Prospects for Recovering Endemic Fishes Pursuant to the U.S. Endangered Species Act

ABSTRACT

If the success of the Endangered Species Act (ESA) is measured by the number of endangered species that have been recovered and delisted, then the act is not very successful. Only 15 species have been delisted because of recovery in the history of the ESA. The Borax Lake chub (*Gila boraxobius*), an endangered species restricted to an Oregon spring system, is considered to be on the brink of recovery and may warrant future delisting. A panel of scientists was convened to determine consensus regarding the species' listing status by reviewing: (1) current habitat conditions, (2) implementation of the recovery plan, and (3) applicability of ESA listing factors. Despite substantial progress towards recovery, threats to the species remain, including habitat degradation and the potential introduction of nonnative species. These are problems common to many fishes of highly restricted distribution. Because the Borax Lake chub occurs in a single spring system, the species remains vulnerable to catastrophic loss and requires continuing protection afforded by the ESA. Like many spring-dwelling fishes with a restricted range, recovery of the Borax Lake chub to the point where ESA protection is no longer required is an admirable but largely unobtainable goal. Prevention of extinction rather than delisting is a more appropriate measure of ESA success for such species.

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According to Section 2 of the Endangered Species Act of 1973 (ESA), the primary purpose of the act is to stem the tide of human-caused extinctions and to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved. The ESA is widely regarded as the most important conservation law in the United States and is viewed as the pinnacle of legislation for protecting wildlife (Bean 1983; Plater 2004). Because of its importance and influence, the ESA has been the keystone for a growing number of conservation battles across the country. Conflicts between application of the ESA and land and water development projects have increased because of several factors, but chief among these is the cumulative effects of a growing human population and increasing resource demand coupled with an increasing number of species listed as endangered or threatened.

The 30-year history of the ESA has been characterized by a growing list of protected species, subspecies, and distinct population segments (hereinafter "species"). When the ESA was signed into law by President Nixon in 1973, 119 species received "grandfathered" protection from the earlier Endangered Species Conservation Act of 1969. From 1973 through 2002, an average of nearly 43 species were added each year to the list of endangered and threatened species until a total of 1,262 species (517 animals, 745 plants) were listed in the United States as of 2003 (U.S. Fish and Wildlife Service [USFWS] 2004a).

Over this same timeframe, 37 species have been delisted and subsequently removed from ESA protection. Of these, 15 were delisted because of recovery, 7 because of extinction, and 15 because of new information or taxonomic revision showing their listing was in error (USFWS 2004b). The low number of recovered species is due largely to inadequate protection from a growing array of threats to species and habitats, and because delisting removes the primary regulatory protection available—that is, from the ESA itself (Doremus and Pagel 2001). Indeed, some scientists and legal scholars have questioned whether we are likely to see the recovery of many listed species, and instead have proposed that recovery should be viewed as an aspirational goal rather than a realistic expectation for many listed species (Doremus 2000; Doremus and Pagel 2001). On the other hand, others have encouraged delistings because of recovery for a variety of practical, political, and philosophical reasons (Bender et al. 1998).

The growing list of protected species and increasing human-caused fragmentation and degradation of natural habitats presents a looming conflagration for conservation efforts. As conflicts escalate between the ESA and human development, there are growing efforts to reduce the impact and effectiveness of the ESA. One way to reduce the impact of the ESA is to reduce the number of protected species, either by slowing the number of new species listings and/or increasing

the number of delistings. For the first 20 years following passage of the ESA, there were only 18 delistings, but since 1993 the rate of delistings has increased. Elements on both sides of the conservation debate have sought to increase the number of delisted species. During the Clinton Administration, Interior Secretary Babbitt believed that the USFWS's ability to delist species because of recovery was a clear indication that the ESA was a success. During this period, USFWS expedited delisting efforts, including development of lists of species that might warrant delisting because of recovery (Bender et al. 1998). As Rohlf (2004) pointed out in a recent review of Section 4 of the ESA, federal agencies have both political incentive and institutional desire to find success in the ESA by pointing to recovered species that may be delisted. Of course, those that oppose the ESA are equally glad to see fewer species protected under the act's provisions, but for different reasons.

Among the species that might warrant contemporary delisting is the Borax Lake chub (*Gila boraxobius*), an endangered species inhabiting a small hot-spring ecosystem in southeastern Oregon. The restricted habitat occupied by the species recently has been acquired by a conservation group and surrounding public land has received additional protections. In 2003, we conducted a review of the conservation status of the Borax Lake chub to develop a scientific consensus regarding the listing status and future conservation needs of that species. The purposes of this article are to report on the results of our evaluation of the Borax Lake chub, discuss implications of our finding for the vulnerability of other species of restricted range, and to provide recommendations for status reviews for endemic species listed pursuant to the ESA. We also offer our opinion regarding appropriate criteria for measuring the success of the ESA itself. Management of endangered and threatened fishes, including their recovery and delisting, are critical topics to fisheries biologists. We hope this article stimulates further debate on measures of success for the ESA and understanding of the appropriate role of delisting.

Case Study: The Borax Lake Chub

The Borax Lake chub is endemic to the geothermally-heated waters of Borax Lake and adjacent wetlands in Oregon's Alvord Basin (Williams and Bond 1980). The chub was listed as endangered in 1980 by emergency rule and again as endangered by final rule in 1982 (USFWS 1982). At the time of listings, the primary threats to the species consisted of potential impacts from geothermal energy development and diversion of the lake's outflows by alteration of the shoreline crusts. Although no recovery team ever was formed for this species, a recovery plan was completed in 1987 that called for protection of the Borax Lake ecosystem through acquisition of key private lands, protection of subsurface and surface waters, controls on access, removal of livestock grazing, monitoring, and other recovery actions (USFWS 1987).

The Borax Lake chub exists as a single population that most likely has been maintained within its historic range of natural variability, and an increase in abundance is not a factor in successful recovery. Recovery, in this instance, is based entirely on habitat integrity, including protection of spring aquifers, and the avoidance of nonnative species introductions.

Borax Lake is a spring-fed ecosystem in Oregon's Alvord Desert and, along with surrounding pools and marshes, the sole habitat for the endangered Borax Lake chub.

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Numerous recovery measures have been implemented during the past two decades to secure habitat for the species. In 1983, the Bureau of Land Management (BLM) designated the public lands surrounding Borax Lake as an Area of Critical Environmental Concern. The Nature Conservancy (TNC) leased two 160-acre private land parcels, one surrounding Borax Lake and the other immediately to the north, in 1983 and purchased them outright in 1993, thereby bringing all lands designated as critical habitat into public or conservation ownership. With the acquisition by TNC, livestock grazing ceased. Passage of the Steens Mountain Cooperative Management and Protection Act of 2000 withdrew public lands from mineral and geothermal development within a majority of the Alvord Basin, including the Alvord Known Geothermal Resource Area and Borax Lake.

With removal of many of the significant threats facing the Borax Lake chub, the U.S. Fish and Wildlife Service began to examine its feasibility for reclassification (R. White, USFWS, pers. comm.). The Borax Lake chub frequently is cited by USFWS as being "on the brink of recovery" (Motivans and Balis-Larsen 2003) and is rated by that agency as having achieved a relatively high percentage of recovery implementation (51–75%; USFWS 2003). In 2003, two of the authors conducted a status review of the Borax Lake chub to determine whether a change in listing status was warranted and to review future management and monitoring needs for the species (Williams and Macdonald 2003). The status review consisted of four components: (1) review of recovery plan implementation, (2) field investigations at Borax Lake to determine current status of the species and habitat, (3) review of the five listing factors from Section 4 of the Endangered Species Act, and (4) convening of a 16-member scientific panel to review findings from the recovery plan, habitat, and listing factor reviews. The panelists were scientists that had worked previously on the species and its habitat, agency biologists with management responsibility for the species, and other scientists with extensive knowledge of desert spring systems in western North America. Panelists were asked, using their best scientific judgment on issues rather than agency positions, to develop a consensus on listing status, management, and monitoring.

The expert panel concluded that substantial progress has been made towards recovery of the Borax Lake chub, but that despite this progress, threats to the species and ecosystem remain. Results of the status review are summarized in Table 1. Threats that had been eliminated included the alteration of lake shoreline and outflows, livestock grazing, and geothermal energy development on public lands. The primary remaining threats were increasing habitat degradation associated with recreational use and the increasing potential of nonnative species introduction. Exotic goldfish (*Carassius auratus*) recently have been introduced into Mann Lake just to the north of Borax Lake (Tim Walters, Oregon Department of Fish and Wildlife, pers. comm.). Both recreation and introduced species received minor attention in the 1987 recovery plan. Borax Lake is located in a remote and sparsely-populated area, but one that is increasingly used by a public seeking opportunities for solitude, wildlife observation, and open space. The panel believed that because the range of the Borax Lake chub is restricted to single geologically fragile site, the species is vulnerable to catastrophic loss despite existing protection. The panel also noted the importance of frequent monitoring to detect and move to extirpate

Table 1. Summary of status review findings for the Borax Lake chub. For recovery plan implementation review, recovery subtasks were scored on a scale of 0–4.

0 = no implementation
1 = minor implementation
2 = approximately half implemented
3 = mostly implemented
4 = fully implemented

Recovery Plan Implementation	Task 1: Secure land and water rights. Average subtask score = 3.7. Task 2: Restore Lower Borax Lake, small ponds, and intervening marshes. Average subtask score = 4.0. Task 3: Protect Borax Lake ecosystem. Average subtask score = 2.7. Task 4: Monitor status of ecosystem. Average subtask score = 2.3. Task 5: Encourage support of recovery through public awareness. Average subtask score = 3.5.
Field Investigations	Habitat and chub population appeared in good condition and within expected range of variation observed historically. Significant recreational use (off-road vehicle use, camping, disturbance of lake substrates from wading) was noted.
Review of 5 Listing Factors	1. Present or threatened destruction, modification, or curtailment of its habitat or range. 1982: threats consisted of chipping of crusts around shoreline, diversion of outflows, development of geothermal resource, and potential development of recreation facility. 2003: threats consist of recreational use and potential water development on private lands. 2. Overutilization for commercial, sporting, scientific or educational purposes. 1982, 2003: no threats for this factor. 3. Disease or predation. 1982: no threats for this factor. 2003: potential introduction of nonnative species. 4. Inadequacy of existing regulations. 1982: no threats for this factor. 2003: no threats for this factor. 5. Other natural or manmade factors affecting its continued existence. 1982: no threats for this factor. 2003: because of restricted range, species vulnerable to disturbance event.

introduced species and to be able to act quickly in the face of other new threats. No change in listing status was recommended although the expert panel concluded reclassification from endangered to threatened could be appropriate in the near future depending primarily upon implementation of a regular monitoring program. The panel further concluded that "maintaining the Borax Lake chub on the list of Endangered and Threatened Wildlife and Plants affords the greatest likelihood that sufficient scientific and agency attention will be focused on Borax Lake such that if habitat integrity is compromised, corrective action will be timely enough to save the species."

Delisting and Vulnerability of Endemic Fishes

Given the plethora of possible causes of population endangerment, determining vulnerability of species to extinction events is difficult. Many factors are relevant, including a species' habitat requirements, population size, and dispersal abilities (Tilman et al. 1994; Driscoll 2004). Furthermore, a search for explanations of status changes in many lesser-known species listed as endangered or threatened often is hindered by our lack of knowledge of their basic life history and habitat requirements. Nonetheless, certain factors common to many endangered species are known to increase the likelihood of their extinction. These factors include small population size (Soulé 1983; Gilpin and Soulé 1986), restriction to a small geographic area (Lovejoy et al. 1986), dependence upon a specific rare habitat type (Terborgh 1974), and inability to move away from increasing sources of stress or habitat degradation (Diamond 1975).

Endemic fishes with a highly restricted range are particularly vulnerable to extinction because they occur as a single or low number of populations, depend upon a specific habitat type, and have low tolerance for habitat modification. Endemic fishes may be common in the limited areas where they occur but often have rigid habitat requirements. These endemic species therefore, become highly vulnerable to habitat change or invasion of nonnative species (Minckley and Deacon 1968; Terborgh 1974). The vast majority of recent U.S. extinctions have been in species with restricted ranges, including freshwater mussels of southeastern rivers, and plants and terrestrial invertebrates of Hawaiian forests (Suckling et al. 2004). In their review of western fish conservation, Deacon and Minckley (1991) concluded that the restricted distributions and small population sizes of many spring-dwelling fishes dictated their virtual permanent status as endangered or threatened.

Of the 15 species that have been delisted because of recovery, most are wide-ranging, such as the American alligator and peregrine falcon. Five fishes have been removed from the list of threatened and endangered species, four because of their extinction (Tecopa pupfish [*Cyprinodon nevadensis calidae*], longjaw cisco [*Coregonus alpenae*], blue pike [*Stizostedion vitreum glaucum*], and Amistad gambusia [*Gambusia amistadensis*]) and one because of taxonomic revision (Umpqua River form of coastal cutthroat trout, *Oncorhynchus clarki clarki*). No fishes have been delisted because of recovery. Although it is difficult to generalize about the characteristics of listed species that make good candidates for recovery, it seems clear that species with the following suite of characters may more readily respond to recovery efforts: (1) habitat requirements are more general than specific, (2) quality habitat remains within historic range, and (3) existing threat factors, such as overharvest, may be easily regulated. Simply stated, recovered species often faced threats that were easier to address through available regulatory channels (Abbitt and Scott 2001). On the other hand, species from specialized habitats and/or smaller ranges may be more vulnerable to loss (Terborgh 1974; Deacon and Minckley 1991). In a review of the conservation status of aquatic species in the Great Basin, Sada and Vinyard (2002) found that declines were greatest in the most narrowly distributed and vulnerable populations. According to their analysis, all extinct taxa and most taxa suffering major declines (68%) had fewer than five small populations.

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Jackrabbit Spring in Ash Meadows, Nevada, provides habitat for the endangered Ash Meadows pupfish and Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*). Other nearby springs provide habitat for the endangered Devils Hole pupfish (*Cyprinodon diabolis*) and warm springs pupfish (*C. nevadensis pectoralis*). Despite designation of the springs as protected areas (Ash Meadows National Wildlife Refuge and disjunct portion of Death Valley National Park), habitats and fishes remain vulnerable.

A report by Bender et al. (1998) listed 22 species considered likely candidates by USFWS for delisting or reclassification because of increased protection, included three fishes: tidewater goby (*Eucyclogobius newberryi*), Ash Meadows pupfish (*Cyprinodon nevadensis mionectes*), and Pahrump poolfish (*Empetrichthys latos*). The tidewater goby is more broadly ranging, but the Ash Meadows pupfish and Pahrump poolfish are both spring-dwelling fishes with restricted ranges that are similar to the Borax Lake

chub in terms of vulnerability. The Ash Meadows pupfish and three other listed fishes are endemic to springs in the Ash Meadows area but remain vulnerable to catastrophic loss because of introductions of nonnative species and/or modification to subsurface aquifers. These threats persist despite protective management of land around surface spring areas. The recovery plan for Ash Meadows species lists protection of aquifers, eradication of nonnative species, and restoration of natural spring habitats as essential criteria that must be met before fishes should be considered for delisting or reclassification from endangered to threatened (USFWS 1990). Recovery of the Pahrump poolfish is doubtful. This species has been eliminated from its single spring historic habitat but exists as an introduced population on the Desert Wildlife Range. Like the Borax Lake chub, these spring-dwelling desert fishes are likely to need the protection afforded by the ESA in perpetuity.

Current procedures for delisting species pursuant to Section 4 of the ESA are similar to listing. That is, the status of the species is compared to the five listing factors contained in Section 4, and if delisting is believed warranted by USFWS, a proposal is published in the *Federal Register* notifying the public of the proposed change and seeking public comments. We suggest the panel review conducted for the Borax Lake chub may provide a suitable model to evaluate the ESA status of endemic species, particularly those lacking recovery teams. For species with recovery teams, the team likely could substitute for the expert panel. Regardless, a variety of factors should be reviewed in any delisting process, including the implementation status of any applicable recovery plans and current status of subject populations and habitats, in addition to an analysis of the five listing factors.

Conclusions

The desire to delist species is driven, at least in part, by the belief that recovery of listed species is an indicator of the success of the ESA. But with only 15 taxa delisted because of recovery in the history of the ESA, success as measured by this indicator is poor. More appropriate indicators would include changes in population trends of listed species and the ability of ESA protections to prevent extinction. In its latest biennial report to Congress on recovery of listed species, USFWS (2003) reported that population trends for 39% of listed taxa were either stable or increasing, while 34% were declining, and 24% were uncertain. Pursuant to this indicator, the ESA fares better. If preventing extinction is the criterion, an assessment of the success of the ESA is even more positive, with only 7 taxa delisted because of extinction. One study estimated that based on risk of extinction alone, 192 listed taxa would have been expected to go extinct between 1973 and 1998 (Schwartz 1999). Recent data from the Center for Biological Diversity (Suckling et al. 2004) supports the value of ESA protections in preventing extinction. An analysis of 114 extinctions of U.S. species since the ESA was passed in 1973 found that 81% of extinction events involved taxa that were not protected by the ESA (19% were listed). Suckling and others (2004) believe that removal of procedural delays in listing species pursuant to the ESA and elimination of the listing backlog would have resulted in increased protection that likely would have prevented many extinctions. Additionally, many rare but non-listed species occur with listed species and may receive protection that could be indirectly credited to the ESA. Regardless, the small number of extinctions of listed species suggests strongly that the ESA has been successful in ensuring the continued existence of the taxa it protects.

Delisting of spring-dwelling fishes with restricted ranges should be approached with considerable caution because of their inherent ecological and biological vulnerability and their ability to serve as umbrella species protecting many lesser-known and unlisted organisms. Although the Borax Lake chub has a higher rate of recovery success than many listed species, it appears to an expert panel to be a poor candidate for delisting largely because of its inherent vulnerability as an endemic species dependent on a specialized habitat. Ironically, because the ESA is a strong regulatory law for species and habitat protection, removal of this protection through the delisting process also removes the preeminent tool for maintaining the species in the long run. The naturally restricted range of many endemic fishes makes their recovery to the point of delisting an admirable but largely unobtainable goal.

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