The status of Alberta's grizzlies

Conflicting reports of the status of the grizzly population underline the division in scientific methodology and assumptions used in the study of North American grizzly populations. There are many reasons for these divergent status reports. One reason: "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" (Garshelis 2002: 1). Yet another reason for uncertainty comes from differences in where the boundaries circumscribing grizzly populations are drawn. Notwithstanding the claims of ESGBP researchers concerning the "progression of extinction" of grizzlies in Alberta's central Rockies—in conventional language, a population decline—other reports indicate that the number of grizzlies in the area is not only stable but growing significantly.

In January 2002, the Government of Alberta and the Alberta Conservation Association released a status report on the grizzly bear population that described an annual growth rate of 2% to 3% per year on provincial lands (Kansas 2002: 12) (see figure 2). This indicates Alberta's grizzly population has risen a dramatic 46% over the past 14 years. There are an estimated 841 grizzly bears on provincial lands, in addition to national park populations conservatively estimated to be between 175 and 185 bears. Jasper National Park is home to between 100 and 110 bears; conservative estimates (used for park planning purposes) set the Banff grizzly bear population at 60 bears; the most recent available estimate for Waterton Lakes National Park is 15 bears. Altogether, the combined park and non-park population is between 1,016 and 1,026 bears (Kansas 2002: 12).

Mortality rate for grizzly bears

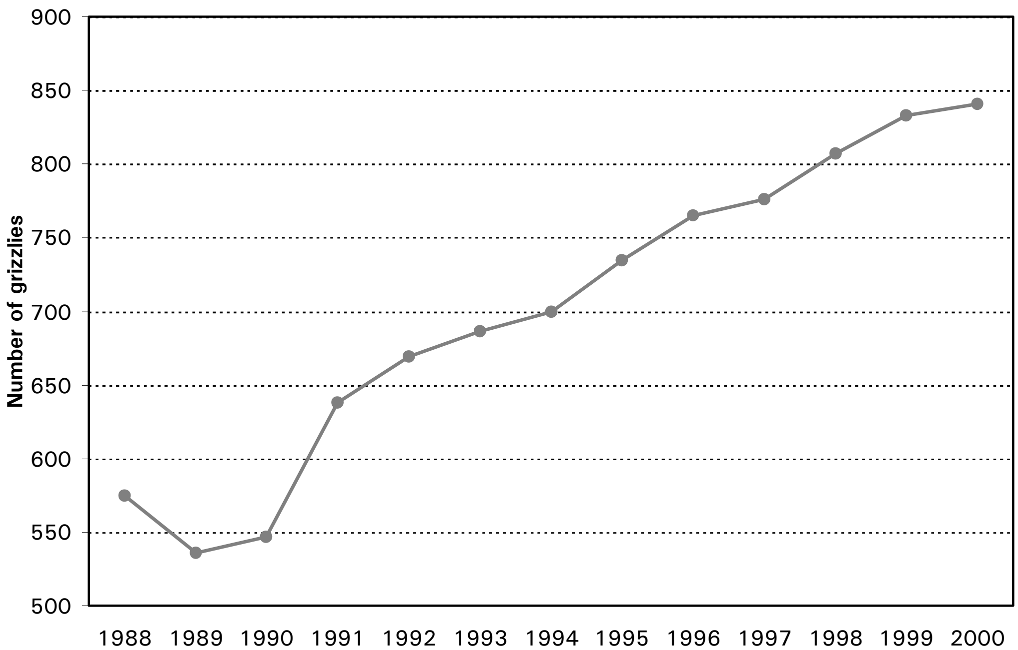
A question of great significance for ascertaining the population growth rate is the mortality rate for grizzly bears. Wildlife managers in Alberta, British Columbia, and the Yukon have accepted a 4% mortality rate "as a conservative estimate of the maximum sustainable mortality for grizzly bear populations, including kills from all sources" (Banci *et al*. 1994: 133). Kansas (2002: 10) writes that "[6%] to 6.5% is considered to be the scientifically acceptable human-caused mortality rate above which mortality would cause a population decline." Yet even employing the more conservative 4% rate, bears in the CRE are still well below the acceptable levels of mortality; with 11 natural deaths and 1 death with an unknown cause, the total known losses in Banff from 1984 to 2001 were 1.7 bears per year (31 in 18 years) (see figure 3). This amounts to 2.9% of 60 bears (the conservative estimate used in Parks Canada management planning), or 2.2% of 80 bears, depending on which "Banff population" estimate is used (Leighton 2000: 12).

The questionably designated "Banff population" is currently thought to include between 60 and 80 grizzlies in Banff National Park, approximately the same as the 1974 estimation of 55 to 85 bears (Herrero 1994: 12). Even using the lower boundary, the loss of 1.7 bears per year equates to 3.1% of 55 bears, still well below the maximum 4% boundary. Moreover, the rate of loss of 1.7 bears per year for Banff alone should be combined with the losses in the other mountain parks, because bears roam across park boundaries. Adding in the population estimates from Yoho and Kootenay, which range from 10 bears (Herrero *et al*. 2000: 28) to between 21 and 31 (Herrero 1994: 12), the mortality rate for bears of all ages killed by all causes is between 1.5% and 2.4%, which is probably the *lowest* grizzly mortality rate in southern Canada (Banci *et al*. 1994: 138).

Furthermore, McLellan (1991: 53) has indicated that "exceptional" populations in the prime habitat of the Flathead Valley, British Columbia have seen annual growth rates as high as 8%. Woods states that

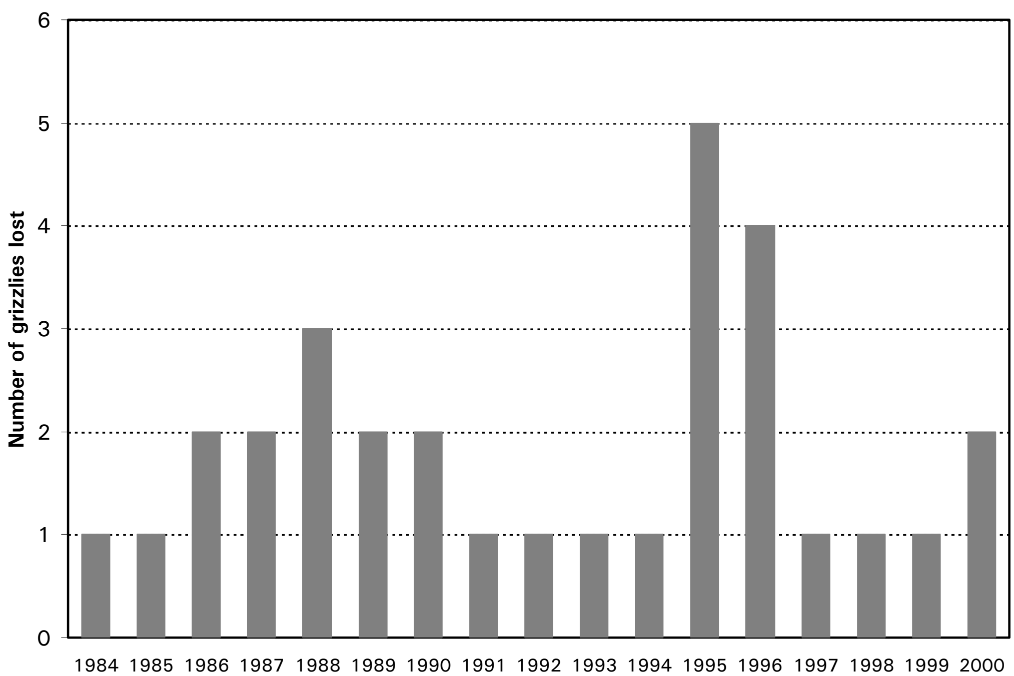
> during the past 25 years we believe that grizzly populations in the Kootenay region of BC (exclusive of the region's four National Parks) have increased . . . by as much as 50%, from approximately 1,350 to 2,000 bears . . . the actual (not minimum, which is used in setting hunting seasons) may exceed 2,500 bears.[4] (1991: 97)

Figure 2: Grizzly population in Alberta (excluding national parks), 1988–2000



Source: Kansas, 2002: 12.

Figure 3: Losses of grizzly bears in Banff National Park, 1984–2000



Note: Losses include accidental killing or translocation of problem wildlife, highway or railway deaths, legal and illegal harvest, research-related deaths, natural deaths, and deaths of unknown cause.
Source: Leighton, 2001: 38.

Amazing growth such as this has not gone undetected. Anecdotal evidence of increasing populations is continually reported (Shelton 1994, 1998, 2001) and even the ESGBP researchers have recently been compelled to admit that the overall grizzly population in the central Rockies is currently "stable" (Gibeau 2001, 2001a).[5]

The importance of a burgeoning population in British Columbia to Alberta's grizzly population is significant. Herrero *et al*. (2000: 38) assume immigration rates as high as 10% from British Columbia's Kootenay region to the southeast region of the CRE in Alberta, and a 5% immigration rate between the northwest and northeast CRE populations. Such consistent immigration from the growing number of grizzlies in British Columbia, means that concerns over extirpation appear unwarranted. Even with these encouraging numbers, a prudent recognition of low rates of fecundity and recovery on the part of wildlife managers is reasonable. There is, however, additional evidence to indicate that the prospect of even a local extirpation of grizzlies in the central Rockies is remote.

In Europe, for example, heavily hunted and managed brown bear populations have rebounded from near extirpation. Despite hunting pressures and the nearly ubiquitous human presence in Norway and Sweden, Dahle reports that brown bears (*Ursus arctos)* in Sweden have grown from "about 100–150 individuals in 1930 . . . to about 1,000 [in 1999], despite the fact that bears have been legally hunted with a quota system since 1947" (1999: 11). Janik (1997) indicates that brown bear populations recovered from less than 60 individuals to 600 in the western Carpathian Mountains of Slovakia. Additional and more compelling evidence that grizzlies can repopulate their range where appropriate conditions exist is available from Yellowstone National Park. American and ESGBP researchers both agree, "the Yellowstone situation is analogous to the three Canadian mountain parks" (Gibeau 1998: 237). Considering the Yellowstone population, which lives in similar habitat conditions but has the added difficulty of being a relatively isolated population with heavier human impacts, it is significant that the number of bears has increased from "200 or fewer" in 1975, when they were listed as threatened, to "an estimated minimum 400–600" (Servheen 2000). Notwithstanding disagreement about the actual number of bears in Yellowstone, even conservative estimates calculate a stable or slowly growing Yellowstone population (Pease and Mattson 1999). The evidence from Europe, Yellowstone, and non-park lands in Alberta and British Columbia indicates that, given sufficient habitat, minimized mortality, and consistent recruitment, which is to say births that survive to reproductive age, grizzly populations will increase. This regenerative ability (albeit slow and delicate) is present in the CRE population.

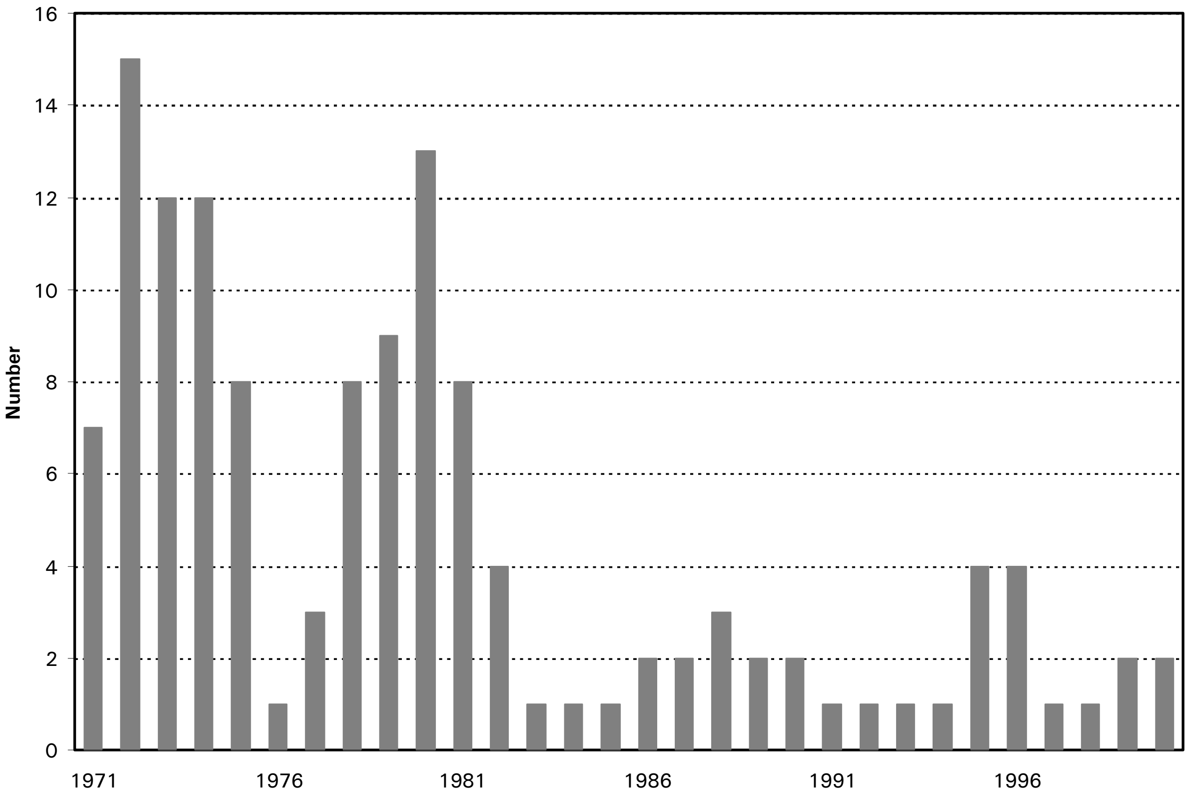
Human populations and the mortality rate of grizzly bears

Nonetheless, a persistent theme in ESGBP research is that an increasing human population in the central Rockies is putting undue stress upon grizzly populations. This link between human population and grizzly bear mortality has been used to justify extensive trail closures and restrictions on human use in and around Banff National Park, Canmore, and Kananaskis Country. Garshelis, however, points to a fatal flaw in this line of reasoning:

> Increases or decreases in levels of human exploitation may not necessarily result in attendant changes in [wildlife] 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. (2002: 10)

Much of the data on grizzly bear mortality comes from ESGBP researcher Byron Benn (1998), who investigated CRE grizzly mortalities within the central Rockies. However, when reviewing the grizzly bear deaths specifically caused by humans, it is evident that these data fail to indicate a statistically predictable pattern. Therefore, using the entire data set to estimate "average" values for the entire period (i.e., from 1971 to 1996) would provide findings that were out of context, misleading, and an incorrect representation of the current impact of human activity in the mountain national parks. The spikes in the 1970s and 1980s, in particular, would bias (on the high side) predictions of future grizzly mortality (see figure 4). Leighton (2000: 89) argues that the use of this type of broad averaging has led to an exaggerated picture of recent grizzly deaths caused by humans. By including the exceptionally high data, one arrives at a figure of 2.92 bears killed each year between 1971 and 1995 (Gibeau *et al*. 1996). However, the average rate for the period from 1991 to 1996 was 0.8 per year. Moreover, Benn (1998: 37) indicated that the quality of the pre-1981 data is highly questionable. His database includes statistics for 32 Banff

Figure 4: Losses of grizzly bears in national parks of the Central Rockies Ecosystem (CRE), 1971–2000



Note 1: Losses include accidental killing or translocation of problem wildlife, highway or railway death, legal and illegal harvest, research-related deaths, natural deaths natural deaths, and deaths of unknown cause.

Note 2: National Parks of the Central Rockies Ecosystem (CRE) are Banff, Yoho and Kootenay.

Source: Benn (1998); Leighton (2001). Benn data has been adjusted to eliminate duplicate recording of one dead bear (1981) and to recognize that two translocated bears (1995) remained within the ecosystem.

Park bears that were "deduced": 12 for 1973, 12 for 1974, and 8 for 1975. In fact, "deductions" of this nature make accurate calculations impossible. Moreover, even if "deduced" bear deaths were included to obtain averages for the entire study period, it would still be necessary to examine management actions during those time periods to determine the *reasons* behind the wildly fluctuating numbers of bear deaths ascribed to human activity. That is, the reason for the deaths needs to be put into a time-series or historical context. If specific management techniques or environmental factors played a significant role in the fluctuating mortality rate over time, then the mortality rate should be interpreted in light of that information.

Management techniques have, in fact, played a significant role in grizzly mortality and a more detailed examination of the history of the interaction between humans and grizzlies can clarify and account for the mortality rate spikes of the 1970s and 1980s. Since the end of the last ice age, human populations have both hunted grizzly bears and competed with them for food (Herrero 1970, 1989; Kay 1994; 1995; Kay and White 1995; Kay *et al.* 1999). As a result of this competition, grizzlies have been both a revered symbol of North American wilderness and a feared and hated competitive nuisance. Ignorance of grizzly biology along with the "man-against-nature" view of the world that typified the nineteenth and early twentieth century ensured a systematic mismanagement of North American grizzly populations. However, by the mid-twentieth century, park managers changed their opinion that grizzlies were pests or hazards to be removed from as many wild areas as possible (Wagner 1994; Burns 2000), and focused instead on reducing human impacts on grizzly populations. This direction in management schemes provided the impetus for promoting viable populations of grizzlies as appropriate park policy.

As it turns out, high rates of grizzly mortality in the 1970s and 1980s were directly related to the closures of park and adjacent municipal garbage dumps. For many years, a significant proportion of the grizzlies in and around the mountain national parks foraged for food in garbage dumps (Herrero 1985, 1989; Benn and Herrero 2000; Leighton 2000, 2001). When the dumps closed, an easily available food source rich in calories was suddenly removed from the diet of many mountain park grizzlies. It seems that the dumps had artificially increased the carrying capacity of the area and allowed bears that would have been unable to compete under natural conditions to prolong their lives. When the dumps closed, the carrying capacity dropped causing "a sudden famine and major social stress on the bear population" (Leighton 2001: 11). Similarly, Shelton notes:

> When the grizzly population reaches maximum-phase, you will see a sharp decline in the survival rate of cubs because of density dependent cub killing by dominant males, and the total bear population will start to be influenced by the [food] resource. (2001: 195)

These bears, trained to rely on human garbage as a significant source of food and largely incapable of surviving in the wild, now had to find new sources of human food. Therefore, they turned to the closest available sources they could find, the towns and human habitations that had supplied the dumps. It was this sudden influx of food-conditioned, hungry bears, into towns and onto highways that brought about the high mortality rates seen in the 1970s and 1980s.

Park, wildlife, and municipal managers had the unfortunate and unenviable task of dealing with the often violent and destructive behaviour of bears that had avoided traffic hazards and arrived in urban settings. After the removal of these "dump habituates," mountain park grizzly populations were likely below a natural carrying capacity. Fortunately, as noted above, reports from the governments of Alberta and British Columbia indicate that the bears killed during the adjustment following the dump closures have been replaced.

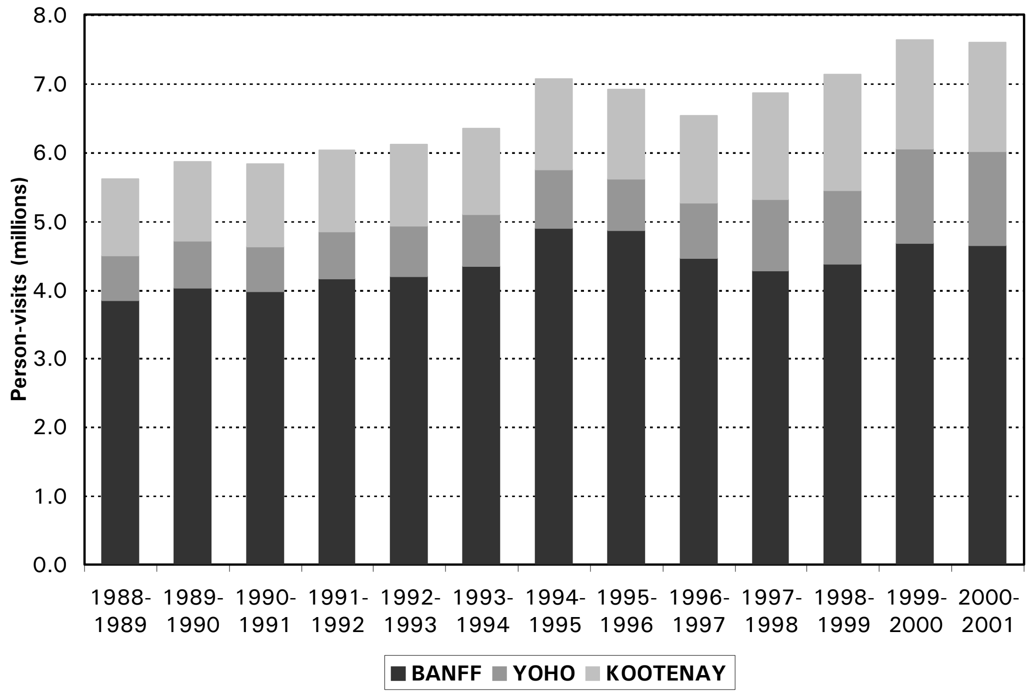
Despite the lack of statistically sound evidence to link human populations to the mortality rates of grizzly bears, the simple presence of humans is assumed by ESGBP researchers to have a negative impact on grizzly habitat (Gibeau 1998; Jalkotzy *et al.* 1999; Herrero *et al.* 2000: 63l). With the uncritical and unquestioned acceptance of "recent estimates" of a sustained 4% annual rate of growth in the human population over the next decade in Springbank, Cochrane, Banff, and Kananaskis, ESGBP research assumes this growth will translate into a 4% increase in human use of the parks and then predicts this use will result in a 4% increase in the mortality rate for adult female grizzlies and eventual "extinction" of grizzlies—the meaning of "extinction" having been changed to "the probability of population decline below current levels." The empirical and logical links in this argument, however, are weak, and the assumption that a 4% increase in the human population must lead to a 4% increase in park use, which in turn will lead to a 4% increase in the mortality of female grizzly bears is not justified by the evidence. (See figures 5 and 6.)

The ESGBP-led Population Habitat and Viability Analysis (PHVA), for instance, involved simulations running with estimated rates of mortality set at 4%, 6%, and 10%. The latter values are wildly unrealistic given that "expectations from field data" indicated a much lower adult female mortality rate (Herrero *et al*. 2000: 41–42). No information from modeling runs based on the more realistic expectations based on field data was published.

On the basis of the assumption that human populations and grizzly populations are inversely related (Herrero *et al.* 2000: 37, 42), participants in the PHVA workshop developed three scenarios to examine the "adverse impact" of humans on grizzly populations "if mitigation measures are not taken." Thus, scenario A (status quo management) describes the 4% increase in human population and the corresponding 4% increase in adult female grizzly mortality. Scenario B claims that with "moderate mitigation efforts" adult female mortality would still increase, although at a lower rate (2%). Scenario C contemplates "aggressive mitigation efforts [that would] actually lead to a *decrease* in adult female grizzly bear mortality despite the increased human population" (Herrero *et al*. 2000: 42, emphasis in original). Under these scenarios, park managers are left with the black and white choice between almost certain grizzly "extinction" in options A and B (Herrero *et al*. 2000: 50) and "aggressive mitigation." The conclusion is obvious: only by introducing aggressive mitigation measures, can park managers save the bears.

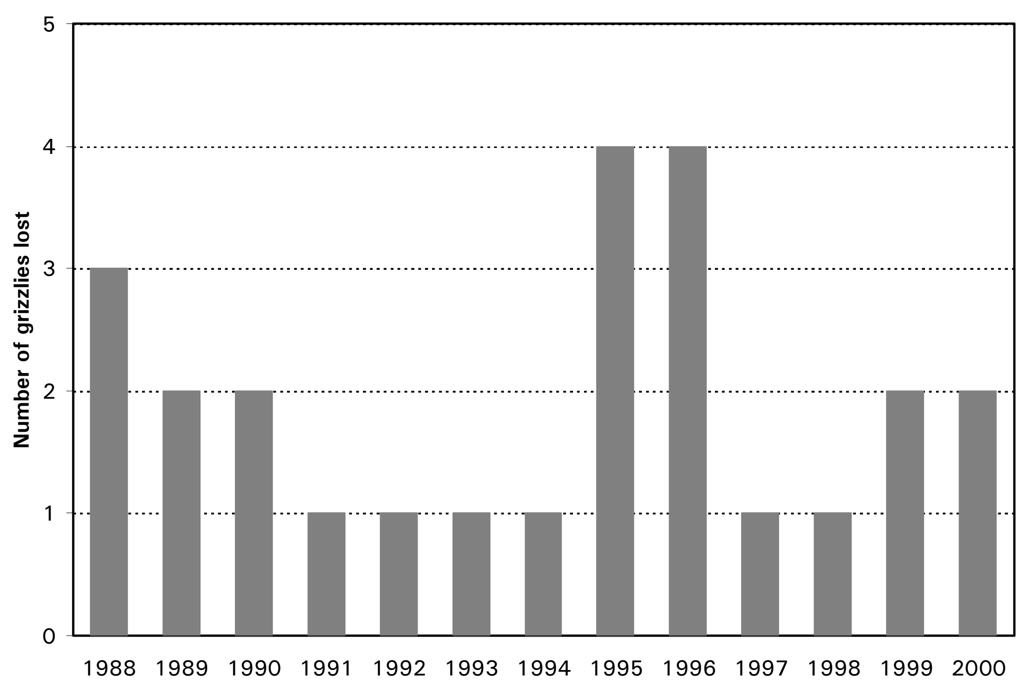
Nevertheless, working on the assumption that the conditions of scenario A (4% human population growth and corresponding 4% increase in adult female grizzly mortality) will persist, the authors of the report are grim in their conclusions, claiming that "even with our best efforts the model clearly demonstrates that a 2% decline would result in a population collapse within a few decades, especially for the east slopes subpopulation" (Herrero *et al.* 2000: 11). The proposed solution? "Restoration

Figure 5: Visits to national parks of the Central Rockies Ecosystem (CRE), 1988–2001



Note 1: National Parks of the Central Rockies Ecosystem (CRE) are Banff, Yoho and Kootenay.
Source: Parks Canada, 2001.

Figure 6: Losses of grizzly bears in national parks of the Central Rockies Ecosystem (CRE), 1988–2000



Source: Leighton 2001.

scenarios must be developed within a decade and must be implemented for at least a decade to reverse this trend." The level of restoration, to be achieved by road and trail closures, and restrictions and relocation of human activity, is set at 2% per year.

The eastern slopes subpopulation

The small sample size used to calculate grizzly bear mortality rates casts further doubt on the reliability of modeled outcomes (Herrero *et al.* 2000: 21). Because of the small sample size, a death rate was calculated directly from the few deaths of radio-collared bears. This meant using a calculation based on a model with few explanatory variables, a simplification that ultimately compromises the validity and reliability of the models. Accordingly, the authors of the report were forced to conclude that the "rate of death as denoted for this analysis *may not be* highly related [to the] death rate directly calculated from fates of radio-collared bears" (Herrero *et al*. 2000: 22, emphasis added).

There are additional problems with the input parameters of the PHVA simulation. Considering an event such as a massive berry crop failure (predicted to occur about once a century), it was assumed that 50% of the grizzly bear population would not survive, because females would cease reproducing and more frequent contacts between humans and bears would result in high bear mortality or removal (Herrero *et al.* 2000: 40). Three simulations were then run through the VORTEX model, in which these catastrophes occurred once every 100 years, once every 50 years, and never.

Given that "extinct" has been redefined to mean population decline, this parameter all but *ensures* the model will predict "extinction" in any modeling run that assumes a catastrophic event every 50 or 100 years. That is, there is a guarantee built into the model of a 100% risk of a decline in population size below the current number of animals. If the decline happens early in the simulation, the population may be able to recover; if the decline happens late in the simulation, the probability of "extinction" is assured.

Female grizzlies—a critical element

Another important measure of the health of grizzly bear populations is the status of female grizzlies. ESGBP researchers rightly argue that the adult female grizzly acts as the reproductive engine of the population and "is the most critical [element in] population viability" (Knight and Eberhardt 1985; Gibeau 2000: 4). When that engine is tuned up and running well, the entire population benefits, and the evidence from the central Rockies clearly indicates a flourishing adult female cohort. A recent ESGBP report (Herrero *et al*. 2000: 29) indicates that pooled data from Benn (1998) and Gibeau *et al.* (2001: 127) showed a 90% survival rate for eastern CRE adult females and a 95% survival rate for western CRE adult females. This report also indicates that analysis of ESGBP data from 1993 to 1998 shows a 99% survival rate for adult females (Herrero *et al*. 2000: 30).

A reasonable reading of the evidence compels the analysis that a 90 to 95%, and for the most recent past, a 99% survival rate, for adult females, is very good. When this survival rate is added to growing numbers of grizzlies outside of the national parks (Alberta Sustainable Resource Development 1999; Kansas 2002: 12), and assumed immigration rates of up to 10% from the growing British Columbian portion of this population (Banci *et al*. 1994; Herrero *et al*. 2000: 30), the argument that recruitment rates are stable or increasing and mortality rates are decreasing appears well founded.

The standard measure of the annual geometric growth rate of a population is called a "lambda" (λ) measure, a measure of the finite rate of population increase. If λ is above unity, the population is increasing; below unity, it is decreasing. For example, if $\lambda = 1.04$, the population is growing at 4% during the time period sampled (Morrison and Pollock 1997). The preliminary calculation of λ for the CRE population is $1.00 \pm .01$, which indicates that the CRE grizzly population is stable (Gibeau 2001a). Accordingly, the answer to the question whether Alberta grizzly bears are really on the brink of "extinction," can be unequivocally answered in the negative. As a consequence, the need for "aggressive mitigation efforts" in order to reduce female grizzly mortality does not exist. It is thus reasonable to conclude that current management efforts have been successful.

The persistent reliance on "conservative" estimates biases the results of the computer simulation elsewhere as well. For instance, "reproductive senescence," which is the age at which breeding activity ceases, was "conservatively estimated to be 20 years" by ESGBP researchers (Herrero *et al.* 2000: 40). This may, in fact, be the mean age of senescence but it is impossible to tell because there is no information provided in support of this figure—other than it was chosen "conservatively." In fact, there are some well known examples of older bears continuing to breed. In the fall of 2000, for instance, Banff's oldest known female grizzly (Bear #33) was alive with cubs at 25 years of age (Gibeau and Herrero 2001; Leighton 2001).

Likewise, by using "conservative" estimates the maximum number of offspring is arbitrarily reduced. The section notes, "bears with 4 cubs have been recorded in the Rockies. However, this is extremely unlikely, and 3 cubs is a more realistic maximum value." (Hererro et al. 2000: 40). There is no question that a more realistic value of cubs is 3. However, the input parameter for the model does not stipulate the "realistic number of cubs;" it stipulates the "maximum number of cubs." With this downgrade, the effect is an enhancement of the threat of the "extinction" of grizzlies.

New ESGBP reports of the status of grizzly bears in the central Rockies appear to heighten this threat (Herrero 2001; Gibeau 2001a). After having reached their goal of collecting "at least 100 reproductive years of data regarding adult female grizzly bears" (Herrero 2001: 1–2), ESGBP researchers calculated that the λ for Eastern Slopes grizzlies was between 0.99 and 1.01. Apparently, the fluctuating bases of ESGBP λ values were the result of incomplete data on the timing of 16 of 24 litters. That is, the cycles of 16 bears were not fully documented during the study period: some began before the study; others have continued after it. Thus, some of the ESGBP's data cells are empty, which degrades the data set. Litter intervals have a direct impact on λ calculation. Initially, ESGBP researchers extrapolated from the 3.4 year mean interval calculated from their field observations of 8 complete intervals to 3.8 years to account for the incomplete intervals. In 1999, ESGBP publications reported a 4.0 year litter interval (0.24 reproductive rate for λ: $[1.9/4.0]/2 = 0.24$) (Herrero and Gibeau 1999). From 2000 until 25 January 2001, they reported an interval of 4.4 years (0.22 reproductive rate for λ). As Leighton (2001a: 2) has noted, despite the fact that no new field data were gathered between 25 January and 10 March 2001, the reported litter interval is now five years ($1.88/5.0 = 0.38$, or 0.19 for λ). This means that the population studied by the ESGBP suffers under the unusual burden of having the highest "mean litter interval" of any North American grizzly population. In fact, these grizzly litter intervals outstrip all other populations noted in this paper by a full two years.

Some simple calculations raise a few additional anomalies. Moving from the 3.4-year interval indicated by field data to the 5-year interval requires that the remaining "16 intervals . . . average 5.8 years—71% longer than the known data suggests for bears living in the same area" (Leighton 2001a: 3). To help explain this 1.6 year jump in the length of the intervals, ESGBP researchers employed a procedure developed by Dr. D. Garshelis to correct for a perceived upward bias of 2%. But this procedure was developed, not to correct for mean litter intervals, but for difficulties "in calculating mean age of first reproduction" (Garshelis *et al.* 1998; Herrero 2001: 6). As Leighton (2001a) again correctly notes, an assumption of this nature normally requires independent scientific review, to determine whether removing 2% of population growth is scientifically sound. This missing 2% could reflect a growth rate of 1% to 3% for the CRE grizzly population, which is similar to the growth rate noted by provincial biologists (Alberta Sustainable Resource Development 1999; Kansas 2002). In any event, even if one agreed to accept all the changes in methodology, along with the new assumptions regarding λ calculations, the CRE grizzly population is still shown to be stable.

One conclusion, at least, seems overwhelmingly obvious: the current management programs in the mountain national parks are meeting the requirement of Section 8(1) of the Canada Parks Act that ecological integrity be maintained or restored with respect to grizzlies. There is no question that the existing practices are sustaining a viable grizzly population. Census data indicate that although human population levels in the main centers of the Bow Valley are increasing, they are doing so at levels well below those used in ESGBP modeling exercises. The most recent statistics indicate that visitor rates to the four mountain parks are stable or decreasing and, even when they do increase, the ESGBP's claims that increasing human use results in increasing grizzly mortality rates is specious because it equates human use with human impact. Both Alberta and British Columbia grizzly populations are (on the average) growing and even ESGBP researchers acknowledge that the grizzly population of the central Rockies is currently stable. The European and Yellowstone populations indicate that populations can be restored if given the proper habitat conditions and protection from excessive human-caused mortality such as existed during the 1970s and 1980s. Willfully ignoring evidence of population stability and the law of diminishing returns as it applies to management of the CRE grizzly population is *prima facie* evidence of ideologically driven research rather than scientific investigation.

Models versus reality

At the outset, participants of the 1999 ESGBP-led PHVA workshop were concerned that the complexity of the PHVA process and the technical sophistication of the models might mean that they would be unintelligible to managers and legislators (Herrero *et al.* 2000: 16). Notwithstanding this concern about the PHVA simulation results, they were endorsed as a sound scientific base for the nearly three pages of recommended closures and restrictions:

> These recommendations are based on scientific observation of grizzly bear behaviour and requirements for survival of the population. We strongly believe there is an adequate base of scientific information on which to base good management decisions that will increase the probability of long term grizzly bear persistence. (Herrero *et al*. 2000: 79)

Given the extensive costs and unanticipated consequences of the recommended management solutions, it is highly questionable that the apparently concrete outputs produced by the models, along with the accompanying policy recommendations, could be accepted by legislators and managers before the simulated results are empirically validated.

We will close this review of the PHVA simulation results by recalling the advice of the author of the VORTEX population model, Dr. Robert Lacy. Park and land managers, government representatives, wildlife and conservation biologists would all do well to heed Lacy's warning before applying it their management plans.

> A final caution: VORTEX is continually under revision. I cannot guarantee that it has no bugs that could lead to erroneous results. It certainly does not model all aspects of population stochasticity, and some of its components are simply and crudely represented. It can be a very useful tool for exploring the effects of random variability on population persistence, but it should be used with due caution and an understanding of its limitations. (Lacy, undated)

While not every recommendation in the PHVA requires restriction or reduction of human activity, with three pages of recommended closures and restrictions on human use, and the promise of more to come, the trend of suggested policy development is evident.