Planning and Implementing a Reintroduction of Wolves to Yellowstone National Park and Central Idaho

Steven H. Fritts[1,5]
Edward E. Bangs[1]
Joseph A. Fontaine[1]
Mark R. Johnson[2,6]
Michael K. Phillips[2]
Edward D. Koch[3]
John R. Gunson[4]

Abstract

The Northern Rocky Mountain Wolf Recovery plan proposed reintroduction of *Canis lupus* (gray wolf) to Yellowstone National Park and central Idaho as part of a wolf restoration plan for the northern Rocky Mountains of the United States. Strong opposition from some factions within the region forestalled the action for two decades. An environmental impact statement, conducted in 1992–1994 with extensive public input, culminated in a proposal to reintroduce wolves designated as "non-essential—experimental" under Section 10 (j) of the federal Endangered Species Act. This approach, approved by the Secretary of the Interior in 1994, provided for wolf restoration while allowing management flexibility to deal with concerns of the local public. A reintroduction plan was developed in the summer and fall of 1994. Acquiring, holding, transporting, and releasing suitable wolves for reintroduction presented a myriad of technical and logistical challenges that required effective planning and coordination by all participants. In January 1995, 29 wolves were captured in Alberta and transported to Yellowstone National Park (14) and central Idaho (15). Idaho wolves were freed immediately upon arrival; Yellowstone wolves (three family groups) were held in acclimation pens in the park until late March. Most Idaho wolves traveled extensively within the area intended for them, averaging 82 km net distance away from release sites after 5 months (range = 30–220 km), and three male-female pairs formed by July. After 5 months in the wild, at least 13 of 15 Idaho-released wolves were alive within the intended area, as were 13 of 14 Yellowstone wolves; one wolf was known to have been illegally killed in each area. No livestock were killed. Wolves released into Yellowstone Park continued to live as packs, stayed closer to their release sites ($\bar{x}$ = 22 km at end of June), and settled into home ranges; two packs produced a total of nine pups. The progress of the reintroduction program in its first year far exceeded expectations. Reintroductions of about 15 wolves to each area for 2–4 more years are scheduled, but the project may be shortened because of early successes. Future reintroduction planners can expect sociocultural issues to pervade the effort, but they can be optimistic that, from a biological standpoint, reintroduction of wolves has strong potential as a restoration technique.

Background and Introduction

Restoration of endangered animals to former range often involves complex biological, social, and political challenges (Griffith et al. 1989; Bowles & Whelan 1994; Clark et al. 1994). After two decades spent overcoming such obstacles, *Canis lupus* (the gray wolf) was reintroduced into Yellowstone National Park and central Idaho in January 1995. The purpose of this paper is to provide others who may contemplate similar programs with the benefit of our experience in obtaining approval for, planning, and carrying out a reintroduction of wolves. In addition, we provide the first biological results of our reintroduction design and protocol as an evaluation of its efficacy.

The gray wolf was once one of the most widely distributed land mammals, occurring throughout most of

[1]U.S. Fish and Wildlife Service, 100 North Park, Suite 320, Helena, MT 59601, U.S.A.
[2]U.S. National Park Service, Yellowstone Center for Resources, P.O. Box 168, Yellowstone National Park, WY 82190, U.S.A.
[3]U.S. Fish and Wildlife Service, 4696 Overland Road, Room 576, Boise, ID 83705, U.S.A.
[4]Alberta Environmental Protection, O S Longman Building, 6909–116th Street, Edmonton, Alberta, Canada T6H 4P2
[5]Current address: U.S. Fish and Wildlife Service, Federal Aid, P.O. Box 25486, Denver, CO 80225, U.S.A.
[6]Current address: Wildlife Veterinary Resources, P.O. Box 969, Gardiner, MT 59030, U.S.A.

the Northern Hemisphere (Mech 1970). In North America, gray wolves lived in almost every type of habitat north of about 20°N and were among the top carnivores in a wide array of ecosystems (Mech 1970). Wolves occupied the intermountain portion of the western United States prior to colonization by Europeans (Young 1944; Curnow 1969; Lopez 1978; Weaver 1978). There, they preyed mainly on *Odocoileus hemionus*, and *O. virginianus* (deer), *Bison bison* (bison), *Cervus elaphus* (elk), *Alces alces* (moose), *Ovis canadensis* (bighorn sheep), and *Antilocapra americana* (pronghorns).

Europeans brought a negative view of the wolf and zealously persecuted this predator (Young 1944; Lopez 1978; McIntyre 1995). The majority of settlers to North America originated in areas of Europe where the views on wolves were most negative (Boitani 1995). Apparently, most viewed the animal as symbolic of an untamed land that had to be subdued in the name of civilization. Beginning in the eighteenth century, the wolf was eliminated from all of the contiguous United States except for northeastern Minnesota in an east-to-west progression. All the northwestern states and adjoining south-central British Columbia (Canada) and southern Alberta (Canada) were cleared of wolves in a matter of 50–60 years, beginning about 1880 (Young 1944; Carbyn 1983). Because the wolf's wild prey was severely reduced at the same time livestock were introduced, wolves preyed on livestock and were reported to cause significant damage (Young 1944). In 1915 the Federal Bureau of Biological Survey began to eliminate remnant wolf populations in the western U.S., including those in remote nonagricultural areas (Young 1944; Curnow 1969; Lopez 1978; Weaver 1978; McIntyre 1995). Apparently, no viable wolf population remained anywhere in the area of Yellowstone National Park and central Idaho by about 1925 (Weaver 1978; Kaminski & Hansen 1984; U.S. Fish and Wildlife Service 1987). Hardly anyone had objected, and future restoration seemed highly improbable. The reputation of the wolf as a vicious killer of livestock and big game and a threat to human safety lived on in legend within the northern Rockies. Such attitudes are still present among many residents of the area, particularly livestock producers (Bath & Buchanan 1989).

Origins of Interest in Wolf Restoration

A few wolves (< 10) were killed from the 1940s through the 1970s in Montana, Idaho, and the greater Yellowstone area (Weaver 1978; Ream & Mattson 1982; U.S. Fish & Wildlife Service [USFWS] 1987). The individuals killed were probably dispersers from breeding populations in Canada about 400–700 km to the north (Nowak 1983). During the mid-1900s, biological and social conditions for the potential return of wolves to the region improved (Fritts et al. 1994). As modern wildlife management was implemented, ungulate populations rebounded from their lows near the turn of the century. Production of domestic sheep declined, and so did the intensive predator control associated with that industry, especially the widespread use of poison baits. The number of people living in rural areas declined. Less than half the land in many western states came to be privately owned (Fritts et al. 1994). Vast tracts of federal land were protected from human development by being designated as national parks, national forests, and (later) as wilderness. As early as the 1940s, Aldo Leopold, champion of professional wildlife management, proposed restoration of wolves to Yellowstone (Leopold 1944). By the late 1960s, before passage of the Endangered Species Act of 1973 (ESA), additional voices called for restoration of wolves to the park. By that time, the wolf's negative image had moderated somewhat, partly because of knowledge gained from scientific studies of the animal (Mech 1970; Dunlap 1988). Also, changing values resulted in Americans becoming more interested in preserving large predators and the natural ecosystems on which they depend (Dunlap 1988). Nonetheless, the closest breeding population of wolves to the northwestern states continued to be hundreds of kilometers to the north in Canada, and the chances for natural recolonization still appeared low.

The ESA brought federal protection to the remaining gray wolves in the lower 48 states and a federal mandate to return the species to a secure recovery level that would allow its removal from protection under ESA. The northern Rockies of the U.S. was identified as one region where wolves should be recovered. The U.S. Fish and Wildlife Service appointed a Northern Rocky Mountain Wolf Recovery Team that developed a plan for recovery. The plan identified three areas—northwestern Montana, central Idaho, and the greater Yellowstone area, totaling about 69,000 km^2—where wolves could be restored, based upon ample prey, sufficient land in public rather than private ownership, and a low potential for conflicts with human economic activities (USFWS 1987; Fig. 1). According to the plan, and to more recent analyses, restoration of 10 breeding pairs of wolves to each of the three areas would create a metapopulation that would be fully viable (USFWS 1994; Fritts and Carbyn 1995). Interchange of wolves among the three main recovery areas would regularly occur, and connectivity with the Canadian population to the north would be assured via the population in northwestern Montana (Boyd et al. 1995). After the recovery-level populations had been reached (total of about 300 wolves) and maintained or exceeded for 3 consecutive years, the species would be removed from ESA protection and managed by state and tribal wildlife agencies. Two other gray wolf recovery programs, guided by their own recovery plans, exist outside the northern

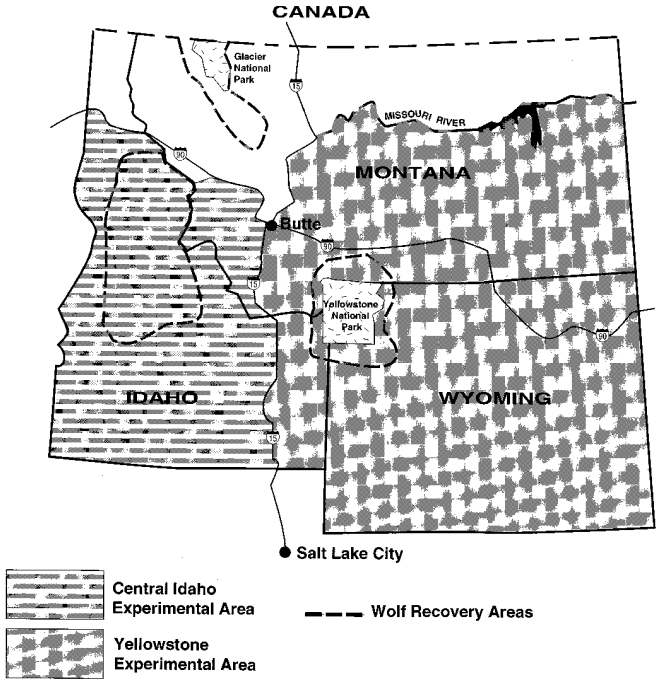

Figure 1. Recovery areas for the wolf in the northern Rocky Mountains of the United States according to the Northern Rocky Mountain Wolf Recovery Plan (U.S. Fish and Wildlife Service 1987), and experimental population areas where wolves are managed according to nonessential-experimental population rules (*Federal Register* vol. 59, no. 224, pp. 60252–60281).

Rockies, one in the upper Midwest (USFWS 1992) and the other in the southwestern states (Parsons & Nicholopoulus 1995).

The recovery plan for the northern Rockies recommended (1) that natural recovery be encouraged in northwestern Montana, (2) that consideration be given to reintroducing wolves into central Idaho if two packs were not found there by 1992, and (3) that wolves be reintroduced to Yellowstone because that recovery area seemed too distant from the other areas for natural recolonization to occur within the next few decades. The recovery plan recommended that reintroduced wolves be given the special designation of "experimental" under Sec. 10(j) of the ESA, which would allow more flexible management of them and could reduce local concerns and opposition to their restoration (USFWS 1987). Even so, they would continue to be protected by the ESA until recovery goals had been reached and they were delisted. The proposed reintroduction to Yellowstone would prove to be the highest profile and most controversial aspect of the recovery program.

During the 1970s and 1980s wolf distribution expanded southward in Alberta and British Columbia, bringing wolves closer to the U.S. border (Ream & Mattson 1982; Gunson 1992; Hayes & Gunson 1995). In 1986 a pack produced pups in Glacier National Park in Montana (Ream et al. 1989), and soon a small population became established along the international border (Ream et al. 1991; Boyd et al. 1995). By 1993 about 87 wolves occupied northwestern Montana and adjacent extreme southeastern British Columbia, including an increasing number that were surviving outside the designated recovery area in Montana where livestock are present (Fritts et al. 1994; Fritts et al. 1995).

Wolves that naturally recolonized northwestern Montana killed livestock as early as 1987; since then depredations have averaged 3 cattle or less and 2 sheep or less per year (Bangs et al. 1995). Although few in number, these depredations received so much attention by the news media that the public received a false impression about the importance of wolves as livestock predators. The wolf was perceived by livestock producers as a major threat in the northern Rockies during the 1980s and 1990s, making public acceptance of wolf restoration in each of the three recovery areas far more difficult to achieve (Bath & Buchanan 1989; Bangs et al. 1995).

Surveys were conducted to assess public opinion about reintroducing wolves (Bath 1991; see summary of survey results in Fritts et al. 1995). These showed that (1) a majority of all the residents sampled (urban and rural combined) in the northern Rocky Mountains supported recovery; (2) visitors to Yellowstone National Park favored reintroduction by a wide margin; (3) strong concern about depredations on livestock existed among those rural people who raise livestock; and (4) any restrictions on the commercial and recreational use of public lands to promote wolf recovery would not be favored by the regional public. Another pertinent finding was that both opponents and supporters of recovery held many misconceptions about the wolf. The studies also supported our impression that wolf recovery was symbolic of other issues. Several conservation groups actively promoted wolf recovery in the 1980s, while other interest groups—primarily livestock and hunting interests—strongly opposed it (Fischer 1995).

The suggested wolf reintroduction to Yellowstone became an issue of widespread public interest during the late 1980s. From 1987 through 1990, bills were introduced in Congress to reintroduce wolves to Yellowstone, but none were passed (Fischer 1995; Fritts et al. 1995). A series of studies required by the U.S. Congress supported the feasibility of wolf reintroduction (Yellowstone National Park et al. 1990; Varley & Brewster 1992) but did not seem to reduce opposition. Political pressure by elected officials from Wyoming, Montana, and Idaho successfully delayed decisive restoration actions in Yellowstone and Idaho until late 1991. In late 1990 Congress directed that a Wolf Management Committee composed of state and federal officials and special interest groups be appointed and charged with develop-

ing a plan for the reintroduction and management of wolves. The committee's recommendation, made in May 1991, was not implemented by Congress, essentially because it was outside the provisions of the ESA (Wolf Management Committee 1991; Fischer 1995). Nonetheless, it helped set the stage for future success.

The Environmental Impact Statement

In November 1991 Congress directed the U.S. Fish and Wildlife Service, in consultation with the National Park Service and the U.S. Forest Service, to prepare an environmental impact statement (EIS) on wolf reintroduction to Yellowstone and central Idaho and provided funding for the project. An EIS is a legally binding, federal planning process that is required by the National Environmental Policy Act of 1969. It is a logical step-by-step process that involves the public in determining the potential effects of, and balancing conflicting biological and social aspects of, federal actions that significantly affect the quality of the human environment. An EIS identifies the problem, defines what information is required to make an informed decision to solve the problem, lists the significant issues to be resolved, provides a reasonable range of alternatives for solving the problem, and recommends the action that will best solve the problem. Congressional language specified that a broad range of alternatives on reintroduction into Yellowstone and central Idaho be considered, consistent with existing law.

An interagency team led by the USFWS conducted the EIS (Bangs and Fritts 1993). The first phase occurred in the spring of 1992; it included 34 informal, nonstructured public meetings ("open houses") in which citizen input and one-on-one exchanges with agency personnel were offered. These meetings served to identify issues relating to wolf reintroduction that were of greatest interest and concern to the public. The 34 meetings attracted 1730 participants. In addition, about 4000 written comments were received. Issues of most concern were the desirability of restoring "original" ecosystems with their full complement of predators and prey; the potential for restrictions on the use of public lands to be made to benefit wolves but resulting in harm to people's income; the potential for wolves to kill livestock; the need for humane treatment and respect for wolves; the potential for wolves to reduce big game populations as related to hunting; and the manner in which wolves would be managed and the cost of that management. The next phase was identification of wolf management options to deal with the issues that were identified earlier. That phase consisted of 27 more open houses, 6 formal hearings attended by some 2000 people in August and September 1992, and receipt of some 5000 additional written comments.

The draft EIS, completed in June 1993, contained five alternatives for resolving the restoration issue. Three of these involved reintroduction to Yellowstone and central Idaho; one was to rest the policy on an eventual natural recolonization of wolves regardless of how long that took, and the fifth was to act in opposition to having wolves in Yellowstone and central Idaho, even if they appeared there through natural dispersal. The alternative recommended by the USFWS in the draft EIS was to reintroduce wolves to both Yellowstone and central Idaho. The wolves would be designated "nonessential experimental" and would be reintroduced only if two or more naturally occurring wolf packs were not located in either area before October 1994. About 1700 copies of the 397-page draft EIS and 42,000 copies of the draft EIS summary were mailed, for review and comment, to potentially affected agencies, special-interest groups, and anyone who requested a copy. The team held 16 formal public hearings on the draft in August and September 1993 and accepted comments until 26 November 1993.

During development of the draft EIS, potential impacts of wolf restoration on the Yellowstone and central Idaho recovery areas ("primary analysis areas") were predicted from detailed studies. The Yellowstone area is about 64,750 km^2, with 76% in federal ownership and 21% in private ownership. Yellowstone National Park is at the center, consisting of 9,000 km^2, and is surrounded by six national forests. This area has over 95,000 ungulates and an annual hunter harvest of 14,300 ungulates, is grazed by about 412,000 livestock, has a $4.2 billion (U.S.) local economy, and receives about 14.5 million recreational visits per year. The central Idaho area is about 53,613 km^2, (nearly all U.S. Forest Service land), has about 241,400 ungulates and a hunter harvest of 33,400 ungulates, is grazed by about 306,500 livestock, has a $1.43 billion local economy, and receives about 8 million recreational visits annually (USFWS 1994). Human density in the two areas averages 2.0 per km^2 and 1.0 per km^2, respectively. The centers of both areas are not used for livestock production. Estimates in the EIS concluded that in the Yellowstone recovery area a minimally recovered wolf population (about 100 wolves) would kill about 20 cattle (1–32), 70 sheep (17–110), and up to 1200 wild ungulates each year. Wolf recovery would increase visitor use and generate an estimated $> 23 million in economic benefits annually (USFWS 1994). In central Idaho, a minimally recovered wolf population of about 100 wolves would kill an estimated 10 cattle (1–17), 60 sheep (32–92) and up to 1650 wild ungulates per year.

The final EIS was approved 14 April 1994. In it the USFWS proposed to reintroduce wolves to both Yellowstone and central Idaho and to establish separate experimental population rules for each area. The objective of that action was to establish viable wolf populations by the year 2002 while managing the wolves to the

greatest extent possible under the ESA in order to tend to the needs and concerns of people who live in the restoration areas. The "experimental" designation would allow certain actions to deal with problems caused by the wolves. Also, state and tribal wildlife management agencies could assume primary responsibility for managing wolves under federal oversight if they desired to do so (except in the national parks and national wildlife refuges). The most noteworthy of the special management provisions proposed in the EIS was to allow livestock owners and their agents to shoot wolves caught in the act of killing livestock on their own private land and, in special circumstances, on public lands.

During the 32 months of public input on the EIS, over 130 public meetings were held, about 750,000 EIS documents distributed, and some 170,000 comments received from the public. Comments were received from every state in the U.S. and from more than 40 other countries. The comments reflected the strong polarization that has plagued management of wolves and were consistent with our belief that most wolf recovery issues have more to do with deeply held personal values about government, influences of people living outside the region, people's relationship to nature, and the political role of special interest groups, than with wolves themselves. A majority of those who commented (many of whom lived in urban areas or outside of the potentially affected areas) indicated that they wanted immediate reintroduction and as much protection of reintroduced wolves as the law would allow. Many others, primarily rural residents living near Yellowstone or central Idaho, stated that they did not want wolves to be recovered, but if wolves were reintroduced they wanted the least possible legal protection and liberal management guidelines for them. They also wanted assurance that restoring another endangered species would not further restrict use of public lands for livestock grazing, mining, timber cutting, and recreation.

The proposal to reintroduce wolves even aroused disagreement among wolf recovery advocates about whether wolves should be reintroduced or allowed to recolonize those areas naturally, even if the latter option required many additional years. Some individuals and organizations believed that small wolf populations already occupied Yellowstone and central Idaho, and the death of a wolf in central Idaho in 1991 and another near Yellowstone in 1992 (Fritts et al. 1995) reinforced that belief. Previously, a lawsuit had been filed to stop reintroduction to Yellowstone based on the conviction that a small population of "original" wolves still exits there, and that placing Canadian wolves among them would eradicate the unique gene pool (Urbigkit vs. Lujan 1991). In addition, on 5 January 1995 the Sierra Club Legal Defense Fund filed a lawsuit on behalf of four organizations against reintroduction of wolves into Idaho, arguing that reintroducing wolves using the "experimental population" provision would reduce the full ESA protection of wolves that they believed already occupied Idaho. Some people argued that natural recolonization was preferable to reintroduction because the latter represented intrusion into biological processes that should be left to nature. Also, there was concern that the use of the "experimental" designation would give up the legal potential to protect wolf habitat under the ESA, even though the USFWS did not view habitat as a limiting factor in recovery (Fritts et al. 1994; Fritts et al. 1995).

The recommendation in the final EIS to reintroduce wolves was based on the following convictions and reasoning: (1) although single dispersing wolves occasionally were reaching the Yellowstone and central Idaho areas, breeding was not occurring, and population establishment was not imminent; (2) population goals for removal from the list of endangered species would be reached faster, and state and tribal management would occur earlier with reintroduction; (3) recovery would be less expensive over the long term because recovery goals would be reached much sooner; (4) genetic variability in the potential Yellowstone and Idaho subpopulations would be greater if wolves were reintroduced from different populations and genetic backgrounds; (5) reintroduced wolf packs were more likely to settle in places where the potential for conflict with humans was lowest; and (6) establishment of a fully viable metapopulation composed of three healthy subpopulations would occur faster and more synchronously if the Yellowstone and Idaho subpopulations were established immediately.

The final step in the EIS process was the Secretary of Interior signing the Record of Decision on 15 June 1994. This action provided Department of Interior approval to proceed with the EIS-proposed reintroduction of wolves designated as "nonessential experimental." After the required public comment on the draft experimental population rules (six more public hearings held, 600 more comments received), they were revised and published as final rules on 22 November 1994 (*Federal Register* vol. 59, no. 224, pp. 60252–60281). The rules described how the U.S. Fish and Wildlife Service would conduct the reintroductions, how wolves would be managed once released, and the exact areas where wolves would be managed under the nonessential experimental population rules (Fig. 1).

Developing the Reintroduction Protocol

In the final year of EIS development we began to consider how a reintroduction could be devised and conducted. A detailed review of the few previous gray wolf reintroductions and translocations had already been made as part of the congressionally mandated studies (Fritts 1993). Aside from the *C. rufus* (red wolf) program

that uses animals of captive origin (Phillips et al. 1995), proven methodology for reintroducing wolves was almost nonexistent. Previous work indicated that translocated wolves tend to separate and travel widely but can survive unless killed by people, and they are capable of finding one another, of pair bonding, and of breeding (Fritts 1993). Because one-time reintroductions inherently seemed more likely to fail, we decided early that repeated infusions should occur over a period of years until a breeding population was established. Based on available information, we expected major difficulty in inducing the wolves to settle and establish breeding packs in the areas where released.

A series of questionnaires was sent to 53 biologists who have worked with wolves in the wild and in captivity in order to obtain their opinions on how to reintroduce wolves. Opinions of the 31 who responded differed greatly on even the most fundamental variables (S. H. Fritts, unpublished data). We realized that our approach would be largely experimental, with many refinements needed as new information became available from experience. This approach has been recognized as "adaptive management" (Walters 1986).

Several key decisions had to be made before most preparations for the reintroduction could proceed. Examples included where to obtain the wolves; whether to radiocollar and monitor wolves from the donor population prior to removal for reintroduction; the type of release (slow or quick); the time of year of release; the number, age, and breeding status of wolves to be used (pups, yearlings, adults, entire packs); and the duration of acclimation, if a slow release were used. There were a myriad of other issues to explore and decisions to be made as soon as possible, such as capture methods (traps, live-snares, darting from helicopter, or net gunning from helicopters); where and how to hold wolves before shipping; how to transport wolves (truck, commercial airline, contracted aircraft); which permits were needed; what to feed wolves during holding, transport, and at release; which immobilizing drugs to use for different phases of the operation; and how to protect wolves from people while they were in captivity. Other specific factors and variables we considered when planning were cost; effect of wolf removals on the donor population; whether to use wolves that were already pair-bonded or attempt to force the pair-bonding of adult wolves after capture; likelihood of breeding in captivity; care needed in captivity; whether to use capture collars, satellite collars, or conventional radio collars; climate and physiography of capture and release sites; whether to conduct reintroductions into Yellowstone National Park and central Idaho concurrently; the number of years over which releases would be necessary to establish a population in each area; and the strong need to learn as much as possible the first year in order to refine future efforts. Supplies and equipment (transport containers, holding kennels, radio collars, veterinary supplies) had to be ordered months in advance of the work. Several competitively bid contracts, such as for pilots and aircraft, had to be in place. We decided to order conventional radio collars because the technology was deemed more reliable and their battery life was many times greater than that of satellite collars. These preparations placed an extraordinary demand on the administrative and support staffs of the U.S. Fish and Wildlife Service and the National Park Service.

The potential for transporting infectious diseases with the wolves was examined by the project veterinarian (Johnson 1995; M. R. Johnson, National Park Service, unpublished report). We decided early that wolves would be taken from areas where significant diseases such as tuberculosis, brucellosis, and terrestrial rabies were not present. A peer-reviewed protocol was developed to prevent transport of harmful diseases with the wolves, to safeguard the health of wolves, and to survey the local wolf population for a variety of diseases. Plans were made for state-of-the-art veterinary care to be available at all times. In addition, we would give careful attention to the comfort and well-being of the wolves to minimize physiological and psychological stress. The expertise of the captive wolf authorities, zoos, and wildlife veterinarians would be called upon throughout the reintroduction process.

Knowing that news media interest would be high, we planned to have public affairs specialists from the U.S. Fish and Wildlife Service and the National Park Service on hand during capture, transport, and release. The media would be given access to essentially every phase of the operation, provided that their activities did not interfere with the safety of the wolves and the project personnel. We agreed to provide still photos and video footage of the operation to the news media by contracting with agency public affairs specialists. We were well aware that any mistakes would be well publicized and that public perception of inadequate planning or animal care would result in strong criticism of the program that could result in its termination.

Final Reintroduction Design

Working with Canadian provincial authorities, we developed plans to capture wolves from areas of British Columbia and Alberta with mountain-foothill habitat where elk and deer were available as prey. Alberta has about 4200 wolves and British Columbia about 8000, with about 11% killed annually by humans in each province (Hayes & Gunson 1995). Populations are believed to be increasing in the southern portions of both provinces. Wolves from southwestern Canada are of the same genetic stock as wolves now colonizing north-

western Montana (Nowak 1983; Boyd et al. 1995; Brewster & Fritts 1995; S. Fain, USFWS, personal communication, D. K. Boyd, University of Montana, personal communication) and are likely quite similar to wolves that occupied the extreme northwestern United States prior to eradication (Nowak 1995). Also, we knew from discussions with Canadian biologists that wolves from those areas would be accustomed to killing the major prey available in Yellowstone and central Idaho (elk and deer), would be from terrain similar to that of the release areas, and would have little if any exposure to livestock. Using wolves from a different country was sure to add to the administrative and logistical hurtles, but excellent cooperation from Canadian officials and administrative staff expedited the operation.

Ideally, the capture areas would have enough treeless landscape to make helicopter darting possible and would be accessible by fixed-wing aircraft or ground vehicles to facilitate transport of the wolves out of the area. Darting was the only method that would provide assurance that captured wolves were from the same pack because they would be observed together at the time of capture or possibly during monitoring work before capture.

A detailed protocol was set up to examine immobilized wolves for infectious diseases, collect blood samples, give vaccinations, and treat for parasites. Blood and fecal samples would be collected to further determine which diseases were endemic in the donor populations. Arrangements were made with several Canadian and American laboratories for analyses of samples. Most of these analyses would not be completed until after the wolves were shipped.

Responses by biologists to the survey on how to release wolves generally fell into two basic schools of thought: slow release and quick release. Each approach offered some distinct advantages and disadvantages. For the first year of the multi-year project we decided to try an experimental approach that would incorporate the core principles of the two divergent strategies and conduct different types of releases in Yellowstone and central Idaho. For Yellowstone, we prepared to hold and acclimate small to moderate-sized packs (4–7 individuals) that ideally included the breeding (alpha) female or pair and pups of the year. The alpha wolves presumably would be more likely to remain together after release because they were already pair-bonded. For central Idaho we would transport and immediately release (without conditioning in holding pens) nonbreeding members of packs that were young adults and yearlings—individuals of prime dispersal age. Although this procedure would likely result in initial separation and extensive movements, we reasoned that it would to a degree replicate the process by which pack formation naturally occurs. Wolves often disperse from their packs as yearlings or young adults and then search for a mate and a vacant area where they can begin their own pack (Rothman & Mech 1979; Fritts & Mech 1981; Peterson et al. 1984; Ballard et al. 1987; Gese & Mech 1991; Boyd et al. 1995). Translocated wolves that do not return home eventually revert to lone wolf–disperser behavior (Fritts et al. 1984) and can survive alone, as well as find mates and establish packs (Fritts et al. 1985; Fritts 1993). Carbyn et al. (1994) reported that the hard (quick) release technique was successful and cost-effective with *Vulpes velox* (swift foxes). Quick releases have been the most common technique for wildlife reintroduction throughout North America, albeit with variable success (Griffith et al. 1989).

Difficult access into central Idaho played a role in the decision to quick-release wolves there. That area consists largely of rugged mountains, and in winter the interior is accessible only by air and to a limited extent by snowmobile. Much of the area is formally designated as wilderness, a classification that prohibits nearly all motorized activity. Construction of acclimation pens for the wolves and housing for personnel who would tend the penned wolves would have been difficult and expensive in central Idaho. In Yellowstone, personnel were available, and road access to release sites in high-quality wolf habitat was relatively easy. Using drastically different approaches in the two areas provided an opportunity to learn in a short period which approach held the most potential for population establishment. Each tactic would be continually evaluated and modified in future years as necessary, according to an adaptive management approach.

We decided to capture wolves in Canada in autumn and release them in Idaho in early to late December after all ungulate hunting seasons were concluded. We planned to release Yellowstone wolves from their acclimation pens in late December or early January, after the local hunting seasons and well before the February breeding season, because of uncertainty about whether they would breed in the enclosures. Legal actions beyond our control would change these plans, as described below.

In Yellowstone, three family groups would be held for 6–8 weeks in three separate, 0.4 ha acclimation pens spaced at least 8 km apart. Pen sites were chosen within 2 km of an east-west road in the northern portion of the park, where the highest concentration of wolf activity occurred historically (Weaver 1978) and where ungulates are abundant in all seasons (Yellowstone National Park et al. 1990). No pens were within view of permanent human facilities or park roads. Areas within 1.6 km of the pens would be closed to the public. Every effort would be made to avoid disturbance or habituation to humans while wolves were in captivity. Pens were constructed in summer 1994 using a 3-m-high, 9-gauge, chain-link fence with an inward overhang and a 1.2-m ground apron. A five-strand, solar powered electric

fence was installed outside the fence to discourage *Ursus arctos horribilis* (grizzly bears) and *U. americanus* (black bears) from reaching the food inside and to discourage bison from damaging the fence. Each pen contained at least one wooden den box per wolf.

At the request of USFWS, the Idaho Department of Fish and Game chose release sites in central Idaho. Two sites, 14 km apart, were chosen based on aerial access, presence of year-round populations of elk and/or deer,

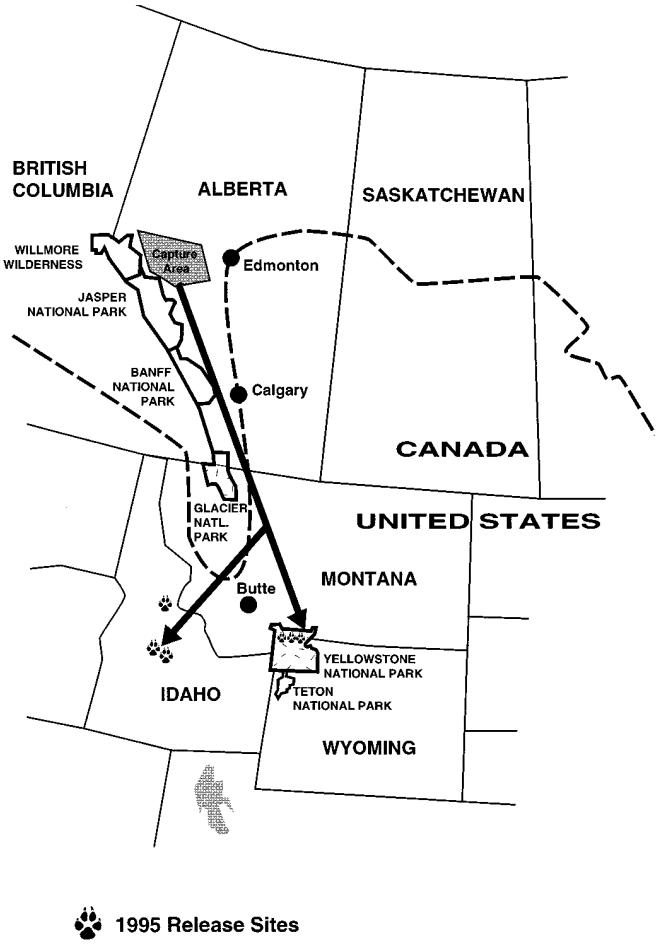

Figure 2. General area of capture and areas of release of wolves reintroduced to central Idaho and Yellowstone National Park in January 1995. The dashed line indicates the southern extent of the breeding range of wolves in southwestern Canada and Montana. Most wolves were taken from the northwestern half of the shaded area in Alberta. Distance to release sites was about 1000 km for Idaho and 1100 km for Yellowstone. Three specific release sites were used in both central Idaho and Yellowstone. The first wolves released in Idaho were at the northern-most site (Corn Creek). The second release occurred at Indian Creek (western-most site) and Thomas Creek. Release sites in Yellowstone National Park were acclimation pens spaced approximately 8 km apart; from west to east they were named Crystal Creek, Rose Creek, and Soda Butte.

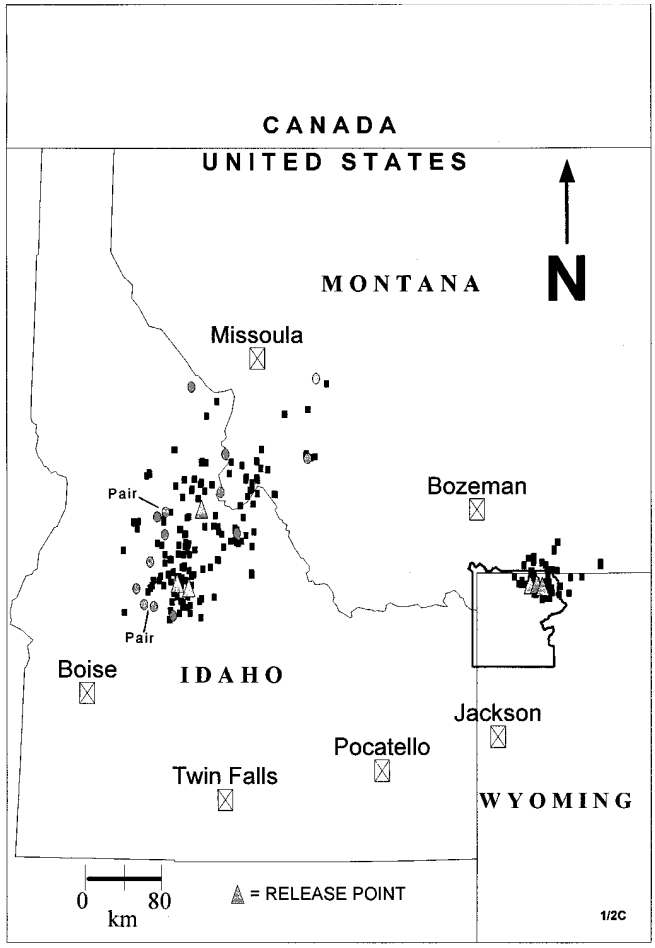

Figure 3. Locations of wolves released into central Idaho and Yellowstone National Park from release through June 1995. Ovals indicate locations of Idaho-released wolves on 25 June 1995. Locations in the Yellowstone area represent general locations of pack home ranges and locations of single wolves. Pack members were together on most occasions, therefore most single squares in and near Yellowstone indicate multiple wolves. Although not shown by this level of resolution, Yellowstone packs occupied home ranges with little overlap.

and remoteness from human habitation (Figs. 2 & 3). Only remote sites accessible by air were selected, in an effort to satisfy perceived desires of the public. Because of poor weather, use of road access for the first four Idaho-released wolves became necessary, and a site had to be chosen hastily.

We planned to reintroduce about 15 wolves into both Yellowstone National Park and central Idaho each year for 3–5 years. Thus, 45–75 wolves would be released in each area. Wolves from the same general areas in Canada, but not the same packs, would be used for the successive releases. The formal objective of the releases was to provide wolves to both areas until we documented that at least two breeding pairs had produced

at least two young each for two consecutive years (*Federal Register* vol. 59, no. 224, pp. 60252–60281). At every opportunity we stressed that the project would likely fail if terminated after one year, but success was almost assured if allowed to continue as designed for 3–5 years.

Monitoring of the Donor Population

We hoped to obtain 15 suitable wolves each from British Columbia and Alberta in 1994, but we were unable to finalize arrangements with British Columbia officials in time. When Alberta wildlife officials offered to supply all 30 wolves for the first year's effort, our attention shifted there. The landscape at the Alberta site had far more trees than the British Columbia site, and capture by helicopter darting would be more difficult. The Alberta site that became our primary capture area was in the west-central part of the province from about Rocky Mountain House and Edson west to within 32 km of Banff and Jasper National Parks (Fig. 2). That area had a population of wolves on provincial lands that seemed high enough to avoid significant effects from the removal of 15–30 wolves annually, and it met all our criteria for a donor population.

For a variety of reasons, we decided to radio-collar and monitor several wolves in the Alberta donor population before holding any animals for reintroduction. Court actions in the United States prevented moving wolves there as early as planned. Second, monitoring would provide basic information on the location, size, and composition of local packs, possibly providing an estimate of wolf density. Third, radio-collared wolves would aid in finding packs and expediting captures when legal clearance was received.

In November, five U.S. biologists and a wildlife veterinarian representing the U.S. Fish and Wildlife Service, the National Park Service, and the U.S. Department of Agriculture (Animal Damage Control) traveled to the donor population area in Alberta and spent up to 6 weeks in preparatory activities. They made contact with Alberta provincial biologists, wildlife managers, and several of the local registered trappers, working out field logistics and arrangements. Alberta Environmental Protection personnel helped establish contact and rapport with over a dozen private trappers who routinely capture wolves in the area and sell their fur.

In Alberta, all wildlife is, for legal purposes, the property of the Crown (Government of Alberta). For purposes of management, the province is divided into geographical units called registered fur management areas (RFMAs). The holder of a RFMA or their designated partner(s) holds the sole privilege of trapping furbearers from a given RFMA in accordance with regulations under the Provincial Wildlife Act. Wolves may also be taken by licensed hunters irrespective of RFMAs. Additionally, the Crown may remove wolves and other furbearers consistent with provincial management reasons. In recognition of the importance of trapper cooperation and assistance to reintroduction program success, the USFWS agreed to pay trappers (1) $1440 (U.S.) for each healthy wolf they captured, radio-collared, and returned to the wild, if they would use specialized neck snares, check them daily, and suspend wolf trapping in the area once two wolves were radio-collared; (2) $360 for each additional wolf they captured for actual transport and reintroduction; and (3) $215 for each wolf that reintroduction personnel darted from their registered traplines.

Trappers began setting neck snares for wolves on 1 November 1994. Snares were equipped with stops to prevent excessive loop constriction and avoid strangulation (Nellis 1968). By 5 December, 13 wolves had been radio-collared at eight locations. While radio-collaring was proceeding in Canada, the final nonessential experimental population rules were published in the Federal Register on 22 November, thus completing all regulatory-procedural processes.

But opponents to the reintroduction had not conceded. On 25 November 1994, 2 days after the final nonessential experimental population rules were published, the American Farm Bureau Federation and its Montana, Idaho, and Wyoming state chapters requested the federal court to stop any reintroduction of wolves by the USFWS. They alleged that the USFWS violated the law by not adequately analyzing the effects of reintroducing wolves and that their members would suffer irreparable damage to their livestock and private property if the project continued. The USFWS agreed not to import any wolves until 1 January 1995, if an expedited court hearing could be held on whether the court should delay wolf reintroduction even further. Several project personnel spent much of December preparing for and participating in court proceedings. Because the fate of Canadian wolves being captured for the program was uncertain, we chose to continue releasing them with radio collars rather than keep them in captivity. The court heard legal arguments in Cheyenne, Wyoming, on 21–23 December, and on 3 January 1995 issued an order denying any further delays in the program. The capture-hold-transport part of the operation was implemented later that week, about a month behind schedule.

By 3 January the trappers and biologists had placed radio collars on 17 wolves. Another wolf had been netgunned from a helicopter. Two of the radio-collared wolves had died in the wild from causes unrelated to the program, leaving 16 collared wolves from 13 packs in the donor population when intensive capture work began in early January. Trappers continued to attempt to snare wolves to supplement the helicopter darting. Altogether, 18 Canadian trappers were paid $34,500 for their services, most of which was for radio-collaring wolves.

Based on the telemetry data obtained, Alberta biologists conservatively estimated 105–140 wolves in the 7,060 km^2 donor area around Hinton, Alberta, or about one wolf per 50–67 km^2 (J. Kneteman, Alberta Natural Resource Service, Hinton, personal communication).

Capturing, Holding, and Transporting Wolves

Personnel for the multi-agency project arrived at the Alberta capture area on or about 5 January. Over 20 news media personnel were already present, awaiting the wolf captures. American participants on site represented the U.S. Fish and Wildlife Service, National Park Service, Animal Damage Control, National Biological Service, Alaska Department of Fish and Game, Idaho Department of Fish and Game, and the Wyoming Game and Fish Department. Many employees of Alberta Environmental Protection (Natural Resources Service and Parks Service) participated. Veterinary staff consisted of three American and two Canadian veterinarians to monitor patient care, provide preventive treatments for disease and treat veterinary emergencies. Two public affairs specialists with the USFWS were on hand for the first week to answer questions from the news media. Their presence was invaluable, as they freed biologists to focus on project details. Representatives from two private conservation groups volunteered assistance. A Canadian helicopter company experienced in wildlife capture was contracted to conduct the aerial darting operation; their crew included two helicopters and pilots and one fixed-wing aircraft and pilot. The services of two biologists highly skilled at immobilizing wolves from aircraft were donated to the project by the Alaska Department of Fish and Game. In total, about 30 Americans and Canadians were involved, and about 15 people were on site at any given time during the capture operation. The project leader remained in Helena, Montana, to coordinate the overall effort, to serve as spokesperson for the project, and to address a barrage of political and legal issues that intensified when program opponents realized that the actual reintroduction was imminent. Other biologists in Idaho and Yellowstone prepared for the arrival of wolves.

At Switzer Provincial Park, Alberta, animal handling facilities were assembled in a heated garage to receive captured wolves and conduct all processing. A veterinary field laboratory was established in an adjoining trailer house to centrifuge blood and to package, label, inventory, and store samples. Twenty-three kennels were constructed outdoors 150 m away from these facilities and associated human activity in a locked fenced compound. The 4 m $\times$ 2 m $\times$ 2 m kennels, made of reinforced 9-gauge chain link fence, held the wolves after initial processing and until their destination (Yellowstone or Idaho) was determined and shipment occurred.

During the first week of January, trappers live-snared and confined five wolves. Aerial darting began on 7 January and continued daily through 17 January. Two Bell 206 helicopters and a Piper SuperCub worked together searching for wolves. Spotters on board each helicopter aided in observing wolves from the air both before and after they had been darted (Ballard et al. 1982; Ballard et al. 1991). Later, we added a second fixed-wing aircraft and an Alaskan pilot who was exceptionally skilled at finding wolves by following their tracks in the snow while flying a SuperCub. Radio collars in 13 packs allowed those packs to be found at will and an assessment quickly made as to whether the habitat they were in that day was suitable to attempt low-level pursuit and darting. We avoided darting wolves within 32 km of Jasper National Park to avoid capturing wolves that might be intermittent residents of that park (Fig. 2).

Wolves were immobilized using a Palmer Cap-Chur gun (Palmer Chemical and Equipment Co., Douglasville, Georgia) and 3 cc darts containing tiletamine hydrochloride and zolazepam hydrochloride (Talazol, A.H. Robins Co., Richmond, Virginia). Darts were preloaded with 500 mg Telazol mixed with 2.0 cc sterile water and 0.5 cc propylene glycol to prevent freezing of the drug mixture. The relatively small variations in body weight of the wolves made it possible to use uniform drug doses in the darts. Wolves were successfully darted from distances of 3–30 m (average about 10 m). Weather was favorable for flying during January, but the snow pack was too shallow and hard for easy darting (deep soft snow reduces wolf mobility and maneuverability). That, combined with heavy tree cover over most of the area, made locating and darting wolves challenging. Despite these difficulties, the efficacy of aerial crews improved rapidly as darters and pilots gained experience in working together. In 11 days they successfully darted 28 wolves from 11 packs (Fig. 4). Altogether, there were 34 successful captures of 33 wolves (one was released and darted again) during January, including the five snared by trappers. Eighteen of the 24 darted wolves that were used in the reintroduction were from radio-monitored packs; others were from unmarked packs found through the skill of the aerial crews. One wolf died when a dart penetrated its body cavity. From the first wolf collared on 5 November until the last capture on 17 January, there were 55 captures of 48 wolves, with no injuries to project personnel.

After each successful immobilization, a helicopter landed for retrieval of the animal and then ferried it back either to lake ice within 400 m of the Switzer Park lab or to some pre-arranged road site where a pickup truck was waiting to transport it to Switzer Park. Although Telazol doses usually resulted in 3–4 hours anesthesia, occasionally anesthesia was extended by 200 mg ketamine (Ketaset, Fort Dodge Laboratories, Fort

Figure 4. A biologist examines a wolf near Hinton, Alberta, after immobilizing the animal by darting from a helicopter. Photo courtesy of U.S. Fish and Wildlife Service.

Dodge, Iowa) or 200 mg additional Telazol. At Switzer Park the wolves were given a physical examination, treated for any wounds, weighed, and examined for age and breeding condition. Females that had produced pups the previous year were identified based on nipple measurements (Mech et al. 1993) and were assumed to be alpha females. Proestrus females were identified by bloody discharge from the vagina and swelling of the vulva. Identification of the alpha males proved difficult and was surmised based on behavior at the time of darting, estimated age, body size, and testicular size.

Wolves were implanted with a passive integrated transponder (InfoPet Identification Systems, Inc., Burnsville, Minnesota) measuring 2.2 mm × 11.5 mm for permanent identification, as used in the red wolf reintroduction program (M. K. Phillips, unpublished data). They were also fitted with a temporary ear tag for short-term visual identification until the destination of each individual was decided. Blood samples were taken for hematology, serum chemistry, and the following serologic tests: canine parvovirus, canine distemper, leptospirosis, canine hepatitis, plague, brucellosis, and rabies. Brucellosis and rabies serologic tests were all negative, confirming that the source population was indeed free of these diseases. Fecal samples were collected for assessing internal parasite loads, and external parasites were collected when observed. (Complete results of the disease analyses and their relevance to wolf translocation will be published separately.) Wolves were vaccinated for rabies, canine distemper, parvovirus, hepatitis, leptospirosis, and parainfluenza and were treated with ivermectin for nematodes and with praziquantel for cestodes. They also were dusted with pyrethrin for external parasites and given penicillin. Then each wolf was placed in a separate kennel. If processing could not be completed on the day of capture, the respective wolf was anesthetized on the following morning with 4 mg/kg ketamine hydrochloride and 2 mg/kg xylazine (Xylazine-100, Butler, Columbus, Ohio) and returned to the heated garage for completion of the procedures described above. This drug combination produced a briefer anesthesia than the Telazol dose for darting and could be antagonized with yohimbine (Wildlife Pharmaceuticals, Fort Collins, Colorado).

Wolves were in kennels at Switzer Provincial Park for 1–10 days ($\bar{x} = 4$). This was the first effort known to us that required holding wild-caught wolves for several days, and we did not know how the wolves would respond. Darted wolves seemed to take longer to become calm than snared wolves, perhaps due to the trauma associated with that type of capture. During the first 24–48 hours of captivity several wolves tested the kennel material. Early in the operation, an aluminum transport box was placed inside each kennel for the wolf to use for seclusion, but was removed when some wolves began biting them, injuring their mouths and teeth. We replaced the boxes with bedding of loose straw and bales of straw stacked to create a cavity where wolves could find seclusion. Covering the sides and tops of the kennels with tarpaulins created a visual barrier that appeared to further reduce stress. Noise was minimized near the kennels. These modifications helped calm the wolves in captivity. Kenneled wolves were fed portions of elk, deer, and moose that had been killed by automo-

biles and trains and were provided with fresh water daily. Consumption was highly variable between wolves. Human visitation to the kennels was minimized; with each visit, wolves were observed for clinical illness or captivity-related anxiety. When observed, they typically were reclining quietly among straw bales in the end of the kennel opposite the door.

We determined if and how each captured wolf would be used in the reintroduction based on its age, sex, breeding condition, probable relatedness to packmates already captured, and the likelihood of capturing additional members of its pack. On the morning of shipping, wolves were anesthetized with Telazol via a syringe pole and were returned to the heated garage (Fig. 5). Temporary identifying eartags were replaced with plastic Rototags that had a color and numbering system specific to each reintroduction site. We attached motion-sensitive radio collars (Telonics Inc., Mesa, Arizona) to each wolf and gave each transmitter a final check. In addition to providing location data, these collars would indicate when a wolf had died or lost its collar. Each wolf was weighed again, measured, examined for any new injuries; blood-sampled again (to assess response to confinement); injected with penicillin; combed to remove any external parasites and weed seeds; dusted for lice (none were found); vaccinated again for canine parvovirus and distemper; tissue-sampled for later DNA analyses; and given 500 ml Lactated Ringer's solution subcutaneously to prevent dehydration. Temperature, pulse, and respirations were recorded from anesthetized wolves, and oxygen saturation was monitored with pulse oximeters (Nellcor, Inc.). The time from removal from kennels to loading into transport containers was 2–4 hours. Each wolf was provided a health certificate signed by one of the attending Canadian veterinarians to satisfy U.S. Department of Agriculture requirements. Personnel from Alberta Environmental Protection (Natural Resources Service) drew up research and collection permits and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITIES) permits that were vital for the international transport of the wolves.

Figure 5. U.S. Fish and Wildlife Service biologist Alice Whitelaw removes an immobilized wolf from a kennel in order for it to be prepared for shipping to the United States. Photo courtesy of U.S. Fish and Wildlife Service.

We placed each wolf in an aluminum transport box 1.22 m long × 0.66 m wide × 0.91 m high, loaded them onto an 8-m commercial moving truck, and drove them for 20 minutes to an airport for loading onto a U.S. Forest Service Sherpa twin-engine aircraft capable of holding 18 boxes. Veterinarians accompanied the wolves on the 3–4–hour flight and stayed with them until they were released into the wild or into acclimation pens. Most wolves traveled quietly, although the anesthesia probably wore off before they were airborne. Three wolves chewed extensively on either the bars at the cage's end or the heavy wire flooring. One wolf fractured a first premolar tooth and another fractured a canine. We assumed the wolves were stressed, but there was no indication that any were in shock. The plane landed for customs checks at either Edmonton or Calgary, Alberta, and at Great Falls, Montana. Two shipments totaling 29 wolves were made on 11 and 19 January (Appendices 1 and 2). The first shipment included 4 wolves for Idaho and 8 for Yellowstone. The second included 11 for Idaho and 6 for Yellowstone. The sex ratio of the wolves shipped to Idaho was 7 males to 8 females, and for Yellowstone was 9 males to 5 females. Ages of wolves bound for Yellowstone were judged to be 8 adults, 5 subadults, and 1 known pup, whereas those taken to Idaho were 9 adults and 6 subadults. Weights averaged 41.0 kg for males and 38.5 kg for females. Color phases of the wolves were 13 black, 15 gray, and one considered by local trappers to be the rare "blue" (silver) color phase. Dekker (1986) reported observing 70 black, 59 gray, and 3 white wolves in

nearby Jasper National Park from 1965 to 1984 and stated that the percentage of black-phase wolves there was the highest reported. Introduced wolves were from nine different Canadian packs. The Idaho group included members of seven packs and the Yellowstone groups four packs; in two instances members of a pack were sent to different areas.

Four captured wolves not used in the reintroduction were released wearing radio collars near their original capture sites on 19 and 20 January. When the capture operation was completed, 12 radio-collared wolves in 10 packs remained in the donor population for continued monitoring. Alberta began monitoring nine wolves in February 1995. Two radio-collared wolves, both subadults, were subsequently killed in March and April, apparently while dispersing. An additional wolf was collared in April 1995 in the Pembina River drainage. Eight wolves were being monitored at the end of April. The total fall-winter loss to the population, including losses from hunting and trapping, was calculated to be 45 wolves, or about 30–40% of the estimated local population (J. Kneteman, Alberta National Resource Services, Hinton, Alberta, personal communication).

Releasing Wolves

While the first shipment of 12 wolves was en route on 11 January, the American Farm Bureau filed a legal motion to stop the program, and a Judge of the Federal Appellate court in Denver, Colorado, placed a 48-hour "stay" on the releases to allow himself time to study that motion. The "stay" prevented release of the wolves from the transport boxes. The transport aircraft carrying the wolves landed at Great Falls, Montana, for the scheduled customs check, but it was required to remain there overnight for the pilots to receive a mandatory rest period. The eight wolves destined for Yellowstone were picked up in Great Falls and ground-transported to Yellowstone via a horse trailer, arriving early on 12 January amid much fanfare and news media coverage. The first transport boxes were personally carried inside the 0.4-ha acclimation pens by the U.S. Secretary of the Interior and the Director of the USFWS (Fig. 6), but the court's stay prevented the wolves' release.

The transport aircraft continued on to Missoula, Montana, on the morning of 12 January with the four wolves destined for central Idaho aboard. The wolves were greeted at the airport by two spiritual leaders of the Nez Perce Tribe, a native American tribe that once occupied much of central Idaho. They held a native prayer ceremony that welcomed back their "brothers," while representatives of nearly a dozen news organizations observed. Because the court's stay also prevented release of these wolves, they and accompanying personnel spent the night of 12 January in the airport hanger while we awaited the judge's decision.

During the court's stay, both the American and Canadian national news networks aired an interview with the U.S. Secretary of the Interior in which he warned that the wolves could die inside their shipping containers because the boxes were not designed for prolonged holding. The possibility of kidney failure and dehydration was a growing concern. Several wolves did take water by chewing on chunks of ice that were placed in the boxes. Animal welfare groups in both the U.S. and Canada threatened to bring charges of animal cruelty against the U.S. government. The USFWS filed an emergency request for reconsideration of the stay, citing the welfare of the wolves. The judge lifted the stay at 6:00 p.m. on 12 January, whereupon the Yellowstone wolves, consisting of six members of a pack (Crystal Creek pen) and an adult female and her pup from another pack (Rose Creek pen) were immediately released into their acclimation pens.

The scheduled airlift of the four Idaho-bound wolves on 13 January was canceled because of bad weather. On that date they were driven from Missoula, Montana, to Salmon, Idaho, where they were held in a U.S. Forest Service garage while we waited for the weather to improve. The attending veterinarian gave them blocks of ice as a water source, provided portions of automobile-killed deer for food, and cleaned their boxes without removing the wolves. With no weather improvement anticipated, plans were developed for release at an alternative site that was accessible by road. On 14 January, after being blessed by members of the Shoshone/Bannock Tribe of southern Idaho, the wolves were driven 96 km to a steep and rugged remote location (Corn Creek) at the edge of the Selway-River of No Return Wilderness that was 77 km northeast of the preselected release points (Figs. 2 & 3). Some 80–100 people, primarily representing news media outlets, followed project personnel and the wolves to the Corn Creek site to document the release. The wolves appeared in good physical condition as they ran from their opened boxes in mid-afternoon, even though they had spent some 90 hours inside them. One wolf was known to scavenge from a cougar-killed deer carcass that was less than 2 km from the release site, and likely found the deer within an hour of being freed.

The second batch of wolves, 11 for Idaho and 6 for Yellowstone, was shipped on 19 January with less publicity and without legal challenge. Every aspect of the second shipment proceeded more smoothly than the first. After arrival in the U.S., the Idaho wolves were immobilized, removed from their transport boxes, flown by helicopter from Missoula and Hamilton, Montana, and released in central Idaho at the Indian Creek and Thomas Creek sites in the Frank Church River of No Return Wilderness on 20 January (Figs. 2 & 3). This

Figure 6. U.S. Secretary of the Interior, Bruce Babbitt, and U.S. Fish and Wildlife Service Director, the late Mollie Beattie, assist in carrying first wolf to Crystal Creek acclimation pen in Yellowstone National Park. Coauthor Michael Phillips, Wolf Reintroduction Project Leader for Yellowstone, is the person in Park Service uniform with walking stick. Photo courtesy of U.S. Fish and Wildlife Service.

time, Idaho-bound wolves spent only 20 hours in transport containers. The second group of Yellowstone wolves was flown as far as Bozeman, Montana. This shipment consisted of a large adult male that was placed with an adult female and her pup from a different pack (Rose Creek pen) and a group of 5 (3 males, 2 females) from another pack that was placed in the third Yellowstone pen (Soda Butte pen).

The 14 penned wolves in Yellowstone adapted well to confinement in the 0.4-ha pens (Smith 1995). They were fed portions of road-killed elk, bison, deer, and moose at a rate of 6.5 kg/wolf/day. The Crystal Creek wolves were observed from a blind intermittently. No serious aggression was observed among wolves in any of the pens, even though their period of confinement included the time of year when intra-pack aggression is highest (Fentress et al. 1987).

The adult wolves in the Crystal Creek pen engaged in courtship behavior, and there was evidence of breeding in the other two pens (Smith 1995), but no copulation was observed. We later learned that breeding and conception had occurred in the Rose Creek and Soda Butte pens. We were uncertain whether the Crystal Creek group and the Soda Butte group included the pair-bonded alpha male and female from their respective packs. Each group included a female that had produced pups in the past and/or was in a proestrus state when captured and a male that we thought had a high probability of being the alpha male. Previously pair-bonded wolves definitely were not used in the Rose Creek group that we formed through pairing adult wolves from different Canadian packs.

We had planned a 42–56 day acclimation period for Yellowstone wolves to reduce homing tendencies, but extended it to 62–70 days. An even longer confinement might have further increased the likelihood of the wolves remaining together and not traveling widely, but a release well before whelping time (third week of April) and prior to grizzly bears emerging from dens seemed advisable.

Early Results

Idaho

Virtually all monitoring of the Idaho wolves required aerial telemetry (Mech 1974) because of the rugged terrain and the wide-ranging movements characteristic of quick-released wolves (Fig. 7). From 17 January through 25 June 1995, 26 telemetry flights were conducted to locate the wolves. Not every wolf was found on every flight because of poor flying weather during spring and extensive movements by some wolves. Most wolves generally traveled a short distance from their release site and remained relatively sedentary for 1–3 weeks before undertaking more extensive movements. The same behavior was noted in previous translocations and reintroductions of wolves (Fritts 1993). The extent of movements during the following few weeks was highly variable, ranging from remaining near the release site to moving dozens of kilometers away and traversing large areas of Idaho and parts of Montana in a zigzag fashion, sometimes revisiting previous locations.

Female wolf B-13 quickly moved 88 km east of her release site only 9 days after release and was illegally shot at a ranch 40 km south of Salmon, Idaho, as she was

Figure 7. Wolf exiting transport container at its release site in central Idaho (quick release). Photo courtesy of U.S. Fish and Wildlife Service

feeding from the carcass of a newborn calf. Investigation by the USFWS Forensics Laboratory revealed that the calf had died of nonpredatory causes. Wolf B-3 has not been located since March 8 when she was in southwestern Montana about 140 km northeast of her release site. This wolf most likely moved out of tracking range or was illegally killed and the radio-collar destroyed.

Many translocated wolves in other studies moved toward their area of origin (see Fritts 1993 for summary of previous studies). The initial direction of most Idaho-released wolves was generally northward, as expected, but was east of a homeward direction. For example, on 28 January (8–14 days after release), the average travel direction of the wolves from the release sites was 110°, which was 34° east of the homeward bearing. On March 26 (64–71 days after release), the average bearing from the release site had changed only slightly to 116°, which was 40° from the homeward direction. In further assessing directionality of movement we examined 108 wolf radio-telemetry locations for 14 individual wolves from eight telemetry flights between 9 February and 25 June. During that period significantly more locations were north of their release sites ($n = 83$, 77%) than south ($n = 25$, 23%) ($\chi^2 = 33.37$, $p < 0.001$). But the relatively short movements of most wolves kept them well within the recovery zone (see below), and by the 25 June flight, 5 of the 13 (39%) wolves were south of their release sites. The rugged terrain and deep snow may have inhibited travel, although quick-released wolves are known to be capable of traversing extremely rugged mountains (Fritts 1993). One wolf, B-10, traveled great distances in short periods of time and traversed steep mountain ranges in doing so (e.g., 70 km in 5 days), but she was not known to travel more than 150 km from her release site (straight-line distance).

One 25 June, 13 of the 15 Idaho-released wolves were still within the experimental population zone delineated for central Idaho (Figs. 1 and 3), having survived in the wild for 156–162 days. Although one was in southwestern Montana and two others periodically ranged into that state, all 13 were within the area for which they were intended. Approximate distances from release sites ranged from 30 to 220 km. Idaho wolves were significantly farther from their release sites ($\bar{x} = 82$ km) than Yellowstone wolves ($\bar{x} = 22$ km) on 25 June ($F = 24.625$, $p \leqslant 0.001$; Fig. 3). By the end of June, some Idaho wolves had ranged widely throughout central Idaho and southwestern Montana. The movements of female B-10 were the most extensive, with 800 km (minimum) documented over 14 radio locations in 5 months. Wolf B-2 exhibited the least documented movement of all released wolves, a total of only 200 km (minimum) over 17 radio locations in generally the same period. To our knowledge, only wolf B-10 was observed by the public (except for B-13, which was shot). This was probably a function of the sparse human presence in central Idaho during the January-June period.

Although pair formation by the wolves in Idaho was not expected during the first several weeks or months after release, two male-female pairs had formed by 25 June (Fig. 3). Female B-6 and male B-8 paired within 16 days of release. After two months together the pair separated but reunited in late June in Bear Valley in south-central Idaho about 40 km southwest of their release

site. Subadult male B-7, a packmate of B-6, traveled with the pair for two weeks in February and March and then separated from them. Subadult female B-16 and adult male B-9 had been together since 5 April in the Chamberlain Basin area, some 80 km north of their release sites. Another two wolves, female B-4 and male B-14, were found together on two dates in March, but then separated. In late July a third pair, male B-5 and female B-10, formed near the Idaho-Montana border (not shown in Fig. 3). By the end of September the three male-female pairs remained together and appeared to have localized their movement). Members of the pairs were from different packs, as is typical in the natural pair-formation process that leads to new packs (Fritts & Mech 1981). Each pair that formed represented a potential breeding unit for the 1996 breeding season.

Yellowstone

The Yellowstone wolves were released about 3 months later than originally planned due to the legal impediments. Their confinement totaled 64–79 days and extended to late March, well beyond the February breeding season, by which time we wanted them freed. Two of the three groups nonetheless bred in the acclimation pens (Fig. 8). Gates to pens containing the three Yellowstone packs (Crystal Creek, Rose Creek, Soda Butte) were opened on 21, 22, and 27 March, respectively, with food left outside the pens. Release dates were staggered to make the initial radio-tracking easier. Most wolves showed an unexpected reluctance to exit pens and remained in them for 1–10 days. Packmates did not all leave pens at the same time. For example, subadult male R-2 remained in the Crystal Creek pen for at least several hours after his five packmates departed, and adult male R-10 exited the Rose Creek pen at least 1 day before pup R-7 and at least 3 days before adult female R-9, who had mated with him.

Thirty-six telemetry flights were completed from late March through 25 June 1995 to locate wolves released into Yellowstone National Park. For the first 2 weeks after release, most wolves restricted their movements to areas near their acclimation pens, and groups of wolves generally remained together. Wolf R-7 separated from her mother and R-10 by 3 April and traveled alone, with the most restricted movements of any Yellowstone wolf, about 390 km^2. During the third week all Yellowstone groups undertook exploratory moves with a strong northeastward tendency: the Rose Creek pair traveled about 80 km to the northeast, the Crystal Creek group about 56 km to the northeast, and the Soda Butte group about 40 km to the north. These moves brought the groups well outside the park to the edge of U.S. Forest Service land and near private lands and livestock. All but the Rose Creek pair returned to the general vicinity of their acclimation pens within a few days. Perhaps a similar return by the Rose Creek pair was prevented solely by the illegal and unprovoked fatal shooting of R-10 about 10 km south of Red Lodge, Montana, at the edge of U.S. Forest Service land on 24 April. His mate, R-9, gave birth to eight pups at an aboveground site (pit den) in that area on or about 26 April and thus was forced to provide for the pups alone in an environment that placed her in danger from humans. After pro-

Figure 8. Wolf in pen during its acclimation period in Yellowstone National Park (slow release). Photo courtesy of U.S. Fish and Wildlife Service.

viding ungulate carcasses for the female for three weeks, we trapped her and transported her and the pups (four males and four females) back to the Rose Creek acclimation pen (80 km) on 18 May, where they were held until 11 October 1995. Their release brought the number of free-ranging wolves in the Yellowstone recovery area to 22. On release, the Rose Creek group was immediately joined by male R-8 from the Crystal Creek pack, who became the new mate of female R-9.

Another Yellowstone female, R-14, a member of the Soda Butte pack, produced one pup around 26 April. From late April through 25 June all members of the Soda Butte pack restricted their movements and showed affinity first to the den site and then to a rendezvous site that were 32 km and 24 km north of the Soda Butte acclimation pen, respectively, and 18 and 10 km north of the Yellowstone Park boundary. Female R-5, the only female in the Crystal Creek pack, exhibited denning behavior for 4 weeks during late May and June but did not give birth to pups.

By 25 June, 13 of the 14 wolves released into the Yellowstone area were alive, and 12 individuals (3 groups, 2 solitary wolves) were being tracked in the wild; all were well within the experimental population zone delineated in the final rule for wolf reintroduction to the Yellowstone ecosystem (Figs. 1 and 3). Approximate distances from release sites on 25 June ranged from 3 to 39 km. The 12 free-ranging Yellowstone wolves were significantly closer to their release sites ($\bar{x}$ = 22 km) than were Idaho wolves ($\bar{x}$ = 82 km) on that date (F = 24.625, $p \leq 0.001$). The wolves appeared to have no difficulty killing prey in their new environment. The Soda Butte pack killed an elk calf about 1 km from their pen on their first excursion away from the immediate vicinity of the pen and within a few hours of exiting it. The diet of the wolves, as indicated by observation of their kills from the air and snow tracking, consisted almost exclusively of elk (D. Smith, National Park Service, personal communication).

The Yellowstone wolf packs generally remained together except for one young female (R-7) who traveled alone and a subadult male (R-2) from the Crystal Creek pack who was often separated from the main group before joining the Rose Creek pack. The Soda Butte pack established residency in the northeastern corner of Yellowstone National Park and the southwestern corner of the Custer National Forest. This pack made extensive use of drainages that included the site of the acclimation pen. The Crystal Creek pack established a home range in the Lamar Valley region of the park and sometimes traveled near or past their acclimation pen. Each pack ranged over about 650 km^2. The location of the Crystal Creek pack near a park highway passing through a wide treeless valley allowed almost daily observation from 13 May to 6 July, by which time about 4000 park visitors had observed the wolves (R. McIntyre, National Park Service, personal communication).

Conclusions

Wolf restoration is not for the impatient. The usual difficulties with restoring endangered animals are magnified if the species happens to be, like the gray wolf, a wide-ranging, controversial predator of big game and livestock; it is amplified even more if the proposed restoration technique is reintroduction by the government. Twenty-three years elapsed between listing of the wolf as an endangered species and its reintroduction to Yellowstone and central Idaho. The inherent interest in wolves, the strong and conflicting attitudes about them, and their symbolic nature, when added to the current acrimony about how public-owned lands in the American West should be used, created difficulty every step of the way. Reintroducing wolves was far more than just a biological issue. This program has involved more scientific inquiry, media coverage, public attention, and controversy than almost any other North American natural resources issue. Certainly, the public involvement process was one of the most exhaustive for a natural resource issue. Even after a successful first year of reintroductions, with no observable adverse effects to anyone, and positive effects for Yellowstone visitors and local businesses, the reintroduction program remains controversial, and some elected officials want to stop it. Three court cases that could stop the reintroduction project are pending (Wyoming Farm Bureau Federation et al. vs. Bruce Babbitt, Secretary of the Interior et al.; National Audubon Society et al. vs. Babbitt et al.; and James R. and Cat D. Urbigkit vs. Babbitt et al.). Rulings on these cases potentially could cause termination of the program and removal of all reintroduced wolves from the wild. Ironically, these lawsuits against the program involve both advocates and opponents of wolf restoration.

Throughout the pre-reintroduction phases of this recovery program the biological feasibility of successfully reintroducing wolves was assumed. Planning for such an undertaking did not begin until 1994, the same year that a decision was made, via the process of environmental impact statement, to do so. Developing an overall design for the reintroduction, planning the logistics, and coordinating between the different participants were formidable tasks. The reintroduction itself, with its many phases, was successful only because of the dedication of the many participants.

Much was learned in the first year of the project about how to conduct a gray wolf reintroduction and about what to expect of the reintroduced wolves. We now know that it is possible to capture, transport, hold, and release wild wolves 1000 km from their capture

sites and that wolves can survive these experiences and function as packs or single wolves upon release in unfamiliar habitat. The fact that two of three slow-released packs bred in acclimation pens showed that our efforts to schedule release prior to the breeding season were unnecessary. The formation of three pairs (the first step toward pack formation) by Idaho-released wolves during their first few months of freedom were significant and encouraging events. Pair bonding occurred even earlier than expected, proving that wolves have the ability and the inclination to seek out mates in such circumstances. One disadvantage of the quick-release approach in Idaho is that the first reproduction will be longer in coming than with slow-released Yellowstone wolves. Nonetheless, both the slow- and quick-release techniques produced satisfactory outcomes, based on these early findings. Perhaps the exact design of a wolf reintroduction is not so important and the technique to be used can be tailored to specific situations. The fact that during the first 5 months no wolves killed livestock and that none were known to travel outside the experimental population areas intended for them was contrary to the predictions of program opponents and favorable for continued public approval of the program.

The slow-release technique used in Yellowstone appears to have prevented pack breakup after release and to have created affinity for the release area, exactly as we had hoped—but such conclusions must await more data. Wolves released in Idaho and Yellowstone appeared to have some sense of the direction toward home, although many initially moved northeastward rather than northwestward. Possibly the lack of reinforcement from failure to encounter familiar sights, sounds, or smells led to the abandonment of northward movement and, in several instances, led to return to the release area. After 5 months, two slow-released packs in Yellowstone had established home ranges that encompassed the acclimation pens. Quick-released Idaho wolves had moved, on average, almost four times farther than the Yellowstone wolves, but due to the size of the central Idaho release area, they were still within remote habitat where opportunities for conflicts with humans were few. The opportunity for wolf-human encounters will increase during the autumn big-game hunting seasons, and some additional mortality then would not be surprising. The deaths of one Idaho wolf and one Yellowstone wolf were unfortunate but fewer than expected. Clearly, wolves are resilient enough to survive the ordeal of reintroduction and resume their natural predatory role and social lifestyle in new environments.

Evaluations will become more meaningful as more wolves are released and data accumulate. Additional wolves should be released, as originally planned, to ensure population establishment. The reintroduction design calls for release of 15 wolves to both Yellowstone and central Idaho for 3–5 years to ensure the establishment of self-sustaining populations in both areas and attain recovery goals for the wolf in the northern Rockies region. At this stage the project is ahead of schedule, and only 1–2 more years of reintroductions may be needed. Whether any additional wolves are actually reintroduced could depend on political processes outside our control. Controversy surrounding wolves, wolf restoration, and wolf management will not soon disappear.

Acknowledgments

Numerous individuals played crucial roles in bringing this reintroduction of wolves to reality. These people include members of the U.S. Congress, members of conservation organizations, and administrators and support staff in the many government agencies involved. W. Brewster (Yellowstone National Park [YNP]) was a dynamic and persistent entity throughout all stages of the program. Recent administrative backing was provided by Secretary of the Interior B. Babbitt, U.S. Fish and Wildlife Service (USFWS) Director M. Beattie (deceased), USFWS Regional Director R. Morganweck, National Park Service Regional Director J. Cook, Superintendent J. Finley, J. Varley (YNP), R. Barbee (former YNP Superintendent), L. Shanks, E. Stevens, R. Jacobson, O. Bray, K. McMaster, and C. Lobdell (USFWS). Administrative and fiscal support was provided by J. Dennis, E. Holman, C. Tenney, K. Pennington, and F. Thompson (USFWS). Completion of the environmental impact statement would not have been possible without the assistance and cooperation of L. Robinson (U.S. Forest Service), J. Talbott (Wyoming Game and Fish), J. Hansen and J. Rachael (Idaho Fish and Game), A. Dood (Montana Fish, Wildlife and Parks), N. Bishop and J. Mack (YNP), L. Kronemann (Nez Perce Tribe), R. Baldes (USFWS), G. Lajeunesse (Wind River Tribe), J. Roybal (USFWS), L. Magnuson (U.S. Forest Service), C. Niemeyer (Animal Damage Control), and many others.

Cooperation from the Alberta provincial government and from Jasper National Park is greatly appreciated. Alberta Natural Resources Services biologists J. Kneteman, E. Bruns, and K. Smith made arrangements for the capture of wolves in western Alberta, and J. Kneteman provided data on the local population. Wolves were initially marked and released by W. Berry, G. Kelley, J. Frank, and several other nongovernment Alberta trappers, with the help of C. Niemeyer and W. J. Paul (Animal Damage Control), V. Asher, J. Till, and A. Whitelaw (USFWS). Subsequent aerial darting was conducted by M. McNay and K. Taylor (Alaska Department of Fish and Game), C. Wilson, C. Armstrong, B. Minor, B. Scott (Bighorn Aviation), and R. Swisher (Quicksilver Air). A. Van Imschoot and J. Brooks made available the facilities at Switzer Provincial Park for housing and processing

wolves for reintroduction. Personnel from Jasper National Park assisted in several ways. D. Quintillio provided housing and other logistical support at the Forest Technology Centre in Hinton, Alberta. Veterinary support was provided by T. Kreeger (USFWS), D. Hunter (Idaho Fish and Game Department), and J. Jones and B. Regehr (volunteers). Others who assisted in the care and processing of wolves in Alberta were V. Asher, J. Haas, A. Whitelaw, J. Till (USFWS), L. D. Mech (U.S. National Biological Service), M. Bruscino (Wyoming Game and Fish Department), R. Askins (Wolf Fund), J. Mack, C. Niemeyer, W. Medwig, and N. Gibson (International Wolf Center), and S. Laverty (Wolf Education and Research Center). Assistance in interacting with the news media during the reintroduction was provided by S. Rose, G. Parham, and P. Million (USFWS) and M. Karle and C. Matthews (National Park Service). L. Robinson coordinated the aerial transport of wolves. Pilot E. Askelson (U.S. Forest Service) and Law Enforcement Special Agents R. Hanlon and R. Branzell (USFWS) played major roles in the international transport process. M. Jimenez and J. Weaver (University of Montana), D. Smith (National Park Service), Timm Kaminski (U.S. Forest Service) and numerous personnel of Yellowstone National Park were indispensable in the care and release of wolves. Radio-telemetry data on released wolves were provided by D. Smith and F. Reed. M. Zallen, C. Perry, M. Averill, and C. Statkus (U.S. Department of Justice) provided legal support. We thank L. N. Carbyn, T. Kreeger, L. D. Mech, and an anonymous reviewer for comments that improved the manuscript and J. Halfpenny for figure preparation. We also acknowledge the many individuals who assisted with various phases of the reintroduction but were not mentioned above.

LITERATURE CITED

Ballard, W. B., A. W. Franzman, and C. L. Gardner. 1982. Comparison and assessment of drugs used to immobilize Alaskan gray wolves (*Canis lupus*) and wolverines (*Gulo gulo*) from a helicopter. Journal of Wildlife Diseases **18:**339–342.

Ballard, W. B., J. S. Whitman, and C. L. Gardner. 1987. Ecology of an exploited wolf population in south-central Alaska. Wildlife Monographs **98**.

Ballard, W. B., L. A. Ayres, K. E. Roney, and T. H. Spraker. 1991. Immobilization of gray wolves with a combination of tiletamine hydrochloride and zolazepam hydrochloride. Journal of Wildlife Management **55:**71–74.

Bangs, E. E., and S. H. Fritts. 1993. Reintroduction of gray wolves to Yellowstone National Park and central Idaho. Endangered Species Technical Bulletin, U.S. Fish and Wildlife Service **18:** 1,18–20.

Bangs, E. E., S. H. Fritts, J. A. Fontaine, D. R. Harms, W. G. Brewster, C. Niemeyer, and M. D. Jimenez. 1995. Control of endangered gray wolves in Montana. Pages 127–134 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Bath, A. J. 1991. Public attitudes about wolf restoration in Yellowstone National Park. Pages 367–376 in R. Keiter and M. S. Boyce, editors. The Greater Yellowstone ecosystem. Yale University Press, New Haven, Connecticut.

Bath, A. J., and T. Buchanan. 1989. Attitudes of interest groups in Wyoming toward wolf restoration in Yellowstone National Park. Wildlife Society Bulletin **17:**519–525.

Boitani, L. 1995. Ecological and cultural diversities in the evolution of wolf-human relationships. Pages 3–11 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Bowles, M. L., and C. J. Whelan, editors. 1994. Restoration of endangered species: conceptual issues, planning, and implementation. Cambridge University Press, Cambridge, United Kingdom.

Boyd, D. K., P. C. Paquet, S. Donelon, R. R. Ream, D. H. Pletscher, and C. C. White. 1995. Dispersal characteristics of a recolonizing wolf population in the Rocky Mountains. Pages 135–140 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Brewster, W. G., and S. H. Fritts. 1995. Taxonomy and genetics of the gray wolf in western North America: a review. Pages 353–374 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Carbyn, L. N., editor. 1983. Wolves in Canada and Alaska: their status, biology and management. Report series 45. Canadian Wildlife Service, Ottawa, Ontario.

Carbyn, L. N., H. J. Armbruster, and C. Mamo. 1994. The swift fox reintroduction program in Canada from 1983 to 1992. Pages 247–271 in M. L. Bowles and C. J. Whelan, editors. Restoration of endangered species. Cambridge University Press, Cambridge, United Kingdom.

Clark, T. W., R. P. Reading, and A. L. Clarke, editors. 1994. Endangered species recovery: finding the lessons, improving the process. Island Press, Washington, D.C.

Curnow, E. 1969. The history of the eradication of the wolf in Montana. M. S. thesis, University of Montana, Missoula.

Dekker, D. 1986. Wolf, *Canis lupus*, numbers and colour phases in Jasper National Park, Alberta: 1965–1984. Canadian Field Naturalist **100:**550–553.

Dunlap, T. R. 1988. Saving America's wildlife. Princeton University Press, Princeton, New Jersey.

Fentress, J. C., J. Ryon, P. J. McLeod, and G. Z. Havkin. 1987. A multidimensional approach to agonistic behavior in wolves. Pages 253–274 in H. Frank, editor. Man and wolf. Dr. W. Junk Publishers, Boston, Massachusetts.

Fischer, H. 1995. Wolf wars. Falcon Press, Helena and Billings, Montana.

Fritts, S. H. 1993. Reintroductions and translocations of wolves in North America. Pages 1–27 in R. Cook, editor. Ecological issues on reintroducing wolves into Yellowstone National Park. Scientific monograph NPS/NRYELL/NRSM-93/22. National Park Service, Denver, Colorado.

Fritts, S. H., and L. N. Carbyn. 1995. Population viability, nature reserves, and the outlook for gray wolf conservation in North America. Restoration Ecology **3(1):**26–38.

Fritts, S. H., and L. D. Mech. 1981. Dynamics, movements, and feeding ecology of a newly protected wolf population in northwestern Minnesota. Wildlife Monographs **80**.

Fritts, S. H., W. J. Paul, and L. D. Mech. 1984. Movements of trans-

located wolves in Minnesota. Journal of Wildlife Management **48:**709–721.

Fritts, S. H., W. J. Paul, and L. D. Mech. 1985. Can relocated wolves survive? Wildlife Society Bulletin **13:**459–463.

Fritts, S. H., E. E. Bangs, and J. F. Gore. 1994. The relationship of wolf recovery to habitat conservation and biodiversity in the northwestern United States. Landscape and Urban Planning **28:**23–32.

Fritts, S. H., E. E. Bangs, J. A. Fontaine, W. G. Brewster, and J. F. Gore. 1995. Restoring wolves to the Northern Rocky Mountains of the United States. Pages 107–125 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Gese, E. M., and L. D. Mech. 1991. Dispersal of wolves (*Canis lupus*) in northeastern Minnesota, 1969–1989. Canadian Journal of Zoology **53:**2946–2955.

Griffith, B., J. M. Scott, J. W. Carpenter, and C. Reed. 1989. Translocation as a species conservation tool: status and strategy. Science **245:**477–479.

Gunson, J. R. 1992. Historical and present management of wolves in Alberta. Wildlife Society Bulletin **20:**330–339.

Hayes, R. D., and J. R. Gunson. 1995. Status and management of wolves in Canada. Pages 21–33 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Johnson, M. R. 1995. Rabies in wolves and its potential role in a Yellowstone wolf population. Pages 431–439 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Kaminski, T., and J. Hansen. 1984. Wolves of central Idaho. Unpublished report. Montana Cooperative Wildlife Research Unit, Missoula.

Leopold, A. 1944. Review of *The wolves of North America* by S. P. Young and E. H. Goldman. Journal of Forestry **42(12):**928–929.

Lopez, B. H. 1978. Of wolves and men. Charles Scribner's Sons, New York.

McIntyre, R., editor. 1995. War against the wolf. Voyageur Press, Stillwater, Minnesota.

Mech, L. D. 1970. The wolf: the ecology and behavior of an endangered species. Natural History Press, Garden City, New York.

Mech, L. D. 1974. Current techniques in the study of elusive wilderness carnivores. Pages 315–322 in Proceedings of the 11th International Congress of Game Biologists. National Swedish Environment Protection Board, Stockholm.

Mech, L. D., T. J. Meier, and U. S. Seal. 1993. Wolf nipple measurements as indices of age and breeding status. American Midland Naturalist **129:**266–271.

Nellis, C. H. 1968. Some methods for capturing coyotes alive. Journal of Wildlife Management. **32:**402–405.

Nowak, R. M. 1983. A perspective on the taxonomy of wolves in North America. Pages 10–19 in L. N. Carbyn, editor. Wolves in Canada and Alaska. Report series 45. Canadian Wildlife Service, Ottawa, Ontario.

Nowak, R. M. 1995. Another look at wolf taxonomy. Pages 375–397 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Parsons, D. R., and J. E. Nicholopoulus. 1995. An update on the status of Mexican wolf recovery program. Pages 141–146 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Peterson, R. O., J. D. Woolington, and T. N. Bailey. 1984. Wolves of the Kenai Peninsula, Alaska. Wildlife Monographs **88**.

Phillips, M. K., R. Smith, V. G. Henry, and C. Lucash. 1995. Red wolf reintroduction program. Pages 157–168 in L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Occasional publication no. 35. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Ream, R. R., and U. I. Mattson. 1982. Wolf status in the northern Rockies. Pages 362–381 in F. H. Harrington and P. C. Paquet, editors. Wolves of the world: perspectives of behavior, ecology, and conservation. Noyes Publications, Park Ridge, New Jersey.

Ream, R. R., M. W. Fairchild, D. K. Boyd, and A. J. Blakesley. 1989. First wolf den in western U.S. in recent history. Northwestern Naturalist **70:**39–40.

Ream, R. R., M. W. Fairchild, D. K. Boyd, and D. H. Pletscher. 1991. Population dynamics and home range changes in a colonizing wolf population. Pages 349–366 in R. B. Keiter and M. S. Boyce, editors. The greater Yellowstone ecosystem: redefining America's wilderness heritage. Yale University Press, New Haven, Connecticut.

Rothman, R. J., and L. D. Mech. 1979. Scent marking in lone wolves and newly formed pairs. Animal Behaviour **27:**750–760.

Smith, D. 1995. Adjusting to new sights, smells and sounds—in captivity. International Wolf **5(2):**20.

U.S. Fish and Wildlife Service. 1987. Northern Rocky Mountain wolf recovery plan. Denver, Colorado.

U.S. Fish and Wildlife Service. 1992. Recovery plan for the eastern timber wolf. Twin Cities, Minnesota.

U.S. Fish and Wildlife Service. 1994. The reintroduction of gray wolves to Yellowstone National Park and central Idaho. Final environmental impact statement. U.S. Fish and Wildlife Service, Helena, Montana.

Varley, J. D., and W. G. Brewster, editors. 1992. Wolves for Yellowstone? A report to the United States Congress, vol. IV, research and analysis. National Park Service, Yellowstone National Park, Wyoming.

Walters, C. J. 1986. Adaptive management of renewable resources. Macmillan, New York.

Weaver, J. 1978. The wolves of Yellowstone. Natural Resources report no. 14. U.S. Department of the Interior, National Park Service, Washington, D.C.

Wolf Management Committee. 1991. Reintroduction of wolves in Yellowstone National Park and the central Idaho wilderness area. A report to the U.S. Congress by the Wolf Management Committee, U.S. Fish and Wildlife Service, Denver, Colorado.

Yellowstone National Park, U.S. Fish and Wildlife Service, University of Wyoming, University of Idaho, Interagency Grizzly Bear Study Team, and University of Minnesota Cooperative Park Studies Unit, editors. 1990. Wolves for Yellowstone? A Report to the United States Congress, vol. II, research and analysis. National Park Service, Yellowstone National Park, Wyoming.

Young, S. P. 1944. The wolves of North America, part I, their history, life habits, economic status, and control, Dover Publications, New York.

Appendix 1. Data for 14 wolves captured in Alberta, Canada in January 1995 and released into Yellowstone National Park in March of 1995.

Release Pen & Pack Name	*No.*	*Sex*	*Wt. kg.*	*Age*	*Breeding Condition*	*Source Pack*	*Date of Capture*	*Date Shipped*	*Date put in Pen*	*Date Released*[1]	*Status*[2]
Crystal Creek	R-2	M	35	Subadult	Sm testes	Petite Lake	1/10	1/11	1/12	3/21	Alive, with pack but often solitary
	R-3	M	36	Subadult	Sm testes	Petite Lake	1/10	1/11	1/12	3/21	Alive, with pack
	R-4	M	44	Adult	Lg testes	Petite Lake	1/10	1/11	1/12	3/21	Alive, alpha male of pack
	R-5	F	44	Adult	Proestrus	Petite Lake	1/10	1/11	1/12	3/21	Alive, only female in pack; did not whelp
	R-6	M	35	Subadult	Sm testes	Petite Lake	1/4	1/11	1/12	3/21	Alive, with pack
	R-8	M	33	Subadult	Med testes	Petite Lake	1/4	1/11	1/12	3/21	Alive, with pack[3]
Rose Creek	R-7	F	34	Pup	Immature	McLeod	1/9	1/11	1/12	3/22	Alive, solitary
	R-9	F	44	Adult	Proestrus	McLeod	1/9	1/11	1/12	3/22	Whelped in the wild; being held in Rose Creek pen/ 8 pups[4]
	R-10	M	58	Adult	Lg testes	Rick's	1/13	1/19	1/20	3/22	Shot on 4/21/95 after breeding with R-9
Soda Butte	R-11	F	51	Adult	Had not whelped	Chase's Flats	1/13	1/19	1/20	3/27	Alive, with pack
	R-12	M	55	Adult	Lg testes	Chase's Flats	1/16	1/19	1/20	3/27	Alive, alpha male of pack
	R-13	M	51	Adult	Lg testes	Chase's Flats	1/17	1/18	1/20	3/27	Alive, with pack
	R-14	F	40	Adult	Proestrus	Chase's Flats	1/17	1/19	1/20	3/27	Alive, with pack; whelped in the wild
	R-15	M	38	Subadult	Med testes	Chase's Flats	1/17	1/19	1/20	3/27	Alive, with pack

[1]Date pen opened. Wolves left pens up to 10 days later.
[2]As of June 25, 1995.
[3]Joined R-9 and her pups mid-October 1995.
[4]Released with pups, October 11, 1995.

Appendix 2. Data for 15 wolves captured in Alberta, Canada and released into central Idaho, January 1995.

Release Site	*No.*	*Sex*	*Wt. kg.*	*Age*	*Breeding Condition*	*Source Pack*	*Date of Capture*	*Date Shipped*	*Date Released*	*Km. from Release*[1]	*Status*[2]
Corn Creek	B-2	M	34	Adult	Lg testes	Obed Lake	1/1	1/11	1/14/95	48	Alive
	B-3	F	35	Subadult	Had not whelped	Athabaska	1/10	1/11	1/14/95	—	Unknown, last located 3/8
	B-4	F	37	Adult	Former Breeder	Petite Lake	1/10	1/11	1/14/95	208	Alive
	B-5	M	41	Adult	Lg testes	Petite Lake	1/4	1/11	1/14/95	40	Alive[2]
Indian Creek	B-6	F	32	Adult	Had not whelped	Oldman River	1/12	1/19	1/20/95	40	Alive w/B-8
	B-7	M	27	Subadult	Sm testes	Oldman River	1/12	1/19	1/20/95	30	Alive
	B-8	M	42	Adult	Lg testes	Petite Lake	1/13	1/19	1/20/95	40	Alive w/B-6
	B-10	F	39	Adult	Had not whelped	Hightower	1/14	1/19	1/20/95	55	Alive[2]
	B-13	F	39	Subadult	Had not whelped	Obed Lake	1/15	1/19	1/20/95	—	Shot 1/29/95
	B-14	M	41	Adult	Lg testes	Pembina Forks	1/17	1/19	1/20/95	160	Alive
	B-15	F	33	Subadult	Had not whelped	Pembina Forks	1/17	1/19	1/20/95	220	Alive
	B-16	F	33	Subadult	Had not whelped	Obed Lake	1/15	1/19	1/20/95	72	Alive w/B-9
Thomas Creek	B-9	M	42	Adult	Lg testes	Rick's	1/13	1/19	1/20/95	80	Alive w/B-16
	B-11	F	39	Subadult	Had not whelped	Hightower	1/14	1/19	1/20/95	50	Alive
	B-12	M	44	Adult	Lg testes	Hightower	1/14	1/19	1/20/95	30	Alive

[1]As of June 25, 1995.
[2]Male B-5 and female B-10 paired in late July 1995.