Brown Bear Problems Related to Expanding Human Activity in the Kodiak Archipelago, Alaska

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The Kodiak Archipelago in southwestern Alaska is reknowned for supporting high brown bear (Ursus arctos middendorfi) densities (Troyer and Hensel 1964) and for producing trophy bears (Nesbitt and Wright 1981). The area has recently gained notoriety for high quality salmon (Oncorynchus spp) and steelhead trout (Salmo gairdneri) sport fishing, and for Sitka black-tailed deer (Odocoileus hemionus sitkensis) hunting. An influx of outdoor recreationists traveling to Kodiak, along with increased pressure from a growing local populace, has resulted in a significant increase in human activity and a corresponding rise in bear/human conflicts. Immediate concerns are increasing conflicts with deer hunters and at rural villages on Kodiak Island. Future development and occupation of private lands in coastal areas is expected to produce chronic bear problems. The agencies with primary responsibility for managing bear populations and habitat, the Alaska Department of Fish and Game (ADF&G) and U.S. Fish and Wildlife Service (USFWS), are faced with the task of improving bear management and habitat protection while operating budgets are decreasing. This report examines current and predicted bear/human conflicts in the Kodiak Archipelago and discusses strategies for maintaining a sound brown bear population.

BACKGROUND

The Kodiak Archipelago consists of 16 major islands located east of the Alaska Peninsula in the Gulf of Alaska (Figure 1). The 2 largest islands, Kodiak (9300 km^2) and Afognak (1800 km^2), comprise 87% of the land area and support most human use (Buck et al. 1975).

Rugged topography, unpredictable weather and dense vegetation characterize the archipelago. Major physiographic features include rugged mountains, rolling hills, broad valleys, and an irregular coastline with prominent headlands, cliffs, and deep, narrow bays. Weather patterns are strongly influenced by the Japanese current and fog, drizzle and high winds occur frequently. Temperatures are mild and annual precipitation exceeds 180 cm. Access to remote areas is by floatplane or boat and only protected bays and inland lakes provide safe anchorage. The poor accessibility tends to concentrate people in localized areas for settlement and other activities.

Vegetation is typified by a moderate to dense shrub cover interspersed with lush, herbaceous meadows. Willows (Salix spp), the dominant shrub in lowland areas, gives way to alder (Alnus crispa sinuata) on drier sites. Large bog and heathland communities occur in southwestern Kodiak island. Extensive Sitka spruce (Picea sitkensis) forest occurs on Afognak and northern Kodiak island. Five species of Pacific salmon are found in the archipelago, with pink salmon (Oncorhynchus gorbuscha) and sockeye salmon (O. nerka) the most abundant. Large mammals include Sitka black-tailed deer, Roosevelt

elk (Cervus elaphus roosevelti), mountain goat (Oreamnos americanus), reindeer (Rangifer tarandus) and brown bear. The brown bear population is estimated to exceed 3000 bears, with the highest densities occurring on Kodiak Island.

Recorded history of the Kodiak Archipelago dates to 1741 when Russian explorers first arrived. The area may have been inhabited by as many as 8,000 native (Koniag) people then. These people and the Russian settlers that later established colonies on the islands, primarily utilized sea resources (Chaffin 1967, Buck et al. 1975). They undoubtedly killed brown bears for food and hides, but little is known about their interactions with bears. During the 1800s bears were commercially hunted for their hides and they were indiscriminately killed as pests by fishermen and ranchers into the mid-1900's. Levels of bear mortality during the late 1800's and early 1900's are unknown but accounts of long-time residents suggest that bear densities were reduced in localized areas. Most bears that became nuisances around settlements were undoubtedly killed at the first opportunity.

Regulation of brown bear hunting began in 1925 with enactment of the Alaska Game Law that prohibited the sale of hides and allowed a 3 bear bag limit with no season restriction. Increasingly conservative hunting regulations have been imposed since that time. Trophy hunting for brown bears on the islands was limited prior to World War II but rapidly increased in popularity during the late 1940's (Troyer 1961). Since 1950 the annual sport harvest has ranged from 92 to 225 bears.

The mean annual sport harvest from 1976 to 1985 was 148 bears (ADF&G files).

In the early 1900's a controversy over bear/livestock conflicts gained momentum and by the late 1930's government hunters were enlisted to reduce livestock losses. That development somewhat paralleled the growing popularity of bear hunting. Hunters and conservation groups became concerned for the welfare of Kodiak's bears and as a result of their efforts, the 7680 km² Kodiak National Wildlife Refuge (Kodiak NWR) was established in 1941 to protect brown bears. Continuing bear/livestock conflicts led to an adjustment of refuge boundaries in 1958 that reduced Kodiak NWR to about 7280 km² (USFWS 1987).

Statehood was granted to Alaska by Congress in 1959 and the responsibility for brown bear management was shifted from the Federal government to ADF&G. The bear/livestock problem continued to be an issue outside the Kodiak NWR. The controversy was aggravated when ADF&G initiated a brown bear control program on cattle ranches in northeastern Kodiak Island (Rearden 1964, Eide 1965). The bear control program was officially discontinued in 1968 by a departmental policy change which left predator bear problems to be handled under the existing "defense of life and property" (DLP) regulation (Appendix I).

The Alaska Native Land Claims Settlement Act (ANSCA) of 1971 and the Alaska National Interest Lands Conservation Act (ANILCA) of 1980

resulted in conveyance of 1250 km² of land to Natives under a village corporate ownership structure. This legislation increased private ownership to about 25% of the land in the Kodiak Archipelago and increased the potential for adverse impacts on brown bears. Development of private land is a particularly serious concern because most of the land is in coastal or riparian areas that are important bear habitats.

Other land developments with potential detrimental effects on brown bears include commercial timber harvest on Afognak Island and a hydroelectric project on northern Kodiak Island. Intensive logging of Sitka spruce began in 1975. An associated road network provides access to much of the eastern half of Afognak Island. The Terror Lake hydroelectric project consists of a dam and 3.2 km² impoundment on the Kodiak NWR and associated facilities adjacent to the refuge. Indirect effects of the project, including improved access, are viewed as important long-term considerations.

The most significant phenomenon in the Kodiak Archipelago in the past decade was the rapid acceleration of human use. The area now supports a population of 13,952 residents, including 12,091 (87%) in the vicinity of Kodiak city, 1,264 (9%) in 6 villages and 597 (4%) in remote locations (Kodiak Island Borough files). The resident population has increased 43% since 1980 and is expected to exceed 21,000 people by the year 2000. Most of the increase has occurred in or near the city of Kodiak. Little actual population growth has occurred in the villages but all have improved their facilities and

expanded into previously undeveloped lands. Off-road vehicle use and trails have proliferated in areas adjacent to some villages. recreational use by area residents and off-island visitors is increasing by about 10% annually. Over 7,000 people visited the Kodiak NWR in 1984 and that number is projected to more than double by 1995 (USFWS 1987). The cumulative effects of a growing resident population, increased recreational use, and development of private land is clearly promoting more frequent bear/human encounters.

CURRENT PROBLEMS

Impacts of human activity on brown bear populations occur indirectly through habitat destruction and directly through mortality (Jonkel 1978). The indirect effects of man's activities on bears generally are insidious and difficult to assess. We have focused on mortality as the the most reliable indicator of trends in bear/human conflicts in the Kodiak Archipelago.

Brown bear sealing records and written reports of people who killed brown bears in defense of life and property in the Kodiak Archipelago from 1974-1986 were analyzed to determine the circumstances of kills and to examine the sex and age characteristics of bears involved. Miller and Chihuly (1987) previously reported on an analysis of DLP kills from 1970-85 on a statewide basis. Our analysis is based on 88 separate incidents involving 93 bears. Some subjectivity was required to interpret the reports but in most cases it was not difficult to assign the kills to specific categories. Because the authors had personal knowledge of nearly every incident,

having interviewed many of the individuals and investigated most of the killings, the data are considered reliable.

Mortality Sources and Trends

Hunters were most often involved (61%) in DLP incidents, followed by residents of remote villages (20%) and homesites (7%), government fish management workers (5%), and commercial fishermen (3%) (Table 1). Forty-seven (87%) of 54 brown bears killed by hunters were shot by deer hunters.

An increasing rate of DLP kills of brown bears has occurred since 1978 (Fig. 2), with 60% of the mortality recorded over the past 5 years. Mean annual DLP mortality for the periods 1974-1981 and 1982-1986 was 5.4 and 11.0, respectively. Most DLP mortality occurred in October (50%) and November (22%) (Table 2). The highest incidence of kills by both hunters (50%) and village/remote homesite residents (46%) was in October.

Distribution of DLP Kills

Although DLP incidents occurred throughout the Kodiak Archipelago (Table 3), villages and deer hunting activities most influenced the distribution of the kill. Seventy-one percent of the kills by villagers and other bush residents (n=20) occurred in northwestern and southeastern Kodiak Island, where the 2 largest villages, Port Lions and Old Harbor, are located. Northwestern Kodiak and Afognak Island sustained 59% of the kills by hunters (n=32). These areas support an estimated 60-65% of the deer hunting effort and harvest in the

archipelago. Only 1 DLP incident occurred in the extreme northeastern part of Kodiak Island which supports 87% of the human population. Bears occur at relatively low densities in this area.

Sex and Age Composition of DLP Kills

The sex and age composition of bears killed in DLP incidents provides insight into the potential effects of this mortality source on the population. Maternal females (20%), 2-4 yr old males (18%) and males 5 yrs or older (17%) were most frequently killed in DLP incidents (Table 4). Fifty-three percent of the bears killed were females (n=49). Excluding 4 juveniles killed with their mothers, 67% of the females (n=30) were $\geq$ 5 yrs old, bears considered to be sexually mature (Hensel et al. 1969). The mean age of the 30 mature females was 14.0 yrs (range =5.5-23.5 yrs). In contrast only 54% of the females killed by sport hunters from 1969-1984 (n=417) were > 5 yrs old with a mean age of 10.2 yrs. The disproportionately high percentage of older mature females in the DLP kill compared with the sport kill suggests that a continued increasing trend in the DLP kill may have significant effects on productivity.

Young bears in age classes 2-4 yrs were involved in 38% of the DLP incidents in which age of the bears was available (n=29). Fifty-two percent of the males (n=17) were aged 2-4 yrs compared to only 25% of the females (n=10). Miller and Chihuly (1987) suggest that subadult males may be less sedentary than subadult females and therefore are more likely to come into conflict with humans.

The killing of maternal females in DLP incidents impacts the population by direct mortality and orphaning of cubs. Five cubs were killed and 35 cubs were orphaned in the 19 incidents involving maternal females. Although cubs as young as 7 months old may be self-sufficient (Johnson and LeRoux, 1973), it is suspected that few cubs less than 2 yrs old survive through the first denning period after losing their mothers.

Conflicts with Hunters

The increasing incidence of bears being killed by hunters in DLP incidents reflects a large increase in deer hunting effort and harvest since the early 1970's. Deer were first introduced to the Kodiak Archipelago in 1924 and have since colonized nearly all the islands (Burris and McKnight, 1973). The first hunting season was held in 1958. A relatively mild climatic trend in the last decade has resulted in the population reaching a historically high level, probably exceeding 80,000 deer. A liberal bag limit of 5 deer and a 5-month season (Aug. 1-Jan 7) attract large numbers of hunters from population centers, including Anchorage and other road-connected communities in southcentral Alaska. In 1972 the deer kill was estimated at 690 deer with 590 hunters afield. By 1984 the estimated kill had increased to 8,900 deer with 3,950 hunters afield (ADF&G files).

Most deer hunting occurs in October and November when bears are entering dens and when favored food sources, including salmon, berries and herbaceous vegetation, are waning. Deer hunting is concentrated

along protected bays and a few inland lakes which permit access by boat or floatplane. Consequently most of the deer harvest occurs in a relatively narrow band of coastline within a day's walk. A conservative estimate is that over 250,000 kg of viscera, bones and carcasses of deer become available to bears during a relatively short period each fall. Bears are rapidly learning to associate deer hunting activities with easily available food.

Deer hunters reported killing a mean of 3.6 bears (range =0-9) annually from 1974-1986 in DLP incidents. Fifty-three percent of the kills (n=25) occurred in the past 3 years (1984-1986). October and November, which are the peak deer hunting months, accounted for 83% of the bears killed (n=39) by deer hunters.

The DLP incidents involving deer hunters were classified into those associated with hunting camps and those which occurred while hunters were in the field (Table 4). Sixty-four percent of the classified incidents (n=27) occurred while hunters were in the field. The field incidents were judged as either chance encounters or incidents in which bears appeared to have been attracted by deer meat. Seventy-eight percent of the incidents (n=21) were apparent chance encounters and 22% of the incidents (n=6) involved deer meat.

The precise events leading up to each DLP incident are not easily discerned, because hunters are aware that they must justify killing a bear to avoid possible prosecution. Undoubtedly some bears are killed more as a convenience than because they pose a real threat. Most

encounters with bears related by deer hunters fit into the following 5 categories:

1. Bear encountered while hunting and perceived to be an immediate threat.

2. Bear becomes a nuisance at camp, sometimes raiding meat or food caches and causing hunters to fear the bear's presence.

3. Bear encountered near scene of the kill when returning to pack out a deer left in the field.

4. Bear appears while hunter is field-dressing a deer or even before the hunter approaches a downed deer.

5. Bear appears while hunter is dragging or packing out deer.

Hunters who have experienced incidents in which bears suddenly appear at the scene of a kill report that the bears are obviously intent on claiming the deer. Most hunters surrender their deer in such circumstances. The offending bears are therefore rewarded and probably become increasingly prone to similar behavior in the future.

Brown bears pose a real hazard to hunters in the Kodiak Archipelago, although the incidence of maulings is low. Seven people have been mauled since 1976, including 5 deer hunters, a bear hunter and a sport fisherman. Two deer hunters mauled by bears in 1986

stated that the bears were attracted to fresh deer meat. One of those hunters was attacked by a sow with cubs that fed on the deer while the injured hunter lay nearby. A single bear attacked another hunter who was packing a deer quarter on her shoulder. In 2 earlier incidents hunters were attacked when they returned kill sites to retrieve a deer. The fifth deer hunter was attacked when he surprised a sow bedded with her cubs near a salmon spawning stream. None of the 7 victims of maulings received seriously debilitating injuries in the attacks. Only one of the bears which mauled a deer hunter was killed.

Village Nuisance Bears

Chronic nuisance bear problems in the 5 remote villages on Kodiak Island are of increasing concern. Although verified kills of bears in these villages averaged only 1.6 bears annually from 1974-1986, the actual kill was probably much greater. As many as 15 bears in a single year may have been killed in each of 2 villages, based on bears found shot and unverified reports. The kills reported from each village probably reflect the relative level of cooperation with managing agencies.

Twenty-one bears were reported killed in 18 incidents from 1974-86 (Table 1). The 2 villages with the largest human population reported the highest kills as follows: Old Harbor-9 bears; Port Lions-5 bears; Larsen Bay-3 bears; Karluk-3 bears; Akhiok-1 bear.

The location of the villages in high density brown bear habitat predetermines bear/human conflicts. Four villages, Old Harbor,

Karluk, Larsen Bay and Akhiok, are located in the Kodiak NWR. The villages are located near salmon streams and in Larsen Bay, bears are frequently observed feeding on salmon within view of roads and residences. Dense brush adjacent to the villages offers excellent cover and plant species which are fed on by bears. Recent expansion of roads, airstrips and housing areas has increased the likelihood of bear/human encounters by opening up bear travel routes to view and providing more opportunity for bears to find garbage and stored food. Increased use of off-road vehicles for hunting deer has produced a trail network radiating from the village of Port Lions. Bears are apparently using these trails regularly which may also be contributing to the frequency of nuisance problems there.

The major attraction for bears in the villages are the village landfill sites. Most landfills are located within 1 km of the villages and bears frequent them year-round. Although the village governments provide limited disposal service most residents haul their own garbage as needed. Maintenance of the landfills consists of intermittently burning and bulldozing the garbage into trenches. Sparse soil, shallow bedrock and poor surface drainage make landfills difficult to maintain.

An added attraction to bears in villages is the harvesting and storage of large quantities of fish and game. Salmon are harvested from May-November and they are smoked or air-dried near residences. Conflicts with bears at smokehouses and fish caches were noted in 3 of the 18 DLP incidents at villages. Bears were attracted to deer meat

stored near residences in 3 incidents. Much of the waste from harvested fish and game is deposited in the village landfills, providing a steady supply of highly attractive food for bears. Garden compost, livestock, and carrion on beaches are other attractions to bears in the villages.

The importance of village landfills or other human food sources to bears is difficult to determine. Villagers often report seeing the same bears frequenting landfills and traversing regular routes near the village for periods ranging from a few days to several weeks. Limited data from aerial locations of radio-collared brown bears during a 5-yr study on impacts of the Terror Lake hydroelectric project indicated that relatively few bears regularly frequented the village of Port Lions.

Movements of 2 radio-collared bears which visited the Port Lions landfill indicate that reliable point sources of garbage can be important. A 10 yr old female with 3 cubs-of-the-year was captured on 4 December 1985 while feeding on garbage at the Port Lions landfill. Radio-locations indicated she remained within 1 km or less of the dump for at least the next 2 weeks. By 23 December she had moved approximately 6.5 km southwest of the village to a den site. She was relocated 35 times in 1986, never closer than 3 km to Port Lions, indicating she did not use the dump. A poor berry crop and the failure of a local salmon run in 1985 were thought to be responsible for her use of the dump that year. The unusually high number of

nuisance bears reported in Port Lions in 1985 was attributed to the low availability of berries and salmon (Smith and Van Daele 1986b).

A 5 yr old single female captured in 1982, occupied a 25 km² home range 12 km NW of Port Lions through October 1985. She lost a litter of 2 cubs-of-the-year shortly before moving to near Port Lions where she remained until she died in mid-May 1986 within 1 km of the landfill. She did not enter a den and was seen at the landfill by villagers several times. Cause of her death could not be determined, but she appeared emaciated, possibly the result of relatively poor food supplies in 1985, combined with the stress of nursing.

Conflicts with Bush Residents

People living seasonally or year-round at isolated locations experience problems with nuisance bears similar to those described for village residents. Nearly 600 people were occupying permanent residences in isolated locations in the Kodiak Archipelago in 1986 (Kodiak Island Borough files). Garbage dumps at some of the 7 seasonally operated salmon canneries on Kodiak Island have been a source of frequent nuisance bear problems. Bears are attracted to shore-based commercial fishing operations, mainly salmon set-gillnetting, where waste fish, garbage, and marine mammals shot by fishermen accumulate. In 1986, 175 set-gillnet sites, each employing 2 or more fishermen, were in operation along the coast (ADF&G files). Because a limited entry permit system is in effect for commercial salmon fishing, this source of nuisance bear problems is expected to be stable in the future.

Although bush residents, including commercial fishermen, were involved in only 8 of 93 DLP incidents (9.1%) from 1974-86, the actual incidence was probably much higher. Commercial fishermen may be reluctant to report nuisance bear kills fearing further limitations on their operations or possible cancellation of their permits to occupy lands in the Kodiak National Wildlife Refuge. Other residents probably fear prosecution for legally indefensible kills or are unwilling to salvage DLP bears.

Recent sales and leasing of State and Kodiak Island Borough lands have resulted in more recreational cabins and year round residences being built in remote locations. Also, individual shareholders in the Native corporations are currently obtaining long-term leases to corporation land for personal use. Conflicts between brown bears and this new wave of settlers is inevitable. The lands chosen for cabin development are generally along protected bays and stream terminuses, favored brown bear habitat. Bears accustomed to feeding and traveling in these areas quickly learn to exploit the food sources associated with human dwellings. Permanently occupied locations usually have a nuisance bear history associated with them which may or may not be documented in the DLP kills statistics. Private recreational cabins, used mainly for hunting and fishing from June-November, will inevitably produce conflicts over improperly stored fish, game and garbage.

Conflicts with Outdoor Recreationists

As was noted earlier, the Kodiak Archipelago is rapidly emerging as a popular recreation area for population centers in southcentral Alaska. Although hunting is currently the major attraction, participation in sport fishing, sightseeing, wildlife photography, camping and hiking in remote locations is increasing.

Sport fishing has a high potential for producing additional conflicts with brown bears. Although sport fishermen were involved in only 1 of 88 DLP incidents (1%) from 1974-1986, several bears have been found shot near popular streams. Unverified reports of sport fishermen shooting bears and numerous reported incidents in which bears were nuisances to sport fishermen have been received. Because many of the popular areas for sport fishing are also heavily used by bears feeding on salmon, the potential for conflicts is high.

Commercial guiding for sport fishing, which is rapidly increasing in the Kodiak Archipelago, has some further implications for brown bears. Guides often cater to large numbers of fishermen; they operate large camps or lodges with attending garbage and food storage problems; and they concentrate their activities at accessible areas with high densities of both salmon and brown bears. Several large lakes and rivers which were recently transferred into Native ownership via ANCSA and ANILCA offer high potential for development of permanent lodges catering to sport fishermen and other outdoor recreationists. Such developments would place large numbers of inexperienced people in areas with high bear densities.

Other "non-consumptive" recreationists, including photographers, campers, and hikers, are not immune to conflicts with brown bears. Photographers are known to be particularly intrusive when trying to film brown bears. Deliberate baiting of bears by photographers has occurred and many photographers carry firearms for personal safety. Concentrations of bears on salmon streams offer the best photo opportunities in the Kodiak Archipelago. A photographer implicated in killing a bear near Karluk Lake left Alaska before he could be interviewed. A professional guide leading a party of photographers near a salmon stream in 1986 killed a maternal female when she charged.

The conflicts between bears and campers and hikers have been well-chronicled for national parks in Canada and the United States. The fact that hikers or campers have not been injured by brown bears is attributed to the relatively low level of these activities in remote areas of the Kodiak Archipelago. One bear was killed by hikers, residents of a logging camp on Afognak Island.

Public recreation cabins are addditional potential locations for bear/human conflicts. Nine cabins administered by Kodiak NWR on a permit basis accommodate 400 visitors annually with most use occurring from June through November (USFWS files). Visitors using the KNWR cabins are provided with information on proper behavior around brown bears. The State of Alaska Division of Parks also operates 2 recreation cabins and additional cabins are being planned. Native

corporations which now own several former public use cabins, are expected to develop additional recreation cabins as a source of revenue in the near future.

Conflicts with Resource Extraction and Development

Various land development and resource extraction activities have resulted in few direct mortalities of brown bears in recent years. Logging, which began on a large scale on Afognak Island in 1975, has resulted in few serious conflicts with bears. One bear was known to have been killed by a worker at a logging camp landfill site, but the bear was buried in the fill. During the 1960's at least 2 brown bears were killed by government workers cruising timber. Logging activity is expected to expand in the near future and bear conflicts will undoubtedly increase.

Only one DLP bear kill, by a contractor on a pre-bidding inspection, was attributed to construction of the Terror Lake hydroelectric project from 1982-1984. At peak activity in 1983 over 400 workers occupied the project site where bear density was estimated at over 1 bear/4 km^2 (Smith and Van Daele 1984). Workers encountered bears daily and although several potentially dangerous confrontations were reported, no workers were injured nor were any bears killed. In several cases helicopters were used to deliberately harass bears away from surveying and transmission line construction crews. The use of an oil-fired incinerator for garbage; frequent bear safety lectures to workers; a no-firearms policy for most crews; and the presence of a

USFWS project monitor at the site contributed to the generally low incidence of nuisance bear problems.

Lax garbage disposal practices during the Terror Lake project did result in occasional conflicts with bears in camps and at work sites. One 6 yr old radio-collared female, was usually radio-located within a few hundred meters of the main construction camp after her capture in July 1984 (Smith and Van Daele 1986a). She was seen feeding in garbage bins within the camp confines several times by workers. Her home range in 1984 was only 4.2 km^2, the smallest among 35 radio-collared females. She emerged from the den with a litter of cubs in 1985 and subsequent radio-locations indicated that she avoided the camp.

Fish and game management and law enforcement personnel occupy remote areas with high brown bear density with the peak work force in the field from late May through September. Twelve salmon counting weirs are manned for 3-15 week periods by 1-4 person crews. The weirs attract bears before salmon normally become available in spawning areas and personnel manning the weirs experience frequent nuisance bear problems. Mobile field crews monitor commercial fishing and hunting activities by small boat and from temporary camps from April through December. Current research projects on salmon, brown bears and bald eagles result in frequent encounters with bears at close range. Only 4 bears were killed by fish and game crews from 1974-1986.

MANAGEMENT STRATEGIES

A combination of preventive and corrective measures are employed to resolve bear/human conflicts in the Kodiak Archipelago. Educational programs, permit systems for regulating commercial use of Kodiak NWR lands and interagency reviews of proposed developments are the predominant methods of preventing conflicts. A State law which allows the killing of bears in defense of life and property provides the major corrective action. Liberal sport hunting in the northeastern corner of Kodiak Island, where most of the human population resides, has reduced conflicts by maintaining bear density at a relatively low level.

Nuisance Bears

Recognizing that people in isolated locations needed a legal means of dealing with legitimate conflicts with wildlife, the State of Alaska passed a regulation in 1960 which provides for "taking of game in defense of life and property" by individuals (Appendix I). Specific guidelines are presented to define legitimate circumstances and reporting requirements for DLP kills. Hides and skulls from bears are required to be salvaged and surrendered to the State. This regulation assigns the primary responsibility for dealing with problem bears to the individual encountering the problem.

The current program for managing nuisance bear problems in the Kodiak Archipelago is largely of an advisory nature. Nuisance bear management has had a low priority and current allocations of budget

and manpower are inadequate to provide on-site attention to complaints. Complaints are usually received by telephone or marine radio. It can usually be determined why bears are becoming a nuisance and the complainant is advised about how to remedy the problem. The DLP law is explained and the complainant is informed of the requirement for salvage and reporting if a bear is killed. An on-site visit may be made if a conflict appears to have long-term implications on bears or if an immediate public safety problem is evident. The ADF&G has primary responsibility for responding to nuisance bear problems, but assistance is often provided by the Alaska Department of Public Safety and staff of the Kodiak NWR.

Current statewide policy discourages the practice of translocating nuisance bears because of high costs and the general ineffectiveness of the technique (Herrero 1985). Considering the relatively high density of year-round residences, seasonal camps, and villages, translocation within the Kodiak Archipelago is not a viable management option.

Killing nuisance bears is not a routine management practice. Only in the case of an immediate threat to human life or property is such action taken. Because most nuisance bear problems occur at remote locations, agency personnel are seldom available to respond to such emergencies. Bears involved in maulings are not sought nor killed by agency personnel on Kodiak.

A high priority is placed on documenting the circumstances of DLP kills and on enforcing the regulations. A standardized questionnaire which must be filled out by individuals killing a bear was introduced on a statewide basis in 1985. The reporting and salvage requirement is reasonably enforced depending on individual circumstances. An individual will be prosecuted if the circumstances clearly show the killing was unjustified.

The level of compliance with the reporting requirement is difficult to ascertain. An apparent increase in the number of dead bears found near villages, seasonal camps and popular recreation areas is indicated in the past 5 years. Reliable sources suggest that up to 15 bear kills may have gone unreported in each of 2 villages in recent years. It is believed that seasonal and permanent residents at isolated locations kill bears with a greater frequency than reports indicated.

An adversary relationship between villagers and the government agencies charged with protection of the brown bear has proven difficult to overcome. The villagers see the nuisance bear problem as an issue in which the State and Federal governments have the responsibility to take direct action. The State's reluctance to initiate translocation or killing of nuisance bears is interpreted as a "do nothing" policy. Villagers often use the lack of direct action by agencies on nuisance bear complaints to defend failure to comply with DLP reporting requirements. The requirement that a DLP bear be salvaged is viewed as an unnecessary burden by villagers who believe

salvage is the State's responsibility. Lack of knowledge of skinning techniques and fear than an improper skinning job will result in legal prosecution are common defenses for failing to salvage a bear. A vigilante attitude appears to have developed among some individual villagers and may be resulting in increased malicious killing of bears.

A program was initiated in 1983 which allows village public safety officers (VPSO) to serve as the primary contact for nuisance bear complaints and DLP killings. The VPSO positions are funded by the State of Alaska to provide basic police services in villages too small to support a municipal police force or an Alaska State Trooper office. Initially, a brief training session was conducted for VPSO's to explain the DLP law and to familiarize each officer with techniques for skinning, salvaging and shipping a bear hide and skull. Informational brochures on the DLP law were given to each VPSO for distribution to villagers. The intent of the program is for VPSO's to assist villagers with nuisance bear problems and provide information and assistance in complying with the DLP requirements.

The VPSO program has not produced uniformly satisfactory results. High turnover in the VPSO ranks and failure to provide training to new officers have handicapped the program. Also, VPSO's have increasingly become involved in killing nuisance bears. Unreported kills in certain villages continues to be a problem.

Conventional methods of aversive conditioning (Bromley 1985) have limited value in dealing with brown bears in the Kodiak Archipelago. The remoteness of problem areas, dense cover, and unavailability of trained personnel to apply deterrents before a bear becomes habituated to a food source are barriers to successful application. Brown bears appear to quickly learn to identify attempts at deterrence and are capable of timing visits to avoid them.

Nevertheless, various non-lethal means are sometimes used to discourage bears from visiting camps and residences. Fireworks, flares, airhorns, and shooting with birdshot have been used with mixed results. A vaariety of 12 gauge "rubber bullet" loads and the 38 mm rubber baton loads have proven largely ineffective in limited trials on subadult brown bears. Repeated shooting with 12 gauge shotshells appears to provide the best results, but because of the hazard to both bears and shooters, only trained personnel have been encouraged to use the method.

Sport Hunting

Maintaining low bear populations in local areas with high human densities is an established management policy in several areas of Alaska. Long hunting seasons have traditionally allowed intensive sport harvest of bears on northeastern Kodiak Island, which supports most livestock operations and almost 90% of the human population. A gradual decline in political lobbying by livestock interests and more public pressure for viable bear populations has resulted in more conservative hunting seasons and a growing bear population on

The present Kodiak NWR permit system has established a ceiling of 24 permits for sport fish guides and 18 permits for transporter/outfitter operations. Both "overnight" and day-use guides are included in the sport fish permit quota and only 2 guides are permitted in each drainage. Further restrictions on overnight use include a 1.6 km minimum distance between camps, a 7-day limit for camping at one location, and a limit of 6 persons (guides an assistants included) per party (USFWS, 1987). Outfitter permittees are allocated to one of 17 geographic areas on the refuge, with a limit of 1 or 2 permits per area. Additional provisions include a maximum of 15 days camping at any location, a minimum of 5 km between camp locations and a party size limit of 6 people. The intent of the special use permit system for sport fish guides and outfitters is to avoid displacement of bears from important feeding sites, reduce the risk of bears becoming conditioned to specific camp sites, and to provide quality hunting and fishing opportunities for refuge visitors.

Demand for other types of guided recreation on the Kodiak NWR has been low and permits are issued on a case-by-case basis. Special use permits are issued only for times and locations where interference with other commercial uses and conflicts with other resources, including brown bears, are not a problem. Seven recreational guides currently are permitted on the refuge.

Regulation of non-guided and outfitted recreational use of Kodiak NWR is less stringent than for commercial recreational use. However, there are some general limitations imposed on all users of the Refuge that are considered important to maintaining quality brown bear habitat. These include prohibiting use of all-terrain vehicles, helicopter landings, wheel-plane landings, and jet-powered boats.

Educational Programs

Educational programs are varied but have a common theme of increasing public awareness on avoiding potentially injurious encounters with brown bears. Emphasis is on reducing attractions for bears; avoiding areas of high seasonal bear density; realistically portraying the danger posed to humans; and dealing with actual confrontations. Most efforts are directed at one of 3 audiences: (1) the general public, (2) hunters and (3) villagers and remote residents.

Several methods of disseminating information to the general public on brown bears are employed, although a formal program has not been developed. A brochure entitled "The Bears and You," which provides basic information on brown bear natural history and avoidance of bears, is distributed statewide through visitor centers and ADF&G offices. Slide talks and lectures to civic groups, clubs, school classes, hunter safety classes, newly arrived military personnel, and other groups are done frequently. Interviews with local news media, including newspapers and radio stations, provide additional exposure.

Disseminating information to deer hunters on bear avoidance has been given a high priority because of the increasing conflicts in recent years. Hunters who visit the ADF&G office in Kodiak are routinely handed a copy of the bear avoidance brochure and given a brief verbal warning to heed its contents. The brochures are also distributed at local air taxi and charter boat offices, visitor information offices and other businesses and government agencies frequented by hunters. Local and statewide news media, attracted by the sensational nature of the problem, have nevertheless been cooperative in communicating essential points on deer hunting safety to a large audience. National hunting magazines have also given some exposure to the bear safety tips in recent articles on Kodiak's deer hunting. This multifaceted approach is considered important because Alaska has a transient population, including a large contingent of military personnel, and many first-time hunters are in the field each year. Feedback from hunters indicates that the informational program has made progress and suggests that a further expansion of educational efforts is warranted.

The need for a vigorous program of information and education in the villages is only beginning to be addressed. The Kodiak NWR recently initiated an information program in the village schools to explain wildlife and land management activities. Incorporating a segment with emphasis on brown bear life history and nuisance problems is planned in the near future. Occasional visits to villages to explain the DLP law have been made periodically in the past, but the irregular nature of the visits has limited their effectiveness.

A public meeting was held at Port Lions in 1985 by ADF&G and the Alaska Department of Public Safety to discuss an unusually high incidence of nuisance bears there. Based on public comments and movements of radio-collared bears adjacent to the village, failure of a local salmon run and poor berry crops were implicated. A summary of public comments and recommendations on improving village sanitation to reduce the attractions to bears was provided to the Port Lions municipal government. Although response of the villagers was not wholly positive, this type of forum will be increasingly important to opening lines of communication in the future.

Environmental Review

An informal program for advising other agencies, village governments, contractors, and the general public about living and working in brown bear country is conducted cooperatively by the ADF&G, the Alaska Department of Public Safety and the Kodiak NWR. This program was active during the construction of the Terror Lake hydroelectric project from 1982-84. Several presentations on safety in brown bear country were made to construction workers and power plant operators. Vigilant efforts were made by the state to require the contractor to abide by project license provisions regarding garbage disposal practices. Another product of this program was the recent recommendation to relocate the Larsen Bay landfill site which has reduced bear nuisance problems in that village.

Proposed developments on State and Federal lands are subject to more vigorous interagency review. This process provides an opportunity to direct developments away from sites with a high potential for bear/human conflicts, to gain protection for critical habitat and to seek mitigation for habitat losses. Some successful applications of the interagency review process in recent years in the Kodiak Archipelago include: modified boundaries of State land disposals; location and maintenance of landfills; modified logging units and road locations; and mitigation of the Terror Lake hydroelectric project impacts. Several conditions for mitigating effects on brown bears were incorporated into the Federal license authorizing the Terror Lake hydroelectric project as the result of an out-of-court settlement negotiated between prominent national conservation organizations and government agencies. Development on private lands is subject to few legal restrictions and little opportunity to influence developments in high density bear habitat is afforded to wildlife managers.

THE FUTURE

The issue of bear/human conflicts in the Kodiak Archipelago will be an increasingly important challenge in the future. The recreational opportunities of Kodiak and Afognak Islands have been discovered and their commercial exploitation has significantly elevated human activity levels. There is little doubt that this trend will continue into the foreseeable future. Kodiak and neighboring islands can no longer be considered pristine brown bear habitat with minimal human presence. Management options necessary to meet this challenge include improving education, increasing law enforcement efforts, more stringent appllication of land-use regulations, and expanding data bases on specific problems.

The need to continue and upgrade current educational programs is clear. Specific tasks we have identified include wider distribution of information pamphlets throughout Alaska; more frequent and timely press releases on the deer hunter/bear problem; printing bear safety tips on deer harvest tickets; and preparation of slide and/or video programs specific to Kodiak situations. We intend to make more frequent visits to villages, emphasizing communication with community leaders and VPSO personnel. Information programs for village schools will be improved. These efforts are expected to improve documentation of nuisance bear mortality near villages by improving the level of cooperation. These activities are considered a long-term contribution to the bear management program and subtantive short-term benefits are not expected. Also, we realize that dissemination of "bear facts"

will not reach nor will it influence some individuals (Herrero 1985) and that some bears will become nuisance animals regardless of precautions taken by people.

A major expansion of law enforcement effort in the Kodiak Archipelago is unlikely because of austere agency budgets and the difficult logistics inherent to Alaskan field work. A more realistic approach is to redirect present resources to focus added attention on areas and time periods when bear/human problems are most prevalent. As an example, the Kodiak NWR marine vessel has been scheduled for annual 4-5 week patrols in October and November to monitor bear and deer hunting activity and to trouble-shoot bear nuisance problems. This program, which began in 1986, involves both State and Federal law enforcement agents.

Another priority is to improve compliance with DLP regulations. The DLP law is necessary for the safety of people in bear habitat, but it also can be misused for the unwarranted killing of bears. There is need for more prompt and agressive investigation of DLP killings to differentiate between legitimate safety concerns and cases in which people were uncomfortable with bears near camp or simply did not want to surrender fish or game to bears. Strict enforcement of the DLP law increases the risk of a decreased reporting rate, but the benefits outweigh possible adverse consequences.

A continued increase in non-sport mortality of brown bears in the Kodiak Archipelago will necessitate measures to reduce or compensate

for losses. On the Kodiak NWR this might entail quotas on numbers of both commercial and non-commercial users for specific geographic units. A reduction of bear harvest permits is a management option that ADF&G would implement for areas where bear densities were declining. Other alternatives being considered include reduced seasonal and daily bag limits on deer and possible closure of the deer hunting season when bears are most susceptible to conflicts.

The growing demands on the resources of the Kodiak area will require a commitment by the State and Federal agencies to maintain current information on human use patterns and associated impacts. Some data will be generated by the education and law enforcement activities mentioned above while additional information will be acquired through studies directed at specific problems. Present research (Smith and Van Daele 1986, Barnes 1986) has improved knowledge of critical habitats and population parameters and contributed to a better understanding of sport harvest data. Cooperative ADF&G and USFWS studies planned for the next few years include brown bear density estimates for specific areas of Kodiak Island, a deer hunter questionnaire survey, and a study of deer hunter/brown bear interactions.

Available information indicates that the brown bear population of the Kodiak Archipelago is stable and has not been seriously affected by human activity. Nevertheless, we are concerned whether present management practices are adequate to maintain that stability. We interpret increasing levels of non-sport bear mortality as an

indication of a much higher level of bear/human interactions throughout the area, one that could have important long-term implications. We share the belief of Schoen et al. (1986) that enlightened management will be necessary to protect Kodiak's brown bears from the pressures that have so severely impacted the species elsewhere.

Table 1. Sources of brown bear DLP mortality, Kodiak Archipelago, 1974-1986.

Source	Incidents		Number of Bears Killed
	Number	%	
Hunter			
Deer	47	53	47
Bear	5	6	5
Elk	2	2	2
Village resident	18	20	21
Bush resident	5	6	7
Government worker	4	5	4
Commercial fishermen	3	3	3
Other[a]	4	5	4
Total	88	100	93

[a] Includes sport fishermen, hikers, photographers, construction workers.

Table 2. Seasonal occurrence of brown bear DLP mortality, Kodiak Archipelago, 1974-1986.

Month	Source of Mortality			Total	
	Hunter	Village/Bush Resident	Other	No.	%
January-May	4	1	1	6	6
June	0	2	3	5	5
July	0	1	2	3	3
August	3	2	3	8	9
September	3	3	0	6	6
October	27	13	1	41	44
November	15	4	1	20	22
December	2	2	0	4	4

Table 3. Spatial distribution of 93 brown bear DLP mortalities, Kodiak Archipelago, 1974-1986.

Area	Number of Bears by Mortality Source			Total
	Hunter	Village/Bush Resident	Other	
Afognak and adjacent islands	16 (30%)	1 (4%)	2 (18%)	19 (20%)
NW Kodiak Island	16 (30%)	10 (36%)	2 (18%)	28 (30%)
NE Kodiak Island	8 (15%)	1 (4%)	0	9 (10%)
SW Kodiak Island	1 (20%)	6 (21%)	4 (36%)	21 (23%)
SE Kodiak Island	3 (6%)	10 (36%)	3 (27%)	16 (17%)

Table 4. Origin of 47 brown bear DLP kills by deer hunters, Kodiak Archipelago, 1974-1986.

Circumstances	Bears Killed			Total	
	Male	Female	Unknown	No	%
In Field					
Without Meat	8	11	2	21	45
With Meat	1	5	0	6	13
Camp Area	5	9	1	15	32
Unknown	1	3	1	5	11

Table 5. Sex and age composition of brown bear DLP mortality, Kodiak Archipelago, 1974-1986.

Sex/age[a]	Number of Bears by Source			
	Hunter	Village/Bush Resident	Other[b]	Total
Male				
Adult	6	9	1	16
Subadult	11	3	3	17
Juvenile	0	1	0	1
Unknown	2	1	0	3
	19 (35%)	14 (50%)	4 (36%)	37 (40%)
Female				
Adult, Single	9	0	2	11
Adult, Maternal	12	4	3	19
Adult, Unknown	4	2	0	6
Subadult	5	3	1	9
Juvenile	0	4	0	4
	30 (56%)	13 (46%)	6 (55%)	49 (53%)
Unknown Sex	5 (9%)	1 (4%)	1 (9%)	7 (7%)
Totals	54	28	11	93

[a] Adult (≥5 yrs); subadult (independent ≤ 5 yrs); juvenile (accompanied by female).

[b] Includes sport and commercial fishermen, government workers, hikers, photographers and construction workers.

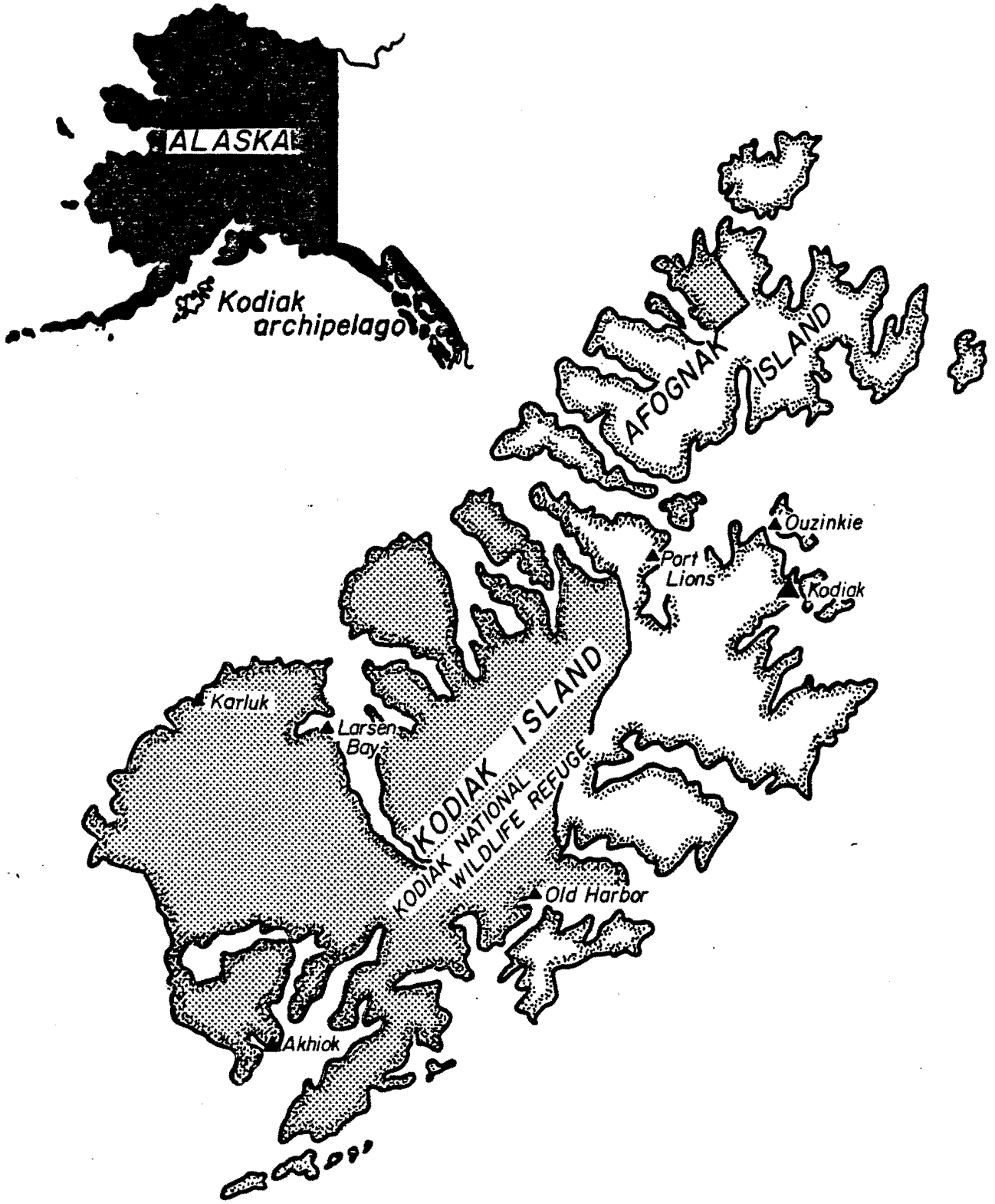

Figure 1. Kodiak Archipelago, including villages and Kodiak National Wildlife Refuge (shaded area). Scale = 1 cm: 11.5 km.

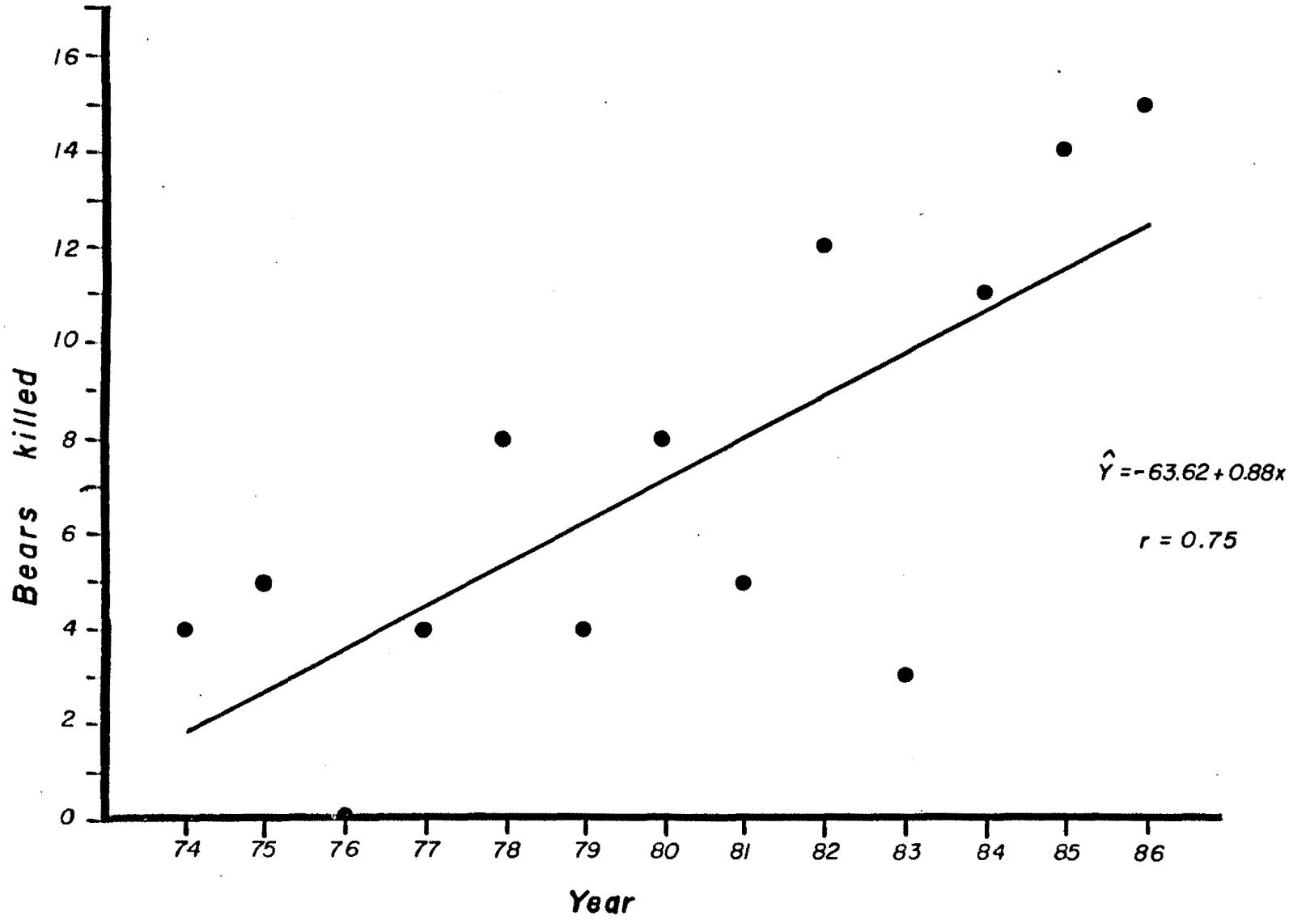

Figure 2. Number and trend of bears killed in defense of life and property in the Kodiak Archipelago, Alaska, 1974-1986.

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APPENDIX I

Alaska defense of life and property regulation (Title 5, Alaska Administrative Code), 1987.

5 AAC 92.410. TAKING OF GAME IN DEFENSE OF LIFE OR PROPERTY. (a) Nothing in this title prohibits a person from taking game in defense of life or property if

(1) the necessity for the taking is not brought about by harrassment or provocation of the animal or an unreasonable invasion of the animal's habitat;

(2) the necessity for the taking is not brought about by the improper disposal of garbage or a similar attractive nuisance; and

(3) all other practicable means to protect life and property are exhausted before the game is taken.

(b) Game taken in defense of life or property is the property of the state. A person taking such game is required to salvage immediately the meat, or, in the case of a black bear, wolf, wolverine, or coyote, the hide must be salvaged and immediately surrendered to the state. In the case of brown or grizzly bear, the hide and skull must be salvaged and surrendered to the state immediately. The

person taking the game must notify the department of the taking immediately and must submit a written report of the circumstances of the taking of game in defense of life or property to the department within 15 days of the taking.

(c) As used in this section, property is limited to

(1) a dwelling, permanent or temporary;

(2) an aircraft, boat, automobile, or other means of conveyance;

(3) a domesticated animal; and

(4) other property of substantial value necessary for the livelihood or survival of the owner.

NOTE: Game taken by hunters is not "property" in the sense of this regulation. It is not legal to shoot a bear to defend your moose or caribou carcass, for example.