

# Alien Species in National Parks: Drawing Lines in Space and Time

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Experience in scientific and public forums during the past 15 years has convinced us that the ecological concepts that underlie national park management goals in the United States need clear explanation and wider recognition. This need was underscored recently by the exchange about management of the mountain goats (*Oreamnos americanus*) introduced into the Olympic Mountains (Anunsen & Anunsen 1993; Scheffer 1993*a*, 1993*b*). Goats are considered alien species (exotic, nonnative, nonindigenous) by the National Park Service—unwelcome additions to the native fauna of Olympic National Park (National Park Service 1981, 1987). The concern of the National Park Service with alien species may be understood more fully when viewed in the broader context of national park management goals. Therefore, we briefly discuss management of natural areas and trace the evolution of National Park Service policies on introduced species, including their ecological and management implications.

## The Management of National Parks

Biologists and managers have struggled to define ecological objectives for the large natural-area parks such as Yellowstone, Everglades, Denali, and Olympic (see Leopold et al. 1963; Houston 1971; Agee & Johnson 1988). The way a particular park is managed depends on whether the goal is to conserve biological states or to preserve natural processes. Management options were outlined succinctly by Shepherd and Caughley (1987: 191):

- (1) If the aim is to conserve specified animal and plant associations that may be modified or eliminated by wild-fire, grazing or predation, then intervene to reduce the intensity of wildfire, grazing or predation.
- (2) If the aim is to give full rein to the processes of the system and to

accept the resultant, often transient, states that those processes produce, then do not intervene. (3) A bit of both—if the aim is to allow the processes of the system to proceed unhindered unless they produce “unacceptable” states, then intervene only when unacceptable outcomes appear likely.

Option 3, with strong emphasis on allowing processes to approach full rein, best describes our perception of the management goals for large parks in the United States. By defining acceptable limits to the ecological processes of interest, we should be able to produce operational guidelines for natural-area parks that are appropriate for the end of the twentieth century. Serious questions remain, however, about our ability to meet biological goals in the future.

Ecosystems leak. Consequently, a truly self-contained natural area will remain an ideal that cannot be fully achieved. Compensatory management may lie in the future for most U.S. parks, but the level of human intervention required is still unclear. Parks are beset with problems that include the difficulties of fully restoring forces (such as fire) that drive ecological processes, the possibility that areas may be too small to maintain viable populations of native species over time (Newmark 1987), and the alteration of ecological processes by the introduction of alien species.

## Alien Species in Parks

Dramatic changes have occurred in the natural distributions of North American species since the waning of the Wisconsin glaciation, a mere 18,000–15,000 years ago (Pielou 1991). Mammal distribution, for example, has changed markedly during just the past 10,000 years, with major shifts of terrestrial species continuing into mid-Holocene times (Graham & Mead 1987; Pielou 1991). The degree to which these shifts in distribution must be considered in designating a species' status in parks is considered below.

Humans have accelerated the spread of species



around the earth. The long-term ecological consequences of these activities are not fully understood (see Elton 1958), but the magnitude of the management problems posed to U.S. national parks by the introduction of exotic or alien organisms is considerable. In a 1980 report to the Congress, 300 National Park Service areas reported 602 perceived threats to natural resources involving alien plants and animals (National Park Service 1980a).

Concern about alien species in parks was expressed in the scientific community as early as the 1920s (Lien 1991) and was reinforced by National Park Service scientists in the 1930s (see Wright et al. 1933). The concern centered on the disruption of established ecosystem processes by introduced species, including dramatic changes in species composition and loss of biological diversity. Policies on the introduction and management of exotic species evolved in concert with the broader biological goals of parks (Cahalane 1948; Leopold et al. 1963; J. G. Dennis, U.S. National Park Service, Washington, D.C., unpublished report, 1980; Wright 1992). Leopold et al. (1963) were particularly blunt that the biota of national parks should "... be limited to native plants and animals."

Current policy states that "Exotic species are those that occur in a given place as a result of direct or indirect, deliberate or accidental action by humans (not including deliberate reintroductions)" (National Park Service 1988). Interpretation of this general policy is usually straightforward. For example, eastern brook trout (*Salvelinus fontinalis*) in Yellowstone and Olympic Parks, feral goats (*Capra hircus*) and eucalyptus trees (*Eucalyptus* spp.) in Maui's Haleakala Park, and European wild boars (*Sus scrofa*) in Great Smoky Mountains Park are exotic beyond reasonable argument (within a time frame of millennia). Troublesome areas remain, however, that involve spatial and temporal scales where policy seems to collide with biogeography. We examined six case histories, including three involving challenges to National Park Service policy, in which the issue was resolved by the courts.

### Burros in Grand Canyon National Park

In the 1970s, the National Park Service proposed to eliminate free-ranging burros (*Equus asinus*) from Grand Canyon National Park because the animals were exotic (feral since the 1870s or earlier) and because they altered native plant communities and possibly competed with native wildlife (National Park Service 1979, 1980b). The proposal was contested on several grounds, but the one of interest here involved several paleontologists who viewed burros as the ecological equivalents of late Pleistocene equids (*E. conversidens*) formerly found in the area. The native equid became

extinct about 11,500 B.P., possibly at the hand of early humans (Martin 1970, 1979; Cole 1980). Other scientists and the National Park Service (Carothers et al. 1976, 1979) disagreed with these interpretations because (1) North American equids were related to the north African progenitors of the burro only at the subgeneric level (see Harris & Porter 1980), and (2) Late Pleistocene environments no longer occurred in Grand Canyon: plant communities differed, and the array of Pleistocene species associated with the extinct equids (including other large herbivores, predators, parasites, and diseases) was now largely absent. A subsequent legal challenge based in part upon the question of the alien status of the burro failed (Coppie 1980; legal papers filed in Civil Case 80-416-PHX-WPC). The court also upheld the validity of the broader National Park Service policy on alien species management.

### Burros in Bandelier National Monument

In a related case, a National Park Service proposal to remove burros from New Mexico's Bandelier National Monument was disputed, initially on grounds that the agency failed to follow requirements of the National Environmental Policy Act (NEPA). The U.S. District Court found in favor of the National Park Service and accepted as "finding of fact" that burros were exotic species, as defined by National Park Service policy (Buciaga 1980). This decision was appealed by the American Horse Protection Association; arguments again invoked the occurrence of Pleistocene equids and the derivative notion that burros should be considered native to New Mexico. The U.S. Court of Appeals (1982) accepted neither this argument nor the others concerning NEPA procedural issues, and the National Park Service prevailed.

### Bolson Tortoise in Big Bend National Park

The bolson tortoise (*Gopherus flavomarginatus*) is an endangered species that occurs in north-central Mexico. Introduction of the tortoise to Big Bend National Park was proposed (Aguirre & Adest 1991) on grounds that the same or a closely related species occupied the region until late Pleistocene-early Holocene times. The fossil record suggests that the tortoise has undergone a reduction in body size and a contraction of geographic range since the late Pleistocene. The tortoise has apparently been absent from the Big Bend area for thousands of years and now occupies 6000 km<sup>2</sup> in Mexico, some 240 km from the park. No assessment has been made of the potential effect of the proposed introduction on the extant flora and fauna of Big Bend. Following detailed review, the National Park Service ruled the tortoise to be an alien species and, therefore, inappropriate to in-

roduce into Big Bend, its status as an endangered species notwithstanding (M. Ruggiero, U.S. National Park Service, Washington D.C., unpublished memo, 1991).

### Bison in Wrangell–St. Elias National Park

Bison (*Bison bison*) were introduced into Alaska's Copper River (1950) and Chitna River Valleys (1962), areas subsequently incorporated into Wrangell–St. Elias National Park and Preserve in 1980 (Peek et al. 1987). Bison evidently persisted in Alaska, at least north of the Alaska Range (about 500 km from Wrangell–St. Elias), until about 500 B.P., just before Euroamerican contact (their extinction was "natural"). South-central Alaska, including Wrangell–St. Elias, was heavily glaciated during Pleistocene advances, and no post-Pleistocene bison remains have been found in the area. Also, the introduced animals were plains bison (*B. b. occidentalis*), not wood bison (*B. b. athabascaae*), a subspecies currently recognized by some mammalogists (Meagher 1986). (This may now be an irrelevant issue because Geist [1991] proposed that *B. b. athabascaae* was simply an ecotype, not a valid taxon.) Peek et al. (1987) questioned whether or not bison should be considered exotic and suggested that the National Park Service define the concept of native species on temporal and spatial scales. The current Wrangell–St. Elias position is to consider the bison alien (K. Jenkins, Wrangell–St. Elias National Park, Glennallen, Alaska, personal communication, 1991).

### Horses in Ozark National Scenic Riverways

In 1990, the National Park Service proposed to remove feral horses (*Equus caballus*) by live capture from the "natural zones" of the 327-km<sup>2</sup> Ozark National Scenic Riverways. The Riverways was authorized by Congress in 1964 with an extremely broad enabling statute to conserve and interpret natural values and objects of historic interest, manage wildlife, and provide outdoor recreation (Higgins 1991).

Fewer than 30 horses occupy the Riverways, and horses have been present since the 1940s. The proposed removal was challenged by local residents on several grounds, including the contention that horses should be considered native species, wildlife, and cultural resources under National Park Service policy.

In June 1992, a U.S. District Court found in favor of the plaintiffs but accepted National Park Service arguments that the horses were rightfully classed as alien species. The court concluded that an error in judgment had occurred "... as to whether governing statutes and management policies required removal of the horses and the decision failed to consider relevant facts, in particular, the damage caused by removal of the horses and

whether the horses are cultural or historical objects" (Limbaugh 1992).

The case was appealed, and in June 1993 the district court decision was reversed. The Court of Appeals found that the earlier decision did not use the proper standard of judicial review of agency decision making and that there was sufficient evidence that the continued presence of the alien horses was in conflict with the purpose of the park (U.S. Court of Appeals 1993). The plaintiff's petition for certiorari to the U.S. Supreme Court to examine the appellate court decision was denied, and thus the appellate decision stands (W. D. Back, Solicitor, U.S. Dept. Interior, Portland, Oregon, personal communication 1994).

### Mountain Goats at Olympic National Park

Though early naturalists reported that mountain goats were absent from the Olympic Mountains, and though the animals were known to have been introduced in the 1920s, Lyman (1988) challenged the idea that the National Park Service should view the goats as alien species. Lyman's arguments were based upon a speculative dispersal model for *Oreamnos* during the late Quaternary. Based on the model, mountain goats might have occupied the Olympic mountains earlier in the Quaternary. He also speculated that mountain goats may have been present historically in unexplored areas of the mountains (Lyman 1988).

This challenge prompted the National Park Service to review the basic premise of goats as alien species. The ethnographic record indicated that mountain goats did not occur in the Olympic Mountains during the nineteenth century but that an extensive trade network among native peoples brought goat wool (prized for blankets and garments) and horns (as utensils) to the Olympic Peninsula (Schalk 1993). Goat bones have not been identified in remains from 24 archaeofaunal sites on the peninsula (mostly from the last 1000 years of the prehistoric record). Schalk (1993) cautioned, however, that because of the temporal range and location of the archeological sites (mostly coastal areas some distance from the mountains) and the general shifts in mammalian distribution during the late Quaternary, the archaeofaunal data did not permit conclusive statements regarding the presence or absence of goats during the late Pleistocene or Holocene prior to the nineteenth century.

Schultz (1993) reviewed historic accounts from the Spanish exploration of the Strait of Juan de Fuca in 1790, through explorations of the mountain range in the late nineteenth century to about 1925, around the time of the goat introductions. Considerably more historical information existed on early conditions in the Olympic Mountains than reported by Lyman (1988). Schultz

noted the difficulties of interpreting negative evidence and the occasional confusion over common names applied casually to wildlife species through the nineteenth century. She concluded that mountain goats were not present historically.

Note that the arguments for considering mountain goats as native species prehistorically in the Olympic Mountains contain elements of analogous arguments concerning bison at Wrangell–St. Elias and burros at Grand Canyon. The National Park Service continues to view the mountain goats as alien to the Olympic Mountains (National Park Service Draft Environmental Impact Statement, in preparation, 1994).

## Discussion

These six case histories raise several philosophical and biological questions for scientists and park managers.

(1) Given the dramatic changes in species distribution in North America from the close of the Pleistocene, what temporal and spatial scales of species distribution are appropriate to consider in defining “alien” and “native” status in national parks? Further, how long does a species have to be extinct, or by what agent, before its reintroduced successors are to be considered alien? Following Peek et al. (1987), is it appropriate for humans to introduce a species that has become extinct from natural causes into a park where the native fauna is to be retained intact?

(2) What obligation, if any, do national parks have to conserve a broader regional species diversity—in other words, should species in jeopardy elsewhere be introduced to a park simply to provide an added measure of protection?

(3) How different must a taxon be before it is judged too different from one present earlier?

Definitive answers cannot be provided to these questions, but we offer a perspective based on the broader objectives for U.S. national parks. Granting the dramatic post-Pleistocene changes in species distribution, our understanding is that the national parks were not established to attempt to recreate late-Pleistocene or early Holocene biotas (National Park Service 1991). Natural-area parks were set aside to conserve the outcome of the dramatic ecological events of the late-Quaternary, including local extinctions, which shaped the existing flora and fauna. Pragmatically then, the National Park Service is primarily concerned with historic, post-Columbian species distributions, recognizing that these too change naturally over time. This view also recognizes that it is appropriate to restore species eliminated directly or indirectly by Euroamericans.

If this perspective is valid, then a conservative interpretation of the National Park Service policy on alien species seems prudent because of the relative rarity of

large natural areas, their value as baselines or controls for other ecosystems exploited by humans (Jenkins & Bedford 1973), and our general ignorance of ecosystem dynamics and processes—we always manage park resources with an air of uncertainty (see Walters 1986). Introducing species adds to uncertainty. Our inability to predict the outcome of interactions of introduced organisms with either the abiotic forces driving ecosystem processes (such as fires or climatic change) or the extant biota means that we risk considerable alteration of ecological relations, unnecessarily, with too liberal an interpretation of the alien species policy.

From this viewpoint, it is irrelevant that an equid occurred in the Grand Canyon, that a tortoise occurred at Big Bend during the late Pleistocene, or that a form of mountain goat might have occupied the Olympic Mountains at an earlier time. In the park situations described, these species are prudently classed as alien, a perspective in accord with the few legal decisions rendered.

Periodically, the notion surfaces to declare alien species, particularly introduced game fishes, “naturalized” and to manage them as natural components of a park ecosystem. Paul Schullery (1984) provides a perspective on this issue: “The idea of creating ‘naturalized’ natives will be a transient paper construct that will never become more than self-delusion. . . . All it does is allow some administrators to trim the yardstick. . . . It would short circuit the park service’s institutional conscience. Once that had been done, and once a few weak people in the right positions had tasted the sweet relief of a problem deftly ignored, it would be hard to stop further encroachments on the remaining principles that parks live by.”

The National Park Service has been inconstant in dealing with alien species within and among units. In our view, this inconstancy involves (1) differences in enabling legislation, (2) the technological feasibility of control, and (3) sociopolitical issues that range from changing resource values and policies to the career tenure of park managers.

Units of the National Park System are sometimes required by Congress (either in the enabling legislation or by Congressional intent as established from the legislative history) to maintain populations of alien species—for example, horses on Assateague Island National Seashore. But so far as we can determine, no large natural-area park with exclusive legal jurisdiction is actually required to maintain alien species. We are less certain about requirements for parks with proprietary and partial jurisdictions (where aspects of jurisdiction are shared with the states), especially with respect to management of alien fishes.

There are species of alien plants and animals in parks for which elimination or even control is technologically unfeasible. This should not cause either undo despair or abandonment of long-term park goals. Recent advances

in molecular biology and genetics suggest that development of highly specific, genetically engineered toxins or agents of biological control may soon become routine (see *Contraception in Wildlife Management: 1993 Symposium*, U.S. Department of Agriculture, Denver, Colorado).

Values and policies change (see Caughley 1983; Scheffer 1993a). Past introductions of alien fishes to formerly fishless lakes and streams throughout the western national parks provide a good example of changing resource values. The alien fish provide recreational opportunities, but maintenance of these populations is being questioned now within the broader context of conserving natural biological diversity, particularly as the effects of the fish on native biota become better understood (see Bahls 1992; Bradford et al. 1993; Leary et al. 1993).

Managers of large national parks are besieged by management issues. Management of established alien species has frequently ranked low among the spectrum of concerns. Moreover, the management of either alien or native species always seems contentious in national parks, particularly management of large mammals (the "charismatic megafauna"). Park managers bold enough to take on these unpopular issues have found that raging controversy is not widely appreciated at other, higher levels of government.

The National Park Service should consider the advantages of narrower policy guidelines for defining alien and native species; a policy without defined temporal and spatial bounds might lead to a "whatever feels right" approach to the management of particular species. This could eventually undercut the value of parks as baseline ecological reserves. We recognize that framing workable guidelines will not be easy and that the attention of ecologists, paleontologists, and conservation biologists will be required.

But new definitions will be insufficient to fully resolve conflicts over alien species in national parks. Parks are surrounded by lands managed by other agencies with dissimilar objectives and policies—where native and exotic species are defined on different spatial and temporal scales. The U.S. Forest Service, for example, defines exotic species as those "... not originally occurring in the United States and introduced from a foreign country" (U.S. Forest Service 1991). Native species are those "... originally occurring in the United States." Originally is interpreted to mean the time of Euroamerican contact (J. Lowrie, Olympic National Forest, Olympia, Washington, personal communication, 1994). Moreover, state fish and wildlife agencies, which manage wildlife on an array of federal lands, tend to consider long-established alien species "naturalized" and to accord them much the same management consideration as natives.

Awareness is growing that national parks cannot be managed in isolation and that interagency ventures into

"ecosystem management" will be necessary. Conservation of biodiversity has been a powerful force driving recent attempts at interagency coordination (spurred by the federal courts). Improved conservation will require revisiting agency policies and definitions, including those concerned with alien species. Forums held to reconcile interagency differences in species management should involve scientists, managers, and public interest groups; they would be, we suspect, both informative and spirited gatherings.

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