SIMON FRASER UNIVERSITY

DEPARTMENT OF BIOLOGICAL SCIENCES
http://www.sfu.ca/biology/

8888 UNIVERSITY DRIVE
BURNABY, BRITISH COLUMBIA
CANADA V5A 1S6
Telephone: (604) 291-4475
Fax: (604) 291-3496

February 15, 2007

Honourable Pat Bell,
Minister of Agriculture and Lands
PO Box 9043 STN PROV GOVT
Victoria BC V8W 9E2

Percy Starr
Kitasoo First Nation
General Delivery
Klemtu BC, V0T 1L0

Dear Sirs,

Enclosed is our report summarizing the findings of the Scientific Panel that considered the "Potential for Gene Swamping of Kermode Bears on Princess Royal Island". The Panel met in Vancouver on January 19 and discussed a number of biological processes in regard to the issue of Kermode bears and logging. After thorough discussion of a range of topics, each led by a member of the Panel who had greatest expertise on the topic, we concluded that: *the effect of logging in the Green River area is not sufficient to change the frequency of the white-phase or Kermode bear on Princess Royal Island over the term of many generations of bears*

On behalf of the Scientific Panel, thank you for the opportunity to contribute our collective expertise on this important matter.

Sincerely,

Alton Harestad,
Chair of the Kermode Bear Scientific Panel
Professor, Department of Biological Sciences
8888 University Way
Simon Fraser University
Burnaby, BC V5A 1S6
(604) 291-4809, 291-4475
email: harestad@sfu.ca

Potential for Gene Swamping in Kermode Bears on Princess Royal Island

Scientific Panel
Workshop Summary Report
Vancouver, BC
February 15, 2007

Potential for Gene Swamping in Kermode Bears on Princess Royal Island
— Summary of Findings of a Scientific Panel —

1. Introduction

The *kermodei* subspecies of the American black bear (*Ursus americanus kermodei*) is distributed throughout northwestern British Columbia, on the mainland and on numerous offshore islands. It occurs in two colour phases, the black phase and the white phase (called Kermode or Spirit Bears). A concern was raised by the Spirit Bear Youth Coalition, a BC-based environmental organization, that logging in the Green River watershed might displace resident black bears from the Green River to Princess Royal Island, and thereby result in the swamping of the expression of the white-phase gene in the black bears on the island.

The BC Minister of Agriculture and Lands made a commitment to hold a workshop of scientists with expertise in biology and management of black bears to address this concern. A Panel of scientists with credible knowledge of the Kermode bear met on January 19, 2007, in Vancouver. Members of the Panel applied their expertise, knowledge and experience to discuss the potential for swamping of the white-phase gene due to dispersal of bears following logging.

The Scientific Panel addressed the question: "*Will logging in the Green River Watershed result in the swamping of the white gene (that is, lower its frequency of expression) in black bears on Princess Royal Island*?"

This report, written for the Minister, summarizes the content and conclusions of the Scientific Panel. It is not intended to reiterate all of the science, or to be a complete record of all that was discussed. Rather, the report serves as a reference for scientific considerations associated with the effects of logging on Kermode bears in the vicinity of Green River, and the effects of logging on bear habitat and populations more generally on BC's central coast.

2. Panel Participants

Alton Harestad, a professor in the Department of Biological Sciences at Simon Fraser University, chaired the Panel. Dr. Harestad is a forest wildlife biologist and specializes in habitat ecology. He was a member of the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound and has been the ecologist on assessment teams for three Forest Stewardship Council certifications in BC. He has participated in several scientific advisory committees and panels.

Tony Hamilton is a bear biologist with the BC Ministry of Environment. He has 25 years of experience with both black bears and grizzly bears in British Columbia and has worked extensively in coastal ecosystems, researching the effects of logging on both bear species. Mr. Hamilton has a strong habitat background and understands bear habitat and population dynamics in relation to disturbances such as logging.

Kermit Ritland is a professor in the Department of Forest Sciences at the University of British Columbia. He specializes in population and quantitative genetics. In collaboration with Western Forest Products, he was involved with a three-year genetic study of Kermode bear populations. Two papers on genetics of white-phased Kermode black bears resulted from this work: Ritland, Newton, and Marshall (2001), *Inheritance and population structure of the white-phased "Kermode" black bear*; and Marshall and Ritland (2002), *Genetic diversity and differentiation of Kermode bear populations.*

Craig Newton is a research scientist with ATG Genetics in Vancouver. He was involved in the identification of the gene that causes the white-phase of the Kermode black bear. He is a co-author of a paper on the genetics of white-phased Kermode black bears, Ritland, Newton, and Marshall (2001), *Inheritance and population structure of the white-phased "Kermode" black bear*.

2.1 Other Attendees

Neil Hamilton, Executive Director, Strategic Initiatives, Integrated Land Management Bureau, BC Ministry of Agriculture and Lands.

Grant Scott, RPF, Kitasoo Forestry Advisor, on behalf of the Kitasoo First Nation.

Simon Jackson of the Spirit Bear Youth Coalition.

Gordon Erlandson, Erlandson Consulting Inc., served as facilitator for the workshop. Reporting to the Panel chairperson, Mr. Erlandson served as writer for the Panel in preparation of this workshop summary report.

Louise Beinhauer, Erlandson Consulting Inc., took workshop notes.

3. Kermode Bear Genetics

Craig Newton and Kermit Ritland presented results of their own research and other related research about genetics, inheritance and population structure of the white-phase Kermode bear.

Ursus americanus kermodei is a subspecies of black bear with a black phase and a rare white phase, both of which inhabit the rainforests on BC's central and north coasts. The white phase is often referred to as the Spirit or Kermode bear. Other colour phases of black bears occur in North America and include brown and cinnamon bears in the western United States and a black-blue coloured bear in northwestern British Columbia and southeastern Alaska. Occasionally, white bears have also been observed in northeastern British Columbia and Manitoba. The Kermode bear was initially considered a separate species in 1905, but since 1928 has been classified as a colour phase of the black bear, kermodei subspecies (*Ursus americanus kermodei*).

DNA samples, collected by Helen Davis and her crew, were analyzed from 220 genetically distinct individual black bears from a total of six west coast islands (Princess Royal, Gribbell, Hawkesbury, Roderick, Pooley and Yeo) and five adjacent areas on the mainland. Of the bears sampled, 22 were Kermodes, and only these 22 Kermodes were homozygous for a nucleotide substitution that causes an amino acid change in the gene Mc1r (a known part of the pathway that controls the production of the pigment melanin). The research confirms both the role of this nucleotide difference in causing the coat colour difference, and the recessive nature of white coat colour (both copies of the gene are required to express the white coat colour). The white phase is not an albino condition.

The total number of white-phase bears in the study region is estimated to be between 100 and 400 individuals. Frequencies of occurrence of the white-phase allele were substantially greater on Princess Royal, Gribbell and Roderick islands, occurring in 20% to 50% of bears, but occurrence was infrequent on the mainland.

The recessive gene is often present in the heterozygous stage, meaning that a black-phase bear can have one copy of the Kermode gene (of the two possible). Heterozygotes act as a reservoir for the white-phase gene among the black bear population. In fact, most Kermode genes are hidden in the heterozygous condition; population genetic theory predicts that if the frequency of the Kermode bear is less than 25%, there are more Kermode genes present in heterozygotes (black coloured bears) than in homozygotes (white bears). Only one island (Gribbell) had a frequency greater than 25% (10 of 23 were white); thus the majority, and probably the vast majority, of Kermode genes exist in heterozygous black bears.

Some new, but preliminary, analysis of the data using landscape genetic models indicated that there are six breeding groups of black bears in the region sampled, and that Princess Royal Island has two of these breeding groups. Previous analyses have assumed that each island is a breeding group (population). In the new analysis, breeding groups are inferred by the genetic similarities at 10 microsatellite loci (microsatellites have many alleles at a locus, and are ideal for "genetic

fingerprinting"). Breeding groups also spanned islands, which is evidence that bears migrate between the Princess Royal Island and the adjacent mainland in perhaps complex patterns.

The question was posed as to why white-phase bears appear to mate more with white-phase bears, given that the breeding system in bears is not segregated and is very open. This may well relate to the spatial relationships of bears, in particular the social tolerance and a high degree of home range overlap among females. Young females tend to stay close to their natal home range (i.e., their mother's home range). This would raise the frequency of mating with another white bear, particularly in geographic locales where the frequency of expression of the white gene is relatively high. If bears breed within these breeding groups as the data suggest, then immigration may have relatively less effect on the frequency of white-phase alleles.

4. Regional Environment and Habitats

Alton Harestad described the regional environment and nature of bear habitat in the vicinity of Green River and Princess Royal Island. He cited two key references, Blood (1997) and the Coast Information Team (2004).

The Green River area is on the mainland of the Central Coast, with Princess Royal Island immediately to the west. Princess Royal is the fourth-largest island on the coast, after Vancouver, Graham and Moresby islands.

The forested area is dominated by the Coastal Western Hemlock (CWH) Biogeoclimatic Zone which accounts for about 90% of the land area, with small amounts of the Mountain Hemlock (MH) Zone in higher elevations. The mainland has proportionally more Mountain Hemlock Zone than Princess Royal Island. In the eastern portions of Princess Royal and in the Green River area, the CWH very wet maritime subzone, submontane variant, is widespread at low elevations. The CWH montane variant is more prevalent at mid-elevations and the MH zone occurs above this variant. There are extensive areas of scrub forest, avalanche tracts, and bog forest. Commercially productive forest, from a wood products perspective, is confined mostly to lower slopes and valley bottoms.

Vegetation available as forage for bears occurs in small estuaries and deltas, riparian sites, beach fringes, wetlands, bog forest, and avalanche tracts. Eighteen species of berries that occur in coastal forest ecosystems are used by bears (e.g., salmonberry, salal, huckleberries, blueberries and elderberries). Old growth forest provides both standing trees and downed wood as structures for winter dens (e.g., western redcedar), as well as some opportunities for feeding, particularly in forest openings.

There are at least 27 salmon spawning streams on Princess Royal Island that provide important sources of abundant, high-quality food for bears from late July through November. Sockeye runs are small, and small to moderate numbers of coho occur in most creeks. Pink salmon spawn in most of the streams, and several streams have runs of 5,000 or more. Runs of 1,000 or more

chum salmon occur in several creeks. Salmon are important for coastal bears because they allow the bears to deposit enough fat to last them through hibernation. The small estuaries and creeks on Princess Royal are important for bears, particularly in spring.

The Green River also has a significant salmon run, adequate to support significant numbers of both bear species, with an average of 10-15,000 pink salmon, 5000 chum and 1000 coho annually. The pink run has been recorded as high as 60,000 fish by the federal Department of Fisheries and Oceans. Although the Central Coast region provides excellent bear habitat, the Green River watershed itself is of moderate value as bear habitat overall, with several high value sites within it.

4.1 Natural Disturbance Regimes

Over most of the Central Coast, stand-replacing disturbances are rare and stands are typically very old. Death and re-establishment of trees occurs primarily in small canopy gaps of 10 trees or fewer. These gaps are typically created by a combination of wind, landslide, flooding and pathogens and comprise approximately 10–30% of the area in old-growth stands.

Detailed study as part of the Central Coast Land and Resource Management Plan found that wind disturbed 0.3%, and geomorphic disturbances (including landslides, avalanches, and flooding) disturbed 1.4% of the area. Mean disturbance frequency (proportion of area disturbed per year) from all sources is less than 0.3% per year.

Geomorphic disturbances such as landslides and snow avalanches are the most important naturally occurring high-severity, stand-replacing events in the area. These events result in herb and berry fields that are important seasonal habitats for bears. Snapped and uprooted trees serve an important ecological role as downed wood in both terrestrial and hydroriparian ecosystems where they provide small pockets of forage as well as some den structures. Hydroriparian ecosystems link portions of the landscape, forming networks of habitat that provide forage and cover for bears. Flooding is the key process shaping floodplains and estuaries. Jams of large woody debris alter flow patterns, create complex channel morphology, and help protect downstream habitat and back channels from flood scouring.

Two Natural Disturbance Types (NDT 1 and NDT 2) occur in the region. NDT 1 (ecosystems with rare stand-initiating events) consists of uneven-aged or multi-storied even-aged stands, with regeneration occurring in gaps created by the death of individual trees or small patches of trees. When disturbances such as wind and landslides occur, they are generally small and result in irregular edge configurations and landscape patterns. The mean return interval for disturbances is generally 250 years for the CWH and 350 years for the MH.

NDT 2 (ecosystems with infrequent stand-initiating events) consists of even-aged stands, but extended post-fire regeneration periods produce stands with uneven-aged tendencies. Wildfires, when they occur, are often of moderate size (20–1,000 hectares), with unburned areas sheltered by terrain features or high site moisture. The mean return interval for these disturbances is about 200 years for the CWH.

4.2 Seral Stages and Bear Habitat

Bear forage is most prevalent in the early seral stages and in old and mature forests when the canopy begins to open up. Closed canopy forests (20–80 years old) offer fewer foraging opportunities for bears. Plant succession after clearcutting would broadly follow the seral stages below:

0–5 years:	herb seral stage (sparse seral stage)
5–20 years:	very high shrub production
20–40 years:	pole sapling stage, the stand closes off
40–80 years:	young forest, very little berry production
80–250 years:	mature forest, forage production increases
> 250 years:	old forest, natural disturbances create openings

However, in partially cut areas where significant numbers of trees are retained within the cutblock (e.g., under a variable retention harvest regime), responses of plants important as forage for bears will vary depending on the degree of canopy opening. Berry production may also benefit as a result of an increase in the amount of light reaching the understory.

5. Forest Harvesting in the Green River Area

Grant Scott presented an overview of the forest harvesting conducted in the Green River watershed, on behalf of the Kitasoo First Nation.

The Kitasoo First Nation comprises approximately 500 people living in the community of Klemtu on BC's Central Coast. The community relies on fishing, aquaculture, eco-tourism and forestry for employment and economic development. The Kitasoo people have been active in land use planning discussions and have generated their own land use plan for their traditional territory. They have worked with other First Nations, the Province of BC, environmental organizations and industries to create protected areas and implement sustainable forest practices in their traditional territory. Total area of the Kitasoo traditional territory is 532,000 hectares, of which 45% (approximately 240,000 hectares) is protected area.

5.1 Green Inlet, Green Lagoon, and Green River Watershed

The forest harvesting proposed by the Kitasoo First Nation was subject to public review in Klemtu and Prince Rupert, and was specifically reviewed by neighbouring First Nations. No identified concerns were outstanding before logging began.

Total area of Green River watershed:	23,286 hectares
Total forested area:	8,963 hectares
Total timber harvesting land base:	3,567 hectares
Total mature volume:	2,023,152 cubic metres
Potential harvest per year:	21,400 cubic metres (based on 100-year rotation)
Potential jobs annually:	58

The Green Inlet, Green Lagoon, and Green River watershed are considered moderate value habitats for bears overall, with some high-value sites within them, and are more suited to grizzly bears than to black bears. Black bears do inhabit the area, however, and white-phase bears have been observed occasionally.

5.2 Kitasoo Forest Company Harvest Plans 2006/07

The Kitasoo Forest Company harvest plan was for 45,000 cubic metres in small variable retention cutblocks, rather than in clearcuts. This level of harvest translated into approximately 124 hectares in 2006/07, or about 1.4% of the forested area, and 2.2% of the total mature volume in the Green River watershed.

The variable retention prescription resulted in about 337 cubic metres per hectare being harvested, and up to 50% of the volume (900–1,000 cubic metres) of each harvested cutblock left standing. The prescription was designed to mimic natural disturbance types. The area was helicopter-logged, with no road or log dump requirements. This eliminates the potential for environmental impacts as a result of these developments. All harvested wood was dropped in the water and barged out. The harvest areas themselves tend to blend in with the surrounding landscape because of the highly variable nature of the forest stands in the area (strips of timber in the low areas, hummocks, wet areas). Natural regeneration is planned because of the small size of any opening and the care taken when removing trees by helicopter.

The Kitasoo First Nation has no plans to log in the upper watershed or the lagoon area. There are no plans for further logging in the Green River area at this time, and certainly not for the next five years.

6. Bear Habitat and Population in the Green River Area

Tony Hamilton described key features of bear habitat on the BC coast and effects of forest harvesting on bear habitat, with particular reference to logging in the Green River area. He referred to two publications: the North Coast Land and Resource Management Plan (LRMP) Information Circular about black bears; and Davis et al. (2006), a paper on the influence of phenology on site selection by black bears.

The starting point for consideration of habitat and population effects from forest harvesting can be drawn from the list of issues of concern about black bears discussed in the North Coast LRMP Information Circular:

- Mortality risk associated with human food and garbage;
- Mortality risk associated with connected road networks;
- Protection of critical denning and foraging habitat;
- Provision of stable landscape-level forage supply;
- Requirement for suitable escape trees in and near forest openings; and
- Displacement from preferred habitat or habituation as a result of disturbance.

One of the important elements from a bear welfare perspective is the change in food production at a landscape scale following logging. Given that home ranges are large, 20 square kilometres for females and up to 300 square kilometres for males, consideration of habitat effects at a stand level needs to be put in the landscape context. As well, most home ranges overlap seasonally, particularly where salmon are present as a fall food source.

The forest harvesting that has occurred at Green River may result in some increased food production within the openings, in response to the variable retention of up to 50% of standing timber, and because heli-logging results in minimal soil disturbance. As well, some habitat elements will stay primarily intact, with structural diversity providing sufficient denning and escape cover to maintain suitable home range conditions for females and cubs. Availability of mark trees and climb trees should not be affected.

Between 200 and 500 bears per 1,000 square kilometres is a conservative estimate for the density of black bears in CWH zone of the Central Coast of BC. The Green River itself may have 30 to 40 bears per 1,000 square kilometres, reflecting the fact that the habitat is less well suited to bears than some other coastal areas. Grizzly bear habitat is moderate and the influence of grizzly bears on black bears is unclear. Regardless, if the disturbance from logging in the Green River area is translated into habitat effects and then into population effects, an increase in bear population of less than 1 bear would be expected. However, such an analysis is not entirely biologically relevant, given availability of a variety of food sources, the scale of home ranges, movement patterns, and social factors. Hence, this expected increase is likely an overestimate and was presented at the workshop only to illustrate, hypothetically, the scale of potential consequence.

Within openings of the scale of logged areas at Green River, only a few species of berries would be affected. However, bears rely on 18 species of berries in coastal BC, all of which will vary naturally from year to year. Salmon is the more important fall food for bears, and this resource also fluctuates annually. Regardless of these variations, coastal bears are not usually considered to be fall-forage limited. The more important consideration is for food sources during spring and the habitats logged were not typical spring foraging units.

At the level of forest retention in Green River area and given the small overall scale of harvest (total of 124 hectares), there is no anticipated shift in home ranges. If there is an influence, it would be a shift in activity centres within the home range itself. Given the short-term disturbance (e.g., noise) during logging operations, the strong affinity of females to their home ranges may negate any shift in home ranges.

If cumulative impact is a concern, it is important that this be assessed based on an understanding of the specific disturbance patterns and locations. Different ecosystems have different values for bear habitat and respond differently over time to disturbance.

7. Summary of Potential Effects of Logging

Panel members applied their collective understanding to the question of potential effects on bear populations and the potential for bear movement following logging. This section provides a summary of the Panel's assessment of the effects of logging in the Green River area with respect to: bear habitat; the frequency of dispersal by bears and the distances bears will move; how many bears would emigrate to Princess Royal Island; and the degree to which emigration might be cause for concern with respect to the expression of the white-phase gene.

7.1 Effects of Habitat Changes on Nutritional, Behavioural, Social and Demographic Factors

From a habitat perspective, harvesting 124 hectares by helicopter, with a retention prescription that leaves up to 50% of the timber standing, will result in a slight increase in habitat suitability in the openings, but not enough to cause behavioral changes or result in demographic consequences. The magnitude of change is insignificant. If forest harvesting similar to what has recently occurred within the Green River area were expanded, provided special recognition were given to the protection of dens and to climb and mark trees, there would unlikely be significant changes at either the individual bear or the subpopulation levels. The ecosystem-based management (EBM) approach adopted by the Kitasoo Forest Company has been deliberately designed to minimize impacts on species and ecosystems.

7.2 Effects of Habitat Changes on Population Size and Productivity of Black Bears

The population size and productivity of black bears would not change as a result of harvesting of 124 hectares in Green River area, as described. Although in some areas of black bear range in North America, at full development of early seral stages (i.e., high forage production), there can be population changes because of increased survivorship, earlier age of breeding by subadult females, and more cubs per litter. These factors are not operative in the Green River area because the magnitude of the habitat changes is too small and logging too dispersed.

Logging occurring to the north and to the south, in the same types of ecosystems, would likely have similar effects on black bear habitat. If the ecosystem-based management (EBM) regime is implemented on the Central Coast as proposed, little change in bear habitat quality would be anticipated. This does not, however, remove concern for logging effects on spring habitat in lower elevations, even with the EBM regime in place. Concerns about access management and bear–human conflict over garbage remain, no matter what the forest management regime.

7.3 Effects of Habitat Changes on Site Fidelity by Adult Black Bears, Home Range Shifts or Abandonment

Black bears have strong fidelity to their home ranges. This fidelity is so strong that wildlife managers have difficulty translocating bears from areas where they cause problems. Black bears have been moved more than 100 kilometres away and have returned to their home ranges. Bears have large home ranges and have different activity centres within their home ranges. Female bears inherit their home ranges from their mother or grandmother. If something happens in a portion of a bear's home range, it will typically shift activity within its home range, unless the disturbance is on such a scale that the whole home range is affected. Because home ranges are large, the impact from this small-scale logging should not affect the bears' fidelity to their home ranges, either by females (who have small home ranges) or by males. Size and distribution of harvest blocks are not factors in this case, particularly because the openings retain habitat suitability after harvest.

With respect to disturbance from the logging practices themselves, most is known about effects from conventional logging. Some shifting appears to take place with first contact. However, bears have strong fidelity to their home ranges and will habituate to most human activities. The logging activity entails the drop-off and pick-up of crews during felling for one week. Helicopters are present to move the felled timber off the site for a matter of a few hours over a 2- to 3-day period. Helicopter activity might shift bear use within their home ranges for short periods, but this would be temporary. There is no evidence that bears would abandon their home ranges because of logging operations of the scale conducted in the Green River area.

7.4 Effects of Habitat Changes on Adult and Post-juvenile Dispersal

There are two ways that animals could be affected by the logging in terms of movement: abandonment of the home range and dispersal of juveniles. Post-juvenile dispersal refers to juvenile bears breaking their ties with their mother, moving and establishing a new home range. In black bears, this can occur as early as 15-16 months. There are instances of adult dispersal, but these are considered very infrequent. Abandonment of a home range for all practical purposes does not occur.

General dispersal patterns are common across a large number of bird and mammal species. Dispersal distance increases with body size and is farther for carnivores than for herbivores and omnivores. Based on these broad relationships, the median dispersal distance is 20 kilometres for a male bear weighing 130 kilograms. The farthest distance noted in a study of 51 subadult black

bears in Alaska is 27 kilometres and a high proportion of males (18 of 21) disperse from their natal area. In a study of 20 male black bears in Minnesota, the maximum dispersal distance was 219 kilometres. In both studies, females tended to not emigrate.

7.5 At the Landscape Level, How Many Kermode Bears from the Green River Area Will Travel and How Far?

Princess Royal Island is within the range of black bears dispersing from the lower Green River watershed. Terrain will have an influence on the direction dispersing bears will move because bears tend to follow valleys. Not all bears will necessarily arrive at the ocean and then swim Graham Reach (approximately 1.2 kilometres across); some may travel up the valley (in a direction other than toward Princess Royal Island). Black bears could swim across Graham Reach, but the channel is an impediment to movement and would reduce the likelihood of bear emigration to Princess Royal Island. Movement of bears to Princess Royal Island likely occurs, but genetic analyses reveal different frequencies in the white-phase gene and show isolation between the islands and the mainland. As well, isolation occurs both within islands and within parts of the mainland. This isolation indicates that interchange between populations of black bears on islands and the mainland are constrained, but happens naturally from time to time even in the absence of habitat disturbance.

Female black bears can live about 25 years and give birth every second year beginning in year 4 or 5. Assume that an increase in habitat suitability in the Green River area results in less than 1 additional migrating bear per year. Assume also that half the post-juvenile bears are male, and therefore only half these bears will migrate. The resulting number must be reduced again by at least half (perhaps by 75%) because of the choice of direction of travel by dispersing bears, and because Graham Reach is an impediment to movement. This translates into the potential for addition emigration to Princess Royal Island by less than 0.1 additional bear per year, or 1 additional bear every 10 years.

7.6 Potential Number of Black Bears Reaching Princess Royal Island and Other Islands Occupied by Black Bears with High Frequency of the White Phase in the Short Term and in the Long Term

Increased suitability of habitat translates into the potential for up to 1 additional bear per decade dispersing to Princess Royal Island, given that the animal will swim the channel and notwithstanding other influences.

The Panel was generally impressed by how benign the forestry factor is in this area with respect to the emigration of bears to Princess Royal Island. The potential for emigration is about the same to Roderick Island, but less likely to Gribbell Island because of the wider channel. These islands are the other two centres of highest frequency occurrence of the white-phase Kermode bear.

7.7 Genetic Consequences of This Rate of Emigration to Princess Royal Island

At the upper end of the spectrum of possibilities (i.e., 1 additional bear moves every 10 years), the Panel assumed that:

- the minimal habitat changes at Green River can be expressed in bear numbers;
- 1 male bear emigrates to Princess Royal Island every 10 years;
- the male is a homozygous black-phase bear, rather than a white-phase or heterozygous bear;
- the average generation period for black bears is 10 years.

At a frequency of 1 bear per generation, based on the above assumptions, it can be calculated that it would take many generations (dozens to hundreds) before a significant change in the expression of the white-phase gene would occur. For example, for an island population of 500 bears, one homozygous black-phase bear immigrating every generation would cause a 10% reduction of the white gene frequency after 52 generations or 520 years. Also, based on the degree of among-island differentiation (as measured by Wright's F_{st}) one can indirectly estimate the "long term" average number of bears that migrate between islands as about two per population per generation. Thus the potential for an additional bear per generation would increase gene flow by 50%. However, these are very crude estimates and the actual levels of historic gene flow may be twice as high or twice as low.

Also, the role of natural selection in maintaining the Kermode condition is completely unknown. If present, natural selection may counteract any influx of black coat colour genes. For example, white-phase bears could be more successful fishers because they may be less visible to salmon in the water. As it is, the relative frequency of the white gene in the face of historical gene flow (2 per generation) is somewhat puzzling, and suggests natural selection. Sexual selection might also play a role, with white bears tending to prefer other white bears such that areas of high white frequency are maintained. Other mitigating factors include: movement between breeding groups on Princess Royal Island; the probability of a heterozygote emigrating; density of populations on the mainland and on Princess Royal Island; carrying capacity; and the potential that some bears disperse intentionally to a specific area.

7.8 Potential Extension of the Question to Other Areas

On the broader spatial scale, we can consider logging occurring to the north and to the south of Green River, in the same types of ecosystems. In these areas, if the ecosystem-based management regime is implemented, no substantive change to bear abundance and distribution would be predicted. In part, EBM is designed to maintain wildlife, fisheries, water and other forest values, as well as allow economic benefits. The lack of bear response is in large part a result of the management regimes that are practiced.

The EBM regime does not, however, remove the concern for logging in low-elevation spring habitat, or remove the concerns about access management or bear-human conflict over garbage. Logging could have a different impact on bears in such areas. Having said this, some anecdotal information indicates that in the areas of greatest logging disturbance (e.g., in the Terrace area), an effect on gene frequency would be more likely because of the higher change to bear habitat suitability. On the other hand, there is also anecdotal information that logging in the Terrace area has not changed the frequency of occurrence of expression of the white gene.

8. Conclusion and Recommendations

It is the conclusion of the Scientific Panel that: *the effect of logging in the Green River area is not sufficient to change the frequency of the white-phase or Kermode bear on Princess Royal Island over the term of many generations of bears.*

Cautionary Note: The Panel wishes to stress that the use of numbers in this report is to help bound the upper limits of expectations of impacts, and cautions against the use of these numbers as implying certainty beyond this intended purpose. Although we use 1 bear per year, the amount of habitat benefit to bears is likely more in line with an estimate of 0.1 bear per year. As well, the effects are not necessarily additive, because of the size and distribution of cutblocks in relation to bear home ranges, use within home ranges and the social system of black bears. No one bear really benefits very much, and we do not expect a population response. We have purposely tried to address uncertainty in our deliberations by over-estimating population response and dispersal rates. The conclusion also captures this uncertainty by the wording "over the term of many generations of bears."

8.1 Associated Recommendations

The Panel offers the following associated recommendations.

- The database for Kermode bear should be improved, and this database will continue to support science-based management of bears. This might include a more systematic sampling of bear hairs (for DNA) and additional genetic analysis of resulting bear DNA to (1) get a more precise estimate of the gene frequency of the white-phase gene, and (2) ascertain whether the gene frequency is changing over the longer term. It is much more efficient to estimate gene frequency by using the molecular genetic assays than by counting numbers of white-phase vs. black-phase bears, because the white genes can be counted in the heterozygous black bears.
- Monitor the number of Kermode and black bears, as well as grizzly bears in the Green River area through the EBM Working Group. This need not be a total count, but could be an index of numbers and frequencies.
- Monitor the population of Kermode bears on Princess Royal Island through indices, such as those designed for the Queen Charlotte Islands.

- There are a suite of proposed EBM objectives for both black bears and grizzly bears on the Central Coast. The Panel would like to endorse the quick implementation of these already identified objectives.
- Genetic drift predicts that the Kermode bear would be extinguished over time, since the probability of eventual loss of a gene equals its current gene frequency, which is relatively low for the Kermode gene. The current frequency could be a result of an ice-age bottleneck wherein the white-phase gene accidentally drifted to a higher frequency, with subsequent decreases of frequency as black-phase genes immigrate. However, this is highly speculative. The role of natural selection in favouring coat colour is unknown. Further study is needed to ascertain the adaptive significance of the coat colour difference. Alleles maintained by natural selection tend to be old. At least, the age of the white-phase gene can be estimated by examining DNA sequence variation around the gene.
- The Province should assist the Kitasoo First Nation with developing a sampling design and data collection protocol so that the Kitasoo can collect relevant bear information as part of their regular weekly field inspections within their traditional territory. The emphasis here is on the provision of practical sampling criteria and field procedures.
- An assessment could be undertaken with respect to the effects of logging that occurs in adjacent areas. This need not be onerous and requires the estimation of type and location of harvest over time. This type of assessment might fit well under the auspices of the regional strategic plan, as a reasonable planning element. It is not the topic for a scientific panel.
- Recognition of the Kermode bear in the areas north and south of Terrace needs greater emphasis. These areas could be brought under the same management regime as for other coastal bear populations.

Some References Used by the Panel

Blood, D.A. 1997. The white-phase Kermode bear, with particular reference to Princess Royal Island, British Columbia. Report prepared for Western Forest Products, Vancouver. 32 pp.

British Columbia Ministry of Forests and British Columbia Ministry of Environment, Lands and Parks. 1995. Biodiversity guidebook: Province of British Columbia, Victoria, BC. http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/biodiv/biotoc.htm

Coast Information Team. 2004. The scientific basis of ecosystem based management. Prepared by the Coast Information Team (CIT), Compendium Team. 118 pp. http://www.citbc.org/c-ebm-scibas-fin-04May04.pdf

Cushman, S.A., K.S. McKelvey, J. Hayden, and M.K. Schwartz. 2006. Gene flow in complex landscapes: Testing multiple hypotheses with causal modeling. American Naturalist 168:486-499.

Davis H., R. Weir, A.N. Hamilton, and J.A. Deal. 2006. Influence of phenology on the site selection by female American black bears in coastal British Columbia. Ursus 17:41-51.

Marshall, H.D., and K. Ritland. 2002. Genetic diversity and differentiation of Kermode bear populations. Molecular Ecology 11:685-697.

Michelfelder, V., and K.P. Lertzman. 2006. Community structure of forage plants consumed by black bears in Nimpkish Valley, British Columbia. B.C. Ministry of Forests and Range, Research Branch, Victoria, BC. Technical Report 035.

North Coast LRMP. 2003. Black bears on the North Coast. North Coast Land and Resource Management Plan, Information Circular. 6 pp. http://ilmbwww.gov.bc.ca/lup/lrmp/coast/ncoast/docs/Black_Bear_Circular_November_5_2003.pdf

Ritland, K., C. Newton, and D. Marshall. 2001. Inheritance and population structure of the white-phased "Kermode" black bear. Current Biology 11:1468-1472.

Rogers, L.L. 1987. Factors influencing dispersal in the black bear. Chapter 5, pp. 75-84 *in* B.D. Chepko-Sade, and Z.T. Halpin (editors). Mammalian dispersal patterns, the effects of social structure on population genetics. University of Chicago Press, Chicago, IL.

Schwartz, C.C., and A.W. Franzmann. 1992. Dispersal and survival of subadult black bears from the Kenai Peninsula, Alaska. Journal of Wildlife Management 56:426-431.

Sutherland, G., A. Harestad, K. Price, and K. Lertzman. 2000. Scaling of natal dispersal distances in terrestrial birds and mammals. Conservation Ecology 4(1):16 [on line] http://www.consecol.org/vol4/iss1/art16