SUSITNA HYDROELECTRIC PROJECT

PHASE II PROGRESS REPORT

BIG GAME STUDIES

Volume VI BLACK BEAR and BROWN BEAR

Sterling D. Miller

ALASKA DEPARTMENT OF FISH AND GAME
Submitted to the Alaska Power Authority
April 1983

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PHASE II, first annual progress report

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Results reported herein deal with portions of a continuing study and should be treated as tentative. Do not cite in technical publications without permission from author.

PREFACE

In early 1980, the Alaska Department of Fish and Game contracted with the Alaska Power Authority to collect information useful in assessing the impacts of the proposed Susitna Hydroelectric Project on moose, caribou, wolf, wolverine, black bear, brown bear and Dall sheep.

The studies were broken into phases which conformed to the anticipated licensing schedule. Phase I studies, January 1, 1980 to June 30, 1982, were intended to provide information needed to support a FERC license application. This included general studies of wildlife populations to determine how each species used the area and identify potential impact mechanisms. Phase II studies continued to provide additional information during the anticipated 2 to 3 year period between application and final FERC approval of the license. Belukha whales were added to the species being studied. During Phase II, we are narrowing the focus of our studies to evaluate specific impact mechanisms, quantify impacts and evaluate mitigation measures.

This is the first annual report of ongoing Phase II studies. In some cases, objectives of Phase I were continued to provide a more complete data base. Therefore, this report is not intended as a complete assessment of the impacts of the Susitna Hydroelectric Project on the selected wildlife species.

The information and conclusions contained in these reports are incomplete and preliminary in nature and subject to change with further study. Therefore, information contained in these reports is not to be quoted or used in any publication without the written permission of the authors.

The reports are organized into the following 9 volumes:

Volume I.	Big Game Summary Report
Volume II.	Moose - Downstream
Volume III.	Moose - Upstream
Volume IV.	Caribou
Volume V.	Wolf
Volume VI.	Black Bear and Brown Bear
Volume VII.	Wolverine
Volume VIII.	Dall Sheep
Volume IX.	Belukha Whale

I. SUMMARY

In 1982, three components of Su Hydro studies were initiated. These included a black bear census in the upstream area, an analysis of fecal samples, and the initiation of a bear study downstream of the proposed Devils Canyon dam site. This downstream study is designed to reveal impacts of project-related changes in bear food abundance (primarily salmon) on resident downstream bear populations. Black bears are emphasized in this downstream study.

Preliminary results of the new components of the Su Hydro bear project are discussed in detail in this report. Components of continuing studies were analyzed in detail only when new findings in 1982 altered or significantly strengthened preliminary findings reported in our earlier report (Miller and McAllister 1982). Bear population models intended to assist in predictions of impacts and evaluations of mitigation alternatives are under development and will form a subsequent addendum to this report.

Additional information on brown bear population parameters essential to track project impacts on bear populations through changes in productivity was collected in 1982. Initial post-emergence litter size of new-born cubs in 13 litters (1978-1982) was 2.15 (range 1-3). Nine of 21 cubs in 10 litters (43%) have been lost between emergence from dens as cubs and emergence as yearlings.

Available data suggest a high rate of loss from yearling litters in 1982, the year following an apparent widespread failure of the berry crop. A high proportion of adult females (54%) may produce cub litters in 1983, 2 years after the apparent berry crop failure. Such pulses in cub production would produce an uneven age distribution in the brown bear population and an analysis of the harvest data suggests the presence of this pattern.

Adult females have smaller home ranges in years they have litters of newborn cubs than in other years. Excluding such females from the analysis, home ranges of brown bears were smaller in 1982 than in the preceding year when berry crops were poor. These observations suggest that project-related changes in the distribution, abundance, or availability of food resources will affect bear populations in the study area. This influence would likely be expressed by decreased survivorship of yearling and subadult brown bears and an increase in reproductive interval.

The previously reported movements of project-area brown bears to Prairie Creek to fish for salmon was repeated in 1982. Prairie Creek is considered an area of critical habitat importance to brown bear populations in the study area.

None of the brown bear dens located in this study would be inundated by the proposed impoundments although as suggested in last year's report, some displacement from denning areas would result form access roads and borrow areas.

Continuing studies on black bear populations in the impoundment area were conducted in 1982. A preliminary summer population estimate of 86 black bears (95% CI=47-172) was made using Lincoln Index techniques. Numerous sources of potential biases were identified in this estimate, most of these would tend to yield an underestimate. This procedure will be repeated in spring 1983 when a different array of sightability biases would exist. The possibility that emigrations of subadult black bears during the poor berry year of 1981 resulted in the lower-than-expected population estimate is discussed.

Limited sampling of bear abundance in two habitats in two locations provided support for the hypothesis that black bear movements in the upstream study area during late summer are motivated by the relative abundance of berries, especially blueberries. At this time bears tend to move upstream and away from the impoundment area. More extensive berry sampling by the Plant Ecology sub-task is recommended for 1983.

Data collected in 1982 support our hypothesis of an inverse relationship between black bear productivity and food abundance. The poor berry crop in 1981 created a situation where 19 of 20 radio-collared black bear females may produce cubs in 1983. This factor is significant because a large proportion of black bear habitat (especially spring habitat) is expected to be inundated by the Watana impoundment. This habitat loss will likely result in decreased productivity in the post-impoundment period.

Analyses of a small sample of black bear scats in the upstream study area suggests the importance of *Equisetum* in spring diets along with grasses and sedges. These data tend to support our hypothesis that early spring food in the area to be inundated by the Watana impoundment may be important to upstream bear populations. The relative availability of these items inside and outside of the impoundment area must be established by Plant Ecology subtask studies.

Of 24 black bear dens found in the vicinity of the proposed Watana impoundment, 13 will be flooded by the impoundment. In contrast, minimal impacts on black bear dens through inundation are anticipated in the vicinity of the Devils Canyon impoundment. Continued high reuse of the same den sites suggest low availability of acceptable den sites and a corresponding major impact through destruction of den sites in the vicinity of the Watana impoundment.

Work was initiated in 1982 to evaluate impacts of reduced salmon spawning in sloughs downstream of Devils Canyon on downstream black bear populations. Salmon spawning sloughs identified by Fisheries subtask workers were inspected in 1982 and ranked relative to bear use and salmon abundance. The movements of all 10 downstream radio-collared black bears (with 1 possible exception) indicated use by the bears of spawning salmon during 1982.

Radio-tracking data indicate 5 bears used identified slough areas, 2 fished in the mainstem Susitna or its tributaries, and 2 others fished in the Chulitna or its tributaries. Another bear may also have fished in the mainstem Susitna but the evidence is inconclusive. Bear feces collected in the vicinity of the salmon sloughs contained more devils club (*Oplopanax horridus*) than any other item. However, there was much direct evidence of bear use of salmon caught in the sloughs. Possible reasons for this bias are discussed. Additional work is required to determine the impacts of reduced salmon spawning in slough habitats on downstream black bear populations.

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V. Introduction and Acknowledgements

This progress report is an updated supplement to our Final Phase I report (Miller and McAllister 1982). The material discussed here does not repeat analyses presented in our earlier report except where additional information was collected in 1982 that modifies or significantly strengthens the results presented in that report. Also included in this report are the preliminary results of studies initiated in 1982. This report is a supplement to our earlier report and does not present all the information available about the proposed Susitna project's impact on bear populations.

The dedication, talents and efforts of Dennis McAllister (ADF&G) have been of crucial importance throughout all aspects of this study. Valuable contributions were also made by K. Schneider, W. Ballard, B. Taylor, N. Tankersley, SuzAnne Miller, J. Whitman, D. Anctil, S. Albert, E. Goodwin, R. Smith, M. Chihuly, T. Otto, P. Smith, and R. Sleeper (all ADF&G). S. Lawler, P. Miles and V. Alexander provided cheerful clerical assistance.

The skills of V. Lofstedt, C. Lofstedt, M. Hauke, and D. Wilson (Kenai Air Alaska) were appreciated in piloting helicopters and fixed-wing aircraft as were the skills of A. Lee (Lee's Air Taxi), K. Bunch (Sportsman's Flying Service), D. Deering (Deering Air Taxi), C. Allen (Allen Flying Service), and several pilots with Air Logistics Inc. Special thanks to Rick Halford (Susitna

Lodge), the Denali Mining Co., and Jim Grimes (Adventures Unlimited) for permission to use their landing strips and facilities for storing fuel. Su-Hydro fisheries study personnel (ADF&G) provided logistic support during our downstream bear study effort.

The cooperation of Granville Couey (ACRES), the Watana Camp manager and his staff was appreciated. Dr. Richard Taber and Dr. Ken Raedeke (Univ. of Washington) made valuable suggestions during their association with TES, several staff members of LGL have also made valuable suggestions.

VI. Methodology.

Methods presented in Miller and McAllister (1982) were continued in 1982. Capture efforts in 1982 were made from 26 May through 11 June. Four black bears (including 2 yearlings) were captured in dens in April 1982. No mid-summer capture efforts were conducted in 1982 except for a brief effort to snare bears in the downstream study area on 30 August-4 September. Efforts to snare bears and evaluate bear use of salmon spawning sloughs downstream of Devils Canyon were conducted by riverboat out of Talkeetna.

The weather was generally cooperative in 1982 and flights to monitor radio-collared bears were conducted on 4/19, 5/4-6, 5/18, 6/1, 6/9, 6/11-12, 6/17, 6/24, 6/29, 7/8-9, 7/15, 7/26, 8/3, 8/10, 8/17-22 (census), 9/8, 9/20, 9/24, 10/6, 10/15, 10/20, 11/15, and 12/17. Some difficulty with weather was encountered during the period of den entrance in fall 1982.

Locations of dens used in winter 1981/82 were located on the ground and marked in early April and revisited for measuring in late June. Dens used in winter 1982/83 have only been plotted from the air at this writing so these data should be considered preliminary.

Methods used in the new components of this study initiated in 1982 are discussed along with the results of these studies (bear density estimate, bear food habits, berry abundance analysis).

Locations obtained in 1982 have been digitized and analyzed only through 9 September, data collected subsequently are not included in analyses.

The data file of all point locations collected to date was supplemented in 1982 with a code for each location indicating my interpretation of the bear's motive for having made the movement from its previous location. This code will be helpful in plotting seasonal home ranges. The codes utilized are listed below.

CODE

A No specialized movement suspected

B In seasonal activity area--caribou calving grounds

C En route to or from caribou calving grounds

D In seasonal activity area--salmon fishing area

E En route to or from salmon fishing area

F In seasonal activity area--searching for food resources that are scarce in that year within normal home range (especially bad berry years)

G En route to or from above area

H In seasonal activity area--denning behavior outside of known non-denning range

I En route to or from above denning area

J In seasonal activity area--generalized early spring lowland foraging

K Suspected dispersal movements

L Initial capture site or recapture site of non-radioed bear

M At or en-route to or from den site within normal home range

In similar fashion codes were added to the data file indicating the reproductive status of the bear at each point location. These data are not automatically collected because often the bear was not actually seen when radio-located. However, if, for example, the bear had offspring with it prior to and subsequent to a location when it was not seen it is probable it also had them during that location. These codes will be useful in isolating movements of bear which may be related to reproductive status (females with cubs vs. females with yearlings, subadult dispersals, etc.). The codes utilized are listed below.

CODE

A with newborn cubs

B with yearling offspring

C with 2-year old offspring

D with 3-year old offspring

E Presence or absence of offspring unknown (had them previously but not subsequently)

F Probable or known estrus female or breeding male (usually accompanied by another bear in the case of males)

G Inactive or unknown or alone (cubs lost or weaned)

H Subadult

VII. The Study Area

The upstream study area (impoundment vicinity) remained as discussed by Miller and McAllister (1982). In 1982, a downstream study was initiated to evaluate bear use of salmon spawning habitats and interchange between upstream and downstream populations. In this downstream study, most bears were captured between Curry and Portage Creek. Based on the movements of these bears, the downstream study area is illustrated in Figure 1 which encompasses an area of 1,157 km^2. This area includes the movements of 11 black bears (B365, B367, B369, B370, B372, B374, B375, B376, B377, and B378) and one brown bear female with newborn cubs (G379). One black bear (B365) moved out of the Susitna drainage into the Chulitna drainage in 1982 and has not returned; excluding this bear and the brown bear, the primary downstream black bear study area in 1982 encompassed 527 km^2 (Figure 2).

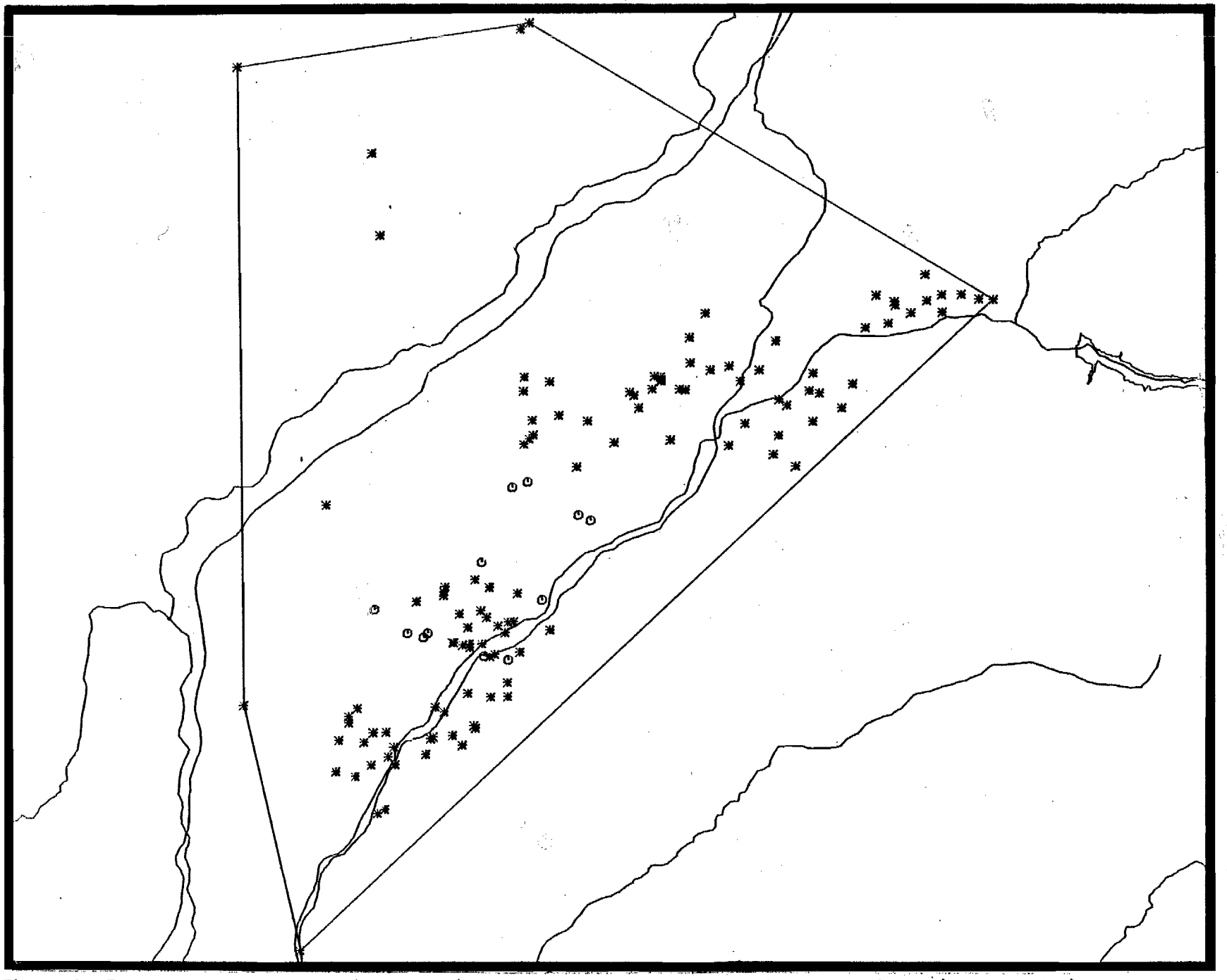

Figure 1. Downstream study area (extensive), polygon encloses 1,157 sq. km, 131 points. (1 cm = 3 km)

Figure 2. Downstream black bear study area (intensive), polygon encloses the 527 sq. km used by 10 radio-collared black bears, 117 points. (1 cm = 2.3 km)

VIII. Results and Discussion--Brown Bears

A. DOWNSTREAM BROWN BEARS

Only one brown bear was captured in 1982 in the downstream study area. This bear (G379, a 5 year old female) had a litter of 2 newborn cubs which survived through the last visual observation of this bear on 20 October. Subsequent to this sighting (near the confluence of the Talkeetna River and Chunilna Creek) G379 moved and entered a den near Portage Creek (near the Susitna River downstream of Curry). This den has an approximate elevation of 1,550 feet, substantially lower than the mean elevation of 4,181 feet (range 2,330-5,150) reported for brown bear in the impoundment study area (Miller and McAllister 1982:67).

This downstream bear also did not follow the pattern of remaining at high isolated locations reported for upstream brown bears with cubs by Miller and McAllister (1982:57). In spring and early summer, this bear remained in relatively high open country but from early August through late September she was found on the Susitna River in the immediate vicinity of the sloughs and tributaries used by spawning salmon (Figure 3). In these areas, this bear probably had a higher probability of encountering other brown bears fishing for salmon and subjecting her cubs to predation than would have been the case at higher elevations. This behavior appears to contradict our speculation (Miller and McAllister 1982:57) that female brown bears with cubs tend to

avoid areas where other brown bears concentrate. The behavior of this individual may be aberrant, our earlier speculation may be incorrect, or it may be that the salmon spawning sloughs utilized by G379 and her cubs were relatively "safe" because they were frequented by few other brown bears. During our examination of the sloughs in the area used by G379, we found relatively little evidence of brown bear presence compared to sloughs farther upstream (above the confluence of the Susitna and Indian Rivers). Perhaps the areas where G379 fished was frequented by few other fishing brown bears. Unquestionably, these sloughs were used by many black bears, including radio-collared black bears. Unquestionably also, these sloughs were used by some brown bears as brown bear fishing for salmon in this area were frequently spotted by local residents and by Su-Hydro personnel conducting fisheries studies. It seems probable that the bear habitat downstream of the Indian River becomes progressively better for black bears and poorer for brown bears and that the cubs with G379 were, corresponding, safer fishing at these downstream sloughs than they would have been at more upstream locations where other brown bears were more abundant or at Prairie Creek. Additional speculation based on the behavior of one individual is not justified. It should be noted that thick vegetation prevented visual observations of G379 or her cubs during the period 3 August through 15 October so it cannot be stated with certainty that her cubs were with her during this period, however, it is most probable that they were.

Females with cub litters or yearling litters are commonly seen fishing for salmon at McNeil River on the Alaska Peninsula (Glenn, et. al. 1974) but appear much more aggressive towards other bears than females without young (Egbert and Stokes 1974).

Efforts to increase the sample size of downstream brown bears will be conducted in spring 1983.

Maps of point locations for each individual radio-collared in the downstream study area are presented in Appendix 1.

B. UPSTREAM BROWN BEAR STUDY

1. Sex and Age Composition of Study Animals.

Sex and age composition of study animals in 1982 did not vary significantly from that presented in Miller and McAllister (1982). Three new upstream brown bears were captured and radio-marked in spring 1982, one previously marked individual (G282) was recaptured and radio-collared, and the radio-collar was replaced on a subadult male (G342a) first captured in 1981.

Initiation of capture efforts in 1982 was delayed until the closure of the spring brown bear hunting season on May 25. The optimal period for capturing brown bears is earlier when snow conditions are better for tracking and bears are more visible and

in better condition. In 1983, the end of the spring hunting season has been extended to May 31. Capture efforts in 1983 will need to be conducted during this spring season in order to be effective and efficient.

Capture statistics on all brown bears captured to date are given in Table 1.

One marked brown bear (G332 at age 3) was shot by a hunter in 1982, the sibling of this bear (G333) was shot in fall 1981 at age 2. A total of 5 marked brown bears have been shot by hunters during the period of 1980-1982.

Eighteen brown bears are currently radio-collared for Susitna studies. Two of these (G380 and G341) are missing probably because of radio failure, unreported hunter kills, or movement out of the study area. Two more brown bears (G293 and G342) are wide-ranging bears seldom found in the primary study area. The effective sample of radio-collared brown bears is currently only 14, this must be increased to approximately 25 in spring 1983. The two bears reported as missing by Miller and McAllister (1982:18, 21) were not found (G308a, G334) in this year of study.

In addition in spring 1983 drop-off collars will be applied on 2-3 year-old subadults to obtain needed data on dispersal from the study area.

Table 1. Brown bears captured in Susitna Dam Studies as of November, 1982

Tattoo	Sex	Capture Age	Wt.	Date	Frequency	Flags	Ear Tags	Comments
(277)	F	10.5	225*	4/10/80		orange	1065/1066	w/2 ylgs, not marked, collar shed 80/81 den
(278)	M	9.5	375*	4/19/80		--	-- --	capture mortality
(279)	M	9.5	400*	4/20/80		orange	1100/1099	collar shed by 6/12/80
280	M	5.5	300*	4/20/80		orange	1097/1098	recollar next spring
(214)	M	4.5	300*	4/22/80		blue	1072/1071	collar shed 9/9/80
281	F	3.5	250*	4/22/80		orange	16175/15950	not turgid
282	M	4.5	325*	4/22/80		orange	1079/1080	see 6/82 recapture
283	F	12.5	280*	4/22/80		orange	690/689	w2 @2.5: 284 and 285
(284)	M	2.5	180*	4/22/80		white	1074/1073	w/283 see 5/5/81 recapture
285	M	2.5	180*	4/22/80		green	687/688	w/283
286	M	3.5	264	5/1/80		orange	1081/1082	
292	F	3.5	174	5/2/80		green	1322/1321	Turgid
293	M	3.5	277	5/2/80		white	1116/1115	
(294)	M	10.5	607	5/2/80		white	-- --	see 8/6/81 recapture
(295)	M	12.5	589	5/3/80		green	1303/1304	collar shed by 5/4/80
299	F	13.5	285	5/4/80		green	1109/1110	w/2 ylgs, turgid
(297)	M	1.5	65	5/4/80		orange	(1301/1302)	w/299, shot by hunter on 9/18/81
298	M	1.5	65	5/4/80		orange	1318/1317	w/299
306	F	3.5	163	5/4/80		white	1319/1320	turgid
308A	M	6.5	480	5/6/80		white	1126/1125	----
(308B)	F	5.5	240	5/6/80		white	1096/1095	turgid(?) - see 8/6/81 recapture
(309)	M	12.5	600	5/6/80		orange	1117/1118	collar shed by 5/14/80
312	F	10.5	319	5/7/80		orange	1312/1311	w/311
(311)	M	2.5	227	5/7/80		orange	-- --	shot on 9/16/80
313	F	9.5	286	5/7/80		orange	1119/1120	w/314 @2.5
314	F	2.5	154	5/7/80		orange	1049/1050	w/313
315	F	1.5	90*	5/7/80		green	1127/1128	alone
(284#)	M	3.5	125	5/5/81		red CF	1074/1073	near 283 w/2c, shot by hunter on 5/18/81
(331)	F	6.5	172	5/5/81		white CF	(1296/1295)	w/332 and 333, died August 1982
(332)	M	2.5	79	5/5/81		--	(1215/1216)	w/331 and 333, shot by hunter on 9/5/82
(333)	M	2.5	67	5/5/81		--	(1240/1239)	w/331 and 332, shot by hunter on 9/3/81
334	F	10.5	325	5/5/81		white CF	1292/1291	w/335, estrus
335	F	2.5	194	5/5/81		--	1220/1219	
281#	F	4.5	--	5/6/81		white CF	1201/1202	estrus?
283#	F	13.5	261	5/6/81		white CF	1089/1090	w/338 and 339
338	M	0.5	12	5/6/81		--	1224/1223	w/283 and 339, not drugged
339	F	0.5	13	5/6/81		--	1222/1221	w/283 and 338, not drugged
312#	F	11.5	280	5/6/81		white CF	1300/1299	w/2c @0.5 - not captured
313#	F	10.5	284	5/6/81		white CF	1120/1119	w/336
336	F	0.5	--	5/6/81		--	1237/1238	w/313, not drugged (abandoned)
337	F	13.5	321	5/6/81		white CF	1294/1293	w/3c (2 captured subsequently not ear-tagged) reunited on 5/9/81
340	F	3.5	190	5/6/81		white CF	1225/1218	not estrus
280#	M	6.5	394	5/7/81		red CF	1097/1267	w/F 341
341	F	6.5	224	5/7/81		white CF	1208/1207	w/M 280
299#	F	14.5	291	5/7/81		white CF	1109/1110	w/2 @2.5 (297 and 298 - not recaptured), not estrus
342A	M	2.5	220	5/7/81		red CF	1228/1227	alone, see 5/25/82 recapture
344	F	5.5	--	5/8/81		white CF	1204/1203	w/2 cubs subsequently

(continued on next page)

Table 1. Brown bears captured in Susitna Dam Studies as of November, 1982, (continued)

Tattoo	Capture Sex	Capture Age	Capture Wt.	Capture Date	Frequency	Flags	Ear Tags	Comments
(345)	M	7.5	495	5/8/81		--	-- --	capture mortality
(308B)#	F	6.8	--	8/6/81		--	-- --	recapture mortality
299#	F	14.8	--	8/6/81		white CF	1109/1110	collar replaced
293#	M	4.8	--	8/6/81		red CF	1115/1116	collar replaced
(294#)	M	11.8	--	8/6/81		red CF	-- --	recapture mortality
347	M	14.8	500*	8/6/81		red	1234/1233	collar shed 9/81
342A#	M	3.5	250*	5/25/82		red CF	1228/1227	collar replaced
373	M	9.5	450*	6/11/82		--	-- --	no tattoo, w/G283 (F)
282#	M	6.5	350*	6/11/82		whi/red	529/1643	recapture of marked bear
379	F	5.5	300*	6/11/82		white EF,CF	1595/1585	w/2@c, Downstream study
380	F	15.5	275*	6/12/82		white EF,CF	1588/532	w/2@1, not captured
381	F	3.5	200*	6/12/82		white EF,CF	533/1592	alone

* Weight estimated, () indicates shed collar or dead bear, # recapture, collar or mark replaced subsequently

Total point-locations obtained for radio-collared brown bears in 1982 was 315 compared to 394 in 1981 and 136 in 1980 (Table 2). A breakdown of these point-locations by individual is given in Table 2.

2. Population Biology and Productivity

Simulation models under development attempt to track project impacts on bear populations through changes in productivity on the premise that project-related changes in food abundance or availability will be expressed by changes in productivity (along with changes in dispersal patterns). Better data on productivity population biology and dispersal are crucial to realistic use of these models. Such data are inadequate at present.

In the period 1978-1982, 28 newborn cubs in 13 litters were spotted with radio-collared females early in the spring, this provides a minimum estimate of initial litter size of 2.15 cubs/litter (range = 1-3). Initial litter size may be actually larger as some mortality doubtless occurs prior to emergence as well as prior to initial spotting following emergence. Ten of these litters (with a total of 21 cubs) were successfully followed throughout their cub year and 9 cubs were lost in this period. This yields a cub mortality estimate of 43% (Table 3).

Table 2. Number of point-locations of radio-collared brown bears for Su-Hydro studies, 1980-1982.

Bear ID	Year of initial capture (age)	No. of radio-locations 1980	1981*	1982	No. River Crossings 1980	1981	1982	Comments
MALES								
342A	1981 (2)	-	8	16	-	1	0	Active, moved downstream
293	1980 (3)	8	11	12	2	0	1	Active, wide-ranging
214	1980 (4)	11	-	-	0	-	-	Collar shed, originally captured in 1978
280	1980 (5)	10	24	16	2	10	3	Active
308A	1980 (6)	4	-		0	-	-	Missing**
282	1982 (6)	-	-	18	-	-	6	Active
373	1982 (9)	-	-	11	-	-	3	Active
279	1980 (9)	2	-	-	0	-	-	Collar shed
294	1980 (10)	14	8	-	1	0	-	Recapture mortality
295	1980 (12)	2	-	-	1	-	-	Collar shed
309	1980 (12)	3	-	-	0	-	-	Collar shed
347	1981 (14)	-	4	-	-	0	-	Collar shed
	All Males	54	55	73	6	11	13	
FEMALES								
335	1981 (2)	-	34	19	-	0	0	Active
281	1980 (3)	13	40	21	1	6	5	Active
340	1981 (3)	-	39	22	-	6	8	Active
381	1982 (3)	-	-	17	-		4	Active
308B	1980 (5)	15	13	-	5	7	-	Recapture mortality
344 (w/2c 1981)	1981 (5)	-	21	21	-	0	0	Active
379 (w/2@c,'82)*	1982 (5)	-	-	19	-		1	Active
331 (w/2c 1979)	1981 (6)	-	24	9	-	4	3	Died in Aug. '82
341	1981 (6)	-	28	8	-	9	0	Missing**
313	1980 (9)	14	24	21	0	0	0	Active
277 (w/2 ylg 1980)	1980 (10)	6	-	-	0	-	-	Collar shed
312 (w/2c 1981)	1980 (10)	12	24	19	0	0	0	Active
334	1981 (10)	-	31	-	-	0	-	Missing**
283 (w/2c 1981)	1980 (12)	12	19	19	0	0	4	Active
299 (w/2 ylg 1980)	1980 (13)	10	23	20	2	2	2	Active
337 (w/3c 1871)	1981 (13)	-	19	19	-	0	0	Active
380 (w/2@1)	1982 (15)	-	-	17	-	-	0	Missing**
	All Females	82	339	242	8	34	27	
	TOTAL BOTH SEXES	136	394	315	14	45	40	
Observations of unmarked bears		24	32	56	-	-	-	
	TOTAL	160	426	371	14	45	40	

* G379 is in downstream study area, G342a also in 1982.

** Possible unreported hunter kill, collar failure, or emigration

The timing of cub losses is significant to productivity because females that loose whole litters prior to or during breeding season may breed and produce a new litter the following spring. Of the 9 cubs lost (Table 3) 5 were lost in the spring (between May 9 and June 17, one of these may have been capture-related), one was lost between 4 August and 1 September and 3 were apparently lost in their winter dens. In only one case was a complete litter lost (G313, with a litter of 1 cub lost by May 9), this bear produced a new litter the following spring (1982). G299 also lost her litter of 1 cub in spring 1982 and may produce a new litter in spring 1983.

The reasons for cub losses are unclear but predation by male bears is considered a probable major factor. The condition of the mother, likely related primarily to food availability, may also contribute to these losses. Most cub losses during this study occurred in 1981, a year of suspected widespread berry failure (Miller and McAllister 1982), however, half of the cub losses observed in 1981 occurred prior to this berry failure. The other 2 losses occurred during or after the berry crop condition was apparent to the bears and may have been influenced by this factor.

In similar fashion, mean size of 20 litters of 32 yearlings observed in the spring was 1.6, 26% less than the mean size of observed cub litters. Four of 14 yearlings (29%) observed throughout their yearling year have been lost, all in 1982

Table 3. Summary of known losses from brown bear litters of cubs and yearlings, (dated from emergence in year of birth to emergence the following year).

Year of emergence	Losses of cubs	Losses of yearlings
1978	2 of 3 lost (1 litter, 207)	0 of 3 (2 litters 221, 220)
1979	2 of 3 lost (1 litter, 321)	0 of 1 lost (1 litter, 207)
1980	No data	0 of 4 lost (2 litters, 299 and 277)
1981	4* of 10 lost (312, 313, 283, 337, 344)	No data
1982 (through Oct.)	1** of 5 lost (299, 313, 379)	4 of 6 lost (312, 283, 336, 344)
TOTALS:	9 of 21 lost = 43%	4 of 14 lost - 29%

* One possibly capture-related from litter of 1 with 313
** From litter of one with 299.

(Table 3). Of the lost yearlings, one was lost prior to May 18, 2 were lost prior to June 17, and one prior to July 26. G344 lost one of her yearlings in June and the remaining yearling in July; this bear then apparently bred and may produce a new litter in winter 1982/83. G283 also lost her litter of one yearling (by May 18), and may have a new litter this winter. G337 lost only one of her 2 yearlings in 1982, so will not breed again until 1983. These data are interesting as they may reflect the impact of the bad 1981 berry crop (Miller and McAllister, 1982) on yearling survival the following year. No losses from yearling litters were observed prior to 1982 (Table 3).

As an initial working hypothesis for simulation models it will be assumed that spring food availability does not affect survivorship of cubs but summer food availability does. Both spring and summer food availability affects survivorship of yearling and older bears.

If the above working hypotheses is correct, poor spring food availability (or poor summer food availability in the preceding year) should result in losses of litters, females that lose these litters should breed again and produce cubs the following year (2 years after a summer food failure or 1 year after a spring food failure). If this hypothesis is correct, twice as many females should produce cubs 2 years after a summer food failure than would have been expected under "normal" conditions of food availability. Under "normal" circumstances, approximately a third of

the adult females would produce a new litter each year. Such pulses in cub production may be self-perpetuating on a 3 or 4 year cycle as a pulse of females born in year x produces their own first litters in year (x+4) or as adult females that produced a pulse in year x produce another pulse in year (x+3). Some evidence for such pulses is apparent in the harvest data (Table 4).

Additional evidence for such pulses may become available from radio-collared females in 1983. Of 13 radio-collared females, 7 (54%) are expected to produce litters of cubs in 1983 (Table 5). Of these 7, four are expected to produce litters because their litter of cubs (G299) or yearlings (G344 and G283) were lost in 1982 (Table 5). These predictions are consistent with the hypothesis that a pulse of cubs will be produced in 1983, 2 years after the apparent berry crop failure in 1981 (Miller and McAllister 1982). This hypothesis is significant to the project as it is expected that the project will adversely affect spring food availability and this would likely affect the productivity of the bear population.

Miller and McAllister (1982:30) reported a reproductive interval of 3 years in the 3 cases where a reproductive interval has been observed in this study. G299 produced cubs in 1982 expanding the number of known 3-year intervals to 4. G331 did not produce cubs in 1982, as would have been expected if this bear was to maintain a 3 year reproductive interval (she weaned a 2-year old litter in 1981 and bred). This 7 year-old bear died of unknown causes in July 1982.

Table 4. Year of birth of subadult brown bears harvested in GMU 13. 1969-1981 data (includes sex unknown bears).

Year of Birth	No. harvested by age when harvested				Totals 1-4 (%)	Totals 2-4(%)	Totals 1-3 (%)
	Yearling	2	3	4			
1965	-	-	-	1			
1966	-	-	3	1			
1967	-	0	2	9			
1968	2	4	8	6	20 (7)	18 (7)	14 (6)
1969	6	14	13	5	38 (13)	32 (13)	33 (14)
1970	7	8	7	6	28 (9)	21 (8)	22 (10)
1971	2	6	6	13	27 (9)	25 (10)	14 (6)
1972	1	14	6	3	24 (8)	23 (9)	21 (9)
1973	10	15	8	5	38 (13)	28 (11)	33 (14)
1974	4	12	2	4	22 (7)	18 (7)	18 (8)
1975	8	9	6	8	31 (10)	23 (9)	23 (10)
1976	5	18	5	11	39 (13)	34 (14)	28 (12)
1977	2	10	11	8	31 (10)	29 (12)	23 (10)
1978	8	17	14	NA			
1979	11	24	NA	NA			
1980	6	NA	NA	NA			
Totals (1968 - '77)	47	110	72	69	298 (100)	251 (100)	229 (100)

Table 5. Predicted spring 1983 reproductive status of radio-collared female brown bears.

ID	1983 age	expected 1983 Status	Comments
281	6	cubs	first litter
335	4	cubs	first litter, bred in 1982
340	5	cubs	first litter
381	4	cubs	first litter
344	7	cubs?	lost yearlings in July '82 and bred
283	15	cubs	lost ylgs in spring '82 and bred
299	16	cubs	lost cubs in spring 1982
379*	6	yearlings	had cubs in 1982
313	12	yearlings	cubs in 1982
341 (missing)	9	yearlings (?)	radio failure in 1982?
312	13	2-year olds	yearlings in 1982
337	15	2-year olds	yearlings in 1982
380 (missing)	16	2-year olds	radio failure in 1982?

* bear occurs in the downstream study area.

3. Home Range Analyses-Brown Bear

a. Home Ranges:

Miller and McAllister (1982) observed that home ranges of radio-collared brown bears were larger in 1981 than in 1980 and hypothesized that bears might have had to range farther in 1981 because of the apparent poor berry crop in that year. If this is correct, 1982 home ranges should be smaller than 1981 home ranges as berry crops appeared about average in 1982. This pattern was observed (Table 6) although the differences are not statistically significant because of the huge variation between individuals (23-2,478 km^2 in 1982, Table 6).

More insight into this hypothesis can be gained by examination of the home range sizes of the same individuals in these 2 years, although sample size becomes small in this analysis. Twelve individuals had adequate locations (n '74) to calculate home ranges in both 1981 and 1982 (Table 6). Since 1982 home ranges have been calculated for points only through 8 September 1982, comparisons should be made with the equivalent period for 1981 (see Table 13 in Miller and McAllister 1982). By this analysis, 1982 home ranges (through 8 September) were smaller than 1981 home ranges (through 1 September) for 6 individuals (342, 280, 335, 281, 313 and 299), larger for 5 individuals (340, 344, 312, 283, and 337), and the same for 1 individual (home range for G293 was only 3% smaller in 1982 than in 1981). The mean decrease was 61% (37-77%) and the mean increase was 91% (14-310%).

Table 6. Annual home range sizes for Su-Hydro study area brown bears. (Includes individuals with 5 or more relocations).

Bear ID (age @ capture)	1980 Observation Period (No. of locations)		1980 Home Range (km^2)	1981 Observation Period (No. of locations)		1981 Home Range (km^2)	1982* Observation Period (No. of locations)		1982* Home Range (km^2)*	Comments
MALES										
342a (2)	---		---	May-Oct	(8)	1776	May-Jul	(11)	690	dispersed in '81
293 (3)	May-Oct no den	(8)	1409	May-Sep	(11)	2727	Jun-Aug	(12)	2578	wide-ranging
214 (4)	April-Sep	(11)	975	---		---	---	---	---	shed collar in '80
280 (5)	April-Oct	(10)	499	April-Oct	(24)	570	May-Aug	(14)	268	
282 (6)	---	--	---	---	--	---	Apr-Sep	(11)	1156	
373 (9)	---	--	---	---	--	---	Jun-Sep	(9)	566	
294 (10)	May-Oct	(14)	495	May-Aug	(8)	100				recapture mort. in '81
$\bar{x}$ (all males) =		(10.8)	845		(12.8)	1149		(11.4)	1052	
S.D. =		--	439		--	965		--	911	
range =		(8-14)	495-1409		(8-24)	100-2727		(9-14)	566-2578	
FEMALES										
335 (2)	---		---	May-Oct	(34)	180	May-Sep	(16)	96	weaned in 1981
281 (3)	April-Oct	(13)	189	April-Oct	(40)	368	May-Sep	(17)	88	single
340 (3)	---		---	May-Oct	(39)	613	May-Sep	(17)	701	single
381 (3)	---		---	---		---	Jun-Sep	(13)	224	
308b (5)	May-Oct	(15)	142	May-Aug	(13)	110	---		---	recapture mort. in '81
344 (5)	---		---	May-Oct	(21)	270(w/2c)	May-Aug	(16)	385	(w/2@1***)
379 (5)	---		---	---		---	Jun-Sep	(12)	58	(w/2@C)
331 (6)	---		---	May-Oct	(24)	1281	May-Sep	(19)	1216	weaned 2@2 in '81
341 (6)	---		---	May-Oct	(28)	889	May-Jul	(8)	23	(w/2@C)
313 (9)	May-Oct	(14)	82	Apr-Oct	(24)	196	May-Sep	(16)	57	(w/2@C in 1982)
277 (10)	April-Oct	(6)	147(w/2@1)	---		---	---		---	shed collar in den
312 (10)	May-Oct	(12)	140	Apr-Sep	(24)	181(w/2c)	May-Sep	(15)	241	(w/1@1)
334 (10)	---		---	May-Sep	(31)	111**	---		---	weaned 1@2 in '81, missing in '82

(continued on next page)

Table 6. (continued)

Bear ID (age @ capture)	1980 Observation Period (No. of locations)		1980 Home Range (km^2)	1981 Observation Period (No. of locations)		1981 Home Range (km^2)	1982* Observation Period (No. of locations)		1982* Home Range (km^2)*	Comments
283 (12)	April-Oct	(12)	233	May-Oct	(19)	93(w/2c)**	May-Sep	(15)	205	(w/1@1****)
299 (13)	May-Oct	(10)	188(w/2@1)	Apr-Oct	(23)	358**	May-Sep	(16)	81	(w/1@C****)
337 (13)	---		---	May-Oct	(19)	270(w/3c)**	May-Sep	(14)	349	(w/2@1)
380 (15)	---		---	---		---	Jun-Aug	(8)	284	(w/2@1)
$\bar{x}$ (all females)=	(11.7)		160		(26.1)	379		(14.4)	--	
S.D.=			48		--	353		--	323	
range =	(6-15)		82-233		(13-40)	93-1281		(8.19)	23-1216	
$\bar{x}$ (all males and females)=	(11.4)		409		(22.9)	594		(13.6)	488	
S.D.=	--		422		--	720		--	616	
range =	(6-15)		82-1409		(8-40)	93-2727		(8-19)	23-2578	

* 1982 relocation data have been compiled only through September 8, subsequent relocations including 1982 dens will change these results.

** Not included in statistical comparisons

*** Yearlings lost in July

**** Yearlings or cub lost in May

These data are confounded by the reproductive status of females, females with cubs appear to have smaller home ranges when they have cubs than when they do not (Miller and McAllister 1982). Of the 5 bears that had larger home ranges in 1982 than in 1981, four (344, 312, 283, and 337) had cubs in 1981 so their increased 1982 home ranges can be explained on this basis. Of the six bears with smaller home ranges in 1982 than in 1981, one can be explained because of the presence of cubs in 1982 (G313 with a 71% decrease in home range size in 1982 relative to 1981). Therefore, excluding individuals with cubs in either 1981 or 1982, 5 individuals had smaller home ranges in 1982 than in 1981 (mean=59% decrease, range=37-77%) and one had an increased home range (+14%). This analysis supports our hypothesis that annual home range size may be a function of the distribution and abundance of food in any year. It also supports our hypothesis that females with cubs have smaller home ranges in years they have litters of newborns than in other years regardless of food availability.

This analysis combined with our earlier observation that females with newborn cubs tend to remain more distant from the areas that will be most impacted by the proposed project relative to other bears (Miller and McAllister 1982) suggests that the proposed project will have minimal direct impact on cub survival during the cub's first year of life. As mentioned elsewhere, however, the project will likely affect yearling and subadult survival

(through reduction of spring food availability) and may also affect the probability or frequency with which adult females have cubs (also through changes in spring food availability). These data suggest that adult brown bears may be able to compensate for changes in the availability of important summer foods (primarily berries in this analysis) by increasing their range of movements.

b. Seasonal movements to areas of food abundance: During salmon spawning season some brown bears in the study area make directional movements to salmon spawning streams. Prairie Creek is the most interior of these streams and 4 radio-marked bears moved to this area in 1980 (of 11 with active collars) and 2 in 1981 (of 18 with active collars) (Miller and McAllister 1982:50). In 1982, the two individuals still radio-collared that had been previously observed making directional movements to Prairie Creek did so again. Three newly collared bears (G282, G373, and G380 also moved to Prairie Creek. Therefore in 1982, of 14 radio-collared upstream brown bears 5 utilized the Prairie Creek salmon resources. G293 repeated the same large movement previously recorded from the upper Oshetna to Prairie Creek. It is interesting that G283 went to Prairie Creek in 1980 (after weaning her litter of 2-year old offspring) but not in 1981 (when she had a litter of cubs). In 1982 this bear lost her surviving yearling in May and again revisited Prairie Creek in August. None of the radio-marked bears that had no previous history of visiting Prairie Creek (N=8) visited it in 1982.

One male bear (G342) dispersed from the impoundment study area in spring 1981 as a 2 year old, but foraged for salmon on the lower Susitna in late summer 1981, and denned near Chunilna Creek. In spring 1982 this bear moved to the Kashwitna River but returned to the Chunilna Creek-Talkeetna River confluence in fall 1982, perhaps to fish for salmon.

As discussed earlier, the only brown bear marked for the downstream study (G379 with 2 cubs) frequented the salmon sloughs along the lower Susitna (Between Curry and Indian Creek) during the salmon spawning period.

4. Den and Denning Characteristics--Brown Bear

Characteristics of dens used in winter of 1980/81 by 13 radio-collared and 3 unmarked brown bears were reported by Miller and McAllister (1982:67). These data along with characteristics of dens used in winter of 1981/82 by 13 radio-collared and 2 unmarked bears are given in Table 7. These data include 2 dens (#37 and #36) in the Chunilna Creek area, downstream of the Devils Canyon damsite. Den sites in both years were located for the following individuals: 283, 313, 337, 344, 312, 299, 281, and 280. Tentative locations for the dens of these same individuals were located in 1982/83.

Mean elevation of these 31 dens was 4,117 feet (range 2,075-5,150 feet, SD=832 feet). Excluding the 2 downstream dens the mean elevation of 29 upstream dens was 4248 feet (2330-5150 feet, SD=683 feet). None of the brown bear dens observed to date would be inundated by the proposed impoundments, including those tentatively located during winter of 1982/83.

To date, no radio-collared brown bear has re-used the same den site. However, many brown bears in the study area tend to den in the same general area in successive years (Table 8). One of the most popular areas for radio-collared bears is in the mountains between upper Tsusena and upper Deadman Creeks, near the Denali access route and the upper Tsusena borrow areas. One bear (G281 a subadult female) has denned in this area in 3 successive years even though her home range during non-denning periods is some distance away (Fog Lakes-lower Watana Creek) (see Figure 15 in Miller and McAllister 1982:158).

Table 7. Characteristics of brown bear dens in the Susitna study area during winters of 1980/81, 1981/1982.

	Den No.	Bear ID No.	Age at Exit	Elevation (Feet)	Slope (Degrees)	Aspect (True N.)	Vegetation	ENTRANCE Ht. (cm.)	ENTRANCE Width (cm.)	CHAMBER Ln. (cm.)	CHAMBER Width (cm.)	CHAMBER Ht. (cm.)	Total Length (cm.)	Previously Used? (Yes/No)	Comments
DUG DENS															
FEMALES															
With offspring (@ exit)															
w/2 cubs	14	G283(sp.)	13	3900	28	192	Tussock grass	-	83	-	138	-	196	No	Spring den/collapsed
w/2 cubs	16	G283(wt.)	13	3725	26	210	Willows	76	64	239	203	92	291	No	Winter den
w/1 cub	22	G313	10	5150	35	166	Tussock/rock slide	-	-	-	104	-	410	No	Collapsed
w/3 cubs	24	G337	13	4825	31	252	Tussock/lg. rocks	57	69	-	152	90	219	No	
w/2 cubs	30	G344	5	4760	-	153	--	-	-	-	-	-	-	-	Collapsed/not visited
w/2 cubs	31	G312	11	4900	-	145	Tundra/rock	-	-	-	-	-	-	-	Collapsed/not visited
w/2 ylg.*	25	G277	11	4925	45	93	Moss/rock slide	-	-	-	165	-	207	No	Collapsed
w/2 @2yr.	28	G299	14	4660	25	138	Tundra/rock	-	-	-	-	-	-	No	Collapsed
w/2 cubs	42	G331	7	3950	30	213	Willow, Grass	67	52	117	127	84**	290	No	Collapsed
w/2 cubs	44	G313	11	4575	34	182	Grass	102**	-	-	-	-	230	No	Collapsed
w/1 ylg	47	G312	12	4925	27	201	--	-	-	-	-	-	-	-	Collapsed
w/2 ylg	52	G344	6	4250	26	202	Grass	49	65	-	-	-	-	No	Collapsed
w/2 cubs	54	G341	7	4575	45**	118**	--	-	-	-	-	-	-	-	Collapsed/not visited
w/1 cub	59	G299	15	3525	31	156	Willow, Alder	58	69	151	136	101	350	No	
w/2 yrl	37***	?	?	2075	36	346	Alder	53**	79	-	-	-	-	No	Partially collapsed
w/o offspring	23	G281	4	4700	39	142	Tussock/rock slide	-	61	-	-	-	-	No	Collapsed
w/o offspring	5	G308b	6	2330	26	358	Alder	69	82	112	112	110	230	No	
w/o offspring	46	G340	4	5150	-	-	--	-	-	-	-	-	-	-	Not visited
w/o offspring	56	G335	3	3525	32	261	Willow, Alder	47	39	-	-	-	224	No	Partially collapsed

(continued on next page)

Table 7. (continued)

	Den No.	Bear ID No.	Age at Exit	Elevation (Feet)	Slope (Degrees)	Aspect (True N.)	Vegetation	ENTRANCE Ht. (cm.)	ENTRANCE Width (cm.)	CHAMBER Ln. (cm.)	CHAMBER Width (cm.)	CHAMBER Ht. (cm.)	Total Length (cm.)	Previously Used? (Yes/No)	Comments
MALES															
	1	G280	6	3950	32	158	Tundra/grass/rock	48	86	-	231	-	269	No	Collapsed
	15	G284?	3	3990	23	216	Tundra/grass	56	83	135	154	77	239	No	ID uncertain
	29	G294	11	2650	30	146	Alder/grass	52	80	-	157	89	188	No	Partially collapsed
	36***	G342A	3	2375	31	288	Alder	38	71	81	86	94	124	No	Partially collapsed
	60	G280	7	4125	26	210	Grass, Willow	-	-	-	-	-	-	No	Collapsed
DUG DENS															
UNKNOWN SEX/ID															
	17	-	-	3925	33	192	Willow	61	62	154	162	122	220	No	
	26	-	-	4090	29	162	Willow/grass	73	65	-	-	-	171	No	Partially collapsed
	27	-	-	4125	26	140	Willow/grass	-	58	-	-	68	-	No	Partially collapsed
	53	?	?	4350	31	195	Grass	-	-	-	-	-	-	No	Collapsed
UNKNOWN CAVITY TYPE															
w/1 yrl	41	G283	14	4000	26	161	--	-	-	-	-	-	-	-	Not visited
w/2 @2	48	G337	14	5050	45**	253**	--	-	-	-	-	-	-	-	Not located
	45	G281	5	4575**	25	176	Grass	-	-	-	-	-	-	-	Not located

* Entered den with 2 yearlings, shed collar in den so exit not observed.
** Approximate value
*** Downstream - Chunilna Ck.

Table 8. Distances between den sites (miles) used in different years by radio-collared brown bears.

Bear ID	Sex	Age*	Distance between dens during winters of: 1980/81-1981/82	1980/81-1982/83**	1981/82-1982/83**	Mean
G283	F	13	3.2	2.4	5.2	3.6
G313	F	10	4.4	4.7	7.8	5.6
G337	F	14	3.6	2.6	3.7	3.3
G344	F	5	3.1	1.6	1.5	2.1
G312	F	11	2.1	0.5	1.7	1.4
G299	F	14	8.9	6.4	3.2	6.2
G281	F	4	1.9	1.7	0.2	1.3
G280	M	6	8.1	6.2	2.2	5.5
G335	F	3	-	-	2.1	-
G340	F	4	-	-	0.3	-
G342	M	3	-	-	NA	-
		$\bar{X}$=	4.4	3.3	2.8	3.4

* Age at exit of first den found

** 1982/83 den locations are preliminary, based on aerial locations.

IX. Results and Discussion--Black Bears

A. DOWNSTREAM STUDY--BLACK BEARS

1. Introduction

The primary emphasis in the downstream study area is to evaluate bear use of salmon spawning in the sloughs and tributaries likely to be affected by altered flow regimes subsequent to project construction. If salmon are less available to bears subsequent to the construction, this is likely to affect bear distribution and abundance in the Susitna watershed between Talkeetna and Devils Canyon. Changes in successional status of forage resulting from altered frequency of flooding may also affect the quality of bear habitat in riparian areas, some insight into these impacts will likely come from vegetation studies being conducted as part of downstream moose studies. As an incidental result of these downstream bear studies information on the relationships between downstream and upstream bear subpopulations will also be gathered, this information will be helpful in evaluating the contributions, through dispersal, that upstream black bears (expected to be heavily impacted by the project) make to surrounding subpopulations. Miller and McAllister (1982:105, 111) noted movements of upstream black bears to downstream areas in the vicinity of salmon spawning sloughs during 1981, a year of apparent widespread berry failure upstream, and speculated that the downstream area may serve as an important buffer zone for

upstream bear populations during these conditions. The project may reduce the effectiveness of this zone to buffer upstream black bear populations.

Loss of slough habitats for salmon spawning may reduce salmon availabiltiy to bears even if salmon spawning is maintained in the mainstem Susitna by mitigative measures if the physical characteristics of the slough habitat increase salmon vulnerability to bear predation relative to mainstem or tributary habitats.

Preliminary evaluations indicate that project-related impacts downstream of Devils Canyon will affect more black bears than brown bears because of the apparent relative greater abundance of black bears in the downstream study area. However resident downstream brown bears will likely also be affected by the same mechanisms as black bears. In the downstream study area brown bears appear to become progressively more abundant proceding upstream towards Devils Canyon, reduced water flow during summer (and corresponding impacts on spawning salmon) are anticipated to become progressively more marked proceding upstream as well (Trihey, pers. commun.).

2. Sex and Age Composition of Downstream Black Bears.

In spring 1982, 11 black bears were successfully radio-collared for downstream studies. Captured bears appeared to be in excep-

tionally poor condition, possibly because of poor nutrition the preceding year, the the lateness of the capture period (3-4 weeks after emergence from dens and just prior to greening vegetation), or both. As a probable result of this poor condition two black bears (368 and 371) died during downstream capture efforts. Another radio-collared bear was killed by a hunter (B366) in August. The current sample of radio-collared bears for downstream studies includes 10 black bears (9 females and 1 male) and 1 brown bear (a female, age 5 with cubs). The black bear male is age 5, the mean age of females in 1982 was 5.7 (3-9). The preponderance of females in the downstream sample relative to upstream black bears may reflect, in part at least, the heavier hunting pressure in the downstream area which is accessible by riverboat. Black bear capture statistics are given in Table 9. Number of point-locations for downstream radio-collared black bears collected in 1982 are given in Table 10.

Table 9. Black bears captured in Susitna Dam Studies as of November, 1982

Tattoo	Capture Sex	Age	Wt.	Date	Frequency	Flags	Ear Tags	Comments
(287)	M	10.5	225*	5/1/80		white	1083/1084	Shot on 9/8/82
(288)	F	10.5	125*	5/1/80		white	1095/1083	w/2 ylgs, turgid, collar shed by 8/27/80
289	F	9.5	130*	5/2/80		white	1103/1104	w/2 ylgs, turgid, had 3 cubs in 1981
(290)	F	8.5	103	5/2/80		blue	1306/1305	w/2 ylgs, turgid, see 8/6/81 recapture
(291)	M	(3.5)	73	5/2/80		orange	-- --	Post-capture mortality
(296)	M	(10.5)	227	5/3/80		--	-- --	Capture mortality
(300)	M	(7.5)	274	5/4/80		orange	-- --	Post-capture mortality
301	F	7.5	115	5/4/80		green	1043/1044	w/1 ylg, turgid, had 2 cubs in 1981
(302)	M	8.5	287	5/4/80		blue	1106/1105	collar shed by 8/4/80
303	M	8.5	217	5/4/80		green	1055/1056	----
(304)	M	10.5	235	5/4/80		orange	1315/1316	collar shed in 1982
(305)	M	(9.5)	217	5/5/80		green		Shot by hunter 8/30/80
(307)	M	2.5	105	5/5/80		orange	1123/1124	Shot by hunter on 5/17/81
310	M	2.5	85	5/6/80		blue/green	1122/1121	----
(316)	F	(12.5)	150*	5/7/80		blue	-- --	w/1 newborn & 1 ylg shot by hunter 8/28/80
317	F	7.8	133	8/18/80		white	1195/1196	w/2 cubs
318	F	5.8	126	8/18/80		white	1046/1045	w/1 cub, also immobilized in den on 3/81
(319)	M	3.8	174	8/18/80		orange	1194/1193	died summer 1981
(320)	M	(4.8)	200*	8/18/80		orange	-- --	shot by hunter 9/9/80
321	F	10.8	175*	8/18/80		white	1243/1244	had 2 cubs in 1981
(322)	M	4.8	154	8/19/80		orange	1087/1088	w/324, collar shed in 80/81 den, see 5/26/82 recapture
323	M	2.8	122	8/18/80		orange	1200/1199	
324	M	5.8	190	8/19/80		orange	1252/1251	w/322
325	F	11.8	164	8/18/80		white	1191/1192	collar shed in 80/81 den, see 8/6/81 recapture
(326)	F	(5.8)	125	8/19/80		white	-- --	w/2 cubs, shot by hunter 8/28/80
327	F	5.8	118	8/19/80		white	1247/1248	w/2 cubs, also immobilized in den on 3/81
328	F	6.8	150	8/19/80		white	1246/1245	w/303, had 2 cubs in 1981
303#	M	8.8	260	8/19/80		orange	-- --	recapture
329	F	1.3	15*	3/23/81		white	1266/1265	w/327 and sibling, w/heavy collar
(330)	M	1.3	31	3/25/81		orange	1276/1275	w/318, died summer 1981
(342B)	M	(5.5)	165	5/7/81		red CF	1206/1205	cinnamon color, shot on 9/15/81
343	M	5.5	184	5/7/81		red CF	1214/1213	alone, Devil Mountain
346	M	9.5	175*	5/9/81		red CF	1226/1184	alone, gaging station
302#	M	9.5	300*	5/9/81		red CF	1257/1105	alone, old collar previously shed
(290#)	F	9.8	160+*	8/6/81		--	1306/1279	neck infected, collar not replaced
(304#)	M	11.8	--	8/6/81		red CF	1286/1316	collar replaced, shed 6/82
325#	F	12.8	150*	8/6/81		white CF	1191/1192	old collar previously shed
303#	M	9.8	250*	8/7/81		red CF	1055/1056	collar replaced
(287#)	M	11.8	200*	8/7/81		red CF	(1083/1084)	collar replaced, shot on 9/8/82
(348)	M	9.8	300*	8/6/81		red CF	1131/1132	alone, shot on 9/82
349	F	4.8	170*	8/6/81		white CF	1326/1325	alone
329#	F	2.3	29	4/1/82		--	same	recapture in den
289#	F	11.3	112	4/1/82		--	same	recapture in den w/350 and 351
350	M	1.3	14	4/1/82		--	514/513	capture in den
351	M	1.3	16	4/1/82		--	516/515	capture in den
(352)	M	2.5	100*	5/26/82		--	--	capture mortality
(353)	M	1.5	29	5/26/82		--	--	capture mortality of B301's yearling
354	F	5.5	150*	5/26/82		hite CF, EF	517/1600	w/2 cubs
355	F	0.5	4*	5/26/82		--	518/519	w/354, no tattoo
356	M	0.5	4*	5/26/82		--	520/521	w/354, no tattoo
357	M	4.5	113	5/26/82		red,CF, EF	501/1651	----

(continued on next page)

Table 9. Black bears captured in Susitna Dam Studies as of November, 1982, (continued)

Tattoo	Capture Sex	Age	Wt.	Date	Frequency	Flags	Ear Tags	Comments
(322#)	M	6.5	90*	5/27/82		red CF, EF	1662/525	recapture, previous shed collar, died summer '82
358	M	2.5	60*	5/27/82		red CF, EF	502/1656	----
359	M	4.5	118	5/27/82		red CF, EF	512/1655	----
360	M	7.5	250*	5/27/82		red CF, EF	511/1657	----
361	F	7.5	175*	5/27/82		white CF, EF	522/1596	----
362	F	2.5*	40*	5/27/82		--	503/504	no tattoo
363	F	4.5	120*	5/27/82		white CF, EF	505/1593	----
364	F	9.5	170*	5/27/82		white CF, EF	521/1591	----
365	M	5.5	100*	5/28/82		red CF, EF	523/1626	downstream study
(366)	M	6.5	200*	5/28/82		red CF, EF	538/1627	downstream study, shot on 8/5/82
367	F	4.5	100*	5/28/82		white CF, EF	524/1579	downstream study
(368)	F	3.5	110*	5/28/82		--	--	capture mortality
369	F	3.5*	90*	5/28/82		white CF, EF	527/1578	----
370	F	7.5	220	5/28/82		white CF, EF	528/1577	----
(371)	M	2.5	150*	5/28/82		--	--	capture mortality
372	F	9.5	135*	5/28/82		white CF, EF	537/1576	----
374	F	6.5	125*	6/11/82		white CF, EF	530/1584	w/1@1, downstream study
375	F	5.5	160*	6/11/82		white CF, EF	507/1630	w/3@1, downstream study
376	F	6.5	125*	6/11/82		white CF, EF	531/1587	w/1@1, downstream study, see 9/2/82 recapture
377	F	5.5	126	6/11/82		white CF, EF	509/1659	downstream study
378	F	6.5	175*	6/11/82		white CF, EF	510/1628	downstream study
376#	F	6.7	160*	9/2/82		white CF, EF	530/1584	recapture, slough 8B, snare

* Weight or age estimated, ( ) shed collar or dead bear, # recapture

Table 10. Number of point-locations for downstream radio-collared black bears for Su-Hydro studies, 1982.

Bear ID	Year of Initial Capture (spring age)	No. of Radio-locations 1982	no. River crossings 1982	Comments
MALES				
365	1982 (5)	11	0	Active, Chulitna River
366	1982 (6)	10	1	Shot 8/6/82
	ALL MALES	21	1	
FEMALES				
369	1982 (3)	18	0	Active
378	1982 (3)	14	0	Active
367	1982 (4)	17	0	Active
376 (w/1@1)	1982 (4)	12	2	Active
375 (w/3@1)	1982 (5)	16	5	Active
377	1982 (5)	15	2	Active
374 (w/1@1)	1982 (6)	3	0	Active
370	1982 (7)	18	0	Active
372	1982 (9)	17	0	Active
	ALL FEMALES	130	9	
	TOTAl BOTH SEXES	151	10	
	Observations of unmarked Bears	NA	-	
	TOTAL	151	10	

3. Food habits of Downstream black bears.

a. Movement to sloughs

Results of radio-tracking the single brown bear captured in the downstream study area were reported earlier in this report.

Three methods were employed to evaluate bear use of salmon spawning areas in the 1982 downstream study: Location of radio-collared bears, evaluation of use by bears of the salmon spawning sloughs identified by fisheries subtask personnel, and analysis of scats collected in the vicinity of the sloughs. A brief summary of the activities of each black bear during the salmon spawning season follows.

B366 was not seen on any sloughs but apparently fished along the main banks of the Susitna River. This bear was shot near Curry in August.

B367 was found on slough 19 on 10 August.

B369 was not found on any sloughs or on the River, remained close to the Susitna River 18-22 August.

B370 was not found on any sloughs but was found near the mouth of the Indian River in early August.

B372 was not found on any sloughs or on the mainstem Susitna but did move close to Byers Lake (Chulitna drainage in early September), perhaps to fish in this area.

B375 extensively fished the mainstem islands in late August, on Portage Creek in early August and was found near sloughs 8B, 8C and 8D in early August.

B376 clearly used slough 8B on 9/2/82 as it was recaptured there in a snare, this is the only location on this slough. This bear also spent a lot of time fishing on the mainstem and islands in the vicinity of slough 8A in mid-late August.

B377 used slough 8A throughout August as well as the nearby mainstem Susitna.

B378 was found in the vicinity of slough 8B in late August.

B365 was captured by the Indian River but moved north of the Chulitna River to the Hidden River drainage and Eldridge Glacier area. It moved to lower Troublesome Creek during salmon spawning but never returned to the main Susitna drainage.

Little data was collected for B374 because of a radio-tracking malfunction.

Of the 9 radio-collared black bears that remained in the vicinity of the Susitna during the salmon spawning period, 5 (367, 375, 376, 377, 378) were radio-located on or in the immediate vicinity of identified salmon spawning sloughs during the salmon run in August. Of the remaining bears, 2 (B366 and B370) were found close (0-0.2 km) to the mainstem Susitna or its tributaries, another (B369) was not found in a location that clearly suggested fishing activity (but was found several times during August within 0.3 km and 500 feet elevation from the mainstem Susitna), and the remaining bear (B372) was not found on the Susitna during salmon spawning but did move to a tributary of the Chulitna where salmon are abundant. Another bear that moved out of the main study area in early spring (B365, a 5 year old male) was found on Troublesome Ck. (a salmon-rich tributary of the Chulitna) during salmon spawning. The movements of all radio-collared bears, except possibly B369, are consistent with an explanation that they were attracted during the salmon spawning period to the salmon spawning sloughs, to the mainstem Susitna, to tributaries of the Susitna or Chulitna Rivers, or to combinations of these. Since none of these bears were initially captured on the salmon spawning sloughs, these observations suggest a very high incidence of use of salmon by resident black bears in the downstream study area. Radio-tracking data of this type is likely to underestimate use of salmon spawning sloughs by fishing bears. Frame (1967) noted that black bears were most active in fishing for salmon in Prince William Sound at dawn and for

several hours before and after dusk. In illustrations of this probable bias, B376 would have had no point locations on slough 8B had it not been recaptured there in a snare set overnight.

b. Scat analyses

Bear fecal samples were collected along the sloughs during late August and early September. Scats were analyzed by Paul Smith (ADF&G, Soldotna) following procedures developed for his analysis of black bear scats on the Kenai. In his technique, scats were weighed, rehydrated, washed through nested sieves (#5, #25, and #30), and the percent volume of each food item was estimated (Smith per. comm.). I lumped items thought to have been incidentally ingested by the bears (typically leaves and stems of berry plants, wood chips ingested while searching for ants, or soil) in the "other" category in Table 11. Scats were initially collected during capture operations (known species of bear) or picked up on the ground during other activities (unknown species). Scats picked up by Plant Ecology subtask personnel are identified by "Helms" in the comments column. Only fresh samples (less than 2 weeks old) were collected, samples were frozen prior to analysis. Portions of scats were retained for subsequent identification of the species of bear dropping the scat using thin-layer chromatography techniques that are still under development (Miller and McAllister, 1982 Appendix 6). Food items present in these samples are presented in Table 11.

The low frequency of identifiable salmon remains and the high frequency of berry remains in scats are remarkable in these data and appear inconsistent with the large number of salmon we observed that had been captured by bears as evidenced by the presence of salmon carcasses carried away from the sloughs and eaten by bears. Explanations for this apparent discrepancy include:

1. There is no discrepancy, salmon form a small portion of the summer diets of bears in this area.

2. Salmon remains are not identifiable in the scats because of high digestibility relative to berries.

3. Bears use both salmon and berries on a daily cycle that makes it unlikely that salmon-rich feces will be found on the salmon spawning areas.

Additional work will be required to identify which of these explanations is correct. Of the berry species found in the fecal samples collected to date it appears that devils club (*Oplopanax horridus*) is an important late summer food item in the downstream study area (Table 11). devils club was a common plant in riparian areas near the sloughs and along the mainstem Susitna, its abundance distant from the river was not evaluated in 1982. Fish were found in only 2 of the 7 samples collected in salmon spawning sloughs in late August (Table 11).

Table 11. Scat analyses of brown bear and black bear scats collected in the Su-Hydro study area, 1980-1982. (Analyses done by Paul Smith, ADF&G, Soldotna). Values are % volume (T=trace, 2=6-25%, 3=26-50%, 4=51-75%, 5=76-100%).

Date Collected	Species of bear	Location	Sample No.	Comments	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
5/26/82	BK (B352)	upstream	9	Capture site	5															T
5/27/82	BK (B363?)	upstream	12	capture site	5												T		T (ants)	T
5/27/82	BK (357)	upstream	30	Capture site		3		2		2				T	4 (calf hair?)				T (ants)	T
6/1/81	BK (B327)	upstream	25	Den				5			2			T						T
6/13/81	BK (B348)	upstream	14	Den	5															T
5/23/81	?	upstream	5	Helms	5														T (1 fly)	T
5/23/81	?	upstream	6	Helms	5	T		5			T		T	T						T
6/1/81	?	upstream	19	Pickup	5														T (ants, beetles)	T
6/6/79	?	upstream	39	Pickup	5															T
6/8/79	?	upstream	15	Helms									5						T (flies)	T
6/8/82	?	upstream	16	Helms	5											T			T (flies)	T
6/16/82	?	upstream	32	Pickup	5							T							T	T
6/19/82	?	upstream	37	Pickup	3								3						2 (ants)	T
6/24/82	?	upstream	33	Pickup	5											2 hare			T	T
6/28/82	?	upstream	54	Helms	4															2
7/1/82	?	upstream										T	5	T						T
7/1/82	?	upstream	51	Pickup								T	5	T						T
7/1/81	?	upstream	2	Pickup	5			T				T	T?		T					T
7/1/81	?	upstream	3	Pickup	5										T					
7/1/81	?	upstream	1	Pickup	5										T					
7/1/81	?	upstream	49	Pickup									3		3?				T	3
7/1/81	?	upstream	47	Pickup	5														T (ants)	T
5/24/79	BR (G245)	upstream	46	Yearling		T		T						T		5 (squirrel)				
SUMMER - FALL Upstream																				
8/18/80	BK (B327)	upstream	36	Capture				T			5			T						2
8/18/80	BK (328)	upstream	38	Capture				3			4			T						2
8/19/80	BK (B303)	upstream	35	Capture				3			3			T						2
SUMMER - FALL - Sloughs																				
8/31/82	?	downstream	13	A					5											T
8/31/82	?	downstream	42	8B		2		3	3									T		T
8/30/82	?	downstream	23	8A-8B	T				5											T
8/30/82	?	downstream	8	8B			T		5											T
8/31/82	?	downstream	31	A			2	T	4											3
8/31/82	?	downstream	20	21				3	3		T							2		T
9/2/82	?	downstream	41	8B					5											2

1. Equisetum spp. (horesetail)

Berries

2. Vaccinium vitis-idea (lowbush cranberry)
3. Viburnum edule (highbush cranberry)
4. Empetrum nigrum (crowberry)
5. Oplopanax horridus (Devils club)
6. Arctostaphylos alpina (bearberrry)
7. Vaccinium uliginosum (blueberry)
8. Lichens
9. Grasses or sedges
10. Ledum sp. (labordor tea)

Animal matter

11. Moose
12. Hare or ground squirrel
13. Feathers
14. Fish
15. Insects

Other

16.

C. Slough inspection.

Between 30 August and 2 September 1982, 14 salmon spawning sloughs identified by fisheries subtask personnel were inspected on the ground by myself and Dennis McAllister. Notes made at that time were used to make a comparative ranking of the relative degree of bear use at the sloughs inspected (Table 12). Bear use was identified by scats, bear tracks, and salmon that had been killed and eaten by bears. Trails were conspicuous along most of these sloughs and it was apparent that these trails were used by bears as well as by fisheries and hydrology personnel studying these sloughs as part of Susitna Studies. Some of the sloughs contained few salmon and others contained many, in general it appeared that use by bears was correlated with the prevalence of salmon (Table 12).

Information on the prevalence of salmon in these sloughs and tributaries collected by Fisheries subtask personnel is presented in Table 13 along with an independent ranking of bear use in 1982 made from memory by Tom Crowe (ADF&G Fisheries subtask, personal communication). Mr. Crowe walked all of these areas periodically during summer 1982 noting ratios of tagged and untagged salmon present. Although the data collected during these counts is difficult to reconstruct into a ranking of sloughs by relative salmon abundance, it appears that sloughs with highest rankings for bear use also had lots of salmon (Table 13). It is also apparent that salmon abundance in any slough varies markedly from year to year (Table 13).

Table 12. Subjective evaluation of bear use of salmon spawning sloughs between Devils Canyon and Curry, 30 August - 2 September 1982. Ranked 1 (lowest) - 10 (highest).

Slough No.*	Index of bear use	Comments	apparent use by radio-collared individuals
8A	8	many salmon killed by bears.	B376, B377
8B	8	many salmon killed by bear.	B375, B376, B378
8C	4	--------	B375
8D	6	--------	B375
A & A'	3	few salmon present	G379
9	7	lots of salmon	G379?
9A	3	few salmon	
9B	3	few salmon	
11	6	lots of salmon, lots of human activity	
16	3	no salmon	
16B	3	no salmon	
21	10	lots of brown bear sign, many fish eaten	
19	3	few salmon	B367
20	3	few salmon (by report from Su-Hydro fisheries staff)	
Indian R	5	difficult to fish in fast water near mouth of Indian River	

* Designations correspond with Su-Hydro Fisheries studies, see their reports for maps of locations.

Table 13. Subjective evaluation of 1982 bear use of salmon spawning areas between Talkeetna and Devils Canyon and results of salmon counts in these areas in 1981 and 1982 (based on information provided by ADF&G personnel conducting Adult Anadromous Investigations for the Su-Hydro Fisheries project).

AREA	RIVER MILE	1982 INDEX OF BEAR USE*	No. Adult Salmon Enumerated** 1981(N***)	1982 (N***)
Slough 21	141.0	10	747 (5)	2424 (9)
Slough 11	135.3	10	5483 (9)	4806 (11)
Slough 8A	125.1	10	1283 (5)	1804 (10)
Slough 20	140.0	9	27 (2)	220 (7)
Slough 9A	133.3	9	484 (6)	146 (3)
Moose Slough	123.5	8	555 (5)	115 (7)
Slough 8B	122.2	8	1 (1)	190 (6)
Slough 8C	121.9	8	0	105 (3)
Slough 17	138.9	7	169 (7)	29 (4)
Slough 15	137.2	7	1 (1)	178 (3)
Slough B	126.3	7	NA	225 (6)
Slough 9	128.3	6	380 (5)	911 (6)
Slough 6A	112.3	NA	27 (3)	101 (4)
Sloughs A & A'	124.7	NA	437 (10)	(0)
Slough 8	113.7	NA	858 (5)	(0)
Slough 9B	129.2	NA	678 (7)	(0)
Slough 19	139.7	NA	84 (6)	(0)
Indian River****	138.6	10	232 (7)	6703 (12)
Lane Ck	113.6	9	569 (7)	2508 (11)
4th of July Ck.	131.0	9	247 (6)	2832 (11)
Little Portage Ck.	117.7	8	NA	407 (9)
Lower McKensie Ck.	116.2	8	97 (6)	492 (6)
5th of July Ck.	123.7	7	2 (1)	224 (4)
Skull Ck.	124.7	6	24 (3)	36 (4)
Portage Ck.	148.9	5	22 (1)	2238 (7)
Gash Ck.	111.6	5	258 (2)	163 (3)
Slash Ck.	111.2	5	NA	6 (1)
Whiskers Ck.	101.4	5	212 (7)	626 (5)
Jack Long Ck.	144.5	4	1 (1)	54 (7)

(continued on next page)

Table 13 (cont'd)

AREA	RIVER MILE	1982 INDEX OF BEAR USE*	No. Adult Salmon Enumerated** 1981(N***)	1982 (N)
Deadhorse Ck	120.9	4	0	NA
Upper McKensie Ck.	116.7	4	0	24 (2)
Chase Ck.	106.9	NA	328 (8)	332 (8)
Gold Ck.	136.7	NA	0	37 (3)
Sherman Ck.	130.8	NA	32 (4)	40 (4)

* Based on recollection of Tom Crowe (ADF&G, Su-Hydro AA program) for 1982, 1 = low, 10 = high bear use.

** These data sum all live and dead fish (Chinook, Sockeye, Pink, Chum, and Coho salmon) recorded by Su-Hydro AA personnel (ADF&G) during stream surveys. Different areas were surveyed from 1 to 11 times during the year which contributes to variation observed between areas and between years in this data, survey conditions also varied. Note that the same fish would likely be recorded numerous times in replicate surveys.

*** N is the number of surveys conducted where salmon were enumerated, surveys where no salmon were seen are not counted.

**** The portion of the Indian River evaluated by Fisheries personnel varied in 1981 and 1982. Most fish were found in 1982 in a tributary about ½ mile up from the mouth (Crowe, pers. commun.), during our investigation of the Indian River we did not observe this location which explains why we gave this area a relatively lower ranking (Table 12).

4. Home Range Analyses--Downstream Black Bears

Home ranges in 1982 of 2 male and 8 female black bears (including only points through 8 September 1982) in the downstream study area are given in Table 14. Although sample sizes are too small to be conclusive it appears likely that males may have substantially larger home ranges than females (Table 14). Relative to upstream female black bears (Table 16) the sample of 8 radio-marked downstream females had smaller (mean=19 km^2) and less variable (SD=15 km^2) than the 13 upstream radio-marked females in 1982 (mean=79 km^2, SD=124 km^2). Although these data are inadequate in number to be significant, they are consistent with a hypothesis that downstream black bears that have access to salmon resources in late summer need a smaller home range than upstream black bears that must range further in search of later summer food resources like berries that are patchy in distribution or abundance. These data would also be consistent with a hypothesis that summer foods other than salmon (like berries) that bears may depend upon are less patchy, more abundant, or in closer proximity to spring foods in the downstream study area relative to the upstream area. In illustration of the last point, it may be that downstream bears use devils club berries in late summer and devils club may be found primarily in riparian areas that coincide with the area used by bears in early spring; upstream bears, in contrast, may use blueberries in late summer (devils club is uncommon in the upstream study area) and must range further from

spring foraging areas to find acceptable concentrations of blueberries. Smaller home ranges in the downstream area, for whatever reason, may mean that the population can maintain a higher black bear density than upstream populations.

Distribution maps for radio-collared black bears are provided in Appendix I. One noteworthy observation in the movements of bears in the downstream area is the apparent dispersal of a 5 year old male (B365, Figure 13) from the Susitna drainage to the Chulitna drainage (this bear denned on the bank of the Chulitna in 1982/83). This apparent dispersal may account for the large indicated home range of this bear (655 km^2, Table 14).

Table 14. Home range sizes for the Su Hydro downstream black bears

Downstream	1982 Observation Period (No. of Locations)	Home Range (km^2)	Comments
MALES			
365 (5)	May-Sep (8)	655	
366 (6)	May-Aug (10)	136	Hunter kill 9/82
FEMALES			
369 (3)	May-Sep (14)	10	
367 (4)	May-Sep (13)	17	
375 (5)	Jun-Sep (13)	17	
377 (5)	Jun-Sep (12)	8	
376 (6)	Jun-Sep (8)	19	
378 (6)	Jun-Sep (11)	8	
370 (7)	May-Sep (14)	15	
372 (9)	May-Sep (14)	54	
$\bar{x}$(all females)=	(12.4)	19	
S.D. =	--	15	
range =	(8-14)	(8-54)	
$\bar{x}$(all males and females)=	(11.7)	94	
S.D. =	--	201	
range =	(8-14)	(8-655)	

B. UPSTREAM STUDY--BLACK BEARS

1. Sex and Age Composition of Study Animals.

In spring 1982 intensive efforts were made on 26-27 May to increase the sample of radio-collared black bears. Most effort was directed at the Watana impoundment area where impacts on black bears are expected to be most marked (Miller and McAllister 1982).

Two radio-collared bears were recaptured in dens on 1 April 1982, one of these was a subadult and the other was a female with 2 yearlings. Dens of other black bears with yearlings could not be entered at this time because of difficult snow conditions. Eleven new black bears were captured and marked (8 new transmitters). In addition, one previously captured bear that had shed its collar in its 1890/81 den was recaptured and recollared. This male (B322) died in mid summer 1982 of unknown causes. It is interesting that this male weighed 154 pounds when first captured on 19 August 1980 (at age 4.8) but its weight was estimated at only 90 pounds in spring 1982; this lends credence to our speculation (Miller and McAllister 1982) that 1981 was a bad berry year for bears and that spring condition is affected by the previous year's berry crop.

Table 15. Number of point-locations of radio-collared black bears for upstream Su-Hydro studies: 1980, 1981, and 1982.

Bear ID	Year of initial capture (age)	No. of point-locations 1980	1981	1982	No. River Crossings 1980	1981	1982	Comments
MALES								
330	1981 (1)	w/318	14	-	-	0		Inactive, died summer 1981
323	1980 (2)	6	18	19	2	4	2	Active
358	1982 (2)	-	-	17	-	-	0	Active
319	1980 (3)	6	9	-	4	3	-	Inactive, died summer 1981
291	1980 (4)	7	-	-	0	-	-	Inactive, died summer 1980
322	1980 (4)	5	-	7	0	-	1	Collar shed in den, recaptured 1982, died June '82
320	1980 (4)	2	-	-	1	-	-	Shot by hunter fall '80
357	1982 (4)	-	-	18	-	-	4	Active
359	1982 (4)	-	-	18	-	-	0	Active
324	1980 (5)	6	19	20	0	4	4	Active
342b	1981 (5)	-	40	-	-	0	-	Shot by hunter, fall '81
343	1981 (5)	-	16	18	-	3	3	Active
300	1980 (7)	3	-	-	-	-	-	Died summer 1980
360	1982 (7)	-	-	20	-	-	2	Active
302	1980 (8)	7	36	10	0	12	2	Collar shed in 1980, but recaptured in 81, radio failure 1982
303	1980 (8)	15	18	18	2	0	0	Active
305	1980 (9)	9	-	-	2	-	-	Shot by hunter fall, '80
346	1981 (9)	-	16	20	-	2	4	Active
348	1981 (9)	-	7	8	-	2	1	Killed by hunter 9/82
287	1980 (10)	17	15	16	0	2	2	Killed by hunter 9/82
304	1980 (10)	15	19	3	0	0	1	Shed collar 5/82
	All Males	98	227	212	11	32	20	
FEMALES								
329	1981 (1)	w/327	19	18	-	2	2	Active
349	1981 (4)	-	6	19	-	0	0	Active
363	1982 (4)	-	-	18	-	-	0	Active
318 (w/1c 1980)	1980 (5)	6	20	18	0	0	0	Active
326 (w/2c 1980)	1980 (5)	3	-	-	0	-	-	Shot by hunter, fall 1980
327 (w/2c 1980)	1980 (5)	6	34	18	1	8	7	Active
354 (w/2@c,1982)	1982 (5)	-	-	19	-	-	0	Active
328 (w/2c 1981)	1980 (6)	6	18	-	0	0	-	Collar shed in 81/82 den
364	1982 (6)	-	-	16	-	-	7	Missing
301 (w/2c 1981)	1980 (7)	20	14	16	2	0	0	Missing
317 (w/2c 1980)	1980 (7)	6	18	17	0	0	0	Active
361	1982 (7)	-	-	18	-	-	2	Active
290	1980 (8)	18	14	-	4	0	-	Inactive, collar not replaced, neck infected
289 (w/3c 1981)	1980 (9)	14	19	19	4	0	0	Active
288	1980 (10)	16	-	-	0	-	-	Collar shed
321 (w/2c 1981)	1980 (10)	6	14	18	0	2	0	Active
325	1980 (11)	6	8	-	0	2	-	Active, collar shed in den but subsequently recaptured
316 (w1c 1980)	1980 (12)	4	-	-	0	-	-	Shot by hunter, fall 1980
	All Females	111	184	214	11	14	9	
	TOTAL BOTH SEXES	209	411	416	22	46	29	
Observations of unmarked bears		49	54	NA	-	-	-	
	TOTAL	258	465	416	22	46	29	

The mean age of 7 males captured in upstream studies during spring 1982 was 4.2 (2-7) and for 5 females it was 5.4 (2-9). The 1982 sex ratio of captured bears in the upstream study (6 males:5 females) was markedly different from that of captured bears in the downstream study (3 males:10 females). Capture data of all black bears handled to date are given in Table 9. Two radio-collared black bears were shot by hunters in 1982 (B287 and B348) Bear (B304) shed its radio-collar. Bear (B302) had a known radio failure. And two bears (B364 and B301) are missing. Nineteen black bears currently have active radio-collars in the upstream study area.

Number of point locations and river crossings by radio-collared upstream black bears are given in Table 15.

2. Black Bear Census

An effort was made on 18-22 August 1982 to census black bear populations in the area of the proposed impoundments. The technique utilized was the Lincoln Index using the ratio of radio-marked to unmarked black bears observed during intensive survey flights (approx. 5 min/mi^2) using approximately ¼ mile transects. Individual sample units (n=31) averaging 14 mi^2 (8-22) were identified on a map using obvious geographic features as boundaries. The total area censused was approximately 445 mi^2 and included most of the known black bear habitat in the upstream study area based on the preceding 2 years of radio-tracking data. Areas

above 3,500 feet elevation were not flown as previous data indicated only 1% of radio-locations were above this elevations. On the day preceding the census (18 Aug.) and following the census (22 Aug.) routine monitoring flights were made to verify the presence of radio-marked bears in the census area. Census flights were conducted on 19 and 20 August in 2 supercubs piloted by Al Lee and Don Deering with S. Miller and D. McAllister as observers. When a bear was spotted during the census, radio-tracking equipment was activated to ascertain whether the bear was radio-marked.

The weather during the census was partly sunny and generally warm, suboptimal conditions under which many bears might be relatively inactive compared to cooler more overcast conditions. Under sunny conditions observability might also be affected by dark shadows. A total of 27 hours of flight time was logged during the 2-day census (excludes dead time between sample units). The total number of black bears observed was 38 (excluding cubs), 14 brown bears were also observed (2 radio-marked). One bear (B323) was in the census area during the pre-census flight but was in a very atypical location for a black bear (Clarence Lake) in the post-census flight. This bear was not seen during the census and was treated in the calculations as present in the census area. All other radio marked bears were in the census and during both pre and post-census monitoring flights.

The timing of the census was chosen to correspond with the period when previous experience indicated that black bears would be visible in the shrubland habitats adjoining forested areas. This shrubland habitat is relatively rich in blueberries at this time of the year. A replicate of this design that will yield a second estimate is planned for spring 1983 when bears have emerged from dens but prior to leaf emergence which would restrict observability.

The study area can be characterized as a finger of acceptable black bear habitat along the Susitna River surrounded by higher elevation, unforested habitats where our radio-marked black bears seldom venture. These conditions describe an essentially closed black bear population not open to immigration or emigration except at the downstream end of the census area. The census results, correspondingly, describe a relatively discrete population. The density of this population would depend on the area utilized in calculating density, in general the area occupied by this black bear population is the smallest in the spring and largest in the late summer at the time the census was conducted.

The formula used in making the population estimate was (Ricker 1975): $N = (M+1)(C+1)/(R+1)$. In this formula M=number of radio-marked bears in the census area (21 black bears), R=number of radio-marked bears observed in the census (9), and C=number of black bears observed during the census (38 excluding cubs). Confidence intervals were based on the Poison distribution (Ricker 1975). Because cubs were excluded the population estimate

reflects the population older than 1.0 years of age. No radio-collared yearlings were present in the census area although unmarked yearlings may have been observed; yearling black bears cannot accurately be identified as yearlings from the air.

Many assumptions must be made in the use of this estimation procedure and numerous sources of bias are possible (see Seber 1973). The most probable source of bias is incomplete mixing of marked and unmarked individuals. Of the 21 marked bears present in the area, 8 were originally captured in August tagging efforts (2 of these were seen during the census) and the remaining 13 were captured in spring tagging efforts (7 of these were seen during the census). It is possible that these 2 groups had different probabilities of being observed during the August census. Also, because recent years' capture efforts have concentrated on the vicinity of the Watana impoundment (where impacts are expected to be more marked), a higher proportion of bears in this area may have been marked relative to more downstream areas. Individuals vulnerable to capture may have had higher probabilities of being seen in the census; if so this would yield an underestimate of population size.

The low numbers of bears seen was surprising. As mentioned in the Phase I report (Miller and McAllister 1982:93) at the same time of the year in 1980, pilot Al Lee saw 35 black bears by himself in a small portion of the census area during 1½ days of spotting effort. No bears were seen in this area during the 1982 census.

Mr. Lee was convinced during the census that "something had happened" to the black bears in this region, I had the same impression. Whether anything actually happened, however, cannot be shown at this time based on available information. During the apparent bad berry year of 1981 several radio-marked black bears moved downstream out of the study area as mentioned in the Phase I report (p. 105), these 3 bears (all males) represented 15% of the 20 black bears marked at that time. One of these bears remained outside during most of 1982 and the other two returned. Only 1 radio-collared bear (B322) died in spring 1982, two died in summer 1981 (B319 and B330 the latter a yearling). It is possible these deaths were related to poor nutrition resulting from the berry failure in 1981, but other causes may have been responsible (B319 died in late July 1981, and B330 in mid-August 1981). These observations on radio-collared bears are difficult to reconcile with a hypothesis that the bad 1981 berry crop resulted in a major reduction in upstream bear populations in 1982. A hypothesis that disturbance from the helicopter traffic associated with project-related studies resulted in the apparent decline is similarly difficult to reconcile with these observations of radio-marked bears.

Straightforward application of the census results provided a 1982 population estimate in the census area of 86 black bears 1 year old or older with a 95% confidence interval of 47-172. Given the above discussion this estimate should clearly be considered preliminary. The planned spring 1983 census will provide an inde-

pendent estimate. Even if correct, this estimate reflects the bear population in 1982. As mentioned above it is possible that the 1982 population was significantly lower than was present when the study was initiated in 1980 and is lower than is typical in the area. My guess on the number of bears in the impoundment study area based on observations in 1980 was 150-200. Acceptance of this guess over the calculated estimate requires either identification of a major source of bias in the census that is not evident at this time or acceptance of the conclusion that a major population reduction occurred through selective losses or emigrations that was more predominant in the unmarked segment of the population than in the radio-marked segment. It is feasible that emigrations of younger individuals (only 1 yearling and no 2-year olds were marked in 1981) during years of berry scarcity would be more common than emigrations of better established older individuals.

Although there is no direct evidence for such a selective emigration of subadult bears it is possible to estimate the magnitude of such a potential source of loss. The census result can also be corrected for cubs by similar guesses added to the census estimate. Cubs, yearlings and 2-year old bears might comprise about 40% of a black bear population. Adding 40% to the census estimate of 90 bears provides an estimate of 126 bears, similar corrections to the confidence interval extends this to 65-241.

3. Home Range Analyses--Upstream Black Bears

Home range data for radio-collared black bears in the upstream study area for each year of the study is given in Table 16. As mentioned by Miller and McAllister (1982), the method currently used to calculate home ranges is imprecise and may include substantial areas not occupied by the bear, especially for bears that make extensive seasonal movements. It should also be noted that home ranges given in Table 16 for 1982 include only points collected prior to 9 September 1982, the data for preceding years include all points. Correspondingly, the 1982 data presented in Table 16 will change (increase) in some cases when additional 1982 points are included in the home range calculations.

Keeping these limitations in mind, the 1982 home ranges averaged smaller than the 1981 home ranges for females (79 km^2 vs. 200 km^2 with corresponding standard deviations of 124 km^2 and 355 km^2, Table 16) and for males (163 km^2 vs 230 km^2 with SDs of 254 km^2 and 185 km^2, respectively). These differences are not statistically significant because of the large variation in individual home range size (6-905 km^2 in 1982, Table 16). Regardless, the differences between 1981 and 1982 are in the direction that would be expected if our hypothesis that the apparent poor 1981 berry crop resulted in larger 1981 home ranges than in 1980 (Miller and McAllister 1982). More insights into this possible pattern can be gained through analyses of annual home ranges of the same individual as was done for brown bear earlier in this report.

Table 16. Home range sizes for Su-Hydro upstream study area black bears. (Includes individuals with 5 or more relocations).

Bear ID (age @ capture)	1980 Observation Period (No. of locations)		1980 Home Range (km^2)	1981 Observation Period (No. of locations)		1981 Home Range (km^2)	1982 Observation Period (No. of locations)		1982 Home Range (km^2)	Comments
Males										
330 (1)	---	--	---	May-Oct	(14)	10	---	--	---	Died 7/81
323 (2)	Aug-Oct	(6)	20	May-Oct	(18)	383	May-Sep	(15)	905	
358 (2)	---	--	---	---	--	---	May-Sep	(14)	6	
319 (3)	May-July	(6)	67	May-July	(9)	43	---	--	---	Died 7/81
291 (4)	May-July	(7)	20*	---	--	---	---	--	---	Died 7/80
322 (4)	Aug-Oct	(5)	10	---	--	---	May-Jul	(7)	21	Collar shed in den 80/81, recaptured 5/82, died 7/82
357 (4)	---	--	---	---	--	---	May-Sep	(14)	10	
324 (5)	Aug-Oct	(6)	29	May-Oct	(19)	248	May-Sep	(17)	140	
342B (5)	---	--	---	May-Sep	(40)	611	---	--	---	Shot by hunter 9/81
343 (5)	---	--	---	May-Oct	(16)	289	May-Sep	(14)	331	
359 (5)	---	--	---	---	--	---	May-Sep	(14)	73	
302 (8)	May-July	(7)	4	May-Oct	(36)	326	May-Jul	(10)	51	Collar shed in '81, recaptured in '82, missing '82
303 (8)	May-Oct	(15)	95*	May-Oct	(18)	92	May-Sep	(15)	74	
305 (9)	May-Aug	(9)	48*	---	--	---	---	--	---	Killed by hunter,'80
346 (9)	---	--	---	May-Oct	(16)	62	May-Aug	(15)	87	
348 (9)	---	--	---	Aug-Oct	(7)	388	May-Jun	(7)	17	Killed by hunter, 9/82
287 (10)	May-Oct	(17)	136*	May-Oct	(15)	268	May-Sept	(16)	239	*, ** Killed by hunter, 9/82
304 (10)	May-Sep	(14)	34*,**	May-Oct	(19)	37*,**	---	--	---	Collar shed 7/82
	$\bar{x}$(all males)=	(9.2)	46		(18.9)	230		(13.2)	163	
	S.D. =	--	42		--	185		--	254	
	range =	(5-17)	4-136		(7-40)	10-611		(7-17)	6-905	

(continued on next page)

Table 16. (continued)

Bear ID (age @ capture)	1980 Observation Period (No. of locations)		1980 Home Range (km^2)	1981 Observation Period (No. of locations)		1981 Home Range (km^2)	1982 Observation Period (No. of locations)		1982 Home Range (km^2)	Comments
FEMALES										
329 (1)	---	--	---	May-Oct	(19)	15	May-Sep	(15)	9	weaned in June 1981
363 (3)	---	--	---	---	--	---	May-Sep	(14)	18	
349 (4)	---	--	---	Aug-Oct	(6)	36	May-Sep	(16)	16	
318 (5)	Aug-Oct	(6)	25(w/1c)	May-Oct	(20)	1036	May-Sep	(14)	471	weaned 1@1 in '81
327 (5)	Aug-Oct	(6)	3(w/2c)	May-Oct	(34)	31	May-Sep	(14)	34	weaned 2@1 in '81
354 (5)	---	--	---	---	--	---	May-Sep	(15)	63	W/2@C
328 (6)	Aug-Oct	(6)	4	May-Oct	(18)	28(w/2c)	---	--	---	collar shed in 81/82 dens
301 (7)	May-Oct	(20)	18*	May-Oct	(14)	12(w/2c)	May-Sep	(16)	18	weaned 1@1 in '80, missing since 9/28
317 (7)	Aug-Oct	(6)	4(w/2c)	May-Oct	(18)	14	May-Sep	(14)	44	weaned 2@1 in '81
360 (7)	---	--	---	---	--	---	May-Sep	(14)	124	
361 (7)	---	--	---	---	--	---	May-Sep	(14)	69	
290 (8)	May-Oct	(18)	45*	May-Aug	(14)	116	---	--	---	weaned 2@1 in '81 not recollared in '81 as neck was infected
289 (9)	May-Oct	(14)	43*	May-Oct	(19)	26(w/3c)	May-Sep	(15)	26	weaned 2@1 in '80, had cubs in 1981
364 (9)	---	--	---	---	--	---	May-Sep	(15)	121	
288 (10)	May-Aug	(16)	7	---	--	---	---	--	---	collar shed in '80
321 (10)	Aug-Oct	(6)	3	May-Oct	(14)	771(w/2c)	May-Sep	(16)	13	lost cubs in August '81 and made big movement
325 (11)	Aug-Oct	(6)	8	Aug-Oct	(8)	117				Collar shed in 80/81 den recaptured in 8/81
$\bar{x}$(All Females)=		(10.4)	16		(16.7)	200		(14.8)	79	
S.D.=			16		---	355		--	124	
Range=		(6-20)	3-45		6-34	12-1036		(14-16)	(9-471)	
$\bar{x}$(All Males & Females)=		(9.8)	31		(17.9)	215		(14.0	119	
S.D.=		---	35		---	273		--	198	
Range=		(5-20)	3-136		(6-40)	10-1036		(7-17)	6-905	

* Included in statistical comparisons

** Excludes atypical location of 80/81 den, with den home range for 1980 & 1981 was 104 km^2.

Home ranges for 16 individual black bears were calculated in both 1981 and 1982, 8 males and 8 females (Table 16). Five males (324, 302, 303, 348, 287) had smaller home ranges in 1982 than in 1981 (mean decrease=51%, range=1-84%), 3 males (323, 343, and 346) had larger home ranges in 1982 than in 1981 (mean increase=-64%, range=15-136%). Four females (329, 349, 318, 321) had smaller home ranges in 1982 than in 1981 (mean decrease=62%, range=40-98%), 3 females (327, 301, 317) had larger home ranges in 1982 than in 1981 (mean increase = 91%, range = 10-214%). One female that had cubs in 1981 had the same size home range in 1982 (B289). For B301 (included above) the 1982 home range was larger than the 1981 home range by 50%, probably because she had cubs in 1981. These data tend in the right direction but do not provide clear support for our hypothesis that black bear movements were more extensive than normal in 1981 because of the apparent poor 1981 berry crop. Excluding females with cubs in either 1981 or 1982, 9 bears had smaller home ranges in 1982 than in 1981 and 5 had larger home ranges.

For male B323 the steady increase in home range in 1980 (20 km^2, Aug.-Oct.), 1981 (383 km^2, May-Oct.), and 1982 (905 km^2, May-8 Sept.) may reflect dispersal rather than food availability (this bear was 2 years old in 1980). In 1982, this bear apparently moved from the High Lake vicinity to the Vee Canyon vicinity and has denned near Vee Canyon, this may account for the 136% increase in 1982 home range size over the 1981 home range. The

largest percentage increase in home range (214% for B317) represented a change from 14 km^2 in 1981 to 44 km^2 in 1982, no reason for this large percentage increase for this individual is readily apparent and it may be a artifact of small numbers or method of calculating home range.

4. Berry Abundance

In the Phase I report (Miller and McAllister, 1982) it was noted that black bears in August 1981 made extensive movement in both upstream and downstream directions. These movements were much less extensive in 1980, when berry crops were thought to have been normal, than in 1981 when berry crops were thought to have been exceptionally bad. Our hypothesis was that black bears made more extensive movements during poor berry years in search of better foraging areas. Downstream movements may have been motivated by salmon runs downstream of Devils Canyon and upstream movements by higher relative berry abundance.

This hypothesis was tested in August 1982, a year during which berry production in the Watana Creek-Tsusena Ck. area was thought to be slightly below average. During this period in 1982, 6 of 16 radio-marked black bears made extensive movements from their spring-early summer ranges to upstream areas as happened in 1981. Others made more moderate upstream movements at this time (see Section IX-B-3). A vegetative transect was run in woodland black spruce habitats in the Deadman Ck. vicinity and another in the same habitat in an upstream location (Vee Canyon-Oshetna River).

Additional transects were run in birch shrub habitats in each of these 2 locations. Each transect was comprised of ten plots (each 1 square meter) oriented so 5 plots were arranged at 10 m spacings downslope and the remaining 5 at the same spacing parallel to the slope. All berries in each plot were picked and counted and canopy coverage of plants in each plot was estimated. The results are given in Table 17. Dot Helms (Plant Ecology subtask) assisted in this work which was conducted on 21 August 1982.

Although insufficient data were collected to provide conclusive evidence, the data were consistent with the hypothesis that the observed movements of black bears were motivated by a more abundant berry crop in upstream locations. All species of berries (except crowberries) were more abundant in upstream woodland spruce habitats than downstream; blueberries were 9.5 times more abundant upstream (Table 17). The same pattern held in the birch shrub habitats (with blueberries 6 times more abundant in the upstream site) except that crowberries were also more abundant in the upstream location (Table 17). In general this pattern was reversed for canopy coverage (Table 17) suggesting that in years when the bushes in downstream areas were productive, sufficient berries would be available to make extensive movements unnecessary; this is likely what happened in 1980.

Contrasting the 2 downstream habitats suggests that berries (except crowberries) were more abundant in the birch shrub than

Table 17. Berry abundance in 4 transects (10 plots of one square meter/transect) in the impoundment study area.

	Transect 1	Transect 4	Transect 2	Transect 3
Location	Between Vee Canyon and Oshetna (upstream)	Confluence of Susitna R. and Deadman	Vee Canyon-Oshetna (upstream) Ck. (downstream)	Middle Deadman-Watana Camp (downstream)
Elevation	2325 feet	2100 feet	3050 feet	2450 feet
Aspect	218°	239°	216°	201°
Slope	8°	4°	5°	7°
Vegetation type	WSB	WSB	B*	B
Blueberries (Vaccinium uliginosum)				
No. berries	303	32	489	77
range (no/plot)	1-191	0-8	0-164	0-31
S.D.	57	3.2	54.9	11.7
% canopy cover:				
mean	21.2	31	36.0	57.0
range	5-60	15-70	5-80	15-80
S.D.	15.9	17.9	24.6	23.0
Lowbush cranberry (V. vitis-idaea)				
No. berries	28	0	45	23
range	0-15	-	0-16	0-15
S.D.	5.1	-	-	-
% canopy cover:				
mean	3.4	3.9	6.7	8.7
range	0-10	0-15	2-10	0-30
S.D.	3.5	5.1	3.0	8.6
Crowberries (Empetrum nigrum)				
No. berries	17	112	200	1
range/plot	0-10	0-58	0-50	-
S.D.	3.1	17.9	19.7	-
% Canopy cover:				
mean	2.9	10.2	10.9	0.4
range	0-10	0-30	0-50	0.2
S.D.	3.4	10.2	14.5	-
Bearberry (Arctostaphylos uva-ursi)				
No. of berries	22	0	0	0
range	0-20	-	-	-

* Transect #2 was clearly in a birch shrub type although according to the vegetation map it was in woodland black spruce (WSB).

in the woodland spruce; this supports the hypothesis of why black bears move out of the spruce habitats into the adjoining shrublands in late August. The same pattern held in comparisons of the 2 upstream habitats except that crowberries were also more abundant in the upstream birch area relative to the adjoining spruce habitat. Canopy coverage of berry plants in both years also suggests the presence of more bushes in the birch shrub type relative to the spruce type.

It is noteworthy that the apparent patchy distribution of berries makes it necessary to contrast berry abundance between different areas in the same habitat type in order to accurately interpret bear movements. Motives for these movements would remain obscure if berry abundance is just characterized by habitat type throughout the study area. These results suggest needed modification in the design of Plant Ecology subtask studies. Insufficient numbers of berry transects were run in 1982 to provide conclusive evidence of relative berry abundance in these habitats, the data collected, however, are consistent with our earlier hypothesis.

5. Population Biology and Productivity--Black Bears

None of the previously radio-collared black bear females had a litter of newborn cubs in 1982 although 4 (317, 318, 327, 321) potentially could have (Table 18). It is possible that the failure of these bears to produce cubs in 1982 was related to the apparent poor 1981 berry crop (Miller and McAllister 1982), similar relationships have been observed in Minnesota (Rogers 1976).

Possibly because of their failure to have cubs in 1982, 19 of 20 radio-collared females (B354 is the exception) could potentially have cubs in 1983 (Table 18). For 9 of these bears (ID numbers from 361-377, Table 18) the reproductive status was not known in 1981 as they were not captured until spring 1982, correspondingly, the high proportion expected to produce cubs in 1983 may be exaggerated by a capture bias against females with newborn cubs that may exist. These data are consistent with our hypothesis that a direct relationship exists between food supply and black bear productivity.

As discussed earlier in the brown bear section, this hypothesis is important to determination of the impact of the project on the bear population. The project is expected to adversely impact a large proportion of available black bear habitat in the study area, especially in the vicinity of the Watana Impoundment (Miller and McAllister 1982). Much of this impact will likely be expressed through decreased productivity of the black bear population if a direct relationship between productivity and available food supply exists as hypothesized.

6. Food Habits of Upstream Bears

Results of analyses of 23 bear scats collected in the upstream study area during spring and 3 collected in late summer are presented in Table 11. The small sample of scats is inadequate to illustrate bear food habits but provides some general indications of what to expect from more intensive work scheduled for 1983.

Table 18. Predicted spring 1983 reproductive status of radio-collared female black bears.

ID	1983 age	expected 1983 Status	Comments
289	12	cubs	weaned ylgs and bred in '82
301 (missing)	10	cubs	weaned ylgs and bred in '82
317	10	cubs	weaned ylgs in '81, no cubs in '82
318	8	cubs	weaned ylgs in '81, no cubs in '82 bred in '82
327	7	cubs	weaned ylgs in '81, no cubs in '82
321	13	cubs	lost cubs in '81, no cubs in '82
349	6	cubs	no offspring in '81, or fall '81
361	8	cubs	no offspring in '82
363	5	cubs	no offspring in '82, bred
364 (missing)	7	cubs	no offspring in '82, bred
354	6	yearlings	cubs in '82
329	3	barren	subadult, not bred in '82
367*	5	cubs	first litter?
369*	4	cubs?	first litter
378*	4	cubs?	first litter
376*	5	cubs?	first litter, thought might have had ylgs in spring '82, based on age this is now considered unlikely
374*	7	cubs	weaned yearlings in '81 (probably)
372*	10	cubs	bred in '82
375*	6	cubs	may have weaned yearlings in '82
370*	8	cubs	------
377	6	cubs	------

* bear occurs in the downstream study area

Horsetail (*Equisetum* sp) occurred in 16 of the spring scats (70%), in most cases this species comprised the bulk of the scat (Table 11). Horsetail is a mesic species and casual observations suggest that a large proportion of the habitat where horsetail is currently found will be inundated. This needs to be verified by sampling efforts of the Plant Ecology Subtask.

Grasses and sedges occurred in 6 scats (25%), mostly in the late spring (Table 112). This observation, along with the abundance of horsetail in scats, is consistent with my speculation (Miller and McAllister 1982) that bear movements to the impoundment area in the early spring may be motivated by the earlier phenology of these species in this area relative to higher elevations. Over-wintered berries were also common in spring scats (Table 11). As expected, berries (especially blueberries and crowberries) were common in late summer scats (Table 11).

7. Black Bear Den and Denning Characteristics--Upstream and Downstream Studies.

Within the upstream study area black bears tend to den in relatively steep, forested terrain in close proximity to the mainstem of the Susitna River or its major feeder streams. Furthermore, black bears tend to den on south-facing slopes although exceptions are not uncommon. Project impacts upon black bear dens will be significant in the vicinity of the Watana Impoundment (Miller and McAllister 1982). Proceeding upstream through the

study area, the band of acceptable denning locations appears to become progressively narrower and more confined to the immediate vicinity of the Susitna River; much the same pattern as seen for overall black bear distribution in the study area. This correlated with the high rate of den inundation by the Watana impoundment (13 out of 24 dens located) and the relatively low rate for the Devils Canyon impoundment (1 out of 18 located). Data indicating a high rate of reuse of dens in successive years (a minimum of 16 out of 25 dens, 2 of these tentative) and competition for den sites (2 instances observed) suggest that acceptable alternative dens are scarce in the upstream study area.

To date, 54 black bear den sites have been located within the study area; 12 downstream of Devil Canyon, 18 within the Devil Canyon dam impact area, and 24 within the Watana Dam impact area. Twenty-five of these dens have been visited on the ground; 2, 14, and 9, respectively, for the above areas.

Three dens were only approximately located, 26 dens in use during the current winter (1982/83) will be visited during the summer of 1983.

The 54 black bear dens range in elevation from 1,000 feet to 4,340 feet, only 2 dens were above 3,100 feet. The mean elevation for the 54 dens was 2,053 feet (SD=575.8). Of the 18 den sites in the vicinity of the proposed Devils Canyon Impoundment,

only one will be flooded at an impoundment elevation of 1,450 feet, the mean elevation of these 18 dens is 2,108 feet (range= 1,400-4,340, SD=670). Of the 24 den sites in the vicinity of the proposed Watana impoundment, 13 would be flooded at an impoundment elevation of 2,200 feet, the mean elevation of these dens was 2,258 feet (range=1,675-3,600, SD=441). Downstream of the Devils Canyon dam site, the mean elevation of 12 black bear dens was 1,560 feet (range=1,000-2,100, SD=369). Included in these values are tentative elevations of the 1982/83 den sites.

Characteristics of den sites used in the last 2 winters (1980/81 and 1981/82) are given in Table 20. Of the 25 black bear dens examined on the ground, 10 were in natural cavities and 15 were excavated. Virtually all of the natural cavity dens appear to have been used in preceding years, some may have been used for decades or longer. Of the 14 dug cavities, 7 were considered to have been previously used. Radio-tracking of tagged black bears provided positive knowledge of reuse of 6 den sites out of 29 observed for more than one year. Additional reuse of these dens by non-radio-collared bears has not been assessed but doubtless is common. Interestingly, 5 radioed individuals have reused the same den for 2 or more years and in 2 other instances an attempted reuse was evident but the den was found already occupied by another radio-collared bear.

Of the 54 black bear dens known, 48 occur within habitat types that include a considerable proportion of alder or larger trees. Only 6 den sites were found in the relatively open habitat types of dwarf birch or tundra.

able 19. Characteristics of black bear dens in the Susitna study area during winters of 1980/1981, 1981/1982

	Den No.	Bear ID No.	Age at Exit	Elevation (feet)	Slope (Degrees)	Aspect (True N)	Vegetation	% Canopy Tree Coverage	ENTRANCE Ht. (cm.)	ENTRANCE Width (cm.)	CHAMBER Ln. (cm.)	CHAMBER Width (cm.)	CHAMBER Ht. (cm.)	Total Length (cm)	Previously Used? (Yes/No)	A	B	C
ATURAL CAVITIES																		
FEMALES w/offspring (at exit)																		
w/2 cubs	8	B321	11	2825	42	208	Alder	0	79	26	127	68	71	610	Yes	2	No	-
w/2 cubs	19	B328	7	1950	40	218	Alder	0	41	93	-	-	-	-	Yes	4	No	-
w/1	32	B328	8	2075	64	W**	Alder, Birch, Moss	50	49	39	84	54	44	180	Yes	3	No	-
	33	B318	7	1890	41	361	Birch	0	51	43	69	76	62	654	Yes	3	No	-
? collar shed in den	6	B325	12	1490	30	178	Birch/alder/spruce	50	49	27	100	74	55	113	Yes	2	No	-
MALES																		
	7#	B287	11	1700	46	170	Cottonwood/willow/ birch	50	62	44	122	89	42	-	Yes	2	No	-
	9###	B324	6	2240	30	88	Alder	0	38	34	137	70	45	-	Yes	3	No	-
	10#	B303	8	1690	50	48	Willow/alder/aspen	-	93	36	108	82	94	869	Yes	1	No	-
	13*	B304*	11	4340	24	52	Rock pile/tundra	0	-	-	-	-	-	-	?*	-	No	-
	18*	B322*	5	1840	53	158	Alder/rock slide	0	-	-	-	-	-	-	?*	-	-	Yes
UG DENS																		
FEMALES w/offspring (at exit)																		
w/2 cubs	2	B301	8	2065	34	191	Alder/birch	90	49	43	97	92	51	151	Yes	3	-	Yes
w/3 cubs	4#	B289	10	2000	18	211	Alder/willow/spruce	70	39	72	142	127	55	290	No	1	-	Yes
w/2 ylgs	11	B317	8	2050	36	86	Alder	0	27	41	93	93	78	128	No	3	No	-
w/1 ylg	12	B318	6	2725	24	122	Dwarf birch/moss/ tundra	0	24	42	95	84	40	145	No	5	No	-
w/2 ylgs	21##	B327	6	2000	35	379	Alder/birch	80	22	59	163	203	116	198	?	4	-	Yes
w/2 ylgs	50	B301	9	2275	43	219	Cottonwood, Spruce	20	28	56	76	136	98	193	Yes	2	-	No
	34	B321	12	2125	22	184	Alder	10	29	43	99	118	79	193	No	2	No	-
	43	B317	9	2250	8	153	Dwarf Birch	0	32	36	92	89	63	150	No	2	No	-
	55	B349	5	2650	21	207	Alder, Spruce	10	39	54	56	92	55	124	No		-	No
	58	B327	7	1675	26	321	Birch, Alder	70	35	49	86	73	61	160	No	3	-	Yes

(continued on next page)

Table 19. (continued)

	Den No.	Bear ID No.	Age at Exit	Elevation (feet)	Slope (Degrees)	Aspect (True N)	Vegetation	% Canopy Tree Coverage	ENTRANCE Ht. (cm.)	ENTRANCE Width (cm.)	CHAMBER Ln. (cm.)	CHAMBER Width (cm.)	CHAMBER Ht. (cm.)	Total Length (cm)	Previously Used? (Yes/No)	A	B	C
MALES																		
	20*	B323*	3	1950	46	176	Alder/birch	-	-	-	-	-	-	-	?*	-	-	Yes
	35	B304	12	1650	36	79	Birch	25	53	147	100	173	-	660	Yes	2	No	-
	38	B343	6	1200	39	313	Birch, Alder, Spruce	60	35	62	-	-	-	-	No	?	-	-
	39	B348	10	1375	43	240	Birch, Spruce	20	57	91	116	172	183	530	Yes	1	-	-
	57	B302	10	2025	41	236	Spruce, Birch	40	55	63	94	138	101	188	Yes	2	-	Yes
SPECIES UNKNOWN																		
	3	-	-	2340	35	(254)	Dwarf birch	0	50	54	-	-	-	170	No	-	-	No
UNKNOWN CAVITY TYPE																		
	40	B324	7	1400**	-	-	--	-	-	-	-	-	-	-	-	-	?	-
	49	B323	4	1875**	41	204**	Spruce, Birch	-	-	-	-	-	-	-	-	-	-	?
	51	B346	10	2500**	-	188**	--	-	-	-	-	-	-	-	-	-	-	No
UNKNOWN SEX																		
	61	?	?	2400	35**	163**	Spruce, Alder, Birch	80	-	-	-	-	-	-	No	4	-	No

* Actual den site not found or too difficult to enter.
** Approximate value
A Subjective characterization of quality, 1 = highest and 5 = lowest.
B Will be flooded by Devil's Canyon?
C Will be flooded by Watana Impoundment?

\# Used by the same bear two consecutive winters
Used by the offspring during natal winter and subsequent winter
Used by different radio-collared bear during subsequent winter

X. References

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XI. Appendices

Appendix I. Home ranges of Individual radio-collared black bears and brown bears in the downstream study area. Points occurring between August 1 and September 9 are indicated with a hexagon. Only data through September 9, 1982 have been compiled and are illustrated.

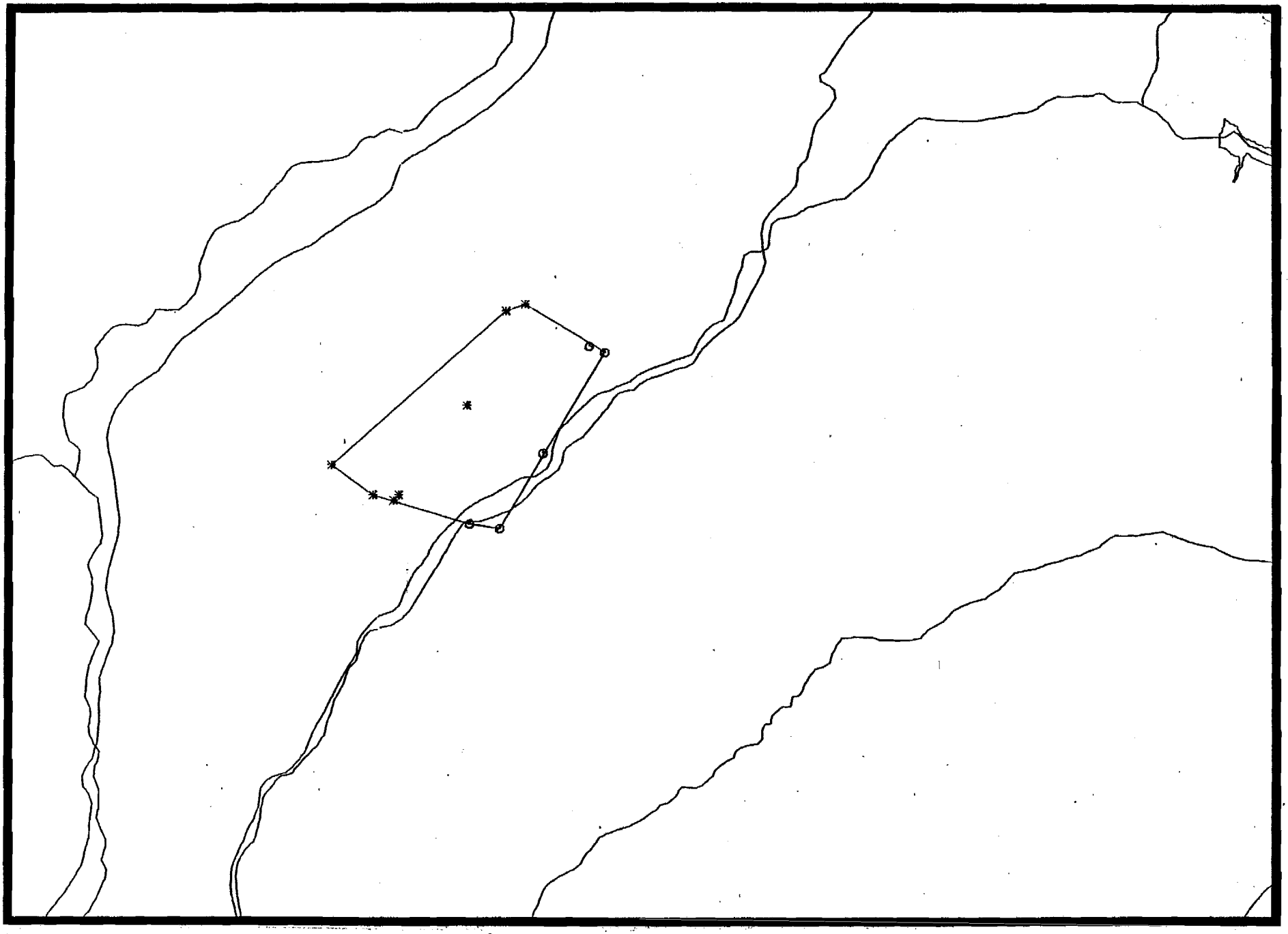

Figure 3. 1982 home range of G379, 12 points. (1 cm = 2.3 km)

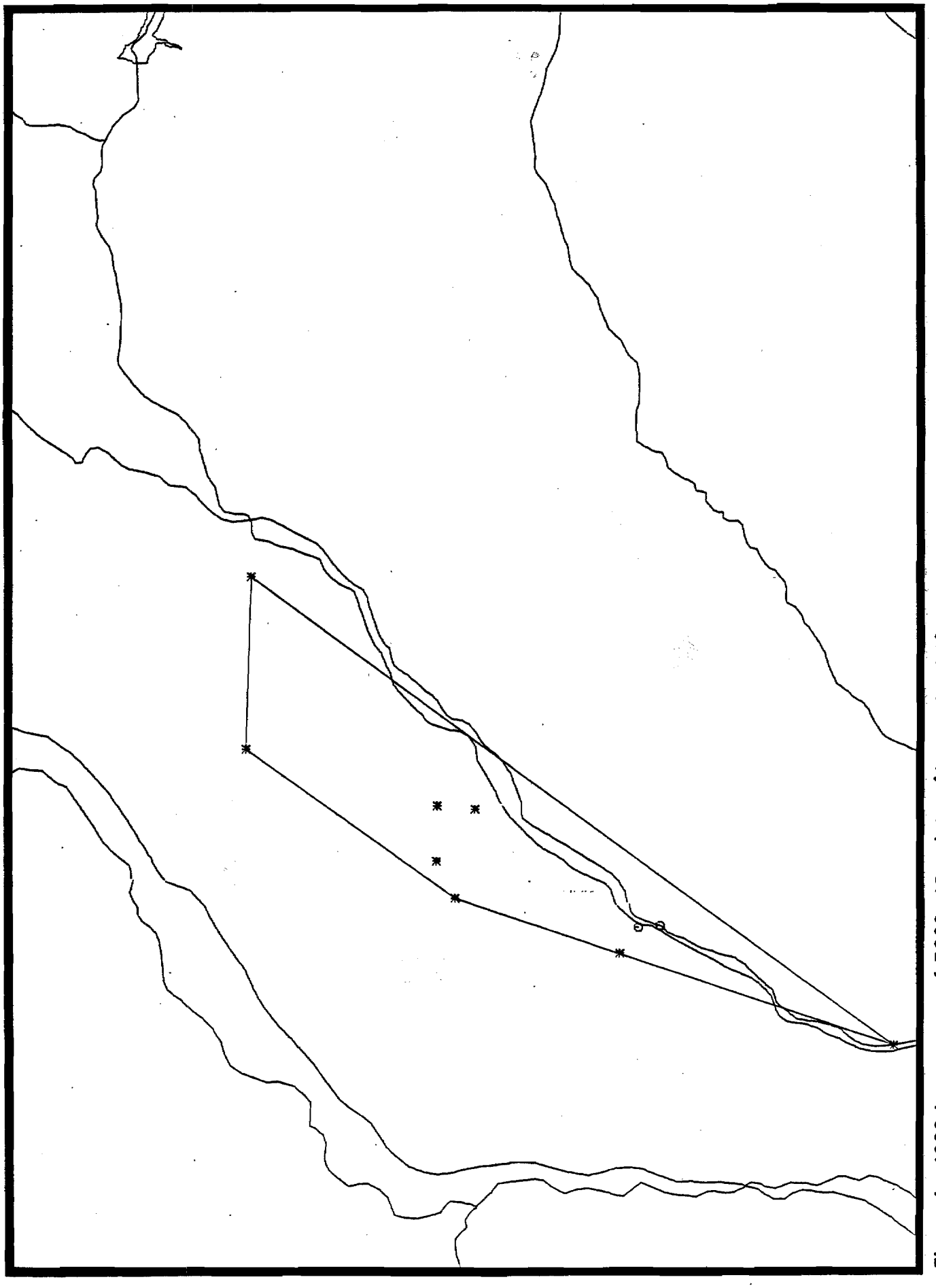

Figure 4. 1982 home range of B366, 10 points. (1 cm = 2.3 km)

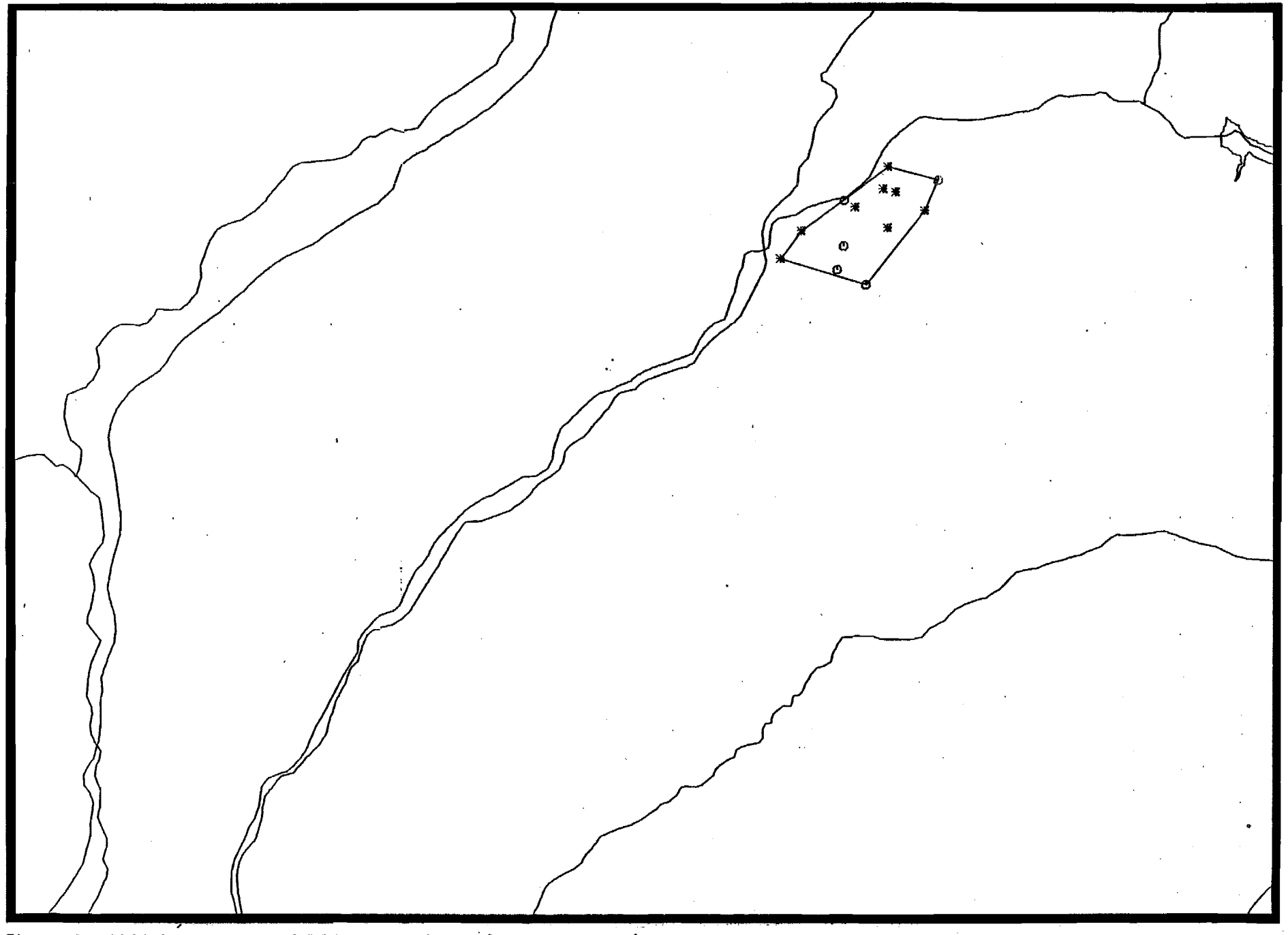

Figure 5. 1982 home range of B367, 13 points. (1 cm = 2.3 km)

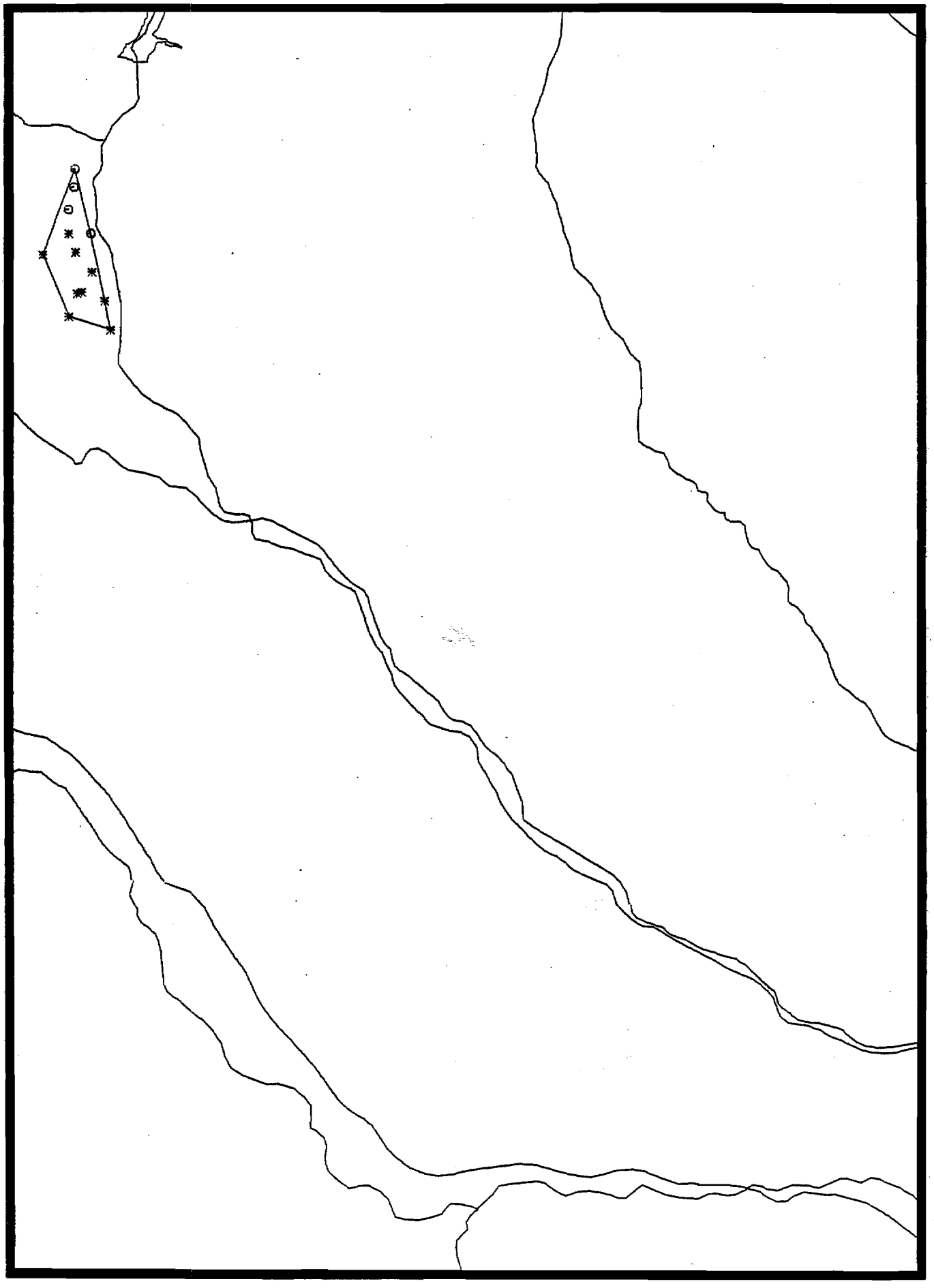

Figure 6. 1982 home range of B369, 14 points. (1 cm = 2.3 km)

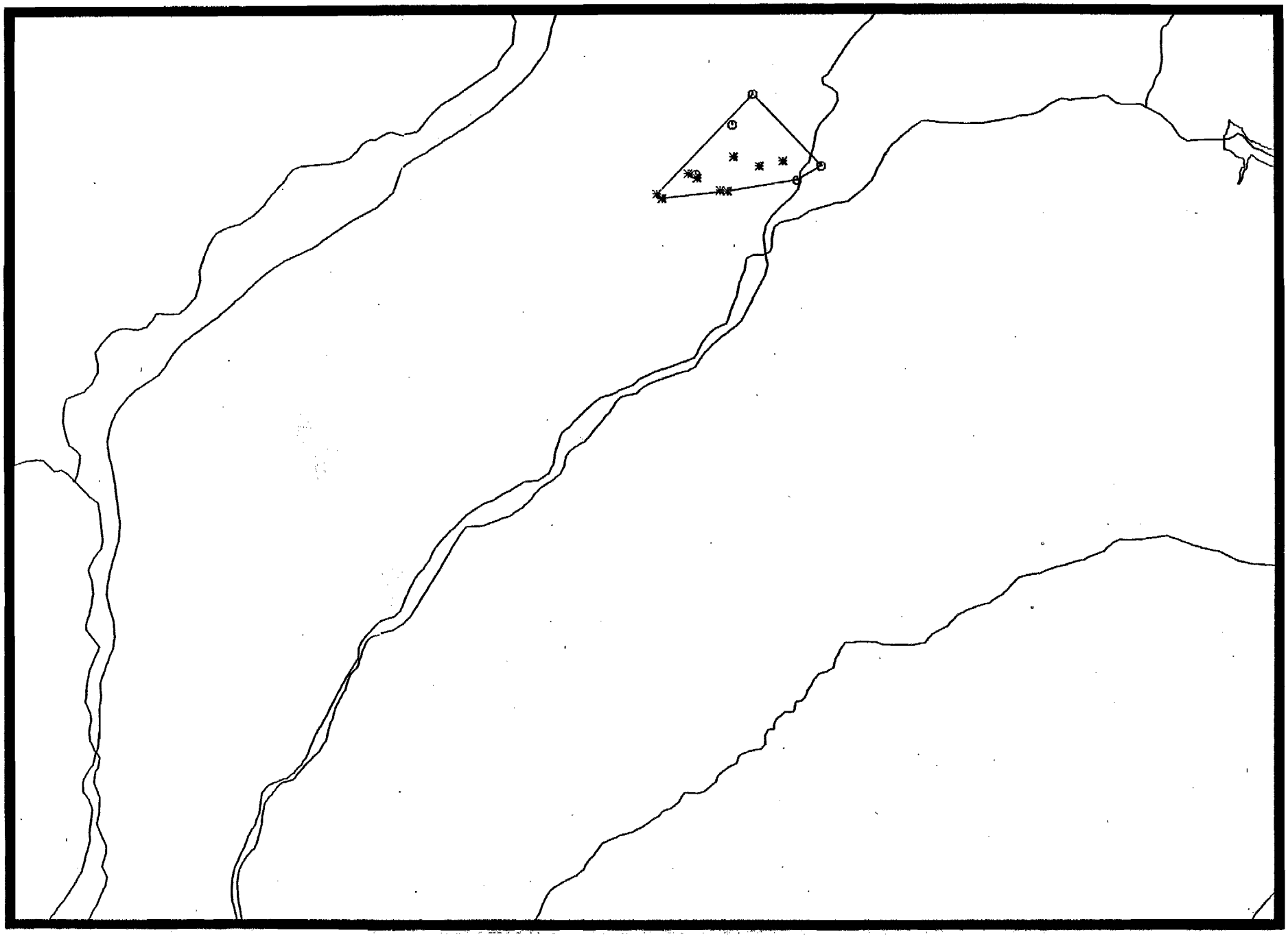

Figure 7. 1982 home range of B370, 14 points. (1 cm = 2.3 km)

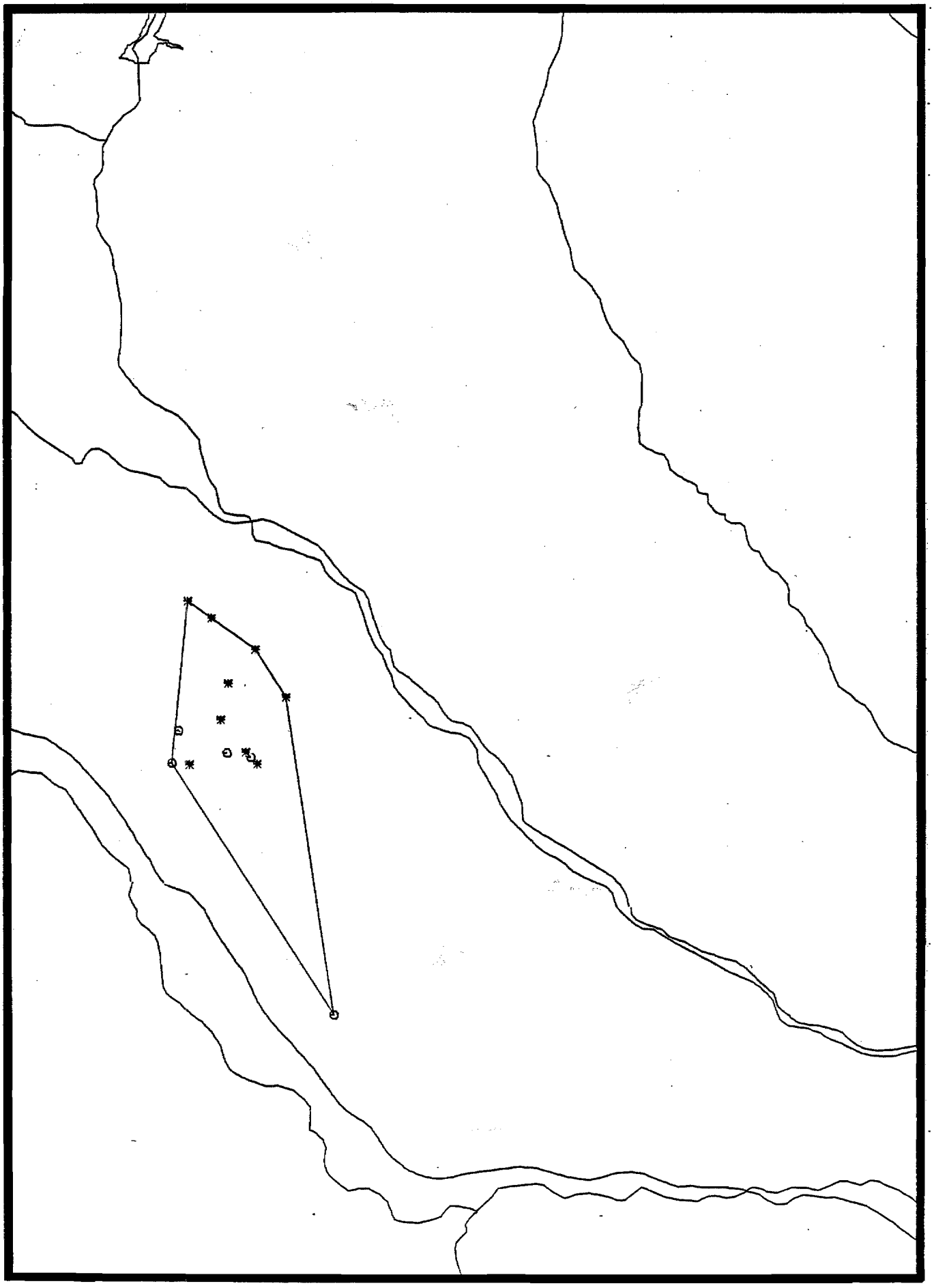

Figure 8. 1982 home range of B372, 14 points. (1 cm = 2.3 km)

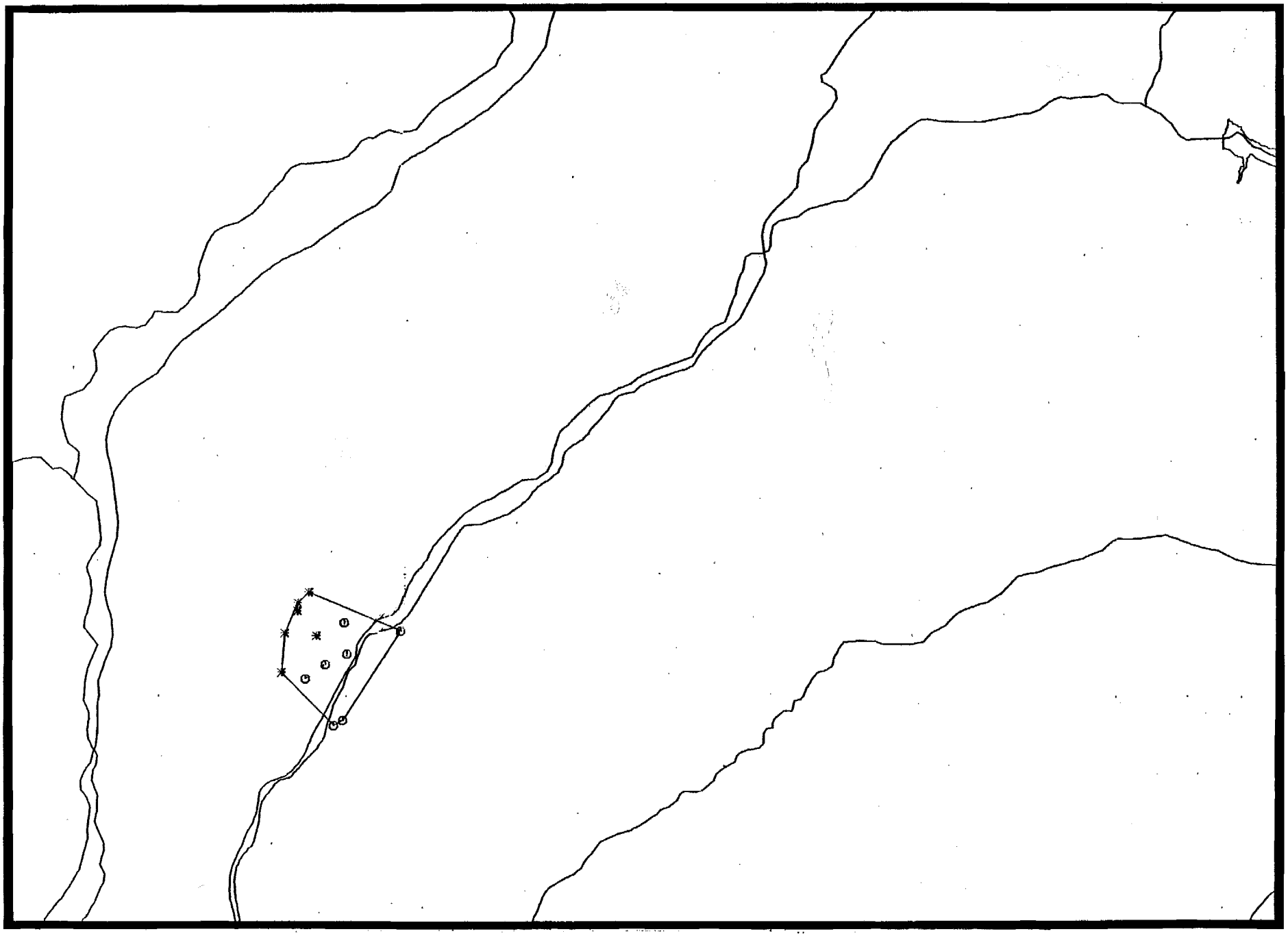

Figure 9. 1982 home range of B375, 13 points. (1 cm = 2.3 km)

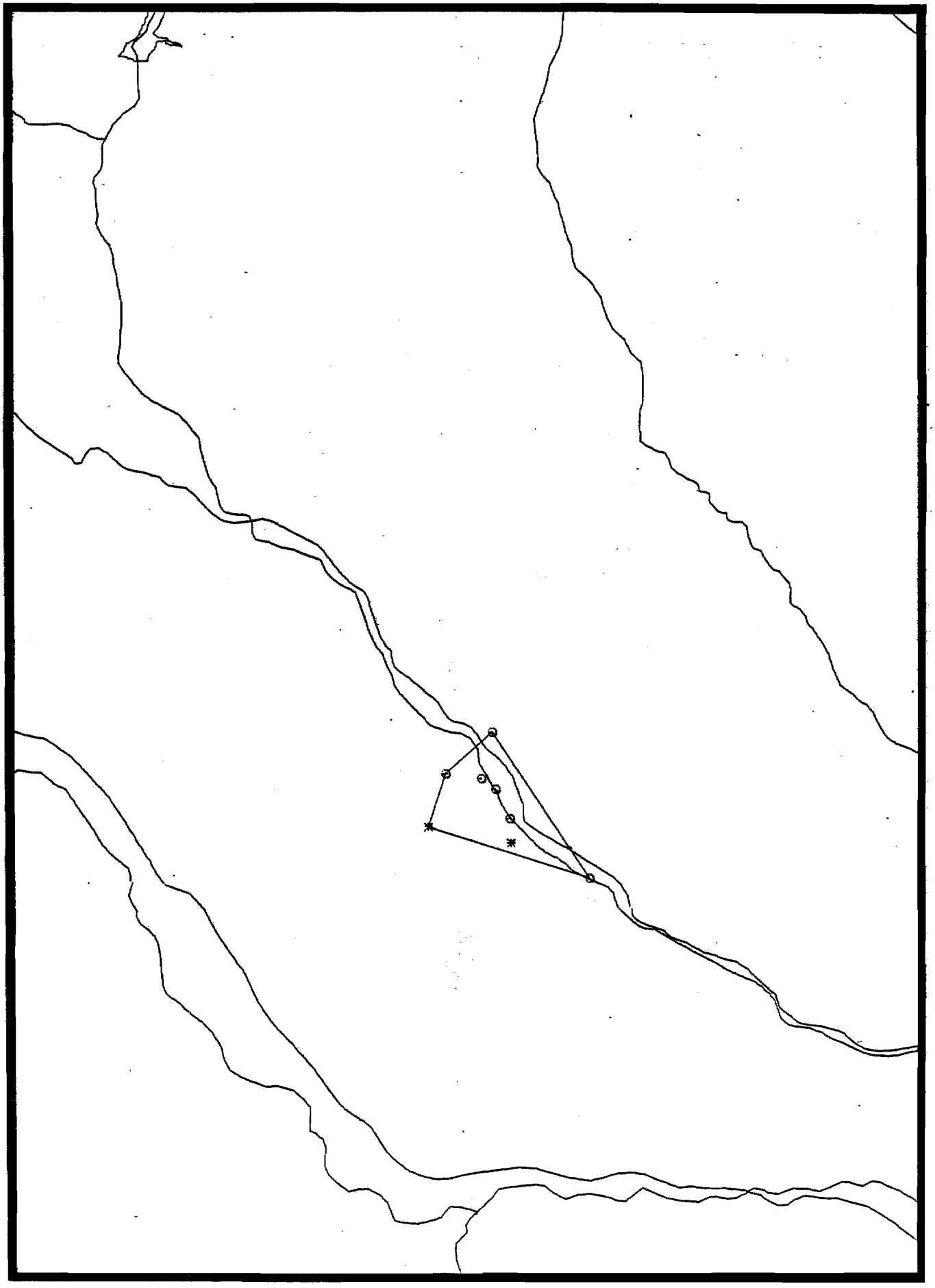

Figure 10. 1982 home range of B376, 8 points. (1 cm = 2.3 km)

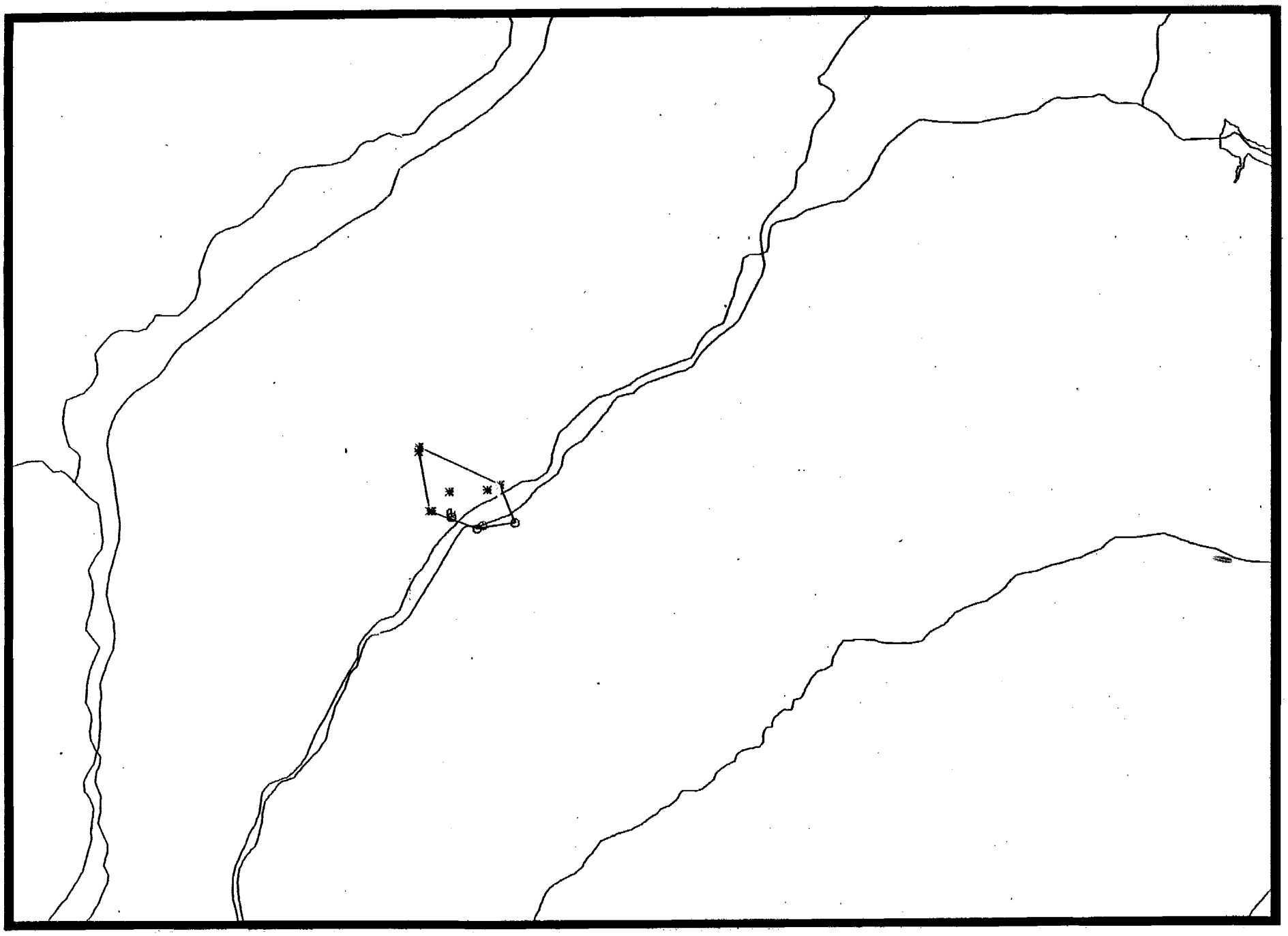

Figure 11. 1982 home range of B377, 12 points. (1 cm = 2.3 km)

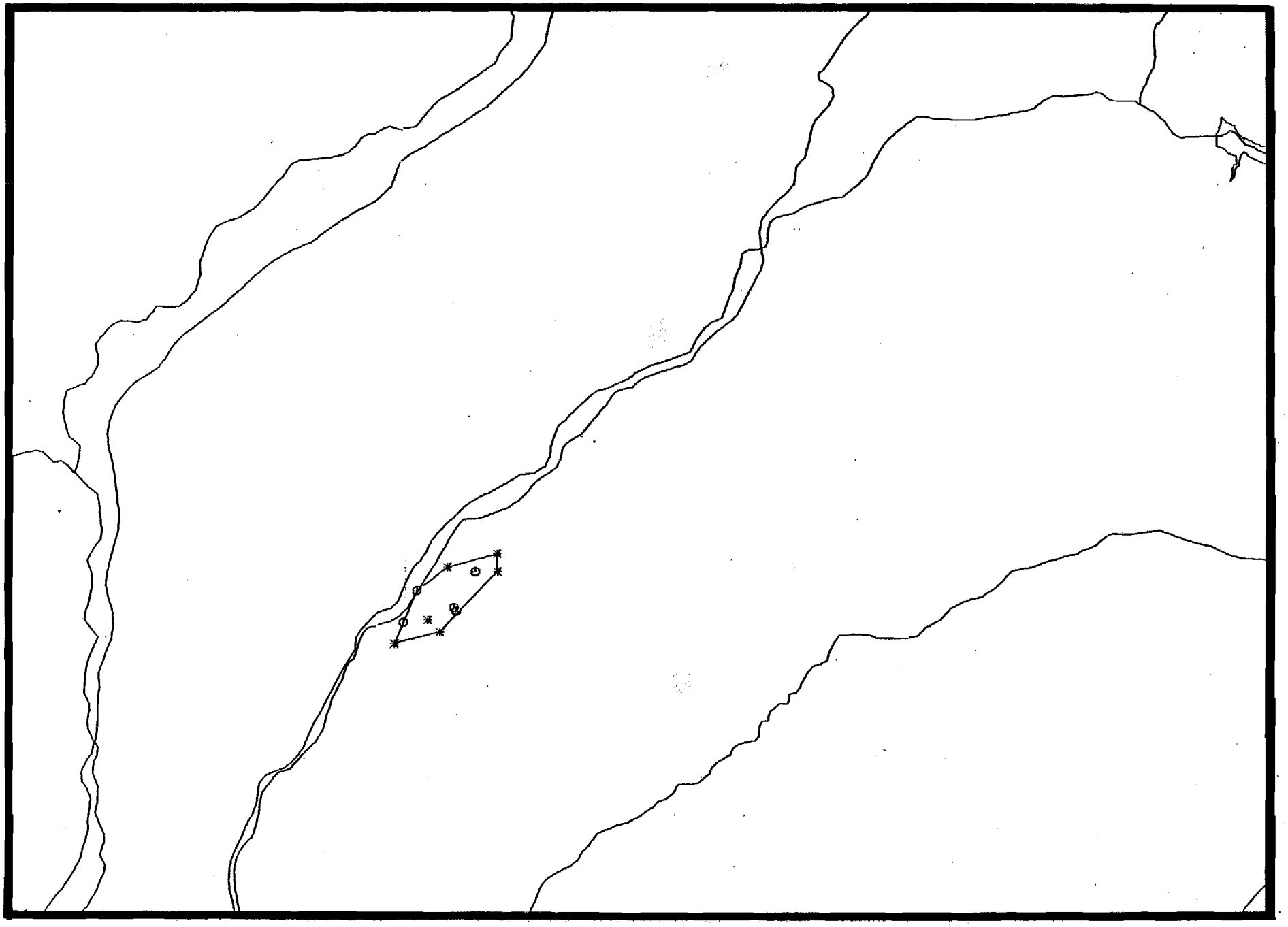

Figure 12. 1982 home range of B378, 11 points. (1 cm = 2.3 km)

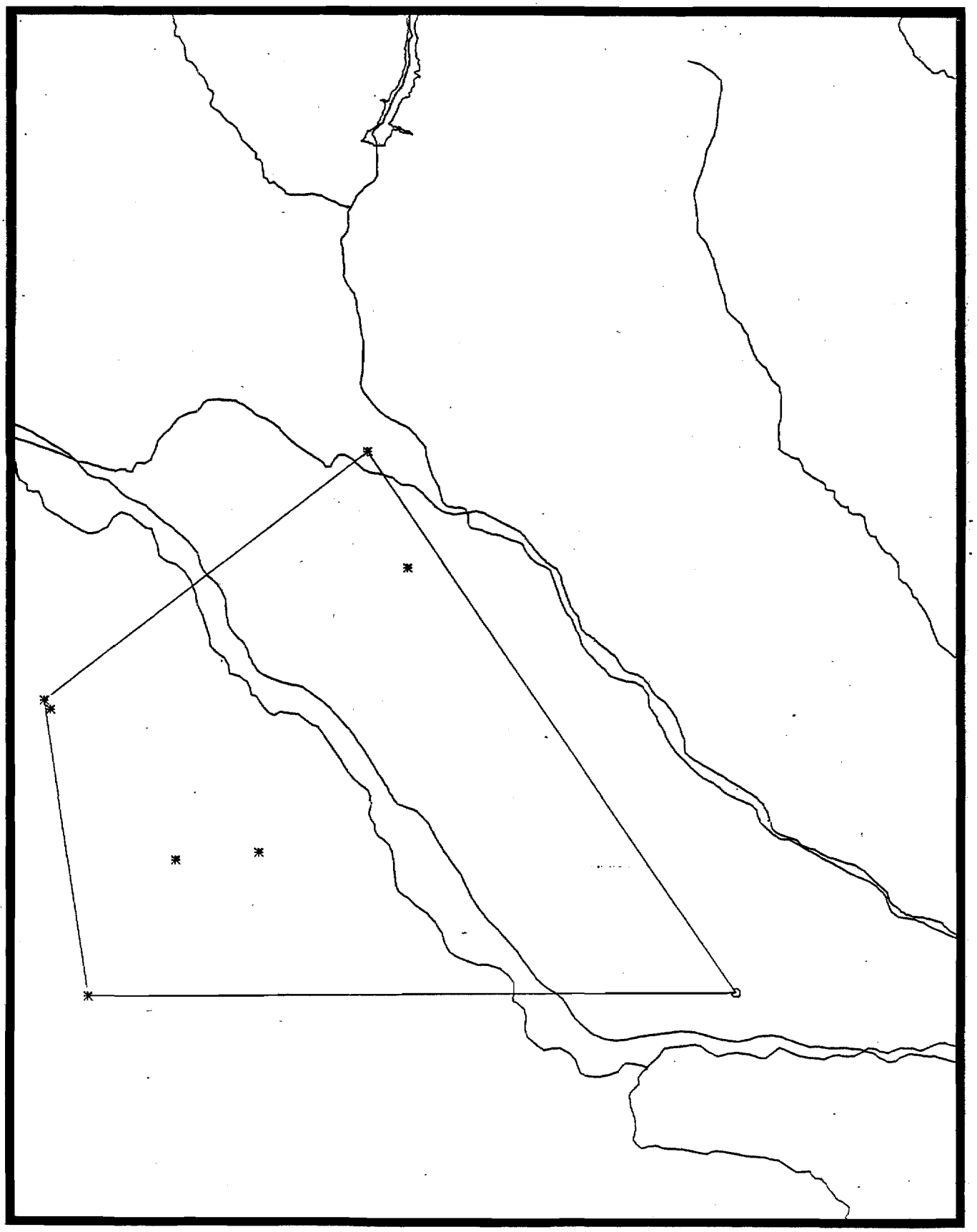

Figure 13. 1982 home range of B365, 8 points. (1 cm = 3 km)

Appendix 2 - Den entrance and emergence data, brown bears and black bears

Table A. Den entrance and emergence dates of radio-collared brown bears for the winter of 1980-81 ("S" is the standard deviation, but it includes variability from the fluctuating time between observations, as well as variability in denning times).

Bear ID	Sex	1980 Entrance			1981 Emergence			Days In Den		
		Min.	Max.	Mid.	Min.	Max.	Mid.	Min.	Max.	Mid.
280	M	13 Oct.	27 Oct.	20 Oct.	7 Apr.	21 Apr.	14 Apr.	162	190	176
281	F	13 Oct.	27 Oct.	20 Oct.	7 Apr.	21 Apr.	14 Apr.	162	190	176
283	F	9 Oct.	27 Oct.	18 Oct.	30 Apr.	5 May	2 May	185	208	197
294	M		27 Oct.		21 Apr.	30 Apr.	26 Apr.	176		
299	F	13 Oct.	27 Oct.	20 Oct.	7 Apr.	21 Apr.	14 Apr.	162	190	176
308	F	13 Oct.	27 Oct.	20 Oct.	30 Apr.	5 May	2 May	185	204	195
312	F	29 Sept.			30 Apr.	6 May	3 May			
313	F	9 Sept.	9 Oct.	24 Sept.	21 Apr.	24 Apr.	22 Apr.	194	207	200
277	F		27 Oct.							
	MEAN	6 Oct.	25 Oct.	15 Oct.	19 Apr.	28 Apr.	23 Apr.	175	198	187
	"S"	13	6	11	11	7	9	13	9	12
	n	7	8	6	8	8	8	7	6	6

Table B. Den entrance and emergence dates of radio-collared brown bears for the winter of 1981-82 ("S" is the standard deviation, but it includes variability from the fluctuating time between observations, as well as variability in denning times).

Bear ID	Sex	1981 Entrance			1982 Emergence			Days In Den		
		Min.	Max.	Mid.	Min.	Max.	Mid.	Min.	Max.	Mid.
280	M	22 Sept.	1 Oct.	27 Sept.	19 Apr.	6 May	28 Apr.	200	226	213
281	F	1 Oct.	7 Oct.	4 Oct.	6 May	12 May	9 May	211	223	217
283	F	1 Oct.	7 Oct.	4 Oct.	12 May	18 May	15 May	217	229	223
293	M	22 Sept.				1 Jun.				
299	F	1 Oct.	7 Oct.	4 Oct.	19 Apr.	6 May	28 Apr.	194	217	206
312	F	1 Oct.	16 Oct.	8 Oct.	12 May	18 May	15 May	208	229	218
313	F	7 Oct.	16 Oct.	12 Oct.	18 May	26 May	22 May	214	231	222
331	F	7 Oct.	16 Oct.	12 Oct.	6 May	12 May	9 May	202	217	210
335	F	1 Oct.	7 Oct.	4 Oct.	19 Apr.	6 May	28 Apr.	194	217	206
337	F	1 Oct.	7 Oct.	4 Oct.	18 May	26 May	22 May	223	237	230
340	F	7 Oct.	16 Oct.	12 Oct.	19 Apr.	6 May	28 Apr.	185	211	198
341	F	1 Oct.	7 Oct.	4 Oct.	12 May	18 May	15 May	217	229	223
342	M		30 Oct.		19 Apr.	4 May	26 Apr.			
344	F	7 Oct.	16 Oct.	12 Oct.	19 Apr.	6 May	28 Apr.	185	211	198
	MEAN	1 Oct.	12 Oct.	6 Oct.	1 May	14 May	7 May	204	223	214
	"S"	5	7	5	12	9	10	13	8	10
	n	13	13	11	13	14	13	12	12	12

Table C. Den entrance and emergence dates of radio-collared brown bears for the winter of 1982-83 ("S" is the standard deviation, but it includes variability from the fluctuating time between observations, as well as variability in denning times).

Bear ID	Sex	1982 Entrance			1983 Emergence			Days In Den		
		Min.	Max.	Mid.	Min.	Max.	Mid.	Min.	Max.	Mid.
280	M	6 Oct.	15 Oct.	10 Oct.						
281	F	6 Oct.	20 Oct.	13 Oct.						
283	F	6 Oct.	15 Oct.	10 Oct.						
299	F	6 Oct.	15 Oct.	10 Oct.						
312	F	6 Oct.	20 Oct.	13 Oct.						
313	F	15 Oct.	20 Oct.	18 Oct.						
335	F	20 Sept.	6 Oct.	28 Sept.						
337	F	20 Oct.	15 Nov.	2 Nov.						
340	F	6 Oct.	15 Nov.	26 Oct.						
344	F	20 Oct.	15 Nov.	2 Nov.						
282	M	20 Oct.	15 Nov.	2 Nov.						
379	F	20 Oct.	17 Nov.	4 Nov.						
381	F	6 Oct.	15 Oct.	10 Oct.						
	MEAN	12 Oct.	28 Oct.	19 Oct.						
	"S"	7	16	12						
	n	13	13	13						

Table D. Probabilities that annual den emergence or entrance dates were different for individual radio-collared brown bears from 1980 through 1982. The numbers are probabilities calculated by taking the number of days by which the entrance (or emergence) period from the later year did not overlap the corresponding period from the earlier year, and dividing by the number of days in the period of the later year. A value of 1.0 indicates no overlap, a value of 0 indicates no apparent difference. "-" indicates no comparison was made because of insufficient data.

			Entrance						Emergence	
			1980 vs 1981		1981 vs 1982		1980 vs 1982		1981 vs 1982	
	Bear ID	1980 Age	Earlier	Later	Earlier	Later	Earlier	Later	Earlier	Later
Males										
	280	5	1.0			1.0	0.8			0.9
Females										
	335	1	-		0.7		-		-	
	340	2	-			0.8	-		-	
	281	3	1.0			0.9	0.5			1.0
	344	4	-			1.0	-		-	
	313	9		0.8		0.8 *2		1.0		1.0 *5 *6
	312	10	-			0.3 *4	-			1.0 *5 *7
	283	12	1.0	*1		0.9	0.3			1.0 *5 *7
	337	12	-			1.0 *4	-		-	
	299	13	1.0	*3		0.9	0.8			0.9 *6

*1 Entered 1981 den with cub(s).
*2 Entered 1982 den with cub(s).
*3 Entered 1980 den with yearling(s).
*4 Entered 1982 den with yearling(s).
*5 Emerged in 1981 with cub(s).
*6 Emerged in 1982 with cub(s).
*7 Emerged in 1982 with yearling(s).

Table E. Mean den entrance and emergence dates of male and female brown bears. ("S" is the standard deviation, but it includes variability from the fluctuating time between observations, as well as variability in denning times).

			Female			Male		
			mean	"S"	n	mean	"S"	n
1980	Entrance	Minimum	4 Oct.	14	6	13 Oct.	N/A	1
		Maximum	24 Oct.	7	6	27 Oct.	0	2
		Mid point	14 Oct.	12	5	20 Oct.	N/A	1
1981	Emergence	Minimum	21 Apr.	11	6	14 Apr.	10	2
		Maximum	29 Apr.	7	6	26 Apr.	6	2
		Mid point	24 Apr.	9	6	20 Apr.	8	2
1981	Entrance	Minimum	3 Oct.	3	11	22 Sept.	0	2
		Maximum	11 Oct.	5	11	16 Oct.	21	2
		Mid point	7 Oct.	4	11	27 Sept.	N/A	1
1982	Emergence	Minimum	3 May	12	11	19 Apr.	0	2
		Maximum	14 May	8	11	14 May	16	3
		Mid point	9 May	10	11	27 Apr.	1	2
1982	Entrance	Minimum	9 Oct.	9	11	13 Oct.	10	2
		Maximum	27 Oct.	16	11	30 Oct.	22	2
		Mid point	18 Oct.	12	11	22 Oct.	16	2

Table F. Den entrance and emergence dates of radio-collared black bears for the winter of 1980-81 ("S" is the standard deviation, but it includes variability from the fluctuating time between observations, as well as variability in denning times).

Bear ID	Sex	1980 Entrance			1981 Emergence			Days In Den		
		Min.	Max.	Mid.	Min.	Max.	Mid.	Min.	Max.	Mid.
287	M	9 Sept.	29 Sept.	19 Sept.	30 Apr.	5 May	2 May	213	238	212
289	F	9 Sept.	29 Sept.	19 Sept.	5 May	15 May	10 May	221	248	235
290	F	1 Oct.	9 Oct.	5 Oct.	5 May	10 May	8 May	208	221	215
301	F	29 Sept.	13 Oct.	6 Oct.	9 May	29 May	19 May	208	242	225
303	M				30 Apr.	5 May	2 May			
304	M				5 May	10 May	8 May			
317	F	9 Sept.	29 Sept.	19 Sept.	5 May	15 May	10 May	218	248	233
318	F	29 Sept.	13 Oct.	6 Oct.	30 Apr.	5 May	2 May	199	218	209
319	M	29 Sept.	13 Oct.	6 Oct.	30 Apr.	5 May	2 May	199	218	209
321	F	9 Sept.	29 Sept.	19 Sept.	10 May	15 May	12 May	223	248	236
322	M	9 Sept.	13 Oct.	26 Sept.						
323	M	29 Sept.	13 Oct.	6 Oct.	6 May	8 May	7 May	205	228	217
324	M	29 Sept.	13 Oct.	6 Oct.	30 Apr.	5 May	2 May	199	218	209
325	F	29 Sept.	9 Oct.	4 Oct.						
327	F	9 Sept.	29 Sept.	19 Sept.	8 May	10 May	9 May	221	243	232
328	F	9 Sept.	29 Sept.	19 Sept.	21 May	29 May	25 May	234	262	248
	MALES	19 Sept.	6 Oct.	28 Sept.	5 May	12 May	8 May	212	236	223
	"S"	11	7	8	6	8	7	11	15	13
	n	14	14	14	14	14	14	12	12	12

Table G. Den entrance and emergence dates of radio-collared black bears for the winter of 1981-82 ("S" is the standard deviation, but it includes variability from the fluctuating time between observations, as well as variability in denning times).

Bear ID	Sex	1981 Entrance			1982 Emergence			Days In Den		
		Min.	Max.	Mid.	Min.	Max.	Mid.	Min.	Max.	Mid.
287	M	24 Aug.	9 Sept.	9 Sept.	4 May	6 May	5 May	237	255	246
289	F	23 Sept.	1 Oct.	28 Sept.	12 May	18 May	15 May	223	237	230
301	F	16 Sept.	22 Sept.	19 Sept.	6 May	18 May	12 May	226	244	235
302	M	16 Sept.	22 Sept.	19 Sept.	?	6 May	6 May*		232	229
303	M	16 Sept.	22 Sept.	19 Sept.	12 May	18 May	15 May	232	244	238
304	M	16 Sept.	1 Oct.	24 Sept.	6 May	12 May	9 May	217	238	228
317	F	9 Sept.	16 Sept.	12 Sept.	12 May	18 May	15 May	238	251	244
318	F	16 Sept.	22 Sept.	19 Sept.	18 May	26 May	22 May	238	252	245
321	F	16 Sept.	22 Sept.	19 Sept.	6 May	12 May	9 May	226	238	232
323	M	22 Sept.	1 Oct.	27 Sept.	6 May	12 May	9 May	217	232	224
324	M	1 Oct.	7 Oct.	4 Oct.	4 May	6 May	5 May	209	217	213
327	F	16 Sept.	22 Sept.	19 Sept.	12 May	18 May	15 May	232	244	238
329	M	22 Sept.	1 Oct.	27 Sept.	12 May	18 May	15 May	223	238	230
343	M	16 Sept.	22 Sept.	19 Sept.	12 May	18 May	15 May	232	244	238
346	M	9 Sept.	16 Sept.	12 Sept.	?	6 May	6 May*		239	236
348	M	16 Sept.	22 Sept.	19 Sept	4 May	6 May	5 May	224	232	228
349	F	9 Sept.	16 Sept.	12 Sept.	?	6 May	6 May*		239	236
325	F	9 Sept.	16 Sept.	12 Sept.						
328	F	16 Sept.	22 Sept.	19 Sept.						
	MEAN	15 Sept.	23 Sept.	19 Sept.	9 May	13 May	11 May	227	240	234
	"S"	8	7	6	4	6	5	9	9	8
	n	19	19	19	14	17	17	14	17	17

* Dates were designated from a point value rather than a time period, because a more accurate mean emergence date was produced.

Table H. Den entrance and emergence dates of radio-collared black bears for the winter of 1982-83 ("S" is the standard deviation, but it includes variability from the fluctuating time between observations, as well as variability in denning times).

Bear ID	Sex	1982 Entrance			1983 Emergence			Days In Den		
		Min.	Max.	Mid.	Min.	Max.	Mid.	Min.	Max.	Mid.
289	F	28 Sept.	6 Oct.	2 Oct.						
303	F	29 Sept.	20 Oct.	10 Oct.						
317	F	20 Sept.	29 Sept.	24 Sept.						
318	F	6 Oct.	15 Oct.	10 Oct.						
321	F	20 Sept.	29 Sept.	24 Sept.						
323	M	6 Oct.	15 Oct.	10 Oct.						
324	M	29 Sept.	6 Oct.	2 Oct.						
327	F	6 Oct.	15 Oct.	10 Oct.						
329	F	29 Sept.	6 Oct.	2 Oct.						
343	M	6 Oct.	20 Oct.	13 Oct.						
346	M	6 Oct.	15 Oct.	10 Oct.						
349	F	29 Sept.	6 Oct.	2 Oct.						
354	F	6 Oct.	15 Oct.	10 Oct.						
357	M	6 Oct.	15 Oct.	10 Oct.						
358	M	29 Sept.	6 Oct.	2 Oct.						
359	M	6 Oct.	15 Oct.	10 Oct.						
360	M	6 Oct.	15 Oct.	10 Oct.						
361	F	6 Oct.	15 Oct.	10 Oct.						
363	F	6 Oct.	15 Oct.	10 Oct.						
365	M	6 Oct.	20 Oct.	13 Oct.						
367	F	6 Oct.	15 Oct.	10 Oct.						
369	F	6 Oct.	15 Oct.	10 Oct.						
370	F	6 Oct.	15 Oct.	10 Oct.						
372	F	29 Sept.	6 Oct.	2 Oct.						
375	F	29 Sept.	6 Oct.	2 Oct.						
376	F	6 Oct.	15 Oct.	10 Oct.						
377	F	29 Sept.	6 Oct.	2 Oct.						
378	F	20 Sept.	29 Sept.	24 Sept.						
	MEAN	2 Oct.	11 Oct.	6 Oct.						
	"S"	5	6	6						
	n	28	28	28						

Table I. Probabilities that annual den emergence or entrance dates were different for individual radio-collared black bears from 1980 through 1982. The numbers are probabilities calculated by taking the number of days by which the entrance (or emergence) period from the later year did not overlap the corresponding period from the earlier year, and dividing by the number of days in the period of the later year. A value of 1.0 indicates no overlap, a value of 0 indicates no apparent difference. "-" indicates no comparison was made because of insufficient data.

			Entrance						Emergence	
			1980 vs 1981		1981 vs 1982		1980 vs 1982		1981 vs 1982	
	Bear ID	1980 Age	Earlier	Later	Earlier	Later	Earlier	Later	Earlier	Later
Males										
	323	2	0.8			1.0		0.2		0.7
	343	4	-			1.0	-		-	
	324	5	0.0		0.3		0.0			0.5
	303	8	-			1.0	-			1.0
	346	8	-			1.0	-		-	
	287	10	1.0		-		-			0.5
	304	10	-		-		-			0.3
Females										
	349	3	-			1.0	-		-	
	318	5	1.0	*		1.0		0.2		1.0
	327	5	0.0	*		1.0		1.0		1.0
	328	6	0.0	**	-		-		-	***
	301	7	1.0	**	-		-		0.2	***
	317	7	0.0	*		1.0	0.0			0.5
	289	9		0.2 **		0.6		0.9		0.5***
	321	10	0.0			0.8	0.0		0.7	
	325	11	1.0		-		-		-	

* Entered den in 1980 with cub(s).
** Entered den in 1981 with cub(s).
*** Emerged from den in 1981 with cubs.

Table J. Mean den entrance and emergence dates of male and female black bears. ("S" is the standard deviation, but it includes variability from the fluctuating time between observations, as well as variability in denning times).

			Female			Male		
			mean	"S"	n	mean	"S"	n
1980	Entrance	Minimum	18 Sept.	11	9	21 Sept.	11	5
		Maximum	4 Oct.	6	9	9 Oct.	7	5
		Mid point	26 Sept.	9	9	1 Oct.	8	5
1981	Emergence	Minimum	8 May	6	8	2 May	3	5
		Maximum	16 May	9	8	6 May	2	6
		Mid point	12 May	7	8	4 May	3	6
1981	Entrance	Minimum	15 Sept.	5	10	15 Sept.*	10	9
		Maximum	22 Sept.	5	10	24 Sept.	8	9
		Mid point	19 Sept.	6	10	19 Sept.	9	9
1982	Emergence	Minimum	11 May	4	7	7 May	4	7
		Maximum	17 May	6	8	10 May	5	9
		Mid point	14 May	5	8	8 May	4	9
1982	Entrance	Minimum	1 Oct.	6	19	4 Oct.	3	9
		Maximum	10 Oct.	7	19	14 Oct.	5	9
		Mid point	5 Oct.	6	19	9 Oct.	4	9

* Bear number 287 entered its den very early between 24 August and 9 September.