**SUPPORTING INFORMATION**

**Supporting information A. GRIZZLY BEAR CAPTURE INFORMATION**

Culvert traps are metal enclosures that bears are baited into with meat or fruit. Leg restraints are made of 1/4 inch wire rope formed into a loop with a one-way locking mechanism (Flaa et al. 2009). Leg restraints are deployed on a bear when the animal triggers an Aldrich spring, which fastens the restraint around the animal’s wrist. We monitored culvert traps and leg restraints with cellular remote cameras so that crews could respond immediately—during daylight hours—to release a captured bear and reduce any impacts of prolonged restraint on the animal.

Grizzly bears were anaesthetized using Telazol (8-10 mg/kg) or a combination of Telazol (3.1 mg/kg) and Xylazine (2.4 mg/kg) (Cattet et al. 2003), delivered intramuscularly from either a Daninject or PneuDart dart gun. The effects of the Xylazine were reversed with Atipamezole (0.2 mg/kg) once handling was finished (usually about 45-60 minutes after immobilization) and the animal had been placed in a secure location and position. All animals were blindfolded during handling.

Once anaesthetized, capture crews affixed a telemetry collar and ear tags. During handling, animals were given supplementary oxygen and temperatures were monitored. If any signs of distress were noted—such as body temperatures outside 36-40 °C or poor respiration—animals were given reversal for the Xylazine that inhibits thermoregualtion. Individual measurements included weight, length, chest girth, zygomatic width and length, and body fat which was collected using body impedance analysis (Farley and Robbins 1994). A large clump of guard hairs was collected from the shoulder for genetic-derived individual and family relatedness identification (Wildlife Genetics International, Nelson, British Columbia) and future diet analysis, a premolar tooth was extracted to determine age through cementum analysis (Matson’s Lab, Milltown, Montana), and a tissue sample was collected via biopsy punch in the ear, creating a small hole where we inserted an ear tag. Round, black ear tags of 1” radius with unique numbers were applied to each ear. For animals that were at least 1.5 years old, GPS satellite collars were fitted around the neck.

Table S1. Capture-related measurements and sample sizes for each grizzly bear sex and age class collected between 2016-2022. Weights are in kilograms, lengths and circumferences are in centimeters, and fat is % body weight. Management signifies how many of the captures were done by conservation officers in response to conflicts.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sex | Ageclass | Individuals | Captures | Management | Age | Weight | Fat | Neck | Chest | Length |
| F | Dependent (0-1) | 4 | 4 | 2 | 0 (0-1) | 34 (34-34) | - | - | - | - |
| F | Subadult (2-6) | 18 | 23 | 4 | 4 (2-6) | 95 (46-130) | 24 (5-34) | 54 (43-61) | 94 (82-108) | 143 (118-155) |
| F | Adult (>6) | 20 | 30 | 1 | 11 (7-20) | 125 (84-163) | 25 (16-39) | 59 (48-68) | 100 (86-117) | 149 (130-162) |
| M | Dependent (0-1) | 4 | 5 | 0 | 1 (0-1) | 59 (30-83) | 35 (35-35) | 42 (36-48) | 72 (60-84) | 112 (96-128) |
| M | Subadult (2-6) | 17 | 21 | 3 | 4 (2-6) | 112 (76-156) | 23 (6-30) | 56 (48-67) | 96 (86-111) | 146 (128-170) |
| M | Adult (>6) | 17 | 27 | 2 | 12 (7-27) | 210 (139-269) | 26 (16-39) | 75 (61-86) | 121 (104-136) | 172 (154-183) |

**Supporting information B. SUPPLEMENTAL FIGURES**

Map

Description automatically generated

Figure S1. Study area extents. Larger unshaded area is the Elk Valley study area defined by 99% UD of telemetry data. Home range centers of collared bears shown as dots. Shaded is the study area used for genetic capture-recapture, which focuses on home range centers only. The genetic capture recapture study area was created with an interior 5 km buffer on the Elk Valley study area and meant to include only home range centers of bears within the Elk Valley study area.

A picture containing text, stationary

Description automatically generated

Figure S2. Reproduction observations for each age class of female. Sample sizes (n females) shown for each age and group.

**Supporting information C. SENSITIVITY OF CUB SIGHTING TIMING**

We estimate reproduction using cub observations mostly from the spring, but also some opportunistic sightings throughout the year. However, this could possibly reproduction low if cubs are lost before we observe them. To address this concern, we re-ran the analysis using only observations from the spring (April-June).

The original estimates with all the data included were as follows: Annual survival of dependent young, 0-1 years old, was 0.73 (90% CI: 0.61-0.83) for both sexes combined. Annual reproduction (female cubs/female/year) by females aged 5-6 was 0.15 (90% CI: 0.00- 0.31), and 0.24 (90% CI: 0.15-0.33) for females over 6 years old.

Filtering the data to spring only, the results changed as follows: Annual survival of dependent young, 0-1 years old, was 0.80 (90% CI: 0.60-0.93) for both sexes combined. Annual reproduction (female cubs/female/year) by females aged 5-6 was 0 (90% CI: 0.00-0.00), and 0.23 (90% CI: 0.13-0.33) for females over 6 years old.

In the end there was little effect on lambda, which originally was 0.94 (90% CI: 0.86-1.01), with 93% of bootstrapped estimates <1, and with spring-only data is 0.94 (90% CI 0.86-1.01) with **91**% of bootstrapped estimates <1. The only notable change with this level of rounding is that originally 93% of bootstrapped estimates were <1 and with spring only 91% are <1.

Due to the lambda results not being sensitive to including all data and not just spring-only, we have opted to keep the analysis as is. The results are the same either way, but we felt it important to include the data that did acknowledge 5- and 6-year-olds can reproduce, thus retaining the “all data” approach.

**Supporting information D: ESTIMATING UNREPORTED MORTALITY**

**Capture, handling, and collaring**

Grizzly bears were captured using multiple methods throughout their active season (April to November) between 2016 and 2022. Some bears were darted from a helicopter, but this method was not viable in all portions of the study area due to human settlement in the valley bottom. In more human-dominated areas, we captured bears in culvert traps and leg-restraining snares, which allowed us to choose captures sites based on safety concerns. Our capture effort was primarily directed toward the valley bottom and tributaries of the Elk Valley and therefore our inference primarily pertains to the areas that correspond to the clusters of telemetry locations (Figure 1).

Bears involved in human-wildlife conflict were sometimes captured by members of the British Columbia Conservation Officer Service (COS). When their capture did not end in euthanasia, we often collared these animals and included them in our sample. Although other studies have separated the demography of conflict bears from the study population, at least until a conflict bear is captured in a research trap and becomes a research animal for the rest of its life (Schwartz et al. 2006), we chose to pool all captured animals together. Unlike other studies that captured bears across large areas, both near and far from human settlements, our study focussed on bears in human-dominated landscapes and thus all the bears in our sample were at least potentially conflict animals. None of the bears first captured by the COS died while collared so their inclusion did not appear to bias our sample.

We used Vectronic VERTEX Lite collars (VECTRONIC Aerospace, Berlin, Germany) and Followit Geos collars (Followit AB, Lindesberg, Sweden), each of which took between 1 and 12 relocations a day and was equipped with a VHF beacon for real time manual locating of individuals. All collars were fitted with a cotton belt break away of varying thickness that was designed to rot within 1-5 years. In addition to the cotton belt break away, most collars were equipped with a remote blow off within the collar that was pre-programmed to activate within 2-4 years (depending on the bear’s age) that could also be activated remotely by satellite at any time. We provide additional details on traps, drug information, and handling procedures in Supporting Information A.

**Supporting information D: ESTIMATING UNREPORTED MORTALITY**

For the second method, hereafter called the “CI ratio” method, we replicated the approach of McLellan et al. (2018) and compared the number of bears killed by COS to the number killed by other sources, both for bears wearing functioning radiocollars and for uncollared bears recorded in the CI database. This second approach assumes all mortalities that involve a Conservation Officer are recorded, which is reasonable because Conservation Officers do extensive reporting on each conflict, especially when it results in a mortality, and all mortalities are required to be recorded in the Compulsory Inspection database. To calculate the underreporting rate using the CI ratio method, we first estimated the number of grizzlies killed by human causes but not reported in the CI database (*HCunreported, eq.1*), where *COSci* is the number of bears killed by COS in the CI data, *HCci* is the number of non-COS human-caused kills in the CI database, *COS* is the number of collared bears killed by COS, and *HC* is the number of collared bears killed by non-COS human causes.

Eq.1 Estimating unreported mortality using the Compulsory Inspection method from McLellan et al. (2018)

To get an underreporting rate, we divided *HCunreported* by the sum of *HCunreported* plus *HCci*.

For the third method, hereafter called the “ear tag ratio” method, we took the ratio of animals with functioning radiocollars killed by COS to those killed by other human sources (described in the CI ratio method above) and compared it to the ratio expected based on returned ear tags. We ear-tagged 76 individual bears, but at any one time only 10-20 bears had functioning radiocollars. Some ear-tagged bears died, but there were many uncollared ear-tagged bears on the landscape, and this number increased through the study. This third approach is based on the assumptions that 1) the collared sample is a subset of the larger sample of animals that were marked with permanent ear tags, and 2) the ear tags are reported when a mortality is reported. Ear-tagged bears were reported by Conservation Officers and highway crews and detected via remote cameras in the area (Emily Chow, pers. comm. April 12, 2022), and it is reasonable to assume all ear tags would be reported with reported mortalities because each bear that dies and ends up in the CI database is handled by either a CO or biologist, and all check for tags.

To calculate the underreporting rate with the ear tag ratio method, we first estimated the expected return ratio of ear tags for COS kills (*TRco*) by dividing the number of COS-killed ear-tagged animals wearing functioning radiocollars by the total number of ear-tagged animals (both collared and uncollared) killed by COS. Because bears euthanized by the COS had perfect recording for both radiocollared and uncollared but ear-tagged bears, this *TRco* ratio was the expected ear tag return rate for other mortality sources, if they also had perfect reporting. However, other causes of mortality that we can detect in the radiocollared sample, such as train and highway kills or poaching, are unlikely to have perfect reporting of uncollared bears. For these causes of mortality, we expect fewer ear tags to be returned for uncollared but ear-tagged animals due to either cryptic poaching or animals dying a short distance from the right of way after a road or rail collision. To calculate the expected number of returned ear tags for mortality sources with imperfect reporting (*TRex*, eq. 2), we divided the number of radiocollared bears deaths for a given mortality source (*CDms*) by the expected ear tag return rate for COS kills (*TRco*).

Eq.2 Estimating the expected number of recovered ear tags, which is then compared to the actual number of recovered ear tags to estimate the unreported rate with the ear tag ratio method.

To get an underreporting rate for the ear tag ratio method, we divided the total reported number of ear-tagged bears killed (*TRrep*) by *TRex* and subtracted it from 1. To contextualize the ear tag method, consider an example where for every radiocollared bear killed by COS, the COS also euthanized 2 uncollared bears with ear tags. We assume the COS report all ear-tagged animals and thus our collared bear represents 1/3 of the total ear-tagged animals killed by COS (*TRco* = 0.33). Now consider a source of mortality with imperfect reporting, such as highway collisions. In this example, 4 deaths of radiocollared animals were reported on the highway (*CDms* = 4), and 2 mortalities of uncollared ear-tagged bears were also reported (*TRrep* = 6). Assuming perfect reporting, we expect one third (1/3) of ear-tagged animals to be wearing functioning collars; however, for the highway sample two thirds (4/6) of ear-tagged animals were wearing a collar, suggesting a lack of ear tag recovery. To calculate the expected number of returned ear tags (*TRex*), we divided 4 (*CDms*) by 0.33 (*TRco*) and found that 12 ear-tagged animals likely died in highway collisions. To get an underreporting rate using the ear tag ratio method for this example, we divided 6 (*TRrep*) by 12 (*TRex*) and subtracted it from 1 to find that an estimated 50% of highway mortalities were unreported.