Ohio Aquatic Gap Analysis— An Assessment of the Biodiversity and Conservation Status of Native Aquatic Animal Species

By S. Alex. Covert, Stephanie P. Kula, and Laura A. Simonson

Executive Summary

The goal of the GAP Analysis Program is to keep common species common by identifying those species and habitats that are not yet adequately represented in the existing matrix of conservation lands. The Gap Analysis Program (GAP) is sponsored by the Biological Resources Discipline of the U.S. Geological Survey (USGS). The gap analysis methods were conceived in the late 1980's and this now National program has traditionally been implemented on a state-by-state project basis with the involvement of people from state agencies and academia. All states except Alaska have completed or are conducting a terrestrial GAP project focusing on vertebrate biodiversity. More recently, GAP efforts have moved towards regional and aquatic projects. The Ohio Aquatic GAP (OH-GAP) is a pilot project that is applying the GAP concept to aquatic—specifically, riverine—data.

The mission of GAP is to provide regional assessments of the conservation status of native animal species and to facilitate the application of this information to land-management activities. OH-GAP accomplished this through

- mapping aquatic habitat types,
- mapping the predicted distributions of fish, crayfish, and bivalves,
- documenting the presence of aquatic species in areas managed for conservation,
- providing GAP results to the public, planners, managers, policy makers, and researchers, and
- building cooperation with multiple organizations to apply GAP results to state and regional management activities.

Gap analysis is a coarse-scale assessment of aquatic biodiversity and conservation; the goal is to identify gaps in the conservation of native aquatic species. It is not a substitute for biological field studies and monitoring programs.

Gap analysis was conducted for the continuously flowing streams in Ohio. Lakes, reservoirs, wetlands, and the Lake Erie islands were not included in this analysis. The streams in Ohio are in the Lake Erie and Ohio River watersheds and pass through six of the level III ecoregions defined by Omernik(1987): the Eastern Corn Belt Plains, Southern Michigan/Northern Indiana Drift Plains, Huron/Erie Lake Plain, Erie Drift Plains, Interior Plateau, and the Western Allegheny Plateau.

Stream Classification and Mapping of Aquatic Habitat Types

To characterize the aquatic habitats available to Ohio fish, crayfish, and bivalves, a classification system needed to be developed and mapped. Classification simplifies, yet attempts to reflect, the complexity of the real world. The process of classification includes delineation of areas of relative homogeneity and labeling these areas using categories defined by the classification system.

To classify Ohio's streams, OH-GAP focused on mapping physical characteristics that endure for decades, if not centuries. Through discussions with Ohio aquatic experts, OH-GAP identified eight separate enduring physical features which, when combined, form the physical habitat type:

- Shreve link (a measure of stream size)
- Downstream Shreve link (a measure of stream connectivity and size)
- Sinuosity
- Gradient
- Bedrock
- Stream temperature
- Character of glacial drift
- Glacial-drift thickness

The variables were linked to the 1:100,000-scale streams of the National Hydrography Dataset of the USGS. OH-GAP's classification scheme consisted of the concatenation of values for each of the eight separate variables into a unique combination of numbers to describe a physical habitat type. The values for the separate variables are maintained in the final habitat type, allowing for the straightforward comparison of two or more physical habitat types. Results of the stream classification reveal 5,269 separate physical habitat types within 65,545 river segments in Ohio. A segment is defined by a change in the value of one or more of the input variables or a topographical break, such as a tributary entering a stream. Based on total length, the top 100 physical habitat types constitute 33 percent of the streams in the state, and the top 300 types classify 54 percent of the streams. This result suggests that although more than 5,000 unique combinations of numbers are defined for Ohio, much of the state can be classified using far fewer habitat types.

Predicted Animal Species Distributions

Potential distribution models were developed for 130 fish, 70 bivalve, and 17 native crayfish species. These models are based on 5,686 fish, 4,469 crayfish, and 2,899 freshwater bivalve (mussels and clams) sampling locations, the variables describing the physical habitat types, and variables indicating the major drainage basins and Omernik's Level III ecoregion. The modeling software package DesktopGarp (Genetic Algorithm for Rule-Set Production) was used in most cases for predicting potential distributions of

each species individually. Using GARP, omission error (the error associated with misclassifying known species habitat locations) was forced to be less than 10 percent for each species. The commission error (the error associated with classifying habitat locations where the species was not found) ranged from 1 to 61 percent for fish, 6 to 70 percent for crayfish, and 1 to 57 percent for bivalves.

The best GARP models (as determined by omission and commission) were combined into one final Geographic Information System (GIS) grid of predicted presence and absence. There is a conscious effort in the GAP process to err on the side of commission. In other words, OH-GAP may predict species as potentially present when they are not. There are two primary reasons for doing so. First, few species have systematic, unbiased known ranges, and science is best served by identifying a greater potential for sampling and investigation than a conservative approach that may miss such opportunities. Second, what appears to be commission error may actually be unsampled locations. In the predictive models, GARP uses known presence points and background points, not known presence points and known absence points. The background points may or may not have been sampled.

A simpler extrapolation method was used for predicting potential distributions when a species had at least one but less than 20 known species-occurrence locations. This method is the product of overlaying or combining GIS layers (OH-GAP physical habitat types) and known biological occurrence points. All stream segments with the same physical habitat type as where the species was sampled were predicted to be potential habitat.

All potential species distributions are displayed and analyzed at the 14-digit hydrologic unit (14-HUs), or subwatershed, level. Mainland Ohio contains 1,749 14-HUs. All statistics and conclusions, as well as spatial data, are discussed and presented in terms of these units.

Land Stewardship and Conservation Status

The Ohio Aquatic Gap Analysis Project compiled a map of public and private conservation lands and OH-GAP classified the lands into four status categories (status 1 through status 4) by the degree of protection offered based on management practices. A status of 1 denotes the highest, most permanent level of maintenance, and status 4 represents the lowest level of biodiversity management, or unknown status. The results of this mapping show that only about 3.7 percent of the state's land (4.3 percent if lakes and reservoirs are also included) is protected for conservation, either publicly or privately. Of this total, state agencies control about 52 percent, and Federal agencies control about 29 percent. Lands considered status 1 are the most highly protected, and in Ohio The Ohio Department of Natural Resources (ODNR) and The Nature Conservancy manage the bulk of these (43.4 percent and 30.3 percent, respectively). Conservation lands are distributed throughout Ohio in 87 of 88 counties. This is largely due to the presence of ODNR, the largest land steward by area in Ohio, which protects lands in 86 counties (all but Van Wert and Union).

Analysis Based on Stewardship and Conservation Status

Conservation areas that presently protect a portion of Ohio's aquatic biodiversity were identified through the analysis of the distributions of species and conservation lands on a 14-HU scale. In addition, based on measures of predicted species richness and taxa richness, 75 (out of 504) 14-HUs in the Lake Erie Basin and 67 (out of 1,291) 14-HUs in the Ohio River Basin were identified for their conservation potential.

Results show that 22 fish species and 2 bivalve species had predicted distributions exclusive of conservation lands classified as status 1 or status 2. Nine of these fish species are considered rare, threatened, or endangered in the state. Status 1 and status 2 lands are generally considered by GAP to offer adequate protection.

Results and Conclusions

Fish species richness increases generally from north to south across Ohio. This can be explained by differences in latitude and by climatic and geologic history, among other factors. The primary factor used by OH-GAP for identifying potential high-priority conservation areas was species richness. Because of the known gradient of species diversity, the Lake Erie and Ohio River Basins were analyzed separately for all taxa. Fifteen percent (75 of 504) of the 14-HUs in the Lake Erie Basin were identified by OH-GAP as high potential priorities for conservation. Thirty-seven of them already have some conservation lands located within them. In the Ohio River Basin, 57 of 1,291 14-HUs (4.5 percent) were identified by OH-GAP as potential high-priority conservation areas for conservation using species richness. Of the 57 14-HUs identified as potential high-priority conservation areas, 56 percent already have conservation lands.

In both the Lake Erie and Ohio River Basins, a larger, though not significant, percentage of 14-HUs with existing conservation land were identified by OH-GAP for their potential for high species richness. It is beyond the scope of this report to assess whether high-quality habitats were deliberately protected or whether conservation of habitat has allowed species to thrive. Because only enduring physical characteristics were used in the models, it is likely that these habitats were deliberately protected, and this gap analysis provides further evidence of the habitat quality.

Data Use and Availability

The primary products of the Ohio Aquatic GAP project are geospatial databases for land stewardship, stream-habitat types, and predicted distribution models for native fish, crayfish, and bivalves. Associated OH-GAP geospatial databases include mapped locations of fish, crayfish, and bivalves. These data, along with this report, are available from the USGS through the Internet. The OH-GAP Web page can be accessed at *http://oh.water.usgs.gov/ohgap/ohgap.html*