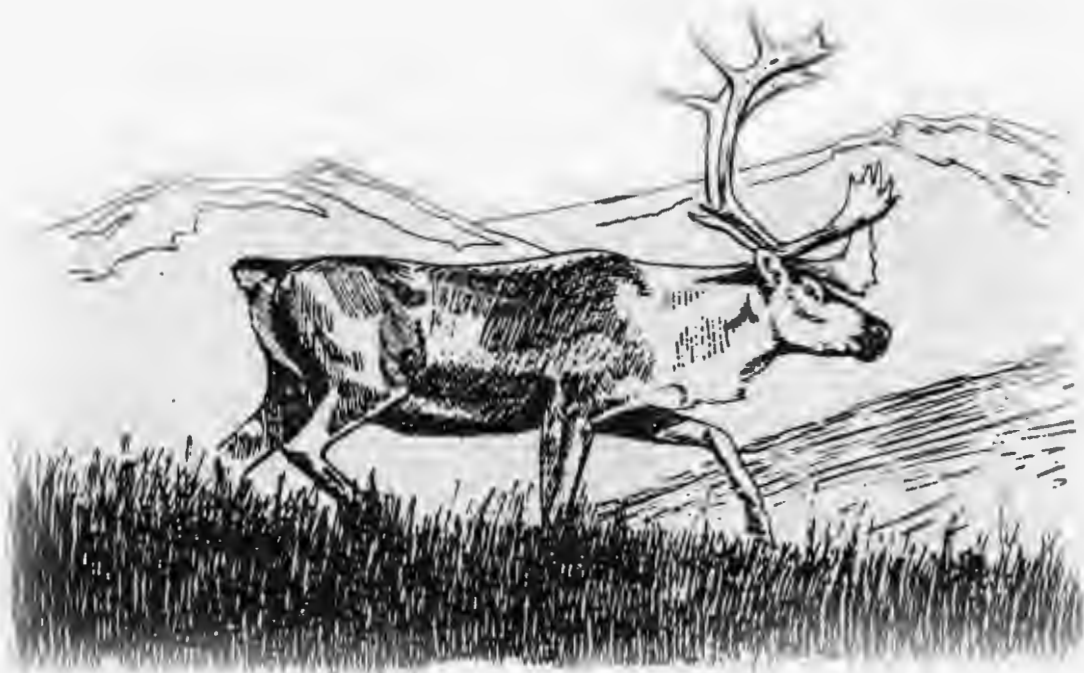


**ENVIRONMENTAL ASSESSMENT FOR  
REMOVAL OF  
INTRODUCED CARIBOU  
FROM ADAK ISLAND, ALASKA**



**July 28, 1994**

**Prepared by:**

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Dear Sir or Madam:

Enclosed is the "Environmental Assessment (EA) for the Removal of Introduced Caribou from Adak Island, Alaska" that is now available for public review.

This EA is a joint project between the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game. The project will be conducted in conjunction with the U.S. Navy. The EA examines six alternatives. After the comments are reviewed, there could be modification to an alternative, a combination of alternatives could be chosen, or an entirely new alternative formulated.

Written comments sent to this office will be accepted until September 8, 1994.

A handwritten signature in cursive script that reads "John L. Martin".

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John L. Martin  
Refuge Manager  
Alaska Maritime National Wildlife Refuge

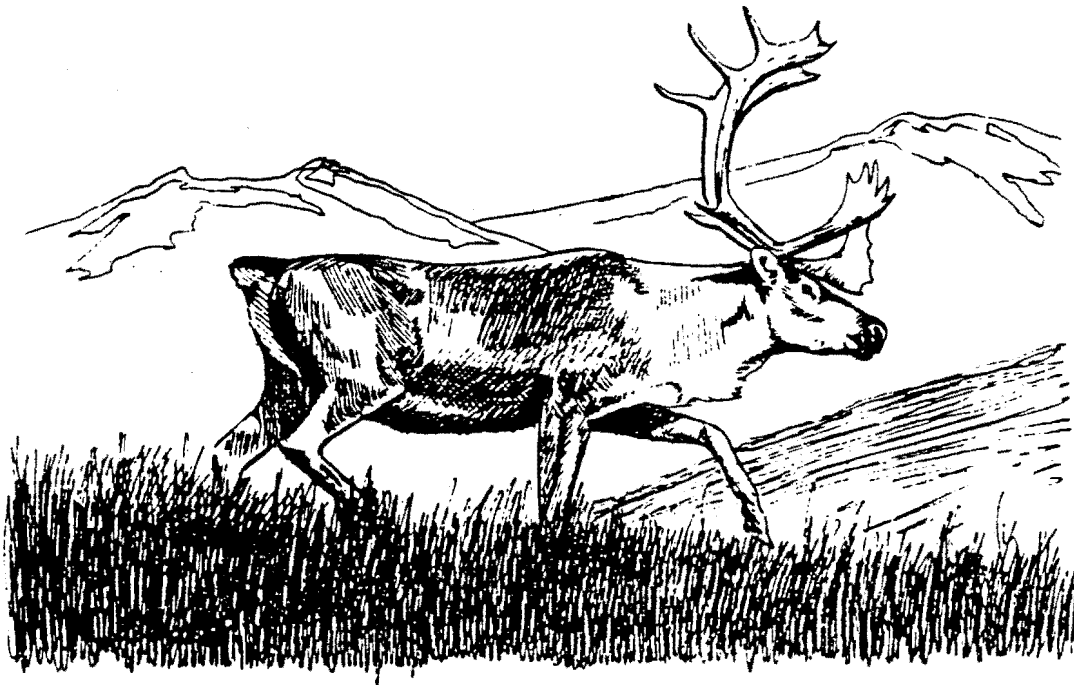
A handwritten signature in cursive script that reads "Ken Pitcher".

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Ken Pitcher  
Regional Supervisor  
Division of Wildlife Conservation  
Alaska Department of Fish and Game

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## **Table of Contents**

Summary	1
1. Introduction	3
1.1. Purpose and need for action	3
1.2. Location	4
1.3. Background	4
1.4. Issues and concerns	8
2. Alternatives including the proposed action and evaluation	9
2.1. Alternative 1 - No action	9
2.2. Alternative 2 - Elimination with salvage of meat	10
2.3. Alternative 3 - Elimination without salvage of meat	11
2.4. Alternative 4 - Translocation	11
2.5. Alternative 5 - Introduction of wolves	13
2.6. Alternative 6 - Sterilization	15
2.7. Alternatives that were considered and rejected	16
2.8. List of permits and authorizations	18
3. Affected environment	19
3.1. Climate	19
3.2. Topography and soils	19
3.3. Vegetation resources	20
3.4. Wildlife resources	21
3.5. Cultural resources	22
3.6. Land ownership and use	22
3.7. Social conditions	23
3.8. Economic and subsistence conditions	23
3.9. Transportation	24
4. Environmental consequences	26
4.1. Air quality	26
4.2. Soils	26
4.3. Vegetation resources	26
4.4. Wildlife resources	30
4.5. Cultural resources	33
4.6. Land use	33
4.7. Social conditions	34
4.8. Economic conditions	35
4.9. Transportation	36
5. List of preparers	37
6. List of agencies and persons consulted	37
7. Literature cited	38

**LIST OF FIGURES**

1. Location of Adak Island with boundaries of the Naval Complex and Alaska Maritime National Wildlife Refuge Wilderness. . . . . 5

**LIST OF TABLES**

1. Caribou harvest at Adak . . . . . 7

2. Cost estimates of the alternatives for removing the caribou from Adak Island . . . . . 12

3. Summary and comparison of environmental impacts of each alternative for removal of caribou from Adak Island, Alaska. . . . . 27

**LIST OF APPENDICES**

A. Reindeer and caribou introductions to islands and the consequences. . . . . 40

## Summary

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Barren-ground caribou (*Rangifer tarandus groenlandicus*) were introduced to Adak Island during 1958 and 1959, to provide recreational hunting and as an emergency supplemental food supply for the Department of Defense personnel. The herd increased rapidly under favorable climatic and habitat conditions. On Adak Island where caribou have no natural predators, hunting has been the management tool used to try to keep the population within the management objective of 150 to 250. Hunting was instituted in 1964, and the annual harvest has averaged 156 caribou over the years, peaking at a high of 236 in the 1993 - 1994 period. Presently the caribou population is estimated at 700 to 850, well beyond the post-hunting season objective. Biologists estimate 400 calves could be born in 1995. The U. S. Navy's decision to sharply reduce the number of personnel at its base on Adak, from 5,500 to 1,100, will render hunting as a management tool virtually ineffective. Tours of duty for the few remaining personnel have been reduced to one year and are now unaccompanied, therefore, it is unlikely there would be enough opportunity and interest in hunting to harvest the annual production of caribou. This would result essentially in the uncontrolled growth of the Adak caribou herd beginning in the fall of 1994, even though there is no closed hunting season and no bag limit on either sex. Both published literature and population management principles gained in other situations, strongly suggest that the ensuing uncontrolled growth of the caribou population would eventually exceed the carrying capacity of the range and result in habitat damage.

As a result of this concern, the U.S. Department of the Interior's Fish and Wildlife Service (Service), as manager of the habitat on this Alaska Maritime National Wildlife Refuge, and the Alaska Department of Fish and Game (ADF&G) as manager of the caribou, propose removing all of these non-native caribou from Adak Island. The project will be done in conjunction with the U.S. Navy. All three agencies are party to a 1976 Caribou Cooperative Management Plan; under this plan, surplus animals would be removed or harvested.

The Service and ADF&G are requesting comments on the six proposed alternatives in this Environmental Assessment. All of the alternatives will accomplish the agencies objectives except Alternative 1, taking no action. Comments from the public will be accepted during the 30 day review period. After the comments are analyzed, revisions will be made to the Environmental Assessment as necessary. Public, agency, and organization comments could lead to modifications of an alternative, allow a combination of alternatives to be chosen, or an entirely new alternative to be formulated. If it is found that there is a significant impact to the human environment, then an Environmental Impact Statement will be prepared, if not, a Finding of No Significant Impact would be prepared.

Alternative 1 is "no action." The caribou herd would remain on Adak and the caribou population would continue to increase with no effective management. Hunting would continue, although at a greatly diminished level due to the downsizing of the Naval Complex. The caribou herd would eventually increase beyond the carrying capacity of the range and the vegetation and soils would be seriously affected. This would be followed by a population crash with death likely from starvation and malnutrition. Overgrazing would result in habitat damage and pose a possible threat to the endangered Aleutian shield fern (*Polystichum aleuticum*).

Alternative 2, The Proposed Action, is to eliminate the introduced caribou herd and to salvage the majority of the meat for human consumption. All animals would be harvested as humanely as possible. The meat would be distributed primarily through a central distribution center. Locating and conducting the management action on all of the caribou would be very difficult to complete due to environmental conditions and the large number of caribou. Follow-up aerial surveys and management would be continued, for the next few years, until all animals are eliminated. A small number (less than 10 percent) of the carcasses would not be fit for human consumption and would not be salvaged.

Alternative 3 is to eliminate the caribou herd. As a cost and time-saving measure the meat would not be salvaged for human consumption. The caribou would be killed as humanely as possible. The nutrients from the carcasses would be naturally recycled on the island. Follow-up aerial surveys and management would continue, for the next several years, until all animals were eliminated.

Alternative 4 is to capture and translocate caribou to one or more sites. The release sites would probably be into the parent Nelchina herd or a herd genetically linked to Nelchina stock. Wildlife managers have biological and legal mandates not to move the caribou to other islands, to areas where existing herds have a different genetic stock, to areas in which harvesting caribou could be used only for private gain, or to areas which do not have adequate forage. Any animals which could not be captured for relocation (up to 10 percent) will be killed and salvaged, if possible.

Alternative 5 is to introduce sterilized wolves (*Canis lupus*) to Adak Island which would prey on the caribou. In time, the wolves would either eliminate the herd or drastically reduce the caribou population. A long-term monitoring program may be initiated to track the wolves and the caribou. Any animals remaining (up to 10 percent) after the majority of the caribou were eliminated, and the wolves die, would be killed and salvaged if possible. This alternative may not be compatible with the refuge purposes if the "threatened" Steller sea lions (*Eumetopias jubatus*) cannot be adequately protected.

Alternative 6 is the sterilization of caribou on Adak which would lead to elimination of the herd. All animals would be marked so they can easily be identified in the following years of surveys for animals missed in the initial operation. At the end of the project, animals which are unmarked and unable to be captured (up to 10 percent) will be killed and salvaged, if possible.

It should be noted that caribou and reindeer are closely related as subspecies of *Rangifer tarandus*. Caribou are managed as game animals by ADF&G. Reindeer are managed as domestic herd animals and can be owned only by Alaskan Natives. There is no Native subsistence hunting or fishing on Adak Island, this is not a traditional subsistence area and Adak was determined to be a non-rural community.

An irreversible and irretrievable commitment of resources may occur if the caribou population is left unchecked as in Alternative 1. Experience with other island populations leads wildlife managers to believe the no action alternative could allow long-term, significant damage to the vegetation and soils, and starvation for the caribou. The consequences of no action would be counter to the refuge mandate "to conserve wildlife populations and habitats in their natural diversity...". Soil erosion and overgrazing of the range by caribou could further threaten the Aleutian shield fern, the only endangered plant in Alaska. A long-term goal of the original project, providing caribou for recreational hunting and as an emergency supply of meat, will be lost under Alternative 1. As the grazing range diminishes biologists expect the herd to become cyclic with a population buildup and consequent crash, buildup, and crash.

Impacts of Alternatives 2 through 6 can briefly be summarized together. The positive long-term effects are the protection of vegetation, soils, habitat, and an endangered plant species. Economic short-term, positive benefits to the human population would be distribution of about 48 tons of meat for human consumption (Alternative 2), economic benefits for a few businesses, and temporary jobs. All alternatives could disturb the threatened Steller sea lions, but to varying degrees. Mitigation measures to protect the sea lions and an evaluation of their effectiveness are being formulated in conjunction with the National Marine Fisheries Service. Alternatives 2 through 6 will have minor short-term negative impacts on air quality, risks to humans from traveling in low-flying aircraft and handling animals, disturbance to wilderness users from aircraft and on wildlife viewing possibilities, on public perception of management techniques, death for some or all Adak caribou, and an expense to taxpayers. The long-term goal of the original project, providing caribou for recreational hunting and as an emergency supply of meat, will be lost under these alternatives. The action alternatives will not impact cultural, historical, or archaeological resources.

# 1. Introduction

---

## 1.1. Purpose and need for action

The purpose of the proposed action is to remove barren ground caribou (*Rangifer tarandus groenlandicus*) introduced to Adak Island. This will preclude the very real potential for a caribou population explosion and crash, eventual habitat damage to vegetation and soils, and possible detrimental impacts on the endangered Aleutian shield fern (*Polystichum aleuticum*). The caribou removal will be one step toward restoration of the island's natural diversity, which is a part of the Alaska Maritime National Wildlife Refuge (Alaska Maritime Refuge). This wildlife management action would be undertaken jointly by the Alaska Department of Fish and Game (ADF&G), the U.S. Fish and Wildlife Service (Service), and the U.S. Navy (Navy).

The Service, Navy, and ADF&G all agree that the caribou population of about 700 to 850 is too large and well above the population objective. The Adak caribou herd is at a critical juncture and without some drastic management action, long-term damage to the habitat may begin soon. This is an opportunity for wildlife managers to initiate action before a crisis occurs. Biologists estimate 400 calves could be born in 1995. The herd will number in the thousands (1,245) by 1995 and the costs of removing so many animals will be compounded. Accurate censusing of the Adak population is difficult due to weather, mountainous terrain and availability of suitable aircraft. The herd had been roughly estimated at about 400 animals, but biologists thought more could be present. When the Naval downsizing was proposed and aircraft became available, a thorough census was done in 1993. At that time wildlife managers found the herd was three times greater than the population management objective of 150 to 250.

Action is being initiated because the U.S. Navy is downsizing the Naval Complex on Adak Island from 5,500 people to about 1,100; effective in the summer of 1994. Hunting by the Department of Defense personnel has been relied on since 1964 to control the herd. Hunters have been harvesting about 156 caribou per year and this has been insufficient to keep the herd at recommended levels. Further personnel reductions may occur in the future. It is expected that about 25 caribou per year could be harvested after the downsizing (Captain W. J. Cummings, Navy, pers. comm.). In the future, Adak military personnel will be less effective in hunting caribou because:

1. The tour of duty for Adak is now 12 months, instead of 18 to 24 months for previous tours. Consequently most personnel will be non-residents, and have more expensive hunting license and tag fees.
2. Assignments to Adak are now unaccompanied (no families are allowed) so there will be fewer opportunities for using any harvested meat. Most personnel will be fed in the galley (mess facility).
3. Good hunting areas on the southern portion of the island are most accessible by water. Watercraft availability has been substantially reduced by having fewer private boats. The Navy tug boat availability is questionable; and the Morale, Welfare, and Recreation boat will cease to operate in the spring of 1995. Approximately 90 percent of the caribou used to be taken in conjunction with boat service provided by the Navy.
4. Shorter tours of duty will also mean personnel will be less familiar with the rugged geography and unpredictable weather on the Island. If hunters were to travel by foot to good hunting areas, they would need to hike 10 to 12 miles one-way over the mountains from the Naval Complex and spend several days for each trip.

When it first became known that the Navy planned to downsize their operations on Adak, interim management actions were taken. In July 1993, ADF&G, through the Alaska Board of Game, authorized



caribou hunting on Adak with no closed season and no bag limit on either sex. These actions were beneficial, as 236 caribou have been taken since April 1993. This has temporarily forestalled most of the 1994 population increase.

The habitat is starting to show signs of over-use. Dr. Stephen Talbot, a Service botanist, reported areas of heavy use from caribou in his casual observations in 1993 while searching for Aleutian shield ferns. A quantifiable range survey to document habitat condition and/or carrying capacity has not been conducted. He noted that lichen cover and lichen biomass are reduced compared to other non-grazed islands. Wildlife managers are sensitive to this scenario, as many other uncontrolled ungulate populations on predator-free islands have quickly grown beyond the carrying capacity of the habitat and caused severe habitat damage. This has occurred on Atka, St. Paul, St. Matthew, and Hagemeister Islands, as well as others (Appendix A).

Management of the refuge is governed by federal law, Service policy, and principles of sound resource management, all of which restrict the range of potential activities. In Section 303 (1)(b) of the Alaska National Interest Lands Conservation Act (ANILCA), one of the establishing purposes of the Alaska Maritime Refuge is "to conserve fish and wildlife populations and habitats in their natural diversity including but not limited to marine mammals, marine birds, and other migratory birds, the marine resources upon which they rely, bears, caribou, and other mammals..." Two of the goals for the National Wildlife Refuge System as stated in the draft *Refuges 2003* (U.S. Fish & Wildlife Service 1993) are "To preserve, restore and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered and ... To preserve a natural diversity and abundance of fauna and flora on refuge lands.."

North American caribou and Eurasian reindeer are considered a subspecies of *Rangifer tarandus*, with a worldwide northern distribution. In Alaska, caribou are managed by ADF&G as a game animal and can be hunted. However, reindeer in Alaska, are managed as a domestic herd animal and can be owned only by Alaskan Native people for commercial and personal use.

## **1.2. Location**

Adak Island (latitude 51°50'N; longitude 176°40'W) is located in the Andreanof Island group near the center of the Aleutian Island chain (Figure 1). Adak Island is 450 miles west of Dutch Harbor/Unalaska which has the nearest large airport, 650 miles southwest of Cold Bay, 750 miles southwest of Dillingham, and 1,200 miles west southwest of Anchorage.

## **1.3. Background**

The Aleutian Islands Reservation, which included the island of Adak, was established in 1913 by Executive Order 1733. The Aleutian Islands, including Adak, have been managed by the Fish and Wildlife Service or predecessor organizations since that time. In 1981, ANILCA legislation created the Alaska Maritime National Wildlife Refuge and included Adak as part of the Aleutian Islands Unit. Adak currently serves as a sub-headquarters for the Aleutian Islands Unit of the Alaska Maritime Refuge.

Artifacts from Native people's cultures are found on Adak; however, Adak was uninhabited prior to World War II when U.S. military forces landed on the island in August 1942. Both Army and Navy forces maintained a large presence on Adak until the end of the war. The Navy was granted a 61,000 acre military withdrawal on the northern one-third of the island after the war and established a permanent base. This base eventually became the Naval Air Station-Adak (NAS) and on July 1, 1994, the base name was changed to the Naval Air Facility-Adak (NAF). The Fish and Wildlife Service manages the southern two-thirds of the island (119,941 acres) as wilderness.

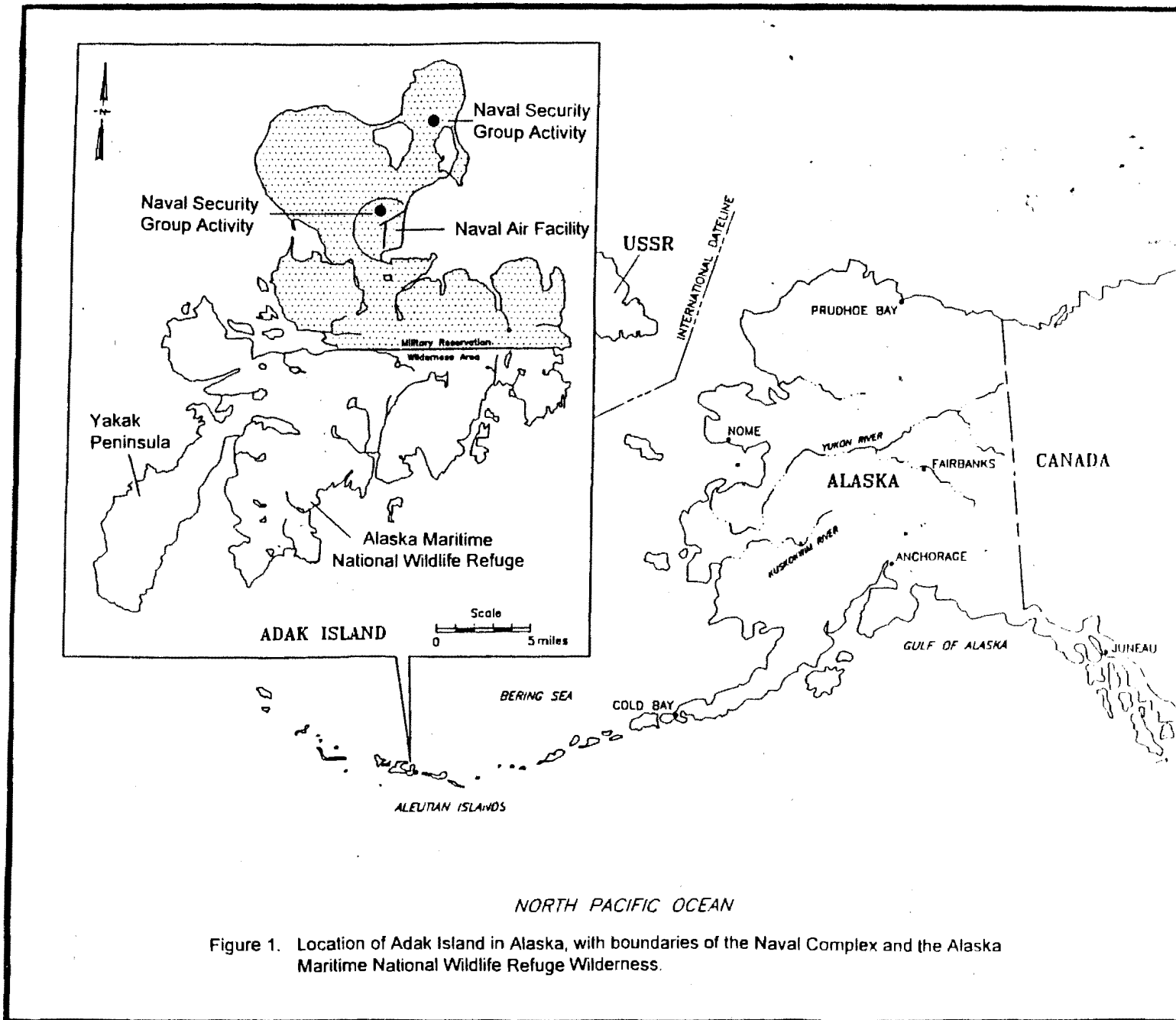


Figure 1. Location of Adak Island in Alaska, with boundaries of the Naval Complex and the Alaska Maritime National Wildlife Refuge Wilderness.

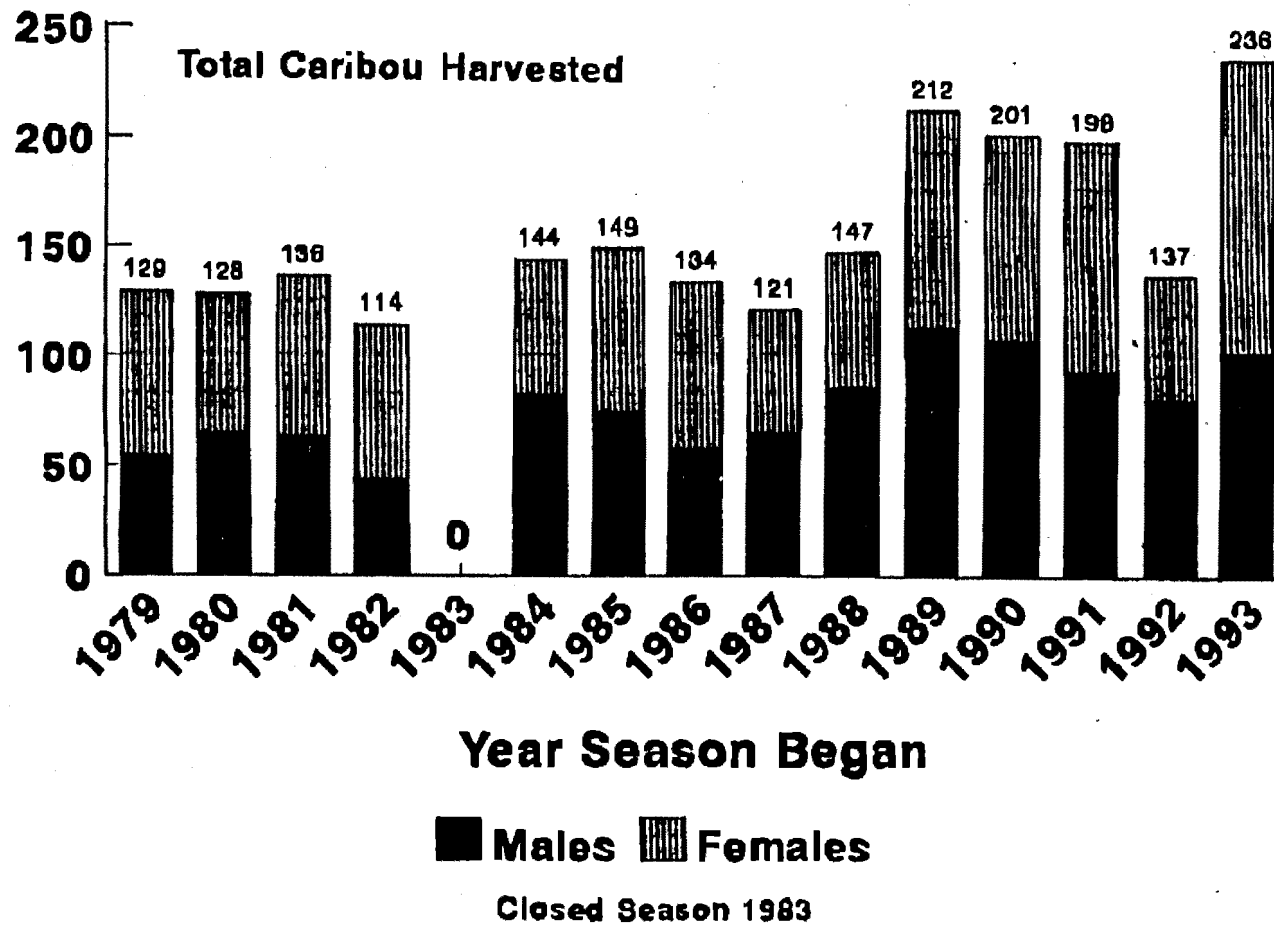
Caribou were introduced to Adak in 1958 and 1959 through a joint effort of the Fish and Wildlife Service and the military community. Caribou calves were taken from the Nelchina herd near Talkeetna with the help of Air Force helicopters; transported to Adak by the Navy, and cared for by Marines until they were old enough to survive independently. Initial mortality was high (approximately 70 percent) while the animals were in captivity, but eventually 23 calves were released (Jones 1966).

Caribou have done well on Adak as parasitic insects are limited, they essentially have no wild predators, no evidence of parasites or disease, a relatively mild climate, and an initially abundant food supply. The only predator has been man. There is a possibility bald eagles (*Haliaeetus leucocephalus*) may prey or scavenge on newly born calves. Measurements of harvested animals indicate that an average sized mature bull may exceed the maximum reported from other native caribou populations (Hall and Kelson 1959).

Hunting has been relied upon since 1964 to limit the growth of the herd and keep it within the carrying capacity of the habitat. Although the entire island is open to hunting, the cost of getting to Adak is expensive and Naval security is restrictive. Even with the Adak population at around 5,500 people, hunting has not successfully kept the herd within the population objectives. The Service issues hunting permits to hunters or visitors associated with the Naval Complex. Commercial fishermen in the area may also harvest some caribou. In an effort to maximize harvest and reduce the Adak caribou herd, the Alaska Board of Game issued an emergency regulation which extended the hunting season, originally scheduled to close March 31, 1993, and removed the two caribou limit. A permanent regulation was authorized with no closed season and no bag limit for caribou on Adak effective July 1, 1993. The expanded hunting regulations allowed for a greater harvest (236 animals) in the 1993 - 1994 period (Table 1). Active duty military personnel can hunt on the military portion of the island without either a license or a tag and residency is not required; however few caribou use this area. Caribou are more frequently found scattered over the southern and eastern portion of the island throughout Yakak Peninsula, Caribou Peninsula, and the coastal regions of the southern island from the Bay of Waterfalls to Kagalaska Strait.

A Caribou Cooperative Management Agreement was developed in 1976 by the Service, ADF&G, and the Navy. This agreement was reviewed in 1990, but not amended. Under the agreement, ADF&G is responsible for management of the caribou, the Service is responsible for habitat management, and the Navy is responsible for providing support and transportation (subject to availability) to ADF&G and the Service for census work, range studies, collections, and removing or harvesting excess animals (emphasis added). There is no longer a military airlift capability at NAF-Adak for transport; however, support capability will continue to exist for the foreseeable future. To prevent damage to the range, ADF&G adopted a pre-calving population objective of 150 while the Service adopted a somewhat more liberal post-hunting season objective of 200-250. However, all parties agree that the current estimated population has far exceeded any established objectives and to prevent habitat damage from overgrazing, caribou must be removed soon.

Published literature, and population management principles indicate that a typical island management syndrome has been repeated many times in Alaska and elsewhere. It begins: (1) with introduction of an ungulate to a pristine environment that has abundant food resources and no predators; (2) the herd increases at a rapid rate; (3) the high density of animals causes over-grazing; (4) the lichen resources then become depleted; and (5) a sharp decline in the ungulate population follows, usually as a result of winter starvation (Swanson and LaPlant 1987). This is expected to be the eventual outcome for the Adak Island caribou with no additional management action. Alaska has experienced these problems with reindeer introductions on St. Matthew, Nunivak, St. Paul, Atka, Hagemeister, Unalaska, Stuart, and St. Lawrence Islands. Canada, Greenland, and Antarctica have also experienced problematic situations. A brief summary of reindeer and caribou introductions to islands; and their typically detrimental environmental effects is in Appendix A.



**Table 1. Caribou Harvest at Adak**

Population dynamics of reindeer herds was described by Karter and Dieterick (1989) as follows. If a herd is allowed to increase in size, it will grow more and more rapidly each year, as much as 30 percent per year with favorable conditions. A population explosion and crash is a frequent Arctic island population response with ineffective controls. The annual growth increases until the herd becomes far too large for its grazing range. At this point the population crashes because large numbers of reindeer die within a very short period. The change from a rapidly growing herd to a rapidly declining herd is usually due to overgrazing. Good quality winter forage is limited by overgrazing and less preferred vegetative species are less nutritious, subsequently caribou starve or die due to malnutrition. An ecological carrying capacity is the maximum number of caribou a region can support, in the absence of harvesting, without causing permanent changes in the quantity and quality of available forage. The population growth stops mainly because there is not enough food for all the animals, resulting in females' failure to produce many calves and the death of many older animals each winter. If conditions worsen, then many more animals die each year than are born and the population declines or crashes.

#### **1.4. *Issues and concerns***

- Effects on native plants and soils
- Prevention of potential inhumane winter starvation
- Public perception of caribou removal
- Funding source
- Opportunities for hunters were maximized
- Elimination or reduction of herd
- Translocation destination for economic and hunting uses
- Management technique to remove herd, the most humane method
- Salvage or wanton waste of meat
- Transportation methods
- Protection of the endangered Aleutian shield fern

## **2. Alternatives including the proposed action and evaluation**

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In this environmental assessment the Fish and Wildlife Service, Alaska Department of Fish & Game, and the Navy are supporting a management action that will eliminate the introduced caribou herd on Adak Island. All of the following alternatives will accomplish this mission except Alternative 1, taking no action. The three cooperating agencies are requesting comments on the six proposed alternatives. Public, agency, and organization comments could lead to modifications of an alternative, allow a combination of alternatives to be chosen, or allow an entirely new alternative to be formulated. The proposed action is Alternative 2 - to eliminate the herd and distribute the majority of the meat for human consumption.

The following items would be true for Alternatives 2 through 6: (1) natural regeneration would be used to allow the vegetation and soil damaged by the caribou to return to its natural state; (2) a contractor could be hired to carry out this management action and would develop the methodology; and (3) no further caribou introductions would be authorized on the island.

### **2.1. Alternative 1 - No action**

The caribou herd would remain on Adak and continue to increase as it has since 1958. Hunting would continue, although at a diminished level as the Navy drawdown becomes effective. About 25 caribou are estimated to be taken annually after the drawdown as compared to 236 in the 1993-94 season. The Service would need to continue to monitor the size of the herd and assess the range condition.

Advantages associated with proposed alternative:

- The responsible agencies would not have to conduct a logistically difficult and expensive management action that would be unpopular with some members of the public.
- Naval personnel would temporarily continue to have caribou for hunting, wildlife viewing and as an emergency food supply.

Disadvantages associated with this alternative:

- The caribou herd would eventually increase beyond the carrying capacity of the range. Habitat would be severely damaged. This would be counter to the refuge mandate to provide habitat protection. Severe, long-term damage to the range would be followed by large scale die-offs of caribou from malnutrition and starvation. Unmanaged, the caribou population may become cyclic. A large scale die-off would be followed by gradual population increases until a severe winter caused another die-off. This cycle would be repeated over a period of years or the entire herd could die. This could be considered inhumane treatment.
- Overgrazing and erosion could:
  - (1) damage or destroy the Aleutian shield fern, which would violate the Endangered Species Act, as this is the only endangered plant in Alaska
  - (2) destroy cultural and historical sites, and
  - (3) cause siltation in salmon streams.
- The Service would find it difficult to assess the population and range because fewer personnel and aircraft would be available for aerial surveys.

- This alternative would not be compatible with the purposes for which the refuge was established - "to conserve fish and wildlife populations and habitats in their natural diversity..."

## **2.2. Alternative 2 - Elimination with salvage of meat**

All Adak caribou would be eliminated from the island and their meat would be salvaged for human consumption. All animals would be killed, as humanely as possible. The introduced caribou herd now numbers approximately 700 to 850 animals. The agencies and a contractor would determine the methods used to carry out this management action. One possible scenario might be shooting from a helicopter, another could be shooting from the ground. The caribou would be field-dressed and transported to the NAF-Adak. The meat could be further processed if necessary and then distributed through a central distribution center. Negotiations are underway for donations of time and transportation from Adak for the handling and distribution of the meat.

An effort would be made to salvage as many carcasses as reasonably practical. Animals would not be salvaged if: (1) salvage endangers the field or helicopter crew; (2) if the meat is unfit for human consumption and; (3) if the animals are inaccessible after death. It is possible that up to 10 percent of the herd would be unsalvageable.

Wildlife management biologists would prefer to remove the caribou during a window of opportunity during the winter of 1994 - 1995. At this time of year external temperatures would keep the meat cool, and no seabird colonies or sea lion rookeries would be disturbed by the activity. The timing of the elimination would be dependent on external factors such as availability of a contractor, availability of Navy funding, National Environmental Policy Act document completion, personnel scheduling, and availability of transportation. Wildlife managers would prefer to conduct the project before calving, when about 400 calves could be added to the population in May 1995 (K. Pitcher, ADF&G biologist, pers. comm.).

The logistics of this operation would be complicated and expensive. Locating and conducting the management action on all of the caribou would be very difficult. Continued management and aerial surveys may be needed several times a year, for the next several years, until all animals are eliminated. After elimination, there would be no recurring problem and no further costs for management would be required. Over time, the habitat on Adak Island would return to its original condition.

Advantages associated with proposed alternative:

- About 48 tons of meat would be salvaged for human consumption and distributed.
- This alternative is compatible with the purposes for which the refuge was established - "to conserve fish and wildlife populations and habitats in their natural diversity..."

Disadvantages associated with proposed alternative:

- Salvage of carcasses for utilization of meat would be labor intensive and transportation would be costly.
- This would require management techniques that are distasteful to some members of the public.

### **2.3. Alternative 3 - Elimination without salvage of meat**

All Adak caribou would be killed as humanely as possible. As a cost- and time-saving measure, meat would not be salvaged for human consumption. The nutrients from the carcasses would be recycled in the island ecosystem. A contractor would help determine what methods would be used to carry out this management action. One possible scenario might be shooting from a helicopter; another could be shooting from the ground.

The logistics of the initial operation would be relatively simple compared to Alternatives 2, 4, 5, and 6. This action could be taken at any time after the decision has been made. Locating and conducting the management action on all of the caribou would be very difficult. Follow-up aerial surveys and management may be needed until all animals were eliminated. Afterwards there would be no recurring problem and no further management costs required. The habitat on Adak Island would not undergo any further deterioration and could return to its original condition over time.

Advantages associated with proposed alternative:

- This is the most cost effective method proposed (Table 2).
- The principal is ecologically sound and recycles nutrients to scavengers and into the soil.
- This alternative is compatible with the purposes for which the refuge was established "to conserve fish and wildlife populations and habitats in their natural diversity..."

Disadvantages associated with proposed alternative:

- Failure to salvage meat is viewed by many people as wasteful and wrong, even though this is a management action and not hunting. Only hunters are required by State law to recover the meat.

### **2.4. Alternative 4 - Translocation**

The caribou on Adak could be captured and translocated to one or more sites. Caribou calves or yearlings are the most resilient and easiest to handle. Capture by the contractor would likely be by use of net guns or tranquilizers shot from helicopters. Animals would then be airlifted to the Naval Air Facility, held until a transport plane can carry them to a release site. Their antlers would need to be removed to minimize injury among animals. This technique would be used in the spring or summer of 1995, so that young animals would be available and the caribou could adapt more quickly to their new surroundings.

Locating and conducting the management action on all of the caribou would be very difficult. Follow-up aerial surveys and management would be needed until animals were relocated. After relocation, there would be no recurring problem on Adak. Additional costs for management may be required in the area where the animals are placed, perhaps for radio tracking, censusing, or other management action. Some caribou (probably less than 10 percent) cannot be relocated due to helicopter avoidance, capture mortality, ill health, animals which are impossible to handle, and other problems. These animals would be shot and salvaged, if possible. The habitat on Adak would eventually return to its original condition.

Wildlife managers and interested parties are submitting recommendations for potential release sites and several sites are being considered. The resource managers have the following concerns on choosing a release site:



Table 2. Cost estimates of the alternatives for removing the caribou from Adak Island, Alaska.

Alternatives	Cost per animal <sup>1</sup>	Cost for all caribou <sup>1</sup>
A. No action	\$43 - \$63 (annual)	\$30,000 - \$54,000 (annual)
B. Eliminate herd, meat salvaged	\$520 - \$655	\$364,000 - \$557,000
C. Eliminate herd, meat not salvaged	\$150 - \$300	\$105,000 - \$255,000
D. Translocation to mainland Alaska	\$700 - \$1570	\$490,000 - 1,335,000
E. Introduction of wolves	\$85 - \$125	\$60,000 - \$106,000
F. Sterilization	\$350 - \$785	\$245,000 - \$667,000

<sup>1</sup> Minimum cost is based on 700 animals taken in 22 days, maximum cost is based on 850 animals taken in 56 days. Costs include only the first year's effort. Costs of air travel to and from Adak are included. No full-time personnel salaries and no contingency factors are included in the cost estimates.

(1) Wildlife managers from the Service, ADF&G, and the Navy are very resistant to transplants to other predator-free island locations because of the history of caribou and reindeer transplants causing habitat problems (Appendix A). It is against Service policy to introduce non-native wildlife to federal refuge lands. ADF&G could authorize the introduction of native and some non-native species to islands or mainland locations if specific concerns are addressed.

(2) Any potential transplant site would require adequate forage. It would be inappropriate to introduce Adak animals into food-stressed populations. Sites like the southern Alaska Peninsula (near Cold Bay), where it appears that the existing caribou herd is limited by food availability, would not be an appropriate translocation site.

(3) Because caribou from different locations throughout the state show different physical characteristics, there are serious reservations about mixing Adak caribou, originally from the Nelchina herd, with other herds that may have genetically adapted to local environmental conditions. This may well be a highly conservative approach but is probably appropriate given the limited knowledge about caribou genetics (K. Pitcher, ADF&G biologist, pers. comm.). It may be inappropriate for Adak caribou to be introduced into any area occupied by caribou not closely related to the parent Nelchina herd. Caribou from the Nelchina herd are found in the Upper Copper and Susitna River Basins and on the Kenai Peninsula.

(4) There are concerns about the humane aspect because of the stress which would be imposed by capturing and transporting Adak animals to distant locations, particularly if large numbers of caribou were involved. There is a high risk of human injury, as well as for caribou, if large numbers of animals were moved. Caribou on Adak are not known to harbor any unusual diseases or parasites; but, to avoid undue risk to mainland caribou, pre-transport testing would be necessary.

(5) Release onto areas of restricted access, such as private lands, is inappropriate if public funding is used.

(6) Costs for large-scale translocations would be high, both financially and because of manpower requirements. In comparison, (1) Hagemester Island reindeer removal in 1993 cost \$410,000 for a 1.5

month operation for removing 295 animals and killing 135 animals. This is \$953 per reindeer. (2) ADF&G spent \$553/animal in 1985 to capture and move 47 caribou using helicopter darting. In 1986 they spent \$191 /animal to capture 67 caribou via drop-netting. This does not include salaries and per diem, and 8 volunteers. These operations were in highway accessible locations.

If all the caribou were translocated, there would need to be over 400 helicopter lifts of caribou, if two were carried at a time from the field to the NAF. It would be necessary to feed large groups of caribou while they are being held for relocation, and send over 30 loads of live caribou on a C-130 from Adak to the destination.

Advantages associated with proposed alternative:

- Animals would be moved to a new area and not killed on Adak, which would be favored by a segment of the public.
- Many agencies and organizations would be pleased to have these animals restocked in their area, as caribou are popular for hunting and wildlife viewing.
- This alternative is compatible with the purposes for which the refuge was established - "to conserve fish and wildlife populations and habitats in their natural diversity..."

Disadvantages associated with this alternative:

- Transportation to a mainland release site would be complicated and very expensive (Table 2). For the animals' safety, they would probably need to be individually crated before being transported. Animals would have to be moved four times: from the wilderness to the NAF, moved to aircraft, crated and shipped by plane, and moved to a truck or aircraft to be transported to the release site. Animals would need to be corralled and fed on Adak and possibly elsewhere. Stress would come from tranquilizers, human handling many times, removing antlers for safety during transportation, a flight of 6.5 hours from Adak to Anchorage, and lack of natural food. Capture myopathy is a physiological reaction to stress commonly resulting in loss of muscle function and death in advanced stages. Losses in a translocation such as this could be 10-20 percent or greater. Animals involved in capture mortality would not be salvaged.
- These caribou would have no experience with predator avoidance, though they are noted on Adak to retain an innate response. They would not be familiar with areas for grazing, water or shelter in the new surroundings. Natural behavior of herds from Adak and the new site may be altered, especially in regard to social hierarchy.

## **2.5. Alternative 5 - Introduction of wolves**

A caribou predator, such as wolves (*Canis lupus*), could be introduced to prey on Adak Island caribou. It has been suggested that wolves would prey heavily on calves and old adults virtually eliminating reproduction. They would also prey on adults and probably eventually eliminate the herd. If wolves do not eliminate the herd they would drastically reduce their numbers. Biologists estimate a small pack of wolves (4 to 5 wolves) may kill one caribou every other day. If this alternative is selected then biologists will develop the details of the project. The initial proposal is to sterilize the male wolves and release from 10 to 30 wolves. They may be able to eliminate the herd in a minimum of 5 to 7 years. Wolves have a life span of about 9 to 15 years and it is planned to bring young adults to the island. A long-term monitoring program may be initiated to track the wolves.

The Steller sea lion rookery at Lake Point on the Yakak Peninsula and the haulouts would need to be protected. It may be necessary to build fences or electronic cable systems to prevent the wolves from approaching the rookery /haulouts. Fish and Wildlife Service guards could be stationed in these areas to ensure that the wolves do not prey on the threatened sea lions. A cabin or semi-permanent housing with generator may need to be built for the field workers.

A contractor may be hired to develop this project and work out the logistics of the operation. It is estimated to be the least expensive option next to no action (Table 2). Wolves would need to be located and captured, transported to Anchorage, examined by a veterinarian, checked for disease and parasites, sterilized prior to transport to Adak and perhaps radio collared. After shipment to Adak, the wolves would be transported into prime caribou habitat and released.

Follow-up aerial surveys for about 10 years would be required to monitor the wolves and the caribou and institute any further management action. For example, wolves would need to be captured approximately every two years to replace the collar batteries, more wolves might need to be reintroduced, and a few remaining caribou may need to be killed after the wolves die out. As long as the population of caribou was declining, the habitat on Adak Island would not deteriorate any further. With elimination over the next 5 to 7 years or more, the habitat could return to its original condition. Any caribou remaining, after the majority are eliminated and the wolves die, would be killed and as many carcasses salvaged as possible. If wolves remain after the caribou are eliminated then they would need to be moved or killed to prevent their starvation.

#### Advantages associated with proposed alternative:

- Costs would be the least in this alternative and logistics would be simpler than in the other alternatives except no action.
- Since the wolves would not reproduce, the original animals would eventually die of natural causes and not cause a continued threat to other resources on the island.

#### Disadvantages associated with this alternative:

- Steller sea lions are listed as a threatened species by the National Marine Fisheries Service (NMFS) and they have a rookery and haulouts on Adak Island. There is serious concern that the wolves might prey or harass sea lions and this would constitute "a take" of an endangered species and would be in violation of the Endangered Species Act of 1973 (16 U.S.C. 1531-1543; 87 Stat. 884). It is possible the wolves could introduce parasites or disease into the seal lions on the rookery or haulouts. If the consultation with NMFS concludes that the wolf introduction would have a deleterious effect on the sea lions, then this alternative would be incompatible with the purposes of the Alaska Maritime Refuge.
- Wolves would consume other prey species after the caribou calves and old adults are taken and the caribou herd is substantially reduced. It is expected there would be a shift in food sources to birds, foxes, rats, and invertebrates.
- It may take several introductions of sterile wolves to eliminate the herd. This would be an on-going commitment of time, money, and monitoring. There could be some degradation of the habitat during the ensuing years.
- There is a valid concern the wolves would not be able to completely eliminate the herd. There was a research/management project conducted on Coronation Island, in the

Alexander Archipelago of southeastern Alaska where an introduction of four wolves, which increased to 13, were unable to completely eliminate a herd of about 500 deer in about 8 years (Klein 1992). Deer could take effective protective shelter in brushy steep terrain in Southeast Alaska.

## **2.6. Alternative 6 - Sterilization**

Sterilization of caribou on Adak would lead to the elimination of the herd. After all of one sex is sterilized the elimination of the herd would be complete in one generation, about 15 years. Sterilization of all the females is being considered. This may be preferable because with male sterilization sometimes a male is not fully sterilized or a male is missed in the survey. Given the behavior of caribou with formation of harems, it is possible that a single male could fertilize many females and the herd could repopulate. Animals could be captured by the contractor, tranquilized, sterilized in the field, and immediately released. Veterinarians can perform a sterilization in about one half hour and the animals have a high rate of successful recovery (D. Mulcahy, veterinarian, pers. comm.).

Sterilized individuals would be permanently marked so they can easily be identified in the following years of surveys. This proposed action may need to be done over a period of time to get as many as possible of the herd sterilized. Any remaining animals (up to 10 percent) would be killed and the meat salvaged, if possible. This would be necessary because some caribou may be in areas that are too difficult to land and handle the animal and some would become experienced at avoiding aircraft and capture.

Research is being conducted by other organizations on the use of chemosterilants on ungulates as a population control mechanism. However this technique has not been perfected to the point where it could be used on a population of this magnitude.

This operation would be time consuming and expensive. Locating and conducting the management action on all of the caribou would be very difficult. Follow-up aerial surveys and sterilization or elimination would be required until all animals were marked. There would be no recurring problem and no further management costs required. The habitat on Adak Island would not undergo any further deterioration and could return to its original condition over time.

Advantages associated with proposed alternative:

- Caribou would remain alive on the island and continue their lives until natural death or harvested by hunters.
- This alternative is compatible with the purposes for which the refuge was established "to conserve fish and wildlife populations and habitats in their natural diversity..."

Disadvantages associated with this alternative:

- Since both sexes of caribou have antlers it is sometimes difficult to tell males from females, especially adult females from young bulls. Every caribou would need to be captured and marked to prevent needless recapture. Expense for tranquilizer, capture, permanent marking, treatment, and release would be high (Table 2) and cause considerable risk to humans from injury.
- Some caribou may die from tranquilizers (if they are used), infection, and stress from handling.

- Finding and capturing all caribou would be difficult and could involve years of effort. Subsequent surveys would need to be flown to assure that no calves are being born.

## **2.7. Alternatives that were considered and rejected**

### **2.7.1. Hunting**

Hunters could be brought in or arrange their own transportation by aircraft or vessel. The hunting season is open year-round and there is no bag limit on either sex. Hunters who are sponsored by Navy personnel can come to Adak at any time now. Big-game guides or anyone who is not sponsored would need to come by vessel and live on the vessel or on the refuge Wilderness of Adak Island. Five public use cabins are available on the south side of Adak Island on a first-come first-served basis.

Advantages associated with proposed alternative:

- People would enjoy hunting for some of the "largest" caribou in the world and they would be helping with the management of this herd.

Disadvantages associated with this alternative:

- Given the logistical difficulty of hunting on Adak, it would be impossible to eliminate the herd, using hunting as the sole management tool.
- Visitors to the NAF must undergo a security check and prior authorization must be in hand before an airline ticket would be issued. Visitors must be personally sponsored by an Adak resident who would be responsible for their overnight housing.
- No aircraft or vessels are available for hire on Adak and motorized vehicles are prohibited off the road system. Hunters need to hike over the mountains about 10 to 12 miles (about 6 hours) to get to a good caribou hunting area and several trips would be required to return with their game and gear.
- Costs of access to Adak Island by commercial or chartered aircraft and vessel are prohibitive (Section 3.9. "Transportation"). Though Adak has been open to public hunting since 1964, the only hunters known to have taken caribou were Adak military personnel or visitors associated with the military base. Residents of the Aleutian chain and Alaska Peninsula have no direct commercial air flights to Adak; they must travel through Anchorage. The closest large airport with commercial airline flights is Dutch Harbor.

### **2.7.2. Reduce the herd**

One proposal was to reduce the caribou herd on Adak to approximately 100 animals, rather than eliminate the population. The herd is proposed to be maintained at this size through hunting or periodic reduction hunts. This reduction action could be conducted in the manner proposed in Alternatives 2, 3, 4, or 6.

Advantages associated with proposed alternative:

- The Navy would be able to continue to have limited hunting and viewing opportunities and a supply of meat in case of an emergency.

Disadvantages associated with this alternative:

- With a herd of 100 animals, caribou can spread widely over the island and be difficult to find. Hunter success would be expected to be low and ineffective. When the herd increases and they are easier to hunt, the few local hunters would be unable to control herd numbers, and the herd would grow unchecked.
- Navy personnel and other hunters were unable to control the population of the herd when the NAF had a population of 5,500. The downsized NAF would have fewer personnel, less incentive to hunt because they would not have a family on the base to provide for, expensive equipment for hunting, shorter tour of duty, non-residency status, and irregular service of recreational boats. It is likely that the hunter pressure would significantly decrease.
- Periodic reduction hunts are expensive and unpopular with ADF&G, the Service, the Alaska Board of Game and very unpopular with the public.

### 2.7.3. Sale of meat and antlers

One option that was considered was to hire a company to remove the animals and allow that business to sell the caribou meat, antlers, or any other salvageable parts. Money from the sale would be used to defray removal costs. If the primary purpose of the operation was to take antlers, the operation would need to be done in July when the antlers are still soft and blood vessels are nourishing them.

Advantages associated with proposed alternative:

- This alternative would reduce expense for all agencies, if the sale of the animals were used to defray removal costs.

Disadvantages associated with this alternative:

- Selling the meat and antlers is now prohibited by state regulation but could be authorized by the Alaska Board of Game for a specific situation, such as on Adak. Both the public and the resources agencies do not want to encourage the selling of animal parts in foreign markets.
- The public is accustomed to the idea that game animals cannot be sold or bartered. It may appear to some people that the agencies are selling the Adak caribou for their own gain.

### 2.7.4. Introduction of disease and/or parasites

The introduction of diseases and/or parasites would bring about a reduction of the caribou herd through mortality and reduced ability to reproduce. Because of their isolation, caribou on Adak are thought to be relatively free of parasites and diseases often found in mainland ungulate populations. Thus, introductions of diseases and or parasites might be effective in initially reducing the population, but it is very unlikely that the herd could be eliminated in this manner. To introduce the pathogen, some caribou would be captured, immobilized, infected with the disease or parasites, then released at the capture site.

Advantages associated with proposed alternative:

- No animals would need to be killed or removed from the island. Logistic problems would be reduced from other alternatives. consequently the cost of the alternative would be low compared to other alternatives.

Disadvantages associated with this alternative:

- Disease introduction may be ineffective as (1) it is unlikely to eliminate the herd and (2) survivors may develop a resistance to both diseases and parasites and the population would again begin to increase. It could be considered inhumane.
- Introduction of exotic species (diseases and/or parasites) is contrary to current Fish and Wildlife Service policy.
- Other non-target species which could be affected are fox, rats, and marine mammals which come ashore. The effect on the threatened Steller sea lion is of special concern.

## **2.8. List of permits and authorizations**

U.S.D.C., National Marine Fisheries Service

- Section 7 consultation under the Endangered Species Act for the Steller sea lion

U.S.D.I., Fish & Wildlife Service

- Compatibility determination
- Section 7 consultation under the Endangered Species Act for Aleutian shield fern
- Service compliance with Archeological Resources Protection Act, Section 106 - completed

State of Alaska, Department of Fish & Game

- Alaska Board of Game authorization to eliminate herd - completed

State of Alaska, Division of Governmental Coordination

- Alaska Coastal Zone Management Act consistency

### **3. Affected environment**

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#### **3.1. Climate**

Adak Island has a maritime climate, characterized by overcast skies, high winds, and frequent cyclonic storms. Weather can be very localized, with conditions of fog, low ceilings, precipitation, and clear weather all possible within a distance of a few miles. Storms can occur during any season, with the most frequent and severe storms during the winter months (Sekora 1973). Air quality is excellent.

Average annual temperatures are cool, but not normally severe, due to the influence of the Japanese Current. Mean monthly temperatures vary from a low of 32.9° F in February to a high of 51.3° F in August. Winter lasts six to nine months and frost can be expected every month except July and August. The occurrence of strong winds and temperatures below 40° F make the wind chill factor an important consideration for human activities (Sekora 1973).

Wind conditions are typified by local shifts and rapid changes in velocity. Average wind speed is 15 knots, with gusts in excess of 125 knots recorded during winter storms and gusts over 50 knots not uncommon. Prevailing wind direction is from the west. Total mean annual precipitation is about 64 inches. Summer months have extensive rain and fog. Snowfall averages over 100 inches a year, mostly falling from December through March. Due to the relatively warm temperatures, snow depth rarely exceeds 1 to 2 feet and is concentrated in the mountains (Sekora 1973).

Daylight on the shortest day is about 7 hours and the longest day about 17.5 hours. Cloudiness dominates throughout the year and reduces solar radiation; therefore, seasonal periods are difficult to define and generally later than in other Alaskan areas. Vegetative growth begins in late May or early June and fall generally arrives in late September or early October (Sekora 1973).

#### **3.2. Topography and soils**

Adak is characterized by four land forms: rugged mountains, broad rolling lowlands, modified volcanic cones (northern Adak Island only), and narrow beaches backed by sea cliffs (Fraser and Snyder 1959). Adak Island is irregular in form, is about 32 miles long and 21 miles wide, and comprises about 290 square miles (Figure 1). It is volcanic in origin (Coats 1956) with a superficial mantle of light soil and ash. Mt. Moffett, an extinct volcano, is 3,900 feet high and is located at the northwest end of the island. Grass-covered on the lower elevations, the island abounds with many lakes and small streams. The southern and central portions of Adak Island are characterized by mountains of older volcanic origin (including Mt. Reed) that were heavily glaciated and now form steep, rugged ridges with numerous rock-basins. There are extensive lowland areas around the island perimeter and a coastline deeply indented by fjords and bays. There are very few beaches suitable for landing on the south shore. The eastern coast of Adak is bordered by steep bluffs and rocky cliffs; it has numerous islands, rocks, and reefs that lie close to the shoreline (Sekora 1973).

Below 1500 feet in elevation, recent ash layers, soil, and vegetation cover much of the bedrock. A typical surficial mantle on southern Adak consists of about 5 feet of volcanic ash, banded with soil and reddish-brown layers and capped with a still-forming, dark-brown soil vegetation layer as much as 3 feet thick. Soils were classified as tundra without permafrost and as alluvial-tundra soil (Fraser and Snyder 1959).



### 3.3. Vegetation resources

#### 3.3.1. Plants and habitats

Vegetative cover is of the alpine-zone type and is classified as maritime tundra. The principal plants are grasses, sedges, sphagnum mosses, lichens, and crowberry (*Empetrum nigrum*). There are no erect shrubs or trees, but an association of prostrate alpine willows (*Salix* spp.), bog blueberry (*Vaccinium uliginosum*) and crowberry are abundant between 300 and 1000 feet elevation. Reindeer moss (*Cladonia* spp.), of particular interest in caribou habitat, is found over all the island south of the NAF. This comprises about 220 square miles and is the area considered available for caribou range. Of this, about 157 square miles lies below 600 feet elevation and is considered the available winter range. Here reindeer moss (a lichen) is one of the dominant plants, reaching 4 inches in height and comprises 80-90 percent of a dense vegetative cover on many level or gently sloping areas. If lichens are available on the winter range, they are highly preferred (Swanson and Barker 1992). The steeper slopes are covered predominantly with grasses, sedges, and other herbaceous plants (Jones 1966).

A technical description of the range on the northern half of the island is given in the Naval Resources Management Plan (Soil Conservation Service 1990). It describes the value to wildlife of different habitat types, susceptibility to erosion and runoff, and response to disturbance. The existing status of the range is not evaluated for either half of the island. A range survey for the southern half of the island, where the caribou are more frequently found was started by the Service (Masteller, Reiswig, and Beach 1981 and Deines and Slater 1984). Their preliminary reports describe the winter habitat and vegetation. Caribou use winter range habitats of seashore, lowland meadow, heath, fen, and alpine meadow (Deines and Slater 1984).

Steve Talbot, Service botanist, conducted a cursory range survey during his search for Aleutian shield ferns in the summer of 1993. He found the range was beginning to show signs of overuse due to caribou. There was significant trailing and the areas where the caribou congregate at the base of rock cliffs was trampled and the earth was torn. Both of these uses create erosion. He also found the overall lichen cover was reduced. He compared lichen cover on Adak with the nearby islets and Rat Island (all are free of caribou) and found the lichen biomass reduced. Visual comparisons can be made by looking at the percentage of lichen covering the ground and the height of the lichens. A definitive range survey, such as those done by the Soil Conservation Service, would need to be conducted for a thorough scientific analysis.

#### 3.3.2. Species of special concern

The Aleutian shield fern, the only Alaska plant species on the threatened and endangered list, was listed as endangered in the 1988 Federal Register (Number 53:31). Historically, it was found only on remote mountain tops of Adak and Atka islands. The fern's status on Atka remains undetermined. Although several attempts were made, the shield fern has not been found on Atka Island since its original discovery in 1932.

The shield fern was originally discovered on Adak Island by D. Smith in 1975 and then re-discovered in 1987. Three locations of groups of the ferns with a total population of 127 plants have been identified on Adak during ongoing research (Talbot and Talbot 1994). Comparative observations of the three areas led Talbot and Talbot (1994) to hypothesize that the fern originates in rock grottos or moist crevices (a narrow microhabitat), is sometimes displaced through erosion, re-establishes itself for a time in meadows a few meters below the original colony, and is eventually either out-competed or the habitat becomes unfavorable with increasing distance from the grottos. The main threat to the fern population on Mt. Reed is the potential loss due to the natural erosive processes in the volcanic soils (S. S. Talbot and B.

Anderson, Service biologists, pers. comm.) Another botanist, Lipkin (1985), stated the fern's survival could be affected from grazing by caribou, depletion by over-collecting, natural population fluctuations, and habitat instability from solifluction and wind erosion. The present caribou population does not seem to be a serious threat to the shield fern. Though caribou utilize resources on Mt. Reed, the steep terrain where known fern populations are located, is not in an area typically frequented by caribou. As the caribou population increases and food resources become limiting, caribou may use this area more extensively.

A candidate or Category 2 species, an Aleutian endemic species, *Saxifraga aleutica*, was reported from Adak (Lipkin 1985). This category means the Service needs further status survey information, evaluation of threats, or taxonomic clarification before the need for listing can be determined.

### 3.4. Wildlife resources

#### 3.4.1. Wildlife

The only three terrestrial mammals existing on the island have been introduced. The barren-ground caribou, and Arctic fox (*Alopex lagopus*) were intentional introductions, but the Norway rat (*Rattus norvegicus*) was accidentally introduced, probably during World War II. Marine mammals commonly found in the waters surrounding Adak Island include: sea otter (*Enhydra lutris*), harbor seal (*Phoca vitulina richardsi*) and the Steller sea lion. There are no known pupping areas for seals on Adak Island although they commonly haul out on offshore rocks and islets (G. V. Byrd, Service biologist, pers. comm.).

A summary of the Adak Island caribou introduction and harvest statistics is in Section 1.3 "Background." In an effort to census the caribou population of Adak, a 17 hour helicopter survey was conducted by the Service, ADF&G, and the Navy in May 21 - 23, 1993 (Meehan 1993). They counted 501 adult caribou and 160 calves. Using percentage calculations, they estimated 66 adults and 100 unborn calves were missed in the survey. They estimated the caribou population in 1993 to be between 800 and 850. In August 1993, a 1.5 hour survey was conducted by the Service and the estimated population was 650 to 700.

There are 155 species of birds, including 34 species which are of "Asiatic" origin, recorded on Adak Island (Fish and Wildlife Service 1987). Casual or accidental visitations by North American and Asiatic species deviating from their normal migration routes are frequent. Most marine bird rookeries are located on many small offshore islands adjacent to Adak; thousands of puffins, cormorants, guillemots, and gulls nest in these colonies. Marine birds are precluded from nesting on the main island of Adak, except on inaccessible cliffs or in the mountains, due to the presence of introduced Arctic foxes. Bald eagles are abundant and nest on Adak. Rock ptarmigan, plus a number of waterfowl and passerines, also persist and continue to nest on Adak in spite of the foxes. Detailed information on avian species is available from the Alaska Maritime Refuge.

Hunting, trapping, and fishing are popular activities on Adak. Species harvested on and around Adak Island are caribou, Arctic fox, ptarmigan, all five species of salmon, Dolly Varden, land-locked silver salmon and rainbow trout.

#### 3.4.2. Species of special concern

Steller sea lions were listed as a threatened species under the Endangered Species Act in 1990 (55FR13488) and are under management by the National Marine Fisheries Service. There were five recorded haulout/rookery areas for the threatened Steller sea lion on the western side of Adak Island (ADF&G 1985). Sea lion populations have been declining since the early 1970's. Current survey data documents sea lions using Lake Point on the Yakak Peninsula as a rookery and Cape Yakak as a haulout site. Sea lions on Lake Point numbered about 2550 in 1959 and 345 in 1992 (Sue Mello, NMFS ecologist,

pers. comm.). The Cape Yakak haulout had 800 in 1959 and 106 at the last NMFS reported survey in 1992. Historical data from ADF&G (1985) show 5 haulout/rookeries areas. In addition to the two previously mentioned, they recorded haulouts at Cape Moffett, Argonne Point, and Crone Island.

The Aleutian Canada goose (*Branta canadensis leucopareia*) was recently down-listed from endangered to a threatened species under the Endangered Species Act (55FR5112). In 1994, the Aleutian Canada goose population is estimated at 15,000. The western segment of the population is doing very well. Recovery efforts are now being shifted to segments in the central and eastern Aleutians where populations seem to be struggling. It is a rarely seen migrant on the nearshore ocean water and lowland lakes and streams on Adak Island (G. V. Byrd, Service biologist, pers. comm.). Nesting on Adak is precluded by the presence of Arctic foxes.

The marbled murrelet (*Brachyramphus marmoratus*), Kittlitz's murrelet (*B. brevirostris*) and harlequin duck (*Histrionicus histrionicus*) are candidate species under Category 2. This means the species might qualify under the Endangered Species Act but the Service needs further status information, evaluation of threats or taxonomic classification before the listing can be determined.

### **3.5. Cultural resources**

Adak Island and the other Aleutian Islands were originally inhabited by the Aleut Native people whose subsistence base was almost entirely marine. Due to the weather, even the smaller camps of the Aleuts tended to have large semi-subterranean houses, each housing several families. The Russian fur trade, along with the Russian Orthodox Church, dominated Aleutian life from the 1850's until the American purchase of Alaska. There was a dramatic decline in the number of Aleuts with the exploitation by the fur traders, introduction of epidemic diseases, and Russian-forced Aleut relocations (Fish and Wildlife Service 1988). Approximately 38 archeological sites have been recorded in coastal areas around Adak Island (McCartney 1972).

More recent history has been marked by a continuation of fur trapping, the introduction of fox farming, and the development of commercial fishing. Aleuts were no longer living on the island in 1942 when Adak was first used as a military base during World War II. This military campaign left many buildings and much equipment behind on many of the Aleutian Islands, including Adak (Fish and Wildlife Service 1988). The number of servicemen living on Adak peaked at 90,000 in 1942 just prior to the invasion of Kiska Island (Soil Conservation Service 1990).

### **3.6. Land ownership and use**

The Aleutian Islands Reservation, including Adak, was established in 1913 by Executive Order. Today, Adak is managed by the Fish and Wildlife Service with the Aleutian Islands Unit as part of the Alaska Maritime National Wildlife Refuge. The northern one-third of the island (111,000 acres) was withdrawn in 1959 for military purposes. Two commands currently make up the Adak Naval Complex - the Naval Air Facility and Naval Security Group Activity (NSGA). Of these, approximately 61,000 acres of the Naval Complex is designated for intensive use, 50,000 acres for moderate use, and the remainder of the island (119,941 acres) is managed as Wilderness.

There is no tourism on Adak, however, Adak military and civilian personnel, their families, and visitors used the refuge for recreation before the downsizing. The local population is interested in wildlife observation, hunting, fishing, trapping, boating, photography, and hiking. Public use on Adak, the neighboring islands, and the surrounding waters will decrease with the reduction in personnel.

The refuge headquarters has a visitor center and provides programs which increase interest in refuge lands and resources. For the safety of their personnel, the Navy requires all newly assigned sailors to attend a briefing regarding the refuge and the various hazards associated with weather, hiking, hunting, and fishing on Adak. Service biologists continue to conduct studies on Adak's natural history.

### **3.7. Social conditions**

The Aleutian Islands had a total human population in 1970 of 5,772 with nearly 90 percent of these people on military bases. By 1990, the Aleutian Islands' population had grown to approximately 9,200. Until recently, Adak was the largest community in the Aleutians, with about 5,500 in 1988. It consisted of a government enclave centered around the Adak Naval Complex. The population of Adak has a history of fluctuations based on changes in national defense policy rather than the local economy. The community of Adak was transient in nature with most military and Department of Defense personnel serving 2 to 3 years; some civilian employees opted to stay longer and a very few even extended their stay beyond 15 years. There is no local government on Adak because it is a military installation. Adak had its own school system and there were a number of active social groups on the island until the downsizing in 1994.

The first plan to downsize NAF-Adak was proposed in March 1993 and is now complete. Plans for additional downsizing of the NSGA may further reduce the number of personnel assigned to Adak. Beginning in August 1993, the tour of duty for military personnel was reduced to one year and became unaccompanied. Most personnel will be housed in barracks, senior enlisted, and officers quarters; meals will be provided at the galley. There will be little incentive to harvest caribou, except for sport; however, cooking facilities and freezer space will be limited.

There is no resident Aleut population on Adak. The closest villages are Atka, 110 miles to the east, and Nikolski 330 miles to the northeast. Atka residents (about 80) are subsistence-oriented and rely heavily on marine resources. A herd of feral reindeer is present on Atka and is utilized opportunistically by local residents. A small halibut fishery and freezer plant provides some cash for local fishermen (Aleutian Regional School District 1985). Nikolski is a Native Aleut village of about 35 people. The people are dependent to large extent upon subsistence hunting and fishing (Aleutian Regional School District 1985). The villagers have reindeer, cattle, horses, and sheep on Umnak Island.

### **3.8. Economic and subsistence conditions**

Economy of Adak is strictly based on the military and Service budget. If the military were to withdraw, there would be no community of Adak. Employment is mainly through the Navy and a few jobs with the refuge will remain after downsizing.

In Alaska, only rural residents have been determined to have customary and traditional subsistence use privileges on Federal public lands. Adak was determined to be an exception to the rural community designation. However, many Adak families did utilize local resources such as halibut, crab, salmon, and caribou, but did not rely upon them for subsistence. The Native people in the closest villages (110 and 330 miles away) do not hunt on Adak Island.

The Aleut Corporation is the regional for-profit organization of the Native people of the area. The Aleutians/Pribilof Islands Association, Inc. is the regional non-profit organization that promotes the economic, social and cultural development of the Aleut people in the region. The Aleutians West Coastal Resource Service Area (AWCRSA) was formed to guide the coastal zone management and protect the coastal environment of the Aleutian Islands, with the exception of Adak Island (Resource Analysts 1990).

Costs for an Adak caribou hunt are high. Members of the military service and their dependents who have been stationed in the state for the preceding 12 consecutive months are considered residents. In addition to license fees, personal hunting costs must be expended for a rifle, clothing, boots, hunting and survival equipment, and food. After the license and gear are acquired then a means of transportation must be arranged (See 3.9. Transportation). Basic costs for hunting on Adak are given below:

Status	License	Tag	Total cost
Resident	\$25	0	\$25
Non-resident	\$85	\$325	\$410
Military non-resident	\$85	\$162.50	\$247.50
Active duty military hunting only on NAF	\$0	\$0	\$0

### 3.9. Transportation

Access to the Adak Naval Air Station is restricted by the Navy for the security of national defense facilities. The Adak Naval Complex receives regular commercial air service, military flights, and surface vessels. Only personnel with an authorized sponsor are permitted to fly to the island. The only accommodations available on Adak Island are those provided by the Navy base, and the five public use cabins and wilderness camping on the refuge.

Adak is serviced by one commercial carrier, Reeve Aleutian Airways. In the spring of 1994, the NAS-Adak had two tug boats and a boat for Morale, Welfare, and Recreation. Alaska Airlines has the military contract for transporting personnel associated with the Department of Defense. McCord Air Force Base in Washington provides two flights a week with food supplies and fresh produce. The Coast Guard stops occasionally in Adak with a C-130 for refueling on its missions which typically fly between Kodiak, Adak, and Attu. Very few small aircraft stop at Adak unless they are from other Federal agencies. Private fixed-wing aircraft are not usually allowed on Adak Island due to security restraints and unpredictable weather.

Current ticket prices round trip from Anchorage to Adak are between \$525 and \$1008 on Reeve Aleutian Airways. Reeve charges about \$1 per pound for shipment of caribou meat. People who wish to go to Adak from Unalaska/Dutch Harbor must travel through Anchorage to Adak.

Aircraft can be chartered privately through Peninsula Airways from Cold Bay to Adak for \$3,388. It is a 7-hour flight by Navajo with about a 1,000 pound total weight for passengers and luggage (Peninsula Airways, pers. comm.). Peninsula Airways from Dutch Harbor to Adak charges about \$6,000 for a Metro that will hold 16 people and 70 to 80 pounds of luggage each, in about a 4-hour round-trip. Both Peninsula Air flights would require two round trips to drop off and pick up hunters/passengers. Aviation gas is not available beyond Atka, only jet fuel is available at Adak.

Vessels may also be chartered from Dutch Harbor, the nearest commercial base. Estimates are \$2,500 to \$3,500 a day for a 120-foot vessel that could carry 6 to 8 passengers. Sailing time to Adak is 2 to 3 days in good weather. The M/V *Tig/ax*, a 120-foot vessel which supports refuge operations for the Alaska Maritime National Wildlife Refuge, is occasionally available for charter for government projects. Its costs are about \$3,700 a day and it can support 16 people. Travel time from Homer is about 5 days. Very few private boats are expected to remain in Adak after the downsizing.

The only roads are within the military withdrawal area. Motorized equipment is prohibited by the Wilderness Act on the Wilderness portion of the island except for motorboats, airplanes, and snowmobiles which are subject to reasonable regulation. Helicopters are permitted for refuge management when it constitutes the minimum management tool (Fish and Wildlife Service 1988).

## 4. Environmental consequences

A brief summary of the impacts for all alternatives is given in Table 3.

### 4.1. Air quality

1. No action - Aerial surveys would continue to be conducted by the Service opportunistically for population counts and other wildlife management activities. This action would continue as long as caribou are present on Adak.
2. Eliminate & salvage, 4. Translocation, 6. Sterilization - There would be a short-term impact to the air quality during the several months of operation occurring over several years from the exhaust emission of the helicopters, aircraft, and vessels associated with transportation. Fuels which could be used on this project are jet fuel and gasoline.
3. Eliminate w/o salvage, 5. Introduction of wolves - There would be fewer short-term impacts to the air quality from the exhaust emission than in the previously mentioned alternatives because animals would be handled less and consequently there would be reduced use of aircraft, vessels, and vehicles.

### 4.2. Soils

1. No action - If the herd is allowed to grow above the carrying capacity of the island then there could be significant long-term damage to the soils due to overgrazing, cratering, and trampling. Overgrazed areas of lichens expose the soil. Overgrazing of shrubs can lead to root exposure, caribou then eat the exposed roots which leads to soil erosion. Caribou congregate in localized sheltered areas which causes trampling and erosion. Trails in the most heavily used areas are cut to bare earth and are eroding in hilly areas (D. Boone, Refuge Manager and S. Talbot, Service biologist, pers. comm.). Severe damage to vegetative cover can result in wind erosion, termed 'blowouts' or 'craters'. These were caused by introduced ungulate species on the Shumagin Islands and Hagemeister Island.
2. Eliminate & salvage, 3. Eliminate w/o salvage, 4. Translocation, 5. Introduction of wolves, 6. Sterilization - Areas which are beginning to show signs of overuse by caribou would recover eventually, probably before extensive damage to the vascular roots and lichens would open the soil to erosion. Areas of potential soil disruption may be found in sheltered areas where animals congregate on heavily-used trails. Elimination of the herd would protect the soils before a crisis occurs. Nutrient cycling, provided by the caribou would be lost, but this historically was not a natural process. The range recovery would begin before removal is complete and would be slower with the wolf introduction and sterilization alternatives.

### 4.3. Vegetation resources

#### 4.3.1. Plants and habitats

1. No action - If the herd is allowed to grow beyond the carrying capacity of the range, there could be long-term significant damage to the vegetation and its associated habitat.

Introduced *Rangifer* populations on St. Matthew Island and Hagemeister Island, Alaska; South Georgia, Antarctica; and Southampton Island, Canada have been studied with regard to the effects of grazing on the vegetation (Appendix A). The limiting factor for caribou health is the availability of lichens during the winter. An explanation of how slowly lichens grow and their sensitivity to grazing can be found in the

Table 3. Summary and comparison of environmental impacts of each alternative for removal of caribou from Adak Island, Alaska. Table continues on next page.

Affected environment	Environmental impacts					
	Alternative A No action	Alternative 2 Eliminate and salvage meat	Alternative 3 Eliminate without salvage of meat	Alternative 4 Translocate	Alternative 5 Introduce wolves	Alternative 6 Sterilize
Air quality	Short-term impact from equipment emissions	Short-term impact from equipment emissions	Short-term impact from equipment emissions	Short-term impact from equipment emissions	Short-term impact from equipment emissions	Short-term impact from equipment emissions
Soils	Long-term potential of soil erosion	Long-term protection from soil erosion	Long-term protection from soil erosion	Long-term protection from soil erosion	Long-term protection from soil erosion	Long-term protection from soil erosion
Vegetation / habitat	Long-term potential loss of vegetation and habitat	Long-term protection of natural quality and quantity of vegetation	Long-term protection of natural quality and quantity of vegetation	Long-term protection of natural quality and quantity of vegetation	Long-term protection of natural quality and quantity of vegetation	Long-term protection of natural quality and quantity of vegetation
Endangered fern	Long-term possible loss of fern	Long-term protection	Long-term protection	Long-term protection	Long-term protection	Long-term protection
Wildlife-caribou	Unstable population with probable, increases & die off in cycles  Not applicable	Long-term loss of life  Not applicable	Long-term loss of life  Not applicable	10-20% may die due to capture stress  Possible long-term increase in productivity, in the relocated herd	Long-term loss of life  Not applicable	Possible deaths due to capture stress  Not applicable
Wildlife-scavenger species	No change  No change  No change	No effect  No effect  May be a loss of some species to ingesting lead shot	Short-term increase in productivity  Long-term less food available for scavenging  May be a loss of some species to ingesting lead shot	No effect  No effect  No effect	No effect  No effect  No effect	No effect  No effect  No effect
Threatened sea lion	No change	Disturbance from management activities will require mitigation <sup>1</sup>	Disturbance from management activities will require mitigation <sup>1</sup>	Disturbance from management activities will require mitigation <sup>1</sup>	Predation & harassment from wolves may be <sup>1</sup> insurmountable	Disturbance from management activities will require mitigation <sup>1</sup>
Land use-wilderness	Short-term use of helicopters will continue	Short-term use of helicopters	Short-term use of helicopters	Short-term use of helicopters	Short-term use of helicopters	Short-term use of helicopters



Cultural	Possible long-term detriment to archeology sites from trampling and erosion	No effect	No effect	No effect	No effect	No effect
Social-recreation	Long-term, when population crashes, hunting and viewing of caribou ends	Hunting and wildlife viewing of caribou ends	Hunting and wildlife viewing of caribou ends	Hunting and wildlife viewing of caribou ends	Hunting and wildlife viewing of caribou ends, viewing of wolves begins possible	Hunting and wildlife viewing of caribou ends
Social - human safety	Short-term human risk in air travel will continue	Short-term human risk in air travel & handling animals	Short-term human risk in air travel & handling animals	Short-term human risk in air travel & handling animals	Short-term human risk in air travel & handling animals	Short-term human risk in air travel & handling animals
Economic - jobs	No change	Short-term increase in temporary jobs	Short-term increase in temporary jobs	Short-term increase in temporary jobs	Short-term increase in temporary jobs	Short-term increase in temporary jobs
Economy - food	Caribou would provide a short-term emergency food supply, but cyclic population growth and die-off would alter food reliability  Nutrients recycled naturally on island	Caribou would no longer provide an emergency food supply  Donation of 96,000 lbs of meat	Caribou would no longer provide an emergency food supply  Nutrients recycled naturally on island	Caribou would no longer provide an emergency food supply  Alaskans may be able to harvest meat eventually	Caribou would no longer provide an emergency food supply  Meat would be used by wolves	Caribou would no longer provide an emergency food supply  Nutrients recycled naturally on island
Economy - Cost to taxpayer	\$30,000 - \$50,000	\$364,000 - \$524,000	\$105,000 - \$242,000	\$490,000 - 1,240,000	\$60,000 - \$100,000	\$245,000 - \$628,000
Transportation	No change  Minor long-term use of non-renewable natural resources	Short-term increase in transportation use  Minor long-term use of non-renewable natural resources	Short-term increase in transportation use  Minor long-term use of non-renewable natural resources	Short-term increase in transportation use  Minor long-term use of non-renewable natural resources	Short-term increase in transportation use  Minor long-term use of non-renewable natural resources	Short-term increase in transportation use  Minor long-term use of non-renewable natural resources

A threatened and endangered species consultation is being conducted with NMFS to determine potential impact and, if possible, develop a project plan that will have no adverse impacts.

Range Survey of Hagemeister Island, Alaska (Swanson and LaPlant 1987). Caribou graze exceptionally close to the ground (Swanson and LaPlant 1987). Lichen recovery may take 20 years (25 to 40 years on upland ridges) following full cropping on coastal tundra (Palmer quoted in Swanson and Barker 1992). Lichen recovery is further complicated by the competitive nature of the vascular plant community. On St. Matthew Island, 22 years after the population crash, lichens had recovered to only 10 percent of the standing crop of living lichen biomass found on the adjacent island where there was no history of grazing (Klein 1987). Trampling during summer dry periods is destructive as the lichens can dislodge and shatter.

2. Eliminate & salvage, 3. Eliminate w/o salvage, 4. Translocation, 5. Introduction of wolves, 6. Sterilization - If caribou are eliminated from Adak, then the impact on forage plants will cease and natural regeneration will eventually return the island to its original state. Lichen productivity would increase and eroded areas would recuperate, other plant species would no longer be subject to grazing. The action alternatives will prevent a crisis situation as has occurred on St. Matthew, Atka, Hagemeister, St. Paul, Unalaska, Nunivak, St. Lawrence, Stuart, Southampton (Canada), and South Georgia (Antarctic Island) Islands. A brief description of problems on these islands is given in Appendix A.

#### 4.3.2. Plant species of special concern

1. No action - The impact of the uncontrolled increase of the caribou herd on the Aleutian shield fern is unknown but may have an adverse impact. Caribou have the ability to graze and travel over the terrain where the fern grows (Lipkin 1985). The direct impact of overgrazing is unknown, but probably detrimental. Any activity, human or animal, in the fern habitat on steep slopes can cause erosion and dislodge plants. Biologists are concerned about the well-being of the shield fern population, if caribou numbers were to increase dramatically.

A Section 7 Threatened and Endangered Species consultation with Ecological Services- Anchorage for the Aleutian shield fern will be done after an alternative is chosen. Differing recommendations have been made to mitigate the effects of grazing, if it is determined to be a threat. Exclosures could be installed around known populations (Lipkin 1985). Conversely, Lipkin says that designating critical habitat or otherwise revealing precise locations would be imprudent because the small population would be vulnerable to over-collecting or vandalism. An exclosure may cause more harm than good because of potential erosion from the installation (S. Talbot, Service biologist, pers. comm.).

Biologists are concerned about the potential loss of this fern due to a similar problem which may have occurred on Atka Island. Forty reindeer were released on Atka Island in 1914 to be managed by the local villagers. The herd eventually became feral and increased to about 2000 animals in the 1980's. This was above the carrying capacity of the range and resulted in blowouts and overgrazing. Severe winters caused many animals to die of malnutrition. The shield fern has never been found on Atka again and the possible effects of reindeer on the fern cannot be discounted (B. Anderson, Service biologist, pers. comm.).

2. Eliminate & salvage, 3. Eliminate w/o salvage, 4. Translocation, 5. Introduction of wolves, 6. Sterilization - The elimination of the caribou in Alternatives 2, 3, and 4 would remove the threat of damage from grazing and erosion due to caribou on the endangered Aleutian shield fern. If helicopters are used for management, then there should not be any impact to the fern because the helicopter would be unable, logistically, to land on the steep slopes where the fern grows. To prevent trampling the Service requested that no foot traffic, associated with the project, be allowed in the vicinity of the fern population on Mt. Reed (B. Anderson, Service biologist, pers. comm.). If wolves were introduced, then elimination of the caribou would take a minimum of 5 to 7 years and the Aleutian shield fern would be in decreasing jeopardy over those years. With sterilization the elimination would take about 15 years.

#### 4.4. Wildlife resources

##### 4.4.1. Game/non-game species

1. No action - As population increases beyond the carrying capacity of the island habitat, winter die-off from starvation, harsh conditions, and disease can be expected. It would be inhumane to leave the caribou in this situation, where they would slowly die by starvation and possibly disease. Experience on Atka (D. Boone, Refuge Manager, pers. comm.) seems to indicate that the die-off would not be complete, but could reduce the herd dramatically. The cycle of population increase, subsequent crash, then another population increase and death could continue for a long time. This would result in adverse public reaction. For example, on Hagemester Island about 800 reindeer died from malnutrition during the winters of 1990 - 1991 and 1991 - 1992. Erosion caused by caribou could cause siltation in the salmon streams on Adak.

2. Eliminate & salvage, 3. Eliminate w/o salvage - The entire herd will be killed using high power rifles. This is the most humane death that is available for caribou in this remote location. There will be no other long-term impacts on wildlife from the permanent elimination of this introduced herd.

The carcasses or gut piles left from field dressing will provide a temporary benefit from an abundant food source to Arctic foxes, bald eagles, common ravens and gulls during the few months that the elimination will be underway. This may lead to a temporary population increase (one generation) of the scavenger species. There is a possibility that the scavenger species could ingest lead bullets and be poisoned. This is a one-time event from which any of the scavenger populations will quickly recover.

4. Translocation The Adak herd would most likely be relocated to an area where the animals are genetically similar to the original herd of origin, the Nelchina population. The ADF&G is considering where the most appropriate translocation sites may be. If the caribou are returned to Nelchina population herds or associated herds, then potential genetic problems will be avoided. Wildlife managers from ADF&G, the Service and the Navy are very resistant to transplanting animals to (1) to predator-free islands; (2) sites with insufficient forage; (3) any site where there is no genetic link to the Nelchina herd and; (4) to areas where there is no public access. See also Section 2.4. "Alternative 4 - Translocation".

The Nelchina herd is doing very well, at approximately 40,000 animals, and is not in need of supplemental animals. Caribou transported here may slightly increase the harvest quota for this area. This herd is believed to be limited by range conditions. It is likely that ADF&G and the Federal subsistence management would allow more animals to be harvested to control the excess animals. Current game regulations allow the harvest of either sex caribou only under the ADF&G Tier II subsistence permit. The Tetlin National Wildlife Refuge allows a Federal subsistence hunt for the villagers of Northway and Tetlin on the Nelchina herd on the refuge. The Bureau of Land Management also manages a federal subsistence hunt in the upper Copper - Susitna River basin. The Nelchina herd also sometimes merges with the 40-mile herd (under Bureau of Land Management and Yukon-Charley National Preserve jurisdiction) and the Mentasta herd on Wrangell-St. Elias National Park and Preserve.

Physically, the closest mainland release point would be approximately 800 miles away, in the Cold Bay area. The resident Southern Alaska Peninsula herd near Cold Bay is in a decline and hunting was stopped in 1993. However, the reason for this population decline is likely due to range limitations, therefore more caribou would not help this population.

One proposal under consideration is to introduce 50-100 calves and yearlings to the Kenai lowland herd near Kenai. This herd originated from Nelchina herd stock and may be able to use the influx of more animals to make it a larger population. Research is being conducted to determine the viability of this idea.

There are no objections from the Kenai National Wildlife Refuge to this proposition. Animals would inhabit state, federal, and private lands in this home range.

The Adak caribou are not physically used to harsh Interior Alaska winters. The introduction should occur at a time of year when the caribou will not need to deal with difficult winter conditions until they have established a range.

Other suggestions have been to introduce the caribou to other Aleutian Islands where they can be kept in check by hunting controlled by residents or hunting guides. If public funding is used then it would be inappropriate for the caribou to be released on private lands. There is a long history of island introductions, which started in the late 1800's with disastrous results to the reindeer and to the habitat. Introduced reindeer populations have undergone population explosions and subsequent crashes due to overgrazing, starvation, malnutrition combined with severe winters on St. Matthew, Nunivak, St. Paul, Atka, Hagemester, Unalaska, Stuart, and St. Lawrence Islands. A brief history of these problems is in Appendix A. Wildlife managers are very resistant to new introductions of ungulates to predator-free islands.

5. Introduction of wolves - It is against refuge policy to introduce or liberate any animals on any National Wildlife Refuge, except as authorized as a wildlife management tool. Introduction of native and some non-native species to islands or mainland locations can be authorized by ADF&G if specific concerns are addressed.

The wolves would be carefully inspected by a veterinarian and perhaps undergo a quarantine period. There is some possibility that the wolves could transmit parasites and diseases to susceptible species on the island, such as sea mammals which have come ashore; and introduced Arctic foxes, rats, dogs, and cats. Loss of any of the introduced mammals would be acceptable, as many prey on ground-nesting birds.

Wolves may turn to other prey when caribou calves grow older and when caribou are no longer readily available. Animals that may become prey are ground-nesting birds such as bald eagles, Chamberlain's rock ptarmigan (*Lagopus mutus chamberlaini*), songbirds and seabirds; Arctic foxes; rats; sea otters, and seal pups when they are ashore; and invertebrates such as terrestrial insects, amphipods, sea urchins, and sea cucumbers. The wolves would compete for some of the same prey species as foxes and rats during the years wolves are on Adak. Sea otters spend very little time ashore so wolf predation on otters would be minimal. Seals have rookeries on rocks offshore of Adak Island but no rookeries have been observed on the island by the refuge staff (G. V. Byrd, refuge biologist, pers. comm.). Wolves may also scavenge dead animals washed ashore and in the Navy landfill. In lean times, the wolves may scavenge near the Naval Complex and human handouts would be discouraged. The primary food item (95 percent) of introduced wolves on Coronation Island was Sitka black-tailed deer (*Odocoileus hemionus sitkensis*). Harbor seals were the second most important item, until they changed their habits to avoid the predators. Other miscellaneous food remains in their scat were from wolf, mink, land otters, mice, birds, cockles (clams), and crabs (Merriam 1965).

It could take a minimum of 5 to 7 years for approximately 30 wolves to eliminate the herd (K. Pitcher, State biologist, pers. comm.). The amount of time it takes for elimination will depend on the availability of other food sources and amount of escape habitat available. If other sources of food are readily available then the wolves may not eliminate the caribou herd. Young adult wolves (1 to 3 years old) will probably be introduced to the island and a typical life span is about 9 to 15 years.

It is possible that the caribou may be forced during chases by the wolves to swim the Kagalaska Strait and establish a population on Kagalaska Island. The Strait is about 0.5 mile wide and has strong currents.

Wolves are not known to be good swimmers, but caribou swim very well. Caribou may already have crossed this strait, but caribou are not known to inhabit Kagalaska Island at this time.

Negative physical effects on the captured wolves would be temporary confinement and sterilization, however, they should recover easily from both. The wolves that would be translocated would come from Interior Alaska and be moved to a maritime climate that is much warmer, much wetter and have no forest or shrub cover. Patterns of feeding and prey would be quite different between the Interior and the sea coast. This may cause loss of some animals until they adapt and learn to find shelter. Mitigation measures would be to introduce animals in the spring or summer when the climate is less harsh. They would have time to adapt to their surroundings, and they would have a readily available prey source.

Another effect on the wolves would be the change in their social behavior patterns. Wolf packs have an intricate social structure and this structure would need to be reformed in both the source and transplanted packs. The non-production of pups may lead to an unnatural pack structure with unknown consequences. On Coronation Island, where there was a dense population of two to three wolves per square mile, the wolves fed opportunistically on whatever prey species were available. As the prey species declined they resorted to cannibalism (Merriam 1965 and Klein 1992).

There will also be an effect on the behavior of the caribou due to predation. Their innate self-preservation instinct will likely take over because they have lived in predator-free isolation from wild animals.

6. Sterilization - Sterilization will only impact the caribou. This may effect the behavior of the caribou due to lack of reproductive activity on the part of females, and loss of calves in the social structure. Some animals may die from complications associated with the sterilization operation, but this is expected to be extremely few (D. Mulchahy, veterinarian, pers. comm.).

2. Eliminate & salvage, 4. Translocation, 5. Introduction of wolves, 6. Sterilization - In these management alternatives there would be some caribou which cannot be salvaged for human consumption, translocated, killed by wolves, or sterilized. The wildlife managers predict this will account for up to 10 percent of the herd or 70 to 85 animals. The reason these carcasses may be left in the field are because retrieval may endanger the crew working on the project, the meat may be unfit for human consumption, the animals are in an unaccessible location, they become adept at avoiding helicopter capture, or have successfully out-lived the wolves. Though carcasses are unavailable to humans, the island's wild scavengers will benefit temporarily and nutrients will return to the soil.

#### 4.4.2. Wildlife species of special concern

1. No action, 2. Eliminate & salvage, 3. Eliminate w/o salvage, 4. Translocation, 6. Sterilization - There would be no expected impact on the Aleutian Canada goose or any of the candidate species under these alternatives. None of the work for any of these alternatives would be conducted for more than a few hours in any of the habitats which these species utilize. After an alternative is chosen, a consultation may be conducted within the Service for a Section 7 Threatened and Endangered Species determination, if there are any potentially affected species.

These project alternatives could adversely affect the Steller sea lions which are particularly sensitive to human disturbance. Any adverse effects associated with these alternatives, such a noise or human disturbance can probably be avoided by developing specific project guidelines with NMFS to minimize the potential for disruption of the sea lions. For example, the agencies could stipulate: (1) no vessel will be used within 3 nautical miles of the rookery ; (2) no aircraft will be flown directly over the animals; (3) Individuals on land cannot approach within one-half mile or within sight of listed rookeries and; (4) the least disruptive time window of work will be determined. A consultation is being conducted with the NMFS

for a Section 7 Threatened and Endangered Species determination on the likely effects of these proposed alternatives on the Steller sea lion.

5. Introduction of wolves - The wolves may prey on the threatened Steller sea lion pups on the rookery at Lake Point or harass or kill sea lions (smaller than adult males) on the haulouts and rookery. Since these sea lions are on the endangered species listing, and if wolves would kill or harass sea lions, this could be considered a "take" and is unlawful under the Endangered Species Act of 1973. To mitigate this factor, it has been suggested that a fence or electronic cable system could be installed to protect the rookery and perhaps near the haulouts. Temporary employees could be stationed nearby to prevent wolves from accessing the sea lions. There is a possibility wolves could transmit parasites and diseases to sea lions. A consultation is being conducted with the NMFS for a Section 7 Threatened and Endangered Species determination on the effects of the proposed alternative on the Steller sea lion. Results of this consultation will be available when it is completed and it will influence the decision on whether this alternative is viable or whether choice of this alternative would require that an Environmental Impact Statement need to be prepared.

The wolves would probably not have an opportunity to prey on the threatened Aleutian Canada geese. They migrate through the area and are only occasionally seen on Adak. The Category 2 species that nest on the ground could be subject to wolf predation. However, they are already subject to other predators such as foxes and rats.

#### **4.5. Cultural resources**

1. No action - As the caribou population increases, they will cause a loss of vegetation and consequent soil erosion. This could possibly lead to exposure and loss of artifacts in archaeological sites if those sites were in an area used by the herd.

2. Eliminate & salvage, 3. Eliminate w/o salvage, 4. Translocation, 5. Introduction of wolves, 6. Sterilization - There are no anticipated impacts to cultural, historical or archeological resources on Adak Island (D. Corbett, Service archeologist, pers. comm.). All workers in the field would be notified that in accordance with the Archeological Resources Protection Act (16 USC 470aa), the disturbance of archaeological or historical sites and the removal of artifacts is prohibited.

#### **4.6. Land use**

##### **4.6.1. Wilderness**

1. No action - Helicopters will continue to be used in wilderness when it constitutes the minimum management tool to protect the purposes of the refuge.

2. Eliminate & salvage, 3. Eliminate w/o salvage, 4. Translocation, 6. Sterilization - The land would return to a more natural state, since the caribou are an introduced species that have altered the habitat for many years. Helicopters will continue to be used in wilderness as a minimum management tool to protect the purposes of the refuge. They might be disruptive to hikers and some species of nesting birds during the management action. Many military personnel may not be disturbed by this type of activity. The time window for management activity be arranged to consider effects on avian species.

5. Introduction of wolves - While this game management action is underway, it could be disruptive to wilderness users. If wolves were introduced, mitigating measures would need to be taken to protect the Steller sea lions. Persons could be stationed at the sea lion rookeries or haulouts. Personnel would erect shelters near the protected areas. Wilderness designation does not affect the ability of the Service to

monitor populations and conduct studies (Fish and Wildlife Service 1988). Helicopters will continue to be used in wilderness when it constitutes the minimum management tool.

#### **4.7. Social conditions**

##### **4.7.1. Recreation**

1. No action - Wildlife viewing and hunting for caribou will be available until there is a caribou population crash.
2. Eliminate & salvage, 3. Eliminate w/o salvage, 4. Translocation, 6. Sterilization - Both wildlife viewing and hunting for caribou would end under these alternatives. Under Alternative 6, these recreational opportunities could continue for up to 15 years until the herd is eliminated. Hunting would need to cease for safety reasons during the management action.
5. Introduction of wolves - Wildlife viewing of wolves and caribou would be available temporarily; however, viewing and hunting for caribou would end in 5 or more years.

##### **4.7.2. Safety**

1. No action - There would continue to be a hazard from infrequent wildlife management operations from low-flying aircraft.
2. Eliminate & salvage - The safety of personnel is at risk in all the alternatives from wildlife management operations conducted from low-flying aircraft. This is a known risk taken by biologists and pilots in performing their jobs. Getting helicopters to Adak can be done by flying them or transporting them up as cargo. Flying a single-engine aircraft is not a preferred method of travel as it is dangerous, but they are flown to Adak infrequently. A twin-engine helicopter, though more reliable, is not as maneuverable in working with the herd. Contract personnel will be certified by the Federal Office of Aircraft Services and familiar with this type of operation.  
  
Caribou are wild, strong animals and can kick or otherwise injure personnel who are handling them. Again this is an acceptable risk for trained personnel in performance of their job.
3. Eliminate w/o salvage - There would be substantially less risk than in Alternative 2 to humans both in flying time and handling time since the number of caribou taken per day is not limited and no caribou would need to be physically handled.
4. Translocation - This is the most dangerous of the operations as it involves more flying time to capture plus more time in handling live animals at the capture, transport, and release sites.
5. Introduction of wolves - This would be the least dangerous of all options, as the flying time to capture the 10 to 30 wolves, transfer them and release them would be considerably less than other action alternatives. There would be some danger from handling the wolves, but less than from handling hundreds of caribou.

The Naval Air Facility is opposed to the introduction of wolves on the grounds of safety.

6. Sterilization - This is also dangerous because the caribou must be handled live and the caribou will be held longer to perform the operation and be marked. There will be considerable flying time involved because hundreds of caribou will need to be handled.

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## 4.8. Economic conditions

### 4.8.1. Economy

1. No action - There would be no change to the economy.
2. Eliminate & salvage, 3. Eliminate w/o salvage, 6. Sterilization - There would be a slight short-term increase in the economy. Six to eight full-time temporary positions would open with the agencies or their contractors for several months.
4. Translocation - See also effects under Alternative 2. Some economic stimulation will be caused in affected parts of the State for capture, veterinary service, and transportation of caribou. The project is expected to cost between \$800,000 and \$1.2 million. There are many communities, agencies, and organizations that have contacted the agencies about having the caribou moved to their area (mainly islands in the Aleutians) for economic gain. They would like to have a herd nearby for personal hunting, they would like to manage them as a domestic herd animal, or organize guiding services for hunters. New hunting opportunities may create more opportunities to attract local tourism.
5. Introduction of wolves - In addition to the impacts in Alternative 2, several full time seasonal positions would open with the Service to monitor the sea lion wolf separation over a period of less than 10 years.

### 4.8.2. Subsistence

1. No action, 2. Eliminate & salvage, 3. Eliminate w/o salvage, 5. Introduction of wolves, 6. Sterilization - There will be no impact on subsistence activities from any of these actions. Removal of caribou is consistent with the refuge purposes with regard to subsistence.
4. Translocation - Removal of caribou has been found consistent with the refuge purposes with regard to subsistence. If caribou are released in an area where subsistence hunting is allowed then they will provide meat to subsistence users through this renewable resource.

### 4.8.3. Food

1. No action - Caribou will remain available (temporarily) as an emergency food source for the military personnel on Adak Island until there is a population crash.
2. Eliminate & salvage - If animals were slaughtered for human consumption, it would make available approximately 96,000 pounds of meat (assuming 800 caribou at 120 pounds each, dressed weight). This would be a short-term positive benefit. Caribou would no longer be available as an emergency food source for the military personnel on Adak Island.
3. Eliminate w/o salvage, 5. Introduction of wolves, 6. Sterilization - There would be no human benefit from the meat in these alternatives. Caribou would no longer be an emergency food source for the military personnel on Adak Island.
4. Translocation - This is an indirect method of providing meat to hunters. Live animals will be moved to a place where they will probably eventually be hunted. This would be a long-term positive benefit if the newly located herd increases to a point where it can be harvested. Caribou would no longer be an emergency food source for the military personnel on Adak Island.



#### **4.9. Transportation**

All alternatives - There will be an increase in the use of helicopters, other aircraft and vehicles to accomplish any of these alternatives. There will be a commitment of non-renewable resources in the petroleum products that are consumed. The following list begins with the alternative which would require the most transportation effort and continues in decreasing order: 4, 2, 6, 3, 5, and 1. Helicopters may be used in all of these alternatives on the Alaska Maritime Refuge Wilderness, when it constitutes the minimum management tool. They are an allowable use in designated Alaskan Wilderness for the purposes of wildlife management. Helicopter use should not be a problem in the early spring, fall, and winter when the avian and sea lion rookeries would not be disturbed.

## **5. *List of preparers***

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## **6. *List of agencies and persons consulted***

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### **6.1. *Consultation and coordination with agencies and affected people***

Letters on the status of the project were sent to all people who had written or called to express interest in this project. Copies of the Environmental Assessment will be distributed to individuals, agencies and organizations on an established list.

Alaska Air National Guard  
Food Bank of Alaska  
State of Alaska

Department of Fish and Game - Carl Rosier, Ken Pitcher, John Westlund, Bruce Bartley  
Board of Game

U.S. Department of the Navy, NAF-Adak - Captain W. J. Cummings, Command Master Chief J. C. Mills  
Engineering Field Activity Northwest - Kent Livezey, Joe DiVittorio

U.S. Department of the Interior, Fish and Wildlife Service

Alaska Maritime National Wildlife Refuge - John L. Martin, Gary Montoya, G. Vernon Byrd, Daniel Boone, Norma Dudiak, Jeff Williams, Joe Meehan, Leslie Slater

Kenai National Wildlife Refuge - Dan Doshier

Regional Office - Walter O. Stieglitz, George Constantino, Mary Lynn Nation, Bob Bartels, Steve Talbot, Debra Corbett, Brian Anderson

Tetlin National Wildlife Refuge - Sue Matthews

Togiak National Wildlife Refuge - Aaron Archibeque

Western Alaska Ecological Services - Brian Anderson

U.S. Department of Commerce, National Marine Fisheries Service - Sue Mello

University of Alaska, Alaska Cooperative Wildlife Research Unit - David Klein

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## Appendix A

### Island Reindeer and Caribou Introductions and the Consequences

The following information is mainly extracted from Swanson and Barker (1992), Swanson and LaPlant (1987), Swanson, Lehner and Zimmerman (1986), and the publications which they cite in their articles.

#### **St. Matthew Island, Alaska**

St. Matthew Island's reindeer herd provides a classic example of an animal introduction to an island ecosystem without natural controls. When 29 reindeer were introduced in 1944, the island was covered with a thick mat of lichens. There was little hunting mortality, good calf production and an abundance of forage. "Heavy grazing by extremely high densities of reindeer on St. Matthew Island resulted in degradation of the lichen stands. Grasses, sedges, and other vascular plants initially increased in response to the removal of lichens under heavy grazing pressure by the reindeer." (Klein 1987). By the summer of 1963 there were 6,000 unmanaged reindeer on the island and less than 50 alive by the next spring. Reindeer density before the die-off in the winter of 1963-64 was one per 33 acres. At the time of the crash there was deep snow covering the forage plants. As the quantity and quality of forage declined, the condition of reindeer declined as well. They lacked adequate fat reserves and 99 percent died. "Twenty-two years following the crash die-off of the reindeer, mosses had invaded large portions of the ground area denuded of lichens, and lichens had recovered to only 10 percent of the standing crop of living lichen biomass occurring on adjacent Hall Island where there is no history of grazing. Lichen species dominating the recovering lichen stands on St. Matthew Island were those of relatively low preference as forage by reindeer in contrast to those in climax lichen stands." (Klein 1987).

In 1982, the last reindeer disappeared from St. Matthew Island. It will take many additional "reindeer-free" years before the island's vegetation will recover from the overgrazing (Karter and Dieterich 1989).

#### **Hagemeister Island, Alaska**

On Hagemeister Island, reindeer were introduced in 1965 and 1967 to stimulate economic development for the native community of Togiak. Without natural predators and with minimal grazing management and applied animal husbandry practices after 1974, reindeer numbers increased beyond the grazing capacity. The lichen resources, the primary winter food source, were decimated. The population increased at 25-30 percent per year before harvesting was initiated. From 1977 - 1987, one reindeer per 114 acres was the lowest stocking density on the island. The herd peaked in 1990 with 1530 animals. During the winters of 1990-91 and 1991-92, more than 800 animals died from starvation and severe weather conditions. A range inventory (Swanson and LaPlant 1987) found that the native plant community on range sites dominated by lichens had been depleted and possibly permanently altered by reindeer grazing. The lichens that remained had little or no value for reindeer. Bare ground from reindeer cratering was found in many areas and gulley type soil erosion was noted as serious. However, lowland summer range was in excellent condition (Swanson and LaPlant 1987). The original carrying capacity of 1,000-3,000 was revised to 100. In 1993, the remaining 327 were removed by the Fish and Wildlife Service from the Alaska Maritime National Wildlife Refuge to protect the habitat. It was estimated that potential lichen producing range makes up 50 percent of the island's acreage. So much of the lichen biomass has been removed that it is doubtful that even without grazing, recovery to the potential level of lichen productivity will not be possible for more than 150 years (Swanson and LaPlant 1987).

### **Unalaska Island, Alaska**

Transport of 16 reindeer was arranged in 1891 to Unalaska and Amaknak Islands to improve living conditions and reduce starvation among Alaskan Native people. These reindeer starved to death for lack of lichen forage (Brickey and Brickey 1975).

### **St. Paul Island, Pribilof Islands, Alaska**

Twenty-five reindeer were introduced in 1911 to St. Paul Island. The St. Paul herd grew slowly and steadily until the early 1930's when it suddenly erupted to 2000 animals. By 1950 there were only eight. Observations point to the lichen flora as the key. At peak population levels in 1938, reindeer had reached a density of one per 11 acres of suitable grazing range. This density equaled three times the range's carrying capacity, which was estimated to be 33 acres per reindeer per year on "average" grazing range. Certain shrub-like forms of lichens serve as emergency rations for reindeer (Scheffer 1951). Palmer (1945) concluded that although lichens are not necessary for reindeer maintenance because of their nature or nutritive qualities, yet from the standpoint of a readily accessible winter food supply, they are essential. They can detect them through as much as four feet of loose snow and reach them by pawing. Grasses and other flowering plants provide summer and fall foods. Lichen recovery following full cropping may take possibly 15 to 20 years (Palmer 1945). Reindeer were observed cratering into mineral soil, foraging on roots of forbs, and eating twigs and dislodged roots of willows.

The government made a serious effort in 1940 and 1941 (when the herd was at three times the carrying capacity) to reduce the size of the herd by doubling and tripling the annual kill. So great was the momentum of the natural factors operating against the herd, however, that the decline continued almost to the zero point, even after killing was suspended in 1945. A combination of starvation from a depleted range and adverse weather (crusted ice) seems to have been mainly responsible for the decline. There were 150 deer carcasses found in 1941. Military troops were stationed on St. Paul when the islanders were evacuated as a military measure during the war. Some residents believed that poaching was a major cause of the herd decline. Disease, the familiar sequel to starvation, has undoubtedly contributed to the decline of the herd. Fighting, accidental deaths, and unfavorable sex ratios have also played a role (Scheffer 1951). The scientific growth curve of the population is evidence that the decline was well underway before 1942 and it continued after 1944. This crash, down to eight reindeer, is mainly a result of production of even one generation beyond a certain critical population level which has overshoot the maximum capacity the environment can support (Scheffer 1951).

The present population of 600 has been kept relatively stable through hunting during recent years (Swanson and Barker 1992).

### **Atka Island, Alaska**

Forty reindeer were released on Atka Island in 1914 to be managed by the islanders. With time the herd became feral and grew to around 2,000 in the 1980's. This was above the carrying capacity and there was considerable evidence of over-grazing and blowouts. Severe winters caused many of the animals to die of malnutrition. Experience on Atka (D. Boone, Refuge Manager, pers. comm.) seems to indicate that this cycle of expansion and die-off due to malnutrition is a characteristic of the Aleutian Islands. The reindeer herd would decline dramatically but not be eliminated.

### **Umnak Island, Alaska**

Umnak Island received reindeer in 1913 and also supports other domestic livestock. Reindeer forage is predominately from vascular plants, kelp, and moss as there are no potential lichen producing sites known.

In 1990, the 4,500 reindeer were divided into two herds. Recent reports of poor condition of reindeer from the southern herd has created a major concern.

### **Greenland**

Greenland's caribou population, which numbered 100,000 animals in the late 1960 s, declined to 20,000 animals by 1978. In 1980, the herd was still declining. An aerial census in that year revealed a total population of 7,000 to 9,000. Herd decline was attributed to overgrazing of winter range, which had eliminated over 95 percent of the fruticose lichen cover and consequently reduced lichen biomass. Former lichen mat areas were being invaded by mosses.

### **St. Lawrence Island, Alaska**

About 10,000 reindeer were reported on St. Lawrence Island in 1940. Shortly afterwards, there was a major die-off caused by starvation and bad weather. Range condition and utilization were assessed in 1982. Lichen utilization was found to be moderate and overall condition was fair to good for lichens. A wet meadow site showed little evidence of grazing. The present reindeer population is estimated at 400 down from 2,000 in 1980.

### **Stuart Island, Alaska**

Stuart Island has been used historically for both summer and winter grazing. Reindeer were grazed on Stuart Island for a brief period around 1918, and in that short time had overgrazed the range. The lichens after grazing were only 2 - 5 mm in height. Lichen cover increased rapidly then slowed as other forbs increased during the later states of recovery. The estimated time for complete recovery was 25 years.

Another introduction of reindeer was in the early 1970's. Herders control the reindeer and they travel back and forth to the mainland. Recently the island has only been grazed in the summer. The present herd numbers 1,500.

### **Nunivak Island, Alaska**

Reindeer were introduced in 1920, 1925, and 1928. The island appeared to provide abundant forage, and the herd grew rapidly in the absence of predators. The population peaked at about 30,000 in 1944 and at about 23,000 in 1964. Both peaks were followed by population crashes. Shortly after 1944, the herd numbers rapidly declined due to winter die-off and heavy slaughtering of the herd. During the peak population periods, reindeer numbered one for every 35 acres. During 1966 - 1969, reindeer numbers were one per 90 acres. There was extensive lichen trampling damage by reindeer. The Soil Conservation Service reports concluded that 68 percent of the winter lichen range was in poor condition in 1984 and 1985. In 1989, 6,500 reindeer were counted and the management objective was to reduce the caribou to 3,000. Herders work with both reindeer and musk ox (*Ovibos moschatus*) on Nunivak. The grazing pressure from each species is not clear cut.

### **St. George Island, Pribilof Islands, Alaska**

In 1911, 15 reindeer were introduced to St. George Island in the Pribilof Islands. Over a 25 year period, and with little interference from man, the herd fluctuated slowly between 10 and 74 animals. There was no population eruption as on St. Paul. The population never exceeded one per 100 acres and suitable lichen grazing sites continued to be available even in the presence of the herd (Scheffer 1951). The population declined from 168 in 1924, to 60 by 1926 and then continued to decline until 1950 when the population disappeared from over-hunting. The ecological differences between the two islands may explain why

reindeer fared differently. The two Pribilof Islands lie between the Arctic Ocean and the North Pacific and slight discrepancies in weather conditions and ocean temperatures bring about noticeable differences in the flora and fauna. St. George weather is slightly warmer and the tundra is wetter (Scheffer 1951).

In 1980, 15 reindeer were re-introduced and the herd increased to 100 by 1991. At present the winter lichen range is in excellent condition (Swanson and Barker 1992).

### **Kodiak Island, Alaska**

On Kodiak Island, a herd of 250 reindeer utilize a small part of the southwest corner. The herd remains stable and numbers are controlled by hunting. The population is under the jurisdiction of the Alaska Department of Fish and Game.

### **Southampton Island, Northwest Territories, Canada**

The first caribou introduced to Southampton Island were hunted to extinction by 1953. In 1967, 48 caribou were released and the herd grew to 13,700 by 1991. The caribou have increased at a steady rate of 27.6 percent, with no indication of any decline in the rate with increasing population density (Ouellet 1992).

On the basis of the general condition of the vegetation, the authors suggest that the range on Southampton Island is in relatively good condition overall. However, lichen biomass on Southampton Island is low relative to other ranges. The short- and long- term changes in lichen standing crop suggest that caribou on Southampton Island rely heavily on lichens in winter (Ouellet 1992). Sites available to caribou in winter (i.e. sites that do not accumulate deep snow) are poorly vegetated and locally overgrazed. Because the lichens are not resilient to grazing (Ouellet 1992) and under the present hunting regime (400 caribou harvested in 1991) it is likely the Southampton Island caribou herd is on its way to a population peak followed by a subsequent decline. It is recommended that hunting pressure should be increased to slow the growth of the herd in order to decrease the probability of a severe crash. However, considering the small size of the community (about 475 people) relative to the size of the herd and the herd's actual rate of growth, it is likely that the population may crash regardless of the suggested increase in the hunting quota (Ouellet, Heard, and Boutin 1993).

### **South Georgia Island, Antarctic Island**

Eleven reindeer were brought to South Georgia Island in 1909 and seven in 1925. These reindeer formed three separate herds: Barff, Royal Bay, and Busen herds. The reindeer have never been husbanded or actively managed although some occasionally are taken by hunting. The reindeer do not depend on lichens for winter forage but on a tussock grass and dwarf shrub. This grass declines more slowly than lichens when grazed and can recover more quickly than lichens. The Busen herd had grown to 3,000 by 1955 and declined to 2,000 by 1975. The other herds grew to 800 by 1973 and are rapidly declining.

The future of the South Georgia herd remains open to question. There is selective grazing on preferred food plants in summer (with elimination of some species) but range quality, and thus body growth are insufficient to allow conceptions in calves, and adult reindeer physical condition varies between seasons. In winter, reindeer depend exclusively on a resilient tussock grass, but grazing pressure has reduced winter range carrying capacity, and the most accessible tussock grass has been overgrazed since 1957. Reindeer now forage in winter on more dangerous areas where they commonly fall from steep cliffs. Some reindeer have serious dental abnormalities from disease and damage (Leader-Williams 1980). An active management policy to eradicate reindeer would be necessary to allow native vegetation to re-establish natural communities. Several management options are available. If revegetation has a point of no return, continued grazing for several more decades may preclude recovery of climax vegetation in the reindeer areas (Leader-Williams, Smith, and Rothery 1987).