Laurel Dace
(*Chrosomus saylori)*

5-Year Review:
Summary and Evaluation

Photo curtesy of David Neely

U.S. Fish and Wildlife Service
South Atlantic-Gulf Region
Tennessee Ecological Services Field Office
Cookeville, Tennessee

March 2021

5-YEAR REVIEW
Laurel Dace (*Chrosomus saylori*)

I. GENERAL INFORMATION

A. Methodology used to complete this review: In conducting this 5-year review, we relied on the best available information pertaining to historical and current distribution, life history, and habitat of this species. Our sources include the final rule listing this species under the Endangered Species Act (Act); the Recovery Plan; peer reviewed scientific publications; unpublished field observations by U.S Fish and Wildlife Service (Service), State, and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists or experts. A *Federal Register* notice announcing the review and requesting information was published on May 7, 2018 (83 FR 20092). Comments received and suggestions from peer reviewers were evaluated and incorporated as appropriate (see Appendix A). No part of this review was contracted to an outside party. The Service's lead Recovery Biologist in the Tennessee Ecological Services Field Office (Cookeville, Tennessee) completed this review.

B. Reviewers

Lead Field Office – Tennessee Ecological Services Field Office, Cookeville, Tennessee: Warren Stiles, 931-525-4977

Lead Region – South Atlantic-Gulf and Mississippi Basin Regions: Carrie Straight, 404-679-7226

C. Background

1. Federal Register Notice citation announcing initiation of this review:
May 7, 2018, 83 FR 20092

2. Listing history
Original Listing
FR notice: 76 FR 48722
Date listed: August 9, 2011
Entity listed: Species
Classification: Endangered

3. Associated rulemakings:
Final Critical Habitat Rule
FR notice: 77 FR 63603
Date listed: October 16, 2012

4. Review History:
Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. Through 2013, we submitted information for the annual recovery data call that included status recommendations for the Laurel Dace. The most recent evaluation for this fish to inform the Recovery Report to Congress was completed in 2016.

5. Species' Recovery Priority Number at start of review (48 FR 43098):
5 (degree of threat is high, potential for recovery is low, and the taxonomy is at the species level).

6. Recovery Plan
Name of plan: Recovery Plan for the Laurel Dace (*Chrosomus saylori*)
Date issued: November 14, 2016

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

1. Is the species under review listed as a DPS? No.

2. Is there relevant new information that would lead you to consider listing this species as a DPS in accordance with the 1996 policy? No.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes, the recovery plan contains objective, measurable criteria.

2. Adequacy of recovery criteria:

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? Yes.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? Yes.

3. List the recovery criteria as they appear in the recovery plan and discuss how each criterion has or has not been met, citing information.

The following criteria will be used to determine whether reclassification and delisting have been met. The criteria will be achieved by reducing or removing threats to the species' habitat and conserving or establishing viable populations

throughout the species' range, as determined by monitoring of demographic and genetic parameters.

Criteria for Reclassification from Endangered to Threatened:
Criterion 1: Suitable instream habitat, flows, and water quality for Laurel Dace, as defined by recovery tasks 5.1 and 5.2, exist in occupied streams.

> *(Task 5.1: Determine life history and microhabitat preferences of Laurel Dace through studies of more robust populations in the Piney River drainage; Task 5.2: Use hatchery-propagated Laurel Dace or surrogate species to evaluate silt and thermal tolerance of Laurel Dace and potential toxicity and exposure risk to the species from pesticides used for control of agricultural pests and hemlock woolly adelgid.)*

Status: Criterion 1 has not been met. Habitat stressors and degraded water quality conditions continue to affect the species, resulting in extirpation of the species from three of six previously occupied streams (Tennessee Aquarium Conservation Institute [TNACI] 2019). Mitchell *et al*. (2017) provided preliminary information on the species' life history and microhabitat preferences (recovery task 5.1), and the species' successful captive propagation at TNACI has opened the possibility of beginning research on the species' sensitivity to silt, elevated temperatures, and agricultural runoff (Cronnon *et al*. 2019; TNACI 2019). The species' complete habitat preferences and tolerance levels to various threats have yet to be determined.

Laurel Dace persist in the predominantly forested watersheds of Bumbee Creek, Youngs Creek, and Horn Branch, in Tennessee, but the species has disappeared from watersheds with reduced forest cover and increased anthropogenic disturbance. Streams in watersheds with greater amounts of agricultural and residential land use (e.g., Cupp Creek and Soddy Creek) are likely subjected to higher sediment loads and other pollutants than streams in watersheds with greater amounts of forest cover (Mitchell *et al.* 2017).

Criterion 2: Viable populations are present throughout suitable habitat in Bumbee, Moccasin, and Youngs Creeks, and at least two of the following streams: Soddy or Cupp Creek or Horn Branch.*

> **Populations will be considered viable when the following demographic and genetic conditions exist:*
>
> - *Demographics – monitoring data demonstrate that (a) populations are stable or increasing, (b) average census size is at least 500 individuals and two or more age-classes are consistently present over a period of time encompassing five generations (i.e., 15 years), and (c) evidence of recruitment is not absent in more than three years or during consecutive years at any point within that period of time.*

- *Genetics – populations will be considered to have sufficient genetic variation to be viable if measurements of observed number of alleles and estimates of heterozygosity and effective population size have remained stable or increased during the five generations used to establish demographic viability*

Status: Criterion 2 has not been met. Laurel Dace are currently known to persist in only three streams (Bumbee and Youngs creeks and Horn Branch) (Figure 1; TNACI 2019). Laurel Dace have not been monitored long enough to determine whether the Bumbee and Youngs Creeks populations are viable. A few young of the year Laurel Dace were rediscovered in Horn Branch in August 2020, though in low numbers and without adults, so we cannot conclude if it is a viable population.

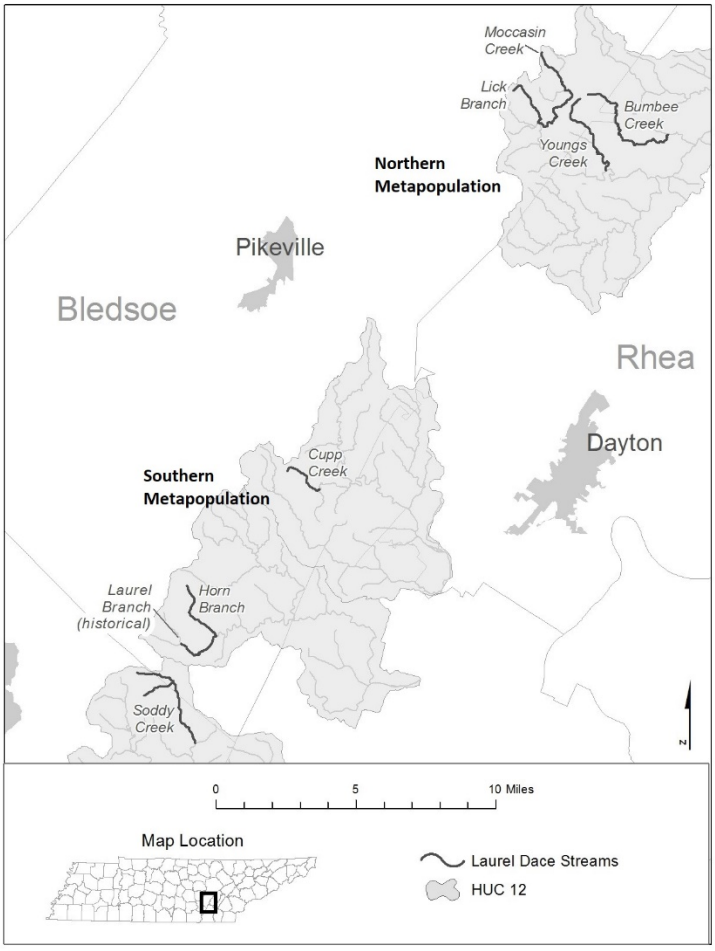

Figure 1: Laurel Dace Range Map, showing the two metapopulations.

Annual monitoring of Laurel Dace began in 2015; however, a population model to estimate the population size in the occupied streams has not been developed.

The number of individuals collected in surveys of Bumbee and Youngs Creeks has fluctuated, showing no clear increasing or decreasing trend (Table 1). Within the occupied streams, there has been consistent evidence of reproduction within a portion of each stream. Fine scale genetic analysis has yet to be completed for each population.

Criteria for Delisting:

Criterion 1: Suitable instream habitat, flows, and water quality for Laurel Dace exist in all occupied streams, and mechanisms exist to ensure that land use activities (including road maintenance) in catchments of streams inhabited by Laurel Dace will be compatible with the species' conservation for the foreseeable future. Such mechanisms could include, but are not necessarily limited to, conservation agreements, conservation easements, land acquisition, and habitat conservation plans.

Status: Delisting Criterion 1 has not been met. As addressed above under the downlisting criteria, a number of the streams considered as occupied when the 2016 recovery plan was written have now been extirpated due to habitat degradation. Two conservation agreements have been completed within the Laurel Dace's range to replace culverts acting as potential fish passage barriers on Horn Branch and Bumbee Creek with cooperation among the Service, TNACI, Timberland Investment Resources, and Bledsoe County.

Criterion 2: Viable populations are present throughout suitable habitat in Bumbee, Moccasin, Youngs, Soddy, and Cupp creeks and Horn Branch, and one additional viable population exists, either through reintroduction into Laurel Branch or discovery of an additional wild population.

Status: Delisting Criterion 2 has not been met. As discussed above in the downlisting criteria, only three occupied streams remain (Table 1), and there is insufficient data to determine whether these populations are viable.

C. Updated Information and Current Species Status

1. Biology and Habitat:

a. Abundance, population trends (i.e., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, and mortality rate), or demographic trends:

Population trends have not been determined for the Laurel Dace due to limited access to occupied streams on private lands as well as variable capture rates. At regularly surveyed sites, collection numbers have fluctuated with streamflow conditions. Following the 2016 drought, Laurel Dace abundance decreased in Bumbee and Youngs Creeks in 2017, especially in more marginal, shallow habitats (TNACI 2019; LDCI 2019; Stiles 2017, pers. obs.). In 2018, the number of individuals encountered in

Bumbee Creek was comparable to 2017, but abundance in Youngs Creek appeared to have increased slightly (TNACI 2019). Changes in both extant populations have not been assessed across time to reveal definite population trends; however, the species' extirpation from several historical streams clearly suggests a negative status trend for the species (i.e., reduced resiliency, redundancy, and representation). Since the species was listed, Laurel Dace have been extirpated in three of these streams (Moccasin Creek, Cupp Creek, Soddy Creek) within the last 5 years (Table 1). These extirpations are likely associated with an increase in row crop agriculture in those watersheds and the indirect effects on habitats of the Laurel Dace (LDCI 2019). Additionally, the small population in Lick Branch was likely extirpated during the 2016 drought (TNACI 2019).

Annual monitoring of Laurel Dace began in 2015; however, a model to estimate the population size in occupied streams has yet to be developed. The number of individuals collected in surveys of Bumbee and Youngs creeks has fluctuated showing no clear increasing or decreasing trend (Table 1). Within the occupied streams, there has been consistent evidence of reproduction within a portion of the stream based on the presence of young of the year and multiple age classes.

Table 1: Survey results for Laurel Dace streams. (*estimated)

Year	Bumbee	Youngs	Lick	Moccasin	Cupp	Horn	Soddy
2015	72	0	n/a	n/a	n/a	n/a	n/a
2016	147	n/a	13	0	n/a	0	n/a
2017	90	160	1	0	0	0	n/a
2018	78	161	0	n/a	0	n/a	n/a
2019	n/a	75-100*	0	n/a	0	n/a	n/a
Last seen (#)	2018 (78)	2019 (75-100)	2017 (1)	2013 (37)	2014 (1)	2020 (3)	2004 (1)

Captive propagation efforts at the TNACI have enabled investigation into the reproductive biology of the Laurel Dace (Cronnon *et al*. 2019). This work has confirmed that Laurel Dace are likely batch spawners (spawning multiple times per season) (Harris 2019, pers. comm.) The species' breeding season behaviors have been observed and categorized; however, actual spawning behaviors have not been observed. Breeding period behaviors were similar to those observed in other *Chrosomus* species. Cronnon *et al*. (2017) also explained that Laurel Dace sex ratios were difficult to assess because external, physical characteristics, such as breeding color, were not reliable for determining the sex of individuals.

b. Genetics, genetic variation, or trends in genetic variation (e.g. loss of genetic variation, genetic drift, inbreeding, etc.):

No genetic studies have been completed for the Laurel Dace other than those used in species delimitation.

c. Taxonomic classification or changes in nomenclature:

There have been no changes in the taxonomy of the Laurel Dace since it was listed (ITIS 2019).

d. Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historic range, change in distribution of the species within its historic range, etc.):

Since the completion of the Laurel Dace Recovery Plan, the species' distribution and abundance have continued to decline. In the 2016 recovery plan, six streams were considered occupied (Service 2016). Currently, the species occurs in only three streams: Bumbee Creek, Youngs Creek, and Horn Branch in Bledsoe and Rhea Counties, Tennessee (Figure 1). All of these streams are located on Waldens Ridge, a finger of the Cumberland Plateau extending east of the Sequatchie Valley. Within Youngs Creek, the species is now restricted to only the upper portions of the stream. This may be the result of land clearing, agriculture, and other development near the stream resulting in reduced water quality. The cause of the species' extirpation in Moccasin Creek is unclear, but increased residential development and row-crop farming resulting in increased sediment and nutrient runoff may have contributed to the decline. The stream has a high concentration of sunfishes (Family Centrarchidae) and a significant amount of silt deposition, but it does not have the concentration of threats seen in other streams. Lick Branch, a tributary to upper Moccasin Creek, is very small and was likely a sink population that relied on its connection to Moccasin Creek. During the 2016 drought, Lick Branch nearly dried up, resulting in the extirpation of Laurel Dace from the stream. Without the species' presence in Moccasin Creek, the Lick Creek population did not reestablish and was extirpated (TNACI 2019).

Since completion of the recovery plan in 2016, two of the remaining three southern populations of Laurel Dace have been extirpated. Laurel Dace have not been collected from Cupp Creek since 2013, and another tolerant minnow species, Western Blacknose Dace (*Rhinichthys obtusus*), has not been observed since 2017. This shift is likely due to the influence of sediment and nutrient runoff from row crop agricultural operations in the upper portion of the stream resulting in a reduction of suitable habitat and the observed increased numbers of sunfish that compete with and prey on the minnow species (Granstaff and Stiles 2019, LDCI 2019.). Laurel Dace numbers in Horn Branch had fallen below the level of detectability (too

few to reliably collect with traditional survey methods) after 2014; however, a few young of the year Laurel Dace were collected in a TNACI survey in 2020 (Fix 2020, pers. comm.). The reason for this decline is not directly attributable to any given cause; however, the small size of this stream makes is susceptible to acute events commonly associated with development (e.g., contaminant spills). The population in Horn Branch has been small for as long as it has been known to exist, making it at higher risk for extirpation (LDCI 2019). Efforts are underway to create an ark population of Horn Branch fish to maintain the genetics of the southern population.

e. Habitat (e.g. amount, distribution, and suitability of the habitat or ecosystem):

Laurel Dace live in small, first to third order headwater streams on Walden Ridge, a part of the Cumberland Plateau. These streams are naturally shaded, flowing over sandstone bedrock, boulders and cobbles with limited silt (Service 2016). The stream reaches occupied by Laurel Dace are low to moderate gradient with pools interspersed with riffles or runs. Since 2016, researchers at the University of Tennessee (Knoxville) and TNACI have been investigating the microhabitat preferences of the Laurel Dace. Pool depth has the strongest correlation with Laurel Dace density in these studies. Given the intermittent nature of these streams, it is understandable that Laurel Dace would be more closely associated with deeper, more permanent pools (Mitchell *et al*. 2017).

f. Conservation efforts:

Two culverts have been replaced in Laurel Dace streams in an effort to improve fish passage ability and reduce erosion of the roadbeds at the stream crossings. The culvert at Hendon Road on Horn Branch was replaced with an oversized elliptical culvert in 2013 in collaboration with Bledsoe County. The Piney Creek Road crossing on Bumbee Creek was replaced with the help of the Service's Fish Passage Team and coordination with the landowner, Timberland Investment Resources, in 2016.

Beginning in 2019, the Laurel Dace Conservation Initiative brought together Federal, State and NGO partners to focus the efforts for the species conservation and build stronger collaborations. Partners include the Service, Tennessee Wildlife Resources Agency (TWRA), TNACI, the Natural Resources Conservation Service (NRCS), Tennessee Department of Agriculture, University of Tennessee Agricultural Extension, Defenders of Wildlife, and county soil and water conservation boards. It is hoped that these partnerships may result in the application of better farming practices, such as filter strips and grassed waterways on the edges of fields

and cover crops planted between rows in vegetable fields to reduce erosion into Laurel Dace streams (Howard 2019). These practices will also help bring farmers into compliance so that they will be eligible for farm subsidies (i.e., they would provide a financial incentive to implement needed conservation measures).

Captive propagation efforts have proven feasible for the species, and fine-scale genetic analysis for each population is being carried out to compare them to other populations and manage a species ark population. These efforts will enable an informed reintroduction program and research to determine Laurel Dace tolerance to stressors such as siltation, temperature, and chemicals.

2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

a. Present or threatened destruction, modification, or curtailment of its habitat or range:

Habitat degradation continues to be the greatest threat to the Laurel Dace. Vegetable agriculture remains the primary source of sedimentation in Laurel Dace watersheds, and there are more vegetable farms in the species range now than when the species was listed. As mentioned previously, sedimentation of habitat has resulted in the extirpation of the species from many of its historical watersheds, with rapid losses taking place over the past five years. Stream reaches in Cupp, lower Youngs, and lower Moccasin creeks have significant sediment deposition in pools, rendering these habitats unsuitable for the species. The species has already been extirpated in both Cupp and Moccasin creeks. Soddy Creek, whose population was likely extirpated sometime in the early 2000's, is the only Laurel Dace stream on the Environmental Protection Agency (EPA) 303(d) list of impaired streams for sediment input from agriculture. For water bodies on the 303(d) (impaired) list, states are required under the Clean Water Act to establish an acceptable total maximum daily load (TMDL) for the pollutants of concern that will bring water quality into the applicable standard. The Tennessee Department of Environment and Conservation has also investigated a potential agricultural chemical spill in Soddy Creek. Portions of other southern metapopulation streams downstream of historic Laurel Dace habitat are also 303(d) listed.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

Overutilization is not known to be a factor in the decline of this species. The collection of wild individuals as broodstock for captive propagation by TNACI has been carried out in close coordination with the Service

under the conditions of TNACI's Section 10 recovery permit and was not considered to be detrimental to the species.

At present, bait collection activities mentioned in the recovery plan are not known to be a current threat in the species' occupied streams.

c. Disease or predation

There is no new evidence of disease affecting the Laurel Dace.

Studies of introduced sunfishes in Laurel Dace streams show evidence of significant diet overlap, potentially resulting in interspecific competition and displacement of Laurel Dace (Fix, in prep.). While direct predation of Laurel Dace by sunfishes has not been observed, Green Sunfish (*Lepomis cyanellus*) and black basses (*Micropterus* spp.) are known to prey on smaller fishes (Mitchell *et al*. 2017). These sunfish species likely entered the streams through the overflow of stocked farm ponds that have become common in the Laurel Dace's range. Predation by sunfishes is suspected as the cause for observed declines in Laurel Dace and Western Blacknose Dace in Cupp Creek (LDCI 2019; TNACI 2019). In June 2019, a multi-agency team initiated a sunfish removal effort in Cupp Creek. A total of 1,057 sunfish were removed using multi-pass depletion electrofishing. This effort will likely be followed by additional removal efforts and experimental reintroductions of Western Blacknose Dace to determine if high sunfish abundance and density contributed to the decline of cyprinids (minnows).

During the process of developing captive propagation techniques for Laurel Dace, high levels of mycobacterium were detected in the offspring produced at TNACI (Fix 2020, pers. comm.; Harris 2020, pers. comm.). While this could have been a result of the captive setting, more research is needed to understand the levels of mycobacterium in the wild populations and if disease is affecting the species.

In November 2020, Laurel Dace with high numbers of trematode (a parasitic flatworm) cysts were captured in upper Youngs Creek during annual monitoring. Trematode infections in Laurel Dace have not previously been observed. A large majority of adult Laurel Dace captured in the survey were infected, some with very heavy parasite loads. Infection rate was much lower in Western Blacknose Dace captured at the same time (Kuhajda and Fix, 2020, pers. comm.). Preliminary genetic identification of the parasites have placed them in the genus *Clinostomum*, similar to species *C. marginatum*, though the exact species has not been determined (Bullard, 2020, pers. comm.). While the sudden appearance of this parasite with very high rates of infection and individual load is cause for concern, this group rarely causes damage to the host. Research into

potential causes of the outbreak and effects to the Laurel Dace population is ongoing.

d. Inadequacy of existing regulatory mechanisms:
The Laurel Dace and its habitats are afforded limited protection from water quality degradation under the Clean Water Act of 1977 (33 U.S.C. 1251 et seq.) and the Tennessee Water Quality Control Act of 1977. These laws focus on point-source discharges, and many water quality problems are the result of nonpoint source discharges. Therefore, these laws and corresponding regulations have been inadequate to halt population declines and degradation of habitat for the Laurel Dace.

In addition, the Laurel Dace is listed as Endangered by the State of Tennessee. Under the Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act of 1974 (Tennessee Code Annotated §§ 70-8-101-112), "…it is unlawful for any person to take, attempt to take, possess, transport, export, process, sell or offer for sale or ship nongame wildlife, or for any common or contract carrier knowingly to transport or receive for shipment nongame wildlife." Further, regulations included in the Tennessee Wildlife Resources Commission Proclamation 00-15 Endangered Or Threatened Species state the following: "Except as provided for in Tennessee Code Annotated, Section 70-8-106 (d) and (e), it shall be unlawful for any person to take, harass, or destroy wildlife listed as threatened or endangered or otherwise to violate terms of Section 70-8-105 (c) or to destroy knowingly the habitat of such species without due consideration of alternatives for the welfare of the species listed in (1) of this proclamation, or (2) the United States list of Endangered fauna." Potential collectors of this species would be required to have a state collection permit.

The ESA provides two paths for incidental take coverage - sections 7 and 10. Section 7 is the more routinely used path, and it requires Federal agencies to consult with the Service when projects they fund, authorize, or carry out may affect the Laurel Dace. However, since its listing, the lack of Federal authority over the many actions likely impacting the species' habitat has become apparent. Many of the threats (including those identified at the time of listing, during recovery planning, and since development of the Recovery Plan) involve activities that likely do not have a Federal nexus (such as water quality changes resulting from residential development, water withdrawals, row-crop agriculture, or forest clearing) and, thus, may not result in coordination with the Service.

e. Other natural or manmade factors affecting its continued existence:

Since the recovery plan for the species was drafted, the Moccasin Creek population has been extirpated and the Horn Branch population reduced to undetectable levels. It is likely that naturally small population size in these headwater streams have resulted in lower resilience, making them more susceptible to genetic depression and increased likelihood of extirpation.

Additionally, there is the possibility of occasional chemical spills from vegetable farms, automotive salvage yards, and residences in the headwaters of Laurel Dace streams, which, depending on the severity of the spill, could put entire populations or stream reaches at risk. In such small streams, the amount of a contaminant needed to reach a lethal concentration is much smaller than in larger streams. Potential contaminants could be automobile fluids, such as fuel, oil, or antifreeze, from both official and unofficial salvage yards, or agricultural and lawn chemicals, such as pesticides, herbicides, or fertilizers, from both residential and agricultural sources in these watersheds.

The small streams inhabited by Laurel Dace are also susceptible to drying during periods of drought. Climate change models for the interior southeastern United States forecast more intense and frequent droughts (Ingram *et al*. 2013). The 2016 drought resulted in loss of the Lick Branch population and reductions in the populations in Youngs and Bumbee creeks. Given the species' low current redundancy, (i.e., small range and few populations), further constriction of the species' range and potential extinction in the wild due to climate change are possible.

D. Synthesis

When listed in 2011, and at the time of the Service's recovery plan for the species in 2016, extant populations of the Laurel Dace were known from six streams in Bledsoe and Rhea counties, Tennessee. Since that time, the species has declined and now occupies only portions of three headwater streams - Bumbee Creek and Youngs Creek in the northern metapopulation and Horn Branch in the southern metapopulation. Additionally, the population in Horn Branch, compared to capture records before 2014, is almost undetectable by current survey methods. Increased sedimentation associated with vegetable production (row-crop agriculture) and potential predation by sunfishes continue to threaten the species. Successful captive propagation and establishment of an ark population would reduce the species' risk of extinction, but success of these efforts is far from certain. Without suitable habitat free from continued threats, the potential for successful reintroductions of lost populations is limited. The species remains highly vulnerable to stochastic events such as droughts or toxic chemical spills.

Due to the Laurel Dace's shrinking range, small population size, and continued threats, it continues to be in danger of extinction throughout its range. Therefore, the species should remain classified as endangered. The recovery priority number of 5 should be retained, reflecting a high degree of threat and low recovery potential for the species.

III. RESULTS

A. Recommended Classification:

__X__ No change is needed

IV. RECOMMENDATIONS FOR FURTHER ACTIONS

The following actions should be undertaken for the Laurel Dace:

- Reduce sediment inputs in Youngs Creek.
- Establish ark populations for both the northern and southern metapopulations.
- Conduct fine-scale genetic analysis to determine suitable reintroduction possibilities.
- Complete a captive propagation plan for the species.
- Refine captive propagation techniques, including ways to prevent or account for mycobacterium.
- Conduct research into the causes and impacts of Youngs Creek trematode infections.
- Complete annual monitoring for populations in Bumbee Creek, Youngs Creek and Horn Branch, and complete population estimates for all three streams.
- Search for previously unknown populations.
- Determine stressor tolerance of a surrogate species, Tennessee Dace (*Chrosomus tennesseensis*), in laboratory studies and look for other factors limiting the species
- Protect existing Laurel Dace watersheds through acquisition, easement, technical assistance, or other conservation measures. Pursuing landowner agreements through the Partners for Fish and Wildlife Program may be particularly attractive.
- Reduce sedimentation across the species' historical range by working with agricultural landowners and developers.
- Restore habitat in occupied and unoccupied streams.
- Monitor water quality in occupied and unoccupied streams.
- Reintroduce Laurel Dace into currently unoccupied streams.
- Investigate mycobacterium levels in wild populations of Laurel Dace.

V. REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Laurel Dace (*Chrysomus saylori*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

_____ Downlist to Threatened
_____ Uplist to Endangered
_____ Delist
__X__ No change is needed

Review Conducted By: Warren Stiles, Tennessee Ecological Services Field Office, Cookeville, Tennessee

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve DANIEL ELBERT Digitally signed by DANIEL ELBERT Date: 2021.03.05 13:11:07 -05'00' Date_____

LEAD REGIONAL OFFICE APPROVAL:

Assistant Regional Director, U.S. Fish and Wildlife Service

Approve CATHERINE PHILLIPS Digitally signed by CATHERINE PHILLIPS Date: 2021.03.10 13:06:42 -05'00' Date _____

APPENDIX A: Summary of peer review for the 5-year review of Laurel dace (*Chrosomus saylori*)

A. **Peer Review Method:** The draft 5-year review document was sent to 4 independent peer reviewers:

- Shawna Fix, TNACI
- Mark Thurman, TWRA
- Justin Howard, NRCS
- Dr. Don Orth, Virginia Tech

B. **Peer Review Charge:** The following email was sent along with the draft 5-year review to the peer reviewers:

On May 7, 2018, the U.S. Fish and Wildlife Service published a notice in the Federal Register (83 FR 20092) announcing a 5-year review of 35 federally listed species, including Laurel Dace. The purpose of five-year reviews is to ensure that the classification of species as threatened or endangered is accurate and reflects the best available information. As a part of the five-year review process, the Service enlists experts in the scientific field to conduct independent peer reviews based on Service current policy and guidelines. To that end, Service personnel assists the Tennessee Ecological Services Field Office to complete peer review of the science in the 5-year review for the Laurel Dace. In order to ensure that the best available information has been used to conduct this five-year review, we are requesting your peer review of the Draft 5-Year Status Review for Laurel Dace (20200828_Laurel Dace 5YR Draft_for_peer_review.docx), because you are knowledgeable about this species or similar species.

Specifically, we ask for comments on:

- Have we assembled the best available scientific and commercial information?
- Is our analysis of this information correct and properly applied?, and
- Can you identify any additional new information related to Laurel Dace that has not been considered in this review?

Please note that we are not seeking your opinion of the legal status of this species, but rather that the best available data and analyses were considered in reassessing its status.

Additionally, as part of the peer review process, we must evaluate the potential for conflicts of interest with the subject species or the action. Please complete the attached Conflict of Interest form and return it with any notes, comments, or questions that you are willing to provide along with your peer review.

We appreciate your interest in furthering the conservation of rare plants and animals by becoming directly involved in the review process of our Nation's threatened and

endangered species. Your review and comments will become a part of the administrative record for this species, and the information, comments, and recommendations you provide will receive serious consideration in assessing the science and the analysis of information related to the species.

Please be aware that this document is in draft form and is predecisional and should not be used or released outside of this review process. By agreeing to participate in the peer review process for this species, you are considered an unpaid, volunteer consultant to assist the Service by providing the best scientific information and clarity in this document.

Additional information or past reviews for the species can be found at this link: https://ecos.fws.gov/ecp/species/1194

We hope that you view this peer review process as a worthwhile undertaking. Once you complete your review of the attached document, please submit comments and signed Conflict of Interest Form to the Atlanta Regional Office, to our Regional Recovery Coordinator, Carrie Straight. Your comments can be provided to Carrie by email carrie_straight@fws.gov or by letter (1875 Century Boulevard, 4th Floor, Atlanta, Georgia 30345) and should be received by September 25, 2020, to help us complete the final 5-year review for signature. If you have any questions, please call Carrie Straight (404) 679-7226, or email her. Thank you in advance for your assistance. We appreciate your time in helping complete this review. We appreciate your time in helping complete this review. If you feel you cannot complete the review in the allotted time or would like to decline review, please let me know.

C. **Summary of Peer Review Comments/Report:** 3 peer reviewers provided comments.

a. Shawna Fix provided annual monitoring data we had not included.

b. Shawna Fix clarified some incorrect geographical and management references.

c. Shawna Fix provided information on the mycobacterium infections in the progeny from the captive propagation efforts.

d. Mark Thurman and Justin Howard agreed with our assessment of the species and future conservation actions needed

D. **Response to Peer Review:** Peer reviewer comments were evaluated and incorporated into the revised document, as appropriate.