Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Research Progress Report
1 July 1994-30 June 1996

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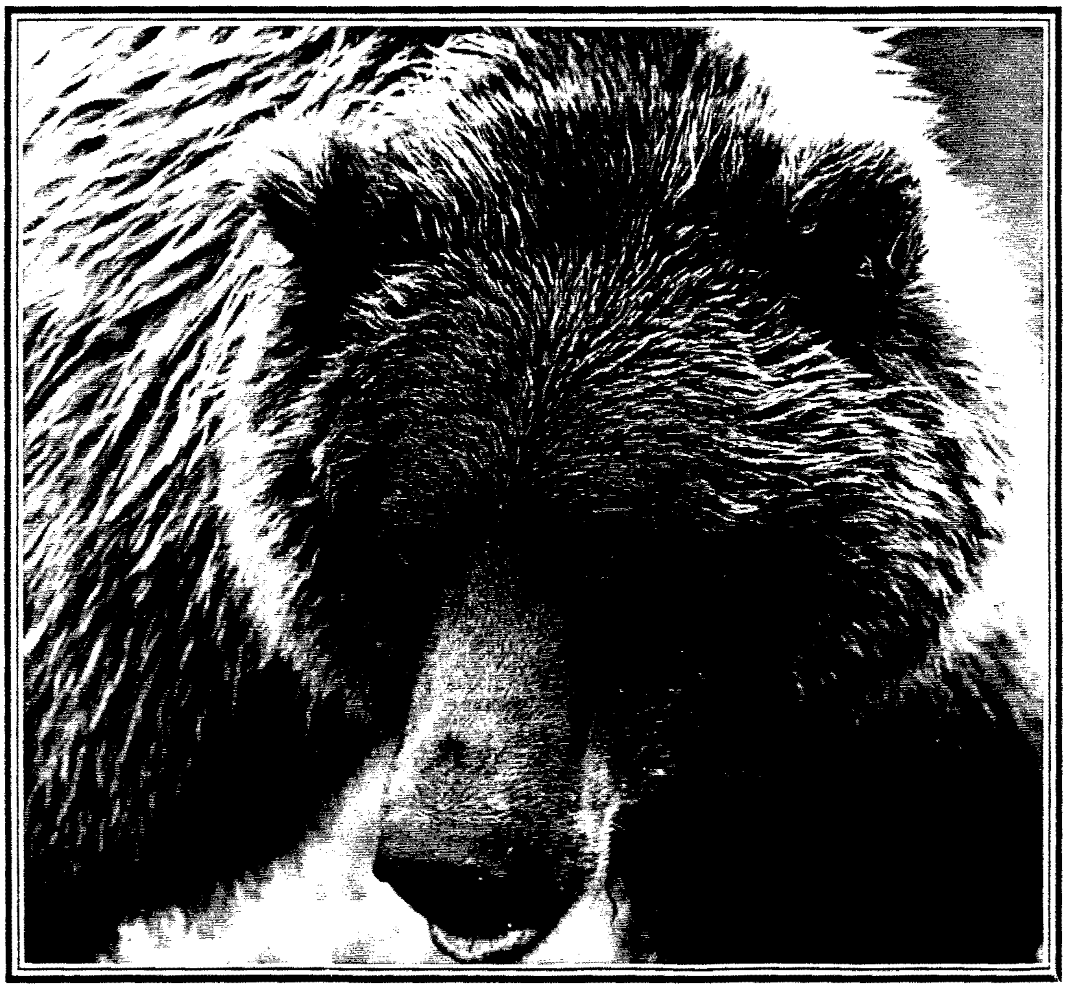
Cumulative Effects Model Verification, Sustained Yield Estimation, and Population Viability Management of the Kenai Peninsula, Alaska Brown Bear



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Study 4.27
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RESEARCH PROGRESS REPORT

STATE: Alaska **STUDY:** 4.27

COOPERATORS: Kenai National Wildlife Refuge, Soldotna; U. S. Department of Agriculture, Forest Service, Chugach National Forest, Anchorage, Alaska; U.S. Department of Agriculture, Forest Service, Chugach National Forest, Seward, Alaska; National Parks Service, Kenai Fjords National Parks, Seward, Alaska; Washington State University, Pullman, Washington.

GRANT: W-24-3 and W-24-4

STUDY TITLE: Cumulative effects model verification, sustained yield estimation, and population viability management of the Kenai Peninsula, Alaska brown bear.

PERIOD: 1 July 1994-30 June 1996

SUMMARY

We initiated a new brown bear (*Ursus arctos*) research project on the Kenai Peninsula Alaska in the spring of 1995. Twenty two bears were successfully captured and 15 were fitted with transmitters. We tested a new prototype Global Positioning System (GPS) transmitter with an uplink via an ARGOS satellite. Results of the test are discussed. One marked bear died from natural causes during the report period. Habitat data were catalogued into a database for future analysis.

Key Words: *Ursus arctos*, movements, home range, GPS/ARGOS transmitter, cumulative-effects modeling, survival.

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BACKGROUND

The Alaska Department of Fish and Game is responsible for management of the brown bear (*Ursus arctos*) on the Kenai Peninsula (KP). We are concerned the viability of this brown bear population may be threatened from increased pressures related to human caused mortality (sport harvest and defense of life or property killing), loss of habitat due to development and logging, and displacement from feeding areas, resulting from increasing recreational pressures (salmon fishing). In light of this, we must determine sustained yield for the population, evaluate a cumulative effects model that will allow predictions relative to habitat effects, and develop a long-term management strategy for brown bears on the KP.

The brown/grizzly bear once ranged from Mexico to the Arctic Ocean and from the Mississippi River to the Pacific Ocean (Rausch 1963). Bear populations south of the Canadian border now exist in only 6 ecosystems, totaling 600-800 individuals. The grizzly bear was listed as threatened under the Endangered Species act in 1975 (USDI Fish and Wildlife Service 1982, LeFranc et al. 1987). The grizzly bear was listed as threatened because it met the following criteria: (1) both present and threatened future destruction and/or modification of habitat; (2) a present loss or potential loss of bears by illegal killing and control actions involving grizzly bears threatening humans or killing livestock; (3) lack of critical data on grizzly bear habitat conditions, carrying capacity, population estimates, annual reproduction, mortality, and population trends; and (4) apparent isolation of some existing populations precluding movements from other areas (Servheen 1981).

In Alaska, brown/grizzly bears range over most of the state and are estimated to number about 31,700 (24,990-39,136) (Miller 1993). In some areas, bear populations and their habitat are declining due to direct human-caused mortality, human encroachment, and habitat alteration.

Little information about brown bear natural history exists, and there is no population estimate for brown bears on the KP. Based on the best professional judgment and extrapolation from other areas with known bear density, ADF&G and USFWS biologists estimate the KP population between 150-250 (Jacobs 1989). This estimate was based on the assumption that only 8,800 km^2 of the 23,310 km^2 area on the KP was regularly used as brown bear habitat. More recently, Del Frate (1994) estimated the population at 277 based on the assumption of 13,848 km^2 of habitat and an average density of 20 bears/1000 km^2.

Annual sustainable harvests (allowable human kill) of brown bears is related to reproductive output of the population and natural mortality rates. Using the best available information for the Kenai Peninsula and elsewhere in Alaska, Jacobs (1989) estimated the sustained yield of bears should not exceed 7% of the population. This assumed a natural mortality rate of 5%. Based on a population estimate of 200-300 bears, the allowable harvest should not exceed 14-21 bears, including crippling loss and defense of life or property kills. In the years 1985-91, the total estimated kill on the KP was 18, 18, 12, 13, 7, 14, and 15, respectively.

In 1992, in spite of a season reduction in 1990, the total annual kill was 27 bears for Units 7 and 15, which comprise the KP. The harvest of brown bears recently exceeded estimates of sustained yield and hunting seasons have been shortened twice. In addition to sport harvest, defense of life or property kills (DLPs) have continued to increase. The season was again shortened in fall 1994 by the Board of Game at their winter meeting in 1993.

The KP brown bear population is probably isolated from the mainland population. The KP is connected to mainland Alaska by a narrow 15 km wide strip of land between Cook Inlet and Prince William Sound. Movement of brown bears through this strip is restricted by human development and physiographic features including 2 communities, 2 airstrips, 13 km of roads, 2 campgrounds, railroad tracks, a 3 km long lake, and several glaciers.. Of approximately 250 gray wolves (*Canis lupus*) marked on the KP over the past 20 years, only 5 have been documented to move off the KP, and marked wolves from elsewhere in Alaska have never been documented to move onto the KP (T. Bailey, pers. commun., KNWR). Brown bears, particularly females, are less inclined to disperse great distances than are gray wolves (Mech 1970, Craighead and Mitchell 1992), indicating that movements of brown bears onto and off of the KP are minimal.

The KP has received some of the most significant human impacts in Alaska (southcentral Alaska ecosystem) to the detriment of its wildlife populations and habitats. Gray wolves and caribou (*Rangifer tarandus*) were extirpated by poison and market hunting by 1915, and salmon populations were depressed by overfishing into the 1950s (Bangs et al. 1982). The human population increased from 24,600 to 43,600 from 1977 to 1987 (Bangs et al. 1982) and is currently estimated at 44,019 (Kenai Peninsula Borough records). Logging, mineral, energy development, and water impoundments all occur on the KP and lead to modifications or destruction of habitat for brown bears.

The Kenai Peninsula is the most popular recreation area in the state of Alaska. Each year an estimated 1,000,000 visitor days occur on the KP for camping, fishing, wilderness hiking, and other outdoor-related activities. In response to this pressure, the Kenai National Wildlife Refuge and the Chugach National Forest are developing, or proposing to develop, campgrounds, hiking trails, and backcountry hostels to accommodate users. Much of this activity is directly associated with the Kenai River watershed and the salmon associated with it.

The Kenai Peninsula is experiencing a widespread infestation of spruce bark beetle. Since the 1950s, over 1.2 million of the 2.2 million acres of forest in the Kenai Peninsula Borough have been infected with bark beetle (Hall 1992). The current estimate of active infestation is 397,771 acres (Hennon et al. 1994). In response to this, the state of Alaska, Division of Forestry, and many private citizens are advocating a rigorous harvest program. For example, there are about 37,600 acres slated for harvest that have been identified as critical brown bear habitat by Jacobs (1989). With this harvest, many roadless areas will be developed. Logging and bark beetles will ultimately change the forest ecosystem on the KP. The effects of these changes relative to brown bears are unknown.

The Interagency Brown Bear Study Team (IBBST) was formed by the USFWS, USDA Forest Service, and ADF&G to foster cooperative collection of information needed to manage KP brown bears. The National Park Service joined the effort in 1990. The goal of the IBBST is to develop management strategies to maintain a viable population of brown bears on the KP in the face of increasing human development and recreation. Research was initiated in 1984 and a draft management plan developed in 1989 (Jacobs 1989). This plan did not include a means to evaluate the effects of human development and habitat modification on brown bears and their habitat. The IBBST took the next logical step and designed a cumulative effects model to assess the effects of management practices on the of habitats to sustain brown bears (Suring et al. 1994).

The cumulative effects model for brown bears on the KP provides an analytical tool to simultaneously evaluate the cumulative effects of human actions on all state, federal, and private lands on brown bear habitat. Habitat capability/cumulative effects models for brown bears have been created for other populations and are being used frequently by land and wildlife management agencies (Christensen and Madel 1982, Christensen 1985, Weaver et al. 1985, Young 1985, Schoen et al. 1994). The brown bear is a management indicator species on both the Chugach National Forest and the Kenai National Wildlife Refuge and represents other animals that require large expanses of relatively undisturbed habitat and quality riparian areas. The direct effects of management activities on the brown bear population on the KP are also a significant management issue.

OBJECTIVES

1. To evaluate a cumulative effects model developed by the Interagency Brown Bear Study Team.

2. To identify critical components of brown bear habitat and movement corridors between these habitats.

3. To estimate the survival rates of radiocollared female brown bears relative to human-caused mortality.

4. Model the brown bear population to establish sustainable yield and assess population viability with the ultimate goal of developing a brown bear management plan.

5. Prepare a final report.

METHODS

Job. 1. To evaluate a cumulative effects model developed by the Interagency Brown Bear Study Team.

Brown bears were fitted with radio transmitters to allow relocation. We used conventional telemetry and tested a new global positioning system (GPS) collar. The cumulative effects model was used to predict seasonal locations of brown bears. These predicted locations were compared with actual locations obtained with the telemetry system. We relied more heavily on the GPS collars for this segment of the study because we collected daily fixes, accurate within 100 m. We used a hand-held GPS to relocate transmitter fixes and to verify location and habitat type. Data were analyzed following recommendations of Manly et al. (1993). If the model deviates from actual results, adjustments will be made based upon the new database. Additional information will then be collected to evaluate changes.

Job. 2. To identify critical components of brown bear habitat and movement corridors between these habitats.

Critical habitat components were identified using radiotelemetry. Although the cumulative effects model identified critical components of habitat, it failed to identify important travel corridors between these components. The locations from GPS transmitters provided these data.

Job. 3. To estimate the survival rate of radiocollared female brown bears relative to human-caused mortality.

To estimate survival rates of female brown bears, we developed a model that divided the year into 2 periods: (1) active period starting 15 April and continuing through 15 November, and (2) the inactive period or denning season encompassing 16 November to 14 April. Data were entered into the model monthly, accounting for newly collared animals and those lost to censoring and death.

Survival and cause-specific mortality was calculated using the Kaplan-Meier procedure (Pollock et al. 1989). Sample size was determined following recommendations presented by Schwartz and Franzmann (1991) for black bears. Their results indicate that a minimum of 19 bears/death must be sampled to be 95% certain the survival estimate is within 10% of the true values. With the survival rates, this should include approximately 25 bears. If mortality is high (i.e., >15%), we will mark additional individuals.

Job. 4. Model the brown bear population to establish sustainable yield and assess population viability with the ultimate goal of developing a brown bear management plan.

Data obtained from Jobs 1, 2, & 3 were used in a deterministic population model (Miller 1988) to evaluate whether the current level of harvest is within the bounds of a sustainable yield of brown bears. In addition, the computer modeling software GAPPS (Harris et al. 1986) was used to evaluate population changes relative to human-caused mortality. GAPPS is a stochastic model which considers random population variation. Such programming should improve our ability to evaluate population viability and determine consequences of harvest . The modeling program was coordinated with Sterling Miller, ADF&G, Anchorage.

The cumulative effects model was used to identify and/or verify critical components of brown bear habitat previously identified in the management plan published by Jacobs (1989). This management plan is being refined and should ultimately represent a working plan used by all land-management - agencies for decision-based resource management.

Job. 5. Prepare a final report.

An annual progress report will be prepared each year with a due date of 31 December. A final report will be prepared at the conclusion of the study on 31 December 1998.

RESULTS AND DISCUSSION

Job. 1. To evaluate a cumulative effects model developed by the Interagency Brown Bear Study Team.

Tagging operations were started on May 19, 1995 and continued through October 1995. During that period, we successfully captured 22 brown bears (Table 1). Of the bears captured, 15 were fitted with conventional VHF radiocollars, 1 glue-on backpack transmitter, and 1 new prototype GPS/ARGOS transmitter. Bears were relocated once every 7-10 days throughout the active season. Locations (n = 207) were recorded into a database for future analysis.

We tested an ARGOS/GPS radiotransmitter on 1 female bear for 1 month in fall. The first prototype failed to transmit data after 4 days and was removed and returned to the manufacturer (Telonics Inc., Mesa AZ). A second prototype was installed on a new bear on 4 October and worked as designed until removed on 1 November. During this period, we successfully obtained 95 of 116 (82%) potential GPS fixes while the collar was attached to the bear. During this same test period an ARGOS uplink successfully transmitted the GPS data daily. After the transmitter was removed, we tested the GPS unit in various habitats to determine the number of successful fixes. In open habitats (grass areas, crushed forest, and mature aspen without leaves), we obtained 100% of expected fixes. Fix success decreased in regrowth spruce (90%), mature open paper birch/white spruce forest (86%), and open birch forest (97%). Accuracy of data locations was not tested.

Job. 2. To identify critical components of brown bear habitat and movement corridors between these habitats.

We catalogued each location point for bears collared with VHF transmitters to specific habitat type, using the Viereck system (Viereck et al. 1992) of habitat classification. In addition, each location was photographed for further classification and confirmation as needed. Vegetation descriptions and codes have been incorporated into a database for future analysis.

Job. 3. To estimate the survival rate of radiocollared female brown bears relative to human-caused mortality.

During this report period, the fall brown bear season was closed by emergency order, so no marked bears were harvested. One bear died by predation (Table 1). The bear was sighted at least once after collaring on 5-19-95 and was located on several locations until 6-22-95. The next location on 7-13-95 on Moose Creek was a mortality signal. When the site was visited later in August, the carcass was found widely scattered and partially consumed by a large carnivore. Canine tooth marks on long bones and the skull were about 60 cm apart, indicating another brown bear ate the bear.

Job. 4. Model the brown bear population to establish sustainable yield and assess population viability with the ultimate goal of developing a brown bear management plan.

No work was performed on this job during this report period.

Job. 5. Prepare a final report.

No work was performed on this job during this report period.

RECOMMENDATIONS

This project is scheduled to run a minimum of 3 years. We recommend continuing data collection for at least 2 more years.

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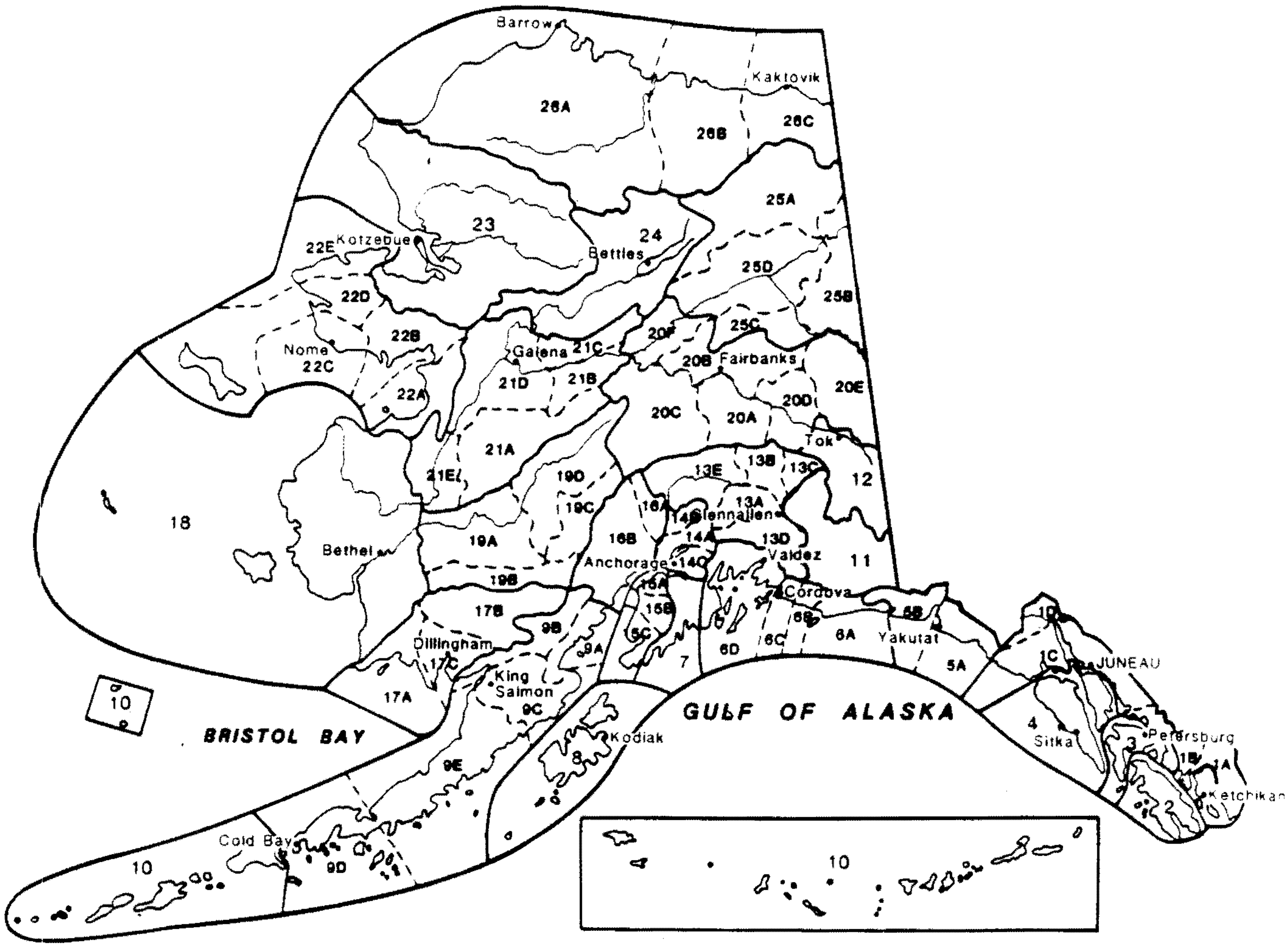
Table 1 Brown bear radiocollaring and tagging status by sex and age, Kenai Peninsula 1995

Bear No.	Radio-Collared	Date	Sex	Age	Tagging Location	Status	Current Status
01	yes	5/19/95	F	3	UPPER MOOSE. CR	alone	dead, predation
02	yes	5/19/95	F	4	TIMBERLINE LK	1 2-yr-olds	active
03	yes	5/19/95	F	3	TIMBERLINE LK	daughter of 02	shed collar
04	yes	5/22/95	F	1	BALD MT. S. SIDE	2 yearlings	active
05	yes	5/30/95	M	13	5 MI S. BIG BAY	alone	shed collar
06	yes	5/30/95	F	3	BEAR CREEK	alone	active
07	no	5/30/95	M	1	UPPER MOOSE CREEK	alone	unknown
08	no	5/30/95	M	1	UPPER MOOSE CREEK	alone	unknown
09	yes	5/31/95	F	7	N. TIMBERLINE LK	2 yearlings	active
11	yes	5/31/95	F	12	W. KILLEY RIVER	alone	active
12	yes	5/31/95	F	16	SKILAK GLACIER	3 cubs	active
13	yes	6/2/95	F	7	HW. COTTONWOOD CR	alone	active
14	yes	6/5/95	F	7	GOAT LAKE	2 yearlings	active
15	yes	6/5/95	F	20	GOAT LAKE	2 2-yr-olds	active
16	yes	6/5/95	F	5	EMMA LAKE	2 yearlings	active
17	yes	6/8/95	M	2	FOREST LANE	alone	unknown
18	yes	6/9/95	F	7	CARIBOU HILLS	2 2-year olds?	shed collar
19	yes	6/20/95	F	5	S. SIDE MT. ADAIR	alone	active
20	no	7/26/98	M	0	PIPELINE		unknown
21	yes	8/14/95	F	8	GLACIER CREEK	2 yearlings	active
22	yes	10/4/95	F	3	GLACIER FLATS	alone	dead

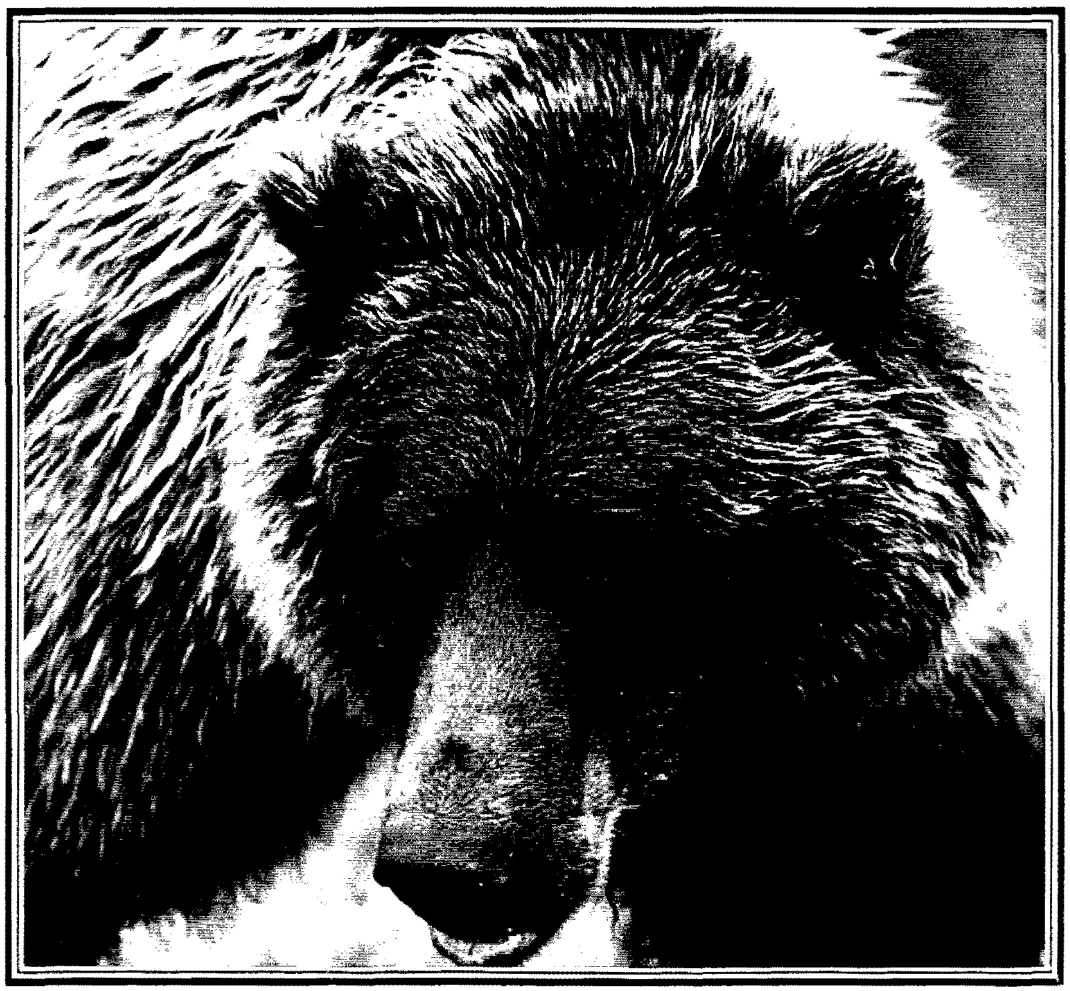
NOTES

NOTES

Alaska's Game Management Units



The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve, and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes for responsible hunting. Seventy-five percent of the funds for this report are from Federal Aid.



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