mammals are expected to benefit from restoration.

Endangered shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus*) were once present in the St. Johns River. McLane (1955) mentions single collections of each over eight years ('46-'54) in the SJR. Both species were also collected from the St. Johns River by the State of Florida in 1981 (Fred Cross, Fish and Wildlife Conservation Commission to K. J. Sulak, USGS, personal communication to J. Clugston in Clugston 2002). No mention of possible use by these species of the Ocklawaha River is made by McLane (1955). McLane (1955) considered the one collection of a shortnose sturgeon in Lake George to be a stray.

Both species are mentioned as possibly using the Ocklawaha River historically, but no collections have ever been reported (Gilbert 1992). For these reasons they are not included in Table 2. Gilbert (1992) lists the shortnose sturgeon as endangered, and the Atlantic sturgeon as threatened. The status of the Atlantic sturgeon has recently (February 2012) been changed to

endangered. Removal of the Kirkpatrick Dam is mentioned in both species descriptions in the 1992 book as a potential restoration method for them, as well as by the National Marine fisheries Service (1998).

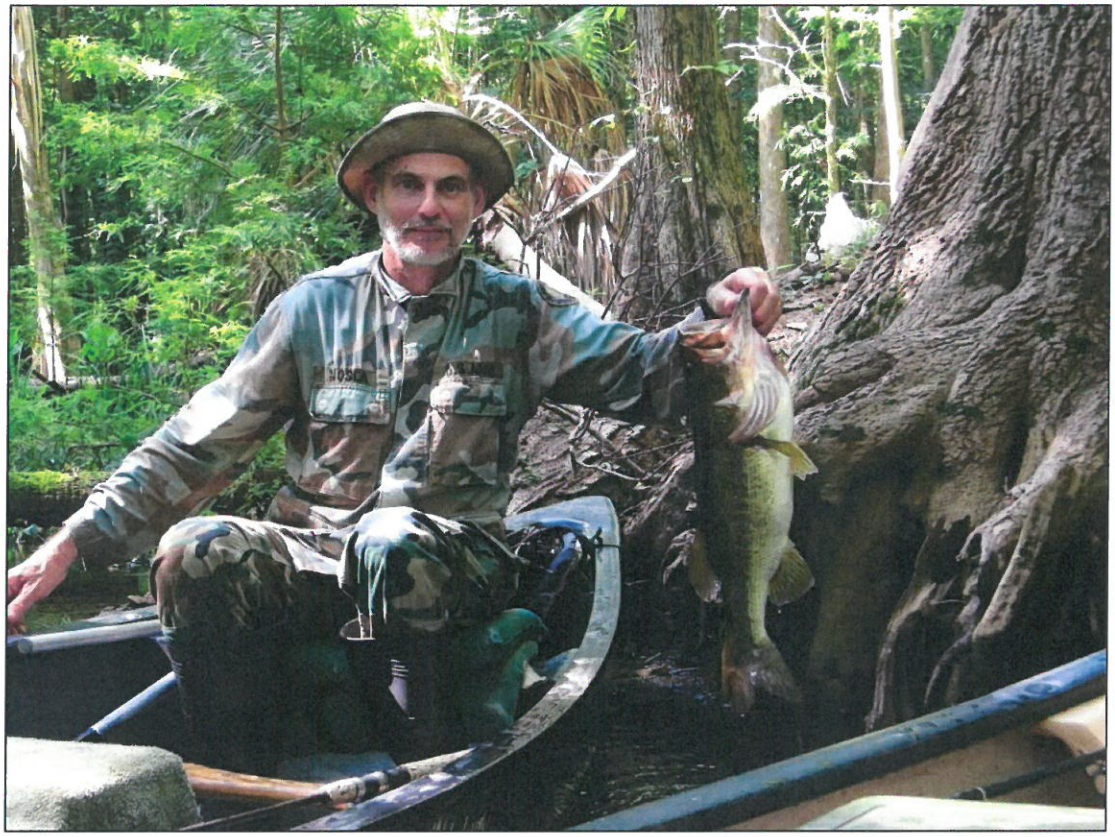


Figure 6. Largemouth bass caught by Paul Nosca on July 24, 2009 in the Middle Ocklawaha River near Gore's Landing. Photograph by K. Alwine.

Munch et al. (2007) conducted visual censuses in Silver Springs using the same techniques used in two previous studies by Odum (1957) and Knight (1980). A table summarizing their results is attached as Appendix A. Overall, 24 species were reported to have been observed historically, although the striped bass is not included in that list. Twenty-two species remain, but overall biomass has declined from 526.7 kg/ha to 41.9 kg/ha, a decline of 92% (Figure 7). As previously noted, striped mullet biomass has declined by 99%. In addition, gizzard shad biomass has declined by 96%, all catfish species biomass by 100% (total absence during sampling), and largemouth bass by 60%. The blocking of seasonal migrations of many of these species and declines in foraging biomass for species like largemouth bass are the likely cause of these major declines as noted by Knight (1980).

Finally, regarding what conditions might result from restoration; we would note that CSA (1994) concluded from their studies that "...the beneficial consequence of restoring a natural Ocklawaha River would be an increase in, and maintenance of biodiversity. The increase

in biodiversity would be accompanied by a decrease in overall biomass of fishes. Conversely, retention of Rodman Reservoir [Pool] or partial restoration would provide high fish biomass production at the expense of biodiversity. The retention scenarios are obviously artificial systems that will require intensive management programs to operate properly." This conclusion, of course, came before the data of Munch (2007) clearly demonstrated a 92% decline in fish biomass in the Silver River (Figure 7). Figure 8 from a recent Report Card for the Silver River and Silver Springs (Florida Springs Institute 2009) reports an additional data point with a 2009 measurement of biomass in the same general area as 196 kg/ha. Averaging the three measurements of fish biomass in Silver Springs post Rodman Pool closure, the mean value is 117.5 kg/ha, or a mean decline of 77.7%. A decline the author would expect to be reversed with restoration. The author would also expect a substantial increase in nursery habitat availability for largemouth bass and sunfish in the LORBKD, and thus increased and better fishing opportunities for these species, both in the LORBKD and the adjacent SJR with restoration, and an expected increase in the inundation of now relatively dry creeks and wetlands In the LORBKD.

As an example of this, Burdick and Hightower (2006) document the results of the removal of a low head dam in North Carolina (Quaker Neck Dam) and report that breaching resulted in an increase in spawning habitat for American shad, hickory shad and striped bass. Also, the recently reported restoration work at the 16,000 acre Mollicy Farms project site on the Ouachita River in Louisiana (Weber et al. 2012) notes that "fish productivity was an order of magnitude higher, and twice as many fish taxa were found during sampling of the undisturbed forested floodplain adjacent to Mollicy Farms than within the Mollicy Farms site [proposed restoration site]." This author would expect similar fish productivity restoration results after breaching of the Kirkpatrick Dam.

Miller et al (2012) describe the current degraded conditions of fish populations in the St. Johns River as follows:

"Since the 1850s, the St. Johns River has supported valuable commercial fisheries (Cary 1885; McLane 1955; Moody 1961). From 1948 to 1953, more than 4.5 million kg (10 million lbs) of fish were commercially harvested by haul seines from Lake George alone (Moody 1961). Other commercial gear types used in the river included trap nets, eel pots, gill nets, otter trawls, wire traps, and trotlines. Dominant species harvested included gizzard shad (Dorosoma cepedianum), black crappie (Pomoxis nigromaculatus), white catfish (Ameiurus catus), channel catfish (Ictalurus punctatus), American shad (Alosa sapidissima), and American eel (Anguilla rostrata)..."

"Recreational sport fishing is also extremely popular in the St. Johns River. The most sought-after freshwater species include largemouth bass (Micropterus salmoides), black crappie, bluegill (Lepomis macrochirus), redear sunfish (Lepomis microlophus), and redbreast sunfish (Lepomis auritus)...Angler survey data...indicate that annual angler sport fishing on the entire St. Johns River in 1975 to 1976 exceeded 2,300 man-hours per river km with yields exceeding 2,200 fish per river km. Compared to other Florida rivers, only the Blackwater River in the panhandle yielded more fish per river km."

*"Even though it continues to support valuable commercial and recreational fisheries, the fish community of the St. Johns River today is impaired compared to the community present 50 years ago. Native striped bass (Morone saxatilis) were extirpated, and populations are now maintained by stocking northern and hybrid strains... Spawning runs of anadromous shad and herring, that for decades supported extensive commercial and recreational fisheries, have dramatically declined ... The abundance of other commercially exploited species such as American eel and river catfish have also declined. In the 1960s, fisheries biologists began documenting shifts in the freshwater species composition in the river away from communities dominated by desirable sport fishes (e.g., largemouth bass and other sunfishes) toward communities dominated by undesirable species, such as gizzard shad and gar (Lepisosteus spp.)... By the 1980s, abundance of sport fishes had declined... Factors considered responsible for changes in the river fish community include overexploitation, persistent declines in water quality associated with urban and agricultural development, fish kills, channelization, over drainage and loss of basin wetlands, aquatic weed treatments, loss of habitat, introduction of exotics, and increased concentrations of herbicides, pesticides, and heavy metals...**Although some community changes (e.g., the extirpation of native striped bass, extensive habitat loss to development) are irreversible, others are not [emphasis added].** For example, water quality improvements or habitat restoration could result in increased abundance of sport fishes and shift communities toward more economically or socially desirable species. On the other hand, future anthropogenic impacts that further exacerbate community stressors could cause additional declines in the St. Johns River fishery resources."*

Unfortunately, Miller et al. (2012) make the mistake of using unscientific descriptions of specific fish species, labeling gizzard shad and gar as "undesirable species" and further make no mention of the reason for the extirpation (local extinction) of the native St. Johns River striped bass (Kirkpatrick Dam construction), and apparently lump it along with other anthropogenic impacts into the "irreversible" category. <u>It is obviously not irreversible, and the likely benefits from dam breaching to both the Lower Ocklawaha River ecosystem, and the St. Johns River fish and wildlife resources are well documented.</u>

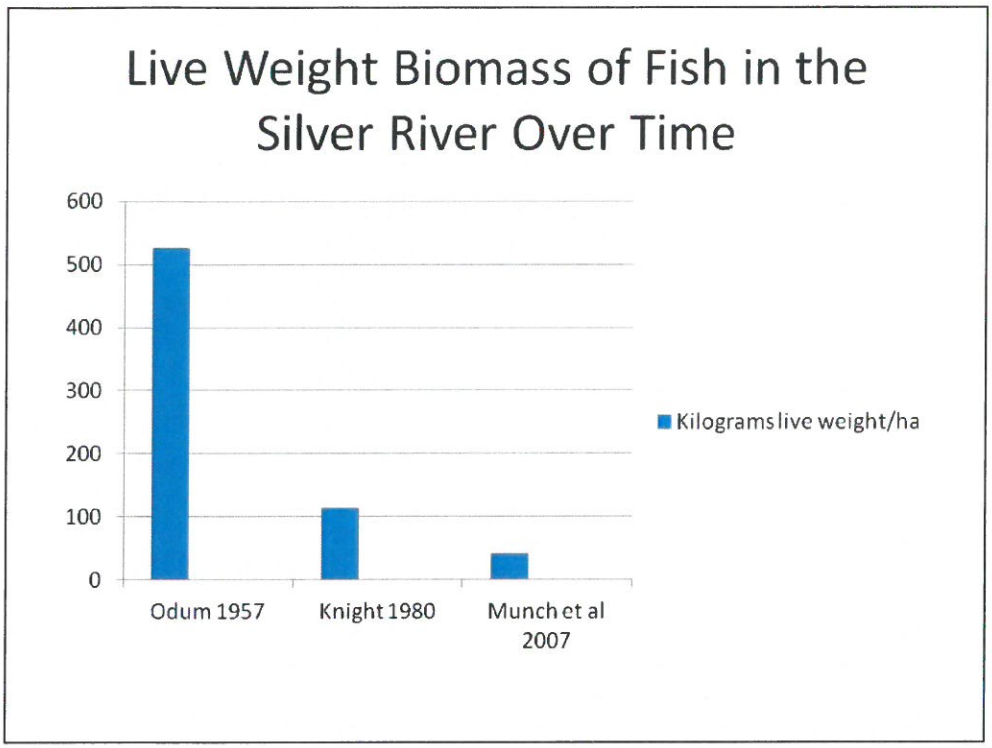


Figure 7. Graph showing the decrease in live weight biomass of fish over time in the Silver River. Data from Munch et al. (2007) (note linear scale v. log scale in Figure 8 below).

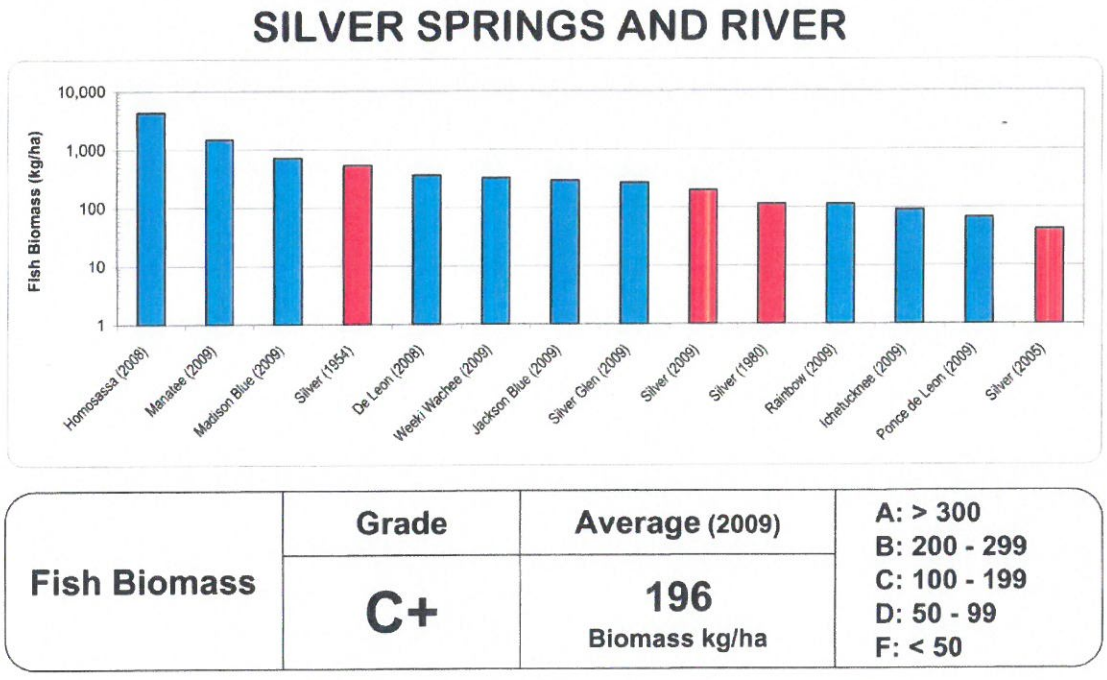


Figure 8. Fish biomass (Silver Springs and River in red) log scale. Courtesy of the Florida Springs Institute, Silver Springs and River Report Card, 2009.

CONCLUSIONS

With all of above information available, this author would conclude that there is no credible scientific basis to predict any permanent decline in fish resources following restoration, given enough time for migratory fish species to return (estimate 3-5 years), nor similarly to predict a specific permanent decline in sports fishing opportunities. The species mix may change, but fish biomass within the restored channels and wetlands (both above and below the existing Kirkpatrick Dam) will likely remain the same or increase over time after the initial breaching of the dam takes place, and migratory species including forage fish such as American shad, mullet and channel and white catfish populations are naturally restored.

Nursery habitat for largemouth bass should increase below the breached dam once normal flows are restored. A viable riverine bass and sunfish fishery will remain throughout the Ocklawaha River, and will likely increase in that portion of the Lower Ocklawaha River between the Kirkpatrick Dam and the St. Johns River. Given an average for three studies of a 77.7% decline in fish biomass in Silver Springs and the Silver River over the last 50 years, it is very likely fish populations would increase significantly in that specific habitat, and other springs and spring run habitats newly available after restoration. Sport fishing opportunities for species like the striped bass will increase with restoration, and the restoration of a self maintaining breeding population of striped bass is very likely.

LITERATURE CITED

Abbott, EF. 1971. Twenty springs of the Ocklawaha. An occasional paper prepared for the Florida Defenders of the Environment. Gainesville, Florida. 13 p + 1 fig.

Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American Eel, Fishery Management Report No. 36. Atlantic States Marine Fisheries Commission, Washington, D.C.

Barkuloo, JM. 1962. Anadromous fish species present, their distribution, and sport fishery potential in Florida. Quarterly Progress Report, Project F-10-R-5, Job 1-A. Florida Game and Fresh Water Fish Commission. Tallahassee, Florida.

Bass, DG and V Guillory. 1976. Cross Florida barge canal restudy report; fisheries study. Florida Game and Fresh Water Fish Commission. Unpublished final report. Volume III.

Blaber, SJM. 2009. Can the ecosystem approach improve management of tropical estuarine fisheries for diadromous species? Pages 649-661 in AJ Haro et al. (eds.), Challenges for diadromous fishes in a dynamic global environment. Symposium 69. American Fisheries Society, Bethesda, MD. 943 p.

Bonvechio, KI, and WE Johnson. 2007. Annual American eel, *Anguilla rostrata*, compliance report to the Atlantic States Marine Fisheries Commission for Florida, 2006-2007. 39 p.

Brierley, GJ, and KA. Fryirs (eds). 2008. River futures – An integrative scientific approach to river repair. Society for Ecological Restoration International. Washington, DC. 304 p.

Burdick, SM, and JE Hightower. 2006. Distribution of spawning activity by anadromous fishes in an Atlantic slope drainage after removal of a low-head dam. Trans. Am. Fish. Soc. 135:1290-1300.

Canfield, DE Jr., EJ Schulz, and MV Hoyer. 1993. To be or not to be – The Rodman Reservoir controversy. Department of Fisheries and Aquaculture, University of Florida, Gainesville, Florida. 59 p.

Cathey, A, A Cameron, H Hall, S Blair, and TT Ankerson. Undated. Large woody material: science, policy and best management practices for Florida sandbed streams. University of Florida Levin College of Law Conservation Clinic. 5 p.

Clugston, J. 2002. Fishes of the Ocklawaha River, Florida. Florida Defenders of the Environment, Gainesville, Florida. 14 p.

Continental Shelf Associates, Inc. 1994. An analysis of fish populations in Rodman Reservoir and the lower Ocklawaha River. Volume 15, Environmental studies concerning four alternatives for Rodman Reservoir and the lower Ocklawaha River, Jupiter, Florida. 57p.

Duchrow, RM and CC Starling. 1972. Water quality investigations. Florida Game and Fresh Water Fish Commission. Unpublished annual progress report, Tallahassee, Florida.

Estes, JR, WA Sheaffer, and EP Hall. 1989. Fisheries studies of Rodman Reservoir (Lake Ocklawaha) and the Ocklawaha River. Wallop-Breaux Project F-55-R, Lower Ocklawaha Basin Fisheries Investigations; 1987-1989 Completion Report. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Evert, JD and CR Gilbert. 2006. Current distribution of spotted bullhead and snail bullhead in Florida. Final Report, FFWCC. Tallahassee, Florida. 50 p.

FDEP. 2001. Basin Status Report – Ocklawaha. FDEP Bureau of Watershed Management, Tallahassee, Florida. 314 p.

FDEP. 2003. Water Quality Assessment Report – Ocklawaha. FDEP Bureau of Watershed Management, Tallahassee, Florida. 436 p.

Florida Department of Environmental Protection (FDEP). 1997. Ocklawaha River restoration project. Environmental Impact Statement. Florida Department of Environmental Protection, Tallahassee, Florida.

Florida Springs Institute. 2009. Report Card for Silver Springs and the Silver River. 7 p. http://floridaspringsinstiture.org. Accessed February 12, 2015.

Fowler, HW. 1945. A study of the fishes of the Southern Piedmont and Coastal Plain. The Academy of Natural Sciences of Philadelphia Monographs, Number 7. 408 p.

Gilbert, CR. 1992. Volume II. Fishes. Rare and Endangered Biota of Florida. University Press of Florida. Gainesville. 247 p.

Haller, WT and JV Shireman. 1984. Monitoring study for Lake Ocklawaha lake management plan. Final report. University of Florida, Gainesville, Florida.

Hill, JE, and CE Cichra. 2002a. Minimum flows and levels criteria development – evaluation of the importance of water depth and frequency of water levels/flows on fish population dynamics – literature review and summary – the effects of water levels on fish populations. SP SJ2002-SP1. SJRWMD, Palatka, Florida. 40 p.

Hill, JE, and CE Cichra. 2002b. Minimum flows and levels criteria development – evaluation of the importance of water depth and frequency of water levels/flows on fish population dynamics – literature review and summary – annotated bibliography for water level effects on fish populations. SP SJ2002-SP2. SJRWMD, Palatka, Florida. 64 p.

Holcomb, D. 1973. Water quality investigations. Unpublished final completion report. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Hoover, JJ, and KJ Killgore. 1998. Fish communities. Pages 237-260 in MG Messina and WH Conner (eds), Southern Forested Wetlands – Ecology and Management. Lewis Publishers, Boca Raton, Florida. 616 p.

Hubbs, CL, and ER Allen. 1943. Fishes of Silver Springs, Florida. Proceedings of the Florida Academy of Sciences. 6(3/4):110-118.

Jordan, F. 1994a. Ocklawaha River migratory fish assessment. Environmental studies concerning four alternatives for Rodman Reservoir and the lower Ocklawaha River, Volume 14. St. Johns River Water Management District, Palatka, Florida. 26 p + appends.

Jordan, F. 1994b. Current status of the southern tessellated darter (*Etheostoma olmstedi maculaticeps*) and the bluenose shiner (*Pteronotropis welaka*) in the Ocklawaha River system. Environmental studies concerning four alternatives for Rodman Reservoir and the lower Ocklawaha River, Volume 13. St. Johns River Water Management District, Palatka, Florida. 7 p.

Leitman, HM, MR Darst and JJ Nordhaus. 1991. Fishes in the forested flood plain of the Ochlockonee River, Florida, during flood and drought conditions. U.S. Geological Survey, Tallahassee, Florida. WRIR Report 90-4202. 36 p.

Knight, RL. 1980. Energy basis of control in aquatic ecosystems. Ph.D. dissertation, University of Florida, Gainesville, FL.

Livingston, J. 2004. A comparison of fishing tournament results in Rodman Reservoir and the St. Johns River and its natural lakes. Florida Defenders of the Environment, Gainesville, Florida. 24 p.

Lewis, R. R., R. G. Gilmore, Jr., D. W. Crewz and W. E. Odum. 1985. Mangrove habitat and fishery resources of Florida. Pp. 281-336 in W. Seaman, Jr. (ed.), Florida Aquatic Habitat and Fishery Resources. Florida Chapter, American Fisheries Society, Kissimmee, Florida. 543 pp.

McBride, RS. 2000. Florida's shad and river herring (*Alosa* species): a review of population and fishery characteristics. FFWCC, FMRI Technical Report TR-5. 26 p.

McKinney, SP, WA Sheaffer, WB Kittrell, Jr., and LE Snyder. 1989. 1985-1986 Fish Management Annual Report. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

McLane, WM. 1955. The fishes of the St. Johns River system. Ph.D. dissertation. University of Florida, Gainesville, Florida. 362 p.

Miller, SJ, RE Brockmeyer Jr., W Tweedale, J Shenker, LW Keenan, S Connors, EF Lowe, J Miller, C Jacoby and L McCloud. 2012. Chap. 12 Fish. In The St. Johns River Water Supply Impact Study. St. Johns River Water Management District, Palatka, Florida.

Munch, DA, DJ Toth, C Huang, JB Davis, CM Fortich, WL Osburn, EJ Philips, EL Quinlan, MS Allen, MJ Woods, P Cooney, RL Knight, RA Clarke and SL Knight. 2007. Fifty-year retrospective study of the ecology of Silver Springs, Florida. SJRWMD prepared for the FDEP. Special Publication SJ2007-SP4, SJRWMD. Various paging.

National Marine Fisheries Service. 1998. Recovery plan for the Shortnose Sturgeon (*Acipenser brevirostrum).* NMFS, Silver Spring, MD. 104 p.

Nico, LG, HL Jelks and T Tuten. 2009. Non-native suckermouth armored catfishes in Florida: description of nest burrows and burrow colonies with assessment of shoreline conditions. Aquatic Nuisanace Species Research Program Bulletin. Vol. 09-01. 30 p.

Odum, HT. 1957. Trophic structure and productivity of Silver Springs, Florida. Ecological Monographs 27:55-112.

Owen, GA. 1988. An evaluation of the fishery and angler effort, harvest, and success in Lake Ocklawaha, Florida. Florida Game and Fresh Water Fish Commission.

PBSJ. 2008. Draft technical memorandum No. 4. Nutrient information. 37 p + appends

PBSJ. 2010. Vegetation and nitrogen loading under various reservoir scenarios in support of the Ocklawaha River restoration project. Report submitted to the FDEP. 63 p.

Pikitch, E, PD Boersma, IL Boyd, DO Conover, P Cury, T Essington, SS Heppell, SS Houde, M Mangel, D Pauly, E Plaganyi, K Sainsbury, and RS Steneck. 2012. Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program, Washington, DC. 108 pp.

SDI Environmental Services, Inc. 2010. Implications of recent hydrologic trends on the safe yield estimate for the Ocklawaha River. A report to the Putnam County Environmental Council, Inc., P.O. Box 1836, Interlachen, FL 32148. 22 pp + append.

Reid, GK. 1970. The native aquatic fauna of the Ocklawaha River. *In:* Carr, M. H., R. F. Dasmond, W. M. Partington, and W. B. Robertson (eds). Environmental impact of the Cross Florida Barge Canal with special emphasis on the Ocklawaha regional Ecosystem. Florida Defenders of the Environment, Gainesville, Florida.

Rogers, MW, and MS Allen. 2004. Relationships between river surface levels and fish assemblages in the Ocklawaha and Withlachoochee Rivers, Florida, and the general implications for setting minimum flows and levels. Special Publication SJ2004-SP18.

Weber, D. J McGowan, S Haase, C Rice, T Kennedy, R Martin and K Ouchley. 2012. Bringing floodplain restoration to scale: the Mollicy Farms project on the Ouachita River, Upper Ouachita National Wildlife Refuge, Louisiana, USA. National Wetlands Newsletter 34(2):16-19.

Wissmar, RC, and PA Bisson (eds). 2003. Strategies for restoring river ecosystems. American Fisheries Society, Bethesda, Maryland. 276 p.

Table 2. Native Fishes Recorded from the Ocklawaha River System. (Modified from: Continental Shelf Associates, Inc., 1994 and Clugston 2002)

	Rodman Pool										Ocklawaha River and Watershed							
Source:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(1)	(11)	(2)	(7)	(12)	(13)	(14)	(15)
Family Sampling	1986	1992	1987	1987	1985	1979	1975	1973	1971	1971	1986	1993	1992	1975	1946	1945	1943	1899
Species Year(s):	- 94		- 88		- 88	- 83			- 72		- 94				-55			
Lepisosteidae																		
1 *Lepisosteus osseus,* longnose gar	●	●	●			●	●	●	●	●	●	●	●	●	●		●	●
2. *Lepisosteus platyrhincus,* Florida gar	●		●			●	●	●	●	●	●	●	●	●	●		●	
Amildae																		
3. *Amia calva*, bowfin	●		●	●		●	●	●	●	●	●	●	●	●	●		●	●
Elopidae																		
4. *Elops saurus*, ladyfish					●													
Anguillidae																		
5. *Anguilla rostrata*, American eel	●					●		●	●	●	●	●	●	●	●		●	
Clupeidae																		
6. *Alosa sapidissima*, American shad															●			
7. *Brevoortia sp.*, menhaden					●													
8. *Dorosoma cepedianum*, gizzard shad	●	●	●		●	●	●	●	●	●	●	●		●	●		●	●
9. *Dorosoma petenense*, threadfin shad	●	●				●		●	●	●	●	●			●	●	●	
Cyprinidae																		
10. *Notemigonus crysoleucas*, golden shiner	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
11. *Notropis chalybaeus,* ironcolor shiner												●			●			
12. *Notropis cummingsae*, dusky shiner												●			●			
13. *Notropis harperi*, redeye chub												●			●		●	
14. *Notropis maculatus,* taillight shiner	●		●	●		●	●	●	●		●	●		●	●			
15. *Notropis petersoni,* coastal shiner	●		●	●		●					●	●	●	●	●		●	●
16. *Opsopoeodus emilliae*, pugnose minnow											●	●			●			●
17. *Pteronotropis hypselopterus,* sailfin shiner												●		●	●			●
18. *Pteronotropis welaka,* bluenose shiner												●			●			●
Catostomidae																		

	Rodman Pool										Ocklawaha River and Watershed							
Source:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(1)	(11)	(2)	(7)	(12)	(13)	(14)	(15)
Family Sampling	1986	1992	1987	1987	1985	1979	1975	1973	1971	1971	1986	1993	1992	1975	1946	1945	1943	1899
Species Year(s):	- 94		- 88		- 88	- 83			- 72		- 94				-55			
19. *Erimyzon sucetta*, lake chubsucker	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
Ictaluridae																		
20. *Ameiurus brunneus*, snail bullhead										●		●		●	●			
21. *Ameiurus catus*, white catfish	●				●	●	●	●	●	●	●	●	●		●		●	●
22. *Ameiurus natalis*, yellow bullhead	●		●	●		●	●	●	●	●	●	●	●	●	●		●	
23. *Ameiurus nebulosus*, brown bullhead	●	●	●	●		●	●	●	●	●	●	●			●			●
24. *Ictalurus punctatus*, channel catfish					●	●	●	●	●	●	●	●		●	●		●	●
25. *Noturus gyrinus*, tadpole madtom	●	●				●	●	●	●	●	●	●			●			
26. *Noturus leptacanthus*, speckled madtom	●		●								●	●			●			
Esocidae																		
27. *Esox americanus*, redfin pickerel	●	●	●			●					●	●			●		●	
28. *Esox niger*, chain pickerel	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
Umbridae																		
29. *Umbra pygmaea*, eastern mudminnow												●						
Aphredoderidae																		
30. *Aphredoderus sayanus*,pirate perch	●	●	●	●		●	●	●	●	●	●	●			●		●	
Atherinidae																		
31. *Labidesthea sicculus*, brook silverside	●	●	●			●	●	●	●	●	●	●	●	●	●		●	●
32. *Menidia beryllina*, inland silverside											●	●			●			
Cyprinodontidae																		
33. *Cyprinodon variegatus*, Lake Eustis pupfish												●			●	●		
34. *Fundulus chrysotus*, golden topminnow	●	●	●			●	●					●			●		●	●
35. *Fundulus lineolatus*, lined topminnow												●			●		●	
36. *Fundulus rubrifrons*,redface topminnow												●			●			
37. *Fundulus seminolis*, Seminole killifish	●	●	●	●		●	●	●	●	●	●	●	●		●	●		
38. *Jordanella floridae*, flagfish	●	●				●	●	●				●			●	●	●	
39. *Leptolucania ommata*, pygmy killifish												●			●		●	

	Rodman Pool										Ocklawaha River and Watershed							
Source:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(1)	(11)	(2)	(7)	(12)	(13)	(14)	(15)
Family Sampling	1986	1992	1987	1987	1985	1979	1975	1973	1971	1971	1986	1993	1992	1975	1946	1945	1943	1899
Species Year(s):	- 94		- 88		- 88	- 83			- 72		- 94				-55			
40. *Lucania goodei,* bluefin killifish	●	●	●	●		●	●	●	●	●	●	●			●	●	●	●
41. *Lucania parva,* rainwater killifish												●			●		●	
Poeciliidae																		
42. *Gambusia holbrooki,* eastern mosquitofish	●	●	●	●		●	●	●	●	●	●	●		●	●		●	●
43. *Heterandria formosa,* least killifish	●	●	●	●		●	●	●				●			●		●	●
44. *Poecilia latipinna,* sailfin molly	●	●	●			●	●				●	●		●	●		●	●
Belonidae																		
45. *Strongylura marina,* Atlantic needlefish	●	●	●	●		●	●	●	●	●	●	●			●		●	
Percichthyidae																		
46. *Morone saxatilis,* striped bass					●							●			●			
Centrarchidae																		
47. *Acantharchus pomotis,* mud sunfish												●			●			
48. *Centrarchus macropterus,* flier												●			●			
49. *Enneacanthus chaetodon,* blackbanded sunfish												●			●			
50. *Enneacanthus gloriosus,* bluespotted sunfish	●	●	●	●	●	●	●	●	●	●	●	●			●			
51. *Enneacanthus obesus,* banded sunfish												●			●			
52. *Lepomis auritus,* redbreast sunfish	●		●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
53. *Lepomis gulosus,* warmouth	●	●	●	●	●	●	●	●	●	●	●		●	●	●		●	●
54. *Lepomis macrochirus,* bluegill	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
55. *Lepomis marginatus,* dollar sunfish	●	●	●	●	●	●	●	●	●		●	●	●		●			
56. *Lepomis microlophus,* redear sunfish	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
57. *Lepomis punctatus,* spotted sunfish	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
58. *Micropterus salmoides,* largemouth bass	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●
59. *Pomoxis nigromaculatus,* black crappie	●	●	●	●	●	●	●	●	●	●	●	●		●	●		●	●

	Rodman Pool										Ocklawaha River and Watershed							
Source:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(1)	(11)	(2)	(7)	(12)	(13)	(14)	(15)
Family Sampling	1986	1992	1987	1987	1985	1979	1975	1973	1971	1971	1986	1993	1992	1975	1946	1945	1943	1899
Species Year(s):	- 94		- 88		- 88	- 83			- 72		- 94				-55			
Elassomatidae																		
60. *Elassoma evergladei,* Everglades pygmy sunfish	●	●	●			●	●				●	●			●		●	●
61. *Elassoma zonatum,* banded pygmy sunfish												●			●			
Percidae																		
62. *Etheostoma edwini,* brown darter												●		●	●			
63. *Etheostoma fusiforme,* swamp darter	●	●	●	●		●	●	●	●	●	●	●			●			●
64. *Etheostoma oimstedi,* southern tessellated darter												●			●			
65. *Percina nigrofasciata,* blackbanded darter	●		●								●	●		●	●		●	
Mugilidae																		
66. *Mugil cephalus,* striped mullet	●		●		●	●		●	●	●	●	●		●	●		●	
67. *Mugil curema,* white mullet																	●	
Paralichthyidae																		
68. *Paralichthys lethostigma,* southern flounder												●			●			
Soleidae																		
69. *Trinectes maculates,* hogchoker											●	●	●	●	●		●	

Sources:

(1) Estes (1994, unpublished data).
(2) Canfield et al. (1993).
(3) Estes et al. (1989).
(4) Owen (1988).
(5) McKinney et al. (1985).
(6) Haller and Shireman (1984).
(7) Bass and Guillory (1976).
(8) Holcomb (1973).
(9) Duchrow and Starling (1972).
(10) Duchrow (1971).
(11) Museum Records (Florida Museum of Natural History).
(12) McLane (1955).
(13) Fowler (1945).
(14) Hubbs and Allen (1943).
(15) Evermann and Kendall (1899).

Table ES-5 Comparison of biomass estimates (kg live weight/ha) of fishes in the Silver River, Florida based on results of visual surveys from Odum (1957), Knight (1980), and this study. Methods used for visual surveys were different among studies. *Anguilla rostrata* was listed as *A. bostoniensis* in Odum (1957). Biomass was derived from grams dry weight per meter ^{2} estimates in in Odum (1957) and in Knight (1980) using standard wet weight/dry weight conversion factors.

Family	Common Name	Scientific Name	Biomass (kg/ha)		
			Odum	Knight	This Study
Amiidae	Bowfin	*Amia calva*		0.58	2.79
Anguillidae	American eel	*Anguilla rostrata*			0.01
Belonidae	Atlantic needlefish	*Strongylura marina*		0.01	
Catostomidae	Lake chubsucker	*Erimyzon sucetta*		1.97	1.10
Centrarchidae	Redbreast sunfish	*Lepomis auritus*			0.26
Centrarchidae	Bluegill	*Lepomis macrochirus*			10.99
Centrarchidae	Redear sunfish	*Lepomis microlophus*			2.42
Centrarchidae	Spotted sunfish	*Lepomis punctatus*			0.04
Centrarchidae	Sunfish sp.	*Lepomis sp.*	47.62	15.56	
Centrarchidae	Largemouth bass	*Micropterus salmoides*	27.14	18.65	11.10
Centrarchidae	Black crappie	*Pomoxis nigromaculatus*		0.02	0.01
Cichlidae	Blue tilapia	*Tilapia aurea*			0.23
Clupeidae	Gizzard shad	*Dorosoma cepedianum*		66.28	2.57
Cyprinidae	Golden shiner	*Notemigonus crysoleucas*		6.32	0.59
Cyprinodontidae	Golden topminnow	*Fundulus chrysotus*			0.00007
Cyprinodontidae	Bluefin killifish	*Lucania goodei*	18.57		0.002
Esocidae	Chain pickerel	*Esox niger*		1.34	2.61
Ictaluridae	Channel catfish	*Ictalurus punctatus*			0.03
Lepisosteidae	Longnose gar	*Lepisosteus osseus*	1.43		2.06
Lepisosteidae	Florida gar	*Lepisosteus platyrhincus*	44.29	1.33	3.52
Mugilidae	Striped mullet	*Mugil cephalus*	266.67	2.57	1.55
Percidae	Swamp darter	*Etheostoma fusiforme*			0.00007
Poeciliidae	Gambusia sp	*Gambusia sp.*	21.43		0.00003
Poeciliidae	Least killifish	*Heterandria formosa*	3.33		0.00003
	Catfish		95.24		
	Shiners		0.95		0.01
TOTAL FISH BIOMASS			526.7	114.6	41.90

PH-50

PUBLIC MEETING
COMMENT FORM

Florida Department of Environmental Protection
Division of Recreation and Parks

Marjorie Harris Carr Cross Florida Greenway
State Recreation and Conservation Area – Unit Management Plan Update

Comments can be emailed to ***FL_StateParkPlanning@dep.state.fl.us*** or mailed to Office of Park Planning, Florida Department of Environmental Protection, Division of Recreation and Parks, 3900 Commonwealth Boulevard, MS 525, Tallahassee, Florida 32399-3000.
Please submit comments by Thursday, November 30, 2017.

Notification of toxic weeds shown + listed at Equine trail heads
Better maps of trails showing marked intersections + way back to trail head
the existing maps are worthless
Bathroom facilities even porta johns would be appreciated

NATIONAL PARKS CONSERVATION ASSOCIATION
Gail Koeck
3531 W Highway 318
Citra, FL 32113-2159

ORLANDO FL 328
18 NOV 2017 PM 2 L
usa forever

Office of Park Planning

RECEIVED
NOV 20 2017
BY: OPP

PH-51

Barber, Alicia W

From: Vaughn, Greg A
Sent: Tuesday, December 12, 2017 4:23 PM
To: Barber, Alicia W
Subject: FW: Public Email Received RE - FW: Kenwood Campground

Please cross check to see if we already have this comment.

Greg Vaughn
ATKINS
greg.vaughn@atkinsglobal.com
850-580-7907

From: Gene Stillman [mailto:gstillman@thinkf4.com]
Sent: Tuesday, December 12, 2017 4:15 PM
To: Vaughn, Greg A <Greg.Vaughn@atkinsglobal.com>
Subject: FW: Public Email Received RE - FW: Kenwood Campground

Gene Stillman, *Project Manager*

F4 Tech
3059 Highland Oaks Terrace
Tallahassee, FL 32301 [map it]

O: 850.309.3914
C: 850.524.6061
F: 850.385.3811
www.thinkF4.com

From: Alsentzer, Daniel [mailto:Daniel.Alsentzer@dep.state.fl.us]
Sent: Tuesday, December 12, 2017 10:45 AM
To: Gene Stillman <gstillman@thinkf4.com>
Subject: FW: Public Email Received RE - FW: Kenwood Campground

For your compilation – a recent brief comment re: Kenwood.

From: Baxley, Demi
Sent: Tuesday, December 12, 2017 8:36 AM

To: Murray, Sine <Sine.Murray@dep.state.fl.us>
Cc: Cutshaw, Steven <Steven.Cutshaw@dep.state.fl.us>; Alsentzer, Daniel <Daniel.Alsentzer@dep.state.fl.us>
Subject: RE: Public Email Received RE - FW: Kenwood Campground

Thank you! ☺

From: Murray, Sine
Sent: Tuesday, December 12, 2017 8:33 AM
To: Baxley, Demi <Demi.Baxley@dep.state.fl.us>
Cc: Cutshaw, Steven <Steven.Cutshaw@dep.state.fl.us>
Subject: RE: Public Email Received RE - FW: Kenwood Campground

Pretty sure this is the Greenway.

Sincerely,
Sine

Sine A. Murray
Senior Planner
Office of Park Planning
Division of Recreation and Parks
Florida Department of Environmental Protection
Phone: 850.245.3061
Cell: 850.284.6551
sine.murray@dep.state.fl.us
Visit The Real Florida at: http://www.floridastateparks.org

From: FLStateParkPlanning
Sent: Tuesday, December 12, 2017 7:52 AM
To: Murray, Sine <Sine.Murray@dep.state.fl.us>
Cc: Cutshaw, Steven <Steven.Cutshaw@dep.state.fl.us>
Subject: Public Email Received RE - FW: Kenwood Campground

Not sure what this is (for filing purposes) ..... ☺

From: Bob [mailto:jabbaclimber@yahoo.com]
Sent: Monday, December 11, 2017 10:38 PM
To: FLStateParkPlanning <FLStateParkPlanning@dep.state.fl.us>
Subject:

Sent from Mail for Windows 10

Please reconsider opening Kenwood campground. We as Boy Scouts have used this park for years and it would be a big loss for us not being about to use this park..

Bob Kass
Troup 25 Orange Park

From:	Alsentzer, Daniel
To:	Baxley, Demi
Subject:	FW: FWC"s Comments on Marjorie Harris Carr Cross Florida Greenway State Recreation and Conservation Area Draft Unit Management Plan - 2017-2027
Date:	Monday, January 8, 2018 9:29:53 AM
Attachments:	Cross-Florida Greenway Draft Unit Management Plan_34087_010418.pdf

---

From: Wallace, Traci [mailto:traci.wallace@MyFWC.com]
Sent: Thursday, January 04, 2018 3:21 PM
To: Alsentzer, Daniel <Daniel.Alsentzer@dep.state.fl.us>
Cc: Thomason, Mickey <Mickey.Thomason@dep.state.fl.us>; GStillman@thinkf4.com; Greg.Vaughn@atkinsglobal.com; Raininger, Christine <Christine.Raininger@MyFWC.com>; Goff, Jennifer <jennifer.goff@MyFWC.com>; Hight, Jason <Jason.Hight@MyFWC.com>; Wettstein, Fritz <Fritz.Wettstein@MyFWC.com>; Wright, Shannon <shannon.wright@MyFWC.com>; Workman, Mindy <Mindy.Workman@MyFWC.com>; Wynn, Chris <Chris.Wynn@MyFWC.com>; Barry, Darlene <darlene.barry@MyFWC.com>
Subject: FWC's Comments on Marjorie Harris Carr Cross Florida Greenway State Recreation and Conservation Area Draft Unit Management Plan - 2017-2027

Please find attached FWC's comments on the above-referenced project. You will **not** receive a hard-copy version of this letter unless requested.

If you wish to reply to our comments, please send your reply to:

FWCConservationPlanningServices@myFWC.com

Traci Wallace, AA III
Office of Conservation Planning Services
850-410-5272

Florida Fish and Wildlife Conservation Commission

Commissioners
Bo Rivard
Chairman
Panama City

Richard Hanas
Oviedo

Gary Nicklaus
Jupiter

Sonya Rood
St. Augustine

Michael W. Sole
Tequesta

Robert A. Spottswood
Key West

Brian Yablonski
Tallahassee

Executive Staff
Eric Sutton
Executive Director

Jennifer Fitzwater
Chief of Staff

Managing fish and wildlife resources for their long-term well-being and the benefit of people.

Office of the
Executive Director
Eric Sutton
Executive Director

(850) 487-3796
(850) 921-5786
FAX

620 South Meridian Street
Tallahassee, Florida
32399-1600
Voice: (850) 488-4676

Hearing/speech-impaired:
(800) 955-8771 (T)
(800) 955-8770 (V)

MyFWC.com

January 4, 2018

Daniel Alsentzer, Park Planner
Office of Park Planning
Florida Department of Environmental Protection
Division of Recreation and Parks
3900 Commonwealth Blvd.
Tallahassee, FL 32399
Daniel.Alsentzer@dep.state.fl.us

RE: Marjorie Harris Carr Cross Florida Greenway State Recreation and Conservation Area Draft Unit Management Plan (2017-2027)

Dear Mr. Alsentzer:

Florida Fish and Wildlife Conservation Commission (FWC) staff has reviewed the above-referenced draft unit management plan. We provide the following comments and recommendations as technical assistance for your consideration, and in accordance with FWC's authorities under Chapter 379, Florida Statutes.

Project Description

The Florida Department of Environmental Protection (FDEP), Division of Recreation and Parks uses the 10-year management plan for the Marjorie Harris Carr Cross Florida Greenway (CFG) as the basis for future management and development. The CFG spans approximately 110 miles and 71,000 acres from Yankeetown on Florida's west coast, to south of Palatka on the St. Johns River, near the east coast of Florida. The State of Florida acquired the lands for the CFG to manage as a Public Recreation and Conservation Area when the Cross-Florida Barge Canal project ended in 1991. The CFG ranges from 300 yards wide to one mile wide and includes portions of four counties in the upper Florida peninsula: Citrus, Levy, Marion, and Putnam. The CFG traverses numerous natural areas, physiographic areas, and human features. Dominant natural land covers include floodplain swamp (15%), sandhill (9%), mesic flatwoods (7%), mesic hammock (6%), and basin swamp (5%). The major highways along the CFG include United States Highway (US) 19/98, US 41, US 27/301/441, and State Roads (SR) 200, 40, and 19. In addition, the CFG crosses Interstate 75 (I-75) just south of Ocala, via the first land bridge constructed over a major interstate roadway in the United States, providing both pedestrian and wildlife crossing opportunities.

Comments and Recommendations

Multiple organizational units within the FWC have management responsibilities or program activities within the CFG. These include: the divisions of Law Enforcement, Freshwater Fisheries Management, Hunting and Game Management, and several sections within the Division of Habitat and Species Conservation including Invasive Plant Management (aquatic and upland) and Wildlife Habitat Management; and the Public Access Services Office. FWC staff comments and recommendations for the CFG Draft Unit Management Plan include information provided by each of these work units. FWC staff supports the draft unit management plans and remains supportive of the cooperative management of conservation lands that include the CFG. General comments and recommendations for the plan are provided below, and detailed recommendations are included in the enclosed Advisory Group Comment Matrix spreadsheet.

Imperiled Species

FWC staff recommends the plan reference the FWC's new Imperiled Species Management Plan which provides updated listing status, species guidelines, and conservation actions for state-listed species (http://myfwc.com/media/4133167/floridas-imperiled-species-management-plan-2016-2026.pdf). The current status for all of Florida's listed species should be updated according to this plan and FWC species-specific conservation measures used as a reference for long-term CFG management planning.

Wildlife Disturbance

FWC staff acknowledges the plan's protective approach towards natural communities, cultural resources, and listed species and discussion of potential impacts that CFG activities may have on these features. It is also important to consider disturbance of general fish and wildlife resources when developing or redeveloping outdoor recreation and public access opportunities. Whether direct or indirect, activities within the CFG may cause unintended disturbance to wildlife and impacts to feeding, breeding, sheltering, or migration activities of wildlife within or through the CFG. Planning for outdoor recreation can improve the "viewability" of the wildlife that the public wishes to see in its natural habitat while minimizing potential negative impacts to sensitive species. Please see the enclosed literature review, *Wildlife and Recreation: Understanding impacts on Florida's natural areas,* compiled by FWC staff, for more detailed information.

Additionally, if planning for new trail systems or recreational opportunities moving forward, FWC staff can assist FDEP staff with planning fish and wildlife surveys, and any avoidance, minimization or mitigation measures, including site design that accounts for state-imperiled species' habitats. Basic guidance for conducting wildlife surveys and conservation measures related to certain listed species found within the CFG can be found within the Imperiled Species Management Plan mentioned above or the Florida Wildlife Conservation Guide (http://myfwc.com/conservation/value/fwcg/).

Invasive Plant Management

FWC staff has reviewed the draft management plan provisions for invasive plant management activities. The plan provides general information about what invasive plants are present, how to treat certain plants, and the history of how the species came to infest Florida. FWC staff recommends the management plan focus on challenges specific to the CFG property and how the management plan will address those specific challenges. It may also be beneficial to include specific targets to measure success. For example, consider documenting long-term goals for rotation and the appropriate treatment interval per species or area. Treatment interval plans for grasses or other fast growth species may need multiple treatments per year.

The *Aquatic Invasive Plant Species Management on the CFG* section could also include an aquatic plant management plan for Rodman Reservoir, similar to Lake Rousseau's plan. This plan could use a maintenance control strategy for invasive aquatic plants which focuses on treatment of smaller plant populations on a more frequent level, as opposed to management after the population has exceeded acceptable limits. This strategy could be used in conjunction with the existing control of fluctuating water levels annually, and temporary drawdowns every 3 to 4 years. For further invasive plant management recommendations, see the attached comment matrix, or contact the FWC staff identified below.

Caravelle Ranch Wildlife Management Area

FWC staff appreciates continued efforts to maintain close communications for land management activities including prescribed fires and timber management conducted along the shared

boundaries of the CFG and the Caravelle Ranch Wildlife Management Area (WMA). Please continue these coordination efforts with the Caravelle Ranch WMA through the lead biologist, Jason Slater, at (386) 329-2517 or by email at Jason.Slater@MyFWC.com. FWC staff will continue to work with FDEP Office of Greenways and Trails staff regarding FWC plans to conduct prescribed fire on adjacent Caravelle Ranch WMA lands. We have also provided a copy of the Caravelle Ranch Establishment Order (enclosed) as requested to clarify acreages and location information.

We appreciate the opportunity to review the proposed CFG management plan and look forward to working with FDEP staff throughout the management process. If you need any further assistance, please do not hesitate to contact our office by email at FWCConservationPlanningServices@MyFWC.com. If you have specific technical questions, please contact Christine Raininger at (561) 882-5811 or by email at Christine.Raininger@MyFWC.com.

Sincerely,

Jennifer D. Goff, Director
Conservation Planning Services

jdg/car
ENV 1-2-2
Cross-Florida Greenway Draft Unit Management Plan_34087_010418

ENCLOSURES:

CFG Advisory Group Comment Matrix, FWC

Jones, P.J., FWC Public Access Services Office, *Wildlife and Recreation: Understanding impacts on Florida's natural areas*, October 2007

Caravelle Ranch Wildlife Management Area, Establishment Order Number WMA 11-04

cc: Mickey Thomason, Park Manager, Mickey.Thomason@dep.state.fl.us
Gene Stillman, F4 Tech Inc., GStillman@thinkf4.com
Greg Vaughn, Atkins Greg.Vaughn@atkinsglobal.com

Cross Florida Greenway Unit Management Plan
Advisory Group Draft CFG
Comment Matrix
October 2017

COMMENT NUMBER	REVIEWER (last name, first name)	SECTION	PAGE	LINE	COMMENT	COMMENT CATEGORY S, R, E (Substantive, Requested, Editorial)	HOW COMMENT ADDRESSED Change Made (CM); Clarification Required (CR); No Change Made (NC)	RESPONSE (by consultant)
1	Matthews, Tom	Various			All instances of American oystercatcher should be changed from *H. palliates* to *H. palliatus*.	E		
2	Matthews, Tom	Various			All instances of gopher frog should be changed from *Rana capito* to *Lithobates capito*.	E		
3	Matthews, Tom	Imperiled Species	87	Table 9	*Gopherus Polyphemus* to *Gopherus polyphemus (lower case)*	E		
4	Matthews, Tom	Imperiled Species	87	Table 9	Suwannee cooter from *Pseudyms concinna suwanniensis* to *Pseudemys suwanniensis*	E		
5	Matthews, Tom	Imperiled Species	87	Table 9	Osprey from *Pandicon* to *Pandion*	E		
6	Matthews, Tom	Various			All instances of Least tern from *Sterna* to *Sternula*	E		
7	Matthews, Tom	Imperiled Species	87	Table 9	Pinewoods dainties to ssp. *Platylepis* (lower case)	E		
8	Matthews, Tom	Imperiled Species	87	Table 9	Black-crowned night-heron from *N. nycticorax l* to *N. nycticorax*	E		
9	Matthews, Tom	Imperiled Species	87	Table 9	Florida sandhill crane to G. canadensis pratensis (lower case)	E		
10	Matthews, Tom	Imperiled Species	91	8	*Mycteria Americana* to *Mycteria americana* (lower case)	E		
11	Matthews, Tom	Imperiled Species	93	21	Tricolored heron scientific name should be spelled out as it has not been used previously in the document: *Egretta tricolor.*	E		
12	Matthews, Tom	Invasive Species	105	Table 12	*Asparagus Athiopicus* to *Asparagus athiopicus* (lower case)	E		
13	Matthews, Tom	Various			All instances of Chinese tallow from *Sapium sebiferum* to *Triadica sebifera*	E		
14	Matthews, Tom	Invasive Species	106	Table 12	*Casuarina eqisetifolia* to *Casuarina eq u isetifolia*	E		
15	Matthews, Tom	Invasive Species	106	Table 12	*Meia azedarach* to *Me l ia azedarach*	E		
16	Matthews, Tom	Invasive Species	107	Table 12	*Dioscoria* to *Dioscor e a*	E		
17	Matthews, Tom	Invasive Species	107	Table 12	*Urena lobate* to *Urena lobat a*	E		
18	Matthews, Tom	Invasive Species	108	Table 12	*Imperata cylindrica l* to *Imperata cylindrica*	E		
19	Matthews, Tom	Invasive Species	109	Table 12	*Eichhornia crass h ipes* to *Eichhornia crassipes*	E		
20	Matthews, Tom	Invasive Species	112	2	*Imperata cylindrica l* to *Imperata cylindrica*	E		
21	Matthews, Tom	Various			Consider changing cogon grass to cogongrass, torpedo grass to torpedograss and Natal grass to Natalgrass which is the standard used by the USF Institute for Systematic Botany, USDA PLANTS Database, and UF IFAS.	E		
22	Matthews, Tom	Various			Caesarweed should be caesarweed or Caesar's weed. Both are used in the text and tables.	E		
23	Matthews, Tom	External Conditions	160	Table 17	Caravelle Ranch WMA also allows horseback riding and bicycles.	S		
24	Matthews, Tom	External Conditions	160	Table 17	Any hunting that is listed in the table is "seasonal" as there are no public lands that allow hunting year-round. All hunting should be listed as "hunting" exclusively or as "seasonal hunting" exclusively.	S		
25	Matthews, Tom				An area of the CFG in Silver Springs Shores, Marion County is managed cooperatively with FWC as Marshall Swamp WMA: http://myfwc.com/hunting/wma-brochures/ne/marshall-swamp/. There is no mention in the document other than the "Midway Road Trailhead" in Figure 18.	S		
26	Raininger, Christine	Imperiled Species	87	Table 9	Bluenose Shiner SSC, now ST	E		
27	Raininger, Christine	Imperiled Species	87	Table 9	Gopher Frog SSC now DL (delisted)	E		

	Cross Florida Greenway Unit Management Plan Advisory Group Draft CFG Comment Matrix October 2017							
COMMENT NUMBER	REVIEWER (last name, first name)	SECTION	PAGE	LINE	COMMENT	COMMENT CATEGORY S, R, E (Substantive, Requested, Editorial)	HOW COMMENT ADDRESSED Change Made (CM); Clarification Required (CR); No Change Made (NC)	RESPONSE (by consultant)
28	Raininger, Christine	Imperiled Species	87	Table 9	Pine Snake SSC now ST	E		
29	Raininger, Christine	Imperiled Species	87	Table 9	Suwannee Cooter SSC now DL	E		
30	Raininger, Christine	Imperiled Species	87	Table 9	Limpkin SSC now DL	E		
31	Raininger, Christine	Imperiled Species	87	Table 9	Little Blue Heron SSC now ST	E		
32	Raininger, Christine	Imperiled Species	87	Table 9	American Oystercatcher SSC now ST	E		
33	Raininger, Christine	Imperiled Species	87	Table 9	Osprey SSC (listed SSC Monroe County Population only) - suggestion to remove from list since osprey is not considered an imperiled species in these counties	E		
34	Raininger, Christine	Imperiled Species	87	Table 9	Florida Mouse SSC now DL	E		
35	Raininger, Christine	Imperiled Species	90	Table 9	White Ibis SSC now DL	E		
36	Raininger, Christine	Imperiled Species		Table 9	MISSING from Table 9 - Please include the Florida Manatee (Trichechus manatus, Federally Threatened [FT]) into Table 9. FWC staff appreciates the information included in Addendum 6, and the impoundments and water control structures section.	S		
37	Raininger, Christine	park significance	10	15	space between are and released	E		
38	Raininger, Christine	facilities development	220	22	accel/decal to accel/decel	E		
39	Slater, Jason	Current Recreation Use...	211	23	Caravelle Ranch WMA actually has 75 days of hunting if you include all the days, however 8 of those are specific to the FWC BOT lease and not conducted on the Greenway property. Should these be included in this document or not since it is Greenway specific? If not, the number is 67.	S		
40	Rob Kipker	Aquatic Invasive Plant Species Management on the CFG	110	23 - 25	Please note there should be no mention of dollar amounts spent/budgeted, especially by agencies other than DEP/DRP. Strike reference to FWC budget for plant control page 120, line 23 to 25. These numbers change when needs change and no water body is guaranteed any funds.(please strike following language) " numerous other benefits ~~FWC budgets approximately $30,000 per year for aquatic plant control in Rodman Reservoir. The FWC budgets up to $1 million per year to control aquatic non-native invasive plant species in Lake Rousseau by using contractors~~."	E		
41	Rob Kipker	Aquatic Invasive Plant Species Management on the CFG	add to page 110		Develop an aquatic plant management plan for Rodman Reservoir similar to Lake Rousseau's. This plan would utilize a maintenance control strategy for invasive aquatic plants, as opposed to crisis management. Maintenance control which is the treatment of smaller plant populations on a more frequent level. This strategy would be used in conjunction with the existing control of fluctuating water levels annually, and conducting temporary drawdowns every 3 to 4 years.	S/R		
42	Rob Kipker	Exotic and Nuisance Species	page 104-109.	Table 12	Recommend adding Hydrilla verticillata to table 12. Present in both Rodman and Rousseau.	R		
43	Rob Kipker	Exotic and Nuisance Species		Table 12	Check spelling of several key species names. It appears as though auto-correct has occasionally changed things.	E		

	Cross Florida Greenway Unit Management Plan Advisory Group Draft CFG Comment Matrix October 2017							
COMMENT NUMBER	REVIEWER (last name, first name)	SECTION	PAGE	LINE	COMMENT	COMMENT CATEGORY S, R, E (Substantive, Requested, Editorial)	HOW COMMENT ADDRESSED Change Made (CM); Clarification Required (CR); No Change Made (NC)	RESPONSE (by consultant)
44	Rob Kipker	Exotic and Nuisance Species		Table 12	Recommend they verify some facts, i.e. Albizia julibrissin is actually a FLEPPC Cat 1 species, not a cat 2 as they've stated.	E		
45	Rob Kipker	Exotic and Nuisance Species	Page 102	28-40	FWC staff would like to recommend inclusion of verbiage within the plan that includes DEP DRPs' contingency plan of action if FWC Invasive Plant Management funds are not available.	R		
46	Rob Kipker	Exotic and Nuisance Species	Page 112-122		Less focus on verbiage about how a particular species came to infest Florida and more verbiage about possiblities or plans to control more location-specific to the CFG property (The plan mainly talks about what they have and how to treat certain plants.)	R		
47	Rob Kipker	Exotic and Nuisance Species	page 103-110	Table 11	FWC staff would like to see a rotation- interval plan (both for in-house and FWC/IPM monies. We recommend a map that shows the Park's Management Units, with actual infestation areas delineated. This map would show actual infestation coverages as well as treatment plan intervals. What is the long-term goal for rotation, which blocks must be treated every other year, every three years? A plan for grasses or species that need multiple treatments per year. Replace points with polygons of species that require multiple treatments a year would be best. While new infestations can occur, for the next 10 years it would be good to have a plan that someone who does not know the area could pick up and follow.	R		
48	Jason Slater and Mike Abbott	Subleases Agreements and Easements	page 157	Table 16	FWC staff recommend checking the statements for accuracy regarding the sublease acres and total acreage of Caravelle Ranch WMA. Please see the enclosed Establishment Order Number WMA 11-04 for the legal description of Caravelle Ranch WMA.	E		
49	Christine Raininger	Table of Contents	i		Check page references for accuracy	E		
50	Major Jay Russel	Eureka Lock Law Enforcement	page 220	lines 12 through 15	FWC Northeast Regional Commander, Major Russel will reach out to Mickey Thomason, Park Manager, on the action items listed for the Eureka Dam.			
51								
52								
53								
54								
55								
56								
57								
58								
59								
60								
61								
62								
63								
64								

	Cross Florida Greenway Unit Management Plan Advisory Group Draft CFG Comment Matrix October 2017							
COMMENT NUMBER	REVIEWER (last name, first name)	SECTION	PAGE	LINE	COMMENT	COMMENT CATEGORY S, R, E (Substantive, Requested, Editorial)	HOW COMMENT ADDRESSED Change Made (CM); Clarification Required (CR); No Change Made (NC)	RESPONSE (by consultant)
65								
66								
67								
68								
69								
70								
71								
72								
73								
74								
75								
76								
77								
78								
79								
80								
81								
82								
83								
84								
85								
86								
87								
88								
89								
90								
91								
92								
93								
94								
95								
96								
97								
98								
99								
100								

Wildlife and Recreation:
Understanding impacts on Florida's natural areas

PJ Jones
Biological Scientist
Public Access Services Office
Florida Fish and Wildlife Conservation Commission

October 2007

Wildlife and Recreation: Managing impacts on Florida's natural areas

Introduction

Natural resource management agencies at all levels of government are frequently charged with a challenging dual mission: To protect ecosystems AND to provide opportunities for the public to recreate. As outdoor recreation continues to rank as one of America's favorite activities, areas of the country that are experiencing rapid population growth will place increased recreational demand on nearby natural areas. The state of Florida, specifically, will undergo unprecedented growth in the near future, with a population expected to increase from 17 to 27.5 million in the next 25 years, and to 36 million by 2060 (Century Commission website). Wildlife and recreation professionals are expressing increasing concern that outdoor recreation is taking a significant toll on wildlife. The challenge today for natural resource professionals is to devise and employ strategies that allow for the coexistence of thriving wildlife populations and recreationists on natural areas.

The Florida Fish and Wildlife Conservation Commission's Public Access Services Office (PASO) exists to provide the public with recreational opportunities based specifically on wildlife viewing. It follows that the success of their efforts relies on healthy wildlife populations. So that the FWC, and other agencies, can ensure that vibrant, diverse wildlife communities continue to thrive in natural areas with recreational access, this report synthesizes the existing body of knowledge on recreation impacts on wildlife and explores strategies for minimizing the harmful impacts of recreational use on wildlife.

**While recreation is thought to have lasting effects on the entire spectrum of wildlife species, the scarcity of studies on wildlife impacts has focused on the short term impacts on birds and large mammals. This report is based on the findings from these studies. New terminology relevant to recreation's impact on wildlife is in bold type.*

Recreation impacts

One of the first steps for natural resource professionals to make in "managing for coexistence" is to obtain a thorough awareness of the existing and potential impacts that recreational use brings to their natural area. Recreational use of a natural area carries some degree of inescapable impact to water, soil, vegetation, and wildlife resources. While all of these impacts are important, this report focuses on wildlife impacts, which has not been studied to the extent of the others, but demands equal consideration (For more information on water, soil, and vegetation impacts, see Recreation Ecology (Liddle 1997) and Wildland Recreation (Hammit and Cole 1998)).

Twenty-two years ago, two wildlife biologists conducted a comprehensive literature review to determine the pervasiveness of recreation's impact on wildlife. They found 166 relevant articles showing that recreation caused changes in wildlife's physiology, behavior, reproduction, population levels, species composition and diversity (Boyle and Sampson 1985).
Since then, studies have continued to identify, explain, and categorize recreation impacts on wildlife, forming a body of knowledge which is useful to natural resource managers.

Levels of impact

Wildlife can experience impacts on levels significant to the individual, the population, and/or the entire wildlife community. Recreation impacts initially fall upon individuals in a wildlife community. Over time, impacts on individuals can manifest into impacts at the population or

community level. Impacts that either preclude wildlife from using suitable habitat or from exhibiting behaviors essential to their survival (feeding, mating, hibernating, young raising) carry the potential to cause these population and community level effects (Taylor and Knight 2003).

It is easiest and most practical to measure and monitor impacts to individuals, and to use this information to make inferences about the well-being of the population and community. Impacts on individuals normally occur over a short span of time, while population and community effects are only observed in the long term. A goal of the natural resource manager should be to detect and mitigate recreation impacts on wildlife before population or community impacts are realized. For example, many of Florida's trails traverse upland ecosystems that house gopher tortoise populations. If a trail system is routed too close to existing tortoise burrows, the burrows could collapse or become abandoned. If the problem was left unmanaged, and recreational pressure continued to increase, spurring the creation of new trails, the entire population of tortoises could eventually become threatened. If the population was degraded significantly, other members of the wildlife community, who rely on the tortoise burrows, could suffer negative impacts, as well.

Types of impacts

Recreation impacts on wildlife can also be categorized as **direct** or **indirect**. Direct impacts occur as a result of direct interactions between wildlife and recreationists. Hunting and fishing are the most blatant direct impacts to wildlife, since individuals are permanently removed from their community. Other forms of recreation frequently cause direct mortality by vehicle collisions. These impacts, where wildlife are immediately removed from their habitat, can be classified as **exploitation** (Knight and Gutzwiller 1995). The other, more subtle, but also more pervasive direct recreation impact on wildlife is termed **disturbance.** Wildlife become disturbed when their daily behaviors (feeding, breeding, resting, etc.) are interrupted, usually by something they perceive as threatening. All species endure some degree of disturbance every day from the other species that share their habitat. Most wildlife species perceive humans as a threat, so when an animal encounters one, it exhibits a protective response, diverting its attention from what it was doing previously (Hammitt and Cole 1998, Knight and Gutzwiller 1995). If individuals are disturbed beyond their ability to compensate for their losses, they will suffer negative impacts. If these negative impacts impair a significant number of individuals, population and community effects will begin to emerge.

These negative impacts usually fall into at least one of the following categories:

- **Energetic compromise**--Energetic compromise occurs when an individual or group is disrupted from feeding (decreased energy input) and/or flushed from its preferred location (increased energy output). Most wildlife survives on a tight energy budget, and a significant loss of energy can result in reduced fitness and survivorship.
- **Reproductive interruption**--Reproductive interruption occurs when an individual or group is disrupted from any reproduction-related behavior (mating displays, nest building, brooding/incubation, young rearing, etc.). Significant reproductive interruption can result in reduced productivity.
- **Displacement**--Displacement occurs when an individual opts to temporarily or permanently abandon otherwise suitable habitat due to excessive disturbance. Unless there is alternative habitat with vacant niches for the displaced wildlife, displacement can eventually result in local extinction. (Rodgers and Smith 1997, Taylor and Knight 2003). Decisions about whether individuals abandon a site are ultimately determined by factors such as the quality of the occupied site, distance and quality of other suitable sites, and the relative risk of predation and competition at different sites (Peters and Otis 2006). Excessive displacement can lead to changes in abundance and distribution of resident wildlife.

Indirect impacts occur when recreation impacts a component of an ecosystem that translates into an impact on wildlife. Habitat modification and pollution/littering are the most common indirect recreation impacts. These impacts are unique in that they persist regardless of the presence of actual recreationists.

- **Habitat modification**--Habitat modification occurs when recreation-related infrastructure (roads, trails, facilities, etc.) converts pre-existing habitat into something new. "Edge" habitat is often found along the perimeters of roads, trails, and facilities. Edge habitat is known to favor certain species (many of which are non-native) and exclude others, and is considered a simplified system with minimal ecosystem function and biodiversity (Hammitt and Cole 1998, Miller et al 1998). Habitat modification can also occur when other ecosystem components (soil, water, vegetation) are impacted by recreational use. Roads and trails also modify habitats by fragmenting them, which can disrupt the movements of certain species and prevent the movement of fire and water across the landscape. When habitats change, previous habitats are thereby lost. If the resident wildlife are unable to adjust to the habitat change, they will not persist in the altered area (Hammitt and Cole 1998).
- **Pollution/littering**--Pollution and littering often come hand-in-hand with any type of public access to natural areas. Pollution associated with illegal dumping can have significant impacts on wildlife, releasing toxic chemicals into the food web. Numerous marine, avian, and terrestrial individuals have died from eating plastic or poisonous trash left behind by recreationists (Hammitt and Cole 1998, Knight and Gutzwiller 1995).

Types of responses

The impact of recreation-related disturbance can be further understood and evaluated by classifying wildlife's general response to human encounters. When faced with a stimulus (for example, a family stopped for lunch along a hiking trail), an animal will exhibit one of three general behaviors: **Avoidance, attraction,** or **habituation**. If the animal avoids the family of hikers, it will either flee to what it feels is a safe distance or hide and watchfully wait for the family to leave. If the animal is attracted to the family, it will approach them, hoping for some positive reinforcement. If the animal is habituated to the family, it will not significantly alter its behavior at all. None of these behaviors is inherently good or bad, but are informative to the land manager, nonetheless (Whittaker and Knight 1998). With this information, the land manager can begin to determine whether the behavior might result in one or more of the three negative impacts of disturbance (energetic compromise, reproductive interruption, displacement).

Once natural resource managers possess a working knowledge of potential recreation impacts on wildlife, they can begin to work toward determining the significance of the impacts to resident wildlife populations and communities. The next step, however, is to understand the factors that interact to determine the significance of recreation impacts.

Influential factors

Unfortunately, there is not a linear, univariate relationship between the amount recreational use and the severity of impacts on wildlife. There are a number of variables that factor in to the significance of these disturbance impacts on individuals, populations, and communities. Each natural area possesses its own unique set of variables, which act synergistically to determine a wildlife community's ability to either absorb or suffer from recreation impacts. It follows that

knowledge of these variables is of utmost importance to a natural resource professional's accomplishment of managing for coexistence.

These influential factors are described by three categories: Wildlife factors, Visitor/activity factors, and Site layout factors.

Wildlife factors

When an animal is affected by recreational use, particularly when it is disturbed to some degree, there are a number of variables that play into the actual impact that the disturbance will have on it. The most widely applicable of these variables are listed below, but many more exist that are unique to individual natural areas and their resident wildlife.

- Physiological stress—If individuals are already under physiological stress, they will be more susceptible to human disturbances, namely those that affect energetic intake and output. "Natural" physiological stress can come as a result of common events such as drought, winter, severe weather, migration, reproductive efforts, or disease. If an animal is already under stress from its natural environment and is trying to mate or raise young, it is susceptible to be distracted from these reproductive behaviors when humans inadvertently preclude parents from obtaining the energetic inputs that they need. A disruption in feeding can prompt a hungry mother to abandon her reproductive efforts. Similarly, if an animal is surviving on an exceedingly tight energy budget due to drought, additional stress from human encounters could be devastating. On the other hand, an animal that is healthy and living in a stable environment will be affected less by human disturbance that disrupts feeding (Knight and Gutzwiller 1995). It should be noted that some animals, particularly wading birds, have shown that in times of physiological stress, they will tolerate *more* (closer) human intrusion while feeding than in times of energetic plenty. Their physiological stress compels them to value feeding more than their risk of harm by the intruder (Beale and Monaghan 2004, Gill 2007). Recreationists have a tendency to approach wildlife, especially when the wildlife seem to be inviting them closer by not flushing, until finally the wildlife flushes. So, even though physiologically stressed individuals may appear more tolerant of human intrusion, there is still a considerable chance that the recreationist will continue approaching until the stressed animal flushes.
- Seasonal stress
    - Breeding season--Many species are especially sensitive to human intrusion when they are breeding or raising young. This may be due to the fact that parents exhibit increased protective behavior on behalf of their offspring. During the breeding season, some species may be more likely to flush from feeding grounds, abandon their nest, or abandon their territory. Birds are generally most tolerant of human intrusion (distance allowed between bird and human) when they are incubating their eggs, and are least tolerant when they are building their nests (Rodgers and Smith 1997). When birds are flushed from their nest, nest contents can be spilled, exposed to predators, or perish due to from unprotected exposure to the element (Carney and Sydeman 1999). Since healthy wildlife populations are reliant upon successful breeding seasons, it is of utmost importance that recreational use is managed to protect wildlife during these times.
    - Winter/dry season—During times of year when food resources are scarce, an animal's energy budget is more sensitive to disruptions to their feeding and resting schedules (Knight and Gutzwiller 1995).
    - Migration season—At any point during a bird's migration, it is living on the very edge of its energy reserves. If migrating wildlife is disturbed as it makes crucial

stops to rest and forage, a failed migration could result (Knight and Gutzwiller 1995).

- Species—It is evident that some species are more skittish than others. However, this is an important aspect of managing recreation impacts on wildlife. Larger species are usually less tolerant of humans than small ones. Generalist species tend to endure recreation impacts, and then actually flourish to fill the ecological voids left by the specialist species that could not persist. Many of these generalist species are not native to the natural area. In order to best manage recreation impacts to a wildlife community, strategies should orient toward the most sensitive/skittish species, especially when determining set-back distances for wildlife viewing areas (See pg. 13). For example, an area that supports a population of gallinules, who tolerate humans more than most other waterbirds, could feature a trail that would give visitors a close look at the birds and their habitat. However, if other, more sensitive species coexisted with the gallinules, like the little blue heron, this trail would need to be located further from the birds' preferred habitat. If sensitive species are ignored by managers, over time, more tolerant species will replace them (Knight and Gutzwiller 1995).
- Age—Many wildlife species are more sensitive to disturbance, and more likely to suffer prolonged effects, when they are juveniles. Juveniles are typically clumsy foragers and are especially reactive to perceived threats. They can me more susceptible to physiological stress, due to their increased metabolic needs and their lack of experience in finding food (Knight and Gutzwiller 1995).
- Group size—It has been noted repeatedly noted that large groups of animals are more sensitive to disturbance than small groups or solitary animals. As soon as the first individual flushes, the entire group follows suit, creating a situation where the group essentially behaves according to the most sensitive individual (Knight and Gutzwiller 1995).
- Habitat type—Many wildlife species, when faced with a potentially disturbing intruder, display more vigilance in areas with dense vegetative cover. A deer, for example, will tolerate a hiker in a wooded area more than it will tolerate a hiker moving through an open, grassy area. In open areas, where wildlife are potentially more visible to humans, and vice versa, wildlife generally require more separation to "feel" safe from harm (Knight and Gutzwiller 1995, Taylor and Knight 2003).

<u>Visitor/activity factors</u>

Variability in the types of allowed recreational activities and the behavior of individual recreationists are also important in determining the significance of recreation impacts on wildlife. The most widely applicable of these variables are listed below, but others exist that are unique to individual natural areas.

- Visitor behavior—Even with strategic regulations and boundaries in place, the decisions of individual visitors are a significant determinant of recreation's impact on wildlife. The literature has repeatedly mentioned the following five visitor behavior characteristics as being relevant to recreation impacts on wildlife.
    - Approaching wildlife—Most visitors to a natural area are hoping to encounter wildlife, even if it's not their primary purpose for visiting (e.g., spending time with family, exercise, relaxation). Most wildlife flees or hides before recreationists even have a chance to see them. However, when recreationists are able to spot wildlife, there is a strong tendency for them to get as close as they can. This "zoo mentality" frequently disturbs wildlife from accomplishing their daily activities (Hammitt and Cole 1998, Knight and Gutzwiller 1995).
    - Noise—A loud band of recreationists romping along a trail imposes disturbance across a much larger geographic area than a quiet group. For many species, the noise created by recreationists is *more* disturbing than their physical presence.

Noise levels are especially significant along water bodies, where sound travels with ease (Burger and Gochfeld 1998, Knight and Gutzwiller 1995).

- Leaving the trail—Resident wildlife keeps a detailed internal map of their territory. If a trail bisects their territory, there is a good chance that they will know exactly where the trail is, who uses it, and when they use it. Studies have shown that off-trail movements are significantly more disturbing to wildlife than on-trail movements (Knight and Gutzwiller 1995, Miller et al 2001, Taylor and Knight 2003).
- Feeding wildlife—In recent history, land managers encouraged visitors into intimate encounters with wildlife by attracting them with food handouts. Today, this practice is known to cause a number of serious problems. Wildlife that is given food by humans (consciously or inadvertently) suffers from compromised nutrition, loses the ability to find food on their own, and/or becomes attracted to humans (Knight and Gutzwiller 1995).
- Dogs in natural areas—Dogs can have significant negative impacts on wildlife species who are used as prey by native canines. While even a leashed dog can disturb canine-sensitive wildlife, unleashed dogs can have an especially profound impact. Unleashed dogs extend impacts a larger geographic area, and can destroy dens/nests/eggs, chase wildlife, introduce endo- and ecto-parasites into natural areas (parvovirus, rabies), or catch and kill wildlife. The effects of dog urine on resident wildlife has never been intensively explored, but is thought to have the potential to disrupt territorial markings by other resident wildlife species (Sime 1999).

- Amount of recreational activity—Historically, managers have favored the use of this variable to determine potential recreation impacts (carrying capacity). It is relatively simple to obtain this information, and it is indeed important to know the amount of recreational activity on a natural area (the number of people that visited an area over a known amount of time). However, this information is infinitely more valuable when coupled with the other variables described in this section of the report.
- Frequency/duration of activities—It is generally thought that frequency of use over time (patterns of use according to day of the week or time of year) carries more potential impact than the actual number of visitors. Also, recreational activities that are characterized by long stays in natural areas typically carry more potential disturbance than activities that can be experienced in a few hours (Hammitt and Cole 1998).
- Timing of activities—Wildlife is generally more active in the morning and evening hours (feeding). Consequentially, they are more likely to be encountered by a recreationist during these times. Recreationists interested in viewing wildlife typically know this, and try to plan their visits during these hours. Other recreationists favor these hours simply because the temperature is more pleasant than during midday. It follows that recreation on natural areas during the morning and evening hours is potentially more disturbing to wildlife than it is in the afternoon. It is also important to monitor visitation patterns during times of the year that are sensitive for resident wildlife (Hammitt and Cole 1998).
- Predictability of activities—Recreational activities that occur along repeated, predictable pathways have shown to be less disturbing to wildlife than activities that occur off-trail, like cross-country horseback riding, cross-country ATV use, orienteering/adventure racing, geocaching. (Miller et al 2001, Taylor and Knight 2003).
- Group size—In most cases, large groups (10 or more people) impose more intense recreation impacts than the same number of visitors broken into smaller groups. Large groups exhibit less regard for rules and regulations, create more noise than small groups, and cause excessive damage to trails designed for single-file travel (Ikuta and Blumstein 2003, Hammitt and Cole 1998).

- Type of recreational activity/Mode of travel—Each type of recreational activity imposes unique impacts on wildlife. One activity may appear benign to one species, but cause great harm to another. Here are some impacts to consider for some of the more popular recreational activities (Hammitt and Cole 1998).
    - Day hiking
        - Hikers move slowly across the landscape, which causes their disturbance to be spatially localized, but more temporally intensive.
        - Large groups of day hikers can be excessively loud.
        - Hikers are liable to venture off the trail, potentially disturbing sensitive areas and/or sensitive wildlife that are unaccustomed to off-trail movements.
    - Horseback riding
        - Horses can cause excessive damage to trails, exacerbating erosion problems and contaminating nearby waterways, imposing indirect effects on wildlife.
        - Horses can transport non-native vegetation to a natural area via their hooves and/or feces, causing indirect impacts on wildlife.
        - Horseback trails are typically long, thus imposing potential disturbance across a large geographic area of wildlife habitat.
        - Riders are liable to lead their horses off the trail, potentially disturbing sensitive areas and/or sensitive wildlife that are unaccustomed to off-trail movements.
    - Driving tours
        - In many cases, vehicles moving slowly through a natural area are less disturbing to wildlife (especially birds) than pedestrians. However, when vehicles stop and/or when passengers exit, wildlife often loses its sense of security and flushes (Klein 1993).
        - Vehicles can collide with wildlife, especially when driving too fast.
        - Vehicles can transport non-native vegetation to a natural area, imposing indirect impacts on wildlife.
    - Camping
        - Since campers spend an extended amount of time on the natural area, wildlife in the vicinity of the campsite are prevented from using the area for an extended time, and may decide to abandon the area surrounding the campsite.
        - Campers create large amounts of garbage and often inadvertently or purposely feed resident wildlife.
    - Off road biking
        - Off road biking trails and unimproved roads are typically long, thus imposing potential disturbance across a large geographic area of wildlife habitat.
        - The only study on wildlife impacts of off road biking showed that biking did not disturb wildlife any more than hiking (the animals studied showed similar flushing sensitivity to hikers and bikers) (Taylor and Knight 2003).
    - Motorized trails
        - Vehicles can collide with wildlife, especially when driving too fast.
        - Vehicles can transport non-native vegetation to a natural area, imposing indirect effects on wildlife.
        - Some vehicles produce excessive noise that can disturb wildlife located a long distance from the trail (ATVs, dirt bikes, snowmobiles).

- Wildlife viewing/nature photography
  - Since this type of recreationist is primarily concerned with viewing wildlife, they are inclined to actively find and approach animals, causing potentially significant disturbance (Boyle and Samson 1985, Klein 1993, Carney and Sydeman 1999).
  - When wildlife viewers encounter wildlife, they usually stay and observe for extended periods of time. These extended interactions can be more disturbing to wildlife than brief ones, especially when they occur during sensitive times of the year (Knight and Gutzwiller 1995).
  - Wildlife viewers often find good viewing spots, and then revisit them regularly. This unmanaged, intensive visitation to wildlife habitat can cause significant disturbance.

Site layout factors

Most of the factors influencing wildlife's sensitivity to recreational activity are associated with the wildlife, the visitors, or the actual activities. Another vital aspect of managing for coexistence is the layout and design of the recreational/public access infrastructure (trails, roads, day use areas, facilities). Strategic site design is especially important for natural areas that will accommodate large numbers of users and/or contain sensitive or endangered habitats. Mindful recreation planning can help managers anticipate and avoid many recreation impacts on wildlife. Some of the site design factors for managerial consideration are listed below.

- Quantity and spatial distribution of public-access infrastructure—If an area is readily accessible by trail or road, the wildlife using (or potentially using) the habitat adjacent to these pathways will be subject to the negative impacts of recreational use (known as the "area of influence", see pg. 12).
  - Quantity—Generally, more roads, trails, and use areas will expose more wildlife to recreation impacts.
  - Spatial distribution—A trail and road system sprawling across a vast portion of a natural area will expose more wildlife to recreation impacts than a system of equal length that is routed circuitously in a concentrated, strategically located geographic area. Also, if a recreational activity is confined to an area of low-grade habitat (early succession with many generalist species), it will impose less impact on wildlife than a recreational activity that traverses high-quality habitat (climax system with many specialist species) (Knight and Gutzwiller 1995).
  - Sensitive and resistant areas—Trails, roads, and use areas can be debilitating to ecosystems that are sensitive to trampling, the introduction of invasive weeds, increased or altered runoff, and/or soil compaction. Conversely, previously disturbed areas and certain types of habitats are considered more resistant and/or resilient to recreation impacts (Hammitt and Cole 1998, Liddle 1997)). Examples of sensitive areas are listed below.
    - Rare ecosystems
    - Habitats supporting listed species
    - Established breeding/roosting areas
    - Established feeding areas
    - Established migration stop-overs
    - Historical/archaeological sites
- Facility design—Facilities, such as use areas, bathrooms, wayside exhibits, offices, and other structures can impact resident wildlife in a number of ways (mechanical noise, human noise, consistent human presence, runoff, litter, etc.).

In order to manage for coexistence, managers must be intimately familiar with their natural area. They should possess and maintain comprehensive, up-to-date knowledge of resident

wildlife's life histories, local population sizes and their geographic distributions, ecological relationships between species, locations of sensitive habitats, various trends in recreational use, and potential impacts of recreation on resident wildlife (Boyle and Samson 1985, Knight and Gutzwiller 1995, Whittaker and Knight 1998). A solid foundation of area-specific knowledge will inform all of these factors that influence the magnitude and significance of recreational impacts on resident wildlife, enabling the natural resource manager to devise management directives that ensure the coexistence of wildlife and recreation.

Management strategies for the coexistence of wildlife and recreationists

Each natural area possesses its own compilation of wildlife, ecosystems, and recreational activities. In turn, each area's management plan must be uniquely tailored to allow for the long-term coexistence of wildlife and recreationists. This report is intended not to serve as a literal manual for managing recreation impacts on wildlife, but to provide managers with awareness of the issues that deserve their consideration and to offer a few general strategies to start them down the road toward devising a management plan that is customized to their natural area. The following strategies are derived from previous studies that explored the impacts of recreational use on wildlife. Most strategies fall into one of two categories: visitor management and site management, which incorporate the influential factors described on pg. 4-9. Typically, primitive (low-use) areas can be managed almost exclusively with visitor management, and as use levels intensify, site management becomes more necessary (Hammitt and Cole 1998).

Visitor management strategies

Visitor management strategies can influence the amount of recreational use, timing of use, type of use, and visitor behavior. These are accomplished primarily with education/interpretation and with formal regulations (Hammitt and Cole 1998).

- Visitor education/interpretation--In the past 20 years, the studies on recreation impacts and wildlife typically include management implications as a part of their report, and most of them have one suggestion in common: to educate visitors about their potential impacts on wildlife while recreating (Burger and Gochfeld 1998, Klein 1993, Klein and Percival 1995, Miller et al 2001, Miller et al 2003, Stolen 2003, Taylor and Knight 2003). Most recreationists fail to recognize the ecological impacts of their activities (Hammitt and Cole 1998, Taylor and Knight 2003). Educational messages should be presented not as regulations, but as relevant information that will lead them to feel personally involved in the well-being of the resident wildlife community. The messages should be presented through a variety of media (area publications, electronic, signage, newspaper articles, personal encounters with visitors, guided tours, etc.) (Hammitt and Cole 1998). Listed below are some of the suggested messages from the literature.
    - Foster an understanding of the specific ways that certain recreationist behaviors affect specific types of wildlife (feeding, resting, reproduction). Many recreationists already acknowledge and value resident wildlife populations, but are simply ignorant of the impacts associated with their recreational activities.
    - Instill in recreationists a strong sense that they are visiting a place that "belongs" to wildlife. Many recreationists feel entitled to do whatever they want and go where ever they please on public lands.
    - Inform visitors of the seasonal changes relevant to resident wildlife, and the associated sensitivities that accompany them (breeding/nesting, migration, winter/drought).

- Proliferate a brief list of wildlife viewing tips, presented positively, and, accompanied with "reasons why", such as (Leave No Trace website, Knight and Gutzwiller 1995, Miller et al 2003):
    - You are being watched. Use binoculars for close up viewing and telephoto lenses for photographs. (Don't approach/disturb wildlife).
    - Stay on the trails and roads. (Don't walk off-trail).
    - Move along roads and trails quietly. (Don't make noise).
    - Let the wildlife feed themselves. (Don't purposely or accidentally feed wildlife).
    - Leave your pets at home. (Don't bring pets to natural areas.)
    - Avoid wildlife during sensitive times of year (mating, nesting, raising young, migration, stressed environment).

- Regulations—Regulations should be used sparingly, and only if they are to be enforced consistently.
    - Spatial restrictions/closed areas—Natural resource managers can determine the locations of sensitive or dangerous areas that should be closed to public access. Ideally, these areas should be far away from trails and roads. If otherwise, managers should be aware that "CLOSED" signs often invite inquisitive recreationists (Hammitt and Cole 1998, Knight and Gutzwiller 1995).
    - Temporal restrictions/seasonal closures—Depending on the resident wildlife and their seasonal behavior, it may be appropriate to close part of an area to recreational use for the part of the year when wildlife is especially susceptible to disturbance (Hammitt and Cole 1998, Klein and Percival 1995, Knight and Gutzwiller 1995).
    - Prohibition/seasonal restriction of certain recreational uses—These can be employed when certain recreational uses are determined to impose unacceptable impacts to resident wildlife on a natural area.
        - Motorized use (noise, wildlife collisions, spatially intensive)
        - Equestrian use (spatially intensive)
        - Pets (wildlife impacts)
        - Geocaching (off-trail movements)
        - Camping/fires (temporally intensive)
    - Permits—A mandatory recreational use permit could include the completion of a primer on recreation impacts on wildlife and appropriate recreational behaviors (Hammitt and Cole 1998).
    - Speed limits—In order to minimize the number of vehicle-wildlife collisions, visitors (and staff) should adhere to conservative speed limits (15-25 mph). During times of year when certain species are moving across the landscape, speed limits can be decreased. Also, vehicles moving rapidly down a road create more noise than slow moving vehicles.

<u>Site management strategies</u>

The spatial arrangement of recreational infrastructure can have an enormous role in determining impacts on wildlife. Well-planned trails, roads, use areas, and facilities can preclude many of the problems that arise from recreational use.

- **Recreational zoning**—Managers can geographically identify regions within their natural area that are most and least susceptible to recreation impacts on wildlife (Miller et al 2001, Klein and Percival 1995). Once identified, managers can define acceptable levels of impact for each recreational zone. Considerations for

sensitive wildlife populations should strongly inform this determination. In turn, regions that are least susceptible to recreation impacts can be developed to accommodate most of the recreational users. Regions that are most susceptible to impacts can be left without public access, can be included as "primitive" recreation areas requiring long distance travel by foot, or can be included as a part of the recreational experience that is intentionally managed, regulated, and monitored. The general idea is to arrange recreational infrastructure so that use is concentrated in resistant areas, instead of widely dispersed. Zones are typically defined by their intended degree of public use (sensitive/closed, primitive, motorized semi-primitive, motorized rural, backcountry, hiker, pedestrian, motorized sightseeing, developed). Once defined, the zones should be monitored and managed to maintain the desired level/type of recreational use. Extensive details on recreational zoning can be found in the National Park Service's VERP Manual (Visitor Experience and Resource Protection, http://planning.nps.gov/document/verphandbook.pdf). For the purposes of protecting wildlife from unacceptable recreation impacts by identifying appropriate recreational zones, the land manager should possess the following geographic knowledge or their area:

- Breeding colonies/nesting areas
- Established roosting areas
- Popular feeding areas
- Sensitive or rare ecosystems
- Listed species populations
- Previously disturbed areas
- Resilient upland ecosystems
- Stable soils

- **Area of influence**—"Area of influence" is a measure of the amount of area subjected to recreation-related wildlife impacts (Miller et al 2001). It takes into account not only the literal "footprint" of use areas, roads, and trails, but also the corridor around them into which wildlife disturbance extends. The width of this corridor can be determined by measuring or estimating the **flushing distances** (distance between an animal and a human when it decides to flee) or **alarm distances** (distance between an animal and a human when it first exhibits alarm behavior) of resident wildlife. Noise level is an important consideration when determining flushing and alarm distances.
  The area of influence is useful for planning new recreational opportunities and for assessing the impact of existing opportunities. It is a very new concept, and has been documented in two studies. These studies first identified a few species of interest (one focused on songbirds, another on large mammals). Next, they determined the perpendicular distance from the trail at which 70% of the observed individuals flushed. This distance, added to either side of the trail/road system, served as the basis for the impacted corridor. The total area of the **impact corridor** and the disturbed areas were added to total the "area of influence".
  The study that focused on large mammals (deer, elk, antelope) determined the corridor distance to be 100 m on either side of the trail/road/use area (Taylor and Knight 2003). The study that focused on songbirds (robin, sparrow, meadowlark) determined the corridor distance to be around 20 m (Miller et al 2001).
  Until further research unfolds, natural areas in Florida supporting large mammals (deer, hogs, panthers, bears, bobcats) should consider an impact corridor of 200 m and those without large mammals (160 acres of influence per mile of trail), but with songbirds and small mammals should consider an impact corridor of 40

m (40 acres of influence per mile of trail). Based on Rodgers's research on set-back distances for wading and shorebirds, impact corridors of 200 m should be considered for areas supporting wading and shorebirds (Rodgers and Smith 1997).

- **Set-back distances (Buffer zones)**—In order to allow visitors to view wildlife without the unmitigated risk of disturbance, managers can demarcate set-back distances. Set-back distances are intended to allow wildlife to continue their daily activities in the presence of humans. While some waterbirds in Florida have been studied to determine appropriate set-back distances, managers should make sure that the pre-determined set-backs are far enough that the resident wildlife don't display any sort of alarm behavior (alarm distance). Managers should not use flushing distance to determine appropriate set-backs, since many animals first "hunker down" when feeling threatened or exhibit some other sort of alert behavior. Set-back distances should be applicable to boats, automobiles, and pedestrians (Ikuta and Blumstein 2003, Rodgers and Smith 1995, Rodgers and Smith 1997, Rodgers and Schweikert 2002). A confounding variable in determining set-back distances is the tendency for well-fed wildlife to exhibit *less* tolerance of disturbance than physiologically stressed wildlife. However, the consequences of disturbance are much greater for stressed wildlife than for the more skittish, well-fed animals (Beale and Monaghan 2004, Gill 2007). If set-back distances are determined during seasons where wildlife are least likely to be under physiological stress, wildlife should be protected from disturbance in times of plenty and in times of stress.
- Visual/noise barriers—When it is not feasible to implement a buffer zone, and wildlife need added protection from human activity (trails, roads, buildings, etc.), barriers can be very effective at reducing wildlife's sensitivity to recreation impacts. Barriers can be fences, walls, berms, or simply vegetation hedges (Ikuta and Blumstein 2003, Knight and Gutzwiller 1995).
- **Internal refuge**—Impacts to wildlife on natural areas can be mitigated by ensuring that there is suitable, available, nearby habitat for them to flee to, in the event that recreationists disturb them from their everyday activities. If managers don't provide "refuge within the refuge", and the resident wildlife suffers significant disturbance from recreationists, there is a possibility that the wildlife community will suffer from compromised energy budgets and/or reproductive success, or they may try to relocate to another area beyond the boundaries of the natural area. During the planning of new recreational opportunities, it may be useful to consider this concept when identifying areas that are suitable for wildlife viewing (Boyle and Samson 1985, Burger and Gochfeld 1998, Gill 2007, Ikuta and Blumstein 2003, Stolen 2003).
- Low-impact, long lasting facilities—Construction activities can be especially disturbing to wildlife, due to loud, unfamiliar noises and a consistent presence of humans (Boyle and Samson 1985, Knight and Gutzwiller 1995). When natural areas provide facilities such as bathrooms, pavilions, and observation platforms, they should be built-to-last using premium materials and sturdy, "overbuilt" construction methods. Facility construction should be scheduled to occur during times of year when wildlife are not especially vulnerable, and projects should be completed promptly. A facility should be designed to visually blend into the surrounding area, minimizing its visual impact on the landscape. Any landscaping should be done with plants native to the site. When determining the location of facilities on a natural area, managers should consider the following:
    - Use of previously disturbed sites.
    - Design of facilities that blend into the surrounding area and minimize the removal of existing vegetation.
    - Use of upland sites that don't require fill.

        - Avoidance of building in the territory of an important resident species.
        - Minimizing the footprint of the facility, allowing native vegetation to encroach to a reasonable proximity.
        - Avoidance of locating facilities near a water/wetland resource.
    - Low-impact, long lasting trails and roads—The quality, quantity, and location of a natural area's trails and roads largely determine the quality of a recreationist's experience and the amount/types of habitat exposed to recreation impacts. Trails and roads should be sited and constructed to provide enjoyable recreation experiences while minimizing impacts to wildlife (Knight and Gutzwiller 1995, Taylor and Knight 2003).
        - When possible, follow existing edges, thus minimizing the creation of new edge habitat (Miller et al 2003).
        - Trails should avoid traversing the interior of vast "open" ecosystems with little vegetative cover.
        - Avoid "sensitive" areas (listed species, feeding areas, watering areas, nesting areas, riparian areas).
        - Create distinct wildlife viewing areas as trail-based destinations.
        - Instead of crafting experiences that immerse visitors in pristine habitat, utilize lower-quality areas to move people between specific, high-quality wildlife viewing areas.
        - Ensure rapid, high quality trail construction.
        - Design for the minimization of erosion and runoff.
        - Approach areas used frequently by wildlife tangentially, not perpendicularly (feeding areas, nesting areas, water bodies).
    - Wildlife observation structures/Designated viewing areas—Wildlife observation structures, such as towers, platforms, and blinds, can satisfy recreationists' perceived need to get close to wildlife in a controlled manner (Boyle and Samson 1985, Klein 1993, Knight and Gutzwiller 1995, Taylor and Knight 2003). Viewing areas should be situated far enough from the preferred habitat that the wildlife are not disturbed, but close enough for the visitors to see. When a viewing structure is strategically located, visitors tend not to venture beyond it. Permanently mounted binoculars further enhance the viewing experience and reduce the temptation to venture beyond the structure (http://www.seecoast.com). Enclosed viewing structures (blinds) may impose fewer disturbances than an open structure (towers, platforms). Approach trails to viewing structures should be shielded from wildlife's view, with signs encouraging recreationists to walk quietly.

<u>Species-specific information</u>

Most of the studies on recreation-related wildlife disturbance have focused on specific species. Derived from these studies, the following is a listing of findings specific to the management of species found in Florida. These findings were obtained by studying specific populations on specific areas, and may not hold true in other areas.

- Wading birds and other waterbirds. See Appendix 1 for more information.
    - 100 m of "set-back" between viewing areas/trails and congregations of wading birds (feeding, loafing, or nesting) is recommended to provide them with enough space to carry on with their daily activities undisturbed (Rodgers and Smith 1995, Rodgers and Smith 1997).
    - 180 m of "set-back" between boats/PWCs and wading birds is recommended to provide them with enough space to carry on with their daily activities undisturbed (Rodgers and Schweikert 2002).
    - Alarm distance is usually 25-40 m beyond the flushing distance for wading and shorebirds (Rodgers and Smith 1995).

- Little blue herons and tricolored herons (listed species of special concern) tend to be the least tolerant of humans and gallinules tend to be more tolerant (Species studied: Glossy ibis, Little blue heron, Tricolored heron, Sora rail, Gallinule) (Burger and Gochfeld 1998).
- Yellow crowned night herons and great egrets tend to be more sensitive to disturbance than snowy egrets, green herons, and great blue herons (Peters and Otis 2006).
- Larger birds tend to be less tolerant of humans than smaller birds. This is thought to be related to the amount of time and space that it takes for flushing (Rodgers and Schweikert 2002).
- Foraging time of wading birds decreases as disturbance levels increase (Rodgers and Schweikert 2002).
- Waterbirds sharing space with recreationists need nearby disturbance-free foraging and nesting areas. (Rodgers and Smith 1997, Stolen 2003)
- Flushing distances are greater for nesting birds than foraging birds of the same species (Rodgers and Smith 1997).
- Management actions should be based on the most skittish species, when dealing with a mixed population of birds (Rodgers and Smith 1997).
- Trails and roads should approach bird viewing areas tangentially (Rodgers and Smith 1995).
- When pedestrians stop moving, birds are more likely to flush (Rodgers and Smith 1995)
- When set-backs cannot be implemented (perhaps colony moves into a new area near pre-established recreational infrastructure) physical barriers can mitigate the problem, reducing visual contact and noise. (Rodgers and Smith 1997, Burger and Gochfeld 1998)
- Migratory birds are generally less tolerant of humans than resident birds. (Klein and Percival 1995)
- For many waterbirds, noise is as disturbing or more disturbing than the physical presence of humans (especially ibis, gallinule, and little blue heron). (Burger and Gochfeld 1998)
- Birds in high visitation areas show signs of habituation to humans (Stolen 2003)
- Foraging waterbirds are more disturbed when passing vehicles slow down or stop (Stolen 2003).
- Out-of-vehicle activity has shown to be more disturbing to waterbirds than in-vehicle activity (Klein 1993).
- Visitation of colonial nesting birds can be less disturbing in the early morning hours, when the air is cooler (Carney and Sydeman 1999).
- Bird watchers can minimize disturbance by moving very slowly and being very quiet (Carney and Sydeman 1999).
- Waterbirds have shown to be more sensitive to boating activity than shoreline activity (Schummer and Eddleman 2003).

- Shorebirds. See Appendix 1 for more information.
  - 100 m of "set-back" between least tern/black skimmer nesting colonies and humans is recommended to provide them with enough space to carry on with their daily activities undisturbed. (Rodgers and Smith 1995).
  - 100 m of "set-back" between foraging/loafing shorebirds (willet, sanderling, ring billed gull, slack skimmer, semipalmated plover, ruddy turnstone) and humans is recommended to provide them with enough space to carry on with their daily activities undisturbed (Rodgers and Smith 1997).
  - Beach-nesting birds and other colonial nesting waterbirds are especially vulnerable to human disturbance, since beach activities are immensely popular (increased chance of human-bird interaction), and beaches are open spaces

which allow humans to find and encroach on shorebirds with ease (Carney and Sydeman 1999, Rodgers and Smith 1997).
    - Visitation of colonial nesting birds can be less disturbing in the early morning hours, when the air is cooler (Carney and Sydeman 1999).
    - Bird watchers can minimize disturbance by moving very slowly and being very quiet (Carney and Sydeman 1999).
- Manatees—The following guidelines were excerpted from the FWCs website.
    - Look, but don't touch manatees.
    - Don't feed manatees or give them water. Do not pursue or chase a manatee if you see one while you are swimming, snorkeling, diving or operating a boat.
    - Never poke, prod or stab a manatee with your hands, feet or any object.
    - If a manatee avoids you, you should avoid it.
    - Give manatees space to move. Don't isolate or single out an individual manatee from its group, and don't separate a cow and her calf.
    - Keep hands and objects to yourself. Don't attempt to snag, hook, hold, grab, pinch or ride a manatee.
    - Avoid excessive noise and splashing if a manatee appears in your swimming area.
    - Use snorkel gear when attempting to watch manatees. The sound of bubbles from SCUBA gear may cause manatees to leave the area.
    - Float at the surface of the water to passively observe the manatees. Remember, look, but don't touch.
- Carnivores—Very few studies have addressed recreation impacts on carnivores such as bears, panthers, bobcats, and foxes. However, due to the well-known life histories of these animals, it is generally thought that they are especially sensitive to the presence of humans.

<u>Determining acceptable levels of impact</u>

It is clear that wildlife communities respond to recreationists on public lands. Questions arise as we try to evaluate the true significance of their reactions. While it is relatively easy to measure and isolate the impacts of recreation on individual animals, it is very difficult to identify specific long-term effects on populations and communities. In other words, it is simple to measure the *magnitude* of recreation impacts, but is difficult to determine the *significance* of them. There is a collection of variables that interplay to determine the significance of recreation impacts on wildlife individuals, populations, and communities. It is the duty of the natural resource manager to 1) detect and identify existing significant recreation impacts on wildlife, 2) predict and anticipate potential significant recreation impacts on wildlife, and 3) determine *acceptable* levels of recreation impacts on their natural area, aiming to achieve the long-term coexistence of wildlife and recreation.

Recreation professionals have developed a useful framework for determining, monitoring, and managing "limits of acceptable change (LAC)". This framework is straightforward and simple, and can easily be put to use by all natural resource managers. The framework boils down to three steps:

1. Determine *specific* management objectives (defined limits of impact) and associated indicators.
2. Employ the indicators to monitor impact levels.
3. Manage use to maintain the acceptable limits of impact.

All three steps are crucial, but the first one is usually the most challenging. Once again, in order for managers to be able to define acceptable limits of impact (objectives) and identify effective indicators, a comprehensive knowledge of resident wildlife, along with a clear perception of the

area's recreational use patterns is paramount. As is the case with undertakings that aim to attach an importance value to a compilation of observations, evaluate trade-offs between competing interests, and then aim to predict and preclude problems in the future, the "objectives" that will guide the management of recreation impacts become subjective decisions *informed* by science (Hammitt and Cole 1998).

Management objectives must be specific. In the case of impacts on wildlife, objectives should target populations and/or distributions. In addition to defining objectives that cover the entire natural area, it may also be helpful to focus objectives on geographic areas associated with recreational use. For example, if a new trail has been planned that will expose an established feeding area for wading birds to humans, a management objective might read, "With the addition of the new hiking trail, disturbance related impacts will not diminish the wading bird diversity or abundance by 5% in a given year, and no impacts to listed species will be accepted." Indicators that would help the manager evaluate the attainment of the objective might be: Number of users, Seasonal and diurnal timing of visitation, party sizes, observations of visitor behavior at the wildlife viewing site, wading bird foraging rates before/during/after human contact, wading bird diversity and/or wading bird abundance. Good indicators are measurable, sensitive, efficient, reliable, and cost effective (Hammitt and Cole 1998).

The following are a few considerations for determining limits of acceptable recreational impact on wildlife:

- Reductions in species diversity, richness, and abundance.
- Compromised utility of established feeding, nesting, or resting areas.
- Direct and indirect impacts to listed species.
- Impediments to intentional restoration or management efforts.
- Inordinate area of influence from recreational infrastructure (trails, roads, use areas).
- Availability and amount of alternative habitat within the natural area (Internal refuge).

The details of the LAC framework are readily available online (http://www.nps.gov). It is formulated to address the entire spectrum of recreation impacts, including ecosystem impacts (soil, water, vegetation) and also impacts to visitors (overcrowding, user conflicts).

Pomerantz and his colleagues also developed a LAC-based framework to help managers make decisions on recreational use of natural areas (Pomerantz et al 1988). Explained in detail in the Wildlife Society Bulletin, the framework utilizes a six-level classification system for recreation impacts to wildlife. The six tiers are:

- Direct mortality
- Indirect mortality
- Lowered productivity
- Reduced use of the refuge
- Reduced use of preferred habitat on the refuge
- Aberrant behavior or stress

The framework encourages the inclusion of "consumptive" recreation impacts (hunting and fishing) with "non-consumptive" impacts. Managers can use the classification system to define acceptable limits of impact (set objectives), then monitor and manage recreational use accordingly.

Once again, when a natural area populated with wildlife is made accessible to the public, recreation impacts are inevitable. Regardless of the framework used, the goal of the manager is to identify true PROBLEMS that arise from the impacts, and to define acceptable levels of impact that keep these problems from significantly affecting resident wildlife. From then on, managers are equipped with defensible criteria for decision making, and impacts can be monitored and

managed using visitor and site management strategies (Hammitt and Cole 1998, Pomerantz et al 1988, Whittaker and Knight 1998).

**Managers can confront the issue of recreation impacts on wildlife from two perspectives: pro-active or re-active. Proactive managers consider the present and anticipate the future. They plan conservatively, taking precautions to ensure the well-being of wildlife populations. Their aim is to confront existing recreation impacts and to avoid impacts that may come in the future as a result of increased recreational demand. Proactive managers make time to monitor recreation trends and impacts on their area. Reactive managers respond primarily to existing problems. They feel that managing recreational access is legitimate only when there is a glaring issue to address. Since it is difficult to detect and evaluate long-term trends, these managers assume that most recreational activities are generally benign, and that, within reason, recreational use can continue unchecked.*

Conclusion

The first and most crucial step towards managing for the sustainable coexistence of wildlife and recreationists is instilling awareness of the issue in land managers, recreation planners, and recreationists themselves. Even as recreational activities have increased dramatically in popularity, encroaching more and more upon the lands occupied by wildlife communities, there has been very little attention paid to the impacts of recreational activities on wildlife, and therefore very little management strategies developed to minimize them. While the issue is receiving increased attention in the literature, it has been very slow to develop. The first studies on the impacts of recreation on wildlife date back to the 1960s. In the 1980s, a few brave wildlife biologists tried to bring the issue to the forefront, but had limited success. Today, it is still a fringe issue, and receives little attention in the literature, and is not included as a point of study in most collegiate programs training new wildlife and recreation managers.

Recreation is an invaluable aspect of conservation. It can serve to educate the public on important topics, along with generating interest and support for natural areas. However, as recreational demand continues to increase, especially in rapidly growing states like Florida, there will be an ever increasing need for land managers and recreationists to become intimately aware of recreation's impact on ecosystems and to devise strategies to minimize them. In a recent study, outdoor recreation was rated the second-most significant threat to federally endangered species (Losos 1995). Managing for coexistence not only protects wildlife, but it ensures that enriching activities like wildlife viewing and nature study will persist for future generations to enjoy. In the end, recreation and wildlife complement one another, working together to establish, manage, protect, and enjoy natural areas.

References

Beale, C.M. and P. Monaghan. 2004. Behavioural responses to human disturbance: a matter of choice? Animal Behavior 68: 1065-1069.

Boyle, S.A, and F.B. Samson. 1985. Effects of nonconsumptive recreation on wildlife: A review. Wildlife Society Bulletin 13:110-116.

Burger, J., and M. Gochfeld. 1998. Effects of ecotourists on bird behavior at Loxahatchee National Wildlife Refuge, Florida. Environmental Conservation 25:13-21.

Carney, K.M., and W.J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. Waterbirds 22:68-79.

Century Commission for a Sustainable Florida website. http://www.centurycommission.org.

George, S.L, and K.R. Crooks. 2006. Recreation and large mammal activity in an urban nature reserve. Biological Conservation 133:107-117.

Gill, J. 2007. Approaches to measuring the effects of human disturbance on birds. Ibis 149: 9-14.

Hammitt, W.E., and D.N. Cole. 1998. Wildland Recreation: Ecology and Management. John Wiley and Sons, Inc., New York, NY, USA.

Ikuta, L.A., and D.T. Blumstein. 2003. Do fences protect birds from human disturbance? Biological Conservation 112:447-452.

Kaiser, M.S., and E.K. Fritzell. 1984. Effects of river recreationists on green-backed heron behavior. The Journal of Wildlife Management 48:561-567.

Klein, M.L. 1993. Waterbird behavioral responses to human disturbances. Wildlife Society Bulletin 21:31-39.

Klein, M.L., Humphrey, S.L., and H.F. Percival. 1995. Effects of ecotourism on distribution of waterbirds in a wildlife refuge. Conservation Biology 9:1454-1465.

Knight, R.L., and K.J. Gutzwiller, editors. 1995. Wildlife and Recreationists: Coexistence Through Management and Research. Island Press, Washington, D.C., USA.

Leave No Trace Center for Outdoor Ethics website. http://www.lnt.org.

Leung, Y, and J.L. Marion. 2000. Recreation impacts and management in wilderness: A state-of-knowledge review. USDA Forest Service Proceedings 5:23-48.

Liddle, M.J. 1997. Restoration Ecology: The Ecological Impact of Outdoor Recreation and Ecotourism. Chapman and Hall, London, England.

Miller, S.G., Knight, R.L., and C.K. Miller. 1998. Influence of recreational trails on breeding bird communities. Ecological Applications 8:162-169.

Miller, S.G., Knight, R.L., and C.K. Miller. 2001. Wildlife responses to pedestrians and dogs. Wildlife Society Bulletin 29:124-132.

Peters, K.A., and D.L. Otis. 2006. Wading bird response to recreational boat traffic: Does flushing translate into avoidance? Wildlife Society Bulletin 34: 1383-1391.

Pomerantz, G.A, Decker, D.J., Goff, G.R., and K.G. Purdy. 1988. Assessing impact of recreation on wildlife: A classification scheme. Wildlife Society Bulletin 16:58-62.

Rodgers, J.A., and H.T. Smith. 1995. Set-back distances to protect nesting bird colonies from human disturbance in Florida. Conservation Biology 9:89-99.

Rodgers, J.A., and H.T. Smith. 1997. Buffer zone distances to protect foraging and loafing waterbirds from human disturbance in Florida. Wildlife Society Bulletin 25:139-145.

Rodgers, J.A., and S.T. Schwikert. 2002. Buffer-zone distances to protect foraging and loafing waterbirds from disturbance by personal watercraft and outboard-powered boats. Conservation Biology 16:216-224.

Schummer, M.L., and W.R. Eddleman. 2003. Effects of disturbance on activity and energy budgets of migrating waterbirds in South-Central Oklahoma. The Journal of Wildlife Management 67:789-795.

Sime, C.A. 1999. Domestic dogs in wildlife habitats. Pages 8.1-8.17 in G. Joslin and H. Youmans, coordinators. Effects of Recreation on Rocky Mountain Wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society.

Stolen, E.D. 2003. The effects of vehicle passage on foraging behavior of wading birds. Waterbirds 26:429-436.

Taylor, A.R., and R.L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13:951-963.

Whittaker, D., and R.L. Knight. 1998. Understanding wildlife responses to humans. Wildlife Society Bulletin 26:312-317.

Appendix 1-- Bird Disturbance: Tabular results from various studies on waterbirds

Figure 4. Mean proportion (SE) of individual wading bird species that flushed (gray bars) and returned (black bars) to the sampling area within 5 minutes during single-pass transects (motor boat moving through tidal creeks) on Cape Romain National Wildlife Refuge, South Carolina, USA, 1999–2000.

From Peters, K.A., and D.L. Otis. 2006. Wading bird response to recreational boat traffic: Does flushing translate into avoidance? Wildlife Society Bulletin 34: 1383-1391.

Table 1. Flush distances (m) of waterbirds in response to the fast approach of a personal watercraft and an outboard-powered boat.

	Personal watercraft			*Outboard-powered boat*			
Species	*number*	*range*	*mean ± SD*	*number*	*range*	*mean ± SD*	*Difference**
Anhinga (*Anhinga anhinga*)	61	19-115	44.51 ± 20.35	55	11-135	53.16 ± 23.06	$p < 0.04$
Brown Pelican (*Pelecanus occidentalis*)	71	5-130	47.11 ± 31.79	76	20-134	52.80 ± 22.70	n.s.
Double-crested Cormorant (*Phalacrocorax auritus*)	90	5-111	49.45 ± 25.68	73	15-129	42.76 ± 19.94	n.s.
Great Blue Heron (*Ardea herodias*)	125	8-123	49.52 ± 22.72	93	10-137	42.16 ± 20.27	$p < 0.01$
Great Egret (*Ardea alba*)	125	10-130	45.53 ± 18.72	90	16-156	50.99 ± 22.64	n.s.
Little Blue Heron (*Egretta caerulea*)	66	16-111	37.29 ± 15.16	51	16-108	49.34 ± 22.23	$p < 0.01$
Snowy Egret (*Egretta thula*)	54	5-85	31.50 ± 17.47	67	9-97	31.78 ± 15.29	n.s.
Tricolored Heron (*Egretta tricolor*)	50	11-91	42.72 ± 19.96	42	10-98	44.36 ± 22.28	n.s.
Reddish Egret (*Egretta rufescens*)	22	19-70	41.14 ± 15.10				
White Ibis (*Eudocimus albus*)	54	5-112	42.15 ± 23.59	53	9-81	35.57 ± 17.26	n.s.
Roseate Spoonbill (*Ajaia ajaja*)	15	39-61	44.98 ± 6.75				
Wood Stork (*Mycteria americana*)	12	17-74	36.17 ± 16.84				
Caspian Tern (*Sterna caspia*)	21	10-70	31.15 ± 11.80				
Royal Tern (*Sterna maxima*)	59	11-138	35.91 ± 21.77	26	10-71	29.03 ± 15.34	n.s.
Forster's Tern (*Sterna forsteri*)	33	9-51	23.50 ± 9.79	30	9-52	23.36 ± 8.54	n.s.
Least Tern (*Sterna antillarum*)	17	5-46	19.53 ± 10.12				
Ring-billed Gull (*Larus delawarensis*)	10	19-88	41.76 ± 21.37				
Laughing Gull (*Larus atricilla*)	59	5-64	28.28 ± 14.86	48	11-56	27.76 ± 10.60	n.s.
Black-bellied Plover (*Pluvialis squatarola*)	46	9-68	23.88 ± 10.12	41	11-48	22.92 ± 9.06	n.s.
American Oystercatcher (*Haematopus palliatus*)	48	5-80	29.12 ± 13.76	37	11-59	30.27 ± 11.48	n.s.
Willet (*Catoptrophorus semipalmatus*)	52	7-65	24.47 ± 10.99	63	17-82	31.41 ± 10.23	$p < 0.01$
Short-billed Dowitcher (*Limnodromus griseus*)	28	9-45	21.37 ± 8.68				
Osprey (*Pandion haliaetus*)	71	20-159	49.53 ± 21.75	58	30-140	57.91 ± 22.23	$p < 0.04$

**A test was performed on log-transformed data.*

From Rodgers, J.A., and S.T. Schwikert. 2002. Buffer-zone distances to protect foraging and loafing waterbirds from disturbance by personal watercraft and outboard-powered boats. Conservation Biology 16:216-224.

Table 2. Minimum recommended buffer-zone distances (m) between waterbirds and fast approach of watercraft directly toward waterbirds to prevent flushing.*

	Type of activity	
Species	*Personal watercraft*	*Outboard-powered boat*
Anhinga	134	149
Brown Pelican	183	147
Double-crested Cormorant	156	132
Great Blue Heron	145	133
Great Egret	130	146
Little Blue Heron	113	144
Snowy Egret	118	110
Tricolored Heron	132	141
Reddish Egret	115	
White Ibis	146	119
Roseate Spoonbill	98	
Wood Stork	118	
Caspian Tern	98	
Royal Tern	137	109
Forster's Tern	87	83
Least Tern	86	
Ring-billed Gull	137	
Laughing Gull	107	92
Black-bellied Plover	88	84
American Oystercatcher	103	96
Willet	91	94
Short-billed Dowitcher	82	
Osprey	142	149

**Minimum recommended set-back (RS) distances calculated by the formula* $RS = \exp(\hat{\mu} + 1.6495\,\hat{\sigma}) + 40$ *m.*

From Rodgers, J.A., and S.T. Schwikert. 2002. Buffer-zone distances to protect foraging and loafing waterbirds from disturbance by personal watercraft and outboard-powered boats. Conservation Biology 16:216-224.

Table 2. Flush distances and recommended buffer distances for nonbreeding waterbirds reacting to 4 types of human disturbances.

Disturbance	Species	Flush distance (m)				Recommended buffer (m)[b]
		n	$\bar{x}$[a]	SD		
Walking	Brown pelican (*Pelecanus occidentalis*)	21	27.38	14.77	A B	107
	Double-crested cormorant (*Phalacrocorax auritus*)	15	31.27	12.90	A B	102
	Great blue heron (*Ardea herodias*)	18	30.57	12.39	A B	100
	Great egret (*Ardea alba*)	28	30.55	9.62	A B	91
	Little blue heron (*Egretta caerulea*)	18	23.02	14.29	A B	104
	Snowy egret (*Egretta thula*)	19	26.81	9.27	A B	87
	Tricolored heron (*Egretta tricolor*)	24	24.09	8.18	A B	82
	Willet (*Catoptrophorus semipalmatus*)	12	20.61	6.26	B C	74
	Sanderling (*Calidris alba*)	13	13.73	4.88	C	67
	Ring-billed gull (*Larus delawarensis*)	12	33.80	8.42	A	91
	Black skimmer (*Rynchops niger*)	29	26.63	8.33	A B	85
All-terrain vehicle	Semipalmated plover (*Charadrius semipalmatus*)	24	19.95	7.24	B	76
	Willet (*Catoptrophorus semipalmatus*)	30	19.27	6.41	B C	73
	Ruddy turnstone (*Arenaria interpres*)	35	14.80	6.82	C	72
	Sanderling (*Calidris alba*)	39	14.97	6.10	B C	69
	Ring-billed gull (*Larus delawarensis*)	20	31.84	12.70	A	101
Automobile	Western sandpiper (*Calidris mauri*)	44	18.66	4.45	B	68
	Willet (*Catoptrophorus semipalmatus*)	25	24.24	6.19	A	77
	Ring-billed gull (*Larus delawarensis*)	36	22.04	9.30	A B	84
Motor boat	Brown pelican (*Pelecanus occidentalis*)	22	34.45	19.17	A B	126
	Anhinga (*Anhinga anhinga*)	12	37.40	17.40	A	120
	Great egret (*Ardea alba*)	11	36.05	13.60	A B	107
	Wood stork (*Mycteria americana*)	19	26.47	5.49	B	77

[a] Means with the same letter, within the same disturbance type, are not different ($P > 0.05$, ANOVA, Fisher's protected least significant difference test)

[b] Buffer distance was calculated by using the formula: distance = $\exp(\bar{x} + 1.6495\,\hat{a}) + 40$ m. Values were rounded to the nearest meter.

From Rodgers, J.A., and H.T. Smith. 1997. Buffer zone distances to protect foraging and loafing waterbirds from human disturbance in Florida. Wildlife Society Bulletin 25:139-145.

Table 3. Comparison of flush distances of nesting and nonbreeding birds.

Species	Disturbance	Mean flushing distance (m)		Difference[b]
		Nesting[a]	Nonnesting	
Brown pelican	Boat	9.4	34.5	$P < 0.01$
Brown pelican	Walk	19.2	27.4	$P < 0.01$
Double-crested cormorant	Walk	27.8	31.3	n.s.
Anhinga	Boat	23.6	37.4	$P < 0.01$
Great blue heron	Walk	32.0	30.6	n.s.
Great egret	Boat	28.9	36.1	$P < 0.01$
Great egret	Walk	28.3	30.6	n.s.
Tricolored heron	Walk	31.5	24.1	$P < 0.01$
Wood stork	Boat	14.8	26.5	$P < 0.02$

[a] Data for nesting birds from Rodgers and Smith (1995).

[b] *t*-test performed on log-transformed data.

From Rodgers, J.A., and H.T. Smith. 1997. Buffer zone distances to protect foraging and loafing waterbirds from human disturbance in Florida. Wildlife Society Bulletin 25:139-145.

Table 1. Recommended set-back (RS) distances between breeding colonial waterbirds and a walking or motor boat approach directly toward the nest.

Order and Species	RS Distance (m)[a]	
	Walking	*Motor Boat*
Pelecaniformes		
Brown Pelican (*Pelecanus occidentalis*)	76	65
Double-crested Cormorant (*Phalacrocorax auritus*)	96	71
Anhinga (*Anhinga anhinga*)		89
Ciconiiformes		
Great Blue Heron (*Ardea herodias*)	100	82
Great Egret (*Casmerodius albus*)	91	87
Snowy Egret (*Egretta thula*)		67
Tricolored Heron (*E. tricolor*)	88	59
Little Blue Heron (*E. caerulea*)		71
Cattle Egret (*Bubulcus ibis*)		70
Black-crowned Night-Heron (*Nycticorax nycticorax*)	97	
White Ibis (*Eudocimus albus*)	76	
Wood Stork (*Mycteria americana*)	65	63
Charadriiformes		
Least Tern[b] (*Sterna antillarum*)	154	
Black Skimmer[b] (*Rynchops niger*)	178	

[a] *RS distance was calculated by using the formula* $\hat{RS} = \exp(\hat{u} + 1.6495\,\hat{\sigma}) + 40$ *m. Values were rounded to nearest whole number.*
[b] *RS distances for these species were based on the upflight response.*

From Rodgers, J.A., and H.T. Smith. 1995. Set-back distances to protect nesting bird colonies from human disturbance in Florida. Conservation Biology 9:89-99.

Table 4. The probability of a bird flushing due to the passage of a vehicle during experiments decreased with distance in a species specific manner. Table entries give the probability of a bird flushing predicted by the selected logistic regression model for selected distances. Model parameters given in Table 3.

Species	5 m	10 m	20 m	40 m	80 m
Tricolored Heron	0.90	0.82	0.55	0.08	<0.01
Great Egret	0.82	0.71	0.39	0.04	<0.01
Snowy Egret	0.41	0.26	0.09	0.01	<0.01

From Stolen, E.D. 2003. The effects of vehicle passage on foraging behavior of wading birds. Waterbirds 26:429-436.

Table 2. Recommendations for minimizing investigator disturbance.

Family	Species	Suggestions for minimizing disturbance	Citation
Sphenisciformes	Adelie Penguin, Jackass Penguin	- approach closer than 30 m only when necessary	18, 35, 58
		- move slowly and deliberately when close to nests	40, 58
		- avoid penguin landing beaches	58
		- use the same boat-landing areas consistently	58
		- conduct highly disturbing work during incubation, when adults least likely to desert nests	58, 63
		- avoid large beach groups	58
		- avoid penguin transiting areas	63
		- approach dense colonies slowly and directly	35
		- handle birds only once per day	6
Procellariformes	Northern Fulmar	- flush birds off of nests as seldom as possible	43
		- minimize # of visitors (<12) to colony	43
		- minimize duration of visits (<4 days) to colony	43
Pelecaniformes	Pelicans	- only enter colonies when absolutely necessary	5
		- do not conduct research in colonies containing less than 500 nests	5
	Cormorants	- enter colonies only when necessary	20, 22, 37
	Boobies	- walk slowly when in close proximity to nests	12
		- work for only brief periods in any part of colony	12
Charidriiformes	Gulls, Skimmers, and Terns	- avoid visiting colonies before laying is complete	17, 41, 49, 52
		- terminate research activities after hatching	8, 11, 25, 52
		- visit colonies early in the day to avoid thermal stress	7, 29
		- avoid unnecessary handling of chicks	7, 11, 29
		- calm chicks which have been handled by covering with a hand briefly before departure	7
		- move slowly and deliberately inside colonies	7, 11
		- handle adults as briefly as possible	9
	Puffins	- disturb burrows only during nestling period	47, 51
Ciconiiformes	Herons	- delay visiting nests until one week before hatching	57
		- limit visitation to once every three days	57
		- avoid visiting colony during inclement weather	57
		- obtain reproductive data at a distance when possible	57
		- if planning to enter colonies to monitor reproductive success, do so repeatedly throughout the chick phase to enable habituation.	44

See Table 1 for citation number codes.

From Carney, K.M., and W.J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. Waterbirds 22:68-79.

Appendix 2—Concepts outline

This outline displays all of the concepts described in the report. It can be used as a reference by natural resource managers to recall important considerations in managing for the coexistence of wildlife and recreation.

Wildlife and Recreation: Managing impacts in Florida's Natural Areas

I. Recreation Impacts
   a. Level of impact
      i. Individual
      ii. Population
      iii. Community
   b. Types of impact
      i. Direct
         1. Exploitation
         2. Disturbance
            a. Energetic compromise
            b. Reproductive interruption
            c. Displacement
      ii. Indirect
         1. Habitat modification
         2. Pollution/littering
   c. Wildlife responses
      i. Avoidance
      ii. Attraction
      iii. Habituation

II. Influential factors
   a. Wildlife factors
      i. Physiological Stress
      ii. Seasonal Events
         1. Breeding
         2. Migration
         3. Winter/Dry
      iii. Species
      iv. Age
      v. Group size
      vi. Habitat type
   b. Visitor/activity factors
      i. Visitor behavior
         1. Approaching wildlife
         2. Noise
         3. Leaving the trail
         4. Feeding wildlife
         5. Dogs in natural areas
      ii. Amount of recreational activity
      iii. Frequency/duration of activities
      iv. Timing of activities
      v. Predictability of activities
      vi. Group size
      vii. Type of activity/Mode of travel
         1. Day hiking
         2. Horseback riding
         3. Driving tours
         4. Camping
         5. Off road biking
         6. Motorized activities
         7. Wildlife viewing/nature photography

c. Site layout factors
    i. Quantity and spatial distribution of public-access infrastructure
        1. Quantity
        2. Spatial distribution
        3. Sensitive and resistant areas
    ii. Facility design

III. Management strategies for the coexistence of wildlife and recreationists

a. Visitor management strategies
    i. Visitor education/interpretation
    ii. Regulations

b. Site management strategies
    i. Recreational zoning
    ii. Area of influence
    iii. Set-back distances
    iv. Visual/noise barriers
    v. Internal refuge
    vi. Low-impact facilities
    vii. Low-impact trails and roads
    viii. Wildlife observation structures

Appendix 3--Planning for the coexistence of wildlife and recreation: RMP survey

This survey can be filled out collaboratively between PASO staff and area biologists. It will give insight to recreation planners, allowing them to create meaningful wildlife viewing experiences on WMAs with minimal impact on resident wildlife populations. The area manager should read "Wildlife and Recreation: Understanding impacts on Florida's natural areas" beforehand.

What are the locations of the following (either use a GIS shapefile or a detailed map of the area)...

- Listed species' home ranges?
- Rare or sensitive ecosystems?
- Breeding colonies?
- Carnivore dens?
- Large carnivore home range boundaries?
- Established feeding/watering areas?
- Roosting areas?
- Migration stop-overs?
- Areas under active management (ecosystem restoration, hydrology restoration, invasive plant eradication, species re-introduction)?
- Mature, climax ecosystems?

What concerns do you have regarding recreational disturbance of these areas?

What are the locations of the following...

- Previously disturbed areas (roads, trails, home sites, structures, agricultural areas, tree plantations)?
- Resilient upland ecosystems?
- Other early succession ecosystems?

When are the breeding/mating/nesting seasons for...

- Songbirds?
- Waterbirds?
- Ground nesting birds?
- Raptors?
- Ungulates?
- Herps?
- Carnivores?
- Small mammals?

What concerns do you have regarding recreational disturbance during these times?

When is the migration season for bird species, namely listed species?
What concerns do you have regarding recreational disturbance during these times?

Are there times of year when species are consistently under physiological stress due to weather? When?
What concerns do you have regarding recreational disturbance during these times?

Recreation impacts extend 40-200 m beyond the footprint of facilities, roads, and trails. One mile of trail can influence 80 acres of wildlife habitat, when the impacts extend 100 m to each side of the trail. What proportion of this WMA can be exposed to trail-and-road-related recreation impacts? Are there existing roads or trails that should be closed? Are there large tracts of high-quality habitat that are not accessible by road or trail?

Where are the area's potential wildlife viewing areas? Would it be feasible to build a wildlife viewing structure? If wildlife flush from the viewing area, is there nearby habitat that can be used as an alternative?

What kind of population and distribution data do you have for resident wildlife? What populations are increasing, decreasing, or stable?

Are there any types of recreational activities that you perceive to be especially disturbing to resident wildlife (camping, horseback riding, driving tours, off road biking…)?

Are there any areas where recreation-related noise (human voices, vehicle noise) could travel across a large expanse (open water, low vegetation)?

Are canines a natural predator in this area (fox, coyote, wolf)?

Are there any large predators (bears, panthers) whose home range includes this area? Do you know the locations of dens or feeding/watering areas?

Are you interested in setting specific objectives that define acceptable levels of recreation impact on wildlife, considering:

- Reductions in species diversity, richness, and abundance.
- Compromised utility of established feeding, nesting, or resting areas.
- Direct and indirect impacts to listed species.
- Impediments to intentional restoration or management efforts.
- Inordinate area of influence from recreational access infrastructure.
- Availability and amount of alternative habitat within the natural area (Internal refuge).

Appendix 4--Relevant items for the Public Access Services Office in minimizing recreation impacts on wildlife

The following are highlights from the report that are especially relevant to the FWCs Public Access Services Office. PASO plays a critical role in helping area biologists manage for the long-term coexistence of wildlife and recreation.

- Include recreation impacts on wildlife in interpretive messages (seasonal events, noise, etc.).
- Consider posting speed limit signs on WMAs, and encourage staff cooperation.
- Minimize off-trail recreation (scouting, horseback riding, adventure racing, geocaching).
- Create vegetative noise barriers around use areas in the open.
- Create identifiable wildlife viewing areas. Trails and roads should not linger in high-quality habitat, but should be routed to minimize wildlife disturbance.
- Concentrate recreational access, leaving vast areas undisturbed.
- While open expanses provide for excellent wildlife viewing, human disturbance extends much further from its point of origin than in wooded areas. Trails and roads should follow the edges of open ecosystems, avoiding the interior. If a viewing structure is to be placed in an open area, it should either be situated on the edge of the area or a short distance into the interior.
- Explore regulations with area staff (seasonal closures, sensitive area closures, activity restrictions).
- Conduct simple set-back distance evaluations before locating and constructing a wildlife viewing area. The area should be situated far enough from the preferred habitat that the wildlife are not disturbed, but close enough for the visitors to see.
- Promote the use of binoculars and telephoto lenses.
- Collect relevant geographic information from area biologists (listed species, sensitive areas, feeding/breeding/roosting/denning areas, etc.)
- Develop long-lasting, low impact trails and facilities.
- Instead of crafting experiences that immerse visitors in pristine habitat, try to utilize lower-quality areas to move people between specific, high-quality wildlife viewing areas.
- When identifying wildlife viewing areas, determine the availability of nearby habitat that can be used for refuge if animals don't tolerate visitors.
- When approaching an area used intensively by wildlife, assess the appropriate set back distance that will allow wildlife to suffer minimal disturbance.
- When siting a wildlife observation structure, assess the tolerance of resident wildlife to determine at what distance they will remain visible in the presence of humans. Open structures, such as platforms and towers, will inflict more disturbance that closed ones (blinds).
- Extend the message of wildlife disturbance to other programs, agencies, organizations (Audubon, Sierra Club, Florida Trail Association, Master Wildlife Conservationists, etc.)

Appendix 5--A compilation of wildlife viewing guidelines from various fish and wildlife agencies in the US

Many fish and wildlife agencies are trying to promote responsible wildlife viewing behavior. The glaring insufficiency in most of these educational campaigns is the absence of information regarding the potential impact of recreation on wildlife. The lists of "tips" mention important behaviors, but fail to explain why they are important. If recreationists are to embrace guidelines, they must first understand themselves as part of a problem. Some of the agencies miss the underlying issue of wildlife disturbance and frame their guidelines as tips that will simply help people to find and observe animals.

Florida Fish and Wildlife Commission website, Sept 2007

Wildlife Viewing Ethics

It's rewarding to have close up views of animals, but it's easy for even the most responsible wildlife watchers to inadvertently put themselves, or the animals they seek, at risk. Keep the following tips in mind as you venture out into Florida's natural areas:

Every animal differs in how close it will allow you to approach before it pauses in its feeding, nesting or resting activities, or flees altogether. Such disturbances can be disastrous for animals, especially the cumulative effect of frequent disruptions, a common occurrence at beaches, waterways and other busy wildlife viewing sites. When disturbed, an animal uses up valuable energy reserves that are no longer available for other uses, such as migrating, tending to young, mating or escaping predators. A fleeing parent may abandon a nest and risk exposing eggs or young to temperature extremes or predators.

How can you tell if you're too close? Look for the obvious: Has the animal stopped feeding? Is it looking at you? Does it appear aggressive or skittish? Did the animal begin to move away or fly into the air? Is it dive-bombing you or circling overhead? Do you see distraction displays such as a bird exhibiting a "broken wing?" These behaviors are all progressive signs of disturbance.

If you see any of these signs, move away immediately. When possible, use binoculars or zoom lenses to extend your view. If an adult animal allows you to approach, something's wrong. It may be sick, injured or aggressive. If you're suspicious, contact the local site manager.

Corals are extremely fragile colonies of soft-bodied animals. It is illegal to collect them and they are damaged by touch. Boats should use mooring buoys rather than anchors.

Respect private property boundaries, even if the animal you are following does not. Obey posted signs near nesting areas and stay on roads, trails and paths to minimize habitat disturbance.

Resist the temptation to feed wild animals. Fed animals may abandon their natural, healthy diet, become dependent on human food and lose their fear of humans. Such animals can become aggressive or dangerous or may risk crossing busy roads to venture close to human habitations. Report people who attract wild dolphins or sharks by feeding them. As of Jan 1, 2002, they're breaking the law. You can call our Wildlife Alert toll free number 1-888-404-FWCC

Young animals are rarely abandoned by their parents, so if you find one that looks helpless, there's a good chance that the parents are nearby, waiting until you leave before they return. The longer you stay, the longer the youngster must go without food and the greater the risk that it will be spotted by a predator.

Finally, your trip will be more successful if you keep your pets at home. They may frighten or harm the wildlife you are seeking and many sites prohibit them altogether. It is against Florida law for you or your pets to chase, harass or harm wildlife.

Minnesota Department of Natural Resources website, Sept 2007

Wildlife Viewing Tips

Just a Little Respect

- Respect private property-ask first before entering.
- Leave pets at home-pets and wildlife don't mix.
- Leave feathers, eggs, nests or animals where you find them.
- Don't harass, pursue, touch or feed animals or remove them or their young from their habitat.
- Be courteous to others you meet.

Improving Your Chances

- Bring binoculars, spotting scope or telephoto lens camera.
- Go out at dawn and dusk for the best viewing.
- Be alert, move slowly and quietly. Be patient.
- Search for tracks in the mud or snow and look for gnawed saplings.
- Look near the edges of forests and fields, pond margins and treetops.
- Choose the right place to find the species you want to spot.
- Look for species during the season they are most likely to be found.
- Avoid moving in for a closer look, which might flush an animal from a favorite perch, feeding area, den or nest.
- Do not approach moose, black bear, rattlesnakes or animals acting strangely.

California Watchable Wildlife Committee website, Sept 2007

California Watchable Wildlife Viewing Tips

The ultimate wildlife viewing experience is watching animals in their normal behavior.
Here are some helpful tips to become a wildlife friendly viewer.

1. **Use the right tools** - A field guide, a pair of binoculars and a comfy pair of shoes are a good start.
2. **Watch at dawn and dusk** - This is the time when most wildlife species are active enough
   to view.
3. **Keep your distance** - Stay on established trails and maintain a distance that is comfortable for the wildlife.
4. **Stay quiet** - Move slowly and quietly to increase your chances of viewing wildlife, and to avoid stressing the animals you wish to watch.
5. **Do not feed wildlife** - There is plenty of food available in the wild. Human food can cause digestive problems, provide improper nutrition, and even kill an animal.

Montana Fish, Wildlife, and Parks website, Sept 2007

Montana Fish Wildlife and Parks Viewing Tips

Have you noticed the new binocular signs along the highway? They mark hundreds of wildlife viewing areas that are described in state guidebooks. Remember though, wildlife can't read the signs. They lurk everywhere, and if you act respectfully, you may encounter animals while traveling to or from the viewing site. "On the way" is all part of the adventure!

Fade into the woodwork

- Wear natural colors and unscented lotions. Remove glasses that glint.
- Walk softly so as not to snap twigs.
- Crouch behind boulders or vegetation to hide your figure or break up your outline.
- Try not to throw a shadow.
- Remember that your reflection may be caught in a pool of water.

Let animals be themselves

- Resist the temptation to "save" baby animals. Mom is usually watching from a safe distance.
- Let animals eat their natural foods. Sharing your sandwich may harm wild digestive systems and get animals hooked on handouts. These animals may eventually lose their fear of cars, campers, or even poachers. As a bonus, you'll learn a lot about an animal by watching what foods it prefers.
- Let patience reward you. Resist the urge to throw rocks to see a flock fly.
- Savor the experience of being in an animal's home. Absorb all that it can teach you about living gently upon the land.

Stick to the sidelines

- Use binoculars or zoom lenses to get that close-up. Aim for pictures of assured, dignified animals, instead of stressed, panting victims.
- Give nests a wide berth. Although you mean well, your visit may lead a predator to the nest or cause the parents to jump ship, exposing eggs or young to the elements.

How to use binoculars

- Find the subject with your unaided eyes.
- Bring the eyepieces just under your eyes.
- Sight the subject over the tops of the eyepieces.
- Slowly bring the binoculars to your eyes.

Come to your senses

- A wildlife encounter is a spectrum of sensations. Deepen awareness by tapping your sense of smell, taste, touch, hearing, and sight.
- Focus and expand your attention, taking in the foreground and then switching to take in the wide view.
- Use your peripheral vision rather than turning your head.
- Look for out-of-place shapes-- horizontal shapes in a mostly vertical forest or an oblong shape on a tree branch.
- Watch for out-of-place motions-- the flight of a bird, for instance, stands out against a backdrop of falling leaves.
- Look above and below you. Animals occupy niches in all the vertical and horizontal layers of a habitat.
- Make "mule ears." Cup your hands around the back of your ears to amplify natural sounds.
- Heed your instincts. If the hair on the back of your neck stands up (a vestige of the days when we had fur), an animal may be near!
- Silence can speak volumes. Animals may fall silent when a predator is passing through an area.

Be easy to be with

- Relax your muscles; animals can easily detect tension.
- Make yourself as small and unassuming as possible.
- Move like molasses: slow, smooth, and steady.
- If you must advance, take a roundabout route, never directly toward an animal.
- Avert your gaze; animals may interpret a direct stare as a threat.

Think like an animal

- Imagine how the animal you are seeking spends its days. Check field guides to find out about life history and preferred habitats.
- As a rule, the border between two habitats is a good place to see residents from both places.
- Look in high-visitation areas: trail intersections, perches, ledges overlooking open areas, and drinking sites.
- Take note of the season and guess whether the animal will be shopping for a mate, feathering its nest, fattening for the winter, or preparing to migrate.
- Figure out the best time of day for viewing by imagining an animal's daily schedule. When does it feed? Nap? Bathe? Drink? Dusk and dawn are usually good bets.
- Factor in the weather. After a rain, for instance, many animals emerge to feed on displaced insects, flooded-out rodents, etc.

Camera tips

- Use at least a 400 mm lens.
- Have the sun at your back.
- Afternoon light is best.

- Aim for featuring wildlife within its natural surroundings, not a full-frame profile.

Wildlife are Watching
We've all had it happen. you look up from the trail just in time to see an animal dive out of sight-- a swoop of wing, a flash of antler, a slap of beaver's tail.

The truth is, most animals see and hear and smell us long before we catch their drift. They size us up, and, depending on how far away we are and how we act, they decide whether to stay, defend themselves, or flee. Fighting and fleeing from us rob them of precious energy.

Fortunately, there are simple ways you can help blend into an animal's surroundings. In return, you'll be treated to a wildlife show that makes your heart pound and your senses hum.

Colorado Division of Wildlife website, Sept 2007

The Colorado Division of Wildlife's Watchable Wildlife program offers the following tips and advice for more rewarding, safer, and responsible wildlife viewing.

- Observe animals from a safe distance—safe for you and safe for the animals. You can get 'close' by using binoculars, a spotting scope, or a camera with a telephoto lens. If the animals you are observing have their heads up, ears pointed toward you, or appear 'jumpy' or nervous when you move, you are probably too close!* Sit or stand very quietly, without making eye contact, or move slowly away to a safer distance. Be especially sensitive to and cautious around adults with young.
- Move slowly and casually, not directly at wildlife. Allow animals to keep you in view; do not surprise them. Avoid eye contact; watch from the 'corner' of your eye.
- Never chase or harass wildlife. Harassment of wildlife is unlawful, and can be very harmful for wildlife.
- Leave your pets at home. At best their presence hinders wildlife watching; at worst they can chase, injure, or kill wildlife, or be injured or killed.

- Using the animals' behavior as a guide, limit the time you spend watching if animals appear to be stressed.
- Respect others who are viewing the same animals.
- Do not feed wild mammals. (See the "Don't Feed the Deer" and "Don't Tempt Them!" links to the left.) Reserve feeding for 'backyard' birds.
- Respect private property; ask for permission to access private lands before your viewing trip.
- Animals at rest need to remain at rest; don't do anything that might make them move.
- Avoid animals that behave unexpectedly or aggressively. They may be ill, injured, or have young nearby.

* Animals have a sense of what is, for them, a 'safe distance' to maintain between themselves and other animals that might pose a threat, including humans of course! If you intrude into this safe distance you alter their behavior, causing stress, unnecessary use of energy, or loss of time for them to rest or feed. Aggressive behavior might be triggered, too. Never, ever, try to approach wildlife when they are clearly trying to move away and maintain safe separation.

Last Updated: 8/13/2007

Establishment Order No: WMA 11-04 Caravelle Ranch
Wildlife Management Area

The Fish and Wildlife Conservation Commission of the State of Florida, under Article IV, Section 9, of the Florida Constitution, and the rules and regulations of the Commission, hereby re-establishes the Caravelle Ranch Wildlife Management Area in Putnam and Marion counties, Florida, with the following described area:

The legal description for the Caravelle Ranch Wildlife Management Area is contained within the following: an Agreement with the St. Johns River Water Management District (SJRWMD); the Fish and Wildlife Conservation Commission (FWC) Contract Number 93085 with the Board of Trustees (BOT) executed November 14, 1996 (BOT Lease Number 4100); a Sublease from the Department of Environmental Protection, Office of Greenways and Trails (OGT); a letter requesting the addition of land to the WMA from the OGT; a request to add lands donated to FWC; written requests from the SJRWMD to add lands to the WMA. Legal descriptions for all properties within this lease and amendments are located in Central Files of the FWC and The Division of State Lands for the BOT.

Agreement with SJRWMD	5,270 Acres	
Original BOT Lease:	5,103 Acres	
Amendment 1:	10 Acres	
Amendment 2:	10 Acres	New for March 2011
Sublease from OGT	3,000 Acres	
Letter of request from OGT	11,486 Acres	
Letter from OGT requesting addition	1,541 Acres	
Donated lands	57 Acres	
SJRWMD Request for addition:	374 Acres	
SJRWMD Request for addition:	400 Acres	

All lands comprising approximately 27,251 acres, and posted as a Wildlife Management Area.

Authority: Article IV, Section 9, Florida Constitution

History: WMA I 91-10, WMA I 92-11, WMA I 93-9, WMA I 94-55, WMA I 95-27, WMA I 96-12, WMA I 98-7, WMA I 01-11, WMA 04-07, WMA 06-08 WMA 08-21, WMA 10-07, WMA 11-04

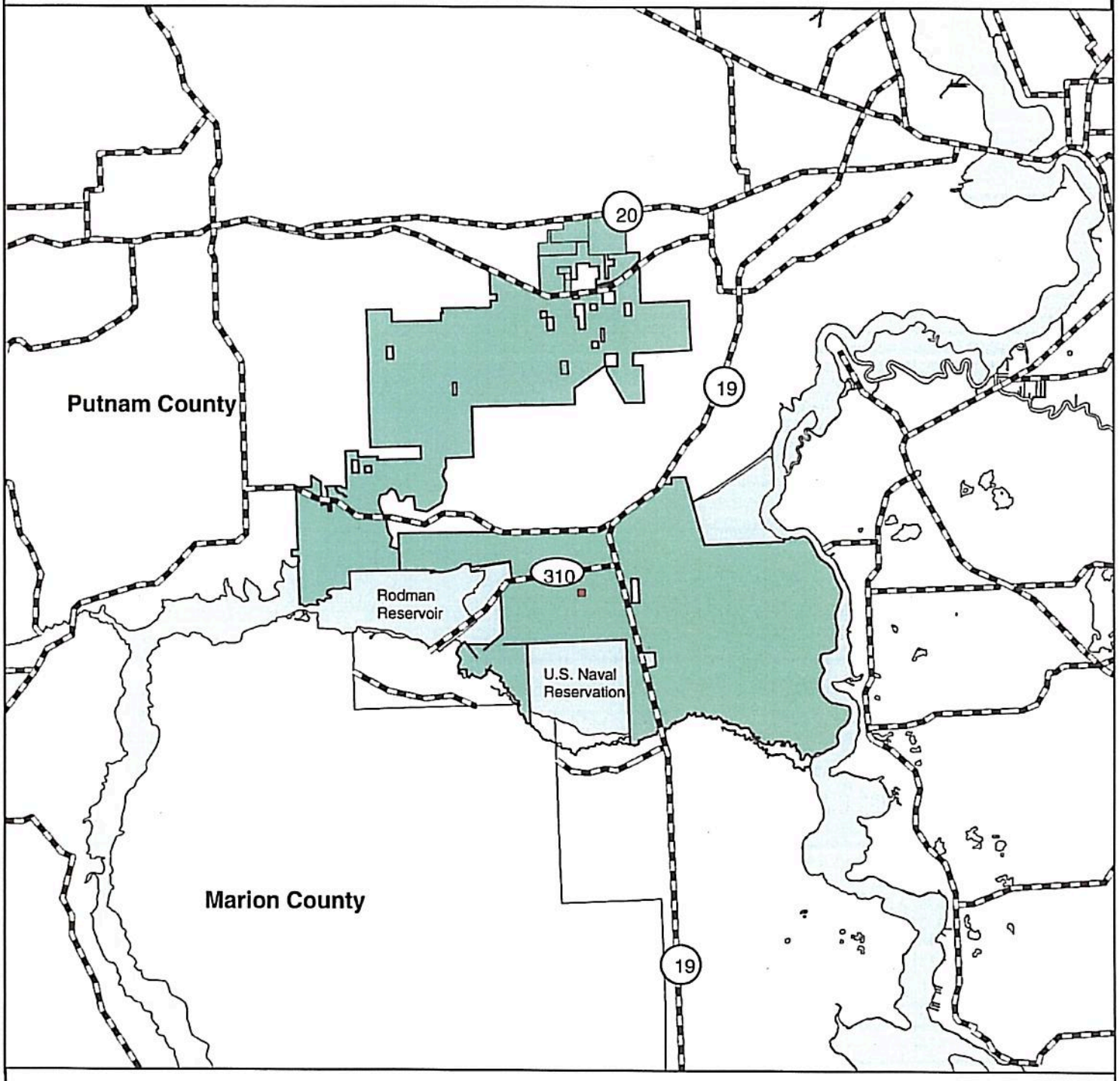
GIVEN UNDER MY HAND AND SEAL OF THE FISH AND WILDLIFE CONSERVATION COMMISSION OF THE STATE OF FLORIDA, THIS 23rd DAY OF MARCH 2011.

Attest: _____
Agency Clerk

FISH AND WILDLIFE CONSERVATION COMMISSION STATE OF FLORIDA

_____
Greg Holder
Assistance Executive Director

Caravelle Ranch WMA
Putnam and Marion Counties
Boundaries are approximate

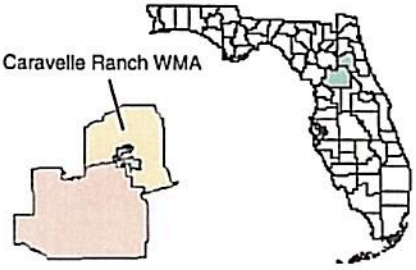


Acreage:
Previous 26,841
Addition 10
New Total 27,251

Caravelle Ranch WMA
Addition

N
W E
S

0 0.5 1 2
Miles



M E M O R A N D U M: **March 18, 2011**

TO: Greg Holder, Assistant Executive Director

FROM: Diane R. Eggeman, Director, Division of Hunting and Game Management

SUBJECT: Caravelle Ranch Wildlife Management Area,
Establishment Order No. WMA 11-04

Please find attached an Establishment Order for re-establishing the Caravelle Ranch Wildlife Management Area (WMA). The establishment order for this WMA was updated to add 10 acres per Amendment No. 2 to Lease No. 4100 with the Board of Trustees of the Internal Improvement Trust Fund with the State of Florida.

Please contact me should you have any questions.

From:	Mary Martinez
To:	FLStateParkPlanning; Marion CountyFL; Killough, Ashley
Subject:	Re: Safety concerns for the Cross Florida Greenway
Date:	Sunday, January 7, 2018 3:50:40 PM
Attachments:	Crossing Paths_ Ocala Star Banner.pdf

Dear state and local officials,

I would like for you to read an article (attached) posted in the Sunday Ocala Star Banner-today. It sums up my sentiments as well as thousands of land owners and tax payers in Marion County and surrounding areas. Clearly, if we continue to pave any more of the Cross Florida Greenway, you will lose the hundreds of people that move to the Ocala area annually specifically for equine purposes. Our economy is dependent on the equestrian community, not only in the property taxes paid, but all the equine related industry in Ocala/Marion County. People move to Ocala because it has (in the past) been equine friendly. Just ask any of our largest realtors where their big commissions come from. It's not from people moving to Ocala to cycle! It's those that move here specifically for equine related reasons. And, we as residents support all the large and small businesses that make Ocala sustainable.

I would like to propose that all future paving be halted, at least until after several years of safety and economic impact this will incur on our area.

Thank you and please feel free to reach out to me at any time.

Sincerely

Mary Martinez

352-804-7104

On Tue, Dec 26, 2017 at 9:47 AM, Mary Martinez <gwstables@gmail.com> wrote:

> I'd like to request that the topic of signage be added to the safety discussion with the state and local governments. How can we (equestrians) get these discussions on the table?
> Rather than having plastic 'Horses signs with arrows' for the equestrian to yield to cyclists, I feel a more appropriate signage be posted on the 'paved' trails, warning cyclist: "**Slow Horse/Pedestrian Crossing**".
> It certainly makes more sense for the road cyclist to slow down than for an equestrian to dismount a large horse.
> (Equestrians will always stop before crossing pavement and proceed across at a safe speed, aka walk, due to horses slipping on pavement).
> Mountain bikers have always show respect and kindness for the equestrians, but we have lived with them for many years and they understand the dangers.
> However, the road cyclists are most likely unaware of the dangers to both horse and cyclists. Their speeds are much great than that of a MB and would take them a much longer time to brake or even slow down.
> Certainly, once these paved trails 'open', there will be many more racing bikes on those trails.
> This weekend, I did pass/see many 'family cyclists' on the paved trails, who obviously were not moving at incredible speeds. But the fast racing road bikes present a very clear danger to the equestrians, so prior to the crossings, bridges and tunnels, I am requesting we open up the discussion to having signage on the paved trails, simply asking the cyclist to **SLOW** at the crossings, bridges and tunnels.
> This really is a matter for safety for everyone. I appreciate you taking the time to read this email and hope we can find a solution for all.
> Hope you had a wonderful holiday and a Happy New Year!
> Kind regards,
> Mary Martinez

--
Mary Martinez, CCRA
GSC, Inc
phone: 352-804-7104
fax: 1-888-804-1557

http://www.linkedin.com/in/marymartinezccra

--
Mary Martinez, CCRA
GSC, Inc
phone: 352-804-7104
fax: 1-888-804-1557

http://www.linkedin.com/in/marymartinezccra

Crossing paths

Equine users of Greenway feeling displaced by paved paths

By Denise Raymond
Special to the Star-Banner

Kat McGrath on Diamond, Tracy Forseth on Rio and Marcia Williams on Cricket, left to right, ride their quarter horses on a horse trail leading to the Land Bridge on the Marjorie Harris Carr Cross Florida Greenway south of Ocala in this 2016 photo. [BRUCE ACKERMAN/STAFF PHOTOGRAPHER/FILE]

Known as the "Horse Capital of the World," Ocala/Marion County is home to the largest number of horses and ponies of any other county in the United States. The diversity of breeds and disciplines make it an ideal setting for any horse lover.

This is what gives our area its unique character, and what sets us apart as a travel destination or a great place to live. The equine industry represents a $2.62 billion annual economic impact on the Ocala/Marion County economy.

I am an equestrian user of the Greenway trails in the Ocala area. I moved to this area almost four years ago because this area has an abundance of safe and natural trails for the equestrian user. I own five acres and 10 equines here in Ocala, and contribute to the economic impact of the area due to the expenses that come along with owning and caring for 10 equines. Additionally, I pay a fairly high amount for taxes.

When I moved to Ocala, I was unaware that a big change was about to take place and that an area that has been marketed as the Horse Capital was about to begin a process of ousting horses from the local trails they have been using for years and replacing beautiful wooded areas with asphalt and garish signs. Little did I know that now, a few years later, those same trails would be overtaken with blacktop that is wide enough to accommodate a large vehicle, and that the horse trails would be pushed to the side in favor of bikes and other wheeled conveyances traveling at speeds of around 25 mph.

The local Greenway office in our area has been largely unresponsive to the needs of the equestrian community that has the largest financial impact on our immediate area. Horse people move to this area for the trails, and equestrian tourists travel from far flung places just to ride our beautiful and until now safe trails.

The local Greenway office employs primarily people who seem to have little knowledge of the needs of the equestrian users of the trails and there is almost no consultation with the equestrian community as a whole with regards to the trails. No one asks for our feedback on local decisions, even though we are the ones out there on those trails.

Attempts to have our needs addressed as a group have been rebuffed. We were told repeatedly that the paved trails would not impact the horse trails, except at intersections. In fact, the paved trails have actually taken over a good portion of the horse trails.

With that said, we now have a paved trail that has taken over large swaths of the beautiful, peaceful, natural trails that equestrians have enjoyed. Suddenly the very same trails we have ridden all along are filled with cyclists zipping up on our horses at fast speeds. There are going to be accidents.

Equestrians have no choice in the use of the bridges and tunnels if they trail ride from trailhead to trailhead, and yet the safety of riders and cyclists has not been addressed at all for these areas. The footing used for the horse side is a rock/shell composition that is not at all horse friendly. For a multi-use trail, it certainly feels as if we equestrians are being made to feel very unwelcome.

Now that the paved trails are here, we are told we have to just accept it and either "go ride somewhere else," as I was told, I would like to at least see some safety issues addressed for the time we have left before we equestrians are completely pushed out of the picture as far as the trails go. Signage has not proven to be effective, although it seems that the NO HORSES ALLOWED signs are mushrooming throughout the woods these days.

See PATHS, A15

PATHS

From Page A9

There needs to be some type of speed enforcement on the trails to keep horses and riders safe from cyclists approaching at high speed. I would suggest a rule requiring cyclists to dismount when going through tunnels or over bridges, especially at any time that horses are present.

If we make these areas unfriendly for horse people, how many will continue to visit our area to use them?

The cyclists have a big movement in which they ask everyone to share their resources — share the road, share the trails, etc. We need the same consideration that is expected by them on the trails, and since the state agreed to sacrifice our woods by putting in a road for their enjoyment, we would like to see laws put into effect providing us with the same rights in our environment.

Equestrians know that our sport is dangerous in a whole different way from the cyclists. We ride the original form of transportation, and are passionate advocates for the powerful animal that the very back of our country was built on. We are the preservers of a history that fades with every inch of asphalt laid through woods once quiet, natural, and peaceful. If we can no longer have the kind of rides that every equestrian dreams of — with pristine woods and encounters with nature — can we at least ask for safety measures? Please do something to slow the users of the paved trails so that at times when horses and other groups share the trail it doesn't become a dangerous experience for horse people.

Equestrians are not represented well by the supporting organizations of the Greenway. We deserve a voice on the Greenway boards. Going forward, in the Ocala area and across the state, I would ask for more consideration of preservation of our land as a natural resource. Just because we can pave paradise, doesn't mean that we should.

Denise Raymond is a writer and a horsewoman who lives in Ocala.