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A national approach for mapping and quantifying habitat-based biodiversity metrics across multiple spatial scales

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ABSTRACT

Ecosystem services, i.e., services provided to humans from ecological systems have become a key issue of this century in resource management, conservation planning, and environmental decision analysis. Mapping and quantifying ecosystem services have become strategic national interests for integrating ecology with economics to help understand the effects of human policies and actions and their subsequent impacts on both ecosystem function and human well-being. Some aspects of biodiversity are valued by humans in varied ways, and thus are important to include in any assessment that seeks to identify and quantify the benefits of ecosystems to humans. Some biodiversity metrics clearly reflect ecosystem services (e.g., abundance and diversity of harvestable species), whereas others may reflect indirect and difficult to quantify relationships to services (e.g., relevance of species diversity to ecosystem resilience, cultural value of native species). Wildlife habitat has been modeled at broad spatial scales and can be used to map a number of biodiversity metrics. In the present study, we present an approach that (1) identifies mappable biodiversity metrics that are related to ecosystem services or other stakeholder concerns, (2) maps these metrics throughout a large multi-state region, and (3) compares the metric values obtained for selected watersheds within the regional context. The broader focus is to design a flexible approach for mapping metrics to produce a national-scale product. We map 20 biodiversity metrics reflecting ecosystem services or other aspects of biodiversity for all vertebrate species except fish. Metrics include species richness for all vertebrates, specific taxon groups, harvestable species (i.e., upland game, waterfowl, furbearers, small game, and big game), threatened and endangered species, and state-designated species of greatest conservation need, and also a metric for ecosystem (i.e., land cover) diversity. The project is being conducted at multiple scales in a phased approach, starting with place-based studies, then multi-state regional areas, culminating into a national-level atlas. As an example of this incremental approach, we provide results for the southwestern United States (i.e., states of Arizona, New Mexico, Nevada, Utah, and Colorado) and portions of two watersheds within this region: the San Pedro River (Arizona) and Rio Grande River (New Mexico). Geographic patterns differed considerably among metrics across the southwestern study area, but metric values for the two watershed study areas were generally greater than those for the southwestern region as a whole.

1. Introduction

The discussion for formal maintenance and conservation of biological diversity (biodiversity) was first organized in a cohesive fashion by the United Nations Environment Programme in 1992 at the Rio Earth Summit. A year following, 168 countries signed the Convention of Biological Diversity (CBD) to protect and ensure conservation and sustainable use of biodiversity. The CBD recognized that the Earth's biological resources are essential to human well-being and economic and social development and thus constitute a global asset of crucial value to both present and future

Abbreviations: BIP, Biodiversity Indicators Partnership; CBD, Convention of Biological Diversity; IPBES, Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services; GEO BON, Group on Earth Observatory Biodiversity Observation Network; MEA, Millennium Ecosystem Assessment; GAP, Gap Analysis Program; SGCN, Species of Greatest Conservation Need; ICLUS, Integrated Climate and Land Use Scenarios; IPCC, Intergovernmental Panel on Climate Change; SWReGAP, Southwest Regional Gap Analysis Project; T&E, threatened and endangered; TEEB, The Economics of Ecosystems and Biodiversity; UNEP-WCMC, United Nations Environment Programme World Conservation Monitoring Centre; US, United States.

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