WOLF STUDIES ON KANUTI NATIONAL WILDLIFE REFUGE, ALASKA

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CONTENTS

ABSTRACT

Radio collars were placed on 32 gray wolves (*Canis lupus*) from an estimated 10 packs captured on or near the Kanuti National Wildlife Refuge (Kanuti Refuge) in 1990 and 1991 (Wilk and Osborne 1991, Zirkel 1995). Collared animals were tracked for 2.5 years to determine wolf densities, distribution, and moose/wolf ratios. In March and April 1992, collared wolves were monitored daily to determine kill rates. In March 1996, 10 additional wolves from approximately 5 packs were collared and tracked until 1998. In March 1998, 3 wolves, originally collared in 1996, were fitted with new collars and 9 more from approximately 5 packs were collared. Wolves collared in 1998 were tracked twice monthly until 2001.

Four to 11 packs representing 45-69 wolves, or 6.5 ± 3.87 wolves per pack, were estimated to use refuge lands during the entire period. Resident, or mostly resident, wolves generally represent 5 packs. When data from all Kanuti Refuge studies are used, the density of wolves on the study area (10,304.89 km^2) was estimated to be about 5.7 wolves/1000 km^2. Based on a 1999 moose census (0.15 moose/km^2) and a density of 5.7 wolves/1000 km^2, wolf/moose ratios for the Kanuti Refuge were determined to be approximately 1:26. The mean productivity per wolf pack on the Refuge varied from 0 pups in 1992 to 3.8 in 1998.

INTRODUCTION

Kanuti National Wildlife Refuge (hereafter, Kanuti Refuge or the Refuge) was established by the Alaska National Interest Lands Conservation Act in part to …"conserve fish and wildlife populations in their natural diversity, including…moose, caribou…, and furbearers." and to provide"…the opportunity for continued subsistence by local residents." The Kanuti Refuge is near several Alaskan communities and is an important hunting area for these rural communities. Wolves are a competitor for food (in particular, moose and caribou), but also a source of fur for Alaskans, including rural residents (U.S. Fish and Wildlife Service. 1987). Wolves can also strongly influence ungulate populations (Boertje et al. 1996, Gasaway et al. 1992). Therefore, the US Fish and Wildlife Service conducted wolf distribution and density studies on the Refuge from 1990 through 2001 to gain a better understanding of wolf ecology in the area.

Wilk and Osborne (1991) initiated a study on Kanuti Refuge in 1990 to determine wolf densities and improve management strategies. Their interest grew out of reports indicating that 28% of the

wolves taken from Game Management Unit (GMU) 24 (Fig. 1) during 1985-90 were harvested from the Kanuti Refuge, and 63% of those wolves were taken using aircraft (Wilk and Osborne 1991). When same day airborne wolf hunting ended during the winter of 1991-1992 because of changes in regulatory interpretation and application, wolf harvest rates on Kanuti Refuge declined dramatically (Zirkle 1995). Following the 1990 study, wolf density estimates for Kanuti Refuge and surrounding areas were estimated to be as high as 10-15 wolves/1000 km^2 (Wilk and Osborne 1991, A. Greenblatt, pers. comm.). It was also thought that approximately 31-36% of Kanuti Refuge's population of wolves were harvested from 1989-1998 and 86% percent of those animals were taken with the assistance of aircraft (Wilk and Osborne 1991). In addition, Wilk and Osborne (1991) reported that the harvest had a disproportionately high female component. Wilk and Osborne (1991) and Zirkle (1995) contain the complete results of these two earlier studies. The following report presents data on territory boundaries, pack size, moose:wolf ratios, densities, and productivity of wolves that occur on and around Kanuti Refuge, including data from the earlier studies, and later work we conducted from 1998-2001.

STUDY AREA

We conducted our study on and around the Kanuti National Wildlife Refuge (6,625 km^2) in north-central Alaska. The Refuge is located in the northeast portion of GMU24, (Fig. 2), approximately 209 km north of Fairbanks, Alaska, and straddles the Arctic Circle. Vegetation in the area is typical of the northern boreal forest (Ricketts et al 1999), and the Refuge encompasses a basin of rolling hills, wetlands, ponds, and streams created by the Koyukuk and Kanuti rivers.

METHODS

Study Design and Purpose

Kanuti Refuge initiated a wolf-collaring project in 1990 to develop information on the Refuge wolf population after "land and shoot" hunting measures ceased. Between 1990 and 2001 the number of animals collared fluctuated somewhat, but the Refuge kept up to 22 radio-collars on wolves, annually, in an effort to determine population parameters (Zirkle A. 1995). From 1998 -- 2001, the Refuge narrowed its focus and used collared wolves to determine territory boundaries, pack size, moose:wolf ratios, densities, document dispersal events, and monitor productivity.

Overview of collaring efforts on the Refuge

Initially, 15 wolves from approximately 5 packs were collared and tracked for 9 months via fixed-wing aircraft (Wilk and Osborne 1991). The Refuge followed these animals until 1992 and determined their kill-rates during daily tracking flights (Zirkle 1995). In 1992, we collared 17 additional wolves, and the Refuge continued to monitor all of the wolves that still carried functioning collars. In 1996, 10 more wolves from approximately 5 packs were collared in response to public predator/prey concerns, and these animals were tracked until 1998 (Zirkle A. 1995). In March 1998, 9 additional wolves were collared and 3 of the previously collared wolves were re-collared (Maxwell 1998). All remaining wolves with functioning collars were radio-tracked until 2001.

Capture and tracking methods 1998-2001

In March 1998, Kanuti Refuge and ADF&G established a cooperative agreement to locate, tranquilize, and radio collar up to 15 wolves on refuge and adjacent lands. Methods recorded here are specific to the 1998 collaring project, but in general are the same as used in the earlier wolf collaring efforts (Wilk and Osborne 1991, Zirkle 1995). We located wolves using two fixed-wing aircraft (Piper Super Cubs), and used a Robinson R-22 helicopter from which to dart animals. We preferentially targeted alpha wolves. Immobilizing darts delivered 654 milligrams of Telazol, hydrostatic water and propylene glycol (to prevent freezing). After immobilization, we landed and fitted animals with radio-collars equipped with mortality sensors (Telonics, Mesa, AZ), and collected body measurements (girth and length), hair and blood samples and determined the approximate age, condition, and weight of each wolf. We relocated collared wolves 24 hours after capture, and then at regular intervals (weather permitting) throughout the study period using fixed-wing aircraft and Telonics or Advanced Telemetry System receivers. We recorded Global Position System (GPS) locations for each collared animal during the relocation flights, and made notations regarding other observations.

Beginning in 1998, we used fixed-wing aircraft to track and observe collared wolves twice monthly, weather permitting, for approximately the next 24 months, or until an animal died, dispersed from the area, or the collar failed. Failure to hear a signal after repeated flights indicated the wolf had dispersed from the study area, the transmitter failed, the wolf had been

killed, or the collar malfunctioned. When an animal left the Refuge, we tracked it beyond the Refuge's boundaries if possible; dispersing animals were also tracked by private pilots or partner agencies. When collared wolves died and could be located, we used a helicopter to access the area where the wolf died, recovered the animal, and performed a necropsy. However, in some cases, only the collars were recovered. Locations, behavior, habitat, pack size and animal age (adult versus pup) were recorded for each animal located during tracking flights. Additional information was recorded on kills. We made no attempt to map kernel home ranges because of data limitations (Worton 1995). Instead, we used Minimum Convex Polygons (MCP) to estimate territory size (Hooge and Eichenlaub 1997) and to establish how wolves used the Refuge over the 10-year monitoring interval.

RESULTS

Population Estimates

Approximately 43 wolves used lands on and around the Refuge (6.0 wolves/1000 km^2) from 1998 through 2001 (Table 1). When data from the entire monitoring period (1991-2001) is used, we estimate the wolf density on Kanuti Refuge, and adjacent areas (10,304.89 km^2) to be about 5.7 wolves/1000 km^2 (Table 2).

Summary of Number, Size, Home Range and Distribution of Packs

Because packs form and die out over time, the number of packs using Kanuti Refuge varied over the course of our study. During the 10 years of radio tracking, we estimated 4-11 packs used Kanuti Refuge and adjacent lands. Five of these packs were considered to be resident on Kanuti Refuge (Wilk and Osborne 1991).

Pack size varied seasonally during our study. We found that packs were larger, up to 17 wolves, during early winter after pups were assimilated into the pack (Grooms 1999), while at other times of the year, packs were much smaller, some having as few as 3 individuals. The mean pack size for the 5 packs we monitored during 1996-2001 was 7.7 ± 2.3 wolves.

We found that the MCP size of wolf pack territories on our study area ranged from 415 km^2 to 960 km^2 (see Figures 1-8 maps of MCPs of pack territory in 1998-2001).

Productivity

Between 1990 and 1992, we identified 10 wolf packs that occurred on or around Kanuti Refuge. In 1992 no pups were produced in the 5 packs that we found resident on the study area (Table 3). A mean of about 1.6 pups were produced per pack in both 1990 (7 packs) and 1991 (9 packs) in packs we located in those years. Between 1998 and 2001, six packs of wolves (the collared male in the Chalatna Creek pack died before we were able to establish productivity for that pack) used our study area and their productivity ranged from 1 to 3.8 pups/pack (Table 4).

Moose:Wolf Ratios

A 1989 moose survey reported an estimated 1,172 moose/ 6773 km^2 or 0.17 moose/km^2 for Kanuti Refuge. Wilk and Osborne (1991) estimated 69 wolves for the Refuge and adjacent lands in the same year, and a wolf:moose ratio of 1:17. Wilk and Osborne estimated the wolf population was 45 in 1991, and using the moose estimate from 1989, determined a wolf:moose ratio of 1:26. A moose census conducted in 1999 produced a density estimate of 1,052 moose/7032 km^2 or 0.15 moose/km^2 (Table 5). Using a mean of 5.7 wolves/1000 km^2, the wolf/moose ratio for Kanuti Refuge is estimated to be 1:26 (Table 6).

DISCUSSION

Territory Size and Wolf Densities

Wolf densities vary by region in Alaska and are dependent local resources. Stout (2003) estimated there were 4-6 wolves/1000 km^2 in the central part of GMU 24 and 6-8 wolves/1000 km^2 in the northern part of the unit, and suggested the difference was related to prey availability. The density of wolves on our study area (5.7/1000km^2) is within this range, and the range expected throughout interior Alaska (Ballard et al 1989). In addition, the wolf densities we report agrees with Alaska Fish and Game fall management goals (5-9 wolves/1000 km^2) for GMU 24 (Stout 2003).

The reported territory sizes of wolves in other parts of Alaska vary greatly. On the Kenai Peninsula the average wolf territory size was 638 km^2 (Peterson et al. 1984), in South-central

Alaska it was found it to be 1645 km^2 (Ballard et al. 1987) and in Northwest Alaska where wolves prey mainly on migratory caribou, territory size was 1868 km^2 (Ballard et al. 1997).

It has been demonstrated that wolf territory size and the number of relocations made per pack per year are related; as the number of relocations increases so does the pack's territory size (Ballard et al. 1987, Burch et al. 2005). One reason for this phenomenon is that in parts of Alaska where moose densities are low and caribou presence is sporadic, wolves are forced to travel great distances in search of prey. As a result, wolf territories may overlap by as much as 70% both spatially and temporally because animals do not frequent and reinforce territory boundaries (Burch pers. comm.). The MCP territories described for Kanuti Refuge are based on fewer than 50 telemetry relocations per pack. In addition, we probably also underestimate true territory sizes because our estimates are based solely on the area used by wolves during daylight hours, when we radio-tracked animals (Burch 2001). For all of these reasons, the territory sizes we present in this report should be considered minimum estimations of the territory sizes for wolf packs in our study area.

Wolf:Moose Ratios

Moose densities on Kanuti Refuge (150/1000 km^2) are consistent with densities where there is no predator control (Van Ballenberghe 1991). Wolf densities on the Refuge are also within the normal range where moose occur at relatively low densities and caribou presence is sporadic (Stout 2003). The low moose densities on Kanuti Refuge may result from of a combination of factors including periodic severe weather (particularly deep snow), and predation by a full complement of ungulate predators, including wolves and grizzly and black bears (Ballard 1991).

Productivity

When compared with other locations in Alaska, the productivity of wolves was low during our study. Ballard et al. (1987) found productivity to range from 3.7 to 7.3 pups/pack on their study area in South-central Alaska and Peterson et al. (1984) found packs produced a mean of 4 pups/pack on the Kenai Peninsula. We do not know if our data are an accurate representation of wolf productivity on our study area, or if the divergence from other studies we report resulted from differences in study techniques.

Management Implications

There are limitations with using VHF radio-collars for wolf studies in remote environments like Kanuti Refuge, including the ever-increasing expense of flying, the risk to personnel of flying in remote locations, weather restrictions, and the fact that wolves are active at night (Mech 1970) when tracking is not possible. These can all be avoided or mitigated by using GPS collars rather than VHF collars. In addition GPS collars provide more data per collar than VHF collars, an important concern when trying to determine wolf densities and territory size. Therefore, in spite of their high initial cost, the use of GPS collars should be given special consideration for future wolf studies on the Refuge.

The large and indiscrete nature of wolf pack territories in Interior Alaska are reasons to be cautious and thoughtful when initiating wolf inventory surveys. Given the limitations of the data available from telemetry flight surveys when VHF collars are used, it is important that managers realize that population estimates are not precise counts and must always be considered cautiously.

The radio-telemetry work on Kanuti Refuge from 1991 – 2001 has accorded us a better understanding of wolf ecology and the relationship of wolves to moose on the Refuge. However, studies have shown that bears play an important role in the survival of moose calves in Alaska, and elsewhere; in some locations bears may take up to 40% of the moose calves produced each spring (Alaska Department of Fish and Game 2001, Ballard and Larsen 1987, Boutin 1992, Bertram and Vivion 2002). No studies have been conducted on bear densities, prey relationships, or habitat preferences on Kanuti Refuge. Therefore, we do not have a complete understanding of the relationship between moose, and the entire resident ungulate predator guild on the Refuge. Investigating the ecology of black and brown bears should be a research priority for Kanuti Refuge in the future.

ACKNOWLEDGEMENTS

Special thanks are extended to all of the pilots whose wolf tracking skills often determined the success of this project. Thanks also to the cooperative agencies, the National Park Service (NPS) and Alaska Department of Fish and Game. Thanks to John Burch (NPS), and Rick Swisher of Quicksilver Air, and to all Kanuti Refuge staff who helped with wolf tracking over the years.

LITERATURE CITED

Alaska Department of Fish and Game. 2001. Koyukuk River Moose Management Plan. Alaska Department of Fish and Game, Fairbanks, Alaska.

Ballard, W. B 1991. Management of predators and their prey: The Alaskan experience. Trans. 56th N. A. Wildl. and Nat. Res. Conf.

Ballard, W. B. and D. G. Larsen. 1987. Implications of predator-prey relationships to moose management. Swedish Wildlife Research suppl.1.

Ballard, W.B., L. A. Ayres, P. R . Krausman, D. J. Reed, and S. G. Fancy. 1997. Ecology of wolves in relation to a migratory caribou herd in Northwest Alaska. Wildlife Monographs No. 135

Ballard, W. B., J. S. Whitman, C. L. Gardner. 1987. Ecology of an Exploited Wolf Population in South-Central Alaska. Wildlife Monographs No. 98.

Bertram, M.R. and M.T. Vivion. 2002. Moose mortality in eastern interior Alaska. J. Wildl. Manage. 66: 747-756

Boertje, R. D., P Valkenburg, and M E McNay. 1996. Increases in moose, caribou, and wolves following wolf control in Alaska. J. of Wildl. Manage. 60: 474-489.

Burch, J. W. 2001. Evaluation of wolf density estimation from radiotelemetry data. Master of Science Thesis. University of Alaska, Fairbanks, Alaska.

Burch, J. W., L. G. Adams, E. H. Follmann, and E. A. Rexstad. 2005. Evaluation of wolf density estimation from radiotelemetry data. Wildl. Soc. Bull. 33:1225–1236.

Boutin, S. 1992. Predation and moose population dynamics: A critique. J. Wildl. Manage. 56: 116-127

Gasaway, W. C., R. D. Boertje, D. V. Grangaard, D. G. Kelleyhouse, R. O. Stephenson, and D. G. Larsen. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. Wildlife Monographs 120.

Grooms, S. 1999. Return of the wolf. Northwood Press, Minnetonka, Minnesota.

Hooge, P.N. and B. Eichenlaub. 1997. Animal movement extension to arcview. Ver. 1.1. Alaska Biological Science Center, U.S. Geological Survey, Anchorage, AK. USA

Maxwell, M. 1998. Progress report: Wolf monitoring on Kanuti National Wildlife Refuge. U.S. Fish and Wildlife Service. Fairbanks, Alaska.

Mech, D. L. 1970. The wolf, the ecology and behavior of an Endangered Species. University of Minnesota Press. Minneapolis MN.

Peterson, R.O., J. D. Woolington and T. N. Bailey 1984. Wolves of the Kenai Peninsula, Alaska. Wildlife Monographs, No. 88.

Ricketts, T.H., E. Dinerstein, D. M. Olson, C. J. Loucks, W. Eichbaum, D. DellaSalla, K. Kavanagh, P. Hedao, P. Hurley, K. Carney, R. Abell, and S. Walters. 1999. Terrestrial Ecoregions of North America: A Conservation Assessment. Island Press, Washington, D.C. 508 pp.

Stout, G.W. 2003. Unit 24 wolf management report. Pages 223-231 *in* C. Healy, editor. Wolf management report of survey and inventory activities 1 July 1999-30 June 2002. Alaska Department of Fish and Game. Juneau, AK.

U.S. Fish and Wildlife Service. 1987. Comprehensive Conservation Plan, Environmental Impact Statement, Wilderness Review. U.S. Fish and Wildlife Service, Anchorage, Alaska.

Van Ballenberghe, V. 1991. Forty years of wolf management in the Nelchina Basin, Southcentral Alaska: A critical review. Trans. 56th N. A. Wildl. & Nat. Res. Conf.

Wilk, R. J. and T. O. Osborne. 1991. Status of the gray wolf and preliminary assessment of the moose-wolf relationship in the Kanuti National Wildlife Refuge, Alaska. Progress report, U.S. Fish and Wildlife Service, Fairbanks, AK.

Worton, B. K. 1995. Using the Monte Carlo simulation to evaluate kernel-based home range estimators. J. of Wildl. Manage. 59: 794-800.

Zirkle, A. 1995. A population assessment of wolves and an account of the predator/prey relationship on Kanuti National Wildlife Refuge. Progress report, U.S. Fish and Wildlife Service, Bettles, Alaska.

Table 1. Wolf pack records for Kanuti Refuge 1998 - 2001.

Pack	Sex of collared wolves	Pack Size	Collaring Location	Age	Relocations	Territory km^2	Color	Fate
Sithylemenkat	M/F	9	Tokasatatquaten Lake	6/6	48	906	Gray/Gray	Killed[1]/Unknown[2]
South Fork	F	5	South Fork/Koyukuk	6	47	302	Blue[3]	Collar not[4] recovered
Taclodahten	F/F	10	Mingkoket Lake	U/8	50	614	Gray/White	Unknown[5]/Died[6]
Henshaw Creek	M/F	6	Double Point Mountain	2/2	46	491	Gray/Gray	Uknown[7]/Dispersed[8]
Chalatna Creek	M	1	Chalatna Creek	2	2	Unknown	Gray	Dispersed/Killed[9]
Kanuti/Kilolitna	M/F	7	Kanuti/Kilolitna River	2		Unknown	Gray/Gray	Died[10]/Dispersed[11]
Bonanza Creek	M/F	5	Bonanza Creek	6/U	19	415	Gray/Gray	Unknown[12]/Killed[13]

[1]Skull and neck bones recovered.
[2]Collar functioning at end of project.
[3]Color varied seasonally; turned light gray/white from April-November.
[4]Collar on mortality at end of project, wolf not recovered.
[5]Collar functioning at end of project.
[6]Entire wolf recovered, apparently died of natural causes.
[7]Collar removed at end of project.
[8]Dispersed to Kilolitna River area.
[9]Dispersed to Help Me Jack Hills then north to John River between Walk Around and Loon Creeks. Shot 40 km east of Kobuk, south of Pah River.
[10]Entire wolf found, apparently died of natural causes.
[11]Traveled to Hodzana River 5/98, returned following winter and traveled back to Hodzana spring of 1999.

[12]Collar recovered frozen in the ice of the Jim River.
[13]Collar and bone fragments located near a moose kill.

Table 2. Wolf population estimations for Kanuti Refuge			
Years	Area (km2)	Wolf estimate	Wolf density (1000 km^2)
90-92	10,304.89	69	6.7
96-97	6,617	30	4.5
98-2001	10,072.38	60	6.0
Mean[1]			5.7

[1] 95 % confidence interval, standard deviation 1.12

Table 3. Productivity of wolf packs on Kanuti Refuge, 1990 - 1992. Values are approximates based on direct observation from aircraft.

Pack	Adults[1]	Pups 1990	Pups 1991	Pups 1992
Alatna	8	0	0	0
Bonanza	8	6	4	0
Central	3 - 7	0	1	--------
Kanuti Canyon	1 - 4	--------	--------	--------
Kilolitna	2 - 3	2	0	--------
Little Kaldoyleit	2 - 3	0	4	0
Old Dummy	2	--------	0[7]	--------
Sithylemenkat	10	--------	0	0
Taclodahten	4 - 11	3	5	--------
Todatonten	1 - 2	0	0	--------
Mean		1.57	1.56	0

Table 4. Productivity of wolf packs on Kanuti Refuge, 1998 – 2001. Values are approximates based on direct observation from aircraft.

Pack	Adults[1]	Pups 1998	Pups 1999	Pups 2000
Henshaw Creek	5	3	2	--------
Sithylemenkat	5	9	1	3
Taclodonten	12	6	0	--------
Kanuti/Kilolitna	8	0	0	1
South Fork	4	3	3	2
Bonanza Creek	5	2	0	--------
Mean		3.83	1.0	2.00

Table 5. Moose population estimates and densities for Kanuti Refuge

Year	Area (km^2)[1]	Range of estimate	Moose estimate[2]	Moose density (1000 km^2)
1989	6772.86	867-1,476	1172	173
1993	6,847.97	1,567-2,453	2010	293
1999	7,031.86	851-1,253	1,052	150
2004	7,018.91	602-1,083	842	120
Mean[3]				184

[1] For all surveys, some survey units extended beyond the refuge boundaries. In 1999 and 2004, most units that intersected the refuge boundary were considered "in" the refuge, even if much of the unit was outside the boundary.

[2] 90% confidence interval

[3] 95% confidence interval, standard deviation 75.8

Table 6. Moose:wolf ratios for Kanuti Refuge

Year	Moose density	Wolf density	Ratio
1993	Moose 293/1000 km^2	1990-1992 Wolves 6.7/1000/km^2	44:1
1999	Moose 150/1000 km^2	1996-1997 Wolves 4.5/1000 km^2	33:1
Mean*	184/1000 km^2	5.7/1000 km^2	32:1

* derived from mean moose densities from 1989 – 2004 and wolf densities in 1993 and 1999.

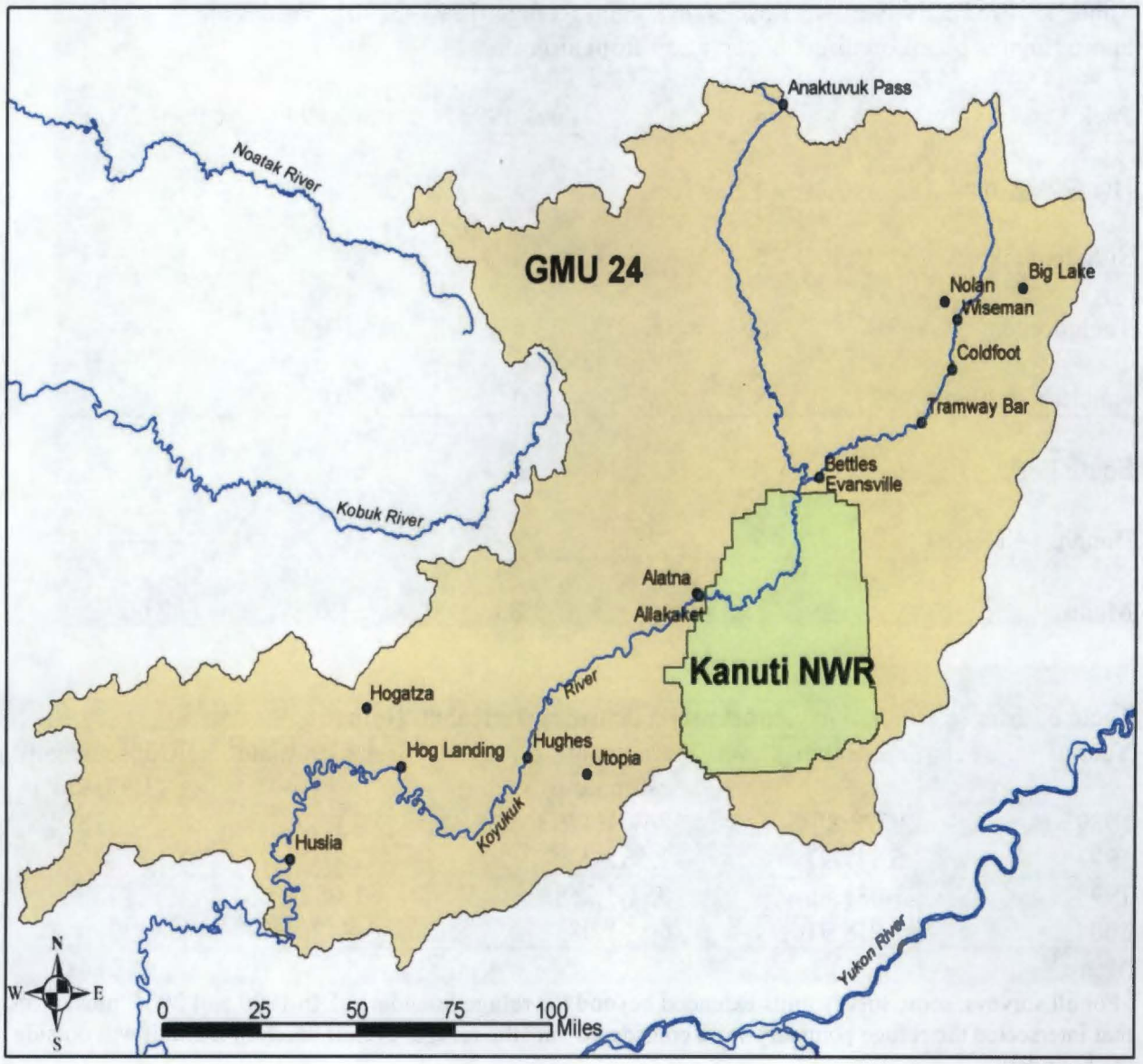

Figure 9. Game Management Unit 24 and Kanuti National Wildlife Refuge, Alaska.

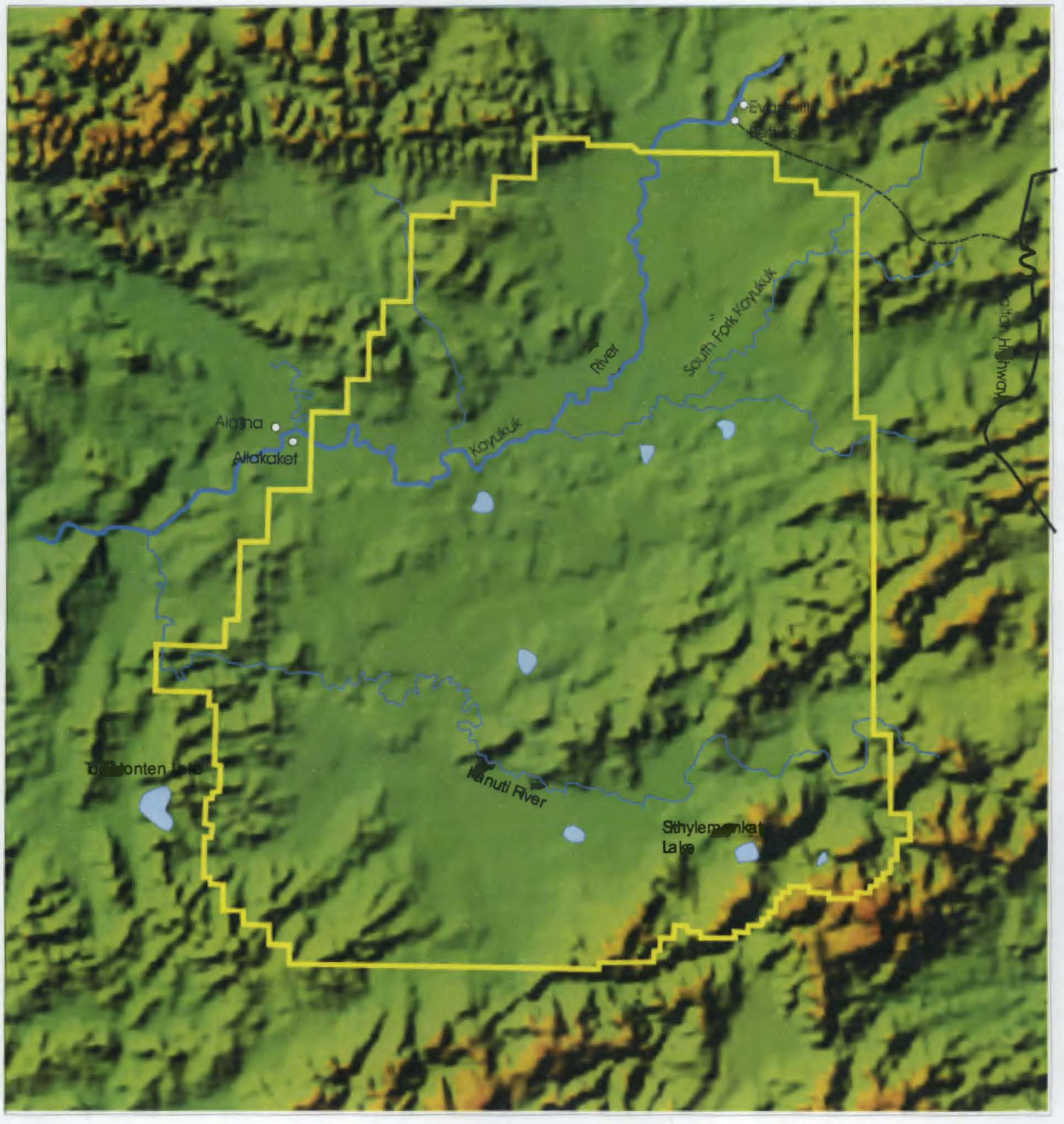

Figure 10. Kanuti National Wildlife Refuge, Alaska.

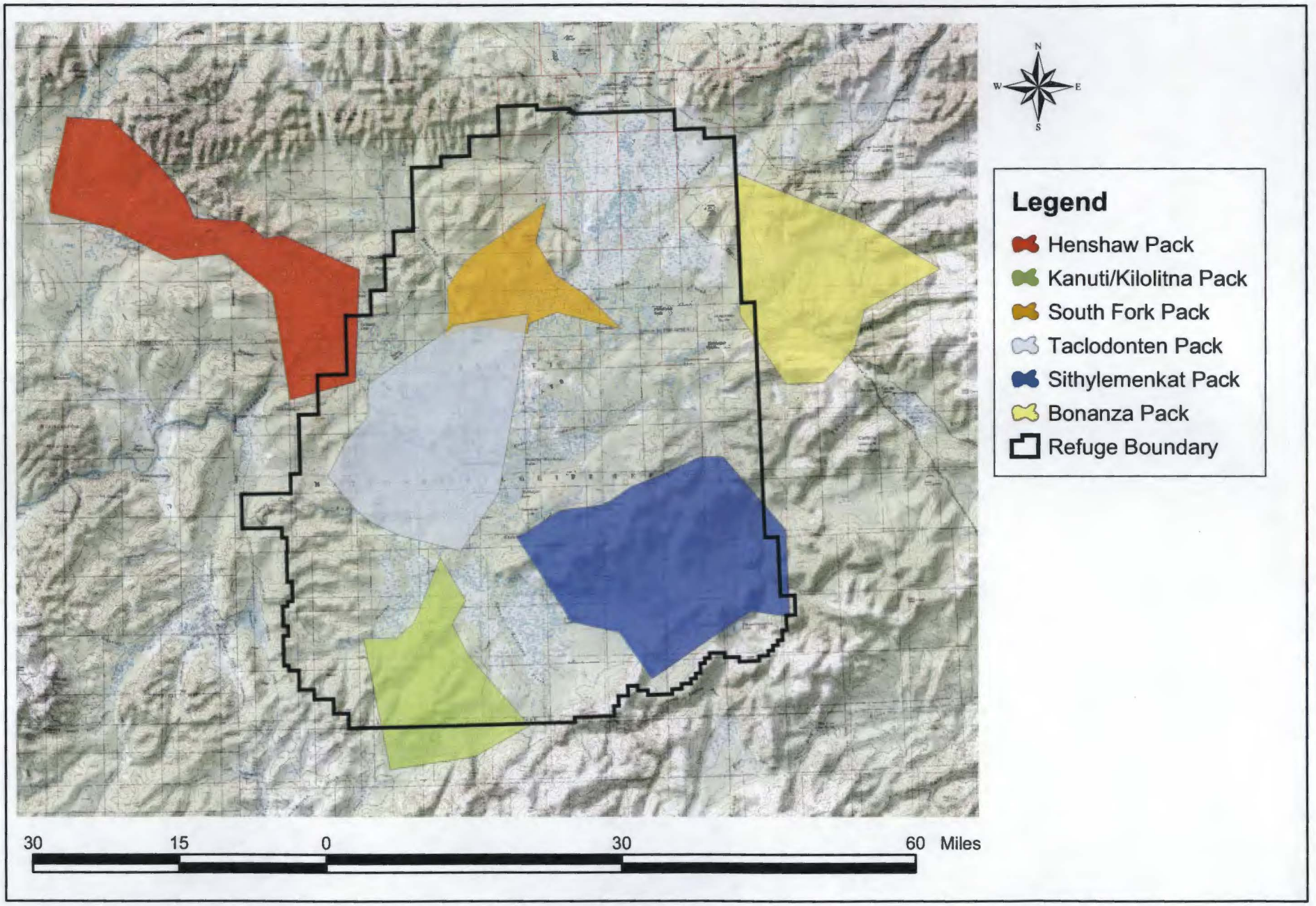

Figure 1. Wolf Packs on the Kanuti National Wildlife Refuge, 1998-2001.

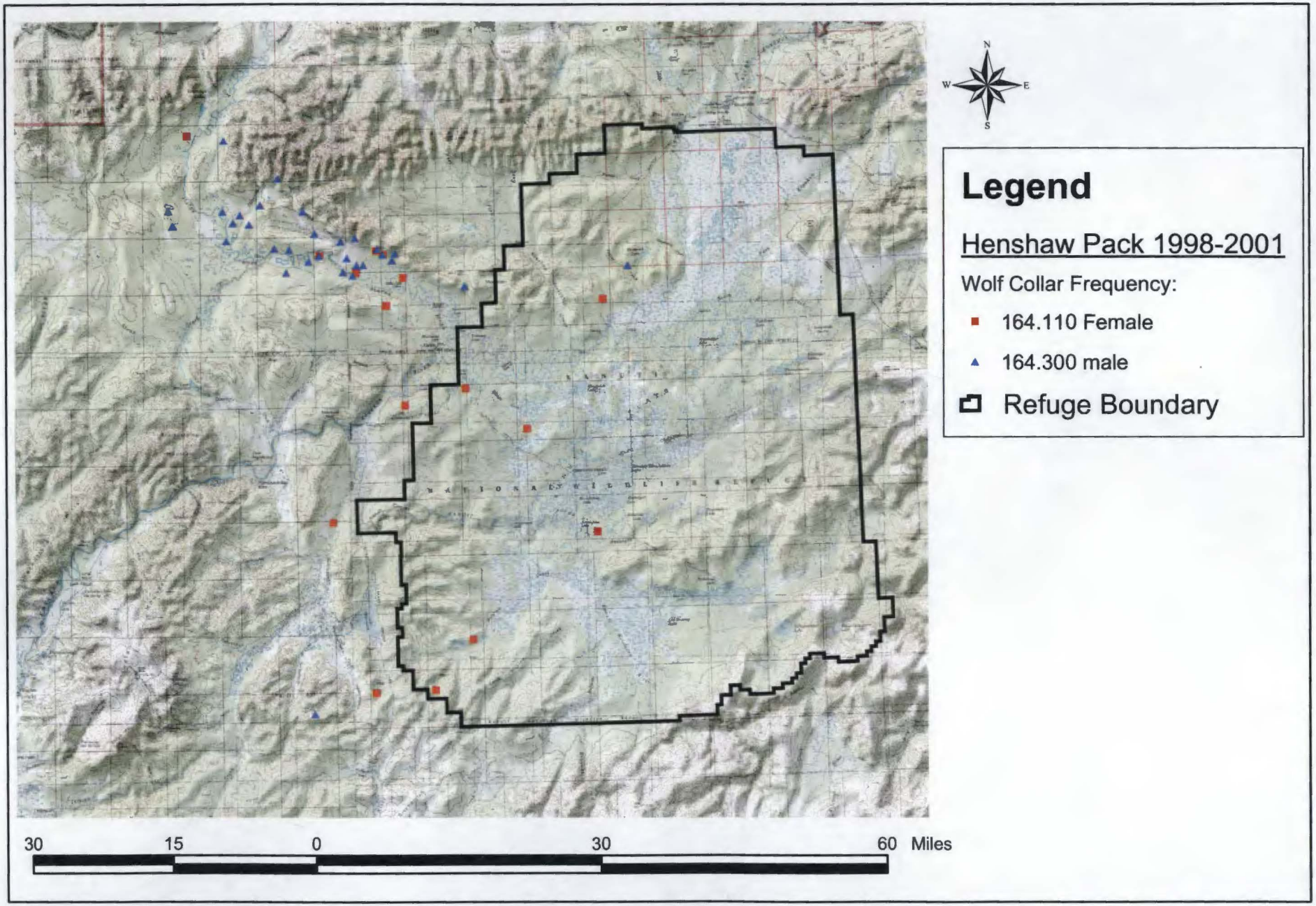

Figure 2. Henshaw Pack locations including female dispersal, 1998-2001, Kanuti National Wildlife Refuge.

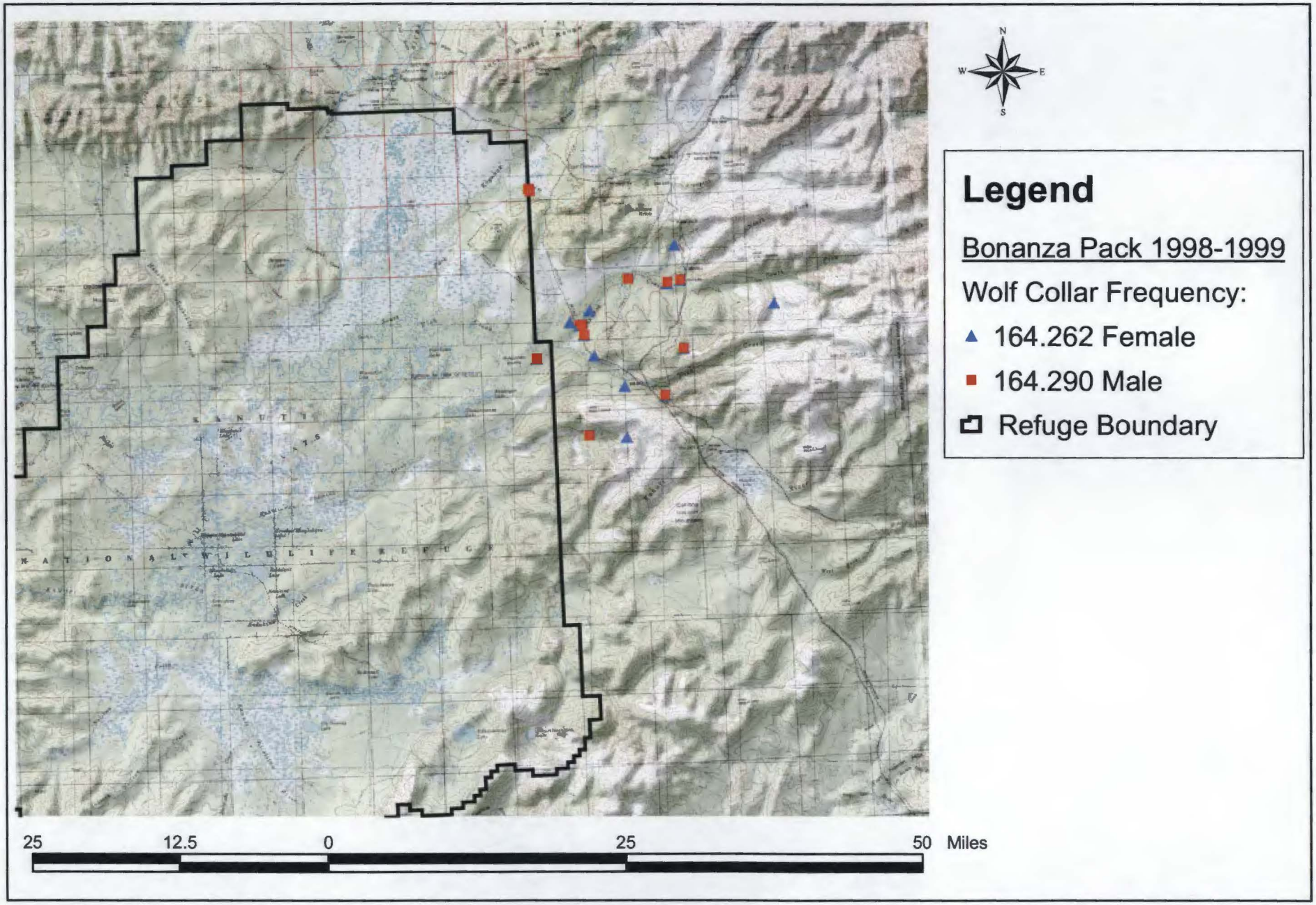

Figure 3. Bonanza Pack locations, 1998-1999, Kanuti National Wildlife Refuge.

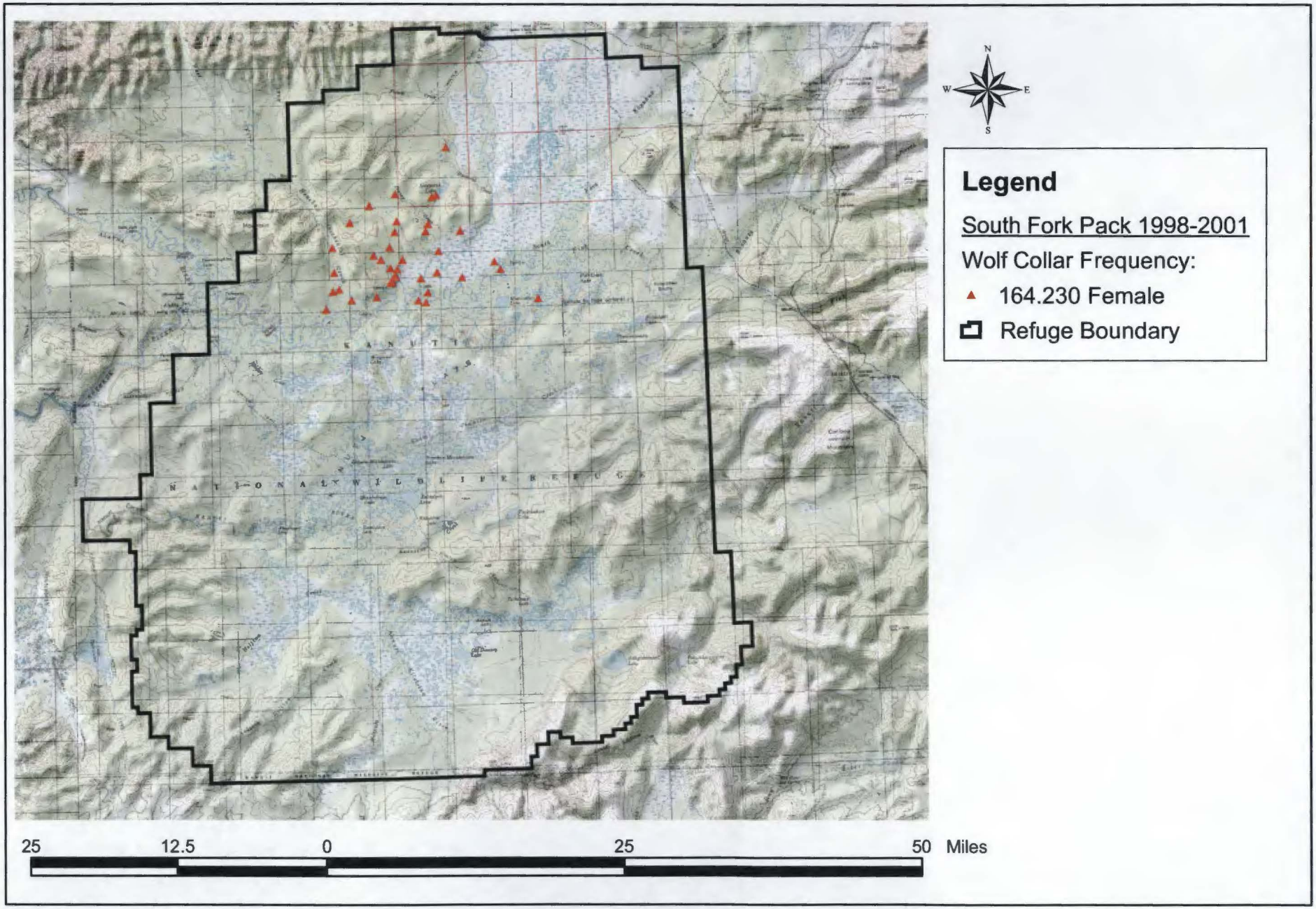

Figure 4. South Fork Pack locations, 1998-2001, Kanuti National Wildlife Refuge.

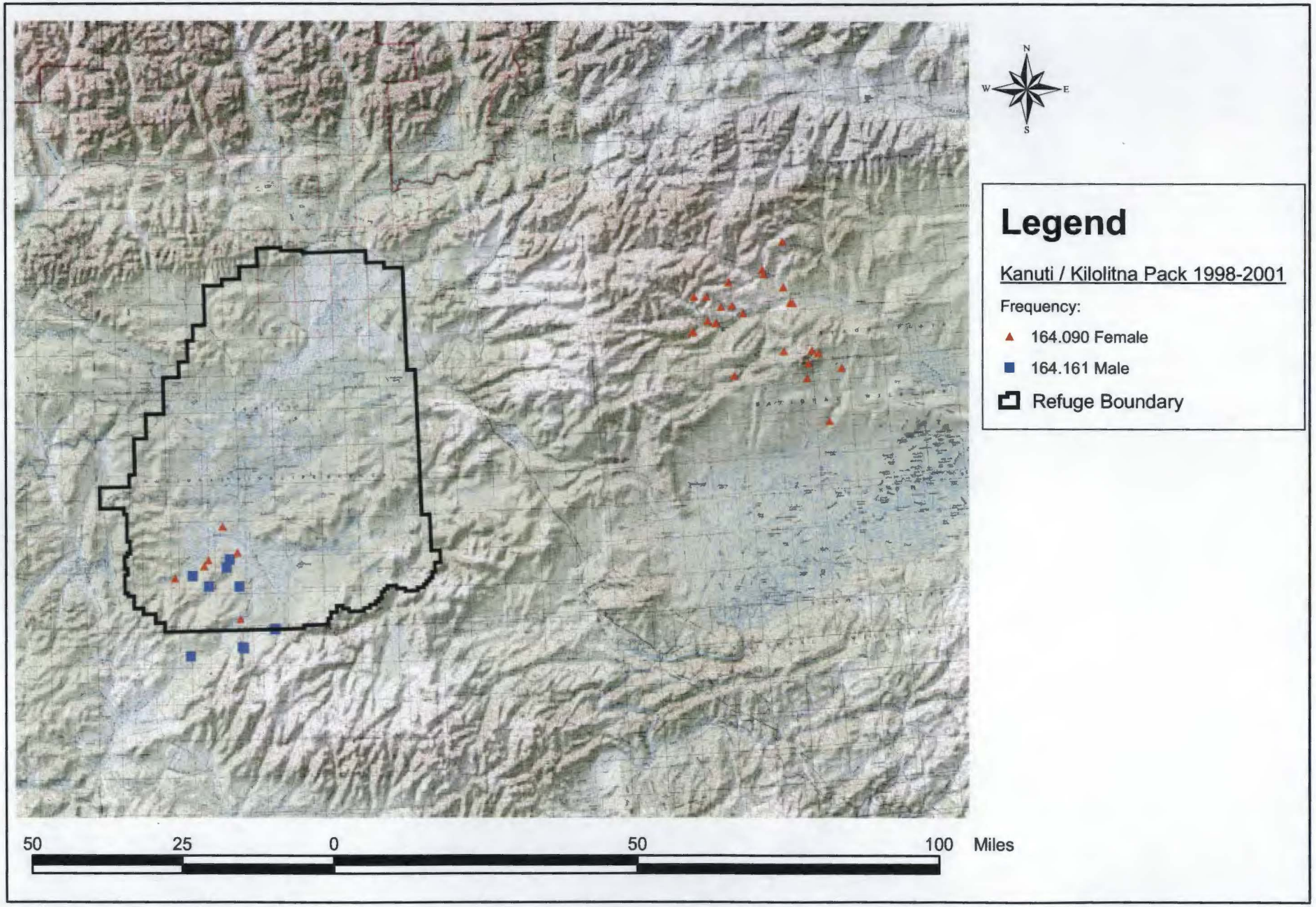

Figure 5. Kanuti / Kilolitna Pack locations including female dispersal, 1998-2001, Kanuti National Wildlife Refuge.

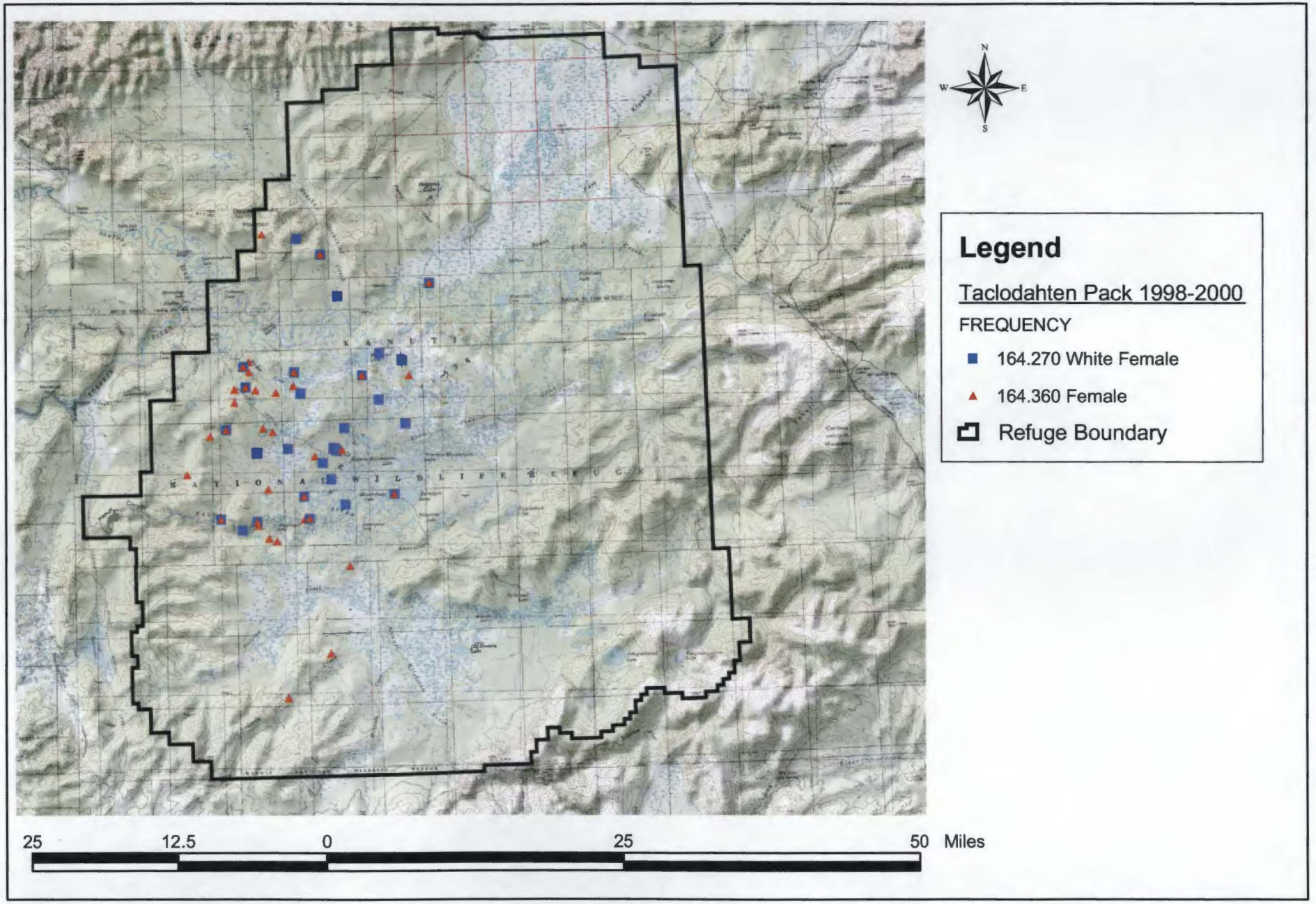

Figure 6. Taclodahten Pack locations, 1998-2000, Kanuti National Wildlife Refuge.

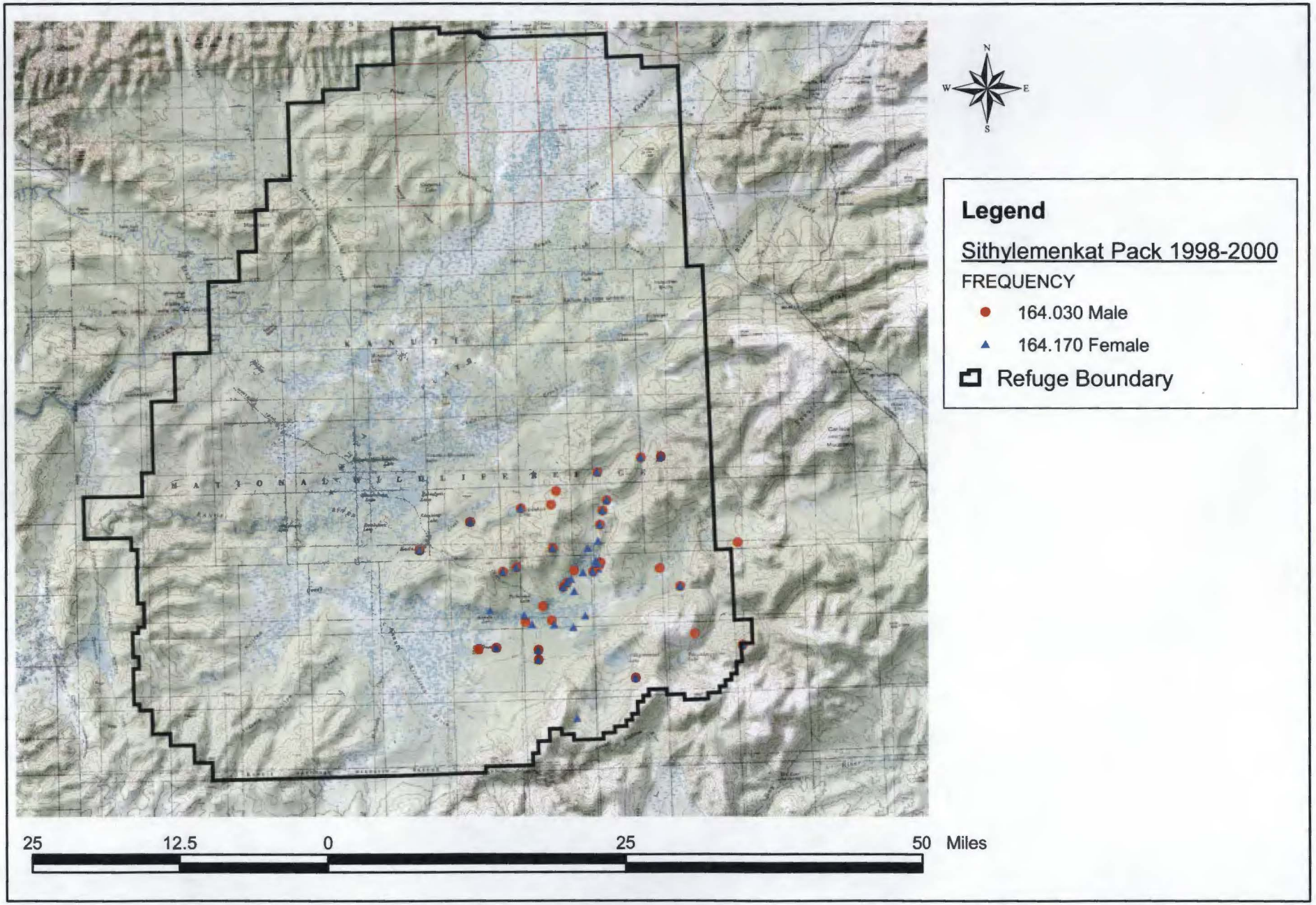

Figure 7. Sithylemenkat Pack locations, 1998-2000, Kanuti National Wildlife Refuge.

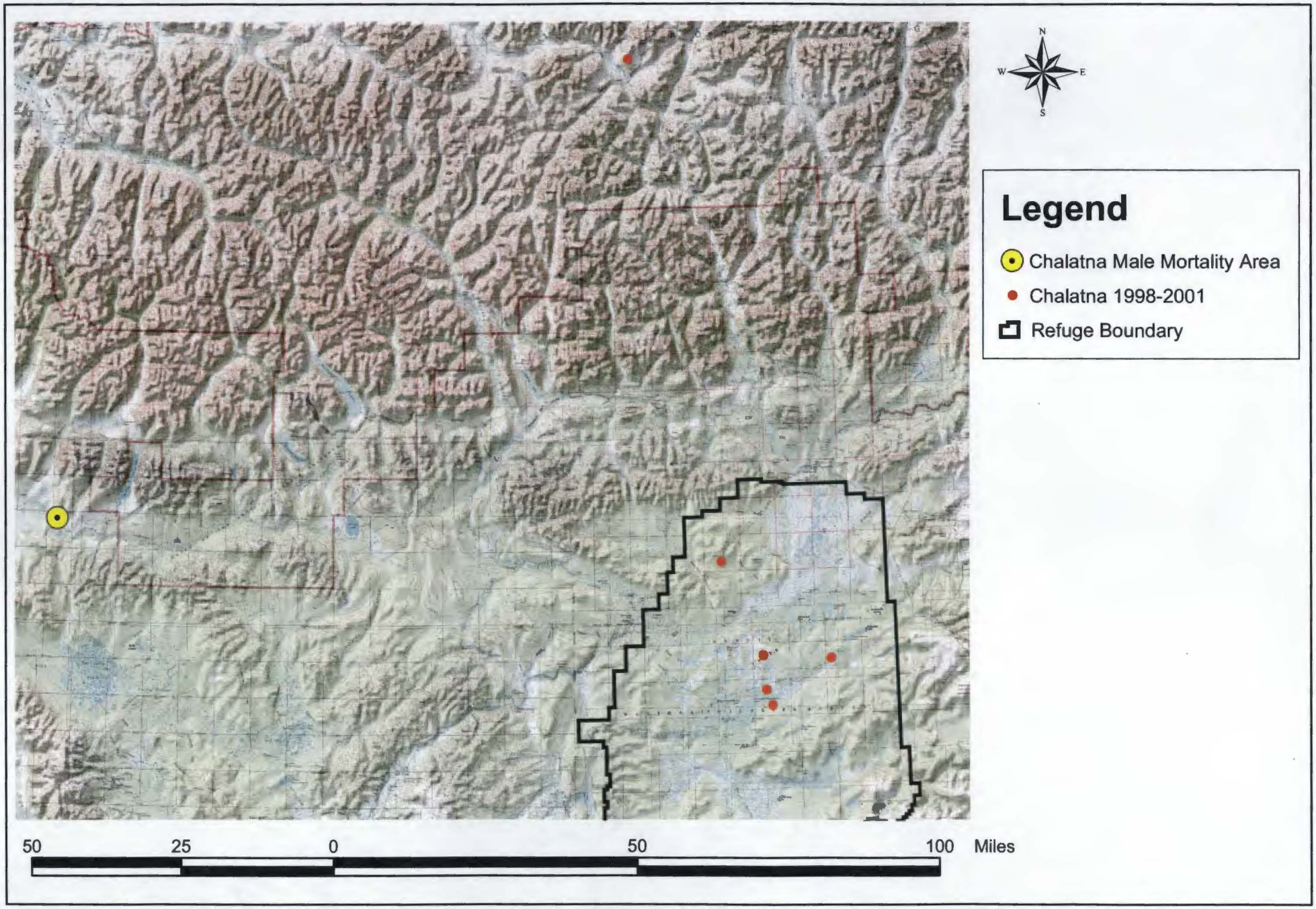

Figure 8. Movements of Chalatna male, 1998-2001, Kanuti National Wildlife Refuge.