

Next Steps; Where From Here?

The Landscape Ecology Research Team at the University of Massachusetts has constructed the research infrastructure for an unparalleled long-term study of amphibian populations in western Massachusetts. This study offers an opportunity to address many research questions with great conservation importance.

- How big an area is needed to support a healthy amphibian population over time?
- How independent or interconnected are amphibian populations from different breeding sites in the same vicinity?
- How do roads and development affect the movement of salamanders to and from breeding ponds and the dispersal of individuals in search of new breeding sites?

Answering these seemingly basic questions about how marbled salamanders live will allow natural resource professionals to go the next step - to determine what habitat conditions these animals need to thrive in the future. With this new information, public and private conservation partners alike may finally have the odds in their favor in their efforts to keep these wonderful creatures around in our Massachusetts woodlands.

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**The Landscape Ecology Program is an integrated program in teaching, research, and outreach promoting sustainable landscape management. To learn more about this program, visit the program's website (www.umass.edu/landeco)*

Implementing the Millennium Power Plant Conservation Plan:

Marbled Salamander Research and Conservation

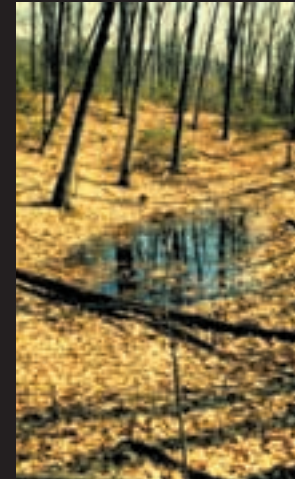


Aldrich Lake

Why the Marbled Salamander?

The marbled salamander is the rarest salamander in Massachusetts. It is listed as a "threatened" species and is protected by the state's Endangered Species Act. Marbled salamanders are threatened, in part, because suburban development and roadways eliminate important habitat and prevent them from reaching their breeding ponds.

These cryptic creatures spend all day and most nights underground, emerging only to snatch a passing cricket or worm. While spending most of their lives in dry woodlands, marbled salamanders depend on unique wetlands called vernal pools for breeding. These pools dry up almost every summer, but fill with water in the winter and spring, creating a rich and fish-free aquatic habitat for many young amphibians and invertebrates.



vernal pool

Unlike other amphibians in Massachusetts, marbled salamanders mate and lay their eggs in late summer and early fall. Eggs deposited in dry vernal pools hatch after they are flooded by autumn rains and the tiny salamander larvae over-winter beneath the ice in these pools. In the spring, these larvae are important predators of





salamander larva

insect larvae, crustaceans and tadpoles. They transform into terrestrial juveniles in May or June and spend the rest of their lives on land as forest animals.

A Partnership for Conservation

During the permitting process for the Millennium generating plant in Charleton, Massachusetts, it was determined that, due to potential impacts to marbled salamanders, a conservation permit was required under the Massachusetts Endangered Species Act. The final conservation plan included three strategies to promote marbled salamander conservation in the vicinity of the power plant and throughout the state.

 **Habitat Conservation:** acquisition and protection of important upland habitat around the power plant

 **Habitat Creation:** increasing the number of salamanders and enhancing the long-term viability of the local population by creating additional breeding pools

 **Targeted Research:** funding research at the University of Massachusetts to better understand salamander habitat use and movement patterns

The University of Massachusetts has been fundamentally involved in implementing this conservation plan. This exciting project has already produced success stories for the marbled salamander, prompting media coverage on regional radio programs and National Geographic Television. Research is shedding light on the life history of the elusive marbled salamander and other unique vernal pool amphibians, providing critical information for conservation decision-making.



Accomplishments to Date

Habitat Conservation



In addition to land around the power plant that was set aside for salamander habitat, broader habitat conservation efforts have emerged

as a result of research and technical assistance provided by the University of Massachusetts.

- After intensive survey efforts, the UMASS research team identified three top priority conservation areas for marbled salamanders in Massachusetts.
- Within these priority conservation areas, at least seven parcels of land totaling over 220 acres have been purchased by the state and private conservation trusts to advance marbled salamander conservation. These lands also offer refuge to several other rare salamanders and turtles and provide broader wildlife conservation and recreational values.



eastern box turtle

Targeted Research - Highlights

With funding provided as a component of the conservation plan, UMASS biologists have initiated an intensive study of marbled salamander ecology at a research site in South Hadley, MA. The research is uncovering critical information about salamander biology. Here are some early findings:



Picky About Ponds. Not all ponds look the same to a salamander. At our study sites, most marbled salamanders are utilizing ponds with medium-length hydroperiods (the length of time a pond holds water). Perhaps this is because they provide the most reliable dry nesting areas, but hold water long enough for larvae to reach metamorphosis in the late spring.



"Boom and Bust" Breeding Cycles. A successful breeding season may indeed be rare for marbled salamanders in Massachusetts. There are countless weather-related variables that must be perfect for salamanders to hatch, survive and transform into young land creatures. The result is a boom and bust cycle with frequent busts! The successful years must compensate for the poor ones, and good years may produce thousands of tiny salamanders from a single breeding pond.



The Longest Mile. Marbled salamanders travel impressive distances away from their breeding ponds, sometimes over a half-mile! In our study, over half of newly emerged salamanders passed a 100-foot barrier within days of leaving their pond; one was found over 3000 feet from the pool where it hatched only a few weeks before. These data suggest that these are truly terrestrial animals, and that protecting upland habitats is just as important as protecting breeding wetlands.



Natural Navigators. Marbled salamanders appear to be amazing navigators. Not only do they return to the same breeding pond for several years, but each salamander enters and leaves from precisely the same direction. This suggests that these animals may establish a home territory where they return year after year.



adult marbled salamander



All Populations Are Not Created Equal.

A great number of variables affect whether a rare species like the marbled salamander will survive in a given locality. Some habitats called "sources" produce an abundance of animals most generations that can disperse to surrounding areas. Other habitats called "sinks" rely on the immigration of animals from source areas to maintain healthy populations. What does this mean for protecting rare species? Conservation areas must be large enough to accommodate many diverse populations to ensure long-term success.

Habitat Creation - Constructed Vernal Pools



constructed vernal pool

In 1999, three vernal pools were constructed in the vicinity of the power plant and one known breeding site for marbled salamanders. In addition to increasing the number of

salamander populations, it is hoped that the establishment of an interconnected network of pools will provide greater long-term stability for salamanders in the area. A UMASS biologist consulted in the design of these constructed pools and researchers from the University have monitored the pools since their creation. Here is what we have found so far.

Seven amphibian species are already using the constructed pools for breeding and/or non-breeding habitat. These include spotted salamanders, red-spotted newts, spring peepers, gray treefrogs, wood frogs, green frogs and bullfrogs.

A variety of invertebrates have also colonized these pools. Most are aquatic insects, including dragonflies, damselflies, beetles, water scorpions, mayflies, caddisflies, midges and other fly larvae. These constitute an important food base for larval salamanders.

These pools will be closely monitored by UMASS researchers for marbled salamanders in coming years. If after five years, marbled salamanders do not naturally colonize the constructed pools, they will be "seeded" with larvae from nearby sites.

Data collected from these pools are an important component of long-term research aimed at addressing important issues affecting salamander conservation.

