

CHARACTERISTICS OF NONSPORT MORTALITIES TO BROWN AND BLACK BEARS AND HUMAN INJURIES FROM BEARS IN ALASKA

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Abstract: We examined the reasons bears are reported killed in defense of life or property (DLP) in Alaska as an index to causes and frequency of conflicts between humans and bears, and compared the sex and age composition of DLP kills with that of sport-killed bears. Data came from standardized questionnaires filled out by persons shooting the bears. Numbers of sport-killed brown bears (*Ursus arctos*) and black bears (*U. americanus*) and number of DLP-killed brown bears increased during 1970–96, but number of DLP-killed black bears did not increase. Overall, bear deaths in DLP circumstances were a small proportion of total deaths for both brown bears (5.2%) and black bears (3.1%). In urban areas, however, DLP deaths represented up to 22.3% of total brown bear mortalities and 6.1% of total black bear mortalities. Compared to sport kills of brown bears, DLP kills contained relatively more subadult males ($P < 0.001$) and more older (age 11–19) females ($P < 0.001$). More DLP brown bears were shot because the shooter considered them an immediate threat (40.8%) or a potential threat (30.1%) than to protect property (29.0%). Only 11% of DLP black bears were considered an immediate threat; 48.9% were considered a potential threat, and 35.3% were shot to protect property. Adult brown bear females accompanied by offspring were much more likely to have been shot because they were an immediate threat (84.4%) than solitary adult females (40.7%) ($P < 0.001$). The type of property most often damaged or threatened by both brown bears and black bears killed in DLP circumstances was a dwelling, but most respondents indicated no property damage occurred. For both species, most DLP bears were killed when the shooter was at home or in a dwelling, but a larger proportion of brown bear (32.1%) than black bear (4.9%) DLP deaths occurred when the shooter was hunting. Based on newspaper accounts collected during 1985–96, brown bear attacks resulted in 2.75 human injuries and 0.42 deaths per year in Alaska. Black bear attacks in Alaska resulted in 0.33 human injuries/year during this same period. Only 1 human death caused by a black bear in Alaska is known to the authors during a period that encompassed >25 years.

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Key words: bear attacks, black bear, brown bear, human deaths, human injuries, hunting, mortality, nonsport mortalities, nuisance bears, population sinks, property damage, *Ursus americanus*, *Ursus arctos*

Bears are large carnivores that present both perceived and real threats to human safety and property (Herrero 1985). These threats frequently result in bears being killed to minimize these dangers to humans. In Alaska, these mortalities are termed kills “in defense of life or property” (DLP) and are legal under state regulations (Alaska Administrative Code Chapter 5). Mortalities in DLP circumstances may represent significant population sinks for bears, especially in areas with dense human populations (Miller and Chihuly 1987, Knight et al. 1988). Analysis of the circumstances that lead to these mortalities provides managers with guidance on what could be done to facilitate coexistence of humans and populations of wild bears.

Alaska has large and healthy populations of both black and brown bears, and circumstances that lead to nonsport shootings of bears are common. This provides a larger sample size to evaluate conflicts between bears and humans than exists in most other regions where similar conflicts occur.

Because both species of bears are hunted in Alaska, the sex and age composition of bears removed by hunting can be contrasted with that of bears removed in nonsport circumstances. Differences may indicate the

necessity to treat these sources of mortality distinctly in population models.

Data presented in this report may be useful in areas where efforts are underway to increase depleted brown bear populations or to reintroduce brown bears where they have been extirpated. There is often significant public opposition to such management efforts, frequently based on inaccurate perceptions of risk of human injury or property damage that occurs in areas with healthy brown bear populations. Because areas proposed for augmented or reestablished brown bear populations in North America frequently have healthy populations of black bears, the comparison of circumstances involving DLP brown bear and black bear deaths in Alaska provide a reference point as to what might be expected when healthy populations of both species are reestablished. In the lower 48 states of the United States, brown bears have been reduced to isolated remnants in a few northern states (Servheen 1989).

Alaska is a large (about 1.5 million km²) and sparsely-populated state with a human population of 570,000. Humans are mostly concentrated in the major population centers of Anchorage, Fairbanks, and Juneau (Alaska Northwest Books 1992). There are about 31,700 brown

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bears in Alaska, and overall population trends appear stable (Miller 1993). Brown bears occur throughout the state, except for some islands in southeastern Alaska (Miller 1993). No systematic estimate of black bear numbers has been made for Alaska, but we believe this species is at least as numerous as brown bears. Black bears inhabit most of Alaska; they do not occur on some islands in southeastern Alaska, the Kodiak Island group, the Alaska Peninsula, and on Alaska's north slope. Generally black bears are uncommon or not present in unforested portions of Alaska.

A previous analysis of 668 nonsport brown bear deaths in Alaska during 1970–85 was presented by Miller and Chihuly (1987). This report supplements the earlier report, with data on nonsport mortalities of 677 brown bears and 361 black bears during 1986–96.

METHODS

The hides and skulls of brown bears and black bears killed for sport in most portions of Alaska must be presented to a representative of the Alaska Department of Fish and Game (ADFG) within 30 days of the kill. At this time a locking tag or seal is affixed to the hide and skull; sport hunters can then process or export their trophies. During this mandatory inspection, termed sealing, the hide is examined to determine the sex of the bear, information on hunt characteristics is collected, and a premolar tooth is pulled from the skulls of brown bears to estimate age by cementum annuli (Matson et al. 1993). Corresponding age data from black bear teeth are not available. Prior to 1973, sealing was not required for black bears.

The same sealing process is required for bears shot in DLP circumstances, but in these cases the hide and skull must be surrendered to the state and the person killing the bear is required to submit a report describing the circumstances that led to the shooting. Prior to 1986, this report was in the form of a narrative drafted by the person who killed the bear. These narratives were inconsistent in the type of information individuals chose to report (Miller and Chihuly 1987). Since 1986, the required report for DLP bear kills has been a multiple choice questionnaire designed to reveal the circumstances leading to the shooting. This questionnaire form also includes a narrative section for the shooter to describe circumstances not adequately covered in the questions. These DLP questionnaires provided most of the information we analyzed.

We also included data from a few kills identified as DLP kills on the sealing form but for which no questionnaire was completed. In these cases, detailed and con-

sistent information on the circumstances leading to the kill was not available, but information on the location of kill, residency of the shooter, and sex and age of the bear usually was included. Discrepancies in sample size between tables presented here result from inclusion of this incomplete data.

For each question on the DLP questionnaire (e.g. *Why was the bear killed?*), a series of options for response was provided (e.g. 1 = bear was an immediate threat (charging), 2 = bear was thought to be dangerous, 3 = to protect property, 4 = other (please explain)). Frequently respondents would enter >1 response (e.g., 2 and 3 in the above example). Each response was tallied for this report, so the number of responses exceeded the number of DLP kills for some questions.

In some areas of Alaska, hunters killing brown bears or black bears are exempted from sealing requirements (they still must report DLP kills). These exemptions are designed for subsistence hunters, frequently Native Americans in remote areas along the western coast. Data on sex and age for these bear kills are not available.

Our DLP records do not include all DLP kills because some bears shot in DLP circumstances are reported as sport kills. Hunters have an incentive to report DLP kills as sport kills because this enables them to keep the hide, skull, and meat rather than surrender these to the state. If the hunting season is open, state biologists often encourage persons complaining about nuisance bears to buy a hunting license and kill the problem bear themselves. Since the hunting season is more liberal for black bears than for brown bears, we suspect that a higher proportion of the DLP black bear kills was reported in the sport harvest than for brown bears.

We include only bear deaths classified as DLP or sport kills. Accidents from highway collisions, research-related mortalities, bears found dead, etc. are not included in the data we categorize as total mortalities.

In this report we use the term "urban" to classify kills from areas where the bulk of the Alaska population lives (the cities of Anchorage, Fairbanks, Juneau, Ketchikan, and the Kenai Peninsula). Everywhere else is classified as rural, although from a southern California perspective, no place in Alaska, except perhaps Anchorage, would be viewed as urban.

Data on injuries and deaths from bear attacks were compiled from newspaper accounts (primarily in the *Anchorage Daily News*) accumulated by the first author during 1986–96. Human deaths from bear attacks are widely reported, and we believe these data are complete. Data on injuries from bears, however, are minimal figures because not all injuries are reported and some newspaper accounts were probably missed. No agency in

Alaska is charged with maintaining records of human injuries caused by wildlife.

Statistics (*F*) on trend in numbers of kills were generated by the ANOVA regression in Excel (Microsoft, Redmond, Washington, USA). χ^2 statistics were also calculated in Excel. Data on reasons for shooting were organized ordinally based on degree of danger from charging to defense of property, so exact probabilities for each reason were obtained; comparisons were made with Kruskal-Wallis (K-W) tests (Mehta and Patel 1995).

RESULTS

Comparisons of Sport and DLP Kills

We obtained data from 677 brown bear kills and 361 black bear kills in defense of life or property circumstances during 1986–96. We compared these data with

hunting kills of 12,615 brown bears and 18,323 black bears from the same period (Table 1). Statewide during this period, DLP kills represented 5.2% of the total kills for brown bears and 3.1% for black bear (Table 1). In urban areas, DLP brown bear kills constituted a higher proportion of total kills (21.7–22.3%) than in rural areas (3.1–7.5%) (Table 2). Similar results were reported by Miller and Chihuly (1987) for Alaska brown bear data prior to 1986. For black bears, a relatively small proportion of total kills were reported as DLP kills in both urban and rural areas (Table 2).

Both sport and DLP kills of brown bears increased during 1970–96 ($F = 84.4, P < 0.001$, and $F = 21.2, P < 0.001$ for sport and DLP kills, respectively; Table 1, Fig. 1). Number of black bears killed in sport circumstances in Alaska also increased during 1970–95 ($F = 94.5, P < 0.001$), but the number killed in DLP circumstances has remained relatively constant ($F = 1.4, P = 0.24$; Table 1, Fig. 2).

Table 1. Number of black bears and brown bears shot annually in sport and defense of life and property (DLP) circumstances in Alaska, 1970–96. Black bear kills were not reported during 1970–73.

| Year | Brown bears | | | Black bears | | |
|---------|-------------|-----------|-------|-------------|-----------|-------|
| | Sport kills | DLP kills | % DLP | Sport kills | DLP kills | % DLP |
| 1970 | 632.0 | 37.0 | 5.5 | — | — | — |
| 1971 | 740.0 | 24.0 | 3.1 | — | — | — |
| 1972 | 834.0 | 42.0 | 4.8 | — | — | — |
| 1973 | 927.0 | 40.0 | 4.1 | — | — | — |
| 1974 | 779.0 | 41.0 | 5.0 | 673.00 | 28.0 | 4.0 |
| 1975 | 827.0 | 46.0 | 5.3 | 918.00 | 30.0 | 3.2 |
| 1976 | 832.0 | 39.0 | 4.5 | 1,032.00 | 61.0 | 5.6 |
| 1977 | 774.0 | 45.0 | 5.5 | 839.00 | 49.0 | 5.5 |
| 1978 | 819.0 | 57.0 | 6.5 | 815.00 | 105.0 | 11.4 |
| 1979 | 883.0 | 32.0 | 3.5 | 833.00 | 35.0 | 4.0 |
| 1980 | 882.0 | 47.0 | 5.1 | 1,128.00 | 44.0 | 3.8 |
| 1981 | 887.0 | 53.0 | 5.6 | 1,104.00 | 45.0 | 3.9 |
| 1982 | 821.0 | 44.0 | 5.1 | 1,045.00 | 27.0 | 2.5 |
| 1983 | 974.0 | 59.0 | 5.7 | 1,164.00 | 10.0 | 0.9 |
| 1984 | 1,118.0 | 62.0 | 5.3 | 1,465.00 | 45.0 | 3.0 |
| 1985 | 1,145.0 | 77.0 | 6.3 | 1,646.00 | 41.0 | 2.4 |
| 1986 | 1,121.0 | 57.0 | 4.8 | 1,584.00 | 32.0 | 2.0 |
| 1987 | 1,215.0 | 63.0 | 4.9 | 1,634.00 | 26.0 | 1.6 |
| 1988 | 1,103.0 | 57.0 | 4.9 | 1,600.00 | 13.0 | 0.8 |
| 1989 | 1,089.0 | 60.0 | 5.2 | 1,486.00 | 21.0 | 1.4 |
| 1990 | 1,145.0 | 56.0 | 4.7 | 1,468.00 | 30.0 | 2.0 |
| 1991 | 1,152.0 | 64.0 | 5.3 | 1,899.00 | 53.0 | 2.7 |
| 1992 | 1,285.0 | 83.0 | 6.1 | 1,818.00 | 50.0 | 2.7 |
| 1993 | 1,126.0 | 34.0 | 2.9 | 1,466.00 | 23.0 | 1.5 |
| 1994 | 1,042.0 | 72.0 | 6.5 | 1,537.00 | 26.0 | 1.7 |
| 1995 | 1,127.0 | 55.0 | 4.7 | 1,918.00 | 34.0 | 1.7 |
| 1996 | 1,210.0 | 67.0 | 5.3 | 1,913.00 | 48.0 | 2.5 |
| Total | 26,489.0 | 1,413.0 | — | 30,985.00 | 876.0 | — |
| Average | 981.1 | 52.3 | 5.2 | 1,347.20 | 38.1 | 3.1 |

Table 2. Number and percent of kills of brown bears and black bears that occur in defense of life and property (DLP) circumstances in urban and rural portions of Alaska, 1986–96.

| Area | Brown bears | | Black bears | |
|--|-------------|---------------|-------------|---------------|
| | Sport kills | DLP kills (%) | Sport kills | DLP kills (%) |
| Urban areas | | | | |
| Anchorage and Matanuska Valley ^a | 108 | 31 (22.3) | 1,000 | 65 (6.1) |
| Kenai Peninsula ^b | 130 | 36 (21.7) | 2,444 | 42 (1.7) |
| Rural areas | | | | |
| Southeastern mainland ^c | 272 | 22 (7.5) | 2,090 | 101 (4.6) |
| Alaska Peninsula ^d | 2,856 | 91 (3.1) | 0 | 0 |
| Kodiak Islands ^e | 1,754 | 116 (6.2) | 0 | 0 |
| Fairbanks area, north of Alaska Range ^f | 559 | 29 (4.9) | 2,681 | 39 (1.4) |
| Western Cook Inlet ^g | 685 | 18 (2.6) | 1,419 | 7 (0.5) |

^a Includes Game Management Unit (GMU) 14 (black bear bag limit = 1/year, season open all year in portion, closed during summer in remainder).

^b Includes GMUs 7 and 15 (black bear bag limit = 2/year, 12-month season).

^c Includes GMU 1 (black bear bag limit = 2/year, season closed July–August).

^d Includes GMU 9, which has few black bears

^e Includes GMU 8, which has no black bears

^f Includes GMU 20 (black bear bag limit = 3/year, 12-month season).

^g Includes GMU 16 (black bear bag limit = 3 bear/year, 12-month season).

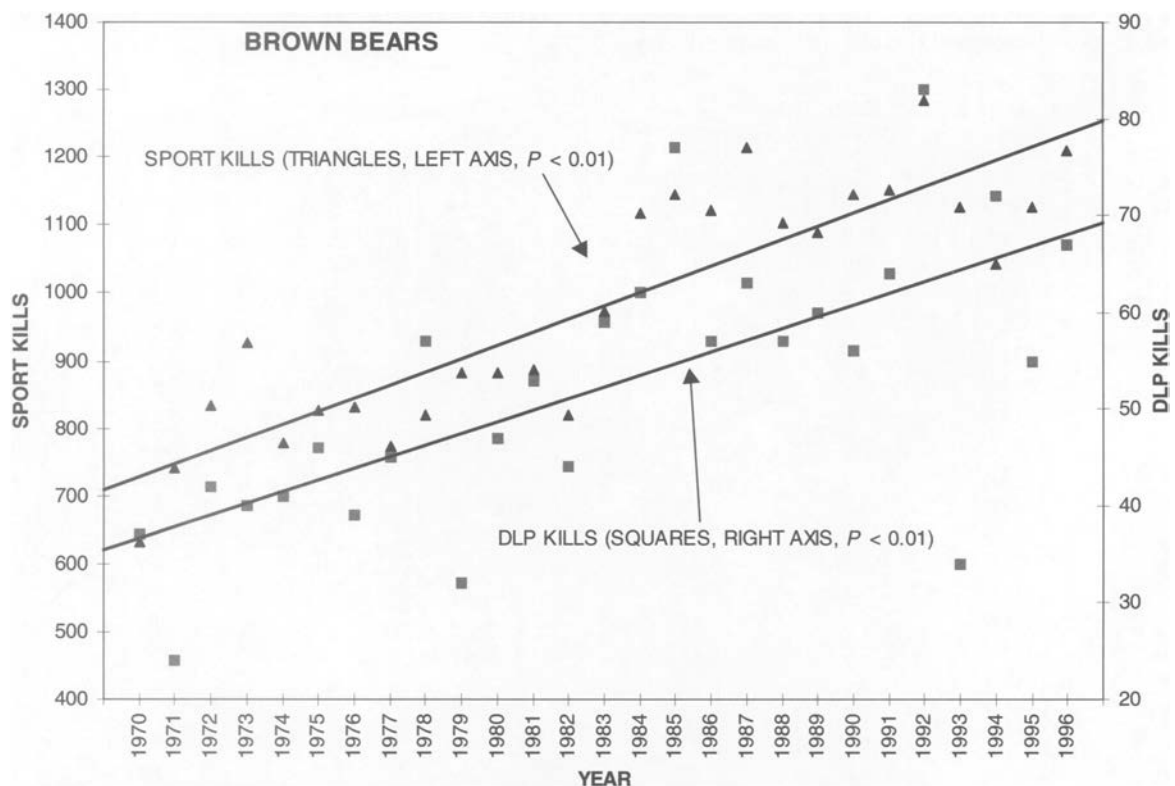


Fig. 1. Trends in number of defense of life or property (DLP)-killed (adjusted $R^2 = 0.44$) and sport-killed (adjusted $R^2 = 0.77$) brown bears in Alaska.

For each sex, there were significant differences in the age composition of brown bears killed in sport and DLP circumstances. Subadult males were more prevalent in the DLP kills than in sport kills ($\chi^2 = 104$, 7 df, $P < 0.001$; Fig. 3). There were also statistically significant

differences between ages of brown bear females killed in sport and DLP circumstances ($\chi^2 = 75.4$, 7 df, $P < 0.001$; Fig. 4). Young adult females (age 4–8) were relatively more common in brown bear sport kills than in DLP kills while older females (ages 11–19) were less com-

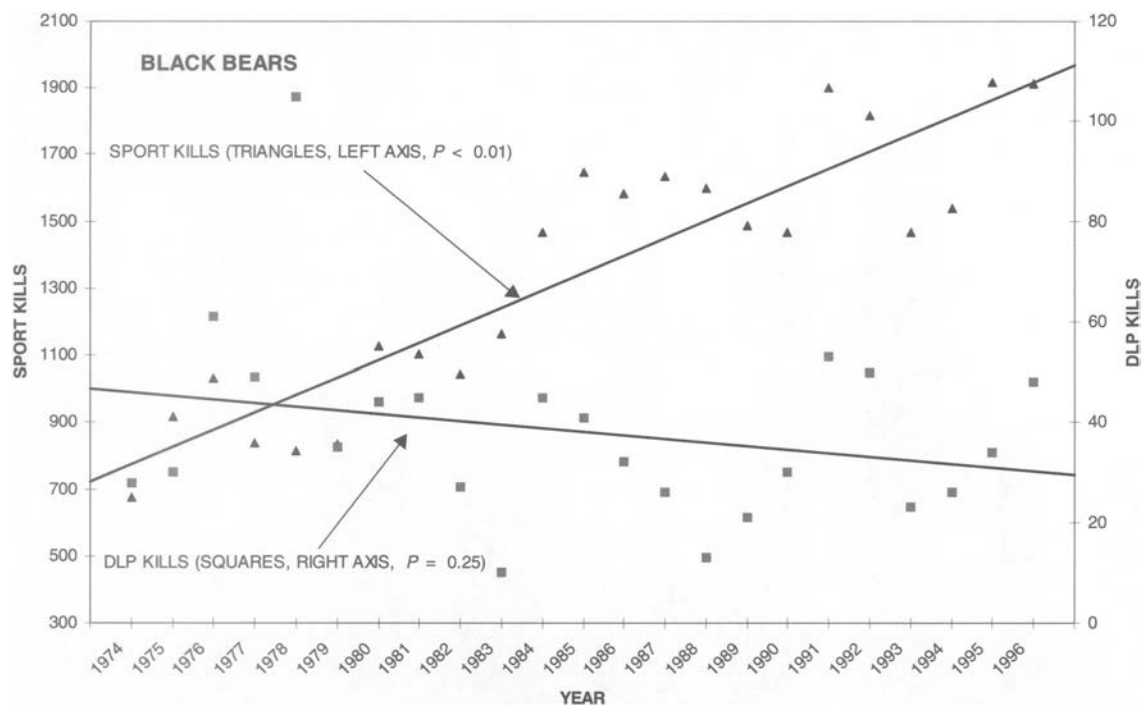


Fig. 2. Trends in number of defense of life or property (DLP)-killed (adjusted $R^2 = 0.02$) and sport-killed (adjusted $R^2 = 0.80$) black bears in Alaska.

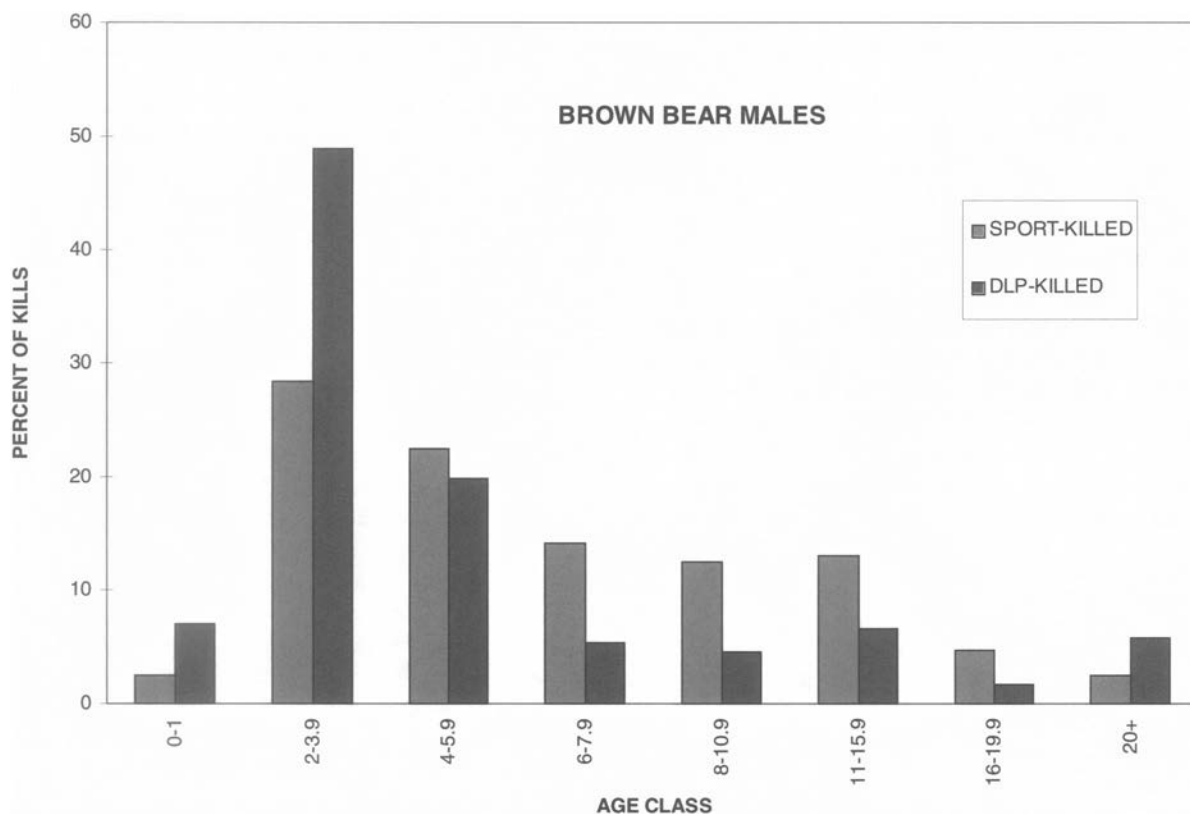


Fig. 3. Age classes of sport-killed and defense of life or property (DLP)-killed brown bear males in Alaska, 1986–96.

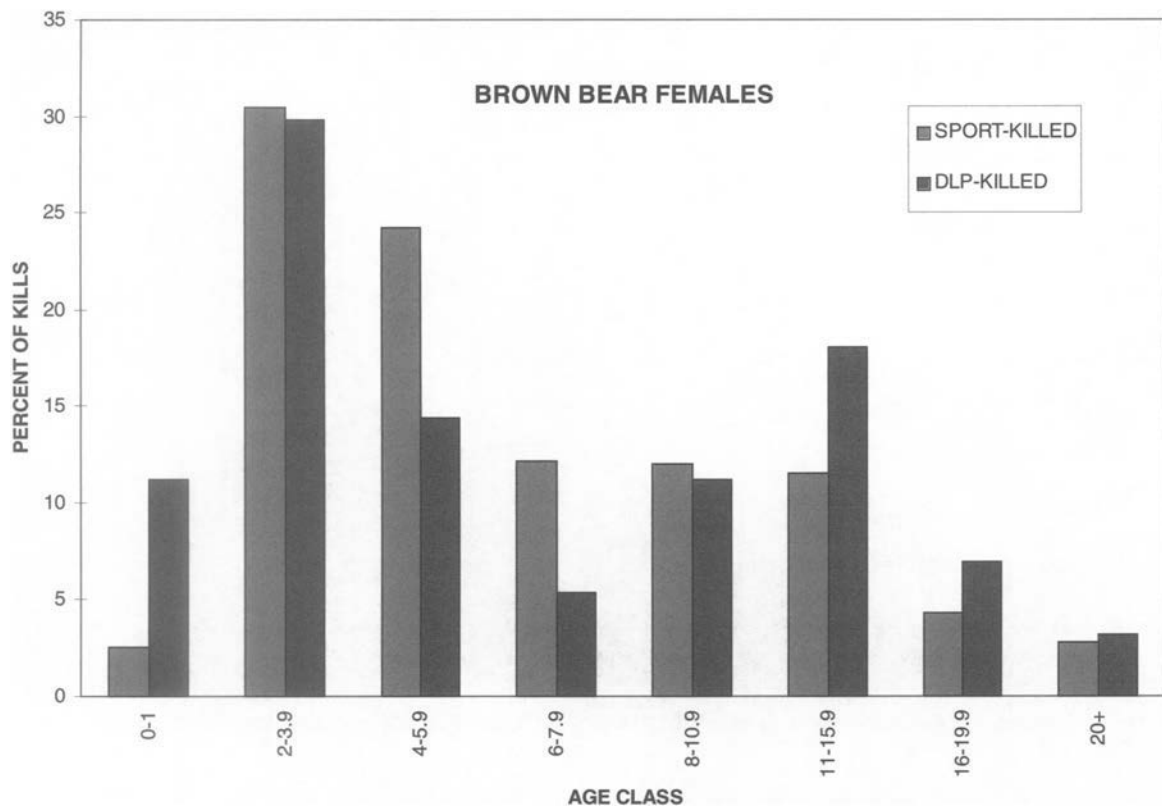


Fig. 4. Age classes of sport-killed and defense of life or property (DLP)-killed brown bear females in Alaska, 1986–96.

mon in sport kills than in DLP kills (Fig. 4). Age comparisons between sport and DLP kills of black bears were not possible, as age data were not available for most black bear kills.

Characteristics of DLP Kills

Associations with Other Bears.—Most brown bears (71.8%) and black bears (90.0%) were alone when killed in DLP circumstances (Table 3). Shooters reported that offspring accompanied the shot bear in 18.5% of brown bear kills and in 4.2% of black bear DLP kills (Table 3).

Typically, female brown bears in Alaska keep their offspring with them for 2 years, separating from them in the spring of the offspring's third year of life. Based on

Table 3. Associations of brown bears and black bears killed in Alaska in defense of life and property (DLP) circumstances, 1986–96. Excludes offspring shot when accompanying their mother (32 brown bears and 5 black bears).

| | Brown bears (%) | Black bears (%) |
|----------------------------------|-----------------|-----------------|
| Alone | 377 (71.8) | 215 (90.0) |
| With offspring ≥ 1 year old | 56 (10.7) | 1 (0.4) |
| With offspring < 1 year old | 41 (7.8) | 9 (3.8) |
| With littermate | 27 (5.1) | 6 (2.5) |
| With another adult | 24 (4.6) | 8 (3.3) |
| Total | 525 (100.0) | 239 (100.0) |

this, a null hypothesis can be formed that two-thirds of adult female brown bears should be accompanied by offspring and one-third should be without offspring. Based on these expected values, DLP deaths of 22 solitary adult females and of 60 adult females accompanied by offspring (Table 4) did not differ from expected values ($\chi^2 = 1.18$, 1 df, $P = 0.21$).

Sex Ratio in DLP Kills.—More brown bear adult (> 4.9 years old) females (85) than males (61) were shot in DLP circumstances ($\chi^2 = 0.32$, 1 df, $P = 0.04$; Table 4). Fifty-three percent of brown bears of all ages killed in DLP circumstances were males; this ratio did not differ from 50:50 ($\chi^2 = 5.4$, 1 df, $P = 0.02$; Table 4). Among sub-adults, there were more males than females in the DLP kills ($\chi^2 = 15.8$, 1 d.f., $P < 0.001$; Table 4). Similarly, more male than female black bears (all ages) were shot in DLP circumstances ($\chi^2 = 38.8$, 1 df, $P < 0.0001$; Table 4). Tests based on age categories for black bears were not possible because of the paucity of age data.

Reasons for DLP Kills.—The distribution of reasons for DLP shootings differed between black and brown bears (Kruskal-Wallis = 25.5, $P < 0.001$). A larger proportion of brown bear DLP deaths resulted from circumstances in which the shooter thought the bear was an immediate threat (40.8%) than for black bears (16%;

Table 4. Associations of brown bears and black bears killed in Alaska in defense of life and property (DLP) circumstances, 1986–96. Data presented here vary from that in Table 3 because of missing information in some records

| | Brown bears adults ^a | | Brown bears (all ages) | | Black bears (all ages) | |
|-----------------------------|---------------------------------|-------------|------------------------|-------------|------------------------|-------------|
| | Males (%) | Females (%) | Males (%) | Females (%) | Males (%) | Females (%) |
| Alone | 58 (95.1) | 22 (25.8) | 224 (84.2) | 100 (46.5) | 129 (91.4) | 42 (77.7) |
| With offspring ≥1 years old | 0 | 33 (38.8) | 4 ^b (1.5) | 47 (21.8) | 0 | 1 (1.8) |
| With offspring <1.0 | 0 | 27 (31.7) | 3 ^b (1.1) | 36 (16.7) | 0 | 8 (14.8) |
| With littermate | 0 | 0 | 12 (4.5) | 7 (3.2) | 3 (2.1) | 1 (1.8) |
| With another adult | 3 (4.9) | 3 (3.5) | 11 (4.1) | 8 (3.7) | 5 (3.5) | 2 (3.7) |
| With its mother | 0 | 0 | 12 (4.5) | 17 (7.9) | 4 (2.8) | 0 |
| Total | 61 | 85 | 266 | 215 | 141 | 54 |

^a Adults defined as bears >4.9 years old.

^b Apparent errors by respondents in classification of age of companion bears, as adult males should not be accompanied by offspring.

Table 5. Reasons reported for shooting brown bears and black bears in Alaska in defense of life and property (DLP) circumstances, 1986–96.

| Reason | Brown bears | | Black bears | |
|--|---------------|-----------------|---------------|-----------------|
| | No. males (%) | No. females (%) | No. males (%) | No. females (%) |
| All bears | | | | |
| <i>Bear was an immediate threat (charging)</i> | 92 (30.9) | 126 (53.4) | 26 (15.5) | 11 (16.4) |
| <i>Bear was thought to be dangerous</i> | 104 (34.9) | 57 (24.2) | 88 (52.4) | 27 (40.3) |
| <i>To protect property</i> | 102 (34.2) | 53 (22.5) | 54 (32.1) | 29 (43.3) |
| Total | 298 | 236 | 168 | 67 |
| Adult (>4.9 years old) bears | | | | |
| <i>Bear was an immediate threat (charging)</i> | 27 (38.0) | 66 (74.1) | 26 (15.7) | 11 (17.1) |
| <i>To protect property</i> | 19 (26.7) | 11 (12.3) | 54 (32.7) | 26 (40.6) |
| Total | 71 | 89 | 165 | 64 |

Table 5). Only 29.0% of brown bear deaths and 35.3% of black bear deaths were identified as resulting from the need to protect property (Table 5).

Reasons for DLP kills differed by sex for adult (>4.9 year-old) brown bears (Kruskal-Wallis = 18.79, $P < 0.001$; Table 5). More females and fewer males were shot when they were described as *charging* than expected under the null hypothesis. Conversely, more males and fewer females were shot to protect property.

A large proportion (84.4%) of the adult female brown bears with offspring that were shot in DLP circumstances were shot because they were *charging* (Table 6). However, only 40.7% of adult female brown bears classified

as *alone* were shot because they were *charging* (Table 6) (Kruskal-Wallis = 12.89, $P < 0.001$).

Type of Property Damaged or Threatened.—A *dwell-ing* was indicated as the most common type of property damaged or threatened by brown bears (18.9%) and black bears (35.3%) killed in DLP circumstances (Table 7). For brown bears, a *game or fish cache or game kill* was the second most common type of property threatened or damaged; threats to this type of property were much less common for black bears killed in DLP circumstances (Table 7). For both species, *threats or damage to live-stock, camping gear, pets, and food* constituted similar proportions of cases where threats or damage to property was indicated (9.7–14.8%; Table 7).

Value of Property Damaged.—Respondents were asked to report the value of damage caused by bears they shot in DLP circumstances. For brown bears and black bears, respectively, 72% and 55% of respondents indicated the question *did not apply* (Table 8). For both species, slightly more than half of respondents who indicated that the bear caused damage reported that the damage caused was in the range \$100–999 (Table 8). Damage exceeding \$1000 was reported in 17.9% of DLP brown bear deaths (where damage was reported) compared to 7.6% for black bears (Table 8). Dollar values reported are those entered by the respondent and were not adjusted to a constant cost basis.

Table 6. Reasons reported for shooting adult brown bear females (>4.9 years old) reported as being alone or with offspring in defense of life and property (DLP) circumstances in Alaska, 1986–96. Data for black bears are unavailable as black bear ages were not systematically obtained.

| Reason | Alone (%) | With offspring (%) |
|--|-----------|--------------------|
| <i>Bear was an immediate threat (charging)</i> | 12 (50.0) | 52 (86.6) |
| <i>Bear was thought to be dangerous</i> | 6 (25.0) | 5 (8.3) |
| <i>To protect property</i> | 6 (25.0) | 3 (5.0) |
| Total | 24 | 60 |

Location of Kills.—For brown bears, most DLP kills (75.7%) occurred in areas identified by the shooter as

Table 7. Property reported to be threatened or damaged by brown and black bears killed in DLP circumstances in Alaska, 1986–1996. Multiple responses are all tabulated.

| Type of property threatened or damaged | Cases for brown bears (%) | Cases for black bears (%) |
|---|---------------------------|---------------------------|
| Dwelling | 87 (18.9) | 84 (35.3) |
| Game or fish cache or game kill | 68 (14.8) | 9 (3.8) |
| Domestic reindeer, livestock, or poultry | 60 (13.0) | 28 (11.8) |
| Camping gear | 51 (11.1) | 24 (10.1) |
| Pets | 48 (10.4) | 23 (9.7) |
| Food | 47 (10.2) | 26 (10.9) |
| Other property | 45 (9.8) | 33 (13.9) |
| Land vehicle, boat, or airplane | 37 (8.0) | 8 (3.4) |
| Subsistence or commercial fishing equipment | 17 (3.7) | 3 (1.3) |
| Total responses | 460 | 238 |

rural (Table 9). The largest proportion of kills in rural areas (36.9%) occurred in back country (*not close to any cabin, dwelling, or campsite*) followed by kills *in or near a village or remote community* (22%; Table 9). The largest number of black bear DLP kills also occurred in rural areas (47.1%), and the largest proportion of these (33.9%) occurred *at or near a permanent residence in a remote*

Table 8. Value of damage (\$US) reported caused by brown and black bears killed in DLP circumstances in Alaska, 1986–96.

| Damage reported (\$US) | Cases for brown bears (%) | Cases for black bears (%) |
|---------------------------------|---------------------------|---------------------------|
| <\$100 | 44 (28.0) | 37 (39.8) |
| \$100–999 | 85 (54.1) | 49 (52.7) |
| \$1000–5,000 | 21 (13.4) | 5 (5.4) |
| >\$5,000 | 7 (4.5) | 2 (2.2) |
| Total responses | 157 (100) | 93 (100.1) |
| Responded <i>Does not apply</i> | 403 | 144 |
| Data missing | 117 | 124 |

Table 9. Responses from persons shooting brown and black bears in DLP circumstances in Alaska, 1986–96, to the question *Which of these best describes where the bear was killed.*

| Location killed | Brown bears | | Black bears | |
|--|-------------|------|-------------|------|
| | <i>n</i> | % | <i>n</i> | % |
| Rural | | | | |
| <i>In back country (not close to any cabin, dwelling, or campsite)</i> | 161 | 28.0 | 15 | 5.8 |
| <i>At or near a temporary campsite</i> | 71 | 12.3 | 21 | 8.2 |
| <i>At or near a lodge or seasonal-use cabin in a remote area</i> | 43 | 7.5 | 21 | 8.2 |
| <i>At or near a permanent residence in a remote area</i> | 64 | 11.1 | 41 | 16.0 |
| <i>In or near a village or remote community</i> | 96 | 16.7 | 17 | 6.6 |
| <i>Public campground</i> | 1 | 0.2 | 6 | 2.3 |
| Subtotal | 436 | 75.7 | 121 | 47.1 |
| Urban | | | | |
| <i>In or near an urban area (town, city, etc.)</i> | 37 | 6.4 | 89 | 34.6 |
| <i>In or near a dump or garbage container in an urban or village area</i> | 24 | 4.2 | 11 | 4.3 |
| Subtotal | 61 | 10.6 | 100 | 38.9 |
| Agricultural | | | | |
| <i>Livestock ranch or farm</i> | 10 | 1.7 | 5 | 1.9 |
| <i>Near reindeer</i> | 10 | 1.7 | 0 | 0.0 |
| Subtotal | 20 | 3.5 | 5 | 1.9 |
| Industrial | | | | |
| <i>Logging camp or logging road</i> | 16 | 2.8 | 18 | 7.0 |
| <i>Mining operation</i> | 2 | 0.3 | 0 | 0.0 |
| <i>At or near a development, construction or mining site (not in an urban area or village)</i> | 3 | 0.5 | 1 | 0.4 |
| Subtotal | 21 | 3.6 | 19 | 7.4 |
| Fishing-related | | | | |
| <i>At a set net or subsistence fishing site</i> | 7 | 1.2 | 1 | 0.4 |
| <i>Near a cannery or related facility</i> | 5 | 0.9 | 1 | 0.4 |
| <i>Near a salmon^a weir</i> | 4 | 0.7 | 0 | 0.0 |
| Subtotal | 16 | 2.8 | 2 | 0.8 |
| Other | 17 | 3.0 | 8 | 3.1 |
| Total ^b | 576 | 100 | 257 | 100 |

^a *Oncorhynchus* spp.

^b For brown bears 550 respondents provided a single answer, 11 provided 2 answers, and 1 provided 4 answers. For black bears 235 provided a single answer and 11 provided 2 answers.

area (Table 9). Compared to brown bears (10.6% of DLP kills), a relatively large proportion of black bear kills (38.9% of DLP kills) occurred in urban areas (Table 9).

Activity of Person Shooting Bear.—For both species of bear, the person shooting the bear most frequently described their activity as *at home or dwelling* (32.6% and 46.6% for brown and black bears, respectively; Table 10). The next most common activity for persons shooting DLP brown bears was *hunting* (32.1%). Hunting was comparatively uncommon for persons shooting DLP black bears (4.9%); a larger proportion of DLP black bears were shot by persons *working* (8.5%) or by agency officials conducting management actions (21.9%; Table 10). For both species, only a small proportion of DLP kills resulted from persons who were *sport fishing* or *photographing* (Table 10).

Persons who listed their activity when they shot a DLP brown bear as *hunting, fishing* or *photographing* were most commonly in search of deer (*Odocoileus hemionus*; 33.3%), moose (*Alces alces*; 18.2%), brown bears (12.3%), caribou (*Rangifer tarandus*; 10.0%), or salmon (7.3%; Table 11). Deer are uncommon in Alaska except for an introduced population on Kodiak Island and adjacent Afognak Island and in southeastern Alaska.

Timing of DLP Kills.—DLP kills of brown bears increased during spring, peaked in July, and remained high and constant until den entrance in November (Fig. 5). Black bear kills also increased during spring to a peak in

July. A likely contributing factor to this July peak was the closure of black bear hunting seasons in some areas during the summer. This closure of sport hunting means that nuisance black bears that were shot could not be claimed as sport kills.

The temporal pattern of DLP deaths varies based, to some degree, on the age of the bear. Subadult brown bears (age 1.0–4.9 years) were most commonly shot in July–September (59.2%). A smaller proportion (43.6%) of adult bears (>4.9 years) was shot during July–September. More adult bears (23.5%) were shot during October than during any other month.

The temporal pattern of DLP brown bear kills varies by region, depending on human activities in those regions (Fig. 6, Miller and Chihuly 1987)). This is most noticeable in the Kodiak and Shuyak Island area where frequency of kills is relatively constant throughout the year except for October–November when many deer hunters are in this area (Fig. 7). The October peak in southeastern Alaska (Fig. 7) also coincides with deer hunting seasons there. As noted above (Table 11), deer hunting was the most common activity for persons who shot DLP brown bears while hunting, fishing, or shooting photos. The large proportion of DLP kills on the Alaska Peninsula in July–August coincides with sport, subsistence, and commercial fishing activities for salmon and the peak in September with the popular caribou hunting seasons (Fig. 7). In the interior and western coast region, which

Table 10. Responses from persons shooting brown and black bears in DLP circumstances in Alaska, 1986–96, to the question What were you (the person who killed the bear) doing when you first saw the bear?

| Shooter's activity | Brown bears | | Black bears | |
|--|-------------|------|-------------|------|
| | No. | % | No. | % |
| <i>At home or dwelling</i> | 191 | 32.6 | 115 | 46.6 |
| <i>Hunting</i> | 188 | 32.1 | 12 | 4.9 |
| <i>Official public safety or wildlife agency response or conducting depredation or other control operation</i> | 48 | 8.2 | 54 | 21.9 |
| <i>Working (stream census, geological studies, survey, mapping, etc.)</i> | 26 | 4.4 | 21 | 8.5 |
| <i>Camping</i> | 20 | 3.4 | 4 | 1.6 |
| <i>Sport fishing</i> | 14 | 2.4 | 5 | 2.0 |
| <i>Reindeer herding</i> | 11 | 1.9 | 0 | 0.0 |
| <i>Traveling on road</i> | 9 | 1.5 | 1 | 0.4 |
| <i>Hiking</i> | 8 | 1.4 | 3 | 1.2 |
| <i>Commercial fishing</i> | 6 | 1.0 | 1 | 0.4 |
| <i>Wildlife research</i> | 5 | 0.9 | 1 | 0.4 |
| <i>Mining</i> | 4 | 0.7 | 1 | 0.4 |
| <i>Photography</i> | 4 | 0.7 | 0 | 0.0 |
| <i>Subsistence fishing</i> | 4 | 0.7 | 1 | 0.4 |
| <i>Logging-related activity</i> | 3 | 0.5 | 10 | 4.0 |
| <i>Other</i> | 45 | 7.7 | 18 | 7.3 |
| Total ^a | 586 | 100 | 247 | 100 |
| Data missing | 118 | | 119 | |

^a For brown bears 534 respondents provided a single answer, 24 provided 2 answers, and 1 provided 4 answers. For black bears 237 respondents provided a single response and 5 provided 2 responses.

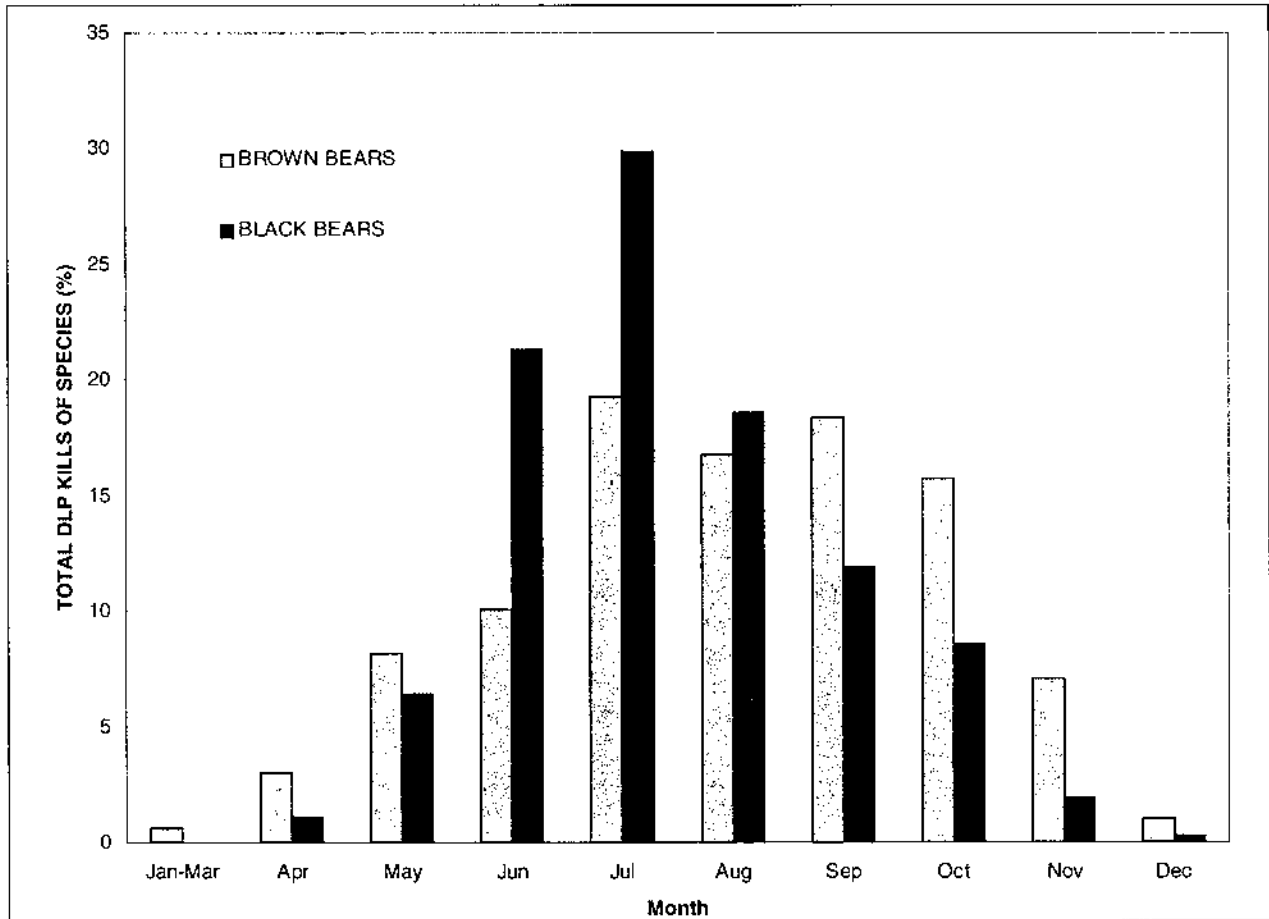


Fig. 5. Month of defense of life or property (DLP) kills of brown bears and black bears in Alaska, 1986–96.

is most of the state, most DLP brown bear kills occur when Alaskans are hunting (September) or involved in other recreational activities in rural areas (July–August).

Injuries to People Caused by Bears

Most of the persons shooting brown bears or black bears in DLP circumstances indicated that no human injury occurred (98.5% for brown bears and 99.2% for black bears). For the brown bear DLP reports, minor human injuries were reported in 2 cases, injuries requiring hospitalization in 6 cases, and human death in 2 cases. For black bear DLP kills, there was 1 incident of minor human injury and 1 case of human death. Records which had no response to this question were not included in these percentages.

However, when injuries or deaths from bears occurred, the bear frequently was not found, so these data under represent the frequency of injury to people from bears. Based on newspaper accounts of human injury resulting from bear attacks during 1985–96, there were 36 brown bear incidents that resulted in 33 human injuries and 5 deaths and 4 black bear incidents that resulted in 3 hu-

man injuries and 1 death. For brown bears, the average during this 12-year period was 2.75 injuries/year and 0.42 deaths/year. For black bears, the average during this 12-year period was 0.33 injuries/year (Table 12). The fatal

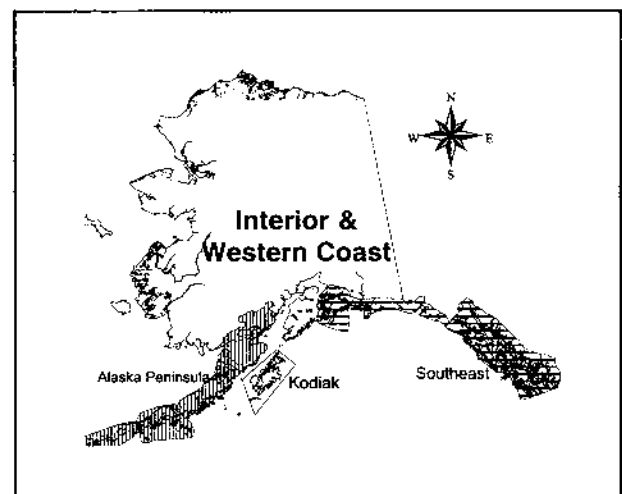


Fig. 6. Regions of Alaska used to evaluate defense of life or property (DLP) kills of bears, 1986–96.

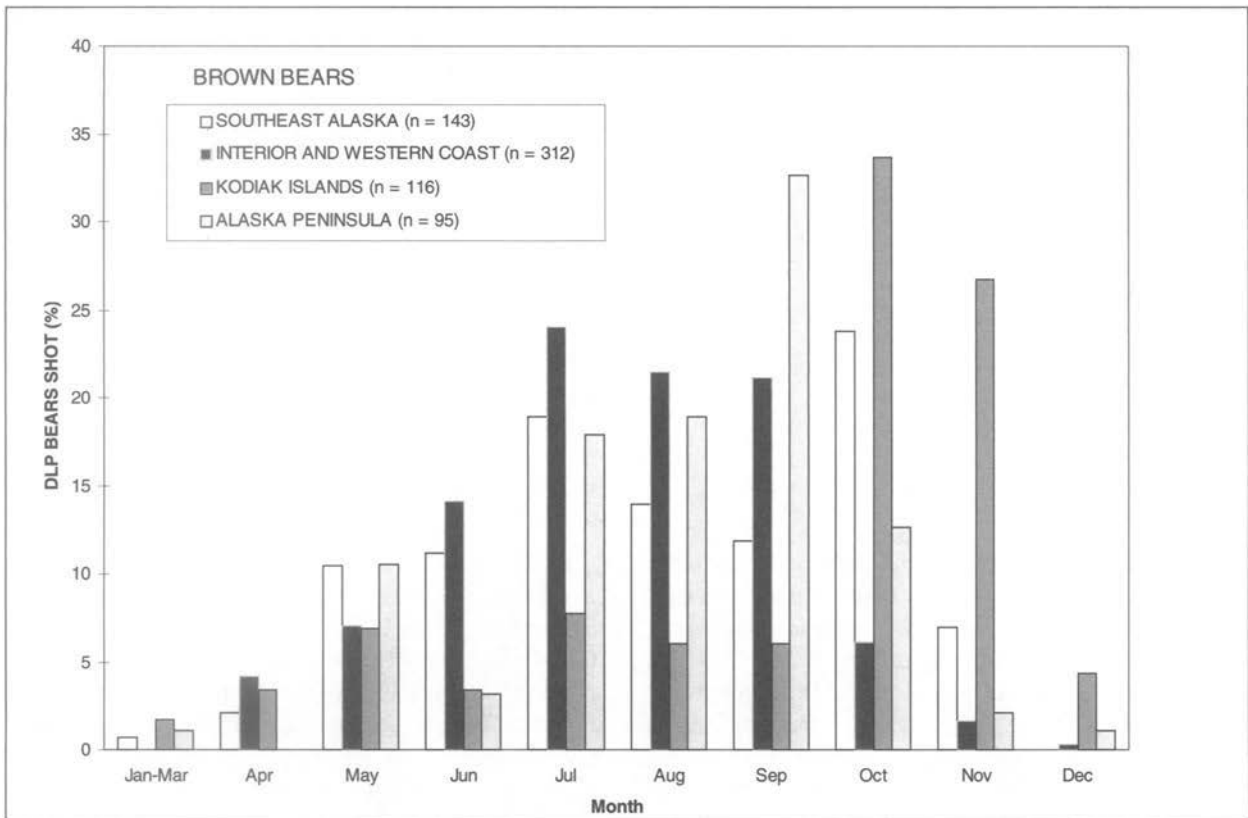


Fig. 7. Month of defense of life or property (DLP) kills of brown bears by region of Alaska, 1986–96.

black bear incident occurred in 1992 and was the only human fatality from a black bear attack in Alaska of which we are aware. We may not have heard of fatalities that occurred prior to about 1975.

Table 11. Target species of hunters, fishermen, or photographers shooting brown and black bears in DLP circumstances in Alaska, 1986–96.

| Target species | Brown bears | | Black bears |
|---|-------------|------|-------------|
| | No. | % | No. |
| Deer | 73 | 33.3 | 2 |
| Moose | 40 | 18.3 | 1 |
| Brown bear | 27 | 12.3 | 1 |
| Caribou | 22 | 10.0 | 0 |
| Salmon | 16 | 7.3 | 3 |
| Sheep (<i>Ovis dalli</i>) | 10 | 4.6 | 2 |
| Black bear | 7 | 3.2 | 2 |
| Elk (<i>Cervus elaphus</i> ; Afognak Island Population) | 6 | 2.7 | 0 |
| Goats (<i>Oreamnos americanus</i>) | 4 | 1.8 | 0 |
| Other | 7 | 3.2 | 2 |
| Total | 219 | 99.9 | 15 |
| Does not apply | 354 | | 228 |

DISCUSSION

Except in large cities, the Alaska Department of Fish and Game (ADFG) makes little effort to systematically collect reports of conflicts between bears and people that are commonly collected in other jurisdictions. In Anchorage, Alaska’s largest city, the ADFG and the Alaska Department of Public Safety offices receive hundreds of calls each year reporting bears passing through yards, knocking over trash cans, and similar incidents. The frequency with which such calls are received varies annually, depending on environmental variables that affect natural foods and on newspaper accounts of injuries caused by bears (R. Sinnott, Alaska Department of Fish and Game, Anchorage, Alaska, USA personal communication, 1997). Many of these calls are for sightings or minor incidents. In Alaska and other jurisdictions, just a few individual bears may generate the bulk of such incident reports. We believe the DLP reports we examined here represent more serious conflicts between humans and bears, because each resulted in the death of a bear. For bear population management, we believe that incidents resulting in a bear’s death are most significant to document.

Table 12. Annual tabulation of number of defense of life and property (DLP) kills of brown and black bears and known incidents of human death or injury caused by bear attacks in Alaska, 1986–96.

| Year | DLPs | Brown bear attacks | | Black bear attacks | |
|-------|-------|--------------------|--------------|--------------------|--------------|
| | | Human injuries | Human deaths | Human injuries | Human deaths |
| 1985 | 118 | 5 | 0 | 1 | 0 |
| 1986 | 89 | 1 | 0 | 0 | 0 |
| 1987 | 89 | 1 | 0 | 0 | 0 |
| 1988 | 70 | 2 | 1 | 0 | 0 |
| 1989 | 81 | 0 | 0 | 0 | 0 |
| 1990 | 86 | 2 | 0 | 0 | 0 |
| 1991 | 117 | 1 | 0 | 1 | 0 |
| 1992 | 133 | 2 | 1 | 0 | 1 |
| 1993 | 57 | 1 | 0 | 1 | 0 |
| 1994 | 98 | 6 | 0 | 0 | 0 |
| 1995 | 89 | 6 | 2 | 0 | 0 |
| 1996 | 115 | 6 | 1 | 0 | 0 |
| Total | 1,024 | 33 | 5 | 3 | 1 |

In Alaska, DLP deaths to both brown bears and black bears remain a small fraction of total human-caused mortalities. However, for brown bears in urban areas, DLP mortalities represent a significant proportion of total mortalities. Because both sport and DLP brown bear kills are increasing in Alaska and the bear populations are not thought to be increasing (Miller 1993), it is likely that DLP deaths will become an increasing proportion of human-caused brown bear deaths in more areas of the state.

Black bear sport kills are increasing in Alaska, but reported DLP deaths are relatively constant. We suspect that DLP black bear deaths may also be increasing, but that such increases are masked by liberal black bear hunting regulations, which encourages reporting DLP black bear kills as sport kills. Black bear sport hunting regulations are typically liberal in urban areas of Alaska. Around Fairbanks, for example, bears may be shot year around, there is a 3 bear/year bag limit, and black bear baiting is permitted. This doubtlessly explains the extremely low frequency of DLP kills around Fairbanks, as well as on the Kenai Peninsula, where similar circumstances exist.

DLP kills of both bear species appear to increase following newspaper accounts of attacks by bears and deaths caused by bears. The largest number of DLP deaths to bears (83 brown bear DLPs and 50 black bear DLPs) occurred during 1992 (Table 12). During that year there was a fatal mauling of a running child by a garbage-habituated brown bear in a remote village, a fatal mauling of a tourist by an apparently predatory black bear, and a widely-reported mauling of the Outdoors Editor of the state's largest newspaper (*The Anchorage Daily News*) during a hunting incident.

In 9 of the 40 incidents in our 12-year collection of newspaper accounts of human injury and deaths caused by bears, the bear involved was shot. This illustrates that the number of injuries and deaths to humans reported in our DLP records underestimates the total. Our file of newspaper accounts also underestimates injuries (but not deaths), because not all injuries are reported and all newspaper accounts are probably not in our file.

The prevalence of young males and older females in the DLP kills of brown bears compared to sport kills suggests that DLP kills have a mixed impact on bear populations compared to sport kills. Young males are probably the most expendable component of bear populations, whereas adult females are the least expendable.

The high number of subadult males in DLP kills compared to sport kills doubtless results from young males dispersing from maternal home ranges and encountering humans in areas where humans are intolerant of their presence. It may also result from preferences of hunters for larger, adult bears.

Relative to sport kills, DLP kills take a higher proportion of adult female brown bears. This may be because adult female bears frequently are accompanied by offspring and hunters are constrained by law and ethics from shooting them.

DLP kills of brown bears noticeably increase during periods when human activities such as hunting or fishing occur in specific regions of Alaska. Similar results were reported by Miller and Chihuly (1987). Black bear DLP kills peaked during the summer period when some areas have closed black bear hunting seasons. At other times, bears that would otherwise have been claimed as DLP kills are reported as sport harvests.

We examined the data on DLP kills by sex and reason for the killing to evaluate whether adult female brown

bears accompanied by offspring are more dangerous than other bears. Under the assumption that two-thirds of adult female brown bears should be accompanied by offspring, the frequency with which solitary and females with offspring were shot in DLP circumstances did not vary from expected. Also, male and female brown bears constituted equivalent proportions of adult bears shot in DLP circumstances. However, female brown bears accompanied by offspring were significantly more prevalent than unaccompanied bears in the category of bears that were shot because they were *immediately dangerous (charging)*. These data support the hypothesis of Herrero (1985) that female brown bears accompanied by offspring are more aggressive than adult females not accompanied by offspring. Adult male brown bears, on the other hand, were more likely to be shot to protect property than adult females.

Brown bears shot in DLP circumstances were much more likely to have been shot because they were immediately dangerous than DLP black bears. Black bears were more likely than brown bears to be shot because they were considered *potentially dangerous* or *to protect property*. This difference probably reflects behavioral differences between the 2 species. Herrero (1985) suggested that brown bears were more aggressive than black bears because they evolved in more open habitats without escape cover.

It is clear that some people needlessly shot brown bears because they considered the bear to be *immediately dangerous or charging*. Over 200 brown bear DLP kills were justified on this basis during a period when we documented a total of 33 injuries and 5 deaths to people. Better education on how to recognize a dangerous bear would help reduce some needless shootings. However, such educational efforts are overwhelmed by sensational accounts of bear attacks in popular media, especially sporting magazines. Such accounts tend to leave a more indelible impression on public perceptions than reasonable educational efforts.

Our data suggest that increased conflicts with both species of bears result from construction of cabins and other dwellings in remote areas. In cases where bears were shot to protect threatened property, a *dwelling* was the most common type of property being threatened by bears. Game or fish harvested by a sportsperson was the second most common type of threatened property resulting in DLP deaths of brown bears; this type of property resulted in black bear DLP deaths less frequently. Reintroduction of brown bears into areas where sport hunting and sport fishing are common likely will result in an increase in human–bear conflicts. In Alaska, protection of harvested game or fish is not a legal reason to shoot

bears under DLP regulations, but this law is seldom enforced because shooters typically claim additional justifications.

Although industrial development such as mining or logging results in increased DLP bear deaths, most of the DLP deaths to both species of bears resulted from people who described their activity as being at their home or dwelling (32.6% for brown bears, 48.6% for black bears). The low number of DLP deaths accompanying industrial development may reflect intentional efforts by these industries to avoid conflicts with bears. In other cases, it may reflect efforts to conceal the frequency of DLP deaths to lessen government interference in their operations.

For brown bears, hunters made almost the same proportion of DLP kills (32.1%) as persons at their homes or dwellings. Deer, moose, and caribou hunters killed the largest proportion of DLP brown bears (61.6% combined). These ungulates are prey for brown bears and many of these DLP kills may have resulted when bears were attempting to usurp hunter kills.

In most cases there was no economic damage reported by bears being killed in DLP circumstances (71.9% of brown bear DLPs and 60.7% for black bears). In the cases where economic damage was reported, however, it was <US\$ 1,000 in 82.1% of brown bear DLP killings and 92.5% of black bear killings. These data underrepresent the damage by bears because they do not include damage when the bear is not shot.

Bears shot in DLP circumstances, instead of surviving to be harvested in sport circumstances or viewed and photographed, are an economic loss to Alaska. The gross value of successful Alaskan brown bear and black bear hunting trips by non-residents was estimated to be \$11,954 and \$8,810 (US 1991), respectively (Miller et al. 1998). For Alaska residents, these values were \$1,286 and \$1,114 (US 1991) for brown bears and black bears, respectively (McCollum et al. 1996, Miller et al. 1998). Gross economic value of wildlife viewing trips during which bears were seen was estimated to be \$962 (US 1991; Miller et al. 1998). The value of a bear to these hunting and viewing uses exceeds the economic loss caused by bears shot in DLP circumstances in most cases.

Based on analysis of newspaper accounts and other records, Middaugh (1987) documented 85 injuries plus 20 fatalities from brown bear attacks in Alaska during 1900–85. At face value, these early records yield an injury rate of 1/year and a death rate of 0.24/year. This is about 36% of the average annual injury rate and 57% of the death rate based on the brown bear attacks we found in our newspaper files during 1985–96. Middaugh's records, like ours, doubtless underestimate the actual fre-

quency of injuries from bear attacks because not all injuries are reported in either set of records. However, Middaugh's data are consistent with our conclusion that the increasing human population of Alaska and increased back-country use associated with tourism contributes to increased frequency of brown bear attacks on humans.

The increasing trend of brown bear deaths in both DLP and sport circumstances in Alaska may foreshadow a day when sport kills will have to be limited to keep total bear deaths within sustainable levels. The Kenai Peninsula is currently the only area in Alaska where management plans call for constraining sport kills of brown bears when combined sport and DLP kills of female bears exceed threshold levels. This type of management likely will need to be adopted in additional areas if current trends continue.

Our data on causes and kinds of DLP deaths to bears in Alaska indicates what to expect in other areas should bears be reintroduced or increase in abundance. However, each area has different attractants and potentials for bear problems. Alaska, for example, has little conflict between bears and apiaries; the rest of the United States likely will have less interaction between salmon fishermen and bears.

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