Proceedings of the Fourth Western Black Bear Workshop

Jeffrey A. Keay, Editor

Technical Report NPS/NRWR/NRTR-93/12

United States Department of the Interior • National Park Service • Western Region

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Yosemite National Park, California

Jeffrey A. Keay, Editor

Denali National Park and Preserve
P.O. Box 9
Denali Park, AK 99755

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Contents

Preface

When asked to coordinate the Fourth Western Black Bear Workshop, I wanted to focus on topics that were little understood yet had important management implications. Also, as a National Park Service employee, I have long believed that one of the great values of our national parks is that they allow us to better understand the processes of natural regulation, which in turn will help us to better manage habitat and wildlife resources outside the parks. The natural regulation of black bear populations is of particular interest to me and seemed an appropriate topic for this workshop. My goal was to summarize our current understanding of natural regulation in black bears, identify important research needs, and help managers and researchers better appreciate how important such an understanding is in managing black bear populations. Bruce McLellan did an outstanding job coordinating that session of the workshop and accomplishing that goal. For the next few years this volume should serve as a springboard for furthering our understanding and for directing research efforts.

Monitoring black bear populations has been a great challenge for most management agencies. Biologists in the eastern United States and Canada felt they had beaten this issue to death. Biologists in the western states and provinces wanted to know more. Dave Garshelis not only has a tremendous understanding of the subject, but developed a valuable teaching technique that helped us learn by participating in data interpretation. The report on Dave's workshop session and his paper published in the Proceedings of the 10th Eastern Black Bear Workshop should serve as valuable references for beginning any black bear population work.

Black bear population management varies by location, human factors, and time. Terry Mansfield and Don Koch pulled together a useful session that focused on the various management issues of today. Comparisons between state and provincial management programs provide an interesting and useful perspective of the state of the art in black bear management and the many pressures affecting that management, including some new twists added through voter initiatives. This volume should help managers assess their programs and glean new ideas for improvement.

Jeffrey A. Keay
Workshop Coordinator

Acknowledgements

Although I coordinated the Fourth Western Black Bear Workshop, its success was due to the session chairs, who provided a truly exceptional program. We owe each of them, Bruce McLellan, Dave Garshelis, Terry Mansfield, and Don Koch, our gratitude. Several people were extremely helpful with logistics. Kay Beeley coordinated registration and volunteer help, Steve Thompson assisted with the announcements and various logistical arrangements, and Bob Roney tape-recorded the discussion sessions, which we summarized in this document. Several others set up tables, collected money, stuffed envelopes, answered questions, and performed other tasks. To each of them a hearty thanks. Of course, great appreciation is due to the National Park Service and specifically Yosemite National Park for hosting the workshop, and Denali National Park and Preserve for supporting my involvement in planning the workshop and publishing the proceedings. Fred Dean assisted with review of the manuscript, and we are very appreciative of his efforts. Thanks to the Yosemite Association for financial support with the announcements and meeting facilities. Of course, we must also thank each of the presenters and attendees for their valuable contributions, either formally or during discussions, and the International Association for Bear Research and Management for sponsoring the workshop. It was a great pleasure and honor for me to work with each of these people and organizations and to help make this workshop a success.

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Black Bear Management

Black Bears in the Southeast: To List or Not to List?[1]

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Summary

The status of black bears in North America ranges from pest to threatened. The species appears relatively secure throughout most parts of its range except the southeastern coastal plain; in this region a number of disjunct populations exist on primarily publicly owned lands. Concern over the status of *Ursus americanus luteolus* led to a petition to list this subspecies under the Endangered Species Act. The Endangered Species Act is arguably the most important wildlife legislation in recent years. However, applying this valuable, but young, untested, and evolving legislation to the black bear subspecies is judged unwarranted and premature because of the following reasons: (1) extensive restocking efforts with *Ursus americanus americanus* from outside the region and empirical evidence of breeding with native animals, (2) bears of different subspecies using dispersal corridors and likely past and future artificial shuffling of bears, (3) genetic evidence of a homogeneous population throughout the region, (4) likely influence of nutrient-rich habitats and phenotypic responses by the bears, (5) historically applying artificial subspecific criteria, (6) historically underestimating initial population estimates and documenting these underestimates through intensive site-specific studies, (7) large amounts of existing bottomland hardwood forests in Louisiana and their concomitant relative stability into the future because of public ownership and regulation, (8) recent history of applying the Endangered Species Act to some charismatic megafauna and resulting problems of consistency, equitability, flexibility, expediency, and perceptions as well as breadth of interpreting the present Endangered Species Act, and (9) many remaining important, unanswered questions. Certainly, the more than 30 "populations" in the Southeast need our attention, particularly the smaller, more disjunct ones. The Endangered Species Act is a valuable tool but the wrong one to apply in this instance without substantially more documentation, research, and modification. Help for bears in the region may better be provided through existing state, federal, and private cooperation by a regional organization such as the Southeastern Association of Fish and Wildlife Agencies.

After extensive public input, the U.S. Fish and Wildlife Service will make a final decision regarding *Ursus americanus luteolus* by July 1991. In the meantime, concerned parties have formed the Black

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[1]Presented at the 10th Eastern Black Bear Workshop, DeGray State Park, Arkansas, April 1990.

Bear Conservation Committee to work on solutions to ensure the future survival of the species in its present range in Mississippi, Louisiana, and east Texas. This committee presently consists of a wide variety of both public and private organizations. Representatives include the Nature Conservancy, Sierra Club, the U.S. Forest Service, Louisiana and Mississippi departments of wildlife and fisheries, a number of private industrial forest landowners, the Louisiana Forestry Association, and Mississippi State University, Louisiana State University, and the University of Tennessee. A strategic plan is being developed and several projects have already been funded. Major purposes of the Black Bear Conservation Committee are habitat management, research, information and education, and funding.

This presentation was published in its entirety in the Proceedings of the 10th Eastern Black Bear Workshop held in April 1990 in Arkansas.

Footnote: On 7 February 1992, the U.S. Fish and Wildlife Service officially listed *Ursus americanus luteolus* as a threatened subspecies under the Endangered Species Act. The Black Bear Conservation Committee continues to play an active role in restoring this subspecies. The organization has produced a black bear management handbook, a draft restoration plan, and a quarterly newsletter. Three major research projects have been initiated as a result of the efforts of the Black Bear Conservation Committee.

Status Reports

Alaska

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Distribution and Abundance

Black bear distribution is generally correlated with spruce forest distribution in Alaska. As such, black bears are distributed over about three-fourths of Alaska. The species is erratic or nonexistent north of the Brooks Range and on the Seward Peninsula, the Kuskokwim Delta, the Alaska Peninsula, and the on Kodiak, Montague, Hinchinbrook, Admirality, Baranof, Chichagof, and Kruzof islands. Brown bears (*Ursus arctos*) are found on all seven of these islands. Black bear distribution in Alaska was illustrated by Schwartz et al. (1979). A reliable estimate of total black bear numbers in Alaska is not available. Data suggest that on a statewide basis, populations are probably stable. Declines in numbers have doubtlessly occurred in some localized areas that are heavily hunted or where extensive human development has occurred.

Population Monitoring System

A check station is mandatory for all bears harvested from the central portion of the state, where most people live. At this check station, bear skulls and hides are sealed with a locking tag. Sealing is required within 30 days of killing a bear. Processing or exporting a hide from the state without this tag is illegal. The sealing requirement is waived in some rural areas where hunters would have difficulty registering their kills at a fish and game office. In most of these areas, the majority of black bears are killed for their meat. During sealing, skulls are measured and a tooth is extracted for age determination, and sex is determined from the hide. Currently, teeth extracted during sealing are aged only in or for selected game management units where concerns exist about potential overharvests. In areas where sealing is not required, population monitoring is based on subjective impressions from hunters, local residents, and local biologists.

Management Objectives and Strategies

The number of bears harvested is examined for population trends. A potential decline in a population may be inferred from either increasing or decreasing trends in the numbers harvested,

depending on the level of hunting effort. Successful hunter effort data are obtained during sealing. Increases in the proportion of females in the harvest without explanations based on season or regulation changes suggest a potential overharvest. In some areas, population size is estimated based on research studies. Sustainable harvest levels are calculated from productivity and mortality data. In these areas, seasons and bag limits are adjusted to keep harvests within these calculated sustainable levels. Special reduced bag limits are in effect for "blue" or "glacier" color phases, which are eagerly sought trophies by some hunters.

Species Management Plan

Species management policies were adopted in 1980. These policies acknowledged that recreation (hunting, observation, and photography) was the most important use of black bears throughout the state. In areas where people are dependent primarily on wildlife for food, management will be designed to meet their needs within the limitation of maximum sustained yield. Commercially harvesting black bears will be opposed (currently, selling any bear parts is illegal).

Recent Research and Publications

Current research is limited to two small-scale projects funded by the military. In the Fairbanks area, a U.S. Army project conducted by John Hechtel (Alaska Department of Fish and Game) is motivated by concerns that the bear population in the Fairbanks area is overexploited. Another study in the Anchorage area is being conducted by personnel from Elmendorf Air Force Base with assistance from Mike McDonald (Alaska Department of Fish and Game). This study is designed to identify ways to minimize problems with nuisance or habituated bears in the vicinity of the base.

Three more long-range studies have been completed. The first of these was a population identity study in Prince William Sound (Modafferi 1982). Subsequent studies have focused on (1) black bear predation on moose (Schwartz and Franzmann 1980, 1983, 1989, 1991; Ballard et al. 1990), (2) black bear population ecology on the Kenai Peninsula (Schwartz et al. 1983, Schwartz and Franzmann 1991), (3) denning ecology (Erickson et al. 1982, Schwartz et al. 1987, Miller 1990*a*), (4) impacts of a proposed hydroelectric project on black bear populations (Miller 1987), (5) general bear management principles (Miller 1990*b*), (6) bear harvest data interpretation (Miller and Miller 1988, 1991), and (7) density estimation techniques (Miller et al. 1987, in prep.). For each management unit in the state, the Alaska Department of Fish and Game publishes an annual report on black bear harvest and status (e.g., Morgan 1990). These reports are prepared by the biologist in charge of each management unit.

Hunting Laws and Regulations

Shooting a black bear accompanied by cubs in their first year of life or shooting a cub in its first year of life is illegal. In most of the state no closed season for black bears exists, and the bag limit is three bears per year. In southeastern Alaska the season runs from September through June and the bag limit is two bears, only one of which may be a blue color phase. The same season exists in Prince William Sound, but the bag limit is one bear. The bag limit is also one bear in the heavily settled Anchorage-Palmer-Wasilla area, but the area has no closed season.

Nonresident hunters must purchase a tag ($225/bear). In most areas hunters must register their kills by presenting the skull and hide to a state fish and game officer within 30 days of the kill. Hunting over bait is allowed in some management units during selected periods; hunters must preregister their bait stations with the department of fish and game. Bear meat is not required to be salvaged unless the hide is not salvaged. A permit is required to hunt with dogs, and only a few bears are taken in this manner. The skull and hide of bears taken in "defense of life and property" must be surrendered to the state.

Harvest Summary

Reported hunter harvests of black bears has averaged 1,594 bears per year during regulatory years 1985-89. Of these, 76% of the bears are killed by Alaska residents. Current harvests represent a 78% increase from the average of 896 bears per year during 1974-78 reported by Schwartz et al. (1979).

Property Damage/Depredation Trends and Policies

No statewide trend in nonsport kills of black bears occurred during the last decade. However, in recent years the state has had an increase in nuisance kills of black bears in the vicinity of Juneau in southeastern Alaska. This situation has improved as a result of an aggressive garbage control and public education program. Reported nonsport kills of black bears in Alaska during 1987-89 ranged from 26 to 37 (mean = 33). In these three years, 71% of nonsport kills were classified as "in defense of life and property" (mean = 18/year) and 16% as road kills (mean = 4/year).

Without Alaska's liberal hunting regulations, nuisance bear incidents would probably be more frequent. Currently, we believe that many potential nuisance bears are taken by hunters. State law prohibits feeding bears or intentionally leaving human food or garbage in a manner that attracts bears. Alaska's policy on managing bear-human conflicts was adopted in 1990. This policy emphasizes avoiding bear problems through public education.

Public Attitudes Towards Bear Management and Hunting

During the last decade, black bear hunting has become increasingly popular in Alaska. This popularity is reflected in higher harvests. In general, the public is in favor of hunting bears and other species in Alaska. However, baiting as a legal method of hunting has been attacked, and whether this practice will continue as a legal hunting technique is uncertain.

Conclusions

Until the 1980s, black bears received little research or management emphasis in Alaska except for a significant effort to document numbers killed and, until recently, to document the age structure

of hunter kills. With increasing harvests over the last decade, this species has received more management attention. Directly documenting trends in black bear numbers remains both technically challenging and expensive.

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Distribution and Abundance

Black bears occur in all major forested ecoregions (Strong and Leggat 1981) in Alberta, including five boreal ecoregions in the north and west and the subalpine and montane in the Rocky Mountains (Figure 1). Agriculture and settlement have greatly reduced black bear distribution in the aspen parkland. Their current range in Alberta encompasses about 488,000 km^2 (2% water), or about 74% of the land area of the province (= 661,188 km^2).

Population dynamics, food habits, or habitat use of black bears has been investigated with radiotelemetric monitoring in seven areas (Figure 1). In addition, movement and behavior of radioed nuisance black bears were observed in the forest and agricultural fringe in the Peace River region of the northwest (Gunson 1980). Estimated densities (xx bears/1,000 km^2) ranged from 370 at Cold Lake (pretreatment, Kemp 1976) to 6-18 at Berland-Wildhay and Swan Hills (Nagy et al. 1989, Nagy and Russell 1978). Actual populations in the latter 2 areas were probably greater than observed because the emphasis there was placed on grizzly capture. Nevertheless, home ranges of adult females in the 2 areas were large (Swan Hills, 244 km^2, N = 3; Berland-Wildhay, 138 km^2, N = 14). At Cold Lake, selectively removing 23 adult males may have encouraged an increase to 625/1,000 km^2 through enhanced survival and subadult ingress (Kemp 1976, Young and Ruff 1982).

Numbers of black bears were calculated for each wildlife management unit in Alberta in 1990. Densities of 0-150 bears/1,000 km^2 of net land area were used, with deductions for land disturbance and muskeg occurrence (Pedocan 1984). The calculated black bear population on provincial lands was 37,000 (average estimated density of 84 bears/1,000 km^2). The estimated total population in Alberta, including national parks, was 40,000. These estimates are considered to be conservative; certain regional populations may be greater than calculated.

Population Monitoring System

Alberta does not conduct systematic inventories (direct counts, sow or cub sighting registries) of black bears. Population information originates with intensive capture studies, hunter success rates, trends in numbers and distribution of complaints, and general observations.

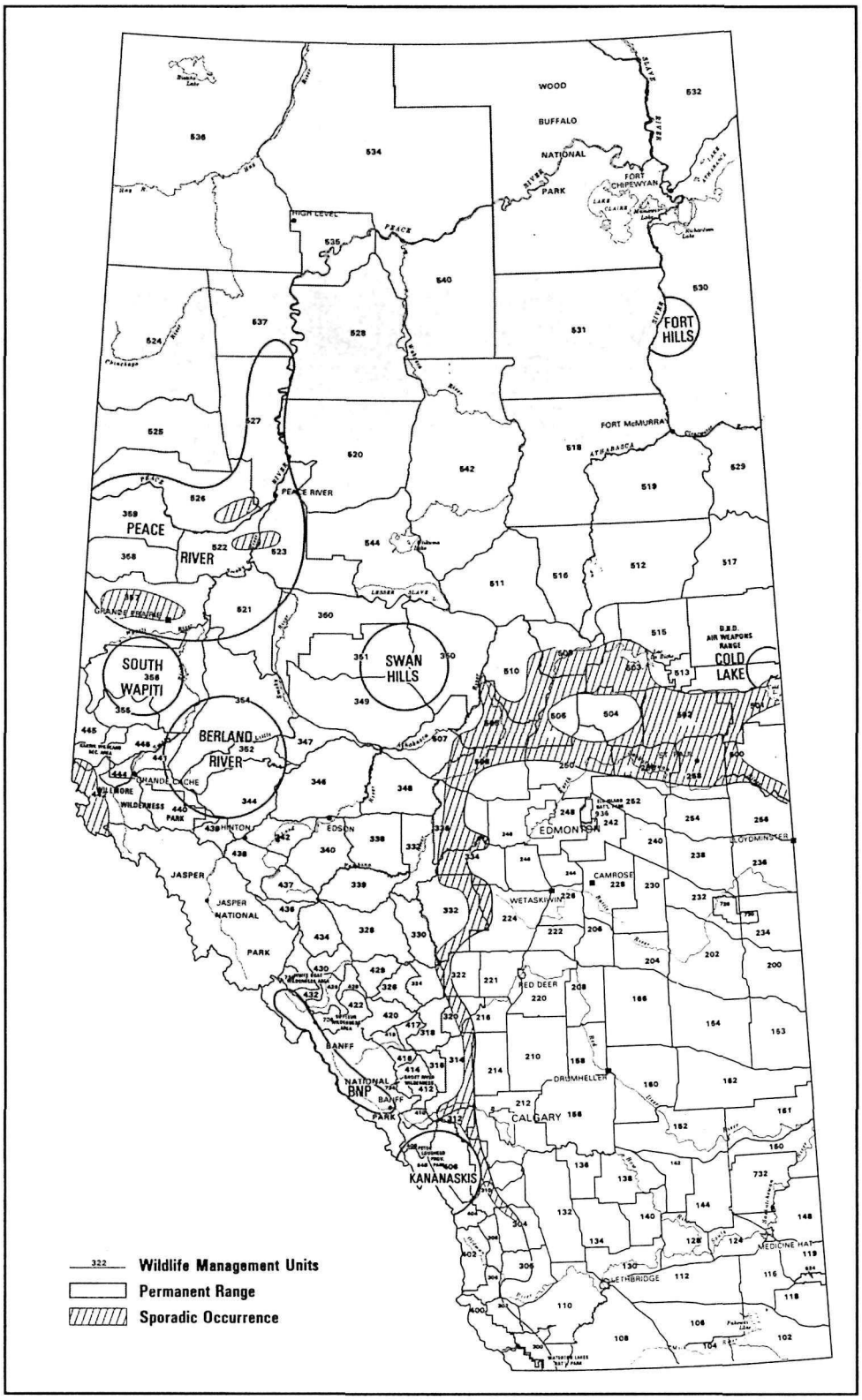

Figure 1. Distribution and intensive study areas of black bears in Alberta.

Management Objectives and Strategies

The primary challenge of black bear management in Alberta is maintaining regional populations in the face of industrial, agricultural, and recreational developments. Other challenges include providing high-quality recreational hunting, reducing the enduring high levels of black bear nuisances, and maintaining response to serious bear-human encounters. Detailed goals, objectives, and strategies to meet these challenges are described in the draft, *Management Plan for Black Bear in Alberta* (Alberta Fish and Wildlife Division 1991). Provisional management objectives and strategies follow:

1. A provincial population of 40,000 bears will be maintained.
2. Nonconsumptive values will have priority in some areas.
3. Capture and marking studies will continue.
4. Regional human-caused mortalities will be limited to 20%.
5. Bears killed by landowners, lessees, or both must be registered.
6. More nuisance bears will be translocated rather than killed.
7. Bear parts sales will continue to be prohibited.
8. The Response to Dangerous Bears Program will continue.
9. Harvest rates, bag limits, and seasons will vary regionally.
10. The provincial harvest will be limited to 12.5%, or 4,500 bears.

Recent Research and Publications

Studies of black bears were not as high a priority in Alberta during the 1980s as during the 1970s. However, several recent projects were completed. In Kananaskis Country, food habits, habitat use, and habitat characteristics of campsites with bear incidents were determined (Holcroft 1986). In Banff National Park, translocation as a management response was reviewed (Kansas and Raine 1987), demographics and habitat use were monitored (Kansas et al. 1989), and a management plan was completed (Kunelius and Browne 1990). Population dynamics of black bears were recorded in studies of grizzly bears in Berland-Wildhay (Nagy et al. 1989), South Wapiti (Canadian Hunter, pers. comm.), and Kananaskis Country (Alberta Fish and Wildlife Division, unpubl. data). The Alberta Fish and Wildlife Division is completing a provincial management plan for black bears.

Hunting Laws and Regulations

To protect property and human life, black bears in Alberta can be killed by shooting on private lands and on grazing leases throughout the year without any limit. Registering such kills is not required but is being considered.

On public lands, productive females (sows with cubs of the year) and cubs of the year are protected. This strategy has been in place for most years since at least 1927. This protection does not apply to private lands or grazing leases.

Licensed registered trappers, whose registered fur management area is north of the Red Deer River, may harvest six black bears per year in their area during the open hunting season. This special quota is intended to encourage harvesting black bears where nuisances are common.

During 1987-89, selling any bear parts was legal in Alberta. Harvesting black bears to sell parts other than hides apparently occurred, though probably rare, and in 1989, sales were again restricted to the hide and attached claws.

Recreational Hunting Management. Black bears are hunted from the beginning of antlered big-game seasons in the fall (early September) to the end of these seasons (usually late November). In the spring, seasons open on 1 April (to coincide with the grizzly season) and close in mid-May (southern mountains and foothills), early June (agricultural fringe and central foothills), and mid-June (northern mountains and the boreal forest).

License regimes and bag limits during 1953-90 are summarized in Table 1. Annual bag limits varied from 1 to 4. Separate spring and fall licenses were used beginning in 1988 to allow more effective harvest monitoring. License sales to residents increased to a peak of 15,915 in 1980-81 (Figure 2). The decline in resident black bear licenses during the 1980s was probably a result of an economic downturn in the province with reduced industrial activity in forested areas. Nonresident black bear hunting has increased in recent years (e.g., 364 in 1983-84; 1,605 in 1988-89). A nonresident hunting policy was formulated in 1988-89. Under this policy, the black bear allocation to outfitter/guides during the initial year (1990-91) was about 2,200 permits.

Table 1. Licensing and bag limits for black bears in Alberta.

Period	Spring License	Bag Limit	Fall License	Bag Limit	Annual Bag Limit
1953-61	spring bear	1	big game	1	2
1962-67	spring bear	2	big game	2	4
1968-70	spring bear	2	moose/elk	1/each	4
1971-75	black bear	1	black bear	1	1
1976-87	black bear	2	black bear	2	2
1988-90	spring black bear	2	fall black bear	2	4

Baiting was legalized in certain wildlife management units without grizzly bears in 1987. Baiting is intended to (1) increase black bear harvests where chronic depredations occur, (2) improve selection for size and color, (3) allow selection of large "trophy" male bears responsible for most predations of livestock and moose calves, (4) improve success in bow hunting, and (5) assist outfitter/guide operations and nonresident hunting.

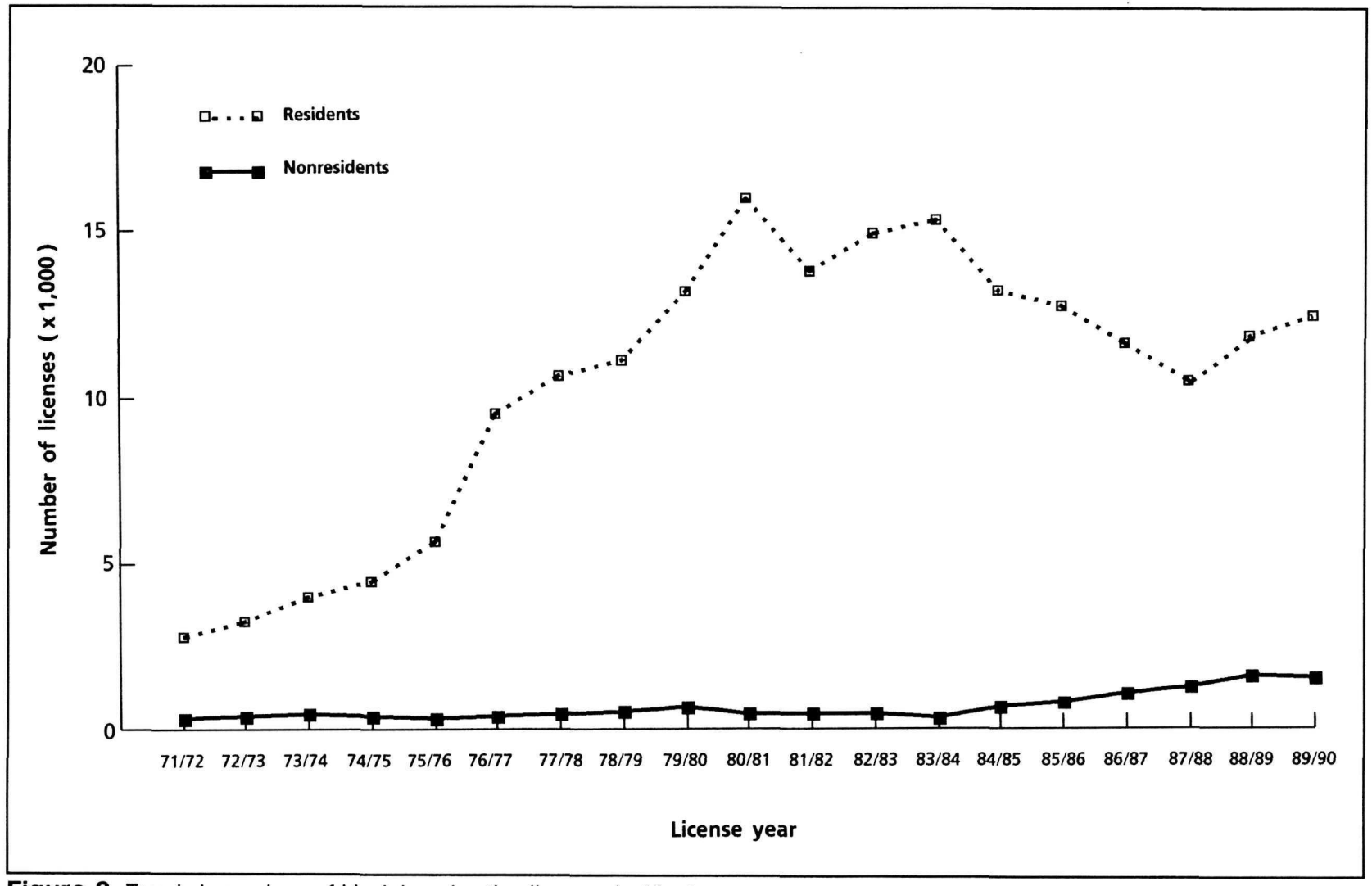

Figure 2. Trends in numbers of black bear hunting licenses in Alberta.

Harvest Summary

Alberta does not have a compulsory black bear harvest registration. Harvest of black bears by resident hunters during the spring season, as estimated on mail questionnaires, increased from 325 in 1968 (Wishart and Erickson 1970) to 1,313 in 1981 (Adamowicz and Phillips 1981). Estimated harvests by nonresidents during those 2 spring seasons were 27 and 46. During recent years, harvests by residents has been determined by a telephone survey (Table 2).

Table 2. Estimated harvests as determined by telephone survey.

Year	Spring	Fall
1986		572
1987	1,007	799
1988	1,045	904
1989	789	792
1990	573	289

Estimated harvest by nonresidents during the late 1980s has increased with greater numbers of hunters. Beginning in 1990, nonresident harvest is recorded by outfitter/guides; harvests were 1,049 (1990) and 800 (1991).

Property Damage/Depredation Trends and Policies

Records of bears causing personal or property damage in Alberta date from 1973, and since 1982 were entered in a computerized data base (the Animal Incident Reporting System). Numbers of black bear complaints varied annually (e.g., 766 in 1978-79; 2,037 in 1980-81), but no major trend was noted during 1973-90 (Figure 3). Complaints increase during years of wild berry failure.

Primary complaint types during 1982-90 (8 years) were (1) problematic sightings in close proximity to areas of human activity (3,291, or 31% of complaints), (2) human harassment (2,355, or 22%), (3) beeyard damages (1,519, or 14%), and (4) livestock or pet killing, harassment, or mauling (1,472, or 14%). Trends in major groupings of complaint types are provided in Figure 4.

Numbers of bears captured in complaint responses are provided in Figure 3. Historically, most nuisance black bears have been killed. In recent years, more nuisance bears have been translocated (5% in 1986-87; 9% in 1987-88; 20% in 1988-89; 33% in 1989-90; and 58% in 1990-91).

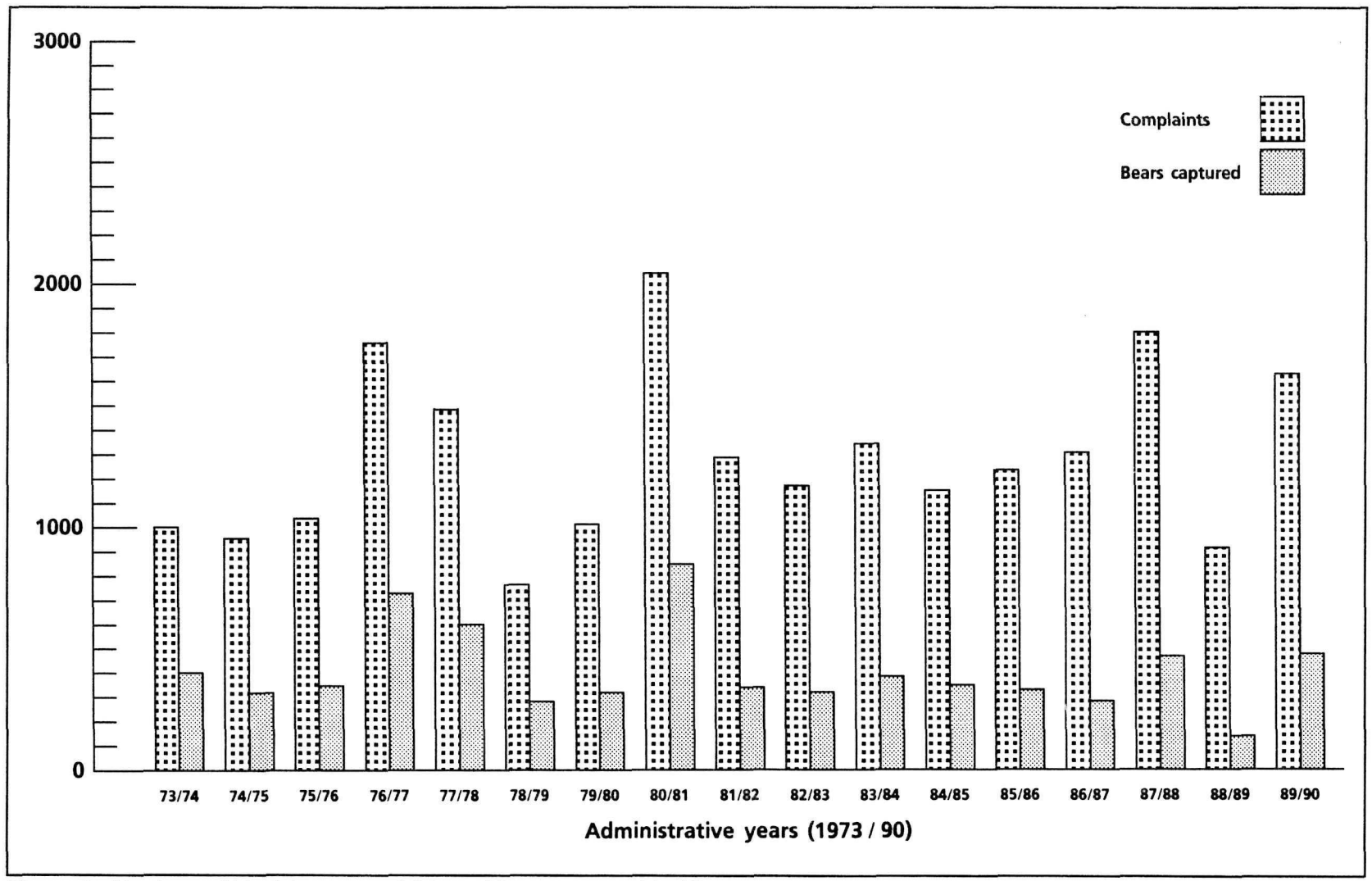

Figure 3. Numbers of black bear complaints and bears captured in Alberta.

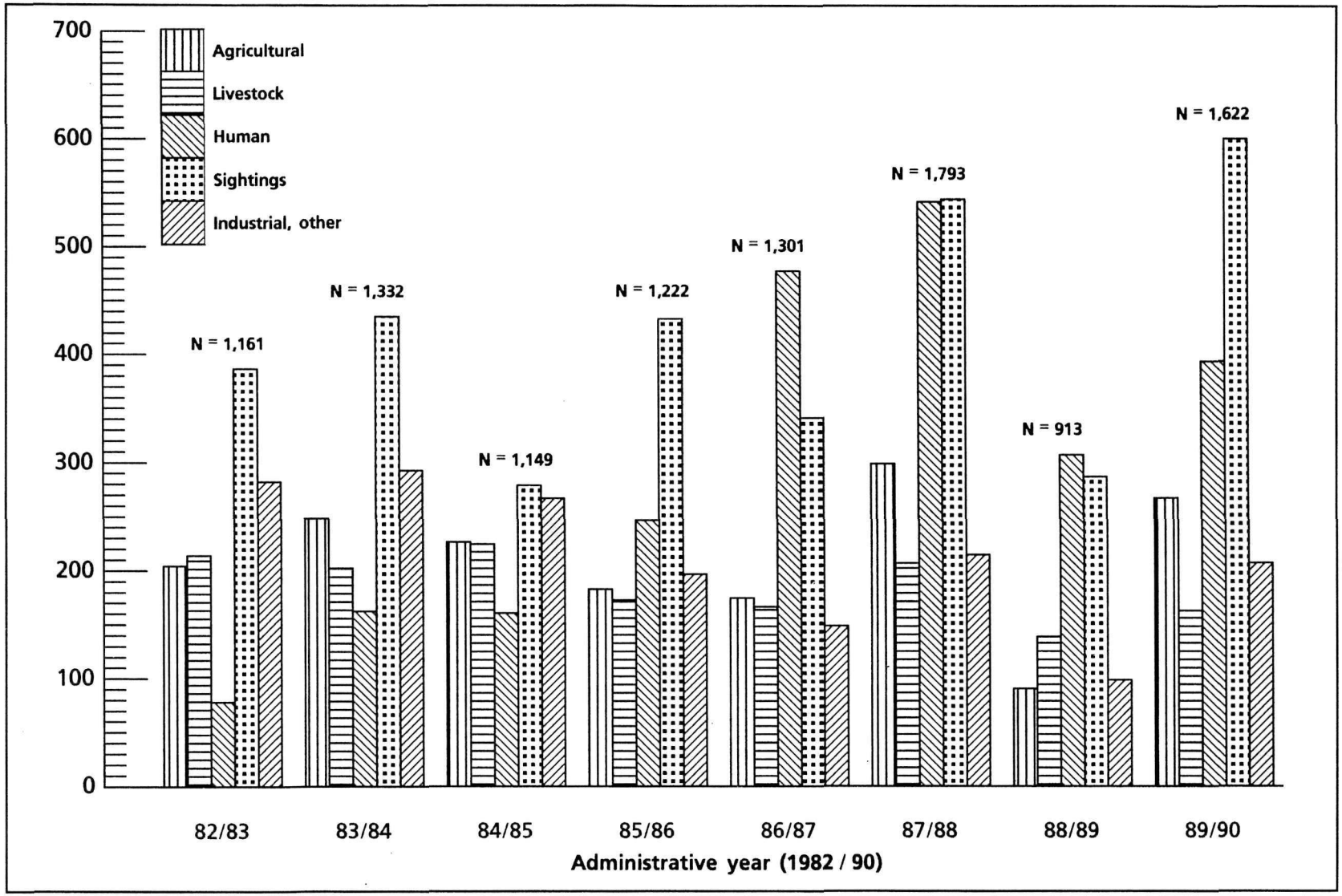

Figure 4. Numbers of black bear complaints and bears captured in Alberta.

Compensation is paid for confirmed livestock predation and depredation (since 1974), beehives (since 1978), and crops (since 1961). Annual compensation paid for bear (mostly black bear, but a few grizzlies included) livestock predation averaged $35,900 during 1974-88 (N = 1,325 approved claims). Annual payments for beeyard damages (operating electric fence required) averaged $5,700 during 1984-88 (N = 88 approved claims).

Bear maulings and fatalities have increased in Alberta during the 1970s and 1980s. Since 1974, at least 12 serious maulings and 5 fatalities have resulted from black bear encounters. A policy and procedure for responding to situations including dangerous bears was developed by a task force during 1980-85. This program included appointing team leaders and preparing equipment kits. The program is used in cases involving human injury or death.

Public Attitudes Towards Bear Management and Hunting

Public attitudes towards black bears remain varied in Alberta. Emotions of disgust by those suffering bear damages are balanced by feelings of wonder and respect by naturalists and hunters. In Alberta, recreational hunters are placing increased value on the black bear as a huntable species. No major opposition to black bear hunting exists in Alberta.

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Arizona

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Distribution and Abundance

Black bears can be found in central and southeastern Arizona (Figure 1). The estimated population is 2,500-3,000 statewide. Approximately 1 bear per 2.59 km^2 is found in suitable habitat.

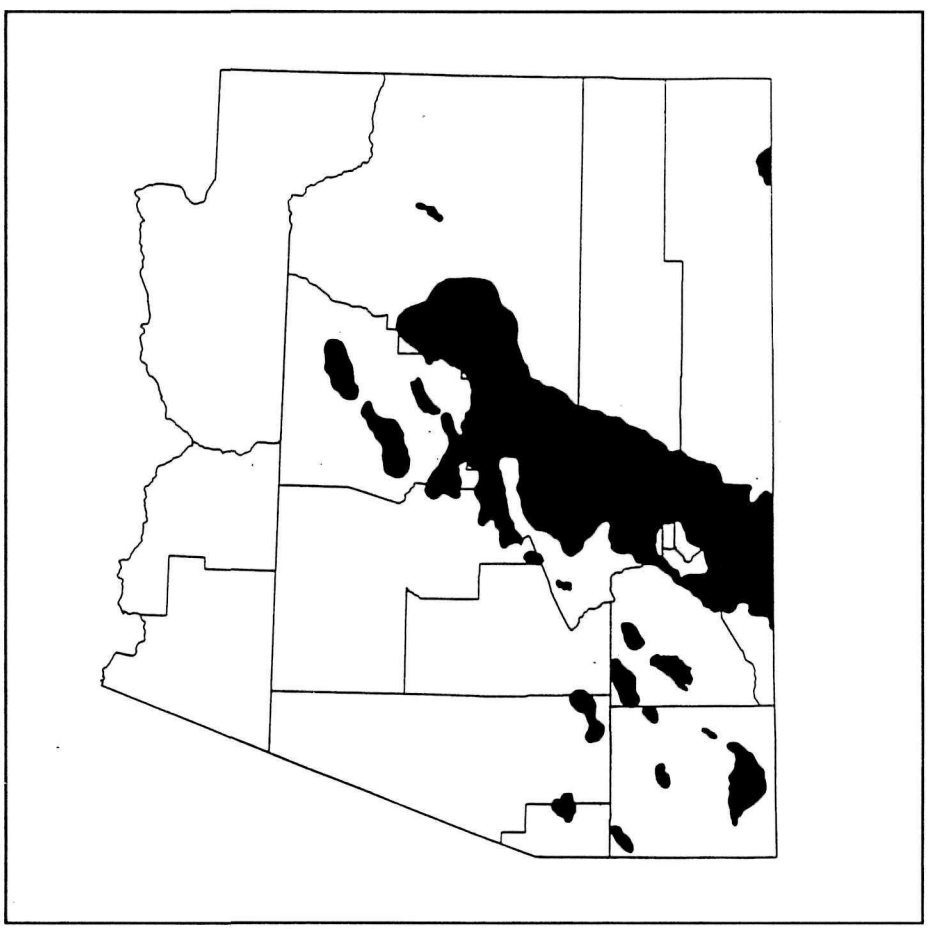

Figure 1. Black bear distribution in Arizona.

Population Monitoring System

Arizona gathers harvest information (kill by hunt unit, sex, age, and reproductive data) and natural history and habitat requirement data from research projects in typical habitat types.

Management Objectives and Strategies

The strategy focuses on maintaining bear populations at habitat carrying capacity by stabilizing or increasing the female segment of the populations and providing hunting opportunities by shifting harvest towards the male segment of the population. The habitat carrying capacity is maintained by protecting bear habitats through cooperation with land management agencies.

Species Management Plan

Arizona's management plan consists of the following:

1. determine carrying capacity and population characteristics on a hunt area basis
2. limit mortality of female bears
3. develop hunt guidelines to shift harvest towards male bears
4. identify areas of critical habitat and ensure protection through cooperation with land management agencies

Recent Research and Publications

LeCount, Albert L. 1990. Characteristics of an east-central Arizona black bear population. Arizona Game and Fish Department, Technical Report No. 2.

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Hunting Laws and Regulations

Arizona has limited entry spring hunts and open fall hunts, with variable season length in individual hunt units and some closed areas.

Harvest Summary

The spring hunt was originally developed for depredation situations and to determine if timing could target male bears. Neither purpose was realized, and a small spring hunt is now being used to develop and test implementing new regulations.

Fall hunts, as currently used, have failed to realize the goal of 70% male bears in the harvest. Bait cannot be used; dogs can be used, and females with cubs are not protected during fall hunts.

Property Damage/Depredation Trends and Policies

Depredation continues at the low, but chronic rate of about 10 bears per year, primarily resulting from attacks on cattle. Expected increases in depredation that were anticipated due to dry spring conditions for the past three years have not materialized. A department nuisance bear policy was developed in 1990 and provides guidance to department and other agency personnel in handling nuisance bear situations. The Arizona Chapter of the North American Bear Society continues to provide invaluable assistance to the public and land management agencies in nuisance bear situations.

Public Attitudes Towards Bear Management and Hunting

The general public in Arizona seems to have no more concern regarding bear hunting than they have with any other type of hunting. The informed public has recently expressed concerns with different aspects of the traditional bear hunting philosophy. The department has so far been able to address these concerns and show progress towards reforms.

Conclusions

Additional refinements in bear management that reflect current knowledge of bear populations will be necessary to maintain hunting as a part of bear management.

Discussion

Question: Why was the use of bait prohibited?

John Phelps: Basically because it was very effective; especially as used by houndsmen and because it was relatively unselective in terms of male and female kill. Some nonbiological aspects of the problem were that some people viewed it as littering and unfair chase. However, our concern was it is extremely effective and unselective.

Question: Do Arizona regulations allow the take of cubs or sows with cubs?

Phelps: There is no protection afforded cubs or sows with cubs in the fall season. In the spring season both cubs and sows accompanied by cubs are protected.

Question: Do you think that is one of the reasons for low cub survival?

Phelps: The low cub survival is due to other factors. The recommendation to protect cubs and sows accompanied by cubs has been made; however, the major stumbling block has been the general consensus that the regulation is unenforceable.

Question: What techniques are you going to use to implement your in-season closure?

Phelps: We have established a 24-hour call-in line. A person must call in and report their kill. We pull a tooth, complete a normal checkout card and telephone to a central location where a running list is kept. We put the burden on the hunter's back. What we said we would do is close down the season at midnight Friday after the second adult female had been taken. The burden was on the hunter's back to make sure the season was still open. So far we haven't had to close it. The season just opened Friday and we only had one male bear killed. Hunters by and large did not object.

British Columbia, Canada

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Distribution and Abundance

Black bears occur throughout the province, including the Queen Charlotte and Vancouver islands. They are absent only from some smaller, offshore islands and from densely inhabited, intensively used human activity areas. Black bear sightings are common in agricultural areas and even in the suburbs of Greater Vancouver and Victoria. Black bear concentrations frequently exist around sites of human activity where seasonally or annually available sources of food within the human environment (such as garbage, fruit trees, and bee hives) attract bears from adjacent wilderness areas. Although the provincial population is believed to be stable to increasing, declines in regional subpopulations because of high numbers of nuisance bear kills have been identified.

The provincial bear population is approximately 62,000-112,000.

Population Monitoring System

Regional biologists have monitored black bear populations using hunter kill data, problem black bear statistics, reports from hunters, trappers, and other field people, and in some regions, sighting and habitat use information.

The number of black bears killed by resident hunters is determined from the annual hunter sample, a random mail survey. Numbers killed by nonresident hunters is recorded on guide/outfitter declarations and is an exact estimate. Hunters are requested to provide the sex and to estimate the age class of their bear, but the accuracy of these data is unknown.

Black bear population monitoring has been inadequate. A model for population inventory of grizzly bears using habitat assessment has been developed. We will be using a similar strategy to inventory black bears in the province. The objective of this model is not to provide absolute numbers of black bears but to assist in identifying important and problem areas. For example, areas of potential overharvest will be indicated if known kills exceed allowable sustainable harvests for the estimated populations. Over time, modelled populations will be verified and estimates will be refined in an iterative fashion. Research will be important in determining ratings or density estimates, how factors such as access and habitat loss reduce habitat suitability, and the importance of grizzly-black bear interactions on black bear habitat use.

Management Objectives and Strategies

Black bears have been viewed in contradictory terms. They are seen as a valuable wildlife species worthy of protection and symbolic of wilderness. They have also been viewed negatively and dismissed as problem animals. Throughout the province, black bears are managed simultaneously as problem animals, big game, producers of commercial products (claws, galls, and hides), and as symbols of wilderness. A clear and cohesive management strategy has been lacking.

Species Management Plan

The Provincial Black Bear Plan is now being developed in conjunction with the activities of the Black Bear Committee. This committee was established in the summer of 1990 and has the mandate of developing a management plan for black bears.

Recent Research and Publications

Fred Hovey of Simon Fraser University (Burnaby, British Columbia) is studying interactions between grizzly and black bears in the Flathead Valley in southeast British Columbia. Fred is also assessing remote-mounted cameras to use in photographically marking bears to estimate numbers.

Estimating black bear numbers using remote cameras and radio-collared bears as a modified mark-recapture technique will also be attempted in coastal areas of the Lower Mainland this year.

Last year, a questionnaire about black bears was sent to all Wildlife and Conservation Service offices in the province and to hunters, trappers, and guide/outfitters. Respondents were asked about the population status of black bears, the trade of bear parts and its impact on populations, problem black bears, and attitudes towards the species. An unpublished report detailing the results of this questionnaire is available from the author.

Hunting Laws and Regulations

Most areas of the province are now on a split season for black bears: spring and fall. The maximum limit for hunters is two bears. Some regions have bow-and-arrow-only seasons before the regular open season. Black bears are also designated as furbearers; trappers are allowed a maximum of two bears for fur. Deleting black bears from the furbearer list is now being discussed between the British Columbia Wildlife Branch and the British Columbia Trappers Association.

Family groups and cubs are protected. Baiting is prohibited; using dogs is allowed during the normal hunting season.

A hunter (or trapper) is required to take either one-fourth of the meat or the complete hide of black bears that are killed. Persons wishing to buy bear parts (gall bladders, paws, claws) must

possess a fur traders license. These regulations were instituted last year because of (1) concerns over the effects of trading bear parts on populations, and (2) the fear that black bears were being killed only for their parts. The intent of the fur traders license was to determine the extent of the trade and to define the marketplace.

Harvest Summary

Since 1981, 4,300-5,300 black bear kills have been documented annually. The hunter harvest has been 79-94% of the annual kill. Resident hunters have taken 71-87% of the harvest. In recent years, the interest by nonresident hunters has been increasing. From 1981 to 1985, nonresidents took 13-20% of the harvest; and from 1986 to 1989 nonresidents took 21-29%. The number of licenses sold to nonresidents has been increasing, from 1,891 in 1981 to 3,062 in 1989.

Trappers have taken from 106 to 382 black bears annually since 1981. The trapper harvest has been 2-9% of the total kill. The rest of the kill, 4-13% annually since 1981, is attributed to problem black bear kills. Some years, especially during times of natural food failure, are worse than others with respect to problem black bears. We suspect that a large number of unreported kills are problem bears or have been killed illegally (i.e., people killing black bears because of dislike for them). We have little to no information on the extent of these illegal kills, on poaching kills, and on other nonhunting kills.

Changing seasons and protecting females with cubs are new regulations, and the data is not sufficient to be able to assess the effects of these changes on the harvest. In 1991-92, we will request hunters to voluntarily return black bear teeth and we will encourage conservation officers to return the teeth of problem black bears that are shot.

Property Damage/Depredation Trends and Policies

The problem bear control program results in the death of several hundred black bears annually, ties up manpower and equipment that could be alternatively devoted to other wildlife management and enforcement programs, maintains an unacceptably high chronic level of threat to human safety and property, and downgrades the wilderness image of an otherwise important and valuable wildlife species. Problem bears and managing human foods, waste, and other attractants is the largest black bear problem in British Columbia. A program is being developed to address this problem and includes improving waste management facilities, educating the public, and emphasizing translocating all black bears in which translocation success is high. A provincial, but regionally based, translocation strategy that defines which age and sex classes will be moved, where black bears will be moved, and how translocation will be conducted is currently being developed.

Public Attitudes Towards Bear Management and Hunting

Recently in British Columbia, the urban public and others have expressed concern about the effects of trading bear parts on black bear populations. The public strongly opposes killing bears for their

parts (i.e., gall bladders) for perceived purposes of aphrodisiacs. The urban public has also expressed concern about Ministry of Environment staff killing large numbers of black bears as problem wildlife. Black bears are an important part of the provincial Viewing Program of the British Columbia Wildlife Branch; they are the one species tourists report they would most like to see in the wild.

The following factors are heightening interest in black bears: (1) the highly publicized trade in bear parts, (2) Japan's recent petition to have the Canadian black bear listed in Appendix I of CITES (the Carnivore Conservation Strategy recently released by the World Wildlife Fund), (3) the growing interest in grizzly bears, in part assisted by the high profile of the Khutzeymateen Valley, and (4) the soon-to-be-released Convention on the Status of Endangered Wildlife in Canada status report on grizzly bears. Black bears are acquiring an unprecedented degree of public interest.

In rural areas, many people still regard black bears with indifference or contempt. "Vandal" bear killing (killing bears out of dislike or because of the fear that every black bear is a potential nuisance and destroyer of property) is a major problem.

The hunting public, residents, and nonresidents regard black bears as a valuable species, and this perceived value is increasing. The high interest in hunting black bears has resulted in an increasing demand and cost of such hunts for nonresidents. In some areas of the province, people show considerable interest in hunting black bears with dogs. Whether this interest is increasing is unknown.

Conclusions

Virtually no studies have been conducted on black bears in this province. British Columbia has a tremendous need to systematically assess population sizes and trends and to validate these estimates through habitat assessments and population studies. The province also needs a covert team to investigate the trade in wildlife parts and to determine the extent of poaching in bear populations. Finally, the province needs education on how to avoid bear-human conflicts, how to live and travel safely in bear country, and how to change negative attitudes. Lack of technology or interest has not prevented these initiatives from being carried out. Resources for wildlife are still limited in this province and the needs of black bears are in strong competition with other needs. Establishing the Black Bear Committee and developing the Provincial Black Bear Plan are first steps at deriving a proactive management plan for this species.

Discussion

Question: If the black bear is proposed for listing at the next CITES Convention in Japan, do you think the Canadian Government will support that proposal?

Bruce McLellan: I am not sure--I can't say what Canada would do.

Question: You indicated that a lot of Asians and Europeans hunt black bears in Canada. If the black bear goes into Appendix I it would eliminate that. Do you think the government will support the listing?

McLellan: I cannot give an official opinion because I do not work for the Ministry of Environment, but if that is the case, I would be surprised if British Columbia would be part of it because bear hunting, both black and grizzly, is a very big business.

Question: With a bear hunting permit you indicate the hunter must take one-fourth of the meat. With a furbearers permit is the requirement different?

McLellan: The same--or the hide. You can shoot a bear and just take the hide.

Question: In recent years you said there has been an increase in nonresident hunters and that you have to have a furbearers permit to trade in bear parts. Do you see a correlation in the number of nonresident bear hunters and an increase in furbearers permits?

McLellan: I don't think so. I think it is becoming more popular to hunt bears. It has been my experience in British Columbia that it is more the European hunter, not the Asian hunter, so it is more of a trophy hunt.

California

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Distribution and Abundance

Black bears inhabit approximately 120,000 km^2 in the mountainous areas of the state. Most bears occur in the Cascade, Klamath, North Coast, and Sierra Nevada mountains. Smaller populations occur in the Central Coast and Transverse mountains (Figure 1). The estimated population size is approximately 15,000-18,000.

Population Monitoring System

Data collected from hunter-killed bears include location, sex, and age. Periodic field studies are also conducted in representative areas of black bear habitat. Radiotelemetry studies have been conducted to document home range size, movements, food habits, reproductive rates, and den site characteristics. Both hunted and unhunted populations have been studied.

Management Objectives and Strategies

Black bears are managed as a valuable game mammal pursuant to the state's wildlife conservation policy and other laws. The primary goal is to maintain a healthy and widely distributed population. Regulated sport hunting is used as one element of the management program. A minimum median age for females of five years is the objective. Regulated fall hunting is provided with restrictions to protect cubs and females with cubs. Recommendations are made to managers of both public and private land to maintain black bear habitat. Emphasis is placed on educating the public in an effort to avoid bear-human problems.

Species Management Plan

A plan for black bears in California was prepared in 1985 and reprinted in 1987. In addition to background information, the plan contains the following elements: investigations, hunting and viewing recreational use, habitat management, law enforcement, depredation control, information dissemination, and periodic plan review. In light of recent challenges to traditional black bear management, the plan needs to be revised. Serious problems that existed before 1985 have been addressed through changes in hunting regulations. The solutions to these problems and the goals and objectives for the future need to be incorporated into the plan.

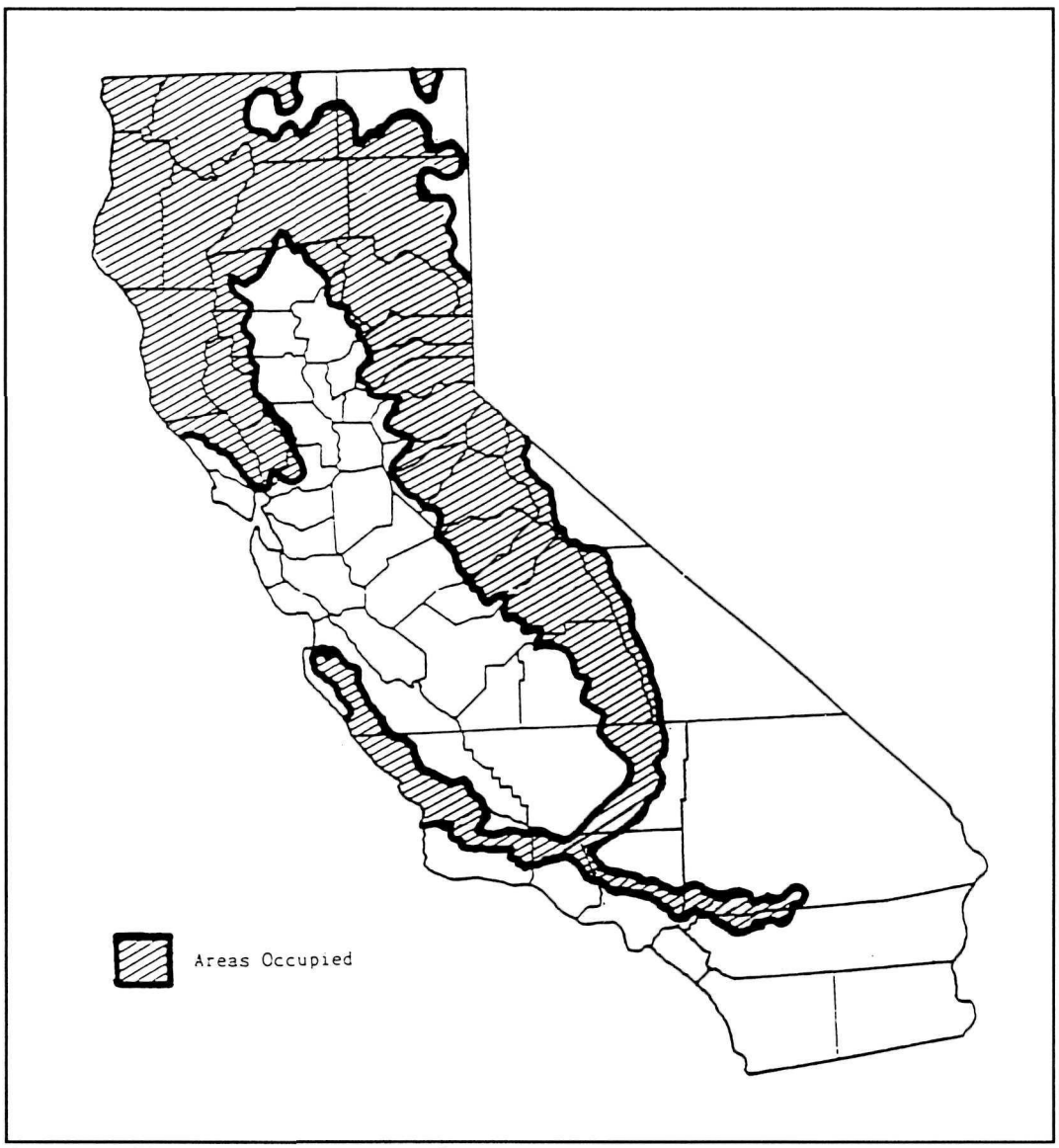

Figure 1. Black bear distribution in California, 1993.

Recent Research and Publications

Keay, Jeffrey A. 1991. Draft environmental document regarding bear hunting. 1990. Black Bear Population Dynamics in Yosemite National Park. Ph.D. dissertation, University of Idaho.

Hunting Laws and Regulations

Black bears are classified as game mammals under state law. The California Fish and Game Commission has the authority to regulate bear hunting and to adopt regulations for killing bears that cause property damage. In 1990, the commission approved a 23-day archery bear season that would have opened on the third Saturday in August. That season was halted by a court order for failing to fully comply with the California Environmental Quality Act. The court upheld the general hunting season. This season involved a 79-day fall season opening on the second Saturday in October. California does not have a spring season, and bait may not be used. Since 1985, pursuing bears with dogs has been illegal except during the general season. Cubs and females with cubs may not be killed. Cubs are defined as bears weighing less than 50 pounds. No more than 15,000 tags may be issued, and the season will be closed when and if 1,250 bears are reported killed.

Harvest Summary

During 1985-88, an average of 1,245 bears were reported killed and 11,516 tags were sold annually. In 1990, 1,187 bears were killed and 8,611 tags were sold. Since eliminating the pursuit season in 1985, the median age of bears in the harvest increased significantly. The mandatory tag return requirement provides additional information regarding the use of guides, dogs, and methods of kill. During 1985-88, the harvest approximated 60% males and 40% females.

Property Damage/Depredation Trends and Policies

Depredation problems are increasing. Since 1982, an average of 123 permits have been issued and 54 bears have been killed annually. In 1990, 213 permits were issued and 77 bears were killed on depredation permits. The California Department of Fish and Game has developed a policy that discourages relocating problem bears. All practical efforts are made to advise property owners to clean up attractive nuisances that lure bears.

Public Attitudes Towards Bear Management and Hunting

Since 1989, black bear hunting in California has been controversial. Groups including The Fund for Animals, The Animal Legal Defense Fund, and The Wildlife Conservancy have filed lawsuits in both 1989 and 1990. These lawsuits are the most recent examples of public opposition to bear hunting, which began in 1977. In response to this public concern, the department has held public scoping sessions to discuss black bear hunting proposals, as well as alternatives, including no hunting. Efforts to openly discuss and professionally analyze potential effects associated with bear hunting appear to improve public understanding of the role of hunting as an element of black bear management. The fact that recent bear hunting seasons have involved fall hunting only with specific prohibitions against using bait and killing cubs and females with cubs appears to have alleviated at least some of the controversy associated with more liberal bear hunting programs in other western states.

Conclusions

The department intends to initiate additional field studies in representative areas of black bear habitat in California in 1991. These field studies will emphasize obtaining a better understanding of population characteristics, the influence of hunting on local populations, and black bear habitat relationships. This new information will also be used to update the state's black bear species management plan with recommendations for future management options. The recent legal challenges to black bear hunting have resulted in an increased emphasis on biological information used in supporting and analyzing black bear hunting in California.

Discussion

Question: Do you have a quota on the number of tags sold?

Tim Burton: There currently is a quota of no more than 15,000 tags to be sold. We only sold approximately 8,600 tags in 1990. We did not expect to sell 15,000 tags; however, a segment of the public did not like the fact that prior to 1990 there was no limit on the number of bear tags that could be sold.

Question: If that was not a concern, what did let you win in court?

Burton: It was the overall issues we covered in the document: population status, compensatory mortality, illegal kill, pain and suffering issues. These were issues that the judge asked us to address in more detail. We did that, and she felt the document was sound and allowed bear hunting except that you could not use archery equipment. Another factor that benefitted the department's case was the in-season closure. The season would be closed if or when 1,250 bears were killed. Basically, the issue was not a biological issue. It was one of procedure.

Question: What do you feel is the effect of poaching on black bears in California?

Burton: Poaching does occur but there are several things we have done to significantly reduce illegal kill. The sale of bear parts is a felony in California and the possession of more than one gall bladder is prima facie evidence of intent to sell. Additionally, we eliminated the training season, or pursuit-only season. We documented a lot of mortality during this former season. An additional factor that is not reported by the media is that when examined by department forensic pathologists, over 90% of the gall bladders confiscated turn out to be from livestock (primarily pigs). Additionally, the bear galls mentioned as being purchased are often purchased from our undercover officers. They obtain these bladders from depredation and/or road-kill bears as well as from legal sport hunters during the bear season.

Question: You have very good information on the numbers killed by hunters and illegal kill. Did you have to make an estimate of crippling loss in your environmental document?

Burton: We did not make a numerical estimate. We did address the effectiveness of the various methods of take and also the aspect of "suffering" during a pursuit. It should be noted that the vast majority of bears killed in California are killed with the aid of trailing hounds--well over 75%. The fact that dogs are present would appear to significantly reduce the crippling loss of bears.

Question: Could you expand on your pursuit season? How did you become aware of illegal mortalities there?

Burton: We became aware of the mortalities primarily by two independent means. One from our radiotelemetry information. We were finding radio collars cut off and hidden under rocks or in creeks. We also experienced episodes where we had been following a bear on a regular basis over several years only to have it "disappear" under suspicious circumstances or where we had informants give fairly explicit details on illegal activities. The second way we documented illegal activity during this time was by numerous undercover operations conducted by our law enforcement branch. They were able to document a significant problem.

Question: Do you see an increase in depredation permits based primarily on increased people numbers in the foothills or do you see movement of bears due to the drought?

Burton: Mostly people moving into bear habitat. Especially in California, where we are growing at an alarming rate, soon to exceed 30 million people.

Question: Are you guys appealing the decision to prohibit the use of archery equipment?

Burton: No we are not. The Fund for Animals is appealing the court's order to allow bear season but it is basically a moot point. The season is over. Our current environmental document has an alternative that would allow the use of archery equipment as well as one that would continue the prohibition of archery equipment.

Question: Do you think that black bears are just the first species? Are deer next?

Burton: It is hard to guess on these things but I would expect that predators and furbearers might be challenged. It is interesting to note that when The Fund for Animals threatened to sue over waterfowl season, the mainstream conservation groups such as Audubon and Sierra Club "sided" with the department, as they were able to realize the significant negative impact the loss of waterfowl hunting would have on the state's wetland habitats.

Question: Do you have any estimate on the cost of the court challenges and the preparation of the environmental documents?

Burton: When we lost in court on bears it cost us in the neighborhood of $400,000-$500,000 in legal fees and lost revenue from license and tag sales. That is just hard costs for the bear lawsuit. It does not account of all the staff time on a statewide basis to prepare all the documents and collect the needed information.

Coahuila, Mexico

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Distribution and Abundance

Black bears are found in the following Mexican states: Chihuahua, Sonora, Durango, Coahuila, Nuevo Leon, and Tamaulipas. Zacatecas, Sinaloa, and San Luis Potosi have unconfirmed populations.

The state of Coahuila has the highest population. Its distribution is in the pine-oak forest and chaparral, and the latest research shows about 15,000 km^2 of habitat, with only 30% of the population in the regular to good class of habitat.

Population Monitoring System

Scent stations. Modified from Lindzey (1977).

Management Objectives and Strategies

The species is protected.

Species Management Plan

The species is protected.

Recent Research and Publications

University Antonio Narro continues the monitoring and is working on a new project concerning predation and range practices. Texas A&I University is working in Coahuila. (For more information, see "Texas," page 74.)

Hunting Laws and Regulations

No hunting is permitted. Black bears are considered an endangered species at the national level.

Harvest Summary

Not applicable.

Property Damage/Depredation Trends and Policy

The biggest problem that black bears face in Coahuila is cattlemen blaming bears with cattle losses and trying to control the population themselves. Some orchard damage occurs in the southeast part of the state. No clear official policy exists for problem bears. Cattlemen currently deal with problem bears by poisoning carcasses, and little is known about the effect of this practice.

Public Attitudes Towards Bear Management and Hunting

The general public is not aware of the black bear population and its cultural and game value. Landowners permit poaching in most of the bears' range. Only few ejidos (common property) charge a fee for hunting on their lands, despite hunting being illegal.

Conclusions

Even though black bears are a protected species in Mexico and are generally considered endangered, especially in the states of Chihuahua and Durango, populations are declining because of poaching and poisoning.

Law enforcement is nonexistent and the public is not aware of the value of the species. Little is known about the black bear population, especially the subspecies *U. a. machetes*, in the states of Chihuahua and Durango. If this decline continues, the species will have problems soon.

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Lindzey, F.G. 1977. Scent station index of black bear abundance. Journal of Wildlife Management 41(1):151-153.

Colorado

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Distribution and Abundance

Black bears are distributed throughout all suitable habitats in the western two-thirds of Colorado. Within this general area of distribution, approximately 75,000 km^2 of suitable habitat exist. Statewide densities are unknown, but two recent black bear studies have been conducted. Based on those two studies, we expect densities to be one bear/5-25 km^2.

Black Bear Management Data Base

Harvest statistics comprise the only standardized data base for monitoring the status and trend of black bear populations. Colorado manages all big game animals by big game hunt units called game management units. These units originally were chosen as discrete herd units for deer and elk populations. For less abundant and far ranging species, such as black bears and mountain lions, game management units are aggregated into larger units called data analysis units, which ostensibly circumscribe "population" units. Colorado has 20 black bear data analysis units. Harvest statistics are maintained separately for each unit. Harvest statistics include information on hunter numbers, hunter residence, sex and age composition of the harvest, date of harvest, breeding and lactational status of harvested females, method of take (bow, rifle, pistol), whether a guide was used, and whether bait, hounds, or both were used in the hunt. Regression analyses are used to detect trends over time.

Management Objectives and Strategies

Historically, black bears in Colorado have been managed with two general objectives: maintaining populations to provide sustained recreational harvests, and minimizing damage to livestock, crops, and private property. To accomplish these objectives, the fundamental management philosophy considered sport hunting preferable to control by private citizens and federal and state animal damage control specialists. Consequently, season timing and length were coupled with limited license hunts and unlimited license hunts to harvest the desired numbers of bears.

Before 1990, two distinct seasons were available for hunting black bears in Colorado--a spring season and a late autumn season concurrent with regular rifle deer and elk seasons. The Colorado Wildlife Commission (CWC) has progressively restricted hunting in the spring by shortening the spring season length from 1 April-30 June in the 1970s to 1 April-15 May in 1990. Spring seasons have become progressively restrictive to reduce the female harvest and to reduce the harvest of females with cubs. The late autumn seasons were intended to provide big game hunters with a variety of species to hunt during a common season framework. Black bear hunting success is so low (approximately 5-10%) during the autumn big game seasons that license sales have not been limited. However, success has been comparatively high during the spring seasons (approximately 25-35%), thus licenses were limited in number and allocated by random drawing.

In 1990, the Colorado Wildlife Commission implemented an experimental September black bear hunting season. The spring season was shortened by two weeks from the previous year (closing on 15 May 1990 versus 31 May 1989) to avoid hunting when females with nursing cubs were active. The Colorado Wildlife Commission compensated for the reduction in spring hunting opportunity with a September season, assuming that cubs of the year were capable of existing independently from their mother at this time. Only those persons who were chosen from the random draw of license applicants could hunt during the spring and September limited license hunts. Hunters could choose to hunt during either or both the spring and September hunt periods. Typically, approximately 90% of the successful limited license applicants actually participate in the limited license hunts.

Historically, 75-80% of the total annual black bear harvest has occurred during the spring limited license season. Since 1979, annual statewide harvests have averaged about 650 black bears. Spring harvests have been composed of approximately 30-35% females, while the October-November harvests have been composed of 35-45% females.

Species Management Plan

Colorado has just completed a comprehensive black bear management planning process. That process identified and defined several outstanding black bear management issues that should be resolved. The Colorado Wildlife Commission considered the issues and developed policy-level objectives for the Colorado Division of Wildlife to accomplish with our black bear management program. These objectives are as follows:

1. Monitor black bear numbers to maintain stable, healthy black bear populations while providing a sustainable annual harvest.
2. Schedule the timing of black bear hunting seasons to protect females with nursing cubs.
3. Focus problem bear management on individual problem bears and stress nonlethal management methods, while effectively reducing the level of bear-caused property and livestock damage.
4. Work together with federal public land managers and private landowners to identify and protect critical black bear habitats throughout the state.
5. Implement law enforcement activities that effectively deter black bear poaching.
6. Develop a prototype black bear watching program to test the feasibility of providing structured watching experiences.

7. Periodically inform the public of our progress towards producing these management outcomes.
8. Educate the public to increase awareness of black bear conservation issues and what must be done to manage bears effectively for the benefit of people.

The Colorado Division of Wildlife is developing operational plans to implement each of these black bear management policy objectives, which began in July 1991.

Recent Research and Publications

The Colorado Division of Wildlife completed fieldwork of a seven-year black bear ecology study in southwestern Colorado in 1985. Results of that work will be reported in a Colorado Division of Wildlife technical publication tentatively scheduled for publication in September 1991. That publication will include population ecology, movements, habitat use, home ranges, denning ecology, and seasonal physiological cycles.

The National Park Service has just concluded a similar study of black bear ecology in Rocky Mountain National Park. No publications have been forthcoming from that study to date, but those interested should contact Dr. Henry McCutchen, 3009 Ringneck Drive, Fort Collins, Colorado 80526.

Gill, R.B. and T.D.I. Beck. 1990. Black bear management plan: 1990-95. Colorado Division of Wildlife Division Report No. 15. 44 pp.

Hunting Laws and Regulations

A summary of the 1990 Colorado black bear hunt regulations follows.

Hunting season schedules:

1 April-15 May
1-30 September
Seasons concurrent with archery, muzzleloading, and regular rifle deer and elk seasons.

Hunter number restrictions:

1 April-15 May and 1-30 September licenses limited in number (2,000) and available only through application and random drawing.

Seasons concurrent with deer and elk hunting seasons. Licenses are unlimited in number and may be purchased over-the-counter from any authorized license sales agent.

Legal methods of take:

Hounds: Legal in both limited license seasons (April, May, and September). Not allowed during seasons concurrent with deer and elk hunting. Pack size limited to not more than eight. May use radio collars on hounds.

Baiting: Legal in both limited license seasons but not allowed during seasons concurrent with deer and elk hunting. Baits must be solely animal or vegetable matter. If livestock or livestock parts are used, person using bait must have veterinarian's certificate that bait is from disease-free animals; size and construction of bait containers are restricted; name and address of baiter must be posted within 10 m of bait site; bait sites limited to two per license holder.

Legal weapons: Handheld or compound bows, crossbows, muzzleloading rifles (40 caliber minimum), rifles (24 caliber minimum), handguns (24 caliber minimum), and shotguns firing a single slug (20 gauge or larger).

Mandatory check:

All black bears that are harvested or taken for damage control purposes must be inspected and sealed within 48 hours of the time they were killed. The hides must be unfrozen when presented for inspection.

Protected classes:

Cubs of the year and black bears accompanied by one or more cubs of the year may not be killed.

Harvest Summary

In Colorado, black bear harvest records have been kept since 1948. Harvests throughout this 42-year period have varied considerably from a low of 199 in 1979 to a high of 895 in 1975. Mean harvests for successive 10-year periods from 1950 to 1990 suggest a gradual increase in harvests over the 40-year period (Figure 1). However, linear regression analysis of harvests for the entire 42-year period suggests that slope is not significantly different from 0.

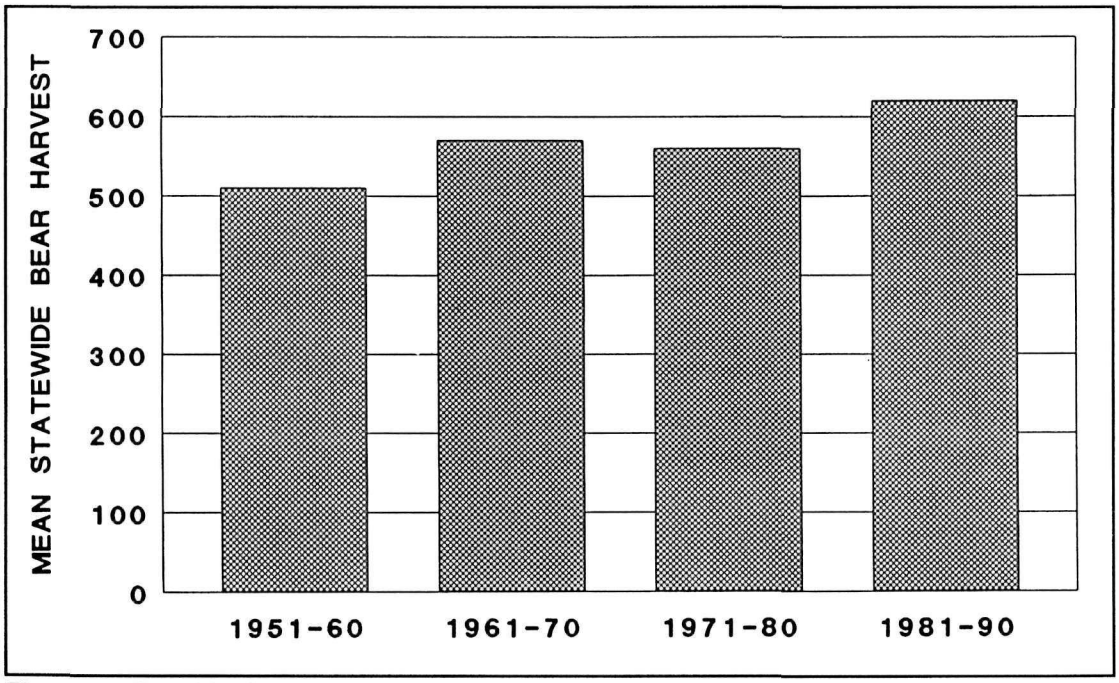

Figure 1. Trend in Colorado black bear harvest, 1951-90.

Over the past 12 years, hunter numbers have averaged 6,463 per year and total harvests have averaged 641 bears per year. Nearly 80% of the total harvest has occurred during the spring season (Table 1). Hunter numbers declined dramatically beginning in 1986 after the limited license hunting was initiated in the spring season.

Hunting with bait is by far the most successful way to hunt black bears in Colorado. The percent of the total harvest taken with bait has increased from approximately 50% during 1979-81 to over 70% during 1986-88 (Table 2). Participation in archery hunting of big game animals is growing in Colorado. From 1979 to 1988 nearly 25% of the total harvest of black bears was accomplished with bows.

Table 1. Summary of Colorado black bear harvest statistics, 1979-90.

Year	Hunter Numbers	Limited License Harvests		Over-the-Counter License Harvests	Total Harvests
1979	8,577	589	---	192	781
1980	8,454	475	---	176	651
1981	8,736	521	---	138	659
1982	10,045	689	---	159	848
1983	9,871	586	---	147	733
1984	4,789	435	---	104	539
1985	4,379	564	---	91	655
1986	3,861	479	--	61	539
1987	4,029	492	---	124	616
1988	4,477	585	---	88	673
1989	3,872	493	---	99	592
1990	2,066	159	133	120	412
Mean	6,463	508	133	124	641

Table 2. Percentage of total harvest attributable to various methods of taking, 1979-88.

Period	Bait (%)	Hounds (%)	Encounter (%)	Rifle (%)	Pistol (%)	Bow (%)
1979-81	53	21	26	71	3	26
1982-85	62	17	21	71	4	25
1986-88	72	13	15	69	6	25

As regulations have shortened the spring season, outfitters have killed fewer bears (Figure 2). Several factors contribute to this trend, but initiating a random drawing for limited numbers of licenses was probably central to the decline.

Percent females in the harvest has averaged 39% from 1979 to 1990 (Figure 3). The trend is declining slightly. One of the long-term harvest objectives has been to decrease and maintain the percent of females in the harvest to less than 40%.

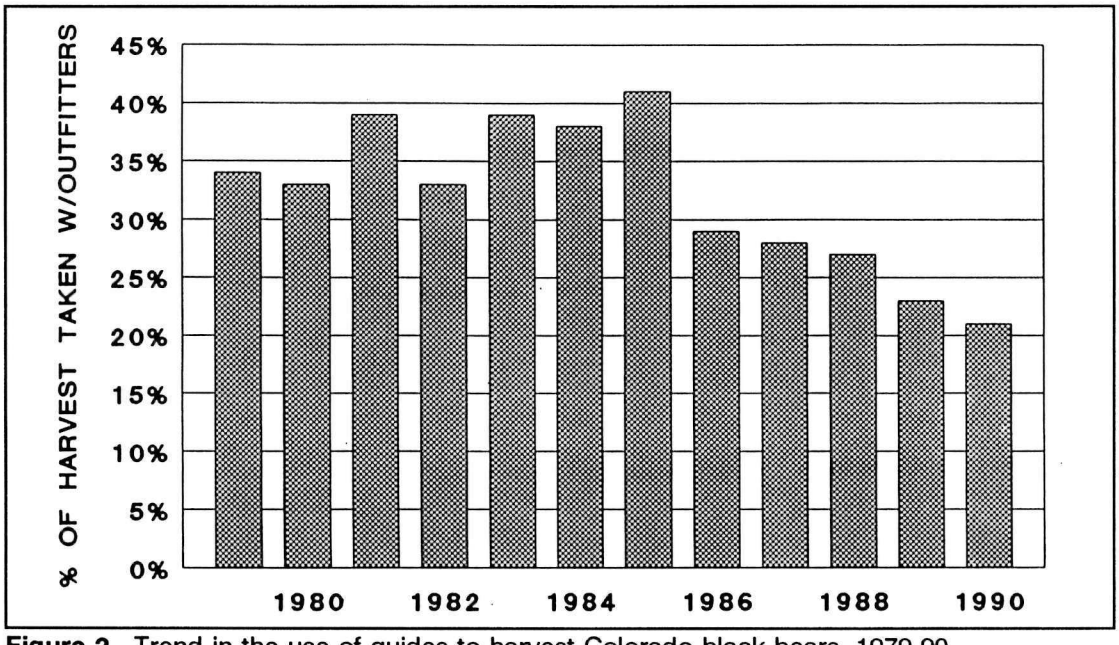

Figure 2. Trend in the use of guides to harvest Colorado black bears, 1979-90.

Property Damage/Depredation Trends and Policies

Colorado law and regulations provide that any landowner can kill any black bear that the landowner believes is threatening property or livestock. Those kills must be reported to the Colorado Division of Wildlife within 48 hours. The Colorado Division of Wildlife reimburses for the cost of verifiable losses at market values.

The Colorado Division of Wildlife has data only for those black bears that are *reported* under the game damage statutory and regulatory provisions. Field personnel believe far more bears are taken than are reported. Numbers of problem black bears killed and reported have declined sharply over the past 25 years from a high of 118 in 1965 to less than 15 in 1975 to the present (Figure 4).

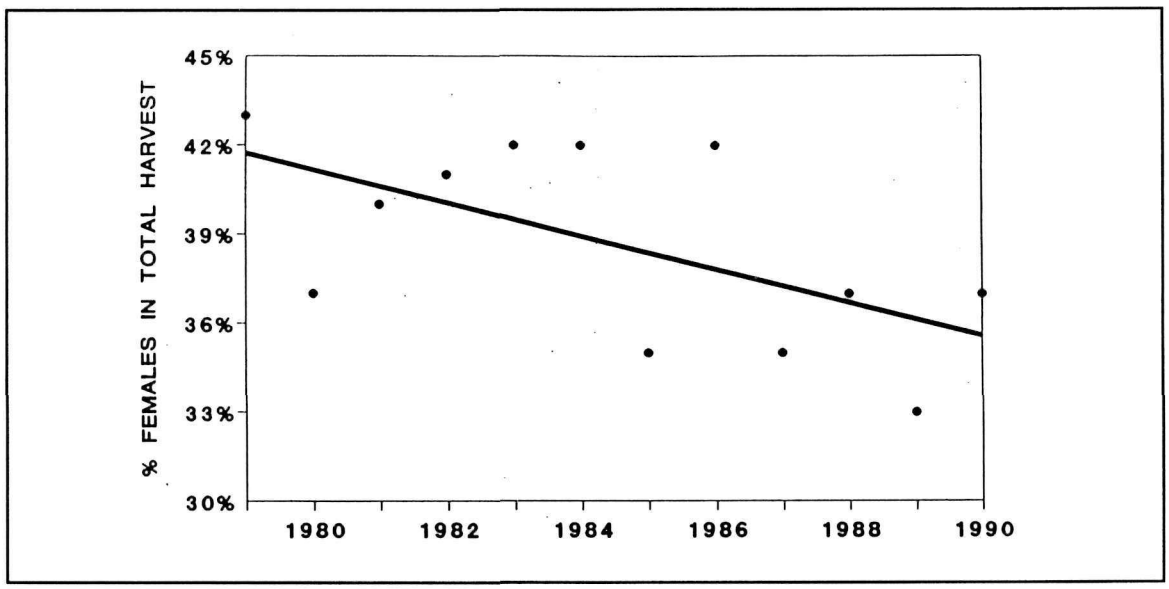

Figure 3. Linear trend in percent females in the Colorado black bear harvest, 1979-90.

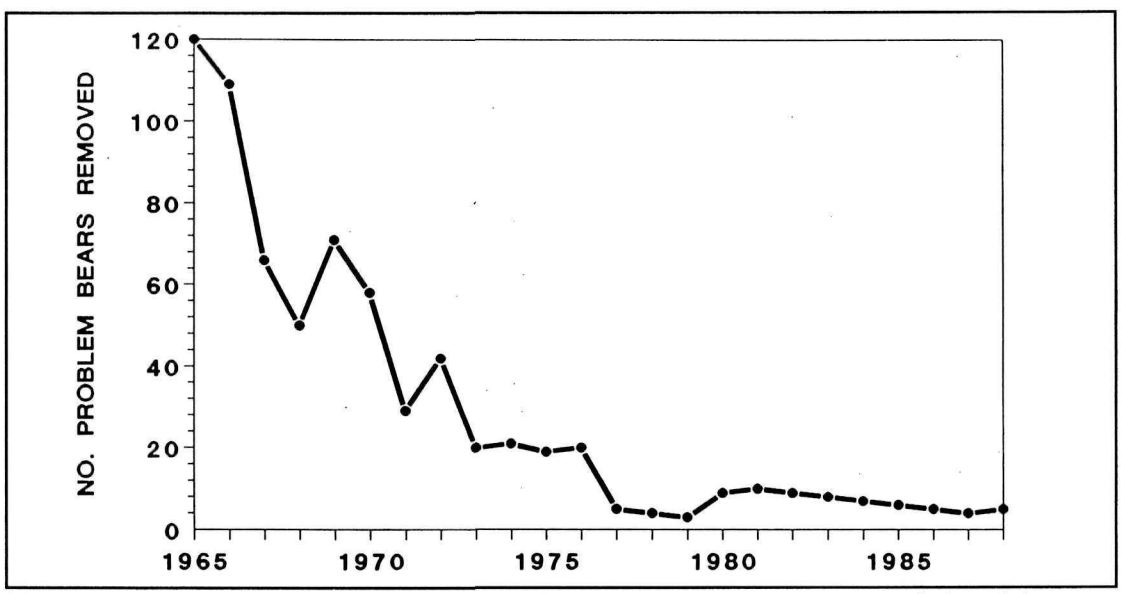

Figure 4. Number of black bears taken and reported under provisions of Colorado's game damage statutes and regulations, 1965-88.

Public Attitudes Towards Bear Management and Hunting

Black bear hunting and management in Colorado is in a dynamic state of flux. Public attitudes towards bears and bear management are changing from permissive to protectionist. Coloradans are demanding more active and direct involvement in establishing bear management policy and hunting regulations. Preservationists, hunters, and livestock owners are polarized on bear management issues, requiring the Colorado Division of Wildlife to reexamine our bear management programs with considerable emphasis on conflict resolution. The future of black bear sport hunting in Colorado almost certainly will be challenged by antihunting groups. Our success in preserving sport hunting will depend on our abilities to find acceptable middle ground management philosophies and programs that are sensitive and responsive to the concerns of all citizens interested in bear management.

The Colorado Division of Wildlife has conducted several public attitude surveys to measure support for wildlife and sentiment regarding hunting issues. As yet, no large-scale public opposition to hunting in general exists. According to Kellert's (1980*a*, *b*) national survey of public attitudes towards wildlife, only 14% of those surveyed disapproved of hunting if the primary purpose was to put meat on the table. In contrast, 80% disapproved of hunting if the primary purpose was perceived to be trophy hunting. A comparable survey of Coloradans (Anonymous 1986) yielded similar results. When asked to express degrees of approval of a variety of reasons for hunting, only 8% disapproved of ". . . hunting for food." In contrast, 74% disapproved of ". . . hunting for a trophy, such as horns or a mounted animal" (Table 3).

Table 3. Comparisons of public attitudes towards hunting for meat and hunting for trophies--national survey vs. Colorado survey.

	Strongly Approve %	Somewhat Approve %	Somewhat Disapprove %	Strongly Disapprove %
National Survey (n = 2455)				
Hunting for meat	22.1	63.1	10.6	3.1
Hunting for trophy	2.0	16.2	36.1	44.1
Colorado Survey (n = 998)				
Hunting for meat	61.8	28.8	3.4	4.5
Hunting for trophy	9.8	14.1	11.7	61.8

Attitudes towards trophy hunting might be expected to vary by the species hunted since the public values various species differently. Thus, the public might not be opposed to hunting black bears for trophies, but they might oppose hunting deer for trophies. When Coloradans were asked to respond to the following statement about black bear hunting, "Black bears do not need to be hunted at all because the primary reason for hunting them is to obtain pelts and skulls for trophies and not the meat for food," 62% of those surveyed agreed with the statement (Table 4).

Table 4. Comparisons of public attitudes towards hunting deer for trophies vs. hunting black bears for trophies.

Against Trophy Hunting	Strongly Agree %	Somewhat Agree %	Somewhat Disagree %	Strongly Disagree %
Deer (by inference from Anonymous 1986) (n = 998)	61.8	11.7	14.1	9.8
Bears (Anonymous 1989) (n = 589)	30.5	21.4	25.8	18.6

Professional wildlife biologists differ markedly from the general public in attitudes towards wildlife. Peyton and Langenau (1985) contrasted the attitudes of Bureau of Land Management (BLM) wildlife biologists with those of the general public. BLM wildlife biologists scored higher in overall wildlife interest than the general public. In addition, BLM wildlife biologists were much more interested in wildlife for their ecological and scientific values than was the general public. The average citizen was much more likely to value wildlife for utilitarian and moralistic reasons than were wildlife biologists.

Much of wildlife policy is based upon "squeaky wheel" responses from a minority of the public willing and motivated to attend CWC meetings or public hearings to champion their causes. On most controversial issues, the views expressed by these members of the motivated public are biased reflections of public attitudes towards wildlife issues. For example, we summarized the views expressed from letters to the governor, the Colorado Department of Natural Resources, the Colorado Division of Wildlife, and the Colorado Wildlife Commission concerning the black bear management issues of hunting in the spring, hunting with bait, and hunting with hounds for the period November 1988-October 1989. We contrasted this summary with written comments received from Colorado Division of Wildlife employees in response to draft editions of the Black Bear Management Plan during the same period. Unsolicited public responses were overwhelmingly against hunting in spring, hunting with bait, and hunting with hounds. In contrast, Colorado Division of Wildlife employees were more divided, but the majority favored hunting in the spring, hunting with bait, and hunting with hounds (Table 5).

Table 5. Comparison of written responses of the general public and Colorado Division of Wildlife employees to the black bear management issues of hunting in spring, hunting with bait, and hunting with hounds.

	Hunting in Spring		Hunting with Bait		Hunting with Hounds	
	% For	% Against	% For	% Against	% For	% Against
General public	5 (7)	95 (149)	6 (6)	94 (101)	11 (6)	89 (49)
Colorado Division of Wildlife employees	58 (14)	42 (10)	64 (6)	36 (9)	69 (9)	31 (4)

Note: Numbers in parentheses are sample sizes.

During the black bear management planning process, some individuals and groups were dissatisfied with the CWC process to resolve black bear management policy conflicts. They believed the CWC process was strongly biased towards hunting interests. At one point the Colorado Wildlife Commission was threatened with a citizen initiative to place black bear hunting issues on the general ballot for a public vote. The Colorado Division of Wildlife had no objective information to assess the likely outcome of a public vote on black bear management issues, but we were concerned about the precedent such a vote could set. Wildlife management by legislation is much less flexible and responsive than management by regulation. Consequently, we contracted with a professional pollster, Standage Accureach, to survey public attitudes towards black bears and key black bear management issues (Anonymous 1989).

The survey showed that hunting in spring, hunting with bait, hunting with hounds, and data adequate to establish safe harvest levels and evaluate harvest effects were still the watershed issues of Colorado black bear management to Colorado citizens. Following are responses to some of the questions addressing these issues.

Focus group discussions have been used by social science researchers to help define critical public policy issues (Morgan 1990). The Colorado Division of Wildlife hosted a focus group discussion to provide preliminary information about what the general public considered major black bear management issues and why these issues were important. The focus group suggested that the general public opposed hunting bears in the spring primarily because it places females with nursing cubs of the year in jeopardy. If the female is killed during the active nursing period, the cubs will almost certainly starve without maternal care. The issue did not address the dynamics of bear populations, but focused on the welfare of individual bears. Hunting with bait and hunting with hounds were considered hunting ethics issues. Focus group participants indicated that they considered hunting with bait and with hounds an unfair advantage over bears. The issue of data adequacy was a population preservation issue. Focus group participants believed the Colorado Division of Wildlife had an obligation to convince the public that allowing the public to hunt black bears did not endanger the bears' future existence.

Hunting in Spring. We followed the focus group discussions with a stratified random survey of public attitudes towards bear hunting and bear management. When presented with the statement, "I am very bothered by the idea of hunting black bears in the spring that might result in the killing of females with nursing cubs," nearly 90% of the respondents agreed. Females agreed more strongly than males, middle-aged persons agreed more strongly than young and old persons, and those with a high school education or above agreed more strongly than those who had no high school education (Table 6).

Table 6. Attitudes of Coloradans towards hunting black bears in the spring when females with nursing cubs are at risk.

Statement: I am very bothered by the idea of hunting black bears in the spring that might result in the killing of females with nursing cubs (n = 605).	**Strongly Agree** %	**Somewhat Agree** %	**Somewhat Disagree** %	**Strongly Disagree** %
Gender				
Males	58.3	28.0	6.3	6.0
Females	78.0	14.4	3.9	1.6
Residence				
Denver-metro	68.5	20.7	5.1	4.3
Eastern Colorado	68.8	22.6	4.8	1.4
Western Colorado	66.9	19.8	5.8	6.6
Age				
18-34 years	62.4	27.4	6.6	2.0
35-54 years	72.4	17.7	3.9	4.7
55+ years	68.4	19.1	5.3	4.6
Education				
Grade school	44.4	22.2	22.2	0.0
High school	73.3	21.7	2.2	2.2
College graduate	68.9	20.5	4.1	4.9
Post graduate	66.3	25.6	4.7	2.3

The interpretation from these data is that spring season is a powerfully emotional issue, which potentially can be used to discredit the Colorado Division of Wildlife's entire black bear management program. If viable alternative periods can be found for scheduling bear hunting

seasons when cubs are not dependent upon maternal care, the Colorado Division of Wildlife would be well advised to reschedule black bear hunting to these periods.

Hunting with Bait. Females are more strongly opposed to hunting black bears with bait than males. Urban residents of the Denver-metro area are more opposed than rural eastern and western Colorado residents. Older residents are more opposed than younger residents, and opposition seems to increase with age (Table 7).

Table 7. Attitudes of Coloradans towards hunting black bears with bait.

Statement: I object to the use of bait as a means of hunting black bears because it gives the hunter an unfair advantage over the bear (n = 602).	**Strongly Agree %**	**Somewhat Agree %**	**Somewhat Disagree %**	**Strongly Disagree %**
Gender				
Males	55.3	21.9	11.3	9.9
Females	60.7	21.3	8.3	7.7
Residence				
Denver-metro	61.0	19.9	9.0	7.9
Eastern Colorado	55.6	26.1	9.2	7.7
Western Colorado	55.1	17.8	12.7	12.7
Age				
18-34 years	55.3	24.4	9.1	8.1
35-54 years	57.9	20.5	11.0	9.8
55+ years	61.1	20.1	8.7	8.1
Education				
Grade school	55.6	33.3	11.1	0.0
High school	58.7	20.1	11.2	8.4
College graduate	66.9	16.1	6.5	8.9
Post graduate	61.6	19.8	10.7	5.8

Hunting with Hounds. Responses to the issue of hunting with hounds was similar to responses to hunting with bait, except for the relationship between the level of education and the degree of opposition. Residents with only a grade-school education objected most strongly to the use of hounds to hunt black bears. Opposition tended to decrease as education level increased (Table 8).

Table 8. Public attitudes towards hunting black bears with hounds.

Statement: I object to the use of dogs as a way of hunting black bears because it is not a fair way of hunting (n = 601).	**Strongly Agree %**	**Somewhat Agree %**	**Somewhat Disagree %**	**Strongly Disagree %**
Gender				
Males	52.8	19.4	14.4	11.0
Females	63.9	16.6	9.9	6.6
Residence				
Denver-metro	60.0	17.5	12.7	6.9
Eastern Colorado	59.9	18.4	10.6	9.2
Western Colorado	52.1	18.5	13.4	12.6
Age				
18-34 years	55.8	16.6	15.1	8.0
35-54 years	59.8	17.7	10.6	9.4
55+ years	58.9	20.5	11.0	8.9
Education				
Grade school	71.4	14.3	14.3	0.0
High school	65.0	16.9	6.8	9.6
College graduate	58.5	13.8	16.3	10.6
Post graduate	61.6	16.3	16.3	2.3

The issue of hunting black bears in the spring is fundamentally an animal welfare issue. Safeguards on the numbers of bears harvested in spring does not address the welfare of individual black bears. Consequently, management tactics that only safeguard the effects of spring hunting on bear populations likely will not resolve the spring hunt issue. Hunting with bait and hunting with hounds are hunting ethics issues and are concerned with concepts of fair chase. We suggest that the public will be more flexible and willing to compromise on the hunting ethics issues than they will be on animal welfare issues.

Adequacy of Black Bear Management Data Base. The Standage Accureach attitude survey did not directly address the question of public confidence in the Colorado Division of Wildlife's bear harvest management data base. That question was addressed indirectly with the statement: "I believe the Colorado Division of Wildlife carefully and effectively regulates the sport hunting of black bears in the state." More than three-fourths of the respondents agreed with the statement, indicating that the Colorado Division of Wildlife's black bear management program retains high credibility with most of the public. However, that credibility seemed to be correlated with how we

manage the controversial issues of hunting in spring, hunting with bait, and hunting with hounds. Only 40% of the public *strongly agreed* that we "carefully and effectively regulate" bear hunting. Therefore public confidence in the Colorado Division of Wildlife's management appears to be tenuous (Table 9).

Table 9. Public confidence that the Colorado Division of Wildlife's management programs "carefully and effectively" regulate black bear hunting.

Statement: I believe the Colorado Division of Wildlife carefully and effectively regulates the sport hunting of black bears in the state (n = 534).	**Strongly Agree %**	**Somewhat Agree %**	**Somewhat Disagree %**	**Strongly Disagree %**
Gender				
Males	42.0	37.5	9.5	5.3
Females	36.7	39.8	11.2	5.6
Residence				
Denver-metro	35.1	35.9	12.2	7.8
Eastern Colorado	40.6	42.8	8.3	3.9
Western Colorado	47.7	37.6	9.2	2.8
Age				
18-34 years	32.4	44.5	12.1	2.9
35-54 years	40.1	33.9	11.9	8.4
55+ years	47.7	37.6	5.3	3.8
Education				
Grade school	75.0	12.5	0.0	0.0
High school	46.3	38.7	8.1	2.5
College graduate	34.0	37.7	8.5	10.4
Post graduate	31.6	42.1	15.8	1.3

Perhaps, significantly, support was lowest among Denver-metro residents and among younger aged and better-educated respondents. Attitudes of these demographic groups are particularly important because they are most likely to vote and are most responsive to animal welfare and hunting ethics issues. Additionally, these groups are most disinclined to support hunting in general.

Hunter-Nonhunter Comparisons. One of the more surprising results of the survey was the degree of attitudinal similarity between hunters and nonhunters regarding hunting in spring, with bait, with hounds, and the adequacy of the Colorado Division of Wildlife's black bear management data base. Hunters and nonhunter responses differed more in degree than in kind. Nonhunters opposed spring hunts, hunting with bait, and hunting with hounds more strongly than big game hunters or black bear hunters, but the majority of all three groups were opposed to spring, bait, and hound hunting (Table 10).

Table 10. Comparative attitudes of nonhunters, big game hunters, and black bear hunters to the issues of hunting in spring, with bait, with hounds, and adequate management data.

Statements: I object to the spring hunt; I object to hunting with bait; I object to hunting with hounds; the Colorado Division of Wildlife carefully and effectively regulates hunting.	**Strongly Agree** %	**Somewhat Agree** %	**Somewhat Disagree** %	**Strongly Disagree** %
Spring Hunting				
Nonhunters	72.5	19.9	4.6	1.3
Big game hunters	63.4	22.8	5.7	6.4
Black bear hunters	56.7	28.3	5.0	10.0
Hunting with Bait				
Nonhunters	61.9	23.7	6.7	6.0
Big game hunters	54.4	19.1	13.1	11.4
Black bear hunters	54.2	11.9	16.9	15.3
Hunting with Hounds				
Nonhunters	59.2	20.1	11.7	5.7
Big game hunters	57.6	15.5	12.8	12.1
Black bear hunters	50.0	16.7	10.0	20.0
Adequacy of Data				
Nonhunters	34.2	37.3	13.7	6.8
Big game hunters	44.4	39.9	7.1	4.1
Black bear hunters	57.4	27.8	3.7	3.7

These data have been challenged as biased. The survey was conducted by telephone interviews. To avoid costly rephoning, if the person in each household who actually hunted was unavailable, any household resident who was 18 years or older was questioned. These other household residents were assumed to respond to questions similar to the way the actual hunter would respond. This assumption was not verified and could be incorrect. But two-thirds of the bear hunters in Colorado hunt in the fall without bait and without hounds during the regular rifle deer and elk hunting seasons. The results of the survey seem to reflect the choices of seasons and methods the majority of Colorado black bear hunters select when hunting black bears.

Antihunting Sentiments. During the black bear management debates, many hunters and hunting groups expressed concern that a few antihunters were generating the perception of controversy concerning black bear management in Colorado. Additionally, hunters were concerned that if the Colorado Division of Wildlife and the Colorado Wildlife Commission "gave in" to these antihunting concerns, the result would be a catastrophic wave of antihunting sentiment throughout the state for all game species. The survey examined the depth of antihunting sentiment among Coloradans with several statements. In general, no overwhelming antihunting sentiment among Colorado residents was found. For example, only about one-third of the respondents strongly agreed with the statement, "Black bears do not need to be hunted at all because the primary reason for hunting them is to obtain pelts and skulls for trophies and not the meat for food." The relatively low level of strong positive response to this question is surprising because the statement links antihunting sentiments with antitrophy hunting sentiments (Table 11).

Collectively, these responses reveal support for the concept of sustained yield harvesting. Respondents did not believe restricting black bear hunting would threaten the future of all hunting. Respondents seem to be about evenly divided over the "sport" aspects of hunting. We believe much of the split over the issue of sport hunting reflects individual feelings about the issue rather that any desire to legislate prescriptive philosophies aimed at stopping others from hunting.

Conclusions

Black bear hunting in Colorado is controversial, as in most western states. Changes in public attitudes and values towards wildlife are the root causes for this controversy, although other reasons exist. Coloradans are becoming more urbanized, feminized, older, and progressively white-collared. These demographic changes signal a need to adjust wildlife management objectives to accommodate changing attitudes. Cryptic species, such as black bears and puma, are regarded as rare by a public that has become more environmentally sensitized and active. The premise that these species can be hunted will be challenged first, along with the ethics of traditional hunting methods.

The Colorado Division of Wildlife now faces challenges to black bear management similar to those California confronted recently. The credibility of the Colorado Division of Wildlife as steward of the public's wildlife will depend upon how well we plan to meet these challenges and how effectively we implement those plans.

Table 11. Antihunting sentiment among Colorado residents as reflected in responses to statements relating to black bear hunting.

Statements	Strongly Agree %	Somewhat Agree %	Somewhat Disagree %	Strongly Disagree %
Black bears do not need to be hunted at all because the primary reason for hunting them is to obtain pelts and skulls for trophies and not the meat for food.	38.7	23.1	25.8	18.6
Bear hunting helps prevent overpopulation of bears.	27.6	35.2	15.9	18.1
Black bear hunting is a form of sport and recreation, and people who want to hunt should be allowed to do so.	20.2	28.3	18.0	29.7
I regard black bears as a renewable natural resource that can be harvested periodically so long as their populations are managed effectively.	51.2	31.6	7.6	8.4
In my opinion, any attempt to restrict black bear hunting in Colorado will threaten the future of all hunting in the state.	13.4	12.2	29.4	41.5

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Idaho

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Distribution and Abundance

Black bear distribution in Idaho corresponds closely to the distribution of coniferous forests. Bears are found throughout the forested mountains and foothills north of the Snake River plain. Few bears occur south of the Snake River, except in southeast Idaho. Most bear habitat is publicly owned.

No reliable bear population estimators are available. But Idaho Department of Fish and Game research has found bear densities of 1.0 bears per 1.3 km^2 in the best habitats. Obviously, densities are lower elsewhere.

Population Monitoring System

The department conducts a series of bait station surveys in some of the best bear units to monitor population trends. The surveys are patterned after those developed in the southeast by Johnson and Pelton, with several modifications to better fit Idaho habitats. This approach has not been fully validated and is time-intensive, so it is not used statewide.

The department puts more effort into monitoring bear harvest, which is used as an indicator of population trends. A telephone survey of 3% of bear hunters is used to monitor statewide bear harvest, hunter effort, and other variables. Sample sizes are such that the data by each unit are not reliable.

A mandatory check and report system was instituted in 1983 wherein successful hunters are required to present the skull of harvested bears to department representatives within 10 days of harvest. A tooth is pulled for aging and the hunter reports the kill location, date, sex of the bear, and other factors. These data are summarized by unit and data analysis unit.

Management Objectives and Strategies

Black bears are managed to provide a variety of recreational opportunities for hunting and nonhunting resource users within the constraints imposed by the resource.

In 1972, the department initiated black bear research to collect biological data for the management program. The ages of black bears captured during that research indicated that lightly hunted populations had a high ratio of adults to subadults (70:30), a high percentage of adult males (35%), and a median age of 7.5 years. Data collected from heavily hunted populations showed adult:subadult ratios favoring subadults (40:60), fewer adult males (21%), and a median age of 2.5

to 3.5 years. Studies of black bear populations in Alaska, Virginia, and Arizona have shown similar relationships between lightly and heavily hunted populations. These data provide the basis for the department's management criteria.

Idaho is divided into five data analysis units for black bear management purposes. The areas are based on general vegetative cover, road access, and proximity to human population centers. Data summary and analysis and season structures are based on data analysis units.

Species Management Plan

The department operates within the framework of a five-year species management plan developed by a team of biologists with input from other agencies and the public. We are currently operating under the 1986-90 plan. The 1991-95 plan will probably not be ready until late 1991 or early 1992.

The primary objectives of the 1991-95 plan follow. The department will develop a list of priority programs to address these objectives.

1. Improve data collections by improving compliance with the mandatory check and intensifying the telephone survey of bear hunters.

2. Strive to increase the variety of recreational opportunities by exploring the potential for additional controlled hunts, season restrictions in selected units, or both.

3. Monitor and refine the management criteria.

4. Reduce bear harvest where data indicate a need.

5. Recognize the importance of population "reservoirs" in the department's management philosophy.

6. Initiate research to
   a. validate the harvest criteria,
   b. develop and test population monitoring techniques,
   c. determine age- and sex-specific vulnerability to harvest techniques, and
   d. test the reservoir concept as a management philosophy.

Recent Research and Publications

No research within the last five years is available. The only publications are the standard Pittman-Robertson reports.

Hunting Laws and Regulations

Idaho offers controlled hunts for bears in one unit. All other bear seasons are general seasons. The spring season opens 1 April and closes 31 May (30 June in some units). Dogs are restricted to 15-31 May in some units. In some units, the fall season opens 1 September and closes 31 October with a two-week closure (16-30 September). Other units have the same fall season, either 15 June-14 July or 15 July-14 August. In general, hunting bears with dogs, bait, or both is not permitted in units that support known grizzly bear populations.

Specific regulations follow.

1. Either sex bear may be taken, except females accompanied by young.

2. Bait may be used for black bears as long as the bait or scent is not
   a. any part of a game bird, game animal, or game fish;
   b. placed on public or private property without permission and is within approximately 183 m of any free water, maintained trail, road, or campsite; and
   c. contained within paper, plastic, glass, metal, wood, or other nonbiodegradable materials.

3. Dogs may be used in units with such a season to take or pursue black bears, but only if the following conditions are met:
   a. a firearm season (excluding muzzleloader) for deer or elk is not open in the area to be hunted;
   b. the owner or person having control of the dogs in the field has a valid houndhunters permit in possession; and
   c. during pursuit season, bears may be pursued and treed but not captured, killed, or possessed.

4. All successful bear hunters must comply with the department's Mandatory Check and Report Program within 10 days of the date of kill.

5. Black bears may not be trapped, snared, or otherwise captured or held without a permit issued by the director.

6. Hunting or pursuing black bears is prohibited within approximately 183 m of the perimeter of any designated dump or sanitary landfill.

Harvest Summary

Harvest information is illustrated in Table 1.

Table 1. Statewide summary of hunting harvest data, 1990.

Black Bears Checked								
Season or Method	**Rifle**		**Bow**		**Other**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Spring								
Incidental	65	8%	2	0%	3	0%	70	8%
Still	243	28	16	2	6	1	265	31
Bait	151	18	118	14	23	3	292	34
Hound	137	16	19	2	44	5	200	23
Other	19	2	1	0	7	1	27	3
Total	615	72	156	18	83	10	854	54
Fall								
Incidental	272	38%	25	4%	12	2%	309	43%
Still	226	32	19	3	7	1	252	35
Bait	16	2	11	2	2	0	29	4
Hound	50	7	17	2	15	2	82	11
Other	22	3	1	0	19	3	42	6
Total	586	82	73	10	55	8	714	46
Total								
Incidental	337	21%	27	2%	15	1%	379	24%
Still	469	30	35	2	13	1	517	33
Bait	167	11	129	8	25	2	321	20
Hound	187	12	36	2	59	4	282	18
Other	41	3	2	0	26	2	69	4
Total	1201	77	229	15	138	9	1568	100

Property Damage/Depredation Trends and Policies

The 1990 Idaho State Legislature passed the first wildlife damage compensation bill in state history. Although funding for this legislation is still pending, legislation does establish procedures to compensate the livestock industry for black bear depredations. Qualifications for compensation is dependent upon livestock owners reporting losses directly to a representative of the U.S. Department of Agricultural Animal, Plant, and Health Inspection Services or Animal Damage Control. Animal Damage Control must investigate within 72 hours and verify the losses. Livestock owners and the Idaho Department of Fish and Game will agree upon the estimated value of animals lost. A $5,000 deductible is required on each claim and the total of all black bear and mountain lion claims paid in one year cannot exceed $25,000.

Public Attitudes Towards Bear Management and Hunting

The department conducted two random surveys to measure public attitudes toward bear baiting. Of the rifle deer and elk hunters, 49% and 51%, respectively, would support prohibiting bear baiting to prevent an overharvest of black bears in Idaho. Only 17% and 16%, respectively, of these same hunters would not accept these prohibitions. When black bear tag buyers were surveyed, a proposed bear baiting prohibition was supported by 45%, opposed by 35%, and 20% of the black bear hunters had no opinion.

Discussion

Question: No bait in 1992 is not definite?

Pete Zager: The bait option in the 1991-95 plan was kicked out. We are back to our old plan at least until the end of next spring season. Baits and dogs are legal in many units for both spring and fall seasons.

Question: Are you still using the sex and age criteria that Beecham developed a few years back?

Zager: Yes. Those criteria are part of the problem because we have found they are not sensitive. We are using median age of females, percent of females in the harvest, bait station visitation, etc., but they are just not sensitive.

Question: Limited entry has been proven to limit the harvest. Is that being investigated in Idaho?

Zager: It will be carefully considered, especially for the spring season.

Question: Is there biological information that would indicate bait is a detrimental technique to take bear?

Zager: Not to my knowledge.

Oklahoma

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Distribution and Abundance

Black bears are found in southwestern Oklahoma, primarily LeFlore and McCurtain counties, in association with the Oachita National Forest.

Population Monitoring System

Black bear distribution and population trends are monitored through a bait station survey, conducted each July/August.

Management Objectives and Strategies

Black bear management is depredation oriented. We are currently monitoring distribution and abundance through bait station survey and addressing nuisance and depredation complaints. The black bear management objective is to increase the population to a harvestable level while reducing nuisance and depredation situations.

Species Management Plan

No management plan exists now. A draft management plan was developed to (1) produce a public information system, (2) determine population parameters of the black bear population in Oklahoma, (3) determine the feasibility of developing viable populations of black bears in Oklahoma, (4) and develop a nuisance and depredating bear control program.

Recent Research and Publications

A pamphlet designed for local residents of LeFlore and McCurtain counties on general bear biology and how to control and prevent bear nuisance and depredation situations is available. The pamphlet, "Oklahoma Black Bears," is available from the Oklahoma Department of Wildlife Conservation, 1801 North Lincoln Blvd., Oklahoma City, Oklahoma 73105.

Hunting Laws and Regulations

A 1915 Oklahoma statute that prohibits killing bears remains in effect. Opening a black bear harvest season in the future depends upon the proposed draft management plan's completion.

Harvest Summary

Not available.

Property Damage/Depredation Trends and Policies

As more bears migrate from Arkansas into Oklahoma, the number of nuisance and damage complaints increases. Our policy in the past has been to trap offending bears and transport them back to Arkansas. This policy is currently being redefined and is not yet completed.

Public Attitudes Towards Bear Management and Hunting

The public is concerned with the growing number of bears migrating into Oklahoma from Arkansas. Most often expressed are fears that bears will cause depredation and damage. Because bears remain a protected species in Oklahoma with a closed season, public opinion is unknown.

Oregon

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Distribution and Abundance

Black bears primarily inhabit the forested portions of the state, which encompass approximately 50% of Oregon's land area. The abundance of black bears varies with habitat type. The highest densities are found in the coastal mountains, southern Cascade Mountains, and the Blue Mountains in northeastern Oregon.

No exact densities have been determined; however, based on density figures published in the literature, Oregon's statewide black bear population is estimated to be 25,000.

Population Monitoring System

Population status and health is monitored by analyzing hunter harvest and bears killed due to damage complaints. Each hunter receives a tooth envelope with instructions on how to remove the first premolar tooth. In addition, the hunter is asked to fill out a short questionnaire that is printed on the envelope and includes the date of kill, sex of the bear, method used to kill the bear, and area in which the bear was killed. Hunters who cooperate are sent a report telling them the age of the bear after it has been determined. The annual number of damage complaints received and total annual harvest data are used as secondary information in assessing population health.

Management Objectives and Strategies

The bear management strategy used in Oregon is designed to provide optimum recreational hunting opportunities while preventing the black bear population from being seriously depleted in the state. A secondary facet of this strategy is to use hunting to alleviate damage that black bears inflict.

The general fall season is basically designed to allow taking an annual harvestable surplus while spring seasons are designed to reduce bear populations in damage areas or to provide recreational opportunities.

Species Management Plan

Oregon's Black Bear Management Plan was adopted in 1987 and is revised every five years. The plan summarizes the history of black bears and their management in Oregon and lists current concerns and associated management strategies that will be used to address those concerns. The plan focuses on hunting and controlling damage that black bears inflict in the state.

Recent Research and Publications

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Copies of federal aid progress reports pertaining to black bear age structure, which were published before 1988, are available upon request from the Oregon Department of Fish and Wildlife, Attention: Wildlife Division, P.O. Box 59, Portland, Oregon 97207.

Hunting Laws and Regulations

Past seasons have consisted of a general statewide fall season that occurs between 1 August and 30 November. In recent years the general season has averaged 98 days in length. A limited number of controlled spring bear hunts, averaging 34 days in length (16 to 44 days), are authorized each year and occur during April, May, or June.

Using hounds or bait is permitted, but bears cannot be snared or trapped. The bag limit is one bear except that cubs less than one year of age and sows with cubs are protected. Legal shooting hours are from one-half hour before sunrise to one-half hour after sunset. A tag sale deadline has been in effect for several years. The deadline becomes effective approximately one month into the season, which corresponds with the tag sale deadline for general buck deer seasons in the state. Those hunters who apply for and receive a controlled spring hunt permit are also allowed to participate in the general fall season if they purchase a tag valid for that season. Fees for licenses and tags in 1990 are as follows: resident hunting license - $9.50; resident bear tag - $10.50; nonresident hunting license - $100.50; nonresident bear tag - $75.50. The number of general season tags that can be sold is not limited; permit numbers for spring bear hunts vary from hunt to hunt.

Bears can be killed with a handgun, rifle, muzzleloader, shotgun, or bow provided these weapons meet the various caliber and weight restriction requirements.

No mandatory harvest report is required; however, all hunters receive a tooth envelope with their tag or permit, complete with instructions for collecting the tooth and providing other pertinent information. Based on information from the harvest survey and the number of tooth samples returned, approximately 40% of successful hunters return a tooth from their bear.

Harvest Summary

The black bear was not declared a big game animal until 1970. Before that time, hunting regulations varied widely from no protection to total protection in certain parts of the state. Hunter numbers and harvests have varied since that time. Overall, changes in harvest have corresponded closely with changes in hunter numbers. Before 1986, we conducted a mail questionnaire harvest survey. Since 1986 we have conducted a telephone survey. Costs associated with the survey forces us to call a small percentage (usually 5-15%, depending on the year) of total tag buyers. In 1990, 20,375 general season bear tags were sold. During the fall season, 17,080 hunters killed 888 bears. In 1990, 1,142 spring permit holders killed 165 bears.

The fall general bear season allows for harvesting surplus animals and is not designed for specific damage problems. However, biologists attempt to direct tag holders to areas where damage has occurred or is present. Hunter success over the past several years has declined, as has harvest. The primary reason for this decline is correlated to a decline in the number of hunters using dogs to hunt bears. At the same time, success rates of hunters using dogs has remained stable. A secondary, but less measurable, cause for this decline is related to regulations associated with other big game seasons scheduled during the overall bear season. In recent years, general season opportunity to hunt deer and elk has declined because more controlled entry deer and elk hunts have been authorized. Hunters are not allowed to hunt with a centerfire rifle in a controlled deer or elk hunt area without an unused deer or elk tag valid for that area and time period in their possession. Consequently, much bear hunting is closed to bear hunters during significant portions of the fall season unless they possess a valid, controlled deer or elk tag. We believe the bear kill has been reduced somewhat because of this restriction.

Spring hunts in western Oregon are primarily designed to reduce bear populations in areas where timber companies are suffering damage to conifer plantations by black bears. The damage includes bears peeling the bark off conifers and feeding on the cambium layer of the tree. This activity either kills the tree or increases the probability of the tree acquiring a disease. Timber operators do not see that these hunts are effective in reducing bear damage to conifer plantations and would prefer to remove damage-causing bears by trapping or snaring. Oregon Department of Fish and Wildlife policy is to use hunting to help resolve damage complaints, and, consequently, spring hunts have been maintained in those areas receiving damage.

In northeast Oregon, the spring hunts are recreational in nature. They provide a unique opportunity for tag holders in that dogs or bait are not necessary to find or kill a bear. The open nature of the habitat in most of these hunt areas allows a hunter to spot bears from a distance and approach within shooting distance. Therefore, about one-half of the tag holders hunt without using dogs.

Most bears killed during the fall season are taken either with dogs or with bait. Preliminary data analysis indicates that the median age of bears taken with bait is younger than those taken with dogs. Evidently, houndsmen have more latitude in taking specific bears because they do not have to hunt at a specific station. Houndsmen may also be more selective in choosing a bear to harvest. We do not see houndsmen placing bait lines so as to increase their odds of striking a bear. However, baiters complain of houndsmen running and killing bears off their bait stations. Both baiters and houndsmen take approximately equal percentages of male (70%) and female (30%) bears. Over the last few years we have seen a slight increase in the number of bears taken with calls, but this take is a small proportion of the total. Hunters report few crippling losses. Since most of the bears killed in the state are taken with dogs and with rifles, we do not see crippling loss to be significant.

In Oregon, cubs less than one year old and sows with cubs are protected during both the spring and fall seasons. Although difficult to measure, we see few violations of this regulation. Under current harvest levels, we do not see hunting as being detrimental to the overall health of the bear population.

Property Damage/Depredation Trends and Policies

Oregon has a specific regulatory statute that allows a landowner or the landowner's agent to kill, without a permit, black bears, cougars, bobcats, or red foxes that are found to be damaging livestock or private property. Consequently, landowners exert some of the control efforts in Oregon.

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), and Animal Damage Control (ADC) agents are employed in most counties in the state and perform a considerable amount of bear and cougar control, especially regarding livestock depredation complaints. The department contributes $40,000 a year to the animal damage control program in Oregon; ADC personnel act as agents of the department.

Department personnel do participate in some bear damage control activities. Most of these efforts are directed towards handling nuisance complaints such as damage to garbage cans, residences, or removing bears from populated areas.

One county within the state has its own damage control program that is similar to but not related to that of the USDA-APHIS-ADC.

The department is not required to pay landowners for damages received from big game animals, although discussions of such a requirement surface during every legislative session. Our success (to date) at avoiding such a requirement may be related to a policy of prompt response to damage complaints.

Overall, we believe that once a bear causes damage, it will continue to cause damage regardless of where it may be relocated. Our policy is to kill any bear that damages livestock. Nuisance bears are usually livetrapped or immobilized, marked, and released in a location where they are less likely to cause damage. If such a bear causes damage a second time, it is killed. Bears causing damage to timber resources are killed or controlled in the spring bear harvest; the bears are not livetrapped and relocated.

A few corporate timber companies are experimenting with feeding bears to prevent damage, a program nearly identical to that used in similar situations in the state of Washington. While this alternative may be acceptable to the public and for reducing damage to conifers in the short term, we are concerned about the effects of this program on overall bear productivity and survival. Increased survival on corporate forestlands may lead to increased damage adjacent to those lands in the future. Likewise, the program is expensive and such expense can be expected to increase as bear populations increase. The department currently has limited involvement in this program.

Several trends in black bear damage/depredation are occurring. In western Oregon we are experiencing an increase in bear damage to conifer plantations. Most damage occurs in the spring for a short period after the bears emerge from their dens.

We are recording a steady increase in nuisance complaints throughout the range of the bears in Oregon. This increase is either related to an increasing bear population or more humans inhabiting "bear habitat."

Black bear damage to livestock is generally increasing in most areas of the state. However, while individual range allotment permittees are experiencing increased damage to domestic sheep, the number of allotments that are active has steadily declined since the early 1960s. Consequently, the potential for damage is decreasing on public land sheep allotments. Public land managers, in response to public sentiment, are becoming more sensitive and restrictive in the amount and types of control methods they are allowing ADC agents to utilize on such allotments.

Public Attitudes Towards Bear Management and Hunting

Public attitudes towards bears are affecting management in Oregon. Public television broadcasts that portray national or international problems with bear poaching and illegal trade in bear parts instill a fear in many Oregonians that the same types of problems are occurring here. A lack of accurate bear population estimates reduces our effectiveness to counter claims that these activities threaten bear populations in Oregon. Many groups opposed to bear hunting are reluctant to accept population statistics acquired from dead bears as representative of overall bear population status.

A percentage of Oregonians are opposed to killing damage-causing bears as a control method. However, our experience with moving such bears to secondary locations has usually resulted in the bear returning to the original location to cause additional damage or causing damage elsewhere. In addition, in timber-damaged areas, an extensive amount of time and manpower would be required to capture and move all tree-damaging bears. The question of acceptable release locations and potential liability claims also deters this approach.

Many Oregonians are not opposed to hunting black bears if they can be assured that hunting does not have a detrimental effect on the overall population. However, an increasing percentage of the public opposes using hounds for hunting bears. Such groups or individuals claim that chasing a bear with dogs is harassment, and shooting a bear from a tree is not a sport. These opponents claim that dogs harass many other species of wildlife while hunting bears and that consequently using dogs should not be allowed. In many cases in Oregon, the bear harvest would be greatly reduced if dogs were not used. Reduced harvest would most likely cause an increase in damage problems and may erode landowner acceptance of bear populations on their properties.

Conclusions

Based on the data collected, the overall black bear population in Oregon is currently classified as healthy and stable or increasing in most areas. Public attitudes toward bear management are changing, and we fear that a general lack of understanding of the bear and bear management may impact our ability to manage bears in the future.

Forest management practices have significantly changed the forested landscapes of the state. Unfortunately, the overall effect of such practices on black bear habitat is poorly understood. We have a definite need to learn more about black bear habitat needs, the current status of the habitat in relation to those needs, and how future forest management activity will affect habitat quality and availability.

Hunting is the primary tool available for regulating bear populations. Assuming that the habitat needs of black bears can be maintained, losing hunting as a management tool will most likely result in increased conflict between black bears and human interests. Ultimately, such increased conflict may negatively alter public attitudes toward the bear and could have a detrimental effect on bear populations.

Discussion

Question: What is your recovery rate on your teeth?

Walt Van Dyke: Based on the hunter survey results, we got about 58% in 1989. I should note that tooth collection is not mandatory.

Question: Do you provide the ages to the hunters?

Van Dyke: Yes, we do.

Question: Are you concerned that you are only having the teeth of big bears turned in and therefore biasing your age data?

Van Dyke: That is a possibility. It could be happening.

Question: You mentioned that tree damage was on the increase. Do you have a feeling this is due to an increase in bears or an increase in the more vulnerable tree class size?

Van Dyke: I think it is a function of the age class and size class of the trees. Commercial thinning also appears to increase bear damage.

Saskatchewan, Canada

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Distribution and Abundance

Referring to the stylized map of Saskatchewan (Figure 1), area 1 does not contain suitable black bear habitat. Area 2 is the zone of secondary quality occupied bear habitat. The prime quality occupied black bear range of the province is within area 3. Area 4 represents an area that contains pockets of black bear habitat that bears may or may not use permanently. Area 5 is a zone that has only limited capability to support black bears due to habitat alternation brought on by agriculture. Bears in this area are usually removed shortly after they are located.

Abundance is highly variable. Presently, we lack accurate estimates of bear numbers and densities. We believe that within the prime black bear habitats (area 1), the density could be slightly in excess of 0.4 bears per square kilometer and range downward to about 0.2-0.25 bears per square kilometer in the secondary (area 2) habitats. Through the remainder of their range, densities are highly variable, reflecting the patchy distribution of suitable habitat. Locally, the ability of hunters to access various portions of the range also influences bear density.

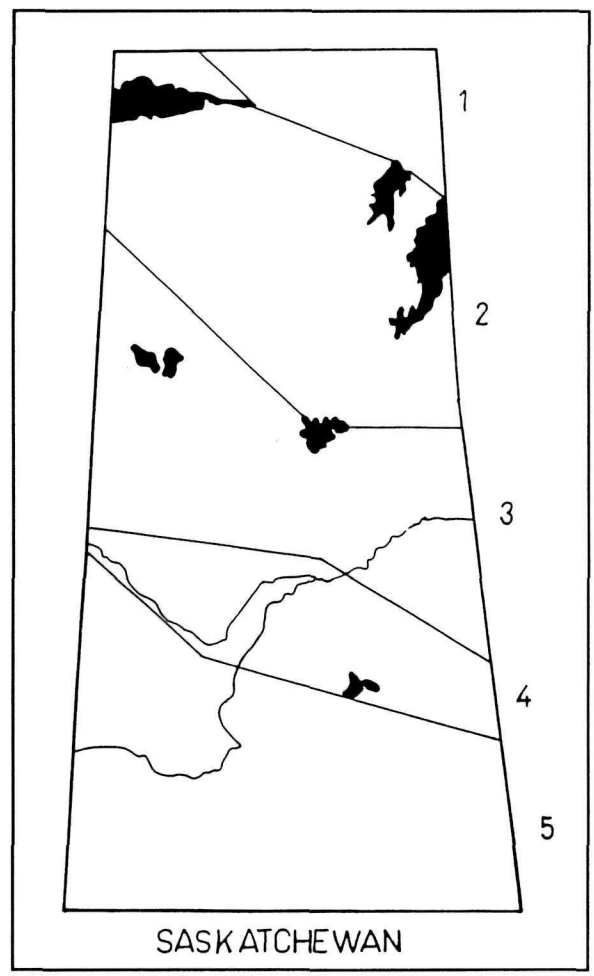

Figure 1. Stylized map of Saskatchewan.

Population Monitoring System

Saskatchewan uses various indices to achieve population monitoring. These indices include, but are not restricted to, data obtained from the harvested animals (e.g., age, sex, size), responses received from hunters through an annual mail-out survey (e.g., days hunted, success rate, location of kill), and public reports of encounters (e.g., depredations, refuse dump observations).

Management Objectives and Strategies

The intent of our management effort is to maintain the black bear population in the forested areas of the province while trying to minimize bear-human conflicts in the settled areas of the range. The major area of conflict is in the forest fringe zone (primarily area 4), where agricultural activities abut the forest.

Recent Research and Publications

Recent work has dealt with the reliability of available age assessments (internal) and the microanatomy of various body organs in conjunction with Ohio State University (published in *Acta anatomica*). Investigations are under way to assess the age-specific reproductive parameters of the Saskatchewan population.

Hunting Laws and Regulations

Saskatchewan has a spring season and a fall season. Depending upon the wildlife management zone, the season length can vary between five and nine weeks in the spring and two and seven weeks in the fall. Generally, the less accessible zones in the north have the longer seasons. A hunter is allowed one bear annually with unfilled spring-purchased licenses valid in the fall. Baiting is allowed but using dogs is not. Nonresidents of Canada must use a registered guide.

Harvest Summary

The major 1990 harvest indices revealed that (1) mean female age was 4.8 years, (2) mean male age was 3.9 years, (3) sex ratio was 1.8 males per female, and (4) color ratio was 2.2 blacks per off-color. Hunter survey data from 1989 indicated that (1) resident hunter success approximated 30%, (2) nonresident (guided) hunter success approached 60-65%, and (3) estimated hunter harvest was 1,200-1,500 bears.

Property Damage/Depredation Trends and Policies

Compensation is paid for agricultural damage that bears cause. Major elements of this program are cattle losses and beehive destruction. Cattle losses are variable from year to year. Beehive losses have been declining over the years, because electric fence packages were issued in lieu of cash. Electric fences are effective deterrents to continued beehive problems.

Campground and cottage problems are not common, and the government does not compensate for bear-caused damage (homeowner insurances may). Chronic problem bears, in all cases, are dispatched.

Public Attitudes Towards Bear Management and Hunting

In general, a wide-based support exists for both bear hunting and the present management approach. A small segment of people believe that bears, like wolves, should all be destroyed. Likewise, some people feel that all wildlife should be left totally unmanaged. The anticonsumptive use lobby within Saskatchewan is presently not large or active. As long as we can demonstrate that we are properly managing bears for their long-term survival, the public will probably view hunting as an acceptable part of the overall approach.

Conclusions

Until recently, many residents of Saskatchewan viewed bears as a nuisance, to be dealt with accordingly. We had high bear numbers in the late 1970s and early 1980s, which tended to exacerbate this feeling. For reasons still not fully understood, a large increase occurred in the number of nonresident bear hunters in the mid-1980s who chose to come to Saskatchewan. At the same time, a marked increase occurred in the number of residents who took up the sport. The result was that bear license sales increased by over 150% between the mid-1970s and 1989 and resulted in a doubling of hunter days spent in the field.

With the increased hunting pressure that the bears were then experiencing, the population monitoring indices showed that the population was in decline. This decline reflected the state of the bear population in the accessible and hunted areas of the province. The existence of bears in remote, unhunted areas undoubtedly helped to moderate this decline via emigration. Saskatchewan Parks and Renewable Resources then began to institute a series of hunting season changes and restrictions, which have led to stabilizing these indices. We believe the population is stable to increasing at this time.

For 1991, Saskatchewan shortened the fall season, which will help the bear population rebound to past levels. Monitoring, research, and management approaches continue to be refined and changes implemented as necessary.

Texas

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Distribution and Abundance

Historically, black bears inhabited all of Texas except the extreme southern portion. By 1960, the bear was extirpated in Texas with only occasional sightings and reports in the forests of east Texas and the rugged mountain areas of west Texas. These reports were determined to be migrants from Louisiana, New Mexico, and Mexico. The decline of the native bear population in Texas was primarily attributed to hunting for food, sport, and predator control. Human encroachment on bear habitat and domestic livestock grazing also contributed to this decline.

Since 1985, we have observed a noticeable change in the status of the bear population in Texas. Although no reports have been received from east Texas, black bears appear to be returning to their native habitat in west Texas. Currently, the statewide population in Texas is estimated to be fewer than 50 animals. In 1990, two small resident breeding populations were reported in the Guadalupe Mountains National Park and the Big Bend National Park in west Texas. This remaining population is scattered and comprises migrants from Mexico and a few in the Chinati and Davis mountains. Good reproductive success and the bear hunting ban in Mexico are important factors in the increasing population at Big Bend. Additionally, improving attitudes and agricultural and livestock practices have had a positive impact on black bears in Texas.

Population Monitoring System

All reports of bear sightings and mortalities are compiled using a standardized black bear investigation report form. Field reports are reviewed by the principal investigator and each bear reported is classified as either "valid (verified)," "valid (unverified)," or "invalid." A sighting is classified as valid (verified) if the field investigator finds tangible evidence of the bear's existence (bear tracks, scat, carcass, etc.) and is confident the sighting is valid. The sighting is classified as valid (unverified) if no tangible evidence can be found but interviews with the observer(s) suggest validity. A reported sighting is classified as invalid when no tangible evidence can be established and interviews with the observer(s) indicate inconsistences or improbabilities in the statements.

Management Objectives and Strategies

The current management strategy in Texas includes total protection, information transfer, public education, and management plan preparation.

Species Management Plan

Texas has not developed a management plan.

Recent Research and Publications

Hellgren, Eric. 1991. Proposal--Status and distribution of the black bear in Big Bend National Park. Caesar Kleberg Wildlife Research Institute, Texas A&I University, Kingsville.

This research will determine the status and distribution of black bears within the park by use of bait station surveys, which began in May 1991. The information will assist park personnel in developing a black bear management plan. The results will also be used to assess the feasibility of a larger, more in-depth study of black bear ecology and movements in a unique, colonizing population.

Martinez, Diana Doan and Eric Hellgren. 1991. Proposal--Ecology of the Mexican black bear with an emphasis on female habitat use and subadult dispersal. Caesar Kleberg Wildlife Research Institute, Texas A&I University, Kingsville.

The research began in May 1991 to study the ecology of black bears in northern Coahuila, Mexico. The objectivity of this project is to determine population productivity, adult female habitat use, and subadult dispersal patterns in a northern Coahuilan population by use of radiotelemetry. The long-term goal is to provide information to assist state and federal agencies in both the United States and Mexico in formulating management plans for the species.

Richerson, Jim V., Philip L. McClinton, Susan F. McClinton, and R. Scot Ferguson. 1991. Analysis of black bear ecology in Big Bend National Park by means of bear scat analysis. Unpublished report, Department of Biology, Sul Ross State University, Alpine, Texas.

From April to mid-September 1990, 17 black bear scats were collected to obtain baseline data on bear ecology in Big Bend National Park. Scats were analyzed for food content and parasite infection. Results of the food analyses indicated that vegetation comprised 73%; animal matter, 18%; and debris, 9%, by volume. Parasite infections were minimal, with only a single *trichurid nematode* (whipworm) and *pentatrichimonid* (protozoan) found in eight samples.

Richerson, Jim V., Philip L. McClinton, Susan F. McClinton, and R. Scot Ferguson. 1991. Proposal--Analysis of black bear ecology in Guadalupe Mountains National Park by means of bear scat analysis. Department of Biology, Sul Ross State University, Alpine, Texas.

Black bear scats were collected from April to September of 1991 in Guadalupe Mountains National Park. These collections were analyzed for food content and parasite infection, and the data obtained will provide a useful baseline to help formulate management strategies for the species.

Hunting Laws and Regulations

In 1925 the Texas State Legislature established a restricted hunting season from 16 November through 31 December with a 1-bear bag limit per hunter per season throughout the state. In 1973, the Texas Parks and Wildlife Commission closed the hunting season for bears in all counties under its regulatory authority. The commission lacked the authority to regulate the bear harvest in 27 counties. In 8 of those counties bears were also allowed to be taken during the October archery season.

The Texas Parks and Wildlife Commission initiated the black bear project under the Big Game Program in 1977 to determine the status and distribution of bears and to evaluate bear habitat in Texas. In 1983, all Texas counties were placed under the regulatory authority of the Texas Parks and Wildlife Commission and bear hunting was prohibited. The black bear was classified as an endangered species in 1987 and placed under the Nongame Wildlife Investigations in 1988.

Harvest Summary

Not applicable.

Property Damage/Depredation Trends and Policies

Not applicable.

Public Attitudes Towards Bear Management and Hunting

The majority of landowners in west Texas have a negative attitude towards the black bear, which is based primarily on perceived threats and a lack of knowledge. Many landowners within the expanding bear habitat are exhibiting signs of tolerance. The landowners' main objections and negative attitudes are directed at governmental interventions (state and federal) regarding overall wildlife management conservation.

Conclusions

The future of the black bear in Texas is promising, but can only be accomplished with landowner assistance, since the majority of the land in Texas is privately owned. However, public opposition could continue to be a major obstacle for a successful comeback. Therefore, state and federal agencies must work to gain landowners' respect and confidence. Public education about black bears should continue and expand. The population must continue to be monitored and research conducted where management and conservation efforts can be directed. The bear is naturally returning to its former range in Texas and its recovery can be a significant accomplishment in Texas wildlife.

Discussion

Question: Does the fact that black bears are classified as endangered by Texans affect land use patterns?

Rick Taylor: No. There are no rules or regulations as to what a landowner wants to do, except he cannot kill a bear.

Question: Is there a provision to allow incidental take of black bear during other hunting seasons?

Taylor: We file charges if it is intentional. We don't file if it was an accident.

Question: Do you have a recovery plan for the black bear? This is where you can get landowners actively involved in preparation of the bear program.

Taylor: No, at this time there are no recovery plans for animals listed at the state level.

Utah

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Distribution and Abundance

Black bears live in the central mountain ranges and the eastern and southeastern mountains and plateaus. The population is estimated to be 800-1,000.

Population Monitoring System

Three population studies are presently under way to determine densities in different habitat types and geographical areas. Harvest is closely monitored, and teeth are collected from all known mortalities for aging. Utah is divided into 30 management units. Presently, 21 of these units are hunted under a limited entry permit system.

Species Management Plan

The Strategic Plan for the Comprehensive Management of Utah's Wildlife Resources is a five-year (1989-94) management plan. Its goal for black bears is to manage Utah black bear populations consistent with habitat, biological, and social constraints to meet the needs of the resource and the resource user.

The objectives of this plan are to

1. provide an annual average of 1,500 bear hunter-days, adjusting when and where necessary to keep the harvest in balance with available surpluses and with less than 30% of the harvest consisting of females
2. protect or enhance habitat on five management areas

We also need to determine

1. the status of the population
2. effects of hunting
3. which available habitats bears inhabit
4. effective ways Animal Damage Control (ADC) can reduce livestock depredation and harvest
5. black bear habitat requirements in various vegetation complexes
6. the magnitude of illegal activities pertaining to Utah black bears

Recent Research and Publications

The following is list of publications in press.

Bates, Steven B., Jerran T. Flinders, and Jordan C. Pederson. In press. Seasonal food habits of central Utah black bears. M.S. thesis, Brigham Young University, Provo, Utah.

Bates, Steven B., Jerran T. Flinders, and Jordan C. Pederson. In press. Home range and habitat selection of central Utah black bears. M.S. thesis, Brigham Young University, Provo, Utah.

Richardson, W. Scott, Herbert C. Frost, and Hal L. Black. In press. Macro- and microhabitat selection by black bears in southeastern Utah. M.S. thesis, Brigham Young University, Provo, Utah.

Frost, Herbert C., W. Scott Richardson, and Hal L. Black. In press. Population and reproductive characteristics of black bears on an isolated mountain in southeastern Utah. M.S. thesis, Brigham Young University, Provo, Utah.

Hunting Laws and Regulations

In 1990 Utah began a limited-entry permit hunting system for black bears. At that time 142 bear permits were issued by management unit.

Spring season: 13 April-9 June 1991
Fall season: 31 August-15 October 1991
2-29 November 1991

Bait may be used after a hunter with a valid bear permit obtains a permit to have a registered bait station. No dogs may be used 31 August-15 October 1991. A two-year waiting period is required for successful applicants before they may apply again. All bears harvested must be taken to a division office within 48 hours to have a permanent possession tag affixed to the pelt and have a tooth removed for aging.

Harvest Summary

The harvest summary is depicted in Table 1.

Table 1. Summary of Utah Black Bear Harvest Statistics.

Year	Number Permits Sold	Total Hunters Afield	Total Sport Harvest	Percent Males	Percent Females	Total Days Afield	Days Per Hunter	Hunter Days/Bear	Hunter Success	Depredation Harvest	Pursuit Permits Sold
1967			15							12	
1968			12							9	
1969	43	31	25						0.81	27	
1970	155	119	9						0.08	18	
1971	59	48	17						0.35	16	
1972	96	77	19						0.25	7	
1973	125	114	25			687	6.0	27.5	0.22	0	
1974	134	117	29			746	6.4	25.7	0.25	9	
1975	161	144	22	59	41	1047	7.3	47.6	0.15	2	161
1976	107	96	10	58	42	659	6.9	65.9	0.10	7	48
1977	149	127	26	67	33	656	5.2	25.2	0.20	6	77
1978	222	185	40	67	33	675	3.6	16.9	0.22	10	114
1979	240	196	26	81	19	685	3.5	26.4	0.13	5	91
1980	217	177	26	72	28	802	4.5	30.9	0.15	6	95
1981	263	227	39	70	30	1185	5.2	30.4	0.17	4	95
1982	229	188	38	61	39	1572	8.4	41.4	0.20	6	93
1983	219	176	18	56	44	1420	8.1	78.9	0.10	9	98
1984	217	184	26	69	31	1403	7.6	58.5	0.13	6	33
1985	269	230	29	73	27	1670	7.3	57.6	0.13	10	86

Year	Number Permits Sold	Total Hunters Afield	Total Sport Harvest	Percent Males	Percent Females	Total Days Afield	Days Per Hunter	Hunter Days/Bear	Hunter Success	Depredation Harvest	Pursuit Permits Sold
1986	332	302	72	55	45	1995	6.6	27.7	0.23	6	90
1987	326	262	44	65	35	2187	8.3	49.7	0.17	25	156
1988	491	394	69	65	35	4242	10.8	61.5	0.17	28	173
1989	687	556	97	70	30	4504	8.1	46.4	0.17	10	187
1990	142*	119	22	82	18	990	8.5	45.0	0.18	16	355*

* Limited entry hunt initiated.

Property Damage/Depredation Trends and Policies

Each year an average of 10 black bears are removed by ADC agents. In 1988, 28 bears were taken by ADC agents and an additional 2 to 5 are usually removed by livestock operators when bears are molesting their livestock.

A bill that provided for payment to livestock operators for cougar and bear attacks on calves, sheep, and lambs passed and began on 1 July 1990.

Bear problems are increasing in rural and summer home areas as more people move into these areas either on a permanent basis or on weekends for recreation.

Public Attitudes Towards Bear Management and Hunting

In the past five years interest in hunting has increased. Protectionist groups have increasingly voiced opposition to using dogs and bait, the length of seasons, and the number of permits issued. The Utah Wildlife Board and the division have responded with some restrictions, but the basic hunting framework has remained in place.

Conclusions

Utah black bear populations are healthy and stable to slightly increasing. Three studies are currently in progress to gain data that can be directly applied to management decisions. Increased interest in bears from both the consumptive and nonconsumptive public makes collecting management information imperative and necessary to answer the questions asked by both groups.

Discussion

Question: Does Utah pay damages to the owners of livestock that are killed by bears?

Jordan Pederson: Yes. The first thing that livestock owners do is contact Animal Damage Control and have the animal killed. Then they contact us--so they have the best of both worlds: the offending animal is killed and they are compensated. The bear harvest (depredation) this year was 13 animals. The year before was 28. They took 46 cougars last year, which was our highest year.

Question: Does Utah pay losses on agricultural commodities?

Pederson: No, only on livestock [lambs, adult sheep, and calves].

Question: You indicated that you felt the Utah Wildlife Board was going to eliminate bear hunting over bait until the people showed up dressed in bear suits. What arguments did these people present to the commission?

Pederson: They indicated it was littering. It's chumming--you're killing an animal when it is doing what it does best, that is, looking for food. They don't allow it for waterfowl. In many other states you cannot bait for deer or elk, so why did Utah allow it for bear? Our regulations are quite tight. You have to have the landowner's permission, you must register your bait with the department. Everything but your name is listed on a card posted at the bait (hunting license number, etc.). The bait must be placed directly on the ground and must be biodegradable. You must remove all bait within 72 hours after the hunt and you are only allowed one bait station per registered hunter. Last year one bear was taken over bait. The year before that 98 bears were taken and 35% of those were taken over bait.

Question: What arguments did people that were supporting bait hunting give the commission?

Pederson: In addition to the above, I need to tell you that only archery equipment can be used to hunt over bait. They said it was sporting. They could take the time to look at a lot of bears. One guy said he "photographed over 30 bears in a two-week period. This year I shot one and last year I did not shoot a bear." They presented a real good case while the other people (dressed as bears) were there based strictly on emotion.

Question: Is it a common practice in Utah to strike off bait?

Pederson: No. It is illegal.

Question: Could you give me the department's rationale for the spring season?

Pederson: We just feel that this is the time that we can get the kill of the bears that we need to harvest. If they aren't killed by hunters, ADC or the livestock people will end up killing them. It provides a recreational opportunity. Last year we had four bears taken and all were in the late season and they were all male bears.

Footnote: In August 1992, the Utah Wildlife Board discontinued the spring bear hunt for the 1993 season. This and other regulations will be reviewed annually.

Wyoming

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Distribution and Abundance

Black bears are found in the mountains of the western two-thirds of Wyoming and the northern and south-central parts of the state. They are not found in the Black Hills. Little is known about the status of the black bear in much of its range, but harvest data indicate the population is stable and healthy.

Population Monitoring System

The harvest data uses bear sex, age, and hunter success.

Management Objectives and Strategies

Wyoming has a spring and a fall hunting season for black bears.

Species Management Plan

All wildlife management programs in Wyoming are managed by objective via five-year planning periods. Objectives for the period ending 1992 are to

1. provide a harvest of 325 black bears
2. provide 13,000 black bear hunting recreation days
3. maintain a harvest success rate of .10 black bear per hunter
4. maintain a hunter effort rate of 40 days hunted per black bear harvested
5. maintain 25,129 km^2 of occupied black bear habitat
6. obtain the informed consent of all potentially affected interests in structuring the population objectives, management strategies, and regulations

Recent Research and Publications

Hammond, Forrest M. 1983. Food habits of black bears in the Greys River drainage. M.S. thesis, Wyoming Cooperative Fishery and Wildlife Research Unit and the Wyoming Game and Fish Department. 50 pp.

Current Wyoming research projects providing potential benefits for black bear management programs in Wyoming include:

Gillin, C., F. Hammond, and C. Peterson. 1992. Aversive conditioning techniques used on grizzly bears in the Yellowstone ecosystem. Wyoming Game and Fish Department. In press.

Gillin, C., S. Reagan, and J. Ertel. Grizzly bear habitat suitability on logged sites in the Bridger-Teton and Shoshone national forests. Wyoming Game and Fish Department. In press.

Gillin, C., S. Reagan, and J. Ertel. Habitat use, distribution, and population characteristics of grizzly bears in the southern third of the Yellowstone ecosystem. Wyoming Game and Fish Department. Research in progress.

Lindzey, F., S. O'Brian, and C. Gillin. Grizzly bear use of alpine insect aggregations. Wyoming Cooperative Fish and Wildlife Research Unit and Wyoming Game and Fish Department. Research in progress.

Mattson, D., C. Gillin, and S. Benson. 1991. Alpine insect aggregation use by grizzly bears in Wyoming. Canadian Journal of Zoology. In press.

Hunting Laws and Regulations

1. Bag and possession limits: One black bear during any one calendar year.
2. Baiting: Using baits for black bear hunting is permitted in all hunt areas except the major portion of hunt area 25, which borders the eastern boundary of Yellowstone National Park. The number and location of bait stations is regulated by the U. S. Forest Service or Bureau of Land Management. The Shoshone National Forest is further restricting the number of bait stations permitted per hunter from multiple permitted bait stations per hunter to only one station per hunter beginning in 1991.
3. Reporting kills: Hunters taking black bears must retain the pelt and skull from each black bear taken. Within 10 days after harvesting a black bear the pelt and skull must be presented to department personnel for examination and reporting.
4. Limitations: Any black bear, except cubs or females with cubs at side, may be taken in open areas during season dates and open shooting hours (sunrise to one hour after sunset). Season dates are generally from 1 May to 30 June during the spring season and from 1 September to 15 November during the fall season.
5. Dogs: Dogs may not be used to hunt, run, or harass black bears.

Harvest Summary

The 1990 black bear harvest in Wyoming reflects past trends. A total of 3,954 hunters spent 25,946 recreation days harvesting 272 black bears in Wyoming during 1990. Males composed 63% of the total harvest. Fifty percent of males aged were adults (age 4 and over) and 43% of the total harvest were adult age-class bears (age 4 and over). Spring hunts produced 59% of the total black bear

harvest, 63% of the overall male harvest, and 77% of the 1990 adult male harvest. Using baits in many areas allows hunters the opportunity to select the larger, older bears, resulting in a higher male harvest in the spring. Incidental harvest, occurring when hunters encounter a bear while hunting other big game during the fall, indicates more subadults were taken (63% and 57% of aged males and females, respectively). Statewide male:female harvest data reflect normal trends. However, harvest has steadily increased in some hunt areas over the last few years and harvest data trends in these areas suggest that recent harvest has been heavy (females in harvest > 40%, adults in harvest < 40%, adult males in harvest < 30%). To correct the problem of heavy harvest, season dates and lengths have been adjusted.

Property Damage/Depredation Trends and Policies

Wyoming statute allows for any black bear damaging private property to be killed by the owner, employee, or lessee of the property. Damage generally occurs in high elevations where domestic stock, particularly sheep, are grazing in bear habitat. Damage payments often reflect recurring localized problems. Concerned livestock caretakers destroying visible bears may explain why bear numbers in some quality bear habitats appear to be lower than expected.

Public Attitudes Towards Bear Management and Hunting

Antihunting sentiment has surfaced in Wyoming. The collection of quality bear data to better evaluate population size and welfare is necessary to effectively counteract possible attempts to close hunting seasons.

Conclusions

The Wyoming harvest fits the normal data for many North American black bear populations, with the harvest being predominantly males. Better management and data collection techniques need to be pursued to evaluate bear populations more closely.

Discussion

Question: Could you elaborate on the adverse conditioning study you mentioned?

Colin Gillin: There is some applicability to adverse conditioning, especially in a park situation where you may not want to kill the bear. It was primarily a grizzly bear study, but some black bears were included to observe their reaction. In all cases, when black bears were "thumped," they retreated.

Question: Were the moths you mentioned the result of some type of an outbreak or is it a persistent food source?

Gillin: We don't know. That's part of the research. There has not been a lot done. Most of the work has been done in the Mission Mountains. With our situation we are finding out it is relatively stable food source. We have been observing bears feeding on them every year since 1986. We are seeing more bears. This could be because our search image is improving or the bears are rediscovering these feeding sites. We interviewed a lot of old-time hunters and guides that hunted this area often in the 1940s and 1950s and they do not recall ever seeing bears in these sites.

Question: Are these aggregations of moths on plants? Are they torpid? What is the circumstance in which the bears are feeding?

Gillin: They are active to about 0° C. When they hit this level the female goes into the rocks and produces some type of pheromone and there are literally billions of moths two feet thick and the bears just lay there and eat until the temperature rises above zero and then the moths fly out.

Question: What time of year was this observed?

Gillin: The moths are above timberline, generally above 10,000 ft. The bears show up in late June, sort of checking things out. From July 1 through the first week or so in September they are feeding. September 1 starts the sheep season so a lot of human activity begins in this area. Therefore, we cannot be sure why the bears leave around the first part of September.

Yukon Territory, Canada

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Distribution and Abundance

No systematic studies have been undertaken to delineate the distribution or to establish the number of black bears in the Yukon. Based on broad ecological classifications, we estimate that roughly 10,000 black bears are in the territory.

The distribution is assumed to generally follow the major river valleys, with occasional seasonal movements into adjacent, less productive forests or subalpine settings seasonally rich in foods. The largest concentrations, based on habitat availability, should be in the valleys of the central and southern Yukon. While unconfirmed reports of black bears on the Arctic coastal plain have been made, the distribution is generally restricted to south of 65°N latitude.

Population Monitoring System

The black bear population is monitored solely through compulsory submission of the skull and information about all bears killed. The sex of each bear is noted, skull measurements are taken, and a tooth extracted for aging. Trends in number, age, and sex ratios are then evaluated.

Management Objectives and Strategies

The general management strategy has been to document all known mortalities. Given our limited resources, we feel this option is the most practical and cost-effective one available. Separating black bear management from grizzly management is difficult; much of our efforts are directed towards the 6,000-7,000 grizzly bears found in the Yukon, with black bears benefitting only indirectly.

Over the past few years black bear management has evolved into primarily waste management. Public education has taken on a major role. Programs have promoted using electric fencing and incinerators and thus reducing the number of nuisance bear complaints.

Unmanaged garbage dumps near settlements have been perennial attractants to black bears. Attempts to clean up these dumps have met with limited success--local residents find it much easier to just shoot the bears than be bothered with properly storing or incinerating their garbage. The same problems occur in the isolated placer gold mining camps found along many of the same rivers and creeks where bears are concentrated. A new Yukon environment act is currently being drafted;

with increased public awareness of the environment in general and waste management in particular, bear-human conflicts should be reduced.

Recent Research and Publications

Much of the information presented here was taken from *Ecology, Status, and Harvest of Black Bears (Ursus americanus) in the Yukon*, by A. Grant MacHutchon and Bernard L. Smith. This internal report, printed in July 1990, covers information up to and including 1986.

Hunting Laws and Regulations

Currently, the black bear bag limit is two bears per license holder per licensing year. In areas not closed to hunting, the spring season extends from 15 April to 15 June and the fall season from 1 August to 31 October. A small region in the southwest Yukon near Whitehorse is open all year.

Nonresident big game hunters must be outfitted by a registered Yukon outfitter or guided by a resident holding a special guiding license. In addition to license ($150) and seal fees ($5), nonresidents are required to pay a trophy fee ($75) and obtain an export permit. A resident license costs $10 in addition to the $5 seal. Indians are not required to purchase a license or submit the skulls for inspection.

Sows with cubs and cubs are protected. A black bear cub includes any black bear that is one year old or younger. All black bear skulls must be submitted for inspection no later than 10 days after the end of the open season for which the animal was killed.

Killing a bear and allowing the hide to spoil is unlawful, but the meat need not be removed from the field. Law forbids buying, selling, bartering, or offering to buy, sell or barter any wildlife or parts thereof except as authorized by permit. Permits are issued to hunters for hides only on a case-by-case basis; trappers may sell up to two hides per year with their trapping license.

Harvest Summary

An average of 89 black bears were killed annually by resident and nonresident sport hunters from 1980 to 1989 (Table 1). Residents in the spring account for 49% of the harvest. The spring bear hunt is often viewed as an excuse for the first camping or river trip of the year. In some years the rivers are not free of ice before leaves emerge; in those years the spring harvest is reduced. Many of these spring hunters are actually interested in grizzly bears, and while they may have tags to shoot a black bear, they are reluctant to compromise their grizzly hunt by taking another animal.

Only 1 out of 22 outfitters offers a black bear-only hunt and that is for bow hunters only. Yukon black bears are small (approximately 50 kg for a large animal) relative to those found in coastal areas and to the south and so are not actively sought as a trophy by nonresidents.

Table 1. Yukon hunting harvest information.

	Resident Hunters				Non-resident Hunters				Total			
		%		X		%		X		%		X
	N	spring	%	age	N	spring	%	age	N	spring	%	age
1980	47	42.6	42.5	5.8	15	20.0	53.3	4.7	62	37.1	45.2	5.5
1981	83	56.6	37.3	6.6	15	13.3	46.7	5.1	98	50.0	38.8	6.4
1982	39	51.3	38.5	6.2	12	33.3	50.0	7.5	51	47.1	41.2	6.5
1983	59	74.6	18.6	5.6	12	25.0	33.3	6.3	71	66.2	21.1	5.7
1984	97	56.7	28.9	7.0	22	40.9	18.2	5.8	119	53.8	26.9	6.8
1985	69	78.3	39.1	8.0	21	42.9	33.3	7.7	90	70.0	37.8	7.9
1986	66	83.3	10.6	7.1	15	33.3	6.7	8.3	81	74.1	9.9	7.3
1987	62	53.2	16.1	7.1	26	46.2	15.4	8.8	88	51.1	15.9	7.6
1988	88	56.8	21.6	8.2	36	47.2	27.8	9.2	124	54.0	23.4	8.5
1989	75	74.7	10.7	8.1	27	25.9	14.8	9.5	102	61.8	11.8	8.6

Black bears are not considered a food species by Yukon Indians and therefore that portion of the total harvest is considered minimal. A new program is now under way to document the Indian harvest of all big game species.

The number of bears reported as "sport" kills that are actually shot in a defense situation is impossible to discern. Many hunters purchase black bear tags only to facilitate killing nuisance bears without contacting a conservation officer or forfeiting the hide. Many black bears, particularly in the fall, are not actively hunted but are shot incidentally to other big game species.

The small size of Yukon black bears means that size, and therefore sex, is a strong selection factor. Hunters frequently estimate the age of their bear to be two or three years and are surprised when they discover the heavy tooth wear indicative of a much older animal.

Property Damage/Depredation Trends and Policies

While the number of complaints varies from year to year, discernible trends in nuisance bear complaints or damage have not been evident in the past 5 years. On average, approximately 15 black bears are reported killed annually in defense of life or property.

The response to nuisance bear complaints relies mainly on the discretion of the officer involved. In all situations where a bear comes in contact with a human, the bear is destroyed. When property damage occurs or when bears are active near developed areas, discretion is used. In any situation, officers first consider their responsibility for the safety of the public and secondly their responsibility for preserving the resource. Relocating nuisance black bears has proven largely unsatisfactory and unsuccessful; few accessible areas exist where relocated bears will not become a nuisance again, and many nuisance animals return to their original location. Trapping with removal is the technique most often used.

Public Attitudes Towards Bear Management and Hunting

Black bears are generally viewed as the less dangerous and less valuable relatives of the grizzly bear. People's attitudes change, however, when they actually encounter bears: all bears are seen as dangerous and tolerance disappears. In the Yukon, the opportunities for encounters are plentiful; even the most urban settings are no more than a few city blocks from forest cover.

Conclusions

Black bear exploitation in the Yukon is low; all sources of mortality, both hunted and defense kills, total less than 1% of the estimated population. We foresee no changes in our general management strategy in the near future.

Discussion

Question: Do you collect teeth to determine bear ages?

Jean Carey: Yes, they are all aged. The average age is 8. A very old bear would be 15.

Question: Is there any evidence for hunting for bear gall bladders or other parts?

Carey: Not really. It is illegal to trade in any bear parts. In one way you would think that the Yukon is a very big, sparsely populated area and you could get away with about anything. However, it is really like one small town. Everybody knows about everything that goes on.

Question: What do you attribute to such a low harvest?

Carey: The bears are not eaten. The grizzly is the preferred species. So it has to be an exceptional black bear to be taken by a hunter.

Natural Regulation of Black Bear Populations

The Role of Habitat Quality in the Natural Regulation of Black Bear Populations

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Abstract: A key factor in black bear habitat quality is the ability of habitat to provide abundant, reliable, and well-distributed food in the spring, summer, and fall. Food supply directly affects growth rate, female age of first reproduction, and cub survival through 1.5 years of age. Food supply may secondarily affect movements, aggression, social organization, cub vulnerability to predation (including predation by other bears), and perhaps susceptibility to disease and parasites. Water and shade are necessities in warm climates but are provided coincident with the forest habitat that provides food. Escape cover, including well-distributed large trees of species that have sturdy, creviced bark for cubs to climb, may be of particular importance where predators (including conspecifics) are abundant. Food acts in a largely density-independent manner in limiting reproduction and cub survival. Factors that act in a density-dependent manner to regulate black bear populations are poorly known. Cub mortality results mostly from natural causes that vary among populations, but the causes have not been well studied because few studies of cubs have employed radio collars. Causes of deaths of radio-collared adults are documented frequently but are mostly from human-related causes; how the few natural deaths of adults might relate to natural regulation is open to speculation. Causes of death, particularly for cubs and dispersing subadults, need further study. We also need to determine the effects of food supply and forest structure on other environmental factors such as competition, predation (including predation by other bears), parasites, disease, human-related mortality, pollution, and weather. We do not know whether any of the environmental factors act in a density-dependent manner to regulate black bear populations and at what population densities these factors may exert an influence. Most populations studied to date have been artificially limited by hunting or other management actions, and densities have probably been below levels at which intrinsic factors are likely to be of primary regulatory significance.

Introduction

Little is known about natural regulation of black bear populations. Too many unstudied factors remain to permit conclusive analysis. Cub mortality *rates* are fairly well known, but *causes* of cub deaths are not. In most studies other than Al LeCount's cub radio-collaring projects in Arizona (this publication), cub disappearances have provided little information on proximate or ultimate causes of death. Causes of deaths of older bears are documented frequently, but most are human-related, especially in hunted populations. How the few natural deaths might relate to natural regulation of population density is open to speculation.

In this paper, I discuss the role of habitat quality in the natural regulation of black bear populations. Habitat is defined in the narrow sense: food, water, thermal cover, and escape cover. A broader sense might include competitors, predators (including other bears), parasites, disease, people, pollution, and weather--factors that might better be termed environmental factors. Food, water, and cover probably mitigate or exacerbate effects of environmental factors on bears (see next section). Effects of predators and competitors will be addressed in detail by the other papers in this report.

Food

Probably the most important aspect of habitat is its ability to reliably provide abundant, well-distributed food. When food is scarce or is concentrated in a small area, malnourishment, social strife, or both are likely. Lack of food can stimulate unusual movements that lead to unusual social encounters (Schorger 1949, Rogers 1987*a*). Weakened cubs and yearlings may become vulnerable to predators, including other bears (Rogers 1987*a*). Starving adults may be more likely to prey on young bears (Rogers 1987*a*). Black bears that aggregate at clumped food sources during food shortages compete more aggressively than usual and inflict unusually severe injuries (Rogers 1987*a*). Malnourished bears may also be more susceptible to disease or parasites (Jonkel and Cowan 1971, Rogers and Rogers 1976). Black bears that forage farther than usual may be more vulnerable to being killed by vehicles or as nuisances (Rogers 1976, 1987*a*). These situations are indirect effects of food shortage.

Food shortage directly affects survival, growth, maturation, and reproductive success (Rogers 1976, 1987*a*; Bunnell and Tait 1981). In the wild, reproduction in black bears is controlled mainly in a density-independent manner by fruit and mast supplies that fluctuate in abundance from year to year (Rogers 1976, 1983, 1987*a*, Bunnell and Tait 1981, Pelton 1989). Food shortage acts primarily in a density-independent manner because food supplies vary much more widely than black bear populations do. Black bear populations typically fluctuate within a narrow range, increasing or decreasing slowly over a period of years. The doubling or halving of a bear population over a period of years would be a noteworthy event, but major foods such as fruits and nuts commonly vary more than 50-fold from year to year (Hamer et al. 1979, Arimond 1979). This variation also helps explain why bear populations show little or no compensatory recruitment following periods of heavy mortality (Miller 1990).

Food shortages are not always absolute. Shortages may also be relative shortages in which food is present but is so spread out that bears cannot feed efficiently enough to gain sufficient weight for reproduction, survival, or both (Andrewartha and Birch 1954).

Captive black bears that receive rich diets develop and reproduce more rapidly than wild bears do, even when the captives are caged with larger bears that dominate them (Rogers 1976). Captive bears of either sex typically produce their first litters at three years of age (Rogers 1976), while wild ones do so at three to eight years (Table 1). This variation suggests that any effects of social factors on growth and maturation, as might be mediated through the endocrine system (Christian 1950, Christian and Davis 1964), are minor relative to nutritional factors (Rogers 1976).

Table 1. Reproductive parameters of female black bears eating natural foods only and supplemental garbage in northeastern Minnesota, 1970-80.

Reproductive Parameter	Mean	Range	N
Natural Foods Only			
Age at first reproduction	6.3 years	4-8 years	17
Intervals between litters	2.3 years	2-4 years	36
No. cubs in first litter	2.1 cubs	1-3 cubs	17
No. cubs in subsequent litters	2.5 cubs	1-3 cubs	35
With Supplemental Garbage			
Age at first reproduction	4.4 years	3-5 years	11
Intervals between litters	2.0 years	2 years	8
No. cubs in first litter	2.5 cubs	1-3 cubs	8
No. cubs in subsequent litters	3.4 cubs	3-4 cubs	10

Source: Rogers 1989.
Note: Excluding intervals of one year due to litters being lost before mating seasons.

In the wild, supplemental food similarly enhances growth rates and reproduction. In northeastern Minnesota, females that ate only natural foods matured more slowly and had lower reproductive rates than those that supplemented their wild diets with garbage (Table 1). The females also matured more slowly and had lower reproductive rates than bears in Pennsylvania (Kordek and Lindzey 1980), where high-energy food is available for a greater part of the year. High-energy mast becomes scarce in northeastern Minnesota by early September, but a variety of hard mast species are often available in Pennsylvania until early December (Rogers 1987*a*, Alt 1980, Kordek and Lindzey 1980). The longer growing period in Pennsylvania enables females to begin reproducing 2 to 3 years earlier (38% by age 3, 88% by age 4) than in Minnesota where the average of first reproduction is 6.3 years (Alt 1980, Kordek and Lindzey 1980, Rogers 1987*a*). Thus, by the time

Minnesota females produce their first litters, 88% of Pennsylvania females have produced 2 litters, and some of the cubs from the first litters are producing cubs of their own (Alt 1980, Kordek and Lindzey 1980, Rogers 1987*a*).

Survival through 1.5 years of age also depends primarily upon food supply (Rogers 1976, 1983, 1987*a*; Bunnell and Tait 1981). In northeastern Minnesota, natural mortality among cubs and yearlings became heavy at the end of 3 successive years of scarce fruit and nuts (1974-76). In 1976, 10 of 20 cubs died, and 3 of 4 yearlings died the following spring (Rogers 1983). During the 3 years of scarce food, the population in the study area declined 35% from 1 bear per 4.1 km in June 1974 to 1 bear per 6.3 km in June 1977. The decline was not entirely due to natural mortality, however, because some bears were shot foraging for garbage (Rogers 1983).

Food scarcity directly increases yearling mortality: death was nearly certain for male and female yearlings that left their dens in spring weighing less than 10 kg , but survival was high for those that left their dens weighing greater than 13 kg (Table 2). Before dying, at least one of the starving yearlings was found to be too weak to climb a tree (Rogers 1987). In such cases, bears would be vulnerable to predation as well as starvation. In Pennsylvania, all studied yearlings exceeded 18 kg (range 18.6 to 63.6 kg) and survival was high (Alt 1980). The fact that black bear yearlings weighing only 13 kg survive as well, or nearly as well, as yearlings several times heavier suggests that growth plasticity is an adaptation to a variable food source. Starvation deaths are rare after 1.5 years of age in northeastern Minnesota.

Table 2. Survival of yearlings as related to body weight in northeastern Minnesota.

Body Weight at 14 Months of Age	Number Surviving as Learned by Telemetry	Number Surviving as Learned by Recaptures
10 kg	0 of 6	1 of 19
10-13 kg	7 of 9	9 of 18
13 kg	15 of 15	22 of 31
all weights	22 of 30	32 of 68

Note: Recapture data includes both radio-collared and nonradio-collared eartagged yearlings. Recapture data tends to underestimate proportion of yearlings surviving because dispersal reduced chances of recapture for some bears.

The presettlement range of the black bear extended from Mexico and Florida north to treeline, which demonstrates that black bears can live anywhere in North America where extensive forests exist. The adaptable black bear, with its ability to grow slowly if necessary, can maintain populations even where land is of relatively low fertility. However, where food is scarce, reproductive success is also low, and mortality rates among adults must be correspondingly low to assure population viability. Food supply may *limit* populations but has not been shown to work in a density-dependent manner to *regulate* populations.

Water

Water must be readily available and well distributed throughout the year if black bears are to use an area in an unrestricted manner (Hugie 1979). Black bears drink frequently when feeding on vegetation, nuts, or insects but seldom drink when feeding on berries (Rogers and Allen 1987). They wallow to cool off on hot days in all seasons (Kellyhouse 1980, Rogers and Allen 1987). Heat stress may prevent bears from fully using forest openings on sunny days (Jonkel and Cowan 1971, Rogers 1980, Rogers and Allen 1987). Wetland and riparian habitats are used for cooling and provide seasonal foods (Rogers and Allen 1987). Drought is one of the causes of berry crop failures in northern forests, especially where soils are shallow and easily desiccated (Rogers 1987*a*). Precipitation exceeds evaporation and transpiration over most of the forested black bear range, making water readily available for drinking or cooling in most regions. The arid Southwest has the greatest potential for water shortage sufficient to render areas unlivable due to lack of water per se or due to secondary effects on forest cover or food. Water may *limit* populations in some regions but probably does not *regulate* them since water shortage would seldom be expected to operate in a density-dependent manner.

Precipitation, humidity, and soil moisture could indirectly affect black bear populations through effects on life cycles of parasites. However, this theory has not been studied. Black bears are tolerant or immune to many diseases, and no wild population has been reported to be decimated by disease or parasites (Rogers and Rogers 1976, Rogers 1983).

Thermal Cover

Thermal cover is shade in areas and seasons in which bears have problems dissipating heat. In northeastern Minnesota, black bears pant and seek shade after a few minutes in direct sunlight on warm, humid days (pers. obser.). By contrast, in northern Labrador, the weather is cool and the humidity is low, and black bears live on the open tundra without forest cover (A. Veitch, pers. comm. 1990).

Thermal cover is a hibernaculum in winter. Hibernacula include burrows, hollow trees, rock crevices, brush piles, and surface nests (Rogers 1987*a*). The latter are typically built next to windfalls or other windbreaks (Rogers 1987*a*).

Newborn cubs depend upon their mothers for warmth and will die if dens are flooded or if mothers are disturbed and forced to leave the cubs for long (Smith 1946, Johnson and Pelton 1980, Alt 1984). Temperatures in black bear dens remain approximately at ambient (outside) temperatures if the entrances are open. Dens whose entrances are blocked with snow have temperatures slightly warmer than soil temperatures (Rogers 1987*a*). Tree dens appear to be preferred (Johnson and Pelton 1981) but are not of critical importance in boreal habitat (northeastern Minnesota) where overwinter survival is greater than 99% despite a paucity of tree dens (Rogers 1987*a*, Rogers and Allen 1987). Tree dens are probably of greater importance farther south where winter thaws, ground den flooding, and winter disturbances by humans or dogs are more likely (Johnson and Pelton 1981, Alt and Gruttadauria 1984, Rogers 1987*a*). Under those conditions tree dens may improve reproductive success for pregnant females, although mature males commonly seek ground

dens (Johnson and Pelton 1981). Whether den sites might act in a density-dependent manner to regulate bear populations depends upon local needs and local abundance of dens. Den sites were not in short supply in northeastern Minnesota (Rogers 1987*a*).

Escape Cover

Escape cover provides protection from predators and other bears. A component of escape cover is readily available, large (>20 inches dbh) trees with sturdy, creviced bark that cubs can safely climb. Cubs sometimes fall from trees with slippery or shaggy bark. Although none of eight observed falls involving spring cubs in northeastern Minnesota were fatal, falls that occur while cubs are escaping from predators could be fatal. The importance of large refuge trees to cub survival and to the natural regulation of black bear populations has not been tested, although mothers strongly select large trees with sturdy, creviced bark as refuge trees. Preferred refuge trees in the northeastern United States are large (20-44 inch dbh) white pines (*Pinus strobus*) and hemlocks (*Tsuga canadensis*) (Elowe 1984, 1987; Rogers et al. 1988). However, black bears survive without trees on the tundra of northern Labrador where wolf and black bear densities are low and grizzly bears no longer live (A. Veitch, pers. comm. 1990).

In areas or times of food scarcity, black bears may roam farther than usual, sometimes beyond the normal range of the species (Rogers 1987*a*). Potential problems associated with habitat fragmentation or limited forest habitat increase in importance when bears range more widely. Thus, habitat fragmentation or limited habitat area may limit bear populations where nonhabitat areas act as sinks in which bears are shot or otherwise killed. Such limitation may not constitute regulation, however, because subsequent reproduction may not compensate in a density-dependent manner. Understanding this aspect of limitation in relation to regulation is confounded by problems of highly variable food supplies, questions of whether dispersal is voluntary or involuntary (Rogers 1987*b*), and by questions concerning black bear social organization (Rogers 1987*a*). Available information suggests that social factors may play a greater role in determining *which* members of a population can occupy an area than in determining *how many* can do so (Rogers 1987*a*).

In the winter, dens provide protection from predators and disturbance (Johnson and Pelton 1981). The need for secure dens, rather than surface nests, may depend in part on densities of predators, including humans, domestic dogs, and bears.

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Intrinsic Population Regulation Among Black Bears

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Abstract: Mechanisms for intrinsic regulation in black bear populations include evicting animals from the population, preventing animals from immigrating into the population, and killing animals within the population. Population regulation appears to be carried out by both adult males and females, but adult males seem to be primarily responsible for control. Since adult males play a major role in intrinsic population regulation their management may be very important. Overharvesting adult males may greatly reduce the effectiveness of intrinsic control and may be detrimental to the population by increasing total mortality.

Introduction

Black bear populations appear to be regulated in two major ways. One way is by environmental, or extrinsic, factors, which affect nutrition. Results of extrinsic factors are observed in lower reproductive rates, slower growth, and poorer offspring survival. The second regulatory mechanism is self, or intrinsic, regulation. Mechanisms for self regulation in bears include evicting animals from the population, preventing animals from immigrating into the population, and killing animals within the population. This paper discusses each of these intrinsic regulatory mechanisms as they relate to bear populations.

Intrinsic Factors

Evicting Animals from the Population. Evicting animals, especially subadult males, from populations has long been hypothesized as a means of population regulation among black bears (Jonkel and Cowan 1971, Kemp 1976, Reynolds and Beecham 1980, Young and Ruff 1982, Stringham 1984). This theory was formed when researchers observed that adults, primarily adult males, acted aggressively toward subadult males and that large numbers of subadult males dispersed from their birthplaces. However, more recent data suggests that actual subadult eviction may be rare.

In studying subadult dispersal, Rogers (1987) found that most subadult males voluntarily dispersed from their mother's territories rather than being evicted by resident males. Whether voluntary dispersal takes place in other populations or at population densities different from that studied by

Rogers (1987) is not known, but certainly is a possibility. From the population standpoint, however, whether subadult males voluntarily disperse or are forcibly evicted from their birthplaces makes little difference because the advantages of such behaviors are the same.

First, male dispersal reduces competition with remaining female kin. Due to sexual dimorphism, by the time subadult males disperse at two to four years of age they usually outweigh their sisters, and in some instances weigh nearly as much as their mothers. Therefore, if they remained in their mother's territory they could compete with their mother and sisters for food supplies. Such competition could reduce the potential for their own growth, which could eventually reduce their ability to win future mating rights.

Second, dispersion also creates a better gene distribution. If young males were to remain in the area where they were born, they would run a high probability of mating with either their mothers or sisters and would be competing with their fathers for mates. The latter would potentially cause fathers to act aggressively toward their sons, which could result in injury or even death of related offspring.

For dispersal to be advantageous, however, young males would have to be able to establish residency in areas where nutrition and breeding opportunities were equal or better than in their birthplaces. Since subadults have been documented moving great distances from their birthplaces (Jonkel and Cowan 1971, Graber 1982, Rogers 1987), they probably have ample opportunity to find such places. However, the factor that prevents subadults from readily taking advantage of such locations and the factor that appears to influence population regulation more than eviction is the role adults play in preventing immigrants from establishing residency.

Preventing Animals from Immigrating into the Population. The behavior of preventing new animals from immigrating into the population can serve several important functions: limiting competition for environmental or genetic resources and regulating the number of animals in the population (Stringham 1984).

Preventing new animals from immigrating into the population appears to be practiced by both males and females but is primarily carried out by resident adult males (Stringham 1984). One of the best examples demonstrating the importance of resident adult males in limiting immigration is seen in the work at Cold Lake, Alberta, by Kemp (1972, 1976), and Young and Ruff (1982). These studies involved experimentally removing approximately 30% of the resident males from an unhunted population. This removal caused the population to double within several years after removal, with most of the increase being attributed to the ingress of subadult males from a large unhunted reservoir area surrounding the Cold Lake study area (Ruff 1982). As these new residents grew to adulthood, immigration was again suppressed, and within five to six years after the initial removal the population had returned to preremoval densities (Young and Ruff 1982).

In most cases immigrating subadults are probably evicted by aggressive behavior rather than actually being killed. If effective, such behavior reduces risk. Rogers (1987) describes an instance of a resident female chasing an unrelated subadult male up a tree, then climbing the tree and throwing him out before chasing him away. Similar cases of adults chasing subadults have also been documented (Herrero 1983). However, cases of resident adults actually killing subadults have also

been documented (Rogers 1983). Such killing of other bears appears to be another method of intrinsic population regulation in bear populations.

Killing Animals in the Population. Wounds and scars, especially on adult males, indicate that aggression takes place among adult black bears. However, such aggression probably is of little importance in regulating bear numbers because few animals have actually been documented being killed (Rogers 1983). In Arizona, mortality rates of adults due to injuries received from other bears was only 3% per year (LeCount 1990).

Adults killing subadults probably plays a bigger role in limiting population size. Evidence of subadults being killed by adults has been commonly recorded (Rogers 1983). As mentioned previously, however, such deaths are probably associated with adults trying to prevent subadults from becoming established within their home ranges rather than adults trying to evict subadults from the population.

Until recently, cub killing, although documented (Rogers 1983), was also thought to be low and was not considered important in population regulation. More recent data, however, show that in some populations this low mortality may not be accurate. Data from Arizona indicate that such mortality can account for almost 50% of all cub losses, with both males and females being implicated in these deaths (LeCount 1987, 1990). Biologically, both sexes can benefit from such behavior.

For males, the advantage of killing cubs appears to be twofold. First, by killing genetically unrelated cubs, an adult male eliminates another male's offspring. Second, since eliminating the nursing stimulus of cubs appears to allow a female to come into estrus (LeCount 1983), a male that kills cubs creates a potential breeding partner for disseminating his own genes. This concept may explain why most cub mortality occurs before the end of the breeding season (LeCount 1987, 1990).

Killing cubs, however, is not without its risks. If a resident male kills his own offspring, he biologically defeats his purpose. Therefore, a male must be able to identify his own cubs. How a male knows which cubs to kill is not known, but several hypotheses have been advanced.

One theory is that males have a way of identifying their own offspring. Other studies of large mammals that also kill young, such as lions (*Panthera leo*) and langurs (*Preshytis sp.*) (Sugiyama 1967, Eisenberg et al. 1972, Schaller 1972, Bertram 1975), have proved this theory, and such a mechanism may also occur with bears. In bear populations males appear to be able to recognize females occupying areas within their home ranges (Herrero 1983). Females, however, tend to confuse males about cub parentage by breeding with more than one male (Rogers 1987). Therefore, if a resident male kills any cubs born by females within his home range he runs a risk that he might kill his own offspring.

Another theory is that new males entering the population may be responsible for most cub killing. Such males do not face the risk of killing their own offspring because they are new in the area. Therefore, any cubs they can kill eliminates a competitor's gene pool, and when the female comes into estrus, these males' chances to perpetuate their own genes is enhanced. Such a mechanism may explain why resident males attempt to prevent new males from immigrating into the population.

Such a system would provide a mechanism where resident adult males could afford their offspring some protection, while at the same time allow themselves the freedom to search for breeding partners.

Population regulation by adult females has also been hypothesized in two forms: maternal infanticide and females preying on unrelated cubs (Lindzey and Meslow 1977, LeCount 1987). Tait (1980) described cub abandonment as a possible reproductive strategy for bears. He demonstrated theoretically that since bears have the capability to produce two or three cubs, that if they produced a single cub there was a reproductive advantage for them to abandon it, come into estrus, breed, and produce two or three cubs the following year. With this reproductive strategy a female could produce a significantly greater number of offspring during her lifetime. Also, failing to raise a single cub of a two-cub litter following the death of one cub could produce similar results if the cub died before the end of the breeding season.

Evidence that such a mechanism might exist is seen in survival rates of varying size litters. Alt (1982) observed higher loss of one-cub litters than multicub litters. Similar results were observed in Arizona (LeCount 1987, 1990). Loss of remaining cubs of a litter after the initial loss of a litter mate has also been documented. Alt (1982) found that 73% of females losing cubs lost all their offspring, and in Arizona, 80% of females losing part of a litter subsequently lost the remainder of their cubs (LeCount 1987).

Causes of cub loss are difficult to document. Evidence of females killing or abandoning their own cubs is rare (Rogers 1983, 1987; Elowe and Dodge 1989). However, mothers killing their own cubs, unless done to eliminate having to raise a single cub, appears to have no reproductive advantage since doing so eliminates her own genes. Another reason for cub mortality that could benefit a female, however, is for females without cubs to kill other females' cubs. Such a strategy has been hypothesized by Lindzey and Meslow (1977) and appears to be a possibility in some populations.

In Arizona, bears breed in a synchronous manner that is possibly due to consistent nutrition (LeCount 1984, 1990). In one year, most breeding-age females in the population produce cubs and in the following year, few have cubs. In years of low production, females that do produce are new females giving birth for the first time or females that lost litters before the end of the breeding season the year before. Cub survival during years of high cub production and low cub production, however, is quite different. In years when most females produce cubs, approximately 75% survive; but in years when few females produce cubs, only about 40% survive (LeCount 1984, 1990). In all years the number of males and other predators attempting to kill cubs appears to be similar. The one thing that varies between years is the number of females not restricted in their movements by attending cubs. Thus, these females can act as predators on other female's cubs. However, they would do so only if some advantage could be gained from such behavior.

One advantage in this situation would be that habitat resources available for their own offspring would increase. Adult females' home ranges normally do not overlap as much as males', but do overlap to some degree (Lindzey and Meslow 1977, Alt et al. 1980, LeCount 1980, Reynolds and Beecham 1980, Young and Ruff 1982, Rogers 1983). Therefore, habitat components in these overlap areas must be shared with other females and their offspring. Because females allow their young to remain in their home ranges for two to four years after birth (Rogers 1987), the food, water, and cover in these overlap areas can become important to the young's growth and survival.

Therefore, if a female can kill another female's cubs, her offspring receive the benefits of these habitat resources and the mother stands a better chance of having her genes survive.

Cub killing by unrelated bears, however, does not occur in all bear populations. Other studies examining cub mortality indicate that offspring die more commonly due to poor nutrition or human-related causes rather than from being killed by other bears (Rogers 1987, Elowe and Dodge 1989). This research seems to indicate that nutrition may play the primary role in limiting populations, but if nutrition is consistent and adequate, intrinsic factors become necessary to regulate population size within the limits of other habitat components. In Arizona, this limiting factor seemed to be cover, which appeared to become limiting before food (Mollohan 1985).

Conclusions

Direct and indirect evidence indicate that intrinsic population regulation occurs in black bear populations and appears to be carried out by both adult males and females. Resident adult males, however, seem to play the biggest role by preventing new bear immigration, especially subadult males, into an area. Preventing resident male immigration appears to serve several important functions by limiting population size, reducing competition for environmental resources and breeding partners, and possibly indirectly protecting their own offspring.

Since adult males appear to play the main role in black bear population regulation, their management is important. As stated by Bunnell and Tait (1981), "If, as field observations and simulations suggest, older male bears are the regulatory mechanism, there are important implications to harvest and control. Removing the older males represents an unnatural or at least unusual form of mortality, and one that greatly reduces the effectiveness of intrinsic control." Losing intrinsic control is potentially detrimental to the population.

In the past, most bear management programs have been based on the assumption that losing adult animals due to hunting would be compensated for by increased production, surviving cubs, or both. Research has shown that bear reproduction is density independent and is influenced by nutrition (Bunnell and Tait 1981, Beecham 1983, Rogers 1987, Elowe and Dodge 1989). Thus, increased hunting pressure will not result in increased cub production.

The same situation may also be true for cub survival. In his review of literature relating to the question of whether increasing mortality of adult bears would be offset by increased survival of young, Miller (1990) concluded that "there is little support for a relationship between hunting pressure and cub survivorship beyond often repeated speculation, misinterpretation of published reports, and observations leading to inferences that have feasible alternative explanations." Thus, managers may not be able to rely on either increased cub production or survival from increased mortality of resident adults. In fact, if this removal allows new males (which might benefit from cub killing) to immigrate, then losing resident adults may actually reduce cub survivorship, thus, making mortality additive rather than compensatory.

The possibility that hunting mortality may be additive rather than compensatory creates a challenge for both researchers and managers. Researchers need to collect more information on intrinsic population regulation. For instance, does intrinsic population regulation take place at both high and

low population densities? How important a role do resident adult females play in regulating numbers? Why is cub mortality caused by other bears high in some populations and low in others? Which bears are responsible for killing cubs, immigrants, or residents?

The challenge for managers is to properly manage bear populations until this data has been collected and the role of hunting mortality is more clearly understood. Since this research will take time, and since mortality by intrinsic control may not be compensated for by hunting mortality, managers need to be conservative in their approach to bear harvest. If managers are not conservative, a risk of overexploitation exists, which, due to the low reproductive and survival rates of bears, could take decades to correct.

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Competition Between Black and Grizzly Bears as a Natural Population Regulating Factor

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Abstract: For over a million years, black bears likely competed with two Tremarctinae bears: the largely herbivorous Florida cave bear (*Tremarctos floridanus*) and the large, predatory giant short-faced bear (*Arctodus simus*). Today, grizzlies (*Ursus arctos*) may be a significant competitor where the two species overlap. Researchers hypothesize that the behavioral and body size differences found in the two species are favored under different ecological conditions. Due to resource depletion during poor food production years, black bears are superior competitors in timbered areas where evenly distributed foods of moderate quality exist. Due mostly to interference, grizzlies are superior competitors in more open habitats with high-quality but patchy foods. Unlike other population regulating factors, competition can cause one species to be extirpated. Because most temperate ecosystems are dynamic, the competitive ability of the two species will likely change dramatically due to natural catastrophes and succession. If both bear species have long-term fluctuations due to environmental changes that influence competitive ability, then the size of reserves needed to maintain viable populations will be affected where both species occur.

Introduction

Black bear populations appear to be naturally regulated by both intrinsic and extrinsic factors. Intrinsic regulating factors include female territoriality, cub killing, subadults forced to egress, and other attributes discussed by Al LeCount (this publication). Extrinsic regulating factors generally include habitat features such as food and cover that are discussed by Lynn Rogers (this publication). A third population regulating factor that is poorly understood but may have been important in the past and remains so in many locations is competition. Unlike other population regulating factors, competition may cause one species to be extirpated. Because black bears forage on such a variety of items, they may compete in some way with many species. Due to their many similarities, however, the grizzly bear is probably the black bear's most important competitor where the ranges of the two species overlap.

Because so little is known about black bear-grizzly bear competition, particularly as a population regulating factor, this paper is speculative. To my knowledge, a detailed investigation of black bear-grizzly bear competition has not been conducted anywhere. Fred Hovey, a Ph.D. candidate at Simon Fraser University, British Columbia, is beginning his fourth year of such a study as part of the Flathead Bear Project.

A History of Black Bear Competition

The probable ancestors of the black bear inhabited North America about 3 million years ago. The earliest finds of black bears date from about 1.5 million years ago. From then until present, black bears have competed for resources with many species. Other ursids have likely been significant competitors and perhaps have played a major role in directing the evolution of black bears.

Two Tremarctinae bears, the Florida cave bear and the giant short-faced bear, were likely important competitors with the black bear for the 1.5 million years that the three species coexisted in North America.

The Florida cave bear was a stocky animal that was probably almost exclusively herbivorous (Kurten and Anderson 1980). Remains of this bear have been frequently found in association with the black bear, indicating ecological dissimilarity. Kurten and Anderson (1980) postulated that the Florida cave bear was more herbivorous than the black bear.

The giant short-faced bear appears to have been the most powerful predator of the Pleistocene on the continent (Kurten 1967). Black bears may have filled the niche as an omnivore between the two Tremarctinaes and did so successfully, as black bears were by far the most common bear in the late Pleistocene (Kurten and Anderson 1980). Although the Pleistocene black bear was larger than it is today, it was still small compared to the predatory giant short-faced bear and may have fallen prey to it as well as saber-toothed cats and dire wolves. Herrero (1972) suggested that black bear cubs required trees for escape cover but that adults probably required trees as well.

Although they may have entered North America earlier, two new omnivores, man and grizzly bears, radiated across North America about 13,000-12,000 years ago (Kurten 1988). Shortly after, many large mammals, including the two Tremarctinae bears that black bears had competed with for over 1 million years, became extinct.

Competitive exclusion between black and grizzly bears was apparent when European man first explored North America. In 1805, while in what is now the Dakotas, Meriwether Lewis wrote, "I do not believe that the black bear, common to the lower part of this river and the Atlantic states, exists in this quarter. We have neither seen one of them nor their tracks, which would be easily distinguished by its shortness of talons when compared with the brown grizzly, or white bear" (Bakeless 1964).

Today we find bears on each of the large Pacific islands along the British Columbian and Alaskan coasts. Black bears occur on the Queen Charlotte islands, Vancouver Island, and Prince of Wales Island, while grizzlies are found on the Admiralty, Chichigof, Baranof, and Kodiak islands. No islands have both species, suggesting competitive exclusion. In Banff National Park, Hamer and

Herrero (1983) studied grizzly bears in a valley devoid of black bears. The morphological, ecological, and behavioral similarities between the two species also suggest that competition is a significant factor in their distribution and numbers.

Some Similarities and Differences Between Black and Grizzly Bears

Grizzly bears are generally larger than black bears; however, in some productive habitats where grizzlies do not occur, black bears approach the size of interior grizzlies. In areas where the two species cohabit, grizzlies are about twice as large (Herrero 1978). Based on energetic equations (Kleiber 1975), the energetic requirement of a grizzly would be approximately 1.7 times that of a black bear one-half its size, but because grizzlies are more mobile, actual energetic costs of grizzlies may be higher.

The ability of black and grizzly bears to digest foods are the same (Pritchard and Robbins 1990). Their relative ingestion rates of various foods, however, remain unknown. For foods such as grass, grizzlies may have a higher ingestion rate due to a larger mouth. Ingestion rates of important bear foods such as berries and fish are unlikely a linear function of mouth size. Small bears can probably eat berries as fast as big bears provided they have access to the same patch.

Grizzlies are much more aggressive than black bears. Herrero (1972) suggests that this trait evolved to enable female grizzlies to defend their cubs in the absence of trees and thus exploit resources in open habitat. After observing many grizzlies in the pristine conditions of 1805, Lewis suggested that their aggressive nature was to defend kills and carrion (Bakeless 1964). The ability to defend cubs and kills were likely both essential to bears in open, Pleistocene habitats when large herbivores were numerous.

In similar habitats, black bears generally occur at higher densities than grizzlies. This difference may be a function of the lower energy requirements of individual black bears or their less aggressive nature.

Morphological differences in claw structure enable grizzlies to dig more efficiently and enable adult black bears to climb trees better than adult grizzlies. Cubs of both species climb well.

Competition and Population Regulation

Interspecific competition occurs when two or more species use the same limited resource and is an interaction that harms both species. Competition becomes more intense as the number of individuals using the limited resource increases and therefore is density dependent. Competition can be due to resource depletion, interference between individuals, or both.

The relationship between two species has been greatly simplified in the Lotka-Volterra equations by using a conversion factor to convert the impact of one individual of a species on the carrying capacity of a competing species. Without competition, a population with an intrinsic per capita growth rate of r increases until it reaches an asymptote, K, or carrying capacity by

$$\frac{dN_b}{dt} = r_b N_b \left(\frac{K_b - N_b}{K_b} \right) \quad (1)$$

For this simple model, adding a competitor is similar to adding more conspecifics equated by a conversion factor, α, so

$$N_b = \alpha N_g, \quad (2)$$

where N_b is the number of black bears and N_g is the number of grizzly bears and α converts the number of grizzlies into the number of black bears. The rate of increase and number of black bears at equilibrium is now calculated by

$$\frac{dN_b}{dt} = r_b N_b \left(\frac{K_b - N_b - \alpha N_g}{K_b} \right) \quad (3)$$

For the impact of black bears on the grizzly population,

$$\frac{dN_g}{dt} = r_g N_g \left(\frac{K_g - N_g - \beta N_b}{K_g} \right) \quad (4)$$

a different conversion factor ß is used, such as if 1 grizzly reduces the number of black bears by 2 it does not mean that 1 black bear will necessarily reduce the number of grizzlies by 0.5.

Obviously, these simple equations make many assumptions; most significant may be that under all conditions of density, a constant conversion factor exists. We will probably never have a factor that converts grizzlies to black bears, but what is interesting and important is how a conversion factor varies with changing environmental conditions. Which conditions favor black bears and which factors favor grizzlies may be important when managing areas to maintain both.

Because of their smaller size, higher densities, and less aggressive nature, black bears may compete with grizzlies by depleting resources. Factors that probably benefit black bears include forest cover and evenly distributed foods of moderate quality. Trees provide escape cover that appears to be essential for young cubs and perhaps adult bears if grizzlies are abundant. Evenly distributed foods that are of moderate quality permit the smaller black bears with lower energy requirements but almost equal ingestion rate to survive and reproduce. Because black bears may attain moderate densities in such areas, they could impact foods during average and poor years and thus compete significantly with or even exclude grizzlies.

Grizzly bears can deplete resources and thus compete with black bears, but due to their larger size and more aggressive nature, interference may be more important. Grizzly bears may do best in

areas with high-quality foods, particularly if the distribution is patchy. The high-quality foods permit the larger bears to obtain required nutrients, and a patchy distribution may permit exclusion of black bears, particularly if few trees exist. Ungulates, productive berry patches, and salmon-spawning streams are beneficial to grizzlies. Black bears can coexist in such systems if they are forested.

Potential Management Implications

So little is known of the interactions between black bears and grizzly bears that making management recommendations is premature. However, we may speculate on the ramification that competition may have on how we manage the species and their habitat.

Disturbances such as fire and avalanches, particularly at higher elevations where succession is slow, may benefit grizzly bears. Intensive forest management that minimizes early successional stages and quickly results in an evenly spaced, fast-growing monoculture may be more harmful to grizzlies than black bears and thus may be beneficial to black bears.

Because most temperate ecosystems are dynamic even without human influences, the competitive ability of the two species may change dramatically due to natural catastrophes and succession. Local black bear extirpations may occur when conditions favor grizzlies, but as conditions change, the black bears may recolonize and perhaps reduce the number of grizzlies to the point of extirpation. If both bear species have long-term fluctuations due to environmental changes, then reserve sizes needed to maintain viable populations where both species occur will be affected.

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A Summary of the Discussion on the Natural Regulation of Black Bears

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Introduction

Bear populations do not increase indefinitely; either the birthrate must decrease or the death rate must increase as the population grows. What factors regulate population growth is a fundamental question of ecology (the science of organism distribution and abundance). During the Fourth Western Black Bear Workshop, one session focused on the natural population regulation of black bears. After presentations by Al Lecount on intrinsic factors, Bruce McLellan on competition, and Lynn Rogers on habitat quality, an open discussion lasted for over two hours. This paper is a summary of that discussion.

A Few Facts

Some aspects related to black bear regulation are strongly supported by data; these are listed next.

1. In areas of good habitat, black bear densities are higher than in areas of poor habitat.
2. Reproductive rates are density independent and largely due to great interannual variation in soft and hard mast production. Female bears in good condition have larger litters than females in poor condition who may not produce a litter.
3. Conspecifics and other species preying on cubs is significant in some areas.
4. Subadult males have a much greater tendency to disperse than females. Female dispersal has rarely been documented.
5. The abundance of adult resident males appears to influence subadult male dispersal.
6. People have significant effects on black bear populations and the ecosystems in which they live. Therefore, separating natural regulation from human-induced regulation may be difficult.

Some Theory

The basic behavioral ecology of bears appears to be complex and thus remains unclear. Evolutionary explanations for observed behaviors are ad hoc at best. Other strategies that bears could, but do not, follow were discussed. Strategies were most often discussed by age and sex class.

Adult Males. Researchers believe that to maximize their fitness, adult males mate with as many females as possible and reduce the chances of other males fathering litters. To be able to compete for mates, males must be large and aggressive and have a large home range to enable encounters with more females. When unrelated males are young and can be dominated, they should be discouraged from sharing the males' range.

To increase their relative fitness, adult males should kill unrelated cubs. This cub killing would reduce the fitness of a competitor and may provide a potential mate, if the killing occurred before the breeding season, as the female may soon become receptive.

In seasons other than the breeding season, males should maximize fat deposition not only for denning but to reduce foraging demands during the following breeding season.

Subadult Males. The primary strategies for subadult males are to stay alive and to grow rapidly. When approaching adulthood, subadult males must increase their range size to encompass the ranges of many females. Subadult males' postnatal range is relatively small and their knowledge of resources within it is not overly significant. Thus, the males do not incur a high cost in leaving it. Subadult males should disperse from their father's range to reduce duplicating reproduction effort among related males for a limited number of females.

Male abundance is apparently regulated naturally by increasing subadult male dispersal and mortality rates as the abundance of males increases. An increase in cub killing as the number of adult males increases may also affect male abundance in a density-dependent fashion.

Adult Females. This age and sex class is more dependent on food and cover resources to maximize fitness than other classes. To maximize fitness, adult females should discourage unrelated bears from using their range, provided she is large and aggressive enough to dominate them. Thus, she may influence settling subadult bears and other adult females. Adult females may permit offspring to establish ranges within her territory. Some evidence shows that adult females may gradually shift their territories to other areas to accommodate daughters, because the older females may be better able to infiltrate a neighbor's range, leaving her range for her daughters. This gradual adult female dispersal may limit population growth, but little data exist to support this theory now.

Subadult Females. Like subadult males, young females' strategies are primarily to stay alive and grow rapidly. Unlike young males, however, subadult females do not have to develop large ranges and may find ample resources within their mother's range. Here in their mother's range, young females know about quality foraging locations and have less pressures from unrelated adult females.

Research Required

Our understanding of the natural regulation of black bear populations remains limited. The experiment in Cold Lake, Alberta, that was conducted over 20 years ago remains a foundation for much of what we know on this topic. Other manipulative experiments should be conducted, particularly in large, unhunted areas where populations can increase and natural regulation can occur.

Specific topics needing further research include:

1. Which bears kill cubs, residents, or bears new to the area?
2. What are the relationships among bear density, habitat conditions, and cub killing?
3. What are the mortality rates and causes of death of subadult bears and are these factors related to bear density?
4. Under certain conditions, female dispersal must occur. This dispersal must be described and factors that influence female dispersal must be identified.
5. We need further understanding of the social structure of black bear populations, particularly the relationship between resident adult males and the ingress of younger, unrelated bears.

Management Implications

The discussion on natural black bear population regulation raised several potentially important management implications. First is the long-term effect of harvesting resident adult males. Observed population increases after removing adult males appears to be due to immigrating subadult males. These new males would not be the fathers of any cubs in the population and thus may be more prone to cub killing. The female population may actually decrease due to additional cub killing, because about half are female cubs. These effects need experimental testing.

Another possible management implication of unrelated males affecting the population could occur in locations where recolonizing available habitat from adjacent areas is desired. Subadult males will be the first to disperse from a high bear-density area into the adjacent low-density area. Females gradually dispersing into the low-density area will be confronted with relatively large numbers of males. These males are unlikely to be the fathers and therefore may be more prone to kill cubs, greatly retarding recolonization. Obviously, this hypothesis also needs testing.

The stabilizing influence that resident adult males have on the social structure may be important if an influx of young males is not desired. Such a situation may occur in tourist recreation areas. Removing a few resident adult males due to bear-human problems may greatly increase the number of subadult males and thus increase bear-human problems, not decrease them. Contending with the few resident adult males may be preferable if they are not a serious threat. Similarly, removing adult males where livestock depredation is a problem may not be wise. The assumption that large bears kill domestic or wild stock may not be true and removing adult males may aggravate the problem in the long term.

These management concerns are speculative at this time and require additional research. Some management recommendations are accepted. Notably, female bears must be protected from hunting when possible. Males can be compensated for; females cannot. One strategy is to have no hunting reservoirs for females and hunting on the perimeter. In the southeastern United States, this management strategy has been implemented. Expanding populations so that the reservoirs function as planned has taken 10 years, but the plan is now is working well.

Black Bear Population Monitoring

Monitoring Black Bear Populations: Pitfalls and Recommendations

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Abstract: Virtually all population monitoring techniques used for black bears have inherent problems, some that can be at least partly corrected in the design stages and others that must be considered during analysis and interpretation. Sex and age composition data often are heavily relied upon for assessing population status. Many management agencies strive for a high percent of males in the harvest and an age structure that is neither too young nor too old. When scrutinized conceptually or through an exercise with actual data, sex-age composition data are often misleading because (1) data obtained either from harvest or capture may yield erroneous impressions of the living population's composition, and (2) even knowing the composition of the living population, assessing population status is difficult, as identical structures can result in opposite population trends and dissimilar structures can yield the same trend. Changes in population structure indicate a change in reproduction, mortality, or both, but relying upon sex-age data as a signal of change is unwise; moreover, other data are needed to determine the source of change. Potential trend indicators, like total harvest, hunting success, bait station visitation, and nuisance complaints, may assist in detecting changes in population size, but none have been adequately tested against measured changes in bear numbers. The perceived utility of population trend indicators may be falsely strengthened by correlations produced from parallel responses to food or weather conditions rather than bear density. Unfortunately, obtaining actual estimates of bear density is difficult and expensive. Furthermore, even these estimates may be biased by movements of bears outside the study area and by behavioral responses of bears to the capture method used to derive the estimate. Some of these biases can be minimized with the assistance of radiotelemetry. Telemetry also has enabled black bear biologists to gather data on reproduction and mortality by following bears to their dens and monitoring them until their death. However, sample size limitations can severely restrict the ability to detect yearly differences among the estimates. These problems impose formidable constraints on our ability to monitor black bear populations, reinforcing the need for utmost care in interpreting results.

Introduction

Population monitoring is vital for responsible black bear management. Data on food habits, habitat use, movements, activity patterns, social structure, behavior, and even physiology may be relevant for developing management strategies, but without demographic information, managers cannot assess the results of their actions. Most management actions for black bears involve hunting, removing nuisance animals, or conversely, protecting bears from human sources of mortality. To determine the effectiveness of these programs, black bear managers must evaluate changes in population size and stability.

Methods for monitoring black bear populations have undergone appreciable evolution. Early researchers relied on track counts (Spencer 1955) or direct counts of roadside bears (Bray and Barnes 1967) as indices of population size. Since then, various other trend indicators have been employed; for hunted populations, most population indicators are linked to harvest data. Many bear biologists have realized that trend indicators are often inadequate, however, so efforts to obtain actual estimates of population parameters like density, reproduction, and mortality have increased.

No method used for monitoring black bear populations is devoid of problems. Recognizing the scope and potential ramifications of these problems is thus imperative for interpreting results. Furthermore, biases and limitations are important considerations in selecting techniques as well as in developing new approaches.

Many of the problems associated with commonly used bear population monitoring techniques have been previously reviewed in some detail (Pelton et al. 1978, 1986; Harris 1986; Miller 1990*a*; Garshelis 1991). Nonetheless, frequently the restrictions seem to be either forgotten or simply ignored at both the design and analysis stage. Thus, I thought it was appropriate to explore some of the pitfalls of population monitoring more thoroughly, and, where possible, offer recommendations for improvement.

This paper examines six major categories of data that are commonly used for population monitoring: sex ratios, age structures, possible trend indicators, and estimates of density, reproduction, and mortality. A conceptual framework for treating each of these types of data is presented, followed by interpretations of example data sets that were evaluated by participants of the Fourth Western Black Bear Workshop.

Methods

Workshop registrants completed a questionnaire inquiring about their level of expertise in dealing with population data and their interest in hunted versus protected populations. The 21 people expressing greater interest in hunted populations were divided into 2 groups that were fairly balanced with regard to experience level; 18 had some experience analyzing population data, whereas only 3 indicated little or no experience. Sixteen participants preferred dealing with data from a protected population, but since half had little or no previous experience, all were placed in a single group.

Participants of each group were asked initially to select (from a list) those data sets that they anticipated would be most useful in assessing population status; at the end of the exercise, participants were asked which data actually seemed most useful. Each participant was given a worksheet with data presented in tabular or graphical form and corresponding explanations of pertinent data collection methods. Under each graph or table were listed some specific interpretive questions. Participants reviewed each data set individually, then discussed interpretations with other members of their group. The chairperson recorded the consensus of the group as well as any disparate opinions, and later presented a synopsis to a reconvened session of all workshop participants.

The data presented on the worksheets were drawn from real population studies. Material from Great Smoky Mountains National Park (Carlock et al. 1983, Eiler et al. 1989, McLean 1991) was used to represent a well-studied protected population. Example data for a hunted population were from Minnesota (Minnesota Department of Natural Resources, unpubl. data). Workshop participants were informed that their analyses involved real data, but were not told the source of the data until the exercise concluded. The example data sets were intentionally selected from eastern states to minimize familiarity by workshop participants, and thus promote more objective critical evaluation.

The actual data presented at the workshop were not reproduced in this manuscript due to their preliminary nature; however, copies of the worksheets that were used will be provided upon request.

Results and Discussion

Interpreting Sex Ratios

Background and Conceptual Framework. In a previous survey (Garshelis 1991), all but one of the western states reported using harvest sex ratios as a primary basis for monitoring the status of black bear populations. The reliance on sex ratio data is much more prevalent in the West than in the East. Many of the western states and provinces have established guidelines that call for less than 40% females in the harvest. Most of the eastern states and provinces have no such standards, although about half of the eastern jurisdictions, especially the southeastern states with small bear populations, generally meet these criteria.

Spring hunting seasons are typically highly skewed toward males, so if the spring harvest represents a high percent of the total harvest, the harvest will be significantly male biased. Likewise, fall harvests can be timed such that most females are denned and thus not available to hunters, resulting in a male-biased harvest. This strategy is used to protect females in several jurisdictions.

Conversely, some states and provinces with apparently large and healthy bear populations regularly harvest more than 40% females (e.g., Maine, Michigan, Minnesota, Pennsylvania, and Wisconsin), and the population in Arkansas has grown rapidly with female-dominated harvests. Thus, we should consider (1) whether attempts to skew the harvest towards males are indeed beneficial, and (2) whether the harvest sex ratio is a useful indicator of population status.

In considering these questions, we can envisage a hypothetical population of constant size in which all mortality is due to hunting. If males are more vulnerable to hunting, then in the first few years the harvest will be male biased. If males are twice as vulnerable as females, then the first harvest will contain twice as many males as females. However, with continued male-biased harvests, males will eventually become only half as abundant as females in the living population. At this point, with males half as abundant but individual males still twice as vulnerable, males and females will be equally represented in the harvest (Table 1). More simply, if all animals born are eventually harvested and the sex ratio at birth is even, the sex ratio in the harvest must also be even (Bunnell and Tait 1980).

To achieve a harvest that is perpetually male biased, either more males than females must be recruited into the population, or more females than males must die due to other causes (Table 1). Several studies have reported slight but statistically insignificant male-biased cub births (e.g., Beecham 1983, Rogers 1987, Alt 1989, Kolenosky 1989); larger samples may indicate a significant male bias among cubs in many areas, and possibly even a male bias among yearlings before the hunt (despite typically higher male mortality among cubs). Such male-dominated recruitment may account for some of the male bias in harvest samples. In modeling the Minnesota population, for example, I found it necessary to incorporate a significant male bias among cubs and yearlings to sustain harvests that averaged about 42% females. However, male-biased births alone probably could not account for harvests that average much less than 40% females.

If female-biased natural mortality is imposed on the hypothetical population discussed earlier, females will never dominate males 2:1 in the living population. With males now somewhat more than half as abundant as females but still twice as vulnerable to hunting, the harvest will contain primarily males (Table 1). Paradoxically, by attempting to achieve sustained male-biased harvests (presumably to protect females), living populations must be skewed toward lower rather than higher proportions of females. If, again, males are twice as vulnerable to hunting (and the sex ratio among prehunt yearlings is 50:50), then to continually harvest twice as many males as females (i.e., only 33% females in harvest), an equal number of males and females must exist in the population, which can be achieved only with significant female-biased nonhunting mortality.

Notably, most studies have reported male-biased rather than female-biased nonhunting mortality, especially among nuisance kills and car kills (e.g., Horstman and Gunson 1982, Garshelis 1989, Hellgren and Vaughan 1989). More females than males likely die of natural mortality (they obviously die of something), but in populations in contact with humans, overall nonhunting mortality for females often may be less than for males. Thus, keeping in mind the hypothetical scenario discussed earlier, it seems enigmatic that males could significantly dominate the harvest--but the fact is, in many areas they do.

Table 1. Effects of sex ratio at birth (or recruited yearlings), nonharvest mortality, and population growth on harvest sex ratios in four hypothetical black bear populations, all with significantly male-biased harvest mortality rates (2:1).

	Stable Population		Male-Biased Births		Female-Biased Nonhunting Mortality		Increasing Population	
Parameter	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Mortality								
Harvest rate	0.30	0.15	0.30	0.15	0.30	0.15	0.30	0.15
Nonharvest rate	0.00	0.00	0.00	0.00	0.05	0.10	0.00	0.00
Recruitment								
Cubs/female	0.353		0.353		0.525		0.588	
Cub sex ratio	50:50		60:40		50:50		50:50	
Population Dynamics								
Starting population	1000	2000	1000	2000	1000	2000	1000	2000
Harvest	300	300	300	300	300	300	300	300
Nonharvest mortality	0	0	0	0	35	170	0	0
Recruitment	300	300	360	240	402	402	500	500
Resulting population	1000	2000	1060	1940	1067	1932	1200	2200
Population sex ratio	33%	67%	35%	65%	36%	64%	35%	65%
Harvest	300	300	318	291	320	290	360	330
Harvest sex ratio	50%	50%	52%	48%	52%	48%	52%	48%

Note: The first scenario, with 50:50 recruitment, no nonharvest mortality, and mortality equaling recruitment, reaches a stable 33M:67F population sex ratio with an equal sex ratio in the harvest. The harvest becomes skewed towards males as a result of any of the three other scenarios: births skewed toward males, nonharvest mortality skewed towards females, or population growth caused by increased recruitment (or decreased mortality).

If cub recruitment is not appreciably male biased and nonhunting mortality is not female biased, how can male-dominated harvests be maintained? One possibility is via an increasing population. Consider again the hypothetical population with twice as many females as males, but males twice as vulnerable to hunting. If the population is not increasing or decreasing, the harvest sex ratio converges upon 50:50, as discussed earlier. However, if yearling recruitment exceeds mortality, both male and female segments will increase, which automatically increases the proportion of males in the living population, enabling males to dominate the harvest. This peculiar result may not be intuitively obvious, but can be clearly demonstrated with simple mathematics (Table 1) or through computer modeling. Miller and Miller (1988) subjected a brown bear (*Ursus arctos*) population model to light hunting and low natural mortality and observed a steadily increasing population composed of 58% females and yielding 40% females in the kill. With continued light natural mortality (which was female biased because the population was concentrated among old age classes) but increased hunting pressure that caused the population to decline, Miller and Miller (1988) found that females composed a higher percent of both the population (63-69%) and the kill (47-48%).

These results seemingly suggest that a heavily male-biased harvest could indeed be used as an indicator of a growing population. I find it a bit inconceivable, though, that black bear populations are significantly increasing in all jurisdictions with heavily male-biased harvests. Moreover, even declining populations can sustain male-biased harvests with male-biased recruitment (due either to male-biased births or immigration from less heavily hunted areas) or female-biased natural mortality (especially if many more females than males live to old age) (Table 1).

Where does this analysis leave us with regard to the issues raised at the outset of this discussion on page 125? First, managing for highly skewed male harvests is not necessarily beneficial in bear management, although it could be. The answer to this question, unfortunately, is ambiguous and depends on cub sex ratio and other sources of mortality. The answer to the question regarding whether harvest sex ratios are a dependable means of monitoring population status is also somewhat tentative. Female composition in the harvest may remain constant and within an established guideline of say less than 40% even if the population is plummeting, indicating that harvest sex ratios may poorly reflect population status. However, if historically a population yielded a fairly fixed harvest sex ratio, a change in that ratio might well signal a change in population status.

Working Group Problems. The working group considering data from the protected population was asked whether a more male-dominated sex ratio among bears captured outside the park (67%) than inside (57%) was indicative of greater male-biased mortality within the park. In other words, since male-biased hunting was greater for bears outside the park than inside, do these sex ratio data suggest that male-biased poaching, for example, was greater inside? The group decided first that neither sample was likely representative of the real populations (i.e., a capture bias towards males existed), and second that the more male-dominated sample outside the park was likely attributable to male-biased dispersal from within the park rather than more male-biased mortality within the park. Evidence from telemetry studies in this area, although not presented in this workshop, seemed to support this explanation. Thus, dispersal can be added to the list of factors that can affect sex ratios.

The exercise dealing with the hunted population pertained to a harvest sex ratio that was correlated with hunting success. Managers often suppose that an increasing percentage of females in the harvest is indicative of a population in which males have been overexploited; thus hunting success,

a possible indicator of population trends, might be expected to decline with an increasing percentage of females in the harvest. In this example, however, hunting success and percent females were positively correlated for a period of eight years. The groups studying this problem believed that both of these variables were likely more responsive to food availability than to bear abundance: hunters (the vast majority using bait) were more successful and the vulnerability of male and female bears were more similar during hunting seasons with poor natural food. This hypothesized relationship appeared to be corroborated by food abundance data (see Garshelis 1991), adding yet another variable that can affect sex ratios.

Interpreting Age Structures

Background and Conceptual Framework. All but one of the western states and half of the western Canadian provinces use harvest age structures, principally mean/median age, to assess population status (Garshelis 1991). Like sex ratios, several jurisdictions have established age criteria to evaluate whether a population is overexploited. The logic for using such age criteria is that increased exploitation will reduce the life span of the average bear, causing populations to become younger. The fact that the average age of males is typically less than that of females and male exploitation is greater than female exploitation may be viewed as evidence that heavier hunting results in a younger age structure.

Additional evidence for the effect of hunting on age structures may be gained by comparing age data (obtained from capture samples) from unhunted or lightly hunted populations versus more heavily hunted populations. I compared age data for 17 different populations and found that only unhunted or lightly hunted populations contained at least 70% adults (4 years and older) among females and 60% adults among males. However, several theoretically protected populations (e.g., Yosemite National Park (Keay 1990), Shenandoah National Park (Carney 1985), and Great Dismal Swamp (Hellgren and Vaughan 1989)) had less than 70% adult females and less than 60% adult males. Relatively low percentages of adults may indicate that these populations were really not as protected as they were supposed to be, or conversely, that the criteria for evaluating the level of exploitation is inadequate.

The effects of exploitation on age ratios can be clarified by reviewing some well-established principles regarding population age structures. Long ago, Lotka (1907, 1922) showed that populations subjected to constant rates of reproduction and survival will attain a stable age distribution, and Leslie (1948) and Caughley (1977) demonstrated that this same distribution will be maintained if survival is changed, as long as the change affects all age classes equally. The explanation is that any change in survival of reproductive-age females will correspondingly affect reproduction. Thus, if bear survival decreases due to increased hunting, for example, reproduction will go down accordingly. So if the age structure was initially stable, no perceptible change in the resulting age structure will occur.

This argument is valid only for females, however, because female recruitment is dictated by the abundance of reproductive females. For males, recruitment is also driven by the abundance of reproductive females. Consequently, if male survival is reduced more than the survival of those females producing male cubs, a disproportionately high number of male cubs will enter the male population and the male age structure will grow younger. Alternately, the male age structure will

grow younger if both male and female survival is enhanced, but survival increases more among cub-producing females than among males. Thus, a theoretical basis exists for observations of declining male age structures collateral with stable female age structures in populations with changing rates of exploitation (e.g., Kolenosky 1986). Managers should recognize that these changes in male age structure are caused by changes in male survival *relative* to females. If bears of all sexes and ages experienced similar shifts in survival, neither sex would exhibit a noticeable shift in age structure.

Ironically, although the age structure of the living population should remain stable with across-the-board changes in survival, the age structure of the harvest might not. If the harvest mortality rate was equal among all age classes, then the harvest age structure would directly reflect the age structure of the living population. In this case, if the age structure of the living population remained unchanged, the harvest age structure obviously would not be altered either. However, if younger bears experienced higher harvest rates than older bears, then although survival rates declined, say 20% for all age classes, mortality rates would increase more among the older bears. If, for example, survival during the hunting season dropped from 70% to 56% among young bears and from 85% to 68% among older bears (a 20% reduction in both cases), hunting mortality (1- survival rate) would have increased 47% among the young bears (from 30% to 44%) but over 100% for older bears (from 15% to 32%). Due to this greater increase in the hunting mortality rate of older bears, the mean/median age of the harvest would actually increase with the increased harvest pressure--a result that is certainly counterintuitive.

A factor not considered so far is that changes in harvest pressure would not have the same effect on cubs (if they are legally protected) as other bears. If survival is reduced for all age groups except cubs, then clearly the age structure becomes younger, which is what managers typically expect as a result of increased harvest. If, however, females with cubs are also protected (or at least commonly avoided by hunters), then increasing harvest pressure could disproportionately reduce the percentage of young females in the population, making the average age of the living population older. Miller (1990*b*) believed this situation explained an increase in the mean/median age of female brown bears that were subjected to increased exploitation.

The upshot, I believe, is that the response of age structures to changing levels of exploitation is just too complex and hence too unpredictable to be relied upon as an indicator of population status. This conclusion does not mean that age structure data are not potentially useful. I think, however, that more sophisticated models, specific to the population in question and including some information on population trends, are necessary to properly interpret age structures. Simple guidelines, especially without any empirical basis, may be more misleading than helpful.

Working Group Problems. The unhunted population working group was presented age structure data from bears caught within the park compared to bears harvested outside the park. Both males and females captured within the park were older, on average, than bears killed outside the park, but the group felt that this difference did not necessarily mean that the bears within the park were subjected to a lower rate of mortality. First, the group felt that comparing capture age data and harvest age data was improper. Second, the group noted that the older age of park bears was due to a scarcity of one- and two-year-olds, which may have been caused by trapping bias or young bears dispersing out of the park. Thus, the group felt that the age data conveyed little about relative mortality within the park versus outside the park.

The groups analyzing data from the hunted population were asked to interpret a declining median age of harvested males coupled with a female age structure that showed no consistent trend. One group suggested that this scenario could have been caused by escalating male vulnerability to hunting, possibly due to intensified male competition for habitat in an increasingly dense population; alternatively, the group posited that reproduction may have increased. This explanation matches the discussion presented earlier, where although cub production per female may be fairly constant, an increasing percentage of females in the population could produce an increasing number of young males, with a corresponding decline in the male age structure. However, both groups thought the age structure data gave little indication of population trend.

Evaluating Population Trend Indicators

Background and Conceptual Framework. Wildlife managers seek cheap, reliable indicators of population trends. Bear managers have used total harvest, hunting and trapping success, nuisance activity, road kills, incidence of sign or sightings, bait or scent station visitation, camera site visitation, and responses from various questionnaires as indices of population trends (Garshelis 1991). None of these potential indices has been adequately tested against known changes in population size, but the pervasive feeling is that (1) some data are better than none, even if they are not always reliable, and (2) several untested indices all pointing in the same direction provide convincing evidence of population trends.

These contentions may seem somewhat ridiculous, but they are not wholly untrue. Certainly having some data, like total harvest or records of nuisance activity, is better than having none. Also, clearly, the more data available the better. And if all the data do point in the same direction, the better yet. The problems, though, are probably obvious.

The principal problem with the "little data are better than none" contention is that these data may in fact be misleading. Suppose the only data available were records of total harvest. First, if these data were estimated via a hunter survey (a common practice among various western states and Canadian provinces) rather than tallied at registration stations, the data points themselves could be inaccurate (certainly each is subject to a potentially large variance component). Second, population trend interpretations from these data would be largely subjective: if the harvest was steadily increasing one manager might conclude that the population must also be on the rise, whereas another manager might be concerned that harvest mortality was increasing and the population was declining. If hunter success was also known (estimated) and happened to match the harvest (higher success in years with higher harvest), then the first manager might assert that his or her interpretation of increasing population size was strengthened--higher bear densities improved hunter success, resulting in higher harvests. The second manager, however, could maintain that mortality rates were actually escalating, with improved hunting success attributable to better hunting techniques, more experienced hunters, more days afield, etc. More data regarding trends in hunting techniques, years of experience, and days spent hunting would clarify this quandary.

That different conditions can produce similar effects also bears upon the second contention, that a conglomerate of indices all pointing in the same direction should yield a reasonable level of assuredness in the population assessment. Building on the above scenario, if bait station visitation had also been increasing, coincident with the increase in harvest and hunting success, then a

population increase seems to become a more compelling interpretation. This reasoning is difficult to shake, as it is unlikely that both bait visitation and hunting success could increase steadily through time, with no common underlying basis. A more ambiguous result, however, would be if bait visitation matched hunting success but neither showed any definitive trend through time. The question then arises about whether yearly variations in hunting success and bait visitation actually mimicked changes in population size or if both merely reflected changes in bear behavior, due, for example, to differing natural food availability.

My feeling is that varying availability of natural food and other independent factors like weather often confound interpretations of data used as population indices. Unfortunately, only one-third of the jurisdictions in North America that hunt bears (13/39) collect data on food abundance (Garshelis 1991). Quantifying food abundance is certainly difficult, but survey techniques have been successfully implemented in Minnesota, for example, that provide a reasonably good index of food based on incidental observations by personnel that are regularly in the field (Noyce 1991). Initiating similar food surveys in other areas would likely prove to be highly beneficial.

Certainly the best approach would be to actually test the validity of data used as population indices, as has been done, for example, with moose (*Alces alces*) (Fryxell et al. 1988). The major difficulty, of course, is obtaining the actual population estimates against which the indices can be tested. Furthermore, even if an index seems to work, variability due to food and other environmental influences may still need to be considered.

Working Group Problems. The unhunted population group was shown a positive correlation between bait station visitation, harvest outside the park, and population estimates from within the park and asked whether using bait station and harvest as indicators of population trends would be valid. The group was concerned that all of these variables could have been driven by food availability: poor food years prompted larger bear movements and made bears hungrier, which resulted both in higher bait visitation and higher harvests outside the park. Furthermore, since the assumption of geographic closure was not considered in estimating population size from mark-recapture, density estimates were likely inflated by the greater bear movements (see following section on Estimating Density).

The hunted population exhibited an increasing number of bear nuisance complaints and a stable or slightly decreasing visitation at bait stations. However, the groups analyzing these two potential population indices did not consider either representative of population trends. The groups felt that both low natural food availability in recent years and possibly growing habituation by bears to human-related foods caused the increase in nuisance activity; that is, this increase could not necessarily be attributed to a growing population. Furthermore, although the groups felt that bait station visitation had the potential to be a more reliable population indicator, they did not trust the results obtained in this particular case, partly because these results seemed to contradict the harvest data, which showed an increasing kill with no decrease in hunter success. Total harvest was directly related to the number of hunters, and that was controlled through a permit system, so harvest alone was judged to be a poor indicator of population trends. The groups thought that hunting success was a better index of bear abundance, but they noted that high hunting success could have been maintained by increased bait hunting and by greater habituation of bears to baits (i.e., all human-related foods). In sum, all of the trend indicators presented (nuisance complaints, bait station

visitation, total harvest, and hunter success), which are the most commonly used population indices among bear managers across North America (Garshelis 1991), were judged to be ambiguous.

Estimating Density

Background and Conceptual Framework. The lack of validated trend indicators underscores the importance of obtaining actual density estimates to track changes in population size. The mark-recapture approaches that are typically employed to estimate population size are logistically constrained to small study areas, which limits their applicability for monitoring populations occupying large geographic areas. Nevertheless, some justification exists for extrapolating the results, although important obstacles remain that detract from the usefulness of this technique. Fortunately, most of these obstacles can be surmounted, to an extent, by modifying the study design.

The first obstacle relates to the restriction that all animals in a mark-recapture study must be equally prone to capture, including both the initial capture and the subsequent recapture. Some captured bears become trap conditioned (trap happy or trap shy), and moreover, some individuals or sex-age classes are more readily caught than others. To minimize the effects of trap conditioning, one trap type could be used for the initial capture and another for the recapture. In a Minnesota study, for example, most bears were initially captured in barrels; however, during subsequent trapping efforts snares were set at trap sites where a tree bait was taken but the bear did not go in the barrel (Garshelis 1992). In a Massachusetts study, the recapture sample was obtained by tracking bears with hounds (T. Fuller, University of Massachusetts, pers. comm.). Differences in individual capture proneness are more difficult to deal with, but differences between sex-age groups can be handled by segregating the data and then summing the population estimates obtained for each group (Garshelis 1992).

Population closure is the other commonly violated assumption that hinders mark-recapture population estimates. Two assumptions dealing with closure exist: demographic closure and geographic closure. In the strictest sense, demographic closure means that births, deaths, immigration, or emigration do not occur. Actually, recruitment will not affect the population estimate at the time of the recapture sample (but will cause the population size to be overestimated at the time of original marking, before the recruitment occurred). Death and emigration will affect the estimate only because these factors result in overestimating the number of marked animals remaining in the population. A way of circumventing this problem is to estimate the number of marks remaining using the Jolly-Seber approach. Alternatively, if animals are marked with radio collars instead of just ear tags, the number of marked animals can be determined directly by counting radio collars present.

If animals are marked with radio collars, then those that permanently disperse from the study area can be omitted from the marked population. Additionally, some animals may leave on prolonged seasonal excursions during the recapture phase of the study, effectively eliminating them from the available marked sample. Furthermore, some animals may move back and forth across the borders of the study area, making them available for capture, but less available than full-time residents of the study area. This movement outside the study area violates the assumption of geographic closure.

Two techniques have been proposed to deal with lack of geographic closure. The first, proposed by Miller et al. (1987) and now used extensively for both black and brown bears in Alaska (Miller et al., draft manuscript), generates what has been called a capture-mark-resight population estimate using (1) the number of marked and unmarked bears seen (during spring, before leaf-out) by aerial observers during surveys over the study area, and (2) the number of radio-marked bears located with telemetry equipment (by an independent observer) within the boundaries of the study area during each survey period. Thus, if bears leave the area temporarily, they are not tallied in the marked sample during the surveys in which they were absent.

The other technique, described by Garshelis (1992), weights each radio-collared bear by the amount of time it spends in the study area. Animals that are full-time residents are counted as a full "bear equivalents," but animals that spend only half their time in the area are recorded as only half a bear. A population estimate is generated using the number of bear equivalents rather than simply the number of bears for each term in the Petersen equation. The advantage of this technique over the capture-mark-resight method is that special flights to observe bears are unnecessary; the estimate can be generated from data collected during a traditional trapping and telemetry project.

Working Group Problems. The unhunted population working group was asked how to interpret data from three different population estimators (mark-recapture based on Petersen and Jolly-Seber equations, and radioisotope feces recapture), all of which showed somewhat different trends. The group felt that the three estimates could not be averaged in any way, but they could not agree on a single best estimate. Lack of geographic closure was evidenced by population changes that were not biologically realistic. Consequently, the group mistrusted the density estimates as well as the population trend information derived from these data.

The groups interpreting density estimates from the hunted population were given five years of data derived from a mark-recapture study that used transmitters to calculate bear equivalents and thereby account for lack of geographic closure. In two of the five years, however, more male equivalents were estimated to reside on the study area than females, which presumably was not representative of the statewide population. The groups were asked whether these findings would prohibit extrapolating the study results (which indicated a steady population increase) to a larger geographic area. This discrepancy was disturbing enough that both groups felt they could not extrapolate the results, but nevertheless they thought the study should be continued rather than abandoned. The skewed sex ratio on the study area seemed to be caused by highly male-biased births in some years (data not available to the groups), which may not have occurred statewide. Curiously, although the total study area population showed a clear increase, this trend was not apparent within each individual sex, making data interpretation equivocal.

Estimating Reproduction

Background and Conceptual Framework. The two most common means of obtaining reproductive information are from collecting reproductive tracts from harvested bears and visiting the dens of radio-collared cub-bearing females. Data from reproductive tracts tend to overestimate reproduction, because neither corpora lutea nor placental scars represent actual births. The number of eggs, blastocysts, or fetuses lost before parturition, or cubs lost directly after parturition cannot be determined from examination of reproductive tracts, and moreover, these losses likely vary both

temporally and geographically. Thus, 13 jurisdictions in North America rely on den visits to obtain more accurate reproductive data (Garshelis 1991).

The major problem with collecting reproductive data from den visits is the sample size constraint inherent in any telemetry study. Miller and Miller (1990) found that 10 marked females were inadequate to accurately estimate any reproductive parameters; some parameters required a sample of 25 females for 3 to 5 years, whereas estimating litter size required 50 females monitored for at least 6 years.

A more subtle problem regards the data analysis. In attempting to describe populations with as few parameters as possible, bear biologists commonly calculate statistics such as mean age of first reproduction, mean litter size, and mean interval between litters to quantify reproduction. When closely examined, these values appear rather simplistic.

A positive relationship between black bear litter size and both the age and weight of the mother has been well established (Rogers 1987, Alt 1989, Elowe and Dodge 1989, Kolenosky 1989). Thus, a good food year might boost litter size among older bears, but also could give rise to a high proportion of first-time mothers, each having a relatively small litter. Pooling these data might yield a "normal" mean litter size, which would be a misleading statistic since reproduction clearly increased. The dynamic nature of reproduction prompted Alt (1991), who undoubtedly has collected more bear reproductive information than anyone, to refuse to report an average litter size for Pennsylvania black bears, even when it was specifically requested. Possibly a more satisfying approach would be to present separate statistics by age group and year, although sample size would obviously suffer.

Average age of first reproduction also can be misleading. DeMaster (1978) presented a generalized method for calculating average age of reproduction from a sample of harvested animals, but problems will be encountered with this method if reproductive age varies by year, which is true for black bears. A more accurate estimate could be obtained from a sample of radio-marked individuals whose reproductive history was closely monitored; however, even in this case, significant biases may occur.

Consider the hypothetical case of 10 radio-marked females monitored over a period of up to 8 years (Figure 1). The first 2 females had their first cubs at 4, 1 gave birth again at 6, and 1 gave birth again at 7. The next 2 females gave birth at 5, 1 of which had cubs again at 7. Two other females had their first cubs at 6. The other 4 females died before they had cubs; 1 died at 4.5 years old, 2 at 5.5 years old, and 1 at 6.5 years old. What is the average age of first reproduction? Based on the observed cub births--2 litters at 4, 2 litters at 5, and 2 litters at 6--the average would appear to be 5 years old. However, the other 4 females, 3 of which clearly would have had cubs after age 5, were not included in this statistic.

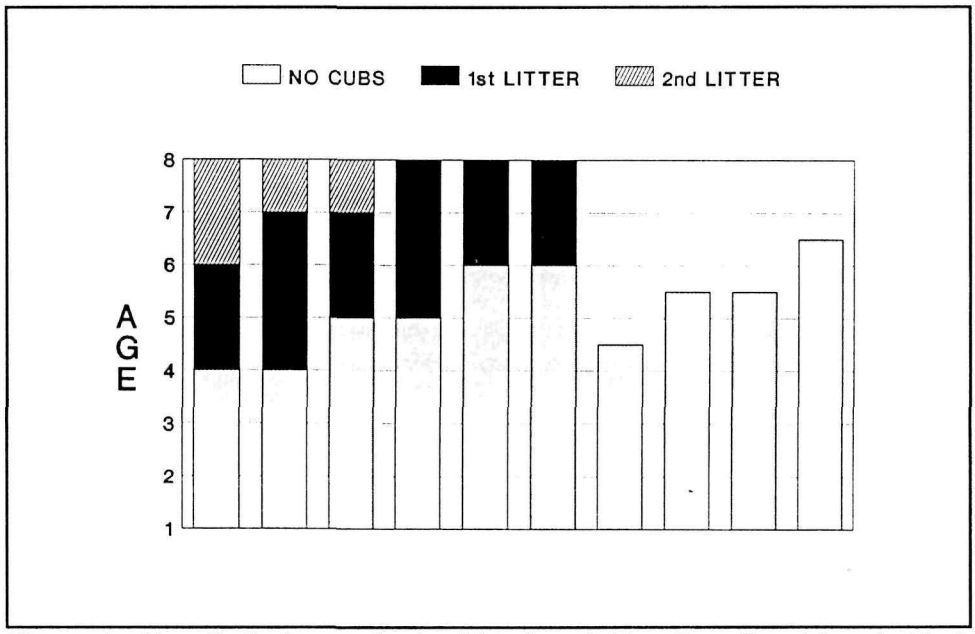

Figure 1. Hypothetical reproductive histories of 10 radio-collared female black bears.

Note: Calculated age of first reproduction is confounded by the death of 4 bears that had not yet had cubs (see text).

This situation is not an anomaly, but an inescapable consequence of bears dying during their reproductive years. Because of this situation, the mean age of reproduction will almost always be underestimated by simply averaging the ages of observed first births. An unbiased estimate could be obtained, however, if values were calculated for each age individually. In the example above: 2 of 10 bears (20%) had their first litter at 4 years old (note that this statistic includes all the bears that reached 4 years old but died before giving birth); 2 of 7 bears (29%) that did not give birth at 4 had cubs at 5; and 2 of 3 bears (67%) that did not previously have cubs had a litter at 6. To generate a single, overall expected age of first reproduction, these conditional probabilities for giving birth would have to be combined with probabilities for surviving to each age.

Unlike the calculation of reproductive age, the average interval between litters is not appreciably affected by bears dying, if virtually all bears produce cubs at 2- or 3-year intervals. If a mother dies within 2 years after the birth of her cubs (and before a second litter), she will not contribute to the calculation of reproductive interval. However, if she dies more than 2 years after a litter and did not give birth to a second litter, her reproductive interval can be regarded as at least 3 years. If few bears have 4-or-more-year intervals, then counting all these 3-and-over intervals as exactly 3 years will not bias the estimate much. Of course this reasoning is somewhat circular in that one is assuming that few bears have a 4-or-more-year interval, while at the same time trying to calculate that interval.

A common pitfall exists, however, in attempting to calculate the average interval between litters using reproductive data from a capture sample rather than by monitoring individuals. As an example, if one-third of the adult females captured were lactating, it might seem reasonable to assume the other two-thirds were in their off year(s), so the mean reproductive interval was 3 years (1/0.33). The problem is that some of the nonlactating individuals may not have had their first cubs yet. If, for simplicity, all the bears in the sample were 4-, 5-, and 6-year-olds, and two-thirds were not lactating but half of these had not yet had cubs, then this half should be discarded; the correctly calculated reproductive interval would therefore be 2 years (with the discards, half were lactating) instead of 3. An obvious problem in application is distinguishing the females that had not yet had cubs from those that were truly in an interval between litters. Nipple coloration and spacing of cementum annuli could be helpful in making this distinction (Garshelis et al. 1989, Coy and Garshelis 1992).

Working Group Problems. The unhunted population group was given data on the reproductive condition of captured females, which were used to calculate the age of first reproduction and the interval between litters. These calculations yielded a similar reproductive interval but a higher age of first reproduction than data derived from monitoring individual radio-collared animals through reproductive age. The group felt that the data from the collared bears were probably more accurate, although, as I discussed in the previous hypothetical example, the estimated age of first reproduction could have been biased low by deaths of reproductive-age animals. Reproductive interval would not be affected by this factor, possibly explaining why the two reproductive interval estimates were similar.

The unhunted population group also considered various ways of calculating litter size and concluded that they should first determine average litter size by age group and then average these averages, rather than either pooling all individuals or averaging mean lifetime litter sizes among individuals. The reasoning was that detection of yearly variation would be obscured by pooling all bears (because, as noted earlier, a large number of bears producing their first litter in good food years would reduce average litter size) or by obtaining lifetime averages for each individual. When asked whether it was better to monitor reproduction of a large sample for a short period of time, or a smaller sample for a longer period (given the same number of female-years of monitoring), the group chose the latter, again to be able to observe yearly variation. Significant yearly variation was observed in this population, with more cub births following autumns with good acorn production. When asked whether this relationship indicated that the population was naturally regulated, the group agreed that it showed some natural reproductive regulation, but population size still could have been regulated by human-related mortality factors.

The groups dealing with the hunted population discussed whether a year of exceptionally high human-caused mortality concomitant with a delayed age of first reproduction would cause an increasing population to decline. Both groups felt that these factors would cause a decline, and this interpretation may in fact be correct. However, the age of first reproduction does not alone determine recruitment. Even if litter size, interval between litters, and cub survival remained constant, reproductive output could still have increased if the age structure was such that a large number of females entered their reproductive years (regardless of their older than normal age). Furthermore, the difference between reproduction and mortality is what determines population growth--if this difference was still positive, despite a decline in reproduction, the population would continue to grow.

Estimating Mortality

Background and Conceptual Framework. Bear mortality rates are commonly calculated by the construction of a life table from the ages of dead bears. This approach is appealing, especially since the harvest age structure is known for many populations. Unfortunately, unless all bears (or a high percent) die as a result of hunting, the harvest age structure is not a good representation of the age at death. The age structure is also probably biased by hunter selectivity and age-differing vulnerabilities, so it is not a good reflection of the age of the living population either. Trapping also does not typically yield an unbiased sample of the living population. These problems greatly hamper constructing a reliable life table. Furthermore, even if one could collect some reasonably unbiased sample of ages at death or ages in the living population, the stringent life table assumptions (e.g., stable age structure, constant and equal rates of birth and death, or known rate of population change) are generally prohibitive for black bears.

Less restrictive estimates of mortality can be obtained by monitoring radio-marked animals until they die. Procedures refined by Heisey and Fuller (1985) and Pollock et al. (1989) use a statistic based on transmitter-days until death to calculate sex-, age-, and cause-specific rates of mortality, including confidence intervals. However, these estimates are sensitive to misclassifications of long-distance dispersals or expired radio transmitters as deaths (or vice versa). If contact with a transmitter is lost but the fate of the animal is not identified, one mortality rate must be calculated assuming the disappearance represented death, and another must be calculated considering the lost contact was due to some other cause. As the number of unknown disappearances increases, the gap between these estimates broadens, and the likelihood of distinguishing differences in mortality rates among sex-age groups or across years decreases.

Even without the problem of unknown disappearances, survival estimates based on transmitter-days tend to have large confidence intervals for sample sizes typical of most black bear studies. In a hypothetical case where 10 of 30 radio-collared males and 5 of 30 radio-collared females died, survival estimates calculated from the Heisey and Fuller (1985) approach seem different (68% for males versus 84% for females), but the confidence intervals greatly overlap (Figure 2). A sample of about 120 bears of each sex would be necessary to obtain nonoverlapping confidence intervals (although statistically significant differences between the sexes would be obtained with samples of "only" 60 bears of each sex). Schwartz and Franzmann (1991) had reasonably large samples of radio-marked bears but were unable to detect statistically significant differences in survival between sexes, ages, or study areas. Clearly, a study specifically aimed at obtaining accurate estimates of mortality would require an uncommonly large sample of radio-collared bears.

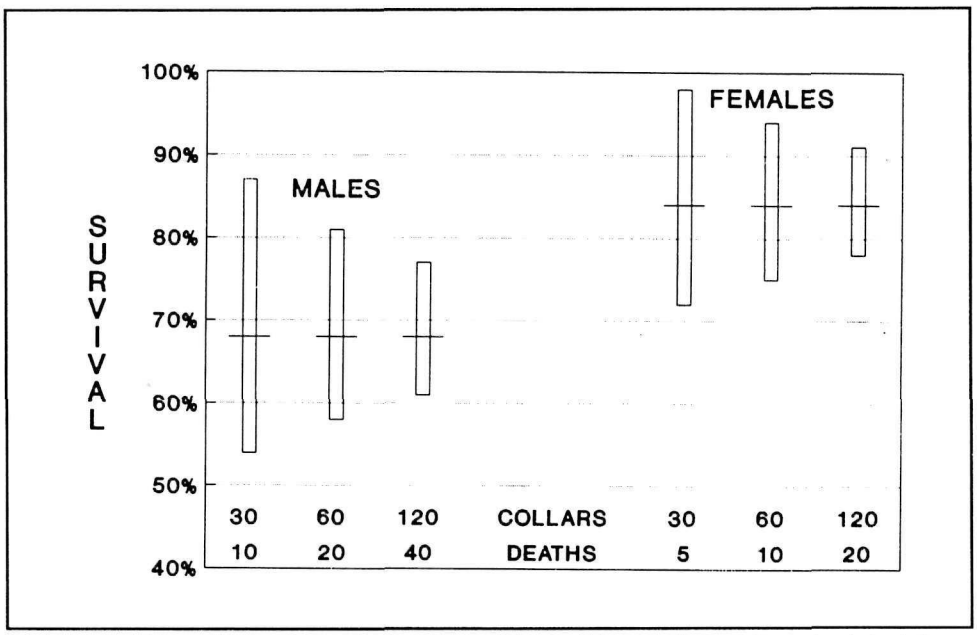

Figure 2. Hypothetical survival rates and confidence intervals calculated from deaths of radio-collared bears, using the approach of Heisey and Fuller (1985).

Note: A typically large samples are needed to obtain reasonably sized confidence intervals.

Working Group Problems. Mortality data for the unhunted population consisted of a tabulation of ear-tagged bears found dead or reported killed by hunters. Hunter kills composed 80% of the recovered bears tagged outside the park compared to only 56% of those tagged within the park. However, a much smaller percent of tagged bears from within the park were found or reported dead (9%), compared to bears tagged outside the park (29%). The group concluded that these data suggested a lower rate of mortality, especially human-inflicted mortality, for bears tagged within the park. Conversely, a life table analysis indicated only slightly lower mortality rates for bears from within the park, implying that nonhunting mortality, possibly including poaching, was much higher for park bears (but these animals were simply not recovered). Determining the validity of the life table mortality estimates, however, was not possible. The group commented on the importance of obtaining better estimates of mortality rates, not just relative causes of mortality, using data from radio-collared bears.

Mortality rates based on transmitter-days were available for the hunted population. The 1990 rates for both males and females were higher than the average sex-specific rates for the previous eight years, although neither the ranges nor confidence intervals were given. The group nevertheless believed that the difference between the point estimates was sufficient to conclude that mortality had indeed increased. When faced with suggestive data that is not necessarily statistically significant, managers of bear populations are inclined, and I think justly so, to tolerate overly conservative management rather than risk overharvest while trying to obtain better data.

Lessons from Working Group Exercises

The group dealing with the unhunted population anticipated that mark-recapture estimates and trend indicators like bait station visitation and total harvest outside the park would be most useful in monitoring population size and effects from humans. However, after analyzing these data, the group found them frustratingly ambiguous. Considering the data presented on reproduction, mortality, sex-age composition, and population trends, only the reproductive data were considered acceptably reliable.

The two groups discussing data from the hunted population both anticipated that mark-recapture estimates and reproductive and mortality data would be important in their assessment; one of these groups also had high expectations for information on hunting success. By the end of the exercise, one group considered all the data sets ambiguous, although they still thought the estimates of density, reproduction, and mortality were most useful. The other group viewed the data sets more positively, but they shared the first group's opinion that determining whether the population was increasing, decreasing, or stable was not possible because interpretations of the various data sets were contradictory.

None of the participants of the groups dealing with the hunted population anticipated computer modeling to be useful for assessing population status. Modeling results presented in the exercise indicated that the population was likely to be numerically stable or increasing (declining population trajectories eliminated entire age classes, and so were considered improbable). One group viewed these results skeptically and maintained that models such as the one used were of little value because of their potential sensitivity to erroneous parameter estimates. The other group, however, felt the model results were important, and by the end of the exercise rated these results among the most useful for determining population status.

A principal objective of the exercise was to encourage critical evaluation of real data. In some cases participants indicated that more definitive decisions could have been achieved if more detailed information was provided. Sometimes this information was available but left out for the sake of brevity. In most cases, however, difficulties encountered in trying to interpret the results of various analyses were intrinsic to the data, rather than attributable to missing data.

Probably the foremost conclusion from this exercise was that even our best data on population status tend to be largely ambiguous. The two data sets chosen for the exercise were from long-term monitoring projects with many facets of investigation. They were selected as representative of best-case scenarios, not data sets with obvious flaws, and yet participants of the workshop had little difficulty finding flaws. Even more disconcerting, however, was that the groups were able to generate few recommendations for improved population monitoring.

Arguably, in real-life situations managers base their decisions on more than just a bunch of tables and graphs. In fact, judging the value of results like those presented in this exercise without the context of on-site experience may be unfair. As I noted previously (Garshelis 1991), bear management is as much an art as it is a science. Managers become experts through experience and are sometimes able to see more in the numbers than an "objective" observer. Such management by experience may explain why most black bear populations across North America appear to be in

pretty good shape (Garshelis 1991), despite what are evidently profound weaknesses in our monitoring procedures.

In Minnesota, where black bear management decisions are made by a committee of managers, conservation officers, and researchers, "hard numbers" are often weighed against contradictory "gut feelings," and the final decision is commonly a compromise. By presenting the Minnesota data to two groups of objective outsiders at this workshop, I had hoped to gain some fresh insights. Notably, both groups highlighted many of the shortcomings in the data that I was already aware of. However, one group concluded that if faced with this situation they would reduce hunting pressure (which is controlled through a quota on license sales), whereas the other group indicated that they would maintain it at the same level. Ironically, a few months before this workshop the Minnesota bear management committee unanimously decided to increase the harvest.

Obviously, the same data set can be interpreted in many ways. Consequently, management decisions may not only be difficult to make but evaluating these decisions in hindsight may be equally difficult because it is rarely possible to identify the specific sources of mistakes. Thus, we should periodically stand back and scrutinize our methods and at least become more aware of their pitfalls. That, of course, was the purpose and essence of this session of the workshop. I hope that highlighting these problems prompts a renewed effort to dig more deeply for solutions.

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