SOCIAL BEHAVIOUR OF BLACK BEARS AT A GARBAGE DUMP IN JASPER NATIONAL PARK

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Abstract: A minimum population of 34 black bears (*Ursus americanus*) visiting and feeding at the town dump in Jasper National Park, Alberta, were observed for over 750 hours on 141 days in 1968. Females with young of the year visited the dump more than any other group. Their average litter size of 2.67 for regular dump visitors suggests that food from the dump contributed to reproductive success. Social interactions between bears were characterized by tolerance, avoidance, and spacing, but we did observe 141 intraspecific agonistic interactions. In 89 out of 91 agonistic interactions, females with young of the year dominated all other age/sex classes, including adult males. These females, even when not with their young, used agonistic behaviour to maintain an individual distance of 3 to 30 m. Twelve postural and 4 vocal components of the agonistic repertoires are described and frequency of use is given for each identified bear. Agonistic signals were stereotyped but not invariant; physical contact was rare. Agonistic interactions were more frequent early in the season than later. The dump was visited by 7,500 to 10,000 tourists; despite hundreds of close approaches, including 57 situations in which people threw rocks or chased bears, a bear never struck, bit, or touched a person. Bears on 15 such occasions directed agonistic signals toward people; these were similar to signals used in intraspecific encounters. Subadults and females with their young climbed trees, where they appeared to find safety from harassment. Bears in trees were seen nursing, playing, sleeping, sheltering, relaxing, or cooling. The dump offered a food source which was concentrated, high-quality, predictable, and prolonged in time. Bears exploited this resource by forming social aggregations, tolerating other bears at shorter distances when at the dump than when away.

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Black bears are members of the order Carnivora whose diet is composed largely of plant foods (Tisch 1961, Hatler 1967). They feed on animal matter when it is available. Protein and fats from animal sources are normally restricted in their diet and these shortages may limit growth, development, and reproduction (Rogers et al. 1976, Rogers 1977). Garbage dumps, such as the one which existed near Jasper townsite, offered a prolonged source of high-quality food for bears because the dump received the garbage of thousands of people each day for about 100 days. Rogers et al. (1976) documented the growth and reproductive advantages accruing to bears which have access to dump foods. In national parks the benefits of this apparently better nutrition may be offset by increased mortality following the involvement of such bears in incidents of property damage and human injuries. Such dumps where black bears have unrestricted access to garbage no longer exist in Canadian or American national parks.

The dump in Jasper for many years attracted numerous black bears and very few grizzly bears (*Ursus arctos*). It offered an excellent opportunity to observe social interactions among bears and between bears and people. The environment surrounding the dump had stands of trees varying in density from very open to closed. We focussed part of our observations on how black bears, believed to be a forest-adapted species (Herrero 1972, 1978), utilized these trees.

Black bears are normally solitary except for associations of females with young, males and females during mating, and siblings after weaning (Rogers 1977). Adult females may have territories (Jonkel and Cowan 1971, Rogers 1977). This social organization and use of space and other resources has been interpreted (Herrero 1978) as being adaptive to exploit food resources which are normally dispersed and are not prolonged in time beyond a month at a given feeding site. The dump offered a uniquely concentrated food resource whose availability was very prolonged in time. This study looked primarily at the social characteristics of black bears which allowed them to come together in aggregations and successfully feed at a dump.

John Courtney shared the observational work and data analysis with me. His help was very valuable. Professors J.J.A. van Iersel and Allan Stokes critically read and commented on a much longer version of this paper. I owe them many thanks. David Hamer and Lynn Rogers kindly reviewed the paper in its present form. The field work for the project was carried out while I was a post-doctoral fellow working under Professor J.B. Cragg, then director of the Environmental

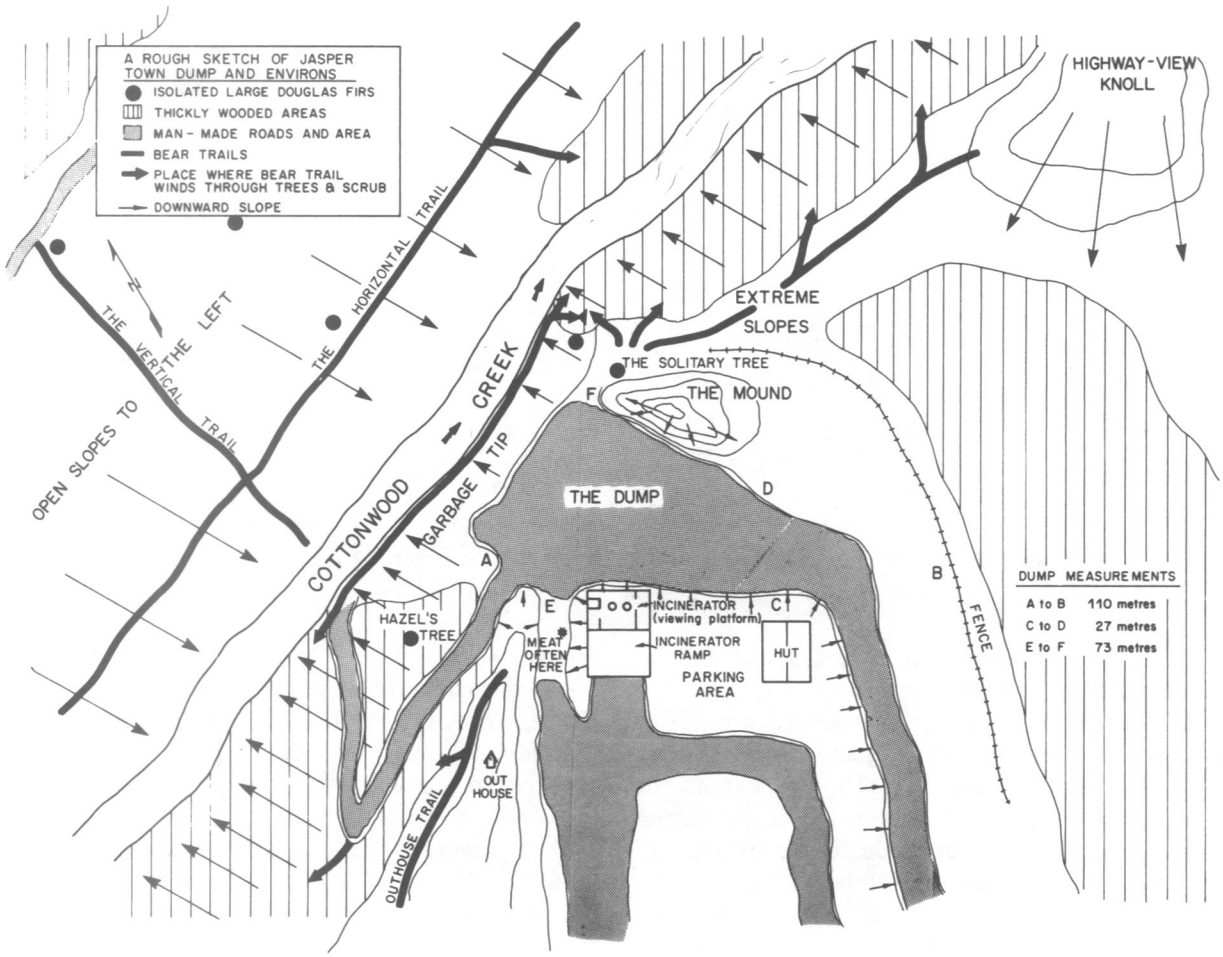

Fig. 1. Topography of the Jasper Town Dump area near Jasper, Alberta, 1968.

Science Centre, Kananaskis, Alberta, Canada. The work was supported by National Research Council funds of Cragg and myself.

STUDY AREA AND OBSERVATION TECHNIQUES

The Jasper town dump, which was 0.9 km north of the townsite, was the centre of our study area. Bears were observed at the dump and within a 1.2-km radius of it. The topography of the dump area is shown in Fig.1. The dump was reached by road and was open to the public. City garbagemen and town dwellers used the dump regularly, mainly between 0800 and 1700. After this there was little dumping, but during the summer months many persons came to observe bears.

Our main period of observation was between 25 May and 12 November 1968. During this time 1 or both of us observed at the dump during 141 days, an average of 4 hours per day. This was supplemented with several hundred hours of observation and habitat examination in the surrounding area. As a rule bear visitation to the dump reached a maximum from late afternoon until dark and we timed our visits accordingly. The 2 dump attendants summarized for us what ursine activity occurred during our daytime absences.

The dump had an incinerator which was much too small to handle the volume of garbage. Most of the garbage was dumped in the area shown in

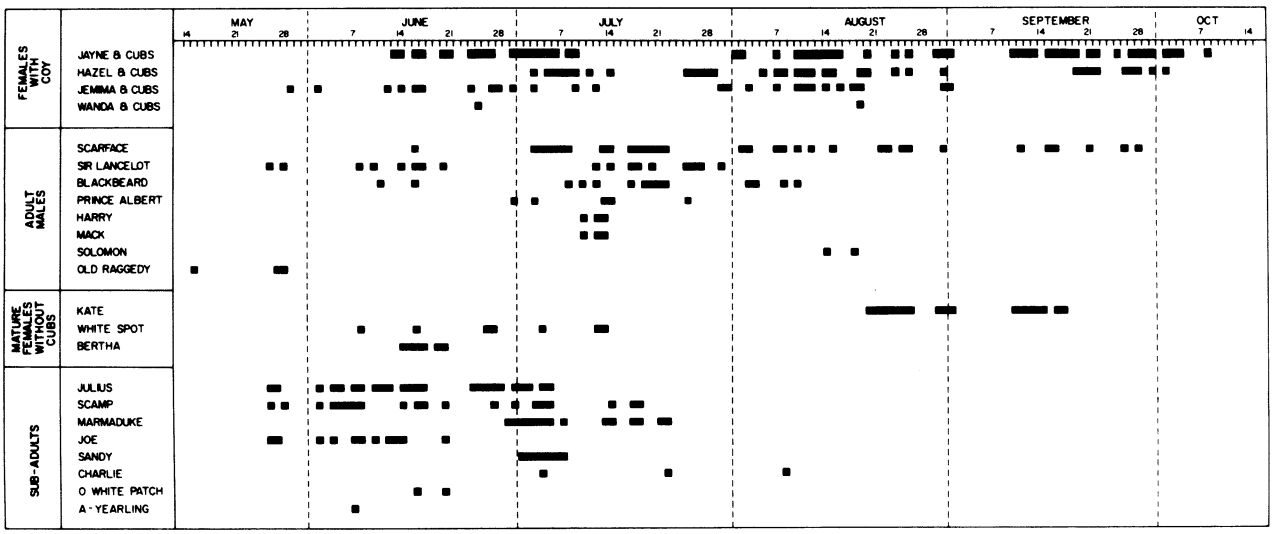

Fig. 2. Days during which individual known black bears visited the dump. (COY = cubs of the year.)

Fig. 1 as "the dump." Here occasional and incomplete burning took place.

Because Jasper is a popular tourist town during the summer months, an adequate supply of food was normally available to visiting bears. The food and garbage supply, reflecting a decrease in tourist visitation to Jasper, decreased in September, and by the middle of October it was relatively small. There was, however, always something to eat for the persistent bear.

At the dump several access and exit routes were used by the bears, the favoured ones leading through or alongside densely forested north-facing slopes (Fig. 1). The forested area behind (northeast) of the dump was typical in this respect. It was a mixture of spruce (*Picea glauca; P. engelmanii*), lodgepole pine (*Pinus contorta*), and Douglas-fir (*Pseudotsuga menziesii*), with occasional aspen (*Populus trichocarpa*). This forested area, and a similar area southwest of the dump, were honeycombed with bear trails.

Marked animals were not used in the study; however, extensive effort was made to identify individual bears by noting their size, build, colour, markings, scars, and behaviour. Sex was determined, usually by sighting of the genitalia, or by noting the presence or absence of cubs.

Age, or at least relative maturity, was estimated by considering a combination of physical size, development, and behaviour. Identified individual bears were classified into one of 5 age/sex classes: adult males, females with cubs of the year, the cubs of the year of these females, adult barren females, and subadults of both sexes. Subadults were estimated to range in age from 1-1/2-year-old yearlings to 3-1/2- or 4-1/2-year-olds.

Bears were usually observed from less than 100 m distance. Binoculars were used when needed to observe detail and especially as darkness increased.

When 2 of us were present 1 would often concentrate on making observations in the off dump areas. By using reasonable caution, bears could often be approached to 23 m. A more typical observation distance was 46 to 69 m. At these distances, even if we approached from downwind, bears were probably always aware of our presence, although they did not act as though our presence was very disturbing. The bears were already thoroughly habituated to people.

RESULTS

Visitation to the Dump

We positively identified a minimum of 34 individual black bears that visited the dump. Of these, 4 were females with cubs of the year; 11 were cubs of the year; 8 were adult males; 3 were adult, barren females; and 8 were subadults.

It was quite easy to get positive individual identification for adult males, females with cubs

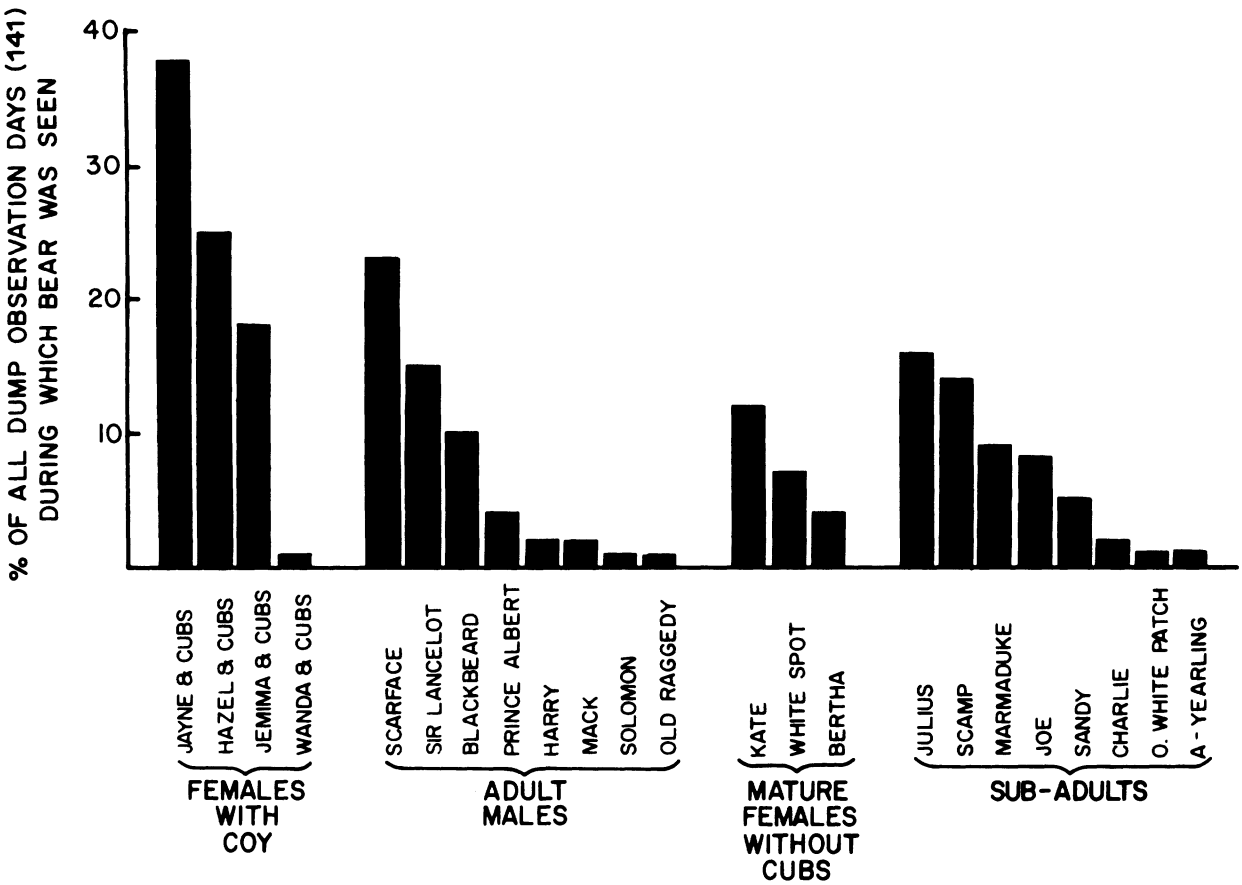

Fig. 3. Percentage of observation days during which individual bears were seen.

of the year, and the cubs of these females. Identifying individual bears of the mature, barren female class was more difficult, and identifying individuals in the subadult class was most difficult. The subadults were a more numerous group than the number of known bear suggests, whereas for the other age/sex classes, except the adult, barren females, the number of known individuals is very close to the total number in that class that visited the dump.

Colour phase of visiting bears ranged from pale to cinnamon to jet black. Nine individuals, all known, comprising 25% of the minimum population estimate, were cinnamon or brown whereas the remainder were black.

The duration of visits on a given day ranged from less than 1 minute up to several hours, and some animals made multiple visits during a given day (Figs. 2 and 3). Duration of visits was recorded for all known bears; it, however, reflected food availability at the dump, and the number and identity of other bears and people present at the dump. For these reasons the number of days on which the dump was visited only suggested the extent of use of the dump by a given animal. Fig. 4 shows the minimum number of different bears visiting the dump per day.

Three females with cubs were relatively frequent visitors to the dump (Figs. 2 and 3). A 4th female, Wanda, who had 3 cubs of the year, came to the dump only twice. Even the 3 females with cubs of the year who were frequent visitors to the dump were occasionally absent for prolonged periods. Jemima and her 2 cubs of the year did not visit the dump from 13 July through 29 July, a total period of 17 days. Jayne, mother

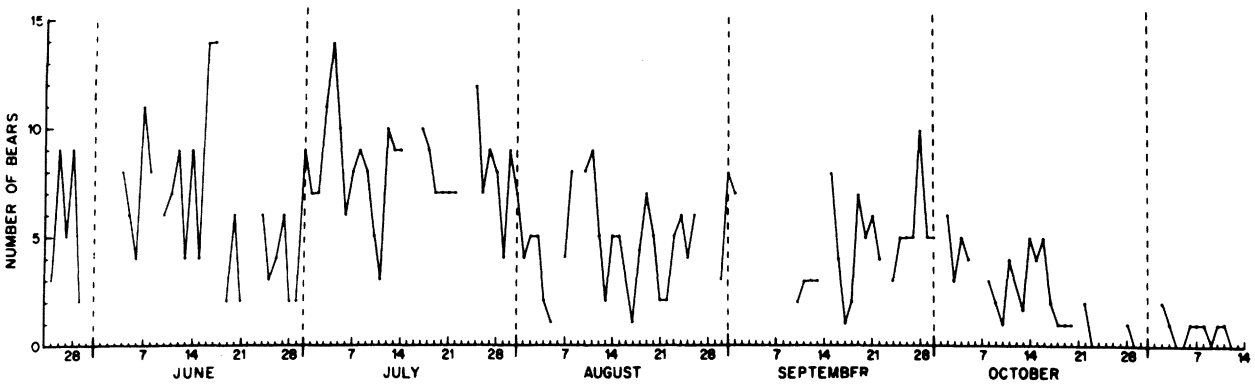

Fig. 4. Minimum number of different bears visiting the dump on each observation day (excluding cubs of the year).

of 4 cubs of the year, did not visit from 11 July through 31 July, a total of 21 days. Hazel and her 2 cubs of the year were also absent for similar but not quite so extended periods. These patterns of visitation suggest that even the most frequent dump visitors, the females with cubs, could get along elsewhere and were not totally dependent on the dump. Other classes of bears which visited the dump less frequently than did females with cubs presumably were less dependent on the dump.

The distribution of dump visits by people paralleled that of the bears, reaching a maximum in July. Daily, from June through August, 1 or 2 tour buses would arrive at the dump as part of a scheduled twilight tour. During 1 July evening we counted 153 human visitors at the dump at 1 time. An estimated total of 7,500 to 10,000 tourists visited the dump during our observation period.

Social Behavior

The Approach to the Dump.—A few bears and occasionally as many as 10 bears would visit the dump between 0800 and 1700 (Canadian Mountain Standard Time). Most, however, waited until the evening. Those that came during the day were more frequently disturbed by garbage trucks and cars than those who came in the evening. Beginning during later afternoon and then continuing until dark, bears began to appear in the area surrounding the dump. Their behaviour suggested that they were waiting for proper conditions at the dump before entering. Black bears seem to be able to vary their periodicity from nocturnal to diurnal depending upon the situation (O.E. Bray and V.G. Barnes, unpubl. lit review, Colorado Coop. Wildl. Res. Unit, Ft. Collins, 1967).

The actual approach and subsequent entry onto the dump area was often characterized by waiting, sensing, and multiple attempts at entry. Entrance was usually gained by preferred routes such as the trail passing beside the "solitary tree" or the trail coming up from the creek (Fig. 1). When these routes were blocked by other bears, especially females with cubs, or occasionally by people, bears used other, less frequented routes.

When females with cubs entered and passed by the "solitary tree" they often climbed the "mound" (Fig. 1), as if to examine the situation on the dump; then if conditions were right they would proceed on to the dump.

Tolerance, Avoidance, and Spacing.—Tolerance between bears, and between bears and people, was the usual situation at the dump. Infrequently this was replaced by agonistic interactions.

Most bears, except females with cubs of the year, could feed about 2–8 m apart and sometimes even nose to nose. This was particularly true of the subadults, and usually true of single adult males feeding with subadults. Adult males tended to maintain spacing from other adult males. Occasionally a bear which was not in the female with cubs of the year class would be feeding at a given spot and use agonistic display toward any other bear that approached. At other times certain bears seemed "irritable" for reasons not obvious to us. Most other bears seemed to quickly sense this and would avoid the aroused bear.

Fig. 5. Most bears at the Jasper Town Dump usually tolerated other bears and humans nearby.

Females with cubs of the year had different spacing. With or without their cubs they maintained an "individual distance." Wherever they were located on the dump they used agonistic display to maintain this distance. The minimum distance tolerated varied with conditions and with individuals; however, we estimated that 3–15 m was the average closest distance to which another bear could approach without eliciting an agonistic display.

In the area surrounding the dump, spacing between bears, except within a family group and between some subadults, was increased. Here the closest distance to which bears could approach each other, or people could approach bears, without an agonistic response, was seldom closer than 15–30 m.

Intraspecific Agonistic Interactions.—The main factors precipitating agonistic interactions were:

1. Females (with or without cubs on the dump, but especially with them) actively maintaining "individual distances" of 3 to 30 m between themselves and other bears outside of their family. If a bear other than her cubs came within this distance this would normally elicit an agonistic response from the female. Certain bears, particularly individual adult males, were recognized by certain females with cubs of the year, and here the minimum spacing distance might be no closer than 30 m or more. At other times, particularly if the cubs were in a tree, much closer distances might be tolerated. Other age/sex classes of bears also maintained "individual distances," but at the dump very small distances down to 1 m or less were usually tolerated.
2. Disputes over food or choice feeding spots on the dump.
3. Apparent recognized antagonism between 2 bears in which 1 would sometimes charge the other on sight. This relationship was rare.

		FEMALES WITH COY			ADULT MALES			
		JAYNE	HAZEL	JEMIMA	SCARFACE	BLACKBEARD	PRINCE ALBERT	HARRY
PHYSICAL	1. ENTERING DUMP AND BEING SENSED	0	2	0	2	1	1	0
	2. SLOW APPROACH	2	8	0	3	3	1	0
	3. HEAD DOWN BACK ARCHED	2	11	1	0	0	0	0
	4. BROADSIDE	0	6	2	0	0	0	0
	5. STANDING STIFF LEGGED FACING ANIMAL	1	0	0	0	0	0	0
	6. MOUTH OPEN JAWS SNAPPING	1	1	0	0	0	1	1
	7. PAW SWAT OR COCK	8	8	3	0	1	1	4
	8. FALSE CHARGE	47	48	16	0	5	3	6
	9. CHASE	37	40	12	0	6	3	4
	10. CHALLENGE POSITION	4	6	2	0	0	0	0
	11. CHARGE WITH CONTACT	0	1	1	0	2	0	0
	12. INFLICTING PHYSICAL INJURY	0	0	0	0	2	0	0
VOCAL	1. HUFFING	1	3	2	0	0	0	0
	2. SNORTING	4	16	10	1	0	0	0
	3. GURGLING	3	5	6	1	2	0	2
	4. LOUD GROWLING	0	0	0	0	1	0	0

Fig. 6. Agonistic behaviour patterns and number of times each was used by certain bears in intraspecific interactions.

4. Redirected aggression where a subordinate bear would immediately leave a disputed area and apparently without provocation direct agonistic behaviour toward a 3rd bear (2 observed cases).

In agonistic interactions a dominant bear was operationally defined as one who was able to cause another bear (subordinate) to move away from or to flee from disputed area.

Agonistic behaviour was composed of a limited set of reasonably stereotyped actions and reactions. Fig. 6 summarizes the agonistic intraspecific repertoire for all bears and tabulates the displays and actions of dominant bears that engaged in at least 4 agonistic encounters. Physical and vocal displays are listed in the order of our impression of their intensity, low to high. The numbers should not be assumed to have more than nominal properties; i.e., they identify but do not rank classes except subjectively.

Most of the listed components of the agonistic repertoire seldom occurred singly except "entering the dump and being sensed," and "slow approach." These passive interactions took place when 1 bear obviously recognized another at its approach, and the subordinate quickly left the dump. More active agonistic interactions usually involved combinations of distinct displays. For instance, the "false charge," so named because the charger could easily have caught and contacted the subordinate, but did not, was in most instances followed by a "chase," the "chase" sometimes punctuated with a "paw swat," in which a forepaw was raised about a half meter and then brought quickly down, striking the ground. The "paw swat," however, might occur without "false charge" or "chase"; in these cases it was often accompanied by a warning "snort." If the bear toward which the "false charge" was directed did not flee, then of course there was no "chase." In this case the 2 bears often went into the "challenge position," in which both animals would face each other and have their noses near the ground and overlapping or centimetres apart, but never touching. The backs were always at least slightly arched when bears were in the "challenge position." In this position the bears appeared to be wound like a spring and in a state of extreme alertness. "Gurgling" by the dominant bear frequently accompanied the charge to this position and sometimes was present during the actual "challenge position." The "head down" display involved 1 animal orienting itself as if it were with another bear in the "challenge position," but in this case the other bear was usually about 1.5 to 9 m away.

Certain agonistic actions were rarely seen but were nonetheless distinct. The "charge with contact," "inflicting physical injury," and "mouth open, jaws snapping" were in this category.

Our observations of agonistic vocalizations were subject to limitations introduced by general dump noises. "Huffing," which was loud deep breathing, could easily have often been masked by dump noises. "Snorting" was a preliminary, first warning display, in which the bear loudly expelled air through its mouth and nostrils much in the manner of a horse snorting. The function seemed to be to draw attention to the "snorting" animal and to serve as a warning. "Gurgling," a

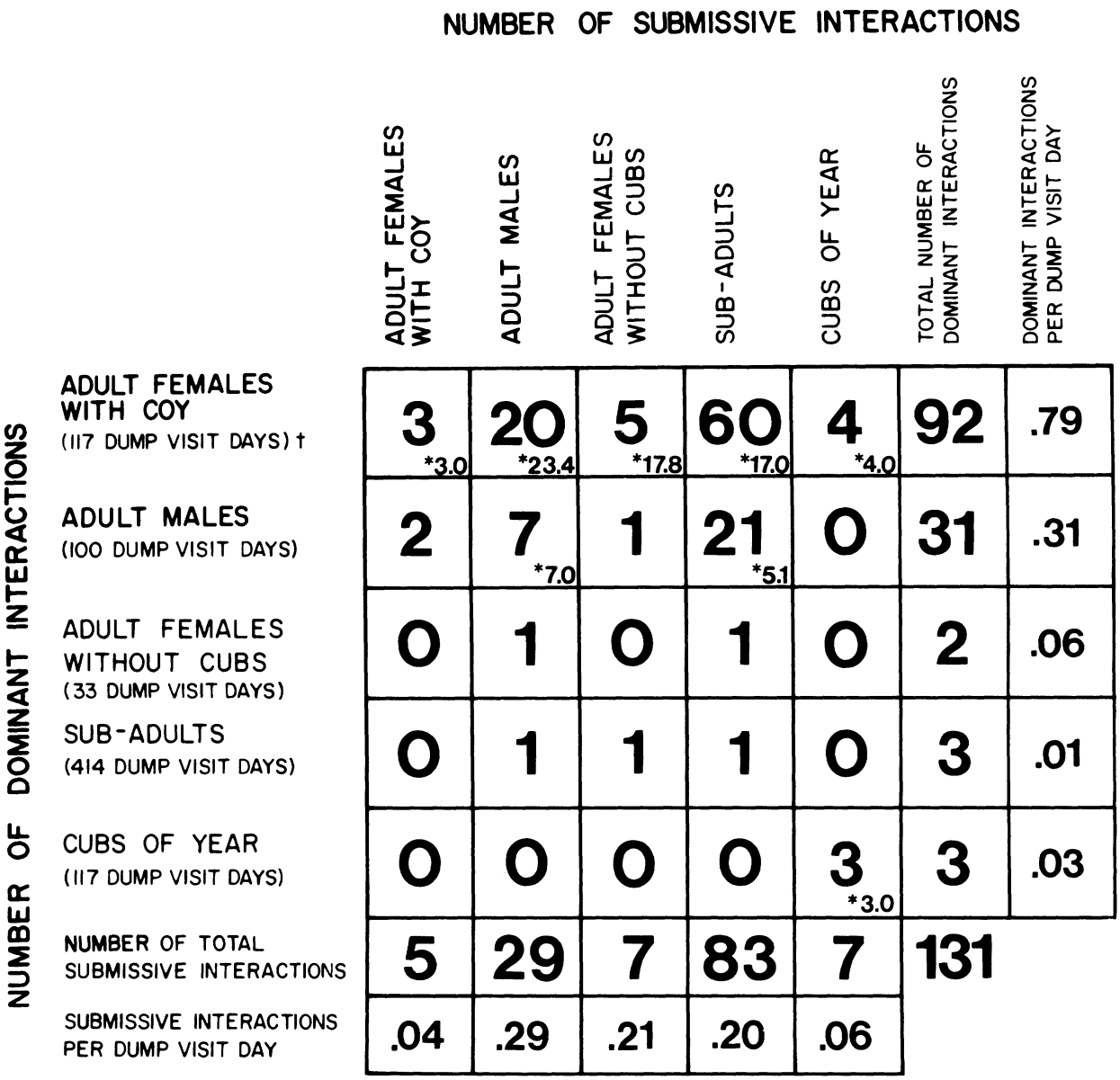

Fig. 7. Dominant and submissive interactions of the 5 age/sex classes of bears. Dump visit days = sum, for all animals of a given class, of the total number of days that each animal within the class visited the dump. Small figures with asterisks represent relative frequency of dominant interaction between 2 classes (R), calculated by $R = (V_d / V_s)\ (T / 1)$, where V = number of dump visit days for the dominant (d) or submissive (s) class, and T = total number of interactions in which this dominant class dominated this submissive class (e.g., number of times adult males were dominant over subadults, etc.).

low-pitched warbling, throaty rumble was seemingly a high-intensity threat. It was given when 2 bears were less than 6 m apart, and usually when they were assuming or in the "challenge position." "Loud growling" was only heard once and this was during an interaction in which the growling bear inflicted physical injury on another bear.

We observed 156 agonistic interactions in which at least 1 known bear was involved. This represents about 90% of all agonistic interactions observed at or near the dump. Since we knew all the females with cubs of the year and most of the adult males in the area, and since these were the animals interacting most, few interactions occurred in which we did not know at least 1 bear. Of the 156 interactions, people were involved in 15. Of the remaining 141, dominance (as defined) was clear in 131 instances. Many of the

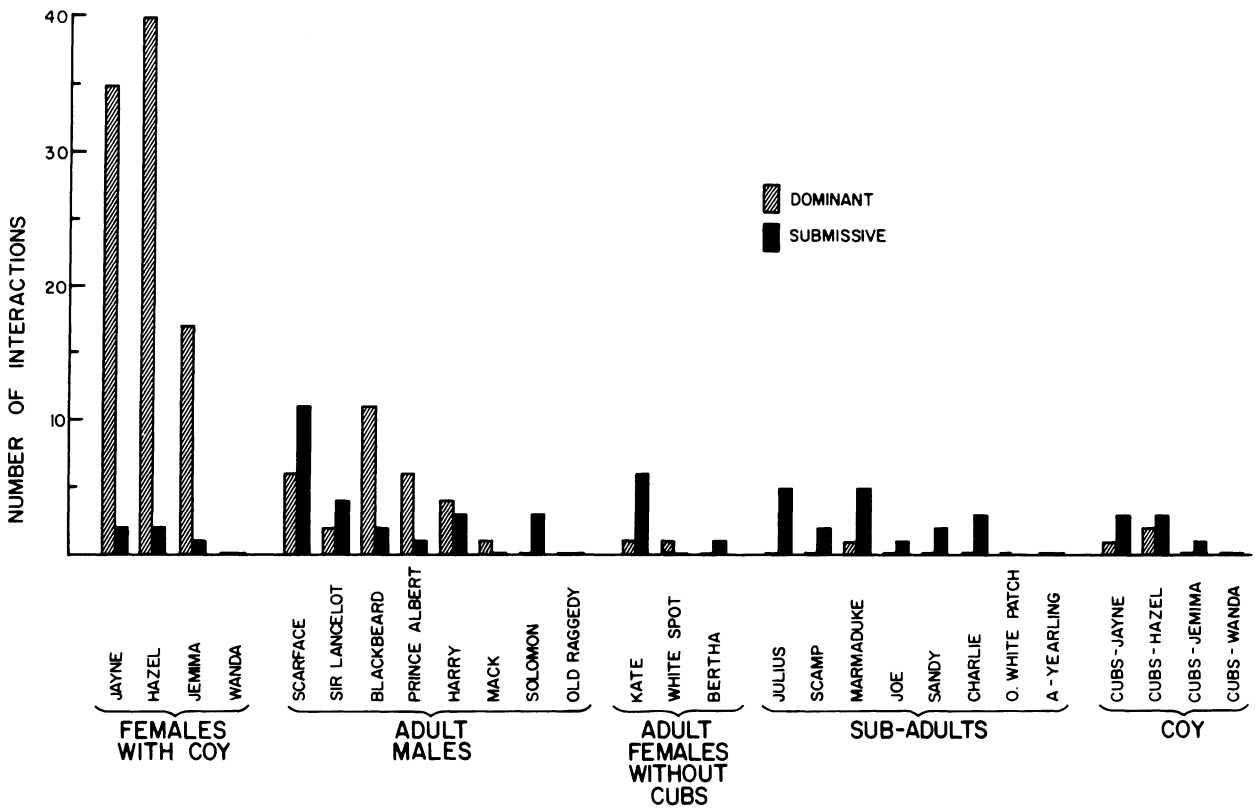

Fig. 8. Total number of dominant and subordinate interactions by individual bears.

156 interactions involved multiple displays and reactions, and some lasted as long as 10 minutes.

Females with cubs were the most dominant bears visiting the dump and surrounding (Fig. 7). They interacted little with each other, despite ample opportunity, probably because each maintained its "individual distance" apparently without display. They were dominant over other classes of animals in 89 instances and subordinate in only 2. They were also involved in 6 encounters in which dominance was not established. These nondecisive encounters were clustered during late August and September (with 1 exception on 15 July). During late August and September the agonistic displays of the females with cubs of the year seemed to be the same as earlier, but the receiving bear showed little response. Females with cubs interacted with all other age/sex classes of bears with about the same relative frequency, the criterion seemingly being whether the other bear came within the range of the female's "individual distance." Females with cubs of the year often were more tolerant when their cubs were in a tree, thus sometimes permitting a reduction in their "individual distance." Figs. 8 and 9 show that each individual female with cubs had a very high absolute number of dominant interactions and a very high ratio of dominant interactions to subordinate interactions per visit day.

Adult males exhibited dominance infrequently over other adult males, and 3 times as often over subadults (Fig. 7). Among the 7 adult male–adult male interactions in which a dominant emerged, only 1 involved physical contact and injury. Three interactions involved the subordinate bear fleeing at the slow approach of the dominant, while in the other 3 cases more active threats were used. It may be important that very few adult males visited the dump or surroundings during June, which was the main part of the breeding season and also a time when adult males would be likely to engage in dominance interactions. Rogers (1977) also found that adult males

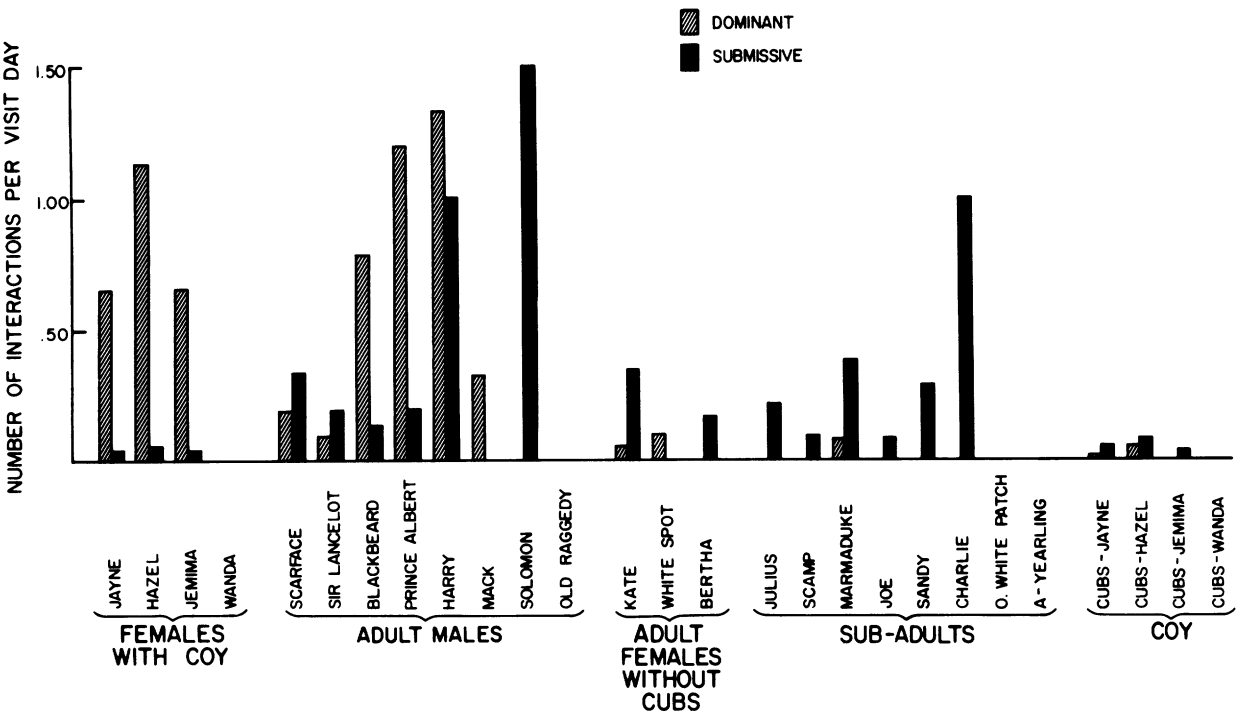

Fig. 9. Number of dominant and subordinate interactions per dump visit day for individual bears.

reduced their use of garbage dumps and roamed widely during the breeding season.

Fig. 9 shows that there was significant individual variation between different adult males in terms of the ratio of dominant interactions to subordinate interactions per visit day. Indeed this was subjectively obvious, as some adult males acted very aggressively, whereas others tried to avoid interactions. The most violent agonistic interactions, 2 cases involving charges with contact and the inflicting of physical injury, were both initiated by 1 aggressive adult male, Blackbeard. Viewed in the context of dominant and subordinate interactions per visit day, some adult males were as agonistically active as were the females with cubs. However, they visited the dump much less and so their total number of agonistic interactions was less.

While females with cubs of the year averaged 0.79 dominant interactions per visit day and adult males 0.31, all other classes of bears had practically none. This strongly suggests the possibility that, as in dogs, the onset of certain intraspecific agonistic behaviour patterns is hormonally determined and correlated with full sexual maturity.

Interactions Between Bears and People.—The dump attracted between 7500 and 10,000 tourists who came specifically to watch the well-known bears of Jasper. Despite hundreds of interactions with humans, a black bear never struck, bit, or even touched a person. Fifty-seven different times from May to November we observed people throwing missiles (usually rocks) at bears. At times this was done from 6 m or less and with accurate hits which evoked pity. A bear might at first threaten a missile thrower, but the persistent thrower always was able to chase a bear away. We had the impression that most of the missile throwers were local residents.

Even the most aroused black bear retreated from people. Early in the season, Hazel, the most aggressive female with cubs, had just arrived at the dump and she was directing agonistic displays toward every bear that came within 15 m. A young man, newly arrived at the dump, leapt from his car, urged on by a friend, and

quickly approached to within 1.5 m of Hazel and took her picture as she directed a "paw swat" display at him. He subsequently chased her from the dump and treed both her and her cubs. On another occasion, Blackbeard, a very powerful and aggressive adult male, had just opened a 130-cm^2 cut in the flank of a subadult and in the process had cleared the dump of bears. Tourists arrived several minutes later and approached within about 8 m of Blackbeard to take pictures. He fed quietly without response.

So it went on hundreds of occasions: people with food in their hand approached bears; other people again and again positioned themselves between a female and her cubs; people suddenly surprised bears at close range; little children approached to about 3–6 m from bears and then ran—all these cases without incident. Unfortunately, these data were not quantitatively recorded. Their importance was revealed retrospectively and hence they are reported as they exist.

People were always dominant over black bears, and usually without any agonistic display a bear would leave as a person threatened or approached. In 15 instances, however, we observed black bears direct agonistic displays at people. There were 12 occurrences of "snorting," 6 of "false charge," 5 of "paw swat," 2 of "slow approach," and 1 each of "head down" and "standing stiff-legged" facing the human. Thus the same agonistic displays were used during these interspecific interactions as were employed during intraspecific interactions. The small sample size cautions against statistical comparison of the frequency of displays used in bear–bear interactions versus the frequency of displays used in bear–people interactions. However, 3 of the 4 most common displays in bear–bear interactions—false charge, snorting, and paw swat or cock—were also the most common in bear–people interactions. One display common in bear–bear interactions, the chase, was never observed in bear–people interactions.

Limited observations suggested that bears were more tolerant of close approaches by humans at the dump than elsewhere. In nearby areas agonistic displays were more easily elicited, usually from greater distances.

Characteristics of Age/Sex Classes and Individuals

Adult Males.—Members of this cohort were normally observed unaccompanied by other bears except during the breeding season. With the single exception of Sir Lancelot, the smallest male classified as an adult, they visited the dump very little during May and June, and then in July suddenly appeared in numbers. Their July appearances correspond to the period during which the mating season was ending. By the end of July most of them had left again. Scarface was a notable exception and he was a frequent dump visitor through late September. He appeared to be older, slow moving, and was a very tolerant bear, often behaving to avoid trouble. His temperament adapted him very well to the dump.

On the dump, adult males usually fed alone, although again there was considerable individual variation. Scarface often tolerated subadults feeding very close by, while some adult males, such as Blackbeard, used agonistic display and occasional physical contact against other bears that came nearby. Adult males behaved as if they knew each other's strengths and weaknesses, and interactions were usually avoided by spacing.

Most adult males were quite tolerant of the numerous subadults, at times wrestling and "pawing and jawing" with them. Usually a particularly forceful swing of the paw, or use of the jaw, would cause a subadult to run off.

Females with Cubs of the Year.—In the Jasper area there were significant differences in the relationship between different females and their cubs. Jayne was a cinnamon-coloured mother to 4 cubs, 2 black and 2 cinnamon. From her first arrival at the dump she seemed to require that her cubs keep track of her. In June and early July she was often observed separated from at least part of her family and several times she was seen feeding, or entering the creek, or sleeping, by herself. Twice we observed her without 2 cubs and we were subsequently able to observe and follow the wanderings of these cubs and listen to their loud cries for several hours. In each case, the next day that we saw her she had her entire family. While she was not a particularly

reactive female to other bears or disturbance, she always actively enforced her "individual distance" and was very effective in threatening other bears away from herself or her cubs. She gave the impression of being a well-practiced mother demanding strict discipline. Later in the season when the cubs had "learned the rules" they followed her closely.

Both Hazel and Jemima behaved very differently. Early in the season they were easily startled, frequently spooked from the dump, and tended to follow their cubs of the year when the cubs ran off. Jemima frequently reared onto her hindlegs to sense disturbances. While she was feeding on the dump she often oriented toward her cubs whether or not they were on the dump. Early in the season Hazel would leave the dump and join her cubs at the slightest sign of disturbance from them. Both females were like Jayne in being very active defenders of an " individual distance." As the season progressed both became less easily aroused; however, they were always more oriented toward their cubs than was Jayne, and were never seen on the dump except when the cubs were nearby.

Cubs. — Their extreme playfulness during May and June gave way to more and more time being spent feeding both on the dump and nearby. This was paralleled by a shrinking of the mother's teats. When the cubs first appeared near the dump they were very reluctant to enter and if they did they would remain for a few minutes at most before leaving and climbing a tree. By late July all cubs had begun serious feeding at the dump; however, this was subject to frequent disturbance. By August and September they evidenced further maturation as shown by attempted mountings, very limited agonistic display, and the independent construction and use of ground beds.

A piercing, loud, human baby-like cry of wan–wan–wan was commonly given in the absence of the female early in the season. This cry must develop very early, for when I first heard it from an about 40-day-old black bear cub in Banff National Park on 28 February, the cry was already quite loud (Herrero 1970*a*). The cry usually brought an absent mother back to the cubs. Again, its use waned but did not disappear over the season. In fact, yearlings separated from their mother in May still sounded this cry.

Yearlings. — We only observed 1 group of 3 yearlings that still remained with their mothers. These yearlings acted like very independent cubs of the year, feeding entirely on their own. We never saw them suckle. By June they had joined the dump society of subadults.

Adult, Barren Females. — We gathered little information on this group except to establish that during May or June they were frequently involved in courtship and at least partial copulation and throughout were seldom involved in agonistic interactions.

Subadults. — This large, amorphous group of bears, though ranging in age from 1-1/2 to 4-1/2 years, were reasonably uniform behaviourally. The subadults were characterized by their frequent tree climbing, by participation in wrestling and "pawing and jawing," by tolerant group feeding, and by subsets of them moving together both on and away from the dump in a loosely-knit society. Their frequent social interactions were facilitated by their infrequent and incomplete agonistic behaviour.

The Role of Trees

Much of black bear behaviour nearby the dump revolved around the use of trees. We made qualitative observations regarding the way in which social behaviour and to a lesser extent maintenance behaviour was influenced by trees.

As mentioned, the most intensively used bear trails at Jasper were either in or near wooded areas or the edges of wooded areas. Other trails, used less frequently, such as the "vertical" and "horizontal" trails along the open slopes to the left, passed close to isolated Douglas-fir (Fig. 1).

Climbing for Escape, Protection, Play, Sleep, Relaxation. — At Jasper these implied functions of tree climbing normally centred upon large and mature Douglas-fir. Trees were used in these manners especially by cubs, but also by females with cubs and by subadults. We never saw adult males or mature barren females climb for these or any other reasons, although it is known that adult black bear males can climb if appropriately motivated, such as when pursued by dog packs.

Early in the season cubs of the year climbed whether or not the female was nearby when the cubs apparently were disturbed by external factors such as other bears, noise, or people; they also climbed in the absence of obvious disturbing

external events. No signal was required from the mother to send cubs up a tree, although the female could easily induce them to climb by somehow arousing them, or by running toward a tree herself. The cubs immediately became aroused when the mother entered into an agonistic interaction with another bear. It usually appeared that the behaviour of the cubs in this respect reflected the intention of mother. However, most cubs also showed considerable independence in tree climbing, sometimes descending after the female had left, or climbing when disturbed and the mother was away.

The tendency to climb, either in response to obvious external disturbances or motivated by less obvious internal factors, diminished as cubs matured. In June the sudden appearance of a new bear near cubs would always result in their running to and then rapidly climbing up the nearest suitable tree. By August certain cubs of the year would sometimes remain on the dump during disturbing circumstances. When there was no obvious external disturbance cubs of the year would sometimes climb, and then play, rest, or sleep. The arboreal habitat was a place free from danger during our observations and the vigilance exhibited on the ground appeared to be relaxed.

The most obvious mother–cub communication in the use of trees occurred when a mother left the dump after feeding and her cubs of the year were still in a tree. Then she would usually (except Jayne, who would sometimes) go to the base of the tree where the cubs were and they would soon come down. On occasion the female would climb the tree and then descend and leave with her cubs. Sometimes when the female was on the ground and her cubs were still in a tree she would make a soft, hollow sound, like one made with the mouth closed –oomph –oomph –oomph. We believe that the females communicated quite well with their cubs without having a highly specific communication system.

Cubs of the year, regardless of the cause of their climbing, would often play or rest once up a tree. Lively chases, and "pawing and jawing" sessions, would sometimes develop among the cubs at heights of over 30 m. We often expected to see fatal falls but actually never even saw a serious slip during play.

Trees also served as shelter for females and cubs, as well as for subadults, when they were pursued by people, during violent thunder and lightening storms, and when responding to heat.

Resting was a form of sheltering with protection against a possible rather than an actual disturbance. As soon as a bear climbed a tree under these circumstances it seemed to lose much of the cautionary alertness normally shown on the ground, and after climbing the bear might become lethargic. The degree of relaxation varied from a few minutes respite from the activities and alertness on the ground, to prolonged and sound sleep lasting for several hours.

The escape, protection, play, sleep, and relaxation aspects of climbing were as true for subadults as they were for cubs; however, the frequency of occurrence was less. A belligerent female with cubs, or an adult male, would have no trouble in treeing a subadult, and like mothers and cubs, subadults climbed when there was no obvious external disturbance. At times a group of 3 or even 4 subadults would climb into a tree and continue in a modified manner wrestling bouts which began on the ground.

Use of Specific Trees. – Certain animals, particularly Hazel and her cubs, and Jayne and her cubs, each used a different tree more frequently than they used others. Early in the season Hazel or Jayne would usually approach the dump, passing close to "their tree" and soon, for 1 reason or another, the cubs would be up the tree. Other animals used these same trees but not to such an extent. Wright (1910) and Mills (1932) also observed that some bears had certain trees which they climbed more frequently than others.

Simultaneous Use of Trees. – An aggressive adult bear on the dump was on occasion the trigger which resulted in 2 or 3 subadults climbing the same tree. Three times we saw individual subadults chased up the same tree where cubs of the year were already located, and twice we saw cubs chased up a tree where subadults were already located. When this first happened we expected the mother of the cubs to aggressively respond; but, in each instance, this was tolerated by the mother and cubs. Twice, however, the subadult was threatened by the mother when the subadult subsequently descended to the ground.

As a correlary to this tolerance for mixed occupancy of trees, people could usually approach the base of a tree where a female's cubs were without evoking a threat from the female while she fed nearby on the dump. I doubt that this would be true for bears not thoroughly habituated to people. This type of human intrusion and approach to treed cubs elicited threat behaviour when away from the dump.

Hazel's cubs were observed 3 times nursing while in "Hazel's tree." Other females with cubs were not seen to nurse while in trees but they did not spend as much time in trees with their cubs as did Hazel. When in a tree the female was almost always located below them. This was the case in all threatening situations except once when Hazel climbed beside a cub, positioning herself between the cub and a man who was throwing rocks at it (Fig. 10). Mothers of cubs, while located at their usual defensive position not far up the tree, would sometimes direct a "paw swat" or "snort" at approaching bears or people. Mothers of cubs occasionally slept for up to several hours in a tree while the cubs sometimes slept and sometimes played higher up.

Fig. 10. Female black bear shielding cub from rocks thrown by visitor to Jasper Town Dump.

DISCUSSION

I have withheld this study from publication for many years because of obvious limitations. I believed that study of social behaviour at a dump should continue for several years, should become quantitative, and that such a study should be interpreted against detailed knowledge of black bear population history and dynamics, and habitat use within the region of a dump. Furthermore, careful documentation of the distribution, abundance, and changes in natural foods would allow the food resources of the dump to be put in perspective. I assumed that such a project would be done; I had hoped to do it myself, but national park management priorities led to closure of the Jasper Town Dump after our 1st year of work. Today large dumps, freely accessible to bears, no longer exist in national parks in North America, and outside of the parks the opportunities for similar observations are complicated by hunting. Seen in this perspective, our 1968 study had many limitations, but it still documented one extreme of social adaptation and interaction in a setting no longer available to researchers.

Rogers et al. (1976) demonstrated that in Michigan black bears who fed at dumps grew more rapidly, matured sooner, and had better reproductive success than bears who ate only natural foods. Our data also suggest good reproductive success, although only 3 family groups were counted and success of non-dump feeders was unknown. Rogers (1977) claimed that the black bears' diet is normally low or deficient in protein and fat. Bacon (1973) showed that in food choice tests black bears preferred foods high in protein or carbohydrate. Dumps appear to offer important sources of limiting or preferred nutrients.

During our study the Jasper Town Dump was an ecologically unique resource having no equivalent in the natural environment. Because tourism is a major industry at Jasper, and the town dump was the biggest in the region, the dump had large volumes of food available from at least June through early September or for a period of about 100 days. Even Alaskan salmon streams do not have concentrated food resources for bears prolonged beyond about 40 days (Egbert and Stokes 1976). As a food resource the Jasper Dump was prolonged in time. The dump also

was in the same location for over a decade. This probably meant that several generations of bears were raised in association with the dump and became accustomed to its characteristics.

The minimum estimated number of bears (34) who shared the dump's food resource suggests the social flexibility of this normally solitary species. While only a few bears, especially females and their cubs of the year, made intensive and prolonged use of the dump, many others visited it occasionally. The visiting females with cubs of the year also dominated social interactions at the dump. They were dominant in 89 out of 91 interactions with other age/sex classes including adult males. This surprising finding appears to contrast with the more casual behavioural observations of black bears at dumps in Michigan by Rogers et al. (1976) and Rogers (1977). Their studies showed that 81% of the bears captured at dumps were males, the largest males could be found at dumps, and large males were the normal social dominants. Male social dominance, based on a combination of larger size and aggressiveness of individual males, is the situation reported for all prolonged concentrations of grizzly bears at food resources (Hornocker 1962, Stonorov and Stokes 1972, Egbert and Stokes 1976). Erickson et al. (1964) reported that in Michigan black bear females with cubs of the year seldom visited garbage dumps. Herrero (1978) reviewed data which suggest that both black and grizzly bears show significant sexual dimorphism with adult males averaging at least 1.5 times heavier than adult females. Male dominance would be expected because of their larger size.

The limited scope of the present study does not give insight into the many historical, population, spacial, and natural food crop factors which may have led to the observed domination of dump use and of social interactions by females with cubs of the year at the Jasper Dump. The observations are further evidence for the marked social plasticity of black bears in responding to local conditions. Detailed field studies of a variety of vertebrates ranging from primates to birds have revealed that flexibility of social organization within a species helps individuals and populations of many different species fine tune themselves to exploit local resources (see, for example, Eisenberg et al. 1972, Stacey and Bock 1978). The concentration of black bears at the Jasper Dump and the use of agonistic behaviour to secure access to resources contrasts very markedly with the distribution in time and space of most black bear populations and with the normal extent of agonistic behaviour (see Herrero 1978 for a review of this topic). Normally, food resources for black bears are much less concentrated both in space and time. Black bears under these conditions typically forage by themselves or as part of family or sibling groups. They do not form social hierarchies; however, adult females may use agonistic behaviour and mutual avoidance to maintain territories, and males form limited social hierarchies with other males, at least during the breeding season (Rogers 1977).

A qualitative look at the behaviour of adult males in relation to females with cubs of the year at Jasper showed that the males normally avoided interactions with such females. Any reasonably aggressive bear, as were most adult males, could easily secure a good meal at the dump without having to displace a mother bear. Tolerance and avoidance could have been energetically efficient foraging strategies. Females with cubs, even when the cubs were off of the dump and up trees, were almost always ready to use agonistic display to maintain spacing even when they were not feeding. There are limits to the extent of social adjustment which certain age/sex classes and individuals can make to exploit food resources.

The main behaviour change which I believe adapted black bears to feeding at the dump was a gradual reduction of "individual distance." When bears first began visiting the dump they were more wary of each other, and normally 1 would flee before 2 bears got close to one another. By July bears behaved as if the behaviour of conspecifics was predictable. Most bears would tolerate other bears feeding close by unless a certain bear was agitated. Egbert and Stokes (1976) documented an increase in mutual tolerance for brown bears (*Ursus arctos*) feeding on a salmon stream as the feeding season progressed. Females with cubs of the year always enforced the greatest individual distance even when their cubs were away from the dump in a tree. Individual distance for all bears which we identified as individuals was greater away from the dump that at the dump. Shrinking of individual distance at the dump appeared to be the primary mechanism which allowed bears to form feeding aggregations

where each individual, or each group of female plus young, foraged on its own.

Our results on the specific components of black bear agonistic behaviour are similar to those reported for captive, zoo, and panhandling bears (Burghardt and Burghardt 1972; Henry and Herrero 1974; Pruitt 1976; Jordan 1976; J.T. Eagar and M.R. Pelton, unpubl. rep., Natl. Park Serv., Southeast Region 1979). Our observations reported in this paper omit reference to ear position and mouth shape signals. Observation conditions at the dump prohibited adequate observation of these postures. Cumulatively, the results of the various teams that have studied the elements of agonistic behaviour demonstrate that Lorenz (1955) made a mistake when he suggested that black bears have few signals with which to warn people or other bears before attack. The agonistic repertoire of black bears is sufficiently diverse and graded to apparently convey intent to conspecifics, or to people who understand it.

The use of vocal warning and threat (Pruitt 1976; this paper) appears to be more developed in black bears than in grizzly bears (Stonorov and Stokes 1972, Egbert and Stokes 1976). Black bears, being more specialized to forest than are grizzly bears (Herrero 1972, 1978), may have had a selective advantage in using vocal as well as visual signals for intraspecific communication. Vision is restricted in forests.

Our results regarding the various functions of trees nearby the dump are further evidence concerning the importance of trees to black bears. Without trees I believe that females with cubs of the year would have been unable to feed on the dump and still have their cubs in a safe place. Females with young, the young by themselves, and subadults often climbed trees. Tree climbing served the following implied functions: safety, escape, sheltering, nursing, rest, relaxation, cooling, and play. The strongly preferential use of specific trees by certain females with cubs of the year probably contributed an important element of predictability and safety while visiting the dump—an environment which was potentially threatening because of the numbers of bears which sometimes visited the dump.

At least 2 additional uses of trees appear to be important in other biogeoclimatic zones: hollow portions of trees are sometimes used as den sites, and mast- or fruit-producing trees are ascended for the purpose of feeding (Pelton and Burghardt 1976).

Our observations on bear–people interactions are superficial compared to those of Eagar and Pelton (unpubl. rep., Natl. Park Serv., Southeast Region, 1979). They confirm the great tolerance which black bears normally show toward people and the aggression and ignorance which some people show around black bears. Most significantly our results further support evidence which shows that human injury "in defense of young" is rare in black bears as compared to grizzly bears (Herrero 1970*b*). This difference in strategies for defending offspring was subsequently related to different natural selection parameters which existed within forested versus more open habitat types (Herrero 1972, 1978).

Despite the number of people injured by black bears in national parks where garbage and food mismanagement have at times conditioned dangerously aggressive bears (Harms 1977; J.T. Eagar and M.R. Pelton, unpubl. rep., Natl. Park Serv., Southeast Region, 1979), overall, black bear aggression toward people culminating in injury is minimal, and this is no doubt one of the important behaviour characteristics which has allowed the black bear to successfully coexist with people in many areas.

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