

## Freshwater Species at Increasing Risk

***Sandra Postel***

Species that depend on rivers, lakes, wetlands, and other freshwater environments for a major portion of their lifecycle are being imperiled and extinguished at an alarming pace. The principal culprit is the destruction of freshwater habitats by dams, river diversions, and pollution, along with the introduction of non-native species. Because communities of freshwater species perform valuable ecological services-filtering and cleansing water supplies, mitigating floods and droughts, and delivering nutrients to the sea, for example-stepped-up efforts to stem the tide of biological decline are needed urgently.

A comprehensive global assessment of freshwater biodiversity is not possible because of the lack of data for most countries. But researchers estimate that at least 20 percent of the world's 10,000 freshwater fish species are now endangered, are threatened with extinction, or have already gone extinct.<sup>1</sup> A significant but unknown share of mussels, amphibians, aquatic insects, and other species that depend on fresh water are also at risk. Many species may be lost even before they are found or named: indeed, scientists have been describing about 300 new freshwater species each year.<sup>2</sup>

In North America, at least 123 species of freshwater fish, mollusks, crayfish, and amphibians have become extinct since 1900.<sup>3</sup> Biologists Anthony Ricciardi and Joseph Rasmussen estimate that in recent decades North American freshwater animal species have been extinguished at an average rate of half a percent per decade.<sup>4</sup> They project, moreover, that this will increase in the near future to 3.7 percent a decade-about five times greater than the projected extinction rate for North American terrestrial animal species.<sup>5</sup> In fact, the relative rate of loss of North American freshwater species is comparable to that of species in tropical rainforests.<sup>6</sup>

The United States stands out as a global center of freshwater biodiversity. The nation ranks first in the world in the number of known species of freshwater mussels, snails, and salamanders, as well as three important insect groups-caddisflies, mayflies, and stoneflies.<sup>7</sup> U.S. waters are home to 300 species of freshwater mussels-29 percent of those known worldwide-and nearly twice as many as live in Europe, Africa, India, and China combined.<sup>8</sup> With approximately 800 species of freshwater fish, the United States ranks seventh in freshwater fish diversity globally but has by far the most diverse assemblage of fishes of any temperate country.<sup>9</sup>

In the most comprehensive survey to date of the conservation status of U.S. plant and animal species, researchers with The Nature Conservancy and the Association for Biodiversity Information found that of 14 major groups of organisms, the 5 with the greatest share of species at risk were all animals that depend on freshwater systems for all or part of their lifecycle.<sup>10</sup> (See Table 1.) An astonishing 69 percent of U.S. freshwater mussels are to some degree at risk of extinction or are already extinct -compared with 33 percent of flowering plants, 16 percent of mammals, and 14 percent of birds.<sup>11</sup>

Although no comparable surveys exist for most of the rest of the world, the prognosis for freshwater life is not good. Swedish scientists Mats Dynesius and Christer Nilsson have found that 77 percent of the 139 largest river systems in the United States, Canada, Europe, and the former Soviet Union-essentially the northern third of the world-are moderately to strongly altered by dams, reservoirs, diversions, and irrigation projects.<sup>12</sup> Worldwide, the number of large dams (those at least 15 meters high) stood at 5,000 in 1950, and three quarters of these were in North America, Europe, and other industrial regions.<sup>13</sup> By 2000, there were more than 45,000 large dams and they were spread among more than 140 countries.<sup>14</sup>

Most new dam construction and major river diversions are occurring in developing countries as they strive to increase irrigation, water supplies, and hydroelectric power, much as industrial countries did before them. Consequently, the rich diversity of freshwater life in tropical Asia, Africa, and Latin America will come under increasing pressure. The Amazon basin alone harbors more than 2,000 species of freshwater fish-about one in five of those known worldwide-and

scientists estimate that 90 percent are found nowhere else.<sup>15</sup> With more than 70 dams planned for Brazil's Amazonian region alone, a good portion of these species are likely to be threatened.<sup>16</sup>

Asia also has a diverse array of freshwater species coming under increasing threat from habitat destruction. Indonesia has at least 1,200 freshwater fish species, China more than 700, and Thailand more than 500.<sup>17</sup> Asian rivers are home to three of the world's five species of true river dolphins-those that never enter the sea-and all three are endangered.<sup>18</sup> Tropical Asia also harbors the world's richest assemblage of freshwater turtles, as well as 8 of the world's 23 crocodilian species.<sup>19</sup> All 8 are now endangered.<sup>20</sup>

The ecology of Asian rivers is driven largely by the monsoons, which create high and low river flows at fairly predictable times of the year. The organisms that inhabit these rivers have adapted and keyed their lifecycles to this flow pattern over time. Dams not only block many of them from migrating up or down river, they smooth out the flow of rivers, thereby eliminating habitats and environmental cues that various species need to complete their lifecycles. They also disconnect rivers from their floodplains, which many species rely on for breeding and feeding.

Combined with pollution, watershed degradation, and the introduction of non-native species, additional dam construction will place a greater proportion of Asian freshwater species at risk. In Southeast Asia, the Mekong Commission has identified a dozen sites for dams on the Mekong River in Laos, Thailand, and Cambodia.<sup>21</sup> Dam construction continues in China, which already has nearly half of the world's large dams.<sup>22</sup>

Finally, the algae, fungi, worms, and other species that live in freshwater environments are also at risk from the alteration of aquatic habitats. Globally, more than 100,000 species of invertebrates are estimated to live in freshwater sediments, along with 10,000 species of algae and more than 20,000 species of protozoa and bacteria.<sup>23</sup> These tiny sediment-dwellers help maintain water quality, decompose organic matter, produce food for animals higher in the food chain, and perform other critical functions. Scientists have found them to be very sensitive to changes in water levels, flow magnitudes, and other hydrologic alterations.<sup>24</sup>

Protecting the valuable ecosystem services upon which society depends requires conserving the unique assemblages of species that perform this work. This, in turn, requires building habitat protection into the management and use of rivers. A guiding principle now gaining ground is that of a freshwater "reserve"-the notion that ecosystems should be allocated the quantity, quality, and timing of freshwater flows needed to maintain their health and functioning.<sup>25</sup> South Africa is pioneering the implementation of this principle following passage in 1998 of a new water act that calls for the establishment of ecological reserves for its rivers.<sup>26</sup>

**Table 1: Risk Status of U.S. Animal Species Dependent on Freshwater Ecosystems**

<b>Animal Group</b>	<b>Total Number of Species</b>	<b>Share that is Extinct, Critically Imperiled, Imperiled, or Vulnerable (percent)</b>
Freshwater		
Mussels	292	69
Crayfishes	322	51
Stoneflies	606	43
Freshwater		
Fishes	799	37
Amphibians	231	36

**Sources:** See endnote 10.

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