NatureServe
A Network Connecting Science With Conservation

Predictive Distribution Modeling

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Conserving species depends in part on knowing where they live. For more than two centuries biologists have conducted field inventories to map the distribution of plants and animals. Yet our understanding of the distribution of most species is still incomplete, due to the challenges of field work. Today, we can say with certainty where a particular species has been found, but are largely unable to extrapolate as to where else it is likely to occur.

Combining data from traditional field work with innovative computer models that include climatic factors such as slope, elevation, and precipitation yields maps of species distribution that are much more precise than previous range maps.

The development of high-speed computers and geographic mapping software now allows us to model the distribution of a particular species by analyzing the environmental characteristics of its known localities. Known as **predictive distribution modeling (PDM)**, this innovative GIS-based method is used to produce predictive maps of where species or habitat types are likely to occur (and likely not to occur). The probability of occurrence is quantified and is directly related to underlying environmental variables and the locations of known occurrences. A variety of environmental GIS data are used as the basis for these spatial models, including digital elevation models, land cover, and digital data layers for precipitation, temperature, and other climatic factors. Models generated in this quantitative fashion are much more detailed than the familiar polygon depictions of species' ranges found in field guides.

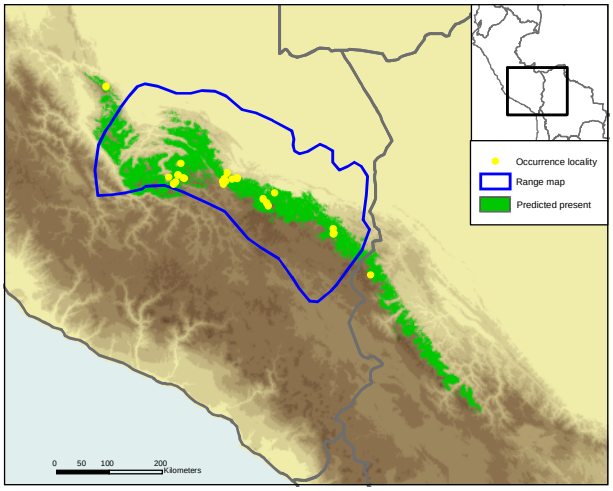
There are several advantages to using PDM (also known as element or species distribution modeling) for inventory and conservation planning:

- Maps of documented occurrences ("dot maps") convey no information on the likelihood of finding an occurrence in areas that have not been surveyed. Range maps from field guides and similar treatments are often too coarse to inform on-the-ground conservation action or research.
- Good predictive distribution maps make field inventories more efficient and effective. They show where to commit limited inventory resources for the highest likelihood of finding a targeted species or habitat type.
- Predictive distribution maps are highly useful for planning efforts such as State Wildlife Action Plans, USDA Forest Service Regional and Forest Plans, BLM Resource Management Plans, and USGS Gap Analysis.
- Predictive distribution maps for multiple species or habitat types, all produced with consistent and defensible methods, are very well-suited for identifying spatial patterns in biological diversity.

Method

Predictive maps are produced through PDM in three steps:

- Compile spatial data associated with the target element and the environment in the area of interest.
- Build a model based on the association of the element to environmental variables (e.g., vegetation, soils, landform, climate) at sites of known occurrence. Models may be deductive (based on suspected habitat affinities) or inductive (extrapolated from known occurrences).
- Map that model via GIS across the area of interest.



PDM results for the Incan shrew possum, a rare Andean mammal: yellow points are known occurrences, green is the predicted occurrence from PDM, and the blue line is the original range map.

Expertise of NatureServe Network

Several natural heritage programs, notably Oregon, New York, and Wyoming, have successfully used PDM to guide inventory work. NatureServe uses PDM extensively to map ranges of narrowly endemic species in Latin America. The Wyoming Natural Diversity Database (WYNDD) has developed a user-friendly GIS modeling tool that makes PDM much more accessible. NatureServe and WYNDD provide training to interested partners. For more information, see http://www.natureserve.org/prodServices/predictiveDistModeling.jsp.

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