A Species Action Plan for the Bluenose Shiner *Pteronotropis welaka*

Final Draft
November 1, 2013

Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, FL 32399-1600
Visit us at MyFWC.com

BLUENOSE SHINER ACTION PLAN TEAM

Team Leader: Theodore Hoehn, Division of Habitat and Species Conservation

Team Members: Chris Paxton, Freshwater Fisheries Management
Dr. Jeffery Wilcox, Division of Habitat and Species Conservation
Katie Woodside, Freshwater Fisheries Management

Acknowledgements: Laura Barrett, Division of Habitat and Species Conservation
Claire Sunquist Blunden, Office of Policy and Accountability
Brie Ochoa, Division of Habitat and Species Conservation

Cover photograph courtesy of Todd D. Crail

Recommended citation:
Florida Fish and Wildlife Conservation Commission.2013. A species action plan for the bluenose shiner. Tallahassee, Florida.

EXECUTIVE SUMMARY

A biological assessment of the bluenose shiner (*Pteronotropis welaka*) determined that the species warranted listing in Florida as threatened. FWC staff, with stakeholder assistance, developed this plan to guide recovery of the species. The goal of this management plan is to improve the conservation status of the bluenose shiner to the point that the species can be removed from the Florida Endangered and Threatened Species List and will not again need to be listed. Objectives are to maintain or increase the bluenose shiner population and area of preferred habitat within 10 years of this plan's implementation. A major strategy for achieving this objective is to maintain the existing water quality, water quantity, and habitat characteristics within identified priority sub-watersheds. Because much is unknown about the specific habitat requirements of the bluenose shiner, achieving these objectives will require research and monitoring efforts by cooperating agencies on both public and private lands.

Specific actions proposed to increase understanding of the bluenose shiner biology and its habitat requirements include:

- Genetic testing to determine any differences among population locations;
- Range-wide surveys to determine population densities, habitat associations, and new occurrence locations;
- Identification and quantification of threats to survival;
- Restoration of historic occurrence locations;
- Assessing existing agricultural Best Management Practices (BMP's) and the development of non-agricultural and agricultural wildlife BMP's to minimize incidental take;
- Education and outreach;
- Coordination with local governments and cooperative organizations to develop a standardized survey protocol, create development guidelines, provide land use planning assistance.

Successful management of the bluenose shiner through implementation of this plan will require cooperation among local, state, and federal governmental agencies; non-governmental organizations; development and industrial interests; private landowners; academic institutions; and the public. The FWC developed this plan in collaboration with identified stakeholders. We recommend this plan be revised in 10 years; any significant changes to this plan will be made with the continued involvement of stakeholders.

This plan details the actions necessary to improve the conservation status of the bluenose shiner. A summary of this plan will be included in the Imperiled Species Management Plan (ISMP), in satisfaction of the management plan requirements in Rule 68A-27, Florida Administrative Code., Rules Relating to Endangered or Threatened Species. The ISMP will address comprehensive management needs for 60 of Florida's imperiled species and will include an implementation plan; rule recommendations; permitting standards and exempt activities; anticipated economic, ecological, and social impacts; projected costs of implementation and identification of funding sources; and a revision schedule. The imperiled species management planning process relies heavily on stakeholder input and partner support. This level of involvement and support is also critical to the successful implementation of the ISMP.

TABLE OF CONTENTS

BLUENOSE SHINER ACTION PLAN TEAM ii
EXECUTIVE SUMMARY iii
LIST OF TABLES v
LIST OF FIGURES vi
GLOSSARY OF TERMS AND ACRONYMS vii
INTRODUCTION 1
Biological Background 1
Conservation History 2
Threats and Recommended Listing Status 3
CONSERVATION GOAL AND OBJECTIVES 7
CONSERVATION ACTIONS 8
Habitat Conservation and Management 8
Population Management 15
Monitoring and Research 16
Rule and Permitting Intent 20
Law Enforcement 21
Incentives and Influencing 21
Education and Outreach 25
Coordination with Other Entities 25
LITERATURE CITED 30
APPENDICES 33
Appendix 1. Cooperating agencies/programs aimed at maintaining aquatic habitat quality. ... 33
Appendix 2. Riparian buffers and management. 35
Appendix 3. Protocols for propagation, translocation, reintroduction, and augmentation. 37
Appendix 4. Monitoring and research protocols. 40
Appendix 5. Coordination with other entities. 45

LIST OF TABLES

Table 1. Summary of habitat conservation and management preliminary recommendations. 14
Table 2. Summary of preliminary population management recommendations. 16
Table 3. Summary of monitoring and research preliminary recommendations..... 20
Table 4. Summary of incentives and influencing preliminary recommendations for local governments and private landowners in the priority areas and areas under restoration. 24
Table 5. Summary of coordination with local governments and state and federal agencies preliminary recommendations. 27
Table 6. Conservation Action Table. 28

LIST OF FIGURES

Figure 1. Panhandle sub-watersheds and occurrence locations for the bluenose shiner, *Pteronotropis welaka*. 4
Figure 2. St. John's river basin sub-watersheds and occurrence locations for the bluenose shiner, *Pteronotropis welaka*. 5
Figure 3. Priority sub-watersheds for the bluenose shiner, *Pteronotropis welaka*. 6

GLOSSARY OF TERMS AND ACRONYMS

BMPs: Best Management Practices. Generally, BMPs represent methods, measures or practices that are developed, selected, or approved by various agencies to protect, enhance and preserve natural resources including wildlife habitat. They include, but are not limited to, engineering, conservation, and management practices for mining, agriculture, silviculture, and other land uses, that are designed to conserve water quality and quantity, soil and associated nutrients, and to simultaneously control nonpoint and point source pollution and other impacts to natural resources including aquatic and terrestrial wildlife habitat.

BRG: Biological review group, a group of taxa experts convened to assess the biological status of taxa using criteria specified in Rule 68A-27.001, Florida Administrative Code, and following the protocols in the Guidelines for Application of the International Union for Conservation of Nature (IUCN) Red List Criteria at Regional Levels (Version 3.0) and Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1).

BSR: Biological status review report, the summary of the biological review group's findings. Includes a Florida Fish and Wildlife Conservation Commission (FWC) staff recommendation on whether or not the species status meets the listing criteria in Rule 68A-27.001, Florida Administrative Code. These criteria, based on IUCN criteria and IUCN guidelines, are used to help decide if a species should be added or removed from the Florida Endangered and Threatened Species List. In addition, FWC staff may provide within the report a biologically justified opinion that differs from the criteria-based finding.

DEP: Florida Department of Environmental Protection

DOACS: Florida Department of Agriculture and Consumer Services

EPA: United States Environmental Protection Agency

ERP: Environmental Resource Permitting program, administered by the Florida Department of Environmental Protection and the water management districts under Chapter 373, Florida Statutes.

F.A.C.: Florida Administrative Code. The Department of State's Administrative Code, Register and Laws Section is the filing point for rules promulgated by state regulatory agencies. Agency rulemaking is governed by Chapter 120, Florida Statutes, the Administrative Procedures Act. Rules are published in the Florida Administrative Code.

FWC: Florida Fish and Wildlife Conservation Commission, the state agency constitutionally mandated to protect and manage Florida's native fish and wildlife species.

F.S.: Florida Statutes

GIS: Geographic Information System

HCP: Habitat Conservation Plan

ISMP: Imperiled Species Management Plan

ITP: Incidental Take Permit

IUCN: International Union for Conservation of Nature, a professional global conservation network.

IUCN Red List of Threatened Species: An objective global approach for evaluating the conservation status of plant and animal species, the goals of which are to: Identify and document those species most in need of conservation attention if global extinction rates are to be reduced; and provide a global index of the state of change of biodiversity.

IWRM: Integrated Water Resource Monitoring Network. The Integrated Water Resource Monitoring Network Program is a multi-level or "tiered" monitoring program designed to answer questions about Florida's water quality at differing scales. The program is supported by several DEP water quality monitoring groups in Tallahassee and in regional (district) offices. In general, Tier I addresses statewide and regional (within Florida) questions, Tier II focuses on basin-specific to waterbody-specific questions, while Tier III answers site-specific questions

LDR: Local Government Land Development Regulations

Lentic: Standing or relatively still water; lakes, ponds, and wetlands.

Lotic: Actively moving water; streams, springs, or river systems.

MFL: Minimum Flows and Levels, the minimum water flows and/or levels adopted by the Water Management District Governing Board as necessary to prevent significant harm to the water resources or ecology of an area resulting from permitted water withdrawals. MFLs define how often and for how long high, average and low water levels and/or flows should occur to prevent significant harm. When use of water resources alters the water levels below the defined MFLs, significant ecological harm can occur."

NANFA: North American Native Fishes Association

NPDES: National Pollutant Discharge Elimination System

NRCS: Natural Resources Conservation Service, a branch of the United States Department of Agriculture.

NWFWMD: Northwest Florida Water Management District

OFW: Outstanding Florida Water; see Rule 62-302.700, F.A.C.

SJRWMD: St. Johns River Water Management District

SL: Standard Length

SMZ: Special Management Zone: The Special Management Zone (SMZ) is a BMP which consists of a specific area associated with a stream, lake, or other waterbody that is designated and maintained during silviculture operations. The purpose of the SMZ is to protect water quality by reducing or eliminating forestry related inputs of sediment, nutrients, logging debris, chemicals and water temperature fluctuations that can adversely affect aquatic communities. SMZs provide shade, streambank stability and erosion control, as well as detritus and woody debris, which benefit the aquatic ecosystem in general. In addition, the SMZ is designed to maintain certain forest attributes that will provide specific wildlife habitat values. Snags, den, and cavity trees as well as mast producing trees left in the SMZ are necessary to meet habitat requirements for certain types of wildlife.

SQL: Structured Query Language

Take: As defined in Rule 68A-27.001(4), F.A.C (General Prohibitions). Taking, attempting to take, pursuing, hunting, molesting, capturing, or killing any wildlife or freshwater fish, or their nests or eggs by any means whether or not such actions result in obtaining possession of such wildlife or freshwater fish or their nests or eggs.

TMDL: Total Maximum Daily Load. A scientific determination of the maximum amount of a given pollutant that a surface water can absorb and still meet the water quality standards that protect human health and aquatic life.

TNC: The Nature Conservancy

USACE: United States Army Corps of Engineers

USFWS: United States Fish and Wildlife Service, the federal agency mandated to protect and manage the nation's native wildlife resources.

USGS: United States Geological Survey

Wildlife Conservation Actions: This term includes the activities designed to restore, maintain, or enhance fish and wildlife populations or their requisite habitat. This term also includes those provisions that avoid or minimize the chance for incidental take of listed species of wildlife when conducting activities specifically designed for land or water use objectives other than wildlife.

WMD: Water Management District

WQ: Water Quality

INTRODUCTION

Biological Background

The bluenose shiner (*Pteronotropis welaka*) is a small to medium sized shiner measuring 33 to 51 mm (1.3 to 2.0 in). The species is olive-colored, with a dark lateral stripe bordered above by a narrow amber stripe, a dark caudal spot highlighted by light-colored areas above and below, and a blue "nose" (adults only). Adult males have large, darkly pigmented dorsal fins and yellow pelvic and anal fins streaked with black (Hipes et al. 2000).

The bluenose shiner is found in southern coastal plain streams from Florida to Louisiana. It is very fragmented in occurrence throughout its range (Albanse et al. 2007). In Florida there are 2 disjunct distributions, the St. Johns River basin and the western panhandle (Figure 1 and Figure 2), with no known occurrences between the St. Johns and the Apalachicola rivers (Gilbert 1992). A western population occurs on the panhandle in the Escambia, Yellow/Shoal, Choctawhatchee/Holmes Creek, and upper Chipola (Apalachicola) rivers; and an eastern population is on the Atlantic slope in the middle St. Johns and Wekiva River drainages. There is an opinion, based upon physical characteristics, by several researchers that the St. Johns River population may be genetically different from panhandle populations, and may represent a separate subspecies or species.

The first specimens were collected from the St. Johns River, near Welaka, in 1897 by William C. Kendall (Bass and Hoehn, unpublished report). In Mississippi, they have been found in clear, first-order streams, with sand and silt substrate and dense vegetation that occurs in patches (Johnston and Knight 1999). In Florida, they have been reported from clear to turbid waters, small to moderate-sized streams and backwaters, deep pools or holes, and areas with dense vegetation and brush to areas that have minimal vegetation (Gilbert 1992, Osprey Data International, Inc. 2001). A confounding factor in determining the life history, habitat requirements, and distribution is the difficulty of effective sampling. The bluenose shiner, which is typically not found in great abundance of individuals, is often known to disappear at certain times of the year from areas where it previously was found. It has also been known to disappear from a location for several years and then re-appear (Osprey Data International, Inc. 2001, Bass et al. 2004).

The life history and reproduction of the bluenose shiner was described by Johnson and Knight (1999) in Mississippi and by Osprey Data International, Inc. (2001) in Florida. Johnson and Knight (1999) reported the maximum standard length (SL) of bluenose shiners males was 51 mm (2 in) and 48 mm (1.9 in) SL for females. Average longevity was estimated to be about 2 years. They observed bluenose shiners spawning over the nests of longear sunfish (*Lepomis megalotis)*, a behavioral tactic where nest-spawning associates derive benefit from aggressive nest-guarding by male sunfishes. Nest parasitism with sunfishes has evolved independently in a few other *Notropis* shiners (Fletcher 1993). In the absence of *Lepomis* species, bluenose shiners are likely epibenthic broadcasters (spawning over a large area of the bottom), probably over sand, woody debris, and macrophytes (Burkhead 2010). Bluenose shiners are reproductively active from May to August and may have 2 reproductive periods within this timeframe (Osprey Data International, Inc. 2001).

Conservation History

The bluenose shiner was listed by the Florida Game and Fresh Water Fish Commission (predecessor to the Florida Fish and Wildlife Conservation Commission (FWC)) as a Species of Special Concern in 1989. Several management plans have been developed for the Yellow, Shoal, and Chipola rivers basins. These include the Gulf Coastal Plain Ecosystem Partnership's Aquatic Management Plan for the Watershed of the Western Panhandle of Florida and Southern Alabama (The Nature Conservancy [TNC] 2006), Inventory and Prioritization of Impaired Sites in the Yellow River Watershed in Alabama and Florida (Herrington 2011), Chipola River Watershed Restoration and Conservation Action (Bearwood and Pettis 2007), and the Chipola River Threats Assessment Report (U.S. Fish and Wildlife Service [USFWS] 2007). These plans contain recommendations for habitat management and restoration activities within the basins. While these plans were not designed for specific conservation and management of the bluenose shiner, they contain strategies and recommendations that support the conservation needs identified within this plan. Some of these plans have received some funding for implementation, but additional funding and cooperation with state and local governments is needed. This plan identifies sub-watersheds (Figure 3) as high priority for maintaining populations that are currently present or have persisted in these sub-watersheds over time.

For all waters of the state, the Florida Department of Environmental Protection (DEP) has defined 5 surface water classifications, based upon their designated use, with specific water quality (WQ) criteria for each classification under rule 62-302.400, Florida Administrative Code (F.A.C.). In addition to its surface water classification, a waterbody may be designated as an Outstanding Florida Water (OFW), under Rule 62-302.700, F.A.C. An OFW is a waterbody designated as worthy of special protection because of its natural attributes. OFW designations overlay surface water classifications, and are intended to preserve existing ambient WQ. DEP provides a factsheet about OFWs on their website at http://www.dep.state.fl.us/water/wqssp/ofwfs.htm. The Shoal, Choctawhatchee, Chipola, and Wekiva rivers, Alexander Springs and Creeks, Yellow River Marsh Aquatic Preserve, and some waters adjacent to Northwest Florida Water Management District (NWFWMD) lands, which contain bluenose shiners, have been designated OFWs. OFWs receive more stringent protections from DEP and the Water Management Districts (WMDs) when reviewing projects (e.g., dredge and fill or wastewater discharge) for permitting. The DEP Environmental Resource Permit Program (ERP) is authorized under Chapters 253, 258, and 373, of the Florida Statutes (F.S.). In addition, Chapter 403, F.S., is used as part of this program to govern activities that may pollute Florida's ground and surface waters, including wetlands. The ERP program and WQ protections should provide additional support for maintaining or improving the WQ and habitat needed by the bluenose shiner.

The Department of Agriculture and Consumer Services (DOACS) has developed agricultural best management practices (BMPs) that are designed to benefit water quality and water conservation while maintaining or even enhancing agricultural production. Based on information available for properties greater than 500 acres (202.3 ha) and landowners that have filed a notice of intent (NOI), only the silviculture BMPs are being implemented by agricultural interests within priority and occurrence sub-watersheds containing bluenose shiners.

Threats and Recommended Listing Status

In 2010, FWC directed staff to evaluate the status of all species listed as Threatened or Species of Special Concern that had not undergone a status review in the past decade. To address this charge, staff conducted a literature review and solicited information from the public on the status of the bluenose shiner. FWC convened a biological review group (BRG) of experts on the bluenose shiner to assess the biological status of the species using criteria specified in Rule 68A-27.001, F.A.C. This rule includes a requirement for BRGs to follow the Guidelines for Application of the International Union for Conservation of Nature (IUCN) Red List Criteria at Regional Levels (Version 3.0) and Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1). FWC staff developed an initial draft Biological Status Review report (BSR), which included the BRG's findings and a preliminary listing recommendation from staff. The draft was sent out for peer review, and the reviewers' input was incorporated into a final report.

The conservation ranks and Florida distribution of the bluenose shiner were summarized by Hoehn (1998). The bluenose shiner has undergone a precipitous decline in the St. Johns River Drainage since the 1970s. None were found there in the 2004 statewide Imperiled Species Survey Investigations (Bass et al. 2004), and none were collected in a recent intensive survey of Alexander Springs using multiple sampling techniques (Steve Walsh, United States Geological Survey [USGS], personal communication). However, they were found in 2012 through a joint sampling effort between FWC and DEP in the Wekiva River and Rock Springs run. Bluenose shiners were collected from 21 sites in northwestern Florida during the Imperiled Species Survey Investigations (Bass et al. 2004). Drainages harboring bluenose shiners included the Escambia, Choctawhatchee, and Yellow rivers. Bluenose shiners were not found during this survey effort at some sites that were known to previously contain them. Primary threats to this species include changes in WQ and quantity, river impoundments for water supply, channel dredging, habitat alteration, encroachment of urbanization, and point source and non-point source pollution.

Based on the literature review, information received from the public, the BRG findings, and peer-review input, FWC staff recommended the bluenose shiner be retained on the list of State-designated Threatened species.

The BRG found the bluenose shiner met the following criteria for listing:

- Criterion B(2), b and c, Geographic Range. Area of occupancy less than 2,000 km^2 (772 mi^2), continued declines in number of individuals and habitat quality, and extreme fluctuations in number of mature individuals.

It is possible the bluenose shiner area of occupancy in Florida has always been <2,000 km^2. As such, conservation actions focus on overcoming the triggered subcriteria by stopping the continuing decline or by reducing extreme fluctuation.

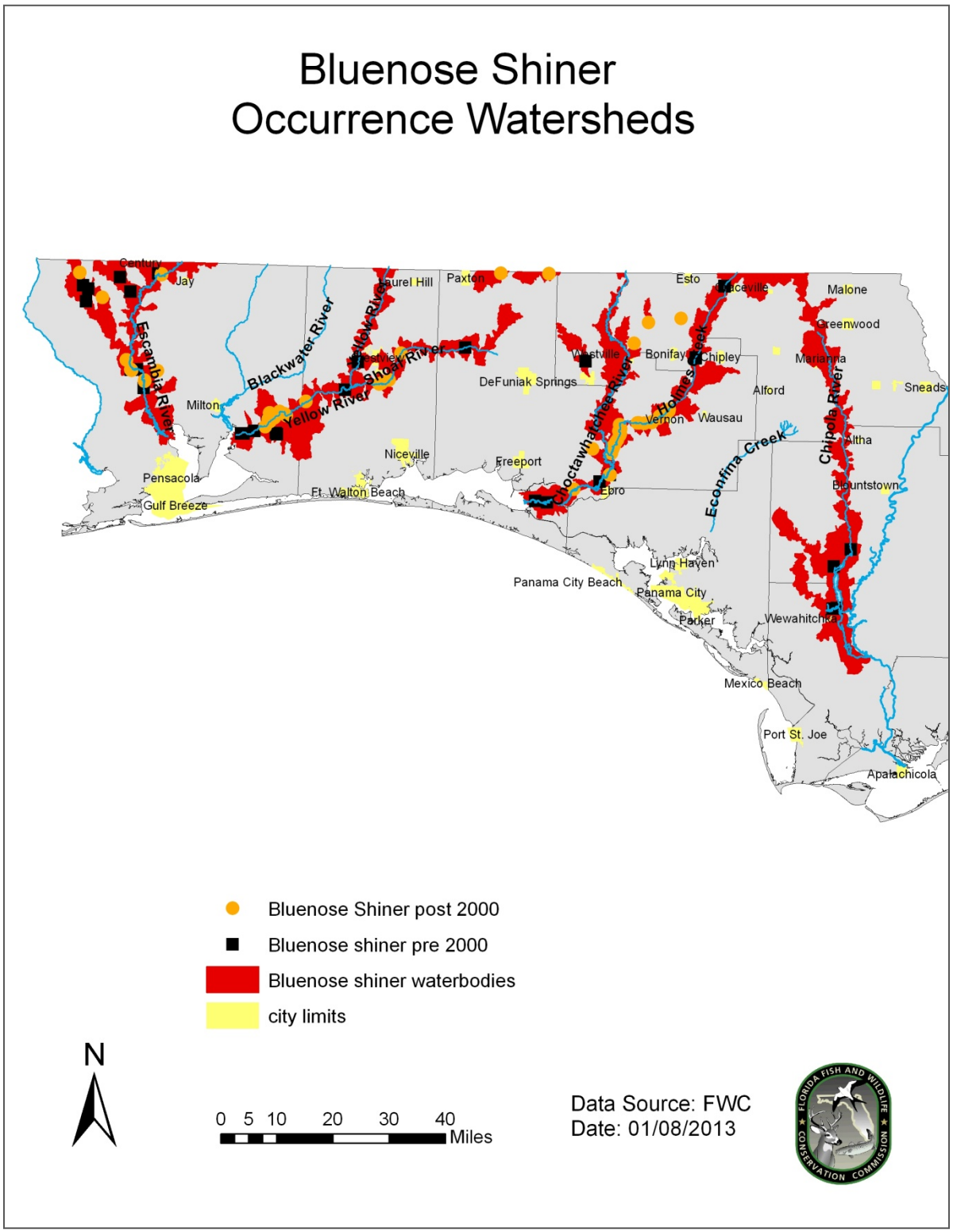

Figure 1. Panhandle sub-watersheds and occurrence locations for the bluenose shiner, *Pteronotropis welaka.*

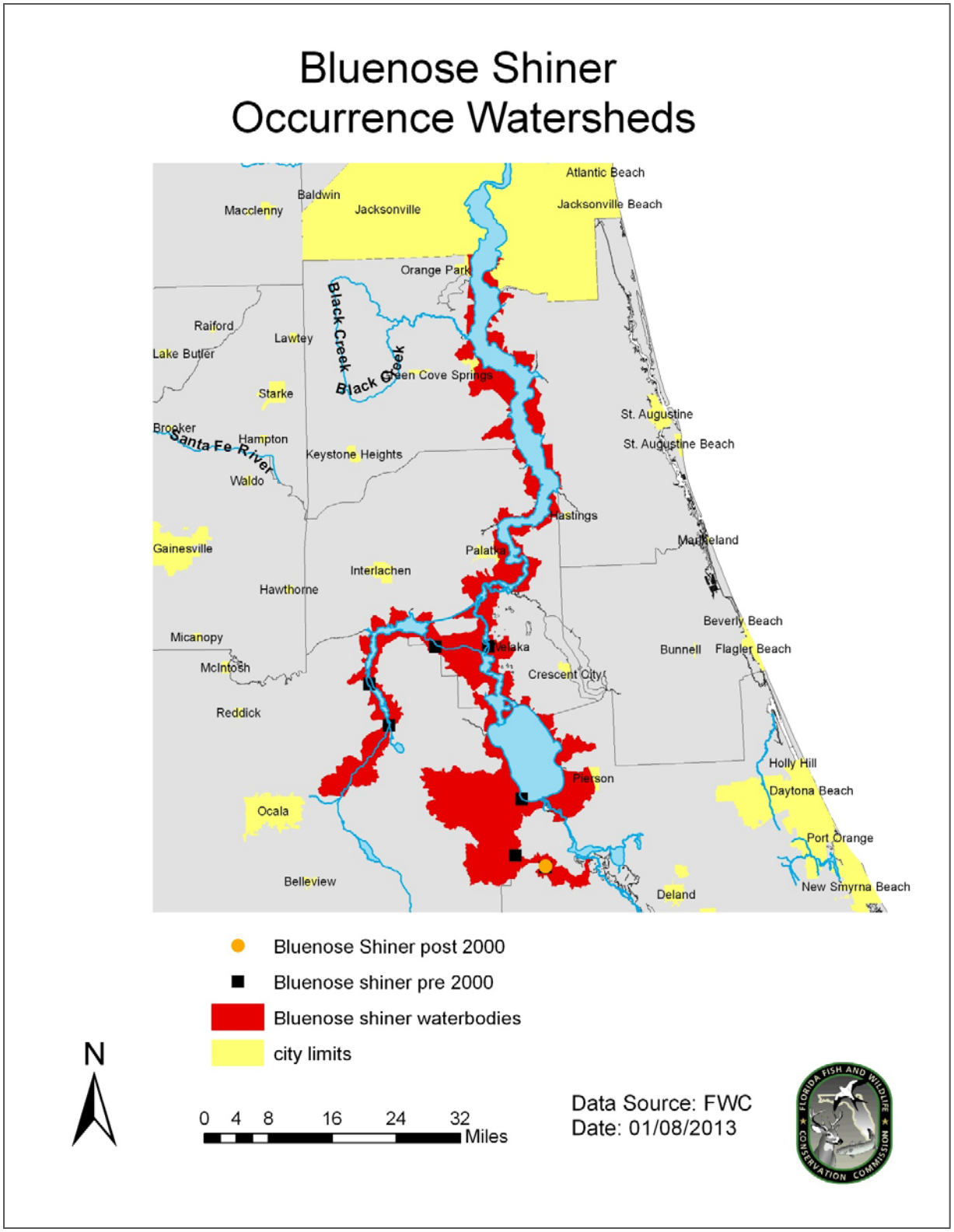

Figure 2. St. John's river basin sub-watersheds and occurrence locations for the bluenose shiner, *Pteronotropis welaka*.

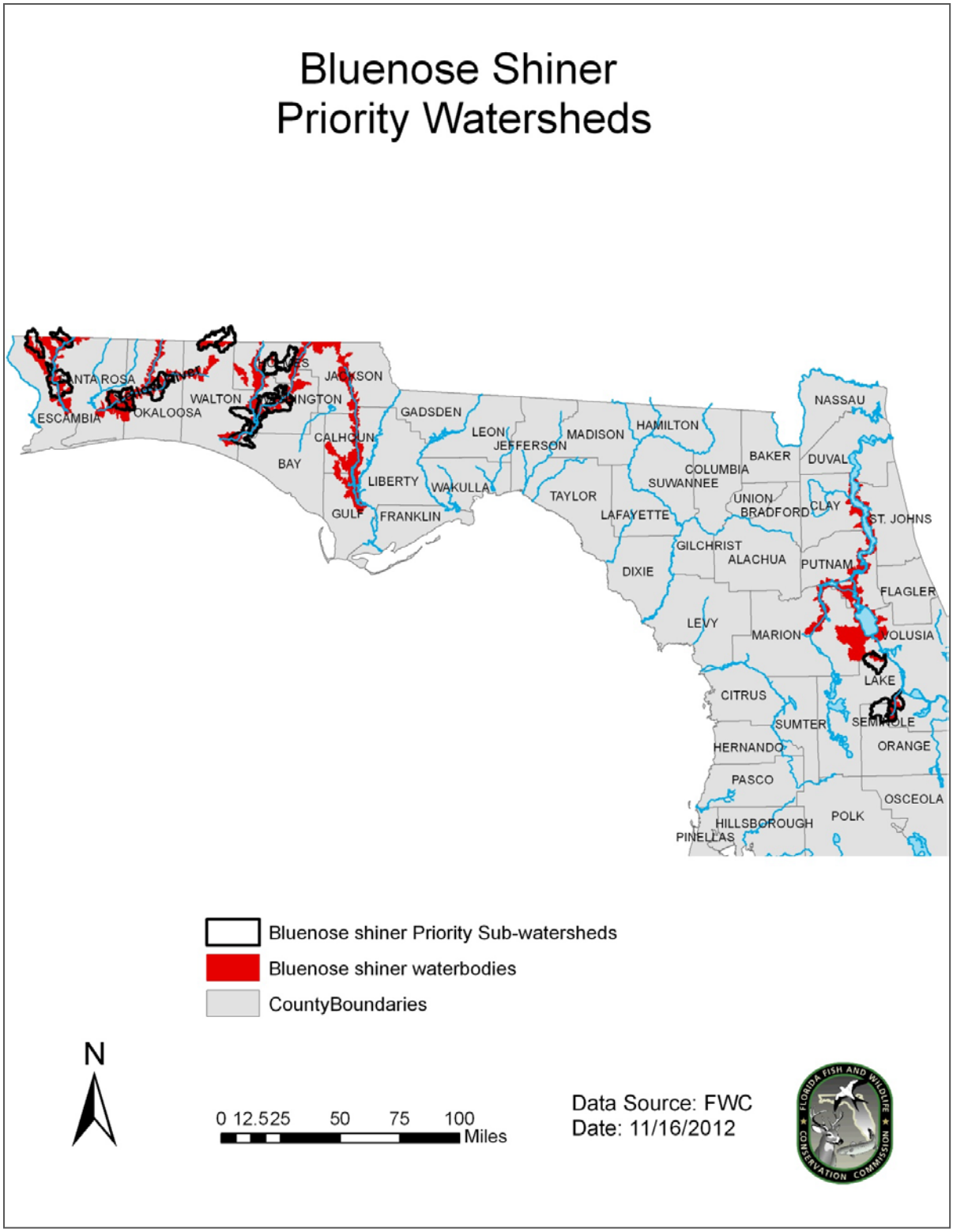

Figure 3. Priority sub-watersheds for the bluenose shiner, *Pteronotropis welaka*.

CONSERVATION GOAL AND OBJECTIVES

Goal

Conservation status of bluenose shiner is improved to a point that the species can be removed from the Florida Endangered and Threatened Species List and will not again need to be listed.

Objectives

I. Maintain existing populations within the 25 known sub-watersheds or improve and maintain to more than 1,000 the number of mature individuals of bluenose shiners in each river of their historical range in the Escambia River, Yellow/Shoal River, Choctawhatchee River, Holmes Creek, Chipola River, St. Johns River, and Wekiva River basins for the duration of plan implementation.

Rationale

The Escambia River, Yellow/Shoal River, Choctawhatchee River, Holmes Creek, Chipola River, St. Johns River, and Wekiva River basins have viable populations. The Choctawhatchee, Yellow River, and Holmes Creek systems contain the largest and most consistent population locations for the species. Recent sampling (Strictland et al. 2011) indicated the occurrence of a substantial and stable population in Holmes Creek. All sites should be maintained to prevent extinction and to preserve genetic diversity. If habitat or WQ or quantity changes occurred within a few of the known areas of occupancy, there could be substantial decrease in abundance within the entire population. Maintaining a population >1,000 mature individuals in each river system should ensure an effective population size that will sustain genetic diversity and reduce or eliminate extreme fluctuations in numbers of mature individuals.

II. Enhance or restore populations of bluenose shiners where they no longer occur within the historical range of the known River Basins within 10 years of plan implementation to increase known current range and decrease population fragmentation.

Rationale

Recent sampling (post-2000) indicated that bluenose shiners were no longer present in several historic locations in all river systems. The known locations where bluenose shiners occur are disjunct and possibly fragmented and do not appear to allow genetic interchange to occur. Bluenose shiners have not been observed in some areas of the Shoal River since the 1970s and in some areas of the St. John’s River and Alexander Springs for over 15 years. It is not certain if the species is still present at very low numbers, which is making detection difficult. Additional sampling may identify new locations or address possible detection issues at the historic sites. An increase in locations would reduce the fragmentation and address some of the criteria that have resulted in the recommendations for listing. There may be environmental or anthropogenic conditions present that preclude the natural movement of the bluenose shiner into potentially habitable areas, or physical/chemical changes in the habitat contributing to the loss of the population in these historic locations. There also may be unidentified sites where the species occurs. Restoration of bluenose shiners to multiple locations in each of the river systems within their native range is necessary to avoid substantial losses to the greater population that might result from long-term habitat degradation or a catastrophic event.

CONSERVATION ACTIONS

The following sections describe the conservation actions that will make the greatest contribution toward achieving the conservation objectives. Actions are grouped by category (e.g., Habitat Conservation and Management, Population Management). The Conservation Action Table (Table 6) provides information on action priority, urgency, potential funding sources, likely effectiveness, identified partners, and leads for implementation.

Habitat Conservation and Management

The specific habitat and WQ needs of the bluenose shiner are currently not known. Monitoring and surveys of WQ, instream habitat, and riparian habitat in known sites containing bluenose shiners should provide this information, which will guide habitat conservation and management. Therefore, maintaining populations that are currently present or have persisted in the same sub-watersheds and watersheds over time is the highest priority (Figure 3). The focus of actions in this section is to:

- Maintain the aquatic habitat, WQ and quantity within the watersheds through a monitoring program and through cooperation and coordination with regulatory entities to ensure that habitats are not significantly altered;
- Maintain riparian or streamside habitat to help filter runoff, and provide necessary structure and shading needed by the species; and
- Restore or enhance areas that historically contained bluenose shiners to increase their distribution and occupied area of occurrence.

It should be noted that DEP, NWFWMD, the St. Johns River Water Management District (SJRWMD), the U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA) are the agencies with jurisdiction over WQ and quantity maintenance. Therefore, the majority of the actions in this section are under the authority of and require active participation by these agencies. As such, the Coordination with Other Entities section is critically important to the conservation of this species.

The habitat management of watersheds containing bluenose shiners has received attention with the development of the Gulf Coastal Plain Ecosystem Partnership's Aquatic Management Plan for the Watershed of the Western Panhandle of Florida and Southern Alabama (TNC 2006), Inventory and Prioritization of Impaired Sites in the Yellow River Watershed in Alabama and Florida (Herrington 2011), Chipola River Watershed Restoration and Conservation Action (Bearwood and Pettis 2007), and the Chipola River Threats Assessment Report (USFWS 2007). These plans primarily were developed as a means for local and regional government entities to better preserve, protect and restore areas within the planning boundaries.

The following sections describe the conservation actions that will make the greatest contribution toward achieving the conservation objectives. Actions are grouped by category (e.g., Habitat Conservation and Management, Population Management). Action priority, urgency, potential funding sources, likely effectiveness, identified partners, and leads for implementation are identified in the Conservation Action Table (Table 6).

WQ and Quantity

Action 1 Develop and implement FWC sampling and habitat evaluation protocols, and provide training to FWC staff, external consultants, and non-FWC volunteers or staff. This will aid efforts to identify locations, identify WQ and habitat needs, determine abundance, and estimate the size of bluenose shiner populations and subpopulations within its present and historical range.

Action 2 Upgrade or establish a new fisheries database to contain comprehensive, species-specific collection data that include negative capture data, sampling staff, sampling protocol, associated environmental data (habitat and WQ characteristics, vegetation species and composition, flow conditions, stream characteristics, adjacent land use), and fish communities.

Action 3 Develop a site occupancy model based on collection data, habitat parameters, and environmental variables in order to identify potential new populations and sites, and factors contributing to habitat loss at historical sites. Verify model accuracy by sampling identified potential sites to determine if the bluenose shiner is present.

Species that occupy a small or fragmented geographic area with few population locations are vulnerable to natural or anthropogenic catastrophes that can cause permanent extirpation. Thus, the physical habitat and WQ/quantity in these locations must be identified (Action 1) and associated environmental parameters determined (Action 2) in order to guide conservation and management. Development of site occupancy models (Action 3) would allow the identification of potential populations, additional sampling sites, and as many occupied locations as possible. WQ and habitat information obtained from sampling, modeling, model verification, and species habitat needs determinations are anticipated to be provided to the various regulatory agencies for use in their various programs. There are several regulatory agencies in Florida, ranging from local to federal levels of government, that work together to maintain quality aquatic habitats. The EPA, USACE, DEP, and the WMDs monitor and regulate WQ and quantity to maintain healthy conditions for aquatic plants, fish, and wildlife (Appendix 1).

Action 4 Participate with the NWFWMD, SJRWMD, DEP, and local governments in the development of minimum flows and levels (MFLs), water reservations, regional water supply plans, and regulatory review of various permits, in order to identify potential water supply reservoirs, water supply intake locations, and other actions within watersheds and sub-watersheds containing bluenose shiners in order to avoid, minimize, or mitigate any potential impacts.

Action 5 Participate with, and develop outreach material for DEP, NWFWMD, SJRWMD, DOACS, local governments, federal agencies, and the public to identify and implement conservation measures that reduce WQ impacts from unpaved roads, agriculture/silviculture, riparian zone management, and development within known areas of bluenose shiner occurrence.

FWC will coordinate monitoring efforts and provide the most up-to-date population survey data in order to maximize WQ protections for the bluenose shiner (Action 4). In addition, this information may be used to identify any changes that may be occurring and which might result in

needed additional sampling and research within the specific basins. Several Integrated Water Resource Monitoring Network (IWRM) status monitoring sites are located within or close to priority and historic bluenose shiner sub-watersheds. These monitoring site are located in the Escambia River drainage (Escambia River Hwy 4 bridge-site 305758087140401; Escambia River at Hwy 184 bridge-site 304014087160101), on the lower Yellow River (Yellow River at Highway 87 bridge-site 303428086553301), on Wright's Creek (Wright's Creek at CR 177A-site S212), on the lower Choctawhatchee River (Choctawhatchee R. NR Bruce-site 302718085533501), on the lower Chipola River above Dead Lakes (Chipola River at SR71-Site 301712087084401), on the Ocklawaha River (Ocklawaha River at SR 316–site 20020012), on the Wekiva River (Wekiva River near Sanford-site 02235000), and on the St. Johns River (St Johns River at Hwy 40 near Astor-site 291005081312501).

In general, DEP or a WMD cannot issue permits for new direct discharges of wastewater into OFWs if the discharge would lower ambient (existing) WQ. In most cases, this deters new wastewater discharges from directly discharging into an OFW. New direct discharges of stormwater must have 50% greater treatment applied than would otherwise be required. DEP or a WMD also may not issue permits for indirect discharges that would significantly degrade a nearby waterbody designated as an OFW. "The Environmental Resource Permit Program (ERP) regulates activities involving the alteration of surface water flows. This includes new activities in uplands that generate stormwater runoff from upland construction, as well as dredging and filling in wetlands and other surface waters. Environmental Resource Permit applications are processed by either the DEP or one of the WMDs, in accordance with the division of responsibilities specified in operating agreements between the Department and the water management districts. The ERP Program is in effect throughout the State" (Florida Department of Environmental Protection 2013). Stormwater construction permits under the National Pollutant Discharge Elimination System (NPDES) are issued separately by the DEP or the WMDs. Areas of regulation under the NPDES program include municipal storm sewer systems, industrial stormwater and discharge, and stormwater construction activities. FWC will continue to coordinate with these entities to ensure permitted activities do not degrade bluenose shiner populations or habitat (Action 4).

In addition to WQ considerations, when issuing permits for construction activities in both OFWs and non-OFWs, one of the factors that must be considered under the ERP and NPDES programs is, "whether the activity will adversely affect the conservation of fish and wildlife, including endangered or threatened species, or their habitats" (See Chapter 373.414(1)(a), F.S.). Coordination with DEP, NWFWMD, and SJRWMD on the location of bluenose shiners within the Shoal, Choctawhatchee, Chipola, and Wekiva rivers, Alexander Springs and Creeks, Yellow River Marsh Aquatic Preserve OFWs, some of the NWFWMD and SJRWMD lands with waters considered as OFWs, and other non-OFW waterbodies will be important in evaluating potential impacts from proposed regulated projects to bluenose shiner habitats and known locations (Action 4). The consideration of conservation measures and other measures that may be identified as part of the Monitoring and Research and Population Management programs during ERP and other regulatory permitting will be vital to ensuring maintenance of populations and habitats in the priority areas. FWC will also coordinate with DEP, DOACS, and other entities to identify and implement conservation measures that reduce water quality impacts from unpaved

roads, agriculture/silviculture, riparian zone management, and development within known areas of bluenose shiner occurrence (Action 5).

DEP currently has a petition to designate Holmes Creek as an OFW from the Citizen Preservation Council of Washington County (2001). The area of designation begins at the County Road 276-A road bridge in Washington County to the confluence of the Choctawhatchee River, 37 mi downstream. The designation of Holmes Creek as an OFW will further the protection of the WQ and provide increased riparian zone buffers, through DOACS BMPs, for this important bluenose shiner system (Action 4).

The NWFWMD Regional Water Supply Plan (NWFWMD 2008) identified several sites for potential water supply reservoirs in Okaloosa County. Okaloosa County acquired over 129.5 ha (320 ac) along the Shoal River for a potential reservoir site and/or mitigation area. This site on the Shoal River has recent collections of bluenose shiners that may be extirpated if a reservoir is constructed. Over the past 15 years, the City of Crestview has investigated the potential of a mainstem reservoir on the Yellow River. While there are currently no plans for its construction, several evaluations have been made as to its feasibility. FWC will need to coordinate and discuss alternative options with the NWFWMD, DEP, Okaloosa County, and the City of Crestview if plans are pursued for the development of this reservoir and other reservoirs where bluenose shiners may occur. The SJRWMD is exploring using waters from the St. Johns River basin to supply Orlando and its metropolitan region, and considerations regarding impacts to bluenose shiner habitat need to be considered in their plans.

Riparian and Streamside Management

Action 6 Increase protection of bluenose shiner habitat through opportunities provided via regulatory permit requirements, conservation lands management, county comprehensive plan land use classification, fee-simple or less-than-fee acquisition, or the potential to develop a USFWS Habitat Conservation Plan for panhandle and northeast Florida river basins for federally listed and certain state-listed fish species (including the bluenose shiner.)

The riparian zone or riparian area is the interface between a river or stream and terrestrial habitat, from the water's edge to the upland edge of the floodplain. It is influenced by its proximity to freshwater rivers and streams including alluvial streams, blackwater streams, seepage streams, and spring-run streams. Riparian zones in Florida include the banks and floodplain of the aquatic system including habitats such as floodplain swamps, bottomland forest, hydric hammock, and alluvial forest. Natural riparian zones tend to have high plant and animal biodiversities. Natural riparian zones provide corridors for wildlife movements and access to drinking water. Functional riparian zones reduce siltation and pollution, thereby improving WQ. Natural riparian zones may increase property values by creating aesthetically pleasing landscapes and reducing the likelihood of flooding. Riparian zones provide nutrients, vegetative cover, and detritus to riverine systems.

The extent of riparian zones or buffers needed to protect fish and wildlife resources vary throughout the United States, especially in the Southeast. Several studies have looked at the effectiveness of various riparian buffers in reducing pollutants and sedimentation and providing

fish and wildlife habitat benefits (Wegner 1999, Mayer et al. 2006). Much of the literature, existing regulations, and BMPs recognize that setting the width of buffers depends upon the slope of the land, rainfall, soil characteristics, catchment size and hydraulic loading, floodplain and wetlands, land use, impervious surfaces, and vegetation surrounding the wetland or waterbody. Wegner (1999) suggests 3 buffer guideline options for WQ and habitat conservation. These guidelines, which apply to both perennial and intermittent streams, are a fixed-width buffer and 2 variable-width buffer options that are dependent upon slope and wetlands. The minimum buffer width regardless of the option is 50 ft (15.2 m). The "conservative option" has a base width of 100 ft (30.5 m) plus 2 ft (0.61 m) per 1% of slope, extending to the edge of the floodplain, and includes adjacent wetlands. Wegner's guidelines are supported by Mayer et al. (2006), who evaluated the riparian buffer effectiveness at removing nitrogen by vegetative cover, hydrologic flow path, and buffer width and soil type. The USFWS developed recommended guidelines for buffer widths that start with options for reducing nutrient and sediment inputs to what is needed for wildlife corridors. These buffer widths vary from 30 to 1,500 ft (9.1 to 457.2 m) with 100 to 300 ft (30.5 to 91.4 m) recommended for aquatic systems (USFWS 2001). DOACS' BMPs for riparian buffers for silviculture and other agricultural practices are designed to protect WQ by reducing, or eliminating, inputs of sediments, nutrients, logging debris, chemicals, and temperature fluctuations. The silviculture BMP (DOACS 2011) identifies a Special Management Zone (SMZ) whose width is based on the size and type of waterbody, soil type (erodible) and slope of the site. The SMZ ranges in size from 35 ft to 300 ft (10.7 to 91.4 m). The primary SMZ adjacent to OFW waterbodies is 200 ft (61 m). For various agricultural practices receiving federal funding, the USFWS has recommended 100-ft riparian buffers along the mainstem of rivers that contain gulf sturgeon critical habitat and 100-ft buffers for streams and rivers containing listed mussel habitat (Natural Resource Conservation Service [NRCS] Conservation Matrix 2011). DOACS' BMPs and the NRCS' conservation recommendations currently provide for buffer widths of 61 m (200 ft) in bluenose shiner waterbodies due to many of these areas being classified as OFWs. For more information on riparian buffers and other protections, see Appendix 2.

This plan recommends that along the mainstem of the rivers that contain bluenose shiners (Chipola, Choctawhatchee, Shoal, and Wekiva rivers, Alexander Springs and Creeks, Yellow River Marsh Aquatic Preserve Rivers), that a minimum 61-m (200-ft) vegetative buffer be maintained since most of these areas are considered OFWs. For all other streams, a (15 m) 50-ft minimum vegetative buffer for development is recommended, depending upon slope and soil characteristics, unless it contains federally listed mussels and other listed aquatic species. An evaluation of riparian buffer widths is included as part of the Monitoring and Research section of this plan. Riparian and streamside management should be considerate of any additional conservation measures and other species requirement measures that may be identified as part of the Monitoring and Research and Population Management programs. In addition, riparian zones in the priority sub-watersheds (Figure 3) and any restoration areas should be evaluated in the future land use maps of the local government comprehensive plans to determine if they are receiving adequate protection.

FWC will participate with DEP, NWFWMD, SJRWMD, DOACS, and other entities to identify riparian zones associated with bluenose shiner populations (Action 4) and implement conservation measures (some of which may be developed as part of the Monitoring and Research

section) that reduce WQ impacts associated with riparian zone activities (Action 5). In addition, FWC will identify opportunities to increase protection of bluenose shiner habitat through county comprehensive plan land use classification, land acquisition, conservation easements, or development of USFWS Habitat Conservation Plans in order to protect bluenose shiner populations and habitat (Action 6).

Restoration

Action 7 Reduce fragmentation of bluenose shiner habitat through habitat restoration and enhancement to promote natural gene flow between subpopulations and encourage natural colonization of unoccupied habitats that will support populations.

Action 8 Augment or reestablish populations in historic range through habitat restoration and enhancement, followed by translocation or introduction of hatchery-reared juveniles.

Action 9 Monitor the success of measures implemented to protect and or enhance bluenose shiners and their habitat; implement changes where necessary.

Several management plans, as noted earlier, have identified preliminary restoration priority areas and some specific restoration sites (TNC 2006, Bearwood and Pettis 2007, USFWS 2007, Herrington 2011). Efforts by the USFWS (2007) and Herrington (2011) focused on the impact of unpaved roads and riparian habitat as factors in the identification of regional priority restoration areas and specific stream crossings. Through the Unpaved Roads Initiative conducted by the USFWS and several of the panhandle counties (Escambia, Okaloosa, Washington, and Jackson), projects addressing many of the unpaved roads in bluenose shiner watershed and sub-watersheds have received funding to stabilize and eliminate much of the sedimentation entering the streams. There are ongoing restoration efforts on Eglin Air Force Base to address sedimentation impacts from several unpaved roads, many of which cross streams that contain bluenose shiners. Herrington (2011) identified several focal areas and areas of interest in the Yellow and Shoal river basins. The area of interest on the Shoal River is near sub-watersheds that historically contained bluenose shiners. Within these identified focal areas and areas of interest are several possible candidates for restoration pending further investigations. The report also provides information on other stream crossings that are within sub-basins where bluenose shiners were found at that time or were historically found. This information may be useful in evaluating previous habitat information and current conditions and threats. Similar information has been developed for the Chipola River Basin (USFWS 2007). While restoration priority areas have not been as clearly defined, enough information has been gathered to identify areas of interest and areas for further restoration planning. Additional restoration areas may be identified through the Monitoring and Research and Population Management programs (Action 3). Once sites have been identified, individual plans and monitoring will need to be developed based upon the specific site's needs and specific bluenose shiner habitat requirements (Action 5, Action 6, Action 7, Action 8, Action 9). Once restoration has occurred, it will be important to maintain the habitat and WQ in these areas through multiple regulatory and inter-governmental mechanisms.

Table 1. Summary of habitat conservation and management preliminary recommendations.

Preliminary recommendations for management of bluenose shiner water quality and quantity habitat	• Maintain or enhance WQ parameters in priority sub-watersheds, as depicted in Figure 3, through review and coordination of projects with the NWFWMD, SJRWMD, DEP, USACE, EPA, and local governments. • Review permits and coordinate assessments of potential project impacts to bluenose shiner populations, WQ, and habitats in priority sub-watersheds and any restored areas with the NWFWMD, SJRWMD, DEP, USACE, EPA and local governments. • Participate with DEP, NWFWMD, and the SJRWMD in the collection of WQ and habitat information at priority and historic sites for use in the development of WQ trend analysis. • Work with the NWFWMD, DEP, Okaloosa County, and the City of Crestview on the development of water supply reservoirs on the Shoal and Yellow Rivers to assist in assessing potential impacts to bluenose shiner populations and habitats.
Preliminary recommendations for riparian habitat management of bluenose shiner waters	• A minimum of a 200-ft vegetative buffer be maintained along the mainstem of rivers that contain bluenose shiners, since most of the mainstem rivers are considered OFWs. For all other streams, a 50-ft minimum vegetative buffer is recommended to be maintained, depending upon slope and soil characteristics, unless other restrictions apply (e.g., it contains federally listed mussels or other listed aquatic species). • Oxbows and some ephemeral locations where bluenose shiners are known to occur should be considered as the edge of the water for buffer recommendations. • Identify parcels in the priority sub-watersheds for possible acquisition or conservation easements through continued participation and coordination with state, local, and non-governmental land acquisition agencies.
Preliminary recommendations for habitat restoration in areas of bluenose shiner occurrence or historic range	• Identify unpaved roads that transect sensitive streams and develop restoration plans, in coordination with state, federal, and local government, and non-governmental organizations, to prevent sediment influxes specific to that stream crossing. • Assess historic locations to identify environmental parameters that may be critical to the bluenose shiner survival (see Monitoring and Research section) and develop plans to recreate those vital habitat parameters if possible.

Population Management

Genetic analyses

Action 10 Describe the genetic characteristics of bluenose shiner populations and subpopulations by collecting and analyzing tissue samples from throughout the present range.

The population structure from disjunct locations needs to be examined using appropriate genetic methods (Action 1), and genetic information should be used to inform any future translocations and augmentations. Conserving the genetic diversity requires a thorough understanding of the existing levels of allelic variation, both within and among populations. Populations that are genetically unique and important to preserve should be documented (Action 2, Action 10). Data on genetic affinities among populations and the importance of geography in determining inter-population genetic similarity can be used to match donor and recipient populations. Fin clips or other appropriate tissue samples of bluenose shiners will be collected and analyzed as part of the Monitoring and Research program. Researchers will need to take necessary precautions to decrease mortality of individuals and prevent loss or significant decline of the population.

The following genetic principles for aquatic organisms provide guidance:

- Maintain the appropriate level of genetic variability,
- Management actions that may lead to increased inbreeding or outbreeding are to be avoided,
- Species managers should maximize the effective population size of managed populations,
- Species managers should perform a risk/benefit analysis for any proposed stocking.

Propagation, Translocation, Reintroduction, and Augmentation

Action 11 Determine the feasibility and implement protocols for hatchery propagation of bluenose shiners.

Guidelines for propagation, translocation, reintroduction, and augmentation recommended by the American Fisheries Society (Williams et al. 1988, George et al. 2009) should be considered prior to undertaking the proposed actions (Action 8, Action 11). Implementation of this section will be dependent upon the results of the genetic analysis and information from the habitat monitoring and research section on locations where re-establishment or augmentation is needed (Action 2, Action 3, Action 7, Action 8, Action 9). Protocols describing reintroduction techniques and propagation methods and subsequent monitoring requirements are contained in Appendix 3. Reintroduction and restoration of areas where the bluenose shiner occurred may potentially increase the number of viable populations. This would address the BSR criteria that resulted in the listing of the bluenose shiner.

Invasive species control

Action 12 Monitor and address the occurrence of exotic species that affect bluenose shiners, whether the affect is direct (predation) or indirect (influence on habitat or species interactions).

There are no known direct predatory or competitive threats to bluenose shiners from invasive species currently found in Florida. Habitat alteration is one of the species greatest conservation threats (Action 12). Tilapia (*Oreochromis* sp.), suckermouth catfish (*Pterygloplichthys* sp.) and grass carp (*Ctenopharyngodon idella*), which occur primarily in peninsular Florida, may alter habitat necessary for bluenose shiners. Flathead catfish (*Pylodictis olivaris*) and blue catfish (*Ictalurus furcatus*) are known predators of sunfish, which are nest associates of the bluenose shiner. However, it is not know if this predation is having any impact on spawning of sunfish and bluenose shiners. A possible future threat to bluenose shiner habitat is the invasive island apple snail (*Pomacea insularum*), which has been shown to decimate native plant communities (Action 12). At present it is not known how exotic plant species may affect bluenose shiner habitat requirements.

Table 2. Summary of preliminary population management recommendations.

Genetic Analysis	• Assay and maintain native genetic diversity. • Conduct genetic analysis of the bluenose shiners within the St. John's River drainage to determine if they are a new species or sub-species.
Propagation, Translocation, Reintroduction Augmentation	• Develop a site augmentation or reintroduction plan prior to conducting any augmentation or re-establishment activities. • Develop a plan to monitor the survival of the of re-established bluenose shiners prior to stocking if that option is determined to be needed.
Invasive Species Control	• Monitor rivers and streams that contain bluenose shiners to determine if the invasive island apple snail (*Pomacea insularum*) appears and determine methods for eradication.

Monitoring and Research

The BRG determined that the continued declines in number of bluenose shiners and habitat quality, extreme fluctuations in the number of mature individuals and the small extent of occurrence and area of occupancy (less than 2,000 km^2 [772.2 mi^2])of the bluenose shiner, warranted retaining the bluenose shiner on the Florida Endangered and Threatened Species List. The BRG determined, however, that existing data, literature, and knowledge may not be sufficient to address the objectives and actions necessary to achieve the goal of removing the species from the Florida Endangered and Threatened Species Llist. The following research and monitoring actions may address the data gaps and can be broken into unique categories such as: desktop habitat analysis, habitat and population studies, genetic analysis, propagation and translocation techniques, and development of BMP assessment research.

Desktop Analysis

Development of a comprehensive, species specific Geographic Information System (GIS)/ Structured Query Language (SQL) database is needed. Figure 1 and Figure 2 show the

distribution of bluenose shiners based upon current database information. Historic and recent records for all rare and imperiled fish species are currently compiled into a GIS database. However, this database does not include information that is needed for additional analysis; this information should include considerations such as sampling staff, sampling methods, and description of associated environmental and fish community parameters. Additionally, these data sets do not include sites where the bluenose shiners were sought but not collected (negative data). Modifications to the existing database or a new database may be necessary to capture this information (Action 2). Additional GIS datasets that may be useful for future analysis are:

- land use and owner information,
- public (state and federal) land boundaries,
- conservation areas and easements,
- water supply and reservoir sources,
- unpaved roads and other potential pollution sources, and
- WMD information highlighting areas with minimum flows and levels.

Development of detailed maps and a comprehensive database will facilitate the identification and location of current and historic sites, selecting sites for potential collection of broodstock or individuals for translocation, selecting sites for stocking, prioritizing sites needing protection, identifying historical sites where habitat information is lacking, and comparing habitat characteristics between sites (Action 1, Action 3).

Prioritization

The GIS and SQL databases will assist with development of prioritization models or schemes. Prioritization, beyond this plan's designation of "priority areas" (Figure 2), is needed to differentiate between locations within these sub-watersheds that:

- Have high conservation value for bluenose shiners and are protected (state, federal, WMD, local government lands) and should continue to be protected;
- Have high conservation value for bluenose shiners but are potentially at risk of future alteration (through development, invasive species, etc.); and
- Have good habitat for bluenose shiners but are in currently developing or threatened areas.

Sites could be further ranked based on the type of future alteration likely to occur. Risk from future alterations is difficult to assess given the lack of knowledge regarding bluenose shiner habitat needs and tolerances. Historical locations once occupied by bluenose shiner that contain suitable habitat should be considered for reintroduction efforts with high priority over historical sites that need habitat restoration. The prioritization and information learned from additional survey and monitoring activities may also aid in the identification of new locations and conservation opportunities (Action 1).

Habitat and Population Studies

Research and monitoring programs and their implementation (collection methods) should be based on clear objectives and a priori hypotheses (Pollock et al. 2002, MacKenzie and Royle 2005). A watershed-level sampling design is needed to update species distribution information, properly characterize occupancy, accurately determine population trends, and determine the influence of both in-stream and landscape attributes on bluenose shiner populations.

Additionally, site-specific sampling is needed to determine persistence, stability, probability of detection, and to characterize site occupancy on a microhabitat level (Action 1, Action 2). This multi-scale approach will allow inferences about population status and trends on both a temporal (changes in time throughout the watershed) and spatial (site-specific) scale (Fausch et al. 2002, Rahal and Jackson 2007). A more descriptive discussion of how to design and implement sampling and monitoring program is contained in Appendix 4.

Sampling design and collection methods.—Bluenose shiners are collected in Florida while sampling under the FWC's lentic and lotic long-term monitoring programs (Bonvechio 2009, Strickland et al. 2011). Waterbodies are sampled on an annual basis and utilize a stratified-random design for sample site selection. While these protocols may be appropriate to monitor community structure, another approach may be needed for long-term monitoring of bluenose shiner populations (Action 1).

Bluenose shiners are rare and often not recaptured at sites of known occupancy, and non-detection can not necessarily be attributed to extirpation or changes in the population (Osprey Data International Inc. 2001); non-detection may be attributed to detection differences. Further, electrofishing may not be the most appropriate sampling tool for monitoring bluenose shiners. Electrofishing using existing FWC protocols has resulted in immediate or delayed mortality of bluenose shiners and could possibly result in mortality of bluenose shiner embryos (FWC staff observation; Holliman et al. 2003, Bohl et al. 2009). Therefore, sampling by alternative methods or electrofishing outside the spawning period should be investigated in order to determine the best and most appropriate collection method (Action 1).

Previous bluenose shiner sampling methods include snorkeling (Bass and Hoehn 2010), dip nets (Osprey Data International Inc. 2001, Albanese et al. 2007), seines (Johnston and Knight 1999, Osprey Data International Inc. 2001, Albanese et al. 2007), and minnow traps. Visual survey sampling techniques are often as effective as conventional fisheries gears such as seining and electrofishing (Jordan et al. 2008, Albanese et al. 2011). A hybrid approach integrating electrofishing with seining methods may be needed when water visibility and/or habitat complexity limit the effectiveness of visual survey methods (Price and Peterson 2010). Furthermore, the best collection method varies based on the objective; while electrofishing may be the best method for monitoring, dip nets may be best when collecting fish for propagation, translocation, reintroduction, and augmentation (Action 1).

Habitat information.—FWC needs to develop a better understanding of how the Florida populations of bluenose shiner are influenced by WQ, vegetation and/or micro-habitat, riparian requirements that might affect- temperature and structure, stream flow conditions, fish associates, and fish community structure.

Fish community data may be necessary for inclusion with bluenose shiner presence and abundance data; bluenose shiner/fish community relationships have not been examined but the bluenose shiner is a known nest associate with longear sunfish (*Lepomis megalotis*) (Johnston and Knight, 1999). Physical habitat information is necessary for inclusion with bluenose shiner presence and abundance data, so that important species-habitat preferences can be further delineated. Albanese et al. (2007) reported that the best selected model predicting proportion of

sites occupied by bluenose shiner contained conductivity and distance to mainstem as habitat characteristics, while the best selected model predicting detection probability contained current velocity as a habitat characteristic (Action 3).

Current FWC monitoring protocols recommend the collection of physical habitat characteristics and fish community data for each sampled transect (Bonvechio 2009, Strickland et al. 2011). Additional habitat characteristics may be considered for collection in future bluenose shiner sampling efforts (Action 1). Habitat and WQ preferences are anticipated to become part of the conservation measures that are to be developed as new information is available. These habitat characteristics should also provide information on where additional sampling should occur to determine if bluenose shiners are present in new areas.

Genetic analyses

We recommend tissue samples be collected from bluenose shiners to examine genetic variability, within and among populations, which indicates diversity and population structure from sites throughout the bluenose shiner range in Florida (Action 10). Tissue samples should also be collected from donor populations and recipient populations prior to population reintroduction or augmentation to ensure genetic compatibility (Action 8). The Population Management section and Appendix 3 provide further details on genetic analysis.

Propagation, translocation, reintroduction, and augmentation techniques

The propagation, translocation, reintroduction, and augmentation of bluenose shiners have not been conducted in Florida on a state-wide level; therefore research is needed following the guidelines recommended by the American Fisheries Society (Williams et al. 1988, George et al. 2009). Research is also needed to determine how to propagate the bluenose shiner in a hatchery. Only a few attempts have been successfully made to propagate this species in captivity. Propagation techniques from successful North American Native Fishes Association (NANFA) hobbyists (Gainer 1998) should be investigated. The Population Management section and Appendix 3 provide further details on this propagation and reintroduction procedures (Action 1, Action 7, Action 8, Action 9, Action 10, and Action 11).

Development of BMP assessment research

FWC is charged under Rule 68A-27.007(2)(d), F.A.C., to "… work cooperatively with the Florida Department of Agriculture and Consumer Services, landowners, and other stakeholders to legislatively authorize, develop, and adopt BMPs to protect wildlife species…". Much of the previous research conducted by DOACS and DEP in the development of the agricultural BMPs focused on macroinvertebrate species and WQ subject to regulatory requirements and did not address fish and wildlife resources per se.

In addition, DEP and the WMDs promote the use of other structural and non-structural BMPs as a means of non-point source management (DEP Nonpoint Website) that may abate some of the threats to the bluenose shiner. In order to better evaluate all WQ-related BMPs and their ability to abate threats to the bluenose shiner, additional assessment and research should consider:

- identifying known locations of bluenose shiners within state or conservation lands that may be influenced by agricultural land uses and/or BMPs,

- developing methodologies and a research plan to evaluate current agricultural practices and the effectiveness of existing and proposed BMPs applicable to land uses in known bluenose shiner habitats,
- developing methodologies and a research plan to evaluate current non-agricultural BMPs and their effectiveness in known bluenose shiner habitats, and
- working with the landowners, DOACS, and DEP to implement research plans to evaluate existing and proposed BMPs as needed.

Table 3. Summary of monitoring and research preliminary recommendations.

Habitat and population studies	• Developing a training program on fish identification, collection techniques, and collection of habitat parameters to allow non-FWC individuals and stakeholder groups to assist sampling efforts at historic sites and in the search for new bluenose shiner sites. • Develop a protocol for determining presence/absence for use by consultants and permit applicants.
Development of BMP assessment research	• Develop methodologies and a research plan to evaluate current agricultural practices and the effectiveness of existing and proposed BMPs applicable to land uses in known bluenose shiner habitats. • Develop methodologies and a research plan to evaluate current non-structural and structural non-agricultural BMPs and their effectiveness in known bluenose shiner habitats.

Rule and Permitting Intent

Action 13 Develop comprehensive conservation measures and permitting guidelines that identify management needs and habitat requirements.

As a Threatened species, the bluenose shiner is protected under Rule 68A-27, F.A.C. The protective measures contained in Rule 68A-27, F.A.C., should provide adequate protections for the species. However, as these rules prohibit harm and harass, there may be a need to develop guidelines to inform the public, FWC's Division of Law Enforcement, and other interested entities what actions are, or are not, likely to result in a violation of the rules. These guidelines along with conservation measures are anticipated to be developed as additional information is obtained. The permit requirements and exemptions as currently provided in Rule 68A-27.007(2), F.A.C., are applicable to the bluenose shiner. However, modifications are needed to the intentional take permitting requirements, and for scientific collection permits that occur within potential bluenose shiner habitats, to help further our understanding of the distribution and trends within known populations, re-colonization of historical locations or new locations, and community structure when the bluenose shiner is collected.

Any permit holders for intentional take will also be required to:

- Notify the Regional FWC law enforcement office of the dates of when intentional collections for scientific or conservation purposes will occur and the location of the anticipated collection efforts,
- Provide FWC within 30 days of the collection effort the coordinates of collections of the Threatened species and a voucher specimen (or location where voucher specimen is located),
- Provide FWC within 30 days of the collection effort the number of individuals collected, released, and kept for vouchers.

Coordination with other agencies and other stakeholders (e.g., North American Native Fish Association [NANFA]) toward outreach regarding and implementation of these rules and permit requirements will be necessary (Action 4, Action 5).

Law Enforcement

Action 14 Develop a training module for FWC's Division of Law enforcement and the baitfish suppliers for identification of bluenose shiners.

The FWC's Division of Law Enforcement, in conjunction with federal, state, and local partners, is responsible for enforcing Florida's wildlife and fisheries laws. FWC biologists and other bluenose shiner subject matter experts will educate law enforcement officers through the development, circulation, and interpretation of bluenose shiner identification tools, distribution maps, and other training materials (Action 13). The bluenose shiner is potentially a species that could be seen in the baitfish market; proper identification tools will be important for documenting violations of Florida's wildlife laws.

In turn, one of the most important components of the enforcement strategy is ensuring compliance through public education. FWC law enforcement officers understand the importance of explaining wildlife laws to the public to avoid unintentional violations (Action 4, Action 5). However, FWC law enforcement officers actively pursue and recommend prosecution for those who intentionally violate wildlife laws. The FWC law enforcement officers also educate the public on how to identify and report violations. The FWC Division of Law Enforcement administers the Wildlife Alert program, which receives information via a toll-free number (1-888-404-3922) that is answered 24 hours a day, 7 days a week. Cash rewards are offered to callers who provide information about any illegal activity that result in an arrest. Callers may remain anonymous and are not required to testify in court.

Incentives and Influencing

Influencing

County growth management plans and land development regulations provide the avenue by which FWC can inform and influence land and water uses that are relevant to the conservation of Florida's fish and wildlife, including state-listed species. Figure 3 identifies priority sub-watershed areas known or having potential to harbor bluenose shiner. The BSR and this plan identify the threats to the bluenose shiner, as well as specific permitting recommendations that

specify means to avoid, minimize, or mitigate activities associated with the threats to the bluenose shiner (see Table 1). FWC offers conservation planning services to local governments during growth management plan development as well as during consideration of plan amendments and associated development proposals (Action 4, Action 5, and Action 6).

In order to promote an understanding of technical assistance and incentives available to landowners, FWC typically provides information to local governments regarding species management plans, permitting options, and incentive programs that are available to applicants, developers, and landowners, as well as the general public. FWC is working to develop conservation measures to address the bluenose shiner and its habitat needs (Action 13) that can potentially inform local land development regulations (see Incentive Programs). However, Chapter 163.3184, F.S., indicates that a county may not require as a condition of processing a development permit that an applicant obtain a permit or approval from any other state or federal agency unless the agency has issued a notice of intent to deny the federal or state permit before the county action on the local development permit.

FWC's Landowner Assistance Program advances species conservation objectives through public-private conservation partnerships. These programs are voluntary and some offer financial assistance to landowners implementing conservation plans (see Incentives Programs). Participation in any of these incentive programs would provide FWC opportunities to gather information on private agricultural lands or those slated for development. FWC assistance in evaluating the effects of development practices on the bluenose shiner population would help provide FWC necessary information to develop better avoidance, minimization, and mitigation options for agriculture and development on private property (Action 5).

Incentive Programs

FWC currently takes advantage of several programs that promote conservation by providing technical and/or financial assistance to private landowners (Action 6). FWC partners with other state and federal agencies to administer the Forest Stewardship Program, Wildlife Habitat Incentives Program, Wetlands Reserve Program, Environmental Quality Incentives Program, Partners for Fish and Wildlife Program, and the Cooperative Conservation Blueprint. These programs are voluntary and some may provide financial incentives, depending on annual appropriation, for wildlife conservation and/or habitat management on private lands. Florida also provides tax incentives including property tax exemptions under Chapter 196.26, F.S., for landowners who put a perpetual conservation easement on their land. Additional incentives may include exemption from permits for activities such as mowing, roller-chopping, and tree stand thinning, as long as they are not a precursor to development. Any number of these incentive programs may be applicable for protecting the riparian habitat and WQ in the bluenose shiner priority sub-watersheds identified in Figure 3.

The Habitat Conservation Plan (HCP) concept was originally developed as a required piece of the application for a Federal Incidental Take Permit (ITP). ITPs authorize the take, as defined in the Endangered Species Act, of listed species incidental to a lawful activity. The intent of the HCP is to make sure the effects of issuing a take permit are adequately minimized and/or mitigated. While it may not be practical to develop individual HCPs for many of the aquatic federally listed species and at the same time include the state-listed fish species, FWC is

investigating the potential for the development of a “watershed based HCP” for multiple aquatic species that include both state and federally listed in the basins containing the bluenose shiner.

Conservation banking is another program available to private landowners interested in habitat conservation. Conservation banking for listed species is comparable to mitigation banking in that lands are permanently protected and can be used to offset development related adverse impacts to wildlife resources, including habitats. FWC may consider developing or supporting a conservation banking program for species in the same watersheds as the bluenose shiner.

Wildlife Conservation Measures.—Approximately 65% of Florida is in some form of agricultural land use. Florida’s fish and wildlife, including many state-listed species, occur on lands or in streams adjacent to lands utilized for agriculture. FWC is currently working with the DOACS and landowners engaged in agriculture to identify agricultural activities that are currently being conducted in a manner that provides a reasonable assurance that take of listed species or habitat will be avoided or minimized (Action 5).

Use of wildlife conservation measures for non-agricultural land uses could preserve or enhance additional habitat or avoid take of the bluenose shiner by identifying such things as the preferred timing of clearing and construction, methods of clearing and re-vegetating, preferred locations and methods of stormwater management features, preservation of onsite ecosystem features, preferred location of open space/green space/conservation areas, inclusion of development or density buffers, or inclusion of conservation easements over conservation areas. Incentives for incorporating these wildlife conservation actions into development proposals could include reduced or expedited permitting, reduced permitting fees, local or state recognition, tax incentives, or density bonuses.

Table 4. Summary of incentives and influencing preliminary recommendations for local governments and private landowners in the priority areas and areas under restoration.

Influencing	• Provide assistance to local governments on the conservation measures that should be considered for incorporation into their local land development regulations. • Provide an information packet to local governments detailing incentives to both public and private entities for the purchase, conservation, restoration, or enhancement of listed species habitat. • Provide to local governments and landowners a set of conservation measures and wildlife conservation actions to address the bluenose shiner and its habitat needs.
Incentive Programs	• Provide through the Landowner Assistance Program, outreach to landowners in the priority and restoration areas regarding the various incentive programs available for the conservation of the species. • Provide assistance to NWFWMD, SJRWMD, DEP, local governments, and other land-acquisition entities in acquiring conservation easements, when the property cannot be purchased fee-simple, or to acquire riparian habitat adjacent to known locations of bluenose shiner. • Provide information to landowners and local governments on the development of a “watershed based HCP” that could replace the need for a federal ITP.
Wildlife Conservation Measures	• Determine the use and effectiveness of the existing multi-agency BMPs and identify further refinements that may be needed for the protection of bluenose shiner habitat.

Education and Outreach

Education and outreach are important components of managing imperiled aquatic species (Action 5, Action 14). Citizens who are well-informed regarding the merits of an imperiled species, and the habitat that supports such species, can make better decisions and support sound conservation measures to secure those species' continued survival. Both formal and informal settings can serve as opportunities to inform Floridians about species on or near the brink in their state.

Many aspects regarding bluenose shiners need to be presented:

- Their service as indicators of habitat condition, WQ, and water quantity;
- Their specific needs for continued survival;
- Their unique characteristics and benefits to the ecology of a region, and
- Their potential to provide medical breakthroughs, even if unforeseen today.

A unified and comprehensive approach to education and outreach will serve to inform the public, at their own pace, regarding the means and needs to protect bluenose shiners. A unified Education and outreach program is anticipated to be developed and included in FWC's Imperiled Species Management Plan.

Coordination with Other Entities

Appendix 5 provides a discussion of intergovernmental coordination requirements and authorities within Florida. The Habitat Conservation and Management section identifies many monitoring and regulatory programs that are under the authority of and require active participation by several regulatory agencies. It is imperative that FWC coordinate and participate with these agencies and their regulatory and monitoring programs in order to effectively preserve and protect the bluenose shiner and its habitat. The development of specific conservation measures (Action 13) should also provide additional guidance to the regulatory agencies for use in their various programs. FWC will continue to collaborate with and provide information to local governments regarding species management plans, permitting guidelines and assistance programs that are available to landowners, as well as to the general public.

County growth management plans and land development regulations (LDRs) provide the avenue by which FWC can inform and influence land and water uses that are relevant to the conservation of the bluenose shiner. Table 1 contains recommendations that could be included in comprehensive plans and LDRs as a means to avoid, minimize, or mitigate activities associated with the threats to the bluenose shiner (Action 4, Action 5, and Action 6). FWC offers conservation planning services to local governments during growth management plan development as well as during consideration of plan amendments and associated development proposals. Early coordination with FWC can streamline FWC's review and approval process.

Local governments can assist FWC in obtaining new occurrence information by adding questions to their development applications asking for information on what listed species surveys have been conducted on the property, or by inspecting parcels for the presences/absence of bluenose shiner (simplified survey protocol). Requiring notification of FWC staff that bluenose shiner or bluenose shiner habitat has been identified onsite prior to issuing clearing or building permits should expedite FWC's review and approval (Action 1, Action 5).

Land development is governed by a variety of federal, state, and local government growth management and permitting processes or requirements. FWC offers conservation planning services to these regulatory agencies and encourages early meetings and coordination efforts to determine presence or absence of listed species onsite as well as other important fish, wildlife and habitat issues (Action 4, Action 5, and Action 6).

The Florida Wildlife Conservation Guide (FWCG) (http://myfwc.com/conservation/value/fwcg/) is an online resource that facilitates effective land use planning, project design, and the management of natural communities, with a focus on wildlife conservation. Developed by FWC in partnership with the USFWS and the Florida Natural Areas Inventory, its purpose is to provide an easily accessible repository of wildlife life history, habitat management, and conservation options. The FWCG aims to provide a common platform of ecologically based wildlife information based on best available scientific information. As a dynamic resource, it is maintained with current guidelines and recommendations for wildlife management and protection, and includes numerous links to relevant external sources of information. The FWGG will have the specific information related to the bluenose shiner and necessary conservation measures once they are developed (Action 13).

Local governments and other agencies also play a substantial role in bluenose shiner conservation and management by providing protected and managed areas for bluenose shiners. Many local governments have created habitat-acquisition and management programs, which can provide important assistance in achieving the goal and objectives of this management plan. FWC will continue to coordinate with local governments and other agencies to help ensure that local land-acquisition programs and county comprehensive plan's policies and implementing ordinances are: 1) consistent with the goal and objectives of this plan and 2) focus on acquisition priorities for bluenose shiner and other important wildlife species (Action 6).

Table 5. Summary of coordination with local governments and state and federal agencies preliminary recommendations.

The FWC will continue to assist and encourage local governments and state and federal agencies to:	• Insure that WQ parameters are maintained at existing or improved levels in priority sub-watersheds and that any regulatory projects consider impacts to bluenose shiner populations and habitats. • Coordinate with FWC before they issue permits that may affect WQ or habitat in priority bluenose shiner sub-watersheds, especially the Wekiva River watershed, and any restored areas. • Consider information on bluenose shiner habitat needs and WQ and quantity needs that could be used in the development of MFLs. • Coordinate with FWC prior to and during planning for the development of water supply reservoirs and their potential impacts to bluenose shiner populations and habitats. • Identify areas containing bluenose shiners for possible acquisition or conservation easements. • Incorporate into LDRs and other regulatory provisions to maintain a minimum 200 ft vegetative buffer along the mainstem of rivers that contain bluenose shiners, since most of the mainstem rivers are considered OFWs. • Provide for all other streams, that a 50-ft minimum vegetative buffer be maintained for development depending upon slope and soil characteristics, unless it contains federally listed mussels. • Identify unpaved roads that transect sensitive streams and develop restoration plans to prevent sediment influxes specific to that stream crossing. • Evaluate historic occurrence locations to identify environmental parameters that may be critical to the bluenose shiner survival and to develop plans with intergovernmental assistance to recreate those critical habitat parameters if possible.

Table 6. Bluenose Shiner (*Pteronotropis welaka*) Conservation Action Table

NOTE: An explanation of acronyms used is below the table.

Objective(s) Addressed	Team Assigned Priority Level	Action Item Number	Action Items	Conservation Action Category	Ongoing, Expanded or New Effort?	Authority	Man Power	Estimated Cost To Implement	Funding Source(s)	Lead for Implementation: FWC Program(s) and/or Section(s)	External partners	Likely Effectiveness	Feasibility	Urgent?
1	1	1	Develop and implement FWC sampling and habitat evaluation protocols, and provide training to FWC staff, external consultants and non-FWC volunteers or staff. This will aid efforts to identify locations, indentify water quality and habitat needs, determine abundance, and estimate the size of bluenose shiner populations and subpopulations within its present and historical range.	Habitat Conservation & Mgmt, Population Mgmt, Monitoring & Research, Coordination with Other Entities	NEW	YES	YES	TBD	Unknown	FWRI	NANFA/DEP/ USFWS/ Universities	High likelihood of success.	Very feasible.	Yes- needed to fill in data gaps; needed to help implement the sampling program and ensure that non-agency staff or volunteers understand the proper collection methods.
1	2	2	Upgrade or establish a new fisheries database to contain comprehensive, species-specific collection datathat includes negative capture data, sampling staff, sampling protocol, associated environmental data (habitat and water quality characteristics, vegetation species and composition, flow conditions, stream characteristics, adjacent land use) and fish communities.	Habitat Conservation & Mgmt, Population Mgmt, Monitoring & Research	EXPANDED	YES	YES	$0-25k	Unknown	FWRI	DEP	High likelihood of success.	Very feasible.	Yes- This may be as simple as adding tables to the existing database that FWRI maintains.
1	3	3	Develop a site occupancy model based on collection data, habitat parameters, and environmental variables in order to identify potential new populations and sites, and factors contributing to habitat loss at historical sites. Verify model accuracy by sampling identified potential sites to determine if the bluenose shiner is present.	Habitat Conservation & Mgmt, Population Mgmt, Monitoring & Research	NEW	YES	YES	$0-25k	Unknown	FWRI	Universities	This will take some time to develop and will rely on the data collected from the monitoring program.	Very feasible, but requires initial sampling to occur at known locations first.	Yes- needed to fill in data gaps.
1	1	4	Participate with the NWFWMD, SJRWMD, DEP, and local governments in the development of the MFL, Water Reservation, Regional Water Supply Plans, and regulatory review of various permits, in order to identify potential water supply reservoirs, water supply intake locations, and other actions within watersheds and sub-watersheds containing bluenose shiners to avoid, minimize, or mitigate any potential impacts.	Habitat Conservation & Mgmt, Protections & Permitting, Law Enforcement, Incentives & Influencing, Coordination with Other Entities	ONGOING	NO	YES	$0-25k	Unknown	HSC	NWFWMD, SJRWMD, DEP, local governments	High likelihood of success.	Very feasible.	This is needed as part of ERP and other permitting reviews.; This will be done once NWFWMD, SJRWMD or the Counties re-start the after supply planning process; This will be done once NWFWMD & SJRWMD start the MFL process
1	1	5	Participate with, and develop outreach material for, DEP, NWFWMD, SJRWMD, DOACS, local governments, federal agencies, and the public to identify and implement conservation measures that reduce water quality impacts from unpaved roads, agriculture/silviculture, riparian zone management, and development within known areas of bluenose shiner occurrence.	Habitat Conservation & Mgmt, Monitoring & Research, Protections & Permitting, Law Enforcement, Incentives & Influencing, Education & Outreach, Coordination with Other Entities	EXPANDED	NO	YES	$0-25k	Unknown	HSC	NWFWMD, SJRWMD, DEP, DOACS, Federal agencies, local governments, conservation organizations, private landowners	There has already been some effort to reduce sedimentation from unpaved roads in some of the counties. But it requires funding and commitment to undertake the effort. This will have moderate effectiveness depending on who the audience for the various outreach products are developed.	Very feasible.	Can be done at any time in the process. Correcting unpaved road issues may have differing urgency depending upon where the project is located.
1	1	6	Increase protection of bluenose shiner habitat through opportunities provided via regulatory permit requirements, conservation lands management, county comprehensive plan landuse classification, fee simple or less than fee acquisition, or the potential to develop a U.S. Fish and Wildlife (USFWS) Habitat Conservation Plan for Panhandle and Northeast Florida river basins for federally-listed and certain state-listed fish species (including the bluenose shiner.)	Habitat Conservation & Mgmt, Incentives & Influencing, Coordination with Other Entities	NEW	NO	YES	$0-25k	Federal Grant with State Match; unknown	HSC	Local Government, DEP, NWFWMD, SJRWMD, DOACS, TNC, Universities, Alabama Agencies	Could be effective if local government and landowners consent to the land use change; HCP process could be very effective but will be a substantial process.	Very feasible but will be dependant on support and cooperation of outside entities.	HCP process and landuse change can be done at any point the process. However, if the HCP process is started early it may provide a start for data collection and early implementation of management.
2	4	7	Reduce fragmentation of bluenose shiner habitat through habitat restoration and enhancement to promote natural gene flow between subpopulations and encourage natural colonization of unoccupied habitats that will support populations.	Habitat Conservation & Mgmt, Population Mgmt, Monitoring & Research	NEW	YES	YES	TBD	Unknown	FWRI/FFM	USFWS	This is something that will be dependant on later activities.	This will be difficult due to the habitats along the river systems	Low urgency
2	4	8	Augment or reestablish populations in historic range through habitat restoration and enhancement, followed by translocation or introduction of hatchery-reared juveniles.	Habitat Conservation & Mgmt, Population Mgmt, Monitoring & Research	NEW	YES	YES	TBD	Unknown	FWRI/FFM	USFWS	This may be moderately effective and will require completion of other actions to implement.	The feasibility will be determined by the information collected from other actions.	Must be done after other actions are taken.

Table 6. Bluenose Shiner (*Pteronotropis welaka*) Conservation Action Table

Objective(s) Addressed	Team Assigned Priority Level	Action Item Number	Action Items	Conservation Action Category	Ongoing, Expanded or New Effort?	Authority	Man Power	Estimated Cost To Implement	Funding Source(s)	Lead for Implementation: FWC Program(s) and/or Section(s)	External partners	Likely Effectiveness	Feasibility	Urgent?
1&2	2	9	Monitor the success of measures implemented to protect and or enhance bluenose shiners and their habitat; implement changes where necessary.	Habitat Conservation & Mgmt, Population Mgmt, Monitoring & Research	NEW	YES	NO	TBD	Unknown	FWRI	NANFA/DEP/ USFWS/ Universities	This may be moderately effective and will require completion of other actions to implement.	The feasibility will be determined by the information collected from other actions.	Must be done after other actions are taken.
1	2	10	Describe the genetic characteristics of bluenose shiner populations and subpopulations by collecting and analyzing tissue samples from throughout the present range.	Population Mgmt, Monitoring & Research	NEW	YES	NO	TBD	Unknown	FWRI	Universities	High likelihood of success.	Very feasible.	Yes- needed to fill in data gaps.
2	4	11	Determine the feasibility and implement protocols for hatchery propagation of bluenose shiners.	Population Mgmt, Monitoring & Research	NEW	YES	NO	TBD	Unknown	FWRI/FFM	USFWS	This may be moderately effective and will require completion of other actions to implement.	The feasibility will be determined by the information collected from other actions.	Must be done after other actions are taken.
1	3	12	Monitor and address the occurrence of exotic species that affect bluenose shiners, whether the affect is direct (predation) or indirect (influence on habitat or species interactions).	Population Mgmt	NEW	YES	YES	$0-25k	Unknown	HCSS-Exotic Species Management	WMD's, Local Government, DEP	High likelihood of success.	Very feasible.	Can be done at any time in the process.
1	2	13	Develop comprehensive conservation measures and permitting guidelines that identify management needs and habitat requirements.	Monitoring & Research, Protections & Permitting, Incentives & Influencing, Coordination with Other Entities	NEW	YES	YES	$0-25k	Unknown	FWRI/HSC	USFWS/DOACS	High likelihood of success.	Very feasible.	Yes- Very critical to conservation of the species
1	1	14	Develop a training module for FWC Law Enforecement and the baitfish suppliers for identification of bluenose shiners.	Law Enforcement, Education & Outreach	NEW	YES	YES	$0-25k	Unknown	OPAWVS	USFWS	This would allow LE to be able to adequately enforce regulations.	Very feasible.	Can be done at any time in the process.

Acronyms used in this table:

DEP:	Florida Department of Environmental Protection
DOACS:	Florida Department of Agricultural and Consumer Services
FFM:	Freshwater Fisheries Management, a Division of the Florida Fish and Wildlife Conservation Commission
FWRI:	Fish and Wildlife Research Institute, the research branch of the Florida Fish and Wildlife Conservation Commission
HCSS:	Habitat Conservation Scientific Services, part of the Landowner Assistance Program Special Initiative of the Florida Fish and Wildlife Conservation Commission
HSC:	Habitat and Species Conservation, a Division of Florida Fish and Wildlife Conservation Commission
LE:	Law enforcement
NANFA:	North American Native Fishes Association
NWFWMD:	Northwest Florida Water Management District
OPAWVS:	Office of Public Access and Wildlife Viewing Services, a program of the Florida Fish and Wildlife Conservation Commission
SJRWMD:	St. Johns River Water Management District
TBD:	To be determined
TNC:	The Nature Conservancy
USFWS:	United States Fish and Wildlife Service
WHM:	Wildlife and Habitat Management, a Section of the Florida Fish and Wildlife Conservation Commission's Division of Habitat and Species Conservation

LITERATURE CITED

Albanese, B., K. A. Owers, D. A. Weiler, and W. Pruitt. 2011. Estimating occupancy of rare fishes using visual surveys, with a comparison to backpack electrofishing. Southeastern Naturalist 10(3):423-442.

Albanese, B., J. T. Peterson, B. Freeman, and D. A. Weiler, 2007. Accounting for incomplete detection when estimating site occupancy of bluenose shiner (*Pteronotropis welaka*) in southwest Georgia. Southeastern Naturalist 6(4):657-668.

Bass, G., and T. Hoehn. Unpublished report, 2010. Florida imperiled fish species. Unpublished manuscript, Florida Fish and Wildlife Conservation Commission, Tallahassee.

Bass, G., T. Hoehn, J. Couch, and K. Mcdonald. 2004. Florida imperiled fish species investigations. Florida Fish and Wildlife Conservation Commission, Tallahassee.

Bearwood, B., and R. Pettis. 2007. Chipola River Watershed restoration and conservation action strategy for West Florida Resources Conservation and Development Council. David H. Melvin Consulting Engineers, Marianna, Florida.

Bohl, R. J., T. B. Henry, R. J. Strange and P. L. Rakes. 2009. Effects of electroshock on cyprinid embryos: Implications for Threatened and Endangered fishes. Transactions of the American Fisheries Society 138(4):768-776.

Bonvechio, K. 2009. Standardized sampling manual for lentic systems. Florida Fish and Wildlife Conservation Commission, Tallahassee.

Burkhead, N. M. 2010. Brief status summary of the bluenose shiner *Pteronotropis welaka* in Florida. U.S. Geological Survey, Southeast Ecological Science Center, Gainesville, Florida.

Fausch, K. D., C. E. Torgersen, C. V. Baxter, and H. W. Li. 2002. Landscapes to riverscapes: bridging the gap between research and conservation of stream fishes. BioScience 52:483-498.

Fletcher, D. E. 1993. Nest association of dusky shiners (*Notropis cummingsae*) and redbreast sunfish (*Lepomis auritus*), a potentially parasitic relationship. Copeia, 1993(1):159-167.

Florida Department of Agriculture and Consumer Services [DOACS]. 2011. Silviculture best management practices. Tallahassee.

Florida Department of Environmental Protection [DEP]. 2013. Environmental resource permitting. <http://www.dep.state.fl.us/water/wetlands/erp/index.htm>. Accessed 5 January 2013.

Gainer, B. G. 1998. The bluenose shiner, the jewel of the Southeast. American Currents, Spring 1998.

George, A. L., B. R. Kuhajda, J. D. Williams, M. A. Cantrell, P. L. Rakes, and J. R. Shute. 2009. Guidelines for propagation and translocation for freshwater fish conservation. Fisheries 34(11): 529-545.

Gilbert, C. R. 1992. Bluenose Shiner, *Pteronotropis welaka*. Pages 58-62 *in* C. R. Gilbert, editor. Rare and endangered biota of Florida. Volume II. Fishes. University Press of Florida, Gainesville.

Herrington, S. J. 2011. Inventory and prioritization of impaired sites in the Yellow River Watershed in Alabama and Florida. U.S. Department of Defense Legacy Program Project Number: 09-432.

Hipes, D., D. R. Jackson, K. NeSmith, D. Printiss, and K. Brandt. 2000. Field guide to the rare animals of Florida. Florida Natural Areas Inventory, Tallahassee.

Hoehn, T. 1998. Rare and imperiled fish species of Florida: a watershed perspective. Florida Fish and Wildlife Conservation Commission, Tallahassee.

Holliman, F. M., J. B. Reynolds, and T. J. Kwak. 2003. A predictive risk model for electroshock-Induced mortality of the endangered Cape Fear shiner. North American Journal of Fisheries Management 23(3): 905-912.

Johnston, C. E., and C. L. Knight. 1999. Life-history of the bluenose shiner, *Pteronotropis welaka* (Cypriniformes: Cyprinidae). Copeia 1999(1):200-205.

Jordan, F., H. L. Jelks, S. Bortone, and R. M. Dorazio. 2008. Comparison of visual survey and seining methods for a benthic stream fish. Environmental Biology of Fishes 81:313-319.

MacKenzie, D. I., and J. A. Royle. 2005. Designing occupancy studies: general advice and allocating survey effort. Journal of Applied Ecology 42:1105–1114.

Mayer, P. M., S. K. Reynolds, M. D. McCutchen, and T. J. Canfield. 2006. Riparian buffer width, vegetative cover, and nitrogen removal effectiveness: a review of current science and regulations. EPA/600/R-05/118, U.S. Environmental Protection Agency, Cincinnati, Ohio.

National Resources Conservation Service [NRCS]. 2011. NRCS conservation practice effects on federal Threatened & Endangered species (T&E) The USFWS-NRCS Interagency Consultation Matrix. Field Office Technical Guide Section II(D)(3)(a).

Northwest Florida Water Management District [NWFWMD]. 2008. 2008 Water supply assessment update. Water Resources Assessment 08-02. Havana.

Osprey Data International, Inc. 2001. Natural history of the bluenose shiner (*Pteronotropis welaka*) and the flagfin shiner (*Pteronotropis signipinnis*). Final report to the Florida Fish and Wildlife Conservation Commission. Tallahassee, NGW Grant No. 99051.

Pollock, K. H., J. D. Nichols, T. R. Simons, G. L. Farnsworth, L. L. Bailey, and J. R. Sauer. 2002. Large scale wildlife studies: statistical methods for design and analysis. Environmetrics 13:105-119.

Price, A. L., and J. T. Peterson. 2011. Estimation and modeling of electrofishing capture efficiency for fishes in wadeable warmwater streams. North American Journal of Fisheries Management 30(2):481-498.

Rahal, F. J., and D. A. Jackson. 2007. Watershed level approaches in analysis and interpretation of freshwater fisheries data. American Fisheries Society. Bethesda, Maryland.

Strickland, P., E. Nagid, and J. Knight. 2011. Federal aid Wallop-Breaux completion report F9846-08-11-F. Project No. F-131. Florida Fish and Wildlife Conservation Commission, Tallahassee.

The Citizen Preservation Council of Washington County. 2001. Holmes Creek biological report for Outstanding Florida Water.

The Nature Conservancy [TNC]. 2006. Stewardship of aquatic resources for the Gulf Coastal Plain Ecosystem Partnership: an aquatic management plan for the watershed of the western panhandle of Florida and southern Alabama.

U. S. Fish and Wildlife Service [USFWS]. 2001. Buffers: An Efficient Tool for Watershed Protection. U.S. Fish and Wildlife Service, Panama City Field Office, Panama City, Florida.

United State Fish and Wildlife Service [USFWS]. 2007. Chipola River threats assessment report. U.S. Fish and Wildlife Service, Panama City Field Office, Panama City, Florida.

Wegner, S. 1999. A review of the scientific literature on riparian buffer width, extent and vegetation. Office of Public Service and Outreach, Institute of Ecology, University of Georgia, Athens.

Williams, J. E., D. W. Sada, and C. D. Williams. 1988. American Fisheries Society guidelines for introductions of threatened and endangered fishes. Fisheries 13(5):5-11.

APPENDICES

Appendix 1. Cooperating agencies/programs aimed at maintaining aquatic habitat quality.

The Florida Department of Environmental Protection (DEP) created the Integrated Water Resource Monitoring Network (IWRM) Program as a multi-resource, multi-level or "tiered" comprehensive monitoring network, designed to answer questions about Florida's water quality (WQ) at differing scales. Tier I monitoring is comprised of 2 monitoring efforts, status monitoring and trend monitoring, which are designed to answer state-wide to regional questions.

The status monitoring network performs a statewide sweep each year to report on the overall condition of Florida's waters. The surface water trend monitoring network consists of 76 fixed-location sites in streams and rivers that are sampled on a monthly basis. The sites are usually located at the lower end of a drainage basin and where possible, are placed at or close to a U.S. Geological Survey flow gauging station. These sites enable DEP to obtain chemistry, discharge, and loading data at the point that integrates the land use activities of the watershed. Data from both networks comprise part of Florida's biannual Water Quality Assessment 305(b) Report to the U.S. Environmental Protection Agency, a requirement of the Federal Clean Water Act.

Tier II monitoring, under the IWRM, includes basin assessments and monitoring required for total maximum daily load (TMDL) development. DEP must develop TMDLs for waterbodies where one or more WQ standards are not met. The TMDL is a scientific determination of the maximum amount of a given pollutant that surface water can absorb and still meet the WQ standards that protect human health and aquatic life. Water bodies that do not meet WQ standards are identified as "impaired" for the particular pollutants of concern (e.g., nutrients, pathogens, metals, etc.) and TMDLs must be developed, adopted and implemented for those pollutants to reduce the level of impairment. The threshold limits on pollutants in surface waters are set forth primarily in Rule 62-302, Florida Administrative Code. DEP provides information on the status and development of TMDLs through their website. Coordination with DEP on the location of bluenose shiners and any WQ and habitat information collected at inhabited sites will be important to improving or maintaining the aquatic habitat.

The water management districts (WMDs) have several programs related to ensuring that water supply needs of both people and natural systems are met. Minimum flows and levels (MFLs) are established for lakes, streams, rivers, wetlands, springs and aquifers in order to prevent significant harm to the water resources or ecology of an area resulting from permitted water withdrawals. Establishing MFLs is a requirement of the State Legislature under Chapter 373.042, Florida Statutes. MFLs identify a range of water flows and/or levels above which water might be permitted for consumptive use. Consumptive Use Permits allow the holder to withdraw a specified amount of water, either from the ground, or surface water such as a canal, a lake or a river. The water can be used for a public water supply; to irrigate crops, nursery plants, or golf courses; or for industrial processes. Individual homeowners using water from their own private well for household purposes do not need Consumptive Use Permits. The WMDs develop regional water supply plans for meeting the needs of future development within their basins while also maintaining protection of natural systems. The plans may identify the additional use of traditional supplies, such as ground and surface waters, or the development of alternative

supplies such as use of reclaimed water, demineralization of brackish water, desalination of seawater, or increased water conservation.

The Northwest Florida Water Management District and the St. Johns River Water Management District are initiating development of MFLs in most of the river systems that contain bluenose shiners. As part of the Research and Monitoring, information that is gathered regarding specific habitat and WQ needs of the bluenose shiner will be provided to the for consideration while they develop the 5-year priority lists and timeframes for MFL plan development and in the actual development of individual MFLs in waterbodies containing bluenose shiners.

Appendix 2. Riparian buffers and management.

Best management practices (BMPs) are designed to protect water quality (WQ) by reducing, or eliminating, inputs of sediments, nutrients, logging debris, chemicals and temperature fluctuations from development, mining, and silvicultural and agricultural practices. The silviculture BMP (Florida Department of Agriculture and Consumer Services 2011) identifies a Special Management Zone (SMZ) whose width is based on the size and type of waterbody, soil type (erodible) and slope of the site. The SMZ ranges in size from 35 ft to 300 ft (10.7 to 91.4 m). The primary SMZ adjacent to Outstanding Florida Waters waterbodies is 200 ft (61 m). The USFWS has recommended 100-ft (30.5-m) riparian buffers along the mainstem of rivers that contain gulf sturgeon critical habitat and 100-ft buffers for streams and rivers containing listed mussel habitat for various agricultural practices receiving federal funding (Natural Resources Conservation Service Conservation Matrix 2011). The Florida Natural Areas Inventory (2011) and the Critical Lands and Waters Identification Project (Oetting et al. 2012) have also identified for planning purposes 1,000-ft (304.8-m) buffers along all rivers and streams based upon the need for removal of nutrients from septic tanks and upland land uses. However, regulatory requirements under Environmental Resource Permitting/Non-point Source permitting typically only require 25-ft (7.6-m) buffers from wetlands for specific WQ parameters. The Blackwater River Watershed Stewardship Plan (Blair et al. 2010) reviewed the adequacy of buffers within the Blackwater River watershed. They recommended that minimum buffer widths of 50 ft (15.2 m) be implemented along the river and its tributaries throughout the watershed. They went on to recommend that local governments should adopt comprehensive planning polices and land development regulations that require or encourage riparian buffers.

If direct land acquisition is not feasible for the preservation of areas containing bluenose shiners, alternative conservation methods may need to be considered. Conservation easements are one of the most effective tools available for the permanent conservation of private lands in Florida. “A conservation easement is a restriction placed on a piece of property to protect its ecological or open space values. It is a voluntary, legally binding agreement that limits certain types of uses or prevents development from taking place now and in the future. In a conservation easement, a landowner voluntarily agrees to donate or sell certain rights associated with his or her property, such as the right to subdivide, and a private organization or public agency agrees to hold the landowner’s promise not to exercise those rights” (The Nature Conservancy 2003). The application of conservation easements by private landowners has successfully protected and retained large tracts of wildlife habitat while meeting expectations for natural resource conservation. Parcels greater than 40 acres under permanent conservation easements are eligible for a tax exemption under Chapter 196.26, Florida Statutes; parcels less than 40 acres (16.2 ha) must meet other requirements and be approved by the Acquisition and Restoration Council. In some cases, conservation easements enable the landowner to qualify for tax benefits under the Internal Revenue Service rules. Additional information on Conservation Easements and Acquisition can found through in the Florida Wildlife Conservation Guide.

Appendix 2, Literature Cited

Blair, S., A. Cathey, A. Darrow, H. Hall, K. Martinez, A. Pinzaino, T. Ankersen, J. Wilks, and L. Wood. 2010. Blackwater River Watershed master plan. University of Florida Conservation Clinic. Florida Department of Environmental Protection, Florida Coastal Management Program Grant No. NA09NOS4190076.

Florida Department of Agriculture and Consumer Services. 2011. Silviculture Best Management Practices. Tallahassee.

Florida Natural Areas Inventory. 2011. Florida Forever Conservation Needs Assessment Technical Report Version 3.33. Tallahassee.

National Resources Conservation Service. 2011. NRCS conservation practice effects on federal Threatened and Endangered species (T&E) The USFWS-NRCS Interagency Consultation Matrix. Field Office Technical Guide Section II(D)(3)(a).

Oetting, J., T. Hoctor, and B. Stys. 2012. Critical lands and waters identification project (CLIP): Version 2.0 Technical Report. Florida Natural Areas Inventory, Tallahassee.

The Nature Conservancy. 2003. Conservation easements: conserving land, water, and a way of life. http://www.nature.org/about-us/private-lands-conservation/conservation-easements/index.htm. Accessed 5 June 2013.

Appendix 3. Protocols for propagation, translocation, reintroduction, and augmentation.

All propagation actions undertaken are to be conducted in a manner consistent with the FWC Genetics Policy for the Release of Finfish in Florida, Final Draft, January 2007; specifically Sections 3A, 4B, 4C, 4D, Section 5, and Section 9.

Donor populations

Within the distribution, populations vary in size, proximity to other populations and may differ significantly in allele frequency. Because of these differences the rehabilitation strategies of each population will also vary. For example, some rehabilitation efforts will focus on supplementation of remnant stocks and others will involve the repatriation of extirpated populations. In each case, the broodstock or donor population selected for use in rehabilitation or repatriation should be the most appropriate source to maintain the genetic variability within and among population diversity and structuring of the remnant populations.

A donor population should be a natural population having a sufficient amount of individuals to minimize the loss of individuals from the reproducing population. Protection of the donor population must be ensured as the population must be sufficiently abundant to support gamete collection, post-spawn egg or larval collection, or adult transfers without harm. For many populations, the most appropriate source for supplementation may be its own stock, if that stock has maintained an appropriate level of genetic diversity. If the donor stock cannot be from the source population then the donor population should be from a metapopulation with similar genetic characteristics (i.e., allele frequencies) or ecological and environmental attributes. Gamete collection and mating techniques should strive to maximize representation of a large number of adults to the recipient population and minimize reproductive variance among adult males and females.

Seining or the use of dip nets for collection of donor individuals is preferred over electrofishing given the probability of instantaneous or delayed mortality of electrofishing mentioned in the collection methods section.

Propagation

Rearing methods or techniques must take into consideration the genetic principles for aquatic organisms as well as fish health and disease transmission issues. Rearing methods should maximize physical and genetic fitness of stocked fish.

The biology, life history and genetics of bluenose shiners in Florida are poorly known. Therefore, controlled propagation will be treated as experimental in nature, and will require detailed proposals prior to issuance of appropriate permits. In general, any parties wishing to conduct controlled propagation must abide by the following propagation guidelines:

- Present a detailed plan to the Florida Fish and Wildlife Conservation Commission (FWC) outlining their expertise, facilities and methodology, species to be propagated, source of stock, disposition of progeny, etc.
- Provide justification for the work, including benefits.
- Obtain all necessary state and federal permits.

- Take all necessary precautions to prohibit introduction or spread of diseases, parasites, and exotic species into controlled environments or suitable habitat.
- Conduct all activities in a manner that will prevent the escape or accidental introduction of individuals outside of their historic range.
- Document all data concerning life history observations, fecundity, survival and mortality, water chemistry, seasonality, and any other conditions or observations important to successful propagation.

A sub-sample of reared bluenose shiners will be sacrificed for genetic analysis from stocked individuals and recipient populations prior to stocking in order to evaluate final parental contribution (in situations where pair-wise breeding does not occur).

Reintroduction, release techniques and site selection

Although many streams have been highly modified, a number of opportunities exist to improve aquatic populations through controlled augmentations and reintroduction. In order to protect genetic integrity, biological diversity, and to avoid conflicts, all activities will be coordinated with appropriate partners (i.e., riparian landowner, affected federal agency).

In an attempt to maximize survival, individuals should be released into receiving waters at locations where wild individuals are known or would be expected to reside at that period in their life history. In addition, stocking techniques consistent with maximizing survival should be employed such as providing acclimation bags or pens in the river and dispersing releases over time and in habitats suitable for the life stage(s) being released.

A site augmentation/ reintroduction plan should be completed prior to conducting any activities. Site plans for potential activities will be developed and distributed to appropriate FWC regional personnel prior to propagation. Site augmentation/reintroduction plans should include as much information as possible, including:

- The exact location where the organisms are to be introduced
- Demographic status of the target species at the site, and why propagation is necessary
- Spatial relationship of the site to other populations of the target species
- Documentation of current habitat conditions at the site
- Assessment of possible limiting factors at the site (e.g., recruitment)
- The source of organisms used for reintroduction (hatchery-produced or wild)
- Detailed monitoring plan and detailed predictions
- List of cooperating and responsible partners
- Copies of all appropriate permits, and, any other pertinent information
- Gamete collection targets and mating techniques
- Stocking numbers
- Rearing techniques

All recovery partners, and any other affected private or public entities identified by the partners, will be notified of planned activities, and will be provided, upon request, the site augmentation/ reintroduction plan prior to relocating or releasing organisms in the wild.

Sites for augmentation/ reintroduction activities should be selected based on criteria and Actions identified above, including historical and current distribution of species, habitat conditions (e.g., water quality, recruitment), and past, present or future threats. Since methods are experimental in nature, activities for a species should be restricted to discrete sites within a specific drainage. The site should be used for augmentation and monitored for a period of years, or until there is evidence of success or failure.

Given the fragility of the many small minnow and darter species and their relatively short life spans (Suttkus and Bailey 1990, Johnston and Knight 1999,) translocation may be preferred over propagation. However, translocation efforts will need to be tested to determine survival due to transportation and stocking shock.

A detailed monitoring plan should be prepared prior to stocking. It is important to obtain information at the proposed stocking site that includes suitable habitat, aquatic organism assemblages and aquatic organism density prior to and post stocking. The fragility may prevent marking fish for recapture and hinder future examination of stocking success. Also, the rarity and low detection probability may require multiple stockings and subsequent sampling to evaluate the success of establishing a new population or augmenting an existing population.

Recovery partners conducting hatchery propagation studies, population augmentation, and population reintroduction, will provide an imperiled species recovery partner report of activities to FWC detailing and documenting the following:

- A description of their propagation program
- Objectives and population data status
- A list of all agencies involved
- Means by which success or failure will be measured
- Documentation of all activities conducted, all locations involved, number of juveniles released and duration of release efforts
- Report on all obstacles encountered during the research, propagation, and reintroduction efforts

Appendix 3, Literature Cited

Johnston, C. E. and C. L. Knight. 1999. Life-history traits of the bluenose shiner, *Pteronotropis welaka* (Cypriniformes: Cyprinidae). Copeia 1999(1): 200-205.

Suttkus, R. D., and R. M. Bailey. 1990. Characters, relationships, distribution, and biology of *Notropis melanostomus*, a recently named cyprinid fish from southeastern United States. Occasional Papers of the Museum of Zoology, University of Michigan 722:1–15.

Appendix 4. Monitoring and research protocols.

Habitat and Population Studies

Research and monitoring programs and their implementation (collection methods) should be based on clear objectives and a priori hypotheses (MacKenzie et al. 2002, MacKenzie and Kendall 2002, Pollock et al. 2002, Mackenzie and Royle 2005). A watershed-level sampling design is needed to update species distribution information, properly characterize occupancy, accurately determine population trends, and determine the influence of both in-stream and landscape attributes on imperiled fish species populations. Additionally, site-specific sampling is needed in order to determine persistence, stability, probability of detection, and to characterize site occupancy on a microhabitat level. This multi-scale approach will allow inferences about population status and trends on both a temporal (watershed) and spatial (site-specific) scale (Fausch et al., 2002, Rahal and Jackson, 2007).

When obtaining unbiased abundance and occupancy estimates, it is necessary to account for different sources of variation (spatial, temporal, detectability). Selected sample areas should reflect the entire area of interest while meeting research and monitoring objectives; the effects of detectability should be estimated or removed (Pollock et al. 2002, Mackenzie and Royle 2005).

Sampling design and collection methods.—Many fish species are collected in Florida while sampling under the Florida Fish and Wildlife Conservation Commission's (FWC's) lentic and lotic long-term monitoring programs (Bonvechio 2009, Strickland et al. 2011). Monitoring data from these long-term programs are stored in a Structured Query Language database. Waterbodies are sampled on an annual basis and utilize a stratified-random design for sample site selection. While these protocols may be appropriate to monitor community structure, another approach may be needed for long-term monitoring of rare fish species populations.

Rare fish species are not often recaptured at sites of known occupancy, and non-detection can not necessarily be attributed to extirpation or changes in the population; non-detection may be attributed to detection differences. Lack of detection may be the result of life history characteristics, sampling biases (gear type or among passes using the same gear), local habitat features, location (watershed or regional differences), or methods of estimation (single-season versus multiple-season estimates) (Bailey and Peterson 2001, Peoples and Frimpong 2011).

Site occupancy models can provide information about population trends in larger areas and models capable of relating spatial patterns to environmental variables should be developed. Site occupancy models facilitate the relationship of detection probabilities to both in-stream habitat and landscape attributes (MacKenzie et al. 2002, Albanese et al. 2007, Anderson et al. 2012). Site occupancy can be estimated from lotic long-term data but it is not known if the current protocol accounts for variation in detectability or incomplete detection. Detection probabilities under different conditions in different habitats cannot be estimated using existing lotic long-term data.

Detection probabilities require multiple site visits over a short period where there is no immigration, emigration, or extinction or that coefficients accounting for extinction or

colonization due to time between sampling events can be utilized (MacKenzie et al. 2002, Peoples and Frimpong 2011). Current protocols use a single pass per location per year instead of multiple passes or consecutive sample days at the same location. Several authors (Bailey and Peterson 2001, MacKenzie and Kendall 2002, MacKenzie et al. 2002, Pollock et al. 2002, Albanese et al. 2007, MacKenzie and Royle 2005) describe methods for developing and modeling estimates of detectability when individuals of targeted rare species are absent from a considerable portion of the samples or sample sites.

In addition, the random design of the current monitoring programs does not allow for site specific assessments that are needed to monitor meta-populations over time and determine specific habitat preferences. Site specific population assessments require a multiple pass sampling design in order to achieve an acceptable level of precision (Widmer et al., 2010). Electrofishing may not be the most appropriate sampling tool for monitoring many rare species. Electrofishing using existing FWC protocols has resulted in immediate or delayed mortality of shiners and could possibly result in mortality of shiner embryos (FWC staff observation; Holliman et al. 2003, Bohl et al. 2009). Therefore, sampling by alternative methods or electrofishing outside the spawning period should be investigated in order to determine the best/most appropriate collection method.

Visual survey sampling techniques may be as effective as conventional fisheries gears such as seining and electrofishing for some species (Bortone 1993, Jordan et al. 2008, Albanese et al. 2011). However, Poos et al. (2007) suggested that electrofishing was more efficient at collecting rare species than seining. It may be necessary to utilize more than 1 method of sampling to adequately document presence and abundance of at risk species since the probability of detecting a species can differ depending on habitat, method, and species (Bortone 1993, Albanese et al. 2007, Poos et al. 2007). A hybrid approach integrating electrofishing with seining methods may be needed when water visibility and/or habitat complexity limit the effectiveness of visual survey methods (Price and Peterson 2010). Furthermore, the best collection method varies based on the objective; while electrofishing may be the best method for monitoring, dip nets may be best when collecting fish for propagation, translocation, reintroduction, and augmentation.

Trained stakeholders such as members of the North American Native Fishes Association, graduate students, and other state or federal agency staff may be provided with opportunities to assist in additional sampling (seining, snorkeling, etc) of new and historic imperiled fish sites. FWC would need to train individuals on fish identification and collection of habitat parameters. Individuals participating in bluenose shiner sampling efforts would need to be included on collection permits such that voucher specimens could be retained.

Habitat information.—FWC needs to develop a better understanding of the factors affecting Florida populations of many imperiled fish species with regard to water quality (WQ), vegetation/micro-habitat, riparian requirements that might affect temperature and structure, stream flow conditions, fish associates, and fish community structure. Fish community data may be necessary for inclusion with imperiled fish species presence and abundance data; imperiled fish species/fish community relationships have not been examined, but other rare fish species, such as the bluenose shiner, are nest associates with the longear sunfish (*Lepomis megalotis*) (Johnston and Knight 1999). Physical habitat information is necessary for inclusion

with bluenose shiner presence and abundance data, so that important species-habitat preferences can be determined. Albanese et al. (2007) reported that the best selected model predicting proportion of sites occupied by imperiled fish species contained conductivity and distance to mainstem as habitat characteristics, while the best selected model predicting detection probability contained current velocity as a habitat characteristic.

Current FWC monitoring protocols recommend the collection of physical habitat characteristics (water temperature; conductivity; dissolved oxygen; depth; a qualitative description and percent area covered [PAC] of shore type; PAC of shore type canopy; PAC of aquatic macrophytes, woody debris, and other forms of structure; the minimum, maximum, and average depth encountered along the transect; water clarity [or turbidity]; co-dominant substrate type) and fish community data for each sampled transect (Strickland et al. 2011). Additional habitat characteristics such as site-specific flow or distance to mainstem may be considered for collection in future bluenose shiner sampling efforts. Maximum depth, percent coverage of vegetation, conductivity, and fish community data should be retained in future imperiled fish species sampling efforts. Habitat and WQ preferences are anticipated to become part of the conservation measures that are to be developed. These habitat characteristics should also provide information on where additional sampling should occur to determine if imperiled fish species are present in new areas.

Appendix 4, Literature Cited

Albanese, B., K. A. Owers, D. A. Weiler, and W. Pruitt. 2011. Estimating occupancy of rare fishes using visual surveys, with a comparison to backpack electrofishing. Southeastern Naturalist 10(3):423-442.

Albanese, B., J. T. Peterson, B. J. Freeman, D. A. Weiler. 2007. Accounting for incomplete detection when estimating site occupancy of bluenose shiner (*Pteronotropis welaka*) in southwest Georgia. Southeastern Naturalist 6(4):657-668.

Anderson, G. B., M. C. Freeman, M. M. Hagler, and B. J. Freeman. 2012. Occupancy modeling and estimation of the Holiday darter species complex within the Etowah River system. Transactions of the American Fisheries Society 141:34-45

Bailey, P. B., and J. T. Peterson. 2001. An approach to estimate probability of presence and richness of fish species. Transactions of the American Fisheries Society 130:620-633.

Bohl, R. J., T. B. Henry, R. J. Strange, and P. L. Rakes. 2009. Effects of electroshock on cyprinid Embryos: implications for threatened and endangered fishes. Transactions of the American Fisheries Society 138(4):768-776.

Bonvechio, K. 2009. Standardized sampling manual for lentic systems. Florida Fish and Wildlife Conservation Commission, Tallahassee.

Bortone, S. A. 1993. Life history, habitat assessment, and systematics of blackmouth shiner (*Notropis* sp.) Blackwater River drainage. Florida Game and Fresh Water Fish Commission, Non-game Wildlife Program, Final Report. Tallahassee.

Fausch, K. D., C. E. Torgersen, C. V. Baxter, and H. W. Li. 2002. Landscapes to riverscapes: bridging the gap between research and conservation of stream fishes. BioScience 52:483-498.

Holliman, F. M., J. B. Reynolds, and T. J. Kwak. 2003. A predictive risk model for electroshock-induced mortality of the endangered Cape Fear shiner. North American Journal of Fisheries Management 23(3): 905-912.

Johnson, C.E., and C. L. Knight. 1999. Life-history of the bluenose shiner, *Pteronotropis welaka* (Cypriniformes: Cyprinidae). Copeia 1999(1):200-205.

Jordan, F., H. L. Jelks, S. Bortone, and R. M. Dorazio. 2008. Comparison of visual survey and seining methods for a benthic stream fish. Environmental Biology of Fishes 81:313-319.

MacKenzie, D. I., and W. L. Kendall. 2002. How should detection probability be incorporated into estimates of relative abundance? Ecology 83:2387-2393.

MacKenzie, D. I., and J. A. Royle. 2005. Designing occupancy studies: general advice and allocating survey effort. Journal of Applied Ecology 42:1105-1114.

MacKenzie, D. I., J. D. Nichols, G. B. Lachman, S. Droege, J. A. Royle, and C. A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. Ecology 83:2248-2255.

Peoples, B. K., and E. A. Frimpong. 2011. Among-pass, interregional, and single- versus multiple-season comparisons of detection probabilities of stream fishes. Transactions of the American Fisheries Society 140:67-83.

Pollock, K. H., J. D. Nichols, T. R. Simons, G. L. Farnsworth, L. L. Bailey, and J. R. Sauer. 2002. Large scale wildlife studies: statistical methods for design and analysis. Environmetrics 13: 105-119.

Poos, M. S., N. E. Mandrak, and R. L. McLaughlin. 2007. The effectiveness of two common sampling methods for assessing imperiled freshwater fishes. Journal of Fish Biology 70:691-708.

Price, A. L., and J. T. Peterson. 2010. Estimation and modeling of electrofishing capture efficiency for fishes in wadeable warmwater streams. North American Journal of Fisheries Management 30(2):481-498.

Rahal, F. J., and D. A. Jackson. 2007. Watershed level approaches in analysis and interpretation of freshwater fisheries data. American Fisheries Society. Bethesda, Maryland.

Strickland, P., E. Nagid, and J. Knight. 2011. Federal aid Wallop-Breaux completion report F9846-08-11-F. Project No. F-131. Florida Fish and Wildlife Conservation Commission, Tallahassee.

Widmer, A. M., L. L. Burckhardt, J. W. Kehmeier, E. J. Gonzales, C. N. Medley, and R. A. Valdez. 2010. Detection and population estimation for small-bodied fishes in a sand-bed river. North American Journal of Fisheries Management 30(6):1553-1570.

Appendix 5. Coordination with other entities.

Florida's growth management law places significant responsibility for land and water use decisions on local governments. Achievement of Florida's species conservation plans will necessitate local government land and water use plans and regulations that recognize important state fish and wildlife resources, including habitat, and provide adequate provision for their conservation. The Florida Fish and Wildlife Conservation Commission (FWC) will continue to collaborate with and provide information to local governments regarding species management plans, permitting guidelines and assistance programs that are available to landowners, as well as to the general public.

Chapter 163.3177, Florida Statutes, requires that county comprehensive growth management plans include a conservation element. The conservation element must include the identification of areas within the county that are locations of important wildlife or habitat resources, including State-listed species. This element must contain principles, guidelines, and standards for conservation that restrict activities known to adversely affect the survival of these species. The FWC is identified as a state agency authorized to review county growth management plans and, including any amendments to ensure important state fish, wildlife, and habitat resources are adequately considered. In addition, local government land development regulations require conditions for land and water uses that specify how such uses will be administered to be consistent with the conservation element of the county growth management plans. Therefore, interagency collaboration on the review and development of the conservation element of these plans is essential for ensuring that they consider wildlife habitat within the county, such as seepage stream and slope habitats.

County growth management plans and land development regulations (LDRs) provide an avenue by which FWC can inform and influence land and water uses that are relevant to the conservation of Florida's fish and wildlife, including state-listed species. Because local governments use the LDRs or ordinances to govern development and expansion under their jurisdiction, coordination with FWC can streamline FWC's review and approval process. This could be implemented by FWC in coordination with the local government by adding questions to their development applications asking for information on what listed species surveys have been conducted on the property, or by inspecting parcels for the presences/absence of imperiled species (simplified survey protocol). Requiring notification of FWC staff that an imperiled species or its habitat has been identified onsite prior to issuing clearing or building permits should expedite FWC's review and approval.

Land development is governed by a variety of federal, state, and local government growth management and permitting processes or requirements. Some of the processes may include Joint Coastal Permits, Environmental Resource Permits (wetland, stormwater, or non-point source), Sector Plans, Developments of Regional Impacts, Master Planned Unit Developments, and Mitigation Banking Permits. Most state and water management district permits require consideration of potential impacts to listed species and their habitats. Local governments and other state or federal agencies often conduct site visits prior to clearing and development. These site visits occur early in the regulatory process, often well before permitting begins. By participating in site visits, project scoping meetings and pre-application reviews as part of an

interagency review team, FWC can help determine presence/absence and help address avoidance, minimization, and/or mitigation prior to the permitting process. An Interagency Review Team would also provide FWC the opportunity to participate in large-scale local government planning efforts, would be able to coordinate with other permitting agencies to reduce redundancy in recommended conditions, and would be able to help large developments plan to avoid habitat impacts. These early meetings and coordination efforts also give local governments and other agencies the opportunity to determine presence or absence of listed species onsite as well as other important fish, wildlife, and habitat issues.

FWC will develop and provide protocol for determining the presence/absence of imperiled species to assist local governments and the regulatory agencies in protecting habitat for the imperiled species. Once presence is determined, FWC can provide assistance to the applicant to avoid incidental take permitting by providing conservation measures such as appropriate site design, or could provide mitigation options such as purchase of land or contribution to a trust fund for conservation of the species or participation in a Habitat Conservation Plan. This is also a good opportunity to make the applicant aware of any FWC incidental take permits or authorizations.

Local governments and other agencies also play a substantial role in imperiled species conservation and management by providing protected and managed areas for imperiled species. Many local governments have created habitat-acquisition and management programs, which can provide important assistance in achieving the goal and objectives of this management plan. The FWC will continue to coordinate with local governments and other agencies to help ensure that local land-acquisition programs and the comprehensive plan's implementing ordinances and policies are: (1) consistent with the goal and objectives of this management plan and (2) focus on acquisition priorities for imperiled species and other important wildlife species.

This management plan identifies areas known to or having potential to support bluenose shiner and encourages research efforts to further determine current distribution and preferred habitats. This plan also identifies the threats to the bluenose shiner, as well as the need to identify preliminary recommendations that specify means to avoid, minimize or mitigate activities associated with these threats (see Habitat Conservation and Management, Monitoring and Research, and Rule and Permitting Intent chapters). FWC offers conservation planning services to local governments during growth management plan development as well as during consideration of plan amendments and associated development proposals.