Appendix A. Geographic range development for 602 terrestrial vertebrate species of the Southeast Gap Analysis Project

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INTRODUCTION

The United States Geological Survey's (USGS) Gap Analysis Program (GAP) is a scientific method for identifying potential inadequate representation of conservation lands (so-called "gaps") for native vegetative communities and animal species. By mapping existing vegetation and land use; conservation land network boundaries and their degree of biodiversity management; and the predicted distribution of terrestrial vertebrates, GAP seeks to provide managers, planners, scientists, and policy makers with data to make informed decisions regarding the conservation of biological diversity (Scott et al. 1993).

Using gap analysis standard protocols (Csuti and Crist 2000), a list of species is assembled and their geographic range extents delineated. Within the southeastern United States, 606 species were identified for inclusion in the Southeastern Gap Analysis Project (SE-GAP). Range maps were digitized as one or more polygons using a Geographic Information System (GIS). Breeding ranges were delineated for the majority of species (587), but for 26 species (25 birds, mostly waterfowl, and one bat); their wintering range only was delineated. Additionally, seven species had their wintering range delineated separately from their breeding range (five species of waterfowl and two bats). A total of 613 digital range maps were created depicting species' breeding and/or wintering ranges. These range maps serve as boundary limiters in subsequent predicted distribution modeling (see Appendix B for methods describing predicted distribution modeling and mapping). Range maps also help both the modelers and model reviewers visualize species' land cover associations, particularly for species with geographically distinct populations. In addition to their utility for gap analysis, these ranges are a stand alone product available to wildlife managers, and researchers.

METHODS

Processes used to create range polygons were unique because information on the current geographic range of a species varies widely. However, a generalized approach used a variety of sources to develop species' ranges. These sources consisted of information in two broad categories: species location records and range maps available digitally and in print, and digital spatial data of environmental parameters. Generally, sources listed below were consulted either as a simple visual representation or in GIS format. Source data available digitally was brought into the GIS through a common geographic projection and coordinate system. Combinations of source data were viewed, extracted, and manipulated to approximate species ranges. Additional generalizations of polygons were digitized to accommodate supplemental data not available digitally. All digital data were conflated to create one or more polygons defining the individual species' range.

Location Records and Range Maps

Standard Published Sources

For most species, several sources were consulted to initiate range development. These sources initially included field guides, breeding bird atlases, and taxa specific compilations containing graphical depictions and/or text descriptions of the geographic range of a given species (e.g. Petranka (1998) or Simpson (1992)). These “standard” sources were altered and augmented (or in some instances disregarded) with additional information from more recent sources if available.

Since species taxonomy can change over time (e.g. splitting and lumping species and/or subspecies), a number of species required in depth analyses and the input of expert opinion. In these instances, an effort was made to find the most recent information available to help delineate a polygon. These sources could be consultation with an expert intimately familiar with the species, its taxonomy and natural history, and/or materials published in relevant peer reviewed journals or books.

Hexagon Ranges

State GAP analyses had been conducted previously for almost all of the 606 species. The exceptions were most often species whose taxonomy has changed based on more recent phylogenetic studies. Hexagon ranges are created as a part of each state GAP process. These hexagons are derived from the Environmental Protection Agency’s Environmental Monitoring and Assessment Program (EMAP) where the North American continent has been divided into ~ 650 km^2 equal area hexagons (White et al. 1992, U.S. EPA 2007). Using various databases and point location records from museums, state natural heritage programs, published material, expert observation, and various other sources, statewide EMAP hexagons were attributed with occurrence codes ranging from 1 to 5 indicating a gradient from presence to absence for each species (see individual state GAP project reports for hexagon range development process details). These hexagon ranges were helpful in broad delineation of polygons. Hexagon codes defining occurrence differ between state GAP projects. However, it was possible to merge hexagons between states and conflate codes. Only hexagons coded as confirmed, predicted, or possible (or similarly stated code definitions) were used. In general, these definitions corresponded to codes of 1, 2, or 3.

Unpublished Reference Materials

Some state and local agencies have data not available to the public or in draft format not yet compiled for publication or distribution. An effort was made for cooperative agreements to share these data. For instance, GA and AL breeding bird atlas data was used to help define polygon ranges for bird species with all or a portion of their range in those states, even though these data at the time, were not yet available for distribution.

Environmental Data Sources

Data developed by state and national agencies were helpful to delineate polygon range boundaries for certain species. These data exist at a variety of spatial scales and represent a wide series of biological, physiographic, and environmental components of the aquatic and terrestrial landscape. Since species exist and function in this landscape, it is natural to assume that they would respond to gradients that can be mapped. These data sources were utilized in polygon range delineation only for species that are explicitly limited by such variables. In most instances, a combination of these data layers were used to help delineate all (rarely), or a portion of the species' range.

Ecoregions

Omernik (1987, 1995) ecoregions were used to help define polygon boundaries for some species when appropriate. These ecoregion polygons were developed through an analysis of biotic and abiotic patterns relating to ecosystem differentiation. They were digitized from base maps that ranged in scale from 1:1,000,000 to 1:250,000. Some species are clearly restricted to the physiographic and geographic patterns and boundaries that ecoregions define. For these species, ecoregions were used as all or a portion of the polygon(s) delineation. If there was a doubt as to the limitations imposed by such boundaries, ecoregions were not used.

Hydrologic Unit Codes

The USGS has divided the country into hydrologic units of progressively smaller size representing boundaries of a surface water drainage basin and/or distinctive hydrologic features (Seaber et al. 1987). The smallest (1:250,000 to 1:100,000 scale) of these polygon data currently available nationwide are termed cataloging units and have unique, 8-digit identification numbers (HUC). It is known that some species are limited to certain watersheds, particularly those that have a life cycle closely dependent on flowing water. For these and similar species, the boundaries of 8-digit HUCs were used to help delineate all or a portion of the range.

National Elevation Dataset

The USGS has collected the "best available" elevation data into a national product termed the National Elevation Dataset. These data represent digital elevation models (DEMs) developed at a 30m spatial resolution. Each 1:24,000 scale quadrangle was compiled as a seamless mosaic from data derived using varying processes (USGS 1999a). While some ecoregions are also defined at least in some part by elevation, there are several species for which specific elevation values are noted in the literature. For species whose range can be limited by elevation, DEMs were helpful in defining boundaries. This is particularly true for species whose range includes at least a portion of the mountainous regions of the Southeast.

Soils

State geographic soils database soil units polygons were developed by the U.S. Department of Agriculture's Natural Resource Conservation Service at a scale of 1:250,000 for the conterminous U.S. (USDA 1995). Although ecoregions consider soils as an abiotic factor in their delineation, for certain species it was necessary to focus more narrowly on soil type to help define a range polygon. For species whose habitat requirements are restricted to certain soil types (particularly some reptiles), soil polygons were used to help delineate all or a portion of their range.

National Hydrography Dataset

The USGS National Hydrography Dataset is data containing information about the country's surface water features, including streams, lakes, ponds, and rivers (USGS 1999b). The data are derived from Digital Line Graphs (USGS 1989, 1990) at scales ranging from 1:100,000 to 1:24,000. Smaller sized and aquatic dependent species are, in some instances, limited by flowing water bodies. These features, particularly large rivers, were used to define portions of species' ranges.

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