GRIZZLY BEAR - MAN RELATIONSHIPS IN YELLOWSTONE NATIONAL PARK

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ERRATA

Table 12, column "Bear No.", line 3, 53 should be 57.

Table 13, column "Age at first capture in campground", line 4, Adult[2] should be 12-1/2.

Table 13, footnote "[2] Exact age unknown" should be omitted.

GRIZZLY BEAR-MAN RELATIONSHIPS IN YELLOWSTONE NATIONAL PARK

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Decrease mortality

Remove artificial food

Feed carrion to bears

Protect Campgrounds

Continue research

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GRIZZLY BEAR - MAN RELATIONSHIPS IN YELLOWSTONE NATIONAL PARK

The grizzly bear, Ursus arctos horribilis, is an intelligent, extremely efficient omnivore and a relatively inefficient carnivore. This large bear feeds on grasses, sedges, tubers, berries, nuts, carrion, meat caches, rodents, big game, livestock, garbage, and even modern packaged foods. The propensity to seek and utilize a wide range of edibles has brought the grizzly into frequent contact with man. This ecological relationship of the omnivorous grizzly associating with omnivorous man and the predatory bear competing with the predatory human has led and will continue to lead to confrontations, property damage, and occasional conflict and injury. The grizzly has a long history of seeking and taking the food it wants with little opposition. The erratic, aggressive, and frequently unpredictable behavior of both grizzly and man increases the probability of conflict. The opportunity for confrontation and for injury to humans is small, but it is greater in national parks than elsewhere.

To understand grizzly bear - man relationships in Yellowstone National Park, we must first recognize that the ecology of bear and man has always overlapped. Within recent geological time, the grizzly bear was at the top of the North American food pyramid. Wherever the species existed, it was

either the dominant mammal or a co-equal with man. Modern man with his lethal weapons has exterminated the species over much of its former range but has not basically altered this relationship. The great bear still seeks food in the presence of man, but without this incentive, the grizzly tends to avoid man. However, in many situations, the grizzly is not submissive to him.

The North American Indian and the grizzly competed for many of the same foods, the bulbs of blue camas (Camassia quamash), the tubers of yampa (Perideridia gairdneri), the biscuitroots (Lomatium spp.), and other starchy roots; berries, pine nuts, acorns, fish, and the large herbivores, especially those weakened by severe winters.

Bears continue to compete and to associate with man today in wilderness areas as well as in congested campgrounds. They do so whether they are black, grizzly, brown, or polar bears. All will raid camps, enter developed areas, or feed at garbage disposal sites. The degrees of association with man and his culture have varied and still do vary with the species of bear. They also vary with motivation and traditional feeding patterns which frequently are associated with easily available food.

The North American Indian and the grizzly bear coexisted in a spacious environment. Two questions we wish to explore are -- can the grizzly bear and modern man coexist in the congested environments of our large national parks? Specifically, can man

and grizzly live together in Yellowstone? Secondly, if they can coexist, how should man achieve this? Both questions require more than theoretical or philosophical answers, ethological extrapolation, administrative decrees, or generalized guidelines.

We, our colleagues, and our graduate students sought to answer these questions 12 years ago when we began a long-term study of the grizzly bear in Yellowstone National Park and adjacent national forests (Craighead, et al., 1960). Since 1959 we have captured, examined, and released over 550 grizzlies, immobilized and individually color-marked 256 and logged over 40,000 man hours observing and recording their activities and behavior. In addition, 24 individual grizzlies have been fitted with radios and radio-monitored for approximately 30,000 hours in order to obtain data on movements, home ranges, food habits, social and denning behavior, and an understanding of bear-man relationships (Craighead and Craighead, 1965, 1969, 1970). We hope to continue the research for a number of years in order to scientifically evaluate the management suggestions we have made to the National Park Service (Craighead and Craighead, 1967).

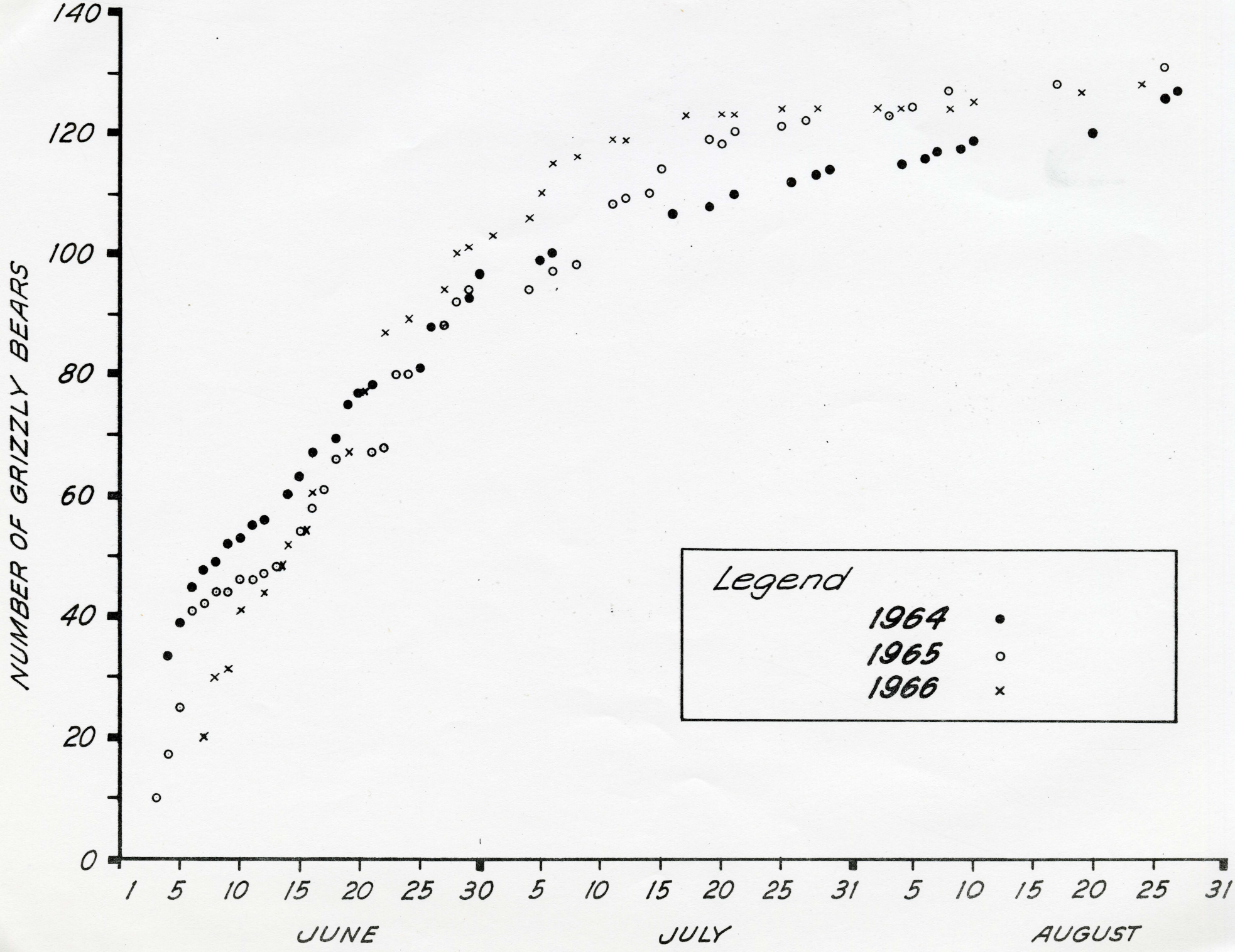
SOME BIOLOGICAL FACTS

Using data from 324 censuses totaling 11,340 hours and from an intensive trapping, re-trapping and marking program, we have calculated a minimum of 175 grizzly bears in the Yellowstone area. One-third of the adult females (about 15) breed each year and produce an average of 33 cubs or a 19% annual increment. Two-thirds of the cubs survive to the age of 1-1/2. Adult females without offspring come in estrus about the first of June and breed with the large males; conception occurs between June and mid-July. The females first breed successfully at 4-1/2 years though many may not produce cubs until they are 8 or 9 years old (Craighead et al., 1969). The annual increment slightly exceeds the mortality rate; thus, the population grew at an average annual rate of approximately six grizzlies per year from 1959 through 1966 (Craighead and Craighead, 1967).

During this same period, 34% of all the mortality recorded for grizzlies occurred from control measures within Yellowstone National Park, 43% from hunting outside the Park, and 23% from all other causes. An increase in the death rate, especially of adult females, could jeopardize the population.

In the summer months, grizzlies gradually, but steadily, congregate at Trout Creek (Fig. 1) and at other major open-pit dumps in and outside of Yellowstone. Grizzlies are attracted to

Figure 1. Seasonal coalescence of grizzly bears at Trout Creek Dump. Each data point represents a 3½ hour census.


NUMBER OF GRIZZLY BEARS
140
120
100
80
60
40
20
0
1 5 10 15 20 25 30 5 10 15 20 25 31 5 10 15 20 25 31
JUNE
JULY
AUGUST
Legend
1964
1965
1966

these dumps from all portions of the Park and from the adjoining national forests. Peak densities are reached in August. Our observations indicate that there are few grizzlies in the Yellowstone backcountry during this time. Mullen and Booth (1969) also found fewer grizzlies on the Shoshone National Forest adjacent to Yellowstone during August than prior to and after this month. More intensive censusing of grizzlies in the backcountry of Yellowstone and within the 4,300 square miles of adjacent national forest lands is needed. However, our census and movement data (Craighead and Craighead, 1967) show that Yellowstone National Park serves as a summer refuge for many grizzly bears whose home ranges extend beyond the Park boundaries. We have computed that a 5,000 square mile area including Yellowstone National Park and an adjacent 10-mile corridor of national forest land supports an average of about one grizzly bear to every 29 square miles. Some grizzlies spend their lives entirely within the Park; others do not. Those that move outside the Park boundaries are hunted. Forty-eight percent of the grizzlies shot outside the Park from 1959-1968 were adult animals and 52% were sub-adults ranging from yearlings to four-year-olds, showing that outward movement from within the Park is not confined to young animals. These data also suggest that grizzlies have not exceeded the carrying capacity of their Yellowstone Park-National Forest environment.

Studies have been made of the movements and home ranges of grizzlies inhabiting Yellowstone and adjacent portions of four

national forests. Data from color-marked and radio-tagged bears show that most, perhaps all, of the grizzlies in this population feed at one or more of the earth-filled garbage dumps (Fig. 2) at sometime during the course of their lives; some visit the dumps frequently, others infrequently. Thus, it is doubtful if the term "wilderness grizzly" is useful if we mean an animal having no contact with "artificial" food sources. For example, 114 marked grizzlies were identified at the Trout Creek Dump during the summers of 1966 through 1968. Table 1 lists the number of these marked animals identified at the dump and also in the backcountry. During a 3-year period, 37% of all the marked grizzlies that visited the Trout Creek Dump were also observed in the backcountry. Because of the pattern of human use in Yellowstone National Park, areas a mile or more from roads and developed areas conform to the definition of wilderness as it is stated in the National Wilderness Preservation Act. This act defines wilderness as "An area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitations . . . ." Approximately 95% of the 3,400 square miles in Yellowstone National Park can be considered backcountry. Most backcountry observations were made in spring and fall when the grizzlies were dispersed. As Table 1 shows, all age classes disperse throughout the Yellowstone backcountry.

Additional observations in the backcountry and at other garbage dumps during other years also show that, in the spring and fall months, the grizzlies that feed in summer at these garbage

Figure 2. Map of Yellowstone National Park showing developed areas, garbage dumps, and incinerators.

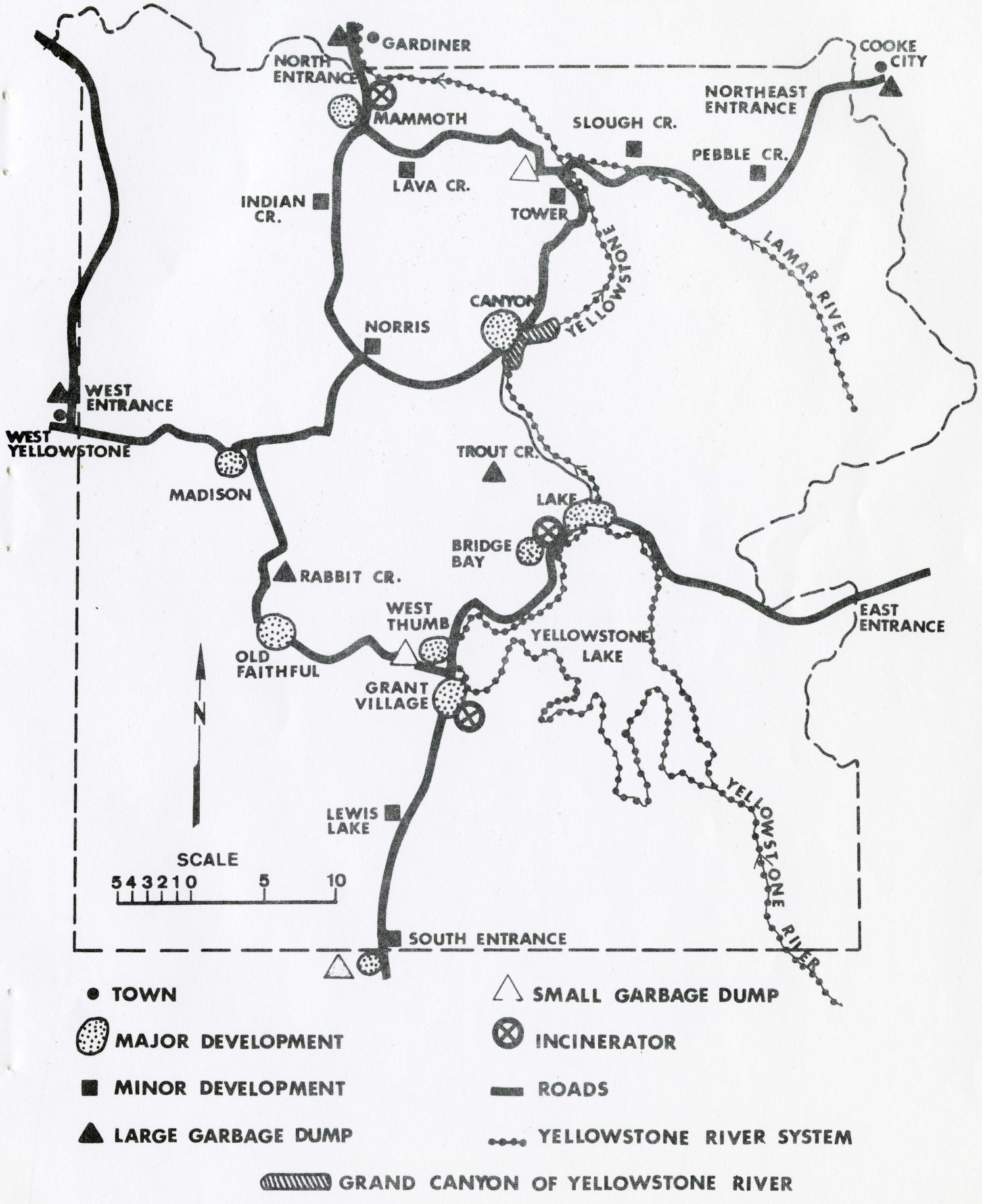

GARDINER
NORTH ENTRANCE
MAMMOTH
COOKE CITY
NORTHEAST ENTRANCE
SLOUGH CR.
PEBBLE CR.
LAVA CR.
INDIAN CR.
TOWER
YELLOWSTONE
LAMAR RIVER
CANYON
NORRIS
WEST ENTRANCE
WEST YELLOWSTONE
TROUT CR.
MADISON
LAKE
BRIDGE BAY
RABBIT CR.
WEST THUMB
EAST ENTRANCE
YELLOWSTONE LAKE
OLD FAITHFUL
GRANT VILLAGE
N
LEWIS LAKE
SCALE
5 4 3 2 1 0 5 10
SOUTH ENTRANCE
YELLOWSTONE RIVER
TOWN
SMALL GARBAGE DUMP
MAJOR DEVELOPMENT
INCINERATOR
MINOR DEVELOPMENT
ROADS
LARGE GARBAGE DUMP
YELLOWSTONE RIVER SYSTEM
GRAND CANYON OF YELLOWSTONE RIVER

Table 1. Color-marked grizzlies observed at Trout Creek Dump and reobserved in wilderness areas[1] of Yellowstone National Park from 1966 to 1968.

Cubs	1-year olds	2-year olds	3-year olds	4-year olds	Adults		Total
					Males	Females	
229	218	183	158	141	30	39	
230	219	202	177	144	207	40	
236	220	216	185	147	217	101	
240	221	227	211	165		112	
241	233		228	183		128	
256				188		132	
				208		141	
						163	
						172	
						173	
						187	
						228	
6	5	4	5	7	3	12	42

[1] Wilderness and backcountry are used synonymously in the text. They are undeveloped, roadless areas retaining their primeval character without permanent improvements or human habitation. In these areas, the earth and its community of life are untrammeled by man, and man himself is a visitor.

disposal areas also frequent the Yellowstone wilderness.

All Yellowstone grizzlies, regardless of their feeding habits or degree of association with man, inhabit wilderness portions of the Park and adjoining national forests from October through April. Thus, management of grizzly bears in Yellowstone Park affects not only resident animals in the Park but also grizzlies inhabiting four national forests in three states.

Food disposal areas (Fig. 2) have attracted grizzlies for over 80 years. They have shaped and are integrally meshed with grizzly bear ecology in Yellowstone. Except for the nature of the food, they are ecological equivalents of the spawning salmon runs that attract and concentrate Alaskan brown bear (Ursus arctos middendorffi) during the summer months. Yellowstone garbage sites concentrate the grizzly bears during a 3-month period from June through August.

Understanding the ursine trait of gathering at these food sites, the bears' daily and seasonal movements to and from the areas, their propensity to form strong habits, and their behavior when concentrated and when dispersed, is fundamental to managing them in the Yellowstone area. Key questions posed are: Have the garbage dumps basically altered the grizzly's relationship to man? Have they increased or decreased grizzly-man conflicts in Yellowstone? Should they be eliminated and, if so, how? To answer these questions we must understand bear-man relationships and the nature of bear-man conflicts.

Plate 1. Female grizzly and cub in Yellowstone's backcountry. This animal and cub also frequented the Trout Creek Dump.

Photo credit -- John J. Craighead



BEAR-MAN RELATIONSHIPS

We can classify grizzly bears inhabiting the Yellowstone area into four types based on their feeding behavior as related to humans. These are: 1) bears which forage at the garbage disposal areas during summer months; 2) those that either occasionally or habitually visit campgrounds or developed areas; 3) bears man-conditioned by food handouts at lodges and construction camps: and 4) grizzlies which reside throughout most of the year in the backcountry and rarely visit a garbage dump, campground, or other developed areas. Overlapping of types occurs, yet the four categories are quite distinct. The majority of bears fall into the first category. Those in the second and third categories, though few, are the most troublesome. Practically no Yellowstone grizzlies qualify for the fourth category.

Behavior of grizzlies frequenting garbage dumps: We have obtained no evidence that the Yellowstone area has two distinct populations of grizzlies -- "wild living" animals inhabiting the wilderness country and "garbage-addicted" grizzlies inhabiting the dumps and developed areas of the Park. On the contrary, thousands of man-hours spent observing grizzlies at open-pit dumps and hundreds spent observing these same color-marked animals and monitoring radio-instrumented bears in wilderness country divulged not two distinct populations but two distinct behavioral

patterns. Many of the grizzlies that feed at the isolated, open-pit, garbage dumps exhibit less fear, and greater tolerance of man at these areas than at other areas. The same animals that ignore human scent at the dumps are quickly alerted by it in the backcountry. When encountered more than 1/2 mile from the dumps, grizzlies are normally wary and respectful of man; they flee when they scent, see, or hear him. Tolerance of man while feeding on artificial food at the dumps is definitely linked with specific sites. It is not a general toleration of humans or of human scent although in rare instances the on-site conditioning may alter behavior in other locations. Animals that feed at garbage dumps, presumably where the human scent is strong, ignore it there but not elsewhere. We have little evidence that garbage feeding changes their human avoidance behavior. Troublesome grizzlies normally develop their behavioral patterns toward humans under quite different circumstances.

The Yellowstone garbage dumps provide grizzlies with an abundance of palatable food, congregate them for an unnaturally long period of time and alter some of their behavioral patterns. Feeding at these dumps does not normally develop grizzlies into garbage-seeking animals, make them dependent on humans (Leopold, 1970) or create incorrigible animals. This does not imply that the garbage dumps are beneficial and should be kept open: it does mean that eating "unnatural" versus "natural" food does not, in

itself, significantly alter the behavior of Yellowstone's grizzlies toward human beings.

Behavior of grizzlies frequenting campgrounds: Of 36 grizzly bears captured and initially marked in campgrounds, 64% re-entered a campground or developed area following their release; 28% re-entered two or more times. Among 221 grizzlies initially captured and marked at garbage disposal sites or in the back-country, 36, or 16%, were later captured in a campground or developed area. Only 9.5% re-entered two or more times (Table 2). Thus, many grizzlies initially captured and marked in campgrounds had already developed chronic campground feeding habits and they became problem animals more often than grizzlies captured and marked elsewhere. The data in Table 2 also suggest that capturing and marking grizzlies, which was essential to document the animals' behavior and movements, did not condition them to man or convert them into troublesome bears. Had this occurred, a much higher percentage of those captured and marked outside of campgrounds would have become "campground foragers." Evidence indicates that most of the troublesome grizzlies were developing or had already developed into problem animals before they were captured and marked in campgrounds.

The large number of animals marked (over 60% of the population at one time), as well as the unmarked grizzlies,

Table 2. Number and percent of 257 color-marked grizzlies captured or recaptured in a campground or adjacent developed area, 1959-1969.

	Grizzlies initially marked inside campgrounds	Grizzlies initially marked outside campgrounds	Total
Number marked	36	221	257
Percent of marked population	14.0	86.0	100
Entering campground or developed area once as a marked bear			
Number	23	36	59
Percent	63.9	16.3 ~~15.8~~	23
Entering campground or developed area two or more times as a marked bear			
Number	10	21	31
Percent	28.0	9.5 ~~12.0~~	12

exhibited a normal range of bear behavior. However, only bear-man relationships involving marked grizzlies could be individually and quantitatively documented. Therefore, few objective or legitimate comparisons can be made between avoidance or confrontation behavior of marked versus unmarked animals. Since we have no evidence that capturing and marking grizzlies altered their behavior toward humans, information obtained from marked animals is considered representative of both marked and unmarked ones.

From observations of marked bears and from records of radio-tagged ones, we learned that grizzlies become accustomed to campground foraging during spring and fall migratory movements when their travel routes intercept campgrounds. During this same period, grizzlies extend their home ranges searching for food. This pattern has been especially evident at the Lake and Canyon Village Campgrounds. Grizzlies also discover campgrounds lying within their home ranges. These home ranges are expanded over a period of many years into life ranges (Craighead and Craighead, Unpub.). Yearlings and 2-year-olds may wander into campgrounds following weaning, a time when they normally begin to disperse and establish home ranges of their own. For this wide-ranging, inquisitive animal, chance alone, no doubt, accounts for the discovery of and addiction to the food available in campgrounds. Grizzlies tend to forage at night but, in spring and fall, they may enter campgrounds during daylight. Those that learn to

frequent campgrounds become conditioned to the near presence of humans. Those that enter infrequently remain shy and secretive. Habitual campground foragers normally develop behavioral patterns in response to the presence of man that are markedly different from those of grizzlies that feed at the isolated, open-pit dumps.

Any grizzly which frequents a campground is a potential hazard because humans may startle it at close range and be attacked. However, it is important to discriminate between habitual offenders and those that enter campgrounds for short periods of time, then move on and do not repeat the offense except infrequently over a period of years. It is difficult to define precisely the habitual offenders or incorrigible animals on a basis of frequency of visitation or frequency of recapture in campgrounds. However, until better criteria can be formulated, we have defined habitual offenders as those recaptured four or more times. Table 3 shows that among 72 grizzlies of both sexes, 69% were either never recaptured or were recaptured only once; 87% were not recaptured or were recaptured one to three times. Only 13% were recaptured four, five, or six times. These individuals constitute the habitual offenders.

Table 4 shows that 28 of the 72 bears captured in campgrounds or developed areas between 1959 and 1969, were killed or sent to zoos; 61% of these had recapture records of zero or one, and 86% had recapture records ranging from zero through three.

Table 3. Recapture record of grizzlies captured in campgrounds -- 1959-1969.

	Number of times recaptured in a campground							
	None[1]	One	Two	Three	Four	Five	Six	Total
Males	13	16	4	4	2	1	1	41 (57%)
Females	13	8	2	3	1	3	1	31 (43%)
Total	26	24	6	7	3	4	2	72 (100%)
Per Cent	36	33	8	10	4	6	3	
	69		18		13			
	87				13			(100%)

[1] None = captured in a campground and never recaptured.

Table 4. History of the 28 grizzlies eliminated following initial capture or recapture in campgrounds -- 1959-1969.

Times recaptured in campgrounds	None[1]	One	Two	Three	Four	Five	Total
Number of males eliminated	4	7	2	0	1	1	15
Number of females eliminated	3	3	2	3	0	2	13
Total grizzlies eliminated in control measures	7	10	4	3	1	3	28
Percent eliminated	25	36	14	11	3	11	
	61		25		14		
	86				14		100%

[1] None = captured once in a campground and eliminated.

Thus, 86% of the campground grizzlies which were eliminated had not become habitual offenders. Obviously, the percentage of habitual offenders would have been greater had bears, which were initially captured or had three or less recaptures, not been dispatched. On the other hand, 51.4% of the 72 grizzlies captured in campgrounds and released had recapture records of less than four and these were not recaptured again. This suggests that grizzlies entering campgrounds should be transplanted long distances following a first capture rather than dispatched. This procedure would tend to break the reward pattern that may develop when grizzlies return frequently to campgrounds and find food. Eight grizzlies handled in this way were eventually taken as trophies by hunters outside the Park.

In general, frequency of recapture is directly related to the time a bear occupied a campground because it was routine procedure to keep traps set whenever grizzlies were observed. There were important exceptions. A few animals became trap-wise or trap-shy, and their recapture records do not accurately reflect their tenancy in the campground. Also, occasionally a grizzly was exceptionally aggressive and inflicted injury or did considerable property damage in a single visit. The reverse was also true -- a few individuals became trap bums, and some individuals which were recaptured many times exhibited no aggressive tendencies. The incorrigibles can be recognized because they will seek food in defiance of visitors and ranger patrols, make repeated bluffing charges at humans, and break and enter tents and trailers. Generally, such bears have a long

history of campground tenancy. One such bear, continuously radio-tracked for a summer, foraged in the Canyon Village Campground by night and bedded by day in lodgepole thickets 1/4 to 1/2 mile from the campground (Craighead and Craighead, 1970). There is no question about the necessity of eliminating such animals. The problem is what to do with infrequent offenders. We believe great discrimination should be practiced in eliminating grizzlies after the first capture or with recapture records of one through three.

Behavior of grizzlies conditioned by food handouts: By radio-tracking grizzlies that had been regularly fed in the presence of humans or that had developed foraging habits bringing them in frequent and close association with man, we learned that such animals developed behavioral patterns that made them extremely dangerous. They learn to associate food-getting with humans and soon lose their fear of man and human scent. They will make false or bluffing charges at close range, approach humans within what is normally a critical attack distance and explore or devour items containing human scent. They have become thoroughly conditioned to man. This conditioning is not associated with a particular feeding area, as is the case with grizzlies that feed at remote garbage dumps, but is a general conditioning to man wherever he is encountered. Such animals may coexist with people for extended periods of time but, sooner or later, these man-conditioned animals are startled by humans at close range, defy interference at a food source, or completely disregard humans in

Plate 2. Grizzly bears feeding at the Trout Creek Dump. Rapid phase out of this dump in 1967 and 1968 forced grizzlies to extend their home ranges and many entered campgrounds.

Photo credit -- John J. Craighead



their attempts to get food. This may occur in a campground, on a trail, or in the backcountry. The result may be a bear - man encounter ending in human injury or death.

For a grizzly to lose its shyness or fear of man requires cooperation and encouragement, and the initiative is usually with man. One male grizzly, No. 202, mentioned earlier, was radio-tracked for 2 consecutive years during the summer and autumn. After he and a litter mate were weaned as yearlings, No. 202 was instrumented and radio-monitored for 56 days in 1965. During that time, he established a 27 square mile home range within the home range of his mother (No. 65), and caused no trouble. He denned on the south slope of the canyon of the Yellowstone River within 4 airline miles of Canyon Village Campground, which is on the north rim. Our radio location data showed that this animal had not visited or discovered this developed area with its food supply. On his trek to his den site in November, he had remained on the south rim of the canyon; however, the following spring when he emerged from winter sleep, he swam the river and traveled the north rim of the canyon which led him directly into the Canyon Village Campground.

As a 2-year-old, he was radio-monitored for 118 days of 1966. He did not leave the vicinity of the Canyon Village Campground during the summer and fall except on five occasions which were closely monitored by radio. Two of these were pre-hibernation

treks to his denning area (Craighead and Craighead, In Prep.). Though frequenting the campground, he gave no serious trouble until fall when he began visiting two construction camps in the area. He received food handouts and soon became bold enough to attempt to enter trailers and to feed fearlessly in the presence of humans. During 1966, this animal established a home range of 125 square miles with Canyon Village Campground as his center of activity. He spent his second winter alone in a den located very close to his first den.

Emerging from winter sleep as a 3-1/2 year old animal, he returned to his old haunts in the campground. No. 202 was not an aggressive bear, had inflicted no injury and had caused little or no property damage, but he had been conditioned by food handouts, had lost his normal respect for man, and, thus, became a potential menace to the safety of visitors. He was shot as a precautionary measure at the age of 3-1/2.

Fortunately, grizzlies conditioned by food handouts at concessionaires or work camps have been rare in Yellowstone National Park. They have been more numerous in Glacier National Park. On the evening of August 13, 1967, at two widely separated locations in Glacier, grizzly attacks resulted in the deaths of two 19-year old concessionaire employees and serious injury to an 18-year old boy. Both attacks can be linked to food handouts and man-conditioned bears (Olsen, 1969; National Park Service, 1967;

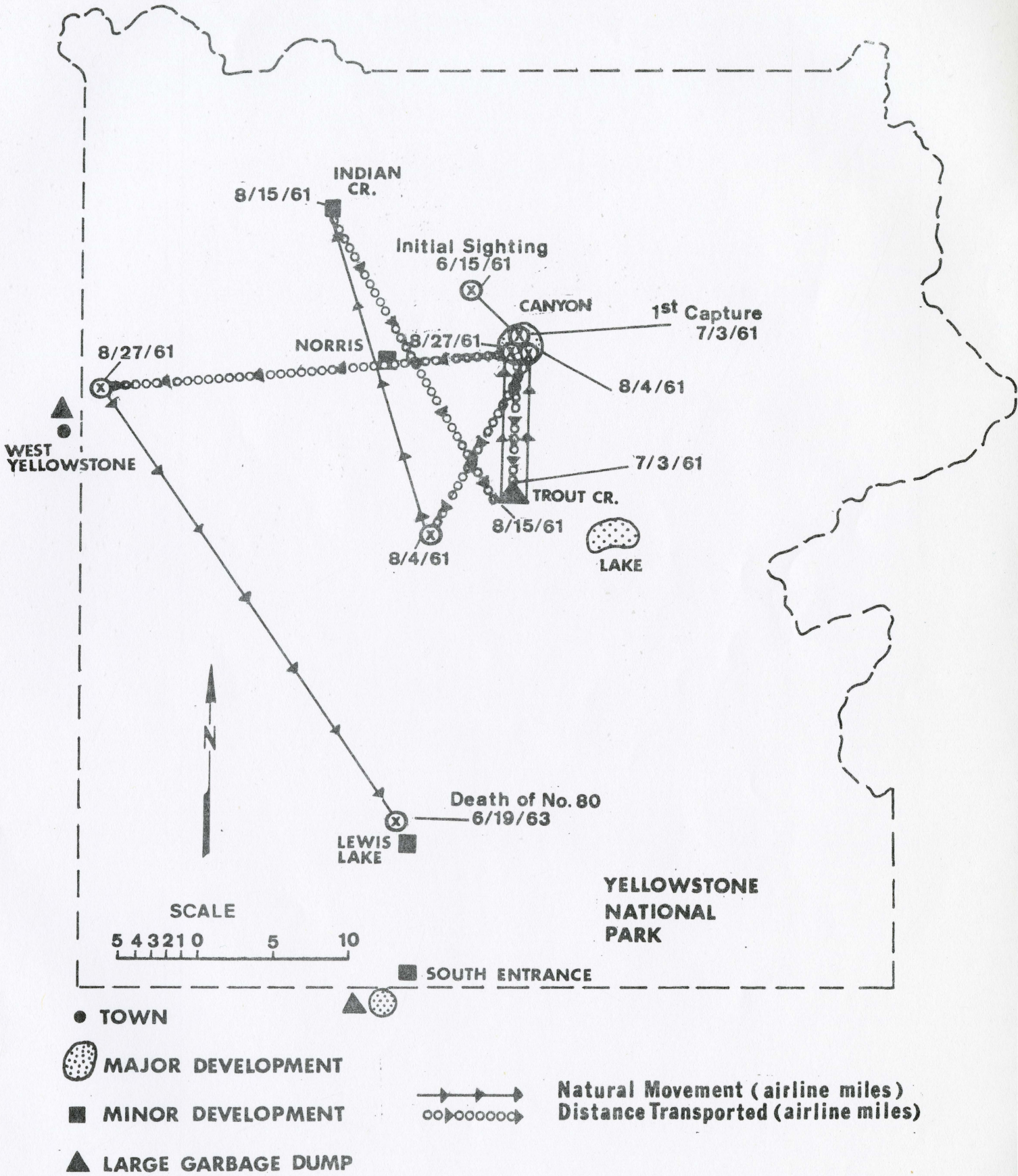
Leopold, 1970; and personal communications, Gerry Atwell, 1967, and Frank Evans, 1967). Once man-conditioned by food handouts, the grizzly must be destroyed. The solution to such conditions is campground sanitation, frequent ranger patrols and throrough enforcement of the National Park Service regulations pertaining to the feeding of bears.

Behavior of grizzlies in the backcountry: Grizzlies encountered in the remote portions of Yellowstone and the adjoining national forests usually retreat, sometimes slowly and deliberately, but more often, in haste. From radiotracking experience in heavily timbered, wilderness country, we learned that humans can approach to within 100 or 200 feet of grizzlies without observing them. We failed to see instrumented animals that retreated from their day beds more often than we saw them. This occurred in spite of our knowing the approximate location of the animals from our directional radio receivers.

Grizzlies, living under wilderness conditions, utilize natural food but may be attracted to food made available by humans, and may become man-conditioned. For example, in 1961, a crew working on the control of blister rust experienced frequent confrontations and attacks from a 3-year-old, male grizzly in the Washburn Range, miles from a developed area. At first the bear was shy and avoided the men. Over a period of several weeks, he

gradually lost his shyness. He excavated buried lunch trash and then accepted lunch scraps thrown to him. Eventually he approached boldly for food, and made bluffing charges. On five occasions, he treed members of the crew and then rifled their packs and lunch pails. The work of the crew was greatly hampered, and we were requested to immobilize the bear. On the day we planned to accomplish this the animal could not be found. The following day, a male grizzly matching the description appeared at Canyon Village Campground and boldly paralleled the highway. We captured, color-marked and numbered him. He became No. 80 and on August 4, 1961, we recaptured him in the Canyon Village Campground, and released him 12 miles away at Mary Lake. He was recaptured 11 days later at Indian Creek Campground, 20 airline miles from Mary Lake, and released at the Trout Creek Dump. Twelve days later, No. 80 was recaptured for the third time at Canyon Village Campground, which is 7-1/2 miles from the dump. We released him at Cougar Creek, which is 30 airline miles from the Campground. This thoroughly man-conditioned grizzly was not observed again until June 1963, when he was shot by Park rangers after molesting visitors camped in wilderness country near Lewis Lake (Fig. 3). This documented account illustrates the role of food handouts in developing incorrigible bears. Generally, conditioning to man evolves in developed areas, but it is not necessarily limited to them.

Figure 3. Movements of Grizzly No. 80


INDIAN CR.
8/15/61
Initial Sighting
6/15/61
CANYON
1st Capture
7/3/61
NORRIS
8/27/61
8/27/61
8/4/61
WEST YELLOWSTONE
7/3/61
TROUT CR.
8/15/61
8/4/61
LAKE
N
Death of No. 80
6/19/63
LEWIS LAKE
YELLOWSTONE NATIONAL PARK
SCALE
5 4 3 2 1 0 5 10
SOUTH ENTRANCE
TOWN
MAJOR DEVELOPMENT
MINOR DEVELOPMENT
LARGE GARBAGE DUMP
Natural Movement (airline miles)
Distance Transported (airline miles)

Attack behavior: The aggressive behavior of individual grizzlies varies greatly. Also the temperament of an animal changes with its physical and psychological condition. A hungry, malnourished, or injured grizzly may become an aggressive animal. When weaning their offspring, females become very irritable and aggressive. However, the weaned offspring, whether yearlings or 2-year-olds, are normally not aggressive. Females with cubs are noticeably nervous and alert, and have a low anxiety threshold. Their critical attack distance is less than for other animals in the population and less than for the same animal when she has yearlings or is without offspring. Aggressive animals are more likely to attack other bears or humans than non-aggressive ones. Attacks occur when grizzlies are startled, cornered or injured and at times apparently without discernable provocation. A female with cubs may charge without warning if she is suddenly surprised by humans at close range. The victim is generally knocked down by blows from the forepaws or by sheer weight and momentum of the bear. The bear inflicts injury primarily by multiple bites. The grizzly may retreat soon after the attack. Struggling or resistance during the attack may prolong it. Movements or an attempt to flee may initiate additional attacks. The behavior of the female appears to be largely a defense reaction. We have frequently observed one or more females with cubs attacking large boars when they approached too closely or exhibited aggressive

behavior. If the male lowers his head between his forepaws, turns his head to the side, and retreats a step the encounter ends. Thus, submissive behavior has appeasement value. There appears to be a correlation and a lesson to be learned when grizzlies attack humans. Review of a number of personal injury cases suggests that submissive behavior or "playing dead" probably minimized injury to human victims. A female with cubs at initial confrontation, whether with a large male bear or with a human, reacts suddenly. The cubs are alerted by their mother and often flee in different directions. When this occurs, the female is unable to retreat with her litter in an orderly fashion. Momentarily she appears confused. With head and neck extended and ears laid back, she rotates, stepping first in one direction, then in another. Suddenly she wheels and attacks the object causing the disturbance and her confusion. If another bear is the victim, the attack may last only seconds and she quickly retreats in search of her cubs. Females with yearlings are normally more placid than females with cubs. The family unit with yearlings is more stable and less likely to react violently under stress.

Critical attack distance: The grizzly has poor vision, and appears unable to identify man beyond 100 to 200 yards away, but the bear can detect motion at this distance and, if upwind, the animal frequently will investigate. It generally does this by circling to get the wind and a scent. If human scent is detected,

the grizzly normally retreats. If the grizzly has moved toward the man as it circles, its behavior will be determined by the distance between bear and man at the moment of discovery. There is a critical attack distance within which the bear apparently feels sufficiently threatened that it attacks rather than retreats. This attack distance varies with individual bears, with their sex, age, and the specific situation. It appears to be an automatic response to danger. We found that this attack distance is generally less than a hundred yards in open country.

Bluffing charges: Bluffing charges are characterized by a swift advance which is generally followed by an equally rapid retreat. They never terminate in body contact. We have experienced these charges on 11 separate occasions in the Yellowstone backcountry when we startled sleeping or resting bears or females with offspring at close range. An incident that occurred with No. 39, an aggressive female, is worth recounting as a typical example.

On October 19, 1964, we were radiotracking No. 39 and her offspring. The female weighed over 450 pounds and the yearlings weighed between 225 and 245 pounds. We were concerned that this aggressive female might charge if approached too closely. Inadvertently, we moved to within 100 feet of the family bedded in a dense stand of lodgepole saplings and downfall before we observed them. We retreated 100 yards and climbed trees, then deliberately talked loudly to scare the family. The female

roared and the entire group charged about 30 yards in our direction then retreated rapidly as revealed by the radio signal.

Plate 3. Members of research team check a marked animal captured in a campground.

Photo credit -- John J. Craighead



BEAR-MAN CONFLICTS

The probability of being injured or killed by a grizzly bear in Yellowstone National Park is very small. From 1900 to 1970 there have been two fatalities from grizzlies (National Park Service, 1880-1970). Both occurred in the early 1900's. From 1931 to 1970, when more detailed records were kept, official National Park Service records show 63 injuries and no fatalities. During these 39 years, an average of a million people per year visited the Park. Thus, the injury rate from grizzlies has been one person per 600,000 visitors.

Although grizzly bear attacks on man are rare, they provide exciting news copy and generate apprehensive, public response. This, in turn, has initiated control action often with over-reactionary measures that have been harmful to the coexistence of the grizzly and man. Following the 1967 fatal incidents in Glacier National Park, four female grizzlies were shot and a cub was wounded. Only one of these animals was conclusively linked with the attacks. The National Park Service Report, "Grizzly Bear Attacks at Granite Park and Trout Lake in Glacier National Park, August 13, 1967", suggested garbage feeding as a conditioning factor, but did not mention the frequent feeding of grizzlies on garbage and food handouts in the presence of human viewers. This conditioned the bears at Granite Park to lose their normal respect for humans and may have man-conditioned the particular animal responsible for the tragedy.

Lightning storms, age and physical ailments of the bears, and unknown reasons, were listed as possible causes of the Trout Lake fatality. Cosmetics, hair sprays and menstrual odors were cited as the probable causes for this particular attack. Subsequently signs were erected at trail heads, warning -- "Women -- Do not travel in the backcountry during menstruation.". This presumed cause for the attack -- to our knowledge unsubstantiated -- was widely publicized and probably deterred many women from making wilderness hikes.

Olsen (1969) reported that numerous confrontations had occurred earlier at Kelly's Camp and at Trout Lake by a grizzly matching the description of the one linked to the Trout Lake fatality. Perhaps this grizzly became conditioned at Kelly's Camp and Trout Lake in a manner similar to the conditioning of No. 80 in Yellowstone. Such conditioned animals behave abnormally because of their complete indifference to man.

Confrontations: In analyzing conflicts between grizzlies and man it is useful to separate confrontations from attacks terminating in bodily contact. A confrontation is a meeting of grizzly and man sufficiently close that each is aware of the other and may feel threatened; it may or may not result in an attack. The distance between a grizzly and man at the moment of confrontation varies with terrain, visibility, wind conditions and other factors. In backcountry this distance is generally less than 100

yards although confrontations may occur as close as 25 yards and as far as 200. In congested campgrounds or developed areas, they occur at much closer distances.

With visitors in campgrounds

During the period 1959 through 1970, numerous confrontations occurred in campgrounds and other developed areas of the Park. Unfortunately, we kept no record of these confrontations. Such information would be very useful in judging the temperament and aggressiveness of individual grizzlies and in making decisions for or against control measures. We did keep detailed records of confrontations involving our research personnel and also a record of confrontations that occurred in the Yellowstone backcountry between grizzlies and humans.

With research personnel in backcountry

In the course of radiotracking 24 individual animals (some for a number of years), we and our associates have experienced many confrontations. On more than a hundred of these, the grizzlies retreated. On eight occasions the animals advanced, and we were forced to seek safety in trees. We were confronted by yearlings, 2-year-olds, adult females, females with cubs, females with yearlings, and large adult males. The nature of these confrontations varied greatly, and we will not attempt to document the details. All confrontations had the potential of

becoming attacks. That they did not was, we believe, the result of two factors: our behavior and our actions, and the temperament of the individual bear.

Because the radio receiver informed us of the location of the bears we were tracking, we took precautions not to startle the animals. When closing in to observe, we frequently took 15 to 20 minutes to move a hundred yards. When detected, we generally held our position or moved slowly into the wind so our scent would be carried to the bear. During such a confrontation, or if anticipating one, we talked in normal conversational tones. The human voice is almost as diagnostic to the grizzly as human scent. We seldom approached close to animals known to be aggressive. For example, one female, No. 40, and her 2 cubs were constant companions of No. 101 and her cub. During the summer and fall of 1966 they traveled, foraged, and bedded together. We radio-tracked No. 40 for 8 consecutive years. She was a docile female and always retreated even when we approached her closely. However, No. 101 was exceptionally aggressive. When radiotracking the two families in 1966, we were forced to respect the aggressiveness of No. 101 because confrontations with her would have resulted in attacks. In spite of hundreds of hours of close-up observing of 24 radioed grizzlies and well over 10,000 miles of backcountry hiking by researchers, we have not yet been forced to use a firearm for protection. We must emphasize that we deliberately

approached radioed grizzlies to observe them closely and undetected. In so doing we were taking calculated risks. However, our record of no injury to either grizzly or man during our years of work shows that the probability of attack from grizzlies in Yellowstone was and can be kept extremely low.

With visitors and Park employees in backcountry

We believe that the confrontations listed in Table 5 are probably more typical than those we and our research personnel experienced. Grizzlies retreated in 88% of of all confrontations. Among 34 of these, 20 terminated in almost immediate retreat by the grizzly. In 10 instances the grizzlies advanced, sometimes aggressively and sometimes to get a scent, but then retreated. Six of these ten instances involved a single, man-conditioned bear. In all but two of these cases, the people involved sought safety in trees, and they thought the grizzlies would have injured them had they not climbed to safety. Four confrontations developed into attacks, one of which resulted in hospitalization. The 12 year average of confrontations is less than three per year, one injury every 3 years, and one injury requiring hospitalization every 12 years.

The Yellowstone administration began recording backcountry use statistics in 1969. Their records for that year show 98,636 person-use days with 10,668 of these overnight. With this volume

Table 5. Confrontations with grizzlies in Yellowstone backcountry, 1959-1970 (visitors and Park employees only).

	Behavior of bear at confrontation			
Year	Retreat	Advance then retreat	Attack	Total
1959	1	0	0	1
1960	1	0	1	2
1961	2	6	0	8
1962	1	0	0	1
1963	1	2	0	3
1964	4	0	0	4
1965	2	0	0	2
1966	1	0	0	1
1967	2	1	2	5
1968	2	0	0	2
1969	1	0	0	1
1970	2	1	1	4
Total	20	10	4	34
Percent	59	29	12	100

of backcountry use, there was one grizzly bear confrontation (Table 5). National Park Service officials have estimated (Official correspondence) that backcountry use has annually increased at the rate of 1,000 person-use days per year. Using this estimate, we calculate 1,129,632 person-use days from 1959 through 1970. Then for the 12 years, 1959 through 1970, there has been one grizzly confrontation for every 33,225 person-use days in the backcountry and one attack for every 282,408. This would appear to be an acceptable risk for the coexistence of grizzly and man in Yellowstone National Park.

Personal injury records: Personal injuries caused by grizzly bears have been recorded in Yellowstone National Park for the past 40 years (1931-1970). We have found it difficult to evaluate these records because the injuries have varied in severity from bruises and minor wounds, requiring no professional medical attention, to those that required hospitalization. Also, there has been doubt whether some injuries were inflicted by grizzlies or by black bears. We have accepted with reservations the data which show 62 known and probable injuries from grizzlies, or 1.55 per year.

From 1959 through September 1970 we worked closely with Park rangers to keep more accurate records of personal injuries inflicted by grizzlies (Table 6). Injuries during this period averaged two per year or approximately one injury for every

Table 6. Injuries from grizzly bears, and control measures in Yellowstone National Park, 1959-1970.

Year	Park visitors[1]	Personal injuries	Control measures: Grizzlies killed	Control measures: Grizzlies sent to zoos	Control measures: Total
1959	1,408,667	0	6	1	7
1960	1,443,288	0	4	0	4
1961	1,528,088	1	1	2	3
1962	1,925,227	2	4	0	4
1963	1,872,417	6	2	4	6
1964	1,929,316	1	2	1	3
1965	2,062,476	4	2	0	2
1966	1,130,313	1	3	0	3
1967	2,210,023	0	3	2	5
1968	2,229,657	1	5	0	5
1969	2,193,814	6	10	0	10
1970[2]	2,200,000	3	14	8	22
Total	22,133,286	25	56	18	74

[1] Data obtained from Yellowstone Park records, 1959-1969.

[2] We estimated visitor numbers for 1970.

900,000 visitors. This is hardly a record that would support the removal of all grizzlies from Yellowstone (Moment, 1968) or a drastic control program within the Park. However, during 3 years of the Park Service's present program of bear management (1968-1970), injuries averaged 3.33 per year. In comparison, injuries were only half as numerous from 1959-1967 -- averaging 1.67 per year. We believe that the increase is due largely to the present management practices that have forced grizzly bears into campgrounds and developed areas of the Park (Fig. 5).

Control measures: Control of grizzlies within the Park is performed by the ranger staff. Troublesome animals are either killed or shipped to zoos. The term "dispatch" includes both of these control measures. From 1931-1970, 140 grizzlies have been killed; this is a 40 year average of 3.50. The exact number shipped to zoos during this period is unknown. Seventy-four grizzlies have been dispatched by the Yellowstone administration during our 12-year period of research. This averages 6.17 grizzlies per year (Table 6). During 9 years of this period (1959-1967), prior to the enactment of the Park Service's present program of bear management, control averaged 4.1 per year. During 3 years of revised management (1968-1970), control averaged 12.3 grizzlies per year. Twenty-two grizzlies were eliminated from the Yellowstone population in control measures in 1970. Information on the number of deaths occurring from other causes during 1970 is not yet available. However, there was an average of 11 such deaths per year from 1959 through 1966. These represent only those deaths where

Plate 4. Grizzlies were individually marked and released back into the population for study. Movements of marked animals throughout the Park and adjoining national forests were recorded. Movements into campgrounds were also recorded.

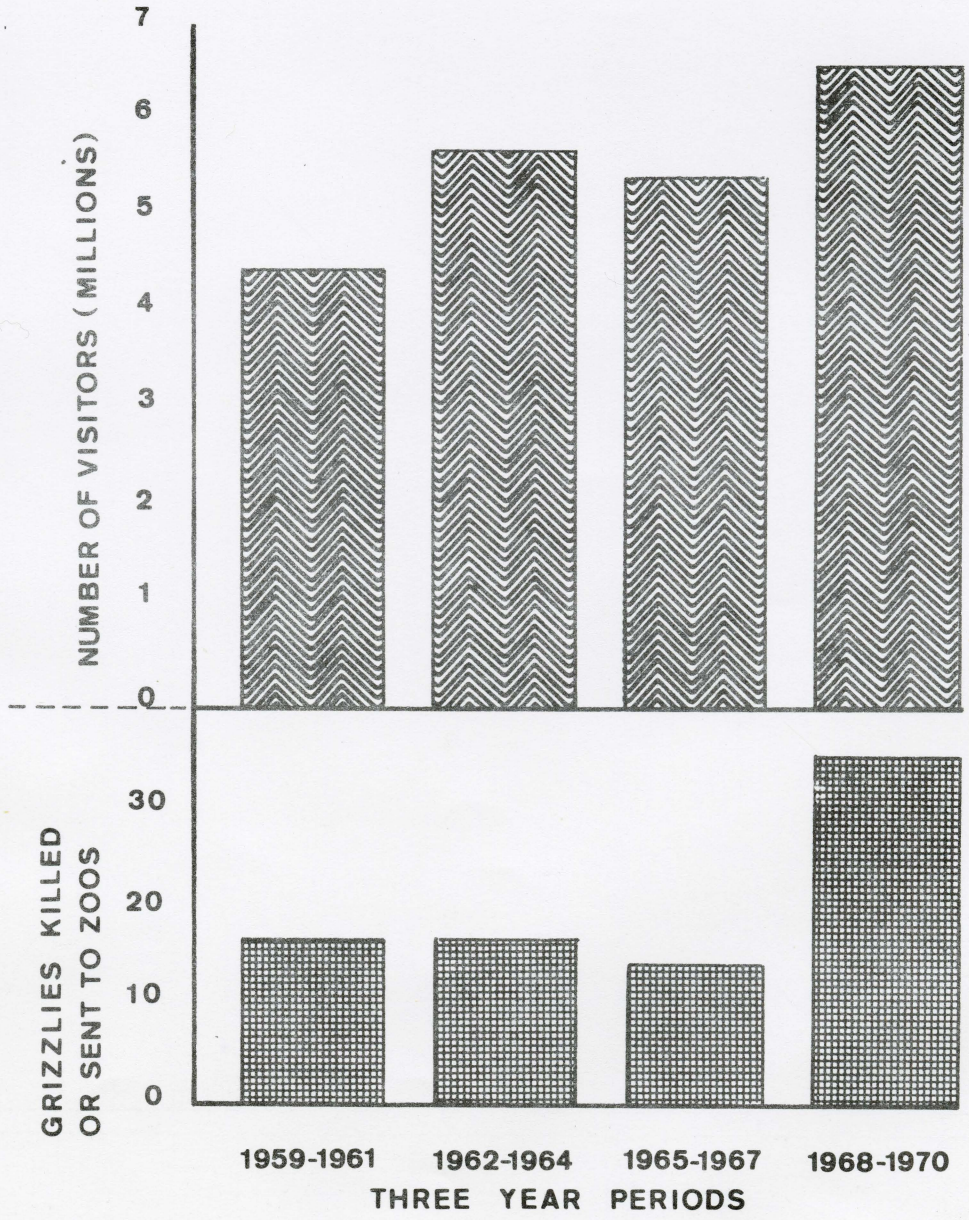
Photo credit -- John J. Craighead



the causes of death were known. If we assume that 11 grizzly bears will die in addition to those eliminated by control, then the known loss from the population during 1970 will total 33. This just equals the average annual increment (Craighead and Craighead, 1967), but statistics compiled during our study indicate that as many grizzlies die each year from unknown as from known causes. Consequently, the population loss for 1970 will greatly exceed the average annual increment. It is obvious that the Yellowstone grizzly population cannot long sustain such losses.

A comparison of the annual control figures and personal injuries with Park visitation from 1959 through 1970 (Table 6, Fig. 4) shows no correlation with the increase in visitor numbers. A correlation should be expected. We attribute the lack of one to the fact that the open pit dumps served to concentrate and isolate the grizzly bear population during the tourist season. Also public use of these areas has been restricted, thereby reducing the probability of grizzly-visitor interactions. We believe that the increased number of bears killed or sent to zoos (Table 6) during 1968-1970 was directly related to the abrupt phasing out of the Trout Creek Dump and the closure of the Rabbit Creek Dump, which forced grizzly bears into campgrounds. This destroyed the effective zoning of grizzly and man that prevailed from 1959 through 1967. As we have shown, the average number of grizzlies dispatched during the last 3 years is three times the average for the preceding 9 years. The population reduction affected by control measures for 1970 alone (through September 15) exceeds 10% of the

Figure 4. Comparison of number of visitors and number of bears dispatched at Yellowstone National Park during 3-year periods, 1959-1970.


NUMBER OF VISITORS (MILLIONS)
7
6
5
4
3
2
1
0
GRIZZLIES KILLED OR SENT TO ZOOS
30
20
10
0
1959-1961
1962-1964
1965-1967
1968-1970
THREE YEAR PERIODS

Yellowstone population.

Control methods must differentiate between the dangerous, but relatively few, man-conditioned animals in the population and those essentially wild animals that for generations have fed at the remote garbage dumps and, in the course of seasonal movements or rare periods of natural food scarcity, have entered developed areas. Grizzlies become man-conditioned by eating in the presence of humans.

Transplants: For many years, troublesome campground grizzlies in Yellowstone National Park have been transplanted to remote areas within the Park. To evaluate the effectiveness of transplant and release as a technique for disrupting the campground foraging habits of grizzlies, we marked captured animals and released them at suitable sites from 1959 through 1967. We then recorded their movements by recapturing them. Starting in 1968, this task has been performed by Park rangers. Table 7 shows that over an 11 year period, there were 145 releases of grizzlies within Yellowstone National Park at varying distances from the campgrounds or developed areas where they were captured. Our data show that 68% of these animals returned to the same or another campground following release. Although the percentage returning decreased with the distance transported, the capture-transport-release technique within the Park is clearly only a partial solution for dealing with troublesome grizzlies. More distant releases on federal lands adjacent to the Park might prove more successful. This presents complex problems of jurisdiction and procedure which are discussed later.

Table 7. Record of the release of grizzlies after initial capture in a campground or developed area and subsequent recapture, 1959-1969.

	Distance grizzlies transported (Airline miles)				Totals
	0 - 10	11 - 20	21 - 30	31 - 40	
Number of releases after initial capture	75	46	20	4	145
Number of recaptures in any campground or developed area after release	53	32	12	1	98
Percent of recaptures in any campground or developed area after release	70.7	69.6	60.0	25.0	67.6

Three of numerous examples illustrate the homing instinct of grizzlies as well as their propensity to return to an available food source. Cub 78 was orphaned when his mother was captured and shipped to a zoo in 1961. The orphan began entering campgrounds and traveling the highways. We captured him in the Lake Campground on July 10, transported him across Yellowstone Lake, and released him on Promontory Point, a large peninsula extending into the lake from the south (Fig. 2). Number 78 returned to his old haunts at the north end of Yellowstone Lake 7 days later. To accomplish this, he traveled due south 6 airline miles, east 4 miles, north 15 miles, then west 3 miles to Pelican Campground -- a total airline distance of 28 miles. Actual ground travel was probably more than double this.

Number 38, a 2-year-old, was captured at Lake Campground and also boated to Promontory Point and released. Four days later, he was back at the Lake Campground after traveling essentially the same route used by No. 78. A few months later, he was shot by a hunter outside the Park.

Number 170 and her two cubs were captured at Gardiner, Montana, just outside the northern border of Yellowstone. They had been making nightly forays from a nearby garbage dump into Gardiner. On July 3, 1964, we released No. 170 and her cubs in Hayden Valley, the geographic center of Yellowstone National Park. The female was color-marked and fitted with a radio transmitter. We radiotracked her for 8 days recording her

movements back to her original place of capture. She traveled 31 airline miles. The ground distance determined by radio fixes was approximately 50 miles. This did not take into consideration elevational movements. Although she did return to her home range and the Gardiner dump, the transplant proved effective; No. 170 did not again enter the town nor was she recaptured in a campground.

Campground management: A concerted effort has been made to remove food from campgrounds or make it unavailable to bears. The installation of numerous, bear-proof garbage cans has helped the sanitation problem. The developed areas and campgrounds at Canyon Village and Lake were not fully equipped with bear-proof garbage cans until the fall of 1968; Grant Village was not so equipped until the spring of 1969. However, campgrounds are still attractive to bears and will probably remain so as long as visitors are careless with their food or deliberately distribute table scraps to entice birds, bears, and other animals. Also many of the campgrounds lie close to major routes which grizzlies follow while traveling to and from summer ranges and winter denning sites.

Ranger patrols have been increased, and the information and education programs have been given new emphasis. Electric fences have been erected at all incinerators, and this has reduced the number of bears frequenting these areas. However, incinerators

contribute to air pollution, and we do not believe that they are the ultimate solution to Yellowstone's sanitation problems.

J. J. and F. C. Craighead

Plate 5. A grizzly individually marked for identification, following immobilization with the drug phencyclidene hydrochloride.

Photo credit -- John J. and Frank C. Craighead



BEHAVIOR OF GRIZZLIES IN RESPONSE TO REVISED MANAGEMENT PRACTICES

In 1968, the Yellowstone administration began abruptly to phase out the Tower, West Thumb and Trout Creek open pit garbage dumps. The Trout Creek Dump had been in existence for 22 years, following the closure of the nearby Otter Creek feeding station where grizzlies and black bears were viewed by the public.

During the summers of 1959 through 1967, approximately 1,000 cans of unsorted edibles and trash were deposited daily at Trout Creek. The refuse was lightly covered with soil, usually on the day of deposit. The volume of food attracted and held grizzlies in the area during the summer months. During 1959-1967 we documented the effect of this artificial feeding situation on the habits and behavior of grizzlies.

In 1967 we made a report to the National Park Service, Management of Bears in Yellowstone National Park, (Craighead and Craighead 1967). In that report, we recommended slow phasing out of the open pit garbage dumps, cautioning that:

> "Because phasing out of refuse dumps will disperse the grizzlies by destroying an attractive, if not essential, food source, the transition from pits to incinerators must proceed gradually, enabling the grizzlies to develop new feeding habits as well as altered social behavior and movement

> patterns. If the transition is slow and follows a recommended procedure, it is possible that no severe changes in population level, distribution or behavior will result. If, on the contrary, the phasing out operation is abrupt, and a carefully planned procedure is not followed, the result most certainly will be increased grizzly incidents in campgrounds, accelerated dispersal of bears to areas outside the Park, and greater concentrations of grizzlies at the public dumps in Gardiner and West Yellowstone, where food will be available but where adequate protection will not. The net result could be tragic personal injury, costly damages and a drastic reduction in number of grizzlies."

Phase-out of open pit dumps: In 1968, edibles were partially separated from trash and dumped, but not buried, at Trout Creek. The sorted food consisted of approximately 50% non-edible trash. Most of the refuse formerly dumped at Trout Creek was handled by the newly installed incinerator at Bridge Bay which had an operating capacity of 6,000 lbs. per hour. The volume of garbage taken to Trout Creek was drastically reduced. Our records, made when the refuse was dumped, showed that a maximum of eight cans per day were deposited from June 3 through June 14; between June 15 and July 15, the number gradually

increased to 40 per day. During the remainder of the summer, the number was not increased significantly except when the Bridge Bay incinerator broke down.

The early summer cut-off of food, followed by a drastic reduction in edibles during the summer of 1968, dispersed the grizzlies throughout the Park. Our documentation of marked animals showed that many found their way into campgrounds, traveling between Trout Creek and the Canyon Village and Lake Campgrounds. Others moved back and forth between Trout Creek and the dumps at Rabbit Creek and West Yellowstone. This type of movement did not occur from 1959 through 1967 prior to the phase-out. Our censuses of population units in the vicinity of each major dump showed that these units tended to be self-contained with very little exchange of animals (Craighead and Craighead, 1967).

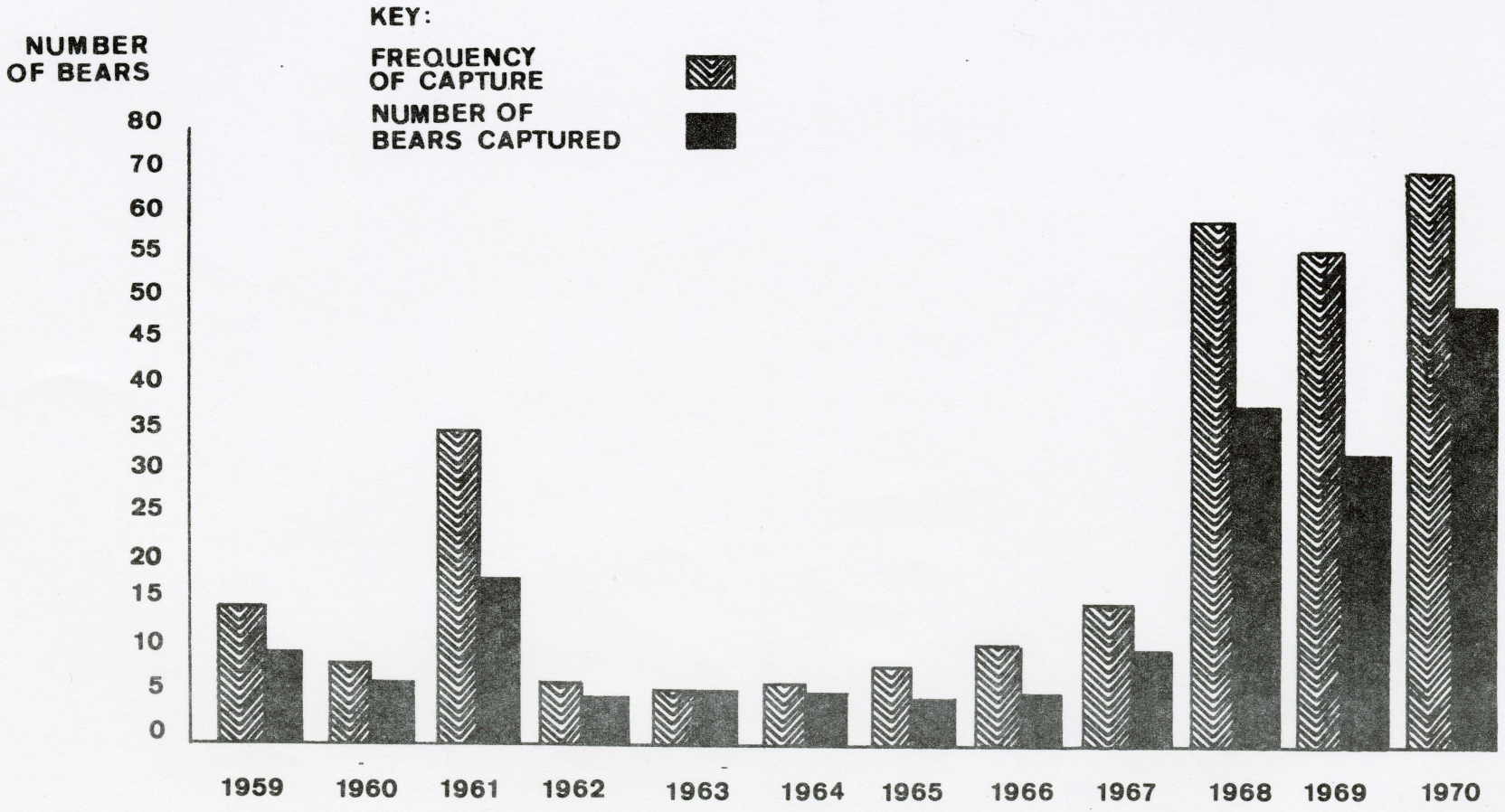
Many unmarked grizzlies also entered campgrounds. Fifty-four percent of the 37 grizzlies captured in campgrounds in 1968, 48% of 33 captured in 1969, and 41% of 49 captured in 1970 were unmarked. The movement of practically all the Trout Creek grizzlies, marked and unmarked, was greatly accelerated. A measure of this movement and disruption of long established habits is reflected in the frequency of capture and the numbers of grizzlies captured in campgrounds each year during the period 1959-1967 as compared to similar data for 1968-1970. The number of individual grizzlies captured in 1968 is approximately four times the average for the previous 9 years and

double the previous high of 1961. Frequency of capture was the highest recorded in 10 years (Fig. 5).

In 1969 we continued on-site measurements of the volume of garbage dumped at Trout Creek. Between 130 and 170 cans were deposited daily from June 15 through August. Most of this was in plastic bags. Only about half the contents were edible. As in 1968, the garbage and trash were not buried, so the grizzlies that arrived at the dumps first were able to consume most of the food by evening; this left little to hold animals which arrived later. From 1959 through 1967 the general procedure was to dump trash with garbage and partially cover it with soil each day. This provided a long feeding period and allowed numerous animals to share the food. This procedure had, in the past, kept the grizzlies concentrated.

The dispersal of grizzlies that began in 1968 continued in 1969. The slight increase in the amount of garbage, designed to rectify the situation, was ineffective. The frequency of capture as well as the number of grizzlies captured in campgrounds and developed areas remained high (Fig. 5). In 1970, following the closure of the Rabbit Creek Dump, frequency of capture of grizzlies in campgrounds climbed still higher to a peak of 72; just twice the value of the 1961 peak. The number of individual grizzlies captured is 49, the greatest number ever recorded (Fig. 5). Thus, data on the number of individual grizzlies captured in campgrounds during the three years of revised management clearly show that the new management practices have been creating problem bears that then must be dealt with by the

Figure 5. Frequency of capture and number of grizzly bears captured in campgrounds.


KEY:
FREQUENCY OF CAPTURE
NUMBER OF BEARS CAPTURED
NUMBER OF BEARS
80
70
60
55
50
45
40
35
30
25
20
15
10
5
0
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970

Park administration. In table 8, the frequency of capture and the number of individuals captured in campgrounds and developed areas during 1959 through 1967 is totalized and compared with similar data for 1968 through 1970. The frequency of capture for 9 years (1959-1967) is 117; for the past three years it is 190. The number of individual grizzlies captured for the same periods is 57 as compared with 70. Therefore, as a result of the rapid 3-year cut-back in garbage, the frequency of capture and the number of individual grizzlies captured in campgrounds during that period exceeded the totals recorded for the preceding 9 years.

Of the total number of grizzlies involved in campground foraging it is particularly revealing that 57 were captured during the 9 years prior to the rapid phase-out of the open-pit dumps, whereas 70 were captured during the first 3 years of phase-out (Table 8). Thus, from 1959 through 1967 an average of six grizzlies became campground bears each year. During 1968 through 1970 an average of 23 grizzlies became campground oriented each year. Data in Table 8 also show that Grant Village, which was first opened to the public in 1967, had no problem bears that year, as none were captured. The following years it was visited by grizzlies. Twenty-five were captured during the three-year period of revised management. Similarly, no grizzlies were captured at Slough Creek, Tower Fall, Madison Junction, and Mammoth from 1959-1967, but were captured at these campgrounds from 1968-1970.

That current management practices are "funneling" grizzlies

Table 8. Frequency of capture and the number of grizzly bears captured in campgrounds.

Campgrounds and developed areas[1]	1959-1967 Frequency of capture	1959-1967 Individual bears captured	1968-1970[2] Frequency of capture	1968-1970[2] Individual bears captured
Canyon Village	48	33	42	24
Lake	40	26	73	48
Old Faithful	9	9	23	17
West Thumb	17	11	7	6
Grant Village	-	-	30	25
Norris	1	1	2	2
Lewis Lake	0	0	1	1
Indian Creek	2	2	0	0
Slough Creek	0	0	3	3
Tower Fall	0	0	3	3
Mammoth	0	0	1	1
Madison Junction	0	0	5	3
Totals	117	82	190	133
Corrected totals[3]		75		124
Total individuals involved		57		70

1 Canyon Village includes - Canyon Village and Otter Creek Campgrounds. Lake includes - Lake, Fishing Bridge, Bridge Bay, and Pelican Creek Campgrounds. Grant Village opened in 1967 when the National Park Service began phasing out open-pit dumps.

2 Unmarked grizzly bears entering campgrounds during 1968 and 1969 could not be individually marked because of Park Service policy prohibiting marking of any animals in Yellowstone. Thus, in addition to marked animals, a minimum number of unmarked individuals, determined by criteria of sex, age, and time of capture were recorded for this period.

3 In 16 instances, bears were captured in two areas during a year. The corrected total of individual grizzlies captured per year corrects for this bias.

into campgrounds and developed areas seems to be further supported by the number of grizzly bear sightings in the Lake area during May-October of 1966-1970 (Table 9). The number for 1968, 1969, and 1970 greatly exceeds that for earlier years. This has occurred in spite of increased campground sanitation.

We must conclude that the new bear management practices, programmed to quickly phase-out the open-pit dumps in Yellowstone without first adequately sanitizing the campgrounds, greatly increased the probability of bear-man conflicts as more grizzlies entered congested visitor areas. This program has rapidly "created" troublesome campground grizzlies. The administration's policy formulated to deal with this situation has been to kill or ship to zoos all two-time offenders entering campgrounds or developed areas within a successive 2-year period.

In 1969, the Natural Sciences Advisory Committee of the National Park Service met with Park administrators, biologists and consultants to review grizzly bear management in Yellowstone National Park and to formulate a bear management policy and program (Natural Sciences Advisory Committee Report, 1969). The Committee summarized the management goals as follows:

1. To maintain populations of grizzly and black bears at levels that are sustainable under natural conditions as part of the native fauna of the Park.

Table 9. Grizzly bear sightings[1] in the Lake area[2] during May-October, 1966-1970.

National Park Service Records

Month / Year	May	June	July	August	September	October	Total
1966	0	1	0	0	1	0	2
1967	0	0	0	2	1	0	3
1968	6	2	25	27	1	0	61
1969	9	3	2	2	0	7	23
1970	5	4	8	11	-	-	28

[1] Bears that were captured (see Table 8) are not included as sightings.

[2] Lake area includes Bridge Bay, Lake, Fishing Bridge, and Pelican Creek.

2. To plan the development and use of the Park so as to minimize conflicts and unpleasant or dangerous incidents with bears.
3. To encourage bears to lead their natural lives with minimum interference by humans.

The ultimate objective agreed upon by all participants was the sanitary disposal of trash and garbage in a manner that would deny this food source to bears.

The report continued:

> "But, in the meantime, there is disagreement as to the sequence of steps leading to the elimination of garbage from availability to grizzlies. One view is to cut off all garbage quickly, forcing the bears to turn immediately to natural foods. The opposite contention is to phase out garbage feeding over a period of time, 'weaning' the bears gradually. The issue hinges on which of these procedures will result in the least number of bears going into campgrounds."

In 1970, following the distribution of the Advisory Committee report, the Park continued its phase-out policy for garbage dumps by completely closing the pit at Rabbit Creek, which prior to this time attracted and held a population that fluctuated between 22 and 48 grizzlies. Our censuses showed an 8-year average of 32 grizzlies in the area during the summer months (Craighead and Craighead, 1967).

Five airline miles away a fenced sanitary land-fill dump was installed at Nez Perce Creek as a replacement for Rabbit Creek. With this accomplished, grizzlies with traditions of feeding at Rabbit Creek were completely denied a long-established food source.

Also, in 1970, in an effort to hold grizzlies in the Trout Creek area, a greater volume of unsorted garbage and trash was deposited at the Trout Creek Dump than during each of the previous 2 years. This was partially successful. Four of five marked females that had entered campgrounds in 1968 and 1969 for the first time because of the rapid withdrawal of food at the Trout Creek Dump (Table 10) returned to Trout Creek during 1970 and were not captured or observed in campgrounds or developed areas.

Movements of individual grizzlies in response to reduced food at the Trout Creek Dump during 1968-1969: Five female grizzlies which frequented the Trout Creek Dump were color-marked between 1960 and 1962 (Table 10). They were captured in campgrounds or developed areas for the first time following the reduction of food at Trout Creek in 1968. The long interval between marking and first capture in a campground can be explained if these bears increased their daily movements and extended their home ranges in search of food. The home ranges of No. 39 and No. 40 had been established earlier by radiotracking (Craighead and Craighead, in Prep.).

No. 39 extended her home range in 1968 to include Lake Campground and the Bridge Bay developed area. During 1968-1969,

Table 10. Campground captures of five female grizzlies following the rapid phase-out of Trout Creek Dump, 1968-1969.

Bear No.	Year Marked	Date of first capture in campground	Interval in years between marking & first capture in campground	Age at first capture in campground[1]	Number of capture areas	Frequency of capture by years	Number of offspring produced between marking & first recapture	Status of female 1969
34	1960	1969	9	19-1/2	1	1969-1	6	Alive
39	1960	1968	8	13-1/2	2	1968-2 1969-5	5	Alive
40	1960	1969	9	11-1/2	1	1969-1	7	Killed for control
109	1961	1969	8	8-1/2	1	1969-2	0	Alive
128	1962	1969	7	18-1/2 Min	1	1969-1	10[2]	Alive

[1] Age in years - all bears were aged by cementum layer technique. Ages designated minimum (Min) represent minimum cementum layer age. (Craighead et al. 1970.)

[2] No. 128 produced 3 more cubs in 1970.

she was captured five times at the Bridge Bay incinerator and twice in adjacent developed areas. In both years she was probably attracted there by odors from the incinerator.

No. 40 was captured in 1960 at the age of 2-1/2 years, color-marked, and her movements were recorded. At 3-1/2 she was instrumented, and we radiotracked her for 8 consecutive years (Craighead and Craighead, in Prep.). While this female was radio-monitored, she was never tracked into a campground or developed area. However, she entered the Lake developed area in 1969 and was shot.

Since grizzlies of all ages made initial campground entries in 1968 and 1969, we do not think that the advanced age of three of the five grizzlies listed in Table 10 was a factor altering their behavior and movements. They were in excellent condition when last captured; all had reproductive records. No. 128 had produced ten cubs prior to her capture in 1969. She bore three more in 1970 at a minimum age of 19-1/2 -- a total of 13 cubs during the 9 years she was marked. From 1960 to 1970, the five females bore a total of 28 offspring (Table 10). It is evident that management practices which "force" productive females into developed areas where they are subject to control could rapidly alter the population level.

Scarcity of the staple natural foods during 1968 and 1969 did not cause the movement, since the availability of these during the period was not importantly different from other years. Our data on the utilization of natural foods by grizzlies and on

the relative abundance of these foods throughout a 12-year period cannot be presented here, but these fully support this conclusion. We, therefore, conclude that the five females recorded in Table 10, as well as 11 other marked grizzlies of both sexes, were captured for the first time in campgrounds in 1968 and 1969 primarily because of the acute food shortage at Trout Creek. Thirty-five unmarked individuals were also captured in campgrounds or developed areas for the first time.

Figure 6 and Table 11 show the movements from Trout Creek of 34 marked grizzlies and two recognizable cubs. Records of these movements were obtained by capturing the animals or by observing their individualized color markings. Sixteen individuals visited the Lake developed area, eight entered Canyon Village, and ten moved to the Rabbit Creek Dump. Two moved to Cooke City, three to Tower, three to West Yellowstone, one to Norris, and one to Grant Village. Eight of the marked bears visited two campgrounds or developed areas (Table 11).

Dispersal of individual grizzlies following the closure of Rabbit Creek Dump in 1970: Grizzlies inhabiting Rabbit Creek dispersed widely following the closure of that open-pit dump in 1970. Figure 7 shows the movements of 12 color-marked and 2 recognizable grizzlies to new feeding areas. All of these grizzlies were observed and recorded at Rabbit Creek for between 3 and 11 years prior to the closure (Table 12). Therefore, all could be considered resident members of this population unit.

Figure 6. Dispersal of 34 marked and two recognizable grizzlies following management changes at Trout Creek Dump during 1968 and 1969.

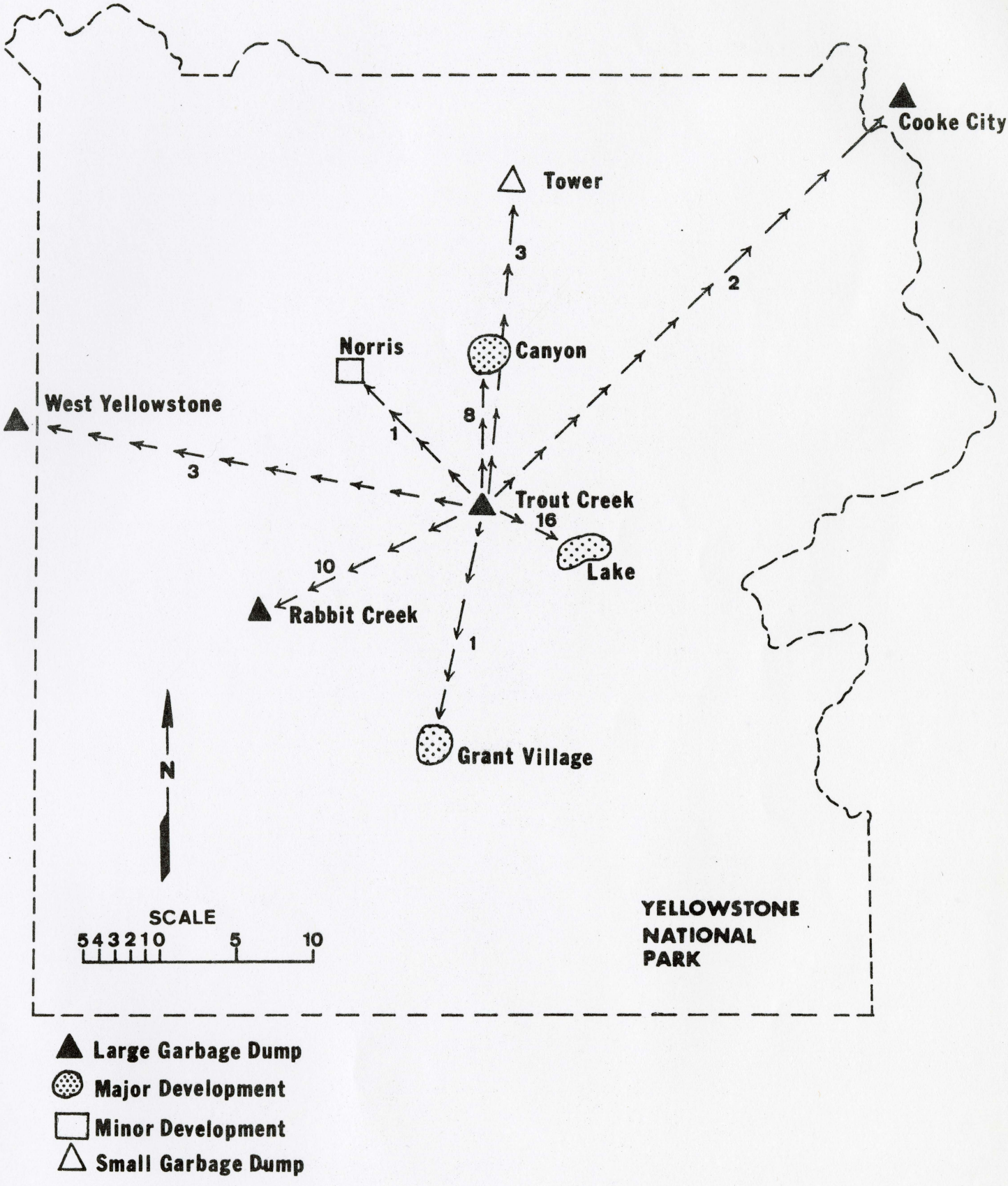
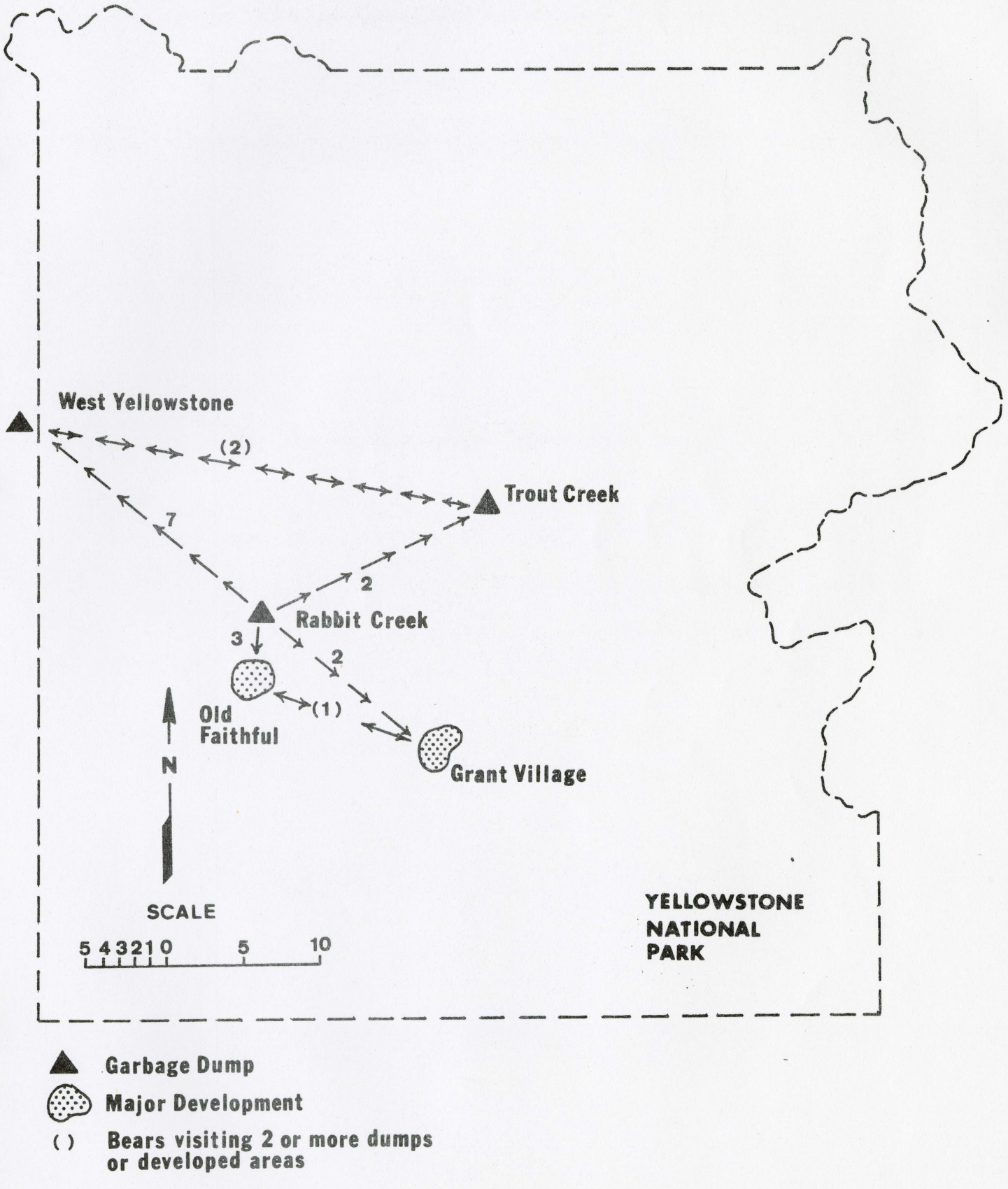

Cooke City
Tower
3
2
Norris
Canyon
West Yellowstone
8
1
3
Trout Creek
16
Lake
10
Rabbit Creek
1
Grant Village
N
SCALE
5 4 3 2 1 0 5 10
YELLOWSTONE
NATIONAL
PARK
Large Garbage Dump
Major Development
Minor Development
Small Garbage Dump

Table 11. Dispersal of 34 color-marked grizzlies and two recognizable cubs from Trout Creek following management changes at Trout Creek Dump during 1968 and 1969.

Marked Bear No.	Campgrounds and developed areas visited by marked grizzlies							
	Lake	Canyon Village	Grant Village	Norris	Cooke City Dump	Tower Dump	West Yellowstone Dump	Rabbit Creek Dump
7								X
10+(2)*						XXX		
30	X							
34					X			
39	X							
40	X							
88								X
109	X							
112		X						
128	X							
130			X					X
141	X	X						
144		X						
147								X
166							X	X
183	X							
188		X						
189								X
190							X	
194								X
201								X
207	X	X						
208	X	X						
210	X							
211	X			X				
213							X	X
217	X							
218								X
228		X						
236	X	X						
240	X							
241	X							
242					X			
256	X							
Totals	16	8	1	1	2	3	3	10

* The cubs of bear No. 10 dispersed with their mother and could be recognized.

Figure 7. Movement of 14 marked or recognizable grizzlies following closure of Rabbit Creek Dump, 1970.



▲ Garbage Dump

Major Development

( ) Bears visiting 2 or more dumps or developed areas

Table 12. Movement of grizzlies following the closure of Rabbit Creek Dump in 1970.

Bear No.	Sex	Number of years previously observed at Rabbit Creek Dump	New area visited[3]	Airline distance from Rabbit Creek Dump to new area
2	M	11	Old Faithful	5
			Grant Village	14
8	F	11	Grant Village	14
53	M	10	West Yellowstone Dump	18
139	F	7	West Yellowstone Dump	18
			Trout Creek Dump	19
147	M	7	Trout Creek Dump	19
164	F	7	Old Faithful	5
171	M	6	Old Faithful	5
213	M	5	Trout Creek Dump	19
217 A	M	3	West Yellowstone Dump	18
			Trout Creek Dump	19
219 A	M	3	West Yellowstone Dump	18
224 A	M	3	West Yellowstone Dump	18
226 A	M	3	West Yellowstone Dump	18
UM[1]	M	4	West Yellowstone Dump	18
UM[2]	M	10	Old Faithful	5

1 This male identified by size, conspicuous wound over left eye and white patches of hair on shoulders. (UM = unmarked.)

2 Large male identified by a wound exposing the upper left canine. (UM = unmarked.)

3 New area visited was determined by observation or capture of marked or recognizable animals.

Seven grizzlies moved 18 airline miles to the West Yellowstone Dump, which lies outside of the Park. Two joined the grizzlies at Trout Creek, 19 airline miles away; these also visited the West Yellowstone Dump. Grizzlies No. 2 and No. 8 moved 14 airline miles to the Grant Village Campground and developed area. Three grizzlies, including No. 2, moved to the Old Faithful area only 5 airline miles distant. Comparison of the 1970 census data taken at Trout Creek and West Yellowstone with other years suggest that many of the unmarked grizzlies from Rabbit Creek also moved to these other open pit dumps.

In 1970 five grizzlies from Rabbit Creek were captured in campgrounds or developed areas and four were dispatched. None of these had previous campground records. The long intervals between marking and first capture in a campground or developed area (Table 13) show that the policy of rapidly closing the long established open-pit dumps was still creating problem bears in Yellowstone. The official solution was still to dispatch the animal. There is circumstantial evidence that No. 8 severely mauled a Park visitor in Grant Village on September 3, 1970. This color-marked animal had not been captured or observed in a campground during an 11 year period prior to this time.

Table 13. Campground captures of five grizzlies following the closure of Rabbit Creek Dump, 1970.

Bear No.	Sex	Year Marked	Interval in years between marking and first capture in campground	Age at first capture in campground	Capture Areas	Frequency of Capture	Status in 1970
2	M	1959	11	15-1/2-16-1/2	Old Faithful Grant Village	2	Killed for control
8	F	1959	11	19-1/2 ± 2	West Thumb Grant Village	2	Killed for control
164	F	1963	7	Adult[2]	Old Faithful	1	Alive - Yellowstone
171	M	1964	6	9-1/2	Old Faithful	3	Zoo for control
UM[1]	M	1960	10	22-1/2-25-1/2	Old Faithful	1	Killed for control

[1] Large male unmarked but identifiable during a 10-year period by a wound exposing the upper left canine.

[2] Exact age unknown.

SOME MANAGEMENT OPTIONS

Special refuges: Moment (1968) argues that great danger exists when grizzly bears and people mix. He suggested the elimination of grizzly bears from Glacier and Yellowstone National Parks and the creation of special preserves, because the natural wonders and opportunities for family outings in Yellowstone and Glacier are unsurpassed, whereas grizzly bears live elsewhere.

There is no end to the pros and cons for such an argument, as Moment learned from the "continual stream of letters" he received from people in all walks of life. Moment's proposal is contrary to the responsibility of the National Park Service to preserve the native wildlife. More to the point, it is ecologically unsound. The grizzlies inhabiting Yellowstone also utilize most of the adjoining national forests. Yellowstone National Park itself is not a complete ecological unit for the existing population of grizzly bears; the larger area is. To eliminate grizzlies from Yellowstone would require eradicating them from one of the largest wilderness complexes in the nation. If grizzlies can be preserved within the contiguous 48 states, this can be accomplished best in the 7,700 square mile Yellowstone National Park-National Forest Ecosystem where grizzlies already thrive.

Moreover, mankind is slowly learning, via the trial and error route, that every time he eliminates a species from an

ecosystem, he reduces its complexity and disrupts its interdependency. The stability of ecosystems is dependent upon the maintenance of their complexity. The Yellowstone ecosystem has already lost the wolf and the cougar and the American Indian; the resulting disruptive effects on the ungulate populations have, in turn, been reflected in adverse vegetative changes, range abuse, and soil erosion. Removing the grizzly would only aggravate ecosystem deterioration. Moment's philosophy, if accepted, could set the stage for eliminating the coyote. Coyotes carry rabies, and rabies and people don't mix nearly as well as grizzlies and people. Philosophical solutions of specific ecological problems can be stimulating; they can be productive when supported by scientific data and its application.

Reduced population level: Another apparent way to solve the grizzly bear problem in Yellowstone is to substantially reduce the number of bears. The Yellowstone administration could maintain a minimum population of grizzlies thought to be consistent with preservation of the species within the Yellowstone ecosystem. This would conceivably reduce the probability of bear - man conflicts, the need for intensive management and the administrator's fear of a serious bear - man encounter. Since the minimum size of a self-perpetuating grizzly population is not known, nor do we yet know the critical level at which its survival might be threatened,

the risk of heavy or excessive bear control is obvious.

Moreover, the grizzly bear population is a common resource of Yellowstone Park, four national forests and three states. Responsible spokesmen for the fish and game departments of Montana, Idaho, and Wyoming, and for the U. S. Forest Service have favored a management program based on maintaining an optimum population through greater protection of and more intensive management for grizzly bears over their entire habitat. This will require close, interagency cooperation with a common objective of preserving as natural a population of grizzlies in Yellowstone and adjacent forest areas as possible under present visitor use conditions. The population can be held at this optimum level by moderate control measures in the Park and special permit, trophy hunting on national forest lands adjacent to Yellowstone. The minimum population concept should be considered only after all other approaches have been tested and have failed.

Interstate transplants: Transplanting of grizzlies to suitable habitat in Idaho, Wyoming, Montana, and Colorado has been suggested as a partial solution to the problem. Techniques that could be applied were developed during the course of our research. Since interstate transplants are technically feasible, we will discuss briefly how such a program might be successfully executed. We should keep in mind that a transplant program, even though

successful in repopulating historic grizzly range, could be a threat to the integrity of the Yellowstone grizzly population if the number annually removed from this population is not strictly limited.

Mortality rates and population data taken over a 7-year period (Craighead and Craighead, 1967) suggest that not more than five or six animals should be transplanted annually. To prevent annual loss from exceeding the annual recruitment, transplants must be a substitute for grizzlies that otherwise would be dispatched and not an additional drain on the population. Since habitual campground bears and incorrigible offenders are not suitable for transplant, such grizzlies will have to be dispatched. However, the less troublesome bears can be used. These will constitute a population loss and must be considered in context with other losses in any population analysis.

The problems of transplants and the prospects for restoring grizzly bear populations will require a thorough investigation by state fish and game departments, the National Park Service, and the U. S. Forest Service. A committee of the International Association of Fish and Game Commissioners is currently accumulating information on the subject and will function as an advisory board to interested parties. A general procedure would entail:

1. A verification of the presence or absence of grizzlies within their historic range in any state contemplating

a transplant.

2. An inventory of grizzly bear numbers and habitat in those states where the species still exists.
3. A thorough sampling of public reaction and political concern for such a program.
4. Researching of the legal responsibilities and liabilities of the organizations that provide the animals and those organizations that receive them.
5. A public education program and public hearings to explain the transplant program and to get public acceptance.
6. Selection of the best possible sites for restoration and release.
7. Screening of all potential transplant animals to minimize the possibility of transplanting an incorrigible bear.
8. Conducting an intensive radiotracking study of initial transplants to determine movements, adaptive behavior, and eventual success or failure of such transplants. (Radio monitoring would also enable a transplanted grizzly to be located and dispatched should bear - man conflicts develop.)
9. Gradual repopulation,by periodic transplants,of historic grizzly bear range where current land use practices permit.

Plate 6. Grizzly bear equipped with a radio collar in order to study grizzly-man relationships in Yellowstone National Park.

Photo credit -- Jay Sumner



The ecological, biological and technical problems inherent in making grizzly bear transplants can now be ascertained. The legal, public relations, and public information aspects are almost unknown entities. Considerable time and effort will be required to lay the necessary groundwork for public acceptance and legal determination. However, there appear to be no insurmountable obstacles to initiating a pilot experiment. Carefully planned and executed experimentation will tell us whether grizzly bears can be successfully transplanted and populations restored in the few wild and spacious areas currently suitable for the purpose.

Feeding and zoning: Management as practiced prior to 1968 can perhaps best be described as feeding and zoning. For 3 months each year, grizzlies were concentrated and isolated at the open pit dumps. Optimum population levels were maintained with a minimum of control in the Park, a maximum hunter harvest outside and relatively few grizzly - man conflicts. The incidence of campground visitation by grizzlies was within acceptable limits (Fig. 5), and a species endangered within the lower 48 states was being protected. This management was highly effective in holding grizzlies out of campgrounds and reducing the probability of attacks. However, it was dependent on maintaining the open pit dumps with their "artificial" food.

Research-based management: Management of the grizzly bear must be flexible, yet based on biological and ecological facts. To accomplish this we recommend four broad management goals (Craighead and Craighead, 1967):

1. To preserve an optimum population of grizzly bears in Yellowstone and adjacent national forests as a part of the native fauna of the area.
2. To harvest and to control grizzlies through inter-agency effort so as to maintain population levels compatible with natural conditions, preservation of the species, a sustained trophy hunt, visitor use, and other land use practices.
3. To administer the Park and the adjacent national forests so as to minimize bear - man conflicts and incidents.
4. To encourage cooperative, long-term research (both basic and management-oriented) as essential to the preservation of the grizzly and the safety and enjoyment of the visiting public.

To realize these management goals will require the implementing and perfecting of certain procedures and techniques. Some procedures will pertain only to Yellowstone National Park and some to the four adjacent national forests, where management of habitat and game animals is respectively a responsibility of the

U. S. Forest Service and the state fish and game departments. Other procedures will require participation by every administrative organization concerned, and the public.

To preserve and to manage the Yellowstone grizzly bear population so as to achieve these broad goals, we suggest the following management procedures:

1. Maintain productivity - It is essential that the present productivity of the grizzly bear population be maintained at the 7 year average of 33 cubs per year (Craighead and Craighead, 1967). This average, net productivity represents 19% of the base population and is adequate to allow it to grow slowly and expand into available habitat.

   The most practical way to maintain the present level of productivity is to provide all possible protection for the highly productive adult females -- a relatively small segment of the population. This can be accomplished by selective bear-control in the Park, by substituting alternatives to control killing, and by refining and standardizing hunting regulations outside the Park.

2. Decrease mortality - Annual recruitment has, in the past, closely approximated annual mortality (Craighead and Craighead, in Prep.). The number of grizzlies dispatched after entering campgrounds and the number

killed outside the Park by hunters can be regulated by management practices. Prior to 1968 these causes accounted for 34% and 43%, respectively, of the losses from the population among all ages where the causes of death were established. An interagency committee is needed to annually evaluate kill statistics and recommend to the agencies the number of grizzlies that should be killed by hunters and the number that may be dispatched by the Park Service so that the annual kill from these two causes does not exceed the annual increase.

3. Remove artificial food - Grizzly bear - man encounters and injuries, as well as the number of animals annually dispatched, can be reduced to a minimum by removing or making unavailable to bears all "artificial" food. To be effective, Yellowstone and the adjoining areas must be thoroughly sanitized. An incomplete job will simply shift the problems from a sanitized area to an unsanitized one. The task will be time-consuming and costly. It can be accomplished only by a cooperative effort of agencies responsible for managing the land and the wildlife of Yellowstone National Park and the adjoining national forest lands.

Sanitation, which would make "artificial" foods

unavailable to grizzlies, must be gradual and orderly to minimize the disruptive effect on the grizzlies and to alleviate, rather than aggravate, grizzly-man encounters. We recommend the following procedures and sequence of action:

(a) Through state, county, city, and community action, thoroughly sanitize all campgrounds immediately adjoining Yellowstone Park, and phase out or bear-proof open-pit dumps. This should be accomplished over a 3 or 4 year period.

(b) Continue to improve the sanitation of all campgrounds and developed areas in the Park.

(c) Locate open-pit dumps outside of prime grizzly bear habitat or replace them with refuse pulverizing equipment to transform garbage into sanitary landfill material.

(d) Keep the Nez Perce Dump open to grizzlies until those at West Yellowstone and the Flagg Ranch have been phased out. Then phase out the Nez Perce Dump over a 2 to 3 year period. This should stop the movement of grizzlies to dumps outside the Park and to campgrounds inside.

(e) Phase out the Trout Creek Dump over a 5 to 8

year period. The phase-out should be thoroughly and objectively documented. Replace the Trout Creek open-pit dump with refuse pulverizing equipment or transport garbage and trash outside of the Park for processing.

Concentrating grizzlies at the open-pit dumps during the visitor season and restricting public use of these areas has been a highly effective technique for preventing grizzly - man encounters. Phasing out of the open-pit dumps will nullify zoning because grizzlies will no longer be concentrated in areas where entry can be denied to the public. This makes imperative a long transition period of phasing out all open-pit dumps.

4. Feed carrion to bears - In executing the sanitation program, carrion could be placed, during the summer months, to draw bears away from campgrounds and to distribute them widely throughout the Park. Some of the surplus elk from the Northern Yellowstone herd, shot in direct reduction programs or captured for transport, could be used for this purpose. The feasibility of this has been tested, and the results were extremely effective. As many as 23 grizzlies have been attracted to one carcass, and, on numerous occasions, troublesome

grizzlies were induced to move 3 or 4 airline miles (Craighead and Craighead, in Prep.). A nice feature of this technique is that energy is retained and utilized within the ecosystem.

5. Protect campgrounds - The Yellowstone administration's present program of campground protection, public education, and ranger patrols should be continued. However, policy forbidding color-marking of campground grizzlies should be rescinded. The capability of individual recognition, both in the campgrounds and in the backcountry, is an essential scientific tool for evaluating whether management objectives are being accomplished.

6. Continue research - Successful management of grizzly bears will require information assembled to date and new data from continuous research. Basic research on the ecology of grizzlies and applied research designed to periodically evaluate management practices can be best accomplished by individuals, research teams, and agencies having no direct land management responsibilities. The research should be coordinated through the land and wildlife management agencies responsible for managing the grizzly in the Yellowstone Park - National Forests Ecosystem.

DISCUSSION

Grizzly bears and man have coexisted in Yellowstone since the establishment of the Park in 1872. They have shared this environment during the past decade with about a million-to-one chance of confrontations leading to personal injury. The open-pit garbage dumps that came into existence with the establishment of Yellowstone Park have become traditional feeding areas for grizzlies. A long-term study showed that these dumps have altered the bear's behavior patterns at these sites, but they have not made grizzlies dependent on man or created the incorrigible animals that are a threat to the visiting public. On the contrary, the isolated dumps, with restricted public access, have effectively concentrated grizzly bears during the height of the visitor season. They have been extremely effective in reducing the probability of grizzly - man encounters and injury.

In order to restore the grizzly to its natural state, to preserve an optimum grizzly bear population, and protect Park visitors while this is being accomplished, the long-established feeding sites must be phased out over a period of many years. Thorough sanitation of campgrounds and developed areas, both inside and outside the Park, must precede the closure of the major open-pit dumps in Yellowstone. In 1968, the Yellowstone administration initiated a management program; its major objective of rapidly

eliminating open-pit garbage dumps has drastically disrupted long established grizzly bear patterns of feeding and movement. This has forced grizzlies into areas of high visitor use and vastly increased the probability of bear - man conflicts. This policy, if continued, could be directly responsible for an encounter between grizzly and man in a campground or developed area that would be fatal to both. Rapid elimination of "artificial" food at the dumps is not forcing the Yellowstone grizzlies to quickly adjust to an all-natural food diet, but is instead moving them into unsanitized areas inside and outside of the Park.

Since practically all of the grizzlies in the Yellowstone area have fed at open-pit garbage dumps during some time in their lives, a "wild population" cannot be made by denying this food and then dispatching all grizzlies that find it elsewhere in campgrounds and developed areas of the Park. The present rapid phase-out policy, combined with the elimination of two-time offenders, could reduce the grizzly bear population of the Yellowstone Park-National Forest Ecosystem to a dangerously low level in a relatively short period of time. We believe that grizzly bears and man can coexist in this vast ecosystem if management is tailored to the facts of bear behavior, if all campgrounds and developed areas are sanitized, if open-pit dumps are slowly phased out, if the visiting public is willing to accept a small risk, and if all agencies having a vested responsibility in solving the problem work cooperatively toward common objectives.

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