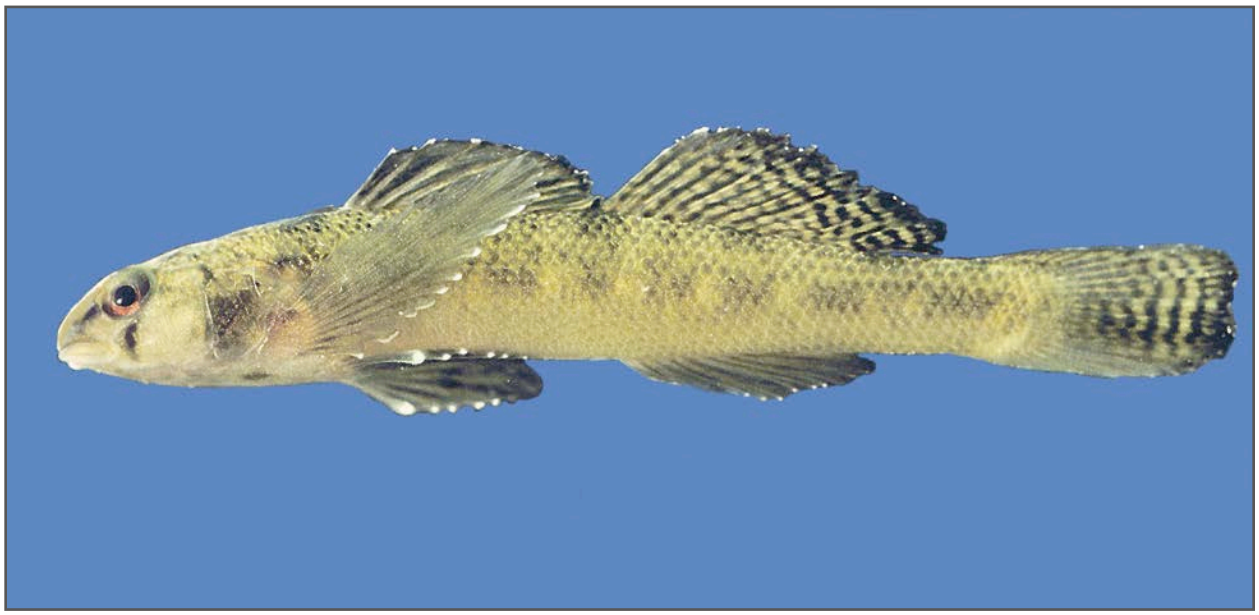
A Species Action Plan for the Southern Tessellated Darter *Etheostoma olmstedi maculaticeps*

Final Draft
November 1, 2013



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EXECUTIVE SUMMARY

The southern tessellated darter (*Etheostoma olmstedi maculaticeps*) is only found within the Ocklawaha River watershed within Florida's state boundaries and is isolated from the next closest population that resides in the Altamaha River, Georgia. It has been collected in only 5 locations within the Ocklawaha River drainage, and the population status in each of these locations is unknown. The small geographic range occupied by this species in Florida suggests that it may be vulnerable to natural or anthropogenic catastrophes that can cause permanent extirpation.

In 2010, the Florida Fish and Wildlife Conservation Commission (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 southern tessellated darter. FWC staff subsequently developed a Biological Status Review report (BSR), which included the findings from a biological review group of experts and a recommendation for state listing. The conservation goal, objectives, and actions described herein are based primarily on the information summarized in the BSR.

The goal of this plan is to improve the conservation status of the southern tessellated darter to the point that it is secure within its historical range. This can be achieved by implementing actions designed to expand the current knowledge of the abundance and locations occupied by the southern tessellated darter, identifying their habitat preferences, and protecting those locations and habitats from both natural and anthropogenic disturbances. Coordination with regulatory agencies and private landowners on land-use activities by means of influencing, incentives, outreach, and education is also a strategy that will be pursued to achieve this goal. The majority of these actions can be accomplished within 5 years of plan implementation, after which FWC will review the status of the southern tessellated darter population relative to the management plan's objectives.

This plan details the actions necessary to improve the conservation status of the southern tessellated darter. A summary of this plan will be included in the Imperiled Species Management Plan (ISMP), in satisfaction of the management plan requirements in Chapter 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. Any significant changes to this plan will be made with the continued involvement of stakeholders.

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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 the 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, 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 or 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

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

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

F.S.: Florida Statutes

GIS: Geographic Information System

Habitat: The area used for any part of the life cycle of a species (including foraging, breeding, and sheltering).

HCP: Habitat Conservation Plan

ISMP: Imperiled Species Management Plan

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

IUCN Red List: (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.

LAP: Landowner Assistance Program, a federal cost-share program administered by the FWC.

MFL: Minimum Flows and Levels, the minimum water flows and/or levels adopted by the 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.

NPDES: National Pollutant Discharge Elimination System

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

SJRWMD: St. Johns River Water Management District

SMZ: Special Management Zone. The Special Management Zone (SMZ) is a BMP that 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 that 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.

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.

UF: University of Florida

USGS: United States Geological Survey

WMD: Water Management District

INTRODUCTION

Biological Background

The tessellated darter (*Etheostoma olmstedi*) is a moderate-sized darter regularly obtaining sizes of 60 mm (2.36 in) standard length (Gilbert 1992). It is typically tan or light brown in color and has a series of 9 to 11 X- or W-shaped brown markings on the side. It ranges from Ontario, Canada, to northern Florida and is considered common or abundant throughout most of its range (Page and Burr 2011). It is normally found in small and medium-sized streams in areas with less than maximum flow and a variety of habitat types, including sand, mud, silt, and gravel bottoms (Gilbert 1992). The southern tessellated darter (*Etheostoma olmstedi maculaticeps)*, 1 of 3 subspecies of *E. olmstedi*, ranges from North Carolina to northern Florida (Page and Burr 2011) and is distinguished from the other subspecies by having 2 anal spines. In Florida, it has only been collected from 5 general locations within the Ocklawaha River Basin, with the next closest known population separated by over 200 km (over 124 mi) at the Altamaha River Basin in Georgia (Gilbert 1992). The 5 collection locations in the Ocklawaha River Basin include: Davenport Landing, Eaton Creek, Little Orange Creek, and 2 locations in Orange Creek (Figure 1). The first collections were made at Davenport Landing in 1948 and 1949 (McLane 1955). However, follow-up attempts for collecting additional specimens at Davenport Landing in the 1970s and 1994 were unsuccessful (Gilbert 1992, Jordan 1994). The Little Orange Creek collection was only made once in 1977. At least 2 collections have been taken from Eaton Creek since 1976. Orange Creek is the only known location in Florida where the southern tessellated darter can be and has been regularly found (Gilbert 1992). Since 1975, there have been at least 15 collections made at Orange Creek near County Road 315 and State Road 21, with the most recent collection being taken as recently as May 2013.

Conservation History

The state of Florida identified the southern tessellated darter as a Threatened species in 1977. It was reclassified as a Species of Special Concern in 1979, and the classification was justified in 2001 based on significant vulnerability to habitat modification, environmental alteration, human disturbance, or human exploitation that may result in its becoming a Threatened species unless appropriate protective or management techniques are initiated or maintained. Watershed protection has indirectly maintained the population status of southern tessellated darters from further deterioration. A substantial portion of the Ocklawaha River Basin is in public ownership as national forests, state and local parks, preserves, recreational areas, and wildlife management areas, where wetlands and upland forest account for over 50% of the basin (Figure 1). Portions of the basin are also classified as Outstanding Florida Waters (OFW) in an effort to protect the ambient water quality.

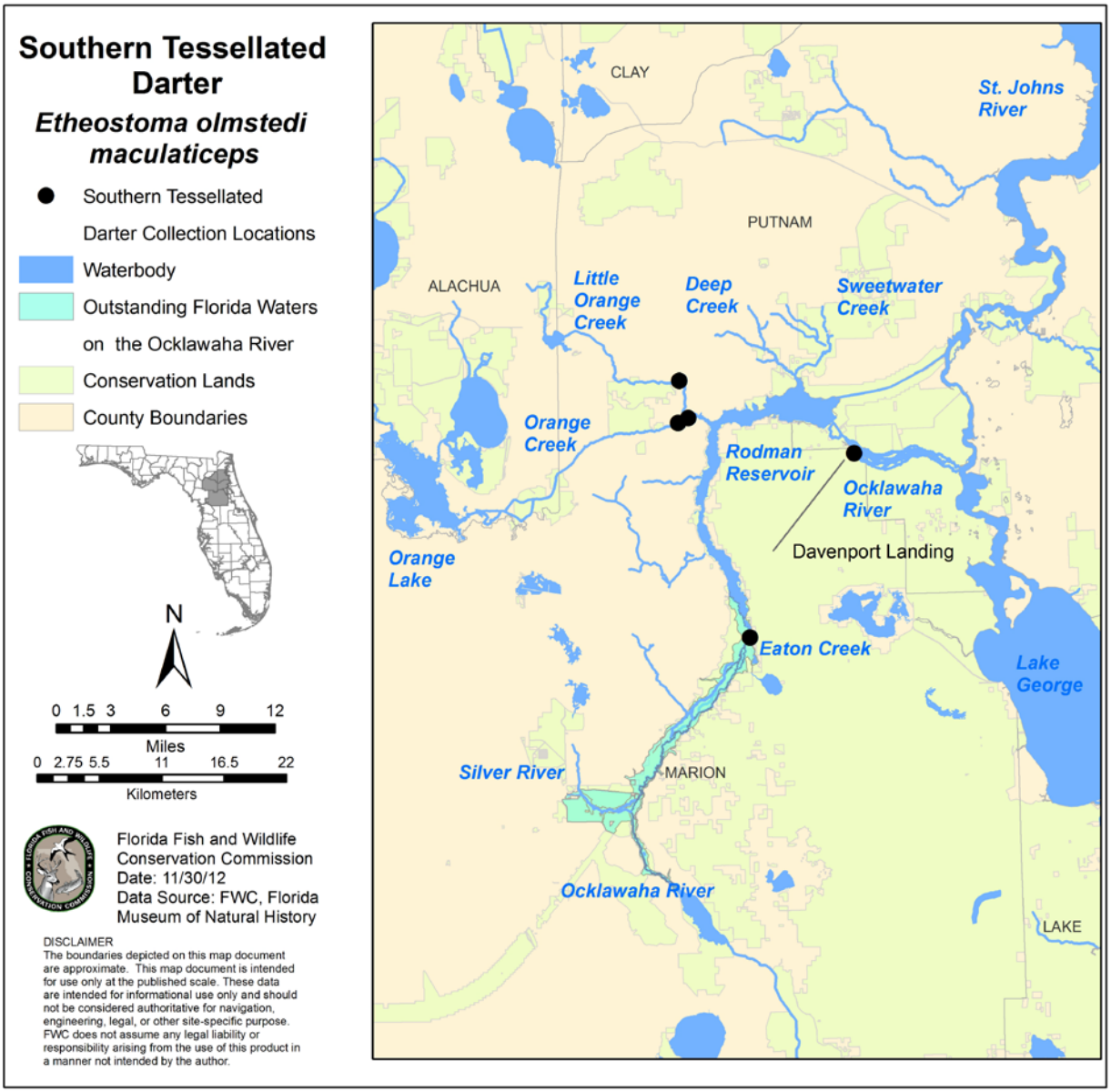

Figure 1. Florida occurrence locations for the southern tessellated darter (*Etheostoma olmstedi maculaticeps*) showing the designated portion of Outstanding Florida Waters and Conservation Lands.

Threats and Recommended Listing Status

In 2010, the Florida Fish and Wildlife Conservation Commission (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 southern tessellated darter. The FWC convened a biological review group (BRG) of experts on the southern tessellated darter to assess the biological status of the species by using criteria specified in Rule 68A-27.001, Florida Administrative Code (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 of a Biological Status Review (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 in a final report.

The BRG stated that the primary threats to the southern tessellated darter are anthropogenic sources of pollution, habitat alteration, population fragmentation, reduced flows, and potential predation, competition, or hybridization with introduced species.

The BRG found the southern tessellated darter met the following criteria for listing:

- Criterion B Geographic Range: Extent and Area of occupancy less than 20,000 km^2 (7,733 mi^2), population is fragmented in fewer than 10 locations, and continued declines in number of individuals and habitat quality.
- Criterion C Population Size and Trend: Population size estimate suspected to number fewer than 10,000 mature individuals, and an estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer.
- Criterion D Population Very Small or Restricted: Population with a very restricted area of occupancy and number of occurrence locations.

Based on the literature review, information received from the public, the BRG findings, and peer-reviewed input, FWC staff recommended the southern tessellated darter be retained as Threatened on the Florida Endangered and Threatened Species List.

CONSERVATION GOAL AND OBJECTIVES

Goal

Conservation status of the southern tessellated darter is improved to the point that the species is secure within its historical range.

Objectives

I. Maintain sustainable populations of the southern tessellated darter within its current distribution indefinitely.

Rationale

The BSR states that the small geographical range (95.6 km^2 [36.9 mi^2]) occupied by the southern tessellated darter in Florida is the primary threat to the conservation of this species. Although a decline in the historic range is suspected (e.g., due to the impoundment of the Ocklawaha River), the historical range is confined to the lower Ocklawaha River basin within Florida, and no historical records exist outside of this basin. The best available information suggests that the natural extent of this species has historically been small and remains relatively unchanged, with the possible exception of the area associated with the reservoir. Standard river monitoring practices may be unsuitable to assess the current population and distribution status due to poor detectability of the species, and incomplete monitoring coverage within the species' range. Recent efforts to capture southern tessellated darters have been directed towards areas where they are known to occur; additional areas within the basin should be explored. Therefore, conservation actions pertaining to this objective focus on increasing the current information of the population status and locations occupied by the southern tessellated darter.

II. Prevent declines in the area, extent, and quality of habitat occupied by the southern tessellated darter indefinitely.

Rationale

The BSR states that declines in the area, extent, quality of habitat, and number of locations or subpopulations of the southern tessellated darter are inferred (Criterion B.2.b.iii,iv). Conservation actions pertaining to this objective focus on protective habitat and water quality/quantity measures within the watershed to minimize anthropogenic disturbances that could result in possible extirpation of the species from Florida.

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 1) provides information on action priority, urgency, potential funding sources, likely effectiveness, identified partners, and leads for implementation.

Habitat Conservation and Management

Southern tessellated darters reside in 5 known locations within one watershed in Florida. Species that occupy a small geographic area with few population locations are vulnerable to natural or anthropogenic catastrophes that can cause permanent extirpation. Thus, the physical habitat and water quality/quantity in these locations must be managed and conserved to prevent irreversible harm to the populations. The following conservation actions are designed to maintain and/or improve the habitat and water quality where southern tessellated darters are known to occur.

Action 1 Designate all portions of the Ocklawaha River and all associated tributaries as OFWs.

The Ocklawaha River holds an OFW designation that is delineated by the eastern line of Section 36, Township 15 South, Range 23 East (water downstream of the Ocklawaha Prairie Restoration Area) and Eureka Lock and Dam, including Turkey Creek, Strouds Creek, Dead River (the waterbody so named near Gores Landing), Cedar Creek (Figure 2), and Fish Creek, but excluding Marshall Swamp, the Dead River (the waterbody so named exiting Marshall Swamp), and all other tributaries. However, tributary creeks and the Ocklawaha River below Rodman Reservoir that are, or have been occupied by southern tessellated darters (Orange Creek, Little Orange Creek, Eaton Creek, and Davenport Landing) are not included under the OFW designation. This special designation is intended to protect existing good water quality, and in general, the Department of Environmentral Protection (DEP) or a water management district (WMD) cannot issue permits for direct discharges to OFWs that would lower ambient (existing) water quality. In most cases, this deters new wastewater discharges directly into an OFW, and requires increased treatment for stormwater discharging directly into an OFW. DEP or a WMD also may not issue permits for indirect discharges that would significantly degrade a nearby waterbody designated as an OFW.

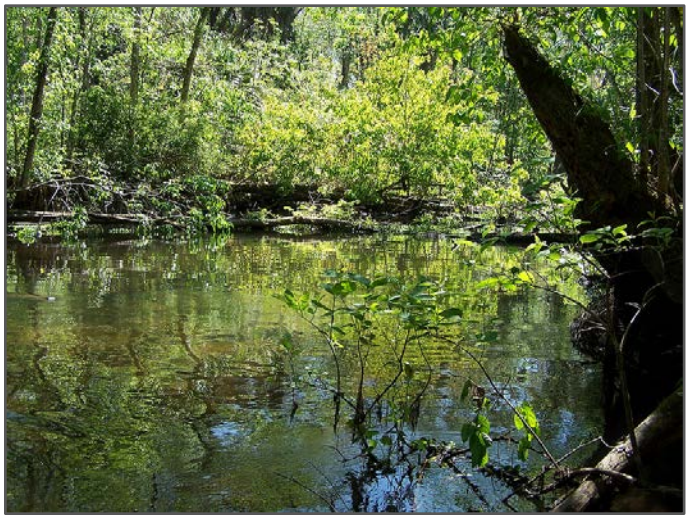

Figure 2. Cedar Creek is one of more than 30 sites at which the FWC research team is studying the southern tessellated darter population. FWC photograph.

Action 2 Communicate known locations occupied by southern tessellated darters to the St. Johns River Water Management District (SJRWMD) so that their habitats are considered in minimum flows and levels rule development.

The SJRWMD's minimum flows and levels (MFL) program offers an area where protective measures may be taken for the habitat conservation of southern tessellated darters. 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 from permitted water withdrawals. Establishing MFLs is a requirement of the State Legislature under s. 373.042, Florida Statutes (F.S.). MFLs identify a range of water flows and levels above which water might be permitted for consumptive use. Coordination by FWC and SJRWMD during the MFL process is important to prevent declines in the area, extent, and quality of habitat occupied by southern tessellated darters. Empirical data or professional knowledge that characterizes the habitats occupied by southern tessellated darters should also be provided or expressed to the SJRWMD.

Action 3 Establish water quality monitoring stations in the vicinity of known locations of southern tessellated darters.

Establishing water quality monitoring where southern tessellated darters are known to occur is important to supplement current Integrated Water Resource Monitoring Network (IWRM) monitoring stations (see Action 19). Since current monitoring stations are primarily associated with mainstem river segments, water quality stations in the vicinity of known southern tessellated darter locations can provide a database by which the patterns and trends of low-order tributaries and distributaries are compared against high-order river segments. These data can be used in conjunction with habitat-use information (discussed in Monitoring and Research) so that habitat suitability criteria (Action 10) may be developed to create or refine MFL rules.

Action 4 Examine the current and projected land use in the areas where known populations of southern tessellated darters exist to identify potential threats to these locations.

It is important to identify and communicate any threats that are revealed during current and projected land-use analyses and coordinate with appropriate partners and stakeholders so that cooperative actions can be made to alleviate identified threats. Depending on the source and severity of identified threats, it may be necessary to acquire land by purchase or long-term conservation easements with property owners to minimize or avoid identified threats. 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 not-for profit organization or public agency agrees to hold the landowner's dedication not to exercise those rights" (The Nature Conservancy 2003). The use of conservation easements by private landowners in cooperation with public agencies and private non-profit organizations has successfully conserved large tracts of wildlife habitat allowing landowners to maintain many of their expectations for revenue generation from agricultural or other business operations while retaining important wildlife habitat conservation features on their land. In some cases, conservation easements enable the landowner to qualify for property and income tax benefits under State and Internal Revenue Service rules. Additional information on Conservation Easements and Acquisition can found through in the Florida Wildlife Conservation Guide.

Action 5 Establish a 15-m (50-ft) minimum buffer from silviculture and land development in Orange Creek and Little Orange Creek.

The majority of the southern tessellated darter range occurs in temperate climates where summer water temperatures are cooler than those of Florida. Maintaining forest cover to regulate water temperature may be an important habitat management strategy. Water quality best management practices (BMPs) are schedules of activities, prohibitions of practices, maintenance procedures, and other management practices designed to prevent or reduce the pollution of waters of the United States. For example, the BMPs for silviculture in Florida protect the riparian zone of a stream by reducing forestry related inputs of sediments, nutrients, logging debris, chemicals and temperature fluctuations. These BMPS are set in Rule 5I-6, F.A.C., and are regulated by the Florida Forest Service Hydrology Section. The riparian zone in these BMPs is designated as part of a Special Management Zone (SMZ), and ranges in width from 10.7 m to 91.4 m (35 ft to 300 ft). The width of the SMZ is based on the size and type of waterbody, soil type (erodible), and slope of the site. Because the Ocklawaha River upstream of Eureka is designated as an OFW, a 61-m (200-ft) buffer to the riparian zone is applied. However, known populations of southern tessellated darters reside in tributaries and/or mainstem portions of the Ocklawaha River that are not included under the OFW designation. Therefore, a narrower riparian zone buffer for silviculture would be applied to these streams. In order to provide protections for southern tessellated darters in Orange Creek and Little Orange Creek, a minimum 15-m (50-ft) buffer should be established for silviculture until the distribution, abundance and habitat affinity is better understood.

Population Management

Action 6 Determine if transplanting or stocking southern tessellated darters is a viable or necessary option.

The best available information suggests that the abundance of southern tessellated darters is low, and at risk of extirpation from Florida. Introductions or re-introductions of southern tessellated darters may be a plausible strategy to address the conservation goal of improving the status of southern tessellated darter to the point that it is secure within its historical range. However, the need for such a strategy must be informed by what is learned about the distribution (Action 8), abundance (Action 9), and habitat suitability (Action 10) of southern tessellated darters described in the Monitoring and Research section below.

Reintroduction involves establishing juvenile and adult individuals into historically occupied river and stream reaches where the species no longer occurs and where habitat is not accessible to natural immigration or recruitment from existing populations. This procedure may be accomplished by either transplanting adults from existing populations or by releasing hatchery-propagated individuals. Reintroducing aquatic organisms into historical habitats may be possible if the conditions that led to its extirpation have been eliminated or improved (e.g., water chemistry, flow, sedimentation, etc.). Some benefits of reintroductions are reestablishment of populations, genetic refugia, and reducing the potential of extinction due to unforeseen events. Regardless of whether introductions are accomplished by transplanting wild individuals or by stocking captive-raised individuals, some guiding genetic principles that should be adhered to are

1) maintain the current level of genetic variability, 2) avoid management actions that may lead to increased inbreeding or outbreeding, 3) maximize the effective population size of managed populations, and 4) perform a risk/benefit analysis for any proposed stocking. Protocols describing reintroduction techniques and propagation methods and subsequent monitoring requirements are contained in Appendix 1.

Action 7 Collect and analyze tissue samples from southern tessellated darters to describe the genetic characteristics of populations or subpopulations.

The population structure of southern tessellated darters in Florida needs to be examined through appropriate population genetic methods. Conserving the genetic diversity requires a thorough understanding of the existing levels of genetic diversity, both within and among populations. Fin clips of southern tessellated darters collected in the Ocklawaha River Basin can be used to describe genetic differences between individuals within a stream and differences between sub-populations between streams. Genetic samples should also be obtained from southern tessellated darters that occur in Georgia, South Carolina, and North Carolina to examine the potential of using other populations outside of Florida to supplement the Ocklawaha River population if necessary for the conservation of the species. Genetic samples are currently being collected from all southern tessellated darters captured from Florida populations. Collaboration between FWC and Georgia Department of Natural Resources, South Carolina Department of Natural Resources, and North Carolina Wildlife Resources Commission is ongoing to obtain genetic samples from populations within those states. Genetic samples are being analyzed by Dr. Jim Austin of the University of Florida (UF).

Monitoring and Research

Effective monitoring of southern tessellated darter populations requires a multi-scale approach. Fish habitat can vary depending on scale, from microhabitat conditions, to stream channel units, to watershed level characteristics (Fausch et al. 2002). These scales form a hierarchy in that factors affecting local conditions are the result of processes occurring at a larger scale (Rahal and Jackson 2007). A watershed-level sampling design is needed to update species distribution information, properly characterize occupancy, and accurately determine population trends. Watershed level sampling also provides a better understanding of how both instream (e.g., sediment size, velocity) and landscape (e.g., geology, gradient) attributes influence southern tessellated darter population dynamics. Additionally, site-specific sampling is needed in order to determine persistence, stability, and 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.

FWC monitors the sport fish populations and fish communities in the mainstem of the Ocklawaha River from the Moss Bluff Dam to the confluence with the St. Johns River under the FWC River Monitoring Program (Strickland et al. 2011). FWC also monitors the sport fish populations and fish community in Rodman Reservoir from Kenwood Landing to the Kirkpatrick Dam under the FWC Lake Monitoring Program (Bonvechio 2011). Fish samples in the Ocklawaha River and Rodman Reservoir are collected on an annual basis in both programs; however, southern tessellated darters have not been collected to date under these annual monitoring programs. Aside from the fact that this species is extremely rare, other reasons for

their lack of capture are due to their cryptic nature, their poor detectability with boat electrofishing, and/or restricting samples to the reservoir pool and mainstem portions of the Ocklawaha River. Consequently, if distribution and abundance information for southern tessellated darters is desired, the programs must be expanded to incorporate tributaries and distributaries of the Ocklawaha River, or use an alternative sampling design and sampling gear with the specific focus of monitoring southern tessellated darters. Several studies have demonstrated that visual survey sampling techniques can be an effective alternative to conventional fisheries gears such as seining and electrofishing to characterize fish population status and trends (Jordan et al. 2008, Albanese et al. 2011). Alternatively, a hybrid approach integrating electrofishing with seining methods may be needed when water visibility and habitat complexity limit the effectiveness of visual survey methods (Price and Peterson 2010). Site-specific population assessments require a multiple-pass sampling design in order to achieve an acceptable level of precision (Widmer et al. 2010). An important component to the approach chosen is the determination of site-specific probability of detection and occupancy that would facilitate a greater understanding of persistence, stability, and population trends of southern tessellated darters.

Action 8 Develop and implement a sampling protocol to collect southern tessellated darters within its current distribution.

Distribution and abundance information for southern tessellated darters is lacking. Most of the historical efforts to capture southern tessellated darters have been directed towards areas where they are known to occur, while little sampling effort has been directed in areas where historical capture records do not exist. Consequently, a monitoring approach was designed in order to address the conservation goal of improving the status of southern tessellated darters to the point that it is secure within its historical range (Appendix 2). Tributaries and side branches of the Ocklawaha River, from the Silver River confluence to the St. Johns River, were split into 50-m (164-ft) segments using geographic information system (GIS) mapping technology to provide a set of possible transects from which random samples can be taken to better describe the southern tessellated darter's occurrence and distribution in the Ocklawaha River Basin. A total of 30 to 40 transects were randomly chosen using a stratified random design, where strata were defined as the various tributaries and distributaries, causing the sampling effort to be spread out in the various watersheds throughout the basin. At each site, 50 m (164 ft) will be delineated and sampled using one of two methods.

1. At wadeable sites, "kick-seining" will be used with small-mesh seines along with back-pack electrofishing equipment. Kick-seining consists of the seine being held by 2 individuals, while another individual carrying a back-pack shocker and another 1 or 2 individuals approach the seine from upstream, thrashing and kicking the water towards the seine as electrical current is applied. Each kick-seine will cover an area measuring approximately 3 m wide × 4 m long (9.8 ft × 13 ft). Therefore, the number of kick-seines required to sample each site will vary by stream width. Kick-seines will be collected by beginning at the downstream extent of each 50-m (164-ft) site, and sampling from one bank to the other moving upstream until the upstream extent of the 50-m site is reached.
2. At non-wadeable sites with high water clarity, snorkeling will be used to visually survey random transects as recommended by Jordan et al. (2008). Snorkeling events

will consist of 2 to 3 divers moving parallel to one another in an upstream direction with the attempt to visually survey the majority of the area within the 50-m transect. The number of divers used will depend on the width of the stream. There will be an attempt to collect all southern tessellated darters observed in visual surveys using plastic nets described in Jordan et al. (2008).

Action 9 Confirm 5 prior locations, identify any new locations, calculate the extent of occurrence, and estimate the population size of southern tessellated darters.

Sites where southern tessellated darters are collected will be revisited and sampled to obtain abundance estimates (Appendix 2). Abundance estimates will be made using multiple-pass depletion methods by first blocking off 50-m stretches of the stream in the area where southern tessellated darters were collected, and then kick-seining wadeable streams or using visual surveys in non-wadeable streams similar to Jordan et al. (2008). Estimates of abundance will be made using individual pass collections described by Dorazio et al. (2005). Alternatively, site occupancy has been used as an index to determine population status of aquatic species when actual population dynamic studies are not feasible (i.e., rare, cryptic, or difficult to collect species) (Bailey et al. 2004, Royle and Dorazio 2008). Such a design may be needed to accurately characterize the current status of this species. Occupancy models are also capable of relating spatial patterns to environmental variables (Action 10), facilitating the ability to potentially relate probability of detection to both instream habitat and landscape attributes (Mackenzie et al. 2006, Albanese et al. 2007, Anderson et al. 2012). It is important to determine whether a reduction in observations of southern tessellated darters over time represents an actual population trend and not simply a decline in capture efficiency on a watershed scale (Hagler et al. 2011).

Action 10 Develop habitat suitability criteria for the southern tessellated darter.

Environmental and physical habitat information associated with locations occupied and unoccupied by southern tessellated darters must be collected to develop habitat suitability criteria and improve the accuracy of the occupancy models if such models are to be used. Habitat information will be collected at each 50-m site that will include stream width, canopy cover, bottom type, percent macrophyte coverage, percent structure, and water pH. In addition, 3 transects will be sampled across the stream at the beginning, middle, and end of each 50-m site to describe available habitat. Parameters will be recorded at 10 equally spaced increments beginning at the shore edge and will include: water depth, water velocity, bottom type, macrophyte coverage, and structure. Water velocity will be recorded at 60% of the water column depth when depths are < 1 m (< 3.3 ft), and recorded at 20% and 80% of the water column depth when depths are ≥ 1 m using a Marsh-McBirney™ Flo-mate 2000 velocity

Figure 3. FWC biologists and a University of Florida fisheries technician measure water velocity and depth along with stream width at Cedar Creek. FWC photograph.

meter. Locations where southern tessellated darters are collected will be defined as used habitat, and the same habitat parameters described above will be recorded. Habitat suitability criteria will be calculated using the available and used habitat data.

Action 11 Establish a database for rare and imperiled fish species.

Records of rare and imperiled fish species in Florida are currently maintained by several fish and wildlife regulatory agencies (e.g., FWC, U.S. Fish and Wildlife Service, U.S. Geological Survey [USGS]) and museums making it difficult to obtain complete capture records. Within FWC, several efforts to have been made to determine the status and trends of rare and imperiled fish species resulting in databases that are now obsolete or have not been updated to include new records. Concurrently, a contemporary fisheries database was developed in 2006 under the FWC Lake and River Monitoring Programs to store fish collection information and associated metadata. The primary use of this database has been for the storage of fish samples collected under the standardized sampling protocol. However, this database can also be used to store fish sample information that is collected by non-standard gears, study designs, and collection methods (e.g., kick seining, visual observations). Regardless of which direction is taken to store rare and imperiled fish information, a database must be established to contain comprehensive species-specific collection data that 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.

Rule and Permitting Intent

Action 12 Amend rule contained in Chapter 68A-27, F.A.C., to include southern tessellated darter as Threatened.

Based on the literature review, information received from the public, the BRG findings, and peer-reviewed input, FWC staff recommended the southern tessellated darter be retained on the list of state-designated Threatened species. As a Threatened species, the southern tessellated darter is protected under Rule 68A-27, F.A.C. (Rules Relating to Endangered or Threatened Species). Permit requirements for intentional take and incidental take as currently defined in Rule 68A-27.007(2), F.A.C. (Permits and Authorizations for the Take of Florida Endangered and Threatened Species) are applicable to the southern tessellated darter.

Action 13 Require that intentional take permits contain comprehensive site-specific collection data, including negative capture data, sampling staff, sampling protocol, environmental data (habitat and water quality characteristics, vegetation species and composition, flow conditions, stream characteristics, adjacent land use), and associated fish communities.

Action 14 Require that the FWC Regional Fisheries Administrator consult with the FWC Fish Taxa Coordinator prior to issuing intentional take permits and send the collection information described in Action 11 to the FWC Fish Taxa Coordinator following collection events.

Intentional take permits of fish are issued from FWC regional offices by the Regional Fisheries Administrator. Intentional take permits must be carefully reviewed by both Division of Freshwater Fisheries Management and the Fish Taxa Coordinator to ensure current populations of southern tessellated darters remain sustainable. If it is determined that the intentional take of southern tessellated darters will not cause irreversible harm to current populations of southern tessellated darters, then the capture information contained from collection efforts may be used to further our understanding of the distribution and trends within known populations, recolonization of historical locations or new locations, and habitat associations.

Incentives and Influencing

Influencing

Action 15 Offer conservation planning services to local governments during growth management plan development and amendments associated development proposals.

County growth management plans and land development regulations provide an avenue by which FWC can inform and influence land and water uses that are relevant to the conservation of southern tessellated darters. This action plan identifies areas known to harbor southern tessellated darters (Figure 1) and potential threats to their conservation which can be conveyed to local governments during county growth management plan development. In order to promote an understanding of technical assistance and incentives available to landowners, information can be provided to local governments regarding species management plans, permitting options, and incentive programs that are available to applicants, developers, landowners, and the general public.

FWC's Landowner Assistance Program (LAP) advances species conservation objectives through public–private conservation partnerships. These partnerships range from development of individual landowner conservation plans to multi-landowner conservation cooperatives organized to address species or habitat threats at a larger landscape level. Where possible, FWC's LAP efforts are focused on areas where public conservation investments occur in an effort to improve those efforts.

Incentive Programs

FWC currently takes advantage of several programs that promote conservation by providing technical and/or financial assistance to private landowners. 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 for wildlife conservation and habitat management on private lands. Florida also provides tax incentives including property tax exemptions for landowners that put a perpetual conservation easement on their land. These

incentives would allow any landowner interested in maintaining their current conservation or agricultural practices into the future to receive a break from property taxes for excluding additional development on their property. Additional incentives may include exemption from permits for activities that enhance wildlife activities such as mowing, roller-chopping, and tree stand thinning, as long as they are not a precursor to development.

Action 16 Investigate the potential for the development of a "watershed-based Habitat Conservation Plan (HCP)" for multiple aquatic species that are both state and federally listed in the basins containing the southern tessellated darters.

The HCP concept was originally developed as a required piece of the application for a federal Incidental Take Permit. Incidental Take Permits 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. Since it may not be practical to develop individual HCPs for many of the state listed fish species, FWC should consider the potential for the development of a "watershed-based HCP" for multiple aquatic species that are both state and federally listed in the Ocklawaha River Basin.

Action 17 Develop or support a conservation banking program for southern tessellated darters.

Conservation banking is 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 adverse development related impacts to wildlife resources, including habitats. These banks offer private landowners the opportunity to preserve, enhance, restore, and/or establish habitat for specified wildlife resources. In exchange for permanently preserving and managing the land, an administrative agency allots "credits" that may then be sold by the bank to developers or applicants needing to mitigate future development projects. With 63 state-listed species and ever increasing development pressures, conservation banking in Florida may provide a viable alternative to development by offering financial incentives to preserve private property.

Education and Outreach

Education and outreach are important components for the conservation and management of southern tessellated darters. Citizens who are well informed regarding the merits of an imperiled species and the habitat that supports such species can make better decisions and can support sound conservation measures to secure those species' continued survival. Both formal and informal settings can serve as opportunities to inform Floridians about the conservation of southern tessellated darters. Some outreach and education information about southern tessellated darters that can be presented to citizens and stakeholders are: their service as indicators of habitat condition, water quality, and water quantity; their specific needs for continued survival; and their unique characteristics and benefits to the ecology of a region.

Action 18 Develop outreach and education media and programs to inform stakeholders about the conservation of southern tessellated darters and associated threats.

Education can take the form of formal education through K-12 grade school. Modules can be developed to highlight scientific principles identified as required knowledge by the State of Florida, including modules for Project Wild. Southern tessellated darters can easily serve to demonstrate myriad biological, chemical, and physics principles. Education and outreach also can be secured by informal presentations to scouting, civic, environmental, and other organizations, as well as by displays at fairs and festivals throughout the state.

Outreach can include permanent signs and displays at state and municipal parks, or print and electric media as either handouts or web-presence. Outreach can also be conducted by FWC staff and officers whenever serving the public face-to-face. FWC's Community Relations Office can serve as the guiding unit for developing both education and outreach materials.

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 southern tessellated darters. FWC seeks to actively engage citizen stakeholders in furthering conservation in Florida. Educating them about the special needs, unique traits, and human benefits of protecting southern tessellated darters is a critical element of this process. Some specific actions that may be implemented are:

- Develop PowerPoint presentations suitable for staff to present or provide to scouting, civic, and environmental organizations which highlight the conservation of southern tessellated darters and threats to their habitat.
- Coordinate with agencies, counties, and municipalities across the state to encourage placement of signage at appropriate locales in state, county, and city parks to highlight the significance and needs of southern tessellated darters.
- Develop or expand the web-presence of southern tessellated darters on FWC’s website. Verify that FWC's Facebook pages, Wikipedia, FishBase, and other taxon databases have accurate, up-to-date details for southern tessellated darters in Florida.
- Develop and circulate print media releases highlighting the conservation needs of southern tessellated darters.

Law Enforcement

There are no southern tessellated darter-specific actions proposed in Law Enforcement at this time. As a state-listed Threatened species, the southern tessellated darter will be afforded protections from take, possession and sale under Rule 68A-27.003, F.A.C..

Coordination with Other Entities

There are several regulatory agencies in Florida from local to federal levels of government that manage the quality of aquatic habitats where southern tessellated darters are known to occur. DEP and SJRWMD monitor and, along with the U.S. Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers, regulate water quality or quantity to maintain healthy conditions for aquatic plants, fish, and wildlife.

Action 19 Coordinate annual reviews of water quality data with DEP from monitoring stations where populations of southern tessellated darters are known to occur.

DEP created the IWRM as a tiered program designed to answer questions about Florida's water quality at differing scales. Tier I monitoring consists of status monitoring and trend monitoring, which are both designed to answer state-wide to regional questions. Tier II monitoring consists of basin assessments and monitoring required for the development of total maximum daily loads (TMDL). The Status Monitoring Network monitors all basins in the state within a 5-year period with usually 5 to 6 basins sampled annually. Data from the Status Network also contribute to Florida's biannual Water Quality Assessment 305(b) Report to the EPA, a requirement of the Federal Clean Water Act. The surface water trend monitoring consists of 75 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 are placed at or close to a USGS 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. There are 2 surface water trend-monitoring sites in the lower Ocklawaha River watershed: Ocklawaha River at State Road 316 (292223081540601, DEP station identifier) and Orange Creek at State Road 21 Bridge (OR006, DEP station identifier). Based in part on these monitoring sites, DEP must develop TMDLs for waterbodies where one or more water quality 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 water quality standards that protect human health and aquatic life. Waterbodies that do not meet water quality 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. DEP provides information on the status and development of TMDLs through their website.

Action 20 Coordinate on the review of Environmental Resource Permits (ERP) Program and National Pollutant Discharge Elimination System (NPDES) permits with DEP and SJRWMD.

The ERPs regulate activities involving the alteration of surface water flows, and include new activities in uplands that generate stormwater runoff from upland construction, as well as dredging and filling in wetlands and other surface waters. The NPDES Program areas of regulation include municipal storm sewer systems, industrial stormwater and discharge, and stormwater construction activities. In addition to water quality considerations, one of the factors that must be considered under the ERP and NPDES programs are "Whether the activity will adversely affect the conservation of fish and wildlife, including endangered or threatened species, or their habitats" (see s. 373.414(1)(a), F.S.). FWC involvement in permitting associated with the Ocklawaha River basin will be important for protecting the southern tessellated darter's habitat.

Action 21 Develop criteria for preserving southern tessellated darter habitat on lands or waters slated for development.

Development of preservation criteria could form the basis of a permitting program or habitat acquisition program in the future. As additional information on southern tessellated darters is collected, coordination between FWC and local governments, other state agencies (i.e. DEP,

Department of Agriculture and Consumer Services, Florida Forest Service, Florida Department of Transportation, and SJRWMD), and federal agencies, will be important in developing habitat conservation and management guidelines. Funding sources for these programs will also need to be identified or developed, such as the Florida Forever program, conservation mitigation banks, or wetland mitigation banks for purchase and management of listed species' habitat, including public lands.

Types of criteria might include:

- Minimum acreages required to support sustainable populations of southern tessellated darters
- Buffer distances around southern tessellated darter habitat to avoid degradation
- Activities that cause permanent disturbance to the habitat of southern tessellated darters
- Compatible land uses in or near southern tessellated darter habitat
- Guidelines for habitat purchase or contribution to a fund for use in purchasing and managing lands for southern tessellated darter conservation

Action 22 Coordinate with local governments by adding questions to their land development applications that requests information on any listed species surveys that have been conducted on the property, or by inspecting parcels for the presences/absence of southern tessellated darters.

Local and municipal governments are required through their comprehensive plans to identify important state resources such as imperiled species and their habitats. Specific objectives, policies, and land use designations are required to address imperiled species and their habitats. These designations are implemented through the land development regulations and ordinances. Because local governments use the land development regulations or ordinances to govern development and expansion under their jurisdiction, coordination with FWC can streamline FWC's review and approval process. Requiring necessary listed species permits prior to issuing clearing or building permits or by notifying FWC staff that southern tessellated darters or its habitat have been identified onsite should expedite FWC's review and approval.

Action 23 Participate in site visits to lands that are in proximity to southern tessellated populations where development permits are being considered.

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, ERPs, Sector Plans, Developments of Regional Impacts, Master Planned Unit Developments, and Mitigation Banking Permits. Most state and WMD 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, 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, coordinate with other permitting agencies to reduce redundancy in recommended conditions, and help large developments plan to avoid habitat impacts. These early

meetings and coordination efforts would also give local governments and other agencies the opportunity to determine the presence or absence of southern tessellated darters.

By developing a simple survey protocol by which presence/absence of southern tessellated darters can be determined, or through knowledge of known locations (see Monitoring and Research section), FWC can assist local governments and the regulatory agencies in protecting habitat for southern tessellated darters (see Habitat Conservation and Management). If the presence of southern tessellated darters is determined, FWC can help the applicant avoid incidental take permitting by providing conservation measures such as appropriate site design, or providing mitigation options such as purchase of land or contribution to a trust fund for the conservation of this species. This may also a good opportunity to make the applicant aware of any FWC incidental take permits or authorizations.

Table 1. Southern Tessellated Darter (*Etheostoma olmstedi maculaticeps*) 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?
2	1	1	Designate all portions of the Ocklawaha River and all associated tributaries as Outstanding Florida Waters (OFWs).	Habitat Conservation & Mgmt	NEW	NO	NO	$0-25k	N/A	FFM, HSC	DEP	High	Feasible, but implementation is contingent on 6 requirements for OFW designation.	Yes. An OFW designation will protect waters occupied by southern tessellated darters from further deterioration.
2	1	2	Communicate known locations occupied by southern tessellated darters to the SJRWMD so that their habitats are considered in minimum flows and levels rule development.	Habitat Conservation & Mgmt	NEW	YES	YES	$0-25k	N/A	FWRI	SJRWMD	High	Feasible	Yes. Implementing instream flow standards that are protective of southern tessellated darter habitat is critical to the immediate survival of the species.
2	2	3	Establish water quality monitoring stations in the vicinity of known locations of southern tessellated darters.	Habitat Conservation & Mgmt	NEW	YES	YES	$0-25k	Unknown	FWRI	DEP, Florida Lakewatch	High	Feasible	Yes. water quality stations in the vicinity of known southern tessellated darter locations can provide a database by which the patterns and trends of low-order tributaries and distributaries are compared against high-order river segments.
2	3	4	Examine the current and projected land use in the areas where known populations of southern tessellated darters exist to identify potential threats to these locations.	Habitat Conservation & Mgmt	NEW	YES	YES	$0-25k	Unknown	FWRI	NA	High	Feasible	Yes. Identifying and predicting the impacts of imminent land use threats will facilitate proactive conservation measures.
2	3	5	Establish a 15-m (50-ft) minimum buffer from silviculture and land development in Orange Creek and Little Orange Creek.	Habitat Conservation & Mgmt	NEW	NO	NO	$0-25k	N/A	HSC	DOACS	High	Feasible	Yes. Forest cover appears to be a habitat trait that is associated with locations where southern tessellated darters are found.
1	4	6	Determine if transplanting or stocking southern tessellated darters is a viable or necessary option.	Population Mgmt	ONGOING	YES	YES	$0-25k	NGTF	FWRI	NA	Unknown	Unknown	TBD. It is currently unknown whether this action is critical to the immediate survival of the species and will be informed by Actions 7-10.
1	1	7	Collect and analyze tissue samples from southern tessellated darters to describe the genetic characteristics of populations or subpopulations.	Population Mgmt	ONGOING	YES	YES	$0-25k	NGTF	FWRI	UF, USGS	High	Feasible	Yes. Understanding the genetic uniqueness and diversity of Florida populations will provide insight into potential augmentation actions.
1	1	8	Develop and implement a sampling protocol to collect southern tessellated darters within its current distribution.	Monitoring & Research	ONGOING	YES	YES	$0-25k	NGTF	FWRI	USGS	High	Feasible	Yes. A sampling protocol designed specifically to capture southern tessellated darters is critical to implement Actions 2, 7, 9, and 10.
1	1	9	Confirm 5 prior locations, identify any new locations, calculate the extent of occurrence, and estimate the population size of southern tessellated darters.	Monitoring & Research	ONGOING	YES	YES	$0-25k	NGTF	FWRI	USGS	High	Feasible	Yes. Understanding the extent of occurrence and population size is critical to future management options and strategies.
1	1	10	Develop habitat suitability criteria for the southern tessellated darter.	Monitoring & Research	ONGOING	YES	YES	$0-25k	NGTF	FWRI	USGS	High	Feasible	Yes. Understanding the habitat affinity of southern tessellated darters is critical so that those habitats may be protected by the appropriate conservation strategies.

Table 1. Southern Tessellated Darter (*Etheostoma olmstedi maculaticeps*) 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	11	Establish a database for rare and imperiled fish species.	Monitoring & Research	EXPANDED	YES	YES	$0-25k	SGTF/NGTF	FWRI, FFM	NA	High	Feasible	Yes. Establishing a database is important to determine the current status and future trends of southern tessellated darter populations and their habitats.
1	1	12	Amend rule contained in Chapter 68A-27, F.A.C., to include southern tessellated darter as Threatened.	Protections & Permitting	NEW	YES	YES	$0-25k	N/A	FFM	NA	High	Feasible	Yes. Amending the rule will afford it protections under Rules Relating to Endangered or Threatened Species
1	3	13	Require that intentional take permits contain comprehensive, site-specific collection data, including negative capture data, sampling staff, sampling protocol, environmental data (habitat and water quality characteristics, vegetation species and composition, flow conditions, stream characteristics, adjacent land use), and associated fish communities.	Protections & Permitting	NEW	YES	YES	$0-25k	N/A	FFM	NA	High	Feasible	Yes. Requiring ancillary data with intentional take permits will provide data that will aid in our current knowledge.
1	3	14	Require that the FWC Regional Fisheries Administrator consult with the FWC Fish Taxa Coordinator prior to issuing intentional take permits and send the collection information described in Action 11 to the FWC Fish Taxa Coordinator following collection events.	Protections & Permitting	NEW	YES	YES	$0-25k	N/A	FFM, HSC	NA	High	Feasible	Yes. Requiring a communication loop will provide additional checks and balances, and ensure that the information obtained from intentional take permits is stored.
2	4	15	Offer conservation planning services to local governments during growth management plan development as well as during consideration of plan amendments and associated development proposals.	Incentives & Influencing	NEW	NO	YES	$0-25k	N/A	FWRI, FFM, HSC	Putman, Marion Counties	Moderate	Feasible, but requires relationships to be established with local governments.	Yes. Providing fish and wildlife expertise and incentives can aid in the immediate survival of the species.
2	4	16	Investigate the potential for the development of a "watershed-based Habitat Conservation Plan (HCP)" for multiple aquatic species that are both state and federally listed in the basins containing the southern tessellated darters.	Incentives & Influencing	NEW	YES	YES	$0-25k	N/A	HSC	NA	Moderate	TBD	Yes. Developing a HSP may ensure the effects of issuing incidental take permits are adequately minimized and/or mitigated.
2	4	17	Develop or support a conservation banking program for southern tessellated darters.	Incentives & Influencing	NEW	YES	YES	TBD	NGTF	HSC	NA	High	TBD	Yes. Conservation banking can permanently protect lands to offset adverse development related impacts to southern tessellated darters.
2	5	18	Develop outreach and education media and programs to inform stakeholders about the conservation of southern tessellated darters and associated threats.	Education & Outreach	NEW	YES	YES	TBD	NGTF	FWRI, OCR	NA	Moderate	Feasible	No. Developing outreach and education materials is not critical to the immediate survival of the species.
2	3	19	Coordinate annual reviews with DEP of water quality data from monitoring stations where populations of southern tessellated darters are known to occur.	Coordination with Other Entities	NEW	NO	YES	$0-25k	N/A	FWRI, HSC	DEP	Moderate	Feasible	Yes. Examining water quality data is important to identify immediate threats and monitoring trends.
2	3	20	Coordinate on the review of Environmental Resource Permits Program and National Pollutant Discharge Elimination System permits with DEP and SJRWMD.	Coordination with Other Entities	NEW	NO	YES	$0-25k	N/A	FWRI, HSC	DEP, SJRWMD	Moderate	Feasible	Yes. FWC's involvement in these programs is important in determining whether the permitted activity will adversely affect southern tessellated darters.

Table 1. Southern Tessellated Darter (*Etheostoma olmstedi maculaticeps*) 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?
2	3	21	Develop criteria for preserving southern tessellated darter habitat on lands or waters slated for development.	Coordination with Other Entities	NEW	YES	YES	$0-25k	N/A	FWC, HSC	Putman, Marion Counties	Unknown	Feasible, but information from Actions 3, 4, 5, 9, 10 is necessary to determine effectiveness.	Yes. Specific habitat preferences of southern tessellated darters will be critical to developing protective criteria that land managers may use for development projects.
2	5	22	Coordinate with local governments by adding questions to their land development applications that requests information on any listed species surveys that have been conducted on the property, or by inspecting parcels for the presences/absence of southern tessellated darters.	Coordination with Other Entities	NEW	NO	YES	$0-25k	N/A	FWC, HSC	Putman, Marion Counties	Moderate	Feasible, but requires relationships to be established with local governments.	Yes. Questions that pertain to listed species surveys or physical inspections is important in identifying imminent land development threats to habitats of southern tessellated darters.
2	5	23	Participate in site visits to lands that are in proximity to southern tessellated populations where development permits are being considered.	Coordination with Other Entities	NEW	NO	YES	$0-25k	N/A	FWC, HSC	Putman, Marion Counties	Moderate	Feasible, but requires relationships to be established with local governments.	Yes. Site visits are important to influence land development permits where possible.

Acronyms used in this table:

DEP:	Florida Department of Environmental Protection
DOACS:	Department of Agriculture and Consumer Services
FFM:	Freshwater Fisheries Management, a Division of the Florida Fish and Wildlife Conservation Commission
FWC:	Florida Fish and Wildlife Conservation Commission
FWRI:	Fish and Wildlife Research Institute, the research branch of the Florida Fish and Wildlife Conservation Commission
HSC:	Habitat and Species Conservation, a Division of the Florida Fish and Wildlife Conservation Commission
NA:	Not applicable
NGTF:	Non-Game Wildlife Trust Fund
OCR:	Florida Fish and Wildlife Conservation Commission's Office of Community Relations
OFW:	Outstanding Florida Water
SGTF:	State Game Trust Fund
SJRWMD:	St. Johns River Water Management District
TBD:	To be determined
UF:	University of Florida
USGS:	United States Geological Survey

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APPENDICES

Appendix 1. 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, 5, 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 and within- and among-population diversity and structuring of the remnant populations.

A donor population should be a natural population having a sufficient number 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.

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 southern tessellated darters 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 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 southern tessellated darters 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).

Re-introduction, 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/re-introduction plan that is approved by FWC 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/re-introduction 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
- Document 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/ re-introduction plan prior to relocating or releasing organisms in the wild.

Sites for augmentation/re-introduction 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, 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
- Document all activities conducted, all locations involved, number of juveniles released, and duration of release efforts
- Report all obstacles encountered during the research, propagation, and reintroduction efforts

Appendix 2. Study proposal to evaluate the distribution, occurrence, abundance, and genetics of the southern tessellated darter (*Etheostoma olmstedi maculaticeps*) in the Ocklawaha River Basin.

EVALUATION OF THE DISTRIBUTION, OCCURRENCE, ABUNDANCE, AND GENETICS OF THE SOUTHERN TESSELLATED DARTER (*Etheostoma olmstedi maculaticeps*) IN THE OCKLAWAHA RIVER BASIN

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Introduction

The tessellated darter *Etheostoma olmstedi* is a moderate sized darter regularly obtaining sizes of 60 mm SL (Gilbert 1992). It is typically tan or light brown in color, and has a series of 9 to 11 X- or W-shaped brown markings on the side. It ranges from Ontario, Canada, to Northern Florida and is considered as being common or abundant throughout most of its range (Page and Burr 2011). Gilbert (1992) states that within the range, it is normally found in small- and medium-sized streams with less than maximum flow and a variety of habitat types, including sand, mud, silt, and gravel bottoms. Henry and Grossman (2008) found them to selectively choose a variety of habitats (i.e., more sand, less bedrock, higher depths, faster velocities), but also found seasonal variation and change in their habitat use. Gray et al. (2005) saw shifts in their habitat use from deeper areas with faster flows and larger substrates where the banded darter *Etheostoma zonale* was absent, to shallower areas with slower flows and smaller substrates when the banded darter was present.

The southern tessellated darter *Etheostoma olmstedi maculaticeps*, one of three subspecies of *E. olmstedi*, is distinguished from the other subspecies by having two anal spines. It ranges from North Carolina to Northern Florida (Page and Burr 2011). In Northern Florida, it has only been collected from six general locations within the Ocklawaha River Basin, with the next closest known population separated by over 200 km at the Altamaha River Basin in Georgia (Gilbert 1992). The six collection locations in the Ocklawaha River Basin include: Davenport Landing, Orange Creek, Little Orange Creek, Eaton Creek and two collections on the Ocklawaha River proper between Gores Landing and Eureka (Figure 1). The first collections were made at Davenport Landing in 1948 and 1949 (McClane 1955; Florida Museum of Natural History, University of Florida, Catalog No. UF6973, UF6974, UF42083). However, follow-up attempts for collecting additional specimens at Davenport Landing in the 1970's and 1994 were unsuccessful (Gilbert 1992; Jordan 1994). The Little Orange Creek (Tulane University Museum of Natural History, Tulane University, Catalog No. TUMNH 102597) and two Ocklawaha River proper (UF 99850; FWC unpublished data) collections were only made once each in 1977 and 1995, respectively. At least two collections have been taken from Eaton Creek since 1976 (UF 23160; FWC unpublished data). Orange Creek is the only known location in Florida where the southern tessellated darter can be and has been regularly found (Gilbert 1992). Since 1975, there have been at least 14 collections made at Orange Creek near County Road 315 and State Road 21 (UF 20856, UF23153, UF23159, UF42082, UF47411, UF81243, UF90427, UF96177, UF96250; TUMNH102581; FWC unpublished data), with the most recent collection being taken as recently as March 2012.

The southern tessellated darter is listed by Florida as a State-designated Species of Special Concern (Florida Department of State 2010; Rule 68A-27.005). In 2010, the Florida Fish and Wildlife Conservation Commission (FWC) directed staff to reevaluate the biological status of all species designated as State-listed Threatened or Species of Special Concern (Florida Department of State 2010; Rule 68A-27.0012). A biological status review (BSR) of the southern tessellated darter was completed in March 2011 by a group of three experts from FWC, U. S. Fish and Wildlife Service, and U. S. Geological Survey (FFWCC 2011). The BSR resulted in the recommendation that the southern tessellated darter be listed as a State-listed Threatened species based on criteria of small geographic range, fragmentation of occurrence, and low population size. In response, a management plan* has been developed by FWC staff with the goal of improving the conservation status of the southern tessellated darter to the extent that it is secure within the historical range. Strategies suggested in the management plan to achieve this goal

**This sentence refers to the the Southern Tessellated Darter Species Action Plan (this plan).*

include increasing the current knowledge of the occurrence and abundance of the southern tessellated darter within its current distribution; identifying and describing habitat characteristics currently occupied by the southern tessellated darter; and transplanting or stocking new individuals in areas within the historic range.

Since 2006 and 2009, FWC has respectively sampled Rodman Reservoir and the Ocklawaha River proper annually with boat electrofishing at areas within the range where the southern tessellated darter is expected or has historically been found to occur. However, FWC has failed to collect an individual in these samples. Furthermore, historic targeted collections of the southern tessellated darter have generally been made in the same areas at easily accessible locations (i.e., bridges, roadways, etc.); while other collections have often been incidental findings during the process of sampling for other goal oriented projects. We propose to initiate a southern tessellated darter sampling project designed to address the strategies suggested in the southern tessellated darter management plan. The objectives of this study are to (1) better describe the distribution, occurrence, and abundance of the southern tessellated darter in the Ocklawaha River Basin, (2) identify and describe habitat where the species occurs within the range of the Florida population, and (3) analyze differences in genetics between southern tessellated darters within the same stream, in separate streams, and differences between the Florida population and next closest population in the Altamaha River, Georgia. The product of this study will increase our current knowledge of the Florida population of the southern tessellated darter and aid with the management goal of improving the conservation status of the species to the extent that it is secure within its historic range.

Methods

Tributaries and side branches of the Ocklawaha River, from the Silver River confluence to the St. Johns River, will be split into 50-m segments using GIS mapping technology to provide a population of possible transects from which random samples can be taken to better describe the southern tessellated darter's occurrence and distribution in the Ocklawaha River Basin. A total of 30 to 40 transects will be randomly chosen using a stratified random design, where strata will be defined as the various tributaries and side branches, causing the sampling effort to be spread out in the various watersheds throughout the basin. There will be additional locations randomly chosen for each strata, which will be used as replacement samples in case the original chosen sites are not accessible or able to be sampled. At each site in Fall 2011, 50 meters will be marked off and sampled using one of two methods.

1. At wadeable sites, we will sample by "kick-seining" using small-mesh seines along with back-pack electrofishing equipment. Kick-seining will consist of the seine being held by two individuals, while another individual carrying a back-pack shocker and another one or two individuals approach the seine from upstream, thrashing and kicking the water towards the seine as electrical current is applied. Each kick-seine will cover an area measuring approximately 3-m wide × 4-m long. Therefore, the number of kick-seines required to sample each site will vary by stream width. Kick-seines will be collected by beginning at the downstream extent of each 50-m site, and sampling from one bank to the other moving upstream until the upstream extent of the 50-m site is reached.
2. At non-wadeable sites with high water clarity, we will use snorkeling to visually survey random transects as recommended by Jordan et al. (2008). Snorkeling events

will consist of two to three divers moving parallel to one another in an upstream direction with the attempt to visually survey the majority of the area within the 50-m transect. The number of divers used will depend on the width of the stream. There will be an attempt to collect all southern tessellated darters observed in visual surveys using plastic nets described in Jordan et al. (2008).

All fish species collected or observed at each site will be recorded. Darters (i.e., *Percina* spp. and *Etheostoma* spp.) will be identified and tallied by species. Caudal fin clips will be taken from southern tessellated darters for genetic samples. Mortality of southern tessellated darters due to caudal fins clips is expected to be minimal, where Champagne et al. (2008) found that no mortality occurred and fins almost completely regenerated within two months in a laboratory study when brown darters *Etheostoma edwini* had caudal fins clipped.

Habitat data will be collected at each 50-m site. General site descriptions will be recorded including stream width, canopy cover, bottom type, percent macrophyte coverage, percent structure, and water pH. In addition, two transects will be sampled across the stream at the beginning and end of each 50-m site to identify available habitat. Parameters will be recorded at 2-m increments starting at the shore edge and will include: water depth, water velocity, bottom type, macrophyte coverage, and structure. Water velocity will be recorded at 60% of the water column depth when depths are < 1 m, and recorded at 20% and 80% of the water column depth when depths are ≥ 1 m using a Marsh-McBirney™ Flo-mate 2000 velocity meter. Collection locations within each site where southern tessellated darter are collected will be defined as used habitat and have the following parameters recorded: water depth, water velocity, bottom type, macrophyte coverage, and structure. Habitat associations will be calculated using the available and used habitat data.

The random site samples will be used to try and better describe the southern tessellated darters occurrence and distribution in the Ocklawaha River Basin. However, there will also be an option to selectively sample sites that are typical or thought to be typical of locations where they may occur. In addition, we will attempt to visit and resample all past collection locations using methods described above when applicable. If past collection sites are not able to be sampled using the previously described methods, other sampling methods (e.g., boat electrofishing, seining, etc.) will be used.

Areas with sites where the southern tessellated darter is collected will be revisited and sampled to obtain abundance estimates. Abundance estimates will be made using multiple pass depletion methods by first blocking off 50-m stretches of the stream in the area where southern tessellated darters were collected, and then kick-seining wadeable streams or using visual surveys in non-wadeable streams similar to Jordan et al. (2008). Estimates of abundance will be made using individual pass collections described by Dorazio et al. (2005). Southern tessellated darters collected in depletion samples will have caudal fins clipped for use in genetic analysis. Habitat measurements (i.e., used and available) of the depletion sites will be made similar to the random site samples.

Fin clips of southern tessellated darters collected in the Ocklawaha River Basin will be used for genetic analysis to describe differences between individuals within a stream and differences between sub-populations between streams. We will attempt to obtain genetic samples of southern tessellated darters that occur in the Altamaha River, Georgia, to compare genetics between the Florida and Georgia populations and evaluate the impacts of potentially using

Georgia obtained darters to supplement the Ocklawaha River population if necessary for the conservation status of the species.

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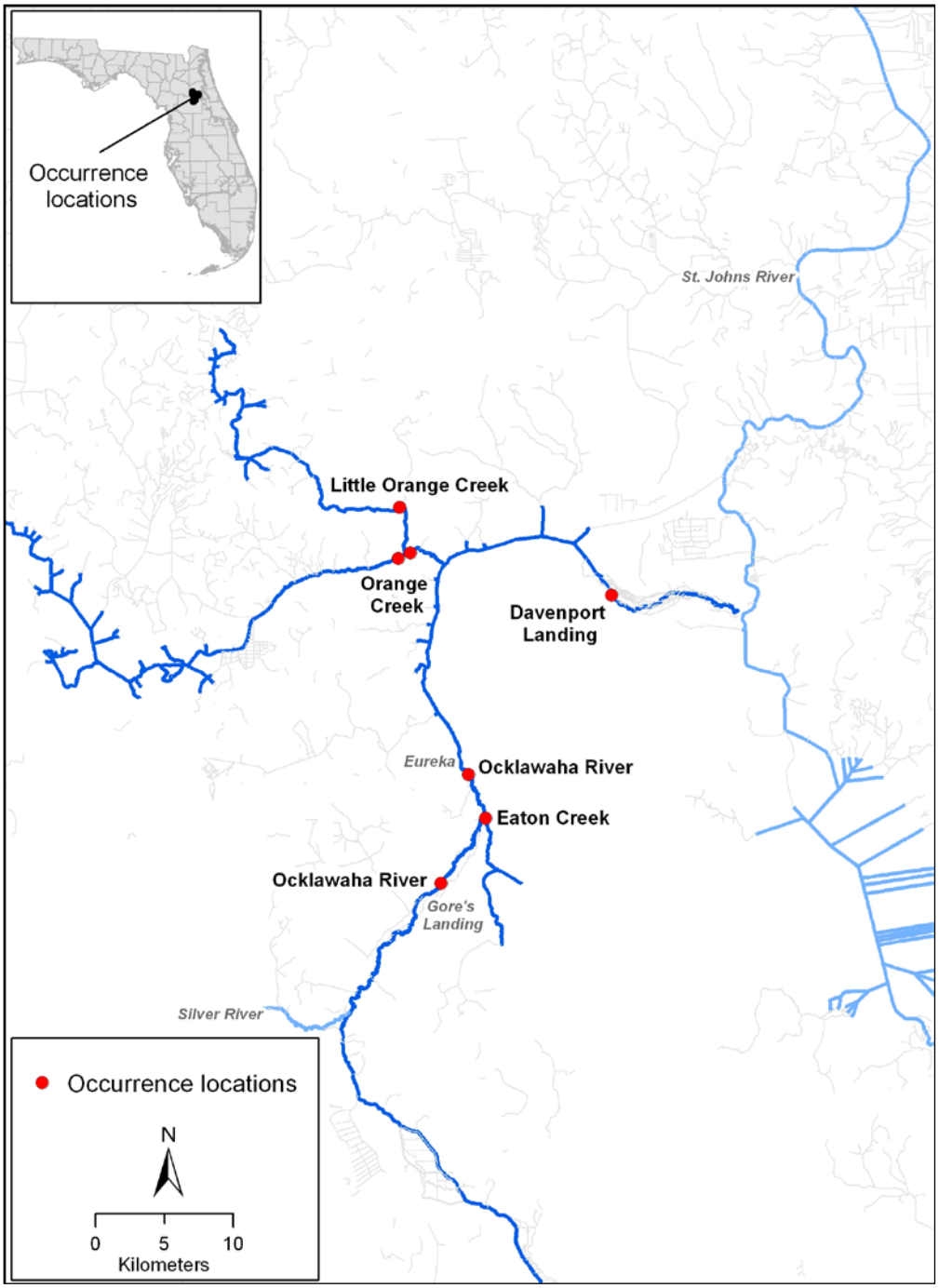

Figure 1. Collection locations of the southern tessellated darter in the Ocklawaha River Basin.