Scientific Criteria for Evaluation and Establishment of Grizzly Bear Management Areas in British Columbia

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ABOUT THE AUTHORS

Four of the authors of this report are PhD conservation biologists with extensive experience with large carnivores including up to 20 years of experience working in the field with grizzly bears in British Columbia (BC). Another is a BC professional biologist (and former federal biologist) with 30 years of bear research experience. All are familiar with BC, its land base and its management.

Three of the authors have conducted a comprehensive critique of the BC Grizzly Bear Conservation Strategy. Two of the authors were on the former BC government Grizzly Bear Scientific Advisory Committee.

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EXECUTIVE SUMMARY & RECOMMENDATIONS

Grizzly Bear Management Areas (GBMAs) have been a focal part of the British Columbia (BC) government's Grizzly Bear Conservation Strategy since 1995, and the BC government's Independent Scientific Panel again recommended in 2003 that they be implemented with provisions to maintain connectivity between populations. In order to develop a conservation biology based model for a comprehensive network of GBMAs, we used the scientific literature, a background review, expert opinion and a two-day workshop of independent bear scientists.

The authors concluded that GBMAs must;

- be fully protected from all ecologically damaging human activities and allow no grizzly bear sport hunting,
- each have a potential population of 500+ individuals,
- contain productive, roadless habitat, and,
- not be further apart than 20-50 km.

In order to maintain connectivity between populations, smaller Habitat Security Management Areas (HSMAs) are required. HSMAs;

- must be at least 68-84% of a female grizzly's home range,
- must be fully protected from all ecologically damaging human activities, and,
- may require no grizzly bear sport hunting.

Collectively, GBMAs and HSMAs must make up 68-84% of the habitat currently occupied by grizzly bears in British Columbia.

Currently, the BC government is proposing three GBMAs for the BC Coast and Mountains Ecoprovince. These are set up to be legally extinguished in a decade, and a preliminary analysis shows that they are poorly designed and likely too small to maintain viable grizzly bear populations. In addition, the habitat within the proposed GBMAs is not fully protected. This is inadequate given that a recent population viability analysis (PVA) for BC coastal grizzlies concluded that this species is already at risk of extirpation and that all grizzly habitat may need to be protected to sustain grizzly bear populations. Additionally, since the GBMAs proposed by the BC government fail to meet the science-based criteria outlined in this analysis, they cannot reasonably be expected to fulfill their stated aim: "to maintain in perpetuity the diversity and abundance of grizzly bears and the ecosystems on which they depend throughout British Columbia."

The authors concluded that pending the implementation of the strategy proposed in this report, or a strategy with equivalent robustness and rigour, all sources of grizzly mortality must be immediately reduced. Given the lack of evidence that, in particular, grizzly bear populations in coastal BC are sustainable, closure of sport hunting/killing of grizzly bears is an option that must be considered. It is therefore imperative that measures are taken to implement this strategy for the establishment of GBMAs of core protected habitat with no grizzly bear sport hunting including the establishment of HSMAs to maintain connectivity, or an equivalent strategy that will provide the necessary protection for grizzly bear populations and their habitats, without any further delay.

1.0 INTRODUCTION

The authors of this report, as well as other scientists, believe that with existing management grizzly bears *(Ursus arctos)* in British Columbia (BC) are on a long-term slide leading to extinction. The historical decline of grizzly bear populations has been well documented, and the BC government predicts that these declines will continue well into the future. The BC government's own data (from BC Min. Environment, Lands and Parks, 1995(b),) predict that by 2065 grizzly bears in British Columbia will be extinct or threatened in 38% of their former range in BC (Horejsi *et al*., 1998). The wide range of threats to grizzly bears in British Columbia include human caused mortality, cumulative habitat degradation, habitat alienation/destruction, population displacement, and the cascading effects of salmon collapse and climate change (BC Min. of Environment, Lands and Parks, 2000). In the future, the range of threats facing grizzlies is likely to change or increase, for example disease may play a more important role. Simultaneously, there is a continued loss of resilience of bear populations to adapt and recover. This is due to changes in population structure and genetics resulting from human caused mortality and disturbances. The result has been smaller population sizes (increased demographic stochasticity) increased isolation (increased genetic stochasticity).

There is strong evidence of a decline in grizzly populations including evidence of genetic isolation and population fragmentation. By using micro satellite-based DNA fingerprinting Proctor *et al.* (2002) concluded that grizzly bear populations in southeastern BC now occur in five peninsulas of mountainous habitat, with isolation/fragmentation having been identified in the Central Rocky Mountain Ecosystem and the Selkirk Mountains. For the Central Rockies, Proctor *et al.* (2002) concluded that legal killing of grizzlies might also adversely affect movement across the Highway 3 corridor if dispersal rates are density dependent. For the Selkirk Mountain population, the authors concluded that genetic isolation is: "a serious threat for the long-term persistence of the southern Selkirk bears."

In 2000, the BC government's Independent Scientific Panel commissioned a biologist, Dr. Philip McLoughlin, to model grizzly bear populations under current management regimes to ascertain how likely current kill rates are to cause population declines. McLoughlin (2002) concluded that the BC grizzly bear populations he modeled had a 50% chance of declining at rates exceeding 20% over 30 years. Declines exceeding 20% over three generations (30 years for grizzly bears) meet the IUCN criteria for a threatened species. McLoughlin (2002) also concluded that current harvest rates are unsustainable: "if the province plans to maintain a 2.8-3.8% annual harvest without first decreasing the amount of uncertainty in population estimates, it is imperative that non-hunting mortality be reduced substantially." McLoughlin also observed that selective targeting of adult male bears by hunters at existing levels has long term and adverse effects on population structure and productivity (McLoughlin, 2003).

Additional problems with grizzly bear conservation in BC include the following:

- The BC government has conflicting goals. For example, in its 1995 Grizzly Bear Conservation Strategy (GBCS) the first stated goal is: "to maintain in perpetuity the diversity and abundance of grizzly bears and the ecosystems on which they depend throughout British Columbia." However, in the background report to the GBCS they indicate that present management will result in a loss of 17% (136,213km^2) of grizzly bear territory by 2065 (BC Min. Environment, Lands and Parks, 1995(b); Horejsi *et al.,* 1998).
- There is a serious lack of government documentation providing the justification for management decisions.
- There is a lack of public and independent, scientific peer consultation on government management plans. In its place is selected consultation with special interest groups most of which are commercial in nature and who stand to gain from hunting bears or not protecting bears.

This evidence indicates that substantive measures to protect grizzly bear populations and their habitats are required.

Protecting large areas of productive habitat is crucial to maintaining viable populations of all species, particularly wide ranging species such

as the grizzly bear. Core protected areas can increase population densities and maintain source populations that can buffer depressed surrounding populations.

Another management tool, the use of no-hunting reserves for North American bear populations which are also being managed for sport hunting is viewed by many scientists as a safeguard against over-kill and other uncertainties. Based on only a partial literature review, one of the earliest management uses of no-hunting reserves in North America was developed for black bears in North Carolina in 1971. The state created 28 black bear no-hunting 'sanctuaries' to: "ensure the survival of black bears and to provide for the continued production of a harvestable surplus of bears for sport hunting" in surrounding areas (Powell *et al.*, 1996). The largest of these, Pisgah, was 2,350km^2. A black bear population study found that the Pisgah sanctuary had a higher density and survivorship when compared to surrounding lands where hunting is allowed (Powell *et al.* 1996). The researchers concluded that: "sanctuaries appear to be a good means of managing black bears" and that: "decreasing human access to bears and their habitat appears crucial, either by making sanctuaries larger or, especially, by eliminating roads." Powell *et al*., (1996) also concluded that, although there were benefits, even the largest sanctuary: "may not … provide its resident bears with enough protection to maintain a viable, core breeding population within its boundaries."

In BC, significant uncertainty surrounds grizzly bear population estimates and the capacity of the BC government to enforce regulations to protect wildlife has been nearly eliminated. A detailed examination of wildlife enforcement capability in BC stated: "the evidence indicates that BC has now crossed the threshold at which protection of fish and wildlife populations and their habitat by enforcement services has effectively and materially been abandoned" (Horejsi, 2002). McCullough (1996) reported that "[no hunting] refuges remain an important conservation need in many parts of the world where … the infrastructure for management [is] weak or non-existent."

In 1995, the BC government made a commitment in its Grizzly Bear Conservation Strategy: "to maintain in perpetuity the diversity and abundance of grizzly bears and the ecosystems on which they depend throughout British Columbia" (BC Min. of Environment, Lands and Parks, 1995(a)). The strategy stressed that: "the greatest single cause of declining grizzly bear populations is loss of habitat," and committed to the establishment of Grizzly Bear Management Areas (GBMAs) that would, *inter alia:*

- "contain high quality grizzly bear habitat
- be managed to secure the long-term survival of grizzly bears,
- be closed to legalized sport hunting of grizzly bears."

Concurrently, an 11-member Grizzly Bear Scientific Advisory Committee (GBSAC) was established in 1995 to help the government effectively implement the Grizzly Bear Conservation Strategy. The government disbanded the GBSAC in 2000 after it was highly critical of the government's progress in implementing the Grizzly Bear Conservation Strategy. The government then appointed another science panel but has implemented few of the Panel report's (Peek *et al.,* 2003) recommendations. Thus despite much promise and public fanfare very little progress in implementation of the Grizzly Bear Conservation Strategy has been made over the past nine years. No new GBMAs have ever been established.

In 2003, the final report by the BC government's new Scientific Advisory Panel (Peek *et al.,* 2003) concluded that: "the concept of establishing large, protected GBMAs in BC has considerable value as a strategy for maintaining the long-term viability of grizzly bear populations" and recommended that the BC government: "implement the provision of the Grizzly Bear Conservation Strategy relative to the establishment of a GBMA within each bioclimatic region of the province. This should include provisions for maintaining connectivity between grizzly bear populations to facilitate movements." However, the panel did not provide any criteria for designation of adequate GBMAs other than it was understood that they would involve no sport hunting of grizzly bears.

2.0 METHODS & APPROACH

Recommendations for the establishment of GBMAs were based on an extensive review of the literature, an independent scientific workshop held 2nd - 3rd December 2003 and the expert opinion of the authors.

The resulting scientifically-based criteria contained in this report constitute an ecologically sound framework for the establishment of an effective network of habitat and population GBMAs. Criteria for ensuring connectivity between the GBMAs are also outlined, including the establishment of smaller Habitat Security Management Areas (HSMAs.) These criteria are based on the fundamental principles of conservation biology (see Paquet *et al.,* 1999) with the intent of fulfilling the stated goal of the BC Grizzly Bear Conservation Strategy: "to maintain in perpetuity the diversity and abundance of grizzly bears and the ecosystems on which they depend throughout British Columbia."

3.0 RESULTS AND DISCUSSION

3.1 Recommended criteria for the establishment of Grizzly Bear Management Areas

The analysis undertaken by the authors resulted in the following set of criteria for the establishment of GBMAs in BC.

3.1.1 Population objectives

The authors concluded that a GBMA network must achieve the following population objectives:

- Long-term (over 500 years) persistence of well-distributed and viable grizzly populations,
- All territory occupied by bears now should be maintained with populations which are at ecologically effective populations densities (i.e. maintaining traditional ecosystem functions) as defined by Soule *et al.* (2003),
- Genetic diversity and potential must be maintained,
- Populations must be stable or increasing,
- Ecologically significant units, including behaviourally unique populations, must be maintained.

3.2.1 Model for a GBMA network

This analysis resulted in a model consisting of large GBMAs supported by a number of smaller HSMAs to maintain connectivity between GBMAs. The protected GBMAs and HSMAs support a wider metapopulation of grizzly bears.

i) Metapopulation

A metapopulation is a group of populations of a species that are loosely connected to one another by immigration and emigration.

- Primary order metapopulation = the Province of British Columbia.
- Secondary order metapopulations will require a potential census population of 2,000 – 7,500 bears with a stable age distribution and balanced sex ratio (Lande, 1987.) The effective population is the available breeding population, which is usually less than 25% of the census, or complete population. Thus, as a conservation objective, the GBMA network should be managed to support a potential effective population of 500 bears and a potential census population of 2,000+ bears in the wider metapopulation area (Allendorf *et al.,* 1991 and Vucetich *et al.,* 1999). Populations below 1,000 are ephemeral in ecological time.
- If the actual census number of bears in the secondary order metapopulation is lower than 2,000, restoration activities must be employed to increase the bear population to potential levels.
- At least 68-84% of the metapopulation area that is currently occupied by bears should be protected in GBMAs and HSMAs, with the greatest priority given to GBMAs. Previous research has demonstrated that this level of protection is necessary to maintain grizzly bear populations (Table 1). Legally enforceable management goals for grizzly bears in specific Montana and Idaho National Forests stipulate that 55-68% of the land base must be in protected core areas (U.S. Forest Service, 1995; IGBC, 1998).

Figure 1: Diagram of a possible GBMA network designed according to the criteria outlined in this report.

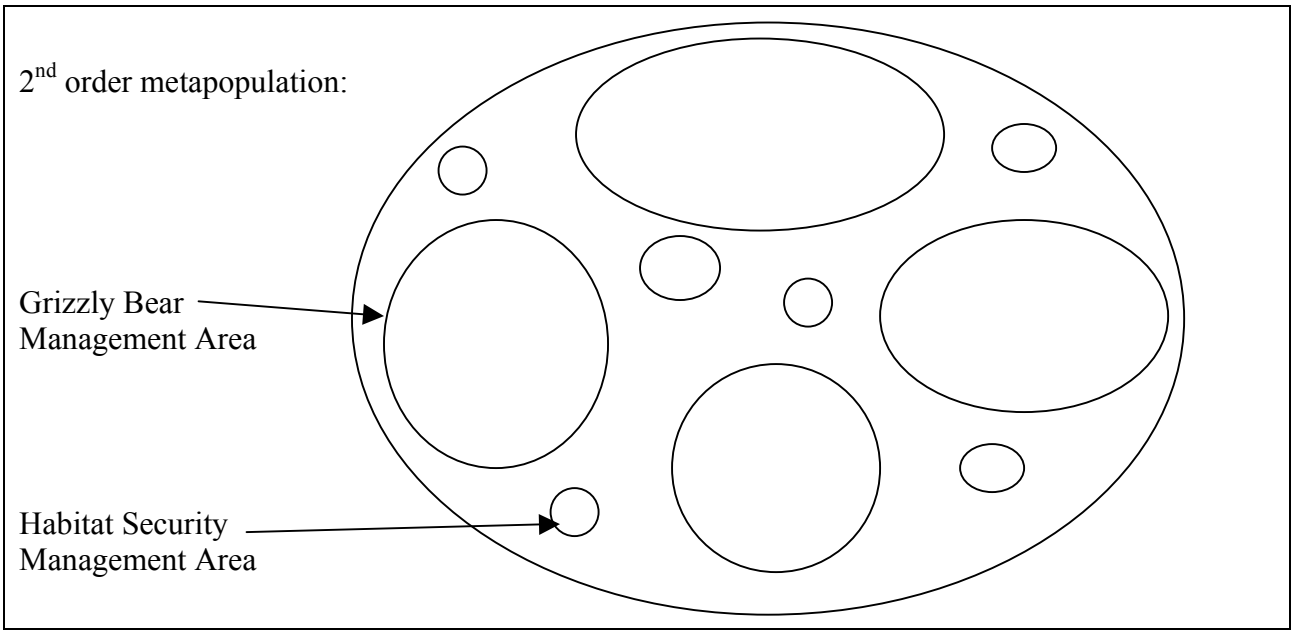

Table 1: Research based core habitat requirements as a function of home range in US grizzly bear ecosystems. The term 'core' here refers to the amount of intact, roadless, secure habitat.

Ecosystem	**% core habitat in home range**	**Population status / comments**	**Reference for core**
Selkirk	Adult female average = 77	Legally recognized as endangered; No demonstrable recovery in 28 years.	Wakkinen and Kasworm, 1997
Cabinet - Yaak	Adult male average = 67 Adult female average = 55	Legally recognized as endangered; No demonstrable recovery in 28 years	Wakkinen and Kasworm, 1997
Northern Continental Divide	Adult female average = 68 Range 58 – 86	Legally recognized as threatened; No demonstrable recovery in 28 years	U.S. Fish and Wildlife Service, 1995 Mace and Waller, 1997
Yellowstone	Adult female average = 84	Some evidence the population is increasing in number and expanding its range	U.S. Forest Service, 1999 Mace and Waller, 1997

A preliminary GIS calculation by the Craighead Environmental Research Institute (CERI) showed the amount of 'occupied' bear habitat in British Columbia is approximately 805,500 km^2. Therefore 68-84% protection would require an estimated 547,740 km^2 - 676,620 km^2 of land to be in GBMAs and HSMAs. This excludes water and glaciers, but does not exclude urban areas and rock. If these cover types are accounted for the total area of grizzly habitat will be slightly less, as will be the area requiring protection. These figures are not intended to be precise, but rather to serve as rough estimates.

The framework for a network of large GBMAs and smaller HSMAs outlined in this report is based on a review of core (i.e. intact, roadless and secure) habitat requirements for grizzly bears. Some authors have suggested lower levels of habitat and population protection. In contrast, this analysis indicated that less than 68% habitat protection would be inadequate. As examples of these other studies in BC, a recent independent Conservation Area Design (CAD) for the central coast by Jeo *et al.* (1999) recommended three large protected core carnivore conservation areas on the central coast, for a total of 51% (23,900 km^2) of the total land base of 47,500 km^2. The central coast CAD included a review of road density and grizzly bear mortality from sport hunting and other causes. The reserves recommended by Jeo *et al.,* (1999) would encompass the best, intact grizzly-salmon areas and rainforest with no grizzly sport hunting allowed. More recently, an Ecosystem Spatial Analysis (ESA) by Rumsey *et al.* (2003) using grizzly and black bears amongst a series of focal species, identified priority areas needed for long-term conservation of the 11-million hectare BC raincoast. It was concluded that a minimum of 44 - 50 % of the land base would need to be protected in order to maintain healthy ecosystems. However, following this, a preliminary population viability analysis (PVA) for BC coastal grizzlies by Jeo *et al.* (*in Prep.*) concluded that to achieve "no-net-loss" of grizzly bears, necessary areas for protection may include the majority, or all, of the remaining habitat areas and watersheds.

The authors of this analysis concluded that the number of bears required for long-term viability, and the percentage of the habitat base that must be protected, are higher than previously expected. While these numbers may startle some observers, this analysis indicates that 68% will represent a minimum habitat protection requirement.

ii). Grizzly Bear Management Areas

This analysis concluded that GBMAs;

- must contain a population that is ecologically effective in isolation
- must contain suitable grizzly bear habitat,
- must include the full range of habitats e.g. low elevation riparian valleys,
- must be roadless. If roads exist, they should be decommissioned. The U.S. Forest Service manages grizzly bear core habitat for zero km/km^2 road density (U.S. Forest Service, 1993). BC government documents stress that road densities greater than 0.4 km/km^2 adversely affect grizzly bears (British Columbia Ministry of Environment, Lands and Parks, 2000),
- must provide all life requisites,
- must ensure that the population growth rate of bears within the GBMA is positive, or after successful establishment of GBMAs, at least stable,
- must contain bear densities over 10 bears per 1 000 km^2,
- must be fixed, not roving,
- can be split into three or four units provided they are not below threshold size and are fully connected,
- must be closed to grizzly bear sport hunting but might allow native hunting for ceremonial purposes,
- must have total protection from all ecologically disruptive human activities, including logging, mining, and other resource extraction, and all motorized human activity. The 1995 Grizzly Bear Conservation Strategy committed to establish GBMAs that will be: "managed to secure the long-term survival of grizzly bear populations." Total protection of core areas is required to achieve this aim (Doak, 1995),
- must support a population that is genetically viable in isolation over the short to medium term. Thus the GBMAs must have a potential census population of at least 500 individuals.

Wielgus (2002) analyzed minimum viable population and reserve sizes for grizzly bears in BC. He concluded that a minimum viable population of 200-250 bears in each of six proposed benchmark no-hunting reserves (GBMAs) was necessary to sustain the provincial population. Further, he determined reserve sizes would have to be in the order of 8,566 km^2 to 17,843 km^2, depending on the population density of each benchmark reserve. Wielgus' model was based on a mean time model for a small probability of decline to a quasi-extinction threshold of 27 adult female bears within 20 years and a mean time of extinction >20 years.

This analysis concluded that GBMAs must contain a greater number of bears than was recommended by Wielgus (2002) as his study did not account for catastrophic events, deteriorating habitat effectiveness, genetic issues or identify the required *effective* breeding population. It was based on a 20-year time frame, which is not even a generation for some male grizzly bears. Additionally, Wielgus (2002) was aiming for a minimum viable population, whereas this analysis has concluded that the population within a GBMA must be ecologically effective, a more substantial requirement than maintaining a minimum viable population.

This criterion is also supported by evidence from Yellowstone, where the population of ~500 bears currently seems to be stable or slightly increasing, satisfying the requirements for short and mid-term persistence in each core area of a metapopulation. The Yellowstone ecosystem population is currently isolated at the moment while the BC GBMAs should not be.

$$\text{Minimum GBMA size} = \frac{1}{\text{Bear density} \times 1/500}$$

iii).Habitat Security Management Areas

This analysis concluded that HSMAs;

- should be smaller than GBMAs, comprising an area that is 68-84% of the average home range of a female grizzly bear (~160 km^2 although this will vary between populations,)
- need not anchor a population but are required to ensure viability of the matrix and connectivity between GBMAs (Mattson, 1993; Carroll *et al., in press* (a); Carroll *et al., in press* (b)),
- must contain bear densities over 10 bears per 1,000 km^2,
- must have total protection from all ecologically disruptive human activities, and,
- may be closed to all grizzly bear sport hunting.

This open designation on grizzly bear sport hunting is due to a severe lack of confidence in the BC government's ability to manage these areas in a manner that would allow grizzly bear sport hunting to occur in a sustainable fashion.

3.2.3 Connectivity

Connectivity between GBMAs within a metapopulation is crucial; the concept of corridors and landscape linkages is more complex than usually understood. In order to fully maintain connectivity, this analysis concluded that the following considerations are necessary;

- constant exchange of individual bears and genetic material is required. This must be demonstrated with monitoring. Two or more successful migrants per generation are required (Mills and Allendorf, 1996),
- HSMAs are crucial for maintaining connectivity, acting as 'stepping stones' of protected habitat between GBMAs which allow bears to traverse an otherwise more insecure landscape,
- GBMAs must not be more than 20-50 km apart. This accounts for any resistance to movement within the landscape which will by definition include human activities and developments, and,
- the landscape within corridors must be extremely permeable, accounting for ease of travel, and the overall network design must account for any resistance to movement within corridors. Grizzly bears disperse incrementally over periods of months or years, therefore the habitat within a corridor must provide all the necessary life requisites for bears as they do not just travel straight through them. They initially are moving through unknown terrain and may explore the limits of the habitat before finding a way through.

3.2.4 Spatial requirements for GBMA network design

- Spatial layout needs to provide resilience for large-scale environmental perturbations, catastrophic events and long-term environmental change such as climate change. An example of this would be to ensure that some populations and metapopulations can be temporarily isolated by management activities, thus providing a barrier to disease transmission. This would be of crucial importance in stopping the spread of an exotic aggressive infectious disease.
- GBMAs should maximize distance from edge and minimize the amount of edge per area. Therefore, the ideal shape for a GBMA is circular.

3.2.5 Special cases requiring protection

(i) Salmon streams as 'attractive sinks' habitat type

Coastal and interior bears that depend on salmon congregate at specific, traditional sites along streams where salmon, their primary food, can be readily caught. Most of these areas are on the lower stretches of streams within easy access to hunters in boats or vehicles. The openness of the sites and regularity of use of these areas by bears make killing bears relatively easy, especially where the hunters use elevated platforms or stands overlooking river reaches. These dense concentrations of salmon-feeding bears are quite different from the distribution of interior bears that do not utilize salmon, making the effects of human disturbance more severe.

Since bears are accustomed to having access to these fish and depend on them for a major portion of their diet, the bears may persist in utilising salmon streams despite the potential risk. This pattern of attraction to insecure or risky areas has been labelled as an "attractive sink" habitat type (Naves *et al.* 2003). Hebblewhite *et al*. (2003) documented an example of this for black bears (*Ursus americanus*) in the Bow Valley of Banff National Park.

The habitat requirement of security in close proximity to food resources has been demonstrated recently in a study of resource selection of black bears in the Cascades of Washington state (Lyons *et al.,* 2003.) When applied to coastal BC grizzly bear populations this infers that habitat security (high habitat effectiveness) is required by bears near their stream feeding sites. The current level of activity facilitated by the presence of openings from land (logging and forest roads,) air (float planes and helicopters) and water (jet boats) can cause all bears to abandon these crucial areas.

The logic of facilitating bear access to rich food for high population productivity is unassailable. Since bears have very low intrinsic rates of reproduction, the risk of local extirpation is always a factor. Local and regional population sinks occur when demand for hunting and potential for poaching is also high. In these cases, protected areas function as source populations and bears that are surplus to the capacity of the habitat to support them emigrate to the under-occupied sink areas (Doak, 1995, Noss *et al*. 1999).

Therefore, this analysis concludes that GBMAs should strive to contain as many salmon streams as possible. When left in the matrix, salmon streams must be afforded special protection.

(ii) BC Pacific Coast Near-Shore Islands

Small numbers of grizzly bears occur on some of the larger near-shore islands in the Central and North Coast of British Columbia but factors explaining such low island numbers when compared to higher numbers on the adjacent mainland are poorly understood (McCrory *et al., in Press*). However, grizzly bears are occasionally hunted on BC islands despite the possibility that some island grizzly populations may be behaviourally and genetically distinct which would increase the conservation significance of maintaining these populations. According to biogeographical theory, islands are extremely susceptible to disturbance due to their increased isolation and low perimeter to interior ratios. Special protection is therefore required for all near-shore islands including habitat protection and closure to grizzly bear sport hunting.

3.2.6 Monitoring and enforcement

For a network of GBMAs to achieve its aims, appropriate funds and capacity will be required to allow for adequate monitoring and enforcement**.**

The MWLAP currently lacks the capacity, and sometimes the authority, to implement the criteria outlined here in terms of a suitable network of GBMAs. The current legal system which is structured in such a way that deferral to other Ministries is often required is not effective at responding to grizzly bear conservation needs.

This problem is exacerbated by the fact that the BC government is currently creating limited GBMAs with varying levels of protection, for example the GBMAs proposed for the coast do not afford any additional constraints on forestry or mining beyond some inclusion of smaller protected areas within the GBMAs. This produces another level of complexity requiring additional management when capacity is already inadequate.

3.2.7 Placement of GBMAs in relation to existing protected areas and no sport hunting zones

GBMAs must be established both where grizzly populations are healthy and also where populations have been degraded by habitat destruction and fragmentation or unsustainable hunting mortality and are in need of recovery.

Placing GBMAs over existing protected areas would be advantageous. However, GBMAs should not only encompass land that is already under a certain level of protection. Although no recent analysis has been done of the BC Parks system, McCrory *et al*. (1987) carried out an "effective population" size estimate with overlapping generations and determined that 393 grizzlies would be needed to survive in isolation. Only the large contiguous complex of provincial and national parks in the Central Canadian Rockies was determined to meet this criterion. At this time, no provincial park in isolation would be sufficient.

The principles of conservation biology lead to these recommendations for a network of large GBMAs that are fully protected from all ecologically disruptive human activities and are closed to sport hunting of grizzly bears, along with a network of smaller HSMAs that facilitate connectivity between the GBMAs and ensure the viability of the matrix.

3.4 Access

The BC government's Independent Scientific Panel also recommended that the BC government: "aggressively address human access into BC's wildlands" (Peek *et al.,* 2003.) The chair of the Panel has stated that: "access issues … are the biggest problems in need of being addressed." (Peek, 2003.)

The strategy and plan outlined in this document, which ensures that all GBMAs are unroaded, is the best way to address this recommendation.

3.5 Review of current/proposed BC Government no-hunting GBMAs

The BC government's Independent Scientific Panel (Peek *et al.,* 2003) recommended the BC government establish only one large ("benchmark") GBMA per each bioclimatic region of the province. There are 14 biogeoclimatic zones in BC, but further clarification with the Panel chair revealed that the intended recommendation was the establishment of one large ("benchmark") GBMA in each of the six Ecoprovinces that still has grizzly bears (Peek, 2003(b)). The Panel provided no analysis in support of their recommendation.

The authors of this analysis concluded that having just one GBMA in each Ecoprovince would be totally inadequate to achieve any goals of population stability. The government is already proposing three GBMAs for the Coast and Mountains Ecoprovince and even this may be inadequate from an overall metapopulation perspective. Two of these GBMAs will be revisions of existing grizzly bear no-hunting reserves that were established in the 1980s.

There are now two proposed large "benchmark" GBMAs, the Skeena-Nass (Khutzeymateen) in the north coast and the Khutze on the central coast. There is one "core" (smaller than "benchmark") GBMA proposed for the Ahnuhati (1,128 km^2). These GBMas would prohibit grizzly bear sport hunting. The GBMAs are now

under consideration before the BC Government's Central Coast and North Coast Land and Resource Management Planning tables.

To the best current knowledge of the authors, the Khutze GBMA and the Ahnuhati GBMA have already been approved by the central coast planning table and have a "sunset clause" by which they will be extinguished in ten years unless the Minister intervenes. This is totally inadequate if they are to achieve the goals for which they were proposed.

Although details on the proposed GBMAs had been requested from BC Ministry of Sustainable Resource Management and BC Ministry of Water Land and Air Protection, the information was unavailable at this time. However, it is understood that the population estimates to define them were based on 2003 data. In addition, it is understood that the Skeena-Nass " benchmark" GBMA in the north coast has an estimated potential population of about 220 grizzly bears (Hamilton, 2003). No scientific or other rationale for the proposed areas has been provided by the BC government.

A systematic review needs to be done based on the criteria outlined in this report and using reliable population data, habitat maps, salmon data and intact/road density GIS layers. This preliminary review of the currently proposed GBMAs indicates that they are poorly designed. They are grossly under-sized and likely too small to maintain viable grizzly bear populations. In addition, none of the GBMAs proposed for the coast offer anything near total protection, the highest being about 45% protected (Ahnuhati and Khutze). In the remaining GBMA area, there will not be "any additional constraints on resource extraction such as logging and mining." Therefore, the levels of protection inside the GBMAs themselves fall considerably short of the levels of protection that this analysis has concluded are required over the province as a whole. This is a violation of the BC government's stated commitment that the GBMAs will be: "managed to ensure long-term survival of grizzly bears."

The authors of this analysis conclude that the coastal GBMAs currently proposed by the BC government do not accommodate scientifically desired considerations and fall extremely short of the criteria defined in this analysis as being necessary for the GBMAs if they are to fulfill their stated purpose: "to maintain in perpetuity the diversity and abundance of grizzly bears and the ecosystems on which they depend throughout British Columbia."

4.0 FINAL CONCLUSIONS

This analysis and the resulting recommendations presented in this report focus on the maintenance and rehabilitation of the landscape that is necessary to support viable grizzly bear populations in British Columbia. Our approach is progressive, visionary and soundly grounded in contemporary conservation science. It accounts for uncertainty and current trends in *inter alia*, habitat loss, climate change and commercial exploitation. With few exceptions, continued invasion of grizzly bear habitat by road access and associated industrial activity is unjustified.

Pending the implementation of this strategy, or an alternative strategy with equivalent robustness and rigour that will maintain current numbers and distribution of grizzly bears, it is recommended that all sources of grizzly mortality must be immediately reduced; given the lack of evidence that, in particular, grizzly bear populations in coastal BC are sustainable, closure of sport hunting/killing of grizzly bears is an option that must be considered.

To date there has been no comprehensive analysis that includes current trends in habitat loss and accounts for demographic and genetic stochasticity in BC. These factors alone, particularly habitat loss, forecast a deterministic decline in grizzly populations throughout the province; the addition of hunting mortality makes this decline more rapid as demonstrated with grizzly populations in the Lower-48 States of America. To prevent this decline, the cessation of grizzly bear sport hunting must be considered, at least until other causes of the decline have been eliminated.

It is imperative, however, that policy makers directly address the range of factors in addition to hunting that are threatening grizzly populations and hindering their potential recovery.

If the government of British Columbia is to fulfill its political, ethical, international and public responsibilities as well as the commitments it has made in its Grizzly Bear Conservation Strategy: "to maintain in perpetuity the diversity and abundance of grizzly bears and the ecosystems on which they depend throughout British Columbia," our proposal or an equivalent strategy must be implemented immediately. To date, the BC government has not come close to doing so.

5.0 LITERATURE CITED

Allendorf, F.W., R.B. Harris, and L.H. Metzgar, 1991. Estimates of effective population size of grizzly bears by computer simulation. Pp. 650-654 in: Proceedings 4th International Congress of Systematic and Evolutionary Biology. Vol. 2. Dioscorides Press, Portland, OR.

British Columbia Ministry of Environment, Lands and Parks (MELP.) 1995(a). A Future for the Grizzly: British Columbia Grizzly Bear Conservation Strategy.

British Columbia Ministry of Environment, Lands and Parks (MELP.) 1995(b). Conservation of grizzly bears in British Columbia. Background report. 70 pp.

British Columbia Ministry of Environment, Lands and Parks (MELP.) 2000. Environmental Trends in British Columbia 2000. State of Environment Reporting.

Carroll, C., R.F. Noss, P.C. Paquet and N.H. Schumaker. *In press*(a). Integrating population viability analysis and reserve selection algorithms into regional conservation plans. Ecological Applications.

Carroll, C., R.F. Noss, P.C. Paquet and N.H. Schumaker. *In press*(b). Extinction debt of protected areas in developing landscapes. Conservation Biology.

Doak, D. F. 1995. Source-sink models and the problem of habitat degradation: general models and applications to the Yellowstone grizzly. Conservation Biology 9:1370-1379.

Grizzly Bear Scientific Advisory Committee. 1998. Three-year review of Grizzly Bear Conservation Strategy, "Three-Year Report Card", letter to Hon. Cathy McGregor, Minister of Environment, Oct. 16, 1998.

Hamilton, T. Ministry of Sustainable Resources. Pers. comm. to Wayne McCrory, May 2003

Hebblewhite, M., M. Percy and R. Serrouya. 2003. Black bear (*Ursus americanus*) survival and demography in the Bow Valley of Banff National Park, Alberta. Biological Conservation 112: 415-425.

Horejsi, B., B. K. Gilbert and F. L. Craighead. 1998. British Columbia's Conservation Strategy. An independent review of science and policy. Western Wildlife Consulting Ltd., Calgary, AB. 64 pp.

Horejsi, B. 2002. Losing Ground: The decline in fish and wildlife law enforcement capability in British Columbia and Alaska. Raincoast Conservation Society, Victoria, B.C. 76 pp.

Interagency Grizzly Bear Committee. 1998. Selkirk/Cabinet-Yaak Grizzly bear ecosystem interim road management strategy. Interagency Grizzly Bear Committee, S/C-Y subcommittee. 9 pp.

Jeo, R.M., M.A. Sanjayan and D. Sizemore. 1999. A conservation area design for the central coast region of British Columbia, Canada. Round River Conservation Studies. 78pp. plus maps.

Jeo, R.M., K. Heinemayer, J. Pollock, and D. Doak. In preparation. Grizzly Bear Population Viability Analysis for the North and Central Coast of British Columbia.

Lande, R., and G. Barrowclough. 1987. Effective population size, genetics variation, and their use in population management. In M.E. Soule (ed.) Viable Populations for Management, pp. 87-124. Cambridge University Press, Cambridge.

Lyons, A.L., W.L. Gaines, C. Servheen. 2003. Black bear resource selection in the northeast Cascades, Washington. Biol. Conserv. 113: 55-62

Mace, R.D., and J.S. Waller. 1997. Grizzly bear ecology in the Swan mountains, Montana. Final Report, Montana Dept. Fish, Wildlife and Parks, Kalispell, MT.

Mattson, D.J. 1993. Background and proposed standards for managing grizzly bear habitat security in the Yellowstone ecosystem. University of Idaho, Moscow, ID. 17 pp.

McCrory, W.P., S. Herrero and E. Mallam. 1987. Preservation and Management of the grizzly bear in BC provincial parks - the urgent challenge. Report to BC Parks, Victoria, British Columbia. 186 pp.

McCrory, W.P., P. Paquet and B. Cross. *In Press.* Conservation analysis and design for a sanctuary for the Kermode bear (*Ursus americanus kermodei*) on the raincoast of British Columbia. Report for Valhalla Wilderness Society, New Denver, British Columbia.

McCullough, D. 1996. Spatially structured populations and harvest theory. Journal of Wildlife Management. 60(1):1-9

McLoughlin, P. 2002. Managing risks of decline for hunted populations of grizzly bears given uncertainty in population parameters. Final report, Submitted to the British Columbia Independent Scientific Panel on Grizzly Bears. University of Alberta, Edmonton, AB. 63 pp.

McLoughlin, P. 2003. Pers. comm. to Paul Paquet, 8th December 2003.

Mills, L.S., and F. W. Allendorf. 1996. The one-migrant-per-generation rule in conservation and management. Conservation Biology. 10 (6): 1509-1518 DEC 1996

Naves, J., T. Wiegand, E. Revilla and M. Delibes. 2003. Endangered species constrained by natural and human factors: the case of brown bears in northern Spain. Conservation Biology 17 (5): 1276-1289

North Cascades Grizzly Bear Recovery Team. 2001. Recovery plan for grizzly bears in the North Cascades of British Columbia. Consensus Recommendation Draft for Consultation.

Noss, R., E. Dinerstein, B. Gilbert, M. Gilpin, B. Miller, J. Terborgh, and S. Trombulak. Core Areas. 1999. Chapt. 5 in M. Soule & J. Terborgh (eds.) Continental Conservation : Scientific Foundations Of Regional Reserve Networks. Island Press. 155 pp.

Paquet, P., R. Noss, C. Carroll and S. Alexander. 1999. Conservation biology primer and carnivores as focal species. Draft report to Sierra Club of BC. 126 pp.

Peek, J., J. Beecham, D. Garshelis, F. Messier, S. Miller and D. Strickland. 2003. Management of grizzly bears in British Columbia: A Review by an Independent Scientific Panel. Submitted to the Minister of Water, Land and Air Protection, Government of British Columbia, Victoria, British Columbia.

Peek, J. 2003(a). Chair of the British Columbia government's Independent Scientific Panel. Pers. comm. to Wendy Elliott. 2nd December 2003.

Peek, J. 2003(b). Chair of the British Columbia government's Independent Scientific Panel. Pers. comm. to Wendy Elliott. 29th September 2003.

Powell, R.A., J.W. Zimmerman, D.E. Seaman and J.F. Gilliam, J.F. 1996. Demographic Analyses of a Hunted Black Bear Population with Access to a Refuge. Conservation Biology 10 (1): 224-234

Powell, R.A., J.W. Zimmerman, and D.E. Seaman. 1997. Ecology and behaviour of the North American black bears: Home ranges, habitat and social organization. Chapman and Hall, New York, NY.

Proctor, M.F., B.N. McLellan and C. Strobeck. 2002. Population fragmentation of grizzly bears in southeastern British Columbia, Canada. Ursus 13: 153-160.

Rumsey, C. Eds. 2003. An ecosystem spatial analysis for Haida Gwaii, central coast and north coast British Columbia. Coast Information Team.

Soule, M.E., J.T. Estes, J. Berger and C. Martinez del Roi. 2003. Ecological effectiveness: Conservation Goals of Interactive Species. Conservation Biology 17(5):1238-1259

Trauger, D.L., B. Czech, J.D. Erickson, P.R. Garrettson, B.J. Kernohan and C.A. Miller. 2003. The Relationship of Economic Growth to Wildlife Conservation.

U.S. Fish and Wildlife Service. 1995. Biological opinion on Amendment 19 to the Flathead National Forest Plan. Montana Field Office, Helena, MT. 61 pp.

U.S. Forest Service. 1993. Grizzly bear management strategy for Westline Timber Sale and Plateau Bear Management Unit, Targhee National Forest, St. Anthony, ID. 104 pp.

U.S. Forest Service. 1999. Final environmental impact statement. Open road and open motorized trail analysis. Targhee National Forest, St. Anthony, ID.

Vucetich JA., T.A. Waite. 1999. Erosion of heterozygosity in fluctuating populations, Conservation Biology. 13 (4): 860-868

Wakkinen and Kasworm. 1997. Grizzly bear and road density relationships in the Selkirk and Cabinet-Yaak recovery zones. Idaho Department of Fish and Game and U.S. Fish and Wildlife Service, Bonners Ferry, ID. 28 pp.

Wielgus, RB. 2002. Minimum viable population and reserve sizes for naturally regulated grizzly bears in British Columbia. Biological Conservation 106 (2002): 381-388

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