Supplemental Information for the Lake Eustis Pupfish

Biological Status Review Report

The following pages contain peer reviews received from selected peer reviewers, comments received during the public comment period, and the draft report that was reviewed before the final report was completed

March 31, 2011

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Peer review #1 from Dr. Mike Barton

To: Elsa M. Haubold, Ph.D. 3 January 2011
Section Leader, Species Conservation Planning

From: Michael Barton, Professor of Biology

Subject: Evaluation of Lake Eustis Pupfish status review

Having read the draft Biological Status Review for the Lake Eustis Pupfish, I concur with their recommendation. Although I believe that this subspecies merits special consideration, the work of the review committee confirms that it does not meet IUCN criteria for "vulnerable" status and could be removed from Florida's list of threatened species. I reach this conclusion because of the following observations:

- The membership of the biological review group, Mr. William Johnson, Drs. Frank Nordlie, and Steven Walsh, represent individuals most qualified to investigate and make recommendations concerning the status of *Cyprinodon* in the southeastern United States.
- The summaries provided with the draft recommendation reflect a sufficiently comprehensive sampling of Eustis Lake Pupfish populations in which the range of habitat types sampled as well as the sampling gear employed assured a reliable estimate of current population status. Sampling indicates that there has been no significant decline in population numbers in the past several years.
- A comprehensive literature search reflected a thorough understanding of the evolutionary history and adaptations of pupfish species. From this, it becomes evident that the Lake Eustis pupfish does not represent a distinct species according to most criteria for species designation, but is a genetically distinctive population that exists within a continuum of the *Cyprinodon variegatus* species complex. This makes assessment of status and vulnerability more difficult as it is not often clear whether criteria established for species can readily be applied in situations where given populations may represent genetically distinct units as a consequence of restricted gene flow, but are not truly reproductively isolated.
- The data provided indicates that the present environmental status of the lake system that encompasses the known range of habitats for the Lake Eustis Pupfish is not in immediate danger of environmental degradation to the extent that the populations are likely to face extirpation.

Adverse impacts experienced by other relict populations, especially of *Cyprinodon* species, should remind us that the current status of this subspecies, as a comparatively healthy population not in immediate danger of extirpation, can easily change. Introduction of exotic species is an event that should be closely monitored in this regard. As such, a management plan should be of the highest priority for the Lake Eustis Pupfish.

Peer review #2 from Gray Bass

January 2010

Lake Eustis pupfish review (by Gray Bass)

To: Ted Hoehn and Bill Johnson

Ted and Bill:

(1) I agree with your conclusions and recommendations regarding the status of the Lake Eustis pupfish. It should be delisted.

(2) Comments: I really don't have any extra comments. This is Bill's little fish. He should know all there is to know about it. We did, as you mentioned, find it readily in the lakes it is known to inhabit.

Sincerely,
Gray

Peer review #3 from Frank Jordan

Frank Jordan's comment on status review of Lake Eustis Pupfish

The information and data in this review appears to be complete and accurate and (2) the assumptions, interpretations of the data, and conclusions of the review appear to be reasonable and justifiable.

I concur with the findings of the report and support the recommendation to remove the Lake Eustis Pupfish from Florida's list of threatened species.

There are a few editorial changes highlighted below, but I see no need for substantive revision.

Given the limited geographic distribution of this subspecies and the extent of development in the area, I encourage continued monitoring of the Lake Eustis Pupfish to ensure that this species does not undergo significant decline in abundance or distribution.

Sincerely,

Frank Jordan
Professor of Biological Sciences
Loyola University New Orleans
6363 St. Charles Avenue
New Orleans, LA 70118
jordan@loyno.edu
504-865-3829

Biological Status Review for the Lake Eustis Pupfish, *Cyprinodon variegatus hubbsi* (Carr 1936)

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of September 1, 2010. Public information on the status of the ~~peregrine~~ Lake Eustis Pupfish was sought from September 17 to November 1, 2010. The members of the Lake Eustis Pupfish biological review group (BRG) met on November 18, 2010. Group members were William Johnson, Frank Nordlie, and Steven Walsh. In accordance with rule 68A-27.0012 Florida Administrative Code (F.A.C.), the BRG was charged with evaluating the biological status of the Lake Eustis Pupfish using criteria included in definitions in 68A-27.001(3) and following the protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 3.0)* and *Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1)*. Please visit

http://www.myfwc.com/WILDLIFEHABITATS/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Lake Eustis Pupfish BRG found that the Lake Eustis Pupfish, *Cyprinodon variegatus hubbsi* did not meet the IUCN regionally-applied criteria for "vulnerable" status, based on the best scientific information available at this time.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

BIOLOGICAL INFORMATION

Life History References – Johnson and Snelson (1978), Guillory and Johnson (1986), Gilbert et al. (1992), Bass et al. (2004)

Taxonomic Classification – This biological status report is for the Lake Eustis Pupfish, Cyprinodon *variegatus hubbsi* (Carr 1936). This subspecies was recognized as a full species before Johnson (1974) determined that variation in meristic and morphometric characters were within the range of variation exhibited by *C. variegatus*. Duggins et al. (1983) suggested *C. v. hubbsi* arose from three founding populations: one derived from a Gulf coast *C. variegates* population (Lake Weir), another from the Florida east coast (lakes Harris, Griffin and Eustis) and a third (Lake Dora) from an unknown population.

Population Status and Trend – This is the only freshwater fish endemic to the St. Johns River watershed, where it inhabits a narrow zone along clean, white sandy beaches subject to heavy wave action in areas largely devoid of vegetation. No population trend data are available. However, Gilbert et al. (1992) noted that this fish flourished in its limited microhabitat in the middle 1970s. Bass et al. (2004) noted that Lake Eustis pupfish were "readily" collected from 10 sites in eight lakes in 2003-2004. The frequency of occurrence of pupfish in seine samples (sand-bottom areas with little vegetation) was 54% in 1978 (Guillory and Johnson, 1986), 31% in electrofishing samples from Lake Eustis (highest value of lakes sampled) in 2006-2008, 29% in 0.01 ha blocknet samples from sand-bottom areas of Lake Griffin in 2008, 40% in $1m^2$ throw traps from sites with $\leq$ 30% vegetative coverage from Lake Harris in 2007, and 10% from all fyke nets sites (although 34% of the fish were caught at sites with $\leq$ 35% vegetation coverage) from Lake Harris in 2008 (FWC unpublished data). Current population sizes are unknown, but can be estimated from throw trap data collected on Lake Harris in 2007 (FWC unpublished data). Pupfish density was $0.63/m^2$ at random sites in < 0.75m of water depth. For example, a 10-m wide band around 211 km shoreline of pupfish-inhabited lakes equals approximately 1.3 million fish.

Geographic Range and Distribution – This small freshwater fish is endemic to central Florida and is known only from lakes in Lake, Marion, and Orange counties (Gilbert et al. 1992). Known populations are marine relicts in the upper Oklawaha River system.

Quantitative Analyses – No population viability analyses are available for this species.

BIOLOGICAL STATUS ASSESSMENT

Threats – The small geographic range and narrow habitat niche inhabited by this species in the heavily ~~population~~ populated central Florida region suggests that habitat loss and contamination are potential threats to this endemic species. Because pupfish prefer clean sandy beaches, lack of management of exotic aquatic vegetation, alteration of lake shore habitat, or introduction of nonnative ~~, carnivorous~~ predatory fish are other threats that may cause population declines.

Statewide Population Assessment – There have been no recent assessments of current distribution and population status.

LISTING RECOMMENDATION

FWC fish taxa experts in consultation, and mindful of the BRG's findings, recommend that the Lake Eustis Pupfish, *Cyprinodon variegatus hubbsi* be removed from Florida's Threatened list because it did not meet criteria as defined in rule 68A-27.001(3), F. A. C.

SUMMARY OF THE INDEPENDENT REVIEW

This will be completed after the peer review.

Copy of the Lake Eustis Pupfish BSR draft report that was sent out for peer review

Draft Biological Status Review for the Lake Eustis Pupfish, *Cyprinodon variegatus hubbsi* (Carr 1936)

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SUMMARY OF THE INDEPENDENT REVIEW

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LITERATURE CITED

Bass, G., T. Hoehn, J. Couch, and K. McDonald. 2004. Florida Imperiled Species Investigation. Final Report to the U. S. Fish and Wildlife Service. Federal Grant: R-3. Florida Fish and Wildlife Conservation Commission. Tallahassee.

Carr, A.F., Jr., 1936. A new species of *Cyprinodon* from Lake Eustis, Florida. Copiea 3:705-708.

Duggins, C. F. Jr., A. Karlin, and K. G. Relyea. 1983. Electrophoretic comparison of *Cyprinodon variegates* Lacepede *and Cyprinodon hubbsi* Carr, with comments on the Genus *Cyprinodon* (Atheriniformes: Cyprinodontidae. Northeast Gulf Science, 6(2):99-107.

Gilbert, C.R., W.E. Johnson, and F.F. Snelson. 1992. Lake Eustis pupfish *Cyprinodon variegates hubbsi*. Pp. 194-199. In C.R. Gilbert, ed., Rare and Endangered Biota of Florida. Vol. II. Fishes. University Presses of Florida, Gainesville.

Guillory, V., and W.E. Johnson. 1986. Habitat, conservation status, and zoogeography of the cyprinodont fish, *Cyprinodon variegatus hubbsi* (Carr). Southwestern Naturalist 31:95-100.

Johnson, W.E. 1974. Morphological variation and local distribution of *Cyprinodon variegatus* in Florida. Master's Thesis, Florida Technological University, Orlando, FL.

Johnson, W.E., and F.F. Snelson. 1978. Lake Eustis pupfish, *Cyprinodon variegatus hubbsi* Carr. Pp. 15-17 in C.R. Gilbert, ed., Rare and Endangered Biota of Florida. Vol. 4. Fishes. University Presses of Florida, Gainesville.

Biological Status Review Information
Findings

Species/taxon: Lake Eustis Pupfish
Date: 11/18/10
Assessors: Johnson, Nordlie, Walsh

Generation length: not applicable

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	No decline in population observed, estimated, suspected or projected.	I	N	Guillory, V., and W.E. Johnson. 1986. FWC (2010) unpublished data
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	No decline in population observed, estimated, suspected or projected.	I	N	Guillory, V., and W.E. Johnson. 1986. FWC (2010) unpublished data
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	No decline in population observed, estimated, suspected or projected.	I	N	Guillory, V., and W.E. Johnson. 1986. FWC (2010) unpublished data
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	No decline in population observed, estimated, suspected or projected.	I	N	Guillory, V., and W.E. Johnson. 1986. FWC (2010) unpublished data
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	208 km^2	E	Y	FWC (2010) unpublished data
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	0.8 km^2	E	Y	FWC (2010) unpublished data
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	9 locations (lakes)	E	Y	Guillory, V., and W.E. Johnson. 1986.

b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	No decline in population observed, estimated, suspected or projected.	I	N	Guillory, V., and W.E. Johnson. 1986. FWC (2010) unpublished data
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No fluctuation in population observed, estimated, suspected or projected.	I	N	Guillory, V., and W.E. Johnson. 1986. FWC (2010) unpublished data
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	Population estimated at 400,000 mature individuals (30% of 1.3 million individuals	E	N	FWC (2010) unpublished data
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR	No decline in population observed, estimated, suspected or projected.	I	N	FWC (2010) unpublished data
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	No decline in population observed, estimated, suspected or projected.	I	N	FWC (2010) unpublished data
a. Population structure in the form of EITHER	No subpopulations	E	N	FWC (2010) unpublished data
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	Not true	E	N	FWC (2010) unpublished data
b. Extreme fluctuations in number of mature individuals	No fluctuation in population observed, estimated, suspected or projected.	I	N	FWC (2010) unpublished data
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	Population estimated at 400,000 mature individuals (30% of 1.3 million individuals	E	N	FWC (2010) unpublished data
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	Number of locations (lakes) is nine.	E	N	FWC (2010) unpublished data
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	No quanitative analysis done.		N	

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Does not meet any criteria	Yes

Is species/taxon endemic to Florida? (Y/N)	Yes
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Does not meet any criteria	Population large and not declining

APPENDIX 1. Biographies of the members of the White Ibis Biological Review Group.

William (Bill) E. Johnson (FWC/FWRI, Lead-Lake Eustis Pupfish)

Bill Johnson has worked for the Florida Fish and Wildlife Conservation Commission for 36 years. He received his B.S. degrees from Stetson University and his M.S. degree from the University of Central Florida. Bill is currently a Biological Administrator II and sub-section leader in Fresh Fish Research for FWRI in Eustis, FL. In the Freshwater Fisheries Biology sub-section, researchers study the age, growth, reproduction, mortality, movement, food habits, diseases, juvenile recruitment, and other life-history parameters essential to understanding the population dynamics of important sport fish species in Florida. Bill's past areas of research include: fresh water sport fish ecology and population studies, endocrine disruption in fresh water fishes and effects of pesticide exposure, habitat restoration of fresh water lakes, bio-manipulation of fresh water fish populations, and genetic studies and nutritional requirements of largemouth bass. Bill did taxonomic research on the Florida populations of pupfish (*Cyprinodon*) in graduate school.

Dr. Frank Nordlie (University of Florida, Professor Emeritus)

Dr. Frank G. Nordlie received his Ph.D. from the University of Minnesota in 1961. He served as professor, and ultimately department chair, of Zoology at the University of Florida; and now has earned Professor Emeritus status. He has conducted numerous osmoregulation studies on subspecies of the sheepshead minnow (*C. variegatus*) including Lake Eustis pupfish, and has publications referent to these fishes ranging over three decades .

Dr. Steve Walsh (US Geological Service)

Dr. Stephen Walsh received his Masters from Southern Illinois University at Carbondale and his Ph.D. in zoology from the University of Florida (1990). He has studied lower vertebrates, particularly teleost fishes, for the last twenty-four years for the Florida Museum of Natural History, the US Fish and Wildlife Service, the National Biological Survey, with the last fourteen years as Research Fishery Biologist at the US Geological Survey.

His expertise in non-game fishes includes: conservation biology of aquatic organisms; ecology and environmental physiology of fishes and aquatic invertebrates, and zoogeography of temperate and tropical freshwater, estuarine, and inshore marine fishes. He has conducted studies on osmoregulation in native non-game fishes and has numerous publications on native non-game fishes.

APPENDIX 2. **Summary of letters and emails received during the solicitation of information from the public period of September 17, 2010 through November 1, 2010.**

No information about this species was received during the public information request period.

APPENDIX 3. Information and comments received from independent reviewers.

To be inserted late