



Unisexual *Ambystoma* (Jefferson salamander dependant population)



Photo: © Jim Bogart

Scientific name

Ambystoma laterale - (2) *jeffersonianum*

Taxon

Amphibians

COSEWIC Status

Endangered

Canadian range

Ontario

Reason for Designation

These unusual unisexual salamanders occupy restricted areas within populated and highly modified areas of Ontario and depend on an endangered sperm donor species, Jefferson Salamander (*Ambystoma jeffersonianum*), for recruitment. The salamander faces numerous threats from human activities, leading to habitat loss and fragmentation, making its continued existence precarious.

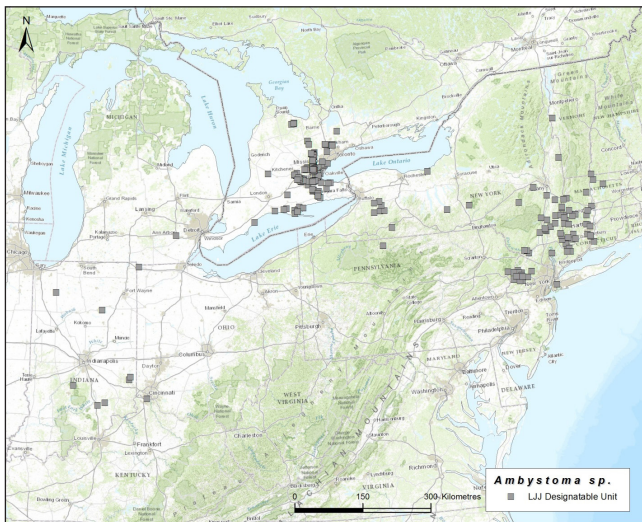
Wildlife Species Description and Significance

All-female populations of *Ambystoma* (i.e., unisexuals) are members of the Mole Salamander family Ambystomatidae. Their morphology is variable and is determined by their nuclear genomes. Unisexuals with two or more Blue-spotted Salamander (*A. laterale*) chromosome complements are black with various amounts of blue flecking, and have relatively short limbs and a narrower head. Unisexuals with two or more Jefferson Salamander (*A. jeffersonianum*) chromosome complements are larger, grey to brown with a small amount of blue flecking, and have relatively long limbs and a broader head. Unisexuals with two or more Small-mouthed Salamander (*A. texanum*) chromosome complements are grey, more slender, and have narrow heads.

Unisexual *Ambystoma* all share a very similar mitochondrial DNA that is distinctly different from any bisexual species. They have a unique genetic system and represent a distinct, monophyletic lineage that arose 3 to 5 million years ago, making them the oldest lineage of unisexual vertebrates known. Eggs normally develop by gynogenesis. This process requires sperm, derived from sympatric bisexual species. The sperm is only used to initiate the development of the eggs and typically is not incorporated in the developing embryo. In rare cases, sperm are incorporated, and when DNA from sperm are incorporated, the ploidy of the embryos increases (i.e., triploid to tetraploid).

Distribution

Unisexual salamanders are found in association with appropriate bisexual species whose males serve as sperm donors. The geographic range of unisexual salamanders in the genus *Ambystoma* roughly coincides with deciduous and mixed-wood forests in northeastern North America from Nova Scotia and the New England States to Indiana. Their northern limits are in Minnesota, north-central Ontario, and southern Quebec, and they range south to Kentucky. Three designatable units are considered in this report, based on their sperm-donor species. In Canada, unisexual salamanders are found in association with the Blue-spotted Salamander in Nova Scotia, New Brunswick, Quebec, and Ontario; with the Jefferson Salamander in Ontario; and with the Small-mouthed Salamander on Pelee Island in Lake Erie, Ontario. In Canada, unisexual populations of salamanders occur in all known Jefferson Salamander and Small-mouthed Salamander populations, as well as in the majority of Blue-spotted Salamander populations that have been investigated. Unisexual Salamanders can be much more numerous than individuals of sympatric bisexual species that serve as sperm donors.



Global distribution of Unisexual *Ambystoma* – Jefferson Salamander dependent population (*Ambystoma laterale* - (2) *jeffersonianum*), they rely on the Jefferson Salamander as a sperm donor. These populations contain individuals that normally possess one Blue-spotted and two Jefferson Salamander chromosome complements (i.e. LJJ).

Habitat

Unisexual Salamanders have the same habitat requirements as their respective sperm-donating species. They are normally found within deciduous or mixed forests containing, or adjacent to, suitable breeding ponds. Breeding ponds are normally ephemeral, or vernal, pools that dry in late summer. Terrestrial habitat is in moist woodlands, where the salamanders find shelter from predators and desiccation under fallen trees or rocks, as well as in mammal burrows. Adults forage during humid conditions at night on the forest floor within ~1 km of the breeding pond. These salamanders also require terrestrial overwintering sites below the frost line.

Biology

In conjunction with individuals of their sperm-donating species, unisexual adults migrate to and from breeding ponds at night very early in spring. Most migration events to and from breeding ponds coincide with rain or very humid conditions. Courtship occurs with sympatric bisexual males and, within a day or two after mating, unisexual salamanders deposit several egg masses on sticks or emergent vegetation at various depths in the breeding pond. Egg deposition may occur under the ice. Duration of egg and larval development is variable and temperature-dependent. Larvae are carnivorous and eat a variety of invertebrates and are also cannibalistic. In Canada, larvae normally transform in July or early August and leave the pond. Juveniles and adults are entirely terrestrial except for the annual breeding period.

Population Sizes and Trends

Estimation of population sizes of unisexual salamanders is difficult because they are morphologically similar to females of their sympatric sperm-donating species. Most of the historical sites surveyed for the Jefferson Salamander in 1990 and 1991 no longer supported either the Jefferson Salamander or unisexual salamanders in 2003 and 2004. Furthermore, at some sites where both Jefferson Salamanders and unisexuals still existed in 2003-2004, there was a notable reduction in the

number of egg masses compared to numbers found in earlier surveys. Population sizes of unisexuals vary with respect to the sperm donor and geographic area. All subpopulations of Jefferson Salamanders and Small-mouthed Salamanders also contain unisexuals that can account for ~ 85% of individuals at a site. The percent of unisexuals found in Blue-spotted Salamander breeding ponds is more variable, and some of those ponds have not yielded any unisexuals.

Threats and Limiting Factors

Loss of sexual sperm donors is a limiting factor unique to unisexual *Ambystoma* because they require the presence of diploid males of their sexual hosts for reproduction. Threats include: i) partial or absolute elimination of suitable habitat by development, including loss of breeding ponds, trees and ground cover; ii) barriers (e.g., roads, silt fences) across migratory routes linked to breeding ponds; and iii) premature pond drying during summer.

Protection, Status and Ranks

Unisexuals coexist with species some of which have a designated conservation status and are morphologically indistinguishable from those species. Connecticut lists *A. jeffersonianum* “complex” and *A. laterale* “complex” as state species of special concern. In Ontario, Jefferson Salamander dominated polyploids are unisexuals that require Jefferson Salamander males. Since 2010, these

individuals have received the same habitat protection as the Jefferson Salamander under the provincial *Endangered Species Act, 2007* (ESA) (see O.Reg. 242/08 s.28). So far, there is no similar regulation for Canadian unisexuals that live with the Endangered Small-mouthed Salamander (*A. texanum*) on Pelee Island, Ontario, or unisexuals that depend on the Blue-spotted Salamander (*A. laterale*).

Source: COSEWIC. 2016. COSEWIC assessment and status report on the unisexual *Ambystoma*, *Ambystoma laterale*, Small-mouthed Salamander–dependent population, Jefferson Salamander–dependent population and the Blue-spotted Salamander–dependent population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxii + 61 pp.

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