

## Reproductive Biology of Female Brown Bears (*Ursus arctos*), McNeil River, Alaska

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### INTRODUCTION

Brown bears *Ursus arctos* congregate in Alaska's McNeil River State Game Sanctuary in July and early August to feed on salmon (*Oncorhynchus* spp.) traveling up rivers to spawn. The area has been closed to brown bear hunting since 1955, and in 1967 it received permanent protection by the Alaska State Legislature as a sanctuary for study and observation of brown bears. Because bear hunting is prohibited in the sanctuary and is infrequent in surrounding areas, bears of McNeil River form a virtually unhunted population. The area is well known for its concentration of bears, and the Alaska Department of Fish and Game limits by permit the number of photographers and observers that can enter it at one time. There are no roads or settlements in the area, and it can be reached only by aircraft and boat.

The Alaska Department of Fish and Game has captured, marked and observed brown bears at McNeil River in most years since a study emphasizing reproductive biology was started in 1963. Information has also been obtained on population composition, food habits, effects of human activity in the sanctuary on bears, and methods for capturing and handling animals. Emphasis of future studies will be to observe marked females to obtain more reproductive data.

### STUDY AREA

The McNeil River State Game Sanctuary includes 185 km<sup>2</sup> on the lower west side of Cook Inlet at the base of the Alaska Peninsula (Fig. 1). The area is characterized by precipitous mountains; short, swift streams; and a narrow coastal plain. Most mountains are less than 1,200 m above sea level with upper elevations consisting of glaciers and snow, bare rock, and alpine plant communities. Alders (*Alnus* spp.), the dominant vegetation between 300 m and sea levels, are interspersed with grasses, forbs and tundra. Extensive grass and sedge flats occur near salt water.

McNeil River, the major drainage, originates from an unnamed glacier and

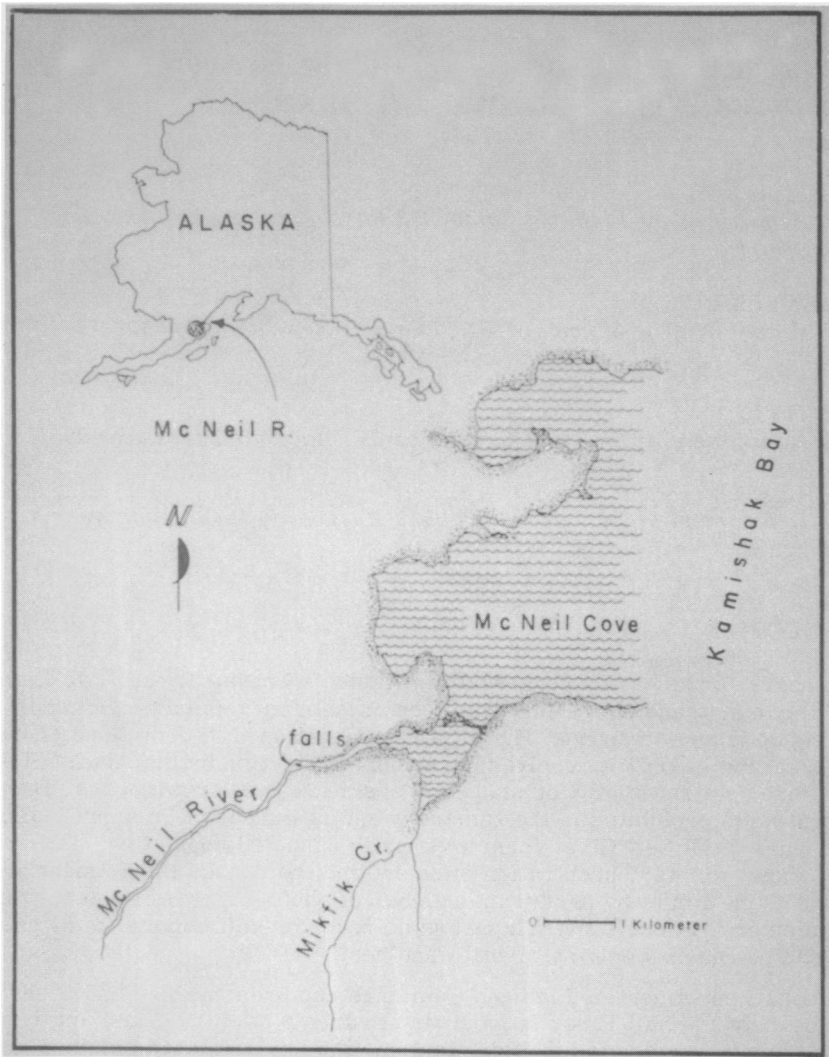


Fig. 1 Map of McNeil River and Alaska location map.

flows 34 km to the intertidal McNeil Lagoon. McNeil Lake drains into the river about 18 km above its mouth. The river flows over a series of boulders 1.8 km upstream from McNeil Lagoon to form McNeil Falls, a 100 m long section of turbulent water which is a partial obstacle to migrating salmon. Bears congregate here to capture primarily chum salmon (*Oncorhynchus keta*) and occasionally silver salmon (*O. kisutch*). Mikfik Creek, also part of the study area, flows about 3 km to McNeil Lagoon. In some years bears feed on chum, red (*O. nerka*) and pink (*O. gorbuscha*), salmon in Mikfik Creek.

#### **METHODS**

Bears were captured when free-ranging by injecting immobilizing drugs intra-

muscularly with projectile syringe guns. The first drugs used were succinylcholine chloride (Anectine) as an immobilizing agent and pentobarbatol sodium an anesthetic (Lentfer *et al.* 1967). In recent years bears were more satisfactorily immobilized with 1.65 mg/kg of phencyclidine hydrochloride (Sernylan), mixed with 50-100 mg of promazine (Tranvet or Sparine) to counteract undesirable side effects of phencyclidine (Seal and Erickson 1969).

Bears were marked with ear tags and numbers tattooed on the inner lip and groin. To facilitate field identification of individuals, nylon flagging and polypropylene rope markers were attached to ears with ear tags, and nylon collars were placed on some adults.

Females with swollen and turgid vulvas were considered to be in estrus, and those with dark mammae larger than 10 mm in diameter and length as having suckled young. A rudimentary premolar was taken from bears older than known age cubs and sectioned to estimate age (Mundy and Fuller 1964; Craighead *et al.* 1970; Willey, 1974).

From 1963 through 1972, 60 individual animals were immobilized a total of 102 times. Marked animals not recaptured were often identified by examining collars and ear markers and tags with binoculars and spotting scopes.

## RESULTS

### Breeding Season

Observations, starting usually the first week in July, were too late to determine the start of breeding. The latest that males were observed following females in estrus was 10 August.

### Minimum Breeding Age

Five (Identification Nos. 03, 905, 57, 124, 1814) of eleven 3.5-year-old females captured had swollen vulvas indicating physiological changes related to the estrous cycle (Tables 1 and 2). Observations during the 2 years following capture indicated that none of these five females was accompanied by young that could have been conceived when the females were 3.5 years old. Among eight 4- to 7-year-old females, three (03, 905, 05) conceived for the first time when 4.5 years old; three (17, 57, 1803) conceived for the first time when 5.5 years old; one (126) conceived for the first time when 6.5 years old; and one (13) conceived for the first time when 7.5 years old. Mammae characteristics suggested that two other females (19A, 124) conceived for the first time when 4.5 years old.

### Maximum Breeding Age

The oldest female with cubs (No. 14) conceived in 1971 when 14.5 years old (Tables 1 and 2). Her maximum breeding age can be determined only by observations in future years. Female No. 22 had nursed young previously when captured or observed each of the following 6 summers.

### Family Breakup and Frequency of Litters

Thirteen litters of brown bears at McNeil River provided definitive information on age at which young separated from females. For three litters, young





TABLE 2. REPRODUCTIVE SUCCESS OF KNOWN AND ESTABLISHED AGE MCNEIL RIVER BROWN BEARS.

Age	No. of Females Mating Successfully	No. of Females not Mating or not Mating Successfully*	Sample Size
2.5	0	16	16
3.5	0	15	15
4.5	5**	10	15
5.5	3	5	8
6.5	3	4	7
7.5	6	0	6
8.5	1	0	1
9.5	2	1	2
10.5	3	2	5
11.5	1	2	3
12.5	1	3	4
13.5	1	3	4
14.5	1	1	2
15.5	0	0	0
16.5	0	1	1
17.5	0	2	2
18.5	0	1	1
19.5	0	1	1
20.5	0	1	1
21.5	0	1	1
22.5	0	1	1

\* Females with cubs or yearlings not included in these figures.

\*\* Includes 2 females which probably bred successfully based on condition of *mamae*.

accompanied females at 0.5 year but not at 1.5 years; for nine litters, young accompanied females at 1.5 years but not at 2.5 years; and for one litter, young accompanied the female through 2.5 years of age. In five other cases, 1.5-year-olds were with females but observations were not made the next year to determine if family breakup had yet occurred. It was not possible to determine the fate of young after family breakup because most were not marked and therefore could not be identified in later years.

For twelve observations of intervals between successful breeding, one was 2 years, seven were 3 years, two were 4 years, and two were 6 years.

### Litter Size, Mortality, and Mixing

Mean size and range of 41 litters of cubs observed at McNeil River were 2.5 and 1-4 respectively. Mean size and range of 69 litters 1.5 years old and older were 1.8 and 1-4. This was a 13 percent reduction in litter size from cubs to older litters. Observations of thirteen litters 2 consecutive years provided a direct measure of loss of young between 0.5 and 1.5 years. Mean litter size of 2.0 cubs (26 cubs/13 females) decreased to 1.23 yearlings (16 yearlings/13 females), a 38 percent reduction in litter size from 0.5 to 1.5 years of age.

Three instances of cub loss were observed. In one instance a female with three cubs was carrying a salmon from the river to an alder patch on higher ground. One cub in the lead took a different trail than the others and was not seen again. The female was later seen with the other cubs and never appeared to be searching for the third cub. In another instance three cubs became separated from their mother when she was attempting to drive off a large male. She found one cub immediately and another 3 days later. After a week, she still had only the two cubs. No other females were observed with an extra cub. In the third instance a dead cub was found at a feeding area with a large wound on the ventral portion of the neck, apparently inflicted by another bear.

Exchange of cubs among different maternal females was observed. In 1974 three females, each with three cubs were first observed, came together and changed litter complements almost daily. There were times, however, when a group remained together for as long as 2 days. When cub interchange was first observed, females appeared to be under stress. In one instance, a female tried to stop the litter with her from leaving with another family group. She managed to keep one cub by grasping it in her mouth and tossing it down a hill. As the summer progressed and cub interchange continued, the females appeared to accept litter mixing as a normal activity. Each female was never observed with less than one or more than six cubs at one time. There was one observation of a female nursing six cubs. Mixing of litters continued to the end of the field season, and it was not possible to determine the final status of each family group.

### Sibling Breakup

Two male siblings were inseparable the summer they were marked as 1.5-year-olds after they had separated from their mother. The next summer they were nearly independent of one another and only occasionally associated for short periods. The bears were completely independent of one another the following two summers when 3.5 and 4.5 years old.

Three marked female siblings remained together as yearlings and 2.5-year-olds, with one individual dominant at 2.5 years. This animal only occasionally associated with the other two when they were 3.5 years old and never during the following summer. The other two only occasionally associated when they were 4.5 years old and did not associate when 5.5 years old.

### DISCUSSION

Breeding by brown bears at McNeil River probably starts about the same time as at Kodiak Island, Alaska, where breeding activity has been observed from the last half of May through mid-July (Hensel *et al.* 1969). Breeding activity has been observed later (10 August) at McNeil River than elsewhere. Craighead *et al.* (1969) state that grizzly bears in Yellowstone National Park, Wyoming,

mate from 26 May to 9 July. Mundy and Flook (1973) report breeding activity of grizzly bear in Canadian mountain parks from 30 April to 25 June. Pearson (1972) states that grizzly bears in southwestern Yukon Territory, Canada, breed from mid-June until late July.

Brown bears at McNeil River most commonly conceived for the first time when 4.5 and 5.5 years old. The oldest age at first breeding was 7.5 years. Age of sexual maturity for female brown bears is reported as 3-6 years on Kodiak Island (Hensel *et al.* 1969), 4-5 years in Yellowstone Park (Craighead *et al.* 1969), and 7 years in the Yukon Territory (Pearson 1972).

The oldest McNeil River female observed with young conceived in 1971 when 14 years old and could have conceived again in 1974. Other older females can also be identified, and maximum breeding age observations will continue in future years. On Kodiak Island a 16.5-year-old female brown bear conceived. She and her two 1-year-old cubs were in poor condition when killed at a garbage dump in January (unpublished data, Alaska Department of Fish and Game files; R. L. Rausch, pers. comm.). Possibly she would not have been able to raise these young or another litter. Females 15 to 18 years old are fairly commonly harvested on the Alaska Peninsula, but females older than 18 are not.

Separation of young from females at McNeil River normally occurred between 1.5 and 2.5 years of age. Observations were not made late enough in the summer and fall or early enough in the spring to determine if separation normally occurred shortly before denning when young were 22 months old or after denning when they were 29-30 months old. On Kodiak Island, Hensel (pers. comm.) found very few 22-month-old bears still with the mother late in the fall just before denning.

A 3-year breeding interval for females, the most common at McNeil River, is the same as that for females on Kodiak Island (Hensel *et al.* 1969), in Glacier National Park (Martinka 1974), and in Yukon Territory (Pearson 1972). Mundy and Flook (1973) assume breeding intervals of 3 and 4 years for female grizzly bears in Canadian mountain parks. Craighead *et al.* (1969) state that young females in Yellowstone Park breed in alternate years, and older bears may show greater intervals between breeding.

Mortality at McNeil River between litters 0.5 year old and litters 1.5 years old and older appeared to be greater among those identified in consecutive years (38 percent mortality for 13 litters) than among those observed more than 1 year but not identified (13 percent mortality for 110 litters). This may be because sample size of identified litters was smaller and because family groups identified in consecutive years spent a greater proportion of time feeding at the falls, thereby increasing chances of cub mortality resulting from interaction with other bears.

Aerial counts reported by Glenn (1973) further south on the Alaska Peninsula provide information on mortality of young. Counts were flown in August. Three hundred and forty-two litters were observed and grouped in two categories; sows with cubs and sows with young one year of age and older. In these counts young 1, 2 and 3 years of age were grouped because these age classes could not be accurately differentiated from the air. A 9 percent reduction in litter size was reported. Reduction from cub to yearling mean litter size reported elsewhere is 10 percent for 201 litters observed on Kodiak Island (Hensel *et al.* 1969), 0 percent for 154 litters observed in Canadian mountain parks (Mundy and Flook 1973), and 0 percent for 65 litters observed in Glacier National Park (Martinka 1974). Craighead and Craighead (1970) report that 27

percent of cubs (sample size not given) in Yellowstone Park do not survive to age 1.5 years. The higher mortality at both McNeil River and Yellowstone Park may be related to congregating of bears and resulting intraspecific strife at feeding areas.

Intraspecific strife has been observed elsewhere. In mid-October on the lower Alaska Peninsula a large bear was seen eating a cub. A female with a frightened cub on her back was in an alder patch about 100 m away (Glenn 1971). On Kodiak Island, Troyer and Hensel (1962) investigated four cases of brown bears killing and eating other bears, three of them cubs.

Cub adoption, perhaps only temporary, has been previously observed at McNeil River. Erickson and Miller (1962) report that two females, each with three cubs, came together and then separated, with one cub accompanying one female and five cubs accompanying the other female. The female with five cubs was observed repeatedly until studies terminated 2 weeks later. The following summer no females were observed with more than three yearlings, and since neither female was marked it was not possible to determine if each female regained her original young or if loss occurred. Mixing of litters and cub adoption could be both beneficial and detrimental to maintenance of populations. Cubs might be provided for by another female if they should lose their mother. On the other hand, a female that adopted extra cubs from another female might not be able to raise all individuals of her oversize litter. Cubs that lost their mother might survive on their own.

Johnson and LeRoux (1973) report that a grizzly bear became self-sufficient at 7 months of age after its mother was killed.

## SUMMARY

The Alaska Department of Fish and Game marked 21 female brown bears at McNeil River on the upper Alaska Peninsula to obtain life history information. Data were obtained in July and August in most years from 1963 through 1974. Some females experienced first estrus at 3.5 years, but did not conceive until older. First successful breeding occurred most commonly at 4.5 years. The oldest McNeil River female known to produce cubs conceived when 14.5 years old. The normal interval between litters was 3 years. Litters contained 1-4 young. Mean size of 41 litters of cubs was 2.1 and of 69 litters 1.5 and 2.5 years old was 1.8.

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