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BROWN-GRIZZLY BEAR

IN ALASKA

ITS ECOLOGY AND MANAGEMENT

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by

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Perhaps the most revered animal on the North American continent is the brown-grizzly bear (Ursus arctos sp.). Tales of his prowess abound in literature and lore. Surprisingly, however, there is a dearth of factual data available on the species.

The scientific classifications of the brown-grizzly bear has been extremely clouded ever since the publication in 1896 of C. Hart Merriam's preliminary synopsis of the American bears. In this and subsequent publications (1900, 1914, 1918 and others) Merriam described over 30 speices of brown and grizzly bears. In these classifications, Merriam used size, pelt color and cranial features as identifying criteria. His analysis gave little consideration to ecological factors or to the fact that bears exhibit marked physical variations even within individual family groups.

Since Merriam's original classifications, considerable argument has been waged between persons and groups interested in the taxonomy of bears. Most recent workers agree that the classifications advanced by Merriam were excessive and either delete many of his species designations or relegate them to a sub-specific status. A fair body of workers recognize the brown bear and grizzly bear as separate species, however. Doubtless, the argument will continue for some time but I am in general agreement with the taxonomic revision by Rausch (1963). This view holds that the so-called brown bear and grizzly bear of the American continent and the European brown bear are a single species, Ursus arctos Linneaus. Sub-specific classifications, although ill-defined and fewer than the number of species described by Merriam, appear justified. Over the greater part of the present and previous range of the species on this continent Ursus a. horribilus Ord applies.

Brown bears on the Kodiak-Afognak Island group off the western coast of southcentral Alaska comprise a reproductively isolated population possessing distinctive cranial features and are classified as U. a. middendorffi Merriam. Other reproductively isolated population also exist but at this time suffidient data are not in hand to say with certainty whether or not they deserve sub-specific designation. Possibly the Alaska Peninsula form is deserving of sub-specific status, as well as the bears of Admiralty Island and Baranof-Chichgos Islands in Southeastern Alaska.

Throughout the remainder of this paper reference to either the brown or grizzly bear is one of synonymy. However, reference to the brown bear does imply coastal populations of the species and to the grizzly bear, interior populations.

GENERAL DESCRIPTION

The brown-grizzly bear is perhaps the largest form of the living bears and as all bears, is bulky in build and quite variable in size depending upon sex, age, time of year and geographic location. The coastal brown bear is on the average considerably larger than the interior grizzly bear. Exceptional specimens attain weights of 1300 pounds though most are considerably smaller. Interior grizzlies are at least a third smaller than coastal forms and, except for pre-puberal age classes, females normally weigh only about hald as much as equivalent aged males in given locales. Fall specimens weigh 20 to 30 per cent more than equivalent spring specimens.

Whether the larger size of the coastal bear is due solely or in part to genetic considerations is unknown, but the same condition prevails in Eurasia where the coastal bear of Kamchatka is appreciably larger than non-coastal forms (Rausch, 1963).

This suggests that the difference is one of nutrition. Throughout the range of the species a richer food supply is generally available to coastal bears, particularly salmon which provides an espeically rich protein diet. The foraging period of coast bears is also several months longer than is the case for interior bears which spend almost half of their lives in winter dens. Rausch (1963) has postulated, also, that brown-grizzly bears differ in size throughout their range along certain geographic clinal planes--namely along a coastal zone from the tip of the Alaska Peninsula to British Columbia, along the arctic coast, and along a cline extending in a southeasterly - northwesterly direction across interior Alaska and Canada. While there is certain merit in this postulation, the arguments advanced are not totally convincing to me at least. Sample sizes were generally small and the differences between most areas of comparison did not appear statistically significant. Statistical tests would have been particularly pertinent to the theses presented yet were omitted except for one or two comparisons which supported the general theory.

It is also questionable that condylobasal skull length provides a valid criterion of size. As has been demonstrated by Neiland and Siniff (1963) for the wolf, even a two dimensional (length plus width) measure of skull size is markedly less reliable than a three dimensional system which includes skull depth. All comparisons were measured against dried skull weights.

The coat color of the brown-grizzly bear is highly variable and several variants may occur in the same litter. As a general rule, coastal forms are quite uniformly medium to dark brown in color. Interior bears appear more frequently mottled in color and a large proportion exhibit a darker undercoat tipped with light-tipped guard hairs giving it the popular silvertip effect. The legs of all forms are generally quite dark. An infrequent, but highly sought color phase is light blond. Occasional specimens are creamy white.

Table 1 presents a breakdown of the coat colors of a sample of bears killed by hunters during the 1961 and 1962 seasons. As is apparent from these data, coat color is quite variable throughout the State though bears from southeastern Alaska are generally darker than those from other areas.

It would be interesting to know how coat color affects a bear's chances for survival. Quite possibly certain color types are more or less easily seen than others and as a consequence suffer differential exploitation by hunters. If so, and if this is a genetic factor, future brown-grizzly bear populations may tend toward colors best suited for survival. This would be expected to vary, of course, in different habitat types.

Brown-grizzly bears also vary in color according to age and the season of the year, and males apparently tend to be darker than females (Table 2). A distinctive feature of most cubs of the year is a white collar band which persists through most of the first summer. Also, cubs do not shed during their first year (Erickson, 1964). Consequently, they do not show the rubbed areas which are characteristic of older animals. Pelt colors also tend to fade from the new coat beginning in the fall and continuing to the time of shedding the following spring. The hair of spring specimens is often curled at the tips, as though singed.

The pattern of hair shedding is of particular interest. As Table 3 shows, 33% of the bears taken by hunters in the spring hunting seasons of 1961, 1962 and 1963 showed substantial rubbed areas as compared to only 5% among fall kills.

TABLE 1. Pelt Colors of Brown-Grizzly Bears Killed in Alaska by Hunters During the 1961 and 1962 Seasons. [1,2]

Area	Pelt Color									
	Blond		Light Brown		Med. Brown		Chocolate		Total	
	No.	Percent for area	No.	Percent for area	No.	Percent for area	No.	Percent for area	No.	Percent for area
S. E. Alaska	3	2	22	14	43	28	88	56	156	100
S. C. Alaska	23	13	36	21	54	31	60	35	173	100
Kodiak-Afognak Is.	15	6	37	15	88	36	106	43	246	100
Alaska Peninsula	27	10	55	20	92	33	103	37	277	100
Interior & Arctic Alaska	30	21	32	22	46	32	35	25	143	100
TOTALS	98	10	182	18	323	33	392	39	995	100

1. As determined by sealing officers.

2. Excludes kills of unidentified area or color.

For spring hides, the greatest proportion of rubbed hides was found in southeastern Alaska where almost half were appreciably disfigured. Approximately 30% of spring hides taken elsewhere in the state were rubbed. It is interesting to note,too, that the proportion of hides rubbed in early spring was as high as for those taken later in the spring. This finding indicates that shedding begins and is well progressed even before bears leave their winter dens.

Since brown-grizzly bears and black bears show many color variations as well as having overlapping ranges, it is not surprising that occasional identification problems arise. This is attested to by the fact that professionally guided hunters occasionally present black bear hides to the Alaska Department of Fish and Game for sealing as brown-grizzly bears. It is significant though that identification difficulties seem limited to smaller bears. In about two dozen cases which I have investigated the animals were all black bears.

To be sure, specimens in the field unless observed at close range may be misidentified. Several criteria may be used to identify specimens in hand, however. Most positive identification is possible by examining the upper rear (3rd) molar teeth. In the brown-grizzly bear these measure more than 1-1/4 inches (32 mm.) while in the black bear the measurement is less. Often, however, identification must be made on the basis of hide examination alone and here absolute determination may be difficult. The fore-claws are perhaps the best clue. Those of the brown-grizzly bear are longer, less sharply recurved and more massive than those of the black bear. Though quite variable in length, depending on the size of the animal and the degree of wear, the claws of the brown-grizzly bear are rarely less than 1-7/8 inches (48 mm.) long and those of the black bear seldom exceed this length. A less variable character, however, is the hair on the toes. In the case of the black bear it extends almost to the claw tips whereas the claws of the brown-grizzly are exposed at least 3/4 of an inch beyond the hair line. Black bear claws are also uniformly pigmented while those of the brown-grizzly bear are often light colored along the central crest of the claw. This is particularly pronounced in older specimens.

TABLE 2. The Pelt Color of Brown-Grizzly Bears by Sex. 1/ 2/

	Pelt Color									
	Blond		Lt. Brown		Med. Brown		Chocolate		Total	
	No.	Percent of each Sex	No.	Percent of each Sex	No.	Percent of each Sex	No.	Percent of each Sex	No.	Percent of each Sex
Males	39	6	89	14	223	35	288	45	639	100
Females	57	17	89	26	96	28	100	29	342	100
Total	96	10	178	18	319	32	388	40	981	100

1/ As determined by sealing officers for the years 1961 and 1962.

2/ Excludes kills of unidentifies sex or color.

TABLE 3. The Condition of Sealed Bear Hides. 1/ 2/

Spring Season

Area	Number of Hides Examined	Percent Rubbed
Southeastern	127	50
Southcentral	14	43
Kodiak-Afognak	258	29
Alaska Peninsula	242	26
Interior-Arctic	52	10
TOTAL	693	31

Fall Season

Area	Number of Hides Examined	Percent Rubbed
Southeastern	100	10
Southcentral	250	6
Kodiak-Afognak	98	8
Alaska Peninsula	194	6
Interior-Arctic	206	4
TOTAL	848	6

1/ As determined by sealing officers for the years 1961, 1962 and 1963.
2/ Excludes kills unidentified to area, season or rubbed areas.

DISTRIBUTION AND HABITAT REQUIREMENTS

The brown-grizzly bear is distributed over practically the whole of Alaska. Except for minor island areas, it is absent only from the Aleutian Island chain beyond Unimak Island and from the islands south of Frederick Sound in Southeastern Alaska.

The distribution of the species on the larger islands of Southeastern Alaska is particularly interesting. The islands of this area were almost completely inundated by ice during the late Pleistocene period and reinvasion by mammals apparently occurred either from the Bering Sea - Interior Alaska refugium to the north on from the refugium south of the continental ice sheet (Klein, 1963). The brown bear appears to have arrived from the north. Why it has failed to establish on the larger islands south of Frederick Sound is an interesting question. Access to at least Kupreanof Island from the mainland seems possible, though several narrow expanses of open water may constitute a barrier. Low population densities on the adjacent mainland may limit the chances of this occurring also. Brown bear-black bear strife seems an unlikely reason for the failure of brown bears to spread to these islands since overlap of their ranges occurs in a number of other areas in the State. Furthermore, physical strife may be discounted since most certainly brown bears would be victorious in most such encounters.

While the exact habitat requirements of the brown-grizzly bear are unknown, the species is seemingly most at home in open tundra and grassland areas. Even where the species occurs in forested areas, as in Southeastern Alaska, it is important that substantial mountain meadows or other grassland areas be present. Perhaps the best indication of the species' habitat requirements is shown by the fact that denser populations occur in lush grassland types such as occur on Kodiak Island and on the Alaska Peninsula. Grassland types appear especially critical for bears during the spring period since bear foods are scarce at that time.

ABUNDANCE

While there are no precise data on the abundance of brown-grizzly bears in the State, there is general understanding of the species' status.

It is probable that the species is today as abundant in the State as during earlier times except where displaced by man. Definite reductions in bear numbers have resulted in areas surrounding population centers. Marked reductions have also occurred on the Kenai Peninsula, and on the Chiniak portion of Kodiak Island where conflict has arisen between livestock interests and brown bears.

It may be considered axiomatic that brown-grizzly bear numbers will be markedly reduced wherever substantial and sustained human endeavor occurs unless accorded specific protection. Even with protection a certain degree of conflict and consequent attrition of bears can be expected. The whole history of the species on this continent since the advent of the explorers has followed this pattern until today the species has been virtually extirpated from its former range in the contiguous United States and Central America and markedly reduced over much of Canada and in small portions of Alaska. The pattern has been the same for the brown bear in Europe. Alaska is, in fact, the last great stronghold for this noble beast.

It is interesting to speculate why the brown-grizzly bear has failed to adapt before man's onslaughts as the black bear has. Explanation probably rests with the fact that the brown-grizzly bear is for the most part an animal of tundra, grassland and other open habitat types as contrasted to open forest types preferred by the black bear. Consequently, the brown-grizzly is the more vulnerable of the two species. The brown-grizzly also appears less wary and more predatory, a factor resulting in his undoing in livestock country.

Despite numerous attempts to determine the abundance of brown-grizzly bears in various portions of the state, little success has been realized. In Southeastern Alaska, Dufresne and Williams (1932) and Klein (1958 and 1959) attempted to measure brown bear populations on Admiralty, Baranof and Chichagof Islands by track counts and measurements. At best, this procedure was judged to provide only general knowledge of abundance. Not only were conditions for counting and measuring tracks unsuited for many of the areas worked, but the presence or absence of bears was affected by the varying abundance of salmon and other foods. The procedure was judged unsuitable, also, because of the tremendous expenditures of time required to conduct surveys as well as by the fact that substantial numbers of bears remained away from stream areas for lengthy periods.

Attempts have also been made by the U. S. Forest Service to census Southeastern Alaska brown bear populations by aerial beach counts in the spring. In 1963, after conducting the surveys for a number of years, the procedure was deemed ineffectual and unreliable even for trend indices and was discontinued. Particular difficulties associated with aerial beach counts were the limited areas permitting direct counts and the tendency for bears to run to forest cover on hearing the approach of survey aircraft.

Recently, attempts have been made by the Alaska Department of Fish and Game to estimate bear numbers on Admiralty Island by aerial counts of spring bear trails in the snow of alpine areas. The procedure is still being tested for feasibility but it does appear better suited as a trend index than either of the previously mentioned methods.

An attempt has also been made by Dean (1958) to assess grizzly bears in Mt. McKinley by observations on foot and by aerial surveys. Working with a sparse population, he believed that it was possible over a period of days to gain almost an absolute ground census in a study area of open tundra. The effort involved renders it impractical for application to extensive areas, however. More importantly, less that 25% of these known populations were detected when censused from the air.

A considerable effort has been made by Troyer (1962 and 1963) to aerially census brown bears on Kodiak Island and by Erickson and others to census brown bears of the Alaska Peninsula. While these surveys were thought at first to reveal meaningful data, a detailed analysis of the survey techniques employed revealed marked inconsistencies and errors in the method (Erickson and Siniff, 1963). Among other things, the tests revealed that survey crews saw less than a third of the known bears in survey tracts. Replicate surveys revealed, too, that bear numbers observed varied markedly in survey areas not only between days, but even within hours. Highest bear densities were generally seen in morning surveys and least during mid-day surveys. However, evening surveys proved less variable than either of the other time periods. Survey results were found to be adversely affected by high winds as well.

A particularly interesting finding was that although observers did not differ significantly in their abilities to make total counts they did differ in their classifications of bears. This finding suggests that where judgement considerations are concerned in population assessment and classification, great caution must be exercised if one is to avoid accepting invalid data.

The above factors, compounded by the fact that the presence of bears along streams is related to fish and other food abundances, led these workers to conclude that attempts to obtain meaningful numbers or composition counts of bears along salmon streams by aerial surveys was impractical.

Siniff and Erickson (1964) also tested the stratified aerial sampling technique for censusing and making composition counts of bears but judged the procedure as being unworkable for censusing

brown bears. Unlike caribou, on which the technique was developed (Siniff and Skoog, 1964), brown bears sought shelter when alarmed by survey aircraft. Consequently, except in relatively open country, the technique was unworkable for censusing bears. Furthermore, the generally sparse density of bear populations requires exceedingly high census coverage to obtain statistically reliable results.

POPULATION DYNAMICS

Information on the population dynamics of the brown-grizzly bear are but imperfectly known. Although authorities disagree on the minumum breeding age in the wilds, records of captives indicate that both sexes attain puberty at approximately 3-1/2 years. Among 200 breeding records for captives, Dittrich and Kronberger (1963) determined this to be the usual breeding age although two brown bears gave birth to cubs on approximately their second birthday. Breeding takes place from approximately late May through mid-July.

Records of coitus are few, though hunters and guides frequently report them for May. This had lead to the general presumption that this is the time of peak breeding rather than during late June and early July when the true peak apparently occurs as judged from my examination of female reproductive tracts. A pair of grizzly bears were also observed by Neil J. Reed, Park Naturalist, to copulate on June 16, 1957 in Mt. McKinley Park. The type of estrus cycle is unknown but presumably the female exhibits a period of continuous heat (seasonally constant estrus) and remains in heat until bred. Copulations occur over a period of days, interrupted by days of non-breeding (Dittrich and Kronberger, 1963).

Gestation lasts approximately seven months, but is highly variable and has been recorded as varying between 194 to 278 days. There is, however, almost no active embryonic growth during the first half of pregnancy and before the time of winter denning. Presumably this is due to a delay in the implanting of the embryo since the corpus luteum is formed shortly after breeding. Implantation usually occurs in late October or in November. Following virginal conception, breeding apparently occurs during alternate years unless the cubs are lost or separated from the mother prior to the subsequent breeding season. Confirmation of these points awaits further study, however. Assuming an alternate year breeding cycle, it may be postulated that in the female with young the suckling stimulus inhibits ovulation during the following breeding season (Cowan and Guiguet, 1956).

The birth and early life of a bear is one of nature's most remarkable phenomena. The young most generally are born during late January or February while the mother is in a winter den. At birth, they weigh only 8 to 10 ounces, the eyes are closed and they have only scant hair. There are two cubs in a normal litter, but three is common and four not unusual. Productivity studies indicate a mean ovulation incidence of 2.4 eggs per breeding. Summer cub and yearling litters average slightly in excess of two each. These data suggest a high survival rate for cubs from conception to family breakup.

Authorities disagree as to when weaning and family breakup occurs in the brown-grizzly. Some contend that cubs suckle for over a year (Dean, 1958) but my examination of the mammary glands of several females with accompanying yearlings has failed to demonstrate lactation. Family breakup apparently occurs in the fall when litters are approximately 17 to 19 months of age. At this time young are about the same size as the mother.

Maximum length of life (longevity) in the wilds is unknown, though captives have attained 30 years. It is unlikely that many wild specimens attain this advanced age since they are subjected to normal mortality and are forced to fend for themselves.

Mortality factors affecting brown-grizzly bear populations are for the most part unidentified. In accessible and inhabited areas, hunting and other human activities are doubtless the most significant mortality sources. Unexploited populations appear naturally limited by other, as yet unidentified, factors. Hibernant loss appears a likely possibility since reports of other natural mortalities are exceedingly rare.

Direct death at the hands of enemies other than man is apparently rare and inconsequential. There are reports of grizzly bears and cubs being killed by wolves and similar reports of cubs being killed by other bears (Troyer and Hensel, 1958). A few bears are victims also of encounters with porcupines. There is no evidence that diseases or parasites are significant mortality causes. Presumably the grizzly bear, like the black bear, is highly resistant to disease in general and when afflicted the debilitating effects of the disease are seldom serious.

Of human-induced mortality, sport hunting is without doubt the most significant at this time. There is, however, high nuisance mortality among grizzly bears near habitated areas. Often mortality is induced by creating situations attractive to bears such as garbage dumps.

FOOD, PREDATORY HABITS AND CANNIBALISM

The omnivorous grizzly bear's diet includes a wide range of animal and plant foods and is highly variable between areas and at different seasons. In the spring, grass and other early-appearing herbaceous plants make up the bulk of the diet. During summer and fall these foods are supplemented by a variety of fruit and berry-producing plants and shrubs. When feeding on these, leaves, plant stems and berries are consumed alike. In Alaska, blueberries and crowberries (Empetrum sp.) are consumed in large quantities. Apparently the bear is an imperfect omnivor, however, since plant foods, even fleshy fruits often pass through the digestive tract unaltered from external appearances.

As a rule, animal matter constitutes a minor portion of the grizzly bear's diet except in coastal areas where abundant salmon comprise a major segment of the diet in season. This food item is apparently less attractive to bears than berry crops, however, since they frequently quit eating salmon when berries ripen (Clark, 1957). Other animal foods include small rodents, insect larvae and occasionally larger prey or carrion.

The brown-grizzly is not considered a serious predator on salmon or other game animals. The very young of big game and occasional adults are killed but these instances appear of little relative importance to the prey species involved or to the welfare of the grizzly bear. It is not unusual, however, for grizzlies to attack and kill livestock and in a large measure this tendency has resulted in his undoing. Though only a few animals apparently develop such traits the species as a whole has been held accountable. This problem has persisted for over 30 years in Alaska on the Chiniak Cape portion of Kodiak Island where about a dozen cattle and sheep ranches have been established. The ranches, situated on what was at one time prime bear range, are bounded by the Kodiak Bear Refuge. Consequently, a natural spill-over of bears onto the ranches regularily occurs and certain of these animals attack livestock. In turn, the ranchers consider all bears on or near the ranges potential threats and kill them wantonly. Exaggerated losses of livestock are frequently claimed, including stock which has died from other causes, the more so if the stock have been fed on by bears (Sarber, 1939).

Sport interests naturally decry the wanton killing of bears by ranchers, contending that the bears are not only of sport interest but a significant economic asset to the state as well; particularly on Kodiak Island, long a favored area for hunting the big bears. Unfortunately, the parties concerned and management and regulatory authorities have made little attempt to date to deal with this conflict in an honorable, and forthright and equitable manner. Rather, this problem, as most politically loaded ones, has for the most part been dealt with according to the dictates of political expediency.

BEAR ATTACKS

Perhaps a discussion of brown-grizzly bear predatory habits would be incomplete without some reference to attacks on man. Attacks may be classed as being either with or without provocation. Provoked attacks arise largely from animals wounded or harassed by hunters. Attacks by sows protecting young should also be considered provoked, as well as those arising from situations where the animal reacts protectively. Instances of this might be a person stumbling across a sleeping bear in heavy cover or a bear protecting an animal carcass that it has killed or claimed.

Attacks without provocation are exceedingly rare. A likely average in Alaska is less than one per year, whereas there are about two provoked attacks per year.

For the most part, precautionary measures can practically eliminate the chances of persons getting into difficulties with bears. For example, when in bear country, campers should dispose of all garbage by burning or removal from the camp and trail areas. They may also discourage bears from entering camp areas by prominently displaying bright objects or placing a dish towel where it will flap in the wind. A further desirable procedure is to leave considerable human scent about. A short walk in the area surrounding the camp is especially advised before retiring or leaving the camp area for a prolonged period. Camps should also be placed away from active game trails. Above all, bears should not be encouraged by feeding them since they make no distinction between food offered them and a food cache. It also breaks down their natural fear of man.

Persons travelling in bear country may similarly avoid difficulties by practicing a few precautions. Most difficulties arise when bears are encountered suddenly at close quarters and the animals react instinctively to what they may assume to be an enemy or a prey species. Consequently, unless silence is in order, it is advisable when passing through dense cover, to sing, whistle, talk or otherwise make noise which will alert bears of one's presence. A few pebbles carried in a can attached to the belt or in the pocket will serve the same purpose. This is particularly so if one is travelling upwind. It is also advisable, to wear a bright light-reflecting garment or hat.

Particular mention should be made of the fact that the brown-grizzly bear is frequently very protective of any large animal carcass on which it is feeding or has fed. Such a bear and even the animal carcass should be strictly avoided unless the bear is being hunted. It is also advisable when returning to a moose, elk or other big game animal which one has killed, to be very alert that a bear has not in the meantime taken over possession of the carcass.

Since bear attacks are experienced by so few persons it is difficult to recommend procedures for dealing with a bear in a situation when one is without an effective firearm. However, there is solace in the observation that few bears pursue an attack until the death of the victim and still fewer victims are consumed. Frequently the attack is broken off suddenly, perhaps when the bear realizes that his adversary is a human. Other attacks are terminated when victims lose consciousness. Victims have frequently reported also that bears again attacked them when they so much as moved or moaned. These observations suggest several procedures that one might follow if confronted or attacked by a bear.

Initially an aggressive attitude is suggested, particularly loud shouting, arm waving and so forth. These techniques have been found effective even in driving sows from their cubs (Troyer and Durley, 1962, and Erickson, 1963).

An attacking bear may also be turned if struck forcefully on the nose with a club or similar weapon. Beyond that one has little defense against a bear, particularly a large specimen. Consequently, one can only hope to protect his person as best possible.

Although documentations are few, fatalities from bear attacks have been usually due to crushing bites at the base of the skull and/or disembowelment. Consequently the head should be protected, as well as the abdomen. A likely defense would be to fall to the ground and curl into as tight a ball as possible with the face between one's drawn-up legs and the arms locked across the back of the head and base of the neck. In this position the top of the head is partially exposed but this is not especially vulnerable since even a very large bear can open his mouth only about five inches. Consequently, bites inflicted to the top of the head tend to slide off. This is particularly so in the case of older bears since the canine teeth are normally broken and blunted. Furthermore, any movement of the head would prevent a secure bite.

Above all, attack victims should if possible, resist any early urge to move or cry out once a bear relinquishes an attack.

PARASITES, DISEASES AND PATHOLOGICAL CONDITIONS

Although about 20 species of parasites are known to infect the grizzly bear, infestation rates are generally low and of little consequence to the health of the animals. Ectoparasites are particularly rare but include ticks, lice and fleas. Endoparasites are common and include trichinae, round worms, tapeworms, hookworms and filariid worms. Horstman (1949) reports that of the parasites infesting bears, four are of public health importance: Trichinae, the broad tapeworm, the hydatid worm and the wood tick.

To this list he adds the common stomach worm, the salmon poisoning fluke and the dog hookworm as being of importance to domestic animals.

Of the parasites infecting bears, trichinae give cause for greatest public concern. Fortunately, it is quite general knowledge that bear flesh should be well cooked before being eaten as protection against trichinae and too, grizzly flesh is less frequently eaten than black or polar bear flesh.

Several incidents of persons contracting trichinoses from brown-grizzly flesh have none the less been recorded in Alaska (Maynard and Pauls, 1962). There is no evidence however, that this disease seriously effects the bears themselves, despite its apparently high incidence. For example, among 20 brown-grizzly bears tested by Rausch et. al. (1960) from the Arctic coast and the Alaska Peninsula, 10 harbored the disease.

Except for dental and skeletal disorders, the diseases reported for grizzly bears are remarkably few. Skeletal disorders appear due for the most part to injuries, often human induced. Others appear due to fighting. A number of large males sustain a break across the lower mandible just posterior to the canine teeth. This fracture frequently heals with the broken portion of the mandible fusing in such a manner that the lower canine teeth project anteriorly. It is apparent, however, from the goodly number of mended fractures and healed scars observed that the brwon bear possesses a remarkable ability to withstand infections and to recover from fractures.

Dental diseases in the grizzly bear are common and are regularly observed in older animals. Canine teeth are frequently broken and many teeth are stained and appear decayed. A detailed study of this condition led Colyer (1936) to conclude, however, that dental caries do not occur in bears. Rausch (1961) does not rule out the possibility of caries, however, and Hall(1940) reported caries among 8 of 360 bear skulls which he examined. Periodontal disease is also frequently encountered in grizzly bears and as in black bears it appears to be more prevalent among older specimens.

BEHAVIOR

Recent live-trapping and marking studies have revealed a number of interesting facets of brown-grizzly bear behavior (Troyer and Hensel, 1962; Troyer and Durley, 1962; Hornecker, 1962; and Erickson, 1963). Recoveries of tagged specimens have shown among other things that the movements of bears are confined to quite limited areas and movements in excess of 30 miles are unusual. A few bears have demonstrated remarkable homing behavior, however.

These studies have shown, too, that sows with cubs are far less protective of cubs than popularly believed. A large number of sows deserted trapped young and only a small portion of sows actually attempted to protect captured cubs from trapping crews.

There is no evidence that grizzly bears attempt to protect a territory as their own. Aggregations of bears commonly occur at favored foraging sites such as can be frequently seen along certain portions of salmon streams. A classical case in point is at the falls on McNeil River on the Alaska Peninsula. Here concentrations of bears regularly occur and 30 or more bears can often be seen at one time. This site is particularly attractive to bears since the falls constitute a partial block to salmon migrations. Consequently fish congregate below the falls and are especially vulnerable to bears. The attractiveness of the falls to the bears is in inverse relation to the size of the salmon runs into the streams of Kamishak Bay. During years of high salmon escapements into these waters, as during 1962 and 1963, relatively few bears congregated at the falls since fish were sufficiently available at many other stream points. Conversely during years of low abundance larger aggregations occur. The composition of the bears at the falls appears markedly different during the two extremes. During times of high bear concentrations all population segments appear at the falls. However, during peak fish years the assemblage at the falls is different. At this time, large males and single females appear to make up the bulk of the animals. As an example, marking operations during 1963 at McNeil resulted in the capture of 10 females without cubs and 5 adult males despite attempts to capture bears as opportunity permitted. Only approximately 30 bears used the falls during 1963 and only two cub groups were observed, both cubs of the year. The complete absence of small and medium males and yearling family groups was striking.

In contrast to the low bear years of 1962 and 1963, population composition during high bear years appears to be represented by all population segments. Explanation for this condition is subject to question but it seems likely that natural segregation occurs. Presumably younger and smaller males avoid larger males, and females with young cubs of the year avoid other bears. A similar condition has been reported for black bears using garbage dumps (Erickson, 1964). This appears odd, however, since little active aggression is manifested between bears except some slight annoyance at close range.

That there is a peck order of types at the falls is evident. Whenever large males are feeding they are give a fairly wide berth by other bears and often the falls are deserted by other elements when they feed. It is interesting, however, that among large males (assumed on the basis of size) a truce seems extant, although there is some slight feigning and growling. Whenever passing one another a cautious stiff-gaited attitude is assumed and a smaller bear will almost always give way to a larger animal, even relinquishing a favored fishing site.

Next in order of dominance to large boars are sows with cubs. Whenever they feed they attempt to chase away all other bears from their immediate area, even large boars. All but the latter quickly flee before such a female's onslaught. Large males stand their ground, however, and simply turn their shoulders toward the

attacker. The female invariably pauses upon reaching the boar, and with open mouth pressed closely to his head and neck snarls threateningly. The male remains immobile throughout this harassment and shortly the female breaks off and returns to her cubs. Having asserted himself the male often drifts off. He may continue fishing, however, in which case the female moves on to another location.

Among the remaining population elements a wide tolerance appears to exist but sows with yearlings occasionally show slight intolerance.

The various population elements also show different feeding patterns. Large males feed predominantly during the night and at dusk and dawn. Other population elements appear to feed intermittently throughout the day. A notable difference in their feeding behavior is that sows with cubs of the year fish intensively for short periods, often retiring to cover to feed on each fish as it is caught. Usually the cubs closely accompany the sow and she appears very alert, even nervous, and seldom loiters. Sows with yearlings and smaller single bears appear more or less active at the falls at all times in areas where large males or sows with cubs are not feeding. These population elements intermingle freely and spend considerable periods of time fishing and lolling in the water, seemingly for fun.

The different activity patterns of bears along salmon streams explains in part difficulties associated with attempts to determine population composition of bears by aerial surveys.

The winter denning period of the grizzly bear is variable as to time and duration according to location and the physical condition of bears. In interior Alaska and northern Canada the animals spend almost half of their total lives in winter dens. Here denning generally begins in late October and extends through April or later.

Much mis-information persists concerning the so-called hibernation of bears. Doubtless it is a unique scheme, shared with many other animal forms, which permits them to survive during critical periods and without which they would be unable to occupy much of their present range. Most, if not all, hibernators or semi-hibernators, den not as a response to cold or wintry conditions alone, but because of the shortage of food that is concomitant with these conditions (Lyman and Chatfield, 1955). For example, captive black bears (except pregnant females) most generally remain active as long as they are fed but will promptly den when feeding is discontinued (Erickson and Youatt, 1961).

Denning is not always an uninterrupted sleep. Warm weather,

particularly when flooding of dens results, often results in bears leaving their dens for a period, and even in the depth of winter reports of bears moving about are not uncommon.

There appears to be little basis for the belief that bears den early or late depending on the general abundance of food in summer and early fall. It is reasonable to assume, however, that the condition in which bears enter hibernation may influence the length of the denning period and that physical condition and the length of the denning period could well be an important factor to over-winter survival.

Sites chosen by grizzly bears for dens appear most generally to be on hillsides. Often dens are located high on mountain slopes. Dens observed by the author on the Alaska Peninsula were usually located in alder clumps and were often lined with grass and leaves. Females and young apparently den earlier in the fall and emerge later in the spring than large males. This is indicated from the fact that bears killed in early spring and late fall are almost exclusively large males.

A particularly interesting feature of brown bear behavior is the fact that sows will adopt the cubs of another. An interesting observation of this was reported by Erickson and Miller (1963). In this instance the litters of two sows became mixed and one retained both litters. Mixed-age litters of yearlings and cubs of the year have also been reported (Erickson, 1964). Such observations are unusual but they do suggest wide intraspecific tolerance.

HARVEST DATA

Prior to 1961 there are no relevant harvest data for brown-grizzly bears in Alaska except for Kodiak Island where the average annual kill has been about 175 bears. (Troyer, 1961).

Since this time precise harvest data are available. This was made possible by a regulation requiring that the hides of all brown-grizzly bears be presented to the Department of Fish and Game within 30 days of take for the purposes of sealing. This procedure has made possible not only assessment of harvests, but has provided valuable additional information as to the sex and size composition of the kill; where, when, how and by whom kills were made; hunter success and other pertinent information.

During the years 1961-1963, brown-grizzly bear hunting regulations, although differing between geographical units of the state, differed only slightly between years. Hunting was split between a fall and spring season, except for most of Southcentral Alaska where hunting was limited to the fall season. During both seasons, cubs and yearlings, and sows with accompanying young were protected.

SIZE OF THE KILL

The sport kill of brown-grizzly bears in Alaska for calendar years 1961, 1962 and 1963 numbered 216, 265 and 221 bears, respectively, for the spring season and 257, 282 and 346 bears, respectively, for the fall season (Table 4). During each of these years, the take increased, particularly for the fall season. The increased take was apparently due to greater hunting pressures since non-resident tag sales have increased while hunter success has remained essentially constant (see Table 5).

On an area basis, composite data for the 1961-1963 period indicates that the brown-grizzly kill was divided 28% for the Alaska Peninsula, 23% for Kodiak-Afognak Islands, 17% for South-central Alaska, and 17% and 15%, respectively, for interior and Southeastern Alaska. It is to be noted, however, that the geographical distribution of the composite 1961-1963 kill was markedly different for the fall and spring seasons. Spring kills were confined largely to Kodiak-Afognak Island (37%), the Alaska Peninsula (35%) and to Admiralty, Baronof and Chichagof Islands in Southeastern Alaska (18%). Kills for the fall seasons were more uniformly distributed (Table 4). This difference is attributed to a large proportion of the fall kill, being made incidental to other hunting, particularly sheep hunting.

THE CHRONOLOGY OF THE KILL

As reported on sealing documents, typical kill chronologies for the spring and fall seasons developed approximately as shown in Figure 1. Composite data for the years 1961-63 indicate that most of the spring kills (80%) occurred in May and approximately 10% in both April and June. The earliest kills for these years were March 18, 1961, and April 18 & 10, 1962 and 1963, respectively.

The patterns of kill for the fall season were heaviest at the beginning of the season and progressively decreased thereafter (Figure 1). Twenty-five per cent of the bears were taken in the season's opening week and 39% of the kills occurred during the first two weeks of hunting. The latest fall kills for the 1961-63 period occurred on December 15, December 31, and December 30, respectively.

TABLE 4. 1961-63 Brown-Grizzly Bear Harvest Data in Alaska. 1/

District	Area	Mgt. Unit	Spring Season 61	62	63	1961-63 No.	Area%	Fall Season 61	62	63	1961-63 No.	Area%	Both Seasons 61	62	63	1961-63 No.	Area%
Southeast		1	6	7	4			7	5	5			13	12	9		
		2	-	-	-			1	-	-			1	-	-		
		3	-	-	-			-	-	-			-	-	-		
		4	28	32	18			9	14	13			37	46	31		
		5	4	1	4			5	6	2			9	7	6		
		6	6	9	11	-	-	7	15	21	-	-	13	24	32	-	-
	Subtotal		44	49	37	130	18	29	40	41	110	13	73	89	78	240	15
Southcentral		7	-	-	-			1	1	1			1	1	1		
		11	-	-	-			5	14	9			5	14	9		
		13	-	-	-			42	33	41			42	33	41		
		14	-	-	-			16	9	13			16	9	13		
		15	-	-	-			4	5	4			4	5	4		
		16	8	3	3	-	-	20	15	23	-	-	28	18	26	-	-
	Subtotal		8	3	3	14	2	88	77	91	256	29	96	80	94	270	17
Kodiak-Afognak		8	82	98	79	259	37	36	33	31	100	11	118	131	110	359	23
Alaska Peninsula		9	69	97	75			51	61	88			120	158	163		
		10	1	3	-	-	-	-	-	-			1	3	-		
	Subtotal		70	100	75	245	35	51	61	88	200	23	121	161	163	445	28
Interior & Arctic		12	3	3	5			11	16	18			14	19	23		
		17	-	-	-			2	3	3			2	3	3		
		18	-	-	-			-	-	-			-	-	-		
		19	-	-	-			13	11	11			13	11	11		
		20	7	5	8			9	21	34			16	26	42		
		21	-	1	-			4	6	3			4	7	3		
		22	-	1	-			1	-	-			1	1	-		
		23	-	2	5			6	4	6			6	6	11		
		24	-	3	3			3	3	6			3	6	9		
		25	1	-	1			3	4	6			4	4	7		
		26	1	-	4	-	-	-	2	6			1	2	10		
	Subtotal		12	15	26	53	8	52	70	93	215	24	64	85	119	268	17
Unidentified Areas[2]					1	-	-	1	1	2			1	1	3		
Grand Total			216	265	221	701	100	257	282	346	881	100	473	547	567	1582	100

1/ Based on bears presented for compulsory sealing. 2. Not included in combined year totals.

HUNTER RESIDENCE

As shown in Table 5, 53% of the bears killed during 1961, 1962, and 1963 were taken by non-resident hunters. Only 49% of spring kills were taken by non-residents, as compared to 57% of fall kills. Hunter success for non-residents was 59, 64, and 61 per cent as judged by comparison of bears sealed to tag sales (Table 5). Collectively, non-resident success was 70% during the spring season and 58% during the fall season. Resident hunter success could not be calculated since species tags are not required for resident hunters.

As seen by reference to Table 6, the residency of hunters killing bears varied considerably between the various areas of the state. Kodiak-Afognak and Southcentral kills were split about equally between resident and non-resident hunters. On the other hand, about two-thirds of the kills in Southeastern Alaska and interior-arctic Alaska were made by residents. The area of greatest harvest by non-resident hunters was the Alaska Peninsula where they took almost 70% of the total.

As a point of interest, the non-resident kill of brown-grizzly bears for the 1961-63 period was divided among the hunters of 48 states and 18 foreign countries.

SEX COMPOSITION OF THE KILL

Sex ratio reports of bears killed during the 1961-63 seasons are shown in Table 7. The reports are listed as verified and unverified. Verified reports are those where the sexes of bears were confirmed, by hide examination, by the author or an immediate assistant. These examinations revealed that hunters and guides reported a number of female bears as males. No discrepancies of the opposite nature were noted.

Assuming that verified reports accurately reflect actual sex ratios resulting in the harvests, adjustment of sex ratios for the two seasons indicated that males made up 53, 64, and 59% of the total kills, for 1961, 1962, and 1963, respectively.

Despite the disparity noted for sex ratio reports, there appears to be little doubt that males predominated among spring bear kills. In contrast, fall kills appeared to favor females, but less strongly than was the case for males in the spring. As a consequence, males predominated in the total take.

It is interesting to speculate as to reasons for the reversing of sex ratios between the spring and fall season.

TABLE 5. The 1961-63 Brown-grizzly bear kill by Hunter Residence 1/ 2/ 3/

Spring Season	License sales			Number of Kills			Percent of Kill			Percent Success		
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
Resident Hunters	-	-	-	103	134	119	48	51	55	-	-	-
Non-resident hunters	-	162	155	112	131	97	52	49	45	-	81	63
Fall Season												
Resident hunters	-	-	-	112	126	143	44	45	42	-	-	-
Non-resident hunters	-	285	319	145	155	194	56	55	58	-	54	61
Both Seasons												
Resident Hunters	37,524	34,609	36,415	215	260	262	46	47	47	-	-	-
Non-resident hunters	437	447	474	257	286	291	54	53	53	59	64	61

1/ Brown-grizzly bears presented for compulsory sealing.
2/ Excludes 16 kills unidentified to residency as follows: 1961, 1; 1962, 1; and 1963, 14.
3/ Non-resident success determined from brown-grizzly bear tag sales. Non-resident license sales as follows: 1961, 3,940: 1962, 3,946; and 1963, 3,895.

TABLE 6. 1961-63 Brown-Grizzly Bear Harvest by Hunter Residency and Area of Kill.

Area and Residency	Composite 1961-63 Kills					
	Spring Seasons		Fall Seasons		Both Seasons	
	No.	Percent of area Kill	No.	Percent of area kill	No.	Percent of area kill
Southeastern						
Res. Hunters	75	58	62	57	137	58
Non-Res. Hunters	54	42	47	43	101	42
Southcentral						
Res. Hunters	8	57	116	46	124	46
Non-Res. Hunters	6	43	138	54	144	54
Kodiak-Afognak						
Res. Hunters	125	49	20	20	145	41
Non-Res. Hunters	131	51	78	80	209	59
Alaska Peninsula						
Res. Hunters	105	43	57	29	162	37
Non-Res. Hunters	139	57	141	71	280	63
Interior & Arctic Alaska						
Res. Hunters	42	81	122	58	164	62
Non-Res. Hunters	10	19	90	42	100	38

TABLE 7. Verified and Unverified Sex Ratio Reports for Bears Killed by Hunters During the I961-63 Seasons.

	Number of Reports								Per Cent Males							
	Verified				Unverified				Verified				Unverified			
	61	62	63	Total 61-63	61	62	63	Total 61-63	61	62	63	Composite % 61-63	61	62	63	Compos % 61-6
Spring Season	31	94	57	182	183	166	154	503	68	78	68	73	81	76	77	78
Fall Season	115	139	160	414	132	131	152	415	40	50	54	49	61	63	60	61

In part, this was likely due to more selective hunting in the spring, a time when bears could not be taken incidental to other hunting. The regulation which afforded protection to sows accompanied by cubs or yearlings likely affects kill sex ratios also. As a consequence of this regulation, a large segment of the female population was not subjected to hunting during either season. Nevertheless, a larger segment of the female population was presumably subject to hunting in the fall since family break-up is believed to occur about this time.

SIZE COMPOSITION OF THE KILL

The mean composite hide sizes reported for bears killed during the 1961-63 spring and fall seasons were 15.4 and 13.6 feet, respectively. These measurements remained essentially constant between years (Table 8). By classical reference to the size of bears by squared hide sizes, these values amounted to 7.7 and 6.8 feet, respectively, for the spring and fall seasons.

Composite skull sizes of bears taken during the years 1961-1963 (Table 9) showed mean spring and fall season values of 24.6 and 22.3 inches, respectively. Skull data were biased, however, since only the skulls of large bears were generally saved by hunter and voluntarily submitted for examination.

Both skull and hide measurement data show the sizes of spring killed bears to exceed fall kills. In part, this is a reflection of greater selection for trophies during the spring.

Unfortunately, hide and skull data, like sex composition data, are unreliable because of the tendency for guides and hunters to exaggerate the sizes of trophies taken.

As seen in Figure 2, the degree of exaggeration is in inverse proportion to the actual size of the bear. Thus, although the trend of hide and skull size would be an excellent technique for detecting changes in the size, and consequently the age, composition of the population, these data can be considered valuable only if actually verified by sealing officers. If this were to be done, a trend toward smaller skull and hide measurements would signify more intensive harvests. It should be pointed out, however, that some reduction in overall average hide size may, in fact, be desirable. A harvest in which large bears are predominant is an indication of an unexploited population. In such a case, a population might be dominated by a population component, perhaps large males, which by virtue of their demands on the environment, or their physical size or behavior, might serve as a depressant on population numbers.

TABLE 8. The Sizes of Sealed Brown-Grizzly Bear Hides Taken by Hunters During the Years 1961-63, in feet.

Area	Spring Season							Fall Season						
	No. of Hides			Average Size				No. of Hides			Average Size			
	61	62	63	61	62	63	61-63 Ave.	61	62	63	61	62	63	61-63 Ave.
Southeastern	41	45	36	14.8	14.5	14.2	14.5	24	39	41	13.5	14.2	13.6	13.8
Southcentral	8	3	3	12.2	14.5	14.8	13.3	83	75	89	12.7	12.6	12.6	12.6
Kodiak-Afognak	79	31	76	16.0	14.7	15.9	15.7	36	33	31	16.3	15.8	16.4	16.2
Alaska Peninsula	65	93	72	16.7	15.9	16.5	16.3	47	59	88	14.9	15.4	14.1	14.7
Interior-Arctic	11	14	24	12.5	11.8	13.3	12.7	50	66	90	12.4	12.6	12.3	12.4
Grand Total	204	186	211	15.6	15.0	15.5	15.4	240	272	339	13.7	13.8	13.4	13.6

TABLE 9. The Sizes of Sealed Brown-Grizzly Bear Skulls Taken by Hunters During the Years 1961-63, in inches.

	Spring Season							Fall Season						
	No.of skulls			Average Size				No.of skulls			Average Size			
Area	61	62	63	61	62	63	61-63 Ave.	61	62	63	61	62	63	61-63 Ave.
Southeastern	18	11	13	24.2	22.0	23.3	23.3	5	8	10	21.4	24.5	20.3	22.0
Southcentral	2	0	0	21.6	-	-	21.6	6	5	11	21.9	19.5	21.9	21.4
Kodiak-Afognak	40	11	46	23.9	21.9	24.4	23.9	12	18	16	23.7	21.7	23.4	22.8
Alaska Peninsula	33	26	39	26.0	26.6	26.8	26.4	3	11	19	21.3	25.0	24.0	24.1
Interior-Arctic	2	2	12	20.4	23.0	21.8	21.8	7	10	17	19.6	21.4	20.8	20.7
Grand Total	95	50	110	24.6	24.4	24.8	24.6	33	52	73	22.0	22.6	22.3	22.3

MANAGEMENT

Alaska is fortunate in having perhaps the world's most bounteous bear population, including the black bear, polar bear and the brown-grizzly. Doubtless the State's populations of the latter exceed the combined populations elsewhere on the continent by several-fold. More remarkedly, grizzly bear numbers in the state today likely number close to those of primeval times.

This condition cannot be expected to prevail indefinitely. As human populations and endeavors grow both within and without Alaska, grizzly bears will be subjected to ever greater stresses. It is inevitable, therefore, that their numbers will be reduced. It is not likely, however, that the stress will come at the hands of the hunter for he will be the most zealous of all to protect and perpetuate the species. The causes for major stress will emanate instead from human population growth and other resource demands on land. This need not be viewed with alarm, however, if early thought is given to dealing with these problems in an enlightened manner. Even the grizzly bear's most ardent admirer cannot hope that the species will be maintained at present levels everywhere in the state. Admitted reductions are justified and called for in areas of greater economic and human potential. The Kenai Peninsula, the Matanuska Valley, part of the Tanana Valley and areas surrounding towns and cities are already such areas of higher priority. On the other hand, it is to be hoped that a valued judgement will be made as to what areas and places would be best retained in the public interest as grizzly bear habitat. Several such areas have already been established--the National Bear Refuge on Kodiak Island, Izembek Refuge, Katmai Monument and McNeil River on the Alaska Peninsula and Mt. McKinley Park.

It does not seem in the public interest, particularly at this time, to consider the grizzly bear resource as a fragile thing, and, therefore, in need of absolute protection. Rather, as any renewable resource, bear populations should be exploited commensurate with sustained yield principles. In fact, a protective attitude at this time spells particular peril when it is considered that in the very near future more of Alaska's vast resources will be tapped. Thus, land now largely the domain of the brown-grizzly bear and other wildlife will be usurped. It is expedient, therefore, to establish early the wildlife resource value of these lands, for as nice as it is to know that today this is the domain of the mighty grizzly, all will be for naught if it cannot be shown that he and his wildlife companions can carry their weight. Two examples will serve to illustrate. Brown bears of the Alaska Peninsula are presumably at or near pristine abundance and no area of equivalent size harbors the density of brown-grizzly bears extant there.

The habitat is on the whole sub-alpine grassland, interspersed with numerous streams containing abundant salmon. On the northern half of the peninsula, a patchwork of alders occurs in upland areas and the streams are bordered by low willows. Already this vast area of public domain has attracted the attention of stockmen and lease applications have been received by the Bureau of Land Management. Although no spreads have developed as yet, this situation will not continue indefinitely, and in the near future it seems certain that attempts will be made to establish cattle or sheep on the peninsula. Doubtless this endeavor would run headlong into conflict with bears, and, as elsewhere, the bear can be expected to lose. Such a test may never come about, however, if proper appreciation is given the economic value that the brown bear itself has on the area.

Attempts should not be made, however, to husband areas for bear use, to the detriment of other resource use, unless they are truly of high bear potential. This view suggests the need for an early survey and classification of the peninsula as a resource use guide. Above all, such a review should delineate areas deemed of highest potential for bears, and every attempt should be made to preserve these critical areas. Conversely, areas of low bear potential may be specifically indicated as being of greater priority for other resource use. Only in this way is it likely that the bear will get a "fair shake" in the long term.

A further example illustrates still another pitfall. Namely, the a priori assumption that another resource use is incompatible or detrimental to the welfare of brown-grizzly bear populations. In certain instances complete compatability may exist. In other instances, less than complete compatability may result, but most equitable and beneficial result may be obtained by joint use. In still other cases the welfare of the species may be actually enhanced by joint exploitation. A likely case in point is on Admiralty Island and other heavily timbered areas of Southeastern Alaska. The timber resource of these areas is of high economic value to the State, and it is only reasonable that this resource be utilized in a manner most beneficial to the State's interest. Nontheless, a considerable cry of lament is heard from persons fearing for the welfare of the bears in thses areas. One cannot question the sincerity of these persons, but on the other hand, one cannot, reasonably, become enamored to their view when it is condiered how extensive our bear resources are in the State.

More importantly, the bear resource of the Southeastern area is exploited only lightly at best and certainly does not contribute enough at this time to justify withholding other resource use because of possible damage to the bear population. It is

very probable, in fact, that in this instance, logging activity may actually benefit the brown bear population. Timber cuts are being made from over-aged climax sprice, hemlock and cedar stands, forest types notoriously sterile as habitat for brown-grizzly bears. Openings created by cuts would seemingly initiate successional patterns, certain stages of which would create conditions more favorable to bears than the present climax state. The early pioneer stages with abundant grasses and other herbaceous growth would appear especially attractive to bears. These requisite foods are scarcely represented in climax stands. A rotational cut would thus result in mixed-aged forest stands some of which would always be of prime importance to bears. This thesis assumes, of course, that adequate safeguards are taken during logging operations to prevent soil deterioration and to maintain watersheds in a condition suited to salmon, an important summer food for bears in much of this area. It must be borne in mind, however, that some mortality will be induced initially simply because of the presence of loggers in the area. Difficulties with bears attracted to activity centers by camp refuse are a particular concern, and naturally such situations should be minimized by proper preventative measures.

As regards management of the brown-grizzly bear otherwise, particular difficulties are posed. Generally, the species does not lend itself to population enumeration along the lines of ungulate big game populations. Populations are generally sparse and the vast areas over which they occur limit enumeration techniques, for practical purposes, to aerial surveys. Unfortunately, this is not only very expensive but, has proved also to be an unreliable technique. Management must, therefore, depend on other methods. Doubtless the best procedure for some time to come will be by analysis of harvest data. This is particularly so for those portions of the state such as interior Alaska where grizzly populations are so sparce as to practically defy counting of the animals.

The sealing program presently in vogue provides an excellent procedure for obtaining such information. The number of bears taken each year is not so large that administering the program is physically impractical. Furthermore, the heavy localized takes of bears from areas such as Kodiak Island and the Alaska Peninsula can, for the most part, be intercepted at one or two key spots.

Properly administered, this program possesses the potential, not only for close and accurate assessment of the harvest, but also for setting seasons and regulations on the basis of harvest characteristics. Factors such as areas of kill, sex and size composition of bears taken, chronology of kill, hunter success of non residents, and pelt quality all provide valuable management

data. For example trends in the number of bears killed can be assessed in light of the sex and size composition of bears taken to determine whether exploitation rates are compatible with sustaining takes at high levels. Initially, increased exploitation rates can be expected to depress average skull and hide sizes. However, this alone should not dictate a cut-back in take since among long-lived animals such as the bear an unexploited population can be expected to contain a large segment of over-age animals. Such a population segment might, in fact, serve as a population depressant and conceivably a higher population may actually result under a regime of harvest. Furthermore, it is generally undesirable to allow populations to develop to an aged state where non-hunting mortality takes a toll. Consequestly, from a numbers standpoint, the closer harvests are to basic production, the greater the exploitation rate possible. It should be added that this view discounts the argument of those who hold that the bear is strictly a trophy animals and should grow to old age if it is to be considered a worthy trophy. I do not concur with this argument since with increased pressures on our bear stocks meeting the demands for greater numbers of persons is more equitable and of greater importance than providing a few over-prime animals for a lucky few. For this reason, it is recommended that torphy size be discounted in importance.

Chronology of take data are also valuable for management purposes. For example, data collected to date from the sealing program show a preponderance of male bears in the spring take and a preponderance of females in the fall take. Obviously, these data suggest that where reductions in the kill are in order, restrictions should occur in the fall season. The data further show that late fall and early spring kills are predominantly males. Here, too, then any reductions should result on the end of the spring season and the beginning of the fall season. It is apparent also that the bulk of the fall kill is at the beginning of the season. This apparently results from hunters taking many bears incidental to sheep, caribou and other hunting. Obviously, this situation is undesirable if the opportunities of persons actively interested in seeking bears are lessened. Again, if cut-backs in the kill are called for, first considera-ation should be given to the hunters actually interested in hunting for a bear.

Pelt quality is a further consideration in management Information to date shows a heavy degree of rubbing in spring hides as compared to only slight rubbing of fall hides. Obviously, from the standpoint of hide quality fall hides are to be favored. Unfortunately, these data run counter to the recommendations in-decated above on the basis of sex, but they are nonetheless a consideration if over-exploitation is not a concern. However, under present conditions limiting seasons is not in order anyway.

As an adjunct to the present sealing program, a regulation requiring that the skulls, as well as the hides, of bears be presented to the Department of Fish and Game for sealing would be of value. Such a regulation would be particularly valuable in enforcing the regulation protecting cub and yearling bears, since these classes are readily identified by tooth replacement. Benefits to management would include accurate assessment of the size and age structure of bears in the harvest. Age data are possible from studies of tooth sections (Rausch, 1963; and Marks and Erickson, 1964) and skull measurements are not only less variable and consequently more reliable that hide measurements, but are more easily obtained as well.

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