

TIME-LAPSE CAMERAS AS AN AID IN STUDYING GRIZZLY BEARS IN NORTHWEST WYOMING

RONALD E. BALL, Alaska Department of Fish and Game, P.O. Box 68, Yakutat 99689¹

Abstract: Time-lapse cameras were effective for gathering limited distribution and population data on grizzly bears (*Ursus arctos*) and black bears (*Ursus americanus*) in northwest Wyoming. Thirty-six stations, each consisting of a camera and a lure, were monitored for 551 camera-days; 83 rolls of film were exposed. Five different lures were tested. Thirty-one bears (5 grizzly, 25 black, 1 unknown bear) were identified at 15 stations. Young:adult and young:female ratios observed (0.4 and 1.5 for black bears and 0.7 and 2.0 for grizzlies) corresponded well with those of other researchers in the region. One sighting recorded on film extended the known range of the grizzly bear in the Shoshone National Forest.

Effective management of wildlife populations requires knowledge of distribution, abundance, and composition. Numerous methods have been used to collect these data, but none has proven completely satisfactory when applied to black bear and grizzly bear populations. Harvest information does not always give a true representation of a population's age structure or sex ratio. In Michigan, Erickson et al. (1964:84-87) found that hunters reported a larger segment of the bear population to be males than was verified by the study personnel. Sex ratios of captured bears have varied from the expected 1:1 and these variations have been attributed to the method of capture. Poelker and Hartwell (1973:124) found that trapping gave the highest proportion of males, dog hunting was selective for females, and still hunting showed no selectivity.

The use of tracks in estimating bear populations (Spencer 1955, Edwards and Green 1959, Klein 1959) was affected by many variables such as berry production and abundance of salmon and other preferred foods. Aerial censuses were affected by time of day, wind velocity, and abundance of vegetation, but were considered valid when used in conjunction with hunter-caused mortality, and direct and sign observations (Erickson and Siniff 1963; Knight et al. 1975:11-13, 1976:7-9). Direct observations at dumps, roadsides, bait stations, and streambanks have been used to gather information on population dynamics (Hornocker 1962, Troyer and Hensel 1964, Barnes and Bray 1967, Jonkel 1967, Craighead et al. 1974). Researchers used marked individual bears and computed total numbers by using the Peterson Index and the Schnabel method (Schnabel 1938).

This paper described and evaluates the adaptation of a

time-lapse camera system (Diem et al. 1973) for monitoring grizzly and black bear populations in northwest Wyoming. Impetus for the study was the need for base-line data from Wyoming for the Interagency Grizzly Bear Study being conducted in Yellowstone National Park and the surrounding areas in Wyoming, Montana, and Idaho. The objective of the study reported in this paper was to provide data on distribution, abundance, and age-classes of grizzly and black bears as a means of evaluating the potential usefulness of the camera system in bear population studies.

I wish to thank the personnel of the Wyoming Game and Fish Department for supplying cameras and equipment and for their valued assistance throughout the study. I also appreciate the assistance obtained through the Department of Zoology and Physiology, University of Wyoming, Laramie. R. Hede provided valuable field assistance during the 1976 field season, and the U.S. Fish and Wildlife Service, Wildlife Research Center, Denver, Colorado, supplied several of the lures used during the study.

STUDY AREA

The study area included approximately 2,800 km² in northwestern Wyoming (Fig. 1). The area is rugged and mountainous, with large ranges of exposed basaltic rock interspersed with meadows and dense coniferous forests. Elevations range from 1,400 m near Cody, Wyoming, to 3,680 m at the summit of Fortress Mountain. Seventy percent of the area is roadless wilderness and travel was by horseback or foot.

METHODS

Fourteen automatic super-8 time-lapse cameras, as described by Diem et al. (1973), were used to monitor 36 stations at various elevations and in various habitat types from 3 July to 21 October 1975 and from 3 June to 14 September 1976 (Fig. 1). The system incorporated an intervalometer circuit that functioned as a light

¹This study was completed while the author was a temporary employee of the Wyoming Game and Fish Department and a graduate student in the Department of Zoology and Physiology, University of Wyoming, Laramie 82071.

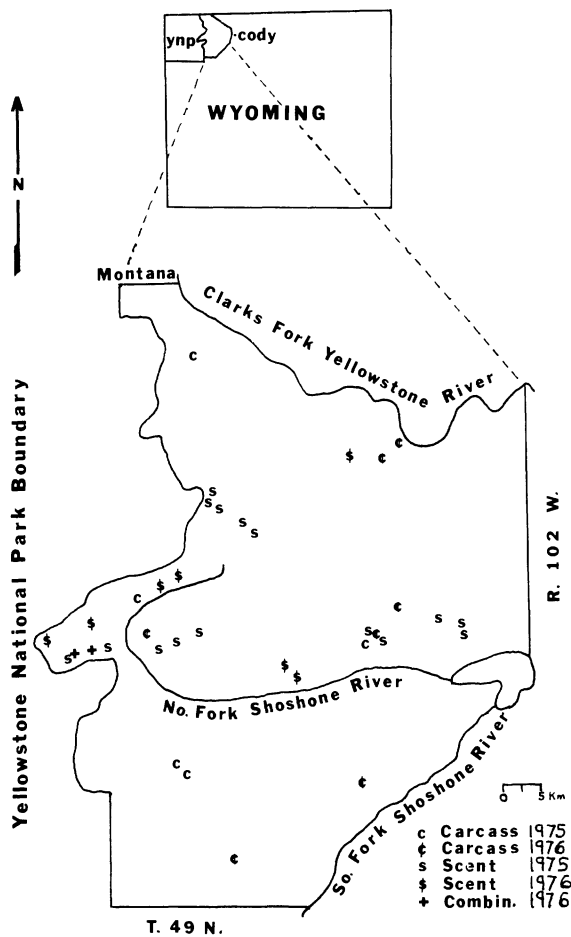


Fig. 1. Map of study area, Wyoming location map, and locations of camera/bait stations for bears.

activation-timer, pulse generator, and electric switch. A photosensor activated the camera at dawn and turned it off at night.

The cameras were equipped with zoom lenses, allowing the horizontal field of view to be varied with the type of lure monitored. Fields of view ranged from 8 m for scent and combination stations to 15 m for carcass stations. Cameras were positioned facing north or south to reduce glare, and most were fitted with a sunshade over the front of the camera box. The stations, each consisting of 1 camera and a lure, were located in areas of known or suspected grizzly bear range. The lures were placed a minimum of 150 m from major trails to reduce human disturbance, with the camera box mounted to a nearby tree with large eyebolts, nylon webbing, and a chain for security.

Preliminary investigations showed Kodak Ektachrome film (ASA 160) produced the best picture quality

and resolution. Film was advanced at 1 frame/2 minutes at all stations in 1975, but to compensate for the reduced time that the bears spent at nonconsumable baits, film speed was increased to 1 frame/1.5 minutes at all stations except carcass baits, which remained at 1 frame/2 minutes.

Three categories of lures were used: scents (nonconsumable), carcasses (consumable), and combination lures (scent and carcass). Except for 1 winter-killed elk (*Cervus canadensis*) used in spring 1976, the monitored carcasses were horse baits put out by big game outfitters or hunters to lure black bears. The scents that were used would lure bears into the area but would not provide a major source of food. Thus, bears would visit the area and then move on. The scents used were fish and chicken (FC), synthetic fermented egg (SFE), putrid fish (PF), pheromone, and estrous grizzly bear urine (EGBU). Two to 3 kg of FC were placed in a burlap sack and suspended between 2 trees at a height of 3 m. Cans of sardines were nailed to the trees or dry dog food was spread below the baits to help keep bears within the field of view long enough to be photographed.

In 1976, this technique was modified to use concentrated scents. Surplus metal 7.62-mm ammunition cans held and protected the lures. The cans were perforated on 4 sides with holes 7-10 mm in diameter spaced about 2 cm apart to allow the scent to escape. Liquid baits were poured over absorbent paper placed loosely in the cans, and solid lures were sprinkled into cans without paper. For each lure station, 250 ml of PF or EGBU, 15-20 of pheromone, or 12-15 g of SFE were used. Cans were tied to trees and their contents replenished every 14 days.

The formula used for the PF was modified from Taber and Cowan (1971). Water was added to the rotten fish to prolong its liquid state because volatility was lost as the mixture solidified from evaporation. The SFE and the formula for the pheromone lure were supplied by the U.S. Fish and Wildlife Service, Wildlife Research Center, Denver, Colorado. Estrous grizzly bear urine was obtained from 2 adult females in captivity at the Denver Zoo, Denver, Colorado.

Film exposed during the study was analyzed in 2 stages. Preliminary analysis was done with a manually operated film editor (Argus, Model 2804). A Bell and Howell multimotion projector (Model 1623Z) was used for final editing. Bears photographed were identified as to species, and distinguishing features (natural markings, size, family groups) that might enable individual recognition were noted. When a bear could not be recognized as a new individual, the visit was considered a

return and the bear was not added to the total number identified.

RESULTS.

Stations were monitored for 551 camera-days (1 camera at a site for 1 daylight period), exposing 83 rolls of film. At carcass stations, the 1 frame/2 minutes interval supplied at sufficient number of photos to identify the bear. A standard 15-m roll of film lasted up to 7 camera-days, depending on day length. This same interval was inefficient at scent stations in 1975. It provided enough photographs for positive species identification of only 4 of 5 bears. When trying to determine distribution and population dynamics of a particular species of bear, this 20 percent rate of failure could greatly affect the results of the study. The more efficient 1 frame/1.5 minutes interval used at scent or combination stations in 1976 used a 15-m roll of film in about 5 camera-days.

Thirty-one potentially different bears (5 grizzly, 25 black, 1 unknown bear) were identified at 15 stations. None of the identified bears was recognized at more than 1 station; however, all were unmarked, and thus a bear could have visited more than 1 lure station without being recognized as the same individual. At several stations, the same bear was identified returning to the site.

Although the sample size was small, the young:adult and young:female ratios recorded on film (0.7 and 2.0 for grizzly and 0.4 and 1.5 for black bears) (Table 1)

Table 1. Young:adult and young:female ratios of bears photographed in northwest Wyoming, 1975 and 1976.

Year	Species	Females with subadults	Females with cubs	Other adults	Young: adult	Young: female
1975	Black	-	-	5	0	0
1976	Black	-	4:6	11	0.40	1.5
1976	Grizzly	1:2	-	2	0.67	2.0
1975-76	Both	1:2	4:6	18	0.35	1.6

compared favorably with the results obtained by Roop (1976) from grizzly bear sightings and sign records in northwest Wyoming and by Barnes and Bray (1967:144) for black bears in Yellowstone National Park.

The small number of bears photographed in 1975 (4 black, 1 unknown) corresponds well with the reduced number of bears observed by Knight et al. (1976:15) and Roop (1976:4) using aerial censuses, backcountry observations, and time-lapse cameras. Knight et al. (1976:15) attributed the below-average number of observations, relative to the 2 preceding years, to lush vegetation and an abundance of natural foods, induced

by a wet spring and early summer. Since bears concentrate in areas with succulent vegetation (Mealey 1975:119), the widespread availability of vegetation throughout the summer probably enabled bears to find abundant forage without resorting to carrion.

Carcass Stations

Baits were monitored for 157 camera-days exposing 20 rolls of film. Eight bears were identified, 1 grizzly and 7 blacks. No bears were photographed near the 5 carcasses monitored in 1975, although 3 were visited by bears. In 1976, bears were photographed at 4 of the 7 stations monitored.

No interspecific or intraspecific interactions were observed at any of the stations. This lack of direct competition for carcasses conflicts with the observations of Barnes and Bray (1967:83-89) and may relate to the abundance and availability of preferred vegetable foods (Tisch 1961, Mealey 1975). Knight et al. (1976) stated that observations from time-lapse cameras used by the Interagency Grizzly Bear Study Team indicated that some bears prefer succulent herbage to carrion. An investigation of black bear hunter success on my study area showed that many baits remained untouched by bears even in areas known to support high bear populations.

In 1976, a single grizzly was photographed feeding at station 22. This bear is believed to be 1 of a group of 3 bears, a female and 2 subadults, observed at the carcass by a hunter 3 days before the camera was installed, and represents an extension of the known range of the grizzly bear in northwest Wyoming.

Scent Stations

A total of 22 scent stations (Fig. 1) were monitored for 313 camera-days exposing 48 rolls of film. Fifteen bears (4 grizzly, 10 black, 1 unknown bear) were identified at 10 stations.

In 1975, 5 bears (4 black, 1 unknown bear) were photographed in 7 visits. Two of the cameras were disturbed by bears without the bears being photographed. Claw marks and hair confirmed that bears were responsible for the disturbances. Seven scent stations were monitored in 1976, with bear activity recorded at 5 locations. Ten bears (4 grizzly, 6 black) were identified from 19 rolls of exposed film.

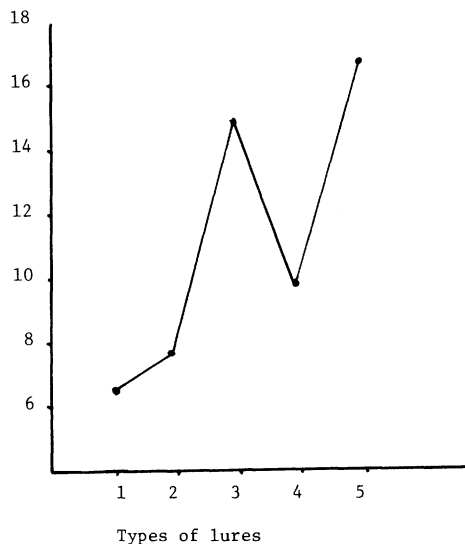
The cool temperatures in 1975, especially at higher elevations, slowed, and sometimes prevented, putrefaction of the FC bait. Bears probably were not attracted to some stations because the lures were not odorous. Therefore, scents used during 1976 were odorous by

design, eliminating the problem of delayed putrefaction. The use of concentrated lures also solved another problem. It was very difficult to prevent bears from tearing down the FC bait and eating it, thus making it unavailable to attract other bears. By changing to concentrated lures and placing them in sealed containers, this problem was eliminated.

Combination Stations

Two stations using a combination of a scent and a carcass as a lure were monitored for 82 camera-days in 1976, exposing 15 rolls of film. One objective of using a combination lure was to conduct a further test of the attracting power of the various concentrated scents by trying to enhance an already existing lure. The results were inconclusive, although 4 bears were observed at each station. At 1 stations, bears had almost totally consumed the carcass by the time the camera and lure were put into position. Bears continued to come to the station and investigate the lure even after the carcass was completely consumed. At the second station, bears had not used the carcass before installation of the lure and camera and did not begin coming to the station until the 32nd day of monitoring.

The mean number of days until a station was first visited by a bear was calculated for the various types of lures (Fig. 2) to determine which scent had the greatest



1	Fish and chicken	(6.5)
2	Putrid fish	(7.8)
3	Pheromone	(15.5)
4	Pheromone and horse	(9.9)
5	Synthetic fermented egg and horse	(16.5)

Fig. 2. Mean number of days until the first visit by a bear for 5 different types of lure, northwest Wyoming, 1975 and 1976.

attracting power and whether prebaiting could increase film economy. Because all carcass baits were in place for at least 1 week before monitoring began, and most had already been visited by bears, they were not included in the calculations. Data indicated that (1) scents most closely representing a natural food source (FC and PF) attracted bears most rapidly, and (2) film economy could be increased by prebaiting a station for 1 week (shortest \bar{X} time, 6.5 days) before activating the camera. PF was the only nonconsumable lure at which grizzlies were photographed.

DISCUSSION AND RECOMMENDATIONS

The time-lapse camera system had several merits. It eliminated the need for numerous trained observers to monitor lure stations and allowed me, in effect, to be in several places at once by providing a permanent film record of concurrent bear activity at different stations. This permanent record is especially valuable at times when a particular sighting has special significance (i.e., a range extension), because it can be examined repeatedly for verification by other viewers.

Although limited in quantity, the system can supply data about population distribution and abundance that have value when used to augment more traditional methods of survey and inventory. It can probably be used most efficiently to monitor stations in habitat types such as dense timber or heavy brush, which restrict the use of other survey methods.

Lures

None of the lures was particularly successful in attracting bears, especially during midsummer to late summer, when amply vegetable foods were available. Since carrion and those lures that represented carrion were the most efficient, maximum advantage can be achieved by monitoring carcasses and bait stations in early spring, before large quantities of vegetation are available. The system can be used throughout the summer but decreased use of the stations can be expected. To maximize efficiency, stations should be prebaited for at least 1 week or until the site shows signs of being used. A bear will often return to a site where it has obtained food, at which time it can be recorded on film.

Some bear activity was missed because the cameras did not operate at night. The exact amount is undeterminable, but the loss appears to be minimal. Usually, close examination of the station and the surrounding area will reveal that a bear was at the site, and often the film will show that the bait has been disturbed and on what night the disturbance occurred. Bear activity was as-

sumed whenever the position of a carcass bait was shifted more than slightly or large quantities were consumed in a short time.

Study Area

To prevent loss of data, the study area should be small enough to allow the film to be replaced as soon as exhausted.

Using the cameras in conjunction with a marked population sample would reduce the need to rely upon natural markings or characteristics to identify individual animals and would provide more information on popu-

lation numbers, since a capture-recapture technique could be used for analysis.

Film Speed

The film advance speed used to monitor a station should be determined and tested prior to the initiation of the study to insure that a sufficient number of photographs will be obtained. For most studies, 1 frame/1.5 minutes may be a good starting speed because, although it is a fairly rapid cycle, it provides some film economy. Cartridge jamming can be reduced by advancing the film 25-30 frames manually when it is first placed in the camera.

LITERATURE CITED

- BARNES, V. G., Jr., AND O. E. BRAY. 1967. Population characteristics and activities of black bears in Yellowstone National Park. Colorado Coop. Wildl. Res. Unit, Colorado State Univ., Fort Collins. 199pp.
- CRAIGHEAD, J. J., J. R. VARNEY, AND F. C. CRAIGHEAD, Jr. 1974. A population analysis of the Yellowstone grizzly bears. Montana For. and Conserv. Exp. Stn. Bull. 40. 20pp.
- DIEM, K. L., A. L. WARD, AND J. L. CUPAL. 1973. Cameras as remote sensors of animal activities. Proc. Int. Congr. Game Biol. 11.
- EDWARDS, R. Y., AND D. E. GREEN. 1959. The measurement of tracks to census grizzly bears. Murrelet 40(2):14-16.
- ERICKSON, A. W., AND D. B. SINIFF. 1963. A statistical evaluation of factors influencing aerial survey results of brown bears. Trans. N. Am. Wildl. Conf. 28:391-409.
- _____, J. NELLOR, AND G. A. PETRIDES. 1964. The black bear in Michigan. Michigan State Univ. Agric. Exp. Stn. Res. Bull. 4. 102pp.
- HORNOCKER, M. G. 1962. Population characteristics and social and reproductive behavior of the grizzly bear in Yellowstone National Park. M.S. Thesis. Montana State Univ., Missoula. 94pp.
- JONKEL, C. J. 1967. The ecology, population dynamics and management of the black bear in the spruce-fir forest of northwestern Montana. Ph.D. Thesis. Univ. of British Columbia, Vancouver. 148pp.
- KLEIN, D. R. 1959. Track differentiation for censusing bear populations. J. Wildl. Manage. 23(3):361-363.
- KNIGHT, R., J. BASILE, K. GREER, S. JUDD, L. OLDENBURG, AND L. ROOP. 1975. Annual report, Interagency Grizzly bear Study 1974. Interagency Grizzly Bear Study Team, Bozeman, Montana. 44pp.
- _____, _____, _____, _____, _____, and _____. 1976. Yellowstone grizzly bear investigation: annual report of the Interagency Grizzly Bear Study Team 1975. U.S. Dept. of Interior Natl. Park Serv. Misc. Rep. 9. 46pp.
- MARTINKA, C. J. 1971. Status and management of grizzly bears in Glacier National Park, Montana. Trans. N. Am. Wildl. Conf. 36:312-322.
- MEALEY, S. P. 1975. The natural food habits of free ranging grizzly bears in Yellowstone National park, 1973-1974. M.S. Thesis. Montana State Univ., Bozeman. 158pp.
- POELKER, R. J., AND H. D. HARTWELL. 1973. Black bear of Washington. Washington State Game Dept. Biol. Bull. 14. 180pp.
- ROOP, L. 1976. Grizzly bear. Wyoming Game and Fish Dept. Fed. Aid in Wildl. Restor. Job Prog. Rep., Proj. W-87-R-2.
- SCHNABEL, Z. E. 1938. The estimation of the total fish population of a lake. Am. Math. Monthly 45(6):348-352.
- SPENCER, H. E., Jr. 1955. The black bear and its status in Maine. Maine Dept. Inland Fish. Game, Game Div. Bull. 4. 55pp.
- TABER, R. D., AND I. McT. COWAN. 1971. Capturing and marking wild animals. Pages 277-317 in R. H. Giles, ed. Wildlife management techniques. The Wildlife Society, Washington, D.C.
- TISCH, E. L. 1961. Seasonal food habits of the black bear in the Whitefish Range of northwestern Montana. M.S. Thesis. Montana State Univ., Missoula. 108pp.
- TROYER, W. A., AND R. J. HENSEL. 1964. Structure and distribution of a Kodiak bear population. J. Wildl. Manage. 28(4):769-772.