Supplemental Indicator 1.04.1:

Biodiversity of Forest-Associated Fishes

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Fishes across the United States rely on a persistent quantity of cool, clean water, a significant benefit and ecosystem service delivered from national forest lands (Sedell et al. 2000). Traditional approaches to quantifying diversity of forest-associated fish, like the results reported in this and prior Sustainability Reports (see fig. 4-1a), may not fully account for the importance of forests to fish (NatureServe staff, personal communication). However, there is a paucity of literature that identifies how to quantify forest association by fishes, particularly at the scale of the entire United States. Therefore, based on available fish and forest cover information, we linked species-specific fish distributions with the quantity of forest land cover contained within that distribution (Bury et al. 2021).

Availability of comprehensive fish biodiversity and forest cover datasets allowed us to develop a data-driven characterization of forest-associated fishes across the United States. This effort has led to the development of two products: (1) a map of forest-associated fish biodiversity; and (2) a map of forest-assocated fishes that have Federal vulnerability status under the U.S. Endangered Species Act. These efforts are necessary to support national and regional analysis of forest-management activities in light of local aquatic biodiversity that relies upon, and contributes to, the health of forested watersheds (Penaluna et al. 2017). Although this effort relied on linking the known distribution of freshwater fishes with current forest cover within those distributions, it is important to recognize that rivers are networks that link the streams and lakes in their watersheds, and that, ultimately, all fishes likely benefit from waters originating in the Nation's forested lands.

We used datasets for both fish and forest cover at the 8th-field hydrologic unit (https://water.usgs.gov/GIS/huc.html) (HUC8) within the conterminous United States (CONUS). The area (percent) of each HUC8 categorized as forested was calculated from a baseline forest raster for the CONUS; this raster was generated by harmonizing Forest Inventory and Analysis forest use classifications with the 2016–2017 statewide total forest areas as defined by the Resource Planning Act (Oswalt et al. 2019). The native fish species biodiversity data we used were compiled by NatureServe, based on literature review (https://www.natureserve.org/conservation-tools/map-risk-species-county-and-watershed). The NatureServe dataset contains 905 species of fishes.

NatureServe also compiled and georeferenced species that have a federally listed vulnerability status under the Endangered Spcies Act. These listings included: endangered or threatened, proposed endangered or threatened, candidate for listing, species of concern, and listed threatened because of similarity in appearance to another species. We used the data on species, populations, and subspecies compiled by NatureServe, which includes 167 taxa.

We defined "forest-associated" fish as those with a distribution that is mostly contained within HUC8s that are majority forested. We identified fish species for which at least 50 percent of their distribution intersected HUC8 watersheds that have at least 50 percent forested land cover. A total of 554 fish species met this criterion, encompassing 61 percent of the entire diversity of fish species included in the NatureServe dataset. We summed the individual species that met this criteria for each HUC8 watershed, and mapped this definition of forest-associated fish biodiversity across the United States (fig. 4.1-1). We also mapped the percent of the fishes present in any given watershed that were designated as forest-associated fishes (fig. 4.1-2). Of the 167 populations and subspecies of federally listed fishes, 134 (80 percent) were part of our

designation of forest-associated fishes. For endangered fishes, we summed the individual infrataxa species by HUC8 and mapped the results across the United States (fig. 4.1-3).

Our results are similar to those presented using a different classification of forest-associated fishes found elsewhere in this report. In both analyses, the southeastern United States in particular exhibits high aquatic biodiversity associated with forests, which is consistent with the overall high aquatic biodiversity in that region (Elkins et al. 2019). We also found that forests are strongly linked to total fish biodiversity on the West and East Coasts, and around the Gulf of Mexico. Regardless of the method of analysis, the importance of forested watersheds for fishes is evident across the country.

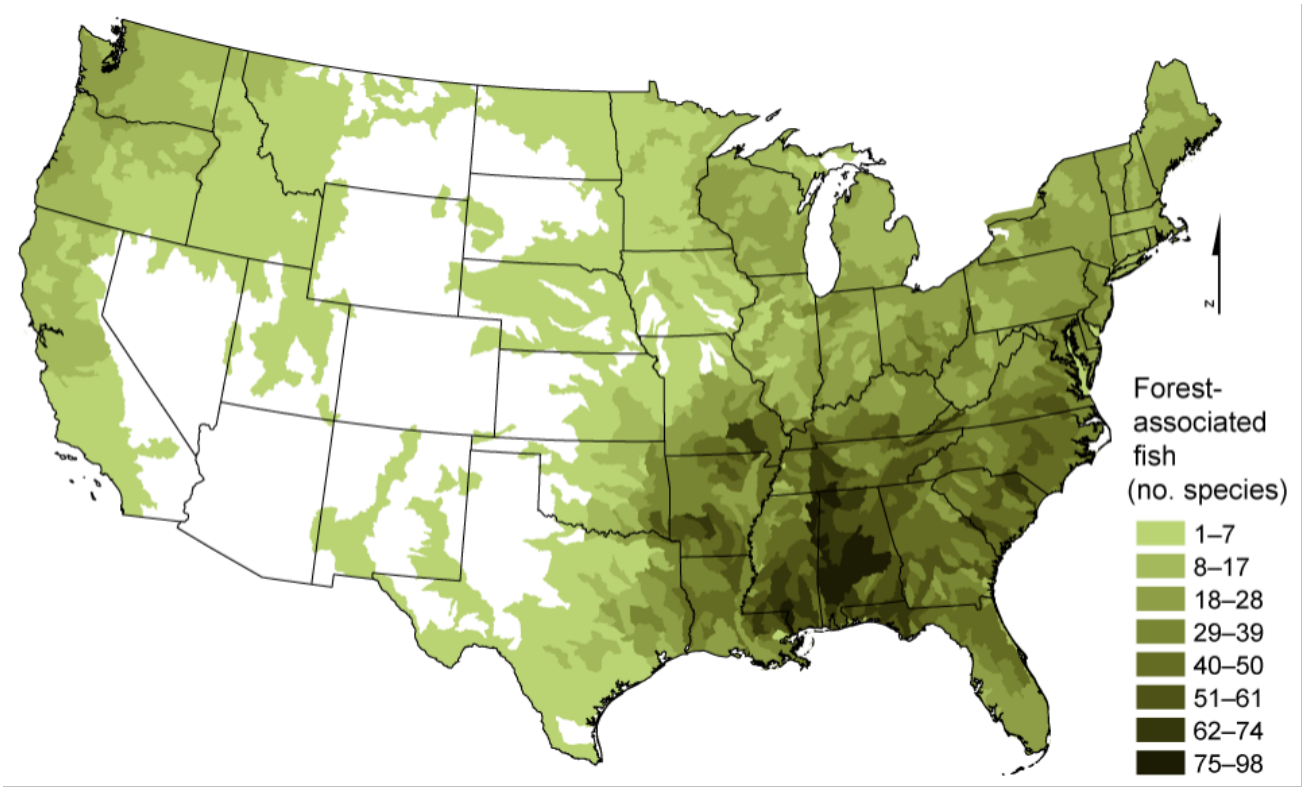

Figure 4.1-1—Number of native freshwater fish species per HUC8 of the conterminous United States that are forest associated. We defined as forest-associated all species that have at least 50 percent of their range in HUC8 watersheds identified as having at least 50 percent forested land cover. Total number of forest-associated fishes mapped is 554. Subspecies and populations were merged into full species in this dataset. White areas represent HUC8s with no forest-associated fish species identified in this analysis.
Source: NatureServe; National Land Cover Database; Watershed Boundary Dataset.

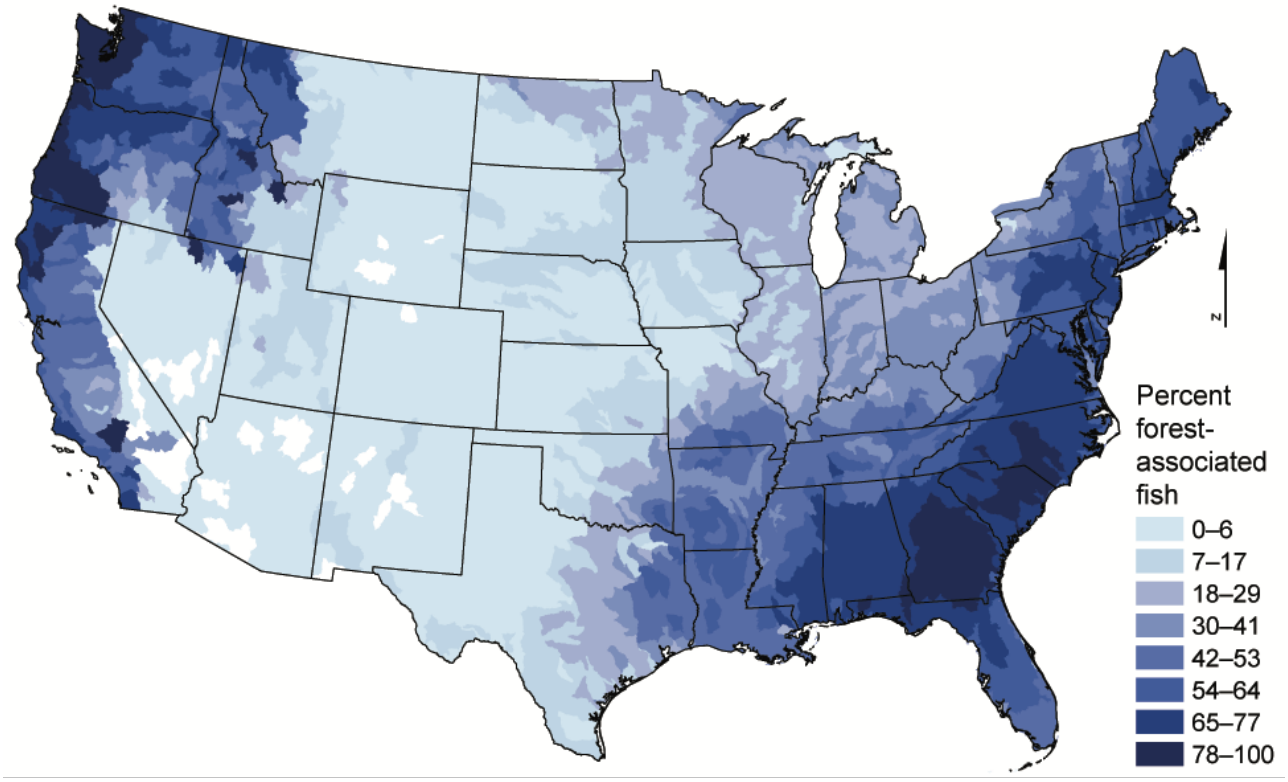

Figure 4.1-2—Percent of native freshwater fish species in a HUC8 watershed that were identified by our analysis as forest associated. A strong association between forests and total fish biodiversity is evident in coastal areas of the West and East Coasts, and around the Gulf of Mexico. White areas represent no recorded data for fish or forest cover.
Source: NatureServe; National Land Cover Database; Watershed Boundary Dataset.

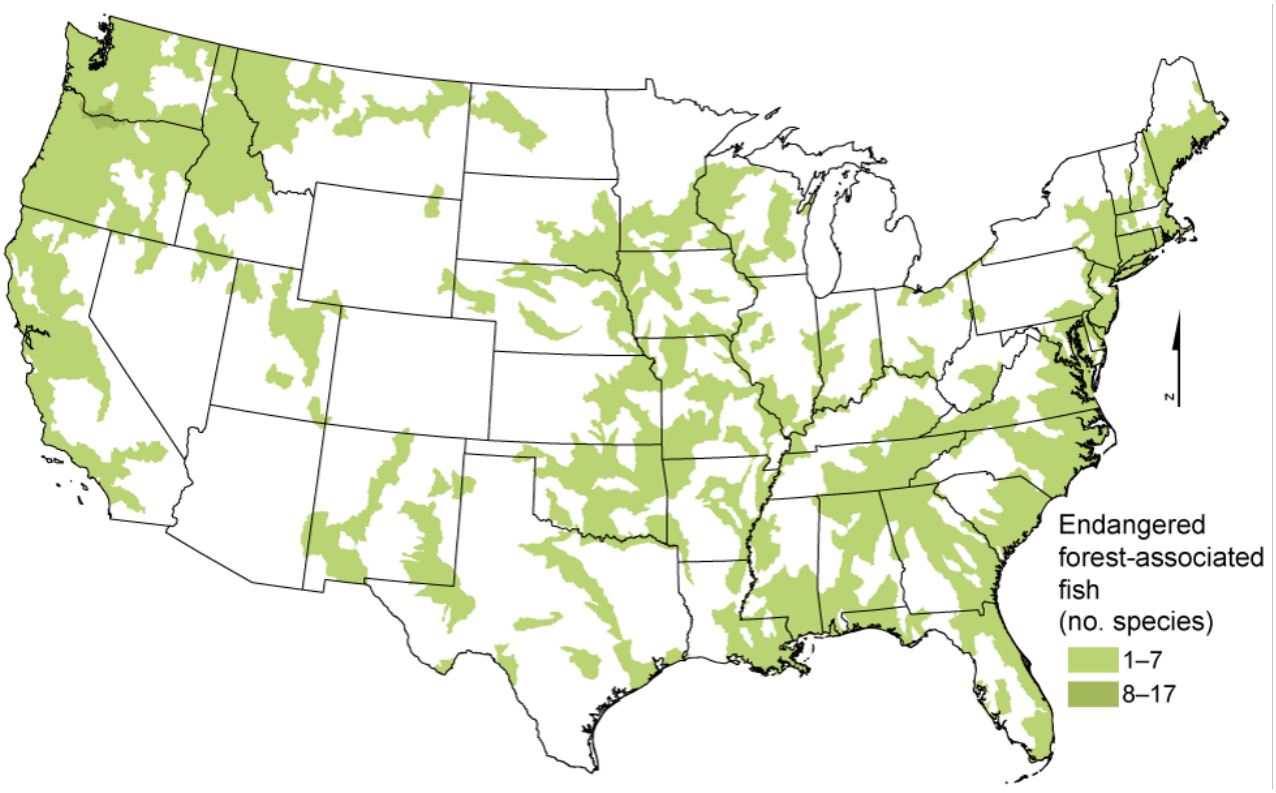

Figure 4.1-3—Number of subspecies, species, or populations with Federal status as endangered or threatened that are also forest associated. We defined forest-associated fishes as species for which at least 50 percent of their range falls in HUC8 watersheds having at least 50 percent forested land cover. The total number of subspecies, species, and populations of fishes with a federal vulnerability status that are also forest-associated is 134. We defined Federal status as fishes in any of the following categories: listed endangered or threatened, proposed endangered or threatened, candidate, species of concern, and listed threatened because of similarity in appearance to another species. White represents areas with no federally listed fishes identified as forest-associated in this analysis.
Source: NatureServe; National Land Cover Database; Watershed Boundary Dataset.

References

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