

BRIEFING PAPER
ON
INFESTATION OF LICE AMONG
WILD CANIDS IN ALASKA

Prepared for the Division Management Team

by

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ABSTRACT

Several biological and social concerns regarding louse infestations in wild Alaskan canids were identified following the recently discovered infestation of lice on wolves (*Canis lupus*) and coyotes (*C. latrans*) in the Mat-Su Valley. The biting dog louse (*Trichodectes canis*) was first identified on a coyote and then on several wolves harvested on the Kenai Peninsula during the winters of 1981–82 and 1982–83. The department attempted to eliminate the louse infestation among the wild canids by capturing and treating them with injections of the antiparasitic drug ivermectin and with ivermectin-treated baits. This effort was not successful in stopping the spread of the infestation, because of the difficulty in catching and treating all infested animals, and funding was stopped precluding treatment after the second winter. In November and December 1998 trappers reported catching wolves and coyotes with evidence of lice in the Mat-Su Valley. Similar efforts to those on the Kenai resulted in all known infested wolves being treated. The results of trying to eliminate lice in coyotes with treated baits were not known. The operational cost of the effort in the Mat-Su Valley was \$60,000. The rapid spread of lice among wolves on the Kenai and the recent outbreak in the Mat-Su Valley raises serious concerns that a similar infestation can happen elsewhere in the state. The source of lice in both areas was believed to be domestic dogs, which are infested with lice in a low-level enzootic stage throughout Alaska. The spread of lice to Interior coyotes and wolves, in particular, could have significant effects on the trapping economy and on the quality of wolf viewing. The relationships between parasites and their hosts can be complex, involving lengthy adaptations to each other. With the spread of lice, we may see higher morbidity of wolves and coyotes, particularly among young animals. However, there is no evidence of direct mortality from lice or of a negative population effect from lice on wolves or coyotes in Alaska or the lower 48 states.

INTRODUCTION

The purpose of this briefing paper is to provide the Wildlife Conservation Division Management Team with an overview of our current knowledge of louse infestations among wolves (*Canis lupus*) and coyotes (*C. latrans*) in Alaska to aid the team in policy development. A specific policy regarding louse infestations among wild Alaskan canids should be considered in light of the recently discovered infestation of lice on wolves and coyotes in the Mat–Su Valley. The policy should address appropriate actions and funds necessary for research and management to implement policy.

The Wolf Conservation and Management Policy for Alaska (revised by the BOG, 29 June 1993) addresses the issue of disease and parasite control as follows:

Like all other species, wolves have evolved in the presence of many natural diseases and parasites. In most cases, wolf populations are capable of responding to the effects of diseases and parasites without the need for human intervention. However, there may be times when action is warranted to halt the spread of a disease or parasite infestation for the benefit of the overall wolf population, particularly if the disease or parasite is introduced to wolves from an unnatural source.

AS 16.05.020 directs and authorizes the Commissioner to protect the wildlife resources of the state. If, in the Commissioner's judgment, it is necessary to take an action to protect wolves or other wildlife from the adverse effects of disease or parasites, such action may be taken without further authorization by the board.

The only situation in Alaska at this time that meets these criteria for human intervention is the infestation of wolves on the Kenai Peninsula by the biting dog louse (*Trichodectes canis*). This louse probably infested wolves through initial contact with domestic dogs.

In this paper, we address the following topics:

1. Background on wild canids and lice, specifically the history of their infestation across North America, on the Kenai Peninsula, and in the Mat–Su Valley
2. Limitations to current knowledge on barriers and potential rates of transmission and on the adaptive ability of wild canids to minimize the effects of lice
3. Efforts to control the spread of lice in wolves and coyotes on the Kenai Peninsula and in the Mat–Su Valley
4. Projected effects of lice on wild canids and their management across Alaska if no further control effort is implemented

BACKGROUND

LICE AND THEIR EFFECTS ON WILD CANIDS

Lice are distributed worldwide but are very host-specific (Turner 1971). The biting dog louse (Order Mallophaga) is an ectoparasite believed to live only on dogs, wolves, and coyotes. These

lice spend their entire life cycle within 1–2 mm of the skin surface of the host. Eggs (or nits) are cemented to hair shafts and hatch in 1–3 weeks. Their life cycle takes 3–4 weeks and may result in 11–14 generations per year (Turner 1971). Nymphs are smaller but similar to adults, which grow to 1–3 mm in length. Lice feed on skin debris, particles of hair, sebaceous secretions from the skin, and blood on the surface of the skin. Biting lice irritate the skin of their hosts by their movement and chewing. They are generally not a problem in healthy animals, and heavy infestations are probably due to poor condition of the host rather than the cause of it (Turner 1971).

The most obvious effect of lice on wolves and coyotes has been to their pelts. Pelts of wolves and coyotes infested heavily with lice are often in extremely poor condition, exhibiting various degrees of damage. In moderate cases guard hairs are broken at 10–20 mm lengths and underfur is matted by sebum that exudes from the skin because of the irritation by lice. This creates a smell described as a mix between rotting flesh and earwax. The irritation causes frequent scratching and rubbing. Hair damage and loss is greatest on the back between the shoulder blades and in the groin area. In extreme cases, pelt damage covers much of the body trunk and exposes the skin surface to the elements, causing skin to turn gray. Pups are usually affected most. The condition of louse-infested pelts makes many of them almost worthless to trappers and furbuyers, particularly later in winter when infestations intensify.

WILD CANIDS AND LICE IN NORTH AMERICA

The occurrence and geographic distribution of louse-infested wolves and coyotes in North America is not well documented. Wolves and coyotes from several counties in Minnesota and Wisconsin were reported to have lice in the early 1980s (Mech et al. 1985), and lice are still common among wolves in Minnesota (William Berg, Minnesota DNR furbearer biologist, pers. commun.). Two coyotes with lice were collected in Michigan in 1979 and 1981. One coyote from Idaho, another from Washington in 1976, and a single wolf near the Manitoba–Saskatchewan border in 1983 had lice.

Although lice are found among several packs across the wolf's range in Minnesota, biologists do not consider them to be a population or management problem there. Controlled trapping of wolves around livestock operations by Wildlife Services (USDA) indicates that only 5–10% of the animals are infested with lice. Minnesota biologists believe the behavior of wolves isolates their packs and may be a factor in limiting the spread of lice (William Berg, Minnesota DNR furbearer biologist, pers. commun.). They also believe it is possible that wolves in Minnesota have developed some level of immunity to the effects of lice. The state takes no action to treat infested packs.

WILD CANIDS AND LICE IN ALASKA

When and how lice first arrived in Alaska is highly speculative. The best guess is that lice were introduced to wild canids from contact with domestic dogs. In most Alaskan communities, there are a large number of dog kennels, dogs that are allowed to run free and feral dogs that often have lice and occasionally come in contact with coyotes and wolves.

The biting dog louse was first identified on a coyote and then on several wolves harvested in Game Management Unit (GMU) 15A on the Kenai Peninsula during the winters of 1981–82 and

1982–83. Lice were found on 11 wolves among 4 packs in 1981–82 and on 10 wolves among 5 packs in 1982–83 (Schwartz et al. 1983). Fourteen of those 21 infested wolves were pups. Louse density on infested areas of 5 pups ranged from 2 to 8 lice/cm². Pups seemed most affected but all infested wolves had hair breakage and loss, seborrhea, dandruff, and lesions, which were most extensive between the shoulders and in the groin (Schwartz et al. 1983). Although all had heavy infestations, most of the 11 wolves initially examined after the outbreak of lice on the Kenai were in good physical condition (Schwartz et al. 1983). The only animal in poor condition was a pup with no visible fat reserves. No additional morbidity or mortality was observed, but department staff became concerned that heavily infested wolves would be more susceptible to disease and cold temperatures and commercial value of their pelts would drop significantly (Schwartz et al. 1983).

Except for the possibility that some heavily infested wolves died from exposure to severe cold, the louse infestation among Kenai wolves does not seem to have restricted reproduction or survivorship. Wolves recolonized the Kenai Peninsula during the 1960s, after being extirpated there 25 years before, and by 1975 had repopulated most of the suitable habitat (Spraker 1997). The population increased rapidly, mainly because of a high-density moose population, and has remained at 180–200 animals since 1981–82. Pups have comprised over 1/3 of the fall population. Wolf distribution has increased over the past 20 years on the Kenai. There are estimated to be 45 wolves among 6 packs in GMU 7 and 155 wolves among 14 packs in GMU 15 (Spraker 1997). Wolf packs are now found across Kachemak Bay down to the southern tip of GMU 15C. However, their numbers and distribution are not consistent over time. Wolf survival on the southern portion of their range is low, which could be due to low numbers of moose and lack of caribou. Spraker (1997) reported that natural mortality rates have been low among Kenai wolves but may be increasing due to high wolf densities and declining prey populations. Trappers and hunters annually harvested 2–12 wolves in GMU 7 and 5–17 wolves in GMU 15 between 1991–92 and 1995–96. The harvest in 1996–97 was 30 for the entire Kenai (Hicks 1997). An agreement with the U. S. Fish and Wildlife Service allows wolf harvest management on a quota system in GMU 15A. Spraker (1997:37) concluded the recent wolf harvest of 15% of the fall population was low and that “the wolf population will probably be controlled by prey abundance, increased dispersal, and natural mortality.”

During the winter of 1991–92, a radiocollared wolf was reported in the Knik River valley of GMUs 14A and 14C, northeast of Anchorage. The wolf was identified as a Kenai wolf, and she and her mate both exhibited frequent shaking and scratching typical of louse-infested animals. The 2 wolves were captured and treated with ivermectin. Subsequent inspection of trapper-caught wolves from that pack indicated a successful cleansing effort.

During the winter of 1992–93, the department initiated a statewide effort to evaluate the extent of infestation by lice in wolves and coyotes. Our goal was to inspect all harvested wolves submitted for sealing. If the department believed the infestation was limited to the Kenai Peninsula, the strategy would be to attempt to confine the infestation there. No evidence of lice was found elsewhere during the evaluation. Furthermore, no subsequent sightings of louse-infested wolves off the Kenai Peninsula were reported until the winter of 1998–99.

In November and December 1998, trappers reported catching wolves and coyotes with evidence of lice between Willow and Talkeetna in the lower Susitna River valley. Department staff

speculated on the extent of infestation and its potential rate of spread and deliberated the feasibility of success in treating infested animals with ivermectin. The decision was made to commit funds and staff to investigate the infestation and then treat or remove infested packs if necessary. Our experiences with infestations in the Kenai packs suggested that if even 1 wolf escaped treatment, its pack would become reinfested and the control effort would fail.

LIMITATIONS TO CURRENT KNOWLEDGE

Several biological and social concerns regarding louse infestations in wild Alaskan canids were identified where our knowledge is limited. The following items incorporate (1) topics presented in the available literature, (2) experience gained through research and management activities by department staff, and (3) some of the ideas suggested by Dr. Walter Boyce, a specialist in wildlife ectoparasites from the University of California at Davis who provided analysis and recommendations at the division's request (Appendix A).

BIOLOGICAL CONCERNS

- Sources and mechanisms of louse transmission: Is the Mat–Su infestation an example of a low-frequency transmission rate that can potentially be controlled, or is this an indication that conditions are now right (e.g., wolf populations are dense enough or the climate has changed enough, etc.) to allow rapid transmission of the infestation northward?
- Extent of infestation among wolves, coyotes, and domestic or feral dogs (including wolf–dog hybrids)
- Level of interaction among wolves, coyotes, and dogs
- Influence of wolf population growth rates and pack stability on the spread of lice
- Survival and reproductive success of louse-infested animals: Will Interior wolves be affected similarly to Kenai wolves (e.g., low mortality, chronic infestation, no or slow rate of adaptation)?
- Susceptibility of individuals to infestation and the influence of disease and suppressed immune systems in wild canids on their vulnerability to lice
- Ability of lice to live in colder, dryer climates
- Genetic variability among lice affecting wolves, coyotes, and dogs

SOCIAL CONCERNS

- Ability of the division to influence dog owners and public agencies to take action to greatly reduce or eliminate the prevalence of lice among domestic and feral dogs
- Level of public concern about the esthetic and monetary value of wild canids that may be lost due to lice
- Level of public concern about the use of different options for eliminating louse infestations among wild canids in the state

LOUSE CONTROL EFFORTS

Most of the material in this section is from a paper presented to the 1999 Annual Meeting of the Alaska Chapter of The Wildlife Society by Herman J. Griese, Ted H. Spraker, and Mark A. Masteller, entitled Recent attempts to arrest the spread of *Trichodectes canis* among wild canids in Southcentral Alaska.

INITIAL EFFORTS

In response to the initial infestation of wolves and coyotes on the Kenai Peninsula during the winter of 1981–82, the department proposed to identify and eliminate all infested packs there, which was the course of action recommended by several ectoparasitologists. However, this proposal followed attempts by the department to enact wolf control programs in Interior Alaska, and a vocal segment of the Anchorage public claimed it was a “smoke screen” to hide our continuing attempt to eliminate wolves. Subsequently, the Commissioner and Governor withdrew the option to kill infested wolves, forcing the department to use other measures to control or eliminate infestation.

During February 1983, ivermectin (an antiparasitic drug from Merck & Co., Inc. developed to eliminate ectoparasites in horses and cattle) was identified as a possible treatment for louse-infested wolves and coyotes (Taylor and Spraker 1983). When administered orally, subcutaneously, or intramuscularly at twice the recommended dosage, ivermectin eliminated the adult lice and any hatching nymphs before the lice could reproduce. Ivermectin was tested on 3 infested wolves held in captivity and was determined to be a possible alternative to killing the infested packs (Taylor and Spraker 1983). However, the efficacy of treating wolves and coyotes in the field had yet to be tested. Because the duration of the drug’s action was limited to 6 months, it was uncertain whether wolves would become reinfested before all affected animals were treated.

Wolves from the 5 infested packs were captured from a helicopter and treated with intramuscular injections of ivermectin in March 1983 (Taylor and Spraker 1983). Baits treated with the liquid form of ivermectin were also scattered in the area at sites of wolf-killed moose. Although treatment with ivermectin appeared to rid at least some of the infested animals of lice, capturing and treating wolves proved ineffective because infested packs were relatively large (up to 18 individuals) and not all pack members could be caught. The treated baits were also of limited value because of the relatively small scope of their coverage and their consumption by nontarget species. Because of the lack of success in stopping the spread of the louse infestation and the significant staff time and resources already invested in the program, funding was stopped after the second winter (1983–84).

Subsequently, the lice rapidly spread to wolves in GMU 15C, then GMU 15B, and eventually GMU 7. An attempt to eliminate the initial foothold of lice in GMU 7 by trapping and treatment was successful but for only a short time. By the early 1990s, it was believed all known packs on the Kenai Peninsula were infested with the biting louse.

RECENT EFFORTS

The most recent louse infestation was localized along the George Parks highway between Willow and Talkeetna, within the drainage of the lower Susitna River in GMUs 13E, 14A, 14B, 16A, and 16B. The area was bounded on the east by the Talkeetna Mountains, on the south by Knik Arm, on the west by the Yenlo Hills, and on the north by Denali State and National Parks. The source of this new infestation was unknown, but it is possible that the wolves were infested from domestic dogs.

Methods

A reconnaissance of the area was made during 4–8 January 1999 and 3 wolf packs were inspected from fixed-wing aircraft. During 19–22 January wolves were captured using 2 Robinson-22 helicopters, each accompanied by 2 spotter aircraft. The objective was to capture at least 1 wolf from each pack in the study area but to strive for 1 adult and 1 pup in each pack.

Wolves were darted using Telazol[®], which is a commonly used immobilizing drug for wolves. At least 1 wolf from each pack was radiocollared and every animal handled was treated with ivermectin at a dosage of approximately 20 mg/100-lb wolf. Numbered tags and flagging was attached to the ears of all wolves caught to aid in identifying treated pack members. Each captured animal was inspected for lice, and samples of hair, blood, lice, and louse egg casings were collected.

During 25–30 January all wolves in each infested pack were captured and treated. Each pack was radiotracked 1–9 times in the subsequent 6-week period to ensure that all infested wolves were treated.

In February and March 1200 treated baits were distributed in the area of infestation. Baits consisted of 3–6 ounces of moose meat injected with 10 mg of ivermectin in paste form. The goal was to reach coyotes and any lone wolves not previously captured and treated. Wildlife Services of U.S. Dep. of Agriculture was contracted to assist in distributing baits and to live-capture as many coyotes as possible within the area of the infested packs. Local trappers were relied upon heavily to disperse the baits and to observe the wolf packs for signs of infestation. Trappers were also questioned on the number and locations of louse-infested coyotes caught.

Results

Wolves. Through the end of January, 14 packs containing a minimum of 135 wolves were found and evaluated (Table 1). In the evaluation phase (19–22 January 1999), 20 wolves from 10 packs were captured and handled and 3 of the 14 packs were verified with lice. One female from the Sheep River pack, died as a result of capture efforts. Eleven wolves were radiocollared.

The infested packs included the Willow Mountain pack, the Montana Creek pack, and the Deshka River/Moose Creek pack (Fig. 1). During 25–30 January 27 of the 34 wolves in the 3 packs were treated (Table 1). An adult female in the Willow Mountain pack also died as a result of capture efforts. At the time it was believed all but 1 member of the 3 infested packs had been captured. A single wolf, observed in the Montana Creek pack during 19–22 January, could not be found during the capture and treatment period.

Nine separate visits to the Montana Creek pack were made over the next 6 weeks to find the remaining untreated wolf. During those visits, the pack declined to 2 adults. A trapper presented a wolf for sealing that he had trapped just inside the adjoining Kashwitna River pack territory. The wolf was unmarked and was infested with lice. This may have been the missing Montana Creek pack member.

Trappers also caught 2 additional infested, unmarked wolves in or near the Deshka River/Moose Creek pack territory. Because of this pack's large size and because tracks of 2 single wolves were observed within this territory, these 2 wolves were probably the 2 lone, untreated members of that pack.

Trappers provided wolf pelts for evaluation from 2 additional packs of the original 14, the Little Susitna–Pt. Mackenzie pack and the Lake Creek pack; these pelts were free of lice. The 2 remaining packs, Upper Yentna River and Kahiltna Glacier packs, were observed at close range from the air and seemed healthy.

By the end of the required pelt sealing deadline (30 April 1999) at the end of the trapping season, trappers presented pelts of 14 wolves from 6 other packs in the general area, and these animals were all free of lice (Table 1). Based on observations and harvests by trappers, 34 wolves were estimated to have lice in the Mat–Su Valley before treatment began. Twenty-seven wolves from the 3 infested packs were treated. Trappers caught 7 more infested wolves, 3 of which were taken after treatment. Thirteen additional uninfested wolves were treated during 19–22 January 1999 (Table 1).

Blood samples were collected from wolves captured during the 1999 treatment program in the Mat–Su area. Serologic tests were conducted for selected disease agents, and antibody prevalence was high for canine parvovirus (18 of 27 wolves tested) and canine corona virus (19 of 27 wolves tested). These values were higher than those found in previous surveys. However, they were comparable with data from other regions of Alaska during the late 1990s. There was no apparent relationship between antibody prevalence for these viruses and louse infestation.

Coyotes. Fourteen active trappers within the study area were questioned and 36 coyotes were evaluated for lice. Although not all of those coyotes were available for inspection, up to 6 of them may have been infested. Department staff confirmed lice on 4 coyotes.

Of note was a coyote that had been killed 26 hours earlier and stored overnight in subfreezing temperatures. Upon inspection most (6 of 7) lice were found still alive on the partially frozen carcass. It had previously been assumed lice would survive only a few hours in freezing temperatures following the death of the host (Turner 1971).

Coyotes readily discovered and consumed the ivermectin-treated bait distributed along roads, trails, and waterways (Fig. 2). In many cases individual coyotes consumed several baits.

Attempts to live-capture coyotes proved unsuccessful. Many of the coyotes had become shy of traps and snares by the end of the trapping season.

Conclusions

It was believed all organized packs were identified and that approximately 90% of the infested wolves in the Mat–Su Valley study area had been treated. Trappers may have captured most of the remaining infested wolves. The 3 infested wolves trapped after treatment are hoped to represent the only remaining untreated individuals. It is believed the infestation was beyond its first year of development, because the posttreatment captures of infested wolves outside territories of treated packs indicated wolves had already dispersed from infested packs.

It is possible there was wolf mortality caused in part by infestation of lice. The disappearance of the 2 younger wolves from the Montana Creek pack followed a period in which temperatures remained below -40°C for a number of days. Such mortality would probably be restricted to pups and yearlings. Adults in fair to good physical condition tend to exhibit less hair loss and thus are less prone to mortality from exposure. Adults in poor condition can have hair loss as severe as pups.

It is unclear why lice have infested virtually all wolf packs on the Kenai but relatively few coyotes. In contrast, in the Mat–Su Valley, initial surveys estimated 10–20% of the coyotes in the study area were infested. This level is well above that observed on the Kenai Peninsula over the past 17 years.

As on the Kenai Peninsula, the suspected origin of the Mat–Su Valley infestation was from free-roaming domestic dogs. The potential for interaction between dog and wild canid has increased substantially in the last 2 decades. As people settled in the valley, they often sought remote locations along the main highway corridor to avoid municipal restrictions (such as leash laws). The concurrent elimination of same-day airborne hunting and an abundant moose resource enhanced the growth of the wolf population. It is also possible that coyotes served as intermediate hosts.

The cost of the effort in the Mat–Su Valley was approximately \$60,000 in operational expenses, not including the time of several staff.

PROJECTED EFFECTS IF NO CONTROL EFFORT IS IMPLEMENTED

This is a difficult topic to address because of the lack of empirical data to support projections. The rapid spread of lice among wolves on the Kenai and the recent outbreak in the Mat–Su Valley raises serious concerns that a similar infestation can happen elsewhere in the state. It is well known that dogs throughout Alaska are infested with lice in a low-level enzootic stage (Zarnke 1985; William Taylor, ADF&G veterinarian, pers. commun.). However, the potential for dogs to transmit lice to wild canids around communities away from the road system may be minimal because wolf harvest there tends to be high. Dispersing Southcentral wolves and coyotes may be a bigger potential factor than domestic or feral dogs in the spread of lice to wild canids in the Interior. The tendency of wolf packs to isolate themselves from one another may help restrict the spread of lice as long as wolves do not come into contact with dispersing, infested animals. Zarnke (1985) found that lice did not establish a chronic infestation in an experiment to infest 4 captive wolves in Fairbanks with lice, which were obtained from free-ranging wolves on the Kenai Peninsula, although he found lice on captive wolves for 2 months

following exposure. This study indicated lice were not as easily transmitted between animals as believed.

The spread of lice to Interior coyotes and wolves, in particular, could have a significant economic effect on trappers because of lost pelt value. In those areas where trapper incentive is reduced, the department would have to reassess ungulate management goals and develop new strategies to manage predators. Louse-infested wolves in Denali National Park would certainly affect the quality of wolf viewing.

The relationships between parasites and their hosts can be complex. Generally, hosts and parasites in well-established relationships have adapted so that neither is seriously harmed by the other. However, parasites that are not endemic to an area are more destructive to new hosts that have never encountered the parasite before (Chandler 1954). This seems to be the case with wild canids and lice in Alaska. Immune responses (whether cellular- or antibody-mediated) by wolves and coyotes may be a factor and play a significant role in their relationship with lice. Wolves and coyotes in Alaska may be suffering from acute allergic reactions to antigens from lice that may diminish over time as the canids and lice adapt to each other. However, heavy infestations, especially coupled with poor body condition, can inhibit the development of an improved immune system and allow further infection (Chandler 1954). Based on our limited observations of the Kenai infestation, it will likely take a significant number of generations of wolves and coyotes to develop an adaptive response that limits the effects of lice on their populations. Environmental conditions may not be severe enough on the Kenai Peninsula to significantly reduce the condition or fitness of heavily infested wolves and coyotes, thus preventing a selection against the condition. This may explain the lack of response by wild canids on the Kenai over the past 18 years. It can be speculated that the harsh winter conditions in the Interior would provide sufficient stress on infested animals to allow adaptation to proceed more rapidly.

With the spread of lice, we may see higher morbidity of wolves and coyotes, particularly among young animals. Animals already food-stressed or otherwise in poor condition will probably be more susceptible to disease and cold if they are also heavily infested with lice (Schwartz et al. 1983). However, there is no evidence of direct mortality from lice or of a negative population effect from lice on wolves or coyotes in Alaska or the lower 48 states.

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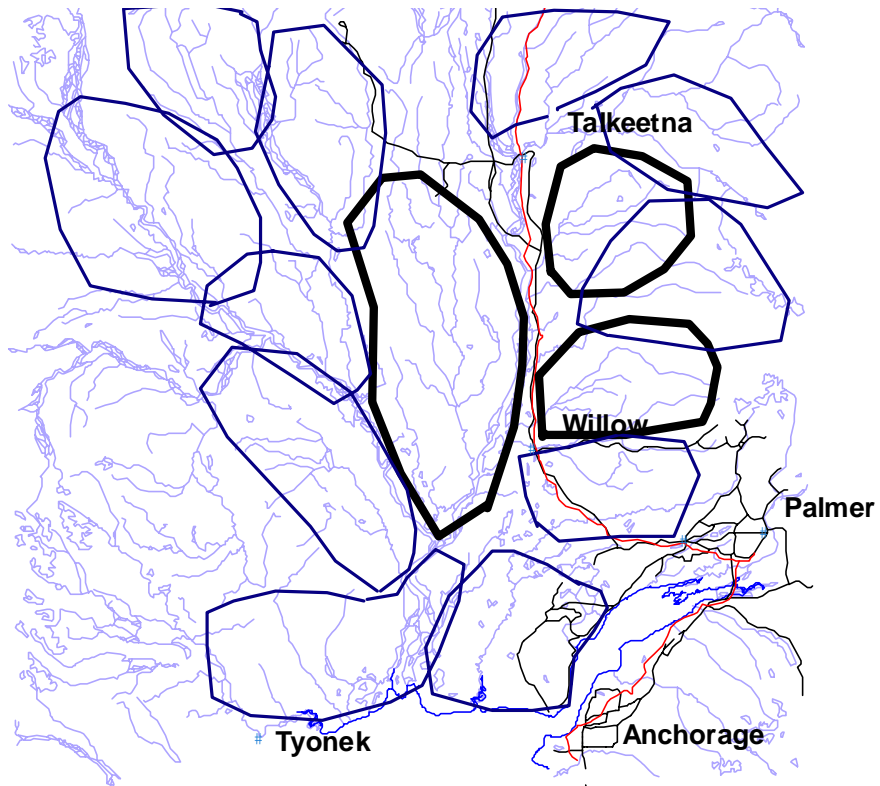


Figure 1 Approximate distribution of wolf packs in the Mat-Su Valley, Alaska, Jan-Feb, 1999. Heavy black lines delineate louse-infested packs.

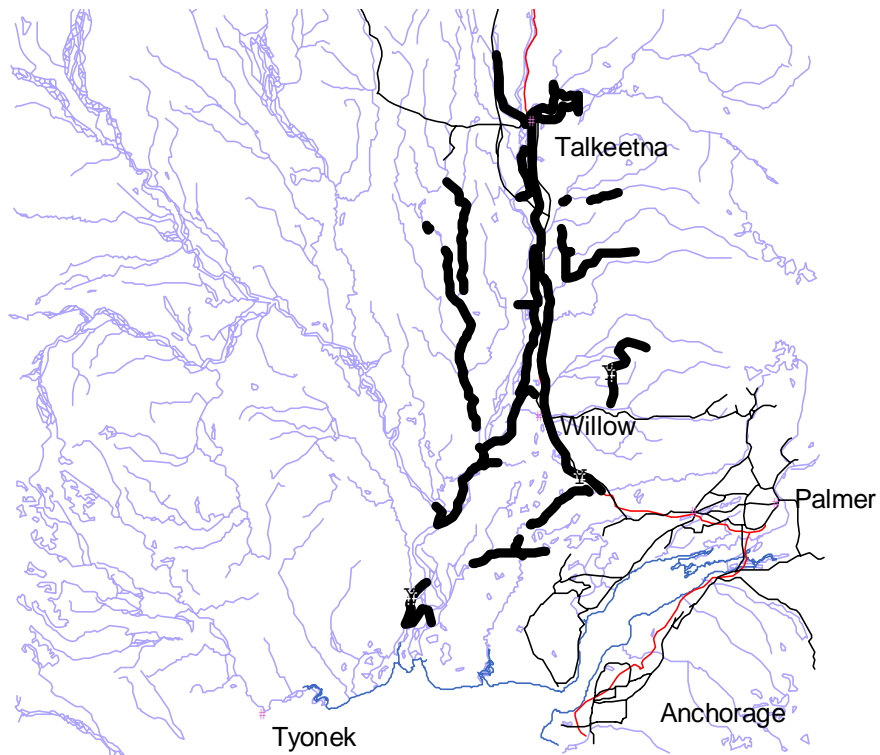


Figure 2 Bait distribution areas (heavy black) in the Mat-Su Valley, Alaska, Feb-Apr, 1999.

Table 1 Status of wolf packs that were examined and treated for lice in Game Management GMUs 13E, 14A, 14B, 16A and 16B, Alaska, December 1998–March 1999. Infested packs are shown in bold type.

Pack Name	GMU	Initial	Observed Condition	Captured	Capture Mortality	Harvest by Trappers		Pack Size as of 15 May
		Pack Size		And Treated		Before Treatment	After Treatment	
Packs found and evaluated before the end of trapping season								
Little Susitna/Point Mackenzie	14A	4	Clean	0	0	0	3	1
Bald Mountain Ridge	14A	5	Clean	2	0	0	4	1
Willow Mountain	14B	14	Infested	12	1	2	1	8
Kashwitna River	14B	16	Clean	1	0	0	0	16
Montana Creek	14B	6	Infested	4	0	1	1^a	2–4^b
Sheep River	14B	5	Clean	2	1	0	0	4
Chunilna Creek	13E	5	Clean	2	0	0	3	2
Kahiltna Glacier	16A/B	2+	Clean ^c	0	0	0	0	2+
Kahiltna River	16A	9	Clean	2	0	0	0	9
Deshka River/ Moose Creek	16A	14	Infested	11	0	1	3^d	10
Upper Yetna River	16B	6	Clean ^c	0	0	0	0	6
Lake Creek	16B	12	Clean	0	0	3	5	4
Alexander Creek	16B	17	Clean	2	0	0	0	17
Theodore River	16B	20	Clean	2	0	1	4	15
Total		135		40	2	8	24	97–99
Adjacent packs evaluated by the end of trapping season^e								
Portage Creek	13E	14	Clean	0	0	0	1	13
Knik River	14A	5–6	Clean	0	0	2	2	1–2
Granite Creek	14A	?	Clean	0	0	0	1	?
Prairie Creek/ Talkeetna River	14B/ 13E	15	Clean	0	0	0	3	12
Yellow Jacket Creek/ Talkeetna River	14B/ 13E	16	Clean	0	0	0	3	13
Beluga River	16B	5	Clean	0	0	0	2	3
Total		55–56		0	0	2	12	42–43

^a A trapper caught a louse-infested wolf after treatment in the territory of the Kashwitna River pack, but we believe it was from the Montana Creek pack.

^b We suspect the mortality of 2 pups or yearlings that disappeared after extreme cold temperatures.

^c Louse infestation was determined from aerial observation.

^d Two wolves captured after treatment were unmarked and had lice.

^e Hides of trapped wolves were inspected for lice.

Appendix A Transcript of analysis and recommendations of Dr. Walter Boyce concerning the infestation of biting lice in Alaskan canids. Dr. Boyce is Associate Professor and Associate Parasitologist in the Department of Pathology, Microbiology, and Immunology at the University of California at Davis. He has extensive experience with ectoparasite–host relationships. His special interest is in ectoparasitic mites and bighorn sheep.

“After reviewing the materials you sent me, and based on our phone conversation, I have put together my thoughts on what you need to know, and how you might gain the answers you need.

Major unknowns and management implications:

1. What effect do lice have on survivorship and reproductive success?

If no effect, then no need to manage. If lice do have negative effects, then appropriate management strategies should be explored.

2. Are lice on the Kenai genetically similar to those on the mainland?

If lice are genetically similar on the Kenai and the mainland, then it is likely that there was/is gene flow between the two locations. In other words, we could not reject the hypothesis that the Kenai served as the original source of lice for infested mainland wolves. If the lice are dissimilar, this implies that there were different sources of lice for the two areas. From a management perspective, a single source of lice suggests more opportunities for effective control, whereas multiple sources of lice would be more difficult to manage/eliminate.

3. Are lice on wolves, coyotes, and domestic dogs genetically similar?

Essentially an extension of #2 with similar implications. If dogs and/or coyotes share lice with wolves, then management becomes very problematic. If however, louse populations are essentially restricted to different host species (i.e., wolf lice, dog lice, coyote lice), then management is simplified. Knowing the answer to #3 will also provide solid insight into the origin of the wolf infestation on the mainland and Kenai (especially in combination with #2).

4. Is treatment an effective management tool?

An essential question given the answers to 1–3 above. Without an effective treatment, management options will be limited. However, it is essential to evaluate the efficacy of treatment since it is all too easy to spend considerable time, money and effort on a less-than-useful treatment program.

My suggestion is to develop and initiate a research and management program that addresses these questions. The design must incorporate testable hypotheses so that every action you take moves you forward.

Hypotheses (null and alternate):

1. H_0 – lice have no effect on survivorship
 H_a – lice significantly decrease survivorship

2. Ho – treatment has no effect on survivorship of infested wolves
Ha – treatment significantly increases survivorship
3. Ho – wolves are susceptible to reinfestation after successful treatment
Ha – wolves are not susceptible to reinfestation
4. Ho – treatment has no effect on pack survival and reproductive success
Ha – treatment significantly increases pack survival and reproductive success
5. Ho – lice on mainland and Kenai wolves are genetically similar
Ha – lice are not genetically similar
6. Ho – lice on wolves, coyotes, and dogs are genetically similar
Ha – lice are not genetically similar

Hypotheses 1–4 could be tested in a field study using radiocollared wolves

Hypotheses 5–6 could be tested in the lab with a molecular study of lice

Outcome – the final outcome of the above studies would be definitive answers to questions that have major conservation and management implications (i.e. those identified at the beginning of this document).

I would be happy to assist in the design, implementation, and interpretation of the above study. Let me know how I might be able to assist you further. I will be back in my office on Monday, April 26.”