

## PANEL 4: BEAR BEHAVIOUR

# Social Behavior of the Alaska Brown Bear

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### INTRODUCTION

This paper concerns the social behavior of the Alaska Brown Bear (*Ursus arctos* L.) and the visual signals it uses to set up and maintain a social structure. Under most circumstances the brown bear is asocial. Exceptions are the relationships between mother and cubs; between siblings recently split off from their mother; and between male and female during the breeding season. Where especially good sources of food are available in certain areas, bears may concentrate as at garbage dumps and salmon-spawning streams. If bears are to use such limited resources efficiently they must develop some form of stable society. The concentration of salmon at the McNeil River Falls provided the opportunity to study the formation of a social structure and to see how bears divided the food resource over space and time.

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### METHODS

Brown bears were observed from June 1 to September 1, 1970 at the McNeil River Bear Sanctuary managed by the Alaska Department of Fish and Game (Fig. 1). Just above tidewater the river descends over and between a 150-yard stretch of large rock slabs—the so-called McNeil River Falls. The falls form the only obstacle for salmon on the river. Above and below the falls the water is too deep for bears to catch salmon readily. For these reasons 30 or more bears may use the falls at one time during the height of the salmon run (Fig. 2). For the same reason photographers are coming in increasing numbers at the very time the bears are at maximum numbers.

All observations of bears were made from a small cave 20 yards from the river. Most bears using the falls were habituated to humans and fished within 50 yards of the cave, but a few never came to the same side of the river as the observers. Thus when our field crew of 2-4 persons arrived at the falls in the morning, bears were usually well-spaced on both sides of the river. Later in the morning as the photographers arrived many bears would move to the opposite side of the river. When this happened considerable fighting or threatening would break out. But this did not disrupt the actual social structure.

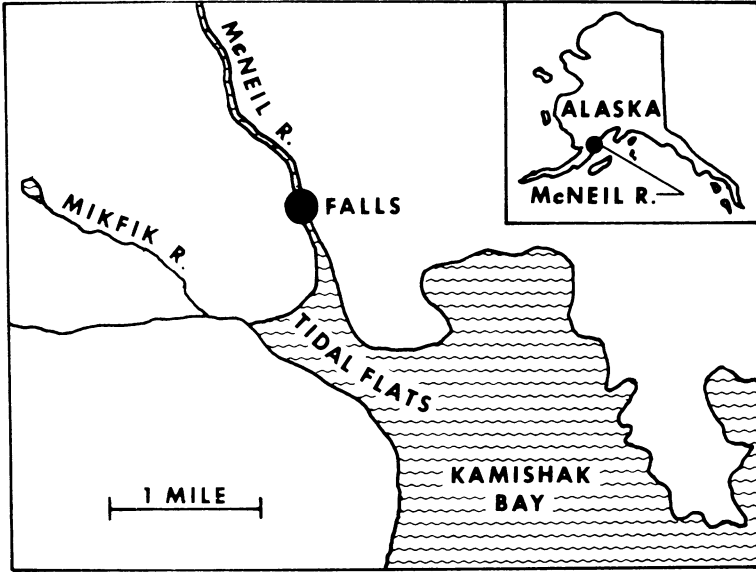


Fig. 1 Map of Alaska showing location of McNeil River Bear Sanctuary and detail of area around McNeil River Falls.



Fig. 2 McNeil River Falls, showing three single bears fishing and a mother and cubs awaiting their turn.

The capture and tagging of 13 bears with dart guns created temporary disruptions as did the occasional overflights by small aircraft. Except for these factors the bears were unmolested.

Bears were identified by facial characteristics, size, sex, scars, ear tags and collars. Our observations were made at various hours between dawn and dusk (4 A.M. to 9 P.M. Alaska Standard Time).

## RESULTS

Fifty-two different bears visited the falls during the summer (Table 1). At least 18 more were seen in the surrounding area, usually as they fished along Mikfik River and fed on the tidal flats at the confluence of McNeil and Mikfik rivers.

TABLE 1. AGE AND SEX COMPOSITION OF 54 BEARS SEEN AT McNEIL RIVER, JULY 1-AUGUST 15, 1970.

|                                 | Number Seen |
|---------------------------------|-------------|
| Males, adult                    | 11          |
| Females with older cubs (12)    | 5           |
| Females with spring cubs (3)    | 2           |
| Females, single*                | 11          |
| Subadult sibling groups (2 + 3) | 5           |
| Subadult (?) small and unsexed  | 4           |
| Cubs                            | 15          |
| Total                           | 54          |

\* 7 known breeders and 4 of unknown age

When we arrived on the study area no salmon were running up McNeil River. Only the occasional bear passed by the falls. Instead, bears were feeding mostly on vegetation of the tidal flats and catching salmon that had begun to migrate up Mikfik River about June 7. Bears first appeared at McNeil Falls July 12, shortly after salmon arrived at the falls. Bears built up quickly in numbers, reaching a peak by July 28 (Table 2).

Final disappearance of bears from the falls came while some salmon were still present. The rapid disappearance of bears followed a sudden rise in the river which made fishing much more difficult. Bears were considerably more numerous at the falls in the afternoon than on mornings, a ratio of about 3 : 1.

Aggression between bears occurred as soon as they began to arrive at the falls. An aggressive encounter is defined as any situation where two or more bears reacted with each other in such a way as to disrupt their ongoing patterns of moving, feeding or resting. We observed about 600 aggressive encounters and described the separate components of behavior for each bear during many of these encounters.

TABLE 2. NUMBERS OF BEARS SEEN AT McNEIL RIVER FALLS, 1970

| Period of Observation | Mean No. Bears Seen/Day |
|-----------------------|-------------------------|
| July 7-11             | 0                       |
| July 12-16            | 10                      |
| July 17-21            | 19                      |
| July 22-26            | 24                      |
| July 27-31            | 31                      |
| August 1-5            | 27                      |
| August 6-10           | 22                      |
| August 11-15          | 11                      |
| August 16-20          | 5                       |
| August 21-25          | 2                       |

It was possible to distinguish between the dominant and subordinate bears in most encounters. A bear was called subordinate when it backed up, walked or ran away. It might rarely lie down and approach a dominant like a fawning dog. The dropping of the head and facing away were additional criteria.

The social rankings of 22 bears are shown in Table 3. These include only those bears seen in at least 7 encounters, and excludes cubs. For the most part very large males were highest in rank. Two males (A and B), both present at different parts of the summer, never lost a decisive encounter to another bear. The disappearance of A the day before we first observed B makes us suspect these two bears had a decisive encounter at the falls when B first arrived there. While large males were normally dominant, one very aggressive medium-sized female (G) who had three large aggressive cubs, could on occasion back down every bear except A.

Below the top males came females with cubs one or more years old. Then came single females and smaller males, both presumably of breeding age as judged by comparing their size with known-aged bears. These single bears were almost completely subordinate to those above them, but were aggressive among themselves. Below these single males and females came sibling groups of non-breeders that traveled together. On occasion these non-breeding bears would dominate single bears in the group above them, but were mostly ineffective in dominating bears other than lone subadults. These lone subadults were at the bottom of the social ladder and largely avoided the falls. Three females with spring cubs also avoided the falls but probably for the safety of their cubs rather than any social inferiority.

The hierarchy was established and maintained by aggressive encounters. Four situations released aggression (the threat of, or actual, physical violence): (1) violation of individual distance, (2) loss of an encounter with subsequent re-directed aggression toward a third bear, (3) competition for a choice fishing spot, and (4) what appeared to be initial meetings between strangers.

TABLE 3. SOCIAL RANK OF 22 BEARS OBSERVED AT McNEIL RIVER FALLS—1970

| Losers       |     |   |   |    |    |    |   |    |    |    |    |    |    |    |    |    |    |    |    |    |   | Total |   |      |
|--------------|-----|---|---|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|---|-------|---|------|
| Bear         | Sex | A | B | C  | D  | E  | F | G  | H  | I  | J  | K  | L  | M  | N  | O  | P  | Q  | R  | S  | T | U     | V | wins |
| A            | m   | — | — | 1  | 3  | —  | 1 | —  | —  | 2  | —  | —  | —  | —  | —  | —  | —  | —  | —  | —  | — | —     | — | 7    |
| B            | m   | — | — | 1  | —  | 3  | — | 1  | 2  | 1  | —  | —  | —  | —  | —  | —  | —  | —  | —  | —  | — | —     | — | 8    |
| C            | m   | 0 | 0 | —  | 2  | 1  | 2 | 5  | 3  | 7  | —  | 4  | 3  | 5  | 1  | —  | 1  | 2  | 1  | 1  | 1 | 7     | — | 46   |
| D            | m   | 0 | — | 0  | —  | 2  | 0 | 1  | 6  | —  | 1  | 1  | —  | 2  | 1  | —  | —  | —  | 1  | —  | — | 1     | — | 16   |
| E            | m   | — | 0 | 1  | 1  | —  | 4 | 9  | 3  | 2  | 5  | 2  | 3  | 1  | 1  | 2  | —  | 5  | 3  | 2  | — | —     | — | 44   |
| F            | m   | 0 | — | 0  | 2  | 1  | — | 8  | 1  | 2  | 4  | —  | 1  | 1  | —  | 1  | 1  | —  | 2  | —  | 1 | —     | — | 25   |
| G            | f*  | — | 1 | 6  | 1  | 3  | 0 | —  | 5  | 11 | 12 | 1  | 2  | 5  | —  | —  | —  | —  | 3  | —  | — | 8     | — | 58   |
| H            | f*  | — | 0 | 1  | 3  | 1  | 0 | 0  | —  | 4  | 4  | —  | —  | —  | 4  | —  | 1  | —  | 2  | 2  | 1 | 7     | — | 30   |
| I            | f*  | 0 | 0 | 3  | —  | 0  | 0 | 1  | 3  | —  | 2  | 4  | 1  | 3  | 4  | —  | —  | 4  | 7  | 1  | — | 7     | 1 | 41   |
| J            | f   | — | — | 2  | 0  | 5  | 0 | 1  | 2  | 1  | —  | 1  | 3  | 1  | 1  | 2  | —  | 3  | 2  | 1  | — | 2     | — | 27   |
| K            | f   | — | — | 0  | 0  | 0  | — | 0  | —  | 0  | 0  | —  | —  | 2  | —  | 4  | 0  | 1  | 3  | 8  | 1 | —     | — | 19   |
| L            | f   | — | — | 0  | —  | 0  | 0 | 0  | 0  | 1  | 0  | 0  | —  | 2  | 1  | 2  | 1  | 6  | 0  | 11 | 1 | 3     | — | 28   |
| M            | f   | — | — | 0  | 0  | 1  | 0 | 0  | —  | 0  | 0  | 2  | —  | —  | 3  | 0  | —  | 4  | 3  | —  | 1 | 3     | — | 17   |
| N            | f   | — | — | 0  | —  | 0  | — | 0  | 0  | 0  | —  | 0  | 1  | 0  | —  | 2  | 5  | —  | 3  | 5  | — | 1     | 5 | 24   |
| O            | m   | — | — | —  | —  | 0  | 0 | —  | 0  | —  | 0  | 0  | 0  | 1  | 0  | —  | 0  | 0  | 2  | 4  | — | —     | — | 7    |
| P            | f   | — | — | 0  | —  | —  | 0 | 0  | 0  | —  | —  | 2  | 0  | —  | 1  | 3  | —  | 2  | 4  | 4  | 1 | —     | — | 17   |
| Q            | ft  | — | — | 0  | —  | 0  | 0 | —  | —  | 1  | 0  | 6  | 3  | 0  | —  | 3  | 2  | —  | —  | 14 | — | —     | — | 29   |
| R            | f   | — | — | 0  | —  | 0  | 0 | 0  | 0  | 0  | 3  | 0  | 1  | 0  | 2  | 1  | 0  | 1  | —  | 1  | 0 | 2     | 0 | 11   |
| S            | f   | — | — | 0  | —  | 0  | — | 0  | 0  | 1  | 0  | 3  | 2  | —  | —  | 1  | 0  | 6  | 1  | —  | — | 0     | — | 14   |
| T            | f   | — | — | 0  | —  | —  | — | —  | 0  | —  | —  | 0  | —  | 0  | —  | —  | 0  | —  | 1  | —  | — | 1     | — | 2    |
| U            | f   | — | — | 0  | —  | —  | — | 0  | 0  | 0  | 0  | —  | 0  | 0  | 2  | —  | —  | —  | 4  | 3  | — | 0     | — | 9    |
| V            | f   | — | — | —  | —  | —  | — | 0  | —  | 0  | —  | —  | —  | —  | 0  | —  | —  | —  | 1  | —  | — | 1     | — | 2    |
| Total losses |     | 0 | 1 | 15 | 12 | 17 | 7 | 26 | 25 | 33 | 29 | 24 | 20 | 23 | 21 | 19 | 11 | 34 | 43 | 57 | 7 | 43    | 6 |      |

\* Females with cubs. † Three subadult females traveling and acting as a unit.

We recorded the individual behavior components seen during encounters to see to what extent bears used threat or appeasement signals to reduce actual physical contact. These components are described below and summarized in Table 4.

#### LOCOMOTION

Approach: Walk towards opponent.

Charge: Short run towards an opponent.

Run or Walk Away: Leaving opponent at run or walk.

Back Up: Backing slowly away from opponent, usually only step or two.

Stiff-legged Walk: A general tensing of muscles, especially of front legs with knees locked. Animal walks slowly and deliberately with stiff-legged or rocking gait.

#### BODY ORIENTATION

Frontal: Body and head directly aligned with opponent.

Lateral: Standing broadside to opponent.

Sitting: Like a sitting dog.

Lying Down: Prone position with rib cage touching ground

Higher Elevation: Standing on higher ground than opponent.

#### HEAD ORIENTATION

Head Down: Head held below horizontal, often almost touching ground.

Head Drop: Sudden drop of head almost to ground and lower than head of opponent. Head held down until encounter ends.

Facing Away: Turning the head away from opponent (Fig. 3).

Neck Stretch: Head and neck extended forward with nose, ears, hump and rump horizontally aligned. Orientation toward opponent.

#### MOUTH

Mouth Open: Mouth open with lips covering canines.

Mouth open, but canines showing.

Muzzle Twist: As above but head rotated sideways. Often leads to jaw to jaw contact with opponent.

Jawing: Stereotyped, often mutual behavior consisting of up and down head movements, mouth open with no canines showing, ears back, lateral orientation, and stiff legs if not done from sitting position (Fig. 4).

#### EARS

Ears Back: Ears lying back on or near head with the openings not conspicuous from the front.

#### CONTACT

Bite: Mouth contact with opponent, usually directly at head.

Swipe: A blow with paw usually to opponent's head.

TABLE 4. BEHAVIOR COMPONENTS OF BEARS DURING ENCOUNTERS AND THEIR RELATION TO SOCIAL STATUS.

| Behavior Component          | Dominance | Subordinance |
|-----------------------------|-----------|--------------|
| Approach                    | 70        | 5            |
| Charge                      | 55        | 10           |
| Run or walk away            | 0         | 82           |
| Back up                     | 0         | 52           |
| Stiff-legged walk           | 31        | 24           |
| Frontal orientation         | 51        | 21           |
| Lateral orientation         | 3         | 12           |
| Sitting                     | 4         | 10           |
| Lying down                  | 0         | 4            |
| Higher elevation            | 11        | 5            |
| Head down                   | 21        | 21           |
| Head drop                   | 0         | 12           |
| Facing away                 | 0         | 9            |
| Neck stretch                | 32        | 10           |
| Mouth shut                  | 13        | 23           |
| Mouth open                  | 24        | 23           |
| Mouth open, canines showing | 35        | 17           |
| Muzzle twist                | 13        | 2            |
| Jawing                      | 17        | 11           |
| Ears up                     | 13        | 14           |
| Ears back                   | 57        | 56           |
| Bite                        | 10        | 3            |
| Swipe                       | 17        | 4            |

Because of its short ears, short tail and long fur, a bear can not effectively use these parts as signals as do many mammals. Instead, orientation with respect to the rival and various movements are the primary means of conveying information to opponents. Certain components were associated largely with dominance: frontal orientation, approach, showing of canines, muzzle twist and neck stretch. Other components were shown largely by subordinates: lateral orientation, turning away and dropping of the head, and sitting or lying down. The data are inadequate to show whether any of these components have signal value, i.e. modify the behavior of an opponent. Nor can we reliably predict the

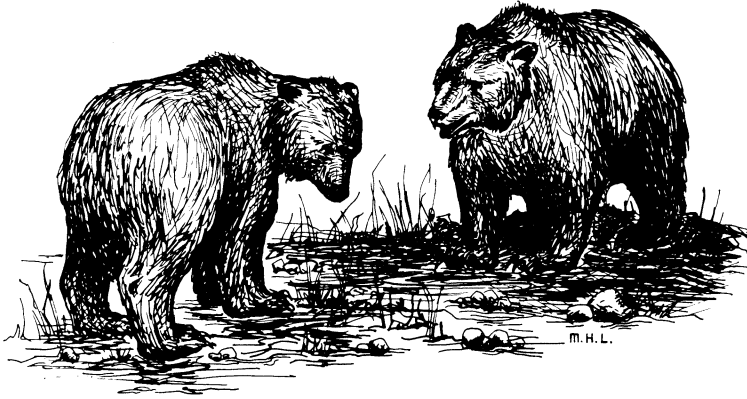


Fig 3 Subordinate bear on left showing 'facing away'.  
Dominant bear on right showing 'frontal' orientation.



Fig 4 Bear 'jawing', directed at bear off the picture to the right. The jawing bear is seated at a good fishing spot.

sequence of behavior patterns as an encounter rises in the intensity and likelihood of attack. However, a typical high-intensity encounter went as follows. The two animals directly faced each other with front legs stiffened, heads slightly lowered, and began a dramatic slowdown in movement. Ears of both combatants were back with mouths wide open, exposing the canines. Salivation sometimes occurred. This phase of the overall encounter was called the 'confront' (Fig 5). If one bear did not back down at this point, a second stage, the 'charge' usually ensued. In a charge one or both bears ran at the other with head slightly lowered, ears back, mouth slightly open, and head and body oriented directly toward the opponent. If neither bear turned aside at this point there were swipes, biting, and locking of jaws. As the fight continued one bear eventually slowly backed away while dropping its head to an even lower position than its opponent. The fight usually ended at this point as the subordinate walked or ran away.

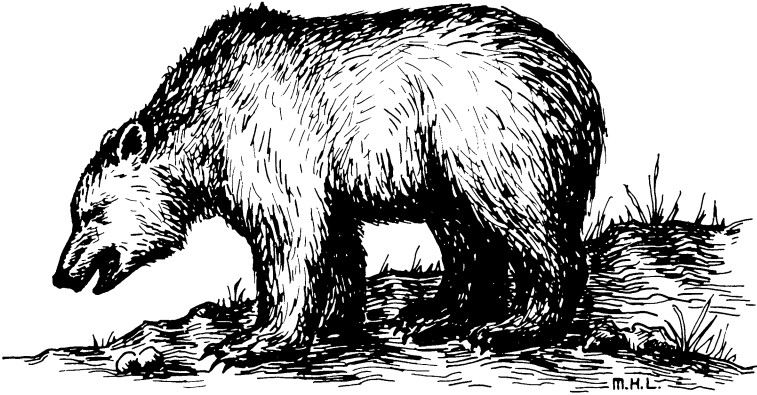


Fig 5 Bear 'confronting' an opponent off the picture to the left. Note lowered head and stiff posture.

When two bears widely separated in rank met, the dominant would typically face the known subordinate and slowly advance. The subordinate would then back away with mouth shut and head facing away (Fig. 3).

When bears of nearly equal status met, 'jawing' was likely to occur, often by both bears at once (Table 5). During jawing bears made rapid head lifts while facing each other and also low vocalizations. One bear often did this while sitting down (Fig 4). Jawing rarely led to actual fighting. More often one bear eventually deferred, i.e. turned aside, backed up, or walked away. 'Jawing' bears gave the impression of being in conflict between moving and staying put. Usually they were actually fishing or close to fishing positions where it would

TABLE 5. FREQUENCY OF 'JAWING' IN RELATION TO DIFFERENCE IN SOCIAL RANK BETWEEN BEARS.

| Difference in rank between bears | Number of Encounters | Percent of total 'jawing' seen |
|----------------------------------|----------------------|--------------------------------|
| 1                                | 7                    | 13                             |
| 2                                | 7                    | 14                             |
| 3                                | 6                    | 9                              |
| 4                                | 7                    | 13                             |
| 5                                | 8                    | 16                             |
| 6                                | 5                    | 10                             |
| 7                                | 3                    | 6                              |
| 8                                | 5                    | 9                              |
| 9                                | 3                    | 8                              |
| 10-21                            | 0                    | 0                              |

have been disadvantageous for a bear to relinquish the place. Of the 52 instances of jawing recorded, 73 percent were between females, 12 percent between a male and female, and only 4 percent between two males.

As summer progressed the nature of encounters changed (Table 6). Encounters involving charges fell sharply; and deferrals rose correspondingly. Contacts and flight did not materially change. It appeared that dominant animals shifted to less intensive threat. Body and head orientation tended to replace showing of canines, and subordinates might inhibit attack by orienting laterally and sitting down.

TABLE 6. CHANGES IN THE FORM OF AGGRESSIVE ENCOUNTERS THROUGHOUT THE SUMMER, McNEIL RIVER FALLS, 1970.

| Date                 | Percent Occurrence of Behaviors |         |         |           |        |        |
|----------------------|---------------------------------|---------|---------|-----------|--------|--------|
|                      | Encounters seen                 | Charges | Contact | Deferrals | Flight | Jawing |
| July 14-18           | 66                              | 62      | 14      | 36        | 19     | 1      |
| July 19-23           | 101                             | 43      | 11      | 52        | 29     | 5      |
| July 24-28           | 168                             | 33      | 9       | 53        | 18     | 13     |
| July 29-<br>August 2 | 81                              | 15      | 10      | 73        | 16     | 12     |
| August 3-7           | 60                              | 27      | 10      | 67        | 23     | 7      |
| August 8-12          | 58                              | 16      | 5       | 67        | 21     | 17     |
| August 13-17         | 3                               | 0       | 0       | 100       | 33     | 0      |

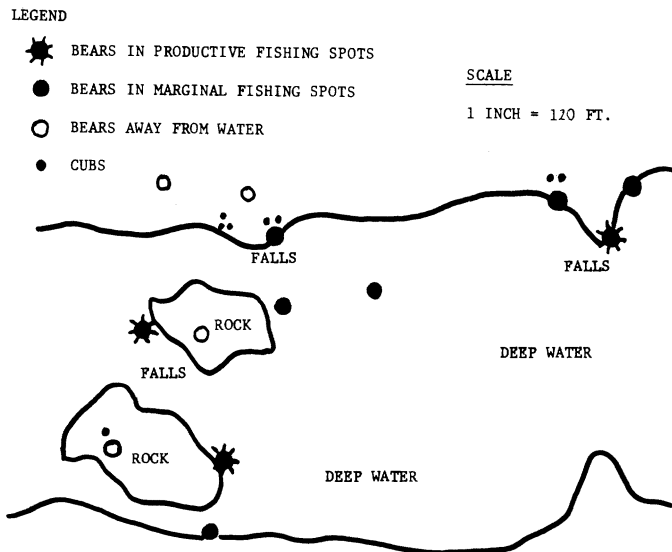


Fig 6 Typical distribution of bears at McNeil River Falls

Bears at the falls minimized competition and conflict not only by spacing out over the available fishing positions, but also through time. The longest a bear stayed at the falls was six hours, and usually much less. So a single fishing location could be used by many different bears during the course of a day. Some bears were absent altogether some days. Whether this was caused by a need for a change in diet or through aggressive behavior, it served to reduce competition. In addition some bears were excluded entirely from the falls, notably mothers with spring cubs and lone subadults. Large bears forced these subadults away from the actual falls. This domination was so effective that some subadults would lie down close to an empty fishing location without ever making an effort to fish.

On a typical mid-July afternoon 15 to 20 bears would be in sight at the falls. Only four or five would be actively fishing. The others would be in marginal fishing spots or back from the river waiting for a fishing spot to become vacant. Figure 6 shows the best fishing locations at the falls and typical spacing between bears on such a day.

## **CONCLUSIONS**

Brown bears meet at McNeil River Falls and contest over fishing locations for less than 45 days a year. During this time they develop a social hierarchy based upon sex, age and size. The social intolerance manifested in various forms of agonistic behavior results in a division of the fishing resource. The most dominant bears gain access to the most efficient fishing locations at will. Lower-ranking animals must wait their turn, use less efficient fishing spots, or even be forced to stay entirely away from the falls. If salmon is critical in the nutrition of the coastal Brown Bear of Alaska, high social rank may bring considerable advantage in weight gain and its subsequent influence upon over-winter survival and reproduction success. Social intolerance might therefore be an important factor in the population regulation of this unshot population.