PATHWAYS: Wildlife Habitat Connectivity in the Changing Climate of the Hudson Valley
Executive Summary

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Maintaining or restoring connectivity is a key adaptation strategy for biodiversity conservation in the face of climate change and in recent years investigators have taken advantage of the multitude of connectivity modeling options to fuel conservation planning at various spatial scales. In this study, we combined species distribution modeling with connectivity modeling using present-day and future climate regimes to identify zones of connectivity—places where management agencies might focus attention on maintaining and restoring connections among populations of rare species.

The 10-county region bordering the lower Hudson River (Figure A) contains a wide range of landforms, geologic types, land-use patterns, and biodiversity. This critical area for rare and common species alike has the opportunity to support local and regional efforts for species adaptation to climate change.

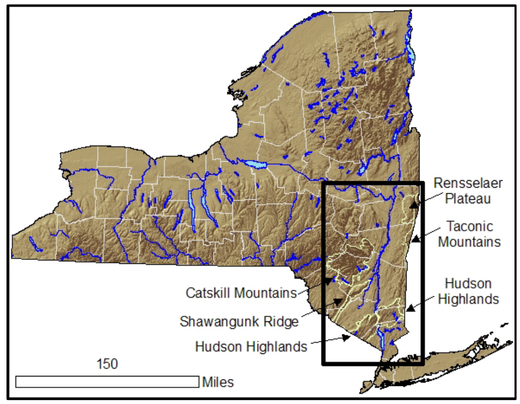

Figure A. Our study area, the lower Hudson River Valley region of New York.

We assessed habitat connectivity under current-day and future climate in the Hudson Valley for 26 Species of Greatest Conservation Need and aggregated these results to identify the importance of land parcels for multiple species. The forest, shrubland, and wetland species in the study included salamanders and frogs (longtail salamander, blue-spotted/Jefferson salamander, four-toed salamander, marbled salamander, northern cricket frog), snakes and lizards (black rat snake, northern black racer, northern copperhead, timber rattlesnake, eastern ribbon snake, common five-lined skink), turtles (eastern box turtle, wood turtle, Blanding's turtle, bog turtle, spotted turtle), dragonflies (arrowhead spiketail, tiger spiketail, gray petaltail), neotropical migratory birds (black-throated blue warbler, Kentucky warbler, scarlet tanager, wood thrush, worm-eating warbler, cerulean warbler), and the New England cottontail.

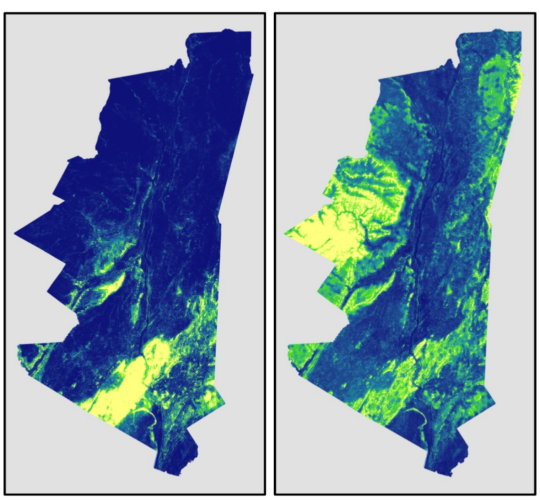

Figure B. Current-day (left) and 2080s (right) probability of suitable habitat (increasing from blue to yellow) for copperhead.

We modeled suitable habitat for each species by analyzing the relationship between known locations and 44 environmental variables that included climate, geology, topography, land cover, and soils. This resulted in a continuous surface depicting the probability of suitable habitat throughout the study area (Figure B, left panel). Using climate model output from the IPCC fourth assessment, we created spatial models depicting the probability of suitable habitat for each species for the decades of the 2050s and 2080s (Figure B, right panel).

Strong shifts in suitable habitat were predicted for many of our target species. Under future climate regimes, suitable habitat appeared upslope and farther north, or simply contracted from existing habitat. A common pattern was for suitable habitat to appear in the Catskills, Taconics, and Rensselaer Plateau for species where none or very little is modeled as suitable in the current-day scenario. Conversely, although suitable habitat patches often contracted greatly at current-day habitat strongholds, small patches of suitable habitat often were predicted to remain within or nearby these habitats for current-day populations. All predictions need to be evaluated in the context of species' presumed adaptability, dispersal abilities, and connectivity to populations outside the study area.

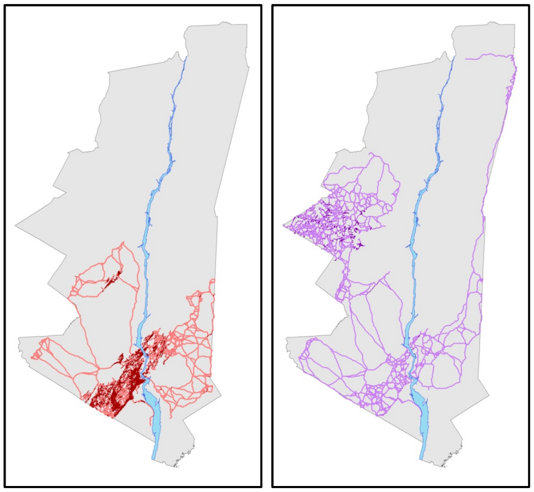

Figure C. Current-day (left) and 2080s (right) habitat patches and modeled LCP connections for copperhead.

We modeled potential connections among habitat patches by finding the least-cost path (LCP) for every single patch-to-patch connection for each species for each time period (Figure C). Each LCP is a function of both distance and resistance—here a quantitative measure of how different a spot on the landscape is from suitable habitat. We included all potential connections in the final output, even long ones depicting paths not likely to be traveled by individuals in a single generation.

In order to encapsulate general patterns into a geographic scale that could be acted on by conservation practitioners, we aggregated all the modeled habitat patches and connections to the tax parcel. We aggregated by counting the number of species for which a certain parcel is important (Figure D), as well as by quantifying the importance of for patch connectivity at the scale of the entire population (betweenness). The patterns that emerged are striking. Parcels within the Hudson Highlands, Shawangunk Ridge, Catskill Mountains, and Harlem Valley had high overlap of species, with areas upslope and northward in the valley attaining greater projected importance over time.

This modeling effort represents a novel assimilation of modern techniques in fine-scale distribution modeling, connectivity modeling, and climate change adaptation planning. In our full report, through a series of discussions and charts, we provide guidance on interpreting these current-day patterns and predicted changes. We envision that land managers and conservation planners will be able to use our results to help identify priority locations for providing for biodiversity adaptation to climate change, and our methods are easily translated to other regions and other species.

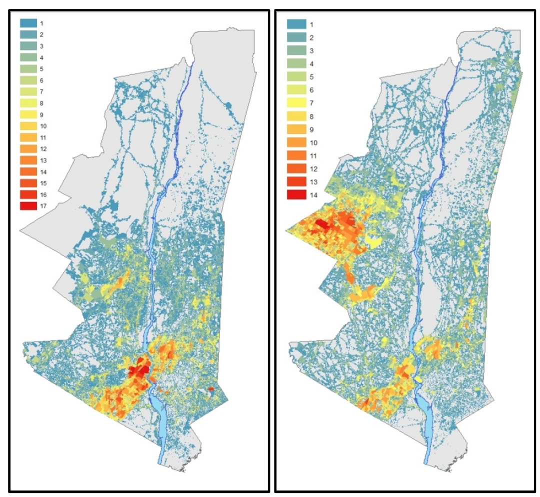

Figure D. Landowner parcels predicted to be important for any facet of life history for one or more species (increasing from blue to red) in current-day (left) and 2080s (right) time periods.

For the complete report or further information, please contact Tim Howard: tghoward@nynhp.org