Intensive fisheries have reduced fish biodiversity and abundance in aquatic ecosystems worldwide. The widespread success of no-take reserves has made them a cornerstone of marine ecosystem-based fisheries management. A set of design principles has emerged to ensure that networks of marine reserves will enhance adjacent fisheries, but the applicability of this paradigm to riverine biodiversity and inland fisheries remains largely untested. Here we show that a diffuse set of 23 community-designated reserves in Thailand’s Salween basin has dramatically increased local fish richness, density, and biomass. We find that several key correlates of protected area success in marine ecosystems-particularly reserve size and enforcement-also predict differences in ecological benefits among riverine reserves. Moreover, occupying a central position in the network confers additional gains, underscoring the importance of connectivity within dendritic river systems. The emergence of network-based benefits is remarkable given that these reserves are young (< 25 years) and arose without formal coordination or spatial planning among communities. Freshwaters are under-represented among the world’s protected areas, and our findings suggest that networks of small reserves offer an effective and generalizable model for protecting biodiversity and augmenting fisheries as the world’s rivers face unprecedented pressures.