Species Status Assessment

Common Name: Northern dusky salamander **Date:** January 8, 2025

Scientific Name: *Desmognathus fuscus* **Updated By:** C. Macklem, J. Butler

Class: Amphibia

Family: Plethodontidae

Species Synopsis:

The northern dusky salamander, *Desmognathus fuscus* (Rafinesque 1820), belongs to the Plethodontidae family of salamanders. The Plethodontidae family of salamanders are often referred to as lungless salamanders, as they lack lungs and are dependent on their skin for respiration. The Plethodontidae family is also the most diverse salamander family with over 500 species.

Evidence suggests that the current *D. fuscus* taxonomy is paraphyletic, with decades-worth of research repeatedly identifying several unique clades within the presently recognized species (Karlin and Guttman 1986, Kozak et al. 2005, Tilley et al. 2008, Moriarty 2017, Pyron et al. 2020). A recent study examining genetic, geographic, and morphological evidence identified six new species from populations that were previously associated with the spotted (*D. conanti*) and northern dusky salamanders, totaling eight unique species (Pyron and Beamer 2023). Inclusion of these new species stabilized the previously paraphyletic taxonomy, though additional cryptic diversity may exist for both *D. conanti* and *D. fuscus* (Pyron and Beamer 2023).

The exact geographic delineations of the newly designated species have not been fully elucidated; therefore, the distribution description of *D. fuscus* is based on the currently recognized taxonomic designation. In Canada, the species can be found in southern New Brunswick, southeastern Quebec, and southern Ontario (Kamstra 1991). In the United States, the species distribution encompasses northern states such as New York, Vermont, New Hampshire, and Maine and extends south to Georgia. The western edge of the species' distribution includes southeastern Indiana, western Kentucky, eastern Tennessee, and northeastern Georgia, while the species' distribution extends south to North Carolina on the eastern edge (Conant and Collins 1991, Titus and Larson 1996, Bonett 2002, Beamer and Lamb 2008).

The species is considered to be widespread and common in New York, though localized declines have been noted, particularly in urban areas. The species is found in close association to streams, springs, and seepages with natural cover objects throughout the state, except in Long Island and portions of the Great Lakes/St. Lawrence River Plain regions (Gibbs et al. 2007).

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed, SGCN

b. Natural Heritage Program

i. **Global:** G5

ii. **New York:** S5 **Tracked by NYNHP?:** No

Other Ranks:

-IUCN Red List: Least Concern
-COSEWIC (2012): Endangered in Ontario
-Northeast Regional SGCN list (2023): Not Listed
-NEPARC Regional List (2010): Species of Low Concern and High Responsibility

Status Discussion:

Within New York, the northern dusky salamander is currently considered to be secure. However, documented declines in specific northern dusky salamander populations have been observed in New York and neighboring states and provinces. The species is considered a SGCN in Connecticut, New Jersey, Rhode Island, and Kentucky. Additionally, the species is currently listed as Endangered in Ontario, Canada, due to the presence of a small, isolated population that is particularly vulnerable to stochastic events (COSEWIC 2012, Environment and Climate Change Canada 2022).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable		N4N5	
Northeastern US	Yes	Stable	Stable		S4S5	No
New York	Yes	Choose an item.	Choose an item.	2005-2015	S5	Yes
Connecticut	Yes	Choose an item.	Choose an item.	2005-2015	S4	Yes
Massachusetts	Yes	Choose an item.	Choose an item.	2005-2015	S4S5	No
New Jersey	Yes	Choose an item.	Choose an item.	2005-2015	S4	Yes
Pennsylvania	Yes	Choose an item.	Choose an item.	2005-2015	S5	No
Vermont	Yes	Choose an item.	Choose an item.	2005-2015	S5	No
Ontario	Yes	Declining	Declining	Through 2022	S1, E	Yes
Quebec	Yes	Declining	Declining	Through 2012	S3	No

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York:

There are currently no regular monitoring activities for the northern dusky salamander in New York. The species was included in the NY Amphibian and Reptile Atlas (Herp Atlas), which was conducted from 1990-1999, and documented the geographic distribution of all species of amphibians and reptiles in the state. The Herp Atlas database also includes pre-1990 records from various sources, such as museum records, researchers' field notes, agency reports, and published literature.

Trends Discussion:

While the species is currently considered widespread and common throughout its range, there are indications of local population declines across the geographic range of the species as well as across a gradient of development from rural to urban. Declines have been documented following development disturbance and as a result of the habitat and microhabitat changes that occur following development. These declines have been documented in several states including New York.

Bank et al. (2006) conducted intensive surveys of stream salamanders in Acadia National Park from 2000-2003 and observed significantly fewer *D. fuscus* than historical data. Although the cause for population decline could not be identified, stressors such as stocking of predatory fish, fungal pathogens, substrate embeddedness, and widespread pollution from atmospheric pollutants of surface waters were mentioned as potential causes. This decline was notable at the time, as the National Park has reduced anthropogenic impacts relative to more suburban or urban *D. fuscus* populations.

In North Carolina, researchers examined the impact of urbanization on *D. fuscus* abundance (Price et al. 2011). They found that urbanization had a negative effect on both larval and adult *D. fuscus* salamander abundances. Larval salamander abundances were reduced one year after urbanization, while adult salamander abundances were reduced three years post-urbanization. They also documented increases in maximum stream conductivity and siltation following urbanization. The average area of urbanized development in the study watersheds was 35% but ranged from 1-78%.

Munshi-South et al. (2013) performed genetic analyses on *D. fuscus* populations and found that heterozygosity was moderately low in a population found in Watchung Reservation, NJ, and two Staten Island populations (H=0.40-0.57), but considerably lower in two populations found in Northern Manhattan (H=0.14 and 0.29). Evidence of genetic bottlenecks were also found in the Manhattan sites and the Watchung Reservation (Munshi-South et al. 2013). Although populations in these fragmented urban sites have held on, it may be just a matter of time before they succumb to genetic drift due to low diversity. Within these same Manhattan sites, biologists with NYC Parks have noticed a decline of the population in one seep that contains the non-native invasive lesser celandine (*Ficaria verna*) along the banks (pers. comms.).

A study performed by Macklem et al. (2020) estimated the density of *D. fuscus* individuals at less than one individual per 30-m stream segment in an exurban environment in Connecticut. This value was noticeably lower compared to an estimated 20 *D. fuscus* individuals per 10-m stream segment in the Piedmont of Western North Carolina (Willson and Dorcas 2003), an annual adult salamander abundance estimate of 12.2-46.6 individuals in non-urban streams and 9.9-40.7 individuals in urban streams in North Carolina (Price et al. 2011), and up to 70 individuals per 10-m stream segment in Georgia (Orser and Shure 1972). The population densities estimated by the study occurred in watersheds with less than 36% development.

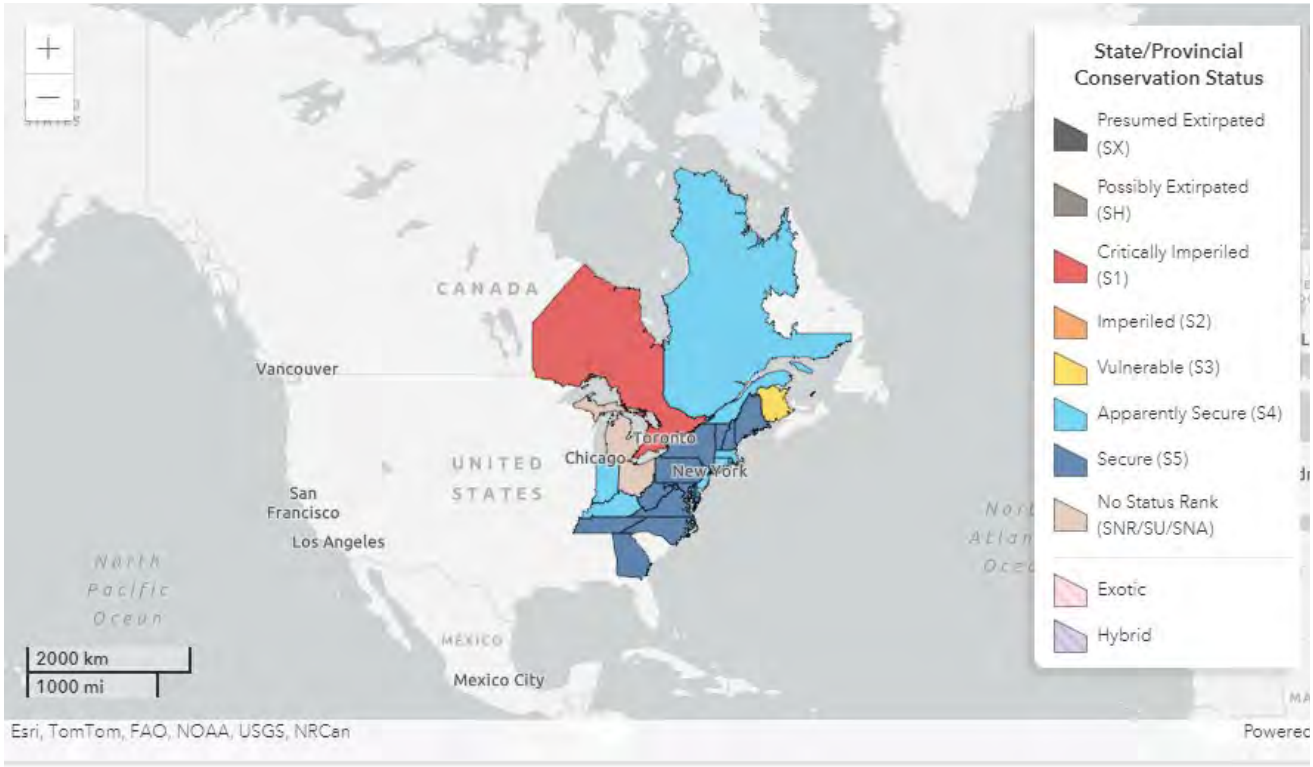

Figure 1. Conservation status of the northern dusky salamander (*Desmognathus fuscus)* (NatureServe 2024)

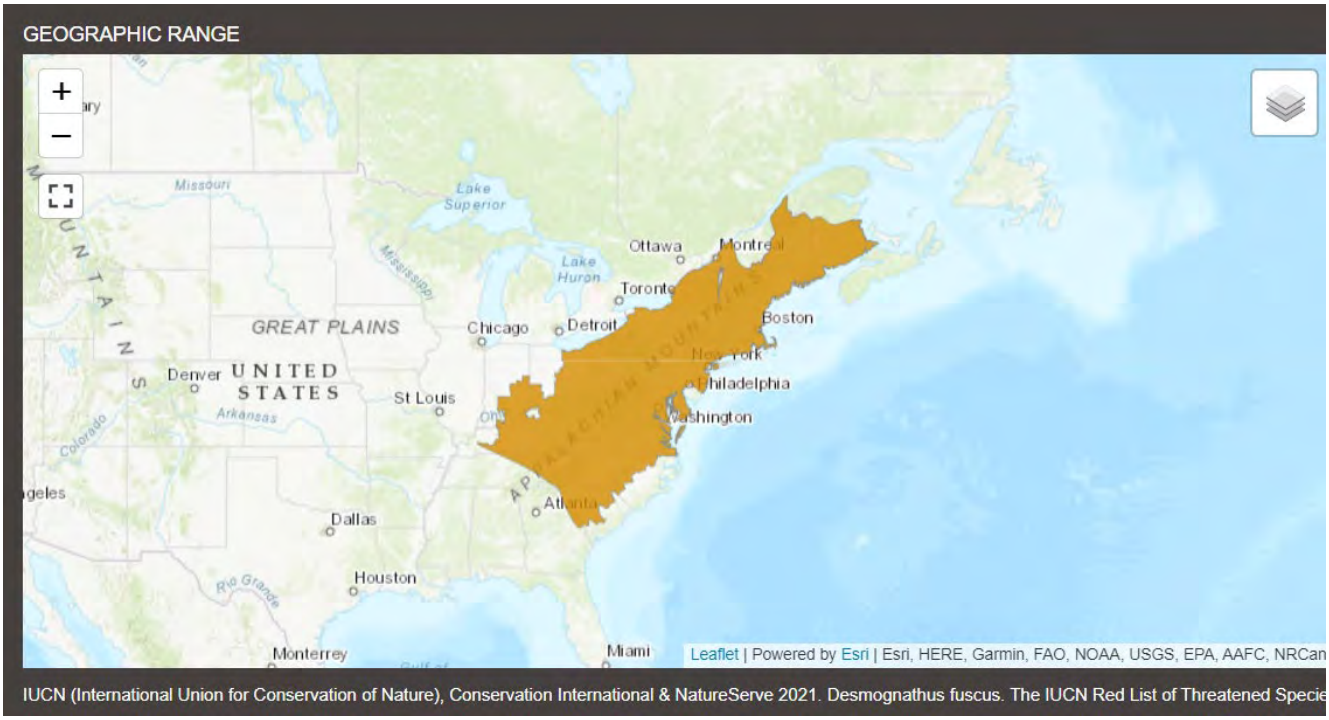

Figure 2. Range of the northern dusky salamander (*Desmognathus fuscus*) in the United States (IUCN 2023).

III. New York Rarity:

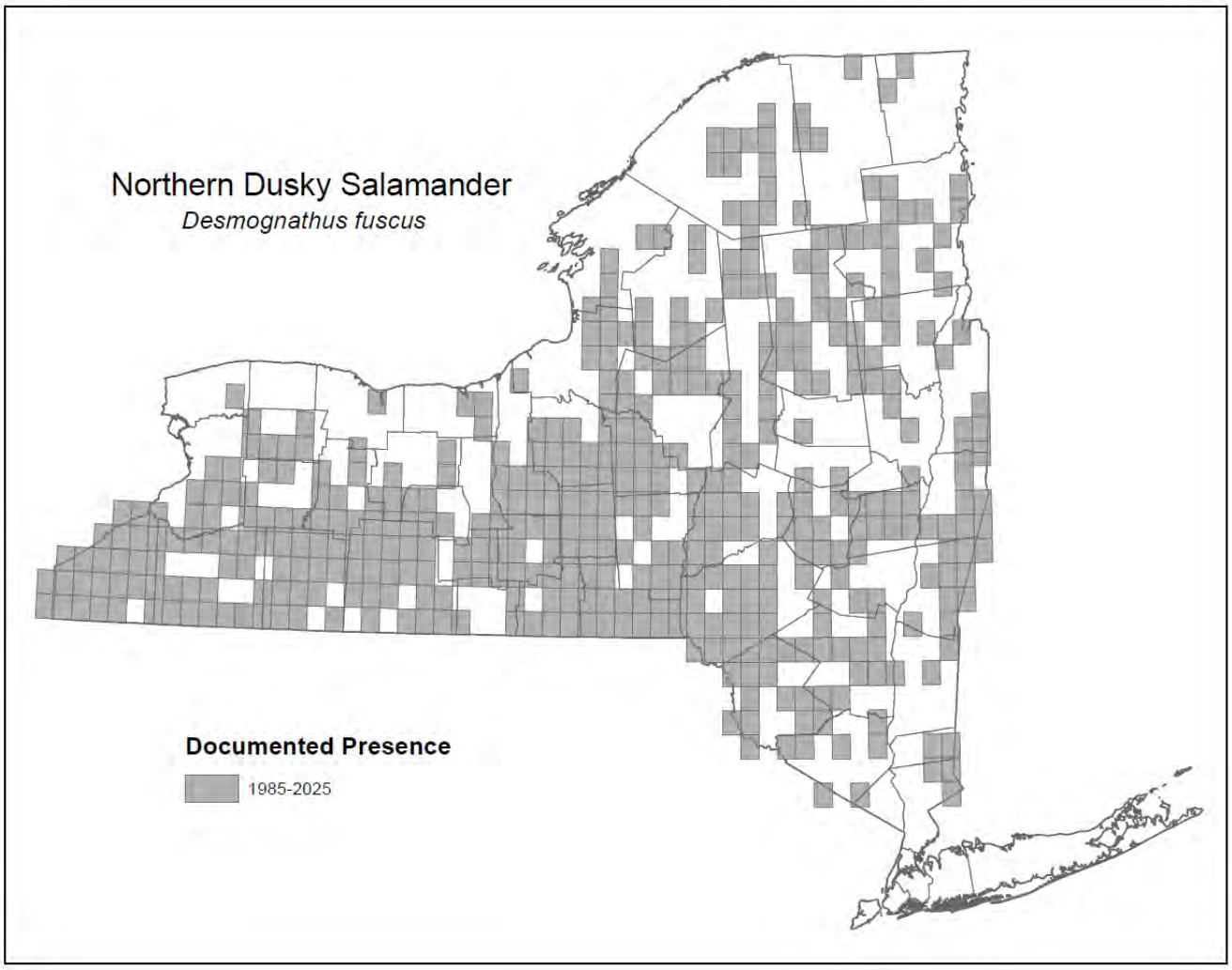

Figure 4. Documented presence of northern dusky salamander in New York (NYS Amphibian and Reptile Atlas).

Details of historic and current occurrence:

The NYS Amphibian and Reptile Atlas (1990-1999) documented northern dusky salamanders in 428 survey quads (USGS 7.5 min topographic quadrangles) and in every county north of New York City; however, they have been confirmed in a number of locations in New York City as well (Munshi-South et al. 2013). Data collected from 1985-1990 and post-1999, add an additional 15 survey quads for a total of 443 survey quads statewide.

Citizen science records submitted through iNaturalist identify an additional 17 quadrangles not included in Figure 4 (iNaturalist 2025). Additionally, only 68 of the 443 known survey quads have been reconfirmed using unobscured iNaturalist data.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Headwater/Creek

b. Riparian

c. Palustrine

d. Floodplain Forest

e. Mixed Northern Hardwoods

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Desmognathus fuscus occurs almost exclusively in or very near running water, preferring woodland streams, seepages, and springs with rocky and/or natural debris cover (Conant and Collins 1998). However, the species is rarely found in fast-flowing water (Wilder 1913). These salamanders use burrows or leaves, rocks, or other natural cover objects in or near the water (Petranka 1998). Eggs are typically also laid in or near the water under moss, rocks, or logs, or in streambank cavities (Petranka 1998). Larvae are fully aquatic (Petranka 1998). In New York, they can be found in these habitats across the state, except on Long Island and in portions of the Great Lakes/St. Lawrence River Plain (Gibbs et al. 2007).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	-	-	Yes	Yes	-

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *:*

Mating occurs on land near stream edges in the spring and fall (Bishop 1941). Females oviposit approximately 12-40 eggs adjacent to the stream, typically in a cavity or under cover such as leaves, logs, stones, or moss (Wilder 1913, Krzysik 1979, Hom 1987). Most females brood the eggs during the 50-80 days until they hatch, as egg clutches that are not brooded experience significantly higher mortality rates (Juterbock 1987). The larvae are fully aquatic and remain in the water for 7-11 months before metamorphosing into terrestrial juveniles (Green et al. 2007). Males typically reach sexual maturity after two to three years, while females tend to reach sexual maturity after three to four years (Petranka 1998).

Desmognathus fuscus salamanders have a limited home range of less than 50 m^2, exceedingly short dispersal movements, and the propensity to stay within 20-30 meters of the aquatic habitat (Barbour et al. 1969, Semlitsch and Bodie 2003, Perkins and Hunter 2006, Campbell Grant et al. 2010).

VI. Threats:

Habitat degradation, fragmentation, and insufficiently protected riparian buffers pose a threat to the long-term persistence of the species. *Desmognathus fuscus* appears to be particularly vulnerable to habitat and land use changes associated with development. Evidence for the species' vulnerability dates back to research in Georgia from the 1970's, which concluded that increased runoff and higher suspended particulate matter were found to significantly impact *Desmognathus* populations (Orser and Shure 1972). Increased runoff and sedimentation are often side effects of urbanization. Later research reiterated this concern by highlighting how *D. fuscus* occupancy and abundance declines with increased conductivity, in accordance with increasing development in the watershed (Willson and Dorcas 2003, Price et al. 2011, Campbell Grant et al. 2014, Bourne 2015, Macklem et al. 2020), and how *D. fuscus* densities are reduced with increased deposition of fine sediments in urban streams (Willson and Dorcas 2003, Price et al. 2011, Macklem et al. 2020). In increasingly urbanized landscapes, the species exhibits losses of genetic diversity and reductions in abundance (Price et al. 2011, Munshi-South et al. 2013, Macklem et al. 2020).

Furthermore, few protections exist for the low order headwater streams inhabited by *D. fuscus*, making them more susceptible to degradation (Power et al. 1988), especially as the first aquatic habitats to be affected by local watershed conditions including development and pollution (Willson and Dorcas 2003, Bank et al. 2006). Additionally, existing riparian buffers may not be sufficient to lessen the impacts of upland watershed development (Willson and Dorcas 2003). In an increasingly urbanized landscape, upland forests are intermixed with an often impermeable matrix of development that is unlikely to provide sufficient area or connectivity to support a species with limited dispersal abilities (Semlitsch and Bodie 2003, Hansen et al. 2005, Prugh et al. 2008, Campbell Grant et al. 2010, Munshi-South et al. 2013).

D. fuscus populations in Canada are threatened by anthropogenic impacts to water supply and quality as well as microhabitat quality and availability. Such anthropogenic impacts include urbanization, road and transmission corridor development, pollution, sedimentation, deforestation, and introductions of predatory fish and novel pathogens (COSEWIC 2012, Environment and Climate Change Canada 2022).

Desmognathus fuscus as well as other species in the *Desmognathus* genus are susceptible to *Ranavirus* infection. One study in Virginia in 2008-2009 found that 9% of *D. fuscus* sampled tested positive for *Ranavirus* (Hamed et al. 2013), while another study in Virginia in 2010 found that 58% of *D. fuscus* sampled tested positive for *Ranavirus* (Davidson and Chambers 2011B). However,

none of the *D. fuscus* salamanders in either study showed external signs of infection. Several studies have confirmed *Ranavirus* infections in other *Desmognathus* species as well (Gray et al. 2009, Davidson and Chambers 2011B, Hamed et al. 2013, Rothermel et al. 2013, Sutton et al. 2015, Bartlett et al. 2021).

Desmognathus fuscus and other *Desmognathus spp.* have also tested positive for chyrid infection. In Connecticut, *D. fuscus* salamanders were estimated to have a *Bd* infection prevalence of 36% (Richards-Hrdlicka et al. 2013). One study in Virginia found a 17% prevalence rate of *Bd* infection in *D. fuscus* as well as *Bd* infection in other *Desmognathus* species (Davidson and Chambers 2011A). Another study found low prevalence of *Bd* infection in *D. fuscus* in Maryland and *D. monticola* in Virginia, neither of which exhibited external signs of infection (Hossack et al. 2010). A later study in a southern Appalachian watershed had a prevalence rate of 2.2% *Bd* infection among *Desmognathus* species, though none exhibited morbidity or gross lesions (Rothermel et al. 2013). However, several studies have failed to detect *Bd* infections in other *Desmognathus* species, which could be indicative of low infection rates, reduced susceptibility relative to other species, and/or the ability to recover following infection (Rothermel et al. 2008, Vazquez et al. 2009, Keitzer et al. 2011).

Threat Level 1	Threat Level 2	Threat Level 3	Spatial Extent*	Severity*	Immediacy*	Trend	Certainty
1. Residential and Commercial	1.1 Housing & Urban Areas	Choose an item. (loss/degradation of habitat)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
2. Agriculture & Aquaculture	2.1 Annual & Perennial Non-Timber Crops	Choose an item. (loss/degradation of habitat)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
5. Biological Resource Use	5.3 Logging & Wood Harvesting	Choose an item. (effects of logging: roads, disrupting migratory movements, reducing water quality)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
8. Invasive & Other Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens (*Ranavirus*)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
8. Invasive & Other Problematic Species	8.4 Pathogens	8.4.3 Fungal pathogens (chytrid)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
9. Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides (pesticides; larvicide & aerial spraying for West Nile)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
11. Climate Change	11.3 Changes in Temperature Regimes	Choose an item.(temperature extremes)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
11. Climate Change	11.4 Changes in Precipitation & Hydrological Regimes	11.4.2 Droughts	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.

Table 1. Threats to northern dusky salamander.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

In 2006, the State of New York adopted legislation (ECL section 11-0107 sub 2) that gave all native frogs, turtles, snakes, lizards and salamanders legal protection as game species, and no salamander species are open to harvest. The legislation also outlaws the sale of any native species of herpetofauna regardless of its origin.

Under Article 24 of the New York State Environmental Conservation Law, the Freshwater Wetlands Act provides protection for wetlands greater than 12.4 acres in size as well as smaller wetlands of 'Unusual importance'. Beginning on January 1, 2028, the default size threshold of regulated wetlands will decrease to 7.4 acres. The Freshwater Wetlands Act also allows the Adirondack Park Agency to protect wetlands over one acre in size or any size wetland adjacent to open water within the Adirondack Park. The U.S. Army Corps of Engineers also protects wetlands, irrespective of size, under Section 404 of the Clean Water Act. Under Article 15 Title 5 of the New York State Environmental Conservation Law, the Protection of Waters program provides protection for the state's water resources, including rivers, streams, lakes, and ponds.

These protections are not adequate to protect all habitats utilized by the species in NYS.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Reduction of pollution and siltation into streams and freshwater wetlands, and conservation of habitat surrounding seeps and springs where northern dusky salamanders are found are some of the top management needs for the species. The species would benefit from increased wetland connectivity through appropriate culvert design and a reduction of road crossings through streams. Maintaining or creating forested buffers around streams and wetlands would minimize impacts of siltation and pollution. Leaving rocks, logs, and debris in streams provides cover for northern dusky salamanders.

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2005) includes recommendations for the following actions for stream salamanders. While northern dusky salamanders were not originally included, these actions would likely benefit the species as well. Actions that have been accomplished, or where progress has been made, are indicated with a check.

Habitat management:

____ Undertake remedial actions as needed to restore habitat quality in degraded streams.

Habitat research:

____ Develop standardized habitat survey protocols, and implement survey protocols at all known and potentially suitable sites, to document the character, quality and extent of occupied habitat.

Life history research:

____ Document life history parameters specific to New York populations of the species, including age and sex ratios, longevity, age at sexual maturity, survivorship of young, predator-prey relationships, and wetland/upland habitat requirements.

Modify regulation:

_✓_ Adopt into New York's Environmental Conservation Law provisions which designate all species in this group of stream salamanders as protected small game species.

Other action:

____ Periodically evaluate status of the species to determine whether the appropriate E/T/SC status listing is in effect.

Population monitoring:

____ Conduct periodic re-survey of known sites of species occurrence, in order to detect population trends.

Statewide baseline survey:

____ Develop standardized population survey protocols, and implement survey protocols at all known and potentially suitable sites, to document the extent of occupied habitat.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Action Category	Action	Description
A.1 Direct Habitat Management	A.1.0.0.0 Direct Habitat Management	Site/Area management
C.6 Design and Plan Conservation	C.6.0.0.0 Design and plan conservation	Site/Area protection
C.6 Design and Plan Conservation	C.6.0.0.0 Design and plan conservation	Resource/Habitat protection
C.6 Design and Plan Conservation	C.6.5.1.3 Develop a conservation, management, or restoration plan for protected private lands	Habitat and natural process restoration
C.7 Legislative and Regulatory Framework or Tools	C.7.1.2.0 Create, amend, or influence legislation	Legislation

Table 2. Recommended conservation actions for northern dusky salamanders.

VII. References

Bank, M. S., J. B. Crocker, S. Davis, D. K. Brotherton, R. Cook, J. Behler, and B. Connery. (2006) Population decline of northern dusky salamanders at Acadia National Park, Maine, USA. Biological Conservation 130:230-238.

Barbour, R. W., J. W. Hardin, J. P. Schafer, and M. J. Harvey. 1969. Home range, movements, and activity of the dusky salamander, *Desmognathus fuscus*. Copeia 1969:293-297.

Bartlett, P. L, T. M. Ward, D. E. Brue, A. K. Carey, and A. L. J. Duffus. 2021. Ranaviruses in North America: a brief review in wild herpetofauna. The Journal of North American Herpetology 2021(2):19-26.

Beamer, D. A., and T. Lamb. 2008. Dusky salamanders (*Desmognathus*, Plethodontidae) from the Coastal Plain: multiple independent lineages and their bearing on the molecular phylogeny of the genus. Molecular Phylogenetics and Evolution 47:143-153.

Bishop, S. C. 1941. The salamanders of New York. New York State Museum Bulletin No. 324.

Bonett, R. M. 2002. Analysis of the contact zone between the dusky salamanders *Desmognathus fuscus fuscus* and *Desmognathus fuscus conanti* (Caudata: Plethodontidae). Copeia 2002:344-355.

Bourne, J. C. 2015. Examining the impacts of valley fills in stream ecosystems on amphibian and aquatic insect communities in southeastern Kentucky. Proquest 1605058.

Campbell Grant, E. H., J. D. Nichols, W. H. Lowe, and W. F. Fagan. 2010. Use of multiple dispersal pathways facilitates amphibian persistence in stream networks. Proceedings of the National Academy of Science of the United States of America 107:6936-6940.

Campbell Grant, E. H., A. N. M. Wiewel, and K. C. Rice. 2014. Stream-water temperature limits occupancy of salamanders in mid-Atlantic protected areas. Journal of Herpetology 48:45-50.

Conant, R., and J. T. Collins. 1991. A field guide to reptiles and amphibians: eastern and central North America. Third edition. Houghton Mifflin Co., Boston, Massachusetts. 450 pp.

COSEWIC. 2012. COSEWIC assessment and status report on the Northern Dusky Salamander Desmognathus fuscus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiii + 56 pp.

Davidson, S. R. A., and D. L. Chambers. 2011A. Occurrence of *Batrachochytrium dendrobatidis* in Amphibians of Wise County, Virginia, USA. Herpetological Review 42(2):214–215.

Davidson, S. R. A., and D. L. Chambers. 2011B. *Ranavirus* prevalence in amphibian populations of Wise County, Virginia, USA. Herpetological Review. 42(4):540-542.

Environment and Climate Change Canada. 2022. Recovery Strategy for the Northern Dusky Salamander (*Desmognathus fuscus*), Carolinian population, in Canada. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. 3 parts, 28 pp. + vi + 30 pp. + 5 pp.

Gibbs, J. P., A. R. Breisch, P. K. Ducey, G. Johnson, J. L. Behler, R. Bothner. 2007. Amphibians and reptiles of New York State: Identification, natural history, and conservation. Oxford University Press. 504 pages.

Gray, M. J., D. L. Miller, and J. T. Hoverman. 2009. First report of *Ranavirus* infecting lungless salamanders. Herpetological Review 40(3):316-319.

Hamed, M. K., M. J. Gray, and D. L. Miller. 2013. First report of *Ranavirus* in Plethodontid salamanders from the Mount Rogers National Recreation Area, Virginia, USA. Herpetological Review. 44(3):455-457.

Hansen, A., R. L. Knight, J. M. Marzluff, S. Powell, K. Brown, P.H. Gude, and K. Jones. 2005. Effects of exurban development on biodiversity: Patterns, mechanisms, and research needs. Ecological Applications 15:1893-1905.

Hom, C. L. 1987. Reproductive ecology of female dusky salamanders, *Desmognathus fuscus* (Plethodontidae), in the southern Appalachians. Copeia 1987:768-777.

Hossack, B. R., M. J. Adams, E. H. Campbell Grant, C. A. Pearl, J. B. Bettaso, W. J. Barichivich, W. H. Lowe, K. True, J. L. Ware, and P. S. Corn. 2010. Low prevalence of chytrid fungus (*Batrachochytrium dendrobatidis*) in amphibians of U.S. headwater streams. Journal of Herpetology 44(2):253-260.

iNaturalist community. 2025. Observations of Northern Dusky Salamanders from New York (United States). Exported from https://www.inaturalist.org on 21 February, 2025.

IUCN SSC Amphibian Specialist Group. 2023. *Desmognathus fuscus*. The IUCN Red List of Threatened Species 2023: e.T78904880A58035807. https://dx.doi.org/10.2305/IUCN.UK.2023-1.RLTS.T78904880A58035807.en. Accessed on 07 October 2024.

Juterbock, J. E. 1987. The nesting behavior of the dusky salamander, *Desmognathus fuscus*. II. Nest site tenacity and disturbance. Herpetologica 43:361-368.

Kamstra, J. 1991. Rediscovery of the northern dusky salamander, *Desmognathus f. fuscus*, in Ontario. Can. Field-Nat. 105:561-563.

Karlin, A. A., and S. I Guttman. 1986. Systematics and geographic isozyme variation in the plethodontid salamander *Desmognathus fuscus* (Rafinesque). Herpetologica 42(3):283-301.

Keitzer, S. C., R. Goforth, A. P. Pessier, and A. J. Johnson. 2011. Survey for pathogenic chytrid fungus *Batrachochytrium dendrobatidis* in southwestern North Carolina. Journal of Wildlife Diseases 47(2):455-458.

Kozak, K. H., A. Larson, R. M. Bonett, and L. J. Harmon. 2005. Phylogenetic analysis of ecomorphological divergence, community structure, and diversification rates in dusky salamander (Plethodontidae: *Desmognathus*). Evolution 59(9):2000-2016.

Krzysik, A. J. 1979. Resource allocation, coexistance, and the niche structure of a streambank salamander community. Ecological Monographs 49:173-194.

Macklem D.C., A. M. Helton, M. W. Tingley, J. M. Dickson, and T. A. G. Rittenhouse. (2020) Stream salamander persistence influenced by the interaction between exurban housing age and development. Urban Ecosystems 23:117-132.

Moriarty, J.J. (editor). 2017. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. 8th edition. SSAR Herpetological Circular 43:1-104. [Updates in SSAR North American Species Names Database at: https://ssarherps.org/cndb].

Munshi-South J., Y. Zak, and E. Pehek. (2013) Conservation genetics of extremely isolated urban populations of the northern dusky salamander (*Desmognathus fuscus*) in New York City. PeerJ 1:e64 https://doi.org/10.7717/peerj.64.

NatureServe. 2024. NatureServe Explorer. Page last published (August 2, 2024). https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.859647/Desmognathus_fuscus. Accessed (October 7, 2024).

NEPARC. 2010. Northeast Amphibian and Reptile Species of Regional Responsibility and Conservation Concern. Northeast Partners in Amphibian and Reptile Conservation (NEPARC). Publication 2010-1.

New York State Department of Environmental Conservation (NYSDEC). 2005. New York State Comprehensive Wildlife Conservation Strategy. Albany, NY. https://extapps.dec.ny.gov/docs/wildlife_pdf/cwcs2005.pdf.

Orser P.N., and D. J. Shure. (1972) Effects of urbanization on the salamander Desmognathus fuscus fuscus. Ecology; 53: 1148–1154. https://doi.org/10.2307/1935428.

Perkins, D. W., and M. L. Hunter Jr. 2006. Use of amphibians to define riparian zones of headwater streams. Canadian Journal of Forest Research 36:2124-2130.

Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington and London. 587 pages.

Power, M. E., R. J. Stout, C. E. Cushing, P. P. Harper, F. R. Hauser, W. J. Matthews, P. B. Moyle, B. Statzner, and I. R. Wais de Badgen. 1988. Biotic and abiotic communities. Journal of the North American Benthological Society 7: 1-25.

Price, S. J., R. A. Browne, and M. E. Dorcas. 2011. Evaluating the effects of urbanization on salamander abundances using a before-after control-impact design. Freshwater Ecology doi:10.1111/j.1365-2427.2011.02699.x 1-11.

Prugh, L. R., K. E. Hodges, A. R. E. Sinclair, and J. S. Brashares. 2008. Effect of habitat area and isolation on fragmented animal populations. Proceedings of the National Academy of Sciences of the United States of America 105: 20770-20775.

Pyron, R. A., and D. A. Beamer. 2023. Systematic revision of the spotted and northern dusky salamanders (Plethodontidae: *Desmognathus conanti* and *D. fuscus*), with six new species from the eastern United States. Zootaxa doi:10.11646/zootaxa.5311.4.1.

Pyron, R. A., K. A. O'Connell, E. Moriarty Lemmond, A. R. Lemmon, and D. A. Beamer. 2020. Phylogenomic data reveal reticulation and incongruence among mitochondrial candidate species in dusky salamanders (*Desmognathus*). Molecular Phylogenetics and Evolution 146:106751.

Rafinesque, C. S. 1820. Annals of nature or annual synopsis of new genera and species of animals, plants, etc., discovered in North America. Lexington: Thomas Smith.

Richards-Hrdlicka, K. L, J. L. Richardson, and L. Mohabir. 2013. First survey for the amphibian chytrid fungus *Batrachochytrium dendrobatidis* in Connecticut (USA) finds widespread prevalence. Disease of Aquatic Organisms 102:169-180.

Rothermel, B. B., S. C. Walls, J. C. Mitchell, C. K. Dodd Jr., L. K. Irwin, D. E. Green, V. M. Vazquez, J. W Petranka, and D. J. Stevenson. 2008. Widespread occurrence of the amphibian chytrid fungus *Batrachochytrium dendrobatidis* in the southeastern USA. Diseases of Aquatic Organisms 82:3-18.

Rothermel, B.B., E.R. Travis, D.L. Miller, R.L. Hill, J.L. McGuire, and M.J. Yabsley. 2013. High occupancy of stream salamanders despite high *Ranavirus* prevalence in a southern Appalachians watershed. EcoHealth 10:184-189.

Semlitsch, R. D., and J. R. Bodie. 2003. Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles. Conservation Biology 17:1219-1228.

Sutton, W. B., M. J. Gray, J. T. Hoverman, R. G. Secrist, P. E. Super, R. H. Hardnman, J. L. Tucker, and D. L. Miller. 2015. Trends in *Ranavirus* prevalence among Plethodontid salamanders in the Great Smoky Mountains National Park. EcoHealth 12:320-329.

Terwilliger Consulting, Inc. and the Northeast Fish and Wildlife Diversity Technical Committee. 2023. Northeast Regional Conservation Synthesis for 2025 State Wildlife Action Plans. Northeast Association of Fish and Wildlife Agencies, Washington, D.C.

Tilley, S. G., R. L. Eriksen, and L. A. Katz. 2008. Systematics of dusky salamanders, *Desmognathus* (Caudata: Plethodontidae), in the mountain and Piedmont regions of Virginia and North Carolina. Zoological Journal of the Linnean Society 152: 115-130.

Titus, T. A., and A. Larson. 1996. Molecular phylogenetics of desmognathine salamanders (Caudata: Plethodontidae): a reevaluation of evolution in ecology, life history, and morphology. Systematic Biology 45:451-472.

Vazquez, V. M., B. B. Rothermel, and A. P. Pessier. 2009. Experimental infection of North American plethodontid salamanders with the fungus *Batrachochytrium dendrobatidis*. Diseases of Aquatic Organisms 84: 1-7.

Wilder, I. W. 1913. The life history of *Desmognathus fusca*. Biological Bulletin. 24:251-342.

Willson J. D., and M. E. Dorcas. (2003) Effects of habitat disturbance on stream salamanders: implications for buffer zones and watershed management. Conservation Biology 17:763–771. https://doi.org/10.1046/j.1523-1739.2003.02069.x

Originally prepared by	John Butler and Cristina Macklem
Date first prepared	October 4, 2024
First revision	
Latest revision	October 15, 2024