Wildlife management activities in wilderness areas in the southwestern United States

Paul R. Krausman and Brian Czech

Abstract Wilderness in the United States has been controversial since its establishment in 1964. One school of thought argues that wilderness policy should prescribe wilderness boundaries and prevent management. Another believes that management practices must be used to maintain wilderness values. We described and tabulated wildlife management activities practiced in all 273 designated wilderness areas in the southwestern United States. We conducted a survey of personnel involved with wildlife management in wilderness including 60 employed by the United States Forest Service (USFS), 19 by the Bureau of Land Management (BLM), 14 by the National Park Service (NPS), 7 by the United States Fish and Wildlife Service (USFWS), and 10 by state game and fish agencies. Wildlife management activities (not including population surveys and research) occurred in 174 wilderness areas. The most frequently mentioned wildlife management activities were maintaining artificial water developments, conservation education efforts designed to protect wildlife, and removing or controlling non-native animal species.

Key words conservation education, introductions, non-native species, translocation, water development, wilderness areas, wildlife management

The Wilderness Act of 1964 (78 Statute 890, codified as amended at 16 U. S. C. §§ 1131–1136) established wilderness in the United States. However, some preservationists believe that wilderness management is an oxymoron and that proper wilderness policy should prescribe wilderness boundaries and enforce the absence of management within. Determinists believe that management practices must be used to maintain wilderness values. Wilderness determinists include wildlife managers who proactively manage wildlife resources within wilderness (Huff 1997).

Wilderness management is an historical and momentous topic in the southwestern United States (i.e., Ariz., N.M., Nev., Ut., Calif.). The roots of the National Wilderness Preservation System lie in Aldo Leopold's successful effort to establish the Gila Wilderness in New Mexico as the first official wilderness in the nation (Flader 1974). Today, the Southwest has the most wilderness areas (n=273), with a cumulative land area of 8,867,103 ha that exceeds any region except Alaska (Rosenberg 1994, Zaslowsky and Watkins 1994). Furthermore, the aridity of the Southwest is conducive to conflicts between preservationists and determinists (Zeveloff and McKell 1992). For example, water development is a focal activity of wildlife managers in the Southwest, sometimes in cases where water development may not be necessary to maintain historical natural processes or prudent to sustainable

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uses (Broyles 1995, Krausman and Czech 1998). Plant communities in arid regions have less ground cover and thinner soils than those in mesic regions and are altered more easily by overgrazing, hikers, packstock, and other disturbances (Holechek et al. 1998).

Despite the prominence of wildlife in wilderness issues, there is a paucity of published literature on wildlife management activities in wilderness. We conducted a literature search using Sabio© (The University of Arizona Library Information System, which included >2,000,000 citations). Using the keyword "wilderness," we found references to 2,201 books. When we added the keyword "wildlife," our reference list dwindled to 76, 60 of which were environmental assessments and other government documents prepared pursuant to federal policies. We performed a second search using Expanded Academic Index© (an interdisciplinary database indexing 1,400 scholarly journals from natural and social sciences and humanities). Using the keyword "wilderness," we found 1,313 citations (including 1,100 from the past 10 years). Only 73 citations also were indexed with the keyword "wildlife" and most of those addressed theoretical issues of conservation biology in wilderness. A few discussed wildlife management implications of wilderness research (Etchberger et al. 1989).

Schoenfeld and Hendee (1978) addressed the breadth of wildlife management activities conducted in wilderness, and Zwickel (1978:xii) called it "...the most perceptive and lucid manuscript concerned with wildlife management that I have read in recent years." Unfortunately, the value of this book is diminished because <13% (5.7 million of today's 44.5 million ha) of the National Wilderness Preservation System was established when Schoenfeld and Hendee (1978) authored it. At that time, there was virtually no designated wilderness in the Southwest or Alaska. Furthermore, the BLM was reorganizing pursuant to the Federal Land Policy and Management Act, federal wildlife jurisdiction was evolving rapidly pursuant to *Kleppe vs. New Mexico* (Buono 1997), and new wildlife management issues were on the horizon.

Hendee et al. (1990) is more current and is "...the Bible of wilderness management, and perhaps also the encyclopedia" (Bolle 1991:36). However, Hendee et al. (1990), as a textbook of principles and examples, did not include an account of the wildlife management activities conducted in any wilderness, much less all wilderness or even wilderness in a state or region. Our objective was to describe and tabulate wildlife management activities practiced in wilderness in the Southwest.

Study area

In the Southwest, there are 273 designated wilderness areas in the National Wilderness Preservation System (Rosenberg 1994, Zaslowsky and Watkins 1994, Watson and Brink 1996). The USFS administers 121 areas (3,114,015 ha), BLM 121 (2,157,207 ha), NPS 15 (2,260,806 ha), and USFWS 7 (553,904 ha, Rosenberg 1994, Zaslowsky and Watkins 1994, Watson and Brink 1996). The USFS and BLM jointly administered 9 wilderness areas (421,171 ha). California, Arizona, and New Mexico are the only states in the country with noteworthy acreage of BLM wilderness (Watson and Brink 1996).

Wilderness encompasses 8,867,103 ha in the Southwest, ranging from the 57-ha Farallon Wilderness in California to the 1,278,040-ha portion of California's Death Valley National Park that is designated as wilderness. The mean size is 32,480 ha. Wilderness encompasses 5,751,222 ha in California (n=132, μ=43,570), 1,817,298 ha in Arizona (n=89, μ=20,527), 653,212 ha in New Mexico (n=23, μ=27,217), 324,641 ha in Utah (n=15, μ=21,632), and 320,730 ha in Nevada (n=14, μ=21,382).

Methods

To determine the extent of wildlife management activities in wilderness in the Southwest, we surveyed personnel involved with wildlife management in wilderness in 1998 following Salant and Dilman (1994). In each wilderness, multiple individuals have wildlife management responsibilities; our results are based on awareness of those individuals we interviewed. The criteria we used to select survey respondents were knowledge of wildlife management activities in wilderness and availability. Potential respondents who estimated they knew <50% of the wildlife management activities conducted in wilderness under their jurisdiction were replaced by respondents who professed a greater knowledge level. We asked respondents about 26 activities fitting the wildlife management triad described by Giles (1978): habitat management, animal management, and human management (Table 1). We used an "other" category to

Table 1. Wildlife management activities that have occurred prior to 1999 in the 273 wilderness areas of the southwestern United States since their wilderness designation.

Habitat management activity	Known application
Maintaining of pre-existing artificial water developments	82
Modifying existing natural water features primarily for wildlife	25
Fencing to protect wildlife habitats primarily from livestock	19
Constructing artificial water developments primarily for wildlife	16
Fire suppression primarily to prevent destruction of wildlife habitats	15
Plant removal to improve wildlife forage or cover	11
Prescribed fire primarily to improve wildlife habitats	9
Providing salt licks or other special wildlife habitat features	9
Fence removal primarily to benefit wildlife	6
Fencing to restrict wildlife other than to protect habitats	6
Fencing to protect wildlife habitats primarily from wildlife	5
Planting seedlings or saplings primarily for wildlife forage or cover	5
Seeding primarily for wildlife forage or cover	2
Animal management activity	
Removing or controlling non-native animal species	44
Introducing native animal species (e.g., bighorn)	38
Introducing non-native animal species (e.g., non-native trout)	31
Predator control primarily for livestock protection	18
Human management activity	
Conservation education efforts designed to protect wildlife	51
Hiking restrictions to prevent wildlife disturbance	29
Dog or other pet restrictions to prevent wildlife disturbance	24
Recreational packstock restrictions to prevent wildlife disturbance	15
Recreational packstock restrictions to prevent wildlife habitat damage	8
Hiking restrictions to prevent wildlife habitat damage	6
Special hunting or fishing restrictions or privileges	6
Dog or other pet restrictions to prevent wildlife habitat damage	3
Other wildlife management practices	13

account for wildlife management activities not identified *a priori* (Table 1). We tallied population surveys and research separately.

For all activities, we included only those conducted "primarily for wildlife." For example, water developments for domestic livestock are sometimes maintained in wilderness with active grazing leases. Although livestock waters may incidentally benefit some species of wildlife, we did not count these maintenance activities as wildlife management activities.

Cases of water development for wildlife or cattle are relatively easy to distinguish, but other management activities, such as prescribed fire, are not so clearly distinguished. In some instances, the primary motive is clearly habitat improvement for a particular species. In others, the primary motive is clearly fuel reduction. Often, these and several other motives are combined. We let respondents decide whether a particular activity was administered "primarily for wildlife."

We did not attempt to ascertain the frequency of the activity per wilderness area, because data are unavailable or unreliable. For example, determining whether non-native species have been introduced to an area is a matter of relative certainty (i.e., they have or have not). However, for wilderness where non-native trout (i.e., *Oncorhynchus, Salmo, Salvelinus* spp.) are stocked, respondents did not have accurate records of how many lakes or streams had been stocked since wilderness designation or how many times each water body had been stocked.

Results

We obtained data for all designated wilderness in the Southwest by surveying 110 personnel employed by the USFS (n=60), BLM (n=19), NPS (n=14), USFWS (n=7), and state game and fish agencies (n=10). Seventy respondents provided data for an individual wilderness and 40 respondents provided data for multiple wilderness areas (range=2–34). Respondents indicated that they "know of virtually every wildlife management activity being conducted" for 210 (77%) of the wilderness areas covered. Respondents indicated that they "probably know about more than half of the wildlife management activities being conducted" for 63 (23%) of the wilderness areas covered.

Survey respondents reported that wildlife management activities representing the wildlife management triad (Giles 1978) have occurred in 183 (67%) wilderness areas. The most common wildlife management activities were maintaining artificial water developments that existed prior to wilderness

designation (i.e., habitat management), conservation education efforts designed to protect wildlife (i.e., human management), and removing or controlling non-native animal species (i.e., animal management;Table 1). Additional wildlife management activities were planned for 129 (47%) of the areas.

Habitat management

Habitat management was the most prevalent form of wildlife management. Results are grouped in broad categories of activities (Table 1).

Water provision. Providing water for wildlife was the dominant habitat management activity. This included constructing new artificial watering facilities, maintaining facilities constructed prior to wilderness designation, or modifying natural water features (Table 1). Most water developments were constructed for desert bighorn sheep (*Ovis canadensis*) and mule deer (*Odocoileus hemionus*) in Arizona and southern California. A few areas in southern California had numerous small-game catchments (e.g., 12 in the El Paso Mountains Wilderness).

Fencing. Fencing projects were used in 30 areas to exclude primarily livestock from wildlife habitats (Table 1). Many were small drift fences to protect springs, seeps, and small riparian areas, but they included some large projects. For example, 137 km of Gila River in the Gila Wilderness was fenced primarily for wildlife objectives.

Fencing also was used to protect plant communities from wild pigs (*Sus scrofa*) and elk (*Cervus elaphus*), Mexican vole (*Microtus mexicanus*) habitat from trampling by ungulates, and snowy plover (*Charádrius alexandrinus*) nesting areas from trampling by humans. Fencing was sometimes used to restrict native ungulates from grazing research plots or to contain reintroduced animals.

Fence-removal projects to facilitate access for wildlife and reduce the potential of wildlife entanglement were conducted in 6 areas. Removing a non-primitive feature was an important but secondary objective of these fence-removal projects.

Vegetation manipulation. Vegetation eradication or supplementing vegetation with seed, seedlings, or saplings occurred in 19 areas, primarily to maintain habitat integrity for native wildlife. Prescribed fires were used in 9 areas, usually to enhance deer or elk habitat or to reduce non-native vegetation to benefit wildlife communities. Fires were suppressed in 15 areas to protect Gila trout (*Onchorynchus gilae*), peregrine falcon (*Falco peregrinus*) nesting areas, spotted owl (*Strix occidentalis*) habitat, and other threatened and endangered species.

Special habitat features. Special habitat features were provided in 9 areas. Salt licks were used to lure bighorn sheep away from humans and for supplemental nutrition. Nest boxes were constructed for songbirds, bat gates were installed to keep people out of roosting caves, and feeding platforms were built for California condors (*Gymnogyps californianus*).

Animal management

Controlling or removing non-native species occurred in 44 areas. Species subject to control or removal included burros (*Equus asinus*), trout, feral cattle and pigs, horses, axis deer (*Axis axis*), fallow deer (*Dama dama*), beavers (*Castor canadensis*), and white-tailed ptarmigan (*Lagopus leucurus*). However, non-native species were introduced in other areas, including rainbow trout (*Onchorynchus mykiss*), brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and Arctic grayling (*Thymallus arcticus*).

Mountain goats (*Oreamnos americanus*) have been introduced near the High Uintas Wilderness in Utah and subsequently inhabited the wilderness. The same phenomenon has occurred with turkeys (*Meleagris gallopavo*) in several areas of Utah and California. In most cases, the geographic range of the species arguably did not include the areas where they were introduced, except perhaps in paleological terms.

In 1993, bison (*Bison bison*) were introduced along the boundary of the Cebolla Wilderness, New Mexico, where managers believe they existed into the late Holocene (P. Sorenson, BLM, personal communication). However, problems ensued, including the difficulty inherent in containing bison, and the animals were removed in 1995.

Native species were translocated in 38 areas, including bighorn sheep, Rocky Mountain elk (*Cervus elaphus nelsoni*), Tule elk (*C. e. nannodes*), beaver, California condors, Apache trout (*Onchorynchus apache*), cutthroat trout (*Onchorynchus clarki*), Gila trout, and Ramsey Canyon leopard frogs (*Rana subaquavocalis*).

Human management

Restrictions on human access (i.e., requiring a permit) were designed to prevent disturbance of bighorn sheep, marine mammals, peregrine falcons, prairie falcons (*Falco mexicanus*), golden eagles (*Aquila chrysaetos*), northern goshawks (*Accipiter gentilis*), blue grouse (*Dendragapus obscurus*), and spotted owls. Nesting and birthing areas were of particular concern. Restrictions also were used to prevent disturbance of wildlife at watering areas and to prevent destruction of habitat for arroyo toads (*Bufo microscaphus californicus*), snowy plovers, and peregrine falcons. Dogs and other pets were banned from all NPS wilderness areas and restricted in 24 other areas, primarily to prevent wildlife disturbance.

Conservation education was conducted on 51 areas. The most common educational tools were signs within and on wilderness boundaries. Trailhead interpretive programs also were used. Most of these efforts were designed to protect threatened and endangered species, marine mammals, or ungulates during birthing seasons. Many other wilderness areas had educational efforts at visitor centers and through local media, but we did not tally these.

Population surveys and research

Population surveys were conducted in 206 areas, including 152 areas where aerial surveys were conducted. Helicopters were used primarily for surveys and >90% of such surveys were for big-game species. Wildlife research was conducted in 81 areas. In 56 areas, only population surveys or research were conducted. In all areas except one where wildlife research was conducted, population surveys also were conducted.

Other wildlife management activities

Other wildlife management activities included modifying, revoking, or buying out grazing permits in 6 areas, using 5 wilderness areas as wildlife stocking sources, and constructing barriers to prevent non-native fish immigration in 2 areas (Table 1).

Although we did not tally management activities conducted primarily for non-wildlife objectives, some of these activities directly involved wildlife. For example, bear (*Ursus* spp.) control was conducted in the Yosemite Wilderness and bear-proof trash containers were installed in several areas, primarily for human safety.

Discussion

Habitat management

Water provision is the most common wildlife management activity in wilderness areas of the Southwest. However, it also is the subject of controversy in more areas than any other wildlife management activity (Czech and Krausman 1999). Czech and Krausman (1999) reported 63 controversial issues (33 on wilderness administered by the BLM, 24 on wilderness administered by the USFS, 4 on wilderness administered by the NPS, 2 on wilderness administered by the USFWS) in 53 wilderness areas.

Water has often been assumed to be the limiting factor for wildlife in arid areas, but this has been demonstrated rarely. Albert and Krausman (1993) demonstrated that existing waters were adequate to support desert mule deer (*Odocoileus hemionus eremicus*) and that additional water did not enhance populations. Likewise, Krausman and Etchberger (1995) found that providing water in western Arizona did not increase productivity or recruitment of desert bighorn sheep. The relative value of constructing watering facilities to enhance wildlife in the desert Southwest has therefore been questioned (Broyles 1995, Krausman and Etchberger 1995).

Managers of desert ungulates cannot depend on the literature for rules of thumb that supersede common sense and a basic understanding of habitat components and limiting factors (Krausman and Czech 1998). Given the slim likelihood of definitive research addressing water needs of wildlife in all wilderness areas, the judgment of experienced managers should remain the primary determinant in decisions pertaining to constructing and maintaining watering facilities. However, managers should account for the potential detriments of water provision when making these decisions. For example, when range conditions around water sources are poor, the continued availability of water may invite irreversible destruction of the plant community.

The fencing projects we were informed about appeared judicious, but, as with all artificial structures, managers are mandated to consider their impacts on wilderness values, especially primitive and unmanipulated conditions (Cole 1996). When managers are compelled to fence native ungulates out of areas to protect habitats, perhaps the native ungulate populations are unnaturally great and management should focus on increased harvest.

This situation requires successful communication between federal managers, who are primarily responsible for habitat conditions, and state managers, who are responsible for harvest regimes. Federal managers may have to participate more actively in state game and fish commission hearings to help support state managers who may have a difficult time persuading commissions and publics to increase harvests.

Fire is a tool with much more potential than that used to date in wilderness areas of the Southwest. However, this probably has less to do with a lack of intent by wildlife managers than with an overwhelming firefighting institution in the United States (Czech 1996). This is an example where habitat management blends into human management because the limiting factor for producing more beneficial wildfire is in the social arena. We encourage managers to strengthen their efforts to inform the public about the important ecological role of fires. Fire season, especially prior to prescribed burns, is a good time of year to submit articles to local newspapers on this topic.

Animal management

Translocations of native animal species are in line with enhancing and maintaining biodiversity as an important component of wilderness. However, we found little justification for translocating species where they were thought to exist only during the early stages of the Holocene, because the biogeography of the Southwest has undergone a great deal of evolution since then (Betancourt et al. 1990). This observation applies primarily to mountain goat introductions in Utah, but could apply in other areas and with other species. As habitats are lost to economic development, wilderness will become increasingly attractive to introduce declining species. Wildlife professionals should obviate the potential tendency to approve translocations based on spurious science and to increase efforts to prevent economic usurpation of habitats outside of wilderness. Ecosystem management views wilderness as benchmarks of diversity on which to expand ecosystem management to all levels. This puts increased emphasis on wilderness naturalness.

We acknowledge the pertinence of Martin's (1967) overkill hypothesis and the related possibility that Holocene cultures caused extirpations. For example, if there is convincing evidence that pre-Columbian cultures caused the extirpation of a species from an area and habitat conditions for the species have changed little since then, it may be appropriate to translocate the species in that area. That may be the case in the Cebolla Wilderness, where bison may have been extirpated by relatively dense populations of farming and hunting Hohokom people and not by habitat constraints (P. Martin, University of Arizona, personal communication). Lacking such evidence, however, it is prudent to forego translocating a species to an area.

Efforts to reduce or eliminate clearly non-native species should be increased. Non-native species have no legal status in wilderness, except for certain arguable exceptions—e.g., pursuant to the Wild and Free-roaming Horses and Burros Act (16 U.S.C. §§ 1331–1340). Clearly, however, the intentional introduction of non-native species to wilderness is inappropriate. This creates a dilemma, because fishermen are traditional and supportive clients of game and fish agencies. Thus, non-native trout stocking is the second most controversial activity in wilderness (Czech and Krausman 1999). This is another case where efforts in public education are paramount and the early trout-fishing season is an opportune time for these efforts.

Although predator control was conducted in 18 areas, respondents indicated that control activities are restricted continually. In most of these areas, predator control has not been conducted for years but was tallied because it occurred some time since wilderness designation. However, many respondents indicated that their knowledge of such activities was not as great as for other activities. This phenomenon probably stems from the administrative structure of predator control, whereby the Animal and Plant Health Inspection Service has a memorandum of understanding with federal and state agencies to control predators on an as-needed basis. We encourage managers who are unsure about the levels of control in their areas to increase the frequency of communication with grazing lessees and predator control personnel.

Human management

Much of the improvement potential for habitat and animal management in the Southwest depends on improved human relations, but there also is room to improve traditional forms of human management. Conservation education efforts are the most common form of human management but they appear insufficient. For example, there are 82 areas where water is provided but only 51 areas with conservation education efforts that occur

within or on the boundaries of the wilderness. If some level of conservation education were provided for every type of habitat project that occurs, it might benefit wildlife, wilderness values, and the wildlife profession.

We did not ascertain the level of quality of conservation education occurring in visitor centers or in local media or query managers about public involvement in their management and public planning. Perhaps the conservation education shortcoming is not as serious as our data suggest. However, we think education in the field, where habitat projects are visible, is more valuable than off-site education. It is unreasonable to expect that every project within a wilderness be interpreted, but every category of project (e.g., water catchments, fencing projects, nesting structures) that exists in a wilderness should be.

Wright (1999) surmised that conservation education on wildlife in national parks was insufficient because NPS interpreters tended to be generalists with little formal training in wildlife ecology. Wilderness rangers are the personnel with the most visitor contact within the boundaries of wilderness, where direct observations and interpretation can be conducted. Forestry, range, and other commodity-oriented disciplines should incorporate wildlife issues in the interpretation of wilderness, where commodity production is largely prohibited.

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