Copperbelly Watersnake
Northern Population Segment
(*Nerodia erythrogaster neglecta*)

5-Year Review: Summary and Evaluation

September 27, 2023

Photo by: Megan Seymour

U.S. Fish and Wildlife Service Ohio Ecological Services Field Office
Columbus, Ohio

5-YEAR REVIEW

Species Reviewed: Copperbelly Watersnake (*Nerodia erythrogaster neglecta*)

Table of Contents

5-YEAR REVIEW
Copperbelly Watersnake Northern Population Segment
Nerodia erythrogaster neglecta

1.0 GENERAL INFORMATION

1.0 Reviewers

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1.2 Methodology used to complete the review

The U.S. Fish and Wildlife Service (Service) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12) as required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The Service provided notice of this status review in the Federal Register (88 FR 2368) and requested new scientific or commercial data and information that may have a bearing on the classification of the copperbelly watersnake (*Nerodia erythrogaster neglecta*) as a threatened species.

Jenny Finfera with the Service's Columbus, Ohio Ecological Services Field Office conducted this review in coordination with staff at the cooperating field offices and the Midwest Regional Office. We reviewed past and recent literature and reports, public comments, the final listing rule (62 FR 4183), the Northern Population Segment of the Copperbelly Water Snake Recovery Plan (USFWS 2008), and the most recent 5-year reviews for the species (USFWS 2010, USFWS 2018).

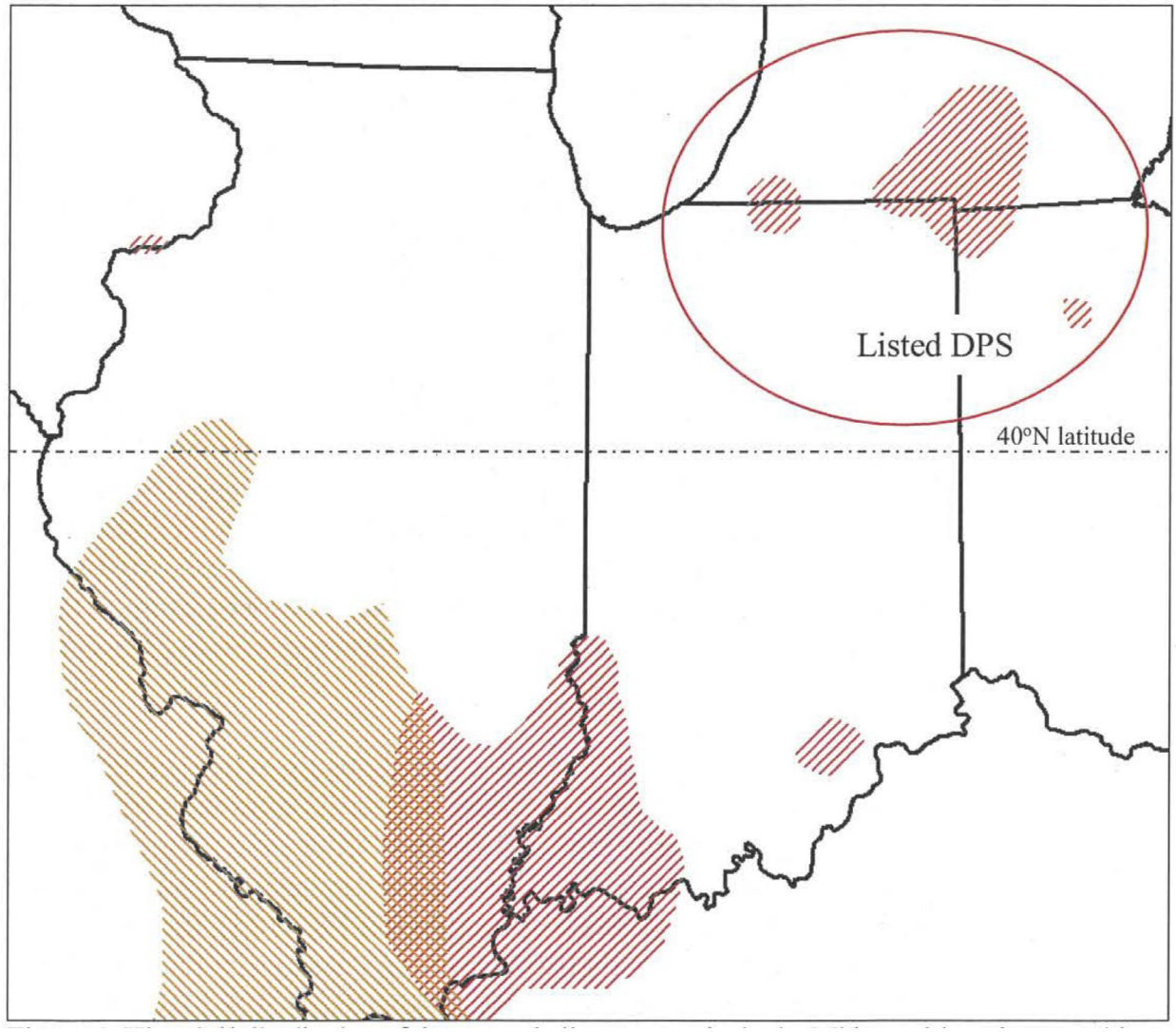
1.3 Background

1.3.1 FR Notice citation announcing initiation of this review: 88 FR 2368 (January 13, 2023)

1.3.2 Listing history

FR notice: 62 FR 4183
Date listed: January 29, 1997
Entity listed: *Nerodia erythrogaster neglecta*, Michigan, Ohio, and Indiana north of 40° N. latitude (see Figure 1)
Classification: Threatened

Figure 1. Historical distribution of the copperbelly watersnake in the Midwest (six polygons with red hatching). To the northeast, north of the 40th North Parallel, are the isolated remaining copperbelly populations of the listed distinct population segment (DPS) (circled area). All known remaining populations of the DPS are within 15 miles of the intersection of Indiana, Michigan, and Ohio. Neither the southern populations nor the southeastern disjunct population near Seymour, Indiana, are federally listed, nor is the northwestern population along the Mississippi River in northwestern Illinois and eastern Iowa. Also shown (yellow hatching) is the Midwestern extension of the distribution of the plain-bellied watersnake, a relative of the copperbelly, whose distribution continues south, and for which there is no Federal protection.



1.3.3 Associated rulemakings: N/A

1.3.4 Review History

May 2010: Copperbelly Water Snake Northern Population Segment (*Nerodia erythrogaster neglecta*) 5-Year Review

September 2018: Copperbelly Water Snake Northern Population Segment (*Nerodia erythrogaster neglecta*) 5-Year Review

This 5-year review summarized all new information regarding the species status, distribution, and threats, leading to the continued recommendation to uplist the species to endangered status.

1.3.5 Species' Recovery Priority Number at start of 5-year review

3C, indicating that it is: (1) taxonomically, a subspecies; (2) facing a high degree of threat; (3) rated high in terms of recovery potential; and (4) in conflict with construction or other development project(s) or other forms of economic activity.

1.3.6 Recovery Plan

Name of plan: Northern Population Segment of the Copperbelly Water Snake (*Nerodia erythrogaster neglecta*) Recovery Plan
Date issued: December 23, 2008

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? Yes

2.1.2 Is the species under review listed as a DPS? Yes

2.1.3 Was the DPS listed prior to 1996? No

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy? No

2.2 Recovery Criteria

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

2.2.2 Adequacy of recovery criteria

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

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? Yes

2.2.3 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 copperbelly watersnake will be considered for delisting when the following criteria are met:

Criterion 1. Multiple population viability is assured:

a) Five geographically distinct populations have population sizes of more than 500 adults, with at least one population exceeding 1,000 adults; or three populations must have a total population size of 3,000 adults, with none less than 500, and

b) These populations must persist at these levels for at least ten years.

Discussion

Various population models have been used in the past to estimate abundance (USFWS 2018). Overall, information from those abundance estimates indicated a declining trend. Survey work was conducted in 2020 and 2021 at various sites in Ohio and Indiana, and a single site that straddles the Ohio-Michigan boundary that had previously been occupied by copperbelly watersnakes and no individuals were detected. In 2022, a total of 6 individuals were observed and collected in Ohio to establish a captive rearing population (USFWS 2023). Surveys during 2023, in the same general area of those conducted in in 2022, resulted in the detection of five individuals with all of these except for one collected. Based on these recent survey results and previous abundance estimates, population levels remain well below the recovery goal of 3,000 adults. Further, none of the extant populations meet the minimum population criterion of 500 adults. Criterion 1 has not been met.

Criterion 2. Sufficient habitat is conserved and managed:

a) Wetland/upland habitat complexes sufficient to support the populations described in Criterion 1 are permanently conserved.
    1) A population of 1,000 adults will require at least five square miles of landscape matrix with a high density and diversity of shallow wetlands embedded in largely forested uplands.

    2) A population of 500 adults will require at least three square miles of the same type of habitat.

b) Multiple (two or more) hibernacula for each population are permanently conserved. A minimum of two hibernacula will be available within one kilometer of all suitable summer habitat included above.

Discussion
The Service's Partners for Fish and Wildlife Program works to restore and enhance private property. Landowner Protection Agreements recognize the voluntary contribution of a landowner

to improve and maintain habitat for copperbelly watersnakes and potentially attract the snakes to their property and does not hold the landowner accountable for any lawful act that may result in take. The goal of the Agreement is to achieve a net conservation benefit for copperbelly watersnakes by expanding or buffering existing occupied habitat and increasing habitat connectivity within their range. Since 2018, the Partners Program has initiated programs at 17 sites in Michigan to restore habitat for this species (Roberts 2023, personal communication).

Criterion 2a has not been met despite significant effort to restore, enhance, and preserve copperbelly habitat. Currently not enough habitat exists to support the populations described in Criterion 1.

There is an insufficient amount of habitat that has been permanently conserved in order for copperbelly to sustain their life history requirements. This includes multiple (two or more) hibernacula for each population are permanently conserved. A minimum of two hibernacula must be available within one kilometer of all suitable summer habitat. Criterion 2b has not been met because multiple (two or more) hibernacula for each population are not permanently conserved.

Two hibernacula may be available within a minimum of one kilometer of all suitable summer habitat, though there is not enough suitable habitat permanently conserved.

Criterion 3. Significant threats due to lack of suitable management, adverse land features and uses, collection, and persecution have been reduced or eliminated:

a) Habitat management and protection guidelines have been developed, distributed, and maintained.

b) Adverse land features and uses, such as row crops, roads and accompanying traffic have been removed, minimized or managed within occupied Criterion 1 landscape complexes to the extent possible.

c) A comprehensive education and outreach program, including persecution and collection deterrence, has been developed and implemented.

Discussion

Successful recovery requires the creation of corridors to link suitable wetland/forest complexes to facilitate a healthy metapopulation structure. The presence of barriers, such as row crops and roads, hinders these efforts. In 2010, a copperbelly was found dead on a road at a new wetland site (Lee and Kingsbury 2014). Three other snakes have been found dead on the road in Michigan since 1959 (Michigan Natural Features Inventory 2023, unpublished data). In 2012, a young copperbelly was found dead in a small wetland in a wetland complex in Michigan (Lee and Kingsbury 2014). The cause of death is not known, but the snake was intact. It is unclear whether the cause of death was due to impeded migration or some other cause. In 2022, a copperbelly was found alive on the road (Kruse 2023, personal communication). These mortalities and the road crossing observation indicate habitat fragmentation disrupts copperbelly movements and migration and also increases their vulnerability to predation as well as road

mortality. These threats continue to impede recovery. Research to investigate the impact of barriers and mitigation measures is needed.

Criterion 3 and subpart 3b have not been met despite significant efforts to restore or enhance wetlands and forests within the range of the northern DPS of the copperbelly. A mosaic of linked wetland and upland habitat is needed to eliminate or reduce the threat posed by roads and row crops. Copperbelly watersnakes are also still believed to be removed from the wild by amateur collectors and commercial dealers, although the frequency and extent to which this occurs is not known. Additional habitat restoration and creation of migration corridors is necessary as well as measures to address illegal collection.

Criterion 3a has been partially met. Habitat management guidelines are available in the recovery plan; however, building awareness among landowners who may not be aware of these practices is a critical piece of this objective that needs to be completed.

Criterion 3c has been partially met through some outreach efforts in Hillsdale County specifically (USFWS 2018), though additional public education and outreach throughout the range of the northern DPS would be beneficial.

The copperbelly watersnake will be considered for reclassification from threatened to endangered status when either of the following criteria is met:

Criterion 1. There are no known populations of more than 500 adults.

Criterion 2. The cumulative population size is estimated at less than 1,000 adults.

As discussed in section 2.2.3, occupancy modeling and other recent monitoring efforts suggest a potential decreasing population trend (USFWS 2018, 2023). Based on the best available information from the most recent surveys in 2020-2023 and previous population estimates, both Criteria 1 and 2 for reclassification, directly above, have been met and the species should be considered for reclassification as endangered.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

In an effort to develop a more efficient survey technique, research into the use of eDNA as a detection tool was conducted. Gene fragments could be detected in the lab, however water samples collected in the field did not detect this species (Gruenthal et al. 2023, unpublished data). Higher numbers of samples may be needed to detect this species (Gruenthal et al. 2023, unpublished data).

In 2022, all individuals detected through observational surveys were captured and placed in captivity following the guidelines in the Captive Rearing Plan. The individual observed crossing the road was not collected. One sub-adult perished in captivity shortly after arrival (USFWS

2023). A single individual observed in 2023 was not able to be captured but all others observed in 2023 were successfully placed in captivity. Based on the continued survival of most of those taken into captivity in 2022, as all snakes are healthy and gaining weight (USFWS 2023), and the persistence of the additional individuals obtained in 2023, this species appears to adapt well to captivity. Individuals, including neonates born in captivity successfully feed on an altered diet, composed primarily of fish, compared to a wild diet principally of amphibians.

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

Previous monitoring appeared to indicate a population decline (USFWS 2018). Surveys in Ohio and a single site in Michigan during 2020 and 2021 and efforts in Indiana in 2021 (IDNR 2021) that failed to find any individuals appear to indicate a continued decline. In 2022, intensive surveys prioritized areas of recent sightings. Seven sightings of snakes were observed. Most snakes were able to be collected on the first sighting but one snake was obtained on its second sighting (USFWS 2023). All six captured were brought into captivity. One sub adult, the smallest individual captured, perished shortly after arriving in captivity in 2022 (Cross 2022, personal communication) but all other adults have continued to persist. These intensive surveys, totaling over 161 survey hours, were repeated in 2023 and resulted in the capture of four individuals for captive breeding (Seymour 2023, personal communication).

Table 1. Individuals Captured for Captive Breeding in 2022 and 2023

Year of Capture	Area	Age	Sex	Current Status
2022	Private Property	Adult	Male	Live
2022	Private Property	Adult	Female	Live
2022	Private Property	Adult	Female	Live
2022	Private Property	Adult	Male	Live
2022	Private Property	Sub-adult	Female	Deceased
2022	Private Property	Adult	Female	Live
2023	Private Property	Adult	Female	Live
2023	Private Property	Sub-adult	Male	Live
2023	Private Property	Adult	Female	Live
2023	La Su An Wildlife Area	Adult	Female	Live

One gravid female that was collected gave birth to 24 young excluding two stillborn (USFWS 2023) in August 2022. Multiple young perished shortly after birth, possibly due to not eating and/or a fungal infection (Cross 2022, personal communication). One young perished nearly a year into captivity. A necropsy was conducted but no definitive cause of death was determined (Cross 2023b, personal communication). A second snake exhibited similar symptoms, but these were resolved after administering a vitamin B injection (Cross 2023b, personal communication). To address a potential vitamin B deficiency the variety of the diet will be increased (Cross 2023b, personal communication). Of the young born in captivity 71% have continued to survive

(Cross 2023, personal communication), which is significantly higher than survival in the wild for the first 1-3 years, during which time high rates of mortality commonly occur to neonates in similar species (Kissner and Weatherhead 2005).

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding): No new information since the 2018 5-year review.

2.3.1.4 Taxonomic classification or changes in nomenclature:

The recovery plan (USFWS 2008) summarizes the taxonomic history of the copperbelly watersnake. At the time of listing, the copperbelly watersnake was regarded as a subspecies of the plain-bellied watersnake (*Nerodia erythrogaster*). DNA research by Marshall *et al.* (2009) utilized seven microsatellite loci from specimens in three states to quantify genetic population structure. Multi-dimensional scaling and AM OVA analyses were consistent with the observed patterns of genetic differentiation as is the STRUCTURE analysis, which indicated there was support for either a two or three population cluster model among the sites (USFWS 2018). While work by Makowsky *et al.* (2010) found that the subspecies show little genetic divergence from one another and concluded that most populations assigned to *N. erythrogaster* represent a single, freely interbreeding, widespread species (USFWS 2018). As a result of this information, the Service requested a technical review from the Service Conservation Genetics Community of Practice. That review suggested that taxonomic reclassification could also incorporate range-wide microsatellite data if more populations were analyzed (USFWS 2018). For more information on this research and review see the 2018 5-Year Review. We concluded that the subspecies designation and delineation as a DPS remain valid until additional genetic analysis provides clarification. The eighth edition of the Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico continues not to recognize any subspecies of plain-bellied watersnake (Bonett et al. 2017).

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

Of the seven clusters of wetlands surveyed in Ohio and Michigan during 2022, copperbellies were only found within one wetland cluster (USFWS 2023). Six (86%) of the seven copperbelly sightings were from the same wetland (USFWS 2023). It appears that many of the wetlands that were occupied by this species in previous years are no longer inhabited. Thus, the population appears to be concentrated into a smaller area. In addition, a single snake was found at La Su An Wildlife Area in 2023 indicating that very few individuals are present at this site. The capture of a gravid female in 2022 (USFWS 2023) appears to indicate that reproduction is continuing to occur in the wild.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem): No significant development has occurred within the immediate vicinity of the only known extant population. Since the last 5-year review was completed in 2018, 266.54 acres have been restored or managed for the copperbelly watersnake in Michigan by the Private Lands program of the Service (Roberts 2023, personal communication). Approximately 90 acres

of habitat improvement occurred for this species in Indiana by the Private Lands program in the last five years (Kiefer 2023, personal communication).

Visual surveys seem to indicate there is still sufficient food with multiple individuals and species of frogs, toads, and other herps detected at every wetland monitored (USFWS 2023). In addition, an x-ray revealed that the gravid female brought into captivity had consumed multiple adult amphibians (Cross 2022, personal communication) indicating that there was no shortage of prey.

2.3.2 Threat Analysis and Current Species Status

Recent surveys in Indiana and Ohio have resulted in no individuals detected in 2020 and 2021 and only six and five individuals observed in Ohio and a single site in Michigan in 2022 and 2023, respectively. The final listing rule indicated small, isolated populations of copperbelly watersnakes are vulnerable to stochastic events, such as weather extremes or fluctuations.

Due to intense concern about the drastic declines in this species' population, species experts decided to initiate captive rearing in an effort to enhance populations by headstarting young. A captive rearing plan was written in 2021 (Cross and Mayer 2021). In 2022, USFWS provided funding for a trailer to be purchased and retrofitted for use as a captive breeding and headstarting facility. While limited mortality has occurred, as expected, most individual copperbellies are doing well in captivity.

The final listing rule identified habitat loss and fragmentation as the primary causes of the decline of the copperbelly watersnake. Other threats addressed in the final listing rule include collection by amateur collectors and commercial dealers and a general persecution of snakes by humans (62 FR 4183) and this continues to be an issue (USFWS 2018).

Since listing the copperbelly water snake in 1997, we have achieved a better understanding of its habitat requirements and foraging movements. While many efforts to restore habitat for the copperbelly have been accomplished and continue to be pursued, landscape-level wetland and upland restoration to improve overall copperbelly populations has not been achieved. Furthermore, habitat connectivity to link small, isolated populations to improve resiliency to stochastic events has not been accomplished as recent surveys have failed to detect individuals at sites where they were previously documented.

Although habitat loss and fragmentation remain the primary threat, climate change may constitute a significant threat for the copperbelly watersnake. According to the Intergovernmental Panel on Climate Change (IPCC) (2022), "Without limiting warming to 1.5°C, key risks to North America are expected to intensity rapidly by mid-century (*high confidence*)." Annual precipitation has increased in the midwestern U.S. with increases in the intensity and frequency of single-day heavy precipitation events (Hicke et al. 2022). However, additional drought related stress may also cause impacts (Hicke et al. 2022). The potential changes to ephemeral wetlands and amphibian populations may have consequences for the copperbelly (USFWS 2018), which relies on foraging for amphibians in ephemeral wetlands. We lack sufficient certainty, however, to know specifically how climate change will affect this species.

Snake fungal disease (SFD) is another threat to copperbelly watersnake populations. All copperbellies brought into captivity are tested for SFD. Snakes that are symptomatic will be treated. Individual adult snakes are housed separately, and other best management practices will limit the spread of SFD to individuals in captivity. Several young perished shortly after birth and samples were sent for testing but SFD was not confirmed (Cross 2022, personal communication). One individual has tested positive when it was tested due to the presence of several blisters (Cross 2023, personal communication). That individual fully recovered without treatment and later tested negative (Cross 2023, personal communication). All adults were tested as well as groups of young that are housed together and all of these tests were negative (Cross 2023, personal communication).

Recent surveys have documented less than a dozen snakes each year indicating that the copperbelly watersnake northern DPS population is likely very small. Occupancy modeling as well as other methods using more recent data suggested a potential decreasing trend (USFWS 2018). Recent surveys in both Ohio and Indiana and the single Michigan site seem to support this trend.

At its current level, the copperbelly watersnake population meets both criteria set forth in the recovery plan for reclassification from threatened to endangered status. Due to concerns about population declines, a propagation plan was developed in 2021. The plan includes both captive propagation as well as headstarting of young so that individuals are released at a more mature age and larger size (Cross and Mayer 2021).

As the recovery criteria have not been met, the known threats have not significantly diminished, climate change represents a new and uncertain threat, and surveys in areas where they were previously detected have not found individuals in 2020, 2021, and 2022 (IDNR 2021, USFWS 2023) we continue to recommend the copperbelly watersnake northern population segment be considered for reclassification from threatened to endangered.

3.0 RESULTS

3.1 Recommended Classification

___ **Downlist to Threatened**
_X_ **Uplist to Endangered**
___ **Delist** (*Indicate reasons for delisting per 50 CFR 424.11*):
    ___ *Extinction*
    ___ *Recovery*
    ___ *Original data for classification in error*
___ **No change is needed**

3.2 New Recovery Priority Number

Recovery Priority Number: 3c (No change is needed).

Brief Rationale: The recovery priority number for the copperbelly water snake is 3c, indicating that it is: (1) taxonomically, a subspecies; (2) facing a high degree of threat; (3) rated high in terms of recovery potential; and (4) in conflict with construction or other development project(s) or other forms of economic activity.

This subspecies continues to face a high degree of threat. These threats include loss or conversion of forest and wetland habitat. Restoration and conservation projects continue to be implemented, as well as research and captive rearing efforts creating high potential for recovery. Although several projects (e.g., conservation easements, restoration grants) have resulted in either the protection or restoration of suitable habitat for the copperbelly watersnake, the threat of habitat loss and fragmentation remains high. Most of the land in the range of the northern DPS is privately owned. The primary form of economic activity in conflict with the copperbelly is agriculture. Row crops in particular do not provide suitable habitat and fragment remaining forest from wetland habitat. Residential development also removes and fragments habitat, but is not widespread in the copperbelly range.

3.3 Listing and Reclassification Priority Number

Reclassification (from Threatened to Endangered) Priority Number: 3

Brief Rationale: The reclassification priority number of 3 indicates: (1) the magnitude of threat is high; (2) the immediacy of threats is imminent; and (3) taxonomically, the copperbelly is a subspecies.

The reclassification priority number of 3 is justified because the copperbelly has already been identified as facing a high degree of threat. The primary threat facing copperbellies, habitat loss and fragmentation, is an actual, known threat that has been well documented in the recovery plan as well as previous 5-year reviews. Taxonomically, it remains a subspecies.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Recommended future actions to proceed with the recovery of this species focus on protecting populations, habitat management and protection, research into causes of population decline, research to gain a better understanding of the species, and possible augmentation of populations. These actions are listed below with highest priority actions listed first:

- Coordinate monitoring among all three states where this species' range occurs so that information is consistent and meaningful for comparisons.
- Continue to monitor this species annually in some locations to determine trends such as number of snakes observed per survey hour.
- Release and monitor captive-reared individuals for reproductive output, recruitment, individual growth, and survival.
- Provide adequate habitat protection for the area where copperbelly watersnakes are still present through the purchase or establishment of conservation easements based on creation of corridors for migration between suitable wetland and upland areas.

- Continue to work with the Toledo Zoo to collect individuals for captive propagation and implement the captive propagation plan.
- Conduct research to determine the cause of recent population declines to determine what actions could increase the viability of populations.
- Continue to gather information on the prevalence of SFD and determine if it contributes to mortality of individuals.
- Conduct adequate management at sites where individuals still exist.
- Continue to work with private landowners to restore habitat.
- Conduct additional genetic analyses using multiple data sources (e.g., comparing mitochondrial and nuclear genomic sequence data) to assess level of gene flow, genetic differentiation among subspecies, and range-wide genetic structure.
- Identify, assess, and reduce threats at known sites and focal management areas.
- Evaluate translocation as a method of population augmentation and potential reintroductions into historical/suitable habitats, as discussed in the captive propagation plan.
- Assess the impact of predation on snakes released from the captive propagation program.
- Investigate the abundance and stability of the southern population and any potential landscape level differences in habitat use and conservation.
- Investigate the relevance of eDNA as a survey tool.
- Develop and implement public education and outreach efforts.
- Analyze morphological variation and ecological niche differentiation between subspecies.
- Conduct research to determine characteristics of high-quality hibernacula and how they are dispersed in the environment.
- Improve baseline understanding of copperbelly watersnake ecology.

5.0 REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Copperbelly Watersnake Northern Population Segment

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

___ Downlist to Threatened
_X_ Uplist to Endangered
___ Delist
___ No change is needed

Appropriate Listing/Reclassification Priority Number: 3

Review Conducted By: Jenny Finfera

FIELD OFFICE APPROVAL:
Lead Field Supervisor (Acting), Fish and Wildlife Service

Approve SCOTT HICKS Digitally signed by SCOTT HICKS Date: 2023.09.27 14:24:11 -04'00' Date: September 27, 2023