ALASKA DEPARTMENT OF FISH AND GAME

JUNEAU, ALASKA

BLACK BEAR MANAGEMENT TECHNIQUES DEVELOPMENT

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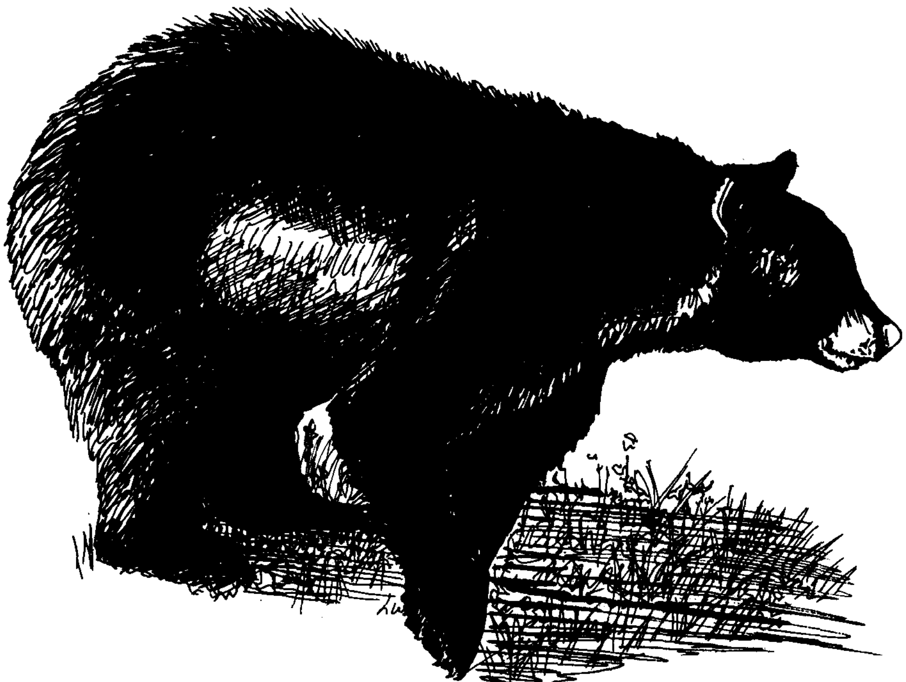

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Questions are raised regarding the interpretations of sex and age data gathered from the skull sealing program.

Simple models are used to simulate densities and harvest rates for populations of black bears in GMU 6. Hypotheses are put forth to explain observed sex and age composition of the harvest sample and of the live captured sample.

In May 1977, 18 parties of black bear hunters (53 individuals) responded to a questionniare survey conducted in Whittier, Alaska. These data indicate where people went, what they did, how many saw bears, how many bears were seen, where the bears were seen etc. It was estimated that $1,486 was spent for each black bear killed.

CONTENTS

BACKGROUND

Widely distributed and apparently abundant, black bears (*Ursus americanus*) provide a full spectrum of recreational opportunities for people throughout most of Alaska. Statewide harvest data and personal communications appear to indicate that black bears are rapidly becoming an important "primary" game species, in addition to being a "secondary" species taken incidental to the hunting of other game animals. The increase in harvest can be attributed, in part, to a greater number of hunters, a decrease in the availability of other big game species, promotional efforts of guides or air taxi operators, and perhaps the realization by many hunters that black bears provide aesthetically pleasing hunts, a respectable trophy and very flavorful meat.

Although recreational use of black bears has increased greatly in recent years, present knowledge about the biology and population ecology of this species in Alaska is still limited. Noteworthy published material on black bears in Alaska include studies by: Rausch (1961) on dentition and growth, Erickson (1965) on general life history, Hatler (1967 and 1972) on food habits, McIlroy (1970 and 1972) on ecology and hunter harvest and Frame (1974) on predation of salmon. A black bear hide and skull sealing program, initiated in many Game Management Units (GMUs) in July 1973 by the Alaska Department of Fish and Game, has provided a bank of data on characteristics of the sport harvest and the bears harvested.

In recent years, there has been a general increase in hunting pressure on black bears throughout the state. Populations in Prince

William Sound, in particular, have experienced a tremendous increase in hunting pressure and harvest and presently deserve close scrutiny. The number of black bears killed (including those killed in defense of life or property) in Prince William Sound (GMU 6) increased by nearly 50 percent from 1974 (108) to 1975 (151), remained elevated through 1976 (162) and then decreased slightly in 1977 (108) (Appendix A). Most of the increase in the kill can be attributed to sport hunting during the spring season (81, 135, 108, and 103 bears killed for 1974 through 1977, respectively) (Appendix B).

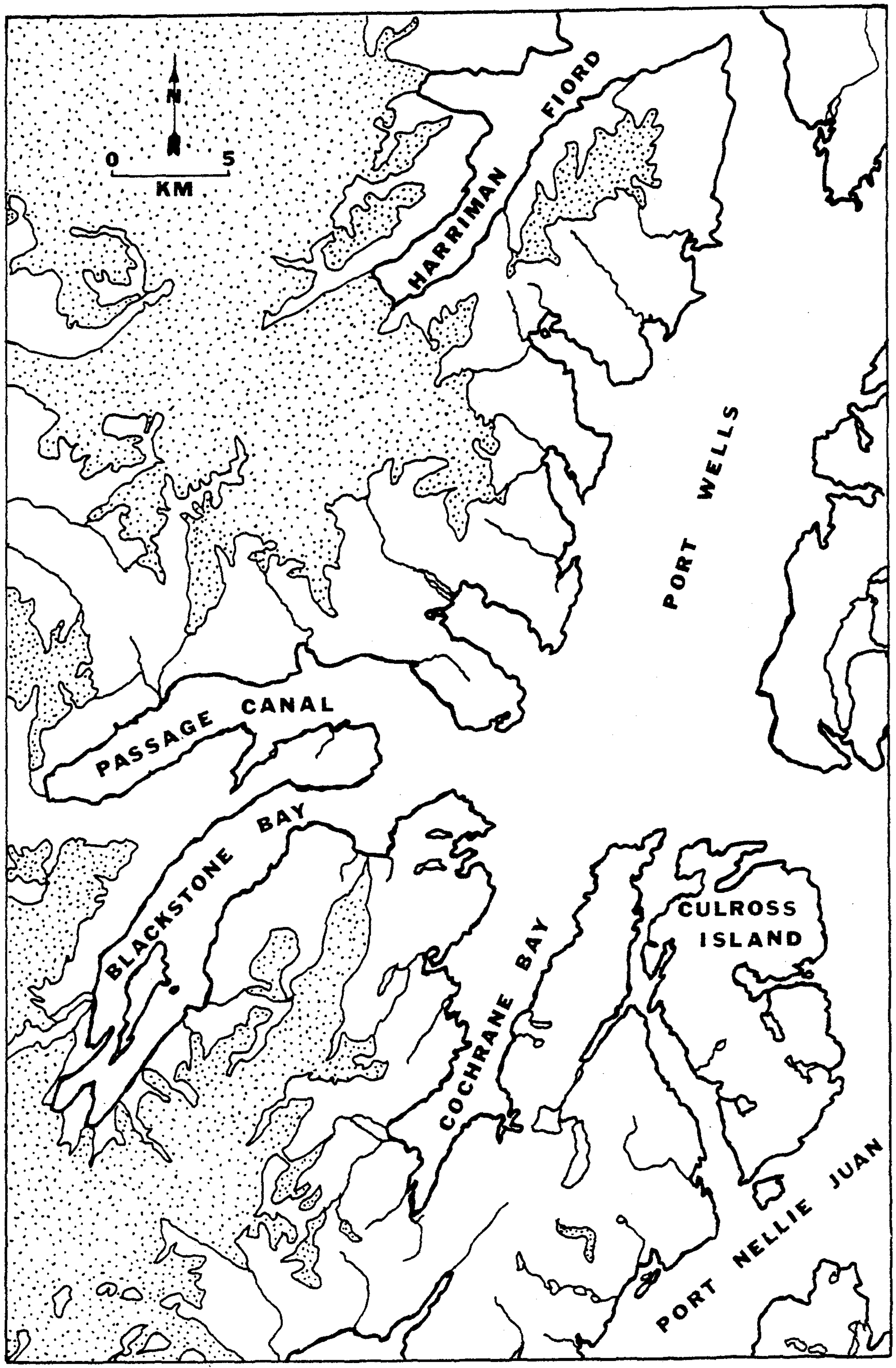
Along with the projected increase in the human populations of Anchorage, Whittier, Valdez, Cordova and Seward, a parallel increase in the sport hunting and harvest of black bears in Prince William Sound can be expected.

Populations of black bears in western Prince William Sound are vulnerable to exploitation for ecological and behavioral reasons. In this area, habitable terrain is limited in depth (remoteness) by extensive snow fields and glaciers and is finely divided into small units by numerous narrow fiords and bays (Fig. 1). Because of the configuration of this habitat and the excellent accessibility afforded hunters by waterways, the farthest a bear can be from a point of access is about 10 km and in most instances this distance is less than 2 km. Even individuals that can be found in most remote portions of available habitat are probably vulnerable at some time during the hunting season, considering that home range sizes of 25 and 80 km^2, respectively, are not unreasonable for female and male black bears (Amstrup and Beecham 1976).

In spring, when black bears leave their hibernacula and move to the snowfree beach fringe areas and avalanche slopes to feed on newly growing vegetation, they are readily visible and extremely vulnerable to hunting. During this period, from mid May to mid June, even bears which normally inhabit the more remote areas may be vulnerable to hunters.

Under these circumstances, essentially the entire area and each bear may be vulnerable to hunting at sometime during the year. Existence of inaccessible and spatially protected segments of the population, which might theoretically function as nuclei for repopulation, appears to be a physical impossibility. Burton (1975) presented circumstantial evidence that an essentially unhunted area, adjacent to a heavily hunted area, functioned as a reservoir from which individuals emigrated to the latter area. Recruitment to the hunted population was mostly attributable to immigration rather than to reproduction by the resident population of bears. Kordek (pers. comm.) believed that such reservoirs were important factors in maintaining the integrity of hunted populations of bears in Pennsylvania. Though obviously not vital to the survival of hunted bear populations, the existence of "emigration reservoirs" can mask actual resilience of bear populations and harvest rates that appear conservative for one population but may in reality be excessive for another apparently similar population.

Fig. 1. Location and extent of glaciers (stippled areas) in western Prince William Sound, Alaska.



In this physical environment, not only may individual bears be vulnerable, but entire populations may also be relatively vulnerable to hunting. Since glaciers, extensive snowfields and large bodies of water divide the northwestern portion of Prince William Sound into many "discrete and complete" ecological units, there may be numerous non-interacting subpopulations of bears in this particular geographical area. It is conceivable that intense hunting pressure and harvest could actually eliminate any such subpopulation.

Because of the anticipated increase in recreational use of the black bear resource, the "limited" and highly accessible nature of the habitat, behavior responsible for extensive movements and seasonal concentrations in open and readily accessible habitat, and the likelihood for distinct subpopulations of bears, there is an immediate need for intensive biological research and perhaps a more restrictive management program for black bears in Prince William Sound.

Ultimate goals of this study will be to provide general information on the basic life history of black bears in Prince William Sound and specific information on population identity, movements, habitat use and population size, production and composition of black bears inhabiting the northwestern portion of Prince William Sound. The most desirable and efficient method of obtaining these data is through a radio telemetry study.

Evaluation and development of equipment and techniques for capturing and handling bears in the Prince William Sound were all prerequisites for a comprehensive field research program and will contribute to basic knowledge on life history and demography of the species.

The Aldrich foot snare has been successfully used to capture black bears in a number of studies (Miller et al. 1970, Jonkel and Cowan 1971, and Poelker and Hartwell 1973), and it was used for capturing brown bears (*Ursus arctos*) in Southeastern Alaska (Wood 1973). Initially Job 17.1R was designed to determine the feasibility of this method for capturing black bears in northwest Prince William Sound. This final report presents the results of research conducted under Job 17.1R and appropriate findings of studies conducted during the period July 1, 1977 through June 30, 1978 under Job 17.2R (Black Bear Movements and Home Range). Additional findings from Job 17.2 will be reported in a subsequent progress report for that job.

OBJECTIVES

To develop and evaluate techniques for monitoring the status of black bear populations and for determining the effects of hunting on selected populations of black bears in Southcentral Alaska.

PROCEDURES

Streams in western Prince William Sound, that in the past have contained good numbers of spawning pink (*Onchorhynchus gorbuscha*) and/or dog (*O. keta*) salmon, were visited frequently throughout July to determine when bears were in these areas feeding on salmon and when to commence trapping activities. An outboard motor powered skiff was used for transportation to and between different trapping areas.

Aldrich spring-activated foot snares were set as trail sets in freshly used bear trails found along the streams that contain spawning salmon.

Twenty-four bears captured in foot snares were immobilized with Sernylan, measured for standard body parameters, weighed with a spring scale, tattooed on the upper lip, and marked with numbered roto tags and colored flagging on the ears. A premolar tooth was extracted and a sample of blood was taken.

Fourteen of the bears captured were fitted with radio collars and were radio-relocated from a skiff during the summer and from a light, fixed-wing aircraft (PA-18) through the fall until the time of denning. In 1977 we worked in a smaller "discrete" study area and all of the bears captured were fitted with radio collars.

Methods for collecting and recording data on black bear skull and hide sealing certificates were reviewed and clarified. A portion of the information gathered from the skull and hide sealing program (1974-76) was summarized in written form and presented at a black bear workshop held at Kalispell, Montana.

The computerized data file was updated with information from revised and newly submitted black bear sealing certificates, and ages of bears from GMU 6 as determined from stained, thin sections of premolar teeth were entered into the file.

Data gathered from black bears killed in GMU 6 1974-77 were summarized and analyzed by sex and age composition and by season, year and subunit. These data were incorporated into a simple population model.

The ecological and management implications of harvest data were evaluated.

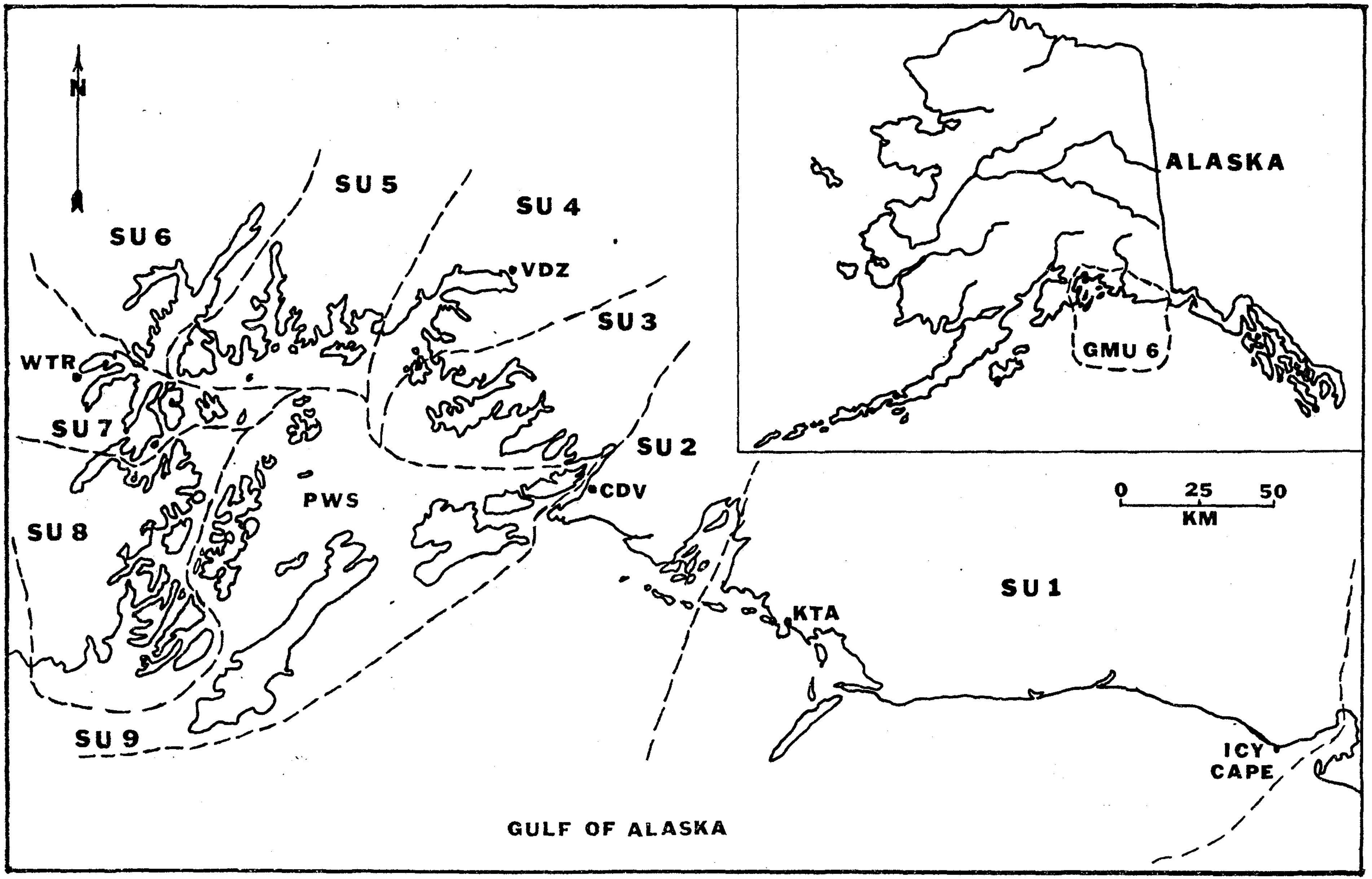
A questionnaire survey of black bear hunters was conducted in Whittier, Alaska to measure various parameters regarding the hunting of black bears in spring in Western Prince William Sound.

Literature on black bears was gathered and reviewed.

STUDY AREA

This study took place in a portion of GMU 6, in northwestern Prince William Sound, Southcentral Alaska (Fig. 2). GMU 6

Fig. 2. Location of Alaska's game management unit 6 (GMU 6) and its 9 constituent subunits (SU). (PWS = Prince William Sound, WTR = Whittier, VDZ = Valdez, CDV = Cordova and KTA = Katalla.



was divided into 9 geographical subunits to facilitate analysis of kill data and management of black bear populations (Fig. 2). Bears for which the kill location was not known were assigned to subunit 10.

Although all areas in Prince William Sound receive relatively heavy hunting pressure and harvest, it is evident that bear populations in the northwestern portion, being near Anchorage and the small boat harbor at Whittier, will undoubtedly experience the brunt of the continuing increase in demands on the resource in the future. For this reason, along with the fact that there are substantial populations of black bears in the area and numerous streams along which bears could be captured when they gather to feed on spawning salmon, this portion of the Sound was selected as a general study area.

Field activities in 1976 were primarily designed to provide familiarity with the study area and to test and perfect techniques for capturing and handling black bears in that general geographical area (Fig. 3).

In 1977, a small portion of this area was selected for intensive study (Fig. 4). The area selected, the Tebenkof Peninsula, has good numbers of bears, is readily accessible to hunters, has numerous salmon spawning streams where bears may be captured, is a somewhat discrete geographical unit because of glaciers and fiords, is convenient for conducting field activities because of its proximity to Whittier and is convenient for routine aerial radio tracking because of its proximity to Anchorage.

FINDINGS AND DISCUSSION

Methods for Capturing Black Bears

There are two general methods of capturing black bears: pursuit methods and trapping methods. Methods involving pursuit, as the name implies, are those where active pursuit results in a capture and those involving trapping are where activities of the bear itself results in a capture.

Each of these methods lends itself to a particular set of circumstances which depend on: the type of study, the goals of the study, the geographical location of the study, etc. Neither of the methods are mutually exclusive and in fact, a combination of both techniques is probably most desirable in any study.

For economic reasons, pursuit methods usually require that the animals be readily visible, relatively concentrated and easily approachable. Pursuit may be by foot (Wood 1973) or with the aid of mechanized equipment as by helicopter (Glenn 1971). One outstanding difference between pursuit and trapping is that in pursuit one can concentrate efforts on a particular individual or a group or class of individuals and avoid unneccessary harassment of previously captured or unwanted animals.

Fig. 3. Location of streams that contained spawning salmon during the 1974 survey (stars) and streams where trapping took place during 1976 and 1977 (abbreviations) in northwestern Prince William Sound, Alaska. (HL = Harrison Lagoon, PC = Pirate Cove, TW = Tebenkof West, TE = Tebenkof East, PK = Parks Creek and PL = Paulson Creek).

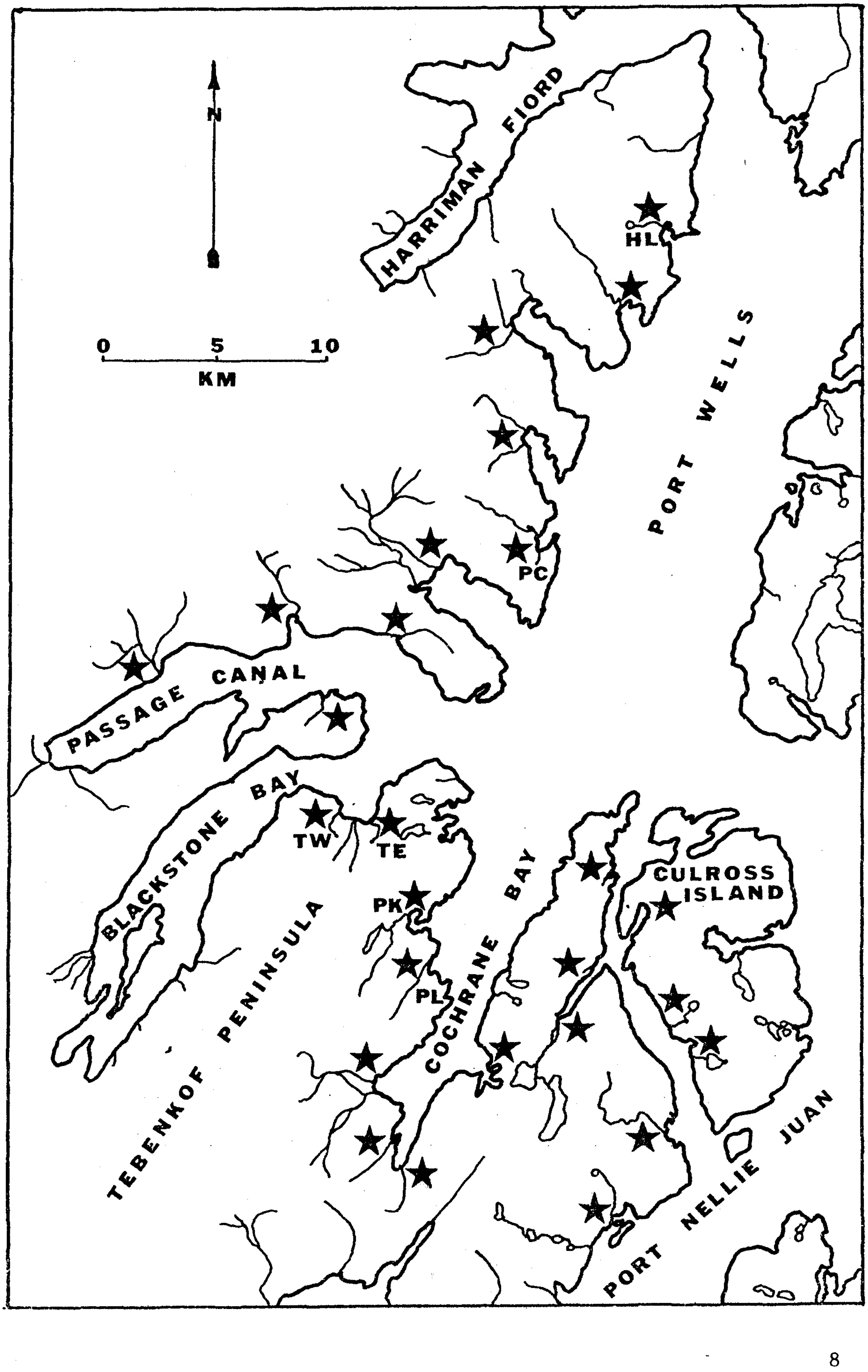
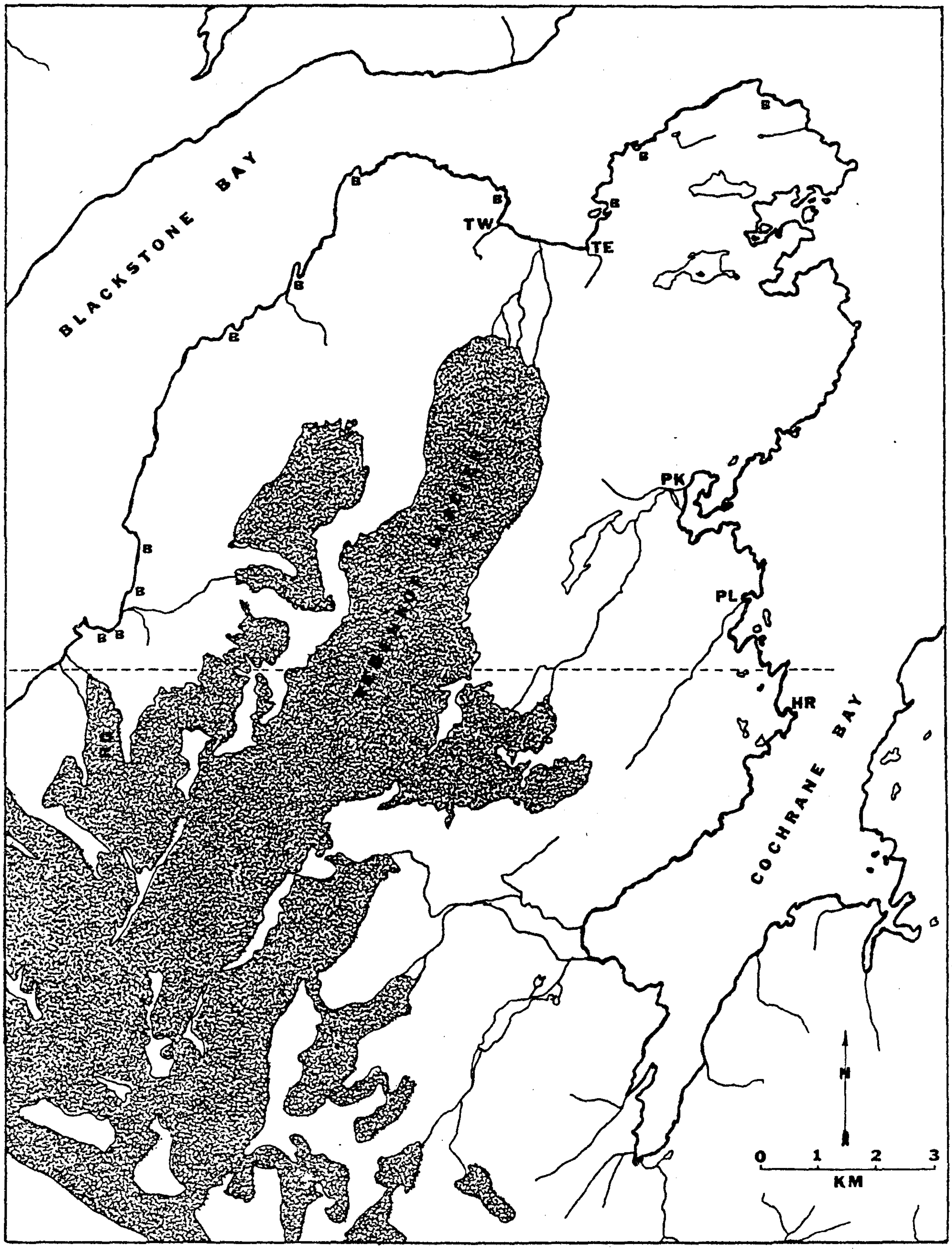


Fig. 4. Location of intensively studied area on Tebenkof Peninsula (north of dashed line) in northwestern Prince William Sound, Alaska. (B = location of baited sites and TW, TE, PK and PL = location of salmon spawning stream sites where trapping took place in 1977. RG = Ripon Glacier and HR = Horse. Darkened areas denote glaciers.)



Because of obvious constraints and the wariness of black bears, the only apparent instance when foot or ground pursuit may be practical is when bears are feeding on spawning salmon; an instance when "still pursuing" from a tree stand may be the most fruitful technique. In most all other pursuit circumstances, one would have to rely on mechanized equipment to get near a bear by utilizing the element of surprise, by pursuing and overtaking an individual or by pursuing and forcing the animal to be at bay; these techiniques would be affective in capturing bears in the spring when they concentrate near moose (*Alces alces*) calving areas or on avalanche slopes, in the summer when they concentrate along streams to feed on spawning salmon or in the fall when they concentrate in alpine areas to feed on berries. However, difficulties may be encountered with this technique when estimating the weight of a bear in order to decide on the proper dose of drug, the influence of pursuit on an animal's reaction to the drug and being able to locate and get to the animal when and where it becomes sedate. Differential use of habitat (open areas) by bears, or differential activity periods (nocturnal activity or activity in inclement weather) will influence the sample of individuals thus obtained.

The trapping method of capturing bears is not limited by visibility, density or approachability of the animals involved, nor is it greatly influenced by habitat type, activity periods or general weather patterns. There are two basic methods of trapping bears: one involves using something to attract (lure or bait) bears to a set (bait set), the other method involves placing the trap in a place likely to be used by a bear (blind or trail set); these methods may also be used in combination (a baited, trail set). Three basic types of traps have been used to live-capture bears: culvert traps, steel leg hold traps and spring-activated foot snares. Steel traps and foot snares can be used for either blind or bait sets, but culvert traps are primarily for use at bait sets.

Use of each type of trap has both advantages and disadvantages (Black 1958). Culvert traps inflict no injury but are expensive, heavy, not very portable and may be selective for smaller animals. When entering a culvert trap bears probably realize it is a strange object and the attraction of the bait must overcome their fears, but these circumstances may lead to biased samples and trap "shyness" or "happiness". Steel traps and foot snares can be used in either bait or blind sets and therefore have a greater chance of making recaptures or capturing shy animals. These types of traps can be anchored firmly or attached to a mobile drag which permits the trap to "set" firmly around the foot before becoming somewhat securely entangled. Whether traps are anchored firmly or attached to a drag, the probability of injury is greater with a steel trap than a foot snare simply because of the size of the extremity held; traps may hold an animal by only 1 or 2 toes whereas snares essentially always are around tarsal or carpal areas. Only very large steel traps (No. 150) can be used for equal effectiveness for all size classes of bears. If properly set, foot snares work as well on cubs as on large adults. Steel trap and foot snare sets should be checked at least once a day to insure against serious injuries.

Capturing Black Bears in western Prince William Sound

Black bears were captured in western Prince William Sound using trail set, spring-activated, foot snares. The snares were set in the well-used trails radiating from and paralleling streams containing spawning pink and/or dog salmon.

In summer 1974, a survey was made of all streams, in Passage Canal, Blackstone Bay, Cochrane Bay, Culross Passage and on the west side of Port Wells, known to harbor substantial quantities of spawning salmon. Each stream was appraised and subjectively rated for availability of fish, quantity of bear sign and desirability of trapping (Fig. 3). Some streams contained very few fish and no bear sign, in some streams the fish spawned too far from the mouth to be effectively trapped, near other streams there was too much recreational activity, others contained large numbers of salmon but had little sign of bears and some streams appeared ideal in all aspects. Several of these streams were selected for trapping in subsequent years.

In summer 1975 attempts at trapping were precluded because field observations indicated very low numbers of spawning salmon and very little activity of bears in areas proposed for the study. Indications, in late July 1975, were that the salmon runs in northwestern Prince William Sound would be later than usual and lesser in numbers. Reports in early August were that few salmon had arrived in the area but that the major portions of the runs should soon be entering the streams. A field trip on August 20-22, to inspect streams and surrounding areas and to trap bears indicated that the areas previously selected for trapping had very few salmon and that evidence of activity of bears was practically nonexistant. Because conditions were not suitable to carry out intended plans, field aspects of this part of the project were postponed for the year.

In July 1976, several field trips were made to each of the salmon spawning streams preselected in 1974, to monitor the quantity of spawning salmon available to bears and the amount and location of bear sign. Streams inspected included 26 of those draining into Passage Canal, Blackstone Bay, Cochrane Bay, Culross Passage and the western side of Port Wells north to Barry Arm (Fig. 3).

Although good runs of salmon were present in many of the streams examined as of July 20, sign of bear activity was apparent at only a few of the sites. It was decided that trapping should commence within a week and locations to be trapped would be the following: Harrison Lagoon (HL); Pirate Cove (PC); Tebenkof Glacier - westside stream (TW) and Paulson Creek (PL) (Fig. 3). While actively trapping in these four areas, inventories to appraise the potential of other areas for inclusion as active trapping sites continued and at the same time consideration was given to the additional time and daily work load required to tend all trap sites.

Frequent monitoring of all areas for the presence of bear sign led to trapping of the Tebenkof Glacier eastside stream (TE) on August 8 and, in part to the discontinuation of trapping at Pirate Cove and Harrison Lagoon. The primary reason for not trapping the latter area during the second trapping period was that inclement weather and resulting rough water prevented attempts to get there for four days. When these snares were tended, a captured bear had lacerations on the foreleg from the snare cable. To avoid similar occurences in the future, it was decided not to continue to trap these two remote locations.

Trapping commenced on July 28, continued for a period of 14 days and was again resumed on August 18 for an additional period of 11 days. During these periods, 15 captures and 1 recapture were made while trapping at the five different streams. A summary of the results of trapping is presented in Tables 1 and 2.

Because we recognized that the sample of bears captured at salmon spawning streams might not be representative of the live population, we made attempts in subsequent years to obtain another, but independent sample. In July 1977, an attempt was made to capture bears at baited foot snare sets before the bears had arrived at streams in search of spawning salmon. From July 18-29 a total of 130 trap nights were expended, attempting to capture bears at baited (salmon, jam and wolf call lure) sets (B) distributed along the coast from Blackstone Point to Ripon Glacier in Blackstone Bay. An additional 96 trap nights were utilized in similar sets along each of the Tebenkof Glacier east and west-side streams (Fig. 4). On July 24, 8 trail sets were added at the Tebenkof Glacier westside stream in response to recent signs of bears and on July 28, 3 more trail sets were added in the same area. On July 29, all but one of the coastal bait sets were removed (bait at one set had been disturbed) and on July 30 the remaining sets were deactivated.

Snaring at trail sets along salmon spawning streams was resumed from August 6-28 at the following four locations: Tebenkof Glacier - eastside (TE) and westside streams (TW), Parks Creek (PK) and Paulson Creek (PL). Three of these streams along which traps were set in 1977 had also been trapped in 1976. During July and August 1977, 14 different bears were captured in these four different locations; five of the bears captured had been previously captured in 1976. A summary of the results for trapping black bears during this period appears in Table 3.

Data in Tables 1-3, indicate several pertinent facts about snaring bears aloug salmon spawning streams. As experience in setting snares was gained, the efficiency ratio (number of snares sprung without capturing a bear : number of snares sprung with capturing a bear) decreased greatly. Many of the sprung snares can probably be attributed to the activities of mink (*Mustela vison*) and otter (*Lutra canadensis*), which also gather in these areas to feed on salmon. In several locations, these animals or signs of them were frequently observed.

Although it appears that success decreased from 1976 to 1977; these data are quite misleading. Usually six snares are sufficient to capture a bear once sign is observed in a particular area but many additional snares are set in prospective sites in the general area with the intent to capture bears visiting the stream for the first time. It is this

Table 1. Summary of results for trapping black bears in northwestern Prince William Sound, Alaska, from July 28 to August 10, 1976

Location	No. days trapped	No. trap nights	No. snares sprung w/o capturing a bear	No. snares sprung with capturing a bear
Tebenkof Glacier				
Westside stream	13	110	18	4
Eastside stream	3	4	1	1
Pirate Cove	12	14	2	0
Paulson Creek	10	49	7	1
Harrison Lagoon	12	53	14	2
Total		230	42	8

Table 2. Summary of results for trapping black bears in northwestern Prince William Sound, Alaska, from August 18-28, 1976

Location	No. days trapped	No. trap nights	No. snares sprung w/o capturing a bear	No. snares sprung with capturing a bear
Tebenkof Glacier				
Westside stream	10	107	9	4
Eastside stream	10	67	7	3
Pirate Cove	7	33	4	1
Total		207	20	8

Table 3. Summary of results for trapping black bears in northwestern Prince William Sound, Alaska, from August 6-28, 1977

Location	No. days trapped	No. trap nights	No. snares sprung w/o capturing a bear	No. snares sprung with capturing a bear
Tebenkof Glacier				
Westside stream	22	464	3	2
Eastside stream	22	161	4	2
Parks Creek	16	249	7	9
Paulson Creek	7	58	0	1
Total		932	14	14

type of set along with temporary trail sets that greatly distort success as related to trap nights.

The sex and age composition and locations for bears captured within and between areas for 1976 and 1977 appear in Tables 4 and 5, respectively. These data indicate an apparent disparate sex ratio among captured bears, an atypical age distribution for males and very light weights for some apparently old female bears. Most of these data will be treated in greater detail in subsequent sections of this report.

Although many hunters report killing or seeing 300-400 lb black bears, field data indicate that a 200-250 lb bear would be a large one for Prince William Sound.

Dates of capture indicate that in 1976 few bears were at salmon streams before August 9 and that in 1977 most bears were captured after August 14 (Table 6). Spawning salmon were available considerably earlier than these dates would indicate. Another interesting observation illustrated by these data is the fact that five of the first six bears captured in 1977 were recaptures from 1977. This could be interpreted to mean that the first bears to visit salmon streams are those that fed on salmon in the previous year. These data also indicate that two of the bears fed at the same salmon stream in consecutive years and that three of the bears fed at different salmon streams.

Since few bears were recaptured on the same stream within each year, it appears that they must only feed on a stream for several days or that capturing and handling procedures frightened those bears away from the general area.

Locations for making snare sets were of two types: (1) old, well established and traditionally used bear trails and (2) newly established, temporarily used, short-lived trails.

Traditional trails are deeply worn into the substrate, are readily apparent at any time of the year and are primarily used by bears when coming or leaving the fishing area. These trails radiate out from as well as parallel the streams that contain areas where salmon spawn. We found it is best to trap a trail, fairly close to the stream's edge, where several other traditional trails have already unified. The ideal location to make a set is where a traditional trail is immediately adjacent and parallel to a section of a stream, preferably near a shallow pool, that contains spawning salmon. Traps may literally be placed in the same location in traditional trails year after year and probabilities of capturing a bear would be quite similar within and between years.

Temporary trails are those immediately adjacent to a stream or those in or across large, open, flat areas; in either case they usually pass through grass or sedge-covered areas and are used while bears are fishing and are perhaps exclusively used by particular individuals. Location and use of these trails varies within a season and between years and is dependent on precise temporal and spatial availability of

Table 4. Location, date, sex, number of cemental annuli, weight and ear tag numbers for black bears captured in western Prince William Sound in Alaska, 1976.

Location of capture	Date	Sex	No. cemental annuli[a]	Weight (lbs.)	Ear tag No. Left	Ear tag No. Right
Tebenkof West	7-29-76	F	3	175	B101	B102
Harrison Lagoon	7-31-76	M	2	115	B103	B104
Tebenkof West	8-2-76	F	8	160	B106	B105
Paulson Creek	8-3-76	M	1	90	B107	B108
Tebenkof West	8-9-76	M	6	185	B109	B110
Tebenkof West	8-9-76	M	1	90	B111	B112
Harrison Lagoon	8-10-76	F	4	120	B113	B114
Tebenkof East	8-10-76	F	2	80	B115	B116
Tebenkof West(R)[b]	8-19-76	F	3	200	B101	B102
Tebenkof West	8-19-76	F	10	150	B117	B118
Tebenkof East	8-19-76	M	1	100	B119	B120
Pirate Cove	8-22-76	M	2	125	B121	B122
Tebenkof East	8-22-76	F	1	85	B123	B124
Tebenkof East[c]	8-24-76	F	4	140	B125	B126
Tebenkof West	8-28-76	F	1	90	B127	B128
Tebenkof West	8-28-76	F	6	155	B129	B130

Total by location	Sex X Area F	Sex X Area M	Age X Sex X Area F	Age X Sex X Area M
Tebenkof West	5	2	10,8,6,3,1	6,1
Tebenkof East	3	1	4,2,1	1
Harrison Lagoon	1	1	4	2
Pirate Cove	0	1	-	2
Paulson Creek	0	1	-	1
Total:	9	6	10,8,6,4,4,3,2,1,1,	6,2,2,1,1,1,

a Each annulus represents a winter or denning period; cubs of year have 0 annuli and an individual with 3 annuli is 3+ years old.

b B101 fitted with bolt on radio collar frequency/channel 4.1.

c Individual accompanied by 2 cubs.

R = Individual captured at prior date.

Table 5. Location, date, sex, number of cemental annuli, weight, radio collar type, number and channel/frequency and ear tag numbers for black bears captured in western Prince William Sound in Alaska, 1977.

Location of capture (R)	Date	Sex[a]	No. cemental annuli[c]	Weight (lbs.)	Radio collar Type	Radio collar No.	Radio collar Channel/Frequency	Ear tag No. Left	Ear tag No. Right
Tebenkof West (R)	7-25-77	F/2C	9	150	Expandable	9404	8.38	B106	B132
Tebenkof West (R)	8-7-77	F/1C	4	--	Bolt-on	--	4.1	B101	B102
Tebenkof East	8-13-77	FC/B106	C	26	Expandable	8406	9.38	B135	B136
Parks Creek (R)	8-14-77	M	2	115	Expandable	9405	9.13	B119	B139
Parks Creek (R)	8-14-77	M	2	135	Bolt-on	9913	1.23	B107	B108
Parks Creek (R)	8-16-77	F/NL	5	148	Expandable	9921	7.25	B125	B126
Parks Creek	8-16-77	F/L	11	136	Expandable	9923	10.27	B141	B142
Parks Creek	8-16-77	F/L	12	180	Bolt-on	9916	3.38	B143	B144
Parks Creek	8-17-77	F/NL	11	170	Bolt-on	9912	1.08	B137	B138
Parks Creek	8-19-77	F	1	72	Expandable	9919	6.15	B147	B148
Parks Creek	8-20-77	M	2	141	Expandable	9924	12.16	B149	B150
Paulson Creek	8-24-77	F	2	94	Expandable	9922	10.10	B151	B152
Parks Creek	8-27-77	M	2	127	Expandable	9920	6.30	B153	B154
Tebenkof West	8-28-77	MC/B101	C	40	Expandable	9403	8.10	B155	B156

Totals by location	Sex X Area F	Sex X Area M	Age X Sex X Area F	Age X Sex X Area M
Tebenkof West	2	1	9,4	C
Tebenkof East	1	-	C	-
Parks Creek	5	4	12,11,11,5,1	2,2,2,2
Paulson Creek	1	-	2	-
Total:	Cubs 1 F; 1 M Older bears 8 F; 4 M		12,11,11,9,5,4,2,1,C	2,2,2,2,C

a F = female; M = male; F/2C = female with 2 cubs; FC/B106 = female cub with sow #B106; F/L = female lactating and F/NL = female not lactating.

b Female later seen with at least one cub.

c Each annulus represents a winter or denning period: cubs of year have 0 annuli and an indiviual with 3 annuli is 3+ years old.

R = Individual also captured in summer of 1976.

Table 6. Dates on which individual black bears were captured and locations for those recaptured (TW, TE, PL and PK)* in western Prince William Sound in Alaska, 1976 and 1977.

1976		1977	
7-29	(B101-TW)	7-25	(B105-TE
7-31		8-7	(B101-TW)
8-2	(B105-TE)	8-13	
8-3	(B107-PL)	8-14	(B119-PK)
8-9		8-14	(B107-PK)
8-10		8-16	(B125-PK)
8-10		8-16	
8-19	(B119-TE)	8-16	
8-19		8-17	
8-19		8-19	
8-22		8-20	
8-22		8-24	
8-24	(B125-TE)	8-27	
8-28		8-28	
8-28			

* TW = Tebenkof Glacier westside stream, TE = Tebenkof Glacier eastside stream, PL = Paulson Creek and PK = Parks Creek.

fish. Effectiveness of individual sets or the probability of a trap capturing a bear may change drastically from one day to the next; again this is entirely attributable to the location of available fish. Predominant factors that may influence location of fish are the following: (1) progression of the fish run and spawning activities, as the season passes fish move farther and farther up the stream and traps will have to be adjusted accordingly; (2) extreme fluctuations in tides, sets appearing good one day may be inundated a portion of the next, fish may be dispersed and available throughout sedge flat areas after the tide recedes and/or the higher water level may have enabled general movement of fish to a more upstream area; and (3) precipitation and high winds that accompany storms may affect water levels of a stream (as tides) and result in changing the location of concentrations of available fish.

Although these temporary trails visually appear attractive for making sets, the majority of trapping effort should be devoted to traditional trails where such traps will always be "working". It is also important to select the most common (hub of the wheel) of the traditional trails in which to make a set. Finding a place to secure snare cables is seldom a problem in traditional trail sets, but commonly a problem for sets in temporary trails. Trapping on temporary trails can be effective, but one must constantly change the location of these sets.

Snare sets were made similar to those methods described by Flowers (1977) for the trail set. Snares were set in all major traditional trails along the salmon stream. Frequently, more than one snare was set in a traditional trail, especially when near temporary trails which contained fresh bear sign (scats or remains of fish). Though the general area in which a set was made depended to a large extent on sign, the exact location of the set was determined by characteristics of the trail (narrowness and surrounding cover) and a suitable anchor for the snare (the base of a tree or preferably an underground tree root). I believe two things are critical when deciding on where to make a set: (1) the area around the "set snare" and within the reach of a captured bear should be relatively clear of trees, slash, brush, debris and not be too near an overhang, ledge or the stream; and (2) the snare should be anchored less than 1 m from where it is set and the closer the better. These precautions are purely for the welfare and safety of a captured bear; if an injury is probable or inevitable you might as well not capture the bear.

Trees, rocks, slash or debris within reach of an ensnared bear increase the probability of: 1) the cable becoming entangled or twisted, thus preventing the swivel from operating or weakening the cable; 2) the bear grabbing something for added leverage; 3) the bear ending up in a tangled or hanging position and 4) the bear directly inflicting self injury. Snares should never be set near enough to the stream so a captured bear could be harmed by the water. Snares were anchored to stationary objects rather than to a drag to reduce the possibilities of these types of accidents.

I believe that if only a short lead is provided, the amount of leverage or inertia the bear can develop is minimized resulting in fewer dislocated joints and lessened problems with blood circulation or dermal abrasions and lacerations from the snare cable.

Holes, about 20 cm in diameter and 15-20 cm deep, were dug to accomodate the spring trigger. A military folding foxhole shovel was excellent for digging in the soft, moist substrate charcteristic of coastal hemlock forests. This deep hole facilitated catches high on the bear's leg.

A leg of the spring was not hooked through an eye of the swivel, as suggested by Flowers (1977:7). I believed that this could become stuck, keeping the spring near the bear and leading to an injury or puncture during the encounter. To maintain a tight cable, I simply threaded the cable, from the spring side, along the outside and front of the left (or right) leg, under the leg bracket and across to the other side, up between the spring and trigger extension hook and through the throw arm hook from where the snare loop originates (Fig. 5).

Stepping sticks, guide sticks and trigger sticks, as described by Flowers (1977), were used. The set snare was covered with fern fronds or leaves. No special precautions were taken to eliminate human scent from the snares or the area of a set.

A small piece of surveyor's tape was tied in the nearest tree, to mark the location of the snare.

Warning signs were displayed at the mouth of each stream, to call attention to people using the area about bear snares being set in the vicinity (Fig. 6).

In several instances, more than one bear was caught at the same set, but usually the trail and surrounding cover is disturbed enough to destroy its desirability for resetting a snare in the same place.

Tending Snares and Handling Black Bears

Snares were always checked by two people, each armed with either a shotgun, large-caliber rifle or large-caliber pistol. In addition to weapons, the entire compliment of equipment needed to immobilize and "process" a bear was carried in backpacks by the individuals tending the snares. This included the following: CO_2 capture pistol; sernylan; sterile water; syringe darts (1-6 cc capacity and 1/2" and 1 1/4" barbed needles) and needles; 250 cc vaccuum bottles and blood transfer set; glass slides; roto tags; leather punch; colored vinyl flagging; lip tattoo pliers and ink; tooth elevator and pliers; radio transmitter collars, transmitter receiver; 200# spring scale; metric tape measure; nylon sling; block and tackle and line; firecrackers and matches; tooth envelopes, whirl pac bags; data forms; field notebook; a folding fox hole shovel; two drive rachets and sockets; aircraft nuts and bolts for radio collars and, when weather permitted, a 35 mm camera.

Fig. 5. Two methods by which cable was threaded through spring and arm hook. (Trigger catch for arm hook not in illustration.)

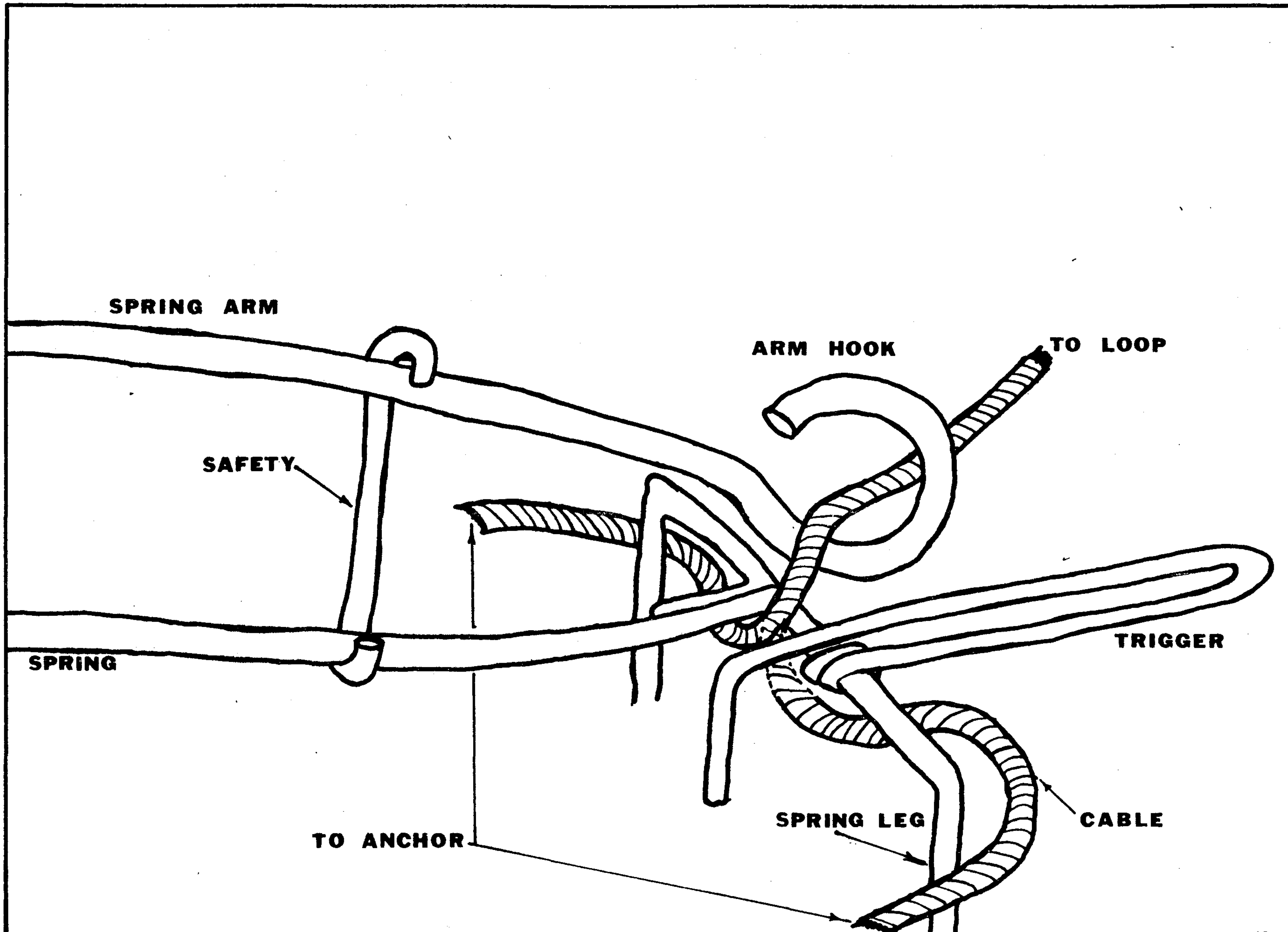


Fig. 6. Sign displayed in areas where foot snares were set.

ATTENTION

We are conducting Black Bear research.

Traps (foot snares) have been set in this vicinity.

If you must use the area, do not go near trees marked with surveyor's tape.

We greatly appreciate your cooperation.

Alaska Dept. of Fish and Game

Initially in the 1976 trapping season, attempts were made to check the snares twice each day (early in the morning and late in the afternoon) to minimize the time bears were in the snares and to reduce injuries. This procedure not only proved to be impractical timewise (work days were 12-16 hours), but also may have scared bears away from the streams or discouraged their use of the areas. For the latter part of the 1976 trapping season, as well as during the entire 1977 trapping season, snares were tended as early as possible each day. Because of the large number of snares some snares were not tended until late afternoon or evening. Since the number and extent of injuries to bears captured in snares tended in this manner were not great, this procedure was probably an adequate alternative to tending the snares twice a day.

If a bear was captured in a snare, for safety reasons, the first objective was to determine if it was a cub of the year. Initial procedures for handling cubs were slightly different than for adults. As soon as it was determined that a cub of the year was in a snare, personnel would return to the skiff, load up the CO_2 pistol with a dart and drug dose suitable for the cub and the powder-charged capture rifle with a doseage suitable for a 175 lb. adult female bear. Attempts should always be made to immobilize the sow before taking care of the cub.

Two of our experiences with cubs in snares may be summed up in the following accounts:

- When walking across a 400-meter grass flat to check a set of snares in a timbered fringe on the opposite side of a creek, we could hear the loud bawl of a cub. Nearby or within 50 meters on either side of the ensnared cub its sow could be seen appearing, disappearing and reappearing in the brush. A second cub was visible, but it soon disappeared into the timber and was not seen again. After we returned from the skiff with the capture rifle and pistol loaded for the sow and cub, respectively, and approached to within 50 yards, the sow's previously described behavior was similar, but more hurried ("anxious and restless"). It appeared that the sow was very hesitant to leave the forest edge cover and come out into the open area near the stream and/or to approach humans too closely. We approached to within 20 m and shot her with a dart from the capture rifle. We promptly retreated and permitted the cub to bawl so as to keep the sow nearby until she became sedate. This plan worked, as the sow soon became quiescent and the cub was then immobilized, processed and placed near the sow to recover.

- Upon departing the skiff on a routine tending of snares, a cub bear could be heard bawling in the vicinity of the sets. Equipped with appropriate gear, we approached to where the sounds came from. At a distance of about 30 m, a cub could be seen in the snare, but its sow was not visible. The cub was caught in a snare set along a stream at the base of a timbered, brush-covered hill. The other side of the stream was lightly timbered with a tall grass and scattered alder and willow understory. The closer we approached the cub, the louder was its bawl. After awaiting for 3-5 minutes at 10 m distance from the ensnared cub and still with no sign of the sow, it was decided to dart the cub. As soon as the cub was hit with the dart it let out with a more violent and different bawl Within seconds the brush on the hill was seen rapidly moving, and down off the hill came the sow. At 10 m distance the sow broke through the brush and came face to face with us. In the next split second, she jumped onto and climbed about 10 m up a spruce tree. We backed away for 5-10 minutes in hopes that she would climb back down, but she remained in the tree. She was then shot with a dart and we again backed away, but to a greater distance. She soon started to descend and after reaching the ground ambled off into the thick brush. After waiting 20-30 minutes we approached, but could not find her. We searched for 15-20 minutes, processed the cub left it near the capture site and continued searching for the sow. She could not be found even with a radio receiver (she had been radio-collared the previous year). The cub was left to recover near the place where it was snared.

This encounter suggested that the sow was less intimidated by humans because of the dense brush cover and lack of a clear opening, but she apparently still feared humans when face to face and resorted to climbing the tree.

Evidence later indicated that this sow and cub had reunited and were traveling together.

In other encounters with sows with cubs, sows were ensnared instead of the cubs. In one instance, the cubs were readily visible in a nearby tree. In several other instances the sow's physical condition indicated that she was accompanied by suckling cubs, but they could not be located in the immediate area. There is the possibility that at times when a sow is ensnared her cubs may be captured in another manner. This was not tried in the present study because of the potential for injury to either human or bear cub in these particular instances.

In another encounter, a sow, known to have a single cub, was ensnared but her cub was not seen in the vicinity. Upon searching in the forest cover about 50 m away two cub bears and then an additional sow were seen. This latter sow had been previously captured and she was known to be the mother of a pair of cubs. Since the snared bear had to be tended, it was desirable to frighten the other sow and cubs away. This was the only instance when firecrackers were really needed but in the torential downpour none could be ignited. After that incident, it was felt that perhaps a blank pistol would be more useful and versatile for making noise or scaring bears.

Procedures for handling solitary adult bears in snares were somewhat similar to those for cubs. When it was determined that a single bear was held in a snare, the animal was approached quietly and unobtrusively to estimate its weight. After deciding on the bear's weight, an unobtrusive retreat was made to a concealed position where a proper drug dose could be prepared. The desired dose (1 mg/lb or 1cc/100 lbs = 2.2 mg/kg.) was

Table 7. Weight relative dose of sernylan (phencyclidine hydrochloride) and induction time for female black bears captured in western Prince William Sound, Alaska, 1976-77.

Date of capture*	Weight (kg)	Sernylan dose Mg	Sernylan dose Mg/Kg	Induction time (min)
7/25/77[a]	68	125[d]	1.8	20
7/29/76[b]	79	250	3.2	12[e]
8/2/76[a]	73	130	1.8	34
8/10/76	54	150	2.8	15
8/10/76	36	75[d]	2.1	34
		50	3.5	48[e]
8/13/77	12	40[d]	3.0	5[e]
8/16/77	62	200[d]	3.2	15[e]
8/16/77[c]	67	150[d]	2.2	5
8/16/77	82	175[d]	2.1	6[e]
8/17/77	77	160[d]	2.1	15
		50	2.7	32
8/19/76[b]	91	60[d]	0.7	55
		100	1.8	80
8/19/76	68	150[d]	2.2	40
		50	3.8	6[e]
8/19/77	33	125[d]	3.8	6[e]
8/22/76	39	130[d]	3.3	4[e]
8/24/77	43	125[d]	2.9	16
		50	4.1	36
8/24/76[c]	63	190[d]	3.0	32
		50	3.8	68
8/28/76	41	10[d]	2.4	10
8/28/76	70	15[d]	2.1	11

* Notations (a,b,c) indicate recapture of same individual.

d Drug dose included 1 cc of sterile water.

e Individual exhibited convulsions.

Table 8. Weight, relative dose of sernylan and induction time for male black bears captured in western Prince William Sound, Alaska, 1976-77.

Date of capture[*]	Weight (kg)	Sernylan dose Mg	Mg/Kg	Induction time (min)
7/31/76	51	120	2.4	30
8/3/76[a]	41	75	1.8	60
		50	3.0	72
8/9/76	84	175	2.1	25
8/9/76	41	90	2.2	18
8/14/77[b]	52	140[c]	2.7	8
8/14/77[a]	61	200	3.3	25
8/19/76[b]	45	120[c]	2.7	6[e]
8/20/77	64	175[c]	2.7	8
		50	3.5	11
8/22/77	57	80[c]	1.4	27
		40	2.1	43
8/22/77	58	150[c]	2.6	11
		50	3.4	13
8/28/77	18	50[c]	2.8	9[e]

[*] Notations (a,b) indicate recapture of some individual.

[c] Drug dose included 1 cc of sterile water.

[e] Individual exhibited convulsions.

inserted into a syringe body and capped with a 1 1/4 inch barbed needle for adults or a 1/2 inch barbed needle for cubs. Sterile water (1 cc) was added to all doses of sernylan measuring 2 cc or less.

The captured bear was then approached by one member of the team with the CO_2 pistol while the other member was ready with a rifle or shotgun in case the bear should escape and charge. For additional safety the attendant with the CO2 pistol usually carried a holstered large-bore sidearm.

In most cases, one person attracted the bear's attention while the other moved in to about 3 m for an unobstructed shot at the bears hind quarter. In all instances, bears were shot in the large muscle mass of a hind leg.

Having darted the animal, tenders would again retreat, so as not to excite the bear any more than necessary, and observe until the bear became sedate and could be handled safely. Depending on dosage, completeness of injection and specific location of injection, the time required for induction varied from 5 to 60 minutes (Tables 7 and 8). These data indicate that ideal dosages amounted to less than 3.0 mg/kg of body weight. Doses of 3.0 mg/kg and greater appeared to induce convulsions and induction time using doses near 1.0 mg/kg was greatly protracted. Induction times of less than 10 minutes appeared to indicate that convulsions were eminent. As a very general comparison, it appears that for a given weight/dose male bears may be more tolerant of Sernylan than females.

Bears that became docile, but not sedate enough to handle safely were subsequently injected in the rump with varying amounts of sernylan (usually 0.5 cc) from a hand held syringe.

As soon as individual bears could be handled, the snare cable was loosened and removed. If the bear was to be collared that was done next; if not, the bear was then tagged with numbered, small-sized roto tags in each ear. Prior to tagging, the end of the roto tag was trimmed back as close as possible to the number. Before attaching the tags, the bear's ears were punched with a leather punch to accommodate the stem of the roto tags. Pieces of colored vinyl flagging, 5 by 7 cm, were likewise punched and placed on the stem of each roto tag so when the tags were locked on the bear's ears the flagging remained on the dorsal surface of the ear and the tag was midway to the tip of the ear on its anterior surface. Various color combinations of flagging were utilized to distinguish individual bears.

Vinyl flagging remained on the ears of one bear from July through June but on the majority of bears it was lost much sooner. Whether bears take it off or whether it tears off in brush is not known. Visual identification of individuals can be very useful and modifications of this technique will be experimented with in the future.

On the five bears recaptured, eight of the ten affixed roto tags were still attached. Those that were lost were not pulled out but the bear's ears had torn. This type of tag appears quite adequate for this purpose.

If the bear was to be collared with a radio transmitter, this took priority over attaching the ear tags and colored flagging. When collaring bears, one must be aware of at least two potential dangers to the bear from tightening collars: 1) Seasonal increase in neck size during the predenning period and 2) Increase in neck size associated with growth, bears increase in body size until about 6 years of age. For these reasons only one bear was collared in 1976. That bear (B101) was the heaviest captured (91 kg) and had gained about 10 kg between late July and mid August when she was collared. This individual has retained the collar up to the present time, a period of 1.5 years.

In 1977 bears of all sizes were collared with an expandable type of collar developed by the AVM Instrument Company (Champaign, Illinois). Although still in developmental stages, it appears that this collar design may solve some of the problems associated with collaring bears. After placing the radio collars on bears the transmitting frequencies were rechecked and recorded.

Standard body and head measurements were taken from the captured bears as reported by Glenn (In Prep.). These are presented in Appendices C and D.

A lower premolar tooth was extracted for age determination (Willey 1974), and a three digit number matching the lower numbered ear tag was tattoed on the lingual side of the upper left and right lips. A sample of whole blood was collected for SMAC - 24 chemical analysis (Appendices E and F), and in 1977 a sample of hair was collected from between the shoulder blades for elemental analyses as performed on moose hair (Franzmann et. al 1975).

Bears were then weighed by tying the spring scale to a tree and with block and tackle hoisting the bear as it lay in the nylon sling. Even though the same procedures were followed in tattooing each bear, permanence of lip tattooes was highly variable. The tattooes on several bears recaptured in 1977 were quite distinct and readable, yet on other bears there was practically no evidence of a tattoo. In all cases, tattoo ink (roll-on type) was applied before the tattoo. After the tattoo needles were removed, ink was again rolled on and vigorously rubbed into the needle holes. A paste type ink will be experimented with in subsequent years.

At this time any open injuries were treated with aersol antiseptic spray and bears with lacerations were injected with an antibiotic serum.

After completing the processing procedures the bear was moved (seldom more than 10 m) to an incline in a somewhat concealed location, as under low spreading branches of an evergreen tree, which was free from sticks and brush that may injure the bear as it regains mobility. Because other snares usually had to be tended, bears were not observed recovering from sedation.

Any snares in the immediate vicinity were deactivated so as not to recapture bears during recovery from the drug. The following day all these snares were reset, if desired.

Management of Black Bears

Techniques and strategies, presently available for managing populations of black bears in Alaska, are extremely limited.

Formal or systematic surveys to determine status or productivity of black bear populations are not conducted.

The only factual data presently collected and available to biologists for management of black bears are those obtained during the process of sealing (attaching a locking metal tag) the hides and skulls of bears; a mandatory requirement in GMUs 1-7, 11-16 and 20. The hide and skull sealing program provides information on the successful hunters, how they hunted bears and characteristics of the bears they killed. Ideally these sorts of information are of value in managing black bears.

However, the following questions should be resolved: 1) what data are available for management of black bears, 2) which data are of practical value to management, 3) how can these data be best utilized and which biases, that are inherent in these data, should managers be aware of? The following treatment of this subject is by no means exhaustive; numbers and kinds of interpretations are essentially unlimited.

Information about the hunter has value both directly for management of a game species and indirectly for enforcement of management regulations. Having the name and address of a hunter enables enforcement personnel or biologists to contact the individual regarding a violation or to obtain more specific information about the person or his hunt. Having the name of individual hunters enables managers to determine if hunters shoot more than one of a species per year or per lifetime.

Information on the residence of hunters gives the manager data on the geographic allocation of the resource; i.e. what proportion of the resource is being utilized by local residents, other residents of the state or residents of other states or foreign countries. These data may indicate the equitability of allocation for a number of user categories.

Questions pertaining to the hunt as: date of kill, duration of the hunt, method of transportation, whether the hunt was guided or not, the specific location of the hunt, whether the kill was incidental to other activities and whether the meat was salvaged for human consumption furnish information on when, where, why and how black bears were reduced to possession. These data are useful in appraising characteristics of the harvest as well as furnishing information on an array of methods that may be utilized to affect the results of a harvest (i.e., tools for management).

Data collected from the bears that are killed, yield information on the physical, morphological and demographic characteristics of the harvest. These data can be related to and integrated with characteristics of the hunt and the hunter and can further be associated with the harvest of a particular sex and age class of bears, but one must be fully cognizant of pertinent environmental factors (spring phenology, severity of winter, food availability, etc.) that were in affect.

Awareness of these factors and their interaction enables biologists to act knowledgeably in formulating and implimenting an effective management program to alter the demography, geography or allocation of the kill.

In general, black bear harvest data, the subject of this discussion, represent a record or tally of black bears killed. These harvest data may be further refined to indicate time of year, location of kill (GMU, Subunit, or even specific drainage), and sex and age of the kill.

These data, when considered as such, are quite concrete, assuming that reporting, recording, transcribing or other mechanical errors are not present. Being concrete, there is no difficulty in interpreting these data; i.e. so many males and females at a particular age were killed at a designated location at a specific time and their hides and skulls measured at the time of sealing. As far as extending these data any futher or interpreting them at more depth than this, particularly regarding the live population, one must have some knowledge about why an animal is reduced to possession, or more specifically the probability of a particular animal being killed.

Animals are represented in the harvest sample because of relative probabilities of being killed. If each animal had an equal probability of being killed, the harvest sample should be representative of the live population. However, if probabilities of being killed are not similar; how then does the harvest sample relate to the live population? Only when and if you know something about the relative probabilities of individuals or categories of individuals being killed can these data be related to the population present at the pre- or post-hunt time.

For instance, when a spring black bear harvest is comprised largely of males and perhaps even very old adult males, there may be several diverse interpretations regarding that population. It may be:

A population largely composed of males (old adult males);
A population which is not largely composed of males, but still the probability of old males being harvested is greater because of behavioral and/or other reasons (larger home ranges; more frequent movements; ranges are more in the vicinity of hunters; more frequently utilize open habitat, be it clearings, avalanche slopes or shorelines; that there was relatively good production and survival of cubs and many females were thus afforded additional protection; lactating females and those with yearlings may have been in the den during a portion of the hunting season; or that sows or sows with cubs avoid areas frequented by males). In fact, if males are four times as vulnerable as females to hunting in the spring, an even sex ratio in the harvest could mean that there are four females for every male in the population. It is apparent that unless these sorts of information about bears are available or are intuitively obvious, one can not accurately interpret kill data or appraise the structure of the population from which it came.

Frequently biologists appraise the status of an animal population by studying the age structure of a harvest sample. What does a drop in the age structure of the harvest sample represent? Does it represent good production and survival in former years; a lack of animals in the older age classes or simply a change in behavior of a sex or age class that ultimately affected their vulnerability or relative probabilities of being harvested? It could also reflect altered patterns, techniques or location of hunters.

Data that are collected in large quantities are frequently, for the sake of simplicity, reduced to ratios or averages. Are ratios and averages always dependable management tools? You may have tremendous (ideal) ratios of sows/boar, cubs/sow, average ages and/or average skull sizes; but you may also have only 100 instead of 1,000 bears present in the population.

Caughley (1974) demonstrated that "age ratios often provide ambiguous information and that their facile interpretation can lead to serious management blunders." He contends that before age ratios can be used in a meaningful analysis of the dynamics of a population, supplementary data on demography and particularly the rate of increase of that population must also be known. But, redundantly, the data on age ratios was collected to furnish information on rate of increase. He further suggested that without support from other demographic data they "seem to be statistics in search of an application."

No matter how crude, it is extremely important to have some grasp of population size to effectively manage any population. Some of the best managed populations in this state are those where we have a good idea of total numbers--a few dall sheep (*Ovis dalli*) populations and the Cordova moose population. With some inkling about population size, you may strive for a desired harvest rate and realize what sort of harvest rate the population had previously sustained and how well it fared. Once you consider or decide on the size of a population, you will be forced to consider desirability of various harvest rates and the biological feasibility of any given harvest rate. Without a figure for population size, how does one consider or utilize data on wounding loss, poaching loss, disease loss, starvation loss or for that matter any type of loss when formulating a management proposal or interpreting the results of a former management scheme.

Several shortcomings of the present black bear hide and skull sealing program are that hunting pressure (effort) or unsuccessful hunters and numbers of bears mortally wounded and not recovered are unknowns. Hunting effort may or may not be valuable in interpreting variations in numbers of animals harvested. Wounding loss, though unaccountable, may be a significant mortality factor for most populations of black bears. It is conceivable that perhaps one out of every four or five bears shot is not recovered and eventually dies. If this assumption were correct, actual numbers of black bears killed would be 25 to 33 percent greater than that figure indicated by the sealing program. A loss of this magnitude must be considered in management of populations of black bears.

A brief key for estimating age of bears from the size of their skulls and season of kill was devised for GMU 6 (Appendix G). Though a rough approximation, these sorts of data are useful for Information and Education duties and are indicative of a bear's sexual maturity.

Modeling and management strategies for black bears in Prince William Sound

Any biologist who has ever designed a new or evaluated an old species management harvest plan has in the process, whether knowingly or not, utilized modeling theory. Under both circumstances, one evaluates the potential effects of various factors on losses or gains of individuals to a population. Although contemporary models also tend to be more intricate and specific, the basic revelation in modeling is, 1) the availability of digital computers, which vastly increase the speed of operation and increase quantity of data that can be processed, and 2) the formalized written format, i.e., all data contributing to the model are on record, neatly filed in specific categories. It is in the latter that I feel lies the practical value of models to all biologists; getting on paper data, ideas and assumptions that are the inherent bases of a management plan.

Models need not be complex. For example, let's interpolate the maximum sustainable rate of harvest for black bears in Prince William Sound (GMU 6) from isoclines, as a function of average age at first reproduction and average natality rate, presented by Bunnell and Tait (In Prep.). Assuming average litter size of two (meager field data available indicate it may be less), average age at reproduction of four and reproduction every two years; we find that the maximum sustainable mortality (hunting plus non hunting) for such a population would be around 20 percent per year. The sex and age structure of the kill was not specified in this model.

Using this calculated maximum sustainable mortality rate (20 percent) and being ultra conservative, let's assume that the reported kill (nonsport plus sport) of black bears in GMU 6 is the sole source of mortality for this population (average for 1974-77; 127+). Therefore, this population (GMU 6) must consist of at least 635 individuals in order to maintain itself, while sustaining a total annual mortality loss of around 130 individuals.

As with any model, assumptions are made; for this model Bunnell and Tait (In Prep.) made the following: 1) mortality rate is constant for all age classes; 2) cubs are assumed to die only if the mother is part of the kill; and 3) mortality rate was balanced against natality rate essential to generate a stationary (non-declining) population. The computed mortality rate is the upper limit to the sustainable rate of harvest.

How realistic are these assumptions and the formulated model and, if violated, how would the population of bears be affected?

Hunting mortality is not constant for all age classes; it is selective for older animals and predominately older males. Kemp (1972) documented increases in density of black bears in Alberta for at least two years subsequent to the removal of adult males. He attributed this to increased survival of subadults from reduced intraspecific intolerance, by adults.

Beecham (In Prep.) found lowered net recruitment rates in a heavily hunted population vs. those rates for a relatively lightly hunted population of black bears in Idaho. Although subadult survival may have increased, the lower proportion of breeding aged females in the population would lower net production and result in reduced densities unless there were nearby unhunted areas (reservoirs) from which mobile subadults could emigrate to fill in the vacancies. McIlroy (1972) also had evidence indicating that densities of bears in Prince William Sound, Alaska, decreased under heavy hunting harvest.

I tend to agree with Beecham's approach and, since territorial systems reduce mutual interference, I further hypothesize that the chaotic social system created by the absence of old, established territorial boundaries and tenant males may lead to increased intraspecific confrontations and result in higher rates of subadult mortality than the very low rate intimated by Kemp (1972).

Furthermore, it is very probable, in the northern and western portion of Prince William Sound, that reservoirs of unhunted populations are physical and spatial impossibilities and do not exist. Also implicit to this model is the assumption that there are no sources of mortality other than hunting. We know that this is not true but we also do not know to what extent these mortalities are additive or compensatory.

However, before increasing the complexity of the model with additional sources of mortality (losses to the population), examine the congruity of the present rates of harvest of black bears to the expected densities or sizes of populations of bears in each subunit or area.

What are realistic estimates of densities of black bears in GMU 6? Data from other studies, indicate a wide range in black bear densities throughout North America (Table 9). Information on densities of black bears in coastal areas is limited.

McIlroy (1972) utilized evidence gained from observing bears feeding along streams containing spawning salmon in Prince William Sound, Alaska and calculated densities of 1 bear/ 32 ha (8 bears per sq mi). It is apparent that these estimates were derived from data collected during a seasonal concentration of bears and that this small portion of habitat is temporarily "ideal". It is probable, that these data are not representative of densities of black bears found throughout most of the GMU 6.

Lindsey and Meslow (in prep.) determined that the density of black bears on a island off the coast of Washington was greater than three bears per sq mi (80 ha per bear), but they were concerned with the fact that the study was conducted on an island and mentioned that "... the potential exists for unique conditions and spatial restrictions to modify behavior."

Table 9. Densities of black bears as estimated in studies conducted in different localities.

Source	Location	Sq mi per bear	Ha per bear[a]
McIlroy (1972)[b]	Alaska (coastal population)	0.1	32
Lindzey (1977)	Washington (an island population)	0.3	67-89
Poelker and Hartwell (1973)	Washington (mainland population)	0.7-1.0	181-259
Piekielek and Burton (1975)	California	0.8-1.0	207-259
Beecham (1976)	Idaho (Councial area)	0.8	207
	Idaho (Lochsa area)	0.9	233
Jonkel and Cowan (1971)	Montana (Bear Creek)	0.8-1.7	207-440
Bray (1967)	Montana (Yellowstone Nat'l Park)	5.2	1347
Pelton (1976)	Tennessee	1.0	259
Kemp (1972)	Alberta	1.0	259
Erickson and Petrides (1964)	Michigan	3.4	881
Stickley (1957)	Virginia	3.9	1010
Spencer (1955)	Maine	5.6	1450
Clarke (1976)	New York (Catskill)	4.0	1036
Clark (1974)	New York (Adirondacks)	2.7	699
	New York (Catskill)	4.2	1088
	New York (Allegany State Park)	10.0	2590

[a] 259 ha equals on sq mi

[b] probably estimated during seasonal concentration

It is very possible, that densities of bears on the mainland are considerably less.

Most probably, densities of black bears in coastal areas of Alaska closely parallel those determined for western and coastal Washington (181-259 ha per bear) by Poelker and Hartwell (1973). In fact, densities of black bears in the best habitat in Prince William Sound are equivalent to those found in the best habitat in Washington (about 0.7 sq mi per bear or 180 ha per bear).

It is not unrealistic to assume that densities of black bears in Prince William Sound are equivalent to or greater than those in most areas of North America, because: 1) the dense coastal coniferous forests are interspersed with numerous open meadows which contain a lush growth of grasses, herbs and berry producing shrubs; 2) numerous slopes are maintained in early successional, subclimax stages (grasses and herbs) by perennial snow avalanches and because of the resulting decrease in snow depth following avalanches, these areas become snowfree exceedingly early in the spring and provide bears with excellent forage; 3) an abundance of cranberries, salmonberries and blueberries provide excellent forage during summer and early fall; 4) runs of spawning salmon in most of the streams in the area provide bears with an optional food source in summer or an alternate food source should there be a poor berry crop; 5) in Western Prince William Sound, the essential absence of ungulates and brown bears eliminates most interspecific competition for food or space; 6) large grass and sedge flats on glacial deltas provide ideal foraging conditions in spring; 7) the mosaic character and interspersion of habitat types is ideally accentuated by numerous narrow fiords, streams and glaciers; 8) although winters in the area are relatively cold and long, and denning periods extend approximately 6-7 months, a deep snowpack common to the area may ameliorate the expectations of poor wintering conditions and 9) the microclimatic effect of topography (slope and aspect) and snowpack on plant phenology creates a temporaly protracted period in which vegatation at a given stage of growth will be available to bears, and 10) preliminary field data indicate that bears in the area may be relatively small in size, in comparison to those of more southerly populations and this may in part contribute to and account for greater densities. Overall, ecological conditions for black bears in GMU 6 and particularly in Prince William Sound appear to be excellent and, although individually the bears may be small in size, it is not unreasonable to believe that populations of 180 ha per bear are common.

In assigning densities of bears to subunits or portions thereof in GMU 6, consideration was given to each of the above features. The most influencial factor detracting from the maximum density of 180 ha per bear was the occurrence of brown bears in the same habitat. Not only, do I believe there is direct conflict between the two species, but I also believe that the subtle ecological differences that make these areas acceptable to brown bears must also detract from their value to black bears (i.e., wide and long river valleys with extensive open areas and lack of forest cover). For this reason, densities in subunits 1, 2, 3, 4 and portions of 8 were reduced from the maximum of 180 ha per bear

(Appendix H and Table 10).

Now, in a model let's compare the values for calculated population sizes with estimates of the sizes of those populations (Table 11). Though extremely simple, this model reveals several significant attributes regarding the distribution of the harvest of black bears in GMU 6. These data indicate that several of the subunits (1 and 2, and 8) could prd abl/ sustain considerably more harvest (about 7x) and yet other areas (3 and 4, and 5) are already sustaining a relatively heavy harvest and the annual kill in these latter subunits probably should not be increased by more than 32 and 65 bears, respectively. These vast differences in relative allocation of the kill between populations of bears exemplify the need for management on a subunit basis.

The lowest harvest deficit occurred in eastern PWS (Orca Bay-Port Gravina-Port Fidalgo-Valdez Arm-Port Valdez), where relatively low densities of black bears were assigned due to their coexistence in the area with brown bears. This contention may or may not be correct and points to the need for more information on the interaction of brown and black bears and the resulting affects on densities of each species.

Since, data in this model are the result of a mimimum estimate of mortality (only that due to hunting) and a reasonable estimate of density or number of bears in respective populations, it furnishes a very conservative theoretical appraisal of mortality and status of these populations.

Hunting of black bears in Prince William Sound occurs primarily in the spring when bears are in open beach fringe areas or on open slopes where in winter snow avalanche slides occur. Due to these circumstances, in many instances, hunters shoot at long distances, probably hit a bear, the bear then manages to get into cover, and for various reasons escapes the hunter, but later dies from the gunshot wound. After talking to a number of guides and hunters, it is not unreasonable to believe that one out of every 4 black bears shot is wounded, escapes the hunter and dies. It is possible that more bears are wounded, but being as tough as they are, many may survive. For these reasons, I believe that, at least for black bears in Prince William Sound, wounding loss is a significant source of mortality and should be considered as a loss to the population.

Perhaps one of the most significant and important parameters for management of black bears is an appraisal of the amount of natural (nonhunting) mortality and the extent that it can be compensated for by hunting mortality.

Data on natural mortality rates for black bears are scarce. Limited data available indicate that black bears may sustain substantial amounts of natural mortality. Kemp (1972) studied an unexploited population of black bears in Alberta, and found that depending on age class between 27 and 37 percent mortality was attributable to natural causes. Data gathered by Jonkel and Cowan (1971) on black bears in Montana indicated about 23 percent natural mortality for a population that was simultaneously sustaining 13 percent mortality from hunting.

Table 10. Estimates for numbers and density of black bears in subunits of game management unit 6, Prince William Sound, Alaska.

Subunit	Location	Size		No. of bears	Density[a]	
		Sq mi	Ha		No. sq mi per bear	No. ha per bear
1	Icy Bay-Copper River	1,164	301,476	754	1.5	400
2	Copper River-Bering River	500	129,500	324	1.5	400
3	Rude River-Mt. Denson	360	93,240	117	3.1	800
4	Mt. Denson-Columbia Glacier	350	90,650	225	1.6	403
5	Columbia Glacier-Esther Passage	300	77,700	432	0.7	180
6	Esther Passage-Pigot Point	215	55,685	310	0.7	180
7	Pigot Point-Taylor Glacier	180	46,620	259	0.7	180
8	Taylor Glacier-Cape Fairfield	420	108,780	575	0.7	189
9, 10,11	Misc. islands-unknown locations	-	-	-	-	-
Total		3,489	903,651	2,996	1.2	302

[a] Sq mi or Ha/No. of bears.

Table 11. Harvest deficits for populations of black bears in subunits of game management unit 6 in Alaska, as predicted from a model stipulating that all mortality is due to hunting and that 20 percent is the maximum annual rate of mortality a population can sustain.

Subunit	No. bears killed[a]	Minimum predicted population size[b]	Estimated population size[c]	Calculated maximum sustainable mortality[d]	Harvest deficit[e]
1 and 2	25	125	1078	216	191
3 and 4	36	180	342	68	32
5	23	115	432	86	65
6 and 7	23	115	569	114	91
8	16	80	575	115	99
9, 10 and 11	4	20	-	-	-
	127	635	2996	599	471

[a] Numbers of bears actually brought to department offices for tagging; absolute minimum values, mean for 1974-77.

[b] Minimum number of bears required to sustain the specified level of hunting mortality which is also equivalent to 20 percent of available population.

[c] Roughly calculated from topographic maps.

[d] Assumed maximum sustainable mortality rate equal to 20 percent of estimated number of bears.

[e] Under specified assumptions, additional number of bears that theoretically could be killed without affecting long range population size.

Contrary to the relatively high rate of natural mortality reported by Kemp (1972) for an unhunted population and that reported by Jonkel and Cowan (1971) for a hunted population, Lindsey and Meslow (1978) believed that natural mortality for black bears in Oregon was negligible in comparison to the 21 percent mortality attributable to hunting.

It is nonsensical to believe that hunted populations of bears do not sustain mortality from any other source. Likewise, it is absurd to contend that hunting mortality is not compensatory to other types of mortality. Although the biological limits for the relationship of hunting mortality to mortality from other sources are known, little data are available for interpreting more precisely the interaction between these sources of mortality i.e., if a given population of bears can sustain a maximum annual mortality rate of 20 percent and realizing that bears die from causes other than hunting; what, then, is the maximum rate of harvest the population can tolerate and yet maintain a relatively stable size?

Although data from these studies may not be directly comparable to those for populations of black bears in Prince William Sound, it appears that bears can sustain substantial amounts of natural mortality, even while under exploitation. For the purposes of this dicussion, however, the approach will again be ultra conservative in selecting a rate of natural mortality for this hunted population. If Prince William Sound black bears can only sustain 20 percent annual mortality, assume that hunting related mortality accounts for 15 percent and natural mortality accounts for the remaining 5 percent. In other words, for every 3 bears killed by hunters one dies of natural causes or out of every 20 bears alive before hunting season, one dies of natural causes. It should be apparent that this rate of natural mortality (5 percent), though perhaps realistic, seems to be much too low when one considers that it also pertains to the very vulnerable cub and subadult age classes.

It is also apparent from the literature that mortality rates for bears are greatly affected by sex and age. An overall average rate of mortality is a gross oversimplification of reality, and an overall rate of 5 percent is a very conservative approximation, since, rates reported in the literature for cubs and subadults are 5-25 percent, for prime animals are 10-15 percent and those for older animals are probably quite similar. In view of these facts, perhaps a more realistic model for these populations of black bears, would be one that considers, in addition to the direct hunting kill, mortality due to other causes such as wounding loss and natural losses.

Utilizing actual retrieved harvest data, estimated rates for wounding loss and natural losses and assuming that populations of black bears in Prince William Sound are biologically capable of sustaining 20 percent annual mortality; the size of respective populations required to sustain that level and rate of mortality can be predicted. When these data are incorporated into a model (Table 12), the size of the population necessary to sustain such a loss (equal to 20 percent of the population) must be about 1,125 bears or almost twice the number as predicted from the very simple model (635 bears).

Table 12. Population size for black bears in subunits of game management Unit 6 in Alaska, as predicted from a model stipulating that populations are stable in sustaining 20 percent mortality which is attributed to hunting loss, wounding loss and natural mortality loss.

	LOSSES				
Subunit	Hunting[a]	Wounding[b]	Other[c]	Total	Predicted population size[d]
1 and 2	25	8	11	44	220
3 and 4	36	12	16	64	320
5	23	8	10	41	205
6 and 7	23	8	10	41	205
8	16	5	7	28	140
9, 10 and 11	4	1	2	7	35
	127	42	56	225	1125

[a] Includes bears killed by sport hunters and in defense of life and property; average for 1974-77.

[b] Numbers of bears that shot, but not retrieved and eventually die; approximately 1 out of every 4 bears shot is wounded.

[c] Includes all non-hunting related mortality (disease, accidents, fighting and etc.); assumed to be equal to one-third of the hunting mortality or 5 percent (1/4) of the 20 percent total mortality.

[d] Predicted from the model that populations sustaining 20 percent mortality can remain stationary.

As with the simple model, total harvest rate for all of GMU 6 appears conservative, but exploitation rates are quite significant when data are evaluated on a subunit basis. In an alternate model in which natural mortality is equal to hunting loss (direct kill plus wounding kill) and where each of the two mortality components is equal to 10 percent of the population, we see that mortality levels in some subunits are under 10 percent and others are approaching the 20 percent maximum sustainable mortality rate (Table 13). These data also reveal that the numbers of bears assigned to some subunits (sizes of populations) are relatively small and therefore a small increase in the loss of bears can have substantial ramifications in harvest rates and population phenomena.

This elementary exercise in the use of simplistic models illustrates that present populations of bears in subunits 3 and 4 may be barely sustaining themselves, populations in subunit 5 are approaching the maximum sustainable exploitation rate and those populations in subunits 6 and 7 can only sustain a slight increase in the level of mortality.

Since many assumptions and speculations went into fabricating these models, one must not quickly accept these data as factual conclusions. These models do, however, yield a framework for formulating hypotheses and gathering field data to support or refute them.

Are there presently other data available which indicate that harvests rates in some subunits may be altering characteristics in the populations of bears. Data on sex composition of the bears harvested indicate altered sex ratios in the live populations (Table 14). In particular, data for subunits 5, 6 and 7, where the percent of females in the harvest has increased from 10 and 25 to 44 and 58 percent, respectively, indicate that there has been a drastic reduction in the ratio of males to females in those populations. Data available indicate that the percentage of females in the harvest has increased tremendously from the late 1960's when only 2 of the 46 (4 percent) black bears killed in a portion of subunit 5 were females (McIlroy 1972). Subunits 3 and 4 have sustained a relatively heavy harvest in the past and though the percentage of females killed in recent years is comparatively high, it is not greatly different from that for the late 1960's when 26 percent of the harvest was females (McIlroy 1972).

There are numerous factors that can affect the sex ratio of the harvest (i.e., breeding success, weather, phenology and behavior of bears and hunters), and one is the actual ratio in the population. If males are two to three times as vulnerable as females (these values are probably much higher for mature males), then a relatively even sex ratio in the harvest would mean that the population contains about two to three females for every male. The genetic composition as well as the natality rate of a population may be adversely affected if the sex ratio is skewed toward females.

The distribution of ages for male and female black bears killed in subunits of GMU 6 for the fall and spring seasons 1973-77 are presented in Appendix I. The age composition of males and females harvested in

Table 13. Estimates for number, density, harvest rate and mortality of black bears resident in subunits and geographical regions of game management unit 6, Prince William Sound (PWS), Alaska.

Subunit	Regional location	Area[a] (ha)	Estimated No. bears[b]	Density (ha/bear)	Estimated mortality (No.)[c]		Size of population necessary to sustain level of mortality		Estimated mortality rate (percent)		Theoretical maximum mortality potential (No. bears)[d]
					A	B	A	B	A	B	
1 and 2	Gulf of Alaska, Rude River-Icy Bay	430,976	1,078	400	44	66	220	330	4	6	216
3 and 4	Eastern PWS, Port Valdez - Valdez Arm	183,890	342	538	64	96	320	480	19	28	68
5	Northcoast PWS, Columbia Glacier - Esther Passage	77,700	432	180	41	62	205	310	10	14	86
6 and 7	Northwestern PWS, Coghill - Whittier-culross-Taylor Glacier	102,305	569	180	41	62	205	310	7	11	114
8	Southwestern PWS, Taylor Glacier-Eshamy-Cape Fairfield	108,780	575	189	28	42	140	210	5	7	115
9, 10 and 11	Misc. islands and unknown locations	-	-	-	7	10	35	50	-	-	-
TOTAL		903,651	2,996		225	338	1,125	1,690	8	11	599

[a] Roughly calculated from topographic map.

[b] Allocated as per Table 10.

[c] Includes losses attributable to hunting, wounding and natural causes; A = 5 percent natural mortality and B = 10 percent natural mortality.

[d] Assumed maximum sustainable mortality rate equal to 20 percent of estimated number of bears.

Table 14. Sex composition of black bears in the sport harvest in subunits of game management unit 6, Alaska, 1974-77.

Subunit number	1974	1975	1976	1977
	Year			
1 and 2				
No. males/No. females[a]	12/2	17/5	13/16	14/4
Males/Female	6.0	3.4	0.8	3.8
Percent females	14	23	55	21
3 and 4				
No. males/No. females	18/16	26/10	27/13	15/7
Males/Female	1.1	2.6	2.1	2.1
Percent females	47	28	33	32
5				
No. males/No. females	9/1	23/5	13/11	10/8
Males/Female	9.0	4.6	1.2	1.3
Percent females	10	18	46	44
6, and 7				
No. males/No. females	16/4	18/7	10/11	8/11
Males/Female	4.0	2.6	0.9	0.7
Percent females	25	28	52	58
8				
No. males/No. females	3/4	10/3	15/6	9/5
Males/Female	0.8	3.1	2.5	1.8
Percent females	57	23	29	36
9, 10 and 11				
No. males/No. females	3/0	1/1	4/4	1/0
Males/Female	3.0	1.0	1.0	1.0
Percent females	0	50	50	0

[a] Based on bears for which the sex was verified.

subunits of GMU 6, 1973-77, does not exhibit any profound trends (Table 15). These data demonstrate that the average age of harvested males is between 5 and 7 years depending on subunit, and that the average age for females is between 5 and 7 years.

However, data presented by McIlroy (1972) show that in the late 1960s the average age of black bears killed in the area of subunits 3 and 4 was 7.2 years and in the subunit 5 area it was 11.3 years. These data indicate that the average age of bears killed in subunits 3 and 4 may have decreased slightly from then to the present (1975-77; average age about 5.9) and certainly evidence a profound decrease in the average age of bears killed in subunit 5 over the same time period (average age 1975-77, 6.2). Similarly, out of the 22 bears from the subunit 5 area, for which McIlroy presented the ages, all were more than 4 years of age; whereas, for 1975-77, 44 percent of the bears killed in this subunit were less than 5 years of age.

Similar to the harvest data, data collected during field research in a small portion of subunit 7 also indicate that mature males may be relatively scarce and that the sex ratio is heavily skewed toward females (Table 15). Only 1 of the 12 adult bears live-captured in 1976 and 1977 was a male.

Likewise, data for age of females captured in the field exemplify a relatively lightly hunted population, but the age structure for males captured indicates a rather high rate of exploitation (Table 15). Only 1 of the 11 males captured was an adult. These statements are based on field data that are supported independently in each of the two years of study.

As previously discussed, biases related to capturing procedures may have affected the representation of adult males in the sample. Nevertheless, these are additional pieces of information that suggest the present rate of harvest has altered the sex ratio of the population.

Although preliminary, other data gathered during field research can be used to further substantiate hypotheses on density of bears and on sex and age composition of the live population.

Population size and density of bears

Evidence gained from field research on the Tebenkof Peninsula can be used to speculate on the numbers of bears actually present in that portion of subunit 7.

Before these calculations can be made, the following assumptions are necessary: 1) all bears visit streams each year to feed on spawning salmon and 2) all bears that visit streams are captured. If either or both of these are not valid the data must be adjusted accordingly.

Because only one mature male has been captured in 2 years, there is reason to believe that the assumptions may be invalid.

Table 15. Summary of age composition (1 to 3 years - 4 to 6 years - 6+ years old) of female black bears killed by sport hunters in subunits of game management Unit 6, Alaska, 1974-77.

	Subunit				
	1 and 2	3 and 4	5	6 and 7	8
1974					
No.	0-1-1	4-5-7	1-0-0	1-4-0	0-1-0
Percent	0-50-50	25-31-44	100-0-0	20-80-0	0-100-0
Mean age	6.0	5.5	2.0	4.8	4.0
1975					
No.	0-3-1	1-7-2	1-2-2	5-3-3	0-2-0
Percent	0-75-25	10-70-20	20-40-40	45-27-27	0-100-0
Mean age	6.0	6.1	6.6	4.8	5.5
1976					
No.	2-11-3	4-3-6	2-4-5	3-6-2	1-4-1
Percent	13-69-19	31-23-46	18-36-45	27-55-18	17-67-17
Mean age	5.8	6.5	6.6	5.0	5.5
1977					
No.	0-1-3	2-2-3	2-2-4	0-3-6	0-1-3
Percent	0-25-75	29-29-43	25-25-50	0-33-67	0-25-75
Mean age	6.3	5.4	6.1	9.1	9.8

Summary of age composition (1 to 3 years - 4 to 6 years - 6+ years old) of male black bears killed by sport hunters in subunits of game management Unit 6, Alaska, 1974-77.

	Subunit				
	1 and 2	3 and 4	5	6 and 7	8
1974					
No.	1-7-4	8-3-7	1-7-1	1-9-3	0-0-3
Percent	8-58-33	44-17-39	11-78-11	8-69-23	0-0-100
Mean age	6.0	5.4	4.3	5.5	7.7
1975					
No.	2-8-7	3-12-10	4-10-9	2-9-7	2-3-4
Percent	12-47-41	12-48-40	17-43-39	11-50-39	22-33-44
Mean age	6.2	6.5	6.7	6.7	6.3
1976					
No.	2-9-2	11-9-7	5-4-4	2-5-2	1-7-6
Percent	15-69-15	41-33-26	38-31-31	22-56-22	7-50-43
Mean age	5.2	4.8	5.7	5.1	7.0
1977					
No.	2-6-7	3-4-7	6-1-3	1-2-4	3-0-3
Percent	13-40-47	21-29-50	60-10-30	14-29-57	50-0-50
Mean age	7.1	6.7	5.7	5.9	5.8

The fact that some bears captured in 1977 had not been captured in 1976, does not indicate that all bears do not visit salmon streams each year. In 1977, most newly captured bears were captured at Parks Creek, a stream that was not trapped in 1976. Data gathered in 1978 should furnish considerably more information on the propriety of this assumption.

There is reason to believe that all bears visiting streams are not captured, but because the bears do use definite trails and large quantities of snares are set in each area, the probability of a bear not being captured is relatively small, and certainly much less than 0.3 and perhaps more likely, less than 0.5; i.e., in the latter case, for every two bears that feed on salmon, one is captured. If this sequence of assumptions is true, then capturing 15 bears implies that 15 others were present and were not captured.

If an imaginary line were drawn along the section line located immediately north of Horse and Ripon Glaciers on the Tebenkof Peninsula, it leaves about 34 mi^2 of land to the north: approximately 1554 ha (6 mi^2) of glacier, 259 ha (1 mi^2) of glacial plain, 3108 ha (12 mi^2) to the west of Tebenkof Glacier and 3885 ha (15 mi^2) to the east of Tebenkof Glacier (Fig. 4). Discounting terrain covered by glacier, there remains approximately 7252 ha (28 mi^2) of habitat which is assumed to be suitable for black bears. Data extrapolated from field research results indicate that a minimum of 20 and 24 bears may have inhabited the area in 1976 and 1977, respectively (Table16). A simple marked:recapture ratio indicates that 34 bears were present in the area, but this value is probably an overestimate as Parks Creek, where five new bears were captured, was not trapped in 1977.

It is believed that most bears feeding on salmon on the Peninsula were at the streams where trapping occurred. Though there were several other streams in Blackstone and Cochrane Bays that contained spawning salmon, there was very little evidence of bear sign near them. Of particular interest, in this regard, is Paulson Creek. During both the 1976 and 1977 August trapping seasons, Paulson Creek has had excellent runs of spawning salmon, but indications from bear sign and trapping success were that this stream failed to attract many bears. Likewise, three other streams in Cochrane Bay farther south than Paulson Creek also contained a number of spawning salmon but there was little evidence of bear sign.

It would seem reasonable to believe that if there were many more bears to the south of Parks Creek, there would have been substantial amounts of bear sign along those streams. If anything, Parks Creek may have drawn some bears from Paulson Creek and other streams to the south and outside the 7252 ha area, thereby inflating estimates of density.

If we assume that densities are equivalent to the appraisal for this subunit (i.e., 180 ha per bear or one bear per 0.7 mi^2), this area of 7252 ha should contain about 40 bears. A further extension of these data, assuming that there was no mortality or emigration, would imply that only 60 percent of the population had been captured or observed and that the area still harbored 16 individuals that had elluded trapping in

Table 16. Theoretical age structure for the black bear population in the Blackstone Bay, Cochrane Bay and Culross Passage areas in western Prince William Sound, Alaska, adapted and inferred from capture and observational data, 1976-77.

Basic assumptions:

- Bears captured in the study area were residents.
- Bears captured in 1977 were also present but not captured in 1976 and bears captured in 1976 were alive but not captured in 1977.
- The sex ratio of bear cubs was 50:50.
- Recaptured bears were recognized.

	1976			1977		
	C/H[a]	A/O[b]	Total[c]	C/H	A/O	Total
Females						
	10	11/G1	11/G1	12/C1	11	12/C1
	8*/G2	10	10	11	7	11
	6	10	10	11	3	11
	4*/C2	1	10	9*/C2	2	11
	3*/G1	C**	8*/G2	5*	2	9*/C2
	2		6	4*/C1	1**	7
	1		4*/C2	2	C	5*
	1		3*/G1	1		4*/C1
			2	C		3
			1			2
			1			2
			1			2
			C			1
						C
						C
Males						
	6	1	6	2*	7	7
	1	1	1	2*	2	2
	1*	C**	1	2	1**	2*
	1*		1	2	C	2*
			1	C		2
			1			2
			C			1
						C
						C

$$\text{Population size} = \text{number marked} \times \frac{\text{number captured}}{\text{marked recaptures}}$$

$$= 12 \times \frac{14}{5}$$

$$= 34$$

a Individuals captured and handled.
b Individuals observed or assumed to be alive.
c Cubs listed separately are also shown associated with their sows.
* Individuals recaptured.
** Assumed to be a cub of 4*/C2.

1976 and 1977. These facts can be interpreted to mean that on the average for both years (14 in 1976 and 16 in 1977), of the 40 bears available, only one bear out of 2.7 visited streams to feed on spawning salmon or that for every 1 bear that visited a stream there were 1.7 that were not captured or did not visit a salmon stream.

If 40 is a good estimate for the number of bears in this portion of the Tebenkof Peninsula, then for the 15 bears captured along salmon streams there were another 15 that were not captured, and there were probably another 10 bears that did not come and feed on spawning salmon. These estimates may merely be representative of reality, but if anything, those numbers for bears not visiting streams or not being captured are much too high.

Determining the quantity of available bear habitat (a three dimensional concept) from topographic maps (a two dimensional format) has its shortcomings. In reality, the quantity of available habitat and the number of bears inhabitating this portion of the Tebenkof Peninsula may be about 5 to 10 percent greater because of the mountainous nature of the terrain.

Following a great deal of speculation, it appears that about 40 bears may inhabit the Tebenkof study area, that a density of one bear per 180 ha or 0.7 mi^2 per bear for similar habitat in Prince William Sound is conservative and quite reasonable and densities greater than this appear unlikely.

Sex ratio of adult bears

Data gathered from field research indicate that of the 30 total bears observed or captured and of the 12 adult bears captured only one was an adult male. These data suggest that for the 9 adult females assumed to be in the area in 1977, there was only one adult male.

The sex ratio for adults captured in the study area is extremely skewed toward females (9:1) when compared to sex ratios of bears as reported in other studies. In Idaho, Beecham (In Prep.) found that the ratio of adult females to adult males was 1:1 and 1.5:1 for relatively unhunted and heavily hunted populations of black bears, respectively. Similarly, Lindsey and Meslow (1977) and Jonkel and Cowan (1971) found that there were 1.5 adult females per adult male in hunted populations of black bears in Washington and Montana, respectively. Kemp (1z72) reported that the sex ratio for adult black bears was not different from 1:1 for an unhunted population in Alberta.

Trapping along salmon spawning areas could greatly bias the sample toward females, but Burton (1975 and pers. comm.) reported that, in California, most bears that feed on spawning salmon are males and they may even travel great distances to be at these streams when salmon are available.

If it can be assumed that adult males do not avoid feeding on spawning salmon (...and why should they?) and they are no more difficult to trap than females, these data certainly indicate a sex ratio heavily skewed toward females. It seems rather unlikely that another four to eight adult males, which would be needed to make the sex ratio somewhat similar, were in the area and avoided being captured.

What are the biological consequences of unbalanced adult sex ratios? Perhaps it is not unreasonable to believe that one boar can breed three or four sows a season. If this were the case, then one or two adult boars could possibly service all of the available sows, since only half of them will come into estrous each year. Although the biological value or necessity of balanced sex ratios for adult bears presently appears unquestionable because of physical reasons, it is evident that in future management schemes consideration will have to be given to the number of boars available per sow, the numbers of sows that a single boar can breed and the ultimate affects of unbalanced sex ratios on the genetics of a population of bears.

Whittier Black Bear Hunter Questionnaire Survey - Spring, 1977

This questionnaire survey was conducted to obtain facts about hunters and hunting of black bears during the spring season in western Prince William Sound. Of particular interest was information pertaining to the following: numbers of people participating in the hunt; how they hunted; where they hunted; why they were hunting; why they hunted in Prince William Sound; duration of their hunts; numbers of bears seen and the location of sightings.

To obtain this information, a questionnaire was designed and a Department representative was stationed in Whittier (May 13 - June 3) to survey hunters as they returned from the field.

As expected, many hunters complained about the complexity of the questionnaire and time required to answer the questions. A train provides access for about 95 percent of those people going to Whittier, and many hunting parties arrived back in town just in time to catch a train. For these reasons time was valuable to hunters and some parties were not pressured into completing the questionnaire at the detriment of the Department's image.

Intentions were to survey hunters from mid-May to mid-June (the normal peak of the harvest), but these were precluded due to personnel reasons. Because spring 1977 was phenologically early and numbers of hunters afield in early June decreased considerably from late May, premature termination of the survey may not have had a detrimental impact on findings of the study.

During the survey a total of 53 people were represented by the 18 parties of hunters contacted. Hunting parties ranged from two to six in number. Nine of the people along on the hunts were not themselves hunting.

Hunting parties spent between one and five days afield; a total of 181 man days were utilized by the 53 participants.

Though all parties were primarily in the area to hunt black bears, 13 of them also engaged in other activities. The following list indicates the "other" activities engaged in and the number of parties partaking: salt-water fishing - 12; crab fishing - 6; boating - 2; viewing - 1 and hiking - 1. One hunter was there as much to boat as to pursue black bears.

All parties contacted were using privately owned boats. Only one party indicated that they did not hunt from the boat and only used the boat for transportation. All other parties were actively hunting while the boat was under power. Only eight parties indicated that they did not spend the nights on board, 10 parties slept on board and four parties indicated sleeping on board their boat as well as camping out. None of the hunting parties indicated that they returned to Whittier and spent the night in commercial facilities.

Of the 35 respondents noting why they selected the Prince William Sound area to hunt bears, 11 indicated that it was close to their home in Anchorage, nine selected this area because of the relatively high density of bears, eight listed hunter success in combination with another reason, four listed solely hunter success, two noted that they regularly boat in the area, one listed high quality of the bears' hides, and one said he had hunted that same area for the last eight years.

When questioned as to why they were hunting black bears, replies from 36 respondents may be summarized in the following manner. Twenty-nine indicated that they hunted black bear for the trophy; 14 listed this as the sole reason, while 10 others indicated multiple uses including the trophy and recreation and primary reasons. In seven of the instances where preference was indicated, recreation was favored in four and the trophy was favored in three. Eleven respondents listed domestic use of meat in combination with other reasons and four hunters were after bears solely for their meat. Of the respondents listing a priority between two or more reasons, recreation was listed as the priority in four, trophy as the priority in three and domestic use of meat as the priority in one.

Eleven of the 18 parties surveyed were successfull in killing at least one bear. One party of four individuals (three hunters) killed three bears and another party of two hunters killed two bears.

Of the 14 bears reported killed, eight of them were first seen on upland slopes and seven of them were first seen on the shoreline. Six of nine hunters that killed bears said that they shot the first bear they had seen and the remaining three hunters indicated that their bear was shot because of its large size.

Five of the 18 hunting parties did not see any bears; each of four parties saw only one single bear, the remaining nine parties saw a total of 58 bears (singles - 39, sows with one cub - two and sows with two cubs - five). One party of four hunters and one party of two hunters saw 15 and 14 different bears, respectively. Parties seeing the most bears (six +) hunted in the Esther Passage, Eaglek Bay and Unakwik Inlet areas. Some parties that hunted only a few days saw three to four bears. Parties hunting the last week of May (after considerable snow melt but before the vegetation had leafed-out) saw the most bears. Hunters afield in mid-May saw fewer bears and those afield in early June saw the fewest.

Most parties hunted in Passage Canal and Port Wells (10); more parties hunted in Cochrane Bay, Culross Passage and areas to the south (eight) then went to the Esther Passage, Eaglek Bay and Unakwik Inlet areas (six). Some of the extreme distances (one way estimates) traveled by hunters in pursuit of bears are the following: Harriman Fiord (42 mi) and Wellesley Glacier (48 mi) to the north; Bainbridge Island (66 mi) to the south and Jonah Bay (60 mi) to the east and north.

All but three of the hunting parties came in contact with other hunters while in the field. Two groups of hunters reported seeing 10 and 12 other hunting parties while out in the field. In total, hunters reported seeing 53 other hunting parties while afield. None of the hunters responding to the survey indicated that they thought hunting conditions were crowded.

Five respondents indicated that they had hunted in the area previously the same year. Previous hunting trips ranged in length from one to five days; seven days was the greatest total number of days recorded for a single hunter in pursuit of black bears.

Ten of 36 respondents had hunted black bears in Prince William Sound in at least one of the previous three years. Five of these hunters hunted in more than one of the previous three years and three had hunted in each of the three preceeding years. Five of these hunters had killed a bear in a previous year. One respondent had killed a bear in two of the previous years and one individual had killed a bear in three of the last four years.

In 11 of 23 instances, bears were reported to be seen primarily along the shoreline, in the remaining 12 instances hunters reported seeing most bears on the upland slopes.

Nineteen hunters responded to the question asking at what time of day were bears generally seen. No hunters indicated that bears were seen before noon, one saw a bear around noon, seven noted that bears were seen in the afternoon and 11 noted that bears were seen in the evening.

If the success of the hunters interviewed in this survey is representative of all hunters in north and western Prince William Sound (subunits 5, 6, 7 and 8), the total number of hunters that pursued black bears in these areas can be calculated. Since 45 hunters took 14 bears, one can speculate that for every bear killed there were 3.2 hunters afield for an average of 3.4 days each or that for each bear killed about 11 man days of effort were expended. Similarly, about 186 hunters and 638 man-days effort were probably required to account for the 58 bears killed in subunits 5, 6, 7 and 8 in spring 1977. These data also imply that about 75 boats or parties of hunters were involved in the harvest of the 58 bears killed in the spring season.

If it is true that about 90 percent of the hunting takes place during the weekends, then on a typical weekend day there are probably 17 boats and parties of hunters hunting in this area. All hunters interviewed judged that these hunting conditions were not crowded.

Since our data were gathered during the time period when bears are most vulnerable and hunter success would be highest, it is likely that more effort per bear was required for each bear taken before or after this particular time period.

If the following assumptions were reasonable: 1) the average income of a bear hunter is $8/hr ($64/day) and hunters are sacrificing income to hunt black bears; 2) about $10 is invested in food, refreshments, and other miscellaneous commodities for each day; about $10 is invested for boat fuel by each hunter for each day; each hunter pays $35 for round trip transportation for himself and his boat from his residence to Whittier; and each person spends $50 for gear specifically for his bear hunt (raingear, gloves, cartridges, etc); we can very tentatively and conservatively conclude that the average hunter spends a minimum of ($64 + $10 + $10 + $35 + $50) $169 to hunt black bears for one day in western Prince William Sound. Since eleven man-days (hunting party days) effort are expended to kill each bear, approximately $1186 (3.2 hunters for 3.4 days or $84 x 3.2 hunters x 3.4 days plus 85 x 3.2 hunters equals $914 + $272) are spent for each bear killed. Therefore, it is not unreasonable to conclude that nearly $70,000 were spent in May and June by hunters pursuing black bears in north and western Prince William Sound in spring 1977. If hides from all black bears killed were mounted into trophy rugs (at about $300 per rug), these 58 black bears would generate an additional $17,400 of revenue and raise the "value" of each sport killed black bear to $1486.

Data gathered in this survey indicate that 28 percent of the hunters interviewed had previously hunted black bears in Prince William Sound and that 13 percent of the hunters had killed a bear in this area in a previous year. This information appears to partly negate the contention that once a person kills a black bear he is not likely to hunt them again.

Though most hunters believe that bears are usually found in the beach fringe areas, in 1977 more than half of the hunters reported seeing more bears on upland slopes and slide areas than along the beaches. This occurrence may in part be explained by the extremely early and rapid disappearence of snow from upland slopes which enabled bears to forage in places other than beach fringe areas.

RECOMMENDATIONS

Aldrich spring activiated foot snares proved to be effective and efficient for capturing black bears in the summer when they gather along streams to feed on spawning salmon. Though effective and efficient for capturing bears, this technique may not yield a sample that is representative of the actual population.

Data from bears captured on the Tebenkof study area during field activities in each of two years (1976 and 1977) along with data from the sport killed sample indicate a preponderance of females in the population. Future studies should be designed to substantiate and/or explain this divergence from the expected 1:1 sex ratio and the scarcity of adult males. Not only is this necessary for management purposes but it is also of importance to determine the "representativeness" of samples of bears captured along salmon spawning streams. Perhaps a pursuit or bait set method of capturing bears would provide an independent set of data to compare with those presently available.

If a time lapse photography system were set up to record the activity of bears along streams where trapping took place, one could further substantiate efficiency and selectivity of foot snaring as a technique for capturing black bears.

In future studies, an effort should made to gather data to explain why in a given year many bears gather at the same stream to feed on salmon, and why the bears may congregate at a different stream in different years. These data will also help substantiate how representative are samples of bears captured in foot snares set along salmon spawning streams.

Phencyclidine hydrochloride was found to be a satisfactory immobilizing agent for black bears. Recent changes in federal registration and regulations and production of this drug dictate use of a different substance in future studies. Roy Hugie (pers. com.) has successfully used ketamine hydrochloride on black bears in Maine. Hugie reported that he had no deaths and recovery times were shorter than for phencylidine hydrochloride. Also the drug was inexpensive and readily available, bears maintained protective reflexes while anesthetized, and the drug was not incumbered by strict federal regulations. He did point out that the drug would be more useful on large bears if it came in higher concentrations (200-400 mg/cc). The highest concentration of the drug currently available (100 mg/cc) requires that 6-8 cc be injected into a 150 lb bear to result in anesthesia. Recently, Hugie further reported handling large bears successfully with initial doses of 6-7 cc and following those up with subsequent and lesser injections by hand-held syringe or jab stick. This technique has extended the normal 20-30 minute down time (@ 5mg/lb) to as long as 6 hours.

Results of blood serum analyses indicate tremendous variation between years. Since handling techniques did not vary significantly, variation may have been due to careless analytical procedures. Regardless, it is recommended that if sera are collected in the future, the whole blood be centrifuged shortly after collection, in opposition to drawing sera off a sample of clotted whole blood. The former procedure would require that a centrifuge be available at the field camp.

Suitable material and an adequate technique for attaching and maintaining colored flagging on ear tags must be developed.

The expandable type collars developed and produced by the AVM Instrument Company appear to function adequately. The transmitters are light weight and small (pack and collar) and the soft and smooth collar material causes minimal irritation and may partly be the reason for them remaining on the animal. In the future this same type of collar and battery pack will be tested as "fixed size" radio collars.

Models presented in this report are extremely crude but do furnish a framework from which more comprehensive ones can be designed. This exercise in modeling demonstrated the desirability of managing black bears in GMU 6 on a subunit basis. In doing this, it points to the need for accurate reporting of kill locations.

Future studies should be designed to determine the extent that fiords, glaciers and snowfields limit movement of bears and to appraise the influence of brown bears on the density of black bears where both species coexist.

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APPENDIX A.

Sex composition of black bears killed in subunits of game management unit 6, Alaska, July 1973-77.

Subunit	1973			1974			1975			1976			1977[b]		
No.	M[a]	F	T	M	F	T	M	F	T	M	F	T	M	F	T
1	1	0	1	4	1	7	15	5	21	5	5	10	10	4	16
2	1	0	1	9	1	10	5	0	6	11	14	25	5	0	6
3	1	0	2	22	14	37	7	5	13	11	9	20	6	3	10
4	5	2	7	3	2	5	22	6	28	19	7	27	8	6	15
5	0	0	0	12	2	14	26	6	35	13	12	27	11	10	24
6	1	0	1	7	1	8	13	2	16	9	6	15	3	6	9
7	1	0	1	9	3	13	5	5	12	1	5	6	5	5	12
8	0	0	2	3	4	11	10	3	15	15	6	24	9	5	15
9	0	0	0	0	0	0	0	0	0	3	1	4	0	0	0
10	1	0	2	3	0	3	1	3	4	1	1	3	1	0	1
11	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0
Total	11	2	17	72	28	108	105	35	151	89	66	162	58	39	108

[a]M = males; F = females and T = males plus females plus bears for which the sex was not verified.

[b]Data represents sealing certificates on file as of December 1, 1977, subject to minor changes.

APPENDIX B.

Subunit, season and sex for black bears killed in game management unit 6, Alaska, July 1973-77.

Subunit No.	1973 Fall[a] M[b]	F	FT	1974 Spring M	F	ST	1974 Fall M	F	FT	1975 Spring M	F	ST	1975 Fall M	F	FT
1	1	0	1	4	1	7	0	0	0	13	3	17	2	2	4
2	1	0	1	7	1	8	2	0	2	2	0	2	3	0	4
3	1	0	2	14	6	20	8	8	17	7	4	12	0	1	1
4	5	2	7	2	2	4	1	0	1	21	6	27	1	0	1
5	0	0	0	12	2	14	0	0	0	26	6	35	0	0	0
6	1	0	1	7	1	8	0	0	0	13	2	16	0	0	0
7	1	0	1	9	3	13	0	0	0	5	5	12	0	0	0
8	0	0	2	2	2	5	1	2	6	7	3	12	3	0	3
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1	0	2	2	0	2	1	0	1	0	2	2	1	1	2
11	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Unit totals by:															
Season	11	2	17	59	18	81	13	10	27	95	31	136	10	4	15
Year	11	2	17	72	28	108				105	35	151			

continued

APPENDIX B. Continued.

Subunit No.	1976						1977[c]					
	Spring			Fall			Spring			Fall		
	M	F	ST	M	F	FT	M	F	ST	M	F	FT
1	5	5	10	0	0	0	10	4	16	0	0	0
2	6	8	14	5	6	11	5	0	6	0	0	0
3	4	6	10	7	3	10	6	3	10	0	0	0
4	7	2	9	12	15	18	8	5	14	0	1	1
5	10	11	23	3	1	4	11	10	24	0	0	0
6	9	5	14	0	1	1	3	6	9	0	0	0
7	1	4	5	0	1	1	5	5	12	0	0	0
8	14	6	23	1	0	1	8	4	13	1	1	2
9	3	1	4	0	0	0	0	0	0	0	0	0
10	1	0	1	0	1	2	0	0	0	1	0	1
11	0	0	0	1	0	1	0	0	0	0	0	0
Unit totals by:												
Season	60	48	113	29	18	49	56	37	104	2	2	4
Year		89	66	162				58	39	108		

[a] Spring = January 1 to July 31; Fall = August 1 to December 31.

[b] M = Males; F = Females; ST = Spring season total and FT = Fall season total; Season totals include bears for which the sex was not verified.

[c] Data represents sealing certificates on file as of December 1, 1977, subject to minor changes.

APPENDIX E. Continued.

Electrophoretic fractions of blood sera proteins from black bear captured in western Prince William Sound in Alaska, 1976.

Bear no.	Sex	Date of collection	No. cemental annuli	Total protein (g/dl & gm%)	Albumin %	Albumin gm%	Globulins Total %	Globulins Total gm%	Alpha 1 %	Alpha 1 gm%	Alpha 2 %	Alpha 2 gm%	Beta %	Beta gm%	Gamma %	Gamma gm%	A/G ratio
B101	F	7-29	3	7.70	42.1	3.24	57.9	4.46	5.9	0.46	8.4	0.65	22.2	1.71	21.3	1.64	0.73
B105	F	8-2	8	5.20	42.8	2.23	57.2	2.97	4.9	0.25	4.7	0.24	20.5	1.07	27.1	1.40	0.75
B107	M	8-3	2	3.90	45.3	1.77	54.7	2.13	5.1	0.20	6.0	0.23	27.1	1.06	16.5	0.64	0.83
B113	F	8-10	4	8.30	38.1	3.16	61.9	5.14	4.3	0.35	12.1	1.01	22.8	1.89	22.8	1.89	0.61
B115	F	8-10	2	6.70	38.8	2.60	61.2	4.10	6.1	0.41	8.4	0.57	19.8	1.33	24.9	1.80	0.63
B117	F	8-19	10	7.70	44.5	3.42	55.5	4.28	4.4	0.38	5.9	0.4[illegible]	23.7	1.83	21.0	1.62	0.80
B119	M	8-19	1	8.10	41.5	3.36	58.5	4.74	6.2	0.50	4.4	0.35	25.4	2.06	17.1	1.86	0.71
B121	M	8-22	2	3.80	47.0	1.79	53.0	2.01	4.9	1.9	5.1	0.19	23.1	0.88	19.9	0.75	0.89
B123	F	8-22	1	5.30	48.5	2.57	51.5	2.73	5.3	0.28	5.2	0.27	22.8	1.21	18.2	0.97	0.94
B125	F	8-24	4	7.30	44.9	3.28	55.1	4.02	6.6	0.48	6.6	0.48	20.5	1.49	21.4	1.56	0.81
B127	F	8-28	1	7.20	41.7	3.00	58.3	4.20	5.0	0.36	8.9	0.64	20.9	1.50	23.5	1.69	0.72
B129	F	8-28	6	7.00	43.2	3.00	46.8	4.00	4.6	0.33	8.1	0.59	26.5	1.91	17.5	1.26	0.76

APPENDIX C.

Date, location, sex, age, linear body measurements and weight for black bears captured in western Prince William Sound in Alaska, 1976.

Date of capture	Location[a]	Sex/No./ sow No.	Age[b]	Total[c] length	Body length	Height at shoulder	Girth	Foreleg girth	Neck circum.	Head Width	Head Length	Pad width (mm) Rear	Pad width (mm) Fore	Weight (lbs.)
7/29/76	TW	F/B101	3	139	99	81	96	31	60	16.4	26.5	9.4	10.5	175
8/19/76	TW	F/B101	3	--	--	--	98	33.5	58	--	--	--	--	200
7/31/76	HL	M/B103	2	129	84	83	83	28	51	14.4	26.5	8.9	9.1	115
8/2/76	TW	F/B105	8	142	97	79	87	30	56	15.8	24.9	8.8	9.4	160
8/3/76	PL	M/B107	1	122	73	73	75	25	42	13.5	24.7	8.5	9.3	90
8/9/76	TW	M/B109	6	143	90	87	93	29	59	17.3	28.3	10.8	12.5	185
8/9/76	TW	M/B112	1	123	73	67	72	26	42	12.8	23.5	9.9	9.0	90
8/10/76	HL	F/B113	4	140	77	83	81	30	45	14.0	25.2	9.2	10.4	120
8/10/76	TE	F/B115	2	115	68	76	69	23	41	13.5	23.0	8.4	9.3	80
8/19/76	TW	F/B117	10	146	79	81	92	30	55	15.3	25.1	8.7	9.9	150
8/19/76	TE	M/B119	2	130	71	75	74	27	47	13.1	24.2	9.3	9.5	100
8/22/76	PC	M/B121	2	132	73	75	82	28	48	14.1	25.0	8.7	9.7	125
8/22/76	TE	F/B123	1	123	67	69	66	24.5	43	12.5	22.3	7.3	8.7	85
8/24/76	TE	F/B125/2cubs	4	146	83	83	83	27.5	51	14.7	25.0	8.2	8.8	140
8/28/76	TW	F/B127	1	118	67	67	74	24	41	12.5	21.9	8.2	8.9	90
8/28/76	TW	F/B129	6	145	83	76	92	30	54	16.0	25.0	8.7	9.8	155

a TW = Tebenkof West
TE = Tebenkof East
H = Harrison Lagoon
PL = Paulson Creek
PC = Pirate Cove

b Number of cemented annuli; equal to the numbers of winters and/or denning periods in lifetime, excluding the winter of birth.

c Measurements in cm. unless otherwise noted.

APPENDIX D.

Date, location, sex, age, linear body measurements, weight and rectal temperature for black bears captured in western Prince William Sound in Alaska, 1977.

Date of capture	Location[a]	Sex/No./ Sow No.	Age[b]	Total[c] length	Body length	Height at shoulder	Girth	Foreleg girth	Neck circum.	Head Width	Head Length	Rear pad (mm) Width	Rear pad (mm) Length	Hind foot Length(mm)	Weight	Rectal tempF°
7/25/77	TE	F/B105/2cubs	9	144	80	79	88	29	53	16.0	24.7	9.0	--	23	150	100
8/7/77	TW	F/B101/1cub	4	--	--	--	--	--	--	--	--	--	--	--	--	--
8/13/77	TE	F/B135/B105	cub	89	45	47	49	16	29	9.6	16.7	5.5	8.0	16	26	98
8/14/77	PK	M/B119	2	149	83	82	84	28	50	14.3	25.0	9.5	14.0	24	115	--
8/14/77	PK	M/B107	2	132	88	81	85	29	50	15.5	25.5	9.0	13.0	24	135	--
8/16/77	PK	F/B125	5	141	83	82	86	27	50	14.8	25.5	8.0	12.5	21	148	98
8/16/77	PK	F/B141/1cub	11	141	77	79	86	28	50	16.0	25.0	8.0	13.0	22	136	99
8/16/77	PK	F/B143	12	155	80	85	100	30	59	17.0	26.8	9.0	14.0	23	180	101
8/17/77	PK	F/B137	11	138	100	78	95	32	51	15.7	25.5	10.0	14.0	22	170	100
8/19/77	PK	F/B147	1	104	65	63	68	23	38	12.3	20.5	6.7	10.4	18	72	103
8/20/77	PK	M/B149	2	137	84	81	88	31	47	15.0	25.5	9.3	13.3	23	141	104
8/24/77	PL	F/B151	2	121	72	68	76	26	44	13.3	22.8	8.0	12.0	21	94	102
8/27/77	PK	M/B153	2	134	71	77	82	29	45	14.0	25.5	9.0	13.3	24	127	101
8/28/77	TW	M/B155/B101	cub	88	47	48	56	20	31	10.5	18.5	6.0	9.2	18	40	103

a TW = Tebenkof West
TE = Tebenkof East
PK = Parks Creek
PL = Paulson Creek

b Number of cemental annuli; equal to the numbers of winters and/or denning periods in lifetime, excluding the winter of birth.

c Measurements in cm. unless otherwise noted.

APPENDIX E.

Elemental components of blood sera from black bears captured in western Prince William Sound in Alaska, 1976.

Bear no.	Sex	Date of collection	No. cemental annuli	Phosphorus mg/dl	Calcium mg/dl	Iron ug/dl	Sodium meq/L	Potassium meq/L	Chloride meq/L
B101	F	7-29	3	4.9	7.9	96	138	4.3	103
B105	F	8-2	8	3.7	5.3	86	97	2.9	74
B107	M	8-3	2	2.8	4.3	165	69	2.4	49
B113	F	8-10	4	4.1	8.7	55	140	4.8	103
B115	F	8-10	2	3.3	6.5	50	118	4.4	91
B117	F	8-19	10	4.2	8.7	125	141	4.1	107
B119	M	8-19	1	5.2	8.8	113	139	4.4	104
B121	M	8-22	2	2.6	4.4	51	78	2.3	58
B123	F	8-22	1	4.9	7.4	70	123	3.8	100
B125	F	8-24	4	7.1	7.1	114	143	4.4	111
B127	F	8-28	1	4.3	7.5	64	140	3.8	106
B129	F	8-28	6	5.5	8.0	93	144	4.4	109

APPENDIX E. Continued.

Carbon dioxide and enzymes and other nitrogenous components in blood sera from black bears captured in western Prince William Sound in Alaska, 1976.

Bear	Date of collect.	Age	Carbon dioxide (meq/L)	LDH (U/L)	SGOT (U/L)	SGPT (U/L)	Alkaline p'tase (U/L)	Creatinine (mg/dl)	BUN (mg/dl)	Creatinine/ BUN	Uric acid (mg/dl)	Total protein (g/dl)	Albumin (g/dl)	Globulin	A/G	Total bilirubin (mg/dl)
B101F	7-29	3	22	990	333	125	56	0.5	15	0.03	1.7	7.7	3.8	3.90	0.97	0.0
B105F	8-2	8	15	670	293	75	42	0.5	22	0.02	1.2	5.2	2.3	2.90	0.79	0.1
B107M	8-3	2	9	1190	363	69	42	0.3	13	0.02	1.2	3.9	2.0	1.90	1.05	0.1
B113F	8-10	4	20	960	177	160	38	0.9	12	0.08	1.7	8.3	3.8	4.50	0.84	0.0
B115F	8-10	2	20	1310	403	230	23	0.5	13	0.04	1.1	6.7	3.0	3.70	0.81	0.1
B117F	8-19	10	23	1041	520	130	43	0.7	24	0.03	1.5	7.7	3.7	4.00	0.93	0.1
B119M	8-19	1	23	1340	244	113	78	0.6	15	0.04	1.7	8.1	4.1	4.00	1.03	0.0
B121M	8-22	2	12	750	263	75	51	0.3	7	0.04	0.8	3.8	1.9	1.90	1.00	0.0
B123F	8-22	1	15	1460	479	290	83	0.7	13	0.05	1.1	5.3	2.8	2.50	1.12	0.4
B125F	8-24	4	18	1510	440	120	61	0.8	27	0.03	1.8	7.3	3.7	3.60	1.03	0.0
B127F	8-28	1	23	1030	192	121	39	0.6	11	0.05	1.2	7.2	3.6	3.60	1.00	0.0
B129F	8-28	6	23	1230	293	170	55	0.6	25	0.02	1.9	7.0	3.7	3.30	1.12	0.0

APPENDIX F.

Elemental components of blood sera from black bears captured in western Prince William Sound in Alaska, 1977.

Bear no.	Sex	Date of collection	No. cemental annuli	Phosphorus mg/dl	Calcium mg/dl	Iron ug/dl	Sodium meq/L	Potassium meq/L	Chloride meq/L
105	F	7-25	9	1.8	3.2	82	64	2.0	46
107	M	8-14	2	2.5	3.1	33	70	2.2	55
119	M	8-14	2	3.7	4.5	56	90	2.3	68
125	F	8-16	5	2.1	2.5	40	52	1.4	32
135	F	8-13	Cub	2.9	2.9	71	56	1.6	37
137	F	8-17	11	2.6	2.9	60	68	1.7	45
141	F	8-16	11	1.1	2.1	32	55	1.4	35
143	F	8-16	12	1.9	2.8	58	59	1 7	34
147	F	8-19	1	1.5	1.9	34	49	1 5	25
149	M	8-20	2	2.5	3.5	93	61	1.7	37
151	F	8-24	2	4.1	4.7	126	89	3.1	64
153	M	8-27	2	3.2	4.6	99	81	2.7	53
155	M	8-28	Cub	5.5	5.5	143	89	2.5	65

APPENDIX F. Continued.

Electrophoretic fractions of blood sera proteins from black bear captured in western Prince William Sound in Alaska, 1977.

Bear no.	Sex	Date of collection	No. cemental annuli	Total protein (g/dl & gm%)	Albumin %	Albumin gm%	Globulins: Total %	Total gm%	Alpha 1 %	Alpha 1 gm%	Alpha 2 %	Alpha 2 gm%	Beta %	Beta gm%	Gamma %	Gamma gm%	A/G ratio
105	F	7-25	9	3.10	48.7	1.51	51.3	1.59	4.8	0.15	2.9	0.09	17.1	0.53	22.6	0.70	0.95
107	M	8-14	2	2.90	47.6	1.38	55.9	1.62	6.6	0.19	5.9	0.17	17.2	0.50	22.4	0.65	0.85
119	M	8-14	2	4.70	38.5	1.81	82.8	2.89	5.3	0.25	9.1	0.43	17.9	0.84	29.1	1.37	0.63
125	M	8-16	5	2.30	38.3	0.88	61.7	1.42	7.4	0.17	7.4	0.17	18.3	0.42	26.5	0.61	0.62
135	F	8-13	Cub	1.90	57.4	1.09	42.6	0.81	7.4	0.14	3.2	0.06	17.4	0.33	14.2	0.27	1.35
137	F	8-17	11	3.10	47.7	1.48	52.3	1.62	3.9	0.12	10.3	0.32	19.4	0.60	18.1	0.56	0.91
141	F	8-16	11	2.20	49.5	1.09	50.5	1.11	4.1	0.09	4.5	0.10	21.4	0.47	20.5	0.45	0.98
143	F	8-16	12	2.50	42.8	1.09	57.2	1.43	5.6	0.14	6.8	0.17	13.2	0.33	31.6	0.79	0.75
147	F	8-19	1	2.00	48.0	0.96	52.0	1.04	4.5	0.09	6.5	0.13	25.0	0.50	16.0	0.32	0.42
149	M	8-20	2	3.30	49.1	1.62	50.9	1.68	5.8	0.19	19.4	0.64	14.0	0.46	7.3	0.24	0.96
151	F	8-24	2	4.00	52.0	2.08	48.0	1.92	4.5	0.18	10.0	0.40	18.0	0.72	15.5	0.62	1.08
153	M	8-27	2	4.70	47.9	2.25	52.1	2.45	4.7	0.22	8.7	0.41	18.7	0.88	20.0	0.94	0.92

APPENDIX F. Continued.

Carbon dioxide and enzymes and other nitrogenous components in blood sera from black bears captured in western Prince William Sound in Alaska, 1977.

Bear	Date of collect.	Age	Carbon dioxide (meq/L)	LDH (U/L)	SGOT (U/L)	SGPT (U/L)	Alkaline p'tase (U/L)	Creatinine (mg/dl)	BUN (mg/dl)	Creatinine/BUN	Uric acid (mg/dl)	Total protein (g/dl)	Albumin	Globulin	A/G	Total bilirubin (mg/dl)
105F	7-25	9	6	493	44	29	21	0.5	2.	0.25	0.9	3.1	2.1	1.00	2.10	0.0
107M	8-14	2	5	500+	182	60	60	0.3	6.	0.05	0.8	2.9	2.2	0.70	3.14	0.0
119M	8-14	2	10	500+	45	41	42	0.3	4.	0.08	0.8	4.7	2.8	1.90	1.47	0.0
125F	8-16	5	4	381	58	39	22	0.3	3.	0.10	0.4	2.3	1.8	0.50	3.60	0.0
135F	8-13	Cub	3	500+	45	25	54	0.4	6.	0.07	0.6	1.9	1.8	0.10	18.00	0.0
137F	8-17	11	9	446	92	40	23	0.4	15.	0.03	0.8	3.1	2.1	1.00	2.10	0.0
141F	8-16	11	5	368	72	30	14	0.4	1.	0.4	0.4	2.2	1.5	0.70	2.14	0.0
143F	8-16	12	6	500+	106	42	24	0.2	8.	0.03	0.5	2.5	1.7	0.80	2.13	0.0
147F	8-19	1	4	413	41	17	13	0.1	5.	0.02	0.5	2.0	1.5	0.50	3.00	0.0
149M	8-20	2	5	500+	105	62	38	0.3	9.	0.03	0.8	3.3	2.2	1.10	2.00	0.0
151F	8-24	2	9	500+	226	74	66	0.6	7.	0.09	1.2	4.0	2.9	1.10	2.64	0.0
153M	8-27	2	9	500+	63	80	42	0.3	6.	0.05	1.1	4.7	2.9	1.80	1.61	0.0
155M	8-28	Cub	10	500+	87	42	96	0.4	10.	0.04	1.1	3.7	3.0	0.70	4.29	0.0

APPENDIX G.

A key for estimating the age of black bear in Game Management Unit 6 with data on season of kill, sex and skull zygomatic width measurements (mm).

MALES

SPRING

If the skull zygomatic width is:

$\leq$ 100 mm,	the age is less than	0.4 years; if it is
> 100 but $\leq$ 130,	the age is less than	1.8 years; if it is
> 125 but $\leq$ 130,	the age is less than	2.4 years or if it is
> 130 but $\leq$ 138 mm	the age is less than	3.4 years and most

male black bears with skulls < 165 mm in width are less than or equal to 6.4 years of age.

FALL

If the skull zygomatic width is:

$\leq$ 110 mm,	the age is less than	0.8 years; if it is
> 110 but $\leq$ 130,	the age is less than	1.8 years; if it is
> 130 but $\leq$ 135,	the age is less than	2.8 years or if it is
> 135 but $\leq$ 147 mm	the age is less than	3.4 years.

FEMALES

SPRING

If the skull zygomatic width is:

$\leq$ 95 mm,	the age is less than	0.4 years; if it is
> 95 but $\leq$ 110,	the age is less than	1.4 years; if it is
> 110 but $\leq$ 125,	the age is less than	2.4 years; if it is
> 125 but $\leq$ 133,	the age is less than	3.4 years and most

female black bears with skulls < 140 mm are less than or equal to 6.4 years of age.

FALL

If the skull zygomatic width is:

$\leq$ 105 mm,	the age is less than	0.8 years; if it is
> 105 but $\leq$ 125	the age is less than	1.8 years; if it is
> 125 but $\leq$ 130	the age is less than	2.8 years; if it is
> 130 but $\leq$ 135	the age is less than	3.8 years and if it is
> 135 but $\leq$ 140	the age is less than	4.8 years.

APPENDIX G. Continued.

Data for this table were derived from bears killed in Game Management Unit 6 and values may only apply to black bear in the area.

No statistical significance is associated with these intervals; they are subjective determinations but should suffice for management purposes.

Field research in western Prince William Sound indicates that female black bears can breed at 3.5 years of age and bear young at 4.0 years of age. It may be assumed that males are capable of breeding at those same ages. However, it is likely that the percentage of bears breeding and reproductive success may be higher in older bears.

Millimeter measurements may be converted to inches by dividing by 25.4.

APPENDIX H.

Estimates for numbers and density of black bears resident in subunits of game management unit 6, Prince William Sound, Alaska.

		Size[a]			Density	
Subunit	Location	Sq. mi.	Ha.	No. of bears	No. sq. mi. per bear	No. ha. per bear
1	Icy Bay-Copper River	1,164	301,476	754	1.5	400
2	Copper River-Rude River	500	129,500	324	1.5	400
3	Rude River-Ellamar-Mt. Denson	360	93,240	117	3.1	800
4	Ellamar-Mt. Denson-Valdez	250	64,750	81	3.1	800
	Valdez-Columbia Glacier	100	25,900	144	0.7	180
5	Columbia Glacier-Cedar Bay	75	19,425	108	0.7	180
	Cedar Bay-Unakwik Inlet-Jonah Bay	100	25,900	144	0.7	180
	Jonah Bay-Esther Passage	125	32,375	180	0.7	180
6	Esther Passage-Golden-Coghill Lake-College Fiord-Point Pakenham	120	31,080	173	0.7	180
	Point Pakenham-Barry Arm-Harriman Fiord-Bettles Bay	55	14,245	79	0.7	180
	Bettles Bay-Pigot Point	40	10,360	58	0.7	180
7	Pigot Point-Whittier-Willard Island-Tebenkof-Shrode Lake-Culross Island-Taylor Glacier	180	46,620	259	0.7	180

continued

APPENDIX H. Continued.

Subunit	Location	Size[a] Sq. mi.	Ha.	No. of bears	Density No. sq. mi. per bear	No. ha. per bear
8	Taylor Glacier-Kings Bay-Nellie Juan Glacier	50	12,950	43	1.2	300
	Nellie Juan Glacier-Eshamy-Chenega Island-Chenega Glacier	180	46,620	259	0.7	180
	Chenega Glacier-Banbridge and Evans Islands-Cape Fairfield	190	49,210	273	0.7	180
9,10,11	Misc. islands and unknown locations	-	-	4	-	-
Total		3,489	903,651	3,000	1.2	301

[a] Calculation where:
- area in sq. mi. estimated from topographic maps.
- 1 sq. mile = 259 ha.
- maximum densities = 180 ha./bear, see Table

$$\text{No bears} = \text{No. sq. mi.} \times \frac{259 \text{ ha.}}{\text{sq. mi.}} \div \frac{\text{No. ha.}}{\text{bear}}$$

$$\text{No. sq. mi. per bear} = \frac{\text{No. ha.}}{\text{bear}} \div \frac{259 \text{ ha.}}{\text{sq. mi.}}$$

APPENDIX I.

Sex and age composition of black bears killed in subunits 1 and 2 (Gulf of Alaska) of game management unit 6, Alaska, July 1, 1973-77.[a]

Year	Males	Females	Sex unknown
1973	2,3[b]	-	-
1974	1,4,4,4,4,4,5,5,8,9,12,12	4,7*,8	5
1975	1,1,4,5,5,5,6,6,6,6,7,7,7,9,9,9*,10,11	4,6,6,8	4,4*
1976	1,1*,3,4,4,5,5,5,6,6,6,6,6*,7,9,20*	0*,3,3,4,4,5,5,5,5,6,6,6,6,6,8,9,11	-
1977	1,3,5,6,6,6,6,6,7,7,9,10,11,11,12	6,8,9,12	5,8

[a] Data represent information on sport and nonsport killed bears as compiled from sealing certificates.

[b] Each number represents an individual bear, the value of the number denotes an individual's age as estimated from counts of cemental annuli in premolar teeth; underlined numbers represent bears harvested between July 1 and December 31 (fall season) of each calendar year and numbers not underlined represent bears harvested between January 1 and June 30 (spring season) of each calendar year; and asterisks denote nonsport killed bears. All data are subject to minor changes.

APPENDIX I. (continued)

Sex and age composition of black bears killed in subunits 3 and 4 (eastern Prince William Sound-Port Valdez, Valdez Arm, Port Fidalgo and Port Gravina) of game management unit 6, Alaska, July 1, 1973-77.[a]

Year	Males	Females	Sex unknown
1973	8,16[b]	-	-
1974	1,1,3,3,3,3,3,3,3,4,4,4,7,8,8,9,9,10,14	1,3,3,3,4,4,4,4,5,7,8,8,8,8,9,9	2,11
1975	2,2,3,5,5,5,5,5,5,5,5,6,6,6,6,8,8,8, 9,9,9,9,10,10,11	3,4,5,5,5,5,5,6,10,13	-
1976	1,1,1,1,1,1*,2,2,2,2,2*,3,3,4,4,4,5, 5,5,5,6,6,7,7,8,8,8,12,17	1,2,2,3,4*5,6,6,7,8,8,9,10*,12,15	0*
1977	2,2,3,4,4,4,4*,5,7,7,9,11,12,12,12	2,3,4,6,7,7,9	6,7

[a] Data represent information on sport and nonsport killed bears as compiled from sealing certificates.

[b] Each number represents an individual bear, the vlaue of the number denotes an individual's age as estimated from counts of cemental annuli in premolar teeth; underlined numbers represent bears harvested between July 1 and December 31 (fall season) of each calendar year and numbers not underlined represent bears harvested between January 1 and June 30 (spring season) of each calendar year; and asterisks denote nonsport killed bears.

APPENDIX I. (continued)

Sex and age composition of black bears killed in subunit 5 (northern Prince William Sound-Columbia Glacier, Esther Passage) of game management unit 6, Alaska, July 1, 1973-77.[a]

Year	Males	Females	Sex unknown
1973	-	-	-
1974	2,4,4,4,4,4,4,4,9[b]	2	-
1975	1,2,3,3,4,4,5,5,5,5,5,5,6,6,8,8,9,9,11,11,12,13,13	2,3*,5,6,7,13	4,5,5
1976	1,2,2,3,3,4,5,6,6,8,8,11,15	2,3,4,5,6,6,7,8,8,11,11	7,14
1977	2,3,3,3,3,3,4,8,14,14	2,2,4,5,8,11,12,13	4,7,12

[a] Data represent information on sport and nonsport killed bears as compiled from sealing certificates.

[b] Each number represents an individual bear, the value of the number denotes an individual's age as estimated from counts of cemental annuli in premolar teeth; underlined numbers represent bears harvested between July 1 and December 31 (fall season) of each calendar year and numbers not underlined represent bears harvested between January 1 and June 30 (spring season) of each calendar year; and asterisks denote nonsport killed bears.

APPENDIX I. (continued)

Sex and age composition of black bears killed in subunits 6 and 7 (western and northwestern Prince William Sound-Coghill, Whittier and Culross Island) of game management unit 6, Alaska, July 1, 1973-77.[a]

Year	Males	Females	Sex unknown
1973	7[b]	-	-
1974	3,4,4,4,4,4,4,4,5,5,7,11, 13	3,4,5,6,6	3
1975	2,3,4,4,4,5,5,5,5,5,5,7,7,8,9,13,14,16	2,2,2,3,3,4,5,6,7,8,11	5,8,10
1976	2,2,4,4,6,6,6,8,8,	2,2,3,4,5,6,6,6,6,7,8	-
1977	2,5,6,7,7,7,7	5,5,6,7,9,10,10,14,16	11

a Data represent information on sport and nonsport killed bears as compiled from sealing certificates.

b Each number represents an individual bear, the value of the number denotes an individual's age as estimated from counts of cemental annuli in premolar teeth; underlined numbers represent bears harvested between July 1 and December 31 (fall season) of each calendar year and numbers not underlined represent bears harvested between January 1 and June 30 (spring season) of each calendar year; and asterisks denote nonsport killed bears.

APPENDIX I. (continued)

Sex and age composition of black bears killed in subunit 8 (southwestern Prince William Sound-Eshamy Chenega and Cape Fairfield) of game management unit 6, Alaska, July 1, 1973-77.[a]

Year	Males	Females	Sex unknown
1973	-	-	8
1974	7,7,9[b]	4,7*	3,8*,8*,10*
1975	1,2,4,5,6,8,9,11,11	5,6	5,6
1976	2,4,4,5,5,6,6,6,7,8,9,9,13,14	2,4,6,6,6,9	4,5,5
1977	2,2,2,7,11,11	6,7,12,14	2

[a] Data represent information on sport and nonsport killed bears as compiled from sealing certificates.

[b] Each number represents an individual bear, the value of the number denotes an individual's age as estimated from counts of cemental annuli in premolar teeth; underlined numbers represent bears harvested between July 1 and December 31 (fall season) of each calendar year and numbers not underlined represent bears harvested between January 1 and June 30 (spring season) of each calendar year; and asterisks denote nonsport killed bears.