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# British Columbia Grizzly Bear Population Estimate for 2012

Ministry of Forests, Lands and Natural Resource Operations
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## Introduction

This report summarizes the current (2012) Grizzly bear population estimate for British Columbia. The previous population estimate was made in 2004 (Hamilton et al. 2004), and updated in 2008 (Hamilton 2008). The 2012 population estimate is primarily derived from a predictive population density model that uses all of the provincial Grizzly bear inventories (mark-recapture DNA estimates) and other inventories across North America to predict densities in areas without mark-recapture inventories on the basis of several environmental and human independent factors that are thought to influence bear numbers. Where they existed, inventory results were directly applied. Expert knowledge of local areas was used in addition to the information provided by the model to determine population estimates for each Grizzly bear Population Unit (GBPU) in the province.

The population estimate is one portion of the information used in managing harvest opportunities for Grizzly bears in BC. *The Grizzly Bear Hunting - Frequently Asked Questions* document (available at www.env.gov.bc.ca/fw/wildlife/management-issues/#grizzly) explains in detail the harvest managment process.

## Grizzly Bear Population Units

The current range of Grizzly bears in British Columbia has been divided into 56 GBPUs that delineate individual bear populations for conservation and management. In the south, GBPU boundaries follow natural (e.g. large rivers) and human-caused (e.g. settled valleys) fractures in Grizzly bear distribution. In the case of many southern GBPUs, the boundaries also reflect a degree of genetic isolation from other populations (Proctor et al. 2012). In northern and coastal British Columbia, GBPU boundaries follow natural and ecological boundaries or transition areas (primarily heights of land between watersheds) as there are few actual barriers to Grizzly bear movement.

GBPU boundaries at the edges of Grizzly bear distribution in the province represent the “occupied/unoccupied” line. This line was drawn to reflect the known and predicted distribution of resident adult females. Transient males, particularly subadults, are occasionally sighted in unoccupied areas. However, these lines are the expected limits of areas regularly inhabited by Grizzly bears. GBPUs serve as the key units for setting population objectives. They are also used for setting land-use priorities during strategic land-use planning. Each GBPU has been assigned a conservation status of either Threatened or Viable. The objective for the 9 Threatened GBPUs in B.C. is population recovery to prevent range contraction and ensure long-term population viability. The objectives for the remaining 47 viable GBPUs includes maintaining current population abundance and distribution, and providing sustainable harvest and viewing opportunities where appropriate.

## Population Estimation

Population estimates for Grizzly bears in BC have changed over the years, as new and more sophisticated methods for estimating populations have become available. In the 1970's the estimate was 6,600 bears. That changed to 13,000 (a minimum estimate) in 1990 and 17,000 in 2004. The last estimate from 2008 was 16,000. The 2012 estimate is 15,000. Because the methods used to estimate the population have evolved and improved over time, the variation in estimates from year to year do not reflect a trend in Grizzly bear numbers in the province. The current estimate uses all available inventories and incorporates the most rigorous statistical modelling approach used to date.

Direct inventories used DNA mark-recapture methods to determine bear density (the number of bears per 1000 $km^2$) in a particular area. This type of inventory, that was first developed in British Columbia (Woods et al. 1999) has been carried out here since 1996 and provides the most reliable population estimates with a measure of confidence for the various studies areas (see summary in Proctor et al. 2010). In several areas, direct application of inventory was used to derive the 2012 population estimate.

In the majority of the province, a predictive population density model (using multiple regression analysis) was used to estimate the number of Grizzly bears. This model used 89 estimates of Grizzly bear density from study areas across western North America to predict Grizzly bear densities in areas of the province using independent variables such as precipitation, vegetation type and human and livestock densities. These variables were found to be significant as general landscape scale predictors of Grizzly bear density. The regression model did not find hunting (harvest/1000$km^2$) to be a significant factor predicting density. The above model was derived for areas where grizzly bears ate little or no salmon (interior). Another model was built to predict density for coastal areas where salmon was a large part of the diet. The coastal model had 18 records of density and included 4 variables. A similar type of multiple regression model was used to obtain the 2008 Grizzly bear population estimate (Mowat et al. 2004). However, the current models incorporate additional data from recent inventories and employ more sophisticated statistical analysis. The new models were also applied at a finer scale (Wildlife Management Units) to better reflect density differences across GBPUs (GBPUs incorporate several Management Units).

Model estimates were carefully considered by ministry regional biologists. They took into account the precision of the model estimate, local knowledge on bear distribution and movements, availability of major food sources such as salmon, as well as the age and sex of past hunter harvests and the frequency of problem bear occurrences. The model estimate was accepted or modified based on the above considerations. For example, the model for the interior areas of the province was better at predicting densities than the model for the coastal areas. For the coastal populations, information from inventories and local knowledge about the abundance of bears was used to estimate the population, rather than a strict reliance on the model.

In some areas the model estimate was modified to be lower or higher through expert opinion. In 17 of 184 Management Units (MUs), the opinion of experts differed greatly from model estimates. In six of these MUs, the model predicted no bears but, because bears do exist in these areas the model estimate was changed. Of the remaining 11 MUs, three were adjusted down and eight were adjusted up. In the majority of these cases (9), the MUs were on the coast or heavily influenced by the presence of spawning salmon. The authors of the model cautioned that the "coastal" version of the model was less reliable than the "interior" version, largely because of the limited number of reliable mark-recapture density estimates available for the coast and the high influence of rainfall as a model input parameter. In the final two MUs, regional biologists applied densities from adjacent Management Units and inventories that were done in nearby areas to adjust the estimate.

The revised Grizzly bear population estimate for British Columbia in 2012 is 15,075 bears. A quantitative measure of precision at the provincial level is not possible because the expert-based approach does not provide a statistical estimate of uncertainty.

The 2012 estimate of approximately 15,000 bears should not be interpreted as a decline in Grizzly bear numbers since 2008 but rather a more accurate estimate of the total population size in the Province. Differences between the 2008 and 2012 estimates are due to the updated model, the application of the model at the Management Unit scale, and the availability of new information, such as recent inventory and monitoring work which informed the revised estimates. Population estimates by GBPU are summarized in Table 1. Grizzly bear densities by GBPU in increments of 10 bears/1000km$^2$ are shown in Figure 1.

## Grizzly Bear Hunting

There is no Grizzly bear hunting in extirpated areas or Threatened GBPUs (Figure 2). Other areas closed to Grizzly bear hunting include Grizzly Bear Management Areas and National Parks. Some GBPUs may be temporarily closed where known mortality has met or exceeded allowable limits, as established through the Ministry's Grizzly bear harvest management procedure. Two GBPUs, the Francois and Moberly, were closed in 2012 as a result of their new, lower, population estimates. In other areas open to hunting the allowable harvest has been adjusted up or down reflecting the new population estimates. While population estimates are used to set allowable harvest limits, other information collected from harvested bears (e.g. sex and age) is also used to ensure a sustainable harvest. For more information on the management of Grizzly bear hunting in British Columbia please refer to the *Grizzly Bear Hunting – Frequently Asked Questions* document on the Fish, Wildlife and Habitat Management Branch website (www.env.gov.bc.ca/fw/wildlife/management-issues/#grizzly).

## Figures

Figure 1. Grizzly bear density by Grizzly Bear Population Unit.

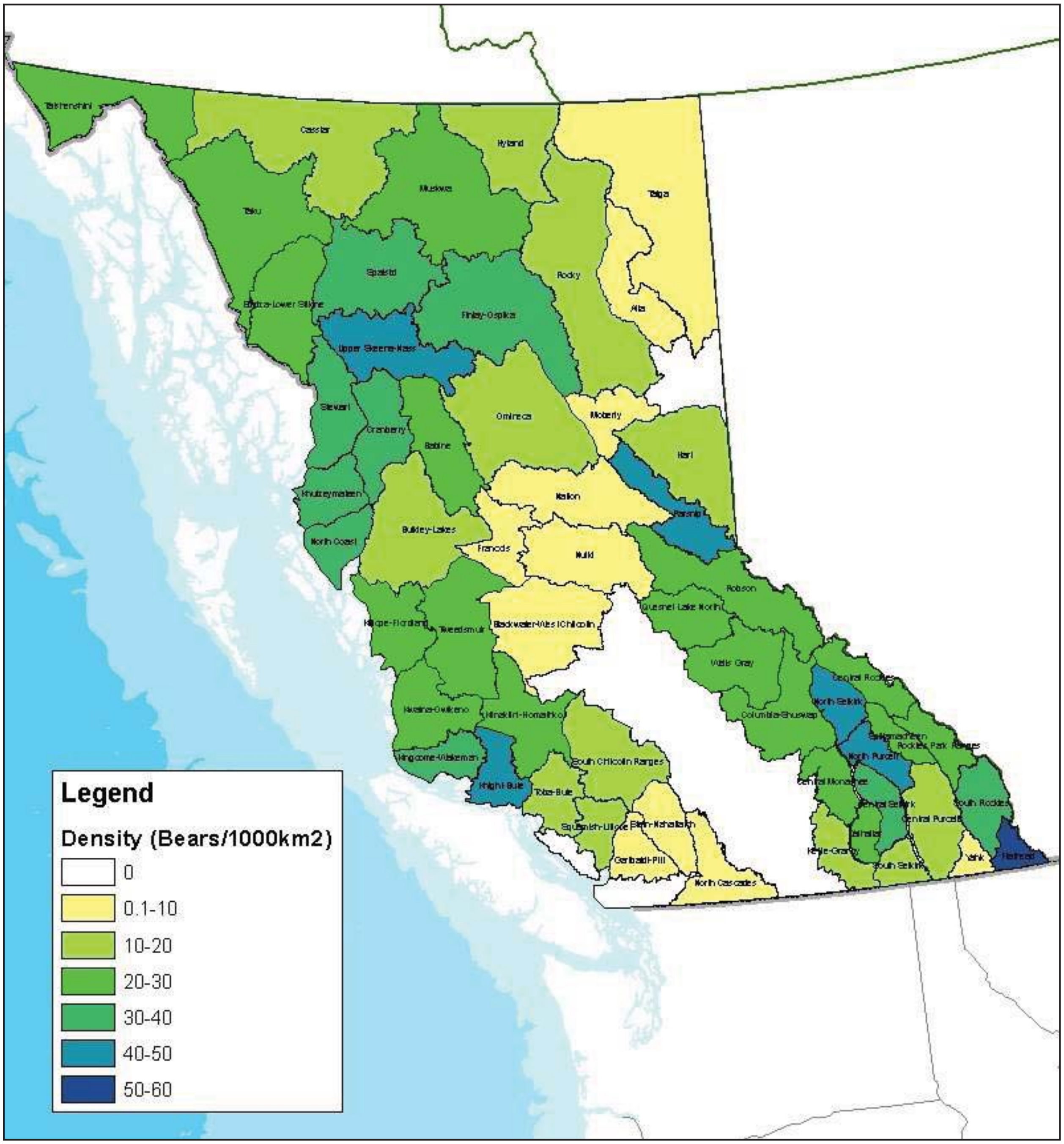
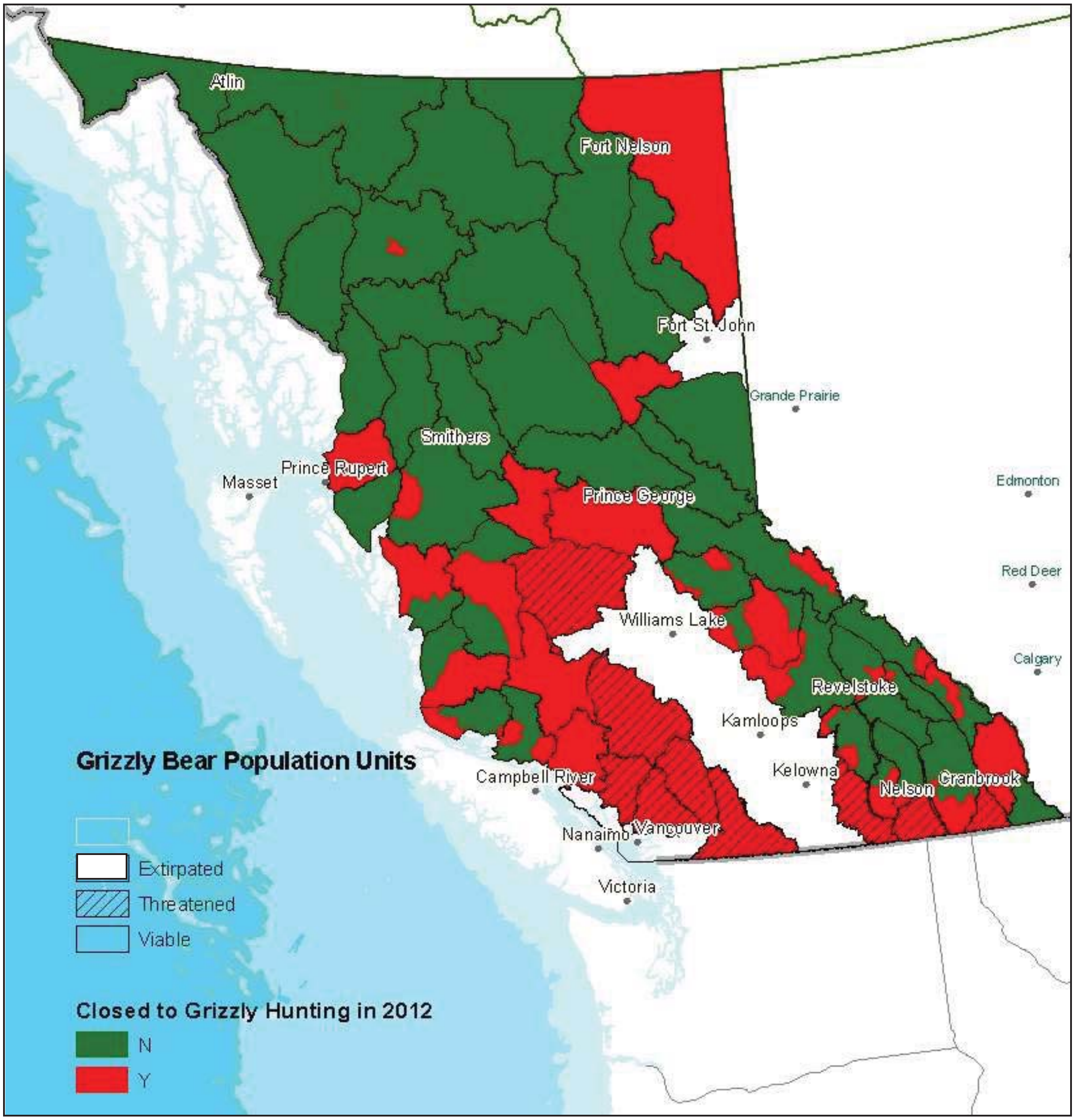


Figure 2. Areas open (green) and closed (red) to Grizzly bear hunting in British Columbia. Threatened units are identified by cross-hatching. White areas within BC are extirpated or never occupied.



## Tables

Table 1. Grizzly Bear Population Estimates for British Columbia by GBPU, 2012. Dark grey indicates threatened units, light grey highlights additional units that are currently not hunted.

| Grizzly Bear Population Unit | 2012 Estimate |
|---|---|
| Alta | 132 |
| Babine | 313 |
| Blackwater-West Chilcotin | 53 |
| Bulkley-Lakes | 439 |
| Cassiar | 612 |
| Central Monashee | 147 |
| Central Purcell (formerly South and Central Purcell) | 176 |
| Central Rockies | 169 |
| Central Selkirk | 188 |
| Columbia-Shuswap | 346 |
| Cranberry | 349 |
| Edziza-Lower Stikine | 398 |
| Finlay-Ospika | 971 |
| Flathead | 175 |
| Francois | 58 |
| Garibaldi-Pitt | 2 |
| Hart | 244 |
| Hyland | 231 |
| Kettle-Granby | 86 |
| Khutzeymateen | 280 |
| Kingcome-Wakeman | 199 |
| Kitlope-Fiordland | 214 |
| Klinaklini-Homathko | 251 |
| Knight-Bute | 250 |
| Kwatna-Owikeno | 229 |
| Moberly | 71 |
| Muskwa | 840 |
| Nation | 170 |
| North Cascades | 6 |
| North Coast | 190 |
| North Purcell | 234 |
| North Selkirk | 265 |
| Nulki | 44 |
| Omineca | 402 |
| Parsnip | 455 |

| Grizzly Bear Population Unit | 2012 Estimate |
|---|---|
| Quesnel Lake North | 187 |
| Robson | 534 |
| Rockies Park Ranges | 116 |
| Rocky | 538 |
| South Chilcotin Ranges | 203 |
| South Rockies | 305 |
| South Selkirk | 58 |
| Spatsizi | 666 |
| Spillamacheen | 98 |
| Squamish-Lillooet | 59 |
| Stein-Nahatlatch | 24 |
| Stewart | 358 |
| Taiga | 94 |
| Taku | 575 |
| Tatshenshini | 407 |
| Toba-Bute | 116 |
| Tweedsmuir | 368 |
| Upper Skeena-Nass | 755 |
| Valhalla | 88 |
| Wells Gray | 317 |
| Yahk | 20 |
| **Total** | **15,075** |

| | |
|---|---|
| Threatened GBPUs | Dark grey |
| Additional un-hunted GBPUs | Light grey |

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# MISCONCEPTIONS, IRONIES, AND UNCERTAINTIES REGARDING TRENDS IN BEAR POPULATIONS

*INVITED PAPER*

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***Abstract:*** Despite our rapidly increasing knowledge of bears, there are few places in the world where we really know how bear populations are faring. I argue that bear conservation would benefit by highlighting rather than hiding this uncertainty. Assessments of bear populations often are based on records of dead animals and trends in habitat availability. These data produce dubious indications of population trend. Case studies relating to the trade in bear parts, sport harvests, and nuisance kills indicate that records of human-killed bears may not be accurate and may not necessarily reflect changes in population size. Increasing bear populations may continue to rise with increased levels of human exploitation (as long as it is below the maximum sustainable take), whereas declining populations may continue to plummet despite reduced exploitation. Similarly, whereas loss of habitat (forest area) probably engenders a decline (of unknown magnitude) in bear populations, unchanging or increasing forested area may not necessarily result in stable or increasing bear numbers. Ironically, bear populations that have been managed for sustained harvests have generally fared better than populations in which hunting has been prohibited, mainly because the former better controls illicit hunting than the latter. Long-term conservation of bears requires better information on population trends, but better techniques are unlikely to be developed if faults and inadequacies of current data are not clearly recognized.

*Ursus 13:321–334 (2002)*

***Key words:*** Asia, bears, conservation, habitat loss, harvest, North America, poaching, population size, population trend, trade in bear parts, uncertainty

In most human societies, knowledge empowers, whereas uncertainty signifies fallibility, timidity, and weakness. Scientists are presumed to be knowledgeable, and thus able to produce accurate facts, explanations, and predictions; those that do so with certainty tend to be held in high esteem by the public. The soothsayers of the past were probably wrong more often than are modern forecasters of environmental and astronomical events, but even today's complicated computer models are prone to error because we lack a full understanding of most natural systems.

A major concern in today's world is the threat of species extinctions due to the activities of humans. There is a strong relationship between human population size and threat of extinction of native fauna (McKinney 2001). Although we recognize the basic causes of extinction (Diamond 1989) and we have been able to identify taxa, ecosystems, and geographic areas that are most susceptible to extinctions (Cole et al. 1994, Mace and Balmford 2000), ecologists and conservation biologists have been struggling to understand how to relieve species from extinction threats. Seemingly basic questions, such as "What is the minimum viable population size and what level of human exploitation is sustainable? What habitats does the species require and how much area should be protected within reserves?" are routinely debated, because empirical data are lacking. Unfortunately, the science of ecology is by nature inexact and laden with uncertainty.

Shrader-Frechette and McCoy (1993:123–124) contend that due to the inherent complexity of ecology, there are few governing principles, so case studies are the best means for achieving understanding. The method of case studies involves scrutinizing the details of particular situations in an attempt to "make sense" of them. Accumulating and comparing results from a series of related case studies advances the science.

For large mammals such as bears, experimentation is rarely employed as a part of the case study. Instead, bear biologists tend to reach conclusions based on patterns in the data, logic, insight, and knowledge of other studies. Case studies generally enter the body of science through a process of peer-review, although much information is contained in less formal reports and even raw data.

At periodic junctures it is worthwhile to review the basis of conclusions and direction of thinking. In experimental sciences, predictions that are not upheld empirically are ultimately discarded. In sciences based on case studies, apparent anomalies may represent truly unique situations, making it difficult to tease out erroneous information. Nevertheless, occasional re-examinations may prove to be fruitful — if not to correct the past, to guide the future — especially in terms of species conservation.

In this paper I draw attention to several misconceptions related to the monitoring and conservation of bear populations. I rely heavily on case studies to illustrate my points. These are used mainly as counter-examples to prevailing views or to exemplify common problems.

A principal purpose of this critique is to highlight the uncertainty, and hence fallibility, of our understanding of bear populations. There are few places in the world where biologists would admit to not knowing whether a bear population was increasing, decreasing, or stable, yet the reality is that there are few places where we really *do* know for sure how bears are faring. Seemingly contrary to my opening remarks, I believe that ultimately we, as bear biologists benefit — because bears benefit — by critically examining the basis of our knowledge and admitting to our foibles and uncertainties.

## MISCONCEPTIONS REGARDING POPULATION TREND

### Trend Ascertained from Numbers of Dead Bears

In a population of unknown size, a large death toll is obviously unnerving. Because most bear populations are of unknown size, a record of increasing known deaths is often taken as *prima facie* evidence of a population decline. Moreover, even poor records with no clear trend but occasional documentation of a surge of deaths may be cause to fear a population decline.

Records of bear parts (principally gall bladders) traded among Asian countries are a salient example of tallies of dead bears being used to interpret population trends. Several good investigative reports exposed the broad geographic scope of this trade (Mills and Servheen 1991; Mills 1995; Mills et al. 1995, 1997), although it was not possible to accurately quantify it. Some evidence suggested increases or decreases in bear kills in certain countries, based on documented or estimated numbers of exported or imported parts. However, population trend assessments based on trends in the trade in bear parts, and hence numbers of bears killed, have been inconsistent. Consider the cases of 3 countries that have been heavily involved in this trade.

*China.*—In China, the killing of bears (other than giant pandas [*Ailuropoda melanoleuca*]) for their parts was legal until 1989. In the decade preceding this restriction (1979–88), several thousand bear gall bladders were exported from China to Japan (Servheen 1990). Additional, but smaller numbers of gall bladders were exported to South Korea (Mills et al. 1995). However, trends and quantities of bears killed for the trade in gall bladders are nearly impossible to discern from bile export data, due to many confounding issues, including trade in fake bear bile (gall from animals other than bears that are claimed as bears) and farmed bile (bile drained from live, captive bears)(Box 1).

Farming bears for their bile began in China in 1984. During 1985–89 hundreds or thousands of bears were removed from the wild to stock captive populations (Fan and Song 1997). However, since 1989, all of the species of bears in China (brown [*Ursus arctos*], Asiatic black [*U. thibetanus*], and sun [*Helarctos malayanus*]) have been protected, inasmuch as killing or capturing is illegal without a special permit, and selling of parts of wild bears is also prohibited (Mills and Servheen 1991, Fan and Song 1997). Has this supposed change in exploitation of bears enabled bear populations to increase? The answer is unclear.

Santiapillai and Santiapillai (1997:23) indicated that "throughout China, bear populations are in decline." They cite an estimate of 15,000–20,000 Asiatic black bears in China, which matches the range reported by Ma and Li (1999), based on "1994 statistics". Ma and Li (1999) believed that over-hunting for bear parts was causing this species to decline, although their chief evidence for recent declines were diminishing numbers of purchased bear skins during 1986–1991. Cheng (1999:123), referring to these same data, concluded that "In recent years, … the number of bears [both black and brown, in one province] has dropped significantly…" Li et al. (1996; citing Ma et al. [1994]), presented higher population estimates (20,000–32,000 Asiatic black bears and 12,000–14,000 brown bears), but also suggested that populations were shrinking. Fan and Song (1997:11) called these estimates "an emotional guess" and presented their own estimates of 46,500 Asiatic black bears, 14,800 brown bears, and 400 sun bears, based on field surveys and interviews with local people. They claimed that after bears were protected in 1989, populations increased. Ma et al. (2001) conducted a more recent survey, also based on field sign and local interviews, and concluded that Asiatic black bears numbered <20,000 and were still declining numerically and geographically. Differences in these opinions appear to be just that — beliefs lacking much factual basis.

*Russia.*—Exportation of bear gall bladders increased dramatically in Russia in the early 1990s for various political and economic reasons (Chestin 1998). Chestin (1998) believed that because of increased economic incentives, legal harvests of brown bears, generally totaling 4,000–4,500 nationwide, might have been matched by an equal number of illegally taken (poached) bears. Imports of bile to South Korea from Russia showed a sharp increase in the 1990s, but still represented a small number of bears killed/year (Box 1). Prior to this rise in poaching, the total number of Russian brown bears appears to have increased, from an estimated population of 80,000 in 1981 to 125,000 in 1990, and the geographic range expanded concomitantly (Chestin 1999). Annual sustainable harvest quotas were established so as not to exceed 10% of the population, but in reality appeared to be far below that. Thus, even if poaching was as high as posited by Chestin (1998), the overall rate of human exploitation may have been sustainable. Most killing for gall bladders has occurred in the Russian Far East (Kamchatka), where some reports suggested an annual take of 1,500–2,000 brown bears, possibly 20% of the population (Nikolaeno

**Box 1. Records of bile imports or exports have been used to estimate the number of bears killed to support that trade. Tabulated below are the supposed numbers of bears killed/year to account for imports of bear bile recorded by the Korean Customs Administration (Mills 1995, Mills et al. 1995) for 4 countries of origin discussed in the text.**

| | Calculated number of bears killed/year | | |
|---|---|---|---|
| Country of origin | 1970s | 1980s | 1990s |
| China | 3 | 3 | 490 |
| Russia | 0 | 0 | 15 |
| Japan | 7100 | 26 | 7 |
| Indonesia | 690 | 3 | 0 |

Although these numbers seem to indicate clear trends in bears killed over time, the data are too confounded to draw such conclusions. Several major difficulties exist in converting bile to bears.

*Variation in Gall Bladder Mass.*—The amount of bile in gall bladders varies by species, geographic area, and time of year, so any conversion of bile mass to dead bear equivalents is subject to appreciable error. Values tabulated are based on 30 grams/whole, dried bear gall bladder (Lay 2001). Mills (1995) suggested an average of 60 grams/gall bladder, but did not present supporting documentation. Further uncertainty involves whether the Korean customs records relate to grams of bile, grams of whole gall bladders, or a combination of both.

*Changes in Regulations, Enforcement, and Recording of Imports.*—Mills (1995) and Mills et al. (1995) reported Korean bile import data by decade, covering 24 years, 1970–93. The Republic of Korea joined the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in July 1993, and in 1996 accepted the Appendix II listing of bears whose populations were not considered threatened; this listing requires documentation to ensure legal import. Korea also concomitantly improved surveillance and enforcement. These actions resulted in better recording of bear imports and more seizures, so the total amount of bile rose by nearly an order of magnitude from the 1990–93 period shown in the table to 1994–99 (Mills et al. 1997, Yoon 1997, Sohn 2001).

*Counterfeit Bile.*—Several investigative reports (Lau et al. 1994, Chang et al. 1995, Gaski 1997) indicated that a very high proportion of the presumed bear gall bladders on the Asian market (94–98%) are from animals other than bears. This would severely inflate the estimate of dead bears based on bile imports. Trade in non-bear gall bladders likely explains the unreasonably large quantity of bile from Indonesia and Japan in the 1970s. It would be impossible to remove >7,000 bears annually for 10 years from a Japanese population of 10,000–15,000 black bears (Hazumi 1999) and 2,000–3,000 brown bears (Moll 2001). Moreover, Japan also has an internal market for bear bile, and exports to countries other than South Korea, so the amount of bile obtained in Japan is far more than indicated on Korean customs records.

*Farmed Bile.*—Bile obtained from catheterized, captive (farmed) bears probably explains the sharp increase in imports from China in the 1990s. Lau et al. (1994) indicated that virtually all the bile imported from China (into Hong Kong) in the early 1990s was from captive bears, not dead bears. The Korean import data do not discriminate between powdered bile (most likely from farmed bears) and whole gall bladders (dead animals, most of which are not bears).

1993, cited in Chestin 1999). In this area it is assumed that numbers declined, although population estimates from aerial surveys showed an equivocal trend (Revenko 1998).

Commercially-motivated poaching of Asiatic black bears in the Russian Far East (the only area of Russia inhabited by this species) also has increased, but estimates of population size and presumed rates of decline have been highly variable and contradictory (Yudin 1993). Moreover, references to population declines in this species generally refer to the distant past. Chestin and Yudin (1999) suggested that Russian Asiatic black bears numbered 25,000–35,000 at the beginning of the 1800s, only 6,000–8,000 in 1970, and 4,000–5,000 by 1985, which is thought to be about the same remaining at present. Until 1983, Russians legally harvested 300–400 Asiatic black bears/year. Since then, black bear hunting has been illegal. It is uncertain whether the previous legal harvest of 300–400 was sustainable (it would seem so if the population was 4,000–5,000), and if so, whether illegal harvests now exceed that. Sustainability of the harvest relates only to the number of bears killed, not whether they were legally or illegally taken. Of course the former is more readily adjusted to remain sustainable, but the later is not by definition unsustainable.

*Japan.*—Japan is an importer and exporter of bear bile, as well as a user of products obtained from native bears. Both import and export of bile appeared to decline dramatically from the 1970s to the early 1990s (Mills et al. 1995), although these data are difficult to interpret (Box 1). Harvesting of brown bears (on Hokkaido) and black bears (on Honshu) is legal, but rather loosely regulated in part because there has been a long-term, purposeful effort to reduce numbers of bears. Hunters can legally sell all parts of bears they harvest, and there are no government-imposed restrictions on the number they can take during the hunting season. It is believed that the opportunity to sell bear parts is largely what sustains interest in hunting (Moll 2001).

Some hunting restrictions were imposed during the 1980s and 1990s (e.g., elimination of the brown bear season during spring when hunters could snow-track bears to or from their dens) (Mano 1998, Moll 2001); this reduced the kill, but not in all areas (Kaji and Mano 1996). Mano and Moll (1999:129) thought that brown bear harvests still exceeded sustainable limits in some places, such as the Oshima peninsula, threatening the "long-term persistence of that subpopulation." In another report, however, Mano (1998:179) indicated that the Oshima brown bear population "persists in high numbers," but suggested that bears in more lightly hunted areas were declining. Aoi (1991:135) described the overall Hokkaido brown bear population as "declining rapidly," whereas Kaji (1992:413) thought that "Further studies are needed to analyze the population trend..." It seems clear from the conflicting reports that Kaji's call for more study is warranted.

Approximately 2,000 Asiatic black bears have been taken annually on Honshu, half by hunting and half explicitly for pest control (Hazumi 1994). Based on density estimates produced from springtime snow-tracking, capture–recapture, and habitat assessment across the island, the total population size has been estimated at 10,000–15,000. The veracity of this estimate is difficult to assess, and even if it is assumed to be accurate, the span is wide enough to preclude judgment as to whether present levels of exploitation are sustainable. Hazumi (1999:209) considered Japanese black bears to be "facing a crisis," due to the combined effects of habitat degradation and uncontrolled harvesting, but he had no real evidence of a population decline. Some prefectural government studies have attempted to assess local population trends, but flaws in their methodology undermined the credibility of their results (Huygens and Hayashi 2001).

*Generalities.*—The 3 countries highlighted above were selected not because they exemplified situations with inadequate data on bear population trends, but rather because, compared to other Asian countries impacted by the gall bladder trade, they had considerably *more* data on their bear populations. Additionally, unlike most of the other Asian countries, some records of the gall bladder trade exist for these 3, and each of the 3 exhibited an apparent temporal trend in the volume of this trade (Box 1). Despite these data, bear population trends in these 3 countries are equivocal, even controversial. The status of bears in other Asian countries is even more uncertain.

I am not suggesting that the gall bladder trade is not cause for grave concern — certainly it is. But this concern should arise from the uncertainty, not the certainty, of the impacts. We cannot discount the possibility that in many areas, the exploitation of bears for parts is *sustainable*. That is, we cannot reject the null hypothesis of *no detrimental effect*. However, employing statistical terminology, we have insufficient power (due to a paucity of data) to reject this hypothesis. Normally, we are concerned mainly with type-I errors: we attempt to avoid erroneously rejecting a true null hypothesis. However, in cases involving harm, to people or the environment, it may be ethically more responsible to err on the side of caution by trying to avert effects that may be nonexistent (i.e., putting more effort toward avoiding type-II errors; Mapstone 1995). Shrader-Frechette and McCoy (1993:153) put it this way: "in cases of *uncertainty* [my emphasis], ecologists ought to adopt an ethical (rather than purely scientific) account of ecological rationality." Thus, for rare species, the burden of proof should switch from proving that a population decline has occurred, to proving that it has not (Taylor and Gerrodette 1993).

A problem with emphasizing the avoidance of type-II errors in cases of potential harm, especially irreversible harm such as extirpation, is losing track of the underlying uncertainty. It can become all too easy, once accepting that a detrimental effect may exist, to begin to prophesize the magnitude of the effect. Without real data, this can become a game of emotional guesstimation. In cases such as the gall bladder trade, where to most Westerners the practice is culturally alien and repugnant, claims of effects often become exaggerated, especially if they are thought to help instigate remedial action. Hence, assertions of Asian bear populations being "devastated," "decimated", or "depleted" (Knights 1996) tend to be widely accepted, or at least not questioned. It is doubtful that such unsubstantiated claims serve the best interest of bear conservation. I believe they do not, mainly because they falsely reflect the certainty of our knowledge. Hence, they create more opportunity for further misinformation, especially related to population level effects of highly visible mortality.

Increases or decreases in levels of human exploitation may not necessarily result in attendant changes in population size. An increasing population may continue to increase in the face of heightened exploitation, whereas a declining population may continue to plummet despite reduced exploitation. The discovery of a massive shipment of gall bladders or a large number of dead bears should not, in itself, be construed to represent a population decline, and neither should the absence of these be cause for complacency.

The examples so far concerned Asian bears and the gall bladder trade. Because this exploitation is largely unregulated, it is presumed to be unsustainable. In contrast, recreational (sport) harvests are overseen by management agencies whose responsibility is to ensure that they are sustainable. Nevertheless, unusually large sport harvests often raise concerns, if not by the management agency, by others interested in bears. I offer 2 examples dealing with American black bears (*U. americanus*).

*Tennessee.*—The legal harvest of black bears in Tennessee in 1997 was at least twice that of previous years, due to a natural food failure that prompted many bears to leave the sanctuary of the Great Smoky Mountains National Park. Pelton (1998:26) reported that in reaction to this high harvest, some biologists, bear advocacy groups, and alarmists in the general public claimed that the population was being "slaughtered" and "driven to extirpation." Long-term research (Pelton and van Manen 1996), however, showed that the population had been increasing for many years and continued to increase afterwards. Unfortunately, the body count was obvious, whereas the biological data either were not appreciated or did not constitute as appealing a story.

*Minnesota.*—Hunting of black bears in Minnesota has, since 1982, been regulated by restrictions (quotas) on the numbers of licenses available. This system was implemented to reduce the rate of harvest on what was thought to be a declining population. After a few years of sharply curtailed harvests, there was ample evidence that the population was growing. However, a food failure in 1985 disrupted normal feeding activities, which resulted in an unusually large number of bears being killed as nuisances. This large killing attracted considerable attention by the news media. Moreover, one bear biologist, who had been monitoring a few radiocollared bears at the time, suggested, in a memo to the management agency, that the food failure caused "severe malnutrition," possibly leading to reduced reproduction and starvation of cubs. He also warned that 2 age classes of young bears might have been "virtually eliminated," thus compounding the high kill (L. Rogers, 1986, unpublished report). Based on this report, an environmental group concluded that "it would be surprising if the black bear population has not already been nearly eliminated ..." (Sierra Club, North Star Chapter, Minneapolis, Minnesota, 1986, unpublished report). Hindsight showed these forecasts to be wrong. Collections of bear teeth from subsequent harvests, used for age determination, showed no indication of weak cohorts. Furthermore, population modeling interfaced with 2 statewide, mark–recapture population estimates (Garshelis and Visser 1997) indicated that the population grew steadily at ~5% annually (D. Garshelis, unpublished data). Fifteen years after the 1985 "high kill" the population had tripled, and despite steadily increasing harvests, the agency's goal of stabilizing population size had not been achieved. As in the other examples above, these data demonstrate that population trend cannot reliably be ascertained from numbers of dead bears.

## Trend Ascertained from Area of Habitat

It seems almost tautological that bear populations decline as a result of habitat loss. However, the explanation for this relationship is not as simple as it may at first appear. If humans did not exploit bears, bear populations would likely exist at or near the carrying capacity (K) of the habitat over the long-term. Any loss of habitat in this case would diminish K, eventually resulting in a population decline from increased natural mortality, diminished reproduction, or both. In the modern world, however, very few bear populations exist at K. Conceivably then, habitat loss would not necessarily cause a population to decline. As an example: if, due to human exploitation, a bear population existed at 1/3 K, and the area of habitat was reduced by 1/3, this reduced area could still easily support the existing population, which — other things being equal — would now be at 1/2 K (Fig. 1).

This seeming paradox is resolved by considering further ramifications of the loss of habitat. If the level of human exploitation remained constant, the above situation might indeed occur; habitat could be lost without affecting bear numbers until the point that the remaining population, confined to a smaller area, exceeded K. In reality though, bear mortality would likely increase inside the smaller patch of habitat because of heightened human exploitation (Fig. 1). Exploitation levels would tend to increase for several reasons. (1) The reduced area would increase the proportion of bears living at the edge, and these edge animals would be more vulnerable to hunters and also more likely to wander into adjoining crop fields and be killed as pests. This explanation seemed to account for dramatic declines in orangutans (*Pongo pygmaeus*) following logging (van Schaik et al. 2001). (2) The diminished size of the patch would make the interior area more accessible to hunters that kill bears either intentionally or inadvertently when seeking other species (e.g., by snaring); in essence, the reduced area would lessen the chance for some part of the region to function as a bear sanctuary. (3) Because bears are known to travel widely, especially during years of natural food failure, they would be more likely to leave the bounds of the smaller patch of habitat and thus be exposed to greater human contact. Recent studies have shown that although protected areas (e.g., national parks) are reasonably effective in maintaining habitat (vegetation) for animals (Bruner et al. 2001), the persistence of wide-ranging animals (including bears), are strongly related to edge effects (Woodroffe and Ginsberg 1998, Revilla et al. 2001) and surrounding human density (Woodroffe 2000). Among the carnivores, it is ironic that the more opportunistic-natured bears, which can often adapt to altered habitats, are thus more prone to encountering humans and associated risks of mortality.

There are also many additional synergistic interactions

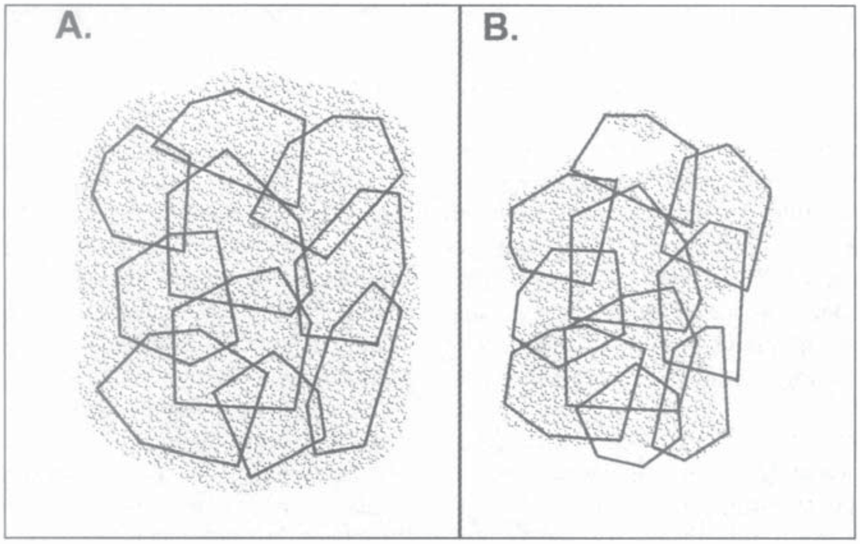


Fig. 1. Hypothetical representation of the effects of habitat loss on bears. In panel A, 10 bears, whose home ranges are indicated by convex polygons, are below carrying capacity because of human exploitation. In panel B, these same 10 bears are forced into a smaller patch of habitat, the fringes of which have been converted to agriculture. This remaining patch of habitat might still suffice to support the 10 bears. However, the smaller size and more irregular shape of the patch makes bears more vulnerable to human exploitation because bears at the edge may be more prone to venture out into the agricultural fields, and people can more easily reach once-secluded areas in the middle.

between habitat loss and other factors that might impact bear populations. Small patches of habitat are more prone to catastrophic fires or food failures (Cochrane 2001) and have less capacity to regenerate fruit-bearing plants because frugivorous seed-dispersers are less likely to visit there (Cordeiro and Howe 2001). Shrinking, isolated patches of habitat also may be less likely to attract immigrant bears, so whereas local overharvest in contiguous habitat can be overcome through source–sink dynamics (what Brown and Kodric-Brown [1977] called the "rescue effect"), small, insular patches of habitat are more prone to extirpation (Peres 2001). Finally, and perhaps most importantly, decreased habitat limits the potential for a population to increase; even if habitat loss does not directly cause a population decline, it may preclude recovery.

For these reasons, habitat loss should be foretelling of reduced bear numbers and population viability. However, the actual relationship between habitat loss and population decline is far from clear. Moreover, sustained or increased habitat is not necessarily indicative of a stable or increasing bear population. These points are illustrated by examples from Asia.

*Giant Pandas in China.*—Two range-wide surveys of giant pandas have been conducted (and a third is nearly completed). These surveys accomplished 2 things: (1) they estimated panda numbers, and (2) they estimated the area of remaining habitat. In the first survey, conducted during the mid-1970s, some 3,000 people scoured the panda's range, recording panda sightings and scats. A "rough" population estimate of 1,050–1,100 was obtained (Schaller et al. 1985:15–16). This narrow range belies the inherent inaccuracies of the method employed and variability among survey participants (Schaller 1993). A decade later, a smaller team of 35 biologists repeated the survey using more rigorous sampling procedures to measure density of sign, including both scats and bedsites. The resulting estimate of about 900–1,400 pandas provided no indication of population change.

A major finding from these surveys, though, was that panda habitat was being lost at a rapid rate. Large tracts of agricultural land bisected the range into small, fragmented populations. Moreover, low elevation areas that once likely provided optimal habitat were no longer available to pandas (Reid and Gong 1999). In response, many more protected areas have been established (total >30) to prevent further loss of habitat. However, it has become increasingly clear that this alone is insufficient to ensure viability of panda populations because these protected areas are small and disconnected by expanses of unsuitable habitat (Loucks et al. 2001); furthermore, habitat quality, even within some of the protected areas, is deteriorating. A case in point is Wolong Nature Reserve, one of the original and presently largest of the Nature Reserves established explicitly for the protection of pandas. Wolong is also an International Biosphere Reserve and the site of both a panda breeding facility and the first intensive study of radiocollared pandas (Schaller et al. 1985). In 1975, the size of this reserve was expanded 10-fold (to 200,000 ha) to improve protection of panda habitat. Since then, the human population *within* the reserve (mainly minority ethnic groups, who are exempt from China's restrictions on family size) has grown by nearly 70% and the number of households has more than doubled (Liu et al. 1999). Number of households is significant because it is related to timber and fuelwood consumption, which has increased dramatically (An et al. 2001). Accordingly, suitability of the habitat for pandas in Wolong has steadily diminished (Liu et al. 2001*a*). There is some debate as to whether Wolong is atypical (Baragona 2001, Brooks et al. 2001) or just the worst-case of a growing problem (Liu et al. 2001*b*), but either way it exemplifies the point that habitat quality can deteriorate from the bear's perspective while outwardly seeming intact from the human perspective.

A good deal of effort is presently being expended to map as well as assess remaining panda habitat using sophisticated procedures for estimating density of their staple food, bamboo, from satellite imagery (Linderman et al. 2000, Loucks and Wang 2002). This is a promising approach, although the knowledge to define suitable habitat for this species is still lacking (e.g., species and density of bamboo, overstory trees, den trees, hill slope; Reid and Hu 1991, Reid and Gong 1999). Thus, quantifying changes in density of bamboo, although better than simple habitat mapping, might still not accurately depict population trend (Reid 1994).

*Sun and Sloth Bears in Southern Asia.*—During 1994–96, J.L.D. Smith and I attempted to initiate a field study of sun bears in Thailand. Our greatest difficulty was in locating an area with sufficient bear density. The Khoa Ang Rue Nai Wildlife Sanctuary in southeastern Thailand was recommended to us because it had a new research facility and satellite maps showed it to have a dense forest. The southern border of the reserve abuts other densely-forested protected areas. Stewart-Cox (1995:107) characterized this area as "the largest tract of lowland evergreen forest in Thailand." A few roads and trails penetrated the forest, which facilitated access for trapping and radiotracking. The main entrance was guarded and gated, and there were several guard stations inside. From these indications we expected this to be an ideal study site.

We set out traps and baits and conducted sign surveys. Although we found some old sign, we soon concluded that there were few bears in this reserve; in fact, there was little sign of any medium–large mammals, even at places where they would typically congregate, such as fig trees (*Ficus* spp.) laden with fruit, salt licks, and water holes. We heard numerous reports of poaching, saw signs of poaching encampments, and heard gunshots. One night a binturong (*Arctictis binturong*) was poached near our camp. We noticed that during both day and night, motorcyclists rode freely around the closed gates and past the guards. We learned that one of the roads through the reserve was a main thoroughfare connecting two parallel highways. This sanctuary was certainly not the "secluded world" that Stewart-Cox (1995:107) had described.

Despite suitable habitat, this area exemplified what Redford (1992:412) called an "empty forest." "Often trees remain in a forest that human activities have emptied of many of its large animals... We must not let a forest full of trees fool us into believing all is well."

We encountered a similar situation with sloth bears (*Melursus ursinus*) in Nepal. We surveyed their entire range, a narrow strip of lowland forest and scattered grasslands called the terai. Sloth bears were abundant in Chitwan National Park, in the center of this range, but were absent at the eastern and western extremities of the range, despite suitable habitat. These areas had good forest cover and abundant termites (a staple food for sloth bears)(Garshelis et al. 1999*a*), but sloth bears had apparently been poached out during the previous 2 decades (Garshelis et al. 1999*b*), creating vacant bear habitat.

*Sun Bears in Borneo.*—Meijaard (2001) reported just the opposite situation for sun bears in Kalimantan (Indonesian Borneo). Here, disappearing forests seemed to be filled with bears, despite supposed periods of heavy poaching. During the 1970s poaching of sun bears appeared to be rampant in Indonesia, as evidenced by the amount of bile illegally exported. During that decade, Meijaard (1999) estimated that gall bladders from about 7,000 Indonesian sun bears were sent to South Korea; additional shipments of gall went to other countries. I previously showed that quantities of traded bile cannot be converted to reliable estimates of numbers of dead bears, or even used to construe trends in levels of bear mortality (Box 1). Nevertheless, it appears from the presently low amount of bile exported, low in-country demand, and according to information from local people, few bears killed for their parts, that during the past 2 decades, the trade in parts has not resulted in large numbers of bears killed (Meijaard 1999).

Interviews with local people across Kalimantan in the mid-1990s indicated that sun bears were still "relatively abundant" in most forested areas (Meijaard 2001). The forests, however, were rapidly being cut, which presumably would escalate human-related mortality and thus reduce numbers of bears (Fig. 1). It is difficult, though, to accept Meijaard's (2001) estimate that habitat loss caused 10,000 sun bears to die in Kalimantan during the 1980s, given his evidence that human-caused sun bear deaths appeared to be relatively low during that decade. Also, while habitat loss is obviously troubling, equally troubling is Meijaard's (2001) tenuous prediction that within another decade, 14,000–28,000 more bears will die.

An irony in presenting such alarming numbers is that one could use them to back-calculate an estimate of present numbers of sun bears. Meijaard (2001) converted habitat loss to numbers of dead bears using a "very crude" density estimate of 1 bear/4 $km^2$ presented by Davies and Payne (1981). This estimate of density was derived from only 2 bear sightings and 9 observations of sign. Extrapolating this density to all of Kalimantan would yield >90,000 sun bears. Extending this density to forested areas of Malaysian Borneo (Sabah and Sarawak) and Sumatra would increase the total to about 190,000 bears (forest areas from Mayaux et al. 1998). Even if sun bear densities in mainland southeast Asia are much lower, the total world population would still well exceed 200,000, which would make this species numerically equivalent to brown bears on a global scale, and second only to American black bears.

The reality is that sun bears are listed by the IUCN as "data deficient," because reliable estimates of population size and trend are unavailable (Baillie and Groombridge 1996). Creating unsubstantiated estimates in the hope of rousing more conservation interest may, as illustrated here, contravene the intended result. Without far better information on the relationship between bear density and habitat, attempts to quantify bear numbers and trends from forest cover data are likely to be misguided.

## IRONIES REGARDING HUNTING AND POPULATION TREND

A particularly noteworthy irony regarding bear populations is that most legally-protected populations seem to be declining, whereas most hunted populations are increasing. One explanation is that protected populations tend to be small, and thus more prone to decline as a simple consequence of low numbers (Caughley 1994). Another explanation is that many of these legally-protected populations are really heavily exploited. Oftentimes, the level of human exploitation may be less under a system of managed hunting than supposed total protection. The reasons for this seeming contradiction have a lot to do with the people, finances, energies, and ideologies entailed in a managed harvest, resulting in an infrastructure of managers, scientists, bureaucrats, and hunters, with non-hunters and anti-hunters as overseers. This complex structure is often lacking in the management of protected areas. However, it is also true that countries with managed bear hunting tend to have stronger economies, which can support bear management activities (e.g., research, enforcement) better than countries where hunting is banned. These points are illustrated first by contrasting the management of American and Asiatic black bears, followed by an example regarding polar bears (*U. maritimus*).

*American versus Asiatic Black Bears*.—The 2 species of black bears are similar in terms of their life histories, and seem similar in terms of reproductive potential, although reproductive data on wild Asiatic black bears is presently insufficient to enable a true quantitative comparison (Garshelis 2002). However, the 2 species are managed very differently. Legal hunting is the main source of mortality for American black bears in most parts of their range, whereas hunting for Asiatic black bears is legal only in Japan. Most American black bear populations appear to be increasing (Williamson 2002), whereas Asiatic black bears are thought to be declining in most areas. The difference is that human exploitation is monitored and controlled in the former case, surreptitious in the latter.

A reviewer of this paper asserted that the cause and effect thesis posed here is reversed. That is, legalized hunting did not result in numerically abundant bear populations; rather, hunting was legalized because bears were numerically abundant. I disagree with this. American black bears were severely over-exploited through the early-mid 1900s. Although regulated exploitation of other North American species, such as white-tailed deer (*Odocoileus virginianus*), dates to the 1600s (Gilbert and Dodds 1987), black bears were much less valued as food so did not inspire efforts to limit the take. Moreover, bears did not generate much interest among recreational hunters on whose behalf game laws were made (Schullery 1983). In fact, mainly during the 1800s and early 1900s, federal, state, and local governments supported programs to destroy both black bears and grizzly bears because they were considered detrimental to raising livestock and crops as well as potentially dangerous to people (Spencer 1955, Cardoza 1976, Brown 1996). An evolution in ideology, beginning in some U.S. states in the early 1900s, eventually led to the designation of black bears as a big game species, with the objective of a sustained harvest (Miller 1990). These laws were passed *because* bear populations had noticeably diminished. Minnesota was one of the last states to classify black bears as big game (1971). In one Minnesota county where bears had been considered "very nearly extinct" prior to their big game listing (Cahn 1921:70, Special Committee on the Conservation of Wildlife Resources 1940), a long-term telemetry study revealed a high density of bears following 20 years of legal hunting (D. Garshelis, unpublished data).

There are many factors — economical, political, historical, cultural, and spiritual — that make it difficult to transfer to Asia the Western traditions of sustained-yield hunting. Proponents of sustainable use in developing countries argue that people are more apt to conserve resources when they have a vested interest in a return from these resources (Gadgil 1992, Kothari et al. 1995, Saberwal 1996). Others, though, have observed that high human densities, abject poverty, class systems, and corrupt governments create a situation where it is nearly impossible to regulate harvests (Bennett and Robinson 2000, Madhusudan and Karanth 2000, Meijaard 2001).

A high market value for bears in Asia makes the regulation of harvest an even more daunting problem. In Korea, for example, Asiatic black bears were subjected to the same sort of government-supported removal efforts as American black bears during the early-mid 1900s (Won 2001). Unlike the situation in North America, however, Korean bear populations continued to plummet from overexploitation into recent times because they were sought commercially. A lesson learned during the evolution of the North American system was that market hunting was detrimental to wildlife populations and was therefore incompatible with recreational and subsistence hunting (Geist 1988, 1994). In fact, recreational hunting enthusiasts were largely responsible for legislation that eventually prohibited market hunting for wildlife in North America (Reiger 1978).

Harvesting animals for profit, though, is not uniformly detrimental to wildlife populations. In North America, many species of furbearing mammals are trapped specifically for sale of their pelts, so the kill fluctuates with fur prices; nevertheless, their populations have been carefully managed by government agencies (Novak et al. 1987). In several European countries, hunters routinely sell their game for personal profit or for income for the landowner or hunting club; in some cases, hunters can only retain a portion of their take. This system has worked for centuries (Bolen and Robinson 1995). In Japan, Moll (2001) suggested that a prohibition against the sale of bear parts might lead to diminished interest in legitimate bear hunting and higher prices for bear gall, which together could result in reduced stewardship of the resource and hence increased danger of bears being over-exploited by poachers.

To be clear, my purpose here was to point out the seemingly paradoxical effects of legal hunting, not to suggest that sport hunting should be promoted where it does not now occur. Simply instituting a legal harvest is obviously not the solution to declining bear numbers. Historically though, in both North America and Europe, managed hunting has been an effective system for protecting bear populations. It has worked because it has enlisted a clientele interested in ensuring continued abundance of the resource. It also has worked because, for species such as bears that can be a nuisance and a threat, it transfers the killing of animals from the general public to a smaller group of people (i.e., the hunters). Both these issues have been instrumental in shaping bear management and conservation in North America, Europe (Klenzendorf and Vaughan 1999, Zedrosser et al. 2001), and Japan (Huygens et al. 2001, Moll 2001). Linnell et al. (2001:348) commented "There is no doubt that the concept of hunting large carnivores as game species is far older in Europe than in North America and has contributed greatly to their persistence." Ironically, in places such as India and Nepal, where bear hunting is now prohibited, preserves that were set aside explicitly for hunting (by both local and European aristocrats) during the 1800s formed the basis of a system of parks and wildlife sanctuaries that now constitute virtually the only remaining areas of intact habitat with viable populations of large mammals, including bears (Israel and Sinclair 1987, Mishra and Jefferies 1991, Rangarajan 2001; negative consequences of these royal hunts and exclusionary policies notwithstanding [Saberwal et al. 2001]).

*Polar Bears.*—During the 1960s it became evident that polar bears were being over hunted. In 1973 an historic conservation agreement was signed among all 5 nations with populations of polar bears (U.S., Canada, Norway [for Svalbard], Denmark [for Greenland], and the former U.S.S.R.). Interestingly, the International Agreement on the Conservation of Polar Bears (International Legal Materials 13:13–18), which took effect in 1976, did not prohibit hunting, but rather limited it to native people using traditional methods (IUCN/SSC Polar Bear Specialist Group 1999). Within this restriction, the member nations went in different directions. Canadian jurisdictions imposed hunting quotas in most areas, whereas the U.S. could not, under the constraint of the Marine Mammal Protection Act of 1972 (16 U.S. Code 1361–1407). However, non-mandatory harvest guidelines have been developed for native communities in Alaska. In Greenland, there are no quotas on polar bears but the harvest is limited to native people who hunt or fish full time. In Svalbard, hunting of polar bears was forbidden after the Agreement. In Russia, a prohibition on the hunting of polar bears predated (1956) the Agreement. Russia thus appears the most restrictive for the longest time, yet in reality, the strongest concerns about poaching polar bears exist in Russia (IUCN/SSC Polar Bear Specialist Group 1999). What may superficially seem ironic but pertinent to this discussion is a recent agreement to permit native Russian people to hunt polar bears in the population shared with Alaska. The presumption is that a legal hunt, with the self-serving interest to remain within sustainable limits, would be more effective at conserving this population than striving (probably unsuccessfully) for total protection. Management for harvest tends to be more successful because it broadens the number and scope of people with a stake in maintaining a healthy population.

## UNCERTAINTY AND CONSERVATION

The only real certainty in bear conservation is that human intrusion, via both direct over-exploitation and habitat destruction, is the main factor threatening bears worldwide. The degree of threat, however, is very uncertain. The best information exists for North American and European bear populations. Geographic ranges are generally well-delineated, and population estimates and growth rates, though often inexact, are usually based on some research data (Table 1). For Andean bears (*Tremarctos ornatus*) of South America, there are good distribution maps but no data-based estimates of abundance or trend (Peyton et al. 1998). Good range maps and an estimate of population size exist for giant pandas, but there is no good information on population trend (Reid and Gong 1999). Very generalized range maps, poor population estimates, and weak evidence of population trend are available for the other Asian species (Table 1). All these species, though, are perceived to be in trouble.

To aid in the conservation of these species, many believe it is necessary to provide population numbers and extinction scenarios. Population viability analyses are certainly productive exercises that may be especially important in illuminating sensitive population parameters and weaknesses in the data (Sæther et al. 1998, Wiegand et al. 1998); however, these should not be confused with actual population projections (Mills et al. 1996, White 2000). We have rarely been able to track population trends in the present, and because we lack vital biological information for many of the species (Garshelis 2002), it seems improbable that forecasting the future would be very accurate. Referring to large whales, but describing a situation applicable to bears, Gerber et al. (2000:318) observed: "our limited knowledge... makes it extremely difficult to quantify the degree to which a population may go extinct in a specific period of time... Unfortunately, the public and the press have not been entirely aware of these difficulties. Worse, advocacy groups on both sides of the environmental continuum and even some scientists have filled this void with inaccuracies."

Some believe that admitting to uncertainty would muddy the message, and thereby detract from conservation initiatives. That view holds that firm, bold, and clear assertions, even if not entirely backed by factual information, yield better results in terms of protecting environmental welfare than does revealing uncertainties. Those opposing this approach warn of blurring the distinction between science and advocacy, which can be especially tempting when both are harbored in the same individual (Bowen and Karl 1999). Schrader-Frechette and McCoy (1999) argue that occasionally compromising science in favor of advocacy will ultimately create the perception that science was abandoned. If we do not universally adhere to all the principles of science, then we must be prepared to wade into ethical battles, where scientific viewpoints no longer have ascendancy.

There is an obvious counter-argument to this reasoning: brandishing uncertainty may not be a powerful means of swaying policies toward better conservation of bears. Acknowledgment of uncertainty in the scientific arena is one thing; highlighting it in the political arena is quite another. There is certainly some wisdom in this, but I offer several reasons why there is usually greater merit in making the uncertainties clear to the public and the politicians. (1) If new data do not support previous suppositions (e.g., about a population decline), and if the uncertainties inherent in the original suppositions were not made clear, scientific credibility will be damaged and future conservation efforts based on scientific information may be compromised. (2) Optimism generally provides more motivation for conservation action than pessimism (Beever 2000), and, in many cases, uncertainty provides a greater array of optimistic scenarios. Uncertainty in this context should not be confused with ignorance, which is always detrimental (Garshelis 1997). (3) Incognizance of uncertainties may detract from efforts to gather more data and improve methodologies. False con-

**Table 1. Relative degree of certainty regarding geographic range, population numbers, and population trends of the 8 species of bears. Symbols (++ reasonably good, + fair, 0 poor or nonexistent) represent subjective ratings by the author[a] for comparisons within and among columns.**

| | | Informational quality[a] | | |
|---|---|---|---|---|
| Species | Geographic area | Range | Numbers | Trend |
| American black | North America | ++ | + | + |
| Brown | North America | ++ | + | + |
| | Europe | ++ | + | + |
| | Asia | + | 0 | 0 |
| Polar | Arctic | ++ | + | + |
| Andean | South America | ++ | 0 | 0 |
| Giant panda | Asia | ++ | + | 0 |
| Asiatic black | Asia | + | 0 | 0 |
| Sloth | Asia | + | 0 | 0 |
| Sun | Asia | + | 0 | 0 |

[a] Based mainly on Servheen (1990), Servheen et al. (1999), Williamson (1999), Sathyakumar (2001), and Zedrosser et al. (2001), plus accumulated knowledge and personal experience.

fidence in presumptions about population declines thus may inhibit discoveries that could aid in detecting population change. This is an extension of Gibbs et al.'s (1998:940) view: "The primary consequence of failing to improve methodologies for identifying population change in ecology will be a chronic failure to detect population change. Unfortunately, these statistical errors will frequently be misconstrued as reflecting population 'stability,' lack of treatment effect, or ineffectiveness of management." Hence, if the uncertainties are not eventually remedied, even effective conservation programs may yield no measure of success because it will not be possible to detect a population increase.

I contend that in the interests of both science and conservation, biologists should *emphasize* the uncertainties of population assessments and thus the necessity for more rigorous research. This may seem counter-intuitive in terms of conservation, but the logic is this: in the presence of uncertainty efforts should be directed toward ensuring no irreparable harm. The wide range of uncertainty about bear populations should be reason enough for claiming a wide berth in erring on the side of caution.

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**Staff, Organizations Directly Affected:**

Director of Fish & Wildlife
Regional Managers
Wildlife Management Staff
Resident Hunters
Guide Outfitters

**Policy Cross-Reference:**

Ministry Policy Manual, Volume 4, Section 7
Subsections:
— 01.01 Allowable Harvest
— 01.03 Harvest Allocation
— 01.05 Quota Allocation – Guided Hunting
— 01.06 Limited Entry Hunting
— 01.07 Wildlife Harvest
— 13.01 Goal of Wildlife Management

**Other Cross-References:**

Ministry Procedure Manual, Volume 4, Section 7
Subsections:
— 01.01.1 Allowable Harvest
— 01.03.1 Harvest Allocation
— 01.05.1 Quota
— 01.05.2 Administrative Guidelines
— 01.06.1 Limited Entry Hunting

British Columbia Grizzly Bear Conservation Strategy, Ministry of Environment, Lands and Parks, June 1995

Wildlife Harvest Strategy, Ministry of Environment, Lands and Parks, April 1996

**Purpose:**

To provide clear direction on the approach and methods for managing grizzly bear harvests province-wide.

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## Definitions:

**"allocation period"** – means the five year period to which an allocation share applies, as defined in the Harvest Allocation Procedure (4-7-01.03.1).

**"allowable mortality rate"** – means the percentage of a grizzly bear population that is allowed to be killed by humans each year (including hunting, illegal reported harvest, control kill, and road kill), except the percentages estimated to be harvested by First Nations for food, social, and ceremonial purposes and killed by other unreported sources.

**"annual allowable harvest" (AAH)** – means the number of grizzly bears that are allowed to be killed by resident hunters and guided hunters each year.

**"annual allowable mortality" (AAM)** – means the number of grizzly bears that are allowed to be killed by humans each year, including those killed by hunting, illegal (reported) harvest, control kills, and road kill but excluding unreported harvest by First Nations and other unreported mortalities.

**"biological data officer" (BDO)** – means the staff person in the Fish & Wildlife Branch, Ministry of Environment, Victoria, responsible for updating the compulsory inspection database.

**"current carrying capacity"** – means the number of grizzly bears that could be sustained in an area, given existing habitat effectiveness.

**"control kill"** – means a grizzly bear killed by a conservation officer or anyone else as a result of a bear-human conflict or interaction.

**"director"** – means director as defined in the *Wildlife Act*, RSBC 1996 c.488

**"female annual allowable mortality" (female AAM)** – means the number of female grizzly bears that are allowed to be killed by humans each year, including those killed by hunting, illegal (reported) harvest, control kills, and road kill but excluding unreported harvest by First Nations and other unreported mortalities.

**"First Nations' harvest rate"** – means the percentage of a grizzly bear population that First Nations are estimated to legally harvest for food, social, or ceremonial purposes each year, not including the percentage that has been recorded in a provincial database.

**"grizzly bear population unit" (GBPU)** – means an identified area that defines an individual grizzly bear population for the purposes of management and conservation.

**"guided hunter"** – means a hunter guided by a licensed guide outfitter, excluding resident clients in possession of a limited entry hunting authorization and resident clients hunting open season species.

**"habitat capability"** – the ability of habitat, under optimal conditions to provide the life requisites of a species, irrespective of its current conditions.

**"habitat effectiveness"** – the actual ability of the habitat to provide the life requisites of a species, given habitat suitability, human disturbance, and fragmentation of the area.

**"habitat suitability"** – the ability of the habitat, under its current conditions, to provide the life requisites of a species, irrespective of human impacts aside from those that directly alter the habitat itself.

**"indefinitely closed"** – means closed as a result of management objectives that are independent of this procedure (e.g. ecological reserves, national parks, some provincial parks, transition and coastal grizzly bear closed areas, and grizzly bear management areas where designated).

**"large carnivore specialist" (LCS)** – means the wildlife biologist in the Ecosystems Branch, Ministry of Environment, Victoria, responsible for the provincial coordination of grizzly bear harvest management.

**"management unit" (MU)** – means a specific and legally designated land area denoted by the initials M.U. and a hyphenated number, e.g. M.U. 3-18 (B.C. Reg. 64/96).

**"maximum allowable mortality rate"** – means the maximum percentage of a grizzly bear population that is allowed to be harvested or killed as a result of other human causes each year (e.g. control kill, illegal reported harvest, road kill).

**"predicted non-hunting mortality"** – means an expected grizzly bear mortality resulting from a human cause other than hunting (e.g. control kill, illegal reported harvest, road kill) that is forecast to occur during an allocation period, based on a review of data collected during the previous allocation period.

**"regional manager" (RM)** – means regional manager as defined in the *Wildlife Act*, RSBC 1996 c.488.

**"regional section head" (RSH)** – means a section head responsible for the management of fish and wildlife within a region, Regional Operations Branch, Ministry of Environment.

**"resident hunter"** – means a hunter who is a resident as defined in the *Wildlife Act,* RSBC 1996 c.488, with the exception of a First Nations hunter hunting for food, social, or ceremonial purposes and a resident who hires the services of a guide outfitter to hunt in a season for which the resident would otherwise require but does not have a limited entry hunting authorization.

**"sub-grizzly bear population unit" (sub-GBPU)** – means an area within a grizzly bear population unit that is assumed to have a uniform grizzly bear population density based on climatic conditions.

**"translocation"** – means one or more grizzly bears removed live from a GBPU and released in a different GBPU.

**"unreported mortality rate"** – means the percentage of a grizzly bear population that is estimated to be killed each year as a result of interactions with humans, but is not known by wildlife management staff and is not recorded in a provincial database (excluding First Nations' harvest).

**"wildlife manager"** – means the manager of the wildlife management section, Fish & Wildlife Branch Ministry of Environment, Victoria.

**"wildlife regulations officer" (WRO)** – means the staff person in the Fish & Wildlife Branch, Ministry of Environment, Victoria responsible for making hunting and trapping regulation changes.

**"WSS manager"** – means the manager of the wildlife science section, Ecosystems Branch, Ministry of Environment, Victoria.

**Procedure:**

**1 Population Management Units**

1.1 Grizzly bear populations will generally be managed to achieve management objectives at the level of grizzly bear population units (GBPUs). In particular circumstances, approval may be sought from the director to manage populations at another spatial scale (e.g. management unit, limited entry hunting zone).

1.2 In delineating GBPUs, the following guidelines apply:

1.2.1 GBPUs will normally be composed of adjacent management units (MUs) that collectively make up a reasonably distinct population.

Partial MUs should not be used, except if required for an ecologically valid GBPU

Limited entry hunt (LEH) zones should be created if an MU is split between two or more GBPUs and these areas are open to grizzly bear hunting.

1.3 GBPU boundaries may, over time, be reviewed, revised, or both. If a GBPU boundary is revised, the new boundary will typically become effective at the start of the next allocation period.

**2 Management Objectives**

2.1 Hunted grizzly bear populations will be managed to avoid a decline in that population, unless a formal management objective determined in section 2.2 specifies otherwise.

2.2 Formal management objectives, developed by regional and headquarters staff and recommended to the director, may be set to allow total human-caused mortality in a GBPU to be managed for:

- increases in the grizzly bear population, or
- reductions in the grizzly bear population.

The process of setting formal management objectives for hunted GBPUs should consider:

- the current population estimate;
- habitat capability, habitat suitability, habitat effectiveness, and resulting estimates of current carrying capacity;
- the threats (if any) to the population and to adjacent populations;
- known or perceived trends in the population or habitat supply;
- the history of grizzly bear-human conflicts in the area;
- the degree of certainty in any of these factors;
- other issues of interest to First Nations, stakeholders, and the general public.

## 3 Harvest Strategy

### 3.1 Population Assessment

3.1.1 Population estimates will be calculated for each GBPU or sub-GBPU using the best available scientific information. Resulting density estimates will be applied to smaller spatial units (e.g. MUs, LEH zones, guide outfitter territories) as needed to implement harvest management strategies.

3.1.2 If possible, population estimates will be based on an inventory of the GBPU. Otherwise, a multiple regression or similar approach for extrapolating grizzly bear densities from known densities in other areas should be used.

3.1.3 If the approach in 3.1.2 is not possible or is considered to be inappropriate, a habitat-based method that modifies habitat capability in a series of step-downs to account for perceived or known human impacts should be used.

3.1.4 Population estimates, developed for the purpose of harvest management, will:

- Include grizzly bears of all ages; and
- Not include the number of grizzly bears in areas >100 km$^2$ that are indefinitely closed to grizzly bear hunting.

### Harvest Management Rules

3.2.1 In general, GBPUs will be managed so as not to exceed the cumulative annual allowable mortality (AAM) or female AAM over the course of an allocation period.

The AAM for each GBPU will typically be calculated by:

3.2.2.1 Using a **maximum allowable mortality rate** of 6%, unless a written rationale (that is consistent with stated management objectives) is available and supports the use of a higher or lower maximum allowable mortality rate. This rationale may consider such factors as:

- uncertainty in the population estimate,
- knowledge of the population's natural growth rate,
- location of the area within the species' distribution, or
- a difference between the estimates of population size and current carrying capacity.

3.2.2.2 Estimating **First Nations' harvest rate**, based on past harvest or allocation information that is not included in provincial records (if available);

3.2.2.3 Estimating the **unreported mortality rate** considering the factors identified in Austin et al. (2004)[1];

3.2.2.4 Determining the **allowable mortality rate** by subtracting the estimated unreported mortality rate and the First Nations' harvest rate from the maximum allowable mortality rate;

3.2.2.5 Multiplying the allowable mortality rate (determined in Section 3.2.2.4) by the population estimate (determined in Section 3.1).

The annual allowable harvest (AAH) for each GBPU will typically be calculated by:

3.2.3.1 Estimating the **predicted non-hunting mortalities**, typically based on the average number of non-hunting mortalities from the previous allocation period; and

3.2.3.2 Subtracting the predicted non-hunting mortalities from the AAM.

The female AAM will be calculated as 30% of the AAM (calculated in 3.2.2).

Despite sections 3.2.1-3.2.3, GBPUs are to be closed to hunting if the total population estimate is <50% of the current carrying capacity or <100 grizzly bears, unless formal management objectives dictate otherwise.

[1] Austin, M.A., D.C. Heard, and A.N. Hamilton. (2004) Grizzly Bear (*Ursus arctos*) Harvest Management in British Columbia. BC Ministry of Water, Land, and Air Protection, Victoria, BC. 9 pp.

Known, reported mortalities of grizzly bears, separated into total mortalities and female mortalities, will be collated on an annual basis for each GBPU. This will include most known human-caused mortalities, including those associated with hunting and other activities (i.e. poaching, control kills, road kills).

3.2.6.1 Grizzly bear mortalities in areas >100 km$^2$ that are indefinitely closed to grizzly bear hunting will not be included.

3.2.6.2 Known human-caused mortalities of grizzly bears <2 years (24 months) old will not be included.

3.2.6.3 Grizzly bear translocations outside of a GBPU will be counted as if they were known mortalities in the source GBPU. Translocated bears will not be added to the population estimate used for harvest purposes of the area of relocation. If they die as a result of human causes they will not be counted as a mortality in the new area.

3.2.6.4 Reported mortalities for which the sex is unknown will be assumed to have a sex ratio of 50:50 to estimate the number of female mortalities (i.e. a reported kill of unknown sex will be recorded as 0.5 of a female bear).

If the AAM or female AAM of a given GBPU is approached, met, or exceeded over the course of an allocation period, the following actions will be taken:

3.2.7.1 A "yellow flag" will be raised if total annual mortalities or annual female mortalities (measured in 3.2.6), averaged over the course of the allocation period, are ≤20% below or have reached the AAM or female AAM, respectively. When a "yellow flag" is raised, the appropriate RSH should closely monitor the harvest and discuss options with stakeholders for keeping the harvest within acceptable limits, such as taking measures to direct the harvest towards males.

3.2.7.2 A "red flag" will be raised if total annual mortalities or annual female mortalities (measured in 3.2.6), averaged over the course of the allocation period, exceed the AAM or female AAM, respectively. When a "red flag" is raised, the director should recommend that hunting opportunities be reduced so that mortalities return to a level at or below the AAM and female AAM.

3.2.7.3 If the AAM or female AAM is exceeded during the course of a five-year allocation period, the overkill (total, female, or both) for the GBPU will be carried forward to the next allocation period and deducted from the AAM, female AAM, or both (as applicable) for that period. Overkill may be tabulated at a different spatial scale if circumstances warrant and additional rationale can be provided.

The AAM (total and female) and AAH will be calculated, and the number and type of mortalities tracked on an annual basis, using the "Grizzly Bear Harvest Management Procedure Spreadsheet".

3.3 Hunting Regulation

Grizzly bear harvests should be regulated using a combination of limited entry hunting (LEH) for residents and quotas for guide outfitters.

The number of LEH authorizations and guide outfitters' quotas should be set in accordance with the Harvest Allocation Procedure (4-7-01.03.1), Quota Procedure (4-7-01.05.1), and Limited Entry Hunting Procedure (4-7-01.06.1).

3.3.2.1 Success rates used to determine the number of LEH authorizations will generally reflect the most recent five years that were open to grizzly bear hunting.

3.3.2.2 Despite Section 3.3.2.1, LEH success rates will be limited to a minimum of 5%.

3.3.2.3 Success factors are not to be used in calculating guide outfitters' quotas.

Allocations of the harvest to resident hunters and guided hunters should reflect the size of grizzly bear populations within allocated areas; for instance, where guide outfitters' territories overlap more than one GBPU, quotas should typically be calculated and assigned in accordance with differences between those GBPUs.

## 4 Regulation Review

4.1 LEH authorizations and quotas will be reviewed on a five-year basis, to coincide with the review of regional allocation shares (see Harvest Allocation Procedure, 4-7-01.03.1), unless:

- A yellow or red flag is triggered during the course of an allocation period;
- The AAM, and therefore female AAM, change during the course of an allocation period;
- New biological information suggests that the management regime should be modified; or
- The predicted success rate for resident hunters changes during the course of an allocation period.

## 5 Timeline, Roles, and Responsibilities in Decision-Making Process

5.1 In general, headquarters and regional staff will work together to develop harvest strategies for grizzly bears that coincide with the timing of annual and five-year allocations.

5.2 Specific deadlines, roles, and responsibilities in the decision-making process are outlined in Appendix A. Note that all dates in this appendix apply to the year before new allocations are issued, unless otherwise indicated. If any dates fall on a weekend or statutory holiday, the following work day will apply.

## APPENDIX A: Deadlines, Roles, and Responsibilities in Decision Process

| Deadline | Task | Person Responsible |
|---|---|---|
| March 31 | Recommend management objectives for GBPUs, as needed, and provide these with a written rationale to the director | RMs |
| April 1 | Prepare population estimates for each GBPU, together with supporting rationale, and provide this to RSHs | LCS |
| May 1 | Review and provide comment on population estimates to LCS | RSHs |
| June 1 | Respond to the comments provided by the RSHs, by either revising the population estimates or further discussing the issue | LCS |
| **August 15** | **Finalize management objectives (as needed) and population estimates*** | |
| August 15 | Prepare a description of any recommended GBPU boundary changes and provide this to RSHs | LCS |
| August 15 | Work with the LCS to determine and prepare supporting rationale on allowable harvest rates for each GBPU | RSHs |
| September 15 | Review and provide comment on proposed GBPU boundary amendments to LCS | RSHs |
| September 15 | Review and provide comment on resulting allowable harvest rates to RSHs | LCS |
| **December 1** | **Finalize GBPU boundaries and allowable harvest rates for each GBPU*** | |
| December 1 | Complete and submit Compulsory Inspection Data Sheets (CIDS) for all grizzly bear mortalities reported throughout the year to the biological data officer (BDO) | Compulsory inspection contractors, conservation officers, and/or fish & wildlife staff |
| December 8 | Enter all CIDS data into the CIDS database and provide this information to the WRO | BDO |

| | | |
|---|---|---|
| December 8 | Provide the WRO with spreadsheets for each region that include the grouping of MUs and LEH Zones by GBPU, population estimates, and allowable harvest rates | LCS |
| December 12 | Complete entry of previous mortality data into spreadsheets provided by LCS, flag concerns, and return spreadsheets to LCS for review | WRO |
| December 15 | Provide regionally-specific spreadsheets to RMs and RSHs | LCS |
| January 6** | Identify and correct any errors in the spreadsheet, in consultation with WRO | RSHs |
| **January 12**** | **Determine guide outfitters' quotas and recommend the number of LEH authorizations, using regional allocation shares provided by the director***** | **RMs** |
| **January 12**** | **Determine the number of LEH authorizations for that year's spring and fall hunts** | **Director of Fish & Wildlife** |
| January 16** | Post the final number of LEH authorizations for the spring and fall hunts on the Ministry of Environment's web site | WRO |

If consensus has not been achieved prior to this step, guidance may be sought from management. Following the organizational structure of the Ministry, direction may initially be sought from the RM, wildlife manager, and WSS Manager, then the Director of Ecosystems, Director of Fish & Wildlife, and Director of Regional Operations, and finally (if necessary) the Assistant Deputy Minister of the Environmental Stewardship Division.

These dates apply to the year for which the new allocations are issued.

Regional allocation shares are only re-calculated every five years, in accordance with the Harvest Allocation Procedure (4-7-01.03.1).

# Using Anecdotal Occurrence Data for Rare or Elusive Species: The Illusion of Reality and a Call for Evidentiary Standards

KEVIN S. McKELVEY, KEITH B. AUBRY, AND MICHAEL K. SCHWARTZ

*Anecdotal occurrence data (unverifiable observations of organisms or their sign) and inconclusive physical data are often used to assess the current and historical ranges of rare or elusive species. However, the use of such data for species conservation can lead to large errors of omission and commission, which can influence the allocation of limited funds and the efficacy of subsequent conservation efforts. We present three examples of biological misunderstandings, all of them with significant conservation implications, that resulted from the acceptance of anecdotal observations as empirical evidence. To avoid such errors, we recommend that a priori standards constrain the acceptance of occurrence data, with more stringent standards applied to the data for rare species. Because data standards are likely to be taxon specific, professional societies should develop specific evidentiary standards to use when assessing occurrence data for their taxa of interest.*

*Keywords: anecdotal, evidentiary standards, fisher, ivory-billed woodpecker, wolverine*

**In conservation and wildlife biology, establishing the** presence of rare or elusive species, including some that have long been considered extinct, can become a near-mythic quest. Because the occurrence of a rare species—or even one that has recently been declared extinct—seems plausible, we tend to believe anecdotal observations (i.e., observations that lack conclusive physical evidence) despite widespread understanding of the intrinsic problems associated with such data. Just as it is difficult to doubt the veracity of a detailed and seemingly reliable statement from an eyewitness in a court of law, it is also difficult to discount a visual observation of a rare, elusive, or extinct species when it is reported by a trained and experienced biologist. Compounding this problem, anecdotal data are often accompanied by inconclusive physical evidence, such as castings or pictures of tracks, fuzzy or distant photographs, or nondiagnostic acoustic recordings. Unfortunately, such weak corroborative data are often treated as confirmatory. Consequently, anecdotal occurrence data continue to be used for making important conservation decisions, such as delineating the current geographic range or deriving rudimentary estimates of abundance for species of concern.

For these reasons, we argue that the use of anecdotal data to establish the presence or geographic range of rare or elusive species is inherently unreliable and can lead to errors with substantial negative impacts on conservation decisionmaking and resulting conservation efforts. This is not to say that anecdotal data cannot provide useful preliminary information for conservation. The multitude of citizen scientists who provide anecdotal observations serve as important sentinels for detecting potential changes in the status of species of concern. For example, anecdotal information can provide early warnings of population declines when numerous observers report that once-common organisms now appear scarce. Alternatively, repeated sightings of species of concern in a given area can be used to identify high-priority areas for

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initiating systematic surveys or new research. However, we argue that conclusions regarding the presence of rare or elusive species must be based on verifiable physical evidence. We present three case histories to illustrate how the use of anecdotal data to assess the current distribution or population status of species of concern can adversely affect conservation goals. Our examples include delays in obtaining needed habitat protections (the fisher [*Martes pennanti*] in the Pacific states), delays in initiating reintroductions or other conservation actions (the wolverine [*Gulo gulo*] in California), and the misallocation of scarce resources for conservation (the ivory-billed woodpecker [*Campephilus principalis*] in the southeastern states). We then show how evidentiary standards for species' occurrence data could be delineated using a gradient of reliability based on current knowledge of the species' status.

## Case history 1: The fisher in the Pacific states

Fishers once occurred in most coniferous forest habitats in the Pacific states of Washington, Oregon, and California (Aubry and Lewis 2003). Perceived range losses and potential threats to their primary habitat resulted in the submission of two petitions during the 1990s to list the fisher in the Pacific states under the Endangered Species Act (Beckwitt 1990, Carlton 1994). Both petitions were denied, the first because reliable information on the status of fisher populations was lacking (USFWS 1991) and the second because anecdotal occurrence data indicated that fishers were distributed continuously across much of their historical range (figure 1a, map at left; USFWS 1996).

To investigate the reliability of these anecdotal data, Aubry and Lewis (2003) mapped the geographic distribution of anecdotal observations of fishers in the Pacific states

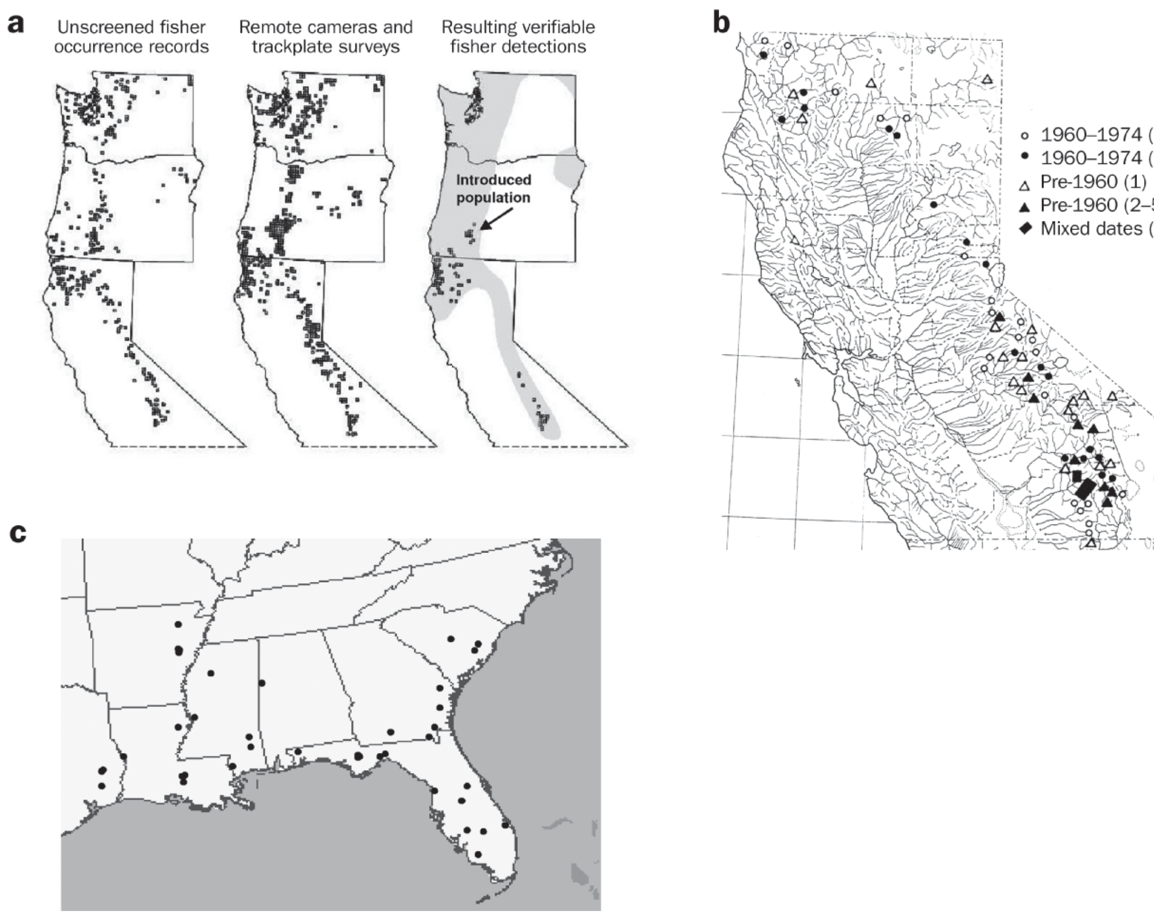


***Figure 1. Recent occurrence records for (a) fisher in the Pacific states (1954–1992; map reproduced from Aubry and Lewis [2003]), (b) wolverine in California (ca. 1960–1974; map reproduced from Schempf and White [1977]), and (c) ivory-billed woodpecker in the southeastern states (1944–2005; modified from* www.fws.gov/ivorybill/IBW-range-map.pdf*). The locations of standardized surveys conducted from 1989 to 2000 for fishers in the Pacific states are shown in (a), center map ("Remote camera and trackplate surveys"); verifiable fisher detections obtained during those surveys and the presumed historical range (gray shading) of the fisher in the Pacific states are shown in (a), map at right ("Resulting verifiable fisher detections"). The arrow in this map points to an introduced population from sources in Minnesota and in British Columbia, Canada. In (b), numbers in parentheses are the number of occurrences associated with each symbol. In (b) and (c), all occurrences are anecdotal.***

obtained during the last several decades (figure 1a, map at left), and compared their geographic extent with that of verifiable occurrence records obtained during the most recent decade using standardized detection protocols (figure 1a, center map; Zielinski and Kucera 1995). Compared with anecdotal records, the results of recent standardized survey efforts revealed a dramatically different assessment of the current distribution of fishers in the Pacific states (figure 1a, map at right). Although standardized surveys have been conducted throughout most forested areas in that region (figure 1a, center map), and many were intentionally located in areas where multiple anecdotal observations of fishers had been made, fishers were detected only in restricted portions of southwestern Oregon and in several disjunct areas in California (figure 1a, map at right). These findings revealed extensive range losses in Washington and Oregon (figure 1a, map at right) and the isolation of extant fisher populations in the Pacific states from other populations in North America (Aubry and Lewis 2003). These results were supported by genetic studies demonstrating that fishers occurring in the southern Cascade Range in Oregon were introduced from British Columbia and Minnesota (Drew et al. 2003), and that populations in the Siskiyou Mountains of northwestern California and southwestern Oregon are indigenous and isolated from the introduced population in the Oregon Cascades (figure 1a, map at right; Aubry et al. 2004, Wisely et al. 2004). Based partly on these findings, a third petition submitted in 2000 (Greenwald et al. 2000) resulted in Pacific Coast fishers being declared "warranted but precluded" for listing under the Endangered Species Act (USFWS 2004), meaning that the US Fish and Wildlife Service (USFWS) acknowledged the need for federal protection, but listing was precluded by higher priorities.

For the Pacific fisher, the use of anecdotal occurrence data led to a significant overestimation of the species' current distribution and a failure to recognize the extent to which range losses had occurred. The 2004 designation of "warranted but precluded" further demonstrated the need for conservation actions to protect fisher populations on the Pacific Coast and initiated a wide array of conservation and management activities, including the establishment of an international team of biologists charged with developing a conservation assessment and strategy for fishers in the Pacific states and British Columbia. Thus, it is likely that misconceptions created by the acceptance of anecdotal occurrence data as empirical evidence delayed the initiation of conservation actions for Pacific Coast fishers by at least a decade.

## Case history 2: The wolverine in California

Grinnell and colleagues (1937) described the California wolverine as being confined to the southern Sierra Nevada and on the verge of extinction. However, from the 1950s to the 1970s, numerous anecdotal occurrence records were compiled and reported in both primary (Ruth 1954, Jones 1955, Cunningham 1959) and gray literature sources (Bruce and Weick 1973, Schempf and White 1977, CDFG 1978, Kovach 1981). In particular, relying entirely on anecdotal data, Schempf and White (1977) arrived at the remarkable conclusion that wolverines were present throughout most of the mountainous regions of California. The authors claimed that the data they compiled left "no doubt" that wolverines were present in the North Coast and North Sierra regions, areas where wolverines were thought absent in Grinnell's time (figure 1b). Subsequently, a status report published by the state of California stated, "Available information suggests that wolverine numbers are increasing in California" (CDFG 1978, p. 66). The broad, contiguous geographic range described in Schempf and White (1977), and expanded by Kovach (1981) to include the White Mountains, has been accepted and repeated by others (Banci 1994) and is still California's official position (CDFG 2008).

Beginning in the late 1980s, a series of survey efforts were initiated to verify wolverine presence using remote cameras, bait stations, and helicopter surveys in many areas of California (Kucera and Barrett 1993, Zielinski et al. 2005). People continue to claim that they have seen wolverines in California, and our molecular genetics facility (*www.fs.fed.us/rm/wildlife/genetics/index.php*) is often called upon to analyze feces and hair samples collected in California near putative wolverine dens or observations. To date, however, none of these surveys or DNA (deoxyribonucleic acid) analyses has detected wolverines in California; the last verifiable evidence of wolverine occurrence in California was obtained in 1922 (box 1; Aubry et al. 2007).

Aubry and colleagues (2007) conducted a detailed analysis of historical patterns of wolverine distribution throughout the contiguous United States. Considering historical records and the current distribution and extent of suitable habitat conditions for wolverines, they concluded that wolverines most likely never occupied montane areas that lacked extensive alpine habitat conditions, such as the North Coast region of California. Schwartz and colleagues' (2007) genetic analyses provided empirical support for these conclusions, indicating that wolverines in the Sierra Nevada of California were isolated from other populations in North America. Thus, the assertion that the wolverine was rapidly expanding its range in California during the 1970s was clearly inaccurate. Most likely, wolverines were extirpated in California early in the 20th century, as Grinnell and colleagues (1937) anticipated.

## Case history 3: The ivory-billed woodpecker in the southeastern states

The last verifiable evidence of the ivory-billed woodpecker was obtained in 1944 in northeastern Louisiana (Fitzpatrick et al. 2005). Since then, however, many people have claimed to have seen the bird. The USFWS has compiled records of these sightings (figure 1c), and they display two traits that are associated with many anecdotal occurrence records: (1) they are located in areas where the sighting is plausible, according to historical information on the organism's distribution and ecological relations; and (2) they show that the species is well distributed within this area of plausibility. Recently, there has been a spate of ivory-bill sightings in Arkansas.

**Box 1. Wolverine recently found in California: Remnant native, natural disperser, or transplant?**

On 28 February 2008, a wolverine was photographed near Lake Tahoe in the north-central Sierra Nevada by a remotely triggered camera. The camera was deployed during a study of the American marten (*Martes americana*) by Katie Moriarty of the US Department of Agriculture (USDA) Forest Service's Pacific Southwest Research Station and Oregon State University. This record represents the first confirmed occurrence of the wolverine in California since 1922 (Aubry et al. 2007). The photograph, and others taken of the same individual at nearby camera stations, was diagnostic; there was no doubt that the organism was a wolverine.

The discovery made the national news and generated a great deal of excitement in California and elsewhere. However, uncertainty remained concerning the wolverine's origin. It could have been a member of a previously undetected population of California wolverines that had persisted since 1922, a natural immigrant from populations in the northern Cascade Range or Rocky Mountains, or a released or escaped captive. Thus, the next step for evaluating the biological significance of this record was to identify the wolverine's source population. The historical population of California wolverines had unique mitochondrial haplotypes substantially different from other haplotypes in North America (Schwartz et al. 2007); consequently, DNA (deoxyribonucleic acid) analysis could determine whether the animal was part of a remnant population of California wolverines. Furthermore, some haplotypes found in northern populations (i.e., Alaska and northern Canada) are absent from extant populations in northern Washington, central Idaho, and northwestern Wyoming. Thus, if the wolverine had any of these exclusively northern haplotypes, it would be reasonable to conclude that it was translocated. If, however, its haplotype occurred in the Cascade or Rocky Mountains, then it could have either dispersed naturally or been translocated.

Noninvasive sampling (hair and scats) was initiated by a group including the USDA Forest Service's Pacific Southwest Research Station, Oregon State University, Tahoe National Forest, and the California Department of Fish and Game, and samples were quickly obtained. The wolverine was haplotype "A" (Wilson et al. 2000), a genetic group that occurs throughout the Rocky Mountains, Alaska, and Canada (USFS 2008). A gender test (Hedmark et al. 2004) revealed that the animal was a male. Thus, although researchers were able to determine that the animal was not a native California wolverine, its exact origins and means of arrival in California remain unknown. These results did, however, have significant implications for wolverine conservation in the contiguous United States, and exemplify the kind of empirical evidence needed to determine appropriate responses to extralimital occurrence records for rare and elusive species. The photographic evidence was diagnostic, but additional DNA evidence was necessary to determine the biological significance of this record.

Fitzpatrick and colleagues (2005) claimed that at least one male ivory-billed woodpecker persisted in the Big Woods region of eastern Arkansas, reversing the common belief that the species became extinct in continental North America in the mid-1900s. Their announcement was based on inconclusive physical evidence and on seven anecdotal visual observations made by individuals whom the authors believed to be experienced and knowledgeable.

Fitzpatrick and colleagues (2005) present two pieces of equivocal physical data: first, acoustic recordings that they acknowledge "cannot be positively distinguished from exceptional calls by blue jays," and second, the "blurred and pixilated" video footage taken by David Luneau in April 2004. Despite the authors' assertions, the video evidence is not diagnostic of the ivory-bill and may represent the pileated woodpecker (*Dryocopus pileatus*), which is similar in appearance and occurs throughout the historical range of the ivory-billed woodpecker (Sibley et al. 2006, Collinson 2007). The appropriate response to the video was taken: a coordinated and extensive search effort was initiated. However, after more than a year of intensive searches by a large cadre of observers (Fitzpatrick et al. 2005, Wilcove 2005), no conclusive evidence was found. Consequently, the announcement that the ivory-billed woodpecker persisted in North America relied on anecdotal visual observations as confirmatory evidence. Fitzpatrick and colleagues stated:

> T. Gallagher and B. Harrison were struck by the apparent authenticity of this [Sparling's] sighting and arranged to be guided through the region by Sparling. At 13:15 CST on 27 February 2004, within 0.5 km of the original sighting, an ivory-billed woodpecker (sex unknown) flew directly in front of their canoe with the apparent intention of landing on a tree near the canoe, thereby fully revealing its dorsal wing pattern. (Fitzpatrick et al. 2005, p. 1460)

In the view of Fitzpatrick and colleagues (2005), there is no uncertainty about whether an ivory-billed woodpecker was seen. Doubts about the match between evidence and conclusions were raised (Jackson 2006) but largely ignored in the general furor and ebullience associated with the "discovery" that a charismatic and iconic species was not extinct after all. In addition to purportedly confirming its escape from extinction, Fitzpatrick and colleagues (2005) made claims about the ivory-bill's population size and reproduction. Others echoed these speculations (Wilcove 2005), and the reported finding was seen as the validation of numerous conservation efforts (Dickinson 2005). In part because of the prestige of the journal *Science,* which published the account, the persistence of a population of ivory-billed woodpeckers has been widely accepted by the general public, and new conservation strategies have been initiated (USFWS 2005). In Arkansas, more than 7400 hectares of swampland have been given protected status to provide habitat for the ivory-bill (White 2006). Funds for habitat acquisition and land stewardship consumed approximately $4,200,000 of federal funds and an additional $2,000,000 in grants (USFWS 2006).

A year later, Hill and colleagues (2006) used similar evidence to report the possible presence of ivory-billed woodpeckers in Florida. Although Hill and colleagues are much more circumspect than Fitzpatrick and colleagues (2005) in their conclusions, they also propose that the ivory-billed woodpecker is present in Florida, without providing any conclusive evidence. Their data consist of sightings (14), many putative vocalizations, and cavities that appeared larger than those created by pileated woodpeckers (Hill et al. 2006).

It is now more than four years since the blurry video was taken in Arkansas, and it remains the only physical data supporting the claim that an ivory-billed woodpecker was found, despite intensive surveys in swampy areas that included annual searches coordinated by the Cornell Laboratory of Ornithology, and ad hoc searches by countless amateurs. Diagnostic DNA markers have recently been developed from museum specimens (Fleischer et al. 2006), so now even a feather or guano could provide proof of the presence of ivory-bills. However, none of these survey efforts has produced any indisputable physical evidence of the persistence of ivory-bills in North America. Although it is always possible to invent rationales to explain the lack of conclusive evidence (e.g., Bivings 2006), available evidence indicates that the ivory-billed woodpecker probably became extinct in the southeastern United States by the middle of the 20th century.

## Conclusions

Anecdotal data are considered notoriously unreliable by most scientists, and many disciplines have endeavored to limit or eliminate their influence. However, anecdotal information continues to influence our political and legal systems as well as the public's understanding of the natural world. In a court of law, jurors generally consider eyewitness accounts to be particularly reliable—much more so than they actually are (Heller 2006). Juries can often be convinced to give little weight to forensic evidence (Thompson and Schumann 1987), but, as Supreme Court Justice William Brennan noted, "[T]here is almost nothing more convincing than a live human being who takes the stand, points a finger at the defendant, and says 'That's the one!'" (Handberg 1995, p. 1014).

Thus, it is important to carefully consider why, for example, we are willing to convict an alleged perpetrator on the basis of a single eyewitness's testimony, but are unwilling to believe hundreds of often compelling sighting reports of the Loch Ness monster or other creatures unknown to science. It seems clear that our weighting of anecdotal data is not related to its intrinsic reliability, but rather to our preconceptions about the described phenomena. We overestimate the reliability of eyewitness accounts in courts of law as much as fivefold (Brigham and Bothwell 1983), but no amount of anecdotal data will convince most people that the Loch Ness monster or Bigfoot exists. The degree to which we accept or reject anecdotal data is therefore largely a matter of belief, not reason. Some have cast the dispute over the presence of the ivory-billed woodpecker in terms of believers versus nonbelievers (Jackson 2006, White 2006), but if the debate is thus reduced, it will never be resolved.

In all three of the case histories presented here, reliance on anecdotal occurrence data led to significant errors regarding the presence, population dynamics, and range of the species in question. For the California wolverine and the ivory-billed woodpecker, the use of anecdotal data led to the resurrection of extinct organisms. In California, not only were wolverines assumed to be present, but the case was made that they were expanding their range and recolonizing their putative former habitat, much of which probably did not support wolverines historically (Aubry et al. 2007). In the case of the fisher, extreme overestimation of its current range led the USFWS to conclude that populations of fishers were large and well connected, when in fact they were small and highly fragmented. In all three cases, the use of anecdotal occurrence data resulted in vast overestimations of range and abundance (figure 1). As the fisher case history illustrates, anecdotal occurrence records are particularly insidious in a conservation context because they are often numerous and well distributed in time and space; consequently, they can preclude biologists from documenting range losses in time for appropriate conservation actions to be taken. Had conservation decisions been based solely on verifiable records, accurate understandings would have been derived and more appropriate management decisions would probably have been made.

Large numbers of anecdotal occurrence records can accumulate over time, and they frequently contain convincing details and occur in plausible locations or habitats. Observers are typically well-meaning and conscientious individuals, and sometimes are experienced, well-trained biologists (e.g., Fitzpatrick et al. 2005). Consequently, it is not surprising that anecdotal data are difficult for many people to dismiss as lacking in scientific value. However, even a very small misidentification rate associated with hundreds of observations made over many decades (60 and 80 years, respectively, in the cases of the ivory-billed woodpecker and California wolverine) will produce a large number of very convincing but misleading occurrence records.

We propose that the reliability of an occurrence data set depends not only on the intrinsic reliability of each record but also on the rarity of the species. As a species becomes rarer, the proportion of false positives will increase. For example, in the contiguous United States, bobcats (*Lynx rufus*) are common and Canada lynx (*Lynx canadensis*) are rare; occasionally bobcat observations are misidentified as lynx. Even if such misidentifications happen only 1 percent of the time, for every 1000 bobcat sightings, 10 will be identified as lynx, and false lynx observations can easily outnumber actual ones. Even if lynx were extirpated from the area, lynx would continue to be reported each year and, over many years, hundreds of spurious lynx records would accumulate.

Records obtained with this misidentification rate would be useful and reliable for bobcats, but extremely misleading for lynx.

Species rarity not only decreases the average reliability of occurrence data but simultaneously increases the social and economic consequences associated with decisions based on such data. Thus, an accepted evidentiary standard for documenting the occurrence of the common American robin (*Turdus migratorius*) would not be appropriate for the potentially extinct ivory-billed woodpecker. We therefore propose the use of a gradient of evidentiary standards for occurrence records that increases in rigor with species' rarity (figure 2). For example, a set of standards might permit the use of anecdotal data when an organism is common and easily recognized, but require indisputable physical evidence before the announcement of the rediscovery of a species thought to be extinct. The best approach to deriving specific standards may be for professional societies associated with particular taxa (e.g., American Society of Mammalogists, American Ornithological Union) to independently develop evidentiary standards for the use of occurrence data by their membership and in their publications. For example, guidelines for the appropriate use of anecdotal data could be included in instructions for authors and reviewers. Once rules were adopted, they could be used to standardize reliability ratings for existing databases, greatly enhancing their value. Such standards should consider a species' rarity, prior evidence of its existence, and the goals of the study or survey (figure 2). We recognize the value of coordinated, long-term survey efforts, such as the Breeding Bird Survey and the Christmas Bird Count, and we do not intend that the establishment of evidentiary standards interfere with the collection of useful data for common species. However, for rare or elusive species, such standards are essential for accurately determining their distribution and status.

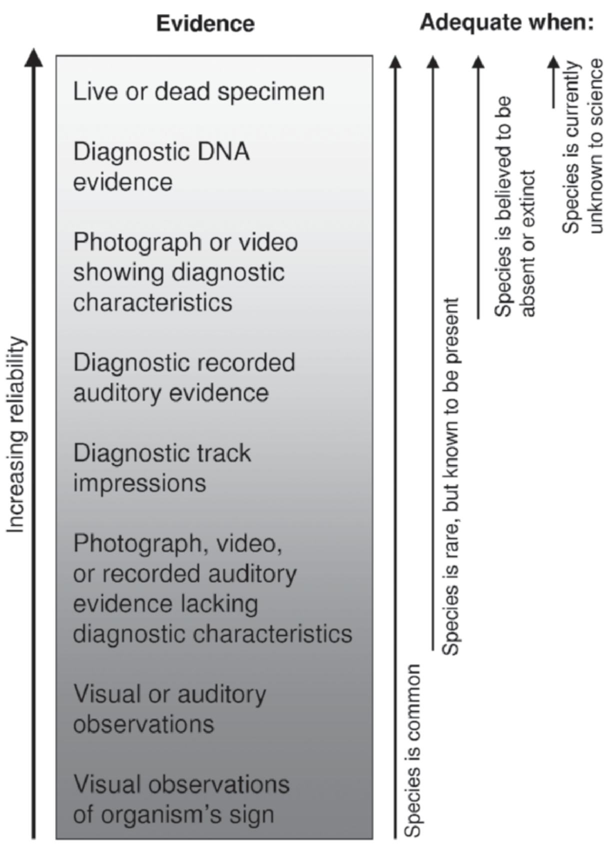


***Figure 2. A sample set of evidentiary standards based on a gradient of increasing species rarity. The relative reliability of data types is expected to vary among taxa.***

Some have argued that making decisions on the basis of the possibility that a species of concern is present is a prudent approach to conservation (i.e., the precautionary principle). Indeed, the Endangered Species Act and many other conservation agreements and accords specifically apply this principle to conservation (Applegate 2000). We agree with the application of the precautionary principle in conservation, but its application is a matter of policy, not science. Consequently, we believe the best way to ensure that policy decisions are based on reliable data and sound understanding is for scientists to establish evidentiary standards for the use of occurrence data. Just as evidentiary standards for the rejection of experimental hypotheses should be arrived at a priori, the existence and distribution of rare organisms should be debated within the context of established evidentiary standards.

## Acknowledgments

Leonard F. Ruggiero and Daniel H. Pletscher provided helpful comments on previous drafts of this manuscript. Three anonymous reviewers offered additional helpful comments. This study was funded by the US Forest Service, Rocky Mountain and Pacific Northwest Research Stations.

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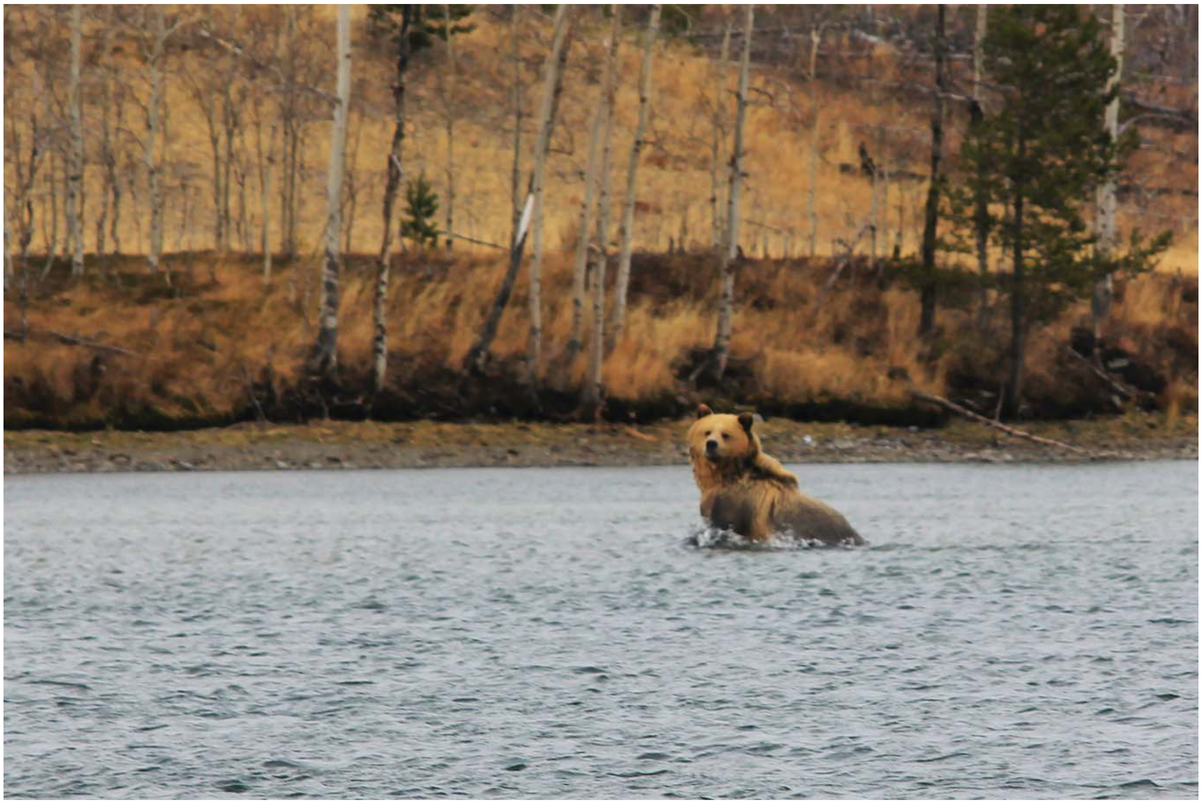

# Chilcotin Coast Grizzly Bear Project

## Annual Progress and Data Summary Report 2011

*Prepared for:*

**The Wilburforce Foundation and the Nature Conservancy of Canada**

**March 31, 2012**

*Submitted by:*

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Cedar Mueller photo

# Chilcotin Coast Grizzly Bear Project 2011

## EXECUTIVE SUMMARY

Very little scientific data has been collected on grizzly bears (*Ursus arctos*) in the Chilcotin/Coast region – the area where the Chilcotin plateau meets the Coast Mountain Range of British Columbia. The dry Chilcotin Plateau is connected to the rainy west coast of British Columbia by habitat rich, low elevation valleys that transect the Coast Range. These valleys - the western and eastern branches of the Homathko, the Southgate and the Klinaklini, for example - provide interior grizzly bears with valuable spring habitat and potential access to the coast. The Chilcotin region is also home to the third largest salmon run in BC, which occurs along the upper Chilko River each fall. With few roads, rich habitat and large expanses of inaccessible wilderness, the Chilcotin/Coast region is home to one of the wildest populations of grizzly bears in Southern Canada and the United States.

The Chilcotin Coast Grizzly Bear Project (CCGBP) was initiated by Osa Ecological Consulting in partnership with the Nature Conservancy of Canada. The second year of this project was generously supported by the Wilburforce Foundation. The main objective of the CCGBP is to collect baseline scientific information on grizzly bears in the Chilcotin/ Coast region to ultimately inform grizzly bear management and conservation policy. Project goals include

estimating the number of grizzly bears using important spring habitats within these low elevation valleys and fall habitats along salmon spawning streams in the region and to document movement between these habitats.

The primary methodology used in this study is DNA analysis of grizzly bear hair. Genetic technology allows for identification of species, sex, and individuals without handling bears. The number of individuals identified from these surveys gives a baseline index of population size for each sampling area. Identified individuals will be used in mark-recapture models to estimate population density and trend. The DNA data will also be used to estimate movement rates between spring and fall sampling areas.

Funding levels for 2011 were reduced from the previous year. The 2011 sampling effort was therefore focused along the upper Chilko River during the fall salmon run.

Out of the 548 hair samples collected along approximately 20 km of the upper Chilko River and sent to the lab for DNA analysis in 2011, a total of 80 individual grizzly bears were identified (46 females, 34 males). Thirty-eight of these were recaptures (detected in previous years of study).

Each year individual grizzly bears from this project are compared with individual bears detected in neighboring DNA studies. To date 12 individual bears have also been detected in the South Chilcotin between 2006 and 2007 and 16 bears have been detected in the headwaters of the Southgate in July/August 2010 (data courtesy of Clayton Apps, Aspen Wildlife Research Inc.). This data indicates that grizzly bears occasionally travel between the coast (upper Southgate and Bute Inlet) and the upper Chilko for salmon. If this is true, the area of influence the Chilko salmon have on surrounding grizzly bear populations is more significant than previously thought.

The long distance movements to access Chilko salmon and the large number of grizzly bears detected along the river during the fall months continue to be strong indications of how important the upper Chilko is for grizzly bears in the Chilcotin/ Coast region.

## INTRODUCTION

Grizzly bears have had a relationship with salmon for thousands of years. One of the places in North America where this relationship is still intact is along the west coast and in the West/Central Chilcotin region of British Columbia where the Chilcotin Plateau meets the eastern slopes of the Coast Range. The West/Central Chilcotin has one of the lowest road densities in southern Canada, and is home to the salmon run of the Chilko River (the 3rd largest sockeye salmon run in BC), and a large and apparently healthy grizzly bear population that congregates on the shores of the river each fall. The coastal zone to the west has multiple inlets lined with salmon spawning streams and provides valuable food for large coastal grizzly bears. The dry Chilcotin Plateau is connected to this wet coast of British Columbia by habitat rich, low elevation valleys that transect the Coast Range. These valleys (the Homathko, the Southgate and the Klinaklini, for example) provide interior grizzly bears with potential access to salmon along the coast and connect them with coastal grizzly bear populations of the Great Bear Rainforest. With few roads, rich habitat and large expanses of inaccessible wilderness, the Chilcotin/Coast region of British Columbia is home to one of the wildest populations of grizzly bears in Southern Canada and the United States.

Extensive wild areas like the Chilcotin/Coast are essential for the long-term survival of long-lived, wide-ranging animals like the grizzly bear. The West/Central Chilcotin is part of a 350-mile broad arc of habitat that stretches from the volcanic Itcha Ilgachuz Mountains in the northwest to the Fraser Canyon in the southeast, encompassing over 6.6 million acres of land. The permanent population of people in the area is small (approximately 1,700 east of Bella Coola and west of Williams Lake) and the number of visitors per year is very low, all of which are confined primarily to the Highway 20 corridor. The coastal region connecting to this extensive wilderness also remains relatively uncompromised. The Great Bear Rainforest, for example, includes 4.4 million acres of undisturbed coastal rainforest.

In contrast, many other wilderness areas that have been identified as refugia for grizzly bears are unlikely to maintain healthy grizzly bear populations in the long term. Banff/Jasper/Kootenay/Yoho National Parks, for example, has a combined area of over 6 million acres. Banff National Park alone receives 4 million visitors per year. The park is also a major transportation corridor (road and rail) with another 4 million people moving through annually. Parks Canada recently stated that the grizzly bear mortality rate in the park continues to be well above sustainable levels.

As wild as the Chilcotin/Coast region is, it is not without threats for bears. Declines in salmon populations both on the coast and in the Fraser-Chilko may have significant impacts on bear populations in the region. Like everywhere else, humans are also steadily infiltrating the area. Settlement, logging, mining, backcountry cattle range use, and recreation are all gradually altering the landscape and compromising this unique wilderness. Global warming is a threat to the area with its warming waters and changes in run-off for salmon populations in the Chilko River. Changing habitats such as wide-scale pine beetle devastation and corresponding changes in water runoff and extensive salvage logging operations - with accompanying road building and habitat alteration – are also a concern. Long-term protection and management of grizzly bears throughout the West/Central Chilcotin is unlikely to be successful without scientific information about the animals and their needs in a local context.

The Chicotin Coast Grizzly Bear Project (CCGBP) builds on a three year project conducted by the Nature Conservancy of Canada between 2006 and 2008 and continues to collect base-line data on grizzly bear numbers and movements in the Chilcotin/Coast region using DNA analysis of grizzly bear hair. Research has included spring and summer grizzly bear surveys in important low elevation habitat in the Tatlayoko and West Branch Valleys (both part of the upper Homathko watershed), and fall surveys during the salmon run along the shores of the upper Chilko River.

The 2011 budget for this project was approximately $23,000. Sampling was therefore focused along the upper Chilko River during the salmon run between September 1st and October 31st, 2011. Individual grizzly bears were also cross-checked with a grizzly bear DNA spring/summer population assessment in the Southgate region to the south of the CCGBP study area.

## GOALS AND OBJECTIVES

Project goals and specific objectives are summarized as follows:

**Overall Project Goals**

- To provide scientific information to help managers make resource and conservation decisions in relation to grizzly bears.
- To enhance eco-regional planning efforts in the region by providing baseline information on grizzly bears in specific habitats and seasons.
- To enhance efforts in protecting and preserving the ecological integrity of the upper Homathko Valleys (Tatlayoko and West Branch) and the upper Chilko River area.
- To increase local knowledge and interest in the status and issues surrounding grizzly bears in the region.

**2011 Project Objectives**

- To estimate and monitor the number of grizzly bears utilizing the upper Chilko River during the fall salmon run.
- To document movement of grizzly bears detected by the CCGBP and a spring/summer grizzly bear population census overlapping with the south Chilko and Bute Inlet area.

## STUDY AREA

The 2011 sampling area includes the ***upper Chilko River*** along 20 km of the river from where it exits Chilko Lake to just downriver of "Henry's Crossing". Road access is via gravel road from Tatla Lake on Highway 20.

The upper Chilko River study area borders Tsylos Provincial Park. The study area borders the the Klinaklini-Homathko Grizzly Bear Population Unit (GBPU) where grizzly populations are currently assigned a conservation status of "viable", and borders the South Chilcotin Ranges GBPU which is assigned a conservation status of "threatened" (Hamilton et al. 2004).

The upper Chilko River is in the Central Chilcotin Ranges Ecosection (CCR), which is a dry mountainous area in the rain shadow of the Coast Mountains. Highest summits are generally about 3,000 m. The ecosection contains three large lakes including Chilko, Tatlayoko, and the two connected Taseko Lakes. The Homathko River flows out of Tatlayoko Lake, converges with Mosley Creek as it flows out of the West Branch Valley, and transects the coast range to Bute Inlet creating a unique low elevation corridor between the dry interior and the wet BC coast. The head of the Southgate River Valley begins near the southwest side of Chilko Lake and flows down to Bute Inlet, providing another viable coastal/ interior connection.

The Chilko River eventually flows into the Fraser River and has one of British Columbia's largest sockeye salmon (*Oncorhynchus nerka*) runs. Chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), and steelhead trout (*O. mykiss*) are also found in the Chilko River. The run occurs annually sometime between late August and October. The spawning beds are located within a few kilometers of Chilko Lake and the run draws large concentrations of both bears and humans to the region each year. During the salmon spawning season, the river, and riparian and upland forest habitats associated with the Chilko River, contains the highest population density of grizzly bears in the Chilcotin Forest district.

Significant human use occurs along the Chilko River during spawning season. Several tourism facilities border the river. Cattle and horses graze in the area and numerous trails follow along the river on both sides. Guided and non-guided recreational fishing occurs from shore and in motorized and non-motorized boats. Department of Fisheries and Oceans conducts salmon enumeration in and along the banks of the river, particularly where Lingfield Creek joins the Chilko. Nemiah First Nations (the Xeni Gwet'in) as well as other First Nation individuals fish along the shores and hold gatherings within the area.

## METHODS

### Fall sampling

The primary methodology for the Chilcotin Coast Grizzly Bear Project is DNA analysis of grizzly bear hair. DNA hair-snagging is a non-invasive, cost-effective method for collecting scientific information on spatial and temporal trends of grizzly bear populations. The second year of this project consisted of a fall grizzly bear survey along the shores of the upper Chilko River during the salmon run. Sampling was conducted between September 1 and October 31$^{st}$ 2011.

Grizzly bear hair was collected at 13 different snag sites during 5 sessions (each session lasted 10-12 days) along the river. Site locations were consistent with locations from previous years and were chosen based on local knowledge of bear use/travel in the area and put in areas where human disturbance was minimal. Hair was collected from barbed wire stretched across bear trails beside the river and across shorelines by stretching wire to a metal post pounded into the river just off shore. Sampling sites did not include a scent lure. Snagging sites were not moved between sessions. Sites were accessed by a 17-foot canoe from the Tsylos Park campground on the north end of Chilko Lake to Henry's Crossing. Sites were removed at the end of the sampling season.

### Lab analysis

All hair samples were sent to Wildlife Genetics International (WGI) of Nelson, BC, for DNA analysis under the supervision of Dr. David Paetkau.

### Salmon volume and timing

Bear numbers along salmon spawning streams may be relative to salmon availability for bears (Boulanger et al. 2004). Data on Sockeye salmon run volume and timing for the upper Chilko River and Chilko Lake, and carcass recovery surveys are collected by the Department of Fisheries and Oceans (DFO) each year.

### Population estimates

Grizzly bear population size and trend estimates for this project will be derived using mark-recapture analysis. Model selection and execution will be performed by John Boulanger with Integrated Ecological Research in Nelson, BC at the end of the study.

### Remote camera

For interest we collected photos and videos at various hair snag sites with a remote camera during the sampling period (Figure 1).

(a)

(b)

**Figure 1 (a and b above). Grizzly bears negotiate a barbed wire site along the upper Chilko River.**

## RESULTS

### Sampling success

A total of 548 hair samples were collected from the upper Chilko and sent to the DNA lab for the 2011 season. Sample numbers were high compared with previous years despite consistent sampling methods (Table 1).

Approximately 30% of the samples collected were grizzly bear samples that were assigned to an individual. The rest of the samples were either excluded due to sub-selection rules, lack of suitable material for extraction, were black bear or some other non-grizzly bear species, or somehow failed during the extraction process. This is consistent with samples collected in previous years.

**Table 1. Number of hair samples collected in each sampling area between 2006 and 2011.**

| Year | Tatlayoko | West Branch | Chilko | Scar Creek |
|---|---|---|---|---|
| 2006 | 509 | - | 344 | - |
| 2007 | 859 | - | 494 | - |
| 2008 | 659 | - | 413 | - |
| 2010 | 298 | 188 | 247 | 145 |
| 2011 | - | - | 548 | - |

### Individual grizzly bears

Out of the 548 hair samples sent for DNA analysis, a total of 80 individual grizzly bears (34 males, 46 females) were detected along the upper Chilko. Thirty-eight bears were recaptures from previous years (Table 2).

Data from this season builds on a three year study conducted by NCC from 2006 to 2008. Between 2006 and 2011 (no data for 2009) a total of 168 different individual grizzly bears (with an average of 55 grizzly bears per year) have been detected on the upper Chilko River during the salmon season.

The total number of different individuals detected over the five years including all sampling areas within the CCGBP is 223 grizzly bears.

**Table 2. Grizzly bears detected in Tatlayoko, West Branch, the upper Chilko and Scar Creek, 2006 – 2011. Recaptures include all bears captured previously in any sampling area.**

| | Tatlayoko | | West Branch | | Chilko | | Scar |
|---|---|---|---|---|---|---|---|
| Year | Individuals | Recaps | Individuals | Recaps | Individuals | Recaps | Individuals |
| 2006 | 17 | 0 | - | - | 41 | 9 | |
| 2007 | 33 | 14 | - | - | 66 | 29 | |
| 2008 | 25 | 16 | - | - | 50 | 30 | |
| 2010 | 26 | 19 | 16 | 3 | 39 | 23 | 16 |
| 2011 | - | - | - | - | 80 | 38 | |
| **Total*** | **68** | | **16** | | **168** | | **16** |

**Total numbers do not add up to the grand total due to individual bear detections in more than one area.*

**South Chilcotin/ Southgate**

Each year we compare individual bears from this project with individual bears detected by neighboring studies. To date 12 individual bears have also been detected in the South Chilcotin between 2006 and 2007 (Figure 2). The South Chilcotin project shifted to include the Southgate drainage and the Southwest side of Chilko Lake in 2010. Sixteen bears detected along the upper Chilko were also captured in the Southgate study area between June 26th and August 10th 2010 (Figure 2 and Figure 3). The majority of these were located near the headwaters of the Southgate River which interestingly is approximately 55 km up the valley from Bute Inlet *and* approximately 55 km from the upper Chilko. Data from both of these studies was provided by Clayton Apps, Aspen Wildlife Research Inc.

**Salmon escapement**

The 2011 sockeye escapement estimate for the Chilko River and Lake was recorded at 919,254 fish (www.dfo-mpo.gc.ca) (Table 3).

**Photographic evidence**

The remote camera recorded several photos of grizzly bears, black bears and birds at each hair snag site (Figure 1 and Figure 2). One video clip shows a grizzly bear stepping carefully "on" the wire rather than over it. Another video clip shows two bears leaping over the wire. Clearly not all bears in the area are necessarily detected with the barbed wire sampling methods. Fortunately mark-recapture population modelling takes this fact into account. The video file sizes are too large to include and send with this report.

**Table 3. Summary of Sockeye escapement for the upper Chilko River and Lake, 2006 – 2011.**

| Year | Total escapement |
|---|---|
| 2006 | 469,504 |
| 2007 | 306,707 |
| 2008 | 250,583 |
| 2010 | 2,500,000* |
| 2011 | 919,254* |

***Department of Fisheries and Oceans near final escapement estimates (www.dfo-mpo.gc.ca)***


**Figure 2. A remote camera captures a grizzly sow and cub approach a strand of barbed wire.**

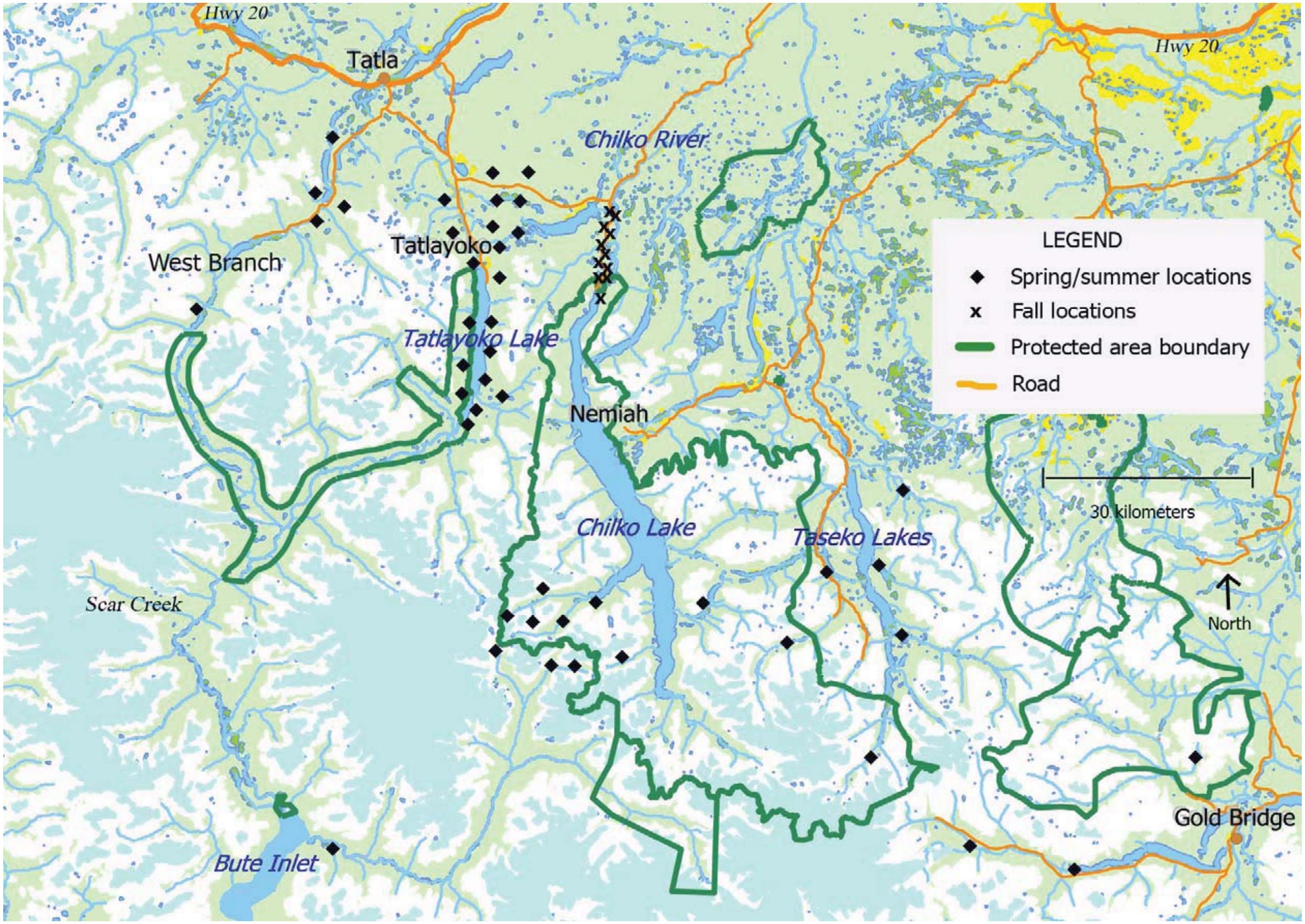


Figure 3. Locations of grizzly bears detected in surrounding areas *and* on the upper Chilko River between 2006 and 2011 (data courtesy of NCC and Clayton Apps).

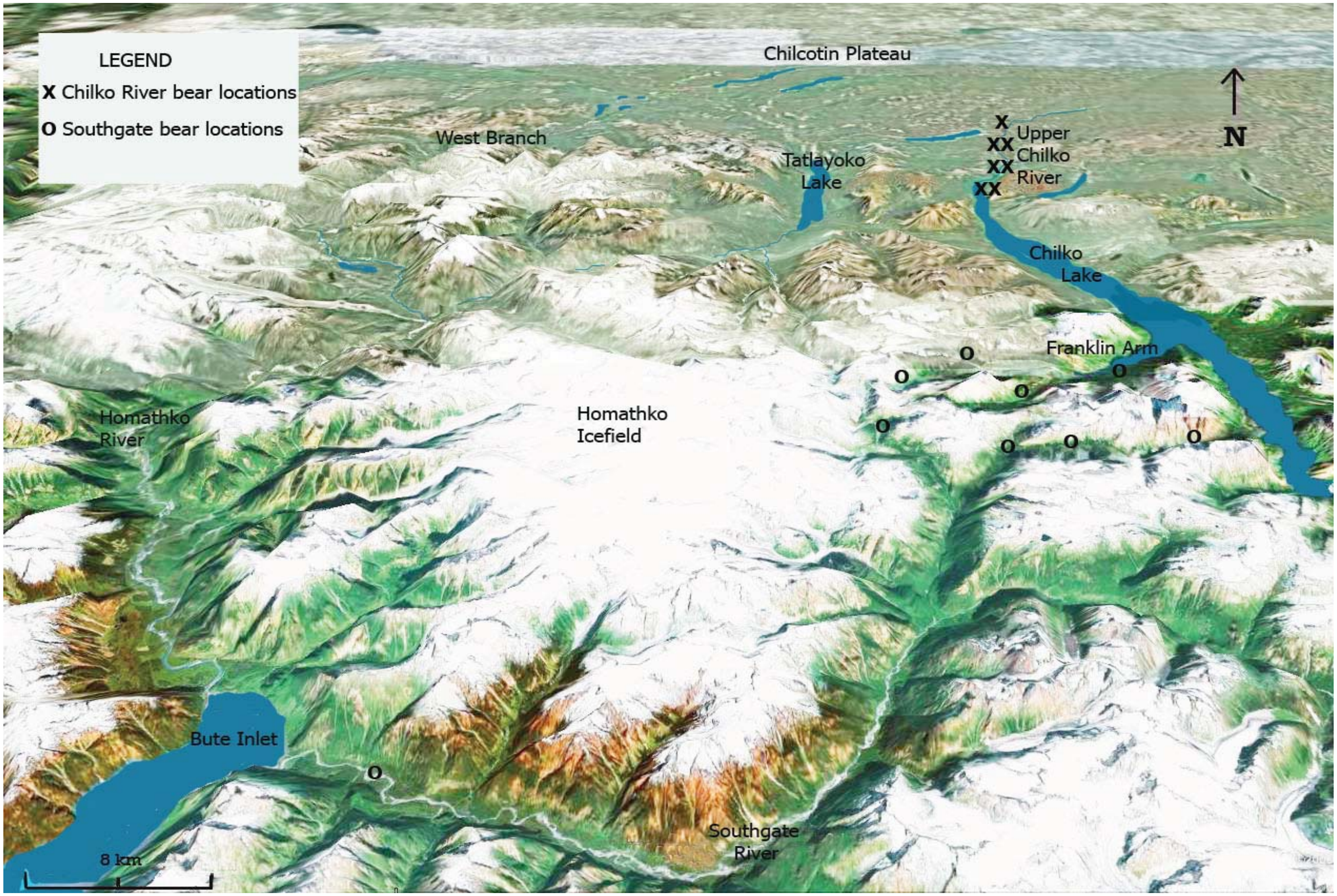


**Figure 4. Google Earth image of the low elevation Homathko and Southgate River Valleys connecting the Chilcotin Plateau to Bute Inlet. Note detection locations of Chilko River grizzly bears by the "Southgate" study in 2010 (data courtesy of Clayton Apps).**

## Discussion

There continues to be significant variation in the annual number of grizzly bears detected along the upper Chilko River during the salmon run. What causes bears to come and feed at the Chilko in some years and not in others?

Previous identified variables include the number of salmon spawning in the Chilko River in a given year, and water levels as an indication of how accessible those salmon are to bears.

Data from the 2011 season may indicate that grizzly bears occasionally travel between the coast (upper Southgate and Bute Inlet) and the upper Chilko for salmon. If this is true, the area of influence the Chilko salmon have on surrounding grizzly bear populations is more significant than previously thought. Perhaps *coastal salmon availability* is also an important variable in determining the annual number of grizzly bears utilizing the Chilko River during the fall months.

Salmon run estimates (escapement) in the Southgate and Homathko Rivers are uncertain due to glacial waters impeding reliable escapement estimates, however the DFO has reported that the Chum Salmon escapement in Bute Inlet is highly variable from year to year with a reported downward trend to 2008 (Van Will et al. 2009).

Future salmon escapement in Bute Inlet may play a role in annual grizzly bear use along the Chilko. However, more data is required to answer this question. With funding in place for at least one more season of grizzly hair sampling along the upper Chilko, the 2011 season yet to be analyzed for the Southgate study, and greater effort by the DFO to reliably estimate annual salmon escapement along the coast (www.dfo-mpo.gc.ca), pending data may shed more light on this possibility.

Regardless, the long distance movements to access Chilko salmon and the large number of grizzly bears detected along the river during the fall months continue to be strong indications of how essential the upper Chilko is for grizzly bears in the Chilcotin/ Coast region.

## ACKNOWLEDGEMENTS

The 2011 season would not have been possible without valuable assistance from many people along the way. Many thanks go to the following people and organizations. Thank you to Wendy Vanasselt, Carol Orr, and the Wilburforce Foundation for project support and funding. Continued coordination and support came from Andrew Harcombe and staff from the Nature Conservancy of Canada in Victoria. Assistance in all aspects of data collection and project logistics came from Roderick de Leeuw and Fritz Mueller. Peter Shaughnessy with NCC provided timely communications within the local community. Chief Marilyn Baptiste and Nancy McLean with the Xeni Gwet'in established research protocols and supported the scientific research on grizzly bears within Xeni Gwet'in territory. DNA analysis was conducted by Dr. David Paetkau and his Wildlife Genetics lab in Nelson. And Clayton Apps of Aspen Wildlife Research Inc. with the South Chilcotin and Southgate grizzly bear studies shared overlapping bear locations.

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vgty7
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Tel/Fax: 250-592-1088

October 29, 2013

Mike Ramsay
Regional Manager
Recreational Fisheries and Wildlife Management
Resource Management
Ministry of Environment

Re; Your file: 200-20/Wildlife Advisory Committee/FN

Dear Mr. Ramsay;

We have been copied your Engagement Request to the Tsilhqot'in National Government concerning recommendations regarding the reopening of the spring Grizzly Bear LEH season in Management Units 5-05, 5-06 and 5-04.

Friends of the Nemaiah Valley (FONV) works closely with the Xeni Gwet'in First Nations Government and the Yunesit'in First Nations Government, as well as the Tsilhqot'in First Nations Government. We have formal Protocols with the XGFNG wherein we agree to work together to protect the environment of the Nemiah Valley and surrounding areas. Our work involves wildlife research, landscape planning, and support for First Nations culture.

The opinions we express here are those of FONV, and not necessarily those of the any Tsilhqot'in government.

Through our research and knowledge of the land we have identified the 'Chilcotin Arc' as an area of great ecological value, especially for apex predators like the grizzly bear. We view this territory as of supreme importance for this species as attempts are made to develop a recovery plan for the species in Southwest British Columbia. We oppose any hunting of grizzly bears in this area. While we do not view hunting as the major threat to grizzlies, that being excessive industrial development and roading, as well as potential mine developments like New Prosperity, in some cases the loss of a one or two breeding animals can have serious impacts. We  believe any economic argument for opening a hunt is exceedingly tenuous.

I am sure you are aware that there is already considerable human caused mortality throughout this area, relatively little of it ever reported. While some of this may be due to legitimate concerns over livestock losses, our local knowledge tells us that most of it is not.

Management Unit 5-04 is indeed a “difficult issue”!  We see absolutely no room in this area whatsoever for a legitimate grizzly bear LEH. We know it well and conduct various research projects in the area. We are highly dubious of the ministry population counts in this area. Various presentations before the panel assessing the impacts of New Prosperity Mine heard ample expert evidence that this is an area where grizzly populations could very easily be pushed over the edge into extinction if the land is further impacted by any development. We include hunting in that assessment. Frankly, we cannot imagine what would ever lead your ministry to conclude that it might be possible to open an LEH here without seriously threatening the survival of the remaining population.

We would be interested to know how you have arrived at your present population estimates and to what extent they are based on actual on the ground evidential surveys rather than modelling and extrapolations based on carrying capacity.

Yours Truly

David Williams
Executive Director
Friends of the Nemaiah Valley

cc Chief Roger William and Council, XGFNG
Chief Russell Myers Ross and Council, Yunesit'in FNG
Chief Joe Alphonse, TNG
Crystal Verhaeghe, TNG
Karen McClean, Chilko Resorts and Community Association

Pages 74 through 88 redacted for the following reasons:
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s.13, s.16
s.16

**From:** Ramsay, Mike K FLNR:EX
**Sent:** Wednesday, February 5, 2014 1:40 PM
**To:** 'Luke Doxtator'
**Cc:** Lyons, Devon ABR:EX
**Subject:** Document from Portal Labeled TNG

Luke:

Here is the entry (the one that mentioned reduced harvest). Please see paragraph 2 which outlines 2 bears should be considered available for harvest not 4.

TNG poratal submission.pdf

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**Mike Ramsay**
**Fish and Wildlife Section Head**
**Resource Management Division**
**Forests, Lands and Natural Resource Operations**
**Cariboo Region**
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FRIENDS of the
NEMAIAH VALLEY

October 29, 2013

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Karen McClean, Chilko Resorts and Community Association

Pages 92 through 93 redacted for the following reasons:
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s.16

**REPORT OF THE FEDERAL REVIEW PANEL**

**NEW PROSPERITY GOLD-COPPER MINE PROJECT**

*October 31, 2013*

## EXECUTIVE SUMMARY

Taseko Mines Limited (Taseko) has proposed the development of the New Prosperity Gold-Copper Mine Project (the Project), 125 km southwest of Williams Lake, British Columbia. The Project would entail constructing, operating, and closing a large open pit mine, which would be built over two years and would operate for 20 years. The Project would include an open pit, concentrator facility, support infrastructure, and associated tailings and waste rock storage areas, and the construction of a 2.8-km access road to the mine site. The Project would also include a 125-km power line, and the transport of mine concentrates to an existing concentrate load-out facility near Macalister, British Columbia.

This report presents the results of the federal Review Panel's (the Panel) assessment of the potential environmental effects of the proposed Project. This report has been completed in accordance with the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and the Panel's Terms of Reference issued by the Minister of the Environment (the Minister). This report addresses the factors identified in the Panel's Terms of Reference and sets out the rationale, conclusions and recommendations of the Panel, including proposed mitigation measures and follow-up programs.

Taseko had submitted a previous project, known as the Prosperity Gold-Copper Mine project (original Prosperity project) which was subject to an environmental assessment under *British Columbia's Environmental Assessment Act* and a federal review panel under the former *Canadian Environmental Assessment Act*. In January 2010, the Government of British Columbia issued an environmental assessment certificate for the original Prosperity project concluding there would be significant adverse environmental effects on fish and fish habitat but that those significant effects were justifiable in the circumstances.

In July 2010, the previous panel concluded that the project as proposed would result in significant adverse environmental effects. In November 2010, the Government of Canada accepted the previous panel conclusions and determined that the significant adverse environmental effects could not be justified under the circumstances. The Government of Canada indicated that its decision did not preclude the proponent from submitting a project proposal that addressed the factors considered by the panel.

Following the Government of Canada decision, Taseko revised its mine proposal to address the factors identified by the previous panel and submitted the New Prosperity Gold-Copper Mine Project for review. The most important change implemented by Taseko in its new proposal was the preservation of Fish Lake (Teztan Biny) and portions of its tributaries. This outcome would be achieved primarily by relocating the tailings storage facility 2.5 km upstream of the lake and by introducing a lake recirculation water management scheme. Taseko stated that the redesign would enable future generations to use these waters for navigation, fishing and recreational activities and would also mitigate the effects on the cultural heritage and on the current use of the lands and resources by Aboriginal peoples. The area disturbed by the new mine development plan would also be reduced by 23% compared to the original proposal. Taseko has also proposed to implement additional measures to assist in the protection of the region's grizzly bear population.

Taseko focused its assessment on those aspects of the Project that had changed or were new from the previous project proposal. There were no changes in the Project design for the transmission line, the existing rail load-out facility or the road access.

The mine site would cover an area of approximately 27 $km^2$ in the Fish Creek (Teztan Yeqox) watershed. The watershed, which drains into the Taseko River (Dasiqox), consists of Fish Lake (Teztan Biny), Little Fish Lake (Y'anah Biny) and the surrounding area called Nabas. The area was characterized as a recreational area as well as an area used by Aboriginal peoples for many traditional activities and cultural practices. The mine site would involve the permanent loss of Little Fish Lake and its surrounding area from the placement of a 12 $km^2$ tailings storage facility, which consists of 7.8 km of earth-rock filled dams up to 115 m high. To make up for the reduction in tributary flow to Fish Lake and to ensure Fish Lake is preserved as a viable ecosystem, Taseko proposed to recirculate Fish Lake water during operations and into closure, until the tailings storage facility lake water is of suitable quality to be released to Fish Lake. The development redesign for New Prosperity would increase the capital cost by $300 million to an estimated total of $1.0 billion dollars. Taseko submitted a fish and fish habitat compensation plan to compensate for the loss of fish habitat in Upper Fish Creek and Little Fish Lake and the temporary reduction in water flows to Lower Fish Creek.

The Project would be located in the Cariboo-Chilcotin Regional district, a sparsely populated, rural region with Williams Lake as the regional service centre. The economy within the local study area was reported to be heavily dependent on forestry and mining. According to Taseko, the Project would be expected to create 550 direct jobs and 1280 indirect over its expected 20 years of operation. Taseko estimated that annual government revenues would be $26.2 million during construction and $48.4 million during operations and would continue for the life of mine operations, exceeding 1 billion dollars.

The Aboriginal groups that would be affected by the Project are the Tsilhqot'in and Secwepemc Nations. The Tsilhqot'in traditional territory includes the mine site area, located in the Fish Lake (Teztan Biny) and Nabas areas, as well as the western portion of the transmission line corridor. The Secwepemc traditional territory includes the eastern portion of the transmission line corridor as well as the mine site. The Aboriginal groups have maintained strong opposition to the Project.

The Project is subject to review under the *Canadian Environmental Assessment Act, 2012* and would likely require Fisheries and Oceans Canada, Transport Canada and Natural Resources Canada to issue permits, approvals, authorizations and/or licences pursuant to the *Fisheries Act*, the *Navigable Waters Protection Act* and the *Explosives Act* respectively. In addition, given Taseko had identified the need to use Little Fish Lake (Y'anah Biny) and Upper Fish Creek (Teztan Yeqox) for the disposal of mine waste, including tailings and waste rock, as well as the management of process water, the *Metal Mining Effluent Regulations* would need to be amended to include these water bodies to Schedule 2 and to designate them as tailings storage, if the Project receives the required approvals.

The federal Minister of the Environment appointed the three-member Panel under the former *Canadian Environmental Assessment Act* on May 9, 2012, and the Panel was continued under the new *Canadian Environmental Assessment Act, 2012*. The Panel consists of Dr. Bill Ross (chair), Dr. George Kupfer and Dr. Ron Smyth. The Panel Terms of Reference require the Panel to conduct an assessment of the environmental effects of the Project and to determine the significance of these effects. The Panel was also instructed to accept and review information from Aboriginal groups on how the Project might affect potential or established Aboriginal rights or title within the Project area and to include this information in its report.

During the environmental impact statement (EIS) review, federal and provincial government departments and agencies participating in the review provided views and expertise on the adequacy and technical merit of the EIS and additional information submitted by Taseko as measured against the EIS Guidelines. The federal departments participated throughout the public hearing, both with written submissions and with presentations by the subject matter experts at the hearing. The provincial government agencies chose to participate by providing written submissions and written responses to questions raised during the hearing. The Panel commends the significant contribution both governments, experts, participants, Aboriginal groups and Taseko made throughout the environmental assessment of the Project.

Taseko submitted its environmental impact statement to the Panel on September 27, 2012 and on June 20, 2013 the Panel determined that the EIS, supplemented by the additional information provided by Taseko, contained sufficient information to proceed to the public hearing. The hearing took place from July 22 to August 23, 2013 in the communities most affected by the Project: Williams Lake, six Tsilhqot'in and two Secwepemc communities. The hearing provided an opportunity for registered interested parties and the public to present their overall views on the Project and its potential environmental effects and for Taseko to present its assessment of the Project and to answer questions from participants. As part of the community hearing sessions the Panel also held two site visits: 1) a site visit near Taseko River (Dasiqox) and at Fish Lake (Teztan Biny), and 2) a site visit at Little Dog, where the proposed transmission line would cross the Fraser River.

The public hearing sessions were well attended, and the Panel was able to hear from most of the participants wanting to present to the Panel. In total, approximately 300 individuals or groups made presentations to the Panel during the various hearing sessions.

This report presents the Panel's conclusions and recommendations and takes into account information obtained during the course of the New Prosperity Project review as well as information generated as part of the previous review In accordance with the Panel's mandate. The list of Panel conclusions and recommendations are presented in Chapter 17. The Panel's key conclusions are summarized below. The Panel makes no suggestion as to whether the Project should proceed; that decision will be made by the governments of Canada and British Columbia.

The Panel concludes that the New Prosperity Project would result in several significant adverse environmental effects; the key ones being effects on water quality in Fish Lake (Teztan Biny), on fish and fish habitat in Fish Lake, on current use of lands and resources for traditional purposes by certain Aboriginal groups, and on their cultural heritage. The Panel also concludes there would be a significant adverse cumulative effect on the South Chilcotin grizzly bear population, unless necessary cumulative effects mitigation measures are effectively implemented.

The reasons for these conclusions are summarized as follows:

Water Quality

The Panel has determined, based on strong evidence submitted by government agencies (both Canada and British Columbia) and other participants, that Taseko underestimated the volume of tailings pore water seepage leaving the tailings storage facility and the impacts on water quality caused by recirculation of water within the Fish Lake (Teztan Biny) and Upper Fish Creek (Teztan Yeqox) system. The Panel has also determined considerable uncertainty remains regarding Taseko's contingency plan for water treatment. Again, this conclusion was based on strong evidence submitted by governments and other participants. The Panel has determined that the proposed target water quality objectives for Fish Lake are not likely achievable and, even with expensive water treatment measures, the protection of Fish Lake water quality is unlikely to succeed in the long term.

Although the seepage mitigation measures proposed by Taseko have the potential to substantially reduce the volume of seepage, the Panel concludes it would not eliminate seepage from entering Fish Lake (Teztan Biny). The Panel concludes the concentration of contaminants of concern in Fish Lake would be considerably larger than Taseko's predictions and that eutrophication of Fish Lake would be a significant problem that is unlikely to be mitigable in the long term.

Fish and Fish Habitat

The likely significant adverse effects on water quality in Fish Lake and the expected eutrophication of Fish Lake would therefore result in a significant adverse effect on fish and fish habitat in Fish Lake.

Aboriginal Matters

The Tsilhqot'in and Secwepemc currently use the mine site area and the transmission line corridor for traditional purposes and for carrying out of ceremonial and spiritual practices. Fish Lake (Teztan Biny) and Nabas areas are places of unique and special significance for Tsilhqot'in cultural identity and heritage and they have occupied Nabas and used Fish Lake for generations. The Panel heard the Tsilhqot'in concerns about likely burial and cremation sites in the Project area, notably around Little Fish Lake (Y'anah Biny), that were not completely identified in archaeological studies for the previous project. This area would be buried under the tailing storage facility.

Taseko committed to maintain access to Fish Lake for Aboriginal peoples to continue practicing their activities. However, the Tsilhqot'in stated that if the Project proceeds, they would avoid going to Fish Lake because of the disturbance resulting from the presence of a mine, their fears of contamination, and the loss of the spiritual and cultural connections they have with a very special cultural place.

In the Panel's view, the loss of Nabas and the changes to the environment caused by the mine components would reduce the area where the Tsilhqot'in can practice their traditional harvesting activities, disturb burial and cremation sites that are of great importance to them and endanger their ability to sustain their way of life and cultural identity. The Panel has determined that the Project would have adverse effects on the

Tsilhqot'in current use of lands and resources for traditional purposes, archaeological and historical sites, and cultural heritage and that these adverse effects could not be mitigated and therefore would be significant.

The Secwepemc stated that the transmission line corridor as proposed would go through their traditional territory, their most important hunting grounds, over important fishing and plant gathering areas, but also through sacred areas notably where the transmission line would cross the Fraser River, which could not be avoided by moving the centreline within the proposed corridor. The Panel recognizes that the proposed transmission line corridor crosses areas of high archaeological potential and significance.

The Secwepemc explained that it is important for their history, culture and identity that they practice their traditional activities and cultural ceremonies and rituals in sacred areas where they have connections with their ancestors. The Panel finds that the presence of the transmission line would constitute an interference with the spiritual nature of the area that would disturb cultural and spiritual activities, and therefore would compromise the Secwepemc cultural heritage.

The Panel recommends that, if the Project proceeds, Taseko be required to consider other feasible alternative routes for the transmission line crossing at the Fraser River, to avoid these areas of cultural significance to the Secwepemc.

If the proposed transmission line crossing at the Fraser River is the only feasible option, the Panel's conclusions on the effects on the Secwepemc current use of land and resources for traditional purposes, cultural heritage, archaeological and historical sites are as follows: one Panel member determines that the proposed Project would result in significant adverse effects; two Panel members determine that, after taking into account the context and temporary nature of the transmission line, these effects would be acceptable and therefore not significant.

Potential or established Aboriginal rights and title

The Tsilhqot'in have proven and asserted Aboriginal rights throughout the mine site area, as well as asserted Aboriginal title. The Esk'etemc and the Stswecem'c Xgat'tem have asserted Aboriginal rights throughout the transmission line corridor and asserted Aboriginal title. The Panel determines that the Project would adversely affect established and asserted rights and title for the Tsilhqot'in and Secwepemc Nations.

Cumulative effect on South Chilcotin Grizzly Bear Population Unit

The South Chilcotin grizzly bear population has been determined by the province of British Columbia to be threatened. The Panel took this determination to be an indication that the population has undergone significant adverse effects in the past and therefore there is an existing (before any effects of the proposed New Prosperity Project) significant adverse cumulative effect on grizzly bears.

According to Taseko, without additional mitigation measures, the Project would have an adverse effect on grizzly bears in the area. This effect would combine with the effects of previous human activities and exacerbate the existing significant adverse cumulative effect. Taseko proposed to undertake further mitigation measures to reduce the existing cumulative effects. The Panel has determined that if the mitigation measures proposed by Taseko were effectively implemented, the South Chilcotin grizzly bear population would be in better shape after the Project than before the Project; however effectively implementing these measures could be challenging.

The Panel believes that the most challenging task would be to effectively control access on existing roads and trails in the region to restore secure grizzly bear core habitat. The Panel concludes that there is a need to control enough access so that, in combination with the other mitigation measures proposed by Taseko, the Project effects are offset and that the access control measures alleviate some of the cumulative effect.

Hunting Proposal for MU 5-05 and 5-06

Key Issues with the current hunt proposal:

1) Underestimate unreported kills at 1%

"minimum standard of 2% per annum of the standing population estimated as illegal and unreported kills" – this is the language I used in the technical report for Taseko and it is what I know to be true for southwest BC.

The use of 1% fails to recognize the following specifics of the Klinaklini-Homathko GBPU:

- High use of the area by ungulate hunters (gut piles and conflict with hunters are known to increase mortality risk and unreported incidents). This means you must account for this source of mortality
- Past overkill (high human caused mortality) which increases the risk of repeating that overkill with a legal hunt . . . note that no evidence is presented which suggests there have been measures taken to reduce conflicts and thus eliminate this problem. Therefore the conflict issues remain, and the risk of repeat overkill is high.
- High cow presence in the northern portions of each of the MUs which increases mortality risk due to livestock-bear conflicts. There is strong anecdotal evidence that unreported Grizzly bear kills over cows occur in the province across range tenures. This must be accounted for in MUs with significant range tenures.

Therefore the use of 1% for unreported is unjustified and erroneous. A minimum of 2% is required for proper stewardship. 2% for unreported is 3.68, leaving 3.68 as the harvestable amount. Conservatively, that means 2 males annually available for harvest, not the proposed 4 animals.

2) Viable GBPUs adjacent to Threatened GBPUs need to be managed as source populations

The latest science on source-sink dynamics shows that source areas have higher irreplaceability values than sink habitats (Nielsen 2011). We cannot recover Threatened GBPUs in a vacuum but need a continuum of management, which must include managing the nearest neighbor viable populations in a way that maintains them as significant source habitats for recovery. That means using higher management criteria before enabling a hunt in such a neighboring unit, using the recovery objective as the highest priority conservation measure required (not the need to provide a hunting opportunity when such opportunities exist with less risk to conservation objectives elsewhere).

The fact that the boundary of 5-05 is Chilco Lake and Chilco River that borders the Threatened South Chilcotin unit, fewer bears than suggested (if any at all) should be hunted in the Klinaklini-Homathko unit. Although the suggested hunt is a spring hunt, which should in theory target only resident bears, the lack of science on the transient bears (see pt #3) means more caution is warranted. The Federal Panel hearing clearly recognized that there are "existing significant adverse cumulative effects" in the South Chilcotin (Federal Panel Review 2013). It is unreasonable to assume these affects stop at the boundary with the adjacent population unit.

3) Use of anecdotal information about summer salmon use to reopen a spring hunt

Anecdotal reports of more bears on the rivers in the summer does automatically not translate into an increase in the resident bear population – this is a leap an unjustifiable leap of logic in a science-based system. Anecdotal evidence is notoriously unreliable and wrong (McKelvey, Aubry et al. 2008) and our best attempts to understand bear population trends are filled with uncertainty (Garshelis 2002). That is why we use science, DNA evidence and collaring data to determine what is really happening on a landscape. There is DNA evidence indicating that transient bears are using the Chilco salmon run, including bears from threatened GBPUs (South Chilcotin and Squamish Lillooet) (pers. comm. Tony Hamilton). Given additional information of the disruption in salmon sources in southwest BC (e.g. the 2009 crash) and other climate change driven changes in food availability (snow pack affecting spring habitat release and unseasonable weather influencing berry production), it is reasonable to assume that bears are moving around on the landscape in response to these habitat pressures. That does not mean that there are more bears. It simply means that bears are being seen in some places more often now than before. This fact does not justify a hunt. There should be a strong rebuke from TNG to the government for promoting such sloppy and unscientific justifications as anecdotal evidence to support reopening a Grizzly bear hunt.

I can give you three very real examples as to why anecdotal evidence can be totally misleading. As an example of just how unreliable this type of thing is, consider our history with the female Grizzly bear Jewel near Lillooet. When she showed up for the first time in 2010 with her cubs, some people were saying there were actually 8 Grizzly bears hanging out in the area. Why? Because people had seen the bears (sometimes together and sometimes apart) in locations across about 5 km and therefore interpreted all of these as different bears, totally to at least 8 individuals. The science (tracking and DNA sampling) told us there was a mother and cub. We learned a similar lesson from the male Grizzly bear Homer in 2006 when he alone was responsible for about 50 sighting reports as he covered an area over 1900 sq km in size. We learned this because he was collared. As a third example, a collared female Grizzly bear (Vanessa) had three cubs one spring and was seen with these cubs and reported, but by the fall all three were dead – without the collar and follow up with this female, the sighting evidence only provided the first information and not the latter, creating a false sense of the habitat situation and trend for that year. Sighting evidence is a helpful addition to a well-rounded science program, but it can never be used to indicate population size or as a reliable measure of trend. It is unacceptable for the government to put forward such unreliable evidence in order to appease the hunting community, or to side step its responsibility for proactively resolving human-bear and livestock-bear conflicts.

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Federal Panel Review (2013). Report of the Federal Review Panel. New Prosperity Gold-Copper Mine Project. October 31, 2013. Executive Summary: 6.

Pages 103 through 137 redacted for the following reasons:
- - - - - - - - - - - - - - - - - - - - - - - - - - - -
s.13, s.14, s.16
s.13, s.16
s.16

**From:** Ramsay, Mike K FLNR:EX
**Sent:** Monday, November 18, 2013 10:33 PM
**To:** Lyons, Devon ABR:EX
**Subject:** Fwd: Elk. Grizzly

Sent from my iPhone

Begin forwarded message:

**From:** "Ramsay, Mike K FLNR:EX" <Mike.Ramsay@gov.bc.ca>
**Date:** November 18, 2013 at 11:32:05 PM MST
**To:** "Cadsand, Becky FLNR:EX" <Becky.Cadsand@gov.bc.ca>, "Dielman, Pat W FLNR:EX" <Pat.Dielman@gov.bc.ca>
**Subject: Elk. Grizzly**

Pat and Becky. In my absence please discuss how much of s.17 we will be using to collar elk and how many collars and how much. And what we need for contract. Also can I get one of you to give a copy of the grizzly bear harvest procedures to Devon Lyons before her wildlife committee meeting Wednesday

Sent from my iPhone

Pages 139 through 140 redacted for the following reasons:
- - - - - - - - - - - - - - - - - - - - - - - - - - - -
s.13, s.16

Kordyban, Jaya ABR:EX

**From:** Lyons, Devon ABR:EX
**Sent:** Wednesday, November 6, 2013 3:38 PM
**To:** Lyons, Devon ABR:EX
**Subject:** Grizzly Bear Article Nov 6 2013

http://www.cbc.ca/news/canada/british-columbia/grizzly-bears-overhunted-in-b-c-say-researchers-1.2417306

**Devon Lyons**
Resource Coordination Officer
Negotiations and Regional Operations Division - Cariboo
Ministry of Aboriginal Relations and Reconciliation
P 250.398.4425 │Fax 250.398.4417 │ Devon.Lyons@gov.bc.ca

| | |
|---|---|
| **From:** | Gash, Michael ABR:EX |
| **Sent:** | Monday, December 16, 2013 10:13 AM |
| **To:** | Lyons, Devon ABR:EX; O'Sullivan, Susan FLNR:EX |
| **Subject:** | http://a100.gov.bc.ca/pub/ahte/hunting/re-open-grizzly-bear-leh-hunts-mus-5-05-and-5-06 |

Pages 143 through 196 redacted for the following reasons:
- - - - - - - - - - - - - - - - - - - - - - - - - - - -
s.13, s.14, s.16
s.13, s.16