Managing for Bears in Forested Environments

October 17 –19, 2000
Revelstoke, British Columbia
Canada

Columbia Mountains Institute of Applied Ecology
Box 2568 Revelstoke BC, Canada V0E 2S0
Phone: 250-837-9311
Email: cmi@revelstoke.net
Web site: www.cmiae.org

Copies of this document may be ordered
at a cost of $20.00 (includes shipping and taxes).

Table of Contents

Managing for Bears in Forested Environments

October 17 –19, 2000
Revelstoke, British Columbia, Canada

Introduction

The Columbia Mountains Institute of Applied Ecology (CMI) hosted this three day workshop. On October 17 and 18, three sessions addressed topics related to bear population census, forestry, and bears, and resolving bear/human conflicts. On October 19, half-day field trips augmented the workshop sessions. Over 280 persons attended all or part of the workshop.

The Columbia Mountains Institute of Applied Ecology would like to thank the following agencies for their financial and in-kind support for this workshop:

- Azimuth Forestry and Mapping Solutions
- Bear Brewing
- Bear in Mind Gifts
- Canadian Mountain Holidays
- Columbia Basin Fish and Wildlife Compensation Program
- Columbia Basin Trust/ Affected Areas and Communities Initiatives
- Columbia Power Corporation
- Downie Bonus Fund
- Ministry of Forests
- Mt. Begbie Brewing
- Parks Canada
- Revelstoke Community Forest Corporation
- Tembec Forest Products

The following summaries were provided by authors who presented papers at the conference. Some presenters did not submit a summary. Please contact the authors directly as necessary.

About the Columbia Mountains Institute of Applied Ecology

The Columbia Mountains Institute of Applied Ecology (CMI) is a non-profit society established in 1996 to promote, facilitate and support cooperative interdisciplinary research centred in the Columbia River Basin of southeastern British Columbia. The Institute seeks to collaborate with individuals and organizations conducting ecological research in the Columbia Basin and to communicate knowledge in the Basin to the public, educators, decision makers, and other researchers.

Session One
Monitoring Bear Populations and Dealing with Imprecise Information

Why Do We Need Better Data on Bears?

John Woods, Parks Canada, Box 350, Revelstoke, British Columbia, Canada, V0E 2S0, 250-837-7527, john_woods@pch.gc.ca

Bears in forested environments are difficult to observe and study. Populations may exist at low densities and individuals may move over large areas. These factors can result in poor precision in monitoring both population size and primary population parameters. Given the potential difficulties in identifying and implementing solutions to bear management issues, research techniques that improve the data quality on bears in forested environments are necessary. This conference addresses this need by presenting research results from recently completed work and work in progress.

Meta-analysis of DNA Mark-Recapture Projects in British Columbia

John Boulanger, Integrated Ecological Research, 924 Innes St. Nelson, BC V1L 5T2, 250-352-2605, boulange@ecological.bc.ca, www.ecological.bc.ca

The main purpose of this talk is to evaluate past applications of DNA mark-recapture methods to bear populations and discuss potential future directions for the application of the DNA technique.

As of the time of the CMI Revelstoke meeting there have been 13 projects in British Columbia which have attempted to use DNA methods with grizzly bear populations. The majority of mark-recapture efforts have focused upon the estimation of population size and density (Woods et al., 1999). The main challenges in obtaining reliable population estimates have been meeting the assumption of population closure, minimizing capture probability variation, and obtaining adequate sample sizes in term of bear recaptures (White et al., 1982). Additional assumptions regarding the genetic analysis of samples are also required for DNA mark-recapture as discussed further in the talk.

Meeting the assumption of population closure is one of the biggest challenges to mark-recapture and most other methods which attempt to estimate population size of large carnivores (Smallwood & Schonewald, 1996). Analysis of data from BC suggests that estimation of population size of bears which frequent the sampling grid and surrounding area (the "superpopulation" of bears as defined by Kendall,(1999)) is possible with this technique if studies are designed appropriately to allow use of robust estimation models. The scaling of superpopulation estimates to density estimates is difficult unless sampling grid areas are topographically closed or radio collared bears are used to index movements across grid boundary areas (Powell et al. 2000). An ad-hoc procedure to gain further inference into the sources of closure violation and provide partially corrected estimates is discussed (Boulanger & McLellan, *In review*). Results of field and simulation studies suggest that mark-recapture data is too sparse to reliably detect capture probability variation using program CAPTURE statistical tests. However, simulation studies suggest that the heterogeneity estimators in program CAPTURE are reasonably robust to most forms of capture probability variation as long as sample size levels are adequate. Case studies are discussed to further illustrate the importance of sampling design and analysis strategy.

Potential methods for estimation of population trend are being explored for use with bear populations as an alternative to costly population estimation-based methods. In general, estimation of trend and survival is relatively robust to issues such as population closure and capture probability variation, which challenge the estimation of population size. Recent developments in mark-recapture methodology allow further inference into biological hypothesis and population trends from data sets (White & Burnham, 1999). This shift has allowed researchers and managers to gain more ecological insight from their data. Basically, the question "What is the population size?" is being replaced by "What factors influence the trend and survival of this population across time and space?" (Anderson et al. 1995; Cooch & White 2000). Results of simulation studies are given to further illustrate these newer methods.

In conclusion, the results of BC studies show that reliable estimates of superpopulation size are possible when study design objectives are met. The estimation and interpretation of population density is a greater challenge given the wide spread movements of bears and the patchy spatial distribution of bears on sampling grids (Clayton Apps, *In prep*). Quantitative tools are available to produce estimates of population size, density, and trend however the ultimate quality and reliability of estimates is determined by sound attention to sampling design, field implementation, and genetic analysis.

Anderson, D. R., White, G. C. & Burnham, K. P. (1995). Some specialized risk assessment methodologies for vertebrate populations. Environmental and Ecological Statistics 2: 91-115.

Cooch, E. & White, G. C. (2000). Analysis of encounter data from marked animal populations: Program MARK: A gentle introduction, Cornell University (Available online at: http://canuck.dnr.cornell.edu/mark/)

Kendall, W. L. (1999). Robustness of closed capture-recapture methods to violations of the closure assumption. Ecology, 80: 2517-2525.

Powell, L. A., Conroy, M., Hines, J. E. & Krementz, D. G. (2000). Simultaneous use of mark-recapture and radiotelemetry to estimate survival, movement, and capture rates. J. Wildlife Manage. 64, 302-313.

Smallwood, K. S. & Schonewald, C. (1996). Scaling population density and spatial pattern for terrestrial carnivores. Oecologia 105: 329-335.

White, G. C., Anderson, D. R., Burnham, K. P. & Otis, D. L. (1982). Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory. Available online at: . http://www.cnr.colostate.edu/class_info/fw663/White1982/WhiteList.html

White, G. C. & Burnham, K. P. (1999). Program MARK: Survival estimation from populations of marked animals. Bird Study Supplement 46: 120-138. http://www.cnr.colostate.edu/~gwhite/mark/mark.htm)

Woods, J. G., Paetkau, D., Lewis, D., McLellan, B. L., Proctor, M. & Strobeck, C. (1999). Genetic tagging free ranging black and brown bears. Wildlife Society Bulletin 27: 616-627

See www.ecological.bc.ca/refs.htm for more DNA MR papers.

Grizzly Bear Abundance and Distribution Survey in the Central Purcell Mountains of Southeast British Columbia - A Case Study

Michael Proctor, University of Calgary, 250-353-7349, mproctor@netidea.com

An abundance and distribution survey of grizzly bears was carried out in the central Purcell mountain range in the southern interior of British Columbia in 1998. The1650 km^2 study area was designed as a baseline environmental assessment of the local grizzly bear population that may be influenced by a proposed all season skiing / recreation resort. Our methodology was based on a systematic repeated sampling of genetic tissue from hair collected from barbed-wire surrounding scent lure bait sites. Microsatellite genotyping was used to identify individuals and capture histories formed the basis for a snapshot of grizzly bear distribution and a mark-recapture population estimate. We used an intense sampling grid design, 64 sampling stations (1 every 25 km2) with 4 collections, in an effort to maximize bear captures, particularly females.

We found a non-uniform distribution of grizzlies across the study area and captured 33 individual grizzly bears including 19 females, 10 males and 4 of unknown sex. We recaptured 45% of our bears (14 individuals) multiple times resulting in a high overall capture probability (0.27) and captured 73% of the estimated population. Using the heterogeneity model of Chao in program CAPTURE we estimated 45 bears use the study area (37-68 95% CI). Results of Monte Carlo simulation trials suggested that the Mh Chao estimator was the most robust to forms of capture probability variation detected in the area. We used Cormack Jolly Seber open population models within Program MARK to estimate "survival" within the study area as an index to closure violation. We estimated the bounded (closure adjusted) population within the study area to be 39 bears (34-59 95% CI). We found females to be relatively evenly distributed across the study area where we captured bears and males more concentrated during the 6 weeks sampling period. The capture rates obtained in this study allowed for a reasonable single-season estimate of the numbers of grizzly bears using the study grid and surrounding area during the spring and early summer seasons of 1998.

Grizzly Bear Occurrence Relative to Broad-scale Factors of Habitat and Human Influence near Golden, British Columbia.

Clayton Apps, Aspen Wildlife Research, 403-270-8663, aspen@cadvision.com

In collaboration with: Bruce McLellan, BC Ministry of Forests, John Woods, Parks Canada, Tony Hamilton, BC Ministry of Environment, Lands and Parks, John Boulanger, Integrated Ecological Research, Michael Proctor, U. of Calgary

Conservation of wide-ranging species requires consideration of habitat and population distribution at scales that extend from geographic range to micro-sites. Although the scale of regional populations is often considered in planning decisions, the necessary information on habitat potential and population distribution are typically lacking. For grizzly bears, hair-snag sampling and DNA analysis techniques, developed for population estimation, hold promise for understanding and modeling population distribution and abundance at broad spatial scales.

I describe a case study in relating broad-scale factors of habitat and human influence to grizzly bear distribution and abundance in the West Slopes Study Area, near Golden, British Columbia. Grizzly bear occurrence was sampled using hair-snag methods in 3 different sampling grids during June and July, 1996 to 1998. DNA analysis confirmed 244 independent grizzly bear visits to 168 station and sample session combinations, while 845 station/sessions received no confirmed visits. I analyzed grizzly bear occurrence relative to 24 variables of habitat and human influence derived from existing digital data sources. Within a GIS, each variable was “aggregated” at each of 3 spatial scales, reflecting mean attribute composition within circular landscapes of successively larger radii. For some variables, associations with grizzly bear occurrence depended on the spatial scale considered. However, grizzly bear occurrences were generally associated with broad landscapes of high elevation and complex terrain of predominantly southern aspect, with higher composition of alpine, avalanche chutes, burns, and other open habitats, while vegetation productivity was relatively low. Although grizzly bears were positively associated with old forest composition at broader scales, occurrences were positively related to only open or non-forested habitats at the finest scale. Negative associations with human influence were evident across scales.

Variables that were at least marginally related to grizzly bear occurrence were entered into a multivariate analysis to define a minimum combination that best described grizzly bear distribution within the sampling area. The resulting model was highly significant, correctly classifying 77% of the sample dataset. I applied the grizzly bear occurrence model to the greater West Slopes Study Area using algebraic GIS modeling. The GIS-based model exhibited significant predictive power in an independent validation analysis against landscapes “occupied” by 49 radio-collared grizzly bears. I then used the model to spatially interpolate a population estimate (J. Boulanger, *unpublished*) derived for the combined multi-year sampling area. This illustrated predicted grizzly bear density and distribution over the greater study area, from which an extrapolated population estimate was possible. I discuss important limitations of this and other spatial modeling approaches, and provide suggestions for future sampling designs.

Boyce, M. S., and L. L. McDonald. 1999. Relating populations to habitats using resource selection functions. TREE 14:268-272.

Klopatek, J. M., and R. H. Gardner. 1999. Landscape ecological analysis: issues and applications. Springer-Verlag, New York, NY.
Manley, B. F. J., L. L. McDonald, and D. L. Thomas. 1993. Resource selection by animals: statistical design and analysis for field studies. Chapman and Hall, New York, NY.
Morrison, M. L., B. G. Marcot, and R. W. Mannan. 1998 Wildlife-habitat relationships: concepts and applications. University of Wisconsin Press, Madison, Wisconsin.
Woods, J. G., D. Paetkau, D. Lewis, B. N. McLellan, M. Proctor, and C. Strobeck. 1999. Genetic tagging of free-ranging black and brown bears. Wildlife Society Bulletin 27:616-627.

Foothills Model Forest Grizzly Bear Research Project – DNA Inventory 1999

Garth Mowat, Fish and Wildlife Division, Timberland Consultants, Box 171, Nelson, B.C, V1L 5P9, 250-359-7606, gmowat@telus.net
Gordon Stenhouse, Alberta Environment, Hinton, AB
Curtis Strobeck, Dept. of Biological Sciences, University of Alberta, Edmonton, Alberta, T6G 2E9
Robin Munro and Kelly Stalker, Foothills Model Forest, Hinton, AB

As part of a 5 year research project investigating grizzly bear response to human activities and population status (Stenhouse and Munro 2000), we estimated the abundance of grizzly bears in a 5350 km^2 area of the Yellowhead ecosystem along the eastern slopes of Alberta. We collected bear hair using carpet-tack rub pads (John Weaver, Wildlife Conservation International, Missoula, Montana) and barbed wire bait sites (Woods et al. 1999). Forty of 199 bait sites and none of the 52 rub pad sites removed grizzly bear hair during this study. Based on sign left at the site, two of 199 (1%) bait sites were approached by what may have been a bear but no hair sample was collected. In contrast, 14 of 52 (27%) rub pad sites were approached but no hair sample was collected, in most cases the rub pads were ripped down or chewed up. We identified 41 different grizzly bears using microsatellite genotyping. The 41 bears were captured 51 different times across 3 trapping sessions; capture success was poor in the third session due to heavy rain and snow. Both the type (guard or under fur) and number of hairs in a sample were related to genotyping success. Increased genotyping success may be achieved by using >10 guard hairs in a sample. Five to 10 times the number of under fur may be necessary to achieve similar genotyping success as with guard hair.

Given the poor capture success at rub pad sites and during the third session, we combined the live capture and hair capture datasets to estimate population size in order to increase the sample size of the mark-recapture dataset. There were 71 captures of 48 different bears in the combined dataset; we created a fourth capture session using bears live captured before hair capture began. The population estimate was 107 using Chao's Model M_{th}. This estimate is likely to be biased high because the assumption of geographic closure was unlikely to have been met (White et al. 1982). We used the method of Kenward et al. (1981) to correct for closure which essentially weights the point estimate by average residency. We had sufficient locations (mean n=174, range 29-338) to estimate residency for 12 bears. The final population estimate for this study area was 100 bears (95% CI 66-185) which generates a density estimate of 18.7 bears / 1000 km^2. This is a moderate density when compared to other areas in the Northern Rockies. This result should be viewed cautiously in light of issues relating to capture probability and study area boundary closure. Further analyses of available data sets from this project are currently being analyzed to provide more insights on these topics.

We cannot recommend the use of carpet tack rub pads for grizzly bears, we did achieve somewhat better success with black bears. We only tried one bait on rub pads in this study and perhaps other more effective baits exist. The use of 3 sample sessions can save considerable field cost but was not well advised in our case given the large variation in capture heterogeneity in our data. Live capture may affect subsequent capture probability causing heterogeneity in capture probabilities. Designs using 2 or 3 sessions with our current study design appears to carry significant risk and may only be advisable when previous experience has shown that there is little risk of behaviour or heterogeneity in capture probabilities. We suggest future workers attempt to put at least 10 guard hairs (15 or 20 may be better) and over 30 under fur in samples to ensure genotyping success.

In addition to the DNA hair sampling conducted in 1999 our research program conducted a co-operative effort with Sam Wasser to investigate the use of trained dogs to locate bear scat during the same sampling periods when the hair capture sessions were underway. The focus of this work was to investigate other DNA collection methods. Sam Wasser will present the results of this work later in this session.

Kenward, R. E., V. Marcström, and M. Karlbom. 1981. Goshawk winter ecology in Swedish pheasant habitats. Journal of Wildlife Management 45:397-408.

Stenhouse, G.B. and R. Munro. 2000. Foothills Model Forest Grizzly Bear Research Project 1999 annual report. Foothills Model Forest, Hinton, Alberta. 107 pp.

White, G. C., D. R. Andersen, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos Nat. Laboratory LA-8787-NERP.

Woods, J. G., D. Paetkau, D. Lewis, B. N. McLellan, M. Proctor, and C. Strobeck. 1998. Genetic tagging free ranging black and brown bears. Wildl. Society Bull. 27:616-627.

Genetic and Endocrine Monitoring of Population and Disturbance Parameters in Ursids using Scat Detection Dogs

Samuel K. Wasser, University of Washington School of Medicine, Box 354693, Seattle, WA 98195, 206-534-0670, wassers@u.washington.edu
Gordon Stenhouse, Alberta Environment, Hinton, AB, 780-865-8331, gordon_stenhouse@gov.ab.ca

There is a pressing need for federal and state wildlife agencies to monitor multiple threatened and endangered species over large remote areas. Effective management requires accurate data on the number and distribution of threatened and endangered species, as well as on the degree to which they are impacted by human and other environmental disturbances. Traditional techniques of acquiring these data for difficult to observe species have included: mark-recapture of tagged individuals; animal track or pellet counts; hidden cameras; and radio-collaring. However, their implementation has been limited by the cost, time, invasiveness and biases associated with data acquisition.

Unbiased, cost effective collection methods are clearly needed for concurrently estimating the number, distribution and degree of disturbance of multiple species at risk over large remote areas. Our project aimed to validate and implement such methods, combining noninvasive fecal DNA and hormone technology with highly trained detection dogs used to locate scat from target species. Scat sampling with detection dogs has the potential to be relatively free of collection biases that have plagued many of the more traditional monitoring techniques because it utilizes high drive dogs, rewarded with play for locating samples independent of the target species' gender or behavior.

Four K-9 teams collected grizzly and black bear scat samples over a 5,350 km^2 area of the Yellowhead ecosystem along the eastern slopes of Alberta Canada. Forty percent of the study area is within Jasper National Park, whereas the remaining 60% is in a multi use study area to the north, exposed to a variety of human disturbances. Scat samples were geo-referenced upon collection using a hand-held GPS unit and plotted on a Geographic Information System (GIS) that also maps disturbances in the study area. Hair sampling (G. Mowat and K. Stalker) and radio-collaring (G. Stenhouse and R. Munro) were conducted concurrently, and compared as part of the assessment of our scat methods.

Both hair snag and scat collection methods obtained comparable numbers of samples (~400 samples each), despite hair snags occurring in over 20% more of the study area (i.e., 64 versus 40 grids). Multiple scat samples collected in the same grid and session also appeared more likely to represent multiple individuals compared to hair snag collections. Visual comparisons suggested close correspondence between hair and fecal sample distributions of both black and grizzly bears. These distributions also appeared similar to telemetry based distributions of the radio collared grizzly bears from the study population. However, hair snags collected 0.47 black bear samples per grizzly bear sample whereas detection dogs collected 2.40 black bear samples per grizzly bear sample.

The stress data demonstrated gender and species differences, with stress levels being higher among grizzly versus black bears, and among males versus females within each species. We are still investigating the relationship between these stress levels and levels of human activities using GIS tools. While more data are needed, cross-sectional fecal cortisol measures across the landscape are beginning to suggest that stress levels for grizzly and black bears may correspond positively to Ursid densities and human disturbances.

The primary problem faced in this study was a lower microsatellite DNA amplification success rate than anticipated. Indeed, the ultimate success of this method hinges on enhancing microsatellite amplification success beyond that obtained in this study. We believe that these problems are surmountable and discuss ways to circumvent them in the future. Once resolved, coupling scat detection dog methods with DNA and endocrine techniques should offer an overall monitoring approach that is ideally suited to address a wide variety of Ursid conservation and management concerns.

DNA Degradation in the Field

Curtis Strobeck, University of Alberta, 780-492-3515, curtis.strobeck@ualberta.ca.

A set of experiments were conducted to determine the ability to extract DNA from hair samples collected under different environmental conditions and left in the field for different lengths of time. Replicates samples of hair from a single black bear male were set out in the field in 5 different conditions (3 at a low elevation [Revelstoke] in natural bush, under a roof, and watered daily and 2 a moderate elevation [Rogers Pass] in natural bush and under a roof). Samples were collected at 7 different times (6, 12, 21, 41, 83, 127, and 385 days after being placed in the field). DNA was isolated using Qiaamp tissue columns from each sample and the typed at six microsatellite loci. The results show the water destroys the ability to extract DNA which can be genotyped as there was no detectable DNA in samples that were continually wetted for 41 days and DNA extracted hair placed under a roof was less degraded than hair placed in natural bush. No DNA was recoverable from any treatment after 1 year in the field. These initial experiments show the need to take samples from the field as quickly as possible and the need for further studies of DNA degradation in the field.

Monitoring Population Trends in Glacier National Park, Montana Using Non-invasive Genetic Sampling

David Roon, University of Idaho, 208-885-5005, roon8505@uidaho.edu

No summary provided.

Genotyping Errors in DNA-based Inventories: a protocol that controls them, complete with empirical validation

David Paetkau, Molecular Artificer, Wildlife Genetics International
4100 EDC Building, 8308-114 St., Edmonton, AB T6G 2V2
780-491-6114, paetkau@telusplanet.net

DNA-based population inventories can fall prey to two classes of genetical error: 1) spurious individuals can be created when more than one genotype is generated for samples coming from the same individual (Gagneux et al 1997, Taberlet et al. 1996) 2) samples from more than one individual can be combined if those individuals are genetically identical at the loci being analyzed. In the first broad-scale, DNA-based, ursid inventory, Woods et al. (1999) dealt with the latter issue by using a match statistic that allowed for the fact that the individuals sampled would include many first order relatives. However, the actual error rate can only be quantified empirically. Here I present data from two well sampled brown bear populations (Craighead et al 1995, Paetkau et al. 1997) in which many relationships are known, and I show that resolving power is conservatively controlled using the method of Woods et al., although the concern over first order relatives was merited. While genotyping errors are more difficult to quantify, they produce characteristic patterns that can be searched for in the data. By establishing an automated routine of identifying and reproducing suspicious genotypes, it should be possible to provide a thorough screen for errors. I present data from several projects on the frequency and type of errors that have been identified by this screening process. In addition, I examine genotype mismatch distributions from known study populations (above) and show that the distributions in the final data sets we have produced are consistent with those expected by chance, and can only be reconciled with error rates on the order of less than one per completed inventory. However, while resolving power will be constant between labs, genotyping error rates depend heavily on data scrutiny and experience.

Craighead, Paetkau, Reynolds, Vyse & Strobeck (1995) J. Heredity 86:255.
Gagneux, Boesch & Woodruff (1997) Molecular Ecology 6:861.
Paetkau, Waits, Clarkson et al. (1998) Conservation Biology 12:418.
Taberlet, Griffin, Goossens et al. (1996) Nucleic Acids Res. 24:3189.
Woods, Paetkau, Lewis, et al. (1999) Wildlife Society Bull. 27:616.

Grizzly Bear Population Estimation and Hunt Management

Guy Woods, BC Environment, 250-354-6341, guy.woods@gems4.gov.bc.ca

Determining grizzly bear populations in localized areas involves detailed research using radio telemetry and DNA hair sampling. Since this cannot be done everywhere, it is necessary to take the knowledge we have and extrapolate it to the remainder of the land base occupied by grizzly bear. The Wildlife Branch does this using a systematic approach based on mapped ecosystems and biogeoclimatic ecosystem classification (BEC) mapping. Existing mapping provides a database of the area of each BEC subzone, nested within Ecosections and Wildlife Management Units (MU).

Grizzly bear densities in BC have been classified into five categories ranging from 10 km^2 bear to 1000 km^2 per bear. Each BEC subzone / ecosection type in the province has been assigned a bear capability classification of 1 to 5. These classifications are used to calculate the population capability of an area to support grizzly bear. However, a wide variety of activities have changed the capacity of habitats to support grizzly bears. To take these into account four variables are used, each with three modification factors. The primary impacts are permanent habitat loss (i.e. cities), habitat alteration (i.e. logging), habitat degradation (i.e. roads) and population impacts (i.e. historical hunting). The first three of these primary impacts is rated according to the quality of the habitat lost, altered or degraded, the quantity of the habitat change, and the relative value of the habitat changed. The product of these ratings and the capability population estimate provides current population estimates.

Known population areas are used to calibrate the estimates of change. Once known areas match in the model we extrapolate to similar adjacent areas that do not have very much data available. This extrapolation provides us with MU population estimates, which are then summed to give Grizzly Bear Population Unit, regional and provincial population estimates. In the Kootenays the net result is a population estimate of between 2100 and 3000 grizzly bears at the present time.

Hunting management requires population estimates at the MU level, safe rates of harvest, estimates of non-hunting losses and unknown losses, and harvest data for resident hunters, non-resident hunters and first nations. Kootenay rates of harvest have historically been set at 0 or 3.8 percent annually, but are now more flexible with a range of 0 to 6 percent annually, depending on population goals and trends. Estimates of unknown losses and historical rates of known non-hunting losses are deducted from available harvest first. The remainder is allocated between residence groups, although in the Kootenay there is virtually no first nations harvest.

Resident hunters are allocated 70 percent of the regional harvest and the provincial Limited Entry Hunt (LEH) allocation system is use to provide hunting opportunities. Non-resident hunting opportunities are provided through a quota system, with licensed guide outfitters receiving 30 percent of the available harvest. Harvest balances are sought over a three-year period in an effort to smooth the flow of hunting opportunity and reduce the impact of year to year variations in total harvest. At the end of each three-year period every effort is made to match the harvest achieved with the harvest goal by adjusting hunting opportunities. Grizzly Bear Population Units are also use to better match the harvest with the area ranged by a grizzly bear population. Most Management Units are too small to encompass a GBPU. Kootenay Region total known grizzly kill has averaged 58 animals annually between 1976 and 1999, with an increasing trend peaking in 1996.

Data for Decision Making: Bears and Environmental Assessments

Matt Austin, BC Environment, 250-387-9799, matt.austin@gems7.gov.bc.ca

Recent legislative changes such as the federal *Canadian Environmental Assessment Act* and British Columbia's *Environmental Assessment Act* have necessitated a more rigorous and transparent approach to the assessment of the potential impacts to bears resulting from a wide variety of proposed developments and other activities. This represents a significant challenge given the difficulties in predicting impacts to bears and in developing mitigative measures to address these impacts. In the face of this challenge the temptation may be to place too great a focus on simply obtaining more information through inventories or other studies. This may be of limited value however, unless it has been clearly identified *a priori* how this information will influence either the mitigative measures being considered or the ultimate decision on whether the proposed development or activity should proceed.

In many cases it may be appropriate to stipulate the most precautionary supposition to be correct (e.g. that an area is important grizzly bear habitat or that there is a high density of grizzly bears in the surrounding area). Those involved can then proceed to considering mitigation to determine how critical additional information (e.g. habitat inventory or a population inventory) is to the decisions being made. Regulators involved in assessing the potential impacts of a project should consider clearly establishing what they believe the general types of potential impacts that may result from the project are and what mitigation techniques might be used to address these impacts as early as possible in the process. Ideally such a strategic overview should allow for assumptions to be easily identified so that in the event that the proponent, or any other person or group, wishes to challenge one or more of the assumptions it will be readily apparent what information could be collected to confirm or refute each of them.

The focus of the environmental assessment process should be on the end result: the decision on whether a project will proceed including any mitigation measures to be implemented if it is approved. If decisions over data collection are considered in terms of how they will specifically contribute towards this end, the result will be a more focused process that provides better information for decision-making. This approach should also help to avoid expending time and effort on the collection of data that is not central to the decision-making process and that may be better focused on the development of effective mitigation measures.

Session Two
Managing Forests for Bears

Habitat, Foods, Energy Balance of Forest Inhabiting Bears

Bruce McLellan, BC Ministry of Forests, Revelstoke, 250-837-7626, bruce.mclellan@gems9.gov.bc.ca. No summary provided.

Grizzly Bear Use of Avalanche Chutes in the Columbia Mountains of British Columbia: Ecology and Implications For Management

Roger Ramcharita, Faculty of Forestry, University of British Columbia,604-822-5410, kramchar@interchange.ubc.ca
Bruce McLellan, BC Ministry of Forests, Research Branch
Fred Bunnell, Faculty of Forestry, University of British Columbia

We examined spring season use of avalanche chutes by grizzly bears (*Ursus arctos* L.) in the Columbia Mountains, southeastern British Columbia. Sixty radio-collared grizzly bears were monitored between 1994 and 1998. The frequency of avalanche chute use, the selection of general habitat characteristics within avalanche chutes, and the selection of specific feeding and bedding activity sites within avalanche chutes by grizzly bears were documented.

Fifty-four percent (366 / 672) of all grizzly bear radio-locations during the spring season were in avalanche chutes. The proportion of radio-locations in avalanche chutes for the 37 grizzly bears that accounted for > 10 spring season radio-locations each ranged between 20% and 90% ($\bar{x}$ = 56% +/- 5.7%). This variation was not attributable to differences in use between sex or age classes.

Within avalanche chutes, grizzly bears selected east and south aspects and areas dominated by grasses and forbs with minimal shrub abundance. Grizzly bears avoided very steep slopes but used all elevational parts of avalanche chutes - upper start zones, tracks, and lower runout zones, frequently. These patterns appeared to be tied to feeding site selection, as evidence of feeding was found at most telemetry locations investigated on the ground.

Grizzly bears selected feeding sites on the basis of forage value and visual cover. Most feeding sites were characterized by high forage value and low visual cover, but weak positive interaction between these two factors indicated that grizzly bears also selected feeding sites with slightly lower forage values but high visual cover. Bed sites were frequently found both in forest adjacent to avalanche chutes and directly within avalanche chutes. All bed sites found in forests were < 25 m from the forest / avalanche chute edge.

Grizzly bears avoided areas within avalanche chutes that were adjacent to cutblocks, possibly due to the removal of escape cover, but selected areas close to logging roads. Most logging roads traversing avalanche chutes in the study area had minimal vehicle traffic and were often situated close to high quality habitat. We present suggestions for managing this important spring season habitat for grizzly bears.

Berries, Bears and Silviculture

Tony Hamilton, BC Environment, Wildlife Branch, Box 9374, Station Provincial Government, Victoria, BC, V8W 9M4

The objective of my talk is to characterize a conflict between the sustainability of bear forage production and traditional silviculture in parts of BC. I will identify and promote several mitigative practices and propose policy changes for addressing this conflict that match the current social and economic environment in the province.

Much of the reforestation after clearcutting in BC has emphasized rapid progression to closed canopies through a variety of methods, including the use of large stock, site preparation, high stocking levels, fertilization and sometimes aggressive vegetation management. As canopies close, understory forage production declines to near zero. As a consequence, both stands and landscapes can have bear forage deficits for the majority of the rotation.

Rapid rates-of-cut followed by successful reforestation can potentially affect local bears and, in some cases, sub-regional populations. Landscapes where the timber harvesting landbase is a significant proportion of the total forested land and where wildfires are suppressed are the greatest concern. Stable rates-of-cut with continuos proportions of the forested land in open clearcuts may seem like a solution, but we do not yet know if forage levels after second growth harvesting will match those that follow harvesting old growth. Indications from Southern Vancouver Island suggest that they do not; budbanks are dead after 70 years of canopy closure, seed banks may be ineffective, and openings appear to be recolonized from roadsides full of weedy invaders and other non-forage species.

Our coastal research in the 1980's led to the development of a set of guidelines for selected ecosystems that relaxed stocking standards and established numerous trials under an adaptive management program. Monitoring of these trials in the late 1990's gave mixed results for forage production, crop survival and growth and yield. These guidelines have been re-written and are now appendices to the Establishment to Free Growing Guidebooks for the Vancouver and Prince Rupert Regions. A central premise of the guidelines is that by managing for fewer stems of greater individual piece value, the volume loss is offset by equivalent or greater economic return I will outline a proposal to expand the coastal stocking guidelines into the ESSF and ICH zones.

I will also discuss the differences between the natural and managed stand-level overstory/understory relationships and will attempt to put the issue into the landscape and bear population contexts. Reduced stocking is only one potential mitigative measure. Others include juvenile spacing and pruning (for mitigation or restoration), variable retention or partial cutting, and linking understory productivity to other stand-level legacies such as coarse woody debris and wildlife trees. Discontinuing attempts to reforest non-satisfactory restocked or backlog sites and seeking mid-seral stage limits in higher level planning are potential solutions at the landscape level.

I will conclude with the suggestion that understory maintenance in managed stands will not only benefit bears, but is a key component of ecosystem management that will help achieve sustainable forestry and, potentially, forest product certification.

Grizzly Bear Habitat Management Guidelines for Avalanche Tracks: mapping and rating avalanche tracks for grizzly bears in the Kootenay region of British Columbia

Garth Mowat, Aurora Wildlife Research, RR1, Site 14, Comp 8, Crescent Valley, BC,V0G 1H0, 250-359-7606, gmowat@telus.net

Matt Besko, Regional Endangered Species Specialist , Northeast Boreal Region, Alberta Environment, Natural Resources Service,14515-122 Ave, Edmonton, Alberta,T5L 2W4, (780)415-1331, fax(780) 974-2641 Matt.Besko@gov.ab.ca

Avalanche chutes are important spring habitat for grizzly bears in mountainous areas. Virtually all studies of bear habitat use in mountainous environments detect use of avalanche tracks in spring and this use often continues with lower intensity through summer and fall. The preferential use of chutes and their scarcity through the landscape have made them a focus of management for grizzly bears in the Kootenay Region of BC.

The first step in applying avalanche track cover retention guidelines is to identify the avalanche chutes in the area of interest. Here we describe the use of air photo interpretation following the classification framework in the BC Vegetation Resources Inventory (VRI). VRI classification is based on landscape position and current vegetation structure; the system is consistent with classification systems used in many other jurisdictions. The methodology presented here is designed for small to medium size areas, similar in size to forest planning areas, and has the flexibility to provide relatively rapid assessment of avalanche chutes in an area. Basic levels of mapping require modest air photo skills (the ability to see in stereo is the main limitation).

We suggest mapping 3 structural classes: herb, shrub, and forest; and 3 broad landscape positions: wetland, upland, and alpine. Users can choose to map various levels of detail in shrub and forest classes; all herb units associated with avalanche chutes should be mapped. We suggest that grizzly bear habitat quality of each chute be rated as high, medium, or low, for consistency with current habitat guidelines. We present suggestions for rating individual avalanche chutes but realize that there will always be a level of subjectively involved because of the many variables that may affect quality of individual chutes, at both the stand and landscape level. A more detailed report will soon be available at: http://www.env.gov.bc.ca/kor/wld/final.html
In the Province of British Columbia, grizzly bears *(Ursus arctos horribilis)* are classified as a blue-listed species, and require management guidelines in identified habitats, especially

those which are seasonally important and/or critical in nature. In the Kootenay - Boundary Land Use Plan Implementation Strategy (KBLUP-IS) and subsequent Higher Level Plan Order, avalanche tracks are identified as one such important habitat type. We present grizzly bear habitat management guidelines for avalanche tracks which are intended as buffers to resource development activities, considering grizzly bear biological requirements (primarily security cover), the needs of resource users, and government direction as per KBLUP IS and the Higher Level Plan order. Principal guideline components include the application of Avalanche Track Management Zones (AMZ's) on 'high' and 'medium' ranked avalanche tracks classified using an index to biophysical/vegetative classifications as derived from coarse filters (Satellite imagery – Ramcharita 2000) or finer filters (Air Photo interp/ground truthing, Mowat 2000, Ramcharita 2000). AMZ's are applied using buffers of 50m or 100m in width on both sides of the track, depending on the frequency of avalanche tracks within a drainage, and the distance between tracks themselves. Harvesting and silvicultural activities, including road access, are considered in drainages that are mapped grizzly bear habitat, provided that disturbance is minimized seasonally.

Science and Road Access Management in Montana: All Roads Lead to the Courthouse

Richard Mace, Montana Dept. Fish, Wildlife and Parks, 490 N. Meridian Road, Kalispell, MT 59901, rmace@digisys.net

Federal land managers in Montana have been grappling with the issue of forest road access and grizzly bears for over a decade. Access guidelines have evolved from earlier periods where there were no biological data, to more recent times when biological data were available. As a field researcher and a member of an inter-agency access management team, I will discuss the history and approach to access management in Montana. I will discuss the opportunities and constraints encountered as a team member when trying to integrate the results of field research with actual management of roads. Relative to access management, I will touch on the subjects of: the Endangered Species Act, the concept of "take", best available data, public participation, land use history, agency expectations, committee dynamics, the role of advocacy, cumulative impacts, thresholds, uncertainty, and the strength of bear data.

Access: North Fork of the Flathead Experience

Fred Hovey, BC Ministry of Forests, Revelstoke, 250-837-7611
fax 250-837-7626. No summary provided.

A Comparison of Resource Selection Patterns Between a Mountain and a Plateau Grizzly Bear in the Parsnip River, BC

Lana Ciarniello, University of Alberta, 250-562-5567, lanac@ualberta.ca

A habitat selection and population study of grizzly bears (*Ursus arctos*) in the Parsnip River, B.C., is being conducted. The study site, approximately 10,000 km^2, encompasses the plateau, which contains rolling hills and flat valleys, and the Hart Ranges of the Rocky Mountains with steep sided bowls, avalanche chutes and upper elevation valleys. Two grizzly bears have been chosen for a comparison of habitat selection at the home range scale. Both bears are female, approximately the same age, and are accompanied by offspring. One of the bear's (Grizzly Female #24) home range is in the plateau where a large portion of the landscape has been modified by human activities, primarily logging. For contrast, the other bear (Grizzly Female #9) ranges in the mountains in an area largely inaccessible to humans. For all female bears in the study combined (n=16; 13 mountain and 3 plateau), plateau bears have larger home ranges than mountain bears ($P=0.036$). In 1999, GF24's Minimum Convex Polygon (MCP) was 63.8 km^2, while GF9's MCP was 32.5 km^2. GF 24's home range is substantially smaller than the other two plateau family groups, whose home range sizes were 426.3 km^2 and 411.8 km^2 respectively. GF9 and GF24's home ranges have been overlain on map images using a Geographic Information System (GIS). Digital Elevation Maps (DEMs) and Forestry Cover (FCM) map images (Ministry of Forests) have been used to obtain terrain (e.g., elevation, slope, aspect) and human use (roads, cutblock placement, etc.) data. Mean elevation for mountain bears ranged from 1,365 meters Above Sea Level (ASL), while the mean elevation of plateau bear locations was 831 meters ASL. 'Distance to' measurements, for example distance to the nearest road or to cover, also have been calculated from these maps. Habitat availability for each bear was determined using GIS, TRIM, and FCM images based on 13 habitat categories. In addition, Landsat TM images were used to calculate greenness scores within each bear's home range. Greenness scores are higher for mountain habitats than the plateau. Bear foods consumed and season of use also differ between the mountains and the plateau. In the mountains, bears tend to dig more for microtines, marmots and roots, while plateau bears tend to forage more on berries and moose. Resource Selection Functions (RSF; Manly *et al.* 1993) have been calculated to determine the probability of use of a habitat type. RSF allows us to map the relative probability of occupancy of a site by grizzly bears as a function of the terrain and landscape variables. RSF will help us to clarify the role of food variables versus human disturbance variables in an attempt to determine whether or not the large home range of plateau bears is related to human activities.

Manly, B.F.J., McDonald, L.L., and Thomas, D.L. 1993. Resource selection by animals: statistical design and analysis for field studies. Chapman and Hall. London, England

Black Huckleberry Biology and Management

Evelyn Hamilton, Ministry of Forests, Research Branch, 712 Yates Street Victoria, V8W 1L4, 250 387-3650, Evelyn.Hamilton@gems8.gov.bc.ca

Black huckleberry is a low to medium sized, deciduous shrub with fairly shallow rhizomes. It is relatively slow growing. Vegetative reproduction is more important than seedling regeneration. Plants under closed forest produce few berries. Pollination is by bees. The best berry production is in partial shade or full sun. Fruit production varies depending upon weather especially frost. Berries usually ripen in August/Sept.

Black huckleberry occurs from Alaska south to California and east to WY, MN, and Michigan. It is a dominant understory species in spruce-fir forests. In B.C. it is most abundant in mountainous areas in the ICH, ESSF, MH and cool moist SBS zones. The best berry producing site are montane/ lower subalpine above 800 m elevation. Black huckleberry prefers acidic well drained soils that have no moisture stress. It is fairly tolerant of cold temperatures and requires moderate amounts of snow cover in the winter.

Response to Management:

Forest canopy removal: There is generally increased berry yield with increasing light levels. Partial shade may be better than full sun on drier sites.

Fire - slash burning: Black huckleberry recovers slowly after burning. Light surface fires kill above ground parts and stimulate sprouting. Intense fires can kill rhizomes. It may return to pre burn cover after 5 years. Production of fruit delayed for several years after burning.

Fire - First Nations burning; Berry patches were burned in late August or Sept, just before a rainfall. Burns were likely low impact. Patches were burned every 3-5 years and were harvested a few years after burning.

Mechanical disturbance/cutting; Heavy scarification can damage rhizomes and reduce resprouting. Black huckleberry is slow to regrow after mechanical cutting (over 7 years to return to pre-cut levels. Pruning promotes resprouting.

Research needs
distribution and abundance by site series
overstory/understory relationships
influence of forest management (e.g. harvesting system, site prep, stocking levels)
optimal fire frequency and severity
density of berry producing plants required for bear forage
annual variation in berry production

Summary

The best berry sites are open, moist mid elevation montane/subalpine areas. Productivity declines as sites become ingrown by trees and other shrubs. More research needed on optimal management regimes and bear requirements.

Bears in Timber Stands: Damage and Preventive Measures

Dale L. Nolte, USDA/APHIS/WS/NWRC
9730-B Lathrop Industrial Drive, Olympia, Washington 98512 USA
Tel 360-956-3793 Fax 360-534-9755 Dale.L.Nolte@USDA.GOV

This paper provides an overview of black bear damage and highlights of studies conducted through the National Wildlife Research Center (NWRC) to assess or develop non-lethal means to reduce bear damage in timber stands. Black bears (Ursus americanus) strip bark from coniferous trees to feed on newly forming vascular tissue during spring. Damage inflicted through this behavior can be extremely detrimental to the health and economic value of timber stands. Timber producers estimate that bears inflict $11.5 million in damage on private lands in western Oregon, and probably cause greater losses in Washington.

A series of studies was conducted by NWRC to assess efficacy and investigate nutritional status and select behavioral characteristics of feeding bears. The first experiment revealed that the percentage of damaged trees in stands with foraging bears varied from 2% to 52%. When supplemental feeding was introduced on these stands, damage was reduced to approximately 10% of that sustained on untreated stands. Bears consuming supplemental feed did gain a significant nutritional advantage while feeding, but this did not equate to long term increases in age-specific body masses or fat content. These results indicate that it is unlikely supplemental feeding is directly increasing the reproductive success of bears. Supplemental feeding also did not affect the home range sizes of bears in feeding areas, but it may serve to concentrate bears in a particular location. Concurrent experiments provided insightful data on bear use of feeding stations. Numerous bears fed at the stations, including females with and without cubs, yearlings, and boars. Bear feeding bouts at the stations were generally short, less than 30 minutes. Bears generally fed alone, although two to three adult bears were observed at a feeder simultaneously and the feeding partners were not consistent. There was little antagonistic behavior observed around the feeders, and no evidence that this behavior inhibited foraging opportunities for long. On the rare occasion a bear was driven from a feeder it returned later that same day to feed, generally within an hour.

Another series of studies investigated whether phytochemicals in Douglas-fir tissue mediate black bear tree selection and whether foraging choices could be altered through silvicultural management practices (thinning, urea fertilization, pruning, genetic selection). Initial studies revealed that bear foraging preferences were based in part on chemical constituents in the forage. Black bears maximized their intake of carbohydrates and minimized their intake of terpenes. Comparing bear preference with chemical constituents in trees grown under varied silvicultural practices we were able to predict the impact of these practices on stand vulnerability to bear damage. Pruning reduces the likelihood of a stand being damaged by bears, while thinning or fertilizing stands increase the potential for damage. The pruning prediction was confirmed through a survey of bear damaged trees on a stand of pruned and unpruned timber. Odds ratios indicate that black bears were four times more likely to forage unpruned Douglas-fir than pruned Douglas-fir; three times more likely to forage unpruned hemlock than pruned hemlock. Another experiment demonstrated that the allocation of constitutive terpenoids in vascular tissues was not at the expense of tree growth. Thus, it may be possible to select for trees that are less vulnerable to bear damage without sacrificing growth potential.

Session 3
Living in Bear Country

Living with Bears in British Columbia

Richard Daloise, Regional Enforcement Manager, Conservation Officer Service
Nelson, 250-354-6394, richard.daloise@gems2.gov.bc.ca

British Columbia is bear country! Bears and humans inhabit or use the same areas or habitats in the province. Bears and humans are in conflict and when that happens, history tells us that one or the other dies. Most often it is the bear that dies!

The rate of conflict between humans and bears seems to be increasing. Statistics indicate that there are more conflicts, more bears are dying and fewer bears are being relocated. Since 1992 more than 8,300 bears have been killed and more than 2,000 have been relocated because of conflicts. In addition, more humans are being killed and injured by bears, mostly in backcountry situations.

There are a number of reasons why conflicts appear to be increasing. The first could be as simple as better information collection, but that does not appear to be the case. Increase in human population is likely a factor. Another possibility is an increase in bear populations or at least a "shrinking" of wild bear habitat, which is being replaced by "urban bear" habitat. However, conflicts are most likely increasing because of human behavior that promotes conflicts as opposed to avoiding conflicts. This is particularly true of attractant management and human encroachment on bear territory.

There are solutions to this problem but they are limited to 2 primary options. The first is to remove or eliminate one of the participants in the conflict. Removing humans isn't likely, which means that removing bears is most likely to occur. The methods of eliminating participants are limited to killing, relocating or "beating" bears or in limited cases, preventing human access. The second possible solution is to prevent the conflict in the first place. This is far harder to do and includes things like education, Bear Aware, Bear Smart communities, bylaws, Dangerous Wildlife Protection Orders and even regulations around the use of the backcountry.

People and Bears – How to Prevent Problems

Darcy Lutz, BC Conservation Foundation, Nelson, 250-352-1160, bearaware@netidea.com

The British Columbia Conservation Foundation is the lead provincial organization developing educational materials and programs to work with communities trying to better manage bear human conflict. We focus on proven techniques of attractant management to make our communities more sustainable for both people and bears. We engage the media, volunteers, and paid local coordinators so that citizens and institutions become more aware of how our day-to-day behaviors impact to human-bear interactions. The public needs to be informed of their role in conditioning bears through their garbage practices and fruit tree management.

The Bear Awareness Program has developing a program materials kit that can be used to deliver a high quality effective Bear Awareness Program in any given community. These include:

- Access to a website that keeps program coordinators in communication with each other, sharing ideas, issues, and solutions. The website also allows us to update materials regularly.
- A Coordinator's Handbook that outlines the elements of successful Bear Aware programs from Revelstoke and other communities where we have been involved over the past two years.
- Volunteer's Handbooks that outline the roles and responsibilities available to community volunteers. Volunteers are central to programming because people find their neighbours more credible then paid program coordinators. Further, every volunteer internalizes bear aware messages and becomes an effective program missionary.
- A slide show to deliver motivating presentations to target audiences.
- Display materials for information displays in public areas and at events.
- Posters, brochures, stickers, and checklists to reinforce our messages.

The British Columbia Conservation Foundation focuses on cooperative respectful processes to further a bear stewardship agenda. Our approach is not political or confrontational.

The Foundation may also be able to help establish local Bear Aware programming through our network of community programs. Bear-human conflict issues are very similar across BC. We strive to minimize the cost and maximize our effectiveness by offering services like large print runs of materials and centralized distribution and coordination. We hope that through our efforts we can help communities to address bear-human conflict in an efficient, comprehensive and progressive manner.

Developing and Delivering Public Education Messages

Debby Robinson, Bear Aware Revelstoke
(250) 837-5813 fax (250) 837-7464 d.robinson@revelstoke.net

History of Revelstoke's Program

- Landfill fenced in Sept, 1994, resulting in many of the 'dump bears' entering Revelstoke
- Statistics:
  1994: Black bears - 33 destroyed
  Grizzly bears - 29 relocated
  1995: Black bears - 13 destroyed, 9 relocated

Grizzly bears - 10 destroyed, 16 relocated

- Public outcry about the number of bears being destroyed prompted our regional district representative to initiate a committee of community representatives and conservation officers. They procured funding and hired a public education coordinator in 1996 to relay messages to the public about managing bear attractants in the city.
- I ran the program for three seasons from 1997 to 1999.

The initial goal of a community Bear Awareness Program should be to create community-wide awareness of the problem of habituated and food-conditioned bears, and community-wide recognition that the elimination of the problem is the responsibility of *everyone* in the community – everyone has something to contribute. In Revelstoke, if this aspect of our message delivery had started prior to the landfill fencing, with a discussion of the ethical and health issues of bears feeding at the landfill, possibly some hostility towards the wrong people (conservation officers) would have been alleviated.

A next step would be to distribute the list of "*do's and don'ts".* We developed checklists to distribute to homeowners and food-based businesses that identify steps to take to manage bear attractants on our properties. But, *how* these messages are delivered is as important as the message itself.

The program co-ordinator must consider:

- The wide audience, with varied belief systems
- Consistency is important. Credibility for the program will be lost if people hear different messages from different people within the Bear Awareness Program
- Important to have the Bear Awareness Program and the Conservation Officer Service delivering the same messages, or C.O. cooperation with the Bear Awareness Program will be non-existent.

Asking people to look at a situation differently than they ever have before will have mixed reaction:

- Some citizens are open to new ideas and approaches
- Give them the information and they accept it
- Others need to see a benefit to themselves before they will make changes, e.g. businesses see no benefit to bear-proofing dumpsters until patrons express displeasure
- Publicity or prizes for 'bear friendly' businesses and homes reinforces efforts
- Some people are resistant to change only for the sake of being resistant
- Dangerous Wildlife Protection Orders from the conservation officers may be the only recourse here
- For some it comes down to dollars and cents; if it costs money to make changes, they will not co-operate. This may apply to homeowners, businesses, or municipal governments.

Recognize and accept these human differences, and use them to guide your message delivery to different groups. The public is more receptive to accepting the bear-proofing recommendations if they are backed up with facts – or in other words the 'why' for each recommendation. For example:

- Without explaining how keen the sense of smell a bear has, many citizens will believe that a lid on the garbage can will eliminate odours.
- Without understanding how physically strong even a small black bear is, many business owners were under the impression that a brick on top of the dumpster lid would keep it closed.
- Asking homeowners to remove ripe fruit seems a ridiculous suggestion to someone who believes that since domestic fruit is a healthy food then it is okay for bears to eat it. A discussion about the difference between healthy foods vs. natural foods is required.

Therefore, some background information and some basic bear biology can help to make the recommendations acceptable to more people. Developing a concrete package of facts and messages will help to avoid misinformation being circulated among the public.

- Public may contradict a bear-proofing recommendation based on their own misinformation
- Misinformation may be circulated to other parties
- We leave opportunities for excuses to be made, and blame to be placed elsewhere

I would suggest three basic facts which can be built upon to help back up the list of recommendations for attractant management. These should help to avoid those information gaps and misconceptions.

We live in bear country.

- Our town occupies traditional bear habitat.
- Bears may travel through our community.
- Follow basic safety precautions.

Bears are opportunistic feeders.

- Bears will seek the easiest food source.
- Bears have keen memories and a keen sense of smell.
- Bears will teach their cubs to return to food sources in town.

An habituated, food-conditioned bear can become a dangerous bear.

- These are the bears that Conservation Officers are forced to destroy.
- Bears that become comfortable in the presence of humans are the most dangerous bears.

Whistler's Bear Aware Program

Sylvia Dolson, J.J. Whistler Bear Society, 604-905-4209, whistlerbearlady@yahoo.com

In 1997, Whistler's Black Bear Task team was formed by a volunteer group of key stakeholders and a Black Bear Management Plan was completed in July 1998. Team membership included representatives from the Municipal government, JJWBS, the local waste company, Whistler / Blackcomb Mountain, Tourism Whistler, Conservation Officer

Service, RCMP, Bylaw Enforcement, a local environmental group, and concerned community members and businesses.

The objective of the plan is to minimize human-bear conflicts through effective waste management practices, public education and enforcement (through by-laws). Virtually all garbage containment in Whistler is now bear-proof and electric-fencing was installed at the landfill.

Education is considered an essential component of the plan. The public must understand and adhere to proper waste disposal methods and eliminate attractants from their backyards. Education is also required to establish a level of tolerance towards bears. Although bears are wild animals, and as such can sometimes be unpredictable and dangerous, there is no need to unjustly fear bears. When we can replace fear and ignorance with respect, then people will become more tolerant and will be more likely to take the appropriate steps towards human-bear co-existence.

Non-lethal bear management is recommended as an alternative to destroying bears that have become a so-called ‘nuisance’. Whistler is currently the only area in the province using this method - local RCMP, By-law officers, and district Conservation Officers have all been trained in the use non-lethal tactics. JJWBS has produced a guidebook to aid in this management technique.

Through this comprehensive bear management strategy, the community of Whistler will have a long-term approach to managing garbage and bears. The ultimate result of the bear management plan is expected to be realized over the next several years with significantly fewer bears destroyed. To date in 2000, the number of bears destroyed in Whistler is down 95% over last year.

Bear Proof Waste Handling System – The Town of Canmore Experience

Environmental Services Centre, 100 Glacier Drive, Canmore, Alberta T1W 1K8
403.678.1580 Fax 403.678.1586, acomeau@gov.canmore.ab.ca

This paper will detail the events, challenges and successes that lead to the elimination of curbside waste collection and the implementation of a complete animal proof waste handling system. The following will be addressed:

- Atmosphere leading to the decision to eliminate curbside waste collection
- Importance of public involvement (Waste Management Committee)
- Requirements for expert input
- Steps taken to site the containers
- Public education process
- Ongoing challenges

In the summer of 1998, due in part to a poor berry crop, the number of bear sightings grew in town and the number of bear / waste related incidents increased substantially. Local Fish & Wild officers pleaded with the Town via the local newspaper to remove curbside collection and provide a complete animal proof waste handling system. In addition, members of the public were sending letters to the paper editor requesting the Town eliminate curbside collection. The summer season continued and the number of bear / waste related problems increased to such a level that the Mayor sent a letter to all residents urging the utilization of the animal proof waste containers only until the bears went into hibernation. The Town of Canmore is now very proud of its waste handling system and how the community has embraced the change. We have completed a long successful process due to public consultation that has enabled us to co-exist with wildlife in terms of waste generation and disposal.

Moving Bears – Does it Work?

John Woods, Parks Canada, Box 350, Revelstoke, British Columbia, Canada, V0E 2S0
250-837-7527, john_woods@pch.gc.ca

During 1994-2000, 9 translocated female grizzly bears were radio-tracked concurrently with 18 female 'wild' (non-translocated) female grizzly bears within the upper Columbia River basin, British Columbia, Canada. Translocated bears were moved 43–200 km from their capture locations. The 2 bears moved the shortest distance (43 km), returned to their point of capture. Four translocated bears were identified as management problems on a second occasion. Five (of 9) translocated bears were known to have died within the study period. During the same interval, 5 (of 18) 'wild' bears died. Post-translocation home ranges (100% MCP) averaged 1053 km^2 (248–2494 km^2). Wild bear home ranges averaged 143 km^2 (29–388 km^2). The importance of defining criteria for successfully translocations was discussed.

Aversive Conditioning Results on 12 Radio Collared Problem Bears
Hal Morrison, Parks Canada, Box 99, Field, BC V0A 1G0, 250-343-6324, hal_morrison@pch.gc.ca

During 1991- 2000, 4 grizzly bears (Ursus arctos horribilis) and 8 black bears (Ursus americanus) in Banff, Yoho, and Kootenay National Parks were subjected to structured aversive conditioning program(s) in an attempt to modify undesired behaviours. Aversive conditioning is a structured reactive program where an animals ability to associate an activity/behaviour with a negative event is used to "teach " the animal a certain activity / behaviour is undesirable.

Each bear was identified as developing a profile of undesired activities or behaviours, its candidacy for undergoing a successful "learning" experience rated and prioritized and the bear was caught and collared if not already collared. An action plan for each bear was developed with a specific methodology identifying: the undesired behaviour / activity, the conditioning tools to be used and in what circumstances, the hours and frequency the bear will be monitored, the geographic boundaries that the actions will take place in, a schedule of dedicated manpower.

Each action plan was typically planned for 6-8 days in length and depending on the specific outcome sought, either 24 hours a day or during daylight hours. Consistency of application of the action plan and sustainability of being able to repeat the effort if the bear lapsed back into the undesired activity/behaviour at a later date were deemed as key components in expecting a successful outcome. An uncontrollable variable in the bears particular personality and its ability/willingness to learn not to do the undesired behaviour determined the amount of effort dedicated and usually the eventual outcome. Due to the intensive manpower requirements, few action plans could be carried out in a season. The following 12 bears represent a wide range of candidacy and in some cases may skew the results and undermine the potential effectiveness of aversive conditioning.

Of the 4 grizzly bears (2 males, 2 females) actioned, 3 remain in the system. Since the initial aversive conditioning effort:

- 1 female maintained in the system 9 seasons and who produced 3 sets of offspring
- 1 female maintained in the system 2 seasons and produced her first cub this year
- 1 male maintained in the system 3 seasons and then removed to the zoo
- 1 male maintained in the system 1 season.

Total hours expended = 2,226.0*
Range of hours per bear = 12.0 - 1,100.0 .
Average hours per season to retain these bears in the system = 148.0

Of the 8 black bears (7 males, 1 female) 3 males remain in the system. Since the initial aversive conditioning effort:

- 3 males continue in the system after 2 seasons each,
- 3 males destroyed after being maintained in the system; 2 seasons, one season and one season, respectively
- 1 male maintained in the system 3 seasons before killed on the railway
- 1 female predated upon by a grizzly bear after one season.

Total hours expended = 604.5 **
Range of hours per bear = 10.0 - 208.5
Average hours per season to retain these bears in the system = 43.2

Although long term solutions to reducing human/bear conflict continue to be the necessity for effective communications, human use strategies and human use concessions , we have found aversive conditioning to be a useful reactive tool in behaviour modification and offers an alternative to relocations and destructions.

* includes 1999 Karelian bear dog hours spent on 1 female grizzly
** includes 1999 Karelian bear dog hours spent on two male black bears

Electric Bear Fencing at Landfills

Jeff Marley, Margo Supplies, High River, Alberta, 403-652-1932,
margo@margosupplies.com . No summary provided

Behavior of Grizzly Bears Before and After Landfill Closures in North-Central BC

Mari Wood, Peace-Williston Fish and Wildlife Compensation Program,
250-565-4191, mari.wood@gems7.gov.bc.ca
and
Pamela E. Hengeveld, Boreas Consulting Services, #310–211 North Ospika Blvd., Prince George, BC V2M 3R1

Existing landfills in smaller communities throughout BC are being phased out over the next few years, and in the process grizzly bears that frequent many of these sites may need to be destroyed. We are investigating an option that may help to conserve some of those bears. Our objectives are to 1) classify the behaviour of individual grizzly bears into those that become a threat to humans after closure of a landfill and those that do not, and thereby 2) improve decisions made by the Conservation Officer Service regarding which individual bears to destroy or not destroy. The project is being conducted at the McLeod Lake landfill in the Sub-Boreal Spruce (SBS) biogeoclimatic zone in north-central BC over a 3-year period: 2000 (pre-landfill closure), and 2001 and 2002 (post-landfill closure). To assist in meeting our objectives, we will be examining several characteristics of each individual bear including age, sex, reproductive status, frequency of landfill use prior to closure, home range size, and movement patterns.

Snares sets and culvert traps were used to capture grizzly bears at the landfill in both the spring and fall of 2000. Thirteen individual grizzly bears were captured (6 spring, 7 fall); 12 were radio-tagged for subsequent monitoring. Trapping success was 3 times higher in fall, with many individual bears captured multiple times. In spring, 9 captures in 238 trapnights resulted in a trapping success rate of 0.04 bears/trapnight , while in fall, 36 captures in 310 trapnights resulted in a success rate of 0.12 bears/trapping night. One adult female was captured 9 times (1 in spring and 8 in fall).

Movements and habitat use of radio-tagged grizzly bears were monitored weekly by fixed-wing aircraft between May and December 2000. Some bears remained within a few kilometers of the landfill all year, while others used the landfill area only in spring and fall. One subadult male visited the landfill briefly in spring but never returned. Nine of 12 collared bears were located at den sites by mid-November. Two adult females moved to den sites by early November while the subadult male reached a den site by early December. Daily use of the landfill by radio-tagged grizzly bears was monitored using a remote datalogger programmed to scan all frequencies at 10-minute intervals. Thousands of records including the time of day each individual bear entered and left the landfill were obtained. Data will be analyzed over the winter of 2000/01.

Radio-tagged bears will continue to be monitored by fixed-wing on a weekly basis between April and December in 2001 and 2002. Of particular interest over the next 2 years is the bears' survival (bears that seek out other garbage sources will likely be destroyed) and changes in their home range size or areas of use. The remote datalogger will also continue to monitor the frequency and timing of bear visits to the old landfill site.

This study is being conducted by the Peace/Williston Fish and Wildlife Compensation Program (PWFWCP). The PWFWCP is a cooperative venture of BC Hydro, BC Environment and Lands, and BC Fisheries, supported by funding from BC Hydro. The Program was established to enhance and protect fish and wildlife resources affected by the construction of the WAC Bennett and Peace Canyon Dams on the Peace River, and the subsequent creation of the Williston and Dinosaur Reservoirs.

Northern Bear Awareness

Tony Boschmann, Prince George, 250-964-0215, boschmann@attcanada.net
No summary provided.

The Partners in Life Program – Keeping Bears Wild

C.L. Hunt and T.L. Manley, Wind River Bear Institute, Box 307, Heber City, UT, 84032, (435) 654-6644, windriver@shadowlink.net; Montana Fish, Wildlife and Parks, 490 N. Meridian, Kalispell, MT, 59901, (406) 892-0802, manley@digisys.net.

The Partners in Life Program (Partners) goal is to improve coexistence between bears and people. Effective solutions that prevent bear conflicts or their reoccurrence are critical. Current methods of controlling problem bears such as relocations are generally ineffective as long-term solutions to the problem. Most problem bears must eventually be destroyed. Development of methods that prevent conflicts is critical for the survival of bears in out fast growing world. The Partners Program is the only one of its kind in the world. The Program "shepherds" bears in a unique, non-invasive approach developed by Hunt called "Bear Shepherding" that incorporates teaching bears and the public correct behaviors. The ideas of teaching bears using Karelian Bear Dogs (KBDs) and the behavioral principals and goals used to teach the bears have never been tried before. Since the Program began in 1995, Bear Shepherding has occurred in Alaska, Montana, California and Alberta. Introductory programs have been given in Washington and British Columbia. More than 200 bear management professionals have attended Bear Shepherding workshops and personal instruction has been given to over 60 bear conflict personnel. Public education and prevention is a key element and over 600 landowners and more than 4000 tourists have been personally contacted. Bear Shepherding has been applied to more than 100 individual black and grizzly bears in over 750 cases. The recently formed Montana Fish, Wildlife and Parks Foundation has selected the Partners In Life Program as its flagship project and is creating an endowment that would fund the Partners Program into perpetuity.

The Causes and Avoidance of Bear Attacks

Stephen Herrero, Environmental Science Program
Faculty of Environmental Design, University of Calgary, AB T2N 1N4,
403-762-1405, herrero@ucalgary.ca

I will summarize data regarding serious and fatal bear attacks in British Columbia, 1960-97. An abstract of this previously presented research follows. Then I will address two questions: 1) is hunting necessary for acceptable levels of safety with bears, and 2) are bears that feed on salmon less aggressive? I will conclude by going on a “walk in the woods” with the audience. While “walking” I will discuss how to avoid encounters with bears. Failing this we will have various interactions with bears. These will include sighting, being approached, deterring bears and what to do if attacked.

The following is from *Ursus, Volume 11, 1999* and a paper by S. Herrero and A. Higgins titled: Human injuries inflicted by bear in British Columbia: 1960-97.

There is controversy in British Columbia regarding how dangerous bears are. Grizzly bear (Ursus arctos) population estimates range from 10,000-13,000; black bears (U. americanus)120,000-160,000. From 1960-97, significantly fewer grizzly bears inflicted about 3 times as many serious injuries (N = 41 versus 14) but the same number of fatal injuries (N = 8) as black bears. The trend in terms of average number of bear-inflicted injuries/year increased each decade from the 1960s through the 1990s, as did the human population in B.C. It is likely that more people in bear habitat affected this increase in the number of injuries. In 88% of serious or fatal grizzly bear attacks, those injured were engaged in hunting, hiking, or working, typically in back-country areas. In 77% of black bear attacks, those injured were either hiking, watching the bear, working, or recreating, typically in front-country areas. Eighty-one percent of parties injured by grizzly bears and 69% of parties injured by black bears were composed of 1 or 2 people. Bear access to human food or garbage was associated with a relatively small number of incidents for each species. In grizzly bear incidents where the age and sex class were known, adult females were identified in 79% of incidents. All incidents where the gender of an attacking black bear was known involved males. These incidents were equally divided between adults and subadults. Poor health of the bear was identified in 16% of black bear and 7% of grizzly bear incidents. Sixty-two percent of the serious or fatal grizzly bear incidents, where the bear’s motivation could be inferred, were categorized as involving a bear being startled at close range (<50 m) and 19% involved ungulate carcasses. For black bear incidents, where the bear’s motivation could be inferred, 83% involved possible predation. None involved ungulate carcasses and none involved the bear being startled. Risk of bear attack can be managed through individual responsibility and communication targeted at individuals and groups such as ungulate hunters, hikers and campers, and persons working in bear habitat.

Print copies of this document are available at a cost of $20 each
(includes taxes and shipping)

Please contact:

Columbia Mountains Institute of Applied Ecology
Box 2568 Revelstoke BC Canada V0E 2S0
cmi@revelstoke.net
250-837-9311