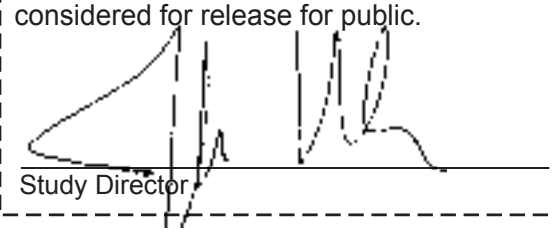
WEST KITIKMEOT / SLAVE STUDY SOCIETY

Re: Wolverine Ecology, Distribution and Productivity in a Tundra Environment
Final Report

STUDY DIRECTOR RELEASE FORM

The above publication is the result of a project conducted under the West Kitikmeot / Slave Study. I have reviewed the report and advise that it has fulfilled the requirements of the approved proposal and can be subjected to independent expert review and be considered for release for public.



Study Director

March 14, 2001
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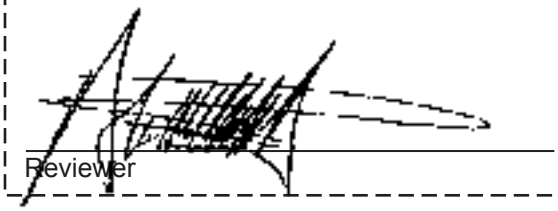
INDEPENDENT EXPERT REVIEW FORM

I have reviewed this publication for scientific content and scientific practices and find the report is acceptable given the specific purposes of this project and subject to the field conditions encountered.



Reviewer

April 12, 2001
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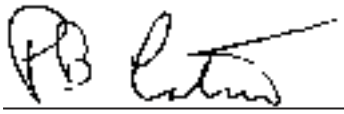
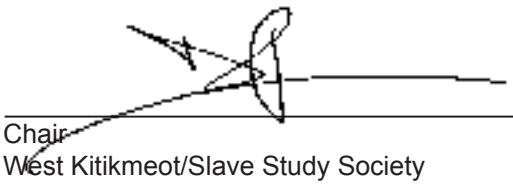


Reviewer

April 26, 2001
Date

BOARD RELEASE FORM

The Study Board is satisfied that this final report has been reviewed for scientific content and approves it for release to the public.



Chair
West Kitikmeot/Slave Study Society

June 6, 2001
Date

Wolverine Ecology, Distribution, and Productivity in the Slave Geological Province

Final Report to the

West Kitikmeot / Slave Study Society

Submitted by

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30 June, 2000

SUMMARY

There are limited data available on the distribution, abundance, and ecology of wolverine (*Gulo gulo*) in the Northwest Territories and Nunavut. It's believed that the current wolverine population on the central barrens is relatively healthy and serves as a refugia which supports the harvest of wolverines in adjacent areas. Mineral exploration and development activity in the Slave Geological Province and construction of permanent or winter roads will likely open up new areas for hunting. Increased human activity on the central barrens is anticipated to incrementally contribute to habitat loss and habitat fragmentation, increased hunting pressure, and may lead to a decline in wolverine abundance. However, an increased understanding of wolverine ecology may provide managers with a better opportunity to mitigate the pending human development pressures facing this species in northern Canada.

This wolverine research project was initiated in 1996, in collaboration with a broad range of supporters including the West Kitikmeot Slave Study Society (WKSS), the Nunavut Wildlife Management Board (NWMB), and GNWT Department of Resources, Wildlife and Economic Development (RWED). Radio telemetry was conducted within a 2,000 km^2 study area to the northwest of Lac de Gras (an area bounded by Lake Providence, and by Yamba, Eda, and Desteffany Lakes). This research attempted to describe the home range size, seasonal movements, feeding habits and reproductive parameters of wolverine on the central barrens. Another aspect of this research was to examine the sex, age and spatial distribution of the wolverine harvest in the Kitikmeot region.

The success of the capture efforts was largely due to the participation of experienced local hunters able to track wolverine using snow machines and by using baited barrel traps. Over the course of six capture sessions, 36 wolverines (15 males (M), 21 females (F)) were captured, including 13 juveniles (3 M, 10 F), 10 yearlings (5 M, 5 F) and 13 adults (7 M, 6 F). Adult male wolverine (n=8) averaged 14.8 ± 1.6 kg. The mean for adult females (n=9) was 11.4 ± 1.5 kg. Weights for yearling males (n=8) averaged 14.9 (8) ± 1.0 kg and the yearling females (n=5) averaged 10.85 ± 1.2 kg. Weights for juvenile males (n=3) averaged 9.0 ± 0.3 kg, and juvenile females (n=9) averaged 9.25 ± 0.9 kg.

As with other wolverine studies, it was challenging to keep radio collars on individual wolverine for an adequate time period in order to acquire home range data. Two females slipped their collars within days of deployment, while another eleven individuals (4 F, 7M) dropped their collars prematurely. During the course of routine telemetry flights, thirteen radio collars went "missing" from the study area. Subsequent information revealed that three of these animals had dispersed prior to being harvested. Although dispersal is a likely scenario for most "missing" animals, premature collar failure is another possible explanation. Two collared yearling females are believed to have died of natural causes, while two animals (1 M, 1 F) died as a result of a collar induced infection. Two wolverines were unsuitable for collaring and were released. Four adult females were still residing in the study area as of early January 2000.

Estimated wolverine home range sizes were 126 km^2 for adult females (n=4) and 404 km^2 for adult males (n=3) using the 95% fixed kernel method. Obtaining reliable estimates of yearling home range size was problematic, but available estimates range from 107 km^2 to 8,736 km^2 using the 95% fixed kernel method. Since various considerations are involved in calculating home range size and wolverine density, further data analysis is being carried out. The opportunistic relocation of several radio collared and ear-tagged individuals provided insight into several long-range movements. Based on straight-line distance, five females dispersed a mean distance of 133 km (range 69 - 225 km), while three males dispersed a mean distance of 231 km (range 73 - 326 km). The longest recorded movement involved a juvenile male that was collared as a transient animal to the west of Daring Lake in December 1997 and relocated several months later to the south-east of Lutsel K'e, a distance of 326 km.

During four years of monitoring the Kitimeot's wolverine harvest, between 1995/96 and 1998/99, 473 wolverines were examined from the Kugluktuk and Bathurst Inlet area. On average, 78% of the animals were shot, 15% involved quick-kill traps, and 4% involved leg-hold traps. The sex ratio of the harvest was 1.9 males : 1 female. A relatively high proportion of the harvest involved juveniles (33.7%) and yearlings (35.1%). Wolverine ages ranged from 0 (juvenile) to 10 years, with a mean of 1.4 years. The proportion of adult ($\geq$ 2 year old) females in the harvest was 11.2%.

Based on 114 female reproductive tracts, none of the juveniles (n=36), 22% of the yearlings (10 of 46), and an estimated 72% of adult females (23 of 32) produced corpora lutea. The mean corpora lutea count for both yearlings and adults was 2.7. At least seven of nine adult females handled during the telemetry study were believed to have been pregnant.

Examination of 373 wolverine stomachs indicated that 96 (25.7%) were empty. Caribou (*Rangifer tarandus*) was the primary food item identified in 172 (62.1%) of the 277 stomachs with contents. Other food items included muskox (*Ovibos moschatus*), Arctic ground squirrel (*Spermophilus parryii*), Arctic hare (*Lepus arcticus*), collared lemming (*Dicrostonyx torquatus*), brown lemming (*Lemmus sibiricus*), northern red backed vole (*Clethrionomys rutilus*), tundra vole (*Microtus eoconomus*), Arctic fox (*Alopex lagopus*), red fox (*Vulpes vulpes*), ermine (*Mustela erminea*), wolverine (*Gulo gulo*), moose (*Alces alces*), as well as unidentified ptarmigan (*Lagopus* sp.), seal, and fish species. Vegetation was observed in 16 (6%) of the stomachs. During telemetry flights, collared wolverines were observed at caribou carcasses on seven occasions. Fall and winter scats collected in the vicinity of Daring Lake revealed a high proportion of caribou in the diet.

ACKNOWLEDGEMENTS

Many private sector and government sponsors have contributed to this wolverine project, including the West Kitikmeot Slave Study Society, Nunavut Wildlife Management Board, the G.N.W.T. Department of Resources, Wildlife and Economic Development, DIAND division of Natural Resources and Environment, Department of the Environment, Canadian Wildlife Service, BHP Minerals, Diavik Diamond Mines Inc., Air Tindi Ltd., and Arctic Excursions.

This research was supported by the Dogrib Renewable Resource Committee, the Yellowknives Dene Lands and Environment Committee, and by the Hunters and Trappers Associations in Kugluktuk, Umingmaktok and Bathurst Inlet. Many individual hunters and trappers in the Kitikmeot region contributed to this study by turning in carcasses and providing kill information.

Many people, including experienced wolverine hunters, wildlife officers, government biologists, technicians, and pilots contributed to this study over the past four years. In particular, Colin Adjun, Andy McMullen and Joseph Tikak, assisted with the collection of carcasses, while Damian Panayi and Cristabelle Westwood were actively involved in the necropsy work at Kugluktuk. Allen Niptanatiak, John Lee, Stanley Klengenberg, Bobby Algona, and Kyle Algona of Kugluktuk, participated in the capture efforts at Daring Lake. Marc d'Entremont, Barry Randle and Donna Mulders assisted with data analysis and the production of graphics. Joachim Obst methodically examined stomach contents, ovaries, and processed tooth samples. Numerous DRWED staff, including Dean Cluff, Kim Poole, Steve Matthews, Anne Gunn, Albert Bourque, Ray Case, Judy Dragon, Lynda Yonge, Rob Gau and Dave Taylor offered various forms of support during this study. A number of skilled northern fixed-wing pilots helped with the collection of radio location data over the past year, including Dave Olesen and Brett Harris (Air Tindi), and Jerry Honigman and Mike Wood (Arctic Excursions).

Much of the credit for initiating and shaping this research project goes to the significant contributions made by John Lee and Allen Niptanatiak.

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1.0 OBJECTIVES

The study objectives, were to:

1) Determine wolverine spatial distribution, home range size, denning locations and fidelity to den sites;

2) Estimate the annual productivity of wolverines in the Slave Geological Province;

3) Document wolverine harvest intensity, composition, and locations from the Nunavut communities in the Slave Geological Province.

2.0 DESCRIPTION

2.1 Background

Ecological data for wolverine (*Gulo gulo*) in a tundra environment is sparse. Only five major wolverine studies have been conducted in North America (Hornocker and Hash 1981, Gardner 1985, Magoun 1985, Banci 1987, Copeland 1996). In northern Quebec and Labrador, wolverines have recently all but disappeared from the tundra. Hunting, poisoning, and diminished caribou populations in the early part of this century are implicated in their decline (Dauphine 1989). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has designated wolverines east of Hudson Bay as endangered, and those west of Hudson Bay as vulnerable. Similarly, the International Union for Conservation of Nature and Natural Resources have classified the wolverine as vulnerable throughout the Holarctic Region. The World Wildlife Fund's Conservation Strategy for Large Carnivores (Hummel 1990) highlights the wolverine as requiring research in Canada.

The Northwest Territories and Nunavut contain large undisturbed tracts of tundra habitat that may act as reservoirs to maintain harvestable populations of wolverines. Significant mineral exploration and development activity is currently under way in the Slave Geological Province. As remote areas become more accessible with the construction of permanent or winter roads, wolverine populations become more susceptible to over-harvest and disturbance. Prior to this study, there was little base-line data on the distribution, abundance or ecology of wolverines in the Slave Geological Province.

During the early stages of this ecological research in January 1996, consideration was given to possibly addressing how the presence of a winter road might affect the distribution and activity of wolverines on the central barrens. However, it quickly became evident that with insufficient resources and potential problems in adequately measuring this activity, this question was beyond the scope of this project. WKSS agreed with the decision to drop this aspect of the research and no subsequent attempt was made to investigate this issue.

2.2 Study Area

This study focuses primarily within an area of the central arctic referred to as the Slave Geologic Province (SGP), situated within Nunavut and the Northwest Territories (Figure 1). The radio telemetry aspects of this research were conducted in the vicinity of Yamba Lake, Lake Providence and Desteffany Lake. The choice of this 2,000 km^2 study area was influenced by the presence of the GNWT's Resources, Wildlife and Economic Development's (RWED's) "Tundra Ecosystem Research Station" (TERS) at Daring Lake, and its general proximity to several mineral developments. As well, this area was assumed to be representative of a relatively undisturbed wolverine population on the barrens. The reproductive components of this research were collected primarily from wolverine harvested from the Kitikmeot communities of Kugluktuk, Umingmaktok, and Bathurst Inlet.

Much of the study area is part of a well-drained peneplain with lakes in the hollows and scattered depressions. Rock hills, outcrops and glacio-fluvial features such as eskers, drumlins, and raised beaches are often the only major relief features of this region. This area is characterized by short cool summers (mean temp. of 10º C) and long cold (often below -30º C) winters. The Bathurst caribou (*Rangifer tarandus*) herd migrates annually through the study area. Within the Kitikmeot region, the adjacent Bluenose and Queen Maud Gulf caribou herds, and muskox (*Ovibos moschatus*) also provide important food items for wolverine.

2.3 Animal Capture and Collaring

Capture sessions were typically conducted in the fall (November/December) or spring (March/April) when snow cover facilitated tracking and use of snowmobiles. In March 1996, a helicopter was initially used to dart and immobilize two wolverine from the air. Given the high number of hours required to locate wolverine, however, helicopter use was found to be relatively expensive and was discontinued. Snow machines provided the primary means of ground-based transportation within the study area. Study animals were generally captured (Appendix I) by using baited barrel traps or tracked by experienced Inuit hunters using snow machines. Up to 18 barrel traps were set up for 5-7 day periods and moved around within the study area and checked on a daily basis. Captured non-target species were released without handling. Baits consisted primarily of fish, beef, and caribou scraps, as well as commercially available animal lures ("Wolverine" and "Long Distance Lures" produced by Forsyth Formula, Stan and Martine Forsyth, Alix, Alberta).

Captured wolverines were immobilized using Telazol® or Zotelil® (tiletamine HCl and zolazepam HCl) at 100 mg/ml. Anaesthesia was typically achieved using a dosage of 10 mg/kg. Drugs were usually administered using Palmer Cap-Chur darts, projected from a Cap-Chur CO_2 pistol. Since trapped and free-ranging wolverines were typically darted at

close range in the rump or shoulder, only a small amount of compression was required with the CO_2 pistol. When cuts, lesions, or dart wounds were encountered, antibiotic ointment (Hibitane®) and penicillin (Penlong®XL) were administered to reduce the chance of subsequent infection. In order to permit animals to recover from anaesthesia with some protection from harsh climatic conditions, wolverine were typically placed in a small constructed snow cave, nestled within a cluster of trees, or returned to the shelter of an open trap.

Study animal identification notation (i.e. F 530) refers to animal sex (F=female, M=male), and ear tag number. Each ear was tagged with a small aluminium tag (Jiffy, Style 893, manufactured by National Band & Tag Co., Newport, Kentucky). Although each tag is stamped with a unique number, the tag with the higher number was assigned as the animal's permanent identification number.

Most study animals were instrumented with VHF radio transmitter collars (Telonics MOD 400 (380 gm) or MOD 335 (240 gm)) in the 150-152 mhz frequency range, which included a mortality mode sensor. During the course of this project, collar specifications were modified to adjust the design and smoothness of the collar webbing, increase support and protection to the external antenna, add break-away inserts and options for increased transmission power. Most collars were equipped with canvas inserts, consisting of weaker fire hose material, which were designed to have the collar fall off the animal within 18 months of being deployed. Despite collaborative efforts with Telonics and Service Argos (Guinn and Lee, 1996), attempts to get a satellite collar to function properly on wolverine were unsuccessful.

Small fixed-wing aircraft (Aviat Husky, Piper Super Cub, and Cessna 185) provided the principle means of obtaining relocation data from the VHF collars. Aerial radio telemetry flights were generally done at 2 to 4 week intervals throughout the study period. Locations were also obtained opportunistically during ground-based capture sessions.

Wolverines were visually spotted whenever possible in order to pinpoint location and observe activity. Locations were obtained from on-board or hand held global positioning system (GPS) units.

2.4 Morphology

Captive wolverine were sexed, aged, weighed, measured, and assessed for overall tooth-wear and relative body condition. In the field, animal age was subjectively classified as juvenile (< 12 months), yearling (12 - 24 months), or adult (> 24 months), based on relative tooth wear, body size, morphology, and teat / testis measurement (Magoun 1985). Although premolar extraction would have permitted age determination by tooth cementum analysis, it was decided that no teeth would be pulled on live captured wolverine during this study. Several hair follicle samples were collected from each captured animal and banked for future genetic (DNA) analysis.

2.5 Home Range and Movements

Location data is used to estimate wolverine movements, distribution, and home range size. An Animal Movement program extension (Hooge and Eichenlaub, 1997), operating under ArcView and Spatial Analyst software, was used to calculate Minimum Convex Polygon (MCP) (Hayne, 1949) and fixed kernel estimates of home range size. In order to address the issue of autocorrelation of the location data (White and Garrott, 1990), only locations separated by at least a 24-hour period were used.

Attempts were made to locate natal den sites in order to monitor fidelity and use. Adult females with litters tend to commit themselves to a single den site, and this fidelity is usually recognized in the telemetry data between the months of February and May. As

well, the capture of lactating individuals should identify reproductively active females. Confirmation that a den is in fact a natal den requires direct evidence of tracks or visual sightings of young at this site between April - June, prior to the female vacating the den. Monitoring active wolverine den sites over several years may provide an indication of the extent to which these sites are re-used, and perhaps vulnerable (Lee and Niptanatiak, 1996).

Our intention had been to capture juveniles with the use of a snow machine, barrel trap, digging out of dens, or on foot at rendezvous sites with the use of a fish net. It was hoped that the number of young present in June may provide an estimate of recruitment. Reproductive information (pregnancy rate, *in utero* litter size) was obtained from wolverine carcasses collected in the mainland Kitikmeot communities of Kugluktuk, Umingmaktok and Bathurst Inlet.

The dynamics of juvenile dispersal is an important component in understanding how and if refugia operate to provide a supply of new residents to repopulate hunted areas. The assumption that dispersing juvenile wolverines from un-hunted areas fill the voids left by harvested animals is largely unexamined. Radio locations and ear tag returns from harvested wolverine should provide information on dispersal patterns. Hair samples (DNA) from captured wolverine will be used to identify familial relationships, and genetic material from Kitikmeot wolverine is being compared with other North American wolverine populations (Kyle and Strobeck, 1999; Wilson *et al.,* 2000).

2.6 Carcass Collection in the Kitikmeot

Wolverine carcass and harvest information was collected from hunters and trappers in the three Kitikmeot communities of Kugluktuk, Bathurst Inlet, and Umingmaktok (Fig. 1). Wolverines are harvested by quick-kill trap, leg-hold trap, or are shot during the open season, which currently extends from November 1 to April 15. Hunters and trappers

were asked to tag skinned carcasses with date and location of capture and specify the method of harvest, and were encouraged to provide carcasses from their entire season's harvest. In return for providing carcasses and information, hunters were provided compensation of $25 per carcass. This payment was provided as fair compensation for their efforts, and was not considered to be an incentive to harvest more animals than would otherwise be taken.

Skinned carcasses were stored frozen and later thawed for necropsy. Carcass measurements consisted of body length, chest girth, condylobasal length, zygomatic width, femur length and skull profile. Carcass weight was taken to the nearest 0.1 kg. The weight of the stomach contents was subtracted from the carcass weight to produce an estimated carcass weight. Effects of blood loss and dehydration were ignored.

Age was determined by cementum aging of a lower canine. The ratio of canine pulp cavity width to tooth width (Poole *et al*., 1994) was also used to identify animals in their first year (juveniles).

2.7 Feeding Habits

Stomach contents were weighed and only those with discernible contents were examined further. Contents were rinsed and dried, then examined macroscopically and microscopically. Using an experienced technician and available reference material, bones, teeth, hair fibres and feathers were used to identify most prey items. Birds were identified to family, and no attempt was made to identify fish remains to family or species. The approach was simply to determine percent occurrence by species or prey category. No attempt was made to estimate biomass per species or prey category. Scat samples were opportunistically collected on the central barrens during the radio telemetry study.

2.8 Reproduction

The female reproductive system was dissected out. Foetuses were freed from the placenta and surrounding tissue before being weighed and the crown-rump length measured. Ovaries were stored in 10% formalin and later cut longitudinally into 1 to 2 mm slices to count corpora lutea. Placental scars were not recorded. Females with corpora lutea, foetuses, or implantation sites present were considered pregnant (Banci and Harestad, 1998; Mead *et al*., 1991).

3.0 RESULTS

3.1 Capture and Telemetry

Over the course of six capture sessions, between March 1996 and February 1999, we captured 45 wolverines (Table 1). Nine of these captures involved recaptures. Of the 36 individuals handled, 15 were male, 21 were female. Among juveniles (< 12 months of age), 3 were male, 10 were female. Among yearlings (between 12 and 24 months of age), 5 were male, 5 were female. Among adults (> 24 months of age), 7 were male, 6 were female. A detailed chronology of wolverine captures is outlined in Appendix I. This list excludes the barrel trap capture and relocation of a juvenile male (M 561) from the Diavik camp in February 1998, and a juvenile female (F 564) and adult male (M 567) from the Ekati site in March 1998.

In March 1996, two male wolverines were captured by darting from a helicopter. Given the difficulty and expense involved with this method, subsequent captures were carried out using baited barrel traps (25 captures) and by darting from snow machines (18 captures). Captured non-target species included arctic fox (*Alopex lagopus*), red fox (*Vulpes vulpes*), arctic hare (*Lagopus arctos*), and marten (*Martes americana*).

Most of the captures (n=34) occurred within a 2,000 km^2 area in the vicinity of Daring Lake (Fig. 2), an area bounded by Yamba Lake, Eda Lake, Lake Providence, and Desteffany Lake. One exception was a male (M 550) captured by helicopter to the south of Lac de Gras, which was never relocated after the initial capture. The temporal distribution of the collared wolverine during the telemetry study is represented in Fig. 3. One male (M 585) was released un-collared because of a pre-existing neck wound, possibly induced during a fight with another wolverine. A satellite collar deployed on an adult male (M 536) failed to function properly; this individual was never recaptured. Thirteen wolverine (F 530, F 577, M 518, M 522, M 525, F 540, F 538, F 548, F581, M

556, M 593, M 593 and M 597) “dropped” their collars in or near the study area. Females F 577 and F 540 actually “slipped” their collars within 5 and 17 days of deployment, respectively. The remaining eleven wolverine tore the collar webbing, usually at the break-away insert, after an average period of 358 days (range 179 - 621 days). On average, females dropped their collars after 428 days (n=5), while males dropped them after 308 days (n=7). These dropped collars were identified and recovered with the assistance of a built in "mortality mode" signal on the collar. This feature also led to the recovery of four wolverines that died while wearing their collars. Two yearling females (F 558 and F 589) are believed to have died of natural causes after dispersing from the study area. Although little remained of their carcasses, it’s believed that these individuals may have been malnourished and vulnerable to predation, possibly by a wolf, a grizzly bear, or by another wolverine. Two other wolverines (F 542 and M 546) were found intact and are believed to have died as result of a collar induced infection. A small protruding edge on several collars likely contributed to a small laceration of the neck, which subsequently led to a fatal bacterial infection. During subsequent recapture efforts, radio collars with this design were removed from two individuals (M 520 and F 52) which were showing signs of hair loss in the neck area.

During this telemetry study, 13 collared wolverine (M 550, M 528, F 544, F 532, F 534, M 583, M 552, F 587, M 554, F 572, F 574, F 90, F 599) went “missing” from the study area. Although dispersal is the most likely explanation when radio signals are not found, premature collar failure and /or the loss of the collar in water bodies or in rocky outcrops are also possibilities. Of these 13 missing collars, however, eventually it was learned that in fact three of these animals had dispersed before being harvested. One ear-tagged male (M 583) was shot (collarless) near Bathurst Inlet 20 months after leaving the Daring Lake area as a yearling. Another ear-tagged yearling male (M 552) was harvested (collarless) near Lutsel K’e about 14 months after passing through our study area as a juvenile. Ear-tagged yearling female F 572 was harvested (collared) north-west of Contwoyto Lake two months after dispersing from the study area. As of December 1999, four collared females

(F 530, F 569, F 88, and F 90) were still residing in the Daring Lake area. No kits were captured or handled during the radio telemetry portion of this study.

3.2 Morphology

Key weights and measurements obtained from wolverines captured during this study are outlined in Tables 2 and 3, for females and males respectively. Adult male wolverine (n=8) averaged 14.8 ± 1.6 kg, while the mean for adult females (n=9) was 11.4 ± 1.5 kg. Weights for yearling males (n=8) averaged 14.9 ± 1.0 kg, while yearling females (n=5) averaged 10.85 ± 1.2 kg. Weights for juvenile males (n=3) averaged 9.0 ± 0.3 kg, while juvenile females (n=9) averaged 9.25 ± 0.9 kg. Only weight and measurement data obtained for individuals during each initial capture were used to calculate group means. Although these small sample sizes limit any meaningful statistical comparison, there appears to be little variation in body weight between the “yearling” and “adult” age classes for both sexes.

Average teat length has been used in age determination for female wolverine (Magoun, 1985). All nine individuals we classified as "juveniles" and three of the five “yearlings” showed essentially no teat development (≤ 1 mm). Adult females had teat lengths ranging from 3 mm to 8 mm (Table 2). Testes development was used as one indicator of age in male wolverine. Testes were not descended in juvenile males, at least through to the age of 8 months. For males older than 12 months, paired testis length ranged from 14.5 mm to 40 mm; paired testis width ranged from 7.0 mm to 27 mm (Table 3), although three of the males classified as "yearlings" did not appear to have distended testes.

3.3 Home Range and Movements

Although this summary will make reference to "annual" home ranges, the locations collected in a given year will vary in terms of how they are distributed throughout the year and do not adhere to a precise 12 month time period. Unfortunately, the shortage of location data obtained during this study will influence how much confidence can be placed on the home range estimates obtained, and ultimately how comparable these results are with other wolverine studies. Using an arbitrary minimum threshold of 22 way-points to calculate the minimum convex polygon (MCP) home range size, four adult females (F 530, F 52, F 88 and F 540) used a mean MCP area of 90 km^2, or 126 km^2 using the 95% fixed kernel method (Table 4). Three adult males (M 520, M 528, M 525) used a mean MCP area of 228 km^2, or 404 km^2 using the 95% fixed kernel method. A single female yearling (569), handled as a juvenile on 2 February 1999, used a MCP area of 104 km^2, or 107 km^2 using the fixed kernel method. Using 22 locations as our minimum standard, none of the remaining 28 collared individuals (15 female, 13 males) technically offer sufficient data to calculate home ranges. However, a cursory examination of the home ranges for some of the yearlings and even several adults suggests that MCP areas in the range of 104 km^2 - 3,938 km^2 are being used (Table 4). Despite the limitations in the volume of available data, an overview of the distribution of all captured wolverine, by capture session are presented in Fig. 4 (March '96), Fig. 5 (Nov. '96), Fig. 6 (April '97), Fig. 7 (Dec. '97), Fig. 8 (April '98) and Fig. 9 (Feb. '99). Over the course of four years, adult female 530 occupied an MCP area of 214 km^2. The distribution of her annual home ranges in 1996 (66 km^2), 1997 (133 km^2), 1998 (50 km^2) and 1999 (104 km^2) are presented in Fig. 10.

With the aid of radio collars and ear-tags, this study was able to document the long range movements of eight wolverines from the Daring Lake area. Females F 574, F 572, and F 587 dispersed northward, and moved 69 km, 83 km, and 97 km respectively from the

northern edge of their home ranges (Fig. 11). Female F 572 was harvested NW of Contwoyto Lake within two months of dispersing. Yearling male M 597 dispersed 73 km to the south before dropping its collar. During mid-winter, yearling female F 544 travelled 225 km to the SE of Lutsel K'e. The following summer its collar was detected in the Daring Lake area on two occasions. Similarly, yearling female F 90 conducted a 189 km excursion to the north shore of Great Slave Lake's McLeod Bay in March 1999. By mid-April it had returned to the Daring Lake area. Yearling male M 583 went missing in June 1997 and was reported as having been harvested near Bathurst Inlet 20 months later. This male travelled a minimum distance of 295 km. Juvenile male 552 disappeared shortly after being collared in December 1997. It's frequency was subsequently picked up in March 1998 to the SE of Lutsel K'e, a minimum distance of 326 km from Daring Lake (Fig. 11). Male M 552 was eventually harvested near Lutsel K'e.

3.4 Patterns of Harvest in the Kitikmeot

Although wolverine harvest information has been collected in the Kitikmeot region since 1986 and will likely be continued by Nunavut's Department of Sustainable Development, this report focuses on the harvest between 1995/96 and 1998/99. During this four year period, a total of 473 wolverine were harvested primarily within Nunavut's Kitikmeot region (Fig. 1). Most of the harvest occurred to the south and west of Kugluktuk and in the immediate vicinity of Bathurst Inlet (Fig. 12). As well, some animals were harvested on Victoria Island, Coronation Gulf, and opportunistically by Kugluktuk residents working at Lupin Mine or operating out of outpost camps in the Contwoyto Lake area.

Since hunters and trappers in the Kitikmeot do not have registered or traditionally exclusive family trap lines or hunting areas, wolverines are generally harvested wherever people travel. The number of hunters and trappers involved in the annual Kitikmeot harvest ranged from 34 - 48 individuals. On average, 78% of the animals were shot, 15%

were taken with quick-kill traps, and 4% were taken with leg-hold traps (Table 5). The sex ratio of the harvest averaged 1.9 males : 1 female. Preliminary analysis suggests that, as a harvest method, trapping results in a relatively even sex ratio of 1:1. In contrast, twice as many males tend to be harvested when animals are tracked and shot. Harvested wolverine ranged from 0 (< 12 months) to 10 years of age, with a mean age of 1.4 years. This relatively low mean age can be attributed to the high proportion of juveniles (33.7%) and yearlings (35.1%) in the harvest (Fig. 13 and Table 6). In combination with the skewed sex ratio of the harvest, adult (≥ 2 years of age) females only comprised 11.2% (range: 9.2 - 13.1%) of the annual harvest.

3.5 Feeding Habits

During the telemetry flights, involving 559 viewing opportunities, wolverines were observed at caribou carcasses on seven occasions. At one of these sites, on the ice along the shoreline of Lake Providence, only a pool of frozen blood remained where a caribou carcass had recently lain. Although M 595's collar was clearly audible on the adjacent shoreline, this animal was not visible. This male had likely butchered and cached this caribou carcass. At two of these caribou carcasses, wolverine were observed in close proximity to wolves. Female F 90 was spotted near three wolves, while F 522 was observed within several feet of a lone wolf.

Examination of late fall and winter scats (n=32) from the Daring Lake area indicated a high proportion of caribou bone in the diet. Other species identified in winter scats included arctic ground squirrel (*Spermophilus parryii*), arctic hare (*Lepus arcticus*), ptarmigan (*Lagopus* sp.), lemming (Microtus sp.) and an unidentified fish species. Caribou (*Rangifer tarandus*), red fox (*Vulpes vulpes*), and a lemming were identified in scats (n=5) collected in August. The high proportion of caribou bone and clay found in winter scats would suggest that wolverine may be relying on cached caribou bones.

Most of our data on wolverine feeding habits was collected during the necropsy of wolverines harvested during the winter months in the Kitikmeot region. Of the 373 stomachs examined, 96 (25.7%) were empty. Vegetative material was found in 16 of the stomachs, although it's unclear whether this was consumed intentionally or whether it was inadvertently ingested while consuming prey items. The primary prey items identified in the remaining 277 stomachs are listed in Table 7. Caribou (*Rangifer tarandus*) was by far the most frequently encountered prey species; it was identified in 172 (62.1%) of the stomachs. Muskox (*Ovibos moschatus*) occurred in 31 of the stomachs, while there was a single occurrence of moose (*Alces alces*) in the stomach of a wolverine harvested on the eastern shores of Great Bear Lake. Arctic ground squirrels (*Spermophilus parryii*), likely cached earlier in the season, occurred in 15 of the stomachs. Collared lemming (*Dicrostonyx torquatus*) (6), brown lemming (*Lemmus sibiricus*) (2), northern red backed vole (*Clethrionomys rutilus*) (1) and tundra vole (*Microtus oeconomus*) (1) were collectively found in 5% of the stomachs. Arctic hare (*Lepus arcticus*) was identified on 3 occasions, while ptarmigan (*Lagopus* sp.) showed up in 13 stomachs. Arctic fox (*Alopex lagopus*) (3), red fox (*Vulpes vulpes*) (2), and ermine (*Mustela erminea*) (1) were also identified. A wolverine (*Gulo gulo*) claw was found in one stomach. Ten of the wolverine taken in the vicinity of Coronation Gulf had seal hair in their stomachs. Wolverines have occasionally been observed out on the sea-ice, and were observed hunting ringed seals pups in their lairs (Anne Gunn, pers. com.). However, the harvest dates for these wolverine carcasses (1 in November, 5 in December, 1 in January, and 3 in February), suggests that these ten wolverine were not hunting seal pups during the pupping season (late March - end of April).

3.6 Reproduction

The collection of productivity data during the telemetry study was limited. Despite routine aerial flights and dedicated searches for kits each June, only one kit was spotted

on 15 June, 1997. This individual was associated with female F 548 and was observed at a caribou kill site. During capture sessions, yearling and adult females were examined closely in order to assess their reproductive status. Female 530 was observed lactating in the spring of 1996, 1997 and 1999. Although she was not lactating on 11 April 1998, palpation of F 530's abdominal area suggested that she was pregnant with two foetuses. Based on lactation and the likely presence of foetuses, we determined that females F 538 (30 March 97), F 548 (31 March '97), F 52 (8 April '98), F 581 (11 April '98), and F 540 (17 April '98), were producing kits. Although F540 was classified as a yearling in November 1996, she would have been two years of age in April '98. Therefore, of nine adult (≥ 2 years of age) females handled, it's reasonable to assume that at least seven produced kits. The reproductive status of females F 542 (11 November '96) and F 599 (16 February '99) was unknown, but would have been difficult to determine at these relatively early dates (Wright and Rausch, 1955). No attempts were made to excavate any maternal dens in late spring to determine litter size.

Additional quantitative data on wolverine reproductive potential was obtained from carcasses examined in the Kitikmeot region. Reproductive tracts of 114 females were examined for the presence of corpora lutea (Table 8). None of the juveniles (n=36), 22% of the yearlings (10 of 46), and an estimated 72% of adult females (23 of 32) had produced corpora lutea. The mean count of corpora lutea per individual was 2.7 for yearlings as well as for adults (≥ 2 years of age).

Since maintaining VHF collars on wolverine for more than several months posed a serious challenge, there were few opportunities to assess whether on not females showed fidelity to particular areas or to specific natal den sites. Only one female (F 530) provided sufficient data to exhibit fidelity to a one geographic area over a four year period (Fig. 10). However, since few attempts were made to dig out the various snow dens identified, little insight was gained into the types of snow dens being used or into the level of fidelity to natal den sites.

4.0 DISCUSSION

4.1 Capture and Telemetry

The collection of wolverine telemetry data has been challenging. A considerable amount of time and effort is required to capture wolverine in order to deploy radio collars. Once deployed, two collars slipped off within days, and eleven collars dropped off prematurely. In addition, 13 collared wolverine went missing. Although the fate of three animals was eventually determined, the fate of the remaining ten wolverine is unknown. The most likely explanation is that these individuals were transient and have dispersed. Within financial constraints, attempts were made to expand the search area of the tracking flights in an effort to locate these collared animals. Although there was some success in opportunistically locating several missing collars, the central barrens is vast and the fate of some of these collars and wolverine could not be determined.

The collection of home range data has been confounded by several problems. Most collars are equipped with canvas inserts, consisting of weaker fire hose material, designed to allow the collar to break away from the animal within 18 months of being deployed. However, the inclusion of this "break-away" insert has allowed a number of collars to fall off prematurely. Although the intent had been for collars to last for at least one year, since November 1997 eight of the deployed collars have broken away after an average period of only eight months (range 6 - 10 months). In addition, two wolverine were able to slip their collars off prematurely. Premature collar loss reduces the number of animal relocations and, therefore, the amount of data available to make home range calculations. In order to address this problem, the break-away portion of the collar was reinforced with additional nylon stitching and with a thin rubberized "shrink wrap" material covering the break-away area. These two modifications proved useful in extending the life of the break-away insert by at least several months. An option to increase transmission

strength (high power) of the VHF signal was adopted in order to increase the chances of relocating dispersed individuals.

There are limitations to the range that VHF radio collars can be effectively used to monitor the movements of a wide ranging species. Satellite collars would be the preferred means of documenting long-distance movements, but for technical reasons these collars have been problematic on wolverine (Guinn and Lee, 1996). This has seriously compromised the ability to document the movement of some individuals, primarily juveniles, as they disperse from the study area. New approaches, possibly involving intraperitoneal implant transmitters (Copeland, 1996), GPS collars or other satellite collar prototypes need to be explored in an effort to further increase our understanding of wolverine ecology on the central barrens.

4.2 Morphology

Additional data analysis, using multi-year necropsy data collected in the Kitikmeot region between 1985/86 and 1999/00 will be carried out and will significantly add to the understanding of wolverine morphology, health and condition.

4.3 Home Range and Movements

Seaman *et al*. (1999) recommends a representative sample of 30 or more locations and preferably more than 50 locations when using kernel methods. Furthermore, among kernel methods, Monte-Carlo simulations have indicated that the fixed kernel method (with the least-squares cross-validation smoothing parameter) is less biased than the adaptive kernel method (Seaman and Powel, 1996; Seaman *et al*. 1999). Unfortunately, it

has been difficult to obtain these levels of location data for wolverine on the central barrens. Further analysis of the available home range data is being conducted.

4.4 Patterns of Harvest in the Kitikmeot

The age distribution of the Kitikmeot wolverine harvest is weighted more toward yearling animals than harvests reported elsewhere. Thirty five percent of the Kitikmeot harvest (Table 6) was composed of yearlings, in contrast to 18 to 28% reported for Alaska, Yukon, and British Columbia (Banci, 1987; Liskop et al., 1981; Rausch and Pearson, 1972).Young of the year made up the largest portion of those harvests. It may be that because the harvest in the Kitikmeot is relatively concentrated, much of the take is of dispersing yearling animals moving into the harvested area.

The Kitikmeot harvest fits the general scenario common to many mustelid harvests where subadult animals are taken in greater proportion in the beginning of the season and adults become a larger proportion as the season progresses. Subadult wolverines are known to be the more transient age group and to make long distance movements during their dispersal (Gardner, 1985, Magoun 1985). Juveniles spend the first winter of their lives in general association with their maternal home range (Copeland, 1996; Magoun, 1985). Those juveniles that occur in the harvest between late October and April are likely still associated with their natal area. Somewhere between the end of this first hunting season and the end of the next, the young wolverines become quite mobile and move away from their maternal area. Young males tend to be more nomadic (Copeland, 1996; Magoun, 1985). This increased movement and likely accompanying nutritional stress could lead to an increased vulnerability that is reflected in the harvest. Magoun (1985) suggests that because male home ranges are considerably larger that those of females and in shorter supply, males tend to remain transient longer and maintain their consequent harvest vulnerability.

4.5 Feeding Habits

As indicated, no effort was made to estimate diet using prey volume or weights. Use of frequency as a measure of importance over emphasises small prey, which occur frequently and underestimates large prey which occur less often (Floyd *et al*. 1978). Since Kitikmeot hunters use a wide range of baits (typically caribou and fish) in their traps, this practise needs to be considered when interpreting the diet data (Table 7). A scavenging lifestyle implies that wolverine have a varied diet. The ability of wolverine to successfully hunt a variety of prey species is an asset in times of low food availability.

4.6 Reproduction

In the Kitikmeot region, the pregnancy rate of 72% was comparable with the Yukon (Banci and Harstad, 1988) and British Columbia (Liskop *et al*., 1981), which reported pregnancy rates of 73% and 77% respectively. Alaska reported an adult pregnancy rate of 92% (Rausch and Pearson, 1972).

Female wolverines do not become sexually mature until sometime after one year of age and no juveniles in this study were found with corpora lutea. The proportion of pregnant females, based on corpora lutea counts, increased from 22% for yearlings to 72% for adults (Table 8). Although some females do breed in their second summer, litter size and pregnancy rate can be quite variable (Hatler, 1989) and lower than for adult animals.

During the telemetry study, limited observational data precluded any meaningful insight into rates of wolverine kit production or survival in the vicinity of Daring Lake. As a result of pre and post-natal mortality, actual litter sizes observed on the ground tend to be smaller and range between 1.8 (Magoun, 1985) and 2.5 (Pulliainen, 1968).

Additional data analysis, using multi-year reproductive data collected in the Kitikmeot region (including foetal data) between 1985/86 and 1999/00 will be carried out and should significantly add to our understanding of wolverine reproductive biology on the central barrens.

Wolverine dens can vary from simple rest beds to complex natal dens with extensive tunnel networks (Pulliainen 1968; Magoun 1985) and are frequently associated with rocky scree slopes and large snowdrifts (Magoun 1985; Bevanger 1992). Although little is known about the denning requirements of wolverine on the central barrens, it would seem reasonable to assume that the abundance of rocky outcrops and snowdrifts would not be limiting factors in the selection of suitable habitat for use as natal dens. Although Lee and Niptanatiak (1996) documented the repeated use of a wolverine den over a three year period, additional marking of wolverines and den site investigations would be required in order to address the gaps in our understanding of denning ecology.

5.0 LINKS WITH PARALLEL STUDIES

The accumulation of baseline ecological data in this study should provide a basis from which to formulate and test additional hypotheses about the impact of human activity on wolverine populations on the central barrens. Nunavut's Department of Sustainable Development has decided to continue monitoring the Kitikmeot's wolverine harvest by continuing with the annual carcass collection. RWED continues to provide the mining industry with advice on how to improve on site design and garbage disposal practices, as well as assist in dealing with "problem" wolverine. In collaboration with other wolverine biologists, survival data obtained in this study will be pooled with other data sets in order to analyse wolverine survival rates across North America.

6.0 TRAINING ACTIVITIES AND RESULTS

An effort was made to include local hunters and trappers in this wildlife research project. The participation of experienced wolverine hunters from Kugluktuk has been particularly beneficial to the study of wolverine on the central barrens. The understanding of wolverine behaviour and strong land skills have been important assets in dealing with the challenge of locating and capturing wolverine. In particular, Allen Niptanatiak has acquired a sound understanding of the technical aspects of the field work, and over the years has made a strong commitment to this study. While biologists gain insight into wolverine behaviour and acquire a better appreciation for land skills, local hunters are learning about the benefits and limitations of animal capture and research techniques, and gain a better appreciation for some of the wildlife management issues facing the north.

To date, this project has taken advantage of the skills and experience available among local hunters and trappers. Allen Niptanatiak, Stanley Klengenberg, Bobby Algona and Kyle

Algona, all from Kugluktuk, and Charlie Wetrade from Rae Lakes, assisted with capture efforts in the field. A large measure of this study's capture success can be attributed to incorporating the experience and knowledge of local hunters in the tracking wolverine. In Kugluktuk, the participation of local assistants to help perform necropsies and visits by various school classes served to increase the profile of wolverine management issues within the region. Nunavut's Department of Sustainable Development plans to continue examining wolverine carcasses in the future.

7.0 EXPENDITURES AND SOURCE OF FUNDS

As per terms of the various contribution agreements, financial statements were periodically submitted over the course of the study.

8.0 SCHEDULE AND CHANGES

The final telemetry flight for this wolverine project has conducted on 8 January, 2000. Although this report will serve as the final report for the project to the West Kitikmeot / Slave Study Society, the author is committed to the dissemination of the data contained in this report to the scientific community. Major aspects of this report (patterns of harvest, reproductive characteristics, and home range and movements) will be submitted individually for possible publication in peer-reviewed, scientific journals.

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TABLES

Table 1. Summary of wolverine captures by age and sex class, and by capture method.

Field Session	Number of "new" Captures						Number of Recaptures						TOTAL	Method of Capture		
	Male			Female			Male			Female					Barrel	
	Ju	Yr	Ad	Ju	Yr	Ad	Ju	Yr	Ad	Ju	Yr	Ad		Helicopter	Trap	Snowmobile
March '96		3	3		1								7	2		5
Nov/Dec '96				4	1	2						1	8		4	4
Mar/Apr '97	1	1		2		2			1			1	8		3	5
Nov/Dec '97	2		2	1	1							1	7		5	2
April '98		1	2		1						1	3	8		8	
Feb '98				3	1	2						1	7		5	2
Totals	3	5	7	10	5	6			1		1	7	45*	2	25	18

Ju = Juvenile; Yr = Yearling; Ad = Adult

* Since capture sessions began in March 1996, 45 wolverine (28F, 16M) have been captured, of which 9 have been recaptures.

Table 2. Physical characteristics of female wolverines captured between 1996 - 1999.

Animal ID No.	Sex	Age[1] Class	Capture Date	Capture F / R [2]	Wt. (kg)	Measurements (cm) Chest	Neck	Body	Tail	Total	Teat (mm)[3] Length (n)
Adult											
52	F	A	29-Nov-96	F	10.60						7.8 (2)
52	F	A	08-Apr-98	R	10.25	44.0	29.5	81.0	21.0	102.0	
52	F	A	13-Apr-98	R	10.25						
88	F	A	09-Feb-99	F	11.50	40.0	31.0	76.0	22.0	98.0	
530	F	A	14-Mar-96	F	10.50	40.0	30.0	82.0	24.0	106.0	5.5 (2)
530	F	A	07-Dec-96	R	13.00	42.0	32.5	73.5	24.0	97.5	3.0 (2)
530	F	A	26-Mar-97	R	9.50	38.5	27.0				6.0 (3)
530	F	A	05-Dec-97	R	10.50	43.0	32.0	74.0	21.5	95.5	3.0 (1)
530	F	A	07-Dec-97	R	10.50						
530	F	A	11-Apr-98	R	10.25	42.0	29.5	81.5	20.5	102.0	6.0 (1)
530	F	A	05-Feb-99	R	11.00	44.5	30.0	77.5	22.5	100.0	3.8 (2)
538	F	A	30-Mar-97	F	10.00	45.0	31.0	85.0	20.5	105.5	4.7 (3)
540	F	A	17-Apr-99	R	10.75	44.0	30.0	85.0	23.0	108.0	8.0 (1)
542	F	A	24-Nov-96	F	15.00	48.0	32.0	83.0	23.0	106.0	3.5 (2)
548	F	A	31-Mar-97	F	11.00	44.0	31.5	87.0		87.0	4.7 (3)
581	F	A	11-Apr-98	F	11.75	42.0	31.5	81.5	22.0	103.5	
599	F	A	16-Feb-99	F	11.25	42.0	31.0	82.0		82.0	
Yearling											
90	F	Y	15-Feb-99	F	11.50	42.0	31.0	80.0	23.0	103.0	2.0 (1)
540	F	Y	23-Nov-96	F	12.50	41.5	31.0	88.0	22.0	110.0	6.5 (1)
558	F	Y	11-Dec-97	F	10.75	43.0	34.0	78.0	21.0	99.0	
581	F	Y	05-Apr-97	F	10.00	41.0	28.5	84.0	21.0	105.0	
589	F	Y	09-Apr-98	F	9.50	41.0	29.0	80.0	21.5	101.5	
Juvenile											
532	F	J	30-Nov-96	F	11.00	39.0	30.0	80.0	21.0	101.0	1.0 (1)
534	F	J	08-Dec-96	F	9.75	41.0	30.0	77.0	21.0	98.0	
544	F	J	28-Nov-96	F	11.75	40.0	31.5	81.0	20.5	101.5	1.0 (1)
564	F	J	12-Mar-98	F	10.50	39.5	30.1	83.0	21.0	104.0	
569	F	J	02-Feb-99	F	9.00	43.0	30.0	72.0	22.0	94.0	
572	F	J	02-Feb-99	F	9.50	41.5	29.5	79.5	21.0	100.5	
574	F	J	02-Feb-99	F	9.50	42.5	30.0	76.0	20.0	96.0	
577	F	J	01-Apr-97	F	9.50	40.0	29.5	87.0	22.0	109.0	1.0 (1)
587	F	J	30-Nov-97	F	9.00	43.0	30.0	74.5	21.0	95.5	

Note: 1. Estimated age at initial capture, classified as J = juvenile (< 12 months); Y = yearling (12-24 months); A = adult (> 24 months); based on relative tooth wear, body size, morphology, and teat development.

2. Capture: F = First or initial; R = Recapture.

3. Mean teat length (Number of teats measured).

- Only data acquired during the "initial" capture was used for calculating group means.

Table 3. Physical characteristics of male wolverines captured between 1996 - 1999.

Animal ID No.	Sex	Age[1] Class	Capture Date	Capture F / R [2]	Wt. (kg)	Measurements (cm)					Testes (mm) [3]	
						Chest	Neck	Body	Tail	Total	Length	Width
Adult												
520	M	A	14-Mar-96	F	14.25	48.5	35.5	89.0	21.5	110.5	40.0	27.0
520	M	A	05-Apr-97	R	16.00	52.0	39.0	90.0	22.5	112.5		
525	M	A	18-Mar-96	F	16.00	46.5	36.0	95.0	21.0	116.0	30.0	19.0
528	M	A	12-May-96	F	17.25	50.0	37.0	107.0	23.0	130.0	36.6	35.1
556	M	A	09-Dec-97	F	16.00	54.0	37.0	91.0	23.0	114.0		
567	M	A	13-Mar-98	F	12.50	41.0	33.3	84.5				
585	M	A	28-Nov-97	F	14.75	50.0	37.5	92.0			14.5	7.0
593	M	A	11-Apr-98	F	13.25	46.5	33.5	85.0	22.0	107.0	28.5	18.0
595	M	A	12-Apr-98	F	14.50	49.0	36.0	91.0	22.0	113.0	31.5	23.0
Yearling												
518	M	Y	03-Dec-96	F	13.50	46.0	33.0	89.0	23.0	112.0	32.0	18.0
522	M	Y	15-Mar-96	F	15.00	49.0	35.5	81.0	20.0	101.0	25.0	20.0
536	M	Y	28-Mar-97	F	14.50	42.5	33.0	98.0	21.5	119.5	31.5	25.0
550	M	Y	11-Mar-96	F	17.00	53.0	36.0	95.0	19.0	114.0	30.0	
583	M	Y	07-May-97	F	14.75	45.0	33.5	90.0	26.5	116.5		
597	M	Y	19-Apr-98	F	15.00	47.0	35.0	91.0	23.0	114.0	33.5	21.5
546	M	Y	28-Nov-96	F	15.25	49.0	34.0	91.0	23.5	114.5		
546	M	Y	05-Feb-97	R	14.50							
Juvenile												
552	M	J	01-Dec-97	F	8.75	42.0	31.0	78.0	19.0	97.0		
554	M	J	05-Dec-97	F	9.25	41.0	30.0	79.0	19.0	98.0		
561	M	J	09-Feb-98	F	9.00	38.0	28.9	83.5				

Note:
1. Estimated age at initial capture, classified as J = juvenile (< 12 months); Y = yearling (12-24 months); A = adult (> 24 months); based on relative tooth wear, body size, morphology, and testis development.
2. Capture: F = First or initial; R = Recapture
3. Mean length and width (mm) of left and right testicles.

- Only data acquired during the "initial" capture was used for calculating group means.

Table 4. Wolverine home range size estimates in the Daring Lake area, using minimum convex polygon (MCP) and kernel methods. Individuals with > 22 locations are highlighted in bold and italics.

Animal ID	Est.[1] Age	Capture Date	Last Contact	Days of Contact	No. of Locations	Area (km^2) MCP	95% Kernal	70% Kernal	Fate of Collar / Wolverine
Females									
530 F	A	14-Mar-96	09-Mar-97	360	***28***	***66***	***121***	***71***	Residing in study area
530 F	A	17-Mar-97	10-Mar-98	358	***24***	***133***	***107***	***15***	Residing in study area
530 F	A	06-Apr-98	05-Mar-99	333	17	50	92	37	Residing in study area
530 F	A	18-Mar-99	08-Jan-00	295	19	104	123	40	Residing in study area
530 F	A	14-Mar-96	30-Dec-99	1387	***88***	***214***	***137***	***29***	Residing in study area
542 F	A	25-Nov-96	17-Jul-97	235	15	102	299	135	Collar related Mortality
52 F	A	29-Nov-96	13-Apr-98	501	***27***	***72***	***143***	***54***	Removed collar
538 F	A	28-Mar-97	20-Apr-98	389	16	91	157	69	Dropped collar - Mort sig.
548 F	A	31-Mar-97	28-Aug-98	516	15	88	195	70	Dropped collar - Mort sig.
581 F	A	07-Apr-97	31-Mar-99	621	19	1,873	4,023	1,101	Dropped collar - Mort sig.
88 F	A	09-Feb-99	30-Dec-99	325	***23***	***72***	***80***	***11***	Residing in study area
599 F	A	17-Feb-99	18-Oct-99	244	16	1,595	3,398	1,844	Likely dispersed to NE
540 F	Y	25-Nov-96	04-May-98	526	***29***	***108***	***181***	***57***	Dropped collar - Mort sig.
558 F	Y	11-Dec-97	15-Jul-98	217	10	43	126	59	Natural Mortality
589 F	Y	09-Apr-98	06-Aug-98	120	8	1,628	8,736	3,315	Natural Mortality
90 F	Y	15-Feb-99	07-Dec-99	296	15	2,111	3,659	1,111	Residing in study area
544 F	J	28-Nov-96	15-Jul-98	595	11	3,938	8,642	4,065	Missing since July '98
532 F	J	02-Dec-96	06-Dec-96	5	2				Missing since Dec '96
534 F	J	09-Dec-96	13-Jun-97	187	5	44	262	142	Missing since June '97
587 F	J	01-Dec-97	05-Jun-98	187	3				Missing since June '98
569 F	J	02-Feb-99	30-Dec-99	332	***23***	***104***	***107***	***50***	Residing in study area
572 F	J	02-Feb-99	30-Nov-99	302	13	1,446	1,736	372	Harvested near Lupin
574 F	J	02-Feb-99	16-Sep-99	227	13	1,110	1,675	411	Dispersed to the NW
577 F	J	01-Apr-97	05-Apr-97	6	1				Dropped collar - Mort sig.
Males									
520 M	A	11-Mar-96	04-Apr-97	390	***32***	***165***	***270***	***142***	Collar removed, released
528 M	A	12-Mar-96	07-Mar-97	361	***24***	***351***	***665***	***325***	Missing since March '97
525 M	A	18-Mar-96	13-Jun-97	453	***28***	***167***	***276***	***116***	Dropped collar - Mort sig.
585 M	A	28-Nov-97	28-Nov-97	1	1				Not collared -due to injury
556 M	A	09-Dec-97	28-Aug-98	263	12	376	764	251	Dropped collar - Mort sig.
593 M	A	13-Apr-98	08-Oct-98	179	10	205	446	158	Dropped collar - Mort sig.
595 M	A	13-Apr-98	29-Jan-99	292	12	112	341	179	Dropped collar - Mort sig.
550 M	Y	11-Mar-96	11-Mar-96	1	1				Missing since March '96
518 M	Y	12-Mar-96	17-Jan-97	312	12	1,596	3,900	1,970	Dropped collar- Mort sig.
522 M	Y	15-Mar-96	05-Feb-97	328	18	1,795	1,298	256	Dropped collar - Mort sig.
546 M	Y	28-Nov-96	05-Feb-97	70	5	30	210	66	Collar related Mortality
536 M	Y	26-Mar-97	31-Mar-97	12	5	72	330	160	Satelite collar - failure
583 M	Y	07-Apr-97	26-Feb-99	68	6	114	476	188	Harvested - Bathurst Inlet
597 M	Y	20-Apr-98	18-Mar-99	333	12	330	705	280	Dropped collar - Mort sig.
552 M	J	01-Dec-97	09-Sep-98	114	4	900			Harvested near Lutsel 'Ke
554 M	J	05-Dec-97	09-Oct-98	309	2				Missing since Oct. '98

1. Estimated age at initial capture, classified as J = juvenile (< 12 months); Y = yearling (12-24 months); A = adult (> 24 months); based on relative tooth wear, body size and morphology.

Table 5. Summary of the Kitikmeot wolverine harvest between 1995/96 and 1998/99.

Parameter	Harvest Season (November - April) 1995/96	1996/97	1997/98	1998/99	Total
No. of Carcasses	85	132	145	111	**473**
No. of Hunters	34	42	48	41	-
Harvest Method:					
Shot	83.5%	71.0%	73.1%	90.1%	**78.2%**
Trap - quick kill	15.3%	21.4%	15.9%	6.3%	**15.0%**
Trap - leg hold	0	6.1%	4.1%	3.6%	**3.8%**
Unknown	1.20%	1.5%	5.5%	0	**3.0%**
Male : Female Ratio	1.9 : 1	1.7 : 1	1.7 : 1	2.4 : 1	**1.9 : 1**
Mean Age (years)	1.1	1.5	1.4	1.7	**1.4**
Age range (years)	0* - 7	0* - 10	0* - 10	0* - 9	0* - 10

* Age of "0" refers to young-of-the-year or Juvenile.

Table 6. Sex and age of wolverines harvested by hunters and trappers from Kugluktuk, Umingmaktuk, and Bathurst Inlet from 1995/96 to 1998/99. Numbers in parathesis are percent of column.

		Harvest Period				
SEX	**Age Class**	**1995/96**	**1996/97**	**1997/98**	**1998/99**	**TOTALS**
Female (34.9 %)	Juvenile	8 (9.4)	18 (15.3)	15 (10.3)	8 (7.2)	49 (10.4)
	Yearling	13 (15.3)	17 (12.2)	20 (13.8)	13 (11.7)	63 (13.3)
	Adult	8 (9.4)	14 (9.2)	19 (13.1)	12 (10.8)	53 (11.2)
Male (65.1 %)	Juvenile	26 (30.6)	30 (22.9)	35 (24.1)	19 (17.1)	110 (23.3)
	Yearling	16 (18.8)	26 (19.1)	26 (17.9)	35 (31.5)	103 (21.8)
	Adult	14 (16.5)	27 (21.3)	30 (20.7)	24 (21.6)	95 (20.1)
Total		**85** (100)	**132** (100)	**145** (100)	**111** (100)	**473** (100)

Table 7. Prey items identified in the stomachs (n=277) of Kitikmeot wolverine harvested during the winters of 1995/96 - 199

Order	Family	Common Name	Species	Frequency	% of Stomachs
ARTIODACTYLA	Cervidae	Caribou	*Rangifer tarandus*	172	62.09%
	Cervidae	Moose	*Alces alces*	1	0.36%
	Bovidae	Muskox	*Ovibos moschatus*	31	11.19%
RODENTIA	Scuridae	Arctic Ground Squirrel	*Spermophilus parryii*	15	5.42%
MICROTINA	Muridae	Unidentified Microtus spp.		5	1.40%
		Collared Lemming	*Dicrostonyx torquatus*	6	2.17%
		Brown Lemming	*Lemmus sibiricus*	2	0.72%
		Red Backed Vole	*Clethrionomyx rutilus*	1	0.36%
		Tundra Vole	*Microtus oeconomus*	1	0.36%
				14	5.05%
LAGOMORPHA	Leporidae	Arctic Hare	*Lepus arcticus*	3	1.08%
PINNIPEDIA	Phocidae	Unidentified seal spp.		10	3.61%
CARNIVORE	Canidae	Arctic Fox	*Alopex lagopus*	3	1.08%
	Canidae	Red Fox	*Vulpes vulpes*	2	0.72%
	Mustelidae	Ermine	*Mustela erminea*	1	0.36%
	Mustelidae	Wolverine	*Gulo gulo*	1	0.36%
AVES		Unidentified ptarmigan spp.		13	4.69%
PISCES		Unidentified fish spp.		3	1.08%
Vegetation		Unidentified spp.		16	5.78%

Table 8. Estimated age-specific productivity for female wolverine in the Kitikmeot region, 1995/96 - 1997/98.

Age Class	0	1	2	3	4	5	6	7	8	≥ 2
Sample Size	36	46	13	7	3	3	2	3	1	32
No. Females with Corpora Lutea	0	10	7	7	2	3	1	2	1	23
% Females with Corpora Lutea	0	21.7	53.8	100.0	66.7	100.0	50.0	66.7	100.0	71.9
Mean No. of Corpora Lutea	0	2.7	2.7	3.1	4.0	1.3	1.0	2.5	2.0	2.7

FIGURES

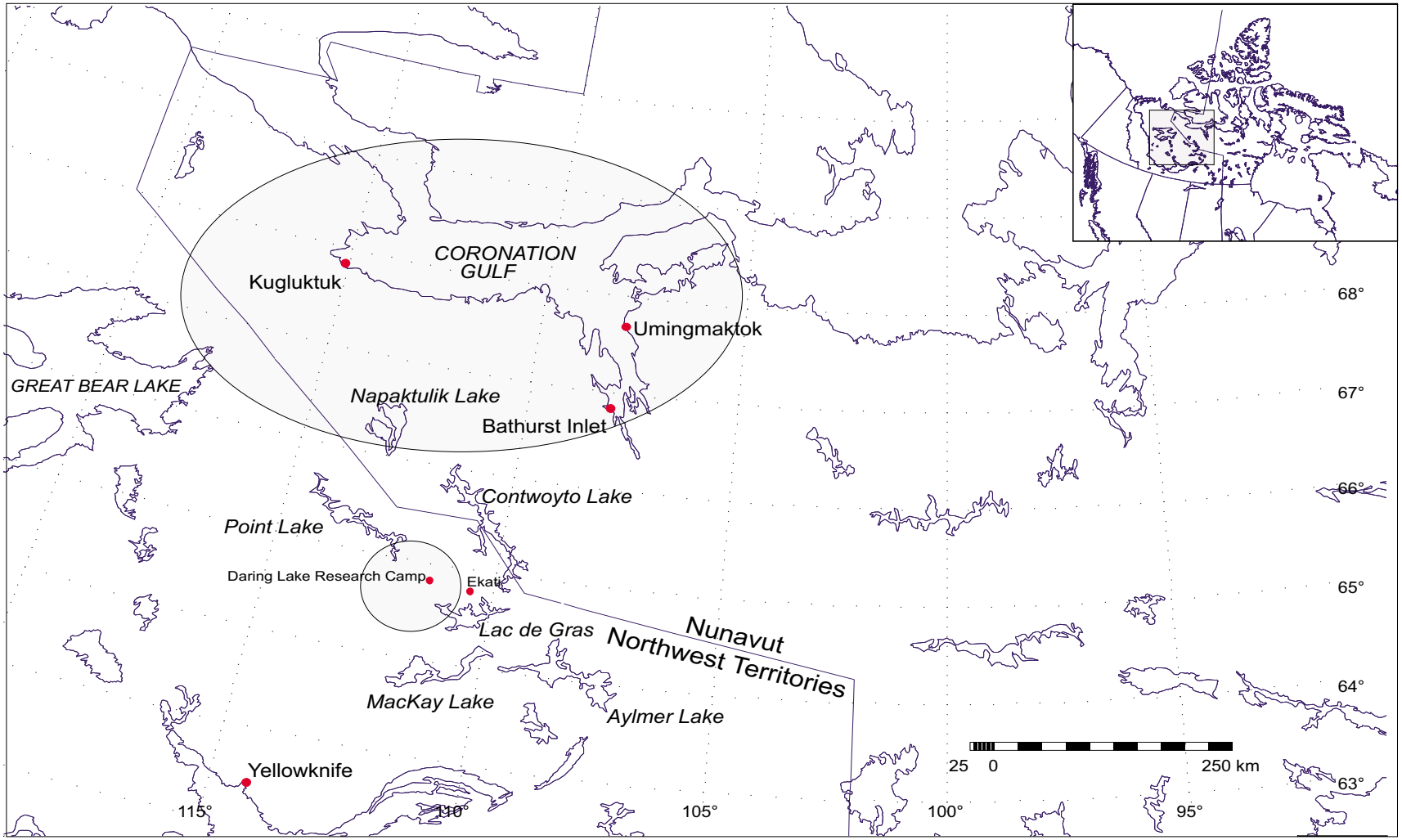


Fig. 1. Wolverine study area within the Slave Geological Province, in NWT and Nunavut. Radio collaring efforts were centred in the Daring Lake area (shaded circle), while the carcass collection occurred in the Kitikmeot region (shaded oval).

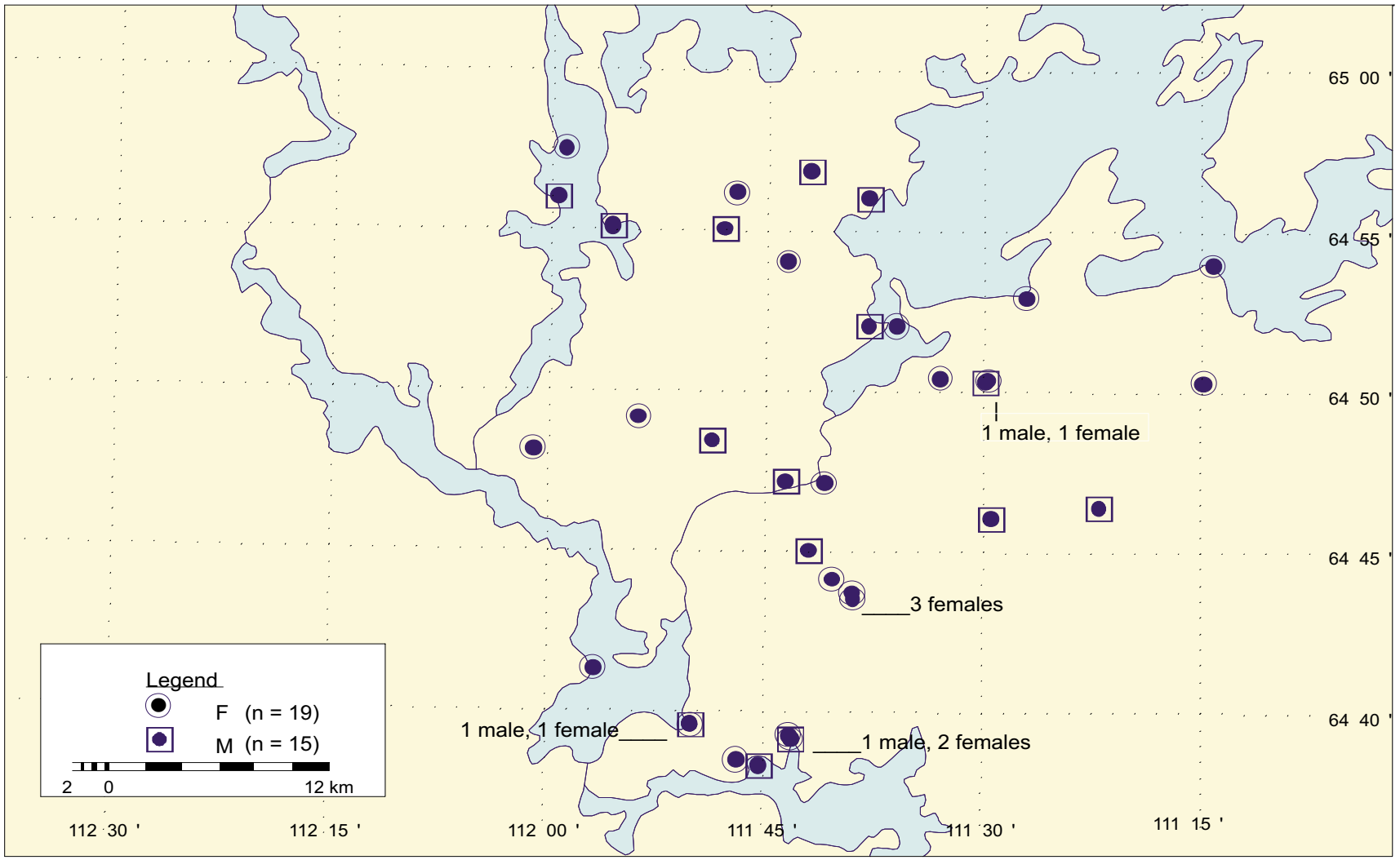
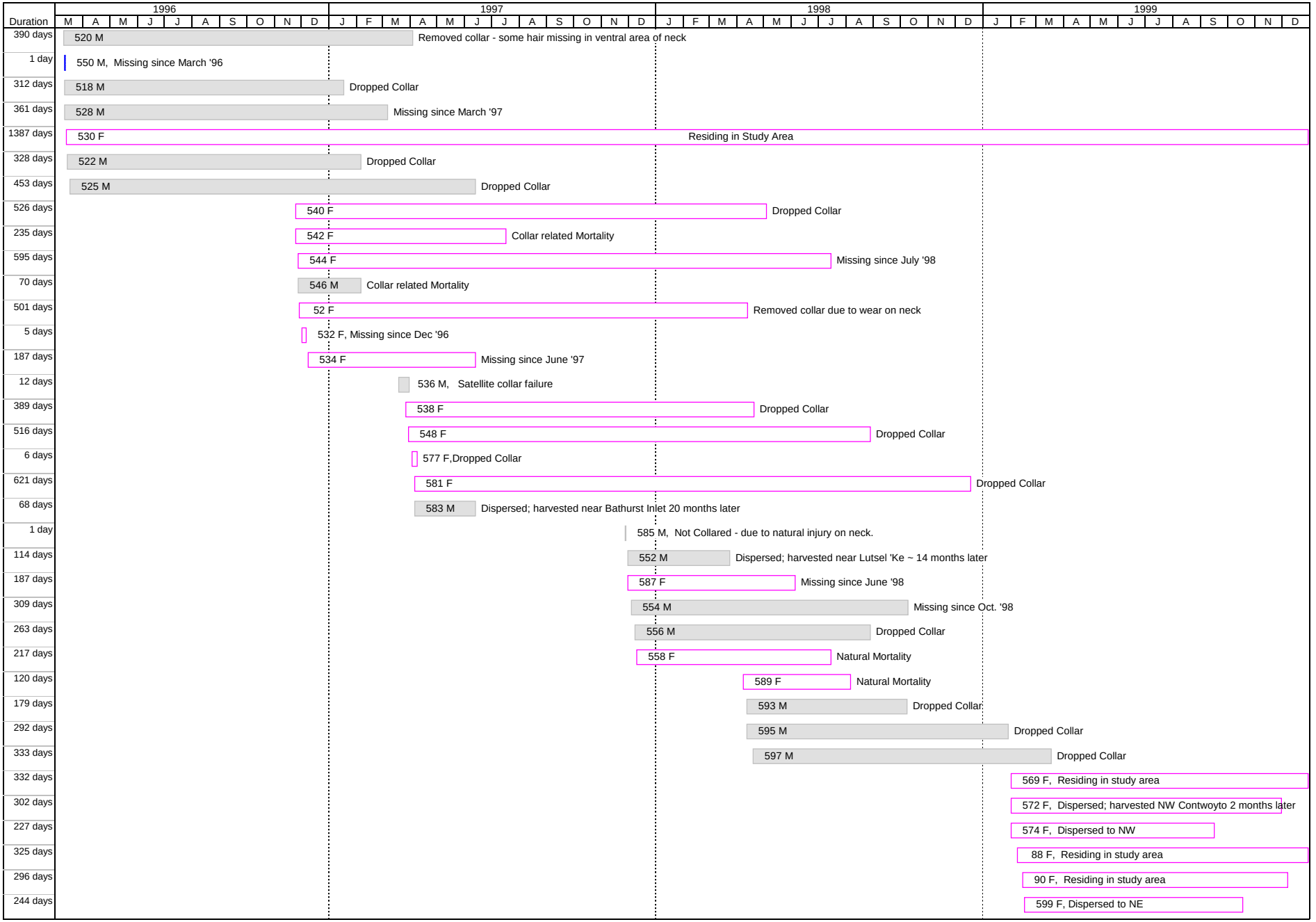


Fig. 2. Wolverine capture locations, by sex, between March 1996 - February 1999.


1996
1997
1998
1999
M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
Duration
390 days
520 M
Removed collar - some hair missing in ventral area of neck
1 day
550 M, Missing since March '96
312 days
518 M
Dropped Collar
361 days
528 M
Missing since March '97
1387 days
530 F
Residing in Study Area
328 days
522 M
Dropped Collar
453 days
525 M
Dropped Collar
526 days
540 F
Dropped Collar
235 days
542 F
Collar related Mortality
595 days
544 F
Missing since July '98
70 days
546 M
Collar related Mortality
501 days
52 F
Removed collar due to wear on neck
5 days
532 F, Missing since Dec '96
187 days
534 F
Missing since June '97
12 days
536 M, Satellite collar failure
389 days
538 F
Dropped Collar
516 days
548 F
Dropped Collar
6 days
577 F,Dropped Collar
621 days
581 F
Dropped Collar
68 days
583 M
Dispersed; harvested near Bathurst Inlet 20 months later
1 day
585 M, Not Collared - due to natural injury on neck.
114 days
552 M
Dispersed; harvested near Lutsel 'Ke ~ 14 months later
187 days
587 F
Missing since June '98
309 days
554 M
Missing since Oct. '98
263 days
556 M
Dropped Collar
217 days
558 F
Natural Mortality
120 days
589 F
Natural Mortality
179 days
593 M
Dropped Collar
292 days
595 M
Dropped Collar
333 days
597 M
Dropped Collar
332 days
569 F, Residing in study area
302 days
572 F, Dispersed; harvested NW Contwoyto 2 months later
227 days
574 F, Dispersed to NW
325 days
88 F, Residing in study area
296 days
90 F, Residing in study area
244 days
599 F, Dispersed to NE

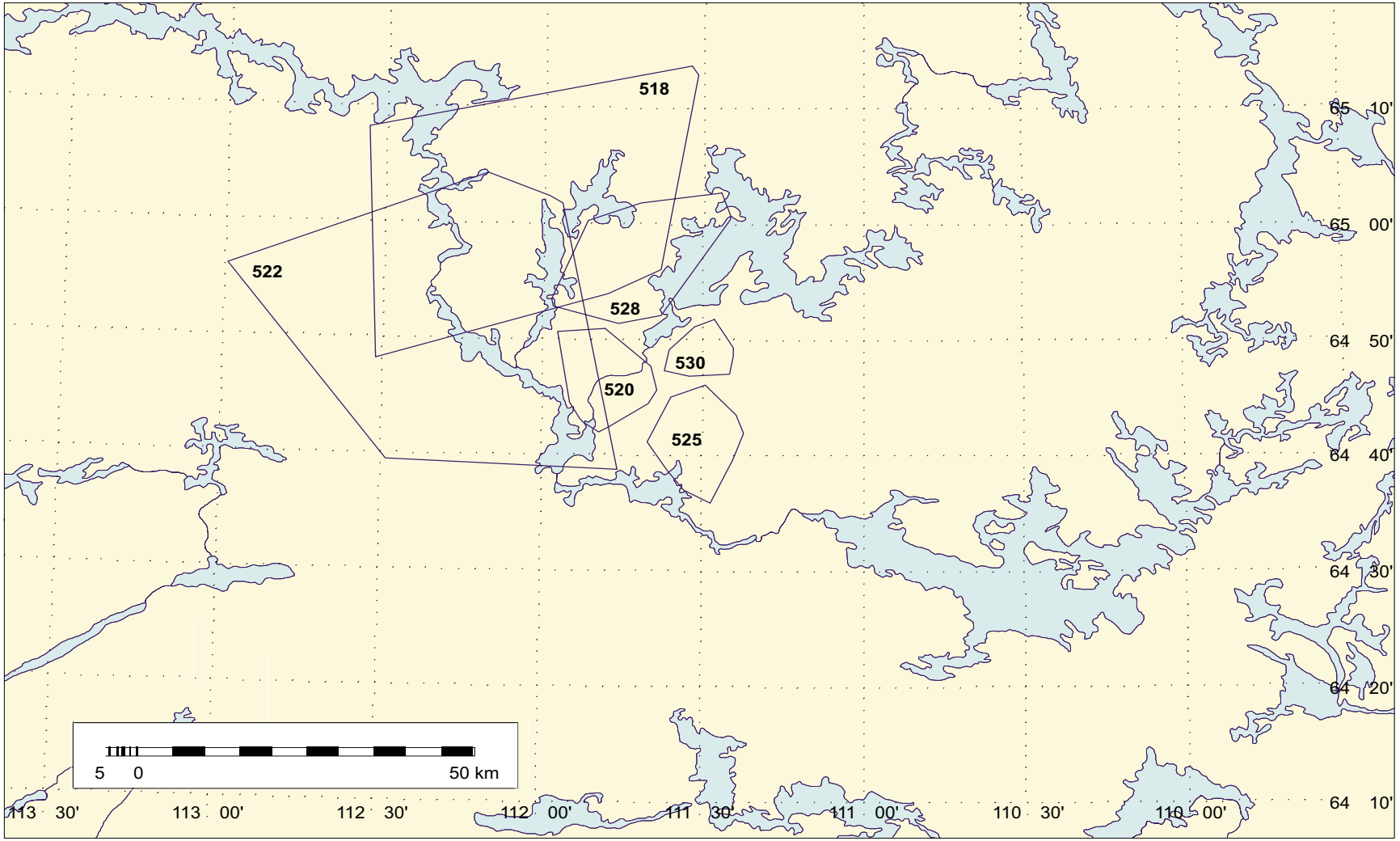


Fig. 4. Home range distribution (MCP) for six wolverine captured in March ‘96.

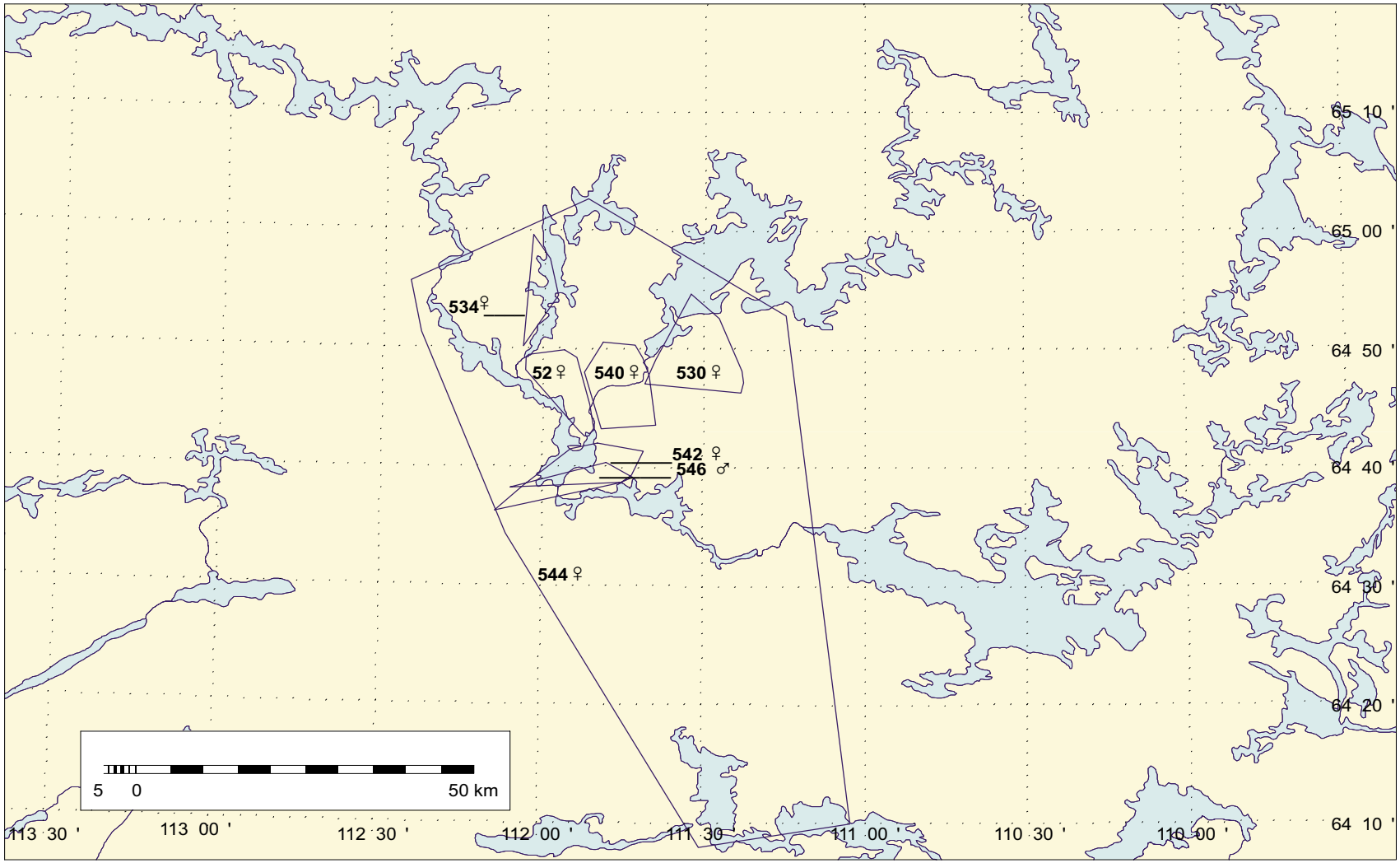


Fig. 5. Home range distribution (MCP) for seven wolverine captured in November ‘96.

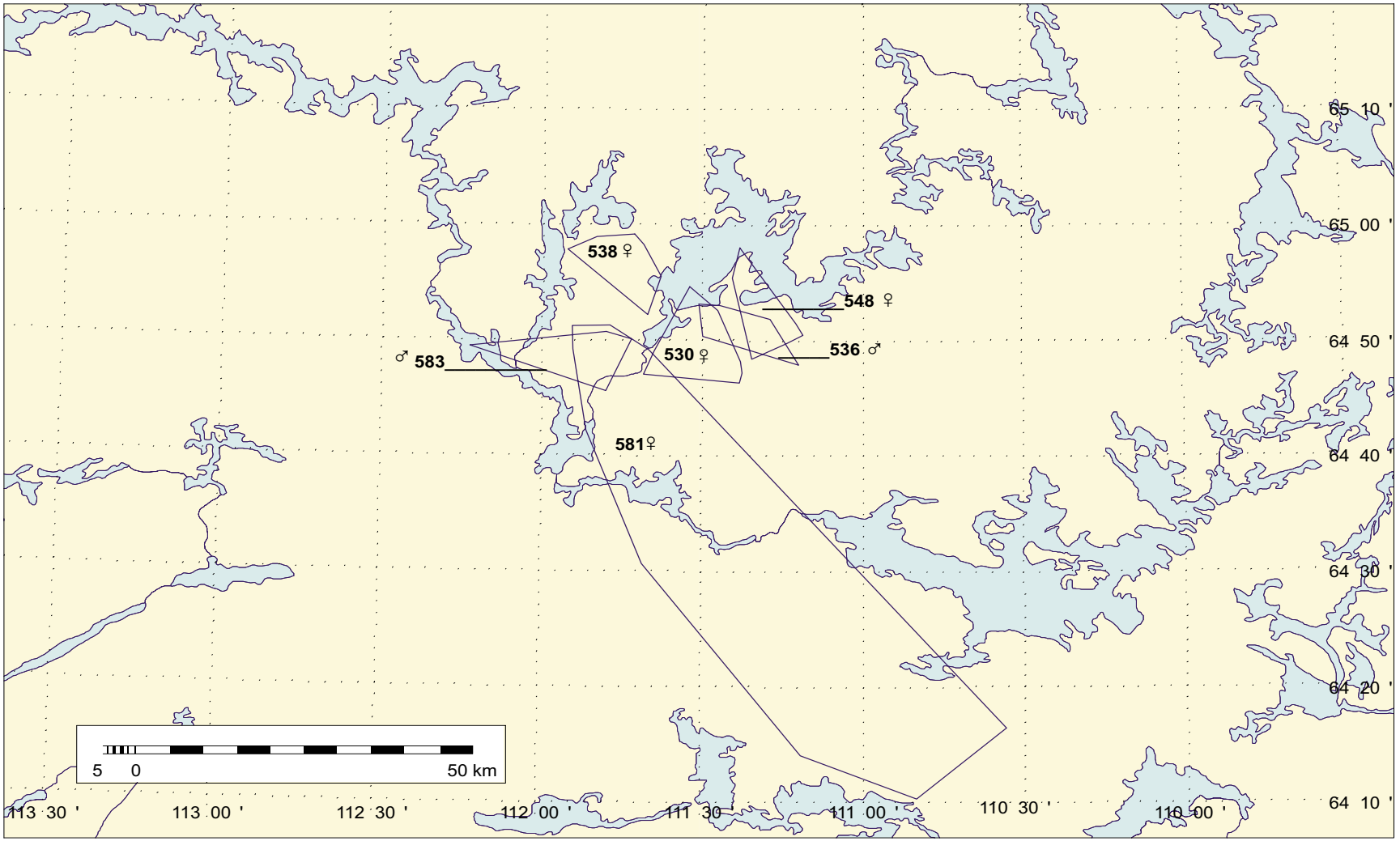


Fig. 6. Home range distribution (MCP) for six wolverine captured in April ‘97.

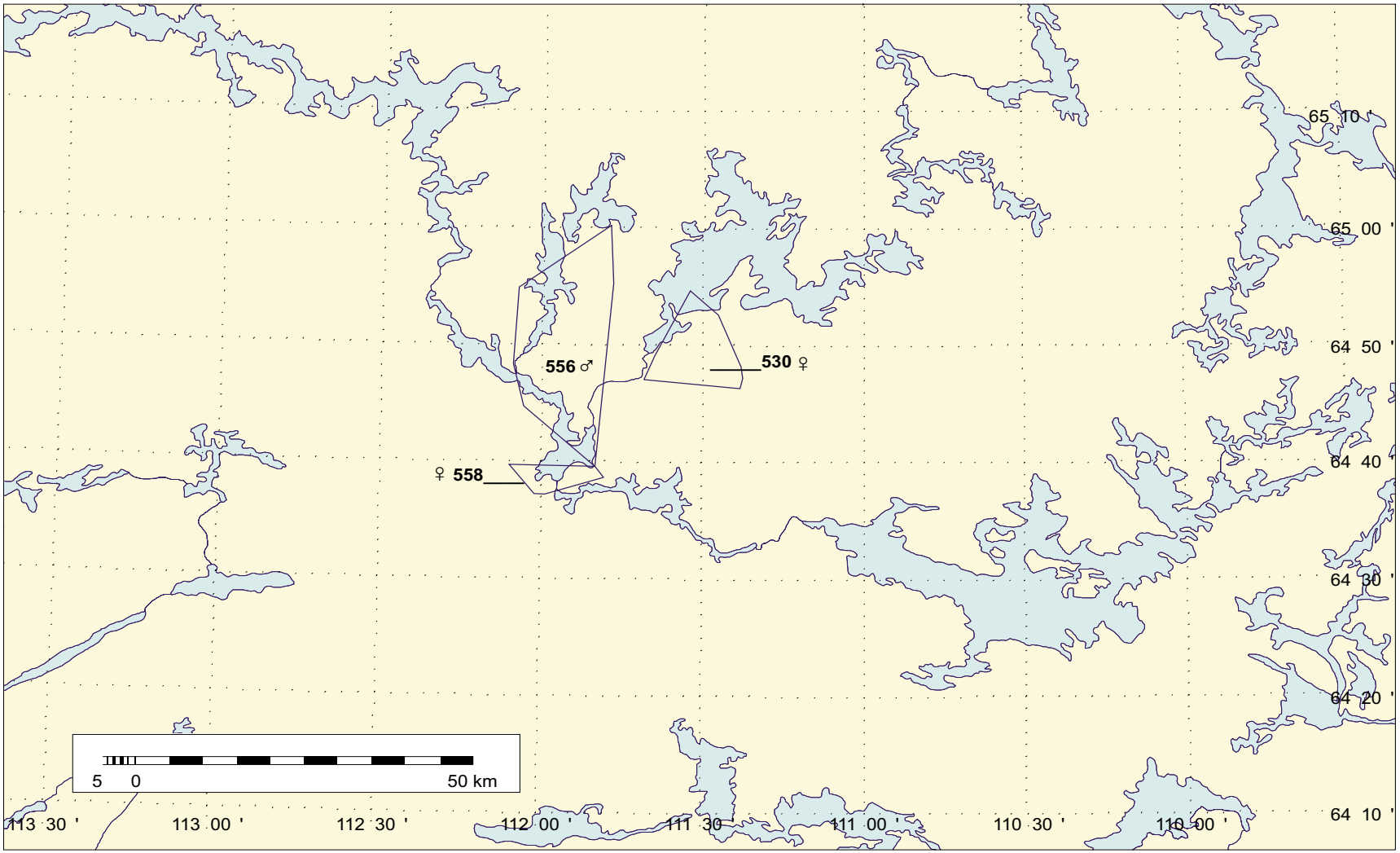


Fig. 7. Home range distribution (MCP) for three wolverine captured in December ‘97.

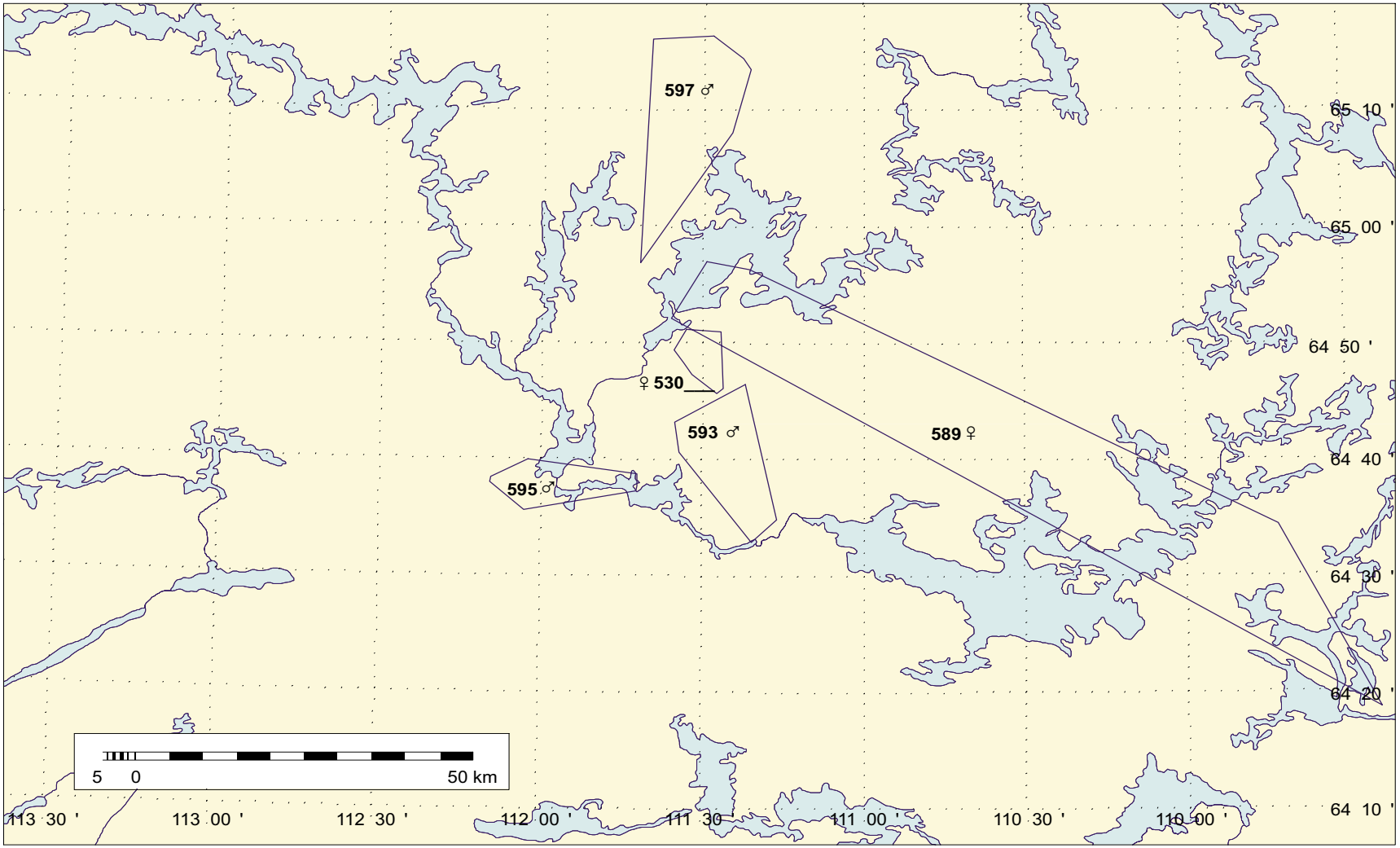


Fig. 8. Home range distribution (MCP) for five wolverine captured in April ‘98.

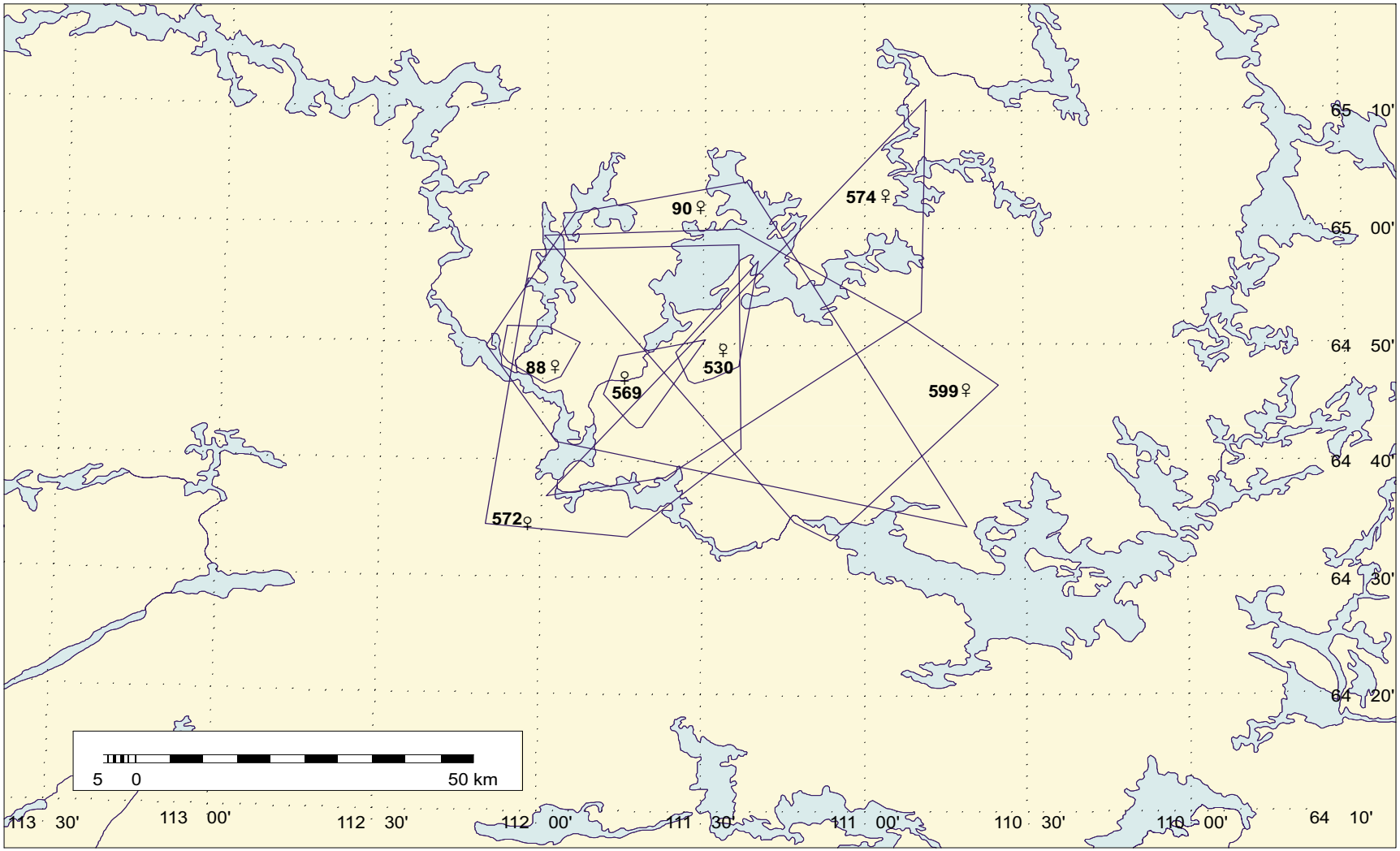


Fig. 9. Home range distribution (MCP) for seven wolverine captured in February ‘99.

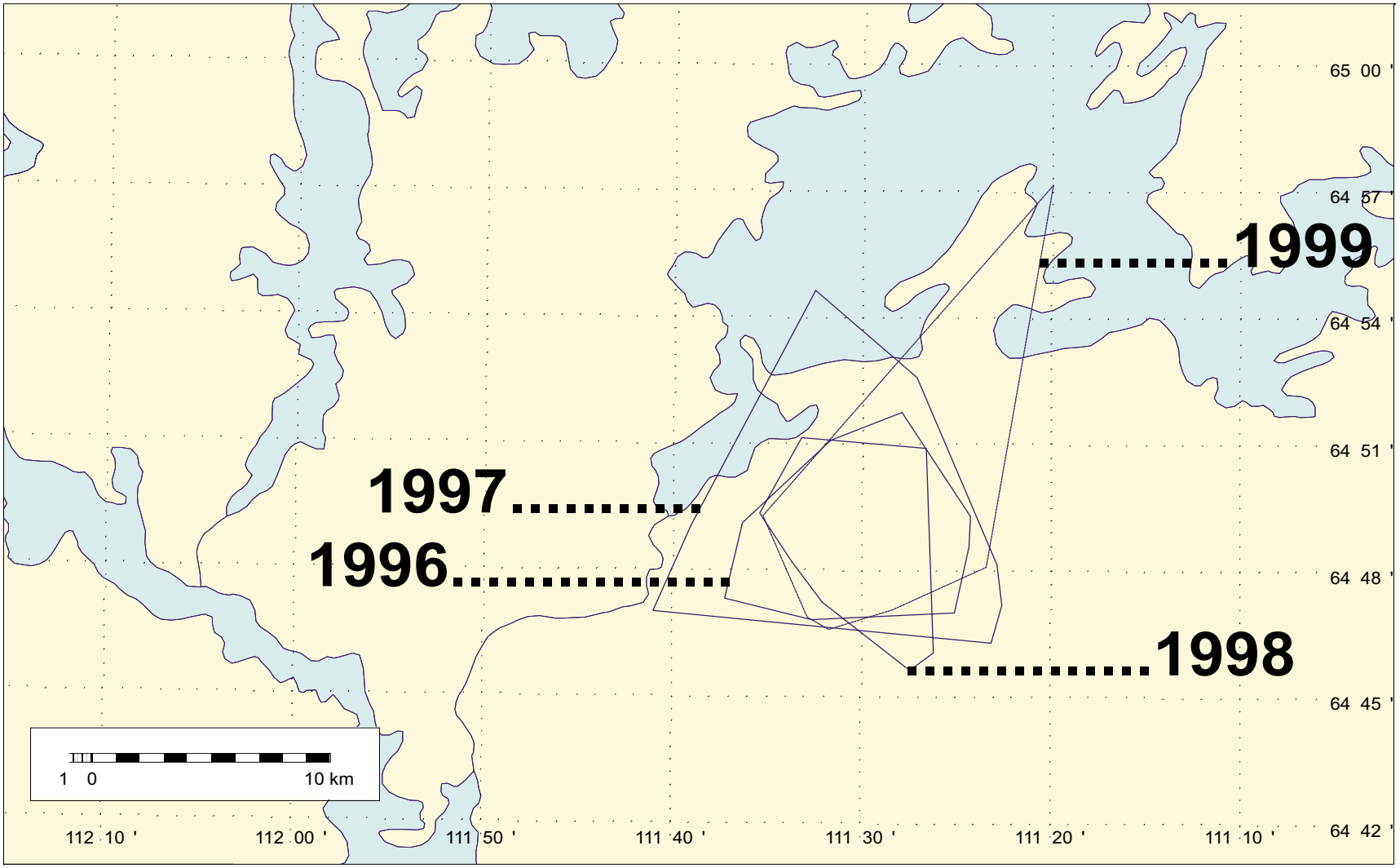


Fig. 10. Annual home range distribution (based on minimum convex polygon) of female wolverine #530 during 1996, 1997, 1998, and 1999.

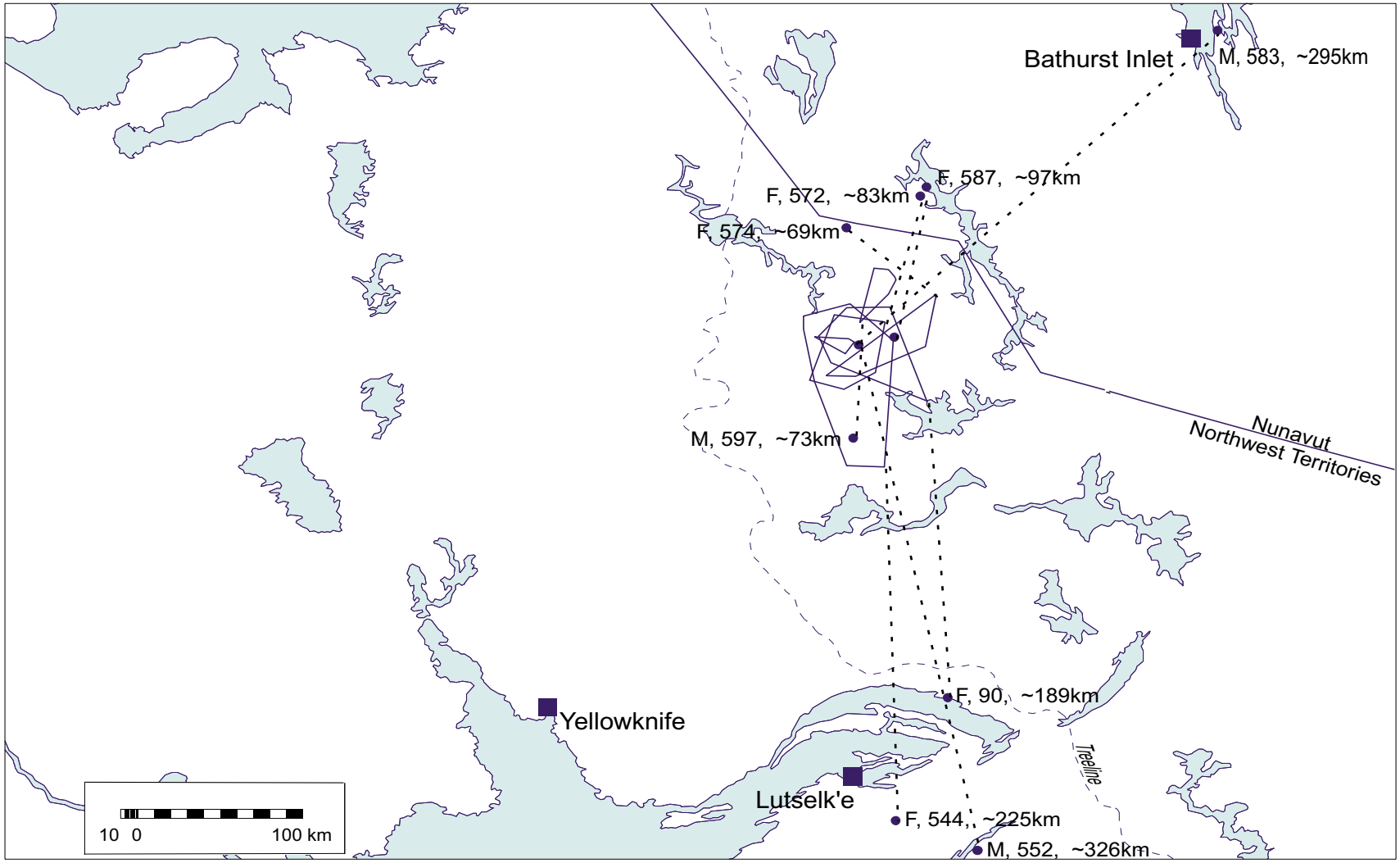


Fig. 11. Documented long-range movements of collared or ear-tagged wolverine from the Daring Lake study area.

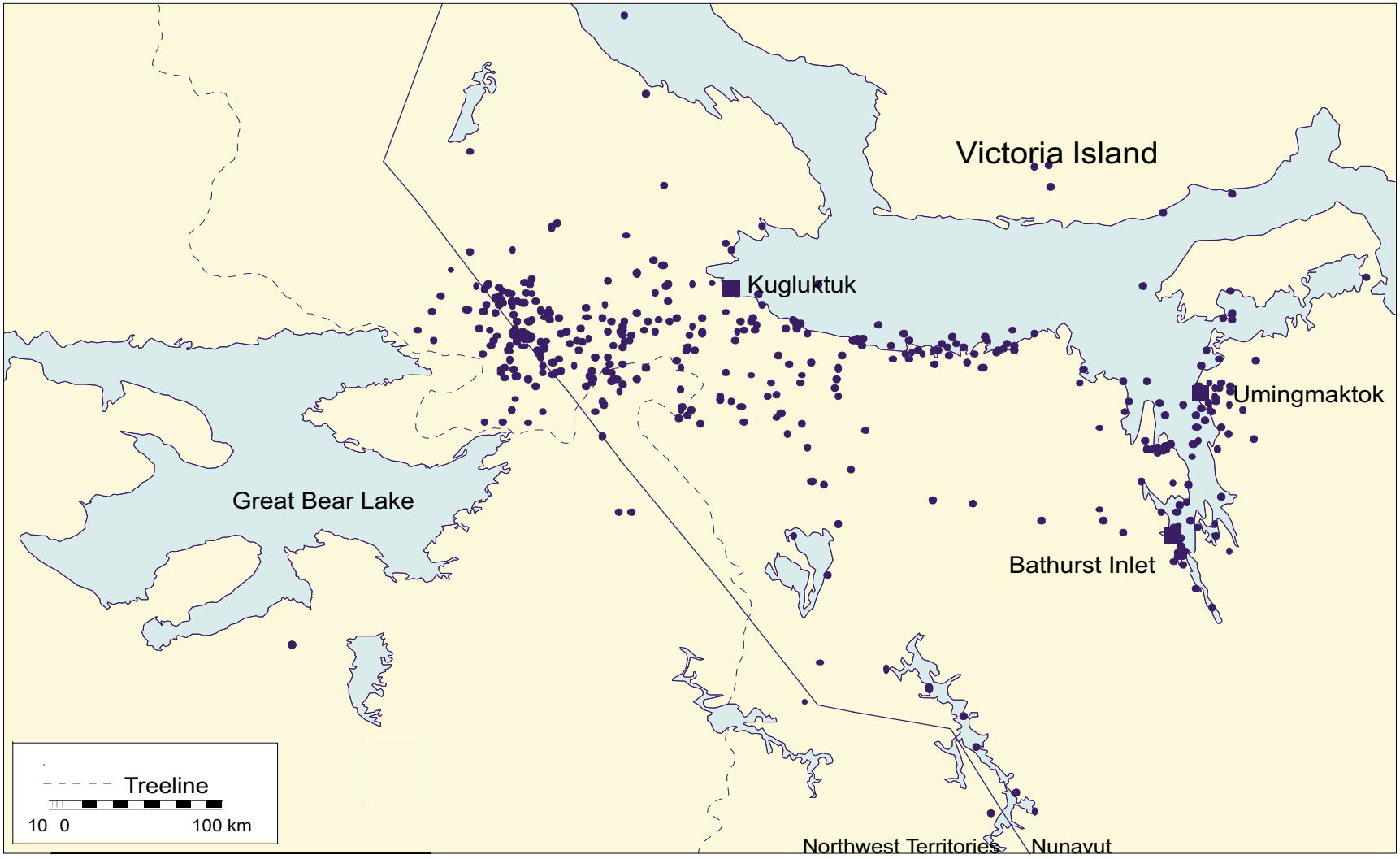


Fig. 12. Distribution of wolverine harvest from Kugluktuk, Umingmaktok, and Bathurst Inlet for the four seasons between 1995/96 and 1998/99.

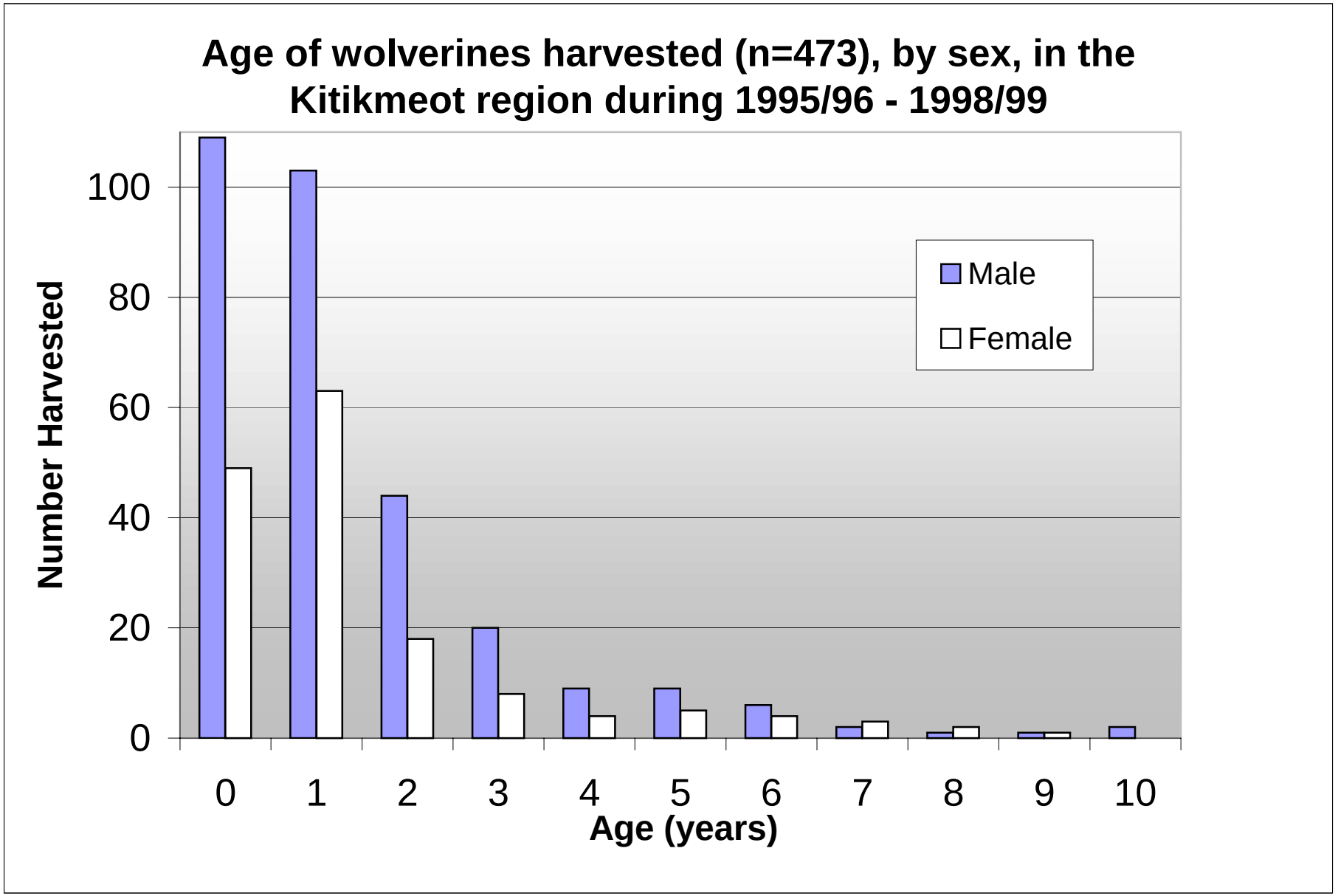


Fig. 13. Sex and age composition of the wolverine harvest in the Kitikmeot region between 1995/96 - 1998/99.

APPENDIX I Chronology of wolverine captures, March 1996 - February 1999.

Wolv No.	Capture Date	VHF Freq.	Sex	Est.[1] Age	Capture Method	Fate of Collar	Comments
520	11-Mar-96	150.268	M	Y	Snowmobile	Removed	Collar removed, released 5-Apr-97
550	11-Mar-96	150.090	M	Y	Helicopter	Unknown	Missing since Mar-96
528	12-Mar-96	150.890	M	A	Snowmobile	Unknown	Missing since Mar-'97
518	12-Mar-96	150.211	M	A	Snowmobile	Dropped	Dropped collar – Mort. Sig. Jun-97
530	14-Mar-96	150.870	F	Y	Helicopter	Unknown	Residing in study area
522	15-Mar-96	150.229	M	Y	Snowmobile	Dropped	Dropped collar – Mort sig. Jan-97
525	18-Mar-96	150.042	M	A	Snowmobile	Dropped	Dropped collar – Mort. Sig. Jun-97
540	23-Nov-96	150.421	F	Y	Snowmobile	Unknown	Dropped collar – Mort. Sig.
542	24-Nov-96	151.210	F	A	Snowmobile	Dropped	Collar related mortality Jun-97
544	28-Nov-96	151.190	F	Y	Barrel Trap	Unknown	Missing since Jul-98
546	28-Nov-96	150.360	M	Y	Barrel Trap	Dropped	Collar related mortality – Feb-97
52	29-Nov-96	151.230	F	A	Barrel Trap	Unknown	Residing in study area
532	30-Nov-96	151.450	F	J	Barrel Trap	Unknown	Missing since Dec-96
530*	07-Dec-96	151.250	F	A	Snowmobile	Functional	Residing in study area
534	08-Dec-96	150.412	F	J	Snowmobile	Unknown	Missing since Jun-97
530*	26-Mar-97	151.250	F	A	Snowmobile	Functional	Residing in study area
536	28-Mar-97	Satellite	M	Y	Barrel Trap	Unknown	Satellite collar failure
538	30-Mar-97	150.381	F	A	Barrel Trap	Unknown	Dropped collar – Mort. sig.
548	31-Mar-97	151.880	F	A	Barrel Trap	Dropped	Dropped collar – Mort. sig.
577	01-Apr-97	150.452	F	J	Snowmobile	Dropped	Dropped collar – Mort. sig.
581	05-Apr-97	150.172	F	J	Snowmobile	Dropped	Dropped collar – Mort.sig. Oct-97
520*	05-Apr-97	150.269	M	A	Snowmobile	Removed	Collar removed, released
583	07-Apr-97	150.240	M	J	Snowmobile	Unknown	Harvested B. Inlet, Feb-99
585	28-Nov-97	-	M	A	Snowmobile	-	Not collared
587	30-Nov-97	151.320	F	J	Snowmobile	Unknown	Missing since Jun-98
552	01-Dec-97	151.129	M	J	Barrel Trap	Unknown	Harvested near Lutsel K'e Sep-98
554	05-Dec-97	150.152	M	J	Barrel Trap	Unknown	Unknown
530*	05-Dec-97	150.250	F	A	Barrel Trap	Functional	Residing in study area
530*	07-Dec-97	150.250	F	A	Barrel Trap	Functional	Residing in study area
530*	08-Dec-97	150.250	F	A	Barrel Trap	Functional	Residing in study area
556	09-Dec-09	150.590	M	A	Barrel Trap	Dropped	Dropped collar – Mort. sig.
558	11-Dec-97	150.190	F	Y	Barrel Trap	Dropped	Natural mortality
52	08-Apr-98	151.231	F	A	Barrel Trap	Removed	Collar removed, released
589	09-Apr-98	150.300	F	Y	Barrel Trap	Mortality	Natural Mortality
530*	11-Apr-98	150.250	F	A	Barrel Trap	Replaced	Residing in study area
581*	11-Apr-98	150.310	F	Y	Barrel Trap	Dropped	Dropped collar, Mort. sig. Nov-98
593	11-Apr-98	150.570	M	A	Barrel Trap	Dropped	Dropped collar, Mort. sig. Oct-98
595	12-Apr-98	150.360	M	A	Barrel Trap	Dropped	Dropped collar, Mort. sig. Feb-99
540	17-Apr-98	150.500	F	A	Barrel Trap	Dropped	Dropped collar, Mort. sig. Jun-99
597	19-Apr-98	150.430	M	Y	Barrel Trap	Dropped	Dropped collar, Mort. sig.Jan-99
569	02-Feb-99	150.050	F	J	Barrel Trap	Functional	Residing in study area
572	02-Feb-99	150.092	F	J	Barrel Trap	Mortality	Harvested near Lupin
574	02-Feb-99	150.112	F	J	Barrel Trap	Unknown	Dispersed to NW
530*	05-Feb-99	150.212	F	A	Snowmobile	Functional	Residing in study area
88	09-Feb-99	150.792	F	A	Snowmobile	Functional	Residing in study area
90	15-Feb-99	150.832	F	Y	Barrel Trap	Functional	Residing in study area
599	16-Feb-99	150.982	F	A	Barrel Trap	Functional	May have dispersed to NE

1. Estimated age (J=Juvenile, Y=Yearling, A=Adult) based on relative body size and tooth wear.

* Indicates a "recaptured" animal.

APPENDIX II Distribution of home ranges of collared female (n=17) and male (n=12) wolverine in the Daring Lake area between 1996 and 1999.

Corresponding estimates of home range size (Table 4) were derived using minimum convex polygon (MCP) and fixed kernel (95% and 70%) methods. Given the abundance of location data for adult female #530, her distribution is presented annually (4 years) as well as a pooled into a multi-year distribution. Note that map scales vary.

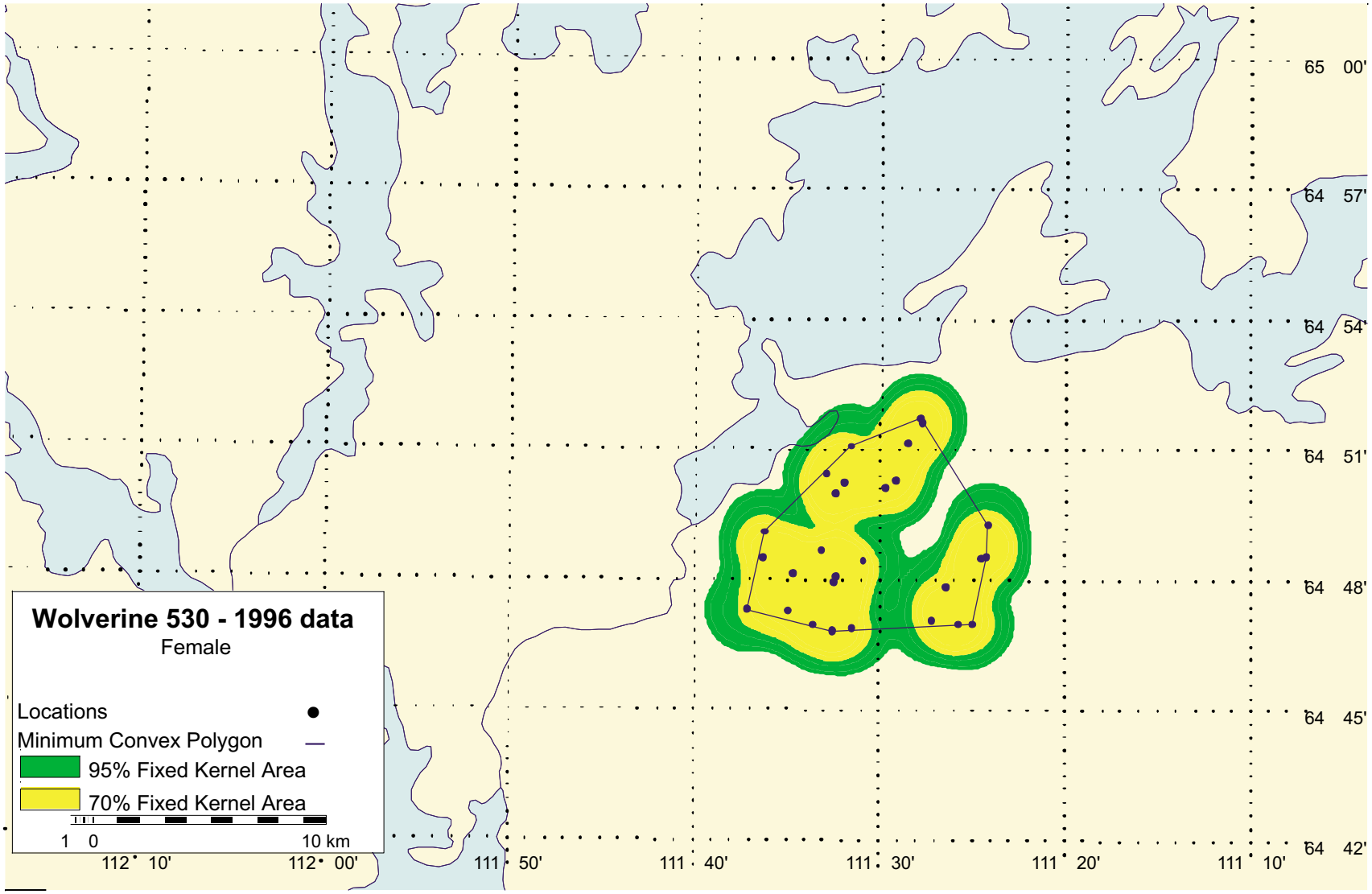
Females

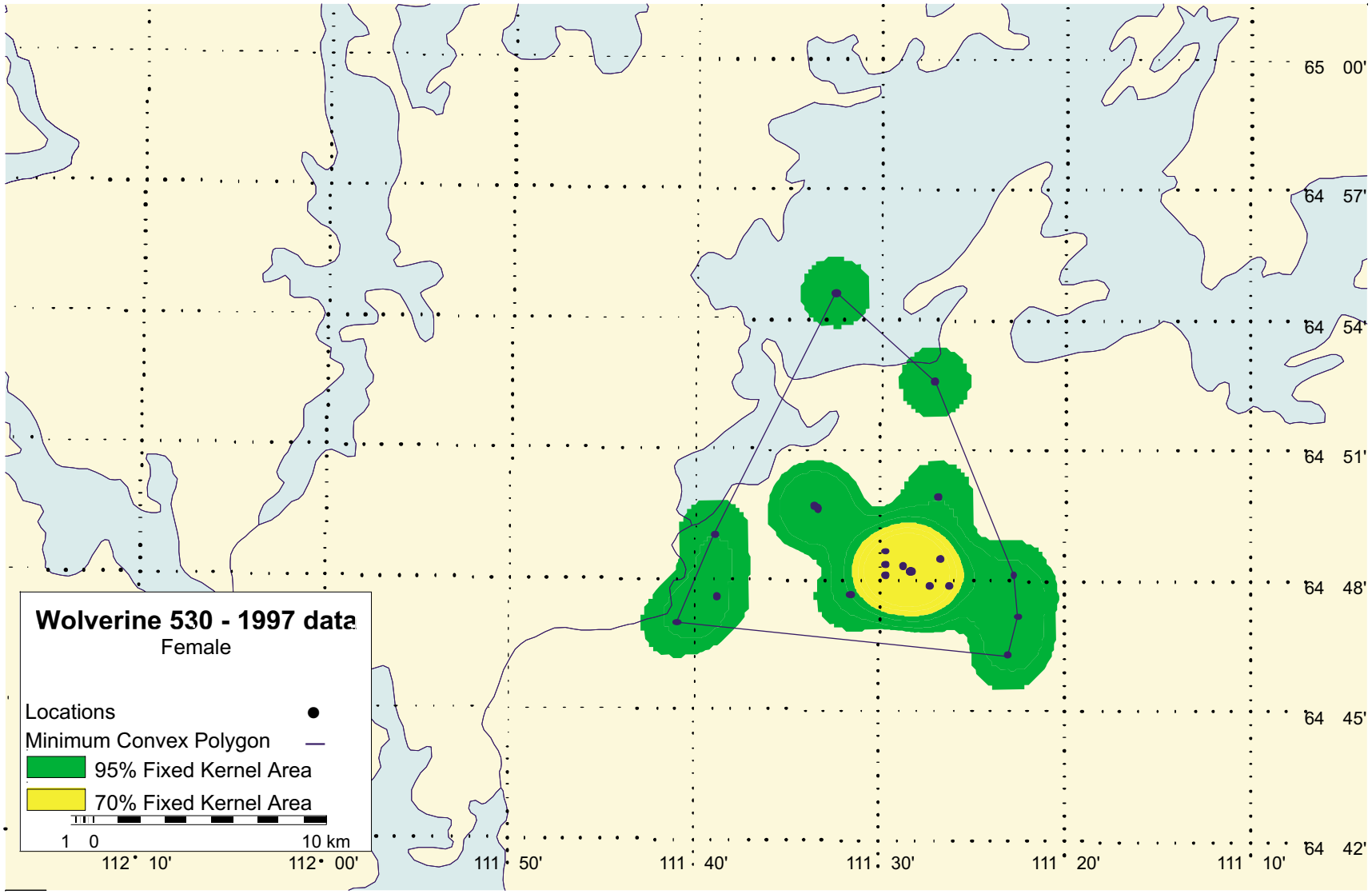
530 (‘96)
530 (‘97)
530 (‘98)
530 (‘99)
530 (1996-99)

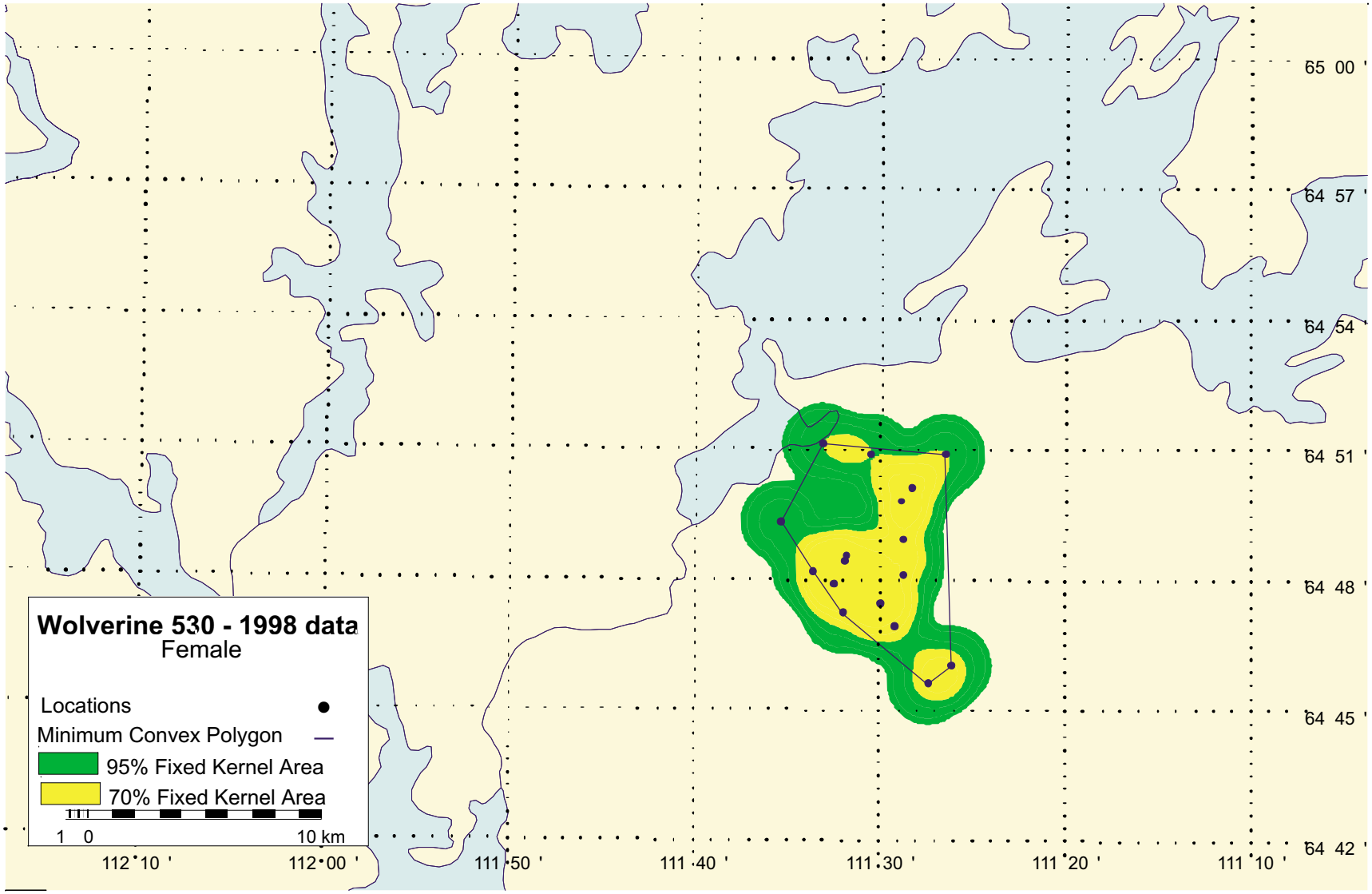
542
52
538
548
581
88
599
540
558
589
90
544
534
569
572
574

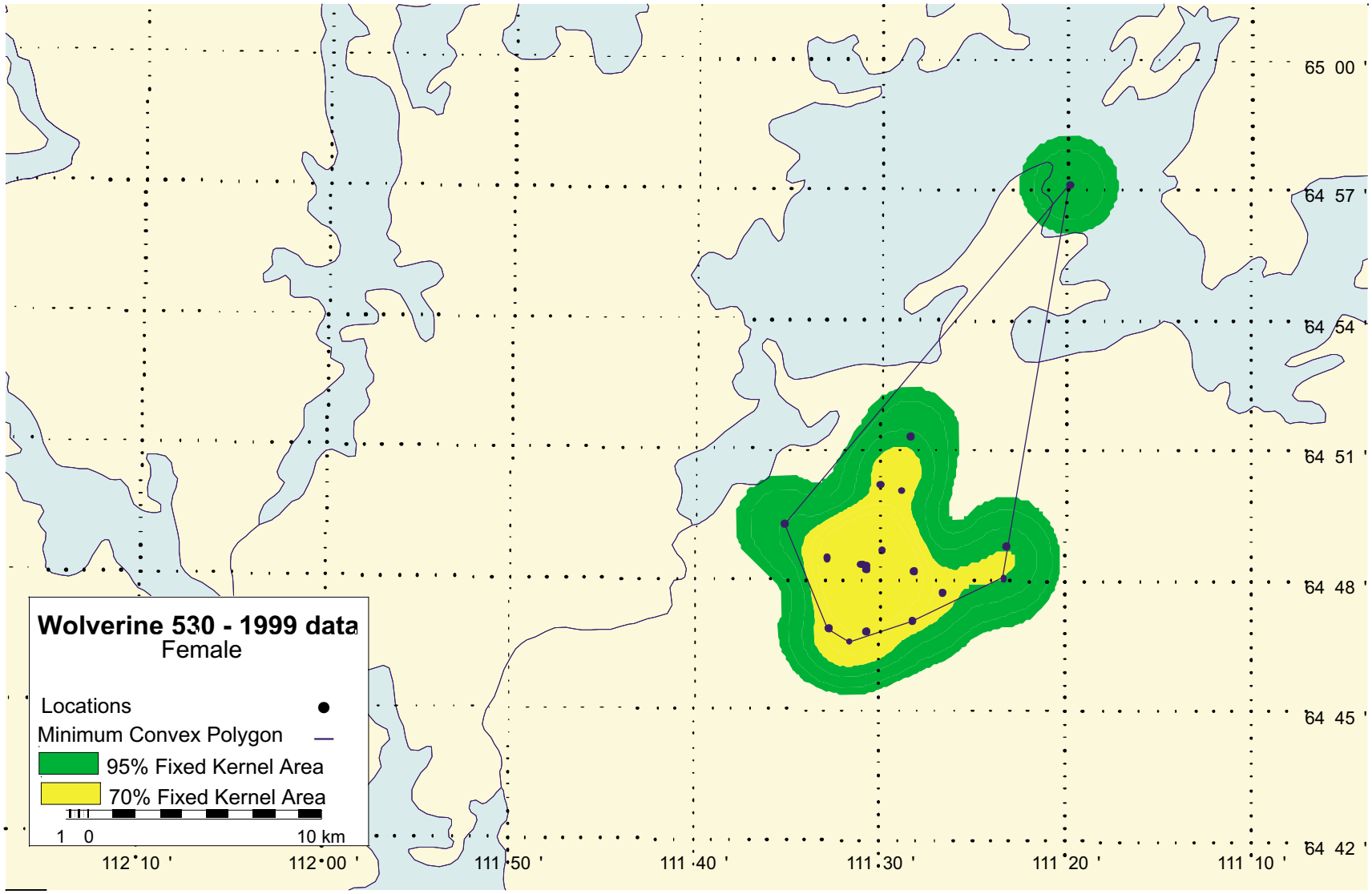
Males

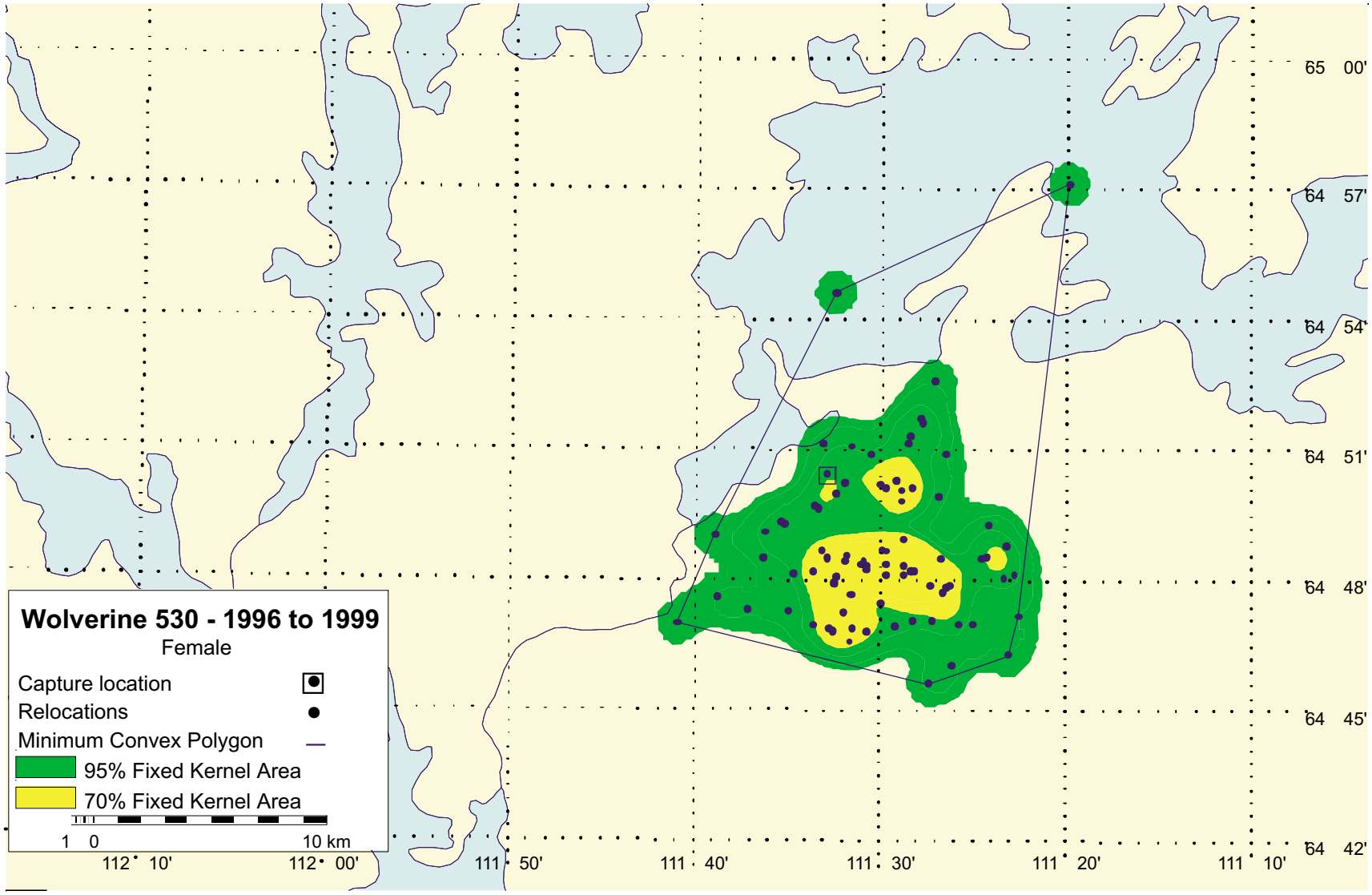
520
528
525
556
593
595
518
522
546
536
583
597

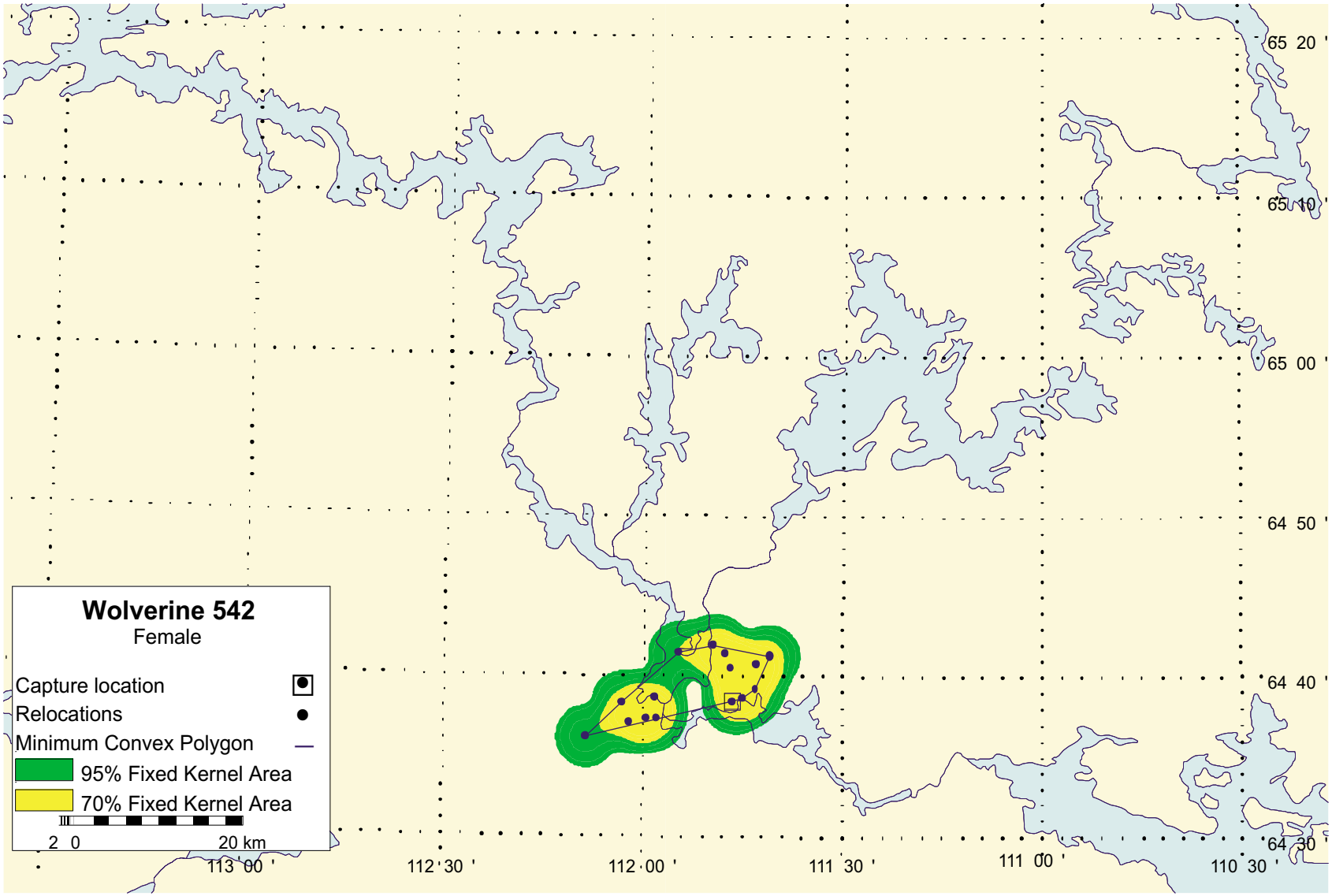

Wolverine 530 - 1996 data
Female
Locations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
1 0 10 km
112° 10'
112° 00'
111° 50'
111° 40'
111° 30'
111° 20'
111° 10'
65° 00'
64° 57'
64° 54'
64° 51'
64° 48'
64° 45'
64° 42'

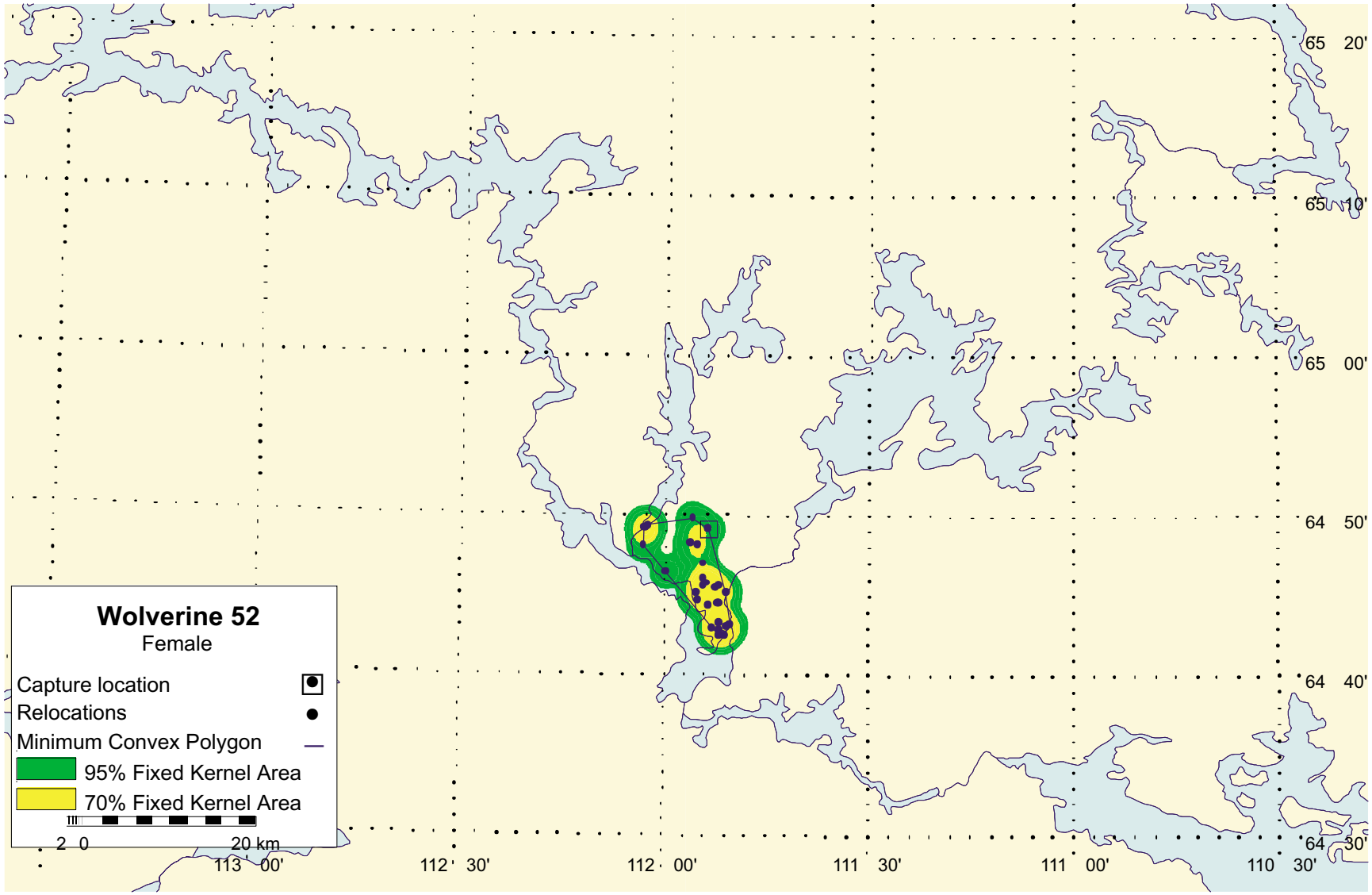

Wolverine 530 - 1997 data
Female
Locations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
1 0 10 km
112° 10'
112° 00'
111° 50'
111° 40'
111° 30'
111° 20'
111° 10'
65 00'
64 57'
64 54'
64 51'
64 48'
64 45'
64 42'

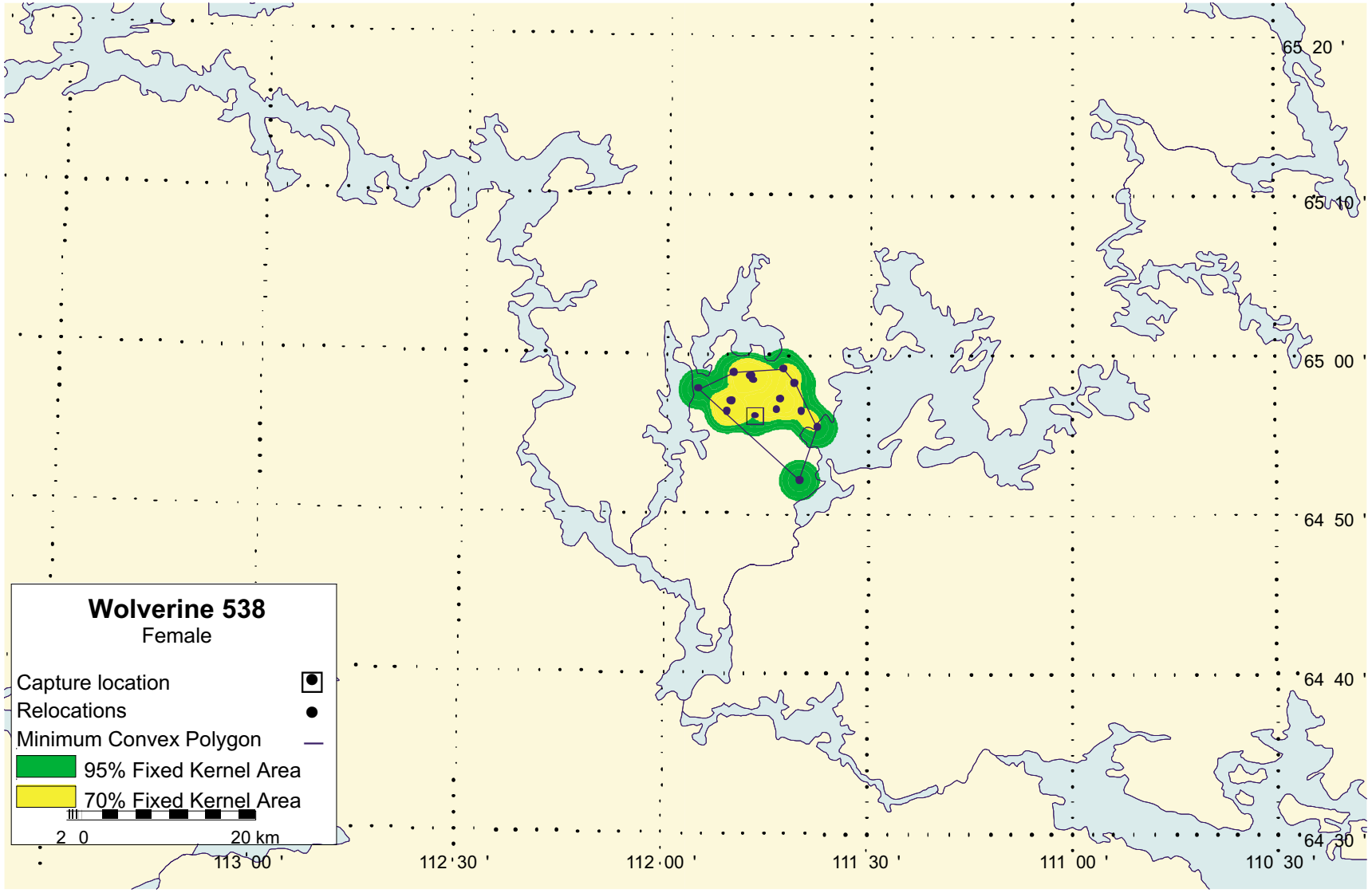

Wolverine 530 - 1998 data
Female
Locations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
1 0 10 km
65 00
64 57
64 54
64 51
64 48
64 45
64 42
112 10
112 00
111 50
111 40
111 30
111 20
111 10

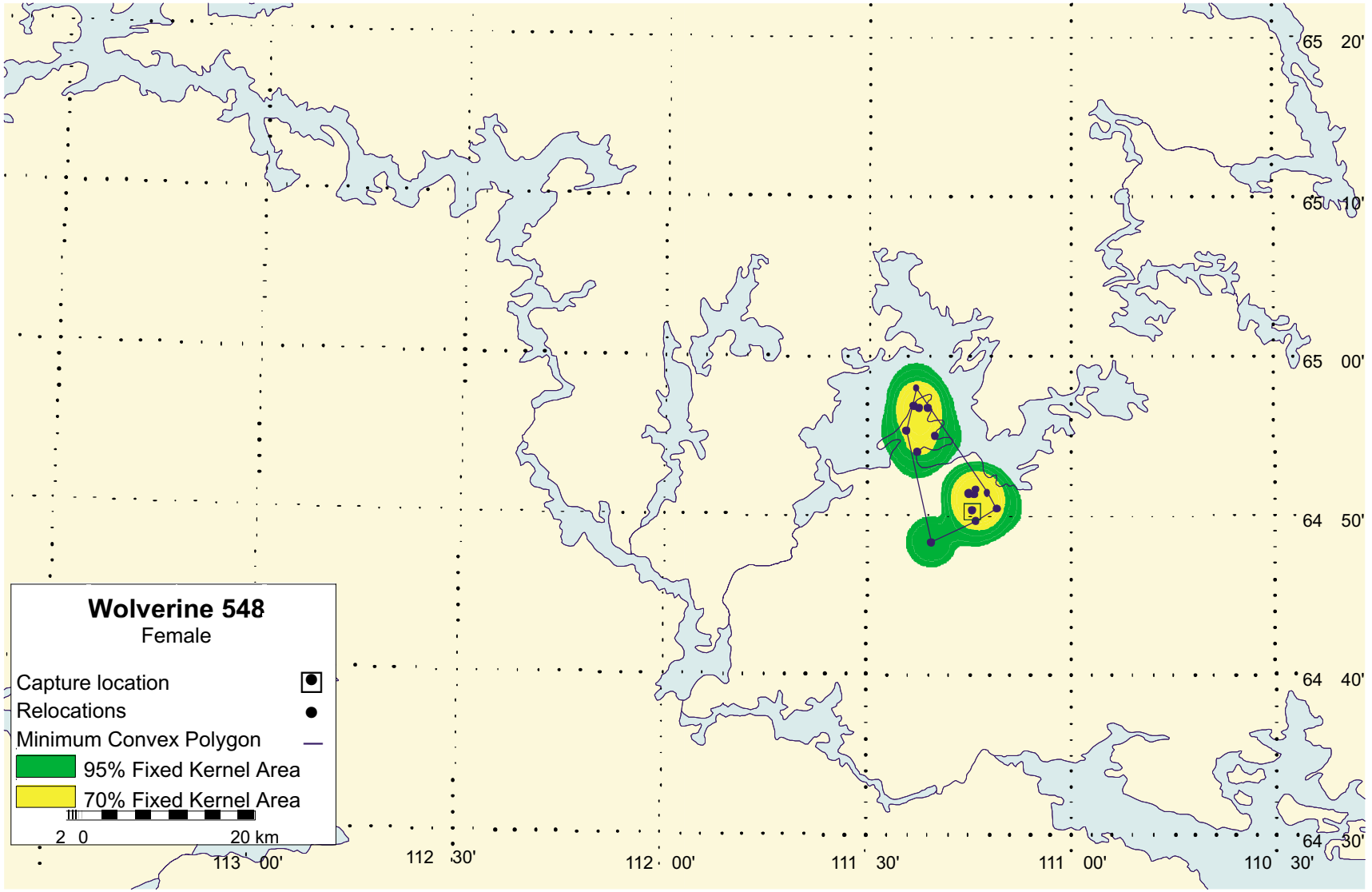

Wolverine 530 - 1999 data
Female
Locations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
1 0
10 km
65 00 '
64 57 '
64 54 '
64 51 '
64 48 '
64 45 '
64 42 '
112 10 '
112 00 '
111 50 '
111 40 '
111 30 '
111 20 '
111 10 '

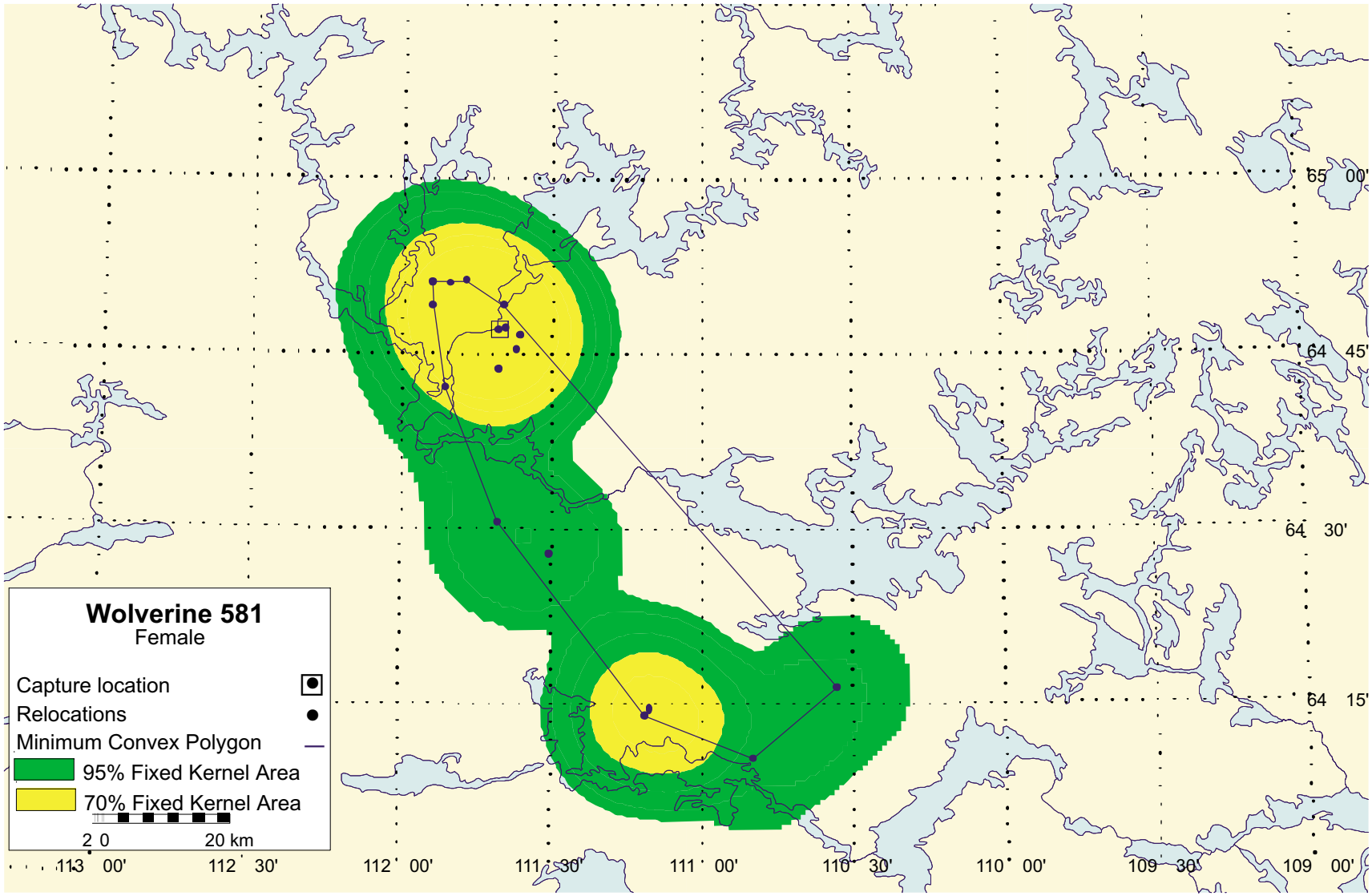

Wolverine 530 - 1996 to 1999
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
1 0 10 km
112° 10'
112° 00'
111° 50'
111° 40'
111° 30'
111° 20'
111° 10'
65 00'
64 57'
64 54'
64 51'
64 48'
64 45'
64 42'

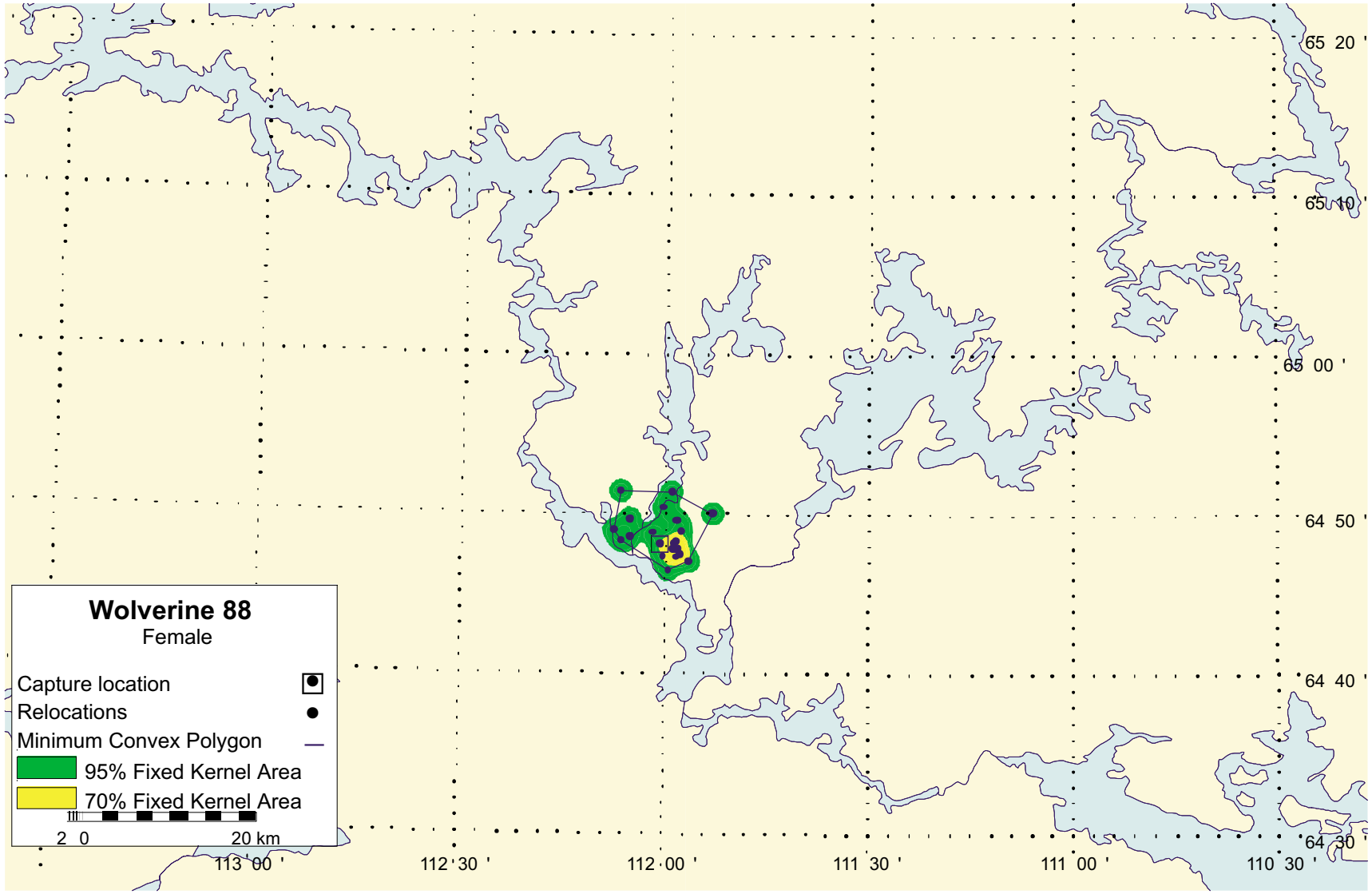

Wolverine 542
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '

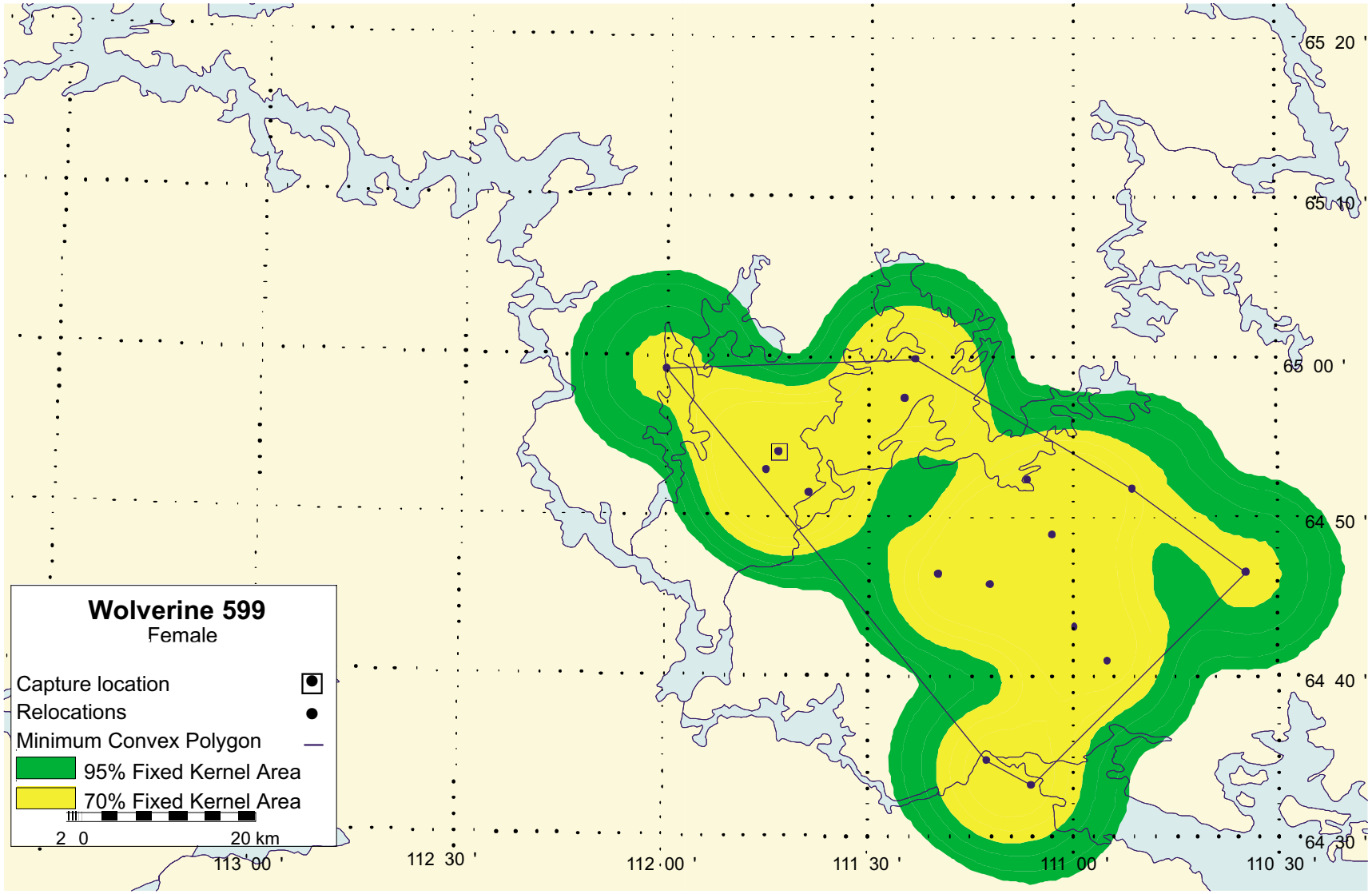

Wolverine 52
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

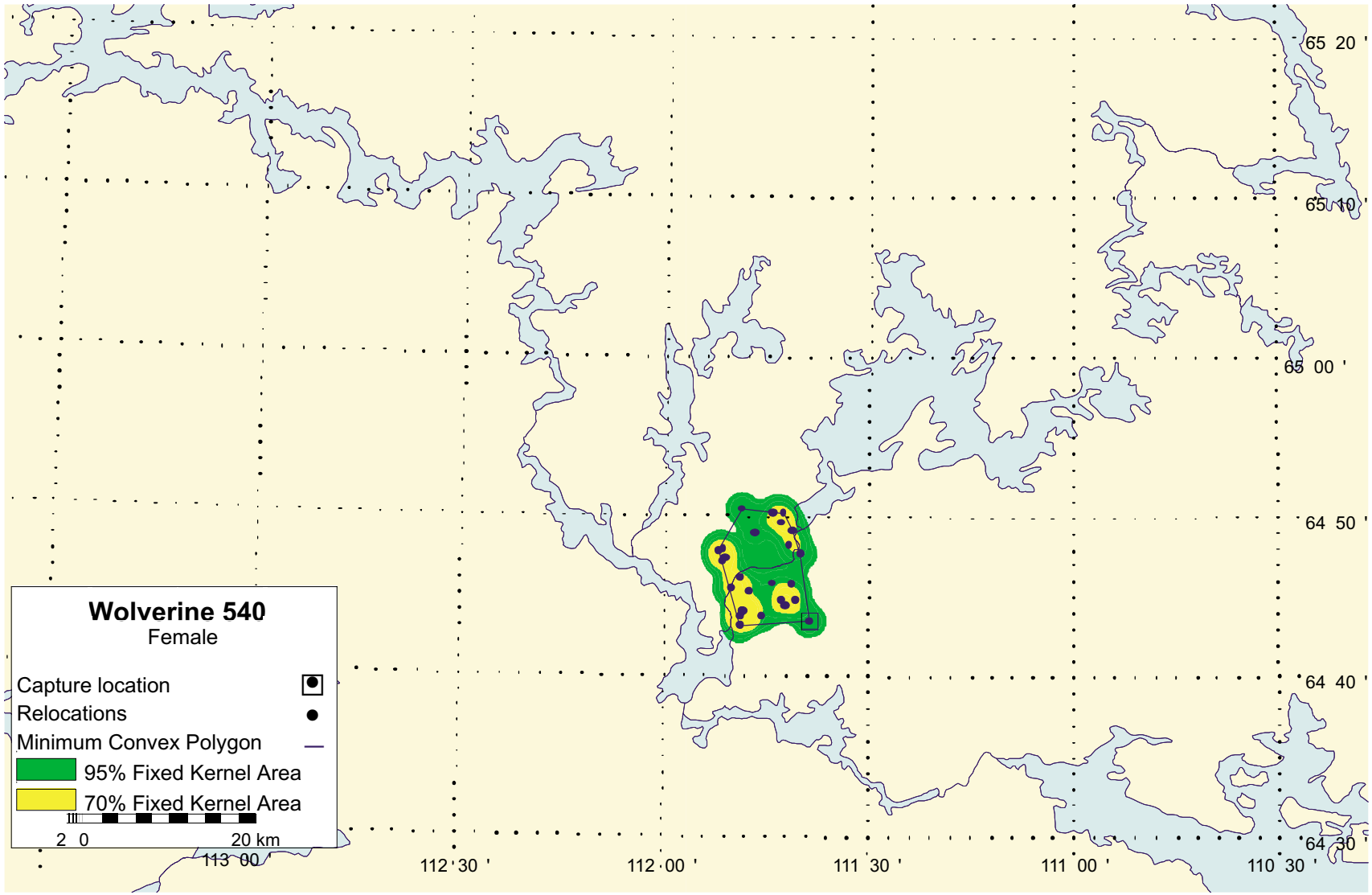

Wolverine 538
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '

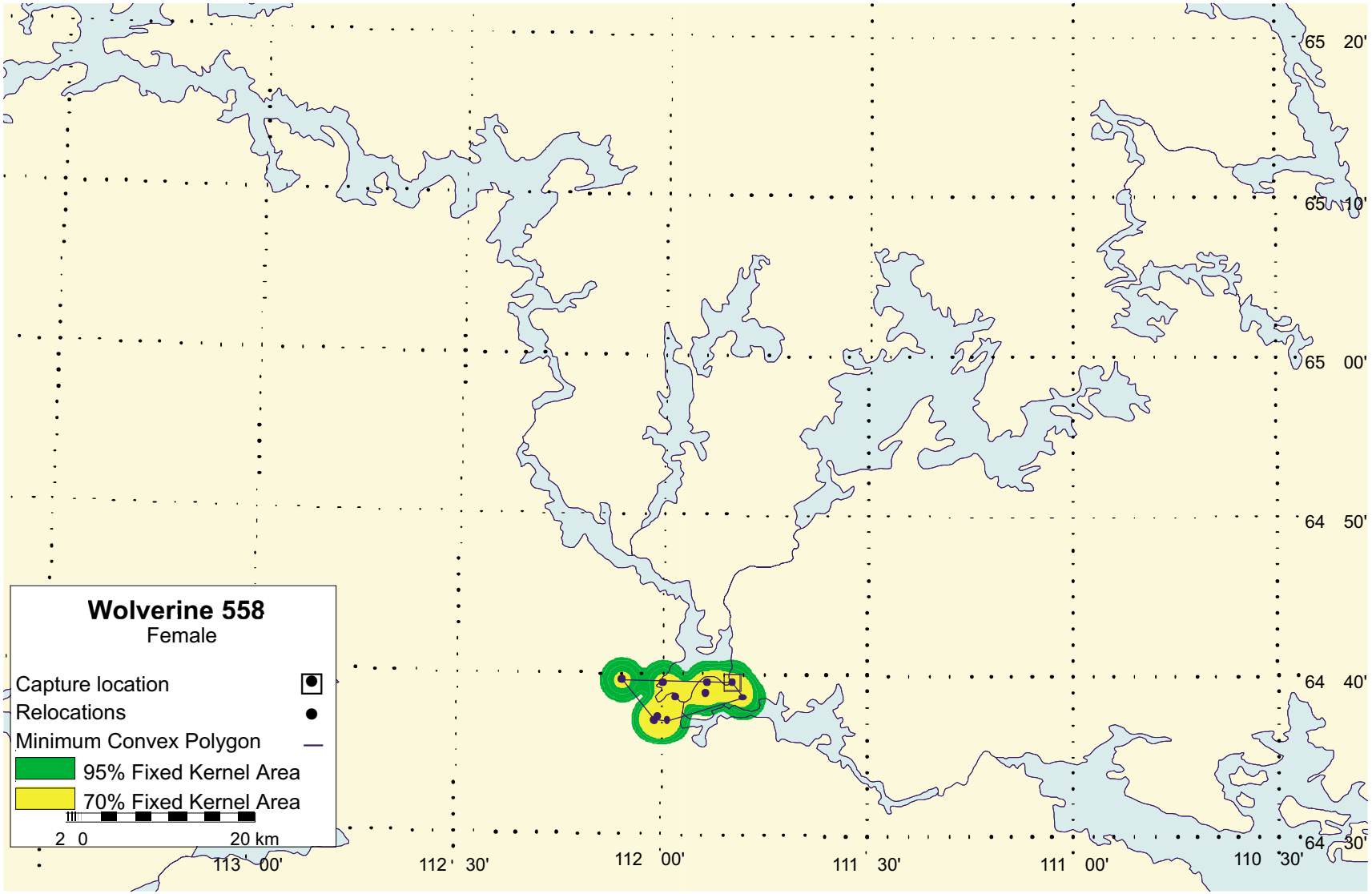

Wolverine 548
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

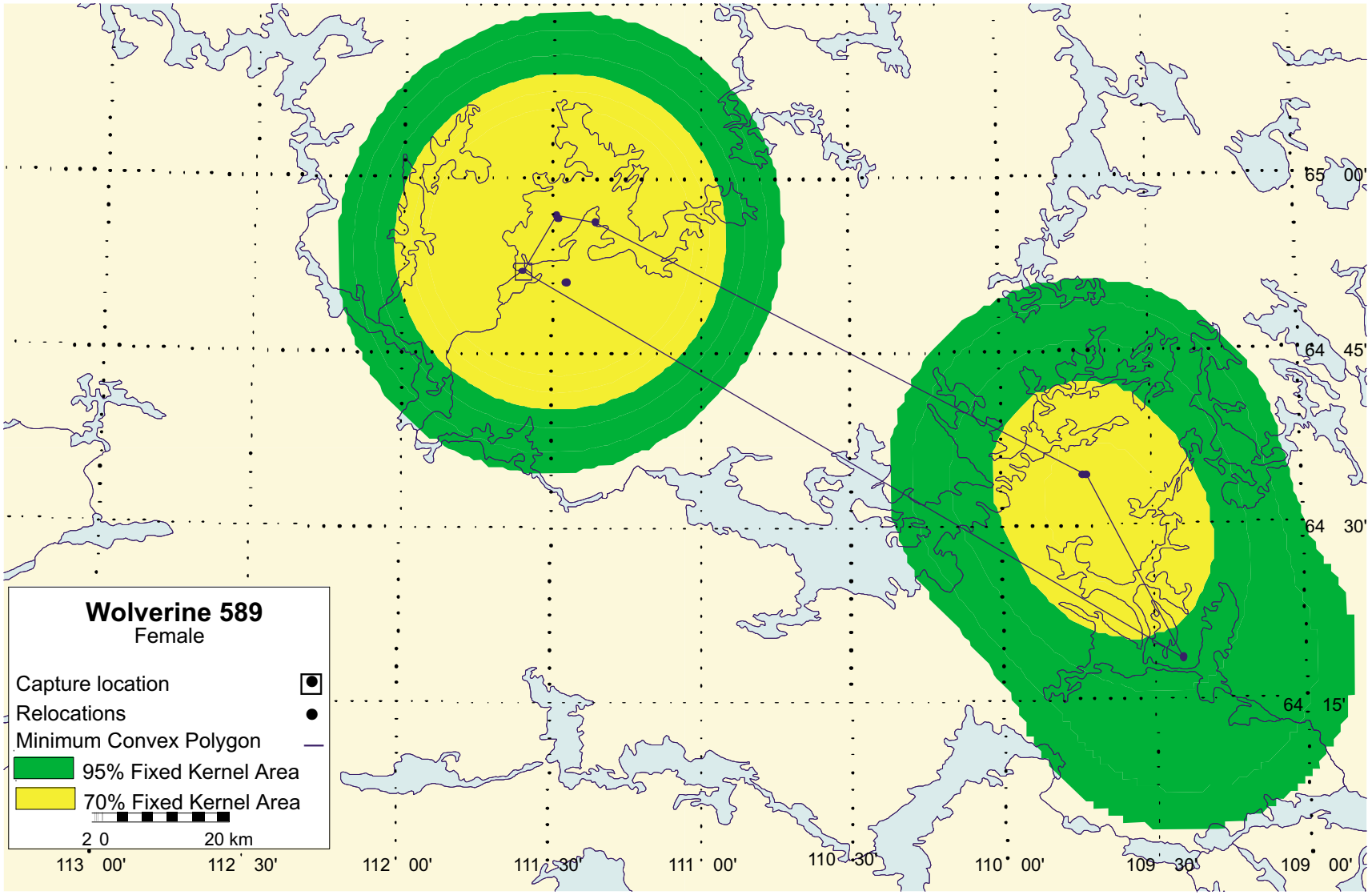

Wolverine 581
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 00'
64 45'
64 30'
64 15'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'
110 00'
109 30'
109 00'

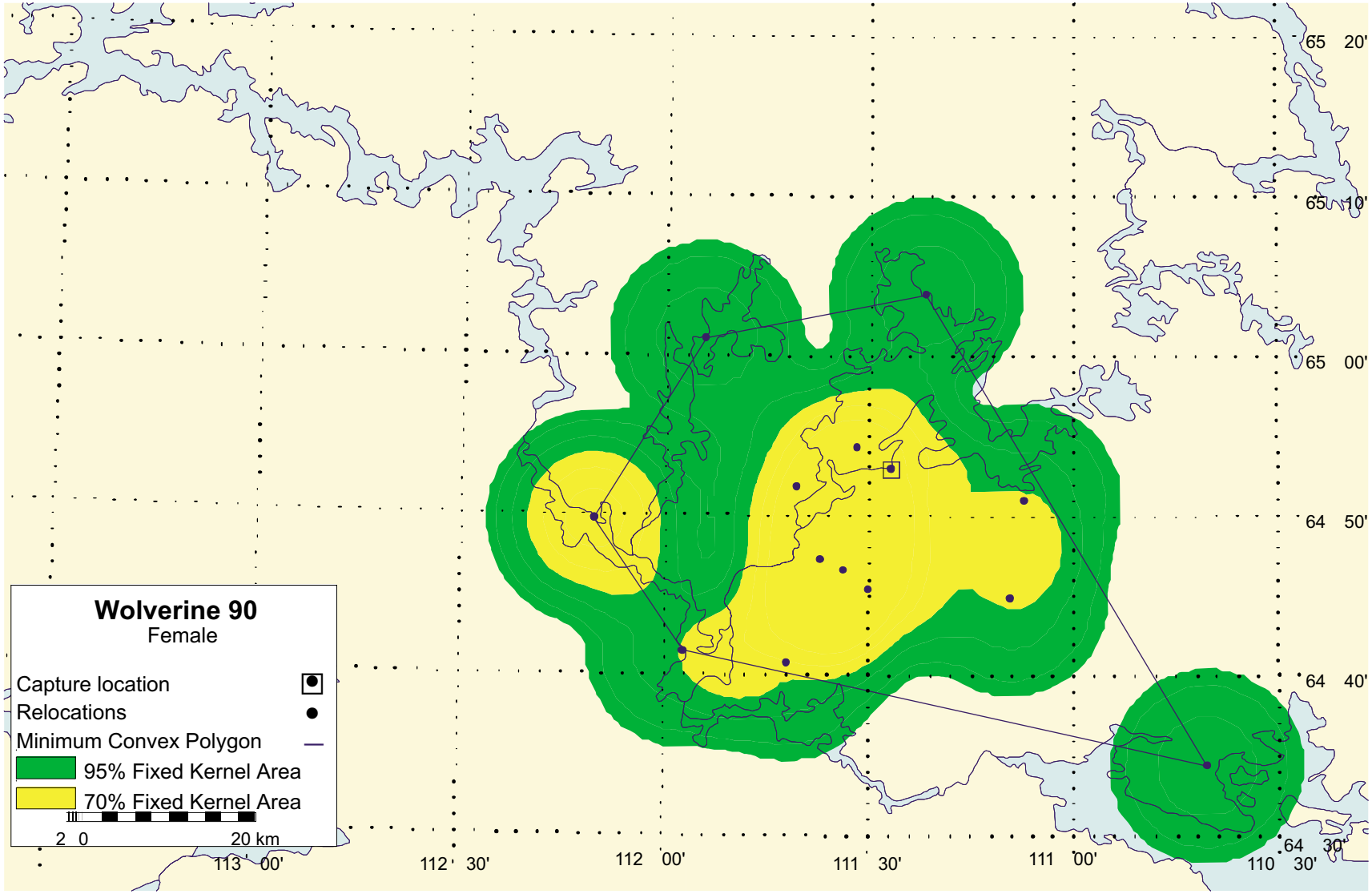

Wolverine 88
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0
20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '

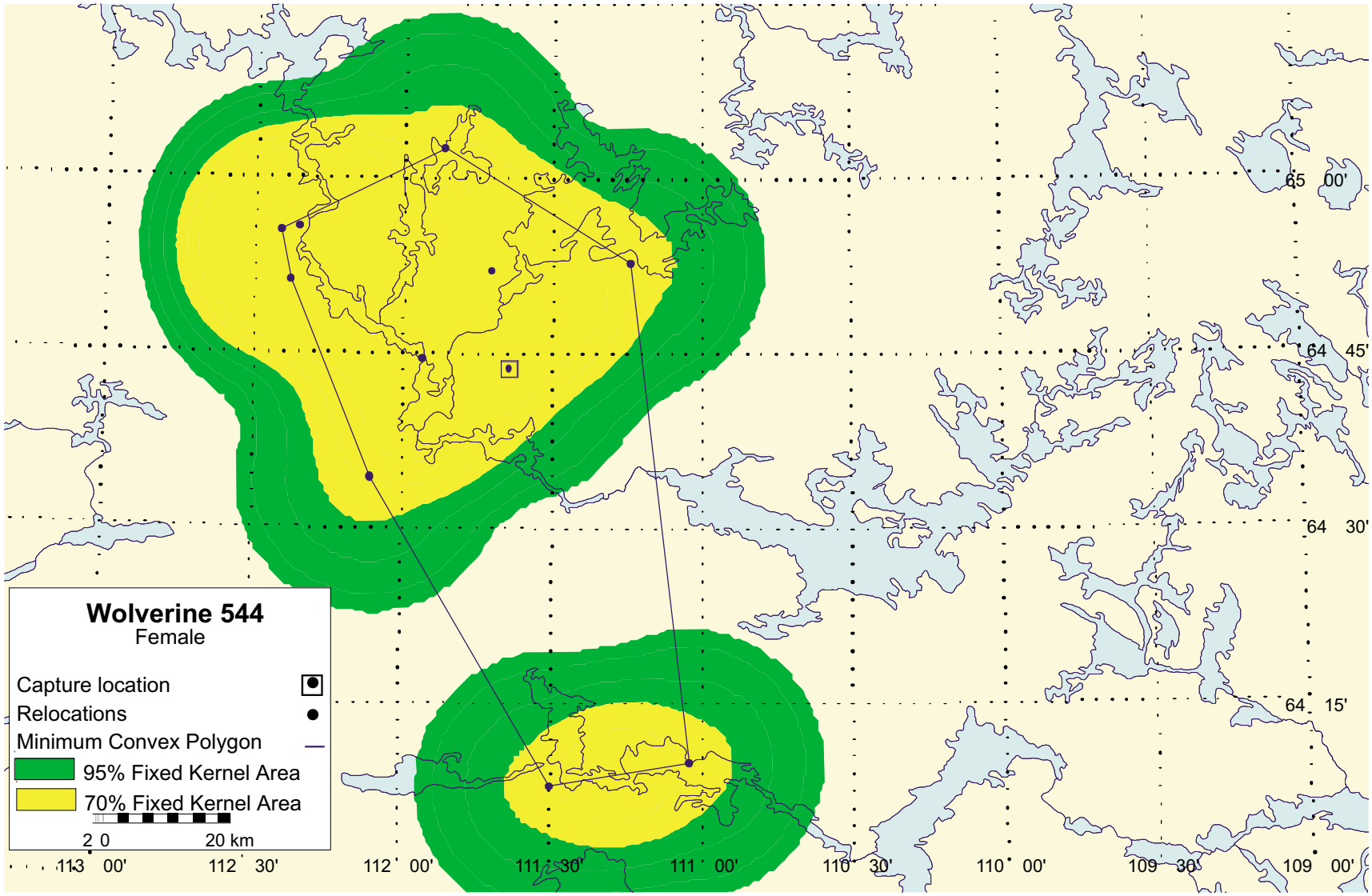

Wolverine 599
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '

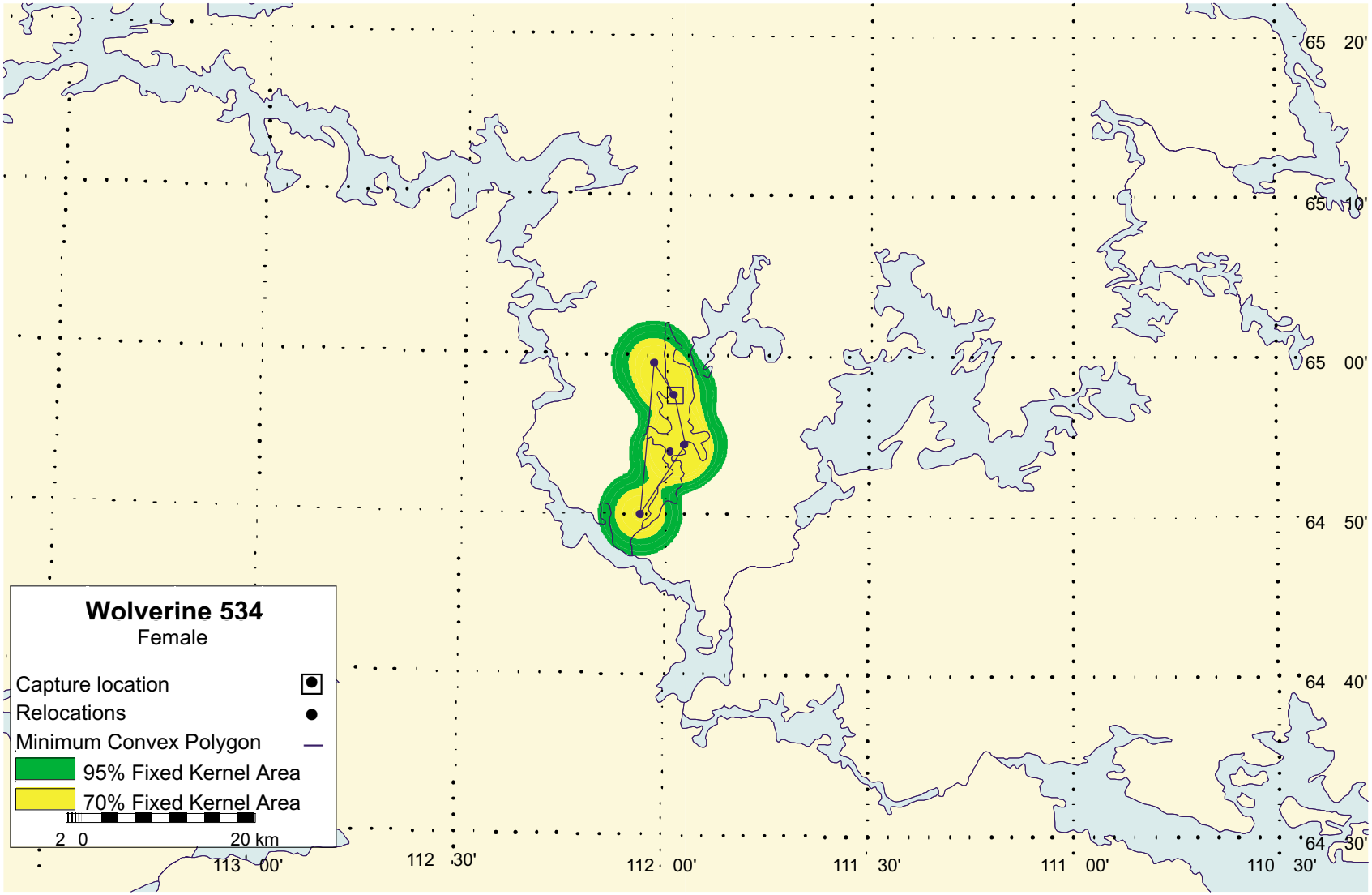

Wolverine 540
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '

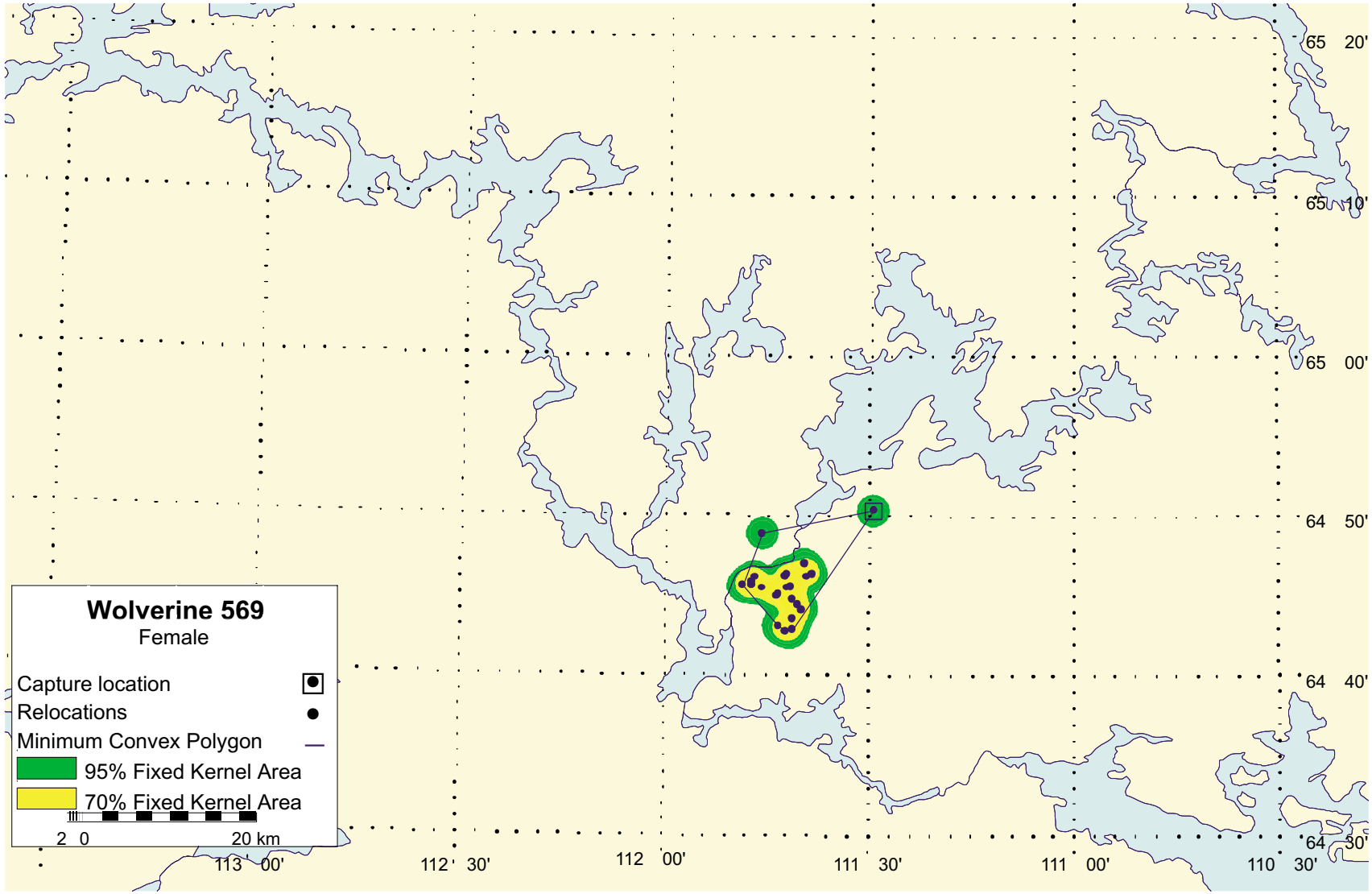

Wolverine 558
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

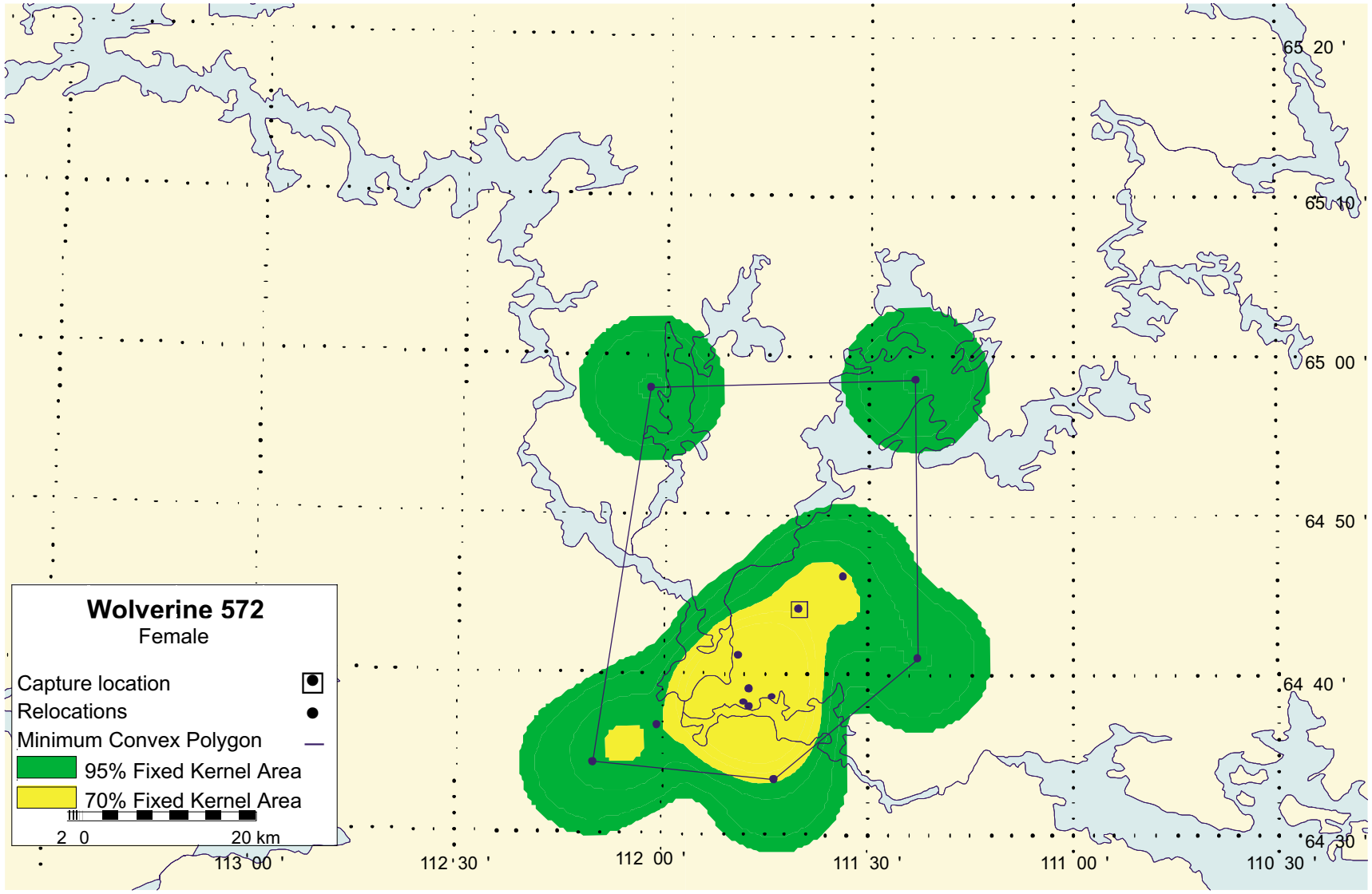

Wolverine 589
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'
110 00'
109 30'
109 00'
65 00'
64 45'
64 30'
64 15'

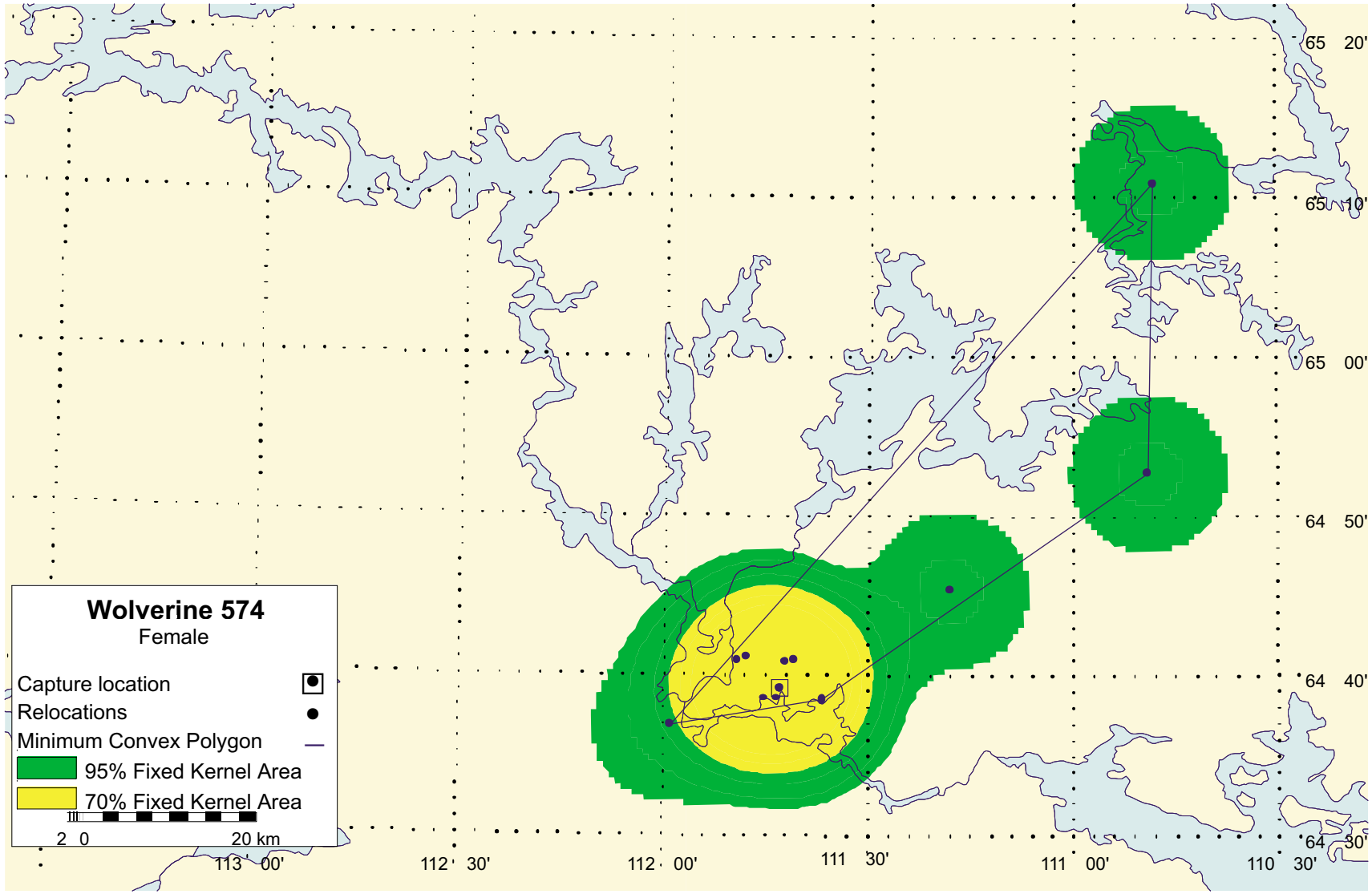

Wolverine 90
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

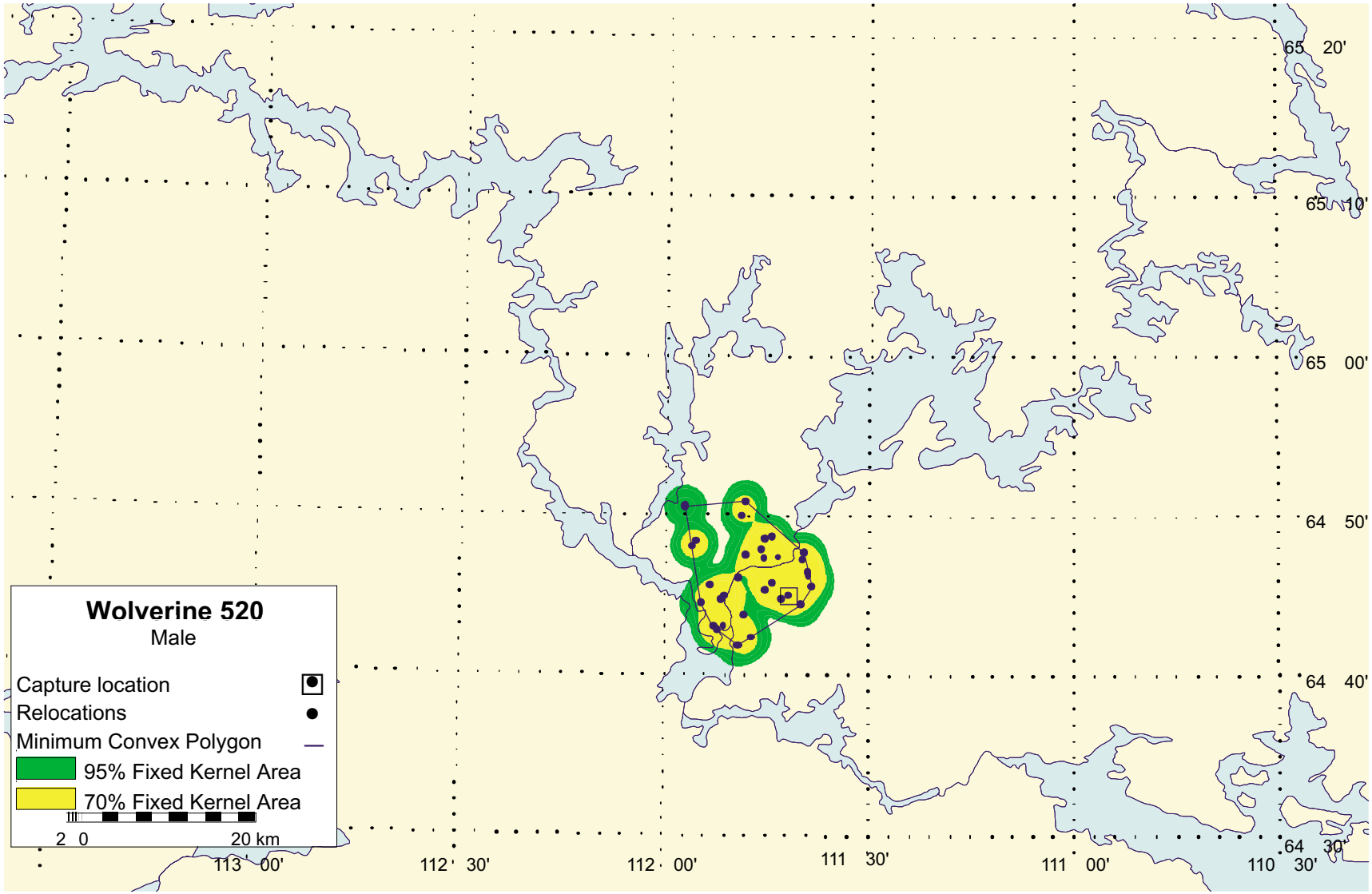

Wolverine 544
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 00'
64 45'
64 30'
64 15'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'
110 00'
109 30'
109 00'

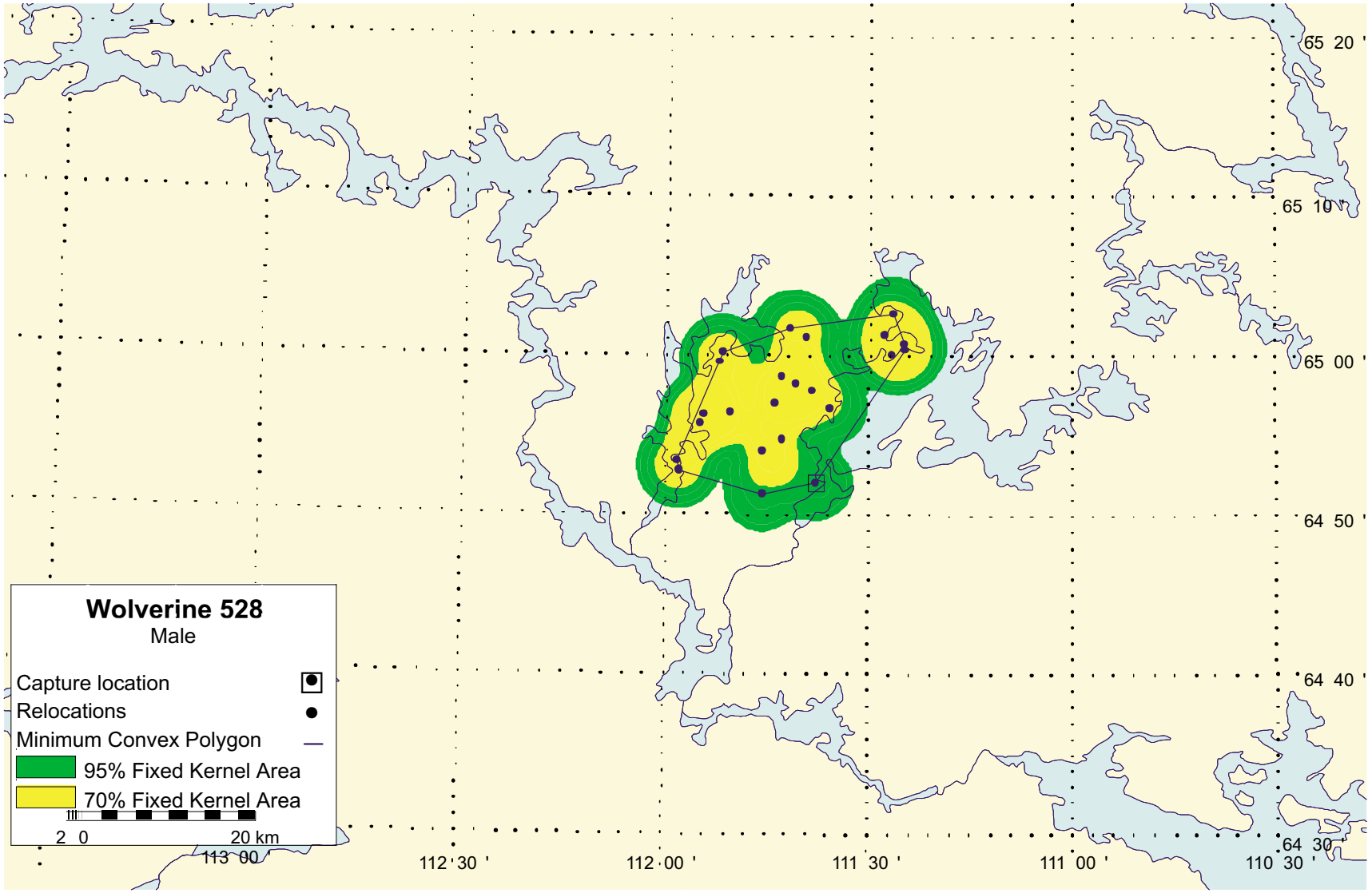

Wolverine 534
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

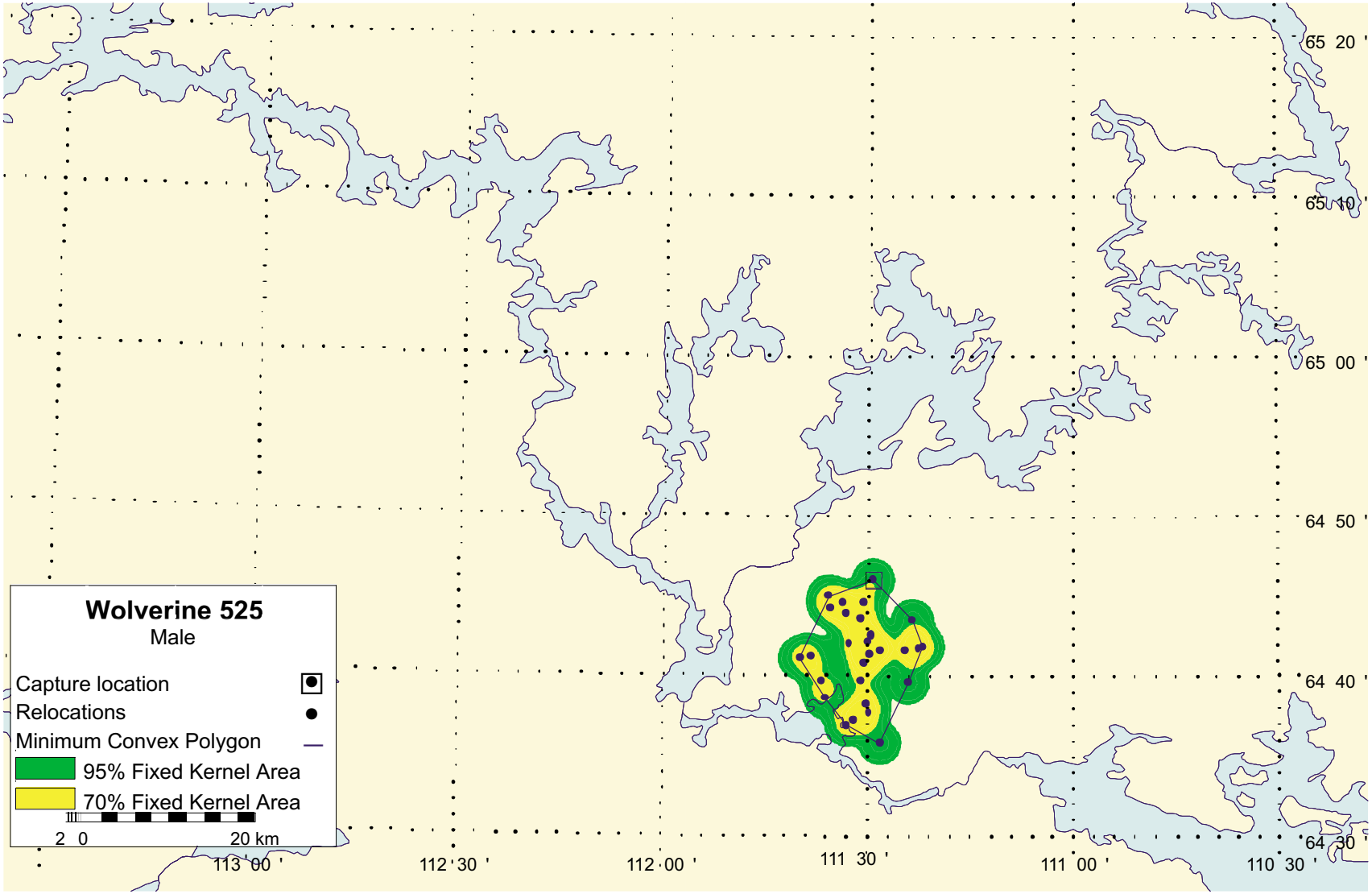

Wolverine 569
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

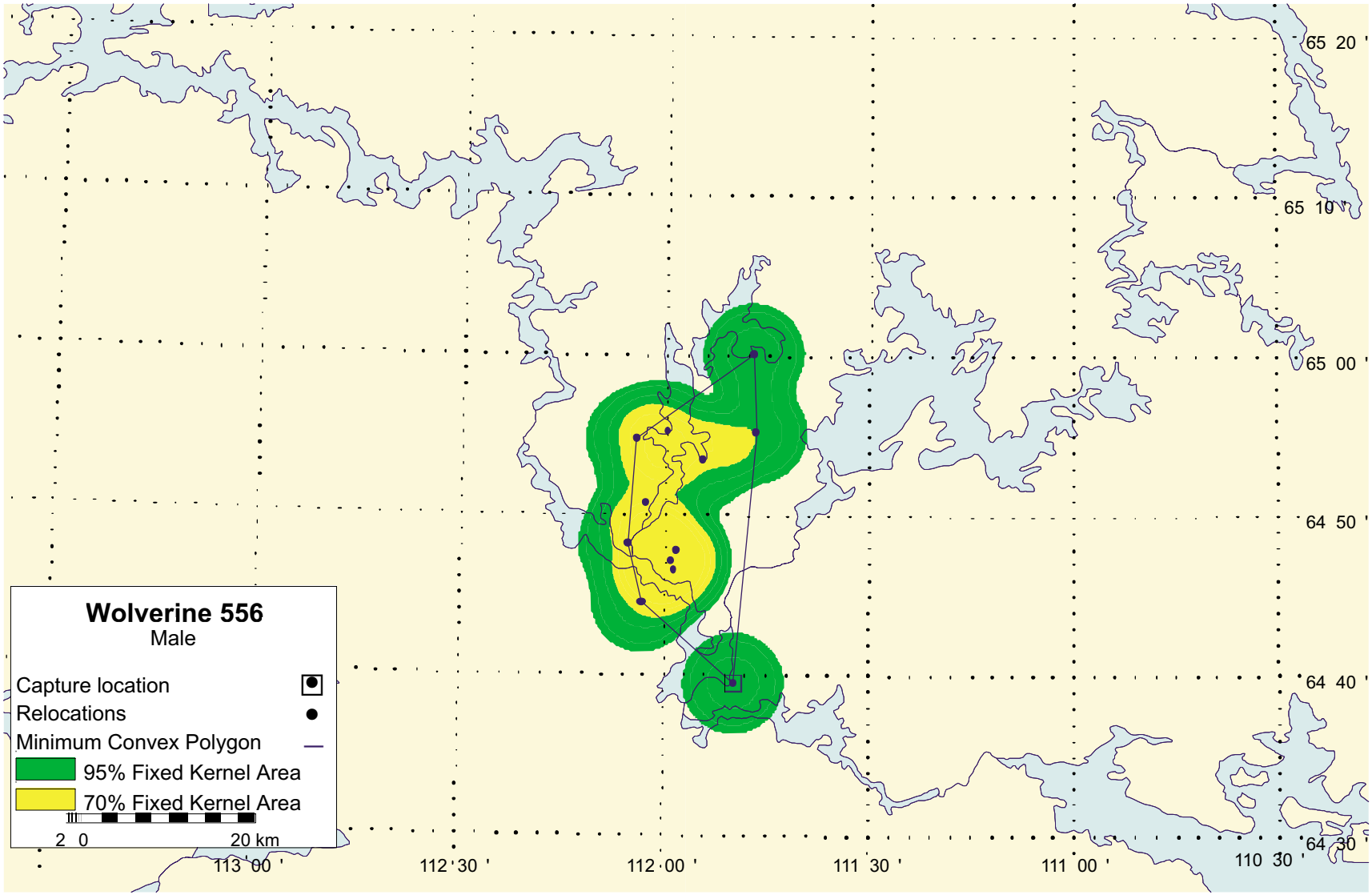

Wolverine 572
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '

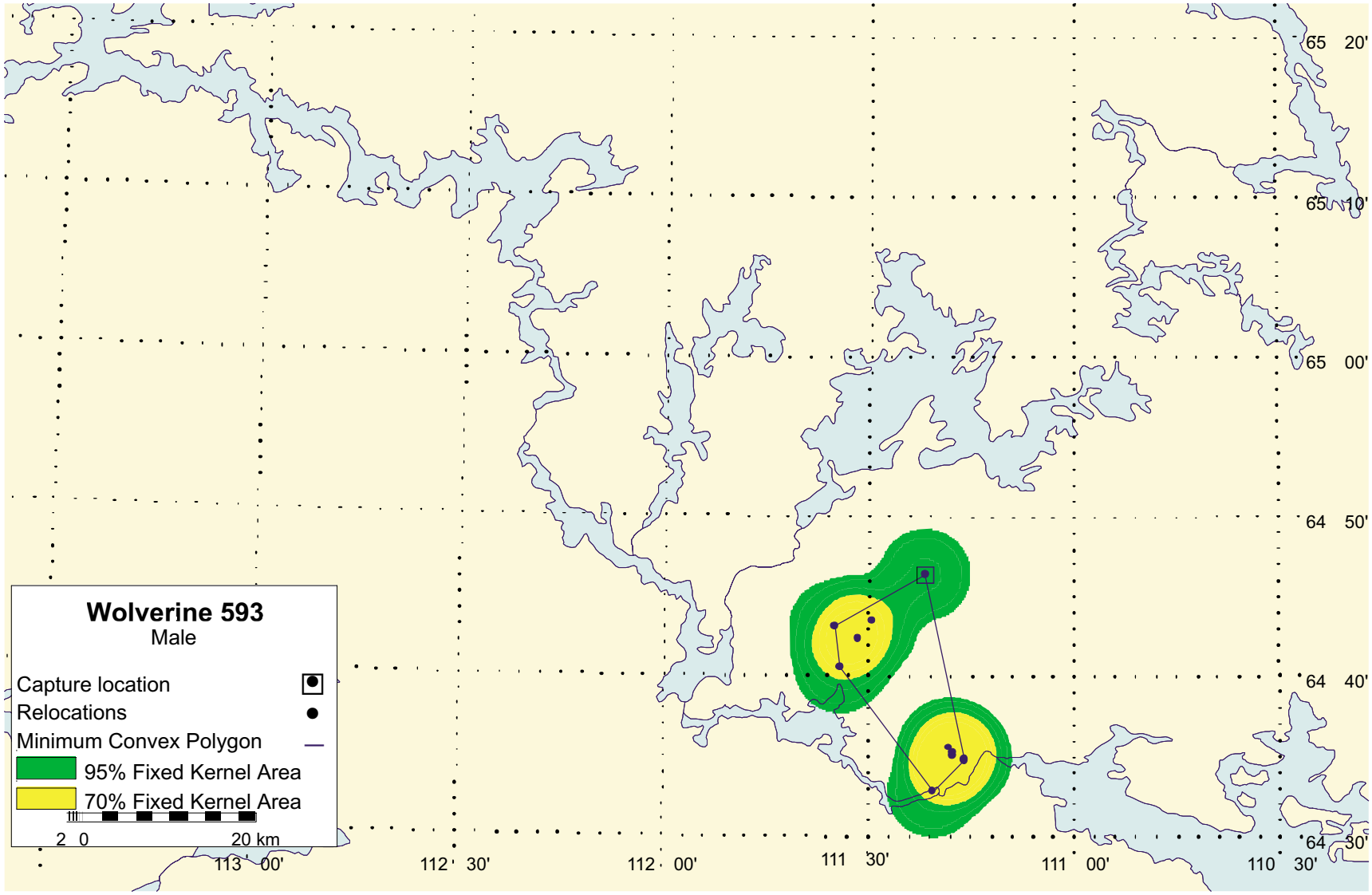

Wolverine 574
Female
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

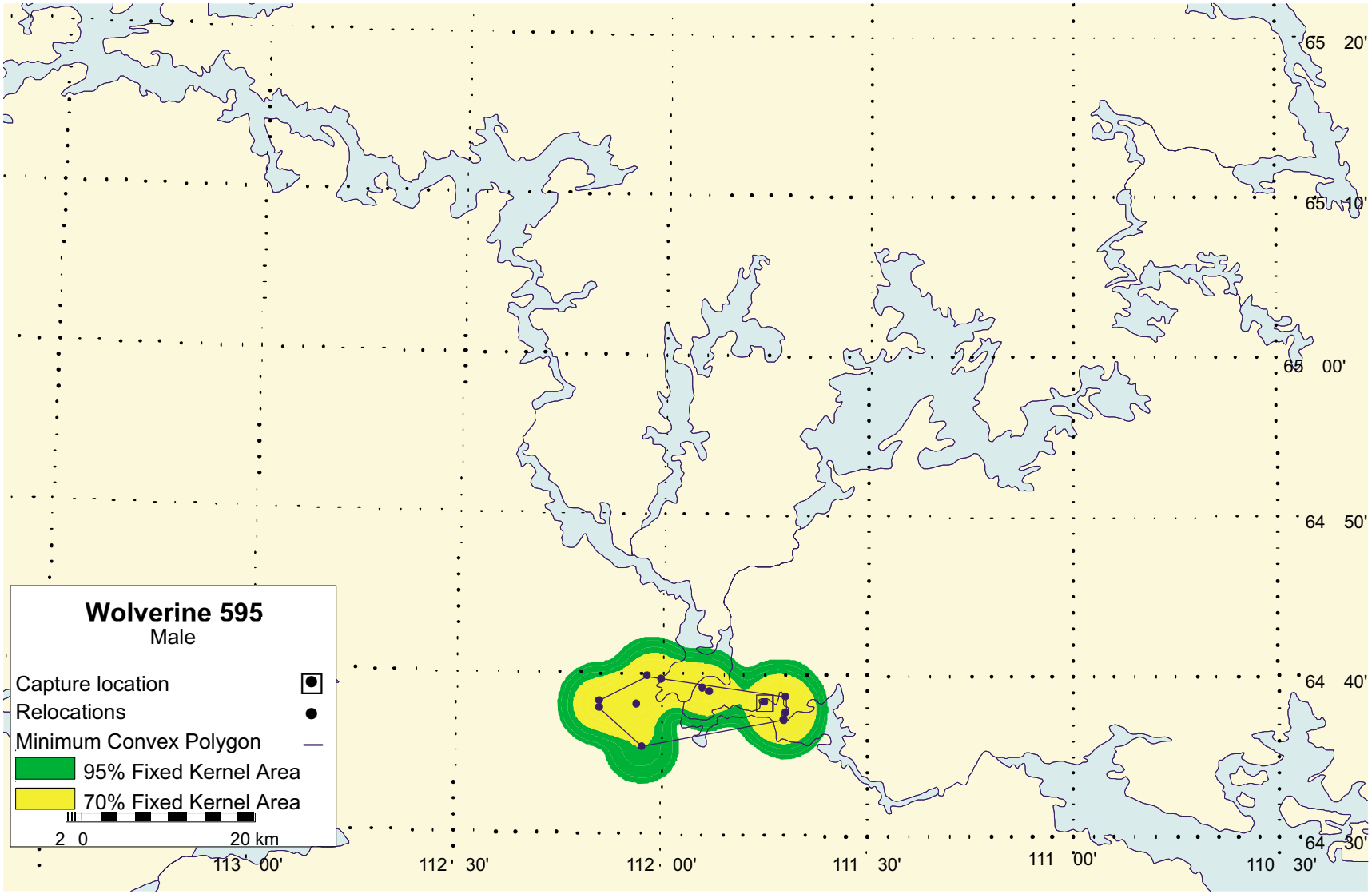

Wolverine 520
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

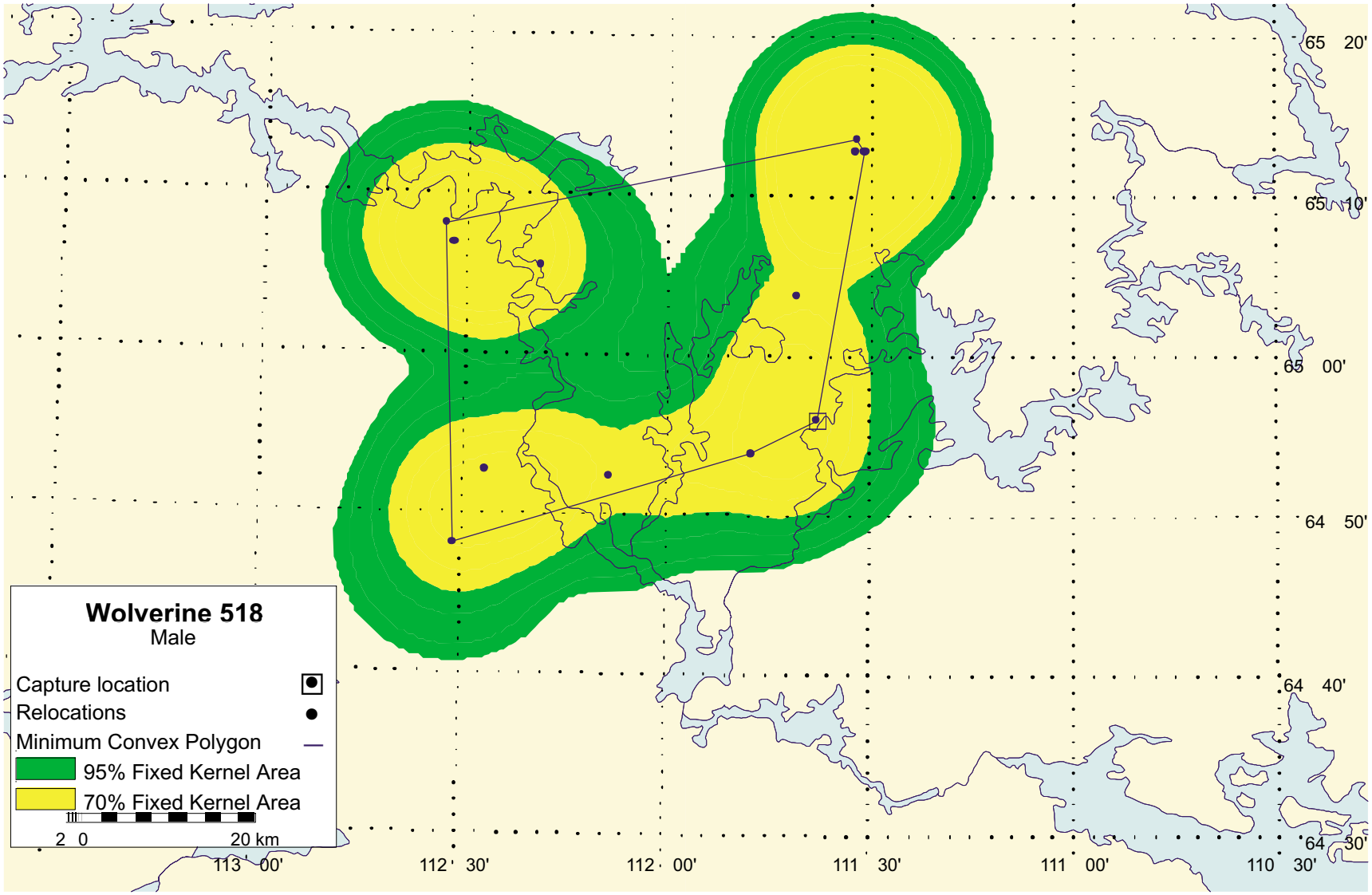

Wolverine 528
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '

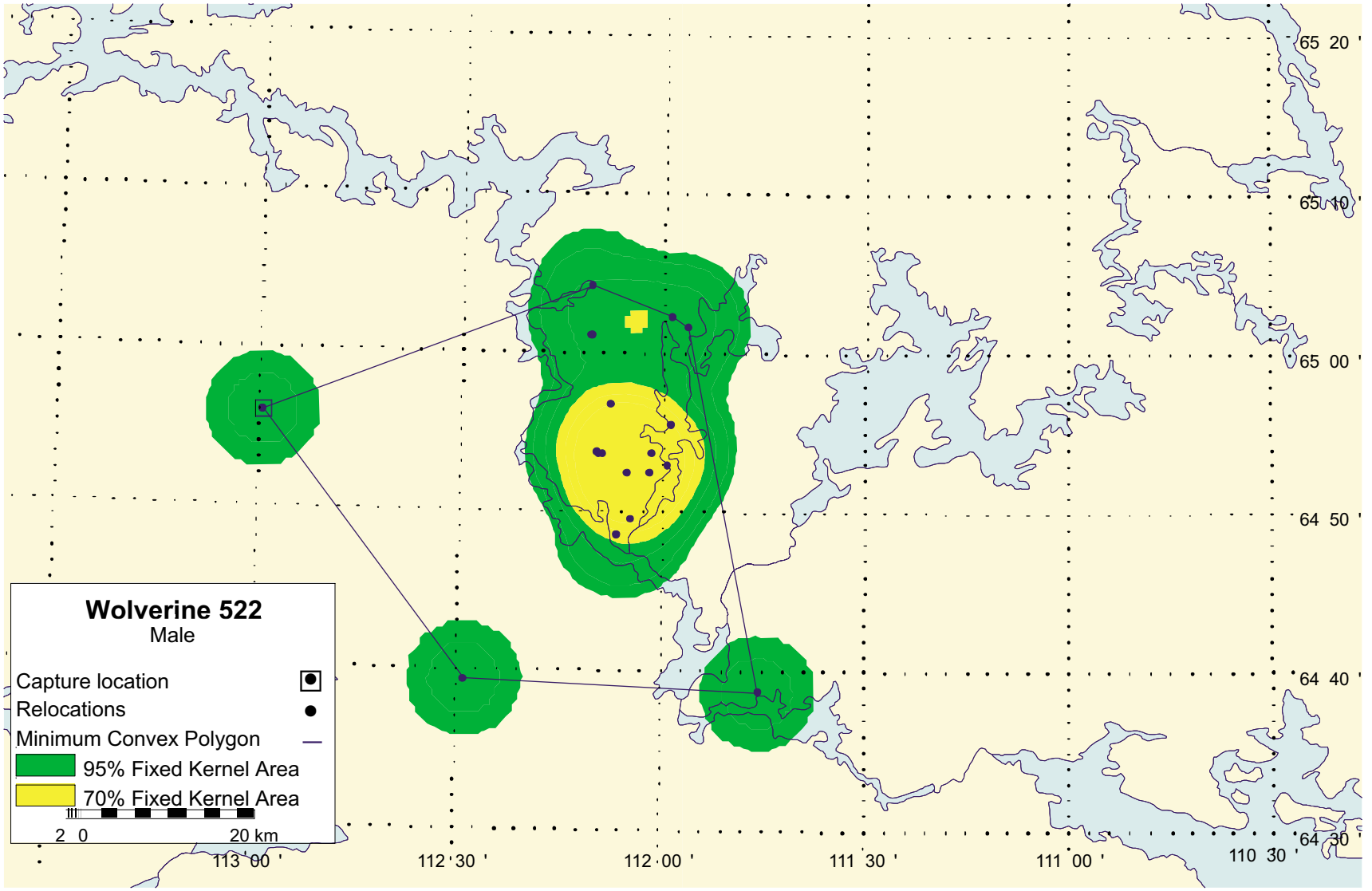

Wolverine 525
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '

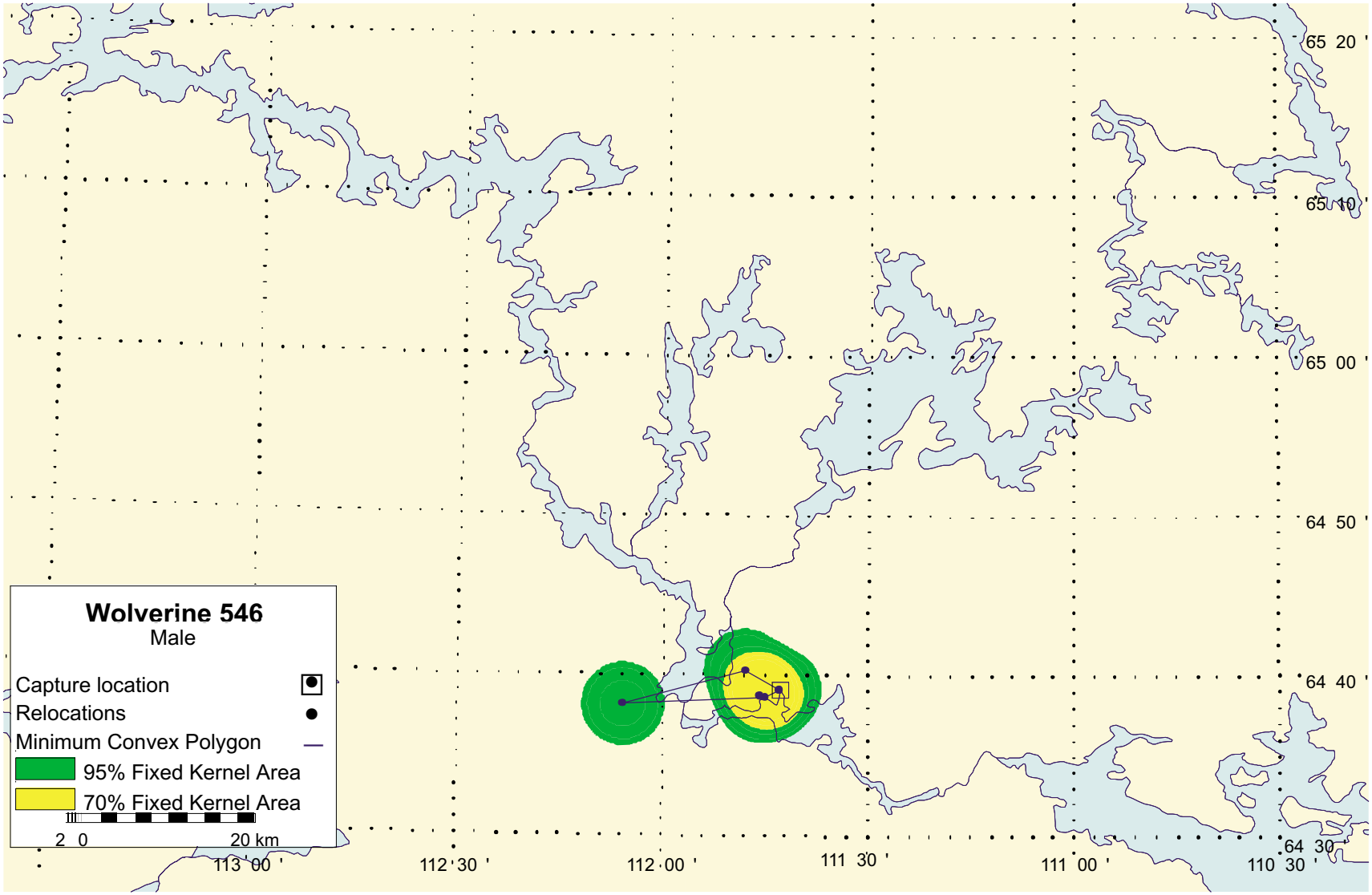

Wolverine 556
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '

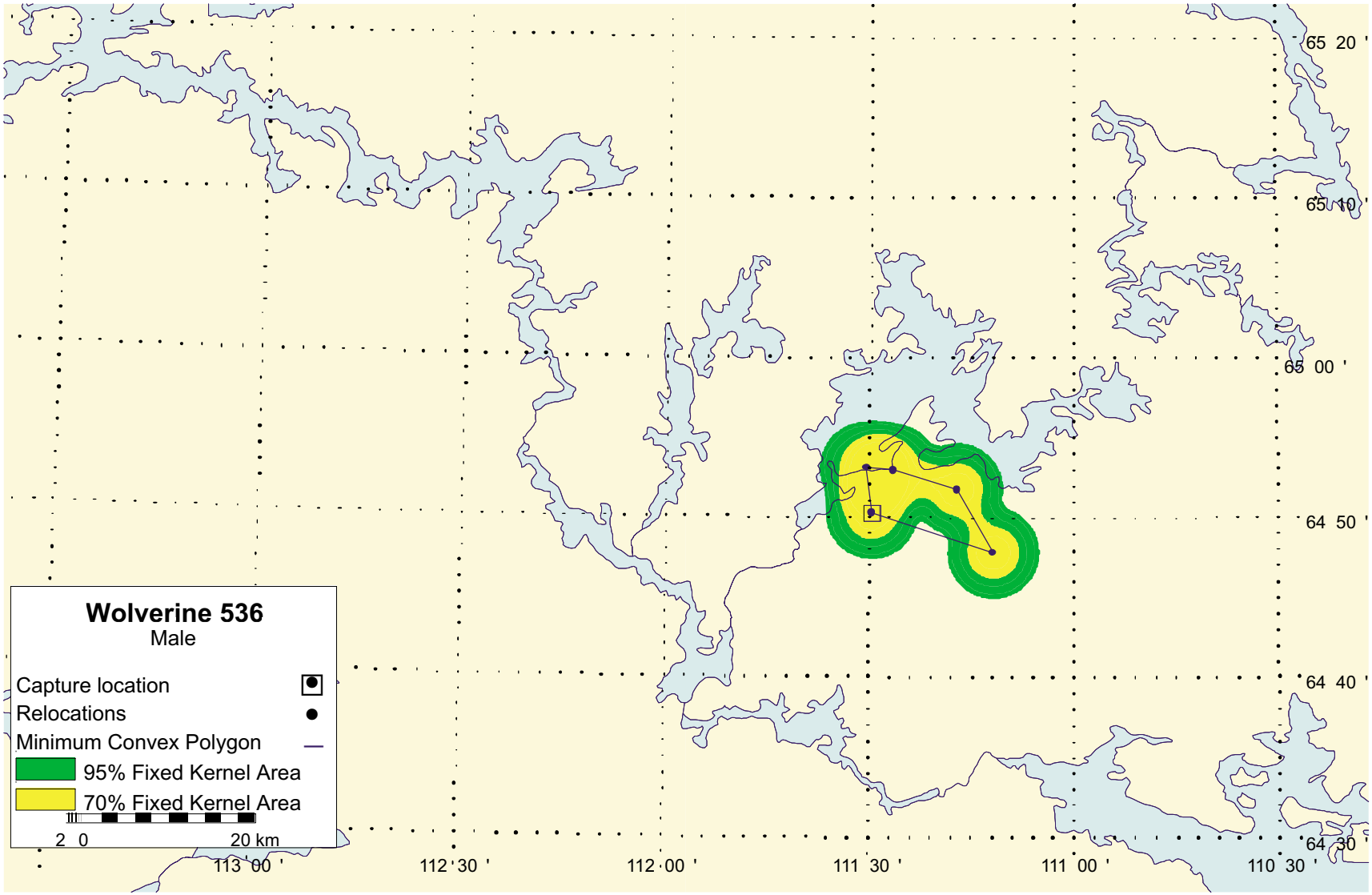

Wolverine 593
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

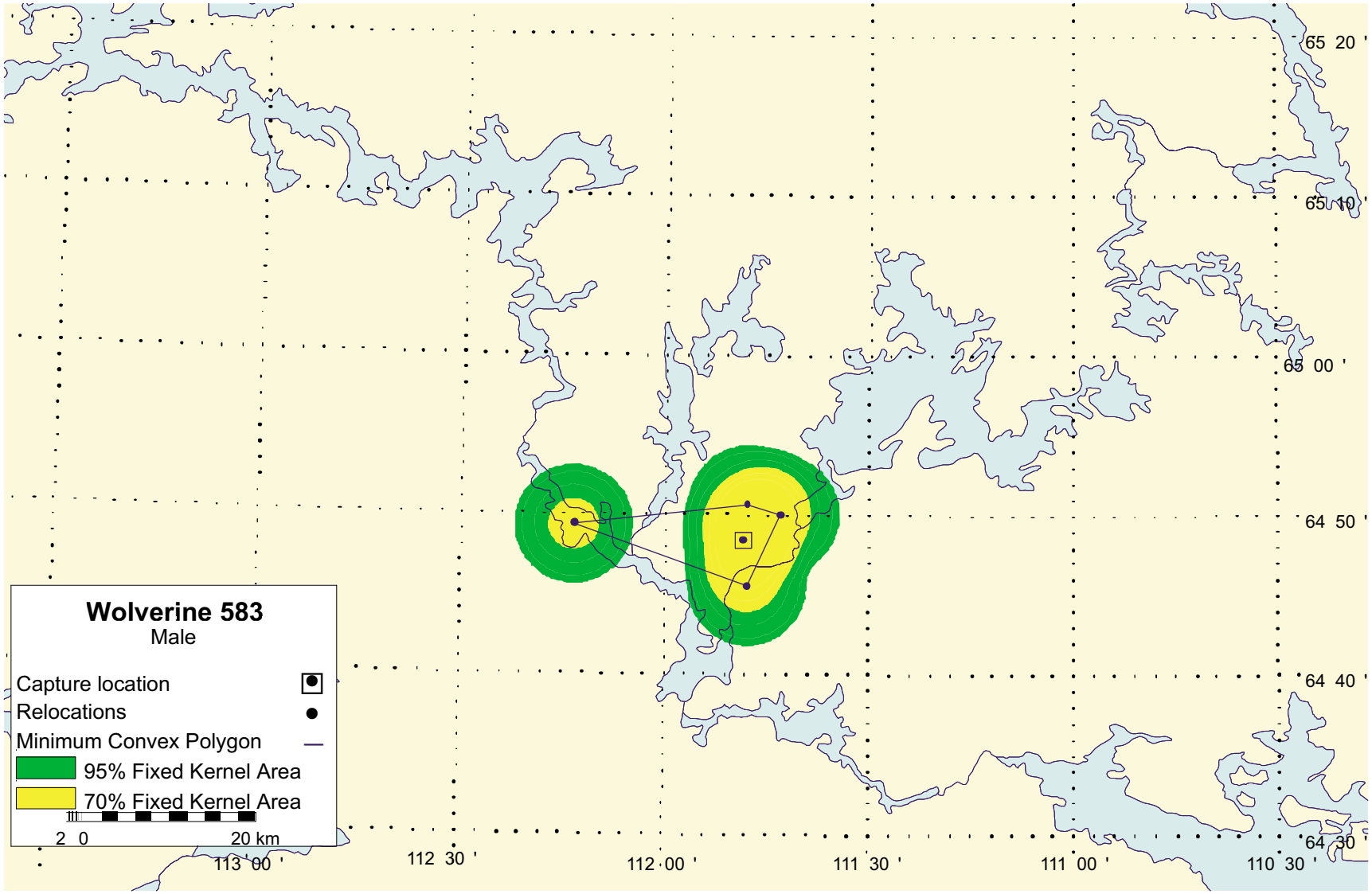

Wolverine 595
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'

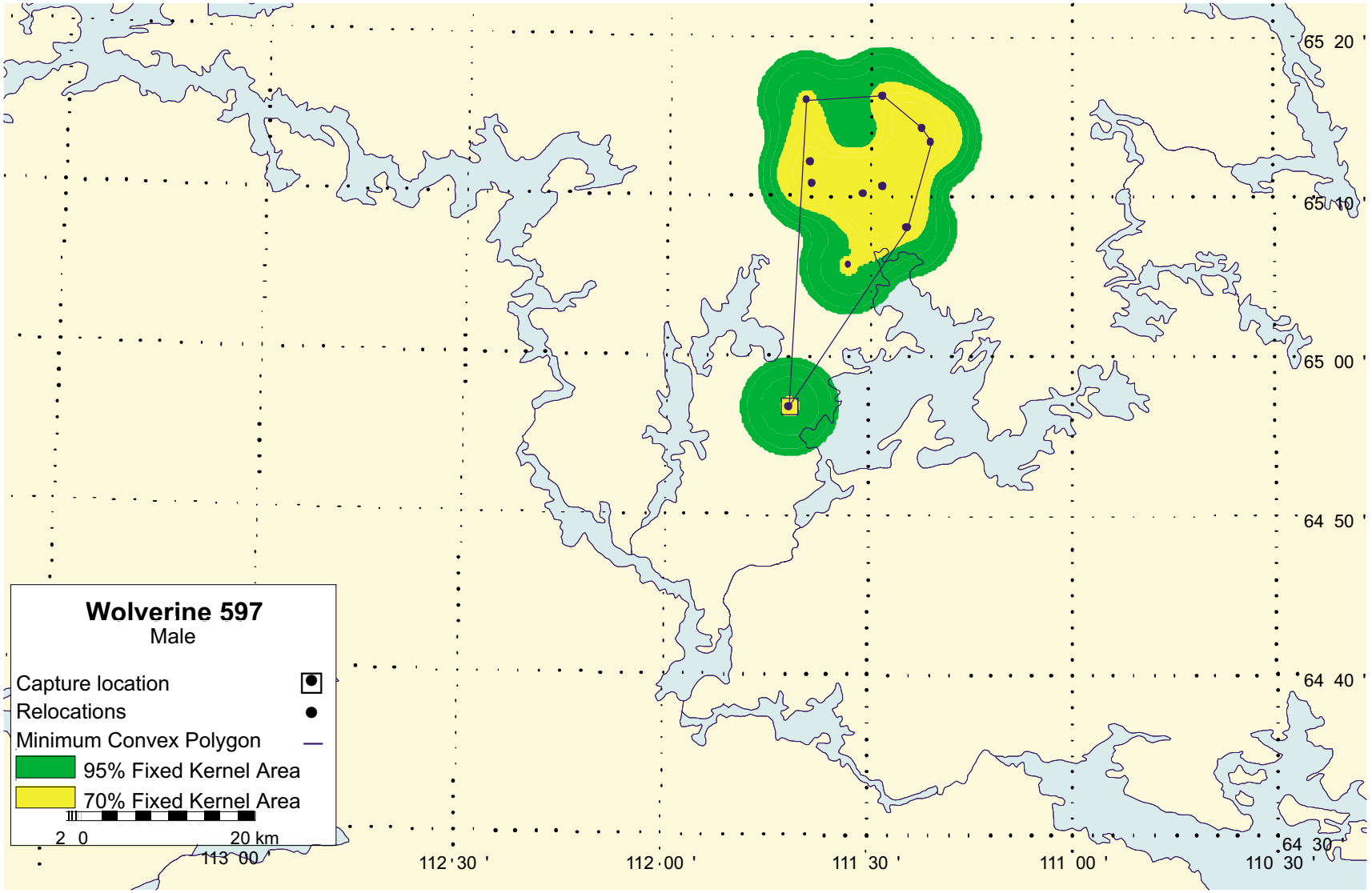

Wolverine 518
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20'
65 10'
65 00'
64 50'
64 40'
64 30'
113 00'
112 30'
112 00'
111 30'
111 00'
110 30'


Wolverine 522
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '


Wolverine 546
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20
65 10
65 00
64 50
64 40
64 30
113 00
112 30
112 00
111 30
111 00
110 30


Wolverine 536
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20 '
65 10 '
65 00 '
64 50 '
64 40 '
64 30 '
113 00 '
112 30 '
112 00 '
111 30 '
111 00 '
110 30 '


Wolverine 583
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20
65 10
65 00
64 50
64 40
64 30
113 00
112 30
112 00
111 30
111 00
110 30


Wolverine 597
Male
Capture location
Relocations
Minimum Convex Polygon
95% Fixed Kernel Area
70% Fixed Kernel Area
2 0 20 km
65 20
65 10
65 00
64 50
64 40
64 30
113 00
112 30
112 00
111 30
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