

Draft Post-Delisting Monitoring Plan
for the
Okaloosa Darter
(*Etheostoma okaloosae*)



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October 2021

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Acknowledgements: The Draft Post-delisting Monitoring Plan for the Okaloosa darter was prepared by Bill Tate, Supervisory Fish Biologist of the U.S. Fish and Wildlife Service, Florida Air Force Partnership at Eglin Air Force Base. We wish to acknowledge assistance that we received in preparing this plan from the Eglin Air Force Base Natural Resources Office (Bruce Hagedorn, Justin Johnson, and Rodney Felix), US Geological Survey (Howard Jelks), and Loyola University New Orleans (Dr. Frank Jordan).

Recommended Citation

U.S. Fish and Wildlife Service. 2021. Draft post-delisting monitoring plan for the Okaloosa Darter (*Etheostoma okaloosae*). U.S. Fish and Wildlife Service, Florida Air Force Partnership, Niceville, Florida, pp.

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I. Introduction

Section 4(g) of the Endangered Species Act of 1973, as amended (Act; 16 U.S.C. 1531 *et seq*) requires the U.S. Fish and Wildlife Service (USFWS) to implement a system in cooperation with the States to monitor for not less than 5 years the status of all species that have recovered and been removed from the Federal List of Endangered and Threatened Wildlife (List). Section 4(g)(2) of the Act directs the USFWS to make prompt use of its emergency listing authorities under section 4(b)(7) of the Act to prevent a significant risk to the well-being of any recovered species. While not specifically mentioned in section 4(g), authorities to list species following the process prescribed in sections 4(b)(5) and 4(b)(6) may also be used to reinstate species on the List, if warranted. Post-delisting monitoring (PDM) refers to activities undertaken to verify that a species delisted due to recovery remains secure from risk of extinction after the protections of the Act no longer apply. The primary goal of PDM is to monitor the delisted species to ensure the status does not deteriorate, and if a substantial decline in the species (numbers of individuals or populations) or an increase in threats is detected, to take measures to halt the decline so that re-proposing it as an endangered or threatened species is not necessary.

II. Brief summary of the roles of all cooperators in the PDM planning effort

The Okaloosa darter's (*Etheostoma okaloosae*) current range primarily falls on Eglin Air Force Base (Eglin). Therefore, the USFWS prepared this draft PDM plan in coordination with Eglin, based largely on monitoring methods developed by the U.S. Geological Survey (USGS) and Loyola University New Orleans (Loyola). The USFWS designed the PDM plan to detect substantial changes in habitat occupied by Okaloosa darter and declines in Okaloosa darter occurrences with reasonable certainty and precision. This plan meets the minimum requirement set forth by the Act because it monitors the status of Okaloosa darter using a structured sampling regime over a 5-year period.

Section 4(g)(1) of the Act requires the USFWS to implement a system, in cooperation with the States, to monitor for no fewer than 5 years the status of all species that have recovered and been removed from the Lists of Threatened and Endangered Wildlife and Plants (50 CFR 17.11 and 17.12). Section 4(g) of the Act explicitly requires cooperation with the States in development and implementation of post-delisting monitoring programs. The USFWS remains responsible for compliance with section 4(g) and therefore, must remain actively engaged in all phases of the monitoring program. The USFWS seeks active participation of other entities expected to assume responsibilities for the species' conservation after delisting or have natural resources management mandates. In keeping with that mandate, the USFWS developed this monitoring plan in cooperation with Eglin, USGS, and Loyola.

A. U.S. Fish and Wildlife Service

The mission of the USFWS is working with others to conserve, protect, manage, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The USFWS implements the provisions of the ESA. The Panama City

Fish and Wildlife Conservation Office, Florida Ecological Services Field Office, and regional Ecological Services program have helped coordinate protection and recovery of Okaloosa darter under the ESA since the species' listing under the Act.

In 1995, the USFWS partnered with the Air Force to establish the Eglin sub-office embedded with the Eglin Natural Resources Office. The primary mission of the Eglin sub-office is to conduct strategic natural resource conservation programs, designed to collect informative data, test and evaluate methods, provide decision support, and enhance the conservation of the natural landscape while maintaining the highest level of capability and flexibility to the military testing and training mission. The Eglin partnership began as the Eglin Aquatic Monitoring Program, focused on monitoring and recovery of the then endangered Okaloosa darter as well as establishing a baseline aquatic monitoring program for the installation. In the 25 years since, the program has expanded to include work on a wide range of species including Gulf of Mexico sturgeon (*Acipenser oxyrinchus desotoi*), freshwater mussels (Family Unionidae), red-cockaded woodpecker (*Leuconotopicus borealis*), reticulated flatwoods salamander (*Ambystoma bishopi*), gopher tortoise (*Gopherus polyphemus*), shorebirds, and sea turtles, as well as habitat restoration programs for aquatic and terrestrial ecosystems. The recovery lead for the Okaloosa darter works full time in the Eglin sub-office and will be the lead for implementation of the PDM.

U.S. Fish and Wildlife Service Roles:

- Prepare a draft PDM plan.
- Incorporate peer review comments on the draft PDM plan from scientific experts and cooperators into the plan.
- Prepare and distribute the draft PDM plan for public comment.
- Consider all comments on the draft PDM plan and produce the final PDM plan.
- Distribute the final PDM plan to all cooperators.
- Determine restoration actions, coordinate monitoring, and estimate budget requirements for PDM implementation.
- Coordinate PDM actions with Eglin and continue to provide input on military mission impacts, restoration actions, and conservation planning.
- Implement the PDM through monitoring, research activities, or restoration actions conducted by USFWS or cooperators.
- Coordinate and convene an annual meeting, and other meetings as necessary, to discuss monitoring results and management activities.

The USFWS's sub-office at Eglin is the USFWS's lead for this monitoring effort and will be responsible, with the cooperation and assistance of the Eglin, USGS, and Loyola, to ensure accomplishment of the monitoring requirements outlined in this PDM plan, including the final report.

B. Eglin Air Force Base.

As the largest forested military reservation in the United States, Eglin supports a multitude of military testing and training operations, as well as many diverse species and habitats. The Eglin Natural Resources Office (NRO) coordinates with the Service to develop and update the Integrated Natural Resources Management Plan (INRMP; U.S. Air Force [USAF] 2019a) and its component plans (USAF 2019a-e), which provide interdisciplinary strategic guidance for the management of natural resources in support of the military mission within the land and water ranges of the Eglin Military Complex. The Eglin INRMP integrates and prioritizes wildlife, fire, and forest management activities to protect and effectively manage the Complex's aquatic and terrestrial environments and ensure "no net loss" in the operational capability of these resources to support Eglin test and training missions. The Eglin NRO has long been recognized as a leader in the Department of Defense (DoD) for its progressive and proactive approach to balancing mission activities with management of Eglin's natural resources.

Eglin Air Force Base Roles:

- Support the preparation and implementation of the PDM.
- Continue to include the Okaloosa darter in decision support tools during future range planning.
- Incorporate enhanced Best Management Practices into real estate agreements, construction projects, and other changes to base infrastructure to prevent future impacts to Okaloosa darter streams.
- Continue to actively manage stream and upland habitat in Okaloosa darter watersheds to promote high functioning ecosystems, as outlined in the Integrated Natural Resources Management Plan (INRMP; USAF 2019a).
- Continue to include monitoring for Okaloosa darter and stream habitat in the INRMP.
- Continue to coordinate management actions or land use change with the USFWS through annual INRMP updates, coordination meetings, and other means.

C. US Geological Survey and Loyola University New Orleans:

The USGS serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. The USGS mission is to monitor, analyze, and predict current and evolving dynamics of complex human and natural Earth-system interactions and to deliver actionable intelligence at scales and timeframes relevant to decision makers.

Loyola Department of Biological Sciences is dedicated to providing students with an integrated and contemporary education that instills in students a deeper understanding of the process of science and the fundamentals of biology. In particular, the department focuses on the study the ecology of freshwater and estuarine systems, with special emphasis on the biology, management, and conservation of fishes. Academic expertise is

essential when developing and evaluating new methods for monitoring and modeling population dynamics of aquatic organisms.

USGS and Loyola Roles:

- Assist with preparation of the PDM.
- Continue long-term monitoring for Okaloosa darter.
- Implement targeted research to address management or population questions.
- Participate in annual meetings and planning efforts.

III. Summary of the Species' Status at Time of Delisting



Figure 1. Okaloosa darter range within Eglin AFB.

The Okaloosa darter is a small fish varying in coloration from red-brown to green-yellow dorsally, and lighter ventrally (cover photo). The entire global population of this species is found in six tributaries to Rocky and Boggy Bayous of Choctawhatchee Bay in the Florida panhandle (Figure 1). These seepage streams have persistent discharge of clear, sand-filtered water through sandy channels, woody debris, and vegetation beds. Approximately 98% of all Okaloosa darters are within the Eglin boundaries (Figure 1). The remaining portions of the watershed are within the urban areas of Niceville and Valparaiso, FL.

Listing history:

- Initially listed as Endangered – June 1973 (38 FR 14678)
- Recovery Plan approved – April 1981
- Recovery Plan revised – 1998 (USFWS 1998)
- 5-Year Status Review – 2007 (USFWS 2007)
- Reclassified to Threatened – April 2011 (76 FR 18087)
- Species Status Assessment – June 2019 (USFWS 2019)

Primary threats to the Okaloosa darter are hydrologic alteration, siltation, and temperature alteration from beaver dams, Eglin range-roads and test ranges, culverts, and urbanized areas. Management for the Okaloosa darter has focused on efforts to minimize erosion in darter watersheds and to restore hydrology in altered stream reaches through road crossing replacements and fish passage barrier removals. Spanning over 20 years, Eglin's erosion

control program led the way for recovery by eliminating approximately 75,000 tons of sediment per year entering Okaloosa darter streams. Eglin and the USFWS have also partnered with other federal, state, non-governmental organization (NGO), and private partners to complete a variety of stream restoration projects (Figure 2). Successful elimination of threats to the Okaloosa darter and its habitat allowed the Okaloosa darter to be reclassified from Endangered to Threatened in 2011. Long-term monitoring, targeted research, and continued stream and habitat restoration provided the basis for scenario modelling during the Species Status Assessment (USFWS 2019) which suggested the species will maintain a stable conservation status even under the most pessimistic management scenarios.

A thorough review of the taxonomy, life history, ecology, and overall viability of the Okaloosa darter and threats to the species is presented in the SSA (USFWS 2019; available at <https://ecos.fws.gov/ecp/species/914>). Summary information for perspective on the PDM are found in sections A and B below.



Figure 2. The phases of stream restoration in an Okaloosa darter stream through the Eglin golf course. From left: prior to restoration, pond drained and muck removed, floodplain established, stream channel created. Okaloosa darters naturally colonized this project within six months of completion.

A. Demographic Parameters

The Okaloosa darter is a small (maximum size 49 millimeters (mm), 1.93 inches (in) Standard Length) percid fish with a well-developed humeral spot, a series of five to eight rows of small spots along the sides of the body, and a first anal spine longer than the second. General body coloration varies from red-brown to green-yellow dorsally, and lighter ventrally, although breeding males have a bright orange submarginal stripe on the first dorsal fin (Burkhead et al. 1992). It is a member of Order Perciformes, Family Percidae. It is a distinct species within the genus *Etheostoma* (Burkhead et al. 1992), although it remains uncertain as to which subgenus this species belongs (e.g., Song et al. 1998; Smith et al. 2014).

The Okaloosa darter is a narrow endemic, known to occur in only six clear stream systems that drain into three Choctawhatchee Bay bayous (Toms, Boggy, and Rocky) in northwest Florida. Okaloosa darters are currently found in the tributaries and the main channels of the following six streams in Walton and Okaloosa counties: Toms, Turkey, Mill, Swift, Deer Moss (formerly known as East Turkey or Turkey Bolton), and Rocky

creeks. Approximately 90 percent of the 457 square kilometer (176 square mile) watershed drainage area that historically supported the Okaloosa darter is federal property under the management of Eglin, encompassing the headwaters of all six Okaloosa darter drainages. The remaining ten percent of these streams flow out of Eglin into the urban complex of the cities of Niceville and Valparaiso (USAF 2019a) before discharging into Choctawhatchee Bay.

The Okaloosa darter's breeding season extends from late March through October, and usually peaks in April. Spawning pairs have been videographed attaching one or two eggs to vegetation and observed attaching eggs to woody debris and root mats (Collete and Yerger 1962; Burkhead et al. 1994); however, little is known about larval development (Burkhead et al. 1992). Okaloosa darters were videographed spawning in the morning hours (Burkhead et al. 1992), although courtship displays have also been observed late in the afternoon (Jelks 2018, pers. comm.). During courtship, a male will follow a single female and fertilize eggs as she deposits them singly among vegetation, roots, or woody detritus. Males will spawn with several females. As with most darters, fecundity is low (Burkhead et al. 1992). Ogilvie (1980) found a mean of 76 total ova (eggs) and 29 mature ova in 201 female Okaloosa darters, although these numbers may under-represent annual fecundity as their prolonged spawning season is an indication of fractional spawning (i.e., eggs develop and mature throughout the spawning season) (76 FR 18088).

Longleaf pine-wiregrass-red oak sandhill (*Pinus palustris*-*Aristida stricta*-*Quercus rubra*) communities dominate the vegetation landscape in Okaloosa darter watersheds. These areas are characterized by high sand ridges where soil nutrients are low and woodland fire is a regular occurrence. Where water seeps from these hills, acid bog communities develop, consisting of sphagnum moss (*Sphagnum* sp.), pitcher plants (*Sarracenia* sp.), and other plants adapted to low nutrient soils. In other areas, the water emerges from seepage springs directly into clear flowing streams where variation of both temperature and flow is moderated by the deep layers of sand. The streams support a mixture of bog moss (*Mayaca fluviatilis*), bulrush (*Schoenoplectus etuberculatus*), golden club (*Orontium aquaticum*), burrweed (*Sparganium americanum*), pondweed (*Potamogeton diversifolius*), spikerush (*Eleocharis* sp.), and other aquatic and emergent plants. Okaloosa darters typically inhabit the margins of moderate- to fast-flowing streams where detritus (organic matter, including leaves, twigs, and sticks), root mats, and vegetation are present (Burkhead et al. 1992; USFWS 2011). They are rarely collected in areas where there is no current or in open sandy areas in the middle of the stream channel. Creeks with Okaloosa darter have temperatures ranging from 7 to 22 degrees Celsius (°C) (44 to 72 degrees Fahrenheit (°F)) in the winter to 22 to 29 °C (72 to 84 °F) in the summer (Mettee and Crittenden 1977; Jelks 2018, pers. comm.). Overhead canopies range from open to fully closed depending on stream width and fire history (Jordan 2018, pers. comm.). Recent research (Ingram 2018) indicates that Okaloosa darters thrive in reaches with relatively open canopies, likely due to either increased abundance of submerged vegetation that is used preferentially for spawning or increased secondary production of insect prey.

Abundance of Okaloosa darter has been quantified by visual census at multiple sites annually since 1995. Densities in 1995 averaged $1.2 (\pm 0.8; \pm 1 \text{ standard deviation})$ Okaloosa darter per meter (3.28 feet) of stream length. Average density peaked at 5.0 ± 3.6 in 2005 due to unusually high numbers of recruits and has since declined to 2.9 ± 2.1 in 2017 (Jordan and Jelks 2020). Between the start of the study in 1995 and 2013, sampling locations in streams that drain into Boggy Bayou (including Toms Bayou) supported significantly more Okaloosa darter than streams that drain into Rocky Bayou; however, this difference has declined since 2013 and they now appear to support similar numbers (Figure 3) (Jordan and Jelks 2020). A range-wide survey was conducted in 2005, estimating the species' population size at 822,500 (95% Confidence Interval 662,916 to 1,058,009). Analyses of a repeat range-wide survey in 2014 and 2020 indicated that overall abundance declined by about 24% from 2005 to 2014 and then again declined from 2014 to 2020 (Jordan and Jelks 2020). The survey in 2005 was an unusually good year for Okaloosa darter; however continued declines from 2014 to 2020 remain unresolved. Recent research suggests that increased riparian canopy cover may be responsible for local declines at these sites (Jordan and Jelks 2020).

B. Residual Threats

Primary threats to the Okaloosa darter are hydrologic alteration, siltation, and temperature alteration from beaver dams, Eglin range-roads and test ranges, culverts, and urbanized areas. Management for the Okaloosa darter has focused on efforts to minimize erosion in darter watersheds and to restore hydrology in altered stream reaches through road crossing replacements and fish passage barrier removals. Spanning over 20 years, Eglin's erosion control program led the way for recovery by eliminating approximately 75,000 tons of sediment per year entering Okaloosa darter streams. Eglin and the USFWS have also partnered with other federal, state, NGO, and private partners to complete a variety of stream restoration projects (Figure 2).

About 90 percent of the 51,397 hectares (127,000 acres) that represent the drainage basins of darter streams are managed by the Eglin NRO. Eglin will continue to include management for the Okaloosa darter in the INRMP, changes to which are reviewed and approved by both the USFWS and the Florida Fish and Wildlife Conservation Commission (FFWCC) as specified under the Sikes Act. At the time of this writing, Eglin has no plans to remove management from the INRMP or limit management within Okaloosa darter watersheds. In fact, Eglin is working with the USFWS to shift prescribed fire management in an effort to reduce canopy cover in Okaloosa darter streams to further bolster darter numbers and stabilize monitoring sites. Additionally, Eglin has placed protective buffers on Okaloosa darter streams into GIS decision support tools for Eglin range planners to prevent land use changes and management actions that might adversely affect Okaloosa darters or their habitat, thus protecting 90% of the darter's watershed area from impacts (USAF 2019a).

Outside the Eglin boundary, the remaining 485.6 hectares (12,000 acres) are situated in the Niceville-Valparaiso urban complex. Okaloosa darters are found at reduced levels or

absent from much of this area. Current stream impacts include erosion, non-point discharge of nutrients and pollutants, impoundment, alteration of flow, and culverting. Within these private lands, conservation agreements and habitat buffering prevent adverse impacts to an additional 3-4% of the potential range (Ruckel Properties 2011). In total, 90-95% of the watershed area has established protections and monitoring will ensure these streams continue to be protected.

The introduction and colonization by non-native invasive species that could compete with or predate on the Okaloosa darter is a realistic threat. The Okaloosa darter recovery plan lists competitive exclusion by the then thought to be invasive brown darter (*Etheostoma edwini*) to be a threat to the Okaloosa darter. Genetic analysis coupled with long-term monitoring show that the brown darter is native to Okaloosa darter watersheds (J. Austin, unpublished data) and not altering the distribution or abundance of Okaloosa darters where they coexist (Jordan and Jelks 2020). Flathead catfish (*Pylodictus olivaris*) are already present in the surrounding river systems and conditions could become suitable for several cichlid species to successfully reproduce in Okaloosa darter habitat (Jelks 2018, pers. comm.). Tilapia (*Oreochromis niloticus*), for instance, are highly invasive and are well documented to cause local extinctions of native species through resource competition, predation, and habitat alteration (Zambrano et al. 2006). Release of aquarium species also remains a possibility. While this threat is speculative and dependent on an intentional release of an unknown invasive species, introduction of a highly competitive predator could lead to severe population depression or potential extirpation of Okaloosa darters. Dispersal of an invasive species among Okaloosa darter watersheds, however, would likely be limited by saltwater giving managers time to take control measures within a single population. Eglin AFB and the Service have long established invasive species monitoring programs and both agencies are committed to routine monitoring, early detection, and control of aquatic invasive species. Early detection and targeted management of invasive species will minimize or eliminate this threat to the Okaloosa darter in the future.

C. Legal and/or Management Commitments for Post-delisting Conservation

The USFWS will continue to coordinate with Eglin, Florida Department of Environmental Protection (FDEP), FFWCC, municipal entities, and private stakeholders to ensure appropriate habitat management, construction actions, and stormwater best management practices are implemented for development projects in the watershed. Water quality and biological data are routinely collected and analyzed by the regulatory agencies to ensure that water quality standards are met and that no biological impairments are occurring. Once de-listed, FFWCC may consider the Okaloosa darter for state listing, thus continuing protections under the state's endangered species permitting system. FDEP has recently assumed regulatory authority for actions within Florida involving the Clean Water Act (CWA). As such, permits for actions in Okaloosa darter watersheds will be the primary responsibility of FDEP. The USFWS will work with

FFWCC and FDEP to minimize future negative actions within Okaloosa darter watersheds.

Adherence to the Sikes Act will ensure close coordination between Eglin and the USFWS on management actions. Because changes to the INRMP must be approved by the USFWS and FFWCC, removal of monitoring or management for the Okaloosa darter will receive attention and concurrence from the two agencies. At the time of this writing, Eglin has no plans to remove management for the Okaloosa darter from the INRMP or other decision support tools. The USFWS will also engage USGS, Loyola, or NGOs to encourage proposal development and implementation of conservation projects as needed.

IV. Monitoring Methods, Including Sampling Considerations

A. Procedures for Selecting and Locating Samples

Monitoring for the Okaloosa darter has been conducted annually at 21 core sites distributed throughout the range since 1995 (Figure 3). The core sites were selected during the 1998 revision to the Okaloosa darter recovery plan to represent the complete range of the species, including each of the six watersheds as well as the major tributary systems. Expanded monitoring of an additional 39 sites was conducted in 2005, 2014, and 2020 to estimate the population size and inform the 5-year status reviews, Species Status Assessment, and the proposed de-listing rule (Figure 3). The expanded monitoring surveys provided complete coverage of the species range, occupied or not by Okaloosa darters. Additional monitoring has been conducted to support specific research projects and ESA Section 7 consultations.

The 21 core sites will be surveyed for Okaloosa darters and habitat conditions in years 2 and 4 post-delisting, and in year 5 as part of the expanded monitoring effort. We have selected 45 additional sites for inclusion in the expanded monitoring programs to be conducted in year 5 post-delisting (Figure 3). Monitoring the core sites track trends for the species while the expanded monitoring data will be used to calculate the population estimates used to assess resiliency of the species. Habitat, water quality, and stream discharge will be quantified at all Okaloosa darter sampling sites. Macro-invertebrate samples will be made at a representative subset of these sites each year.

Post-Delisting Okaloosa Darter Sampling

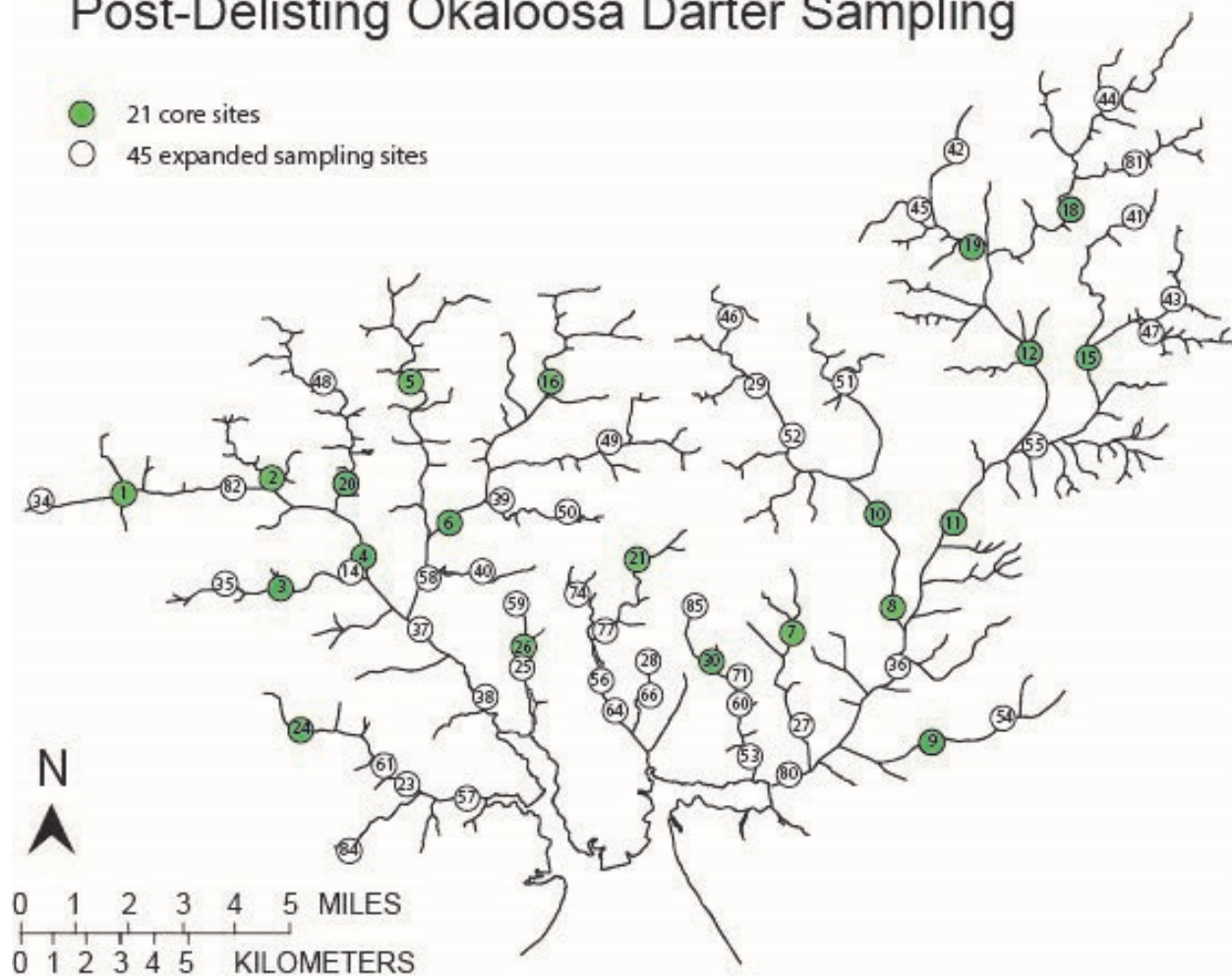


Figure 3. Post-delisting sampling sites throughout the range of the species, including 21 core sites (solid green circles) and 45 expanded sampling sites (hollow circles).

B. Field measurement and data recording procedures

1. Species-Level Monitoring

An impressive geochronology database has been assembled for Okaloosa darters (Burkhead et al., 1994), but these data were obtained sporadically, using different sampling methods and levels of effort. Although these data provide insight into various aspects of the biology of Okaloosa darters, there remains a need for analysis of spatial and temporal variability in the size of Okaloosa darter populations. A long-term monitoring program for the Okaloosa darter was initiated in the spring of 1995 in order to meet this need.

The current survey method for Okaloosa darters include visual surveys (i.e., snorkel surveys) within a 20-meter reach at each of 21 core monitoring sites. Surveys are conducted during the late summer and involve two divers working on opposite banks of the creek channel. Two divers move upstream along the banks, carefully examining root mats, vegetation, and other forms of cover within a 20-meter stream reach. When spotted, Okaloosa darters are collected with plastic nets and transferred to holding tanks. In order to estimate detection probability for observation of Okaloosa darters, divers repeat this search for a total of three removal passes in a randomized subset of reaches. All fish captured are released into the sampling reach upon completion of the survey. Additional details on survey methods are available in Jordan et al. (2008). For analysis, Okaloosa darter numbers are totaled for each 20-meter reach, corrected for detection probability, and then standardized to darters per meter for each monitoring site following detailed methods described in Jordan et al. (2008). This method will continue as the main species-level monitoring of this plan. Any deviation to the standard protocol will be approved by all cooperators.

2. Habitat-Level Monitoring

In association with each species-level monitoring event, habitat data are collected at each of the Okaloosa darter monitoring sites. Habitat and discharge data are collected at each site, as detailed in Jordan and Jelks (2020). At each 20-meter monitoring site, two cross sectional transects are established at 5 and 15 meters within the sample reach and the following parameters are measured at intervals within each transect: water depth, substrate type, and canopy cover. Canopy cover and stream bottom substrata are measured with a 0.25-m² (2.7-ft²) quadrant that is subdivided into 25 10-cm² (1.6-in²) grid cells. For each transect, the number of grid cells is totaled for each substrate type and divided by the total grid cells for that transect to calculate the percent substrate type. Percent substrate for the sampling reach is calculated by averaging the two transect scores. Total stream discharge is measured at a minimally turbulent stream transect at each site, typically the same location each year but not necessarily within the darter sampling reach. The discharge transect is divided into equal twentieths and midwater (60 percent of depth) flow is measured at each interval. Discharge is then calculated by multiplying the area of water in a channel cross section by the average velocity of the water in that cross section.

Eglin has partnered with the USFWS to actively monitor stream ecosystem health across the military installation (USAF 2019c). The USFWS personnel will continue to utilize the Rapid Bioassessment Protocols employed by the FDEP for CWA compliance monitoring of Florida surface waters. The Stream Condition Index (SCI), Rapid Bioassessment (Biorecon), and habitat assessment methods have been employed by USFWS personnel at Eglin for more than 20 years and provide an effective means to track water quality trends in Eglin streams. Complete methods for FDEP SCI, Biorecon, and habitat assessments can be found at: <https://floridadep.gov/dear/bioassessment/content/bioassessment-methods#Streams>.

Habitat assessments along with SCI or Biorecon surveys will be conducted at 10-15 sites within Okaloosa darter watersheds during years 1, 3, and 5 post-delisting. Sites

will be selected based on sampling history, data gaps, and potential impairment, and will be spatially distributed throughout the range of the Okaloosa darter. Data gathered for CWA monitoring will be utilized where available, but a minimum of 10-15 monitoring efforts, either using existing data or collected specifically for the PDM, at sites that are spatially distributed across the species range will be assessed in year 1, 3, and 5.

At all monitoring sites, standard water quality parameters (temperature, dissolved oxygen, pH, conductivity, and salinity) will be measured on site, using multi-meters properly calibrated to the manufacturer's specifications. Conductivity, in particular, has proven to be an early indicator of stream impairment on Eglin (USFWS 2019) and elevated conductivity could signal the need for more targeted water quality testing. In cases where water quality parameters are outside normal ranges for Okaloosa darter watersheds, the USFWS will work with stakeholders to identify sources of impairment and recommend appropriate management actions. Continued biological, chemical, and physical monitoring of tributaries in Okaloosa darter watersheds will ensure Eglin continues to provide stewardship of the natural resources necessary for the protection of the Okaloosa darter and its habitat.

3. Threats

Eglin NRO staff will continue to coordinate threats monitoring for the Okaloosa darter with the USFWS. The Eglin INRMP (USAF 2019a) details a variety of programs that target threats to the Okaloosa darter.

Eglin NRO staff plan and oversee environmental protections for activities on Eglin. They will ensure protections to streams are maintained during mission and infrastructure operations (USAF 2019a) and the USFWS will continue to work Eglin NRO and the Eglin Real Property Office to incorporate Best Management Practices for stormwater control and erosion prevention into enhanced-use lease agreements. This oversight should minimize threats related to construction, clearing and grubbing operations, stormwater failures, and accidental spills, therefore these threats are analyzed as they are planned, and implemented.

The Eglin invasive species program locates, tracks, and controls invasive plants and nuisance wildlife, particularly beavers that impound streams and fragment Okaloosa darter habitat (USAF 2019e). The USFWS personnel at Eglin will continue to conduct early detection and rapid control of aquatic invasive species in accordance with USFWS and Air Force directives.

Each year of the PDM, Eglin NRO will document any residual threats that are impacting Okaloosa darters on Eglin. Eglin NRO and USFWS will assess the level of threat and determine if those threats meet the trigger of being a magnitude or imminence to threaten Okaloosa darters (see Section V, below).

C. Procedures to Assure Consistency of Data Collection Across the Species Range and Between Sampling Periods.

Because Eglin is the primary stakeholder within the Okaloosa darter's range, we will continue to utilize the long-standing monitoring program outlined in the Eglin INRMP (USAF 2019 b and c). Methods for estimating Okaloosa darter densities, habitat characteristics, and water quality will rely on established methods which have been consistently employed by Eglin, the USFWS, federal, state, and NGO partners over the past two decades. Annual review and coordination under the Sikes Act will ensure that alterations to management actions or monitoring protocols are vetted through the USFWS.

D. Frequency and Duration of Monitoring

The monitoring program for Okaloosa darter is broken into multiple temporal scales. Trends monitoring will be conducted at the 21 core sites allowing managers the ability to track local population trends through time. These sites will be monitored in years 2 and 4 post-delisting and as part of the final expanded monitoring effort. Expanded monitoring, conducted in year 5, will allow for estimation of Okaloosa darter population size at watershed and species scales. Continued surveys of the core sites in years 2, 4 and as part of a wider effort in year 5 will track current local trends post-delisting and response to management actions planned for upcoming years. For example, increased canopy cover is thought to be the primary reason for recent declines observed at some core sites (Jordan and Jelks 2020) and management actions have been planned to reduce canopy cover in riparian areas (USAF 2019 b and c). As management actions are implemented, annual assessment of threats and periodic surveys in years 2, 4, and 5 will inform adaptive management so that prescribed fire regimes or herbicide treatments will be adjusted for more effective population response.

Because there has been a general declining trend in the estimated Okaloosa darter population, an expanded monitoring effort was included at the endpoint of the PDM to allow for population assessment and to assess decision triggers and potential adaptive management prior to the completion of the PDM.

V. Definition of Thresholds/Triggers for Potential Monitoring Outcomes and Conclusions

Effective PDM requires timely evaluation of data and responsiveness to observed trends. In order to assure timely response to observed trends, it is necessary to identify possible outcomes from monitoring that could be anticipated and general approaches for responding to these scenarios. In order to identify thresholds that would trigger alternative responses in the case of the Okaloosa darter, USFWS will analyze data from the 20-year period from 2000 to 2020 to identify the range of variability that has been observed with respect to each of the variables that will be monitored during the PDM

period. From this analysis, it will be possible to categorize observations into one of the following three possible PDM outcomes.

A. Category I: Stable

Okaloosa darter remains secure without ESA protections.

This would be true if:

1. The estimated density remain at or above one standard deviation below the 20-year mean for no less than 80% of the core sites,
2. Population estimates for each of the six populations remain sufficient to maintain viability into the foreseeable future,
3. Water quality and available habitat remains stable, or
4. No new or increasing threats to the species are observed that are considered to be of a magnitude and imminence that may threaten the continued existence of the Okaloosa darter within the foreseeable future.

In this case, PDM would be concluded at the end of the timeframe specified in this 5-year Plan.

B. Category II: Uncertain

Okaloosa darter may be less demographically stable than anticipated at the time of delisting, but information does not indicate that the species meets the definition of threatened or endangered.

This would be true if:

1. The estimated density at more than 20% of the core monitoring sites drop below one standard deviation of the 20-year mean,
2. Population estimates for one of the six populations drops below the threshold to maintain viability into the foreseeable future,
3. Water quality and available habitat remain stable, or
4. There are no new or increasing threats that are considered to be of a magnitude and imminence that may threaten the continued existence of Okaloosa darter within the foreseeable future.

In this case, the PDM period should be extended for an additional five years, and if necessary, sampling intensity could be increased to provide greater precision in detecting trends. Existing data will be analyzed to determine if any management interventions are available that would be expected to reverse declines and stabilize or improve trends.

C. Category III: Declining

PDM yields substantial information indicating that threats are causing a decline in the status of the Okaloosa darter since the time of delisting, such that listing the species as threatened or endangered may be warranted.

This would be true if:

1. The estimated density at 10% of the core monitoring sites drop below two standard deviations of the 20-year mean,
2. Population estimates for one or more of the six populations drops below the threshold to maintain viability into the foreseeable future,
3. Water quality has degraded with impairments noted and available habitat has declined, or
4. There are new or increasing threats that are considered to be of a magnitude and imminence that they could threaten the continued existence of Okaloosa darter within the foreseeable future.

If only the first of these conditions is true, then the USFWS should initiate a formal status review to assess changes in threats to the species, its abundance, population structure, and distribution to determine whether a proposal for relisting is appropriate. If all of these conditions are true, then the USFWS should promptly propose that Okaloosa darter be re-listed under the Act in accordance with procedures in section 4.

VI. Data Compilation and Reporting Procedures and Responsibilities

The USFWS will work with Eglin Natural Resources staff to compile and maintain all monitoring data for the Okaloosa darter. For each species-level monitoring event, an estimated Okaloosa darter density will be calculated. Additionally, in year five population sizes will be estimated for all six populations following existing procedures.

Annual reports will be submitted annually, reviewed internally, and shared with partners and stakeholders. An annual coordination meeting will be organized by the USFWS and Eglin to discuss the status of the Okaloosa darter, research needs, or management actions that may affect the species.

If, during the annual review, the response triggers in Section IV above are met or exceeded, the USFWS will consult with Eglin, FFWCC, and other partners to determine whether to conclude the PDM process or to pursue alternative actions as described in Section IV. Our determination also will include, if necessary, an evaluation of the threats to Okaloosa darter using the five factors required under the Act to list a species on the Federal List of Threatened and Endangered Wildlife and Plants.

VII. Estimated Funding Requirements and Sources

Anti-Deficiency Act disclaimer. Post-delisting monitoring is a cooperative effort among the USFWS; state, tribal, and foreign governments; other Federal agencies, and other non-governmental partners under the Act. Funding of post-delisting monitoring presents a challenge for all partners committed to ensuring the continued viability of the Okaloosa darter following removal of ESA protections. Although the Act authorizes expenditures of both recovery funds and section 6 grants to the states to plan and implement PDM, Congress

has not allocated or earmarked any special funds for this purpose. To the extent feasible, the USFWS intends to provide funding for PDM efforts through annual appropriations. Nonetheless, nothing in this Plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in contravention of the Anti-Deficiency Act (31 U.S.C. 1341) or any other law or regulation.

The primary entity conducting the PDM and preparing reports will be Eglin, who has accomplished most of the recent recovery monitoring for Okaloosa darter. Based on costs associated with recovery monitoring efforts, annual PDM expenditures will continue at \$208,000 per year for the first five years of PDM, followed by an annual reduction according to the reduced volume of sampling after the initial expanded monitoring effort. The USFWS will work with Eglin to minimize the financial burden on the Air Force. The Service will provide assistance as needed and as resources permit, especially during the analysis that is planned for the fifth and tenth year after delisting.

VIII. PDM Implementation Schedule

The schedule below outlines the proposed monitoring and responsible parties for the Okaloosa darter. This schedule may be revised or altered upon coordination with Eglin and other stakeholders.

Table 1. Post Delisting Monitoring schedule for the Okaloosa darter.

Component	Monitoring Type	Responsibility	Frequency
Abundance	Trends	USFWS, USGS, Loyola Univ	Years 2 and 4
Abundance	Population Estimate	USFWS, USGS, Loyola Univ	Year 5
Habitat	Biotic Trends	USFWS, FDEP	10-15 SCI or Biorecon sites Years 1, 3, and 5
Habitat	Water Quality	USFWS, USGS, Loyola Univ	Standard water quality parameters at all sites sampled
Threats	Sedimentation	Eglin, USFWS	Annually
Threats	Invasive Species	Eglin, USFWS	Annually
Threats	Habitat Fragmentation	Eglin, USFWS	Annually

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