SPIRIT BEARS UNDER SIEGE

THE CASE for the PROTECTION of GRIBBELL ISLAND – Mother Island of the White Bear

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Report to:
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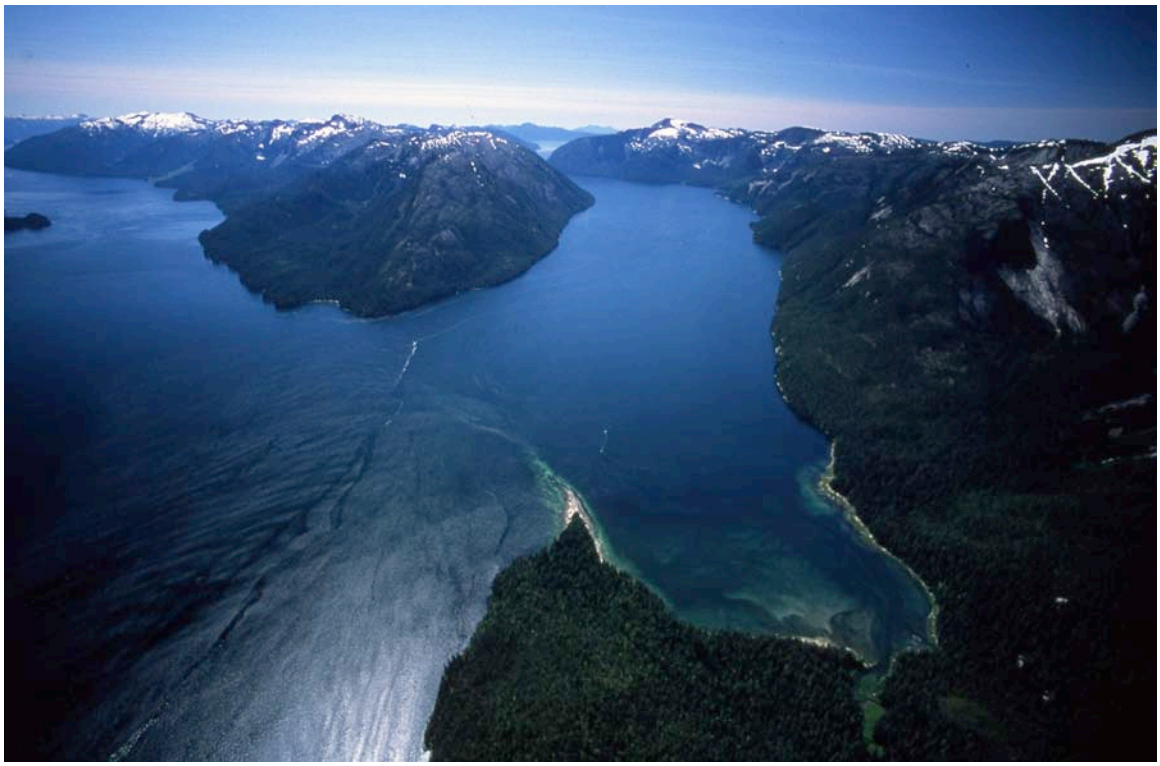

Elongated Gribbell Island (middle) sits astride two of BC's central coast marine shipping lanes, the Inside Passage and Douglas Channel. This small but rugged 20,690 ha island is evolutionarily significant as over 40% of its small isolated population of Kermode bears, a subspecies of the North American black bear, are white. It represents Canada's Galapagos. Past over hunting and trapping and collection of white hides for museums, clearcut logging, declining salmon runs, climate change and the new threat of a major tanker oil spill if the Enbridge Pipeline is approved threaten this world unique bear gene pool. [Photo by Ian McAllister].

Although the term 'inexhaustible' has been applied to the timber resources of this coast, it is very evident that its application is not justifiable. The heavy timber growth is confined to limited areas….the day is not far distant when the large trees will be a feature of a remarkable past…..If once the forest is cut down, reforesting will be a difficult or impossible problem…..since the removal of trees permits the scanty soil to be readily washed from the steeper slopes, thus changing portions of this wonderful landscape into a veritable rock desert….the Government would do well to reserve one or two of the most picturesque fiords as parks, while they are yet in a state of almost primeval grandeur. J. Austen Bancroft. 1913. Memoir No. 23. Geology of the Coast and Islands between the Strait of Georgia and Queen Charlotte Sound, BC Geological Survey, Canada Department of Mines, Ottawa.

ACKNOWLEDGEMENTS

We gratefully acknowledge Elder Helen Clifton and the late Gitga'at Hereditary Chief John Clifton for their everlasting support and dedication to protection of "Mis-aula", the white bear. To Marven Robinson for his endearing enthusiasm for the white bear and for his invaluable research information and for the many happy days we spent tromping the bear trails on Gribbell Island. We would like to thank the following Gitga'at community leaders for their interests and for reviewing this report: Hereditary Chiefs Albert Clifton, Ernie Hill and Arnold Clifton. Elected Chief Arnold Clifton and councilors Bruce Reece, Cam Hill, Kyle Clifton and Marven Robinson. CEO Ellen Torng is also thanked. Dan Cardinal is also thanked for his many discussions on how to best protect the spirit bear and for his scrambles with the field crew through steep side hills on Gribbell Island. Art and Pat Sterritt are also thanked for their enthusiasm and proactive actions to protect Kermode and grizzly bears on the BC coast and for inviting me to make a spirit bear presentation in Hartley Bay way back when.

Scientists who have devoted their attention to the Kermode bears of Gribbell Island and whose research and expertise in one way, shape or form has contributed significantly to the views of the need to protect Gribbell and for the conservation data base we now have to support that, include Dr. T. Reimchen (University of Victoria), Dr. Bristol Foster (evolutionary biologist and former head of the BC Ecological Reserves program), Dr. Kermit Ritland (white bear genetics expert, University of British Columbia), research student Dan Klinka, noted carnivore biologist Dr. Paul Paquet, and Dr. Chris Darimont. Dr. J. Bergdahl is thanked for his earlier salmon analyses and conservation biology reviews of the white bear. Without the expert mapping and GIS habitat modeling of Baden Cross, this project would not have been complete. Biologist Maggie Paquet is thanked for her editing. Thanks also to Dr. David Hancock for his history of the last live-trapping effort for white bears on Princess Royal Island and for his interest in protecting the white bear. Dr. Chuck Jonkel and the Great Bear Foundation are also thanked for their on-going support.

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Last but no least is the late "Lucy" McCrory, expert bear research dog and a star on the Tv Program "Dogs with Jobs" who made sure we were safe in all of our bear surveys and who nearly lost her life by stepping into a wet, greasy granite stream channel on a steep slope on Gribbell but used her skillful claws to brake just before a fatal precipice.

This report is dedicated to my colleagues at the Valhalla Wilderness Society including my late sister Colleen McCrory, an international award-winning conservationist, without whose vision and spirit, much of this work would have floundered. Her spirit in preserving the earth and its wild things lives on with us.

SUMMARY OF FINDINGS & RECOMMENDATIONS

Gribbell Island is a small mountainous island of some 20,690 hectares (50,932 acres) lying off the northern tip of Princess Royal Island and within the vast, convoluted, and intricate fiordal archipelago of British Columbia's central coast. The island is famous for its high incidence of Spirit, or Kermode, bears, a white-phase subspecies (*Ursus americanus kermodei*) of the North American black bear. Before the turn of the 20th century, white bears on the island were targeted by trappers and hunters for the fur trade; for a period they were prized by museum collectors and trophy hunters.

For countless centuries, the bear has been known as "Mosgm'ol" in Sm'algyax, the Coast Tsimshian language. To the Gitga'at people of Hartley Bay, in whose traditional territory lies Gribbell Island, Spirit bears are known as "Mis-aula." Both words mean "white bear." For thousands of years the Gitga'at have revered the white bear. One Tsimshian legend refers to the white bear being created by Raven as a reminder of the last Ice Age. The late John Clifton from Hartley Bay was at one time the last hereditary chief on the BC coast to have the right to wear a white bear robe for ceremonial purposes, a tradition which he has passed along to family members with the inherited clan name.

In 2006, the Gitga'at, along with conservation groups and the BC provincial government, were instrumental in protecting large areas of their traditional territory, including significant habitats for the spirit bear on Princess Royal Island and the adjacent mainland. The joint First Nations-BC government land use planning announcement in 2006 protected roughly one-third of BC's north and central coast through the addition of some 108 new conservancies. Unfortunately, this did not include Gribbell Island, which was designated a "Kermode Bear Stewardship Area" to allow a continuation of logging, and possibly also mining and hydro-electric development. That designation was made in spite of the fact that large areas of Gribbell had already been clearcut and roaded.

Gribbell Island lies adjacent to major ocean-going vessel shipping lanes, including Wright Sound, which is at the intersection of the north-south Inside Passage shipping lane and the east-west Douglas Channel shipping lane. Douglas Channel is a narrow 100 km-long fiordal marine passageway that enables ocean-sized vessels to access the port of Kitimat. Currently, an international conglomerate, Enbridge Corporation, has a proposal to build a twinned set of pipelines, the "Northern Gateway" project, to carry an estimated 525,000 barrels a day of bitumen from Alberta's tar sands to the port of Kitimat, and then have 225 tankers per year navigate these intricate shipping lanes in order to ship the bitumen to Asia. The second pipeline would carry 150,000 barrels a day of condensate (a mixture of chemicals and petroleum used to dilute tar sands crude oil to make it viscous enough to flow in pipelines) in the other direction from Kitimat to the Alberta tar sands. The proposal is very controversial and currently the subject of a major Joint Review Panel (JRP) of the National Energy Board and the Canadian Environmental Assessment Agency (under the jurisdiction

of Environment Canada). The review is expected to be completed in summer 2013, after which a decision will be made by the federal government to approve or not approve the Northern Gateway project. Many consider the potential for a large oil spill as a grave threat to Kermode bears, especially on Gribbell Island.

An elder spirit bear surveying its rainforest domain

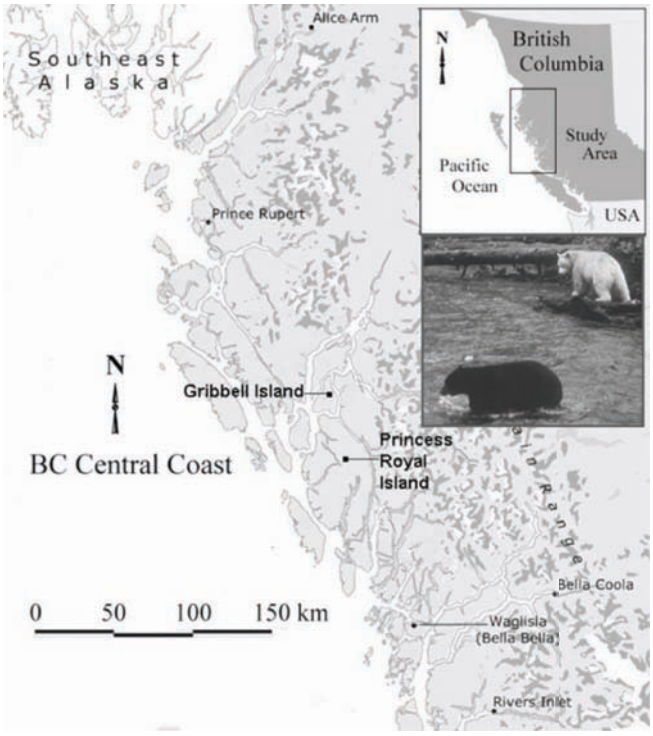
Study approach

We used the Spirit, or Kermode, bear as a focal and umbrella species to provide a broad-brush conservation overview of Gribbell Island. Our review includes an evaluation of the evolutionary significance of Gribbell Island's identified unique ratio of white-phase to black-phase Kermode bears, and its vulnerability as a small island ecosystem to additional man-made developments and natural disturbances. In order to assess the current level of human-caused ecosystem changes, we used a cumulative effects approach that looked at the following significant factors:

- the potential effects on the ratio of white- to black-phase Kermodes from early 20th century hide-hunting and the collection of white-phase bears for museum specimens;
- forestry practices, including clearcut logging and associated roading;
- changes to Pacific salmon stocks caused by logging and commercial ocean harvest of salmon that are natal to small (coastal streams) salmon runs;
- climate change, including warmer fresh and marine waters and sea level rise; and
- effects of research and bear-viewing/tourism activities.

A separate environmental assessment is being completed by Valhalla Society scientists on the threats to Gribbell Island by potential effects of the proposed Enbridge project oil tanker traffic in the adjoining marine channels. So far, we consider the high probability of an Exxon Valdez type of oil spill a very serious threat to the genetically unique but small Kermode bear population on Gribbell, but further in-depth quantification is being done. One of the central shortcomings of the Enbridge Northern Gateway Pipeline (ENGP) Environmental-Social Assessment (ESA 2010) is its lack of documentation of baseline information on animal and fish populations against which to assess the impacts of a potential tanker spill. This Kermode report helps sets a baseline for Gribbell Island to be used in our assessment of the ENGP ESA (2010). This will be made available at later date.

To make our assessments of cumulative effects and the evolutionary significance of flora and fauna on Gribbell Island, we used information from field surveys; previous studies; interviews with Gitga'at people, bear viewing operators, and others; and the scientific literature. Information on bear habitat values came largely from ground surveys and a previous conservation analysis for the Spirit Bear Conservancy Proposal. To assess possible impacts of logging, we used joint Gitga'at-Valhalla Society field surveys of bear plant foods and logging site damage combined with a GIS (Geographic Information System) analysis of overlays of past logging on three types of habitat models: (a) Kermode bear vegetation maps, (b) Kermode potential den habitat maps, and (c) Sitka deer winter range maps. We used field surveys to assess marine estuary habitats. To assess the conservation status of Pacific wild salmon runs, we used available Department of Fisheries and Oceans (DFO) salmon escapement data and other studies, as well as local observations from the Gitga'at and others. To assess estimated numbers of white versus black Kermodes on Gribbell and adjacent islands and mainland, we used known black bear densities from several Alaskan islands combined with the frequency of the white-phased gene known as "A893G" as determined from the University of British Columbia genetic study. This included "GG" or white bears with the double recessive A893G gene, AG or black individuals that carried the A893G gene, and "AA" or black individuals that did not carry the A893G gene. We evaluated Gribbell Island in the context of an Evolutionary Significant Unit (ESU) not only in terms of adjacent Kermode island and mainland differences in genetic frequency of A893G between white and black individuals, but adjacency to other known bear subspecies, island-mainland differences in occurrence and distribution of Kermodes versus grizzly bears, and genetic uniqueness of coastal wolves.



[Map Courtesy of Klinka and Reimchen 2009]

Genetic studies on the Kermode bear

Recent genetic studies have confirmed what the Gitga'at First Nations have known for centuries, that Gribbell Island has a unique, high incidence of white-phase Kermodes compared to other areas in this near-pristine archipelago. Genetic experts have concluded that the double recessive gene A893G for the white bear variant is unique and of "*untold value*" as it has not been identified in any other mammal. Genetic studies also concluded that Gribbell Island is not only the island richest in white bears, but exhibits substantial genetic isolation. Kermodism is hypothesised to have been established and maintained in populations by a combination of genetic isolation and somewhat reduced population sizes in insular habitats. These studies suggest that white bears evolved on either Gribbell Island or adjacent Princess Royal Island and that such incipient speciation is a model for evolutionary biology. A separate study on Gribbell Island found that white bears had an efficiency advantage over black individuals when capturing salmon during fall daytime hours due to a white predator being less conspicuous to salmon against the background sky.
Using the allele A893G frequencies from the UBC genetics study and low-high population density estimates from two Alaskan coastal black bear studies (50 black bears/1000 km^2 for Prince William Sound and 73 bears/1000 km^2 for Mitkof Island), we derived low-high population estimates for different core Kermode areas on the BC Central Coast for the three genetic variances: GG (white), AG (black with the allele A893G) and AA (black with no A893G). For adjacent mainland areas, we used BC Ministry of Environment coastal black bear density estimates for our review.

In the total core genetics area of the BC Central Coast (excluding Hawkesbury Island), we estimated an average of 220-310 (17%) white bears out of a total population of 1,290-1,820 Kermodes comprising this rare and unique gene pool. This is only a portion of the overall Kermode Range that extends from about Rivers Inlet in the south to the Nass Valley in the north, with much of this area not being sampled.

Gribbell Island has by far the highest incidence of white-phase bears yet discovered, with an estimated 45-65 white bears, or 43% of a total population of about 100-150 Kermodes. Adjacent Princess Royal Island, with an estimated 17% white bears of a population of 890-1,250 Kermodes being white, would have 150-210 white bears, and Roderick-Pooley Islands, with an estimated 10% white bears of a population of 190-260, would have only 19-26 white bears. The adjacent mainland, with an estimated 3% of a small population of 110-144 Kermode bears, would have 3-4 white bears. The starkest contrast in occurrence of the white bear allele revealed in the UBC genetic study involves Gribbell and Hawkesbury islands. Separated from Gribbell on the west by only a narrow marine channel some 3-5 km wide, only one hair sample of 25 collected from Hawkesbury had the allele A893G for the white coat. No white bear hair samples were collected and we could find only one sighting. Hawkesbury is nearly twice the size of Gribbell, with an estimated 180-279 Kermodes, nearly all of which would be black if the 25 hair samples analysed from there are reflective of the overall island subpopulation. Overall, only 4% on Hawkesbury would carry the white bear gene A893G, similar to mainland areas adjacent to Gribbell, Princess Royal, and Roderick-Pooley islands.

These numbers reflect crude estimates only, and may be skewed or inaccurate due to small

sample sizes and limitations of the method for collecting bear hairs, which focused on bait stations that "spot sampled" near salmon streams in the fall. Whether these numbers crudely represent the true population and estimate of the white bear allele is a matter of scientific debate and contention. Certainly a more reliable grid-sampling method would be appropriate in the future, but this method is very expensive and is itself subject to statistical error. In the absence of more scientific certainty, we compared the estimates of white bears for different areas to historic data and more recent anecdotal sightings derived from our 20 years of field surveys and observations of other researchers, First Nations, and bear viewing operators. We concluded that, give or take reasonable margins of errors and annual variation in individual bear sightings at the same location, the figures we arrived at using genetic frequencies and crude bear density data are consistent with empirical data and crudely reflect what we believe would be found in nature.

Evolutionary Significance of Gribbell Island

In terms of evolutionary significance, although we do not understand all of the contributing factors and circumstances that led to the existence of the unique white-phased gene known as "A893G" for BC's Kermode bear, this genetic phenomenon represents, better than any other bear subspecies in North America, thousands of years of a unique type evolution in the making based on isolation on one or two adjacent islands, just as the larger and the totally different and isolated black bear subspecies on Queen Charlotte Islands (Haida Gwaii) 70 km across the Pacific to the west represents a somewhat different evolutionary process. Given the diversity of four subspecies of black bears found on the BC coast, the disparity in grizzly distribution between near shore islands and adjacent mainland, and the existence of a genetically unique type of coastal wolf, we agree with evolutionary scientists that the central coast terrestrial and marine archipelago represents "Canada's Galapagos." And of all areas, Gribbell Island is "the mother island of the white bear" and should have a high priority for full protection as a provincial conservancy or Gitga'at white bear aboriginal preserve or Tribal Park.

These factors also support the classification of the Kermode Bear as an Evolutionary Significant Unit (ESU) as proposed by Moritz (1994), and consequently warrants conservation status. The ESU designation would recognize and protect the functioning of evolution.

Habitat values constrained for small insular island Kermode population

Our GIS habitat model shows that some 33%, or 6,820 ha, of Gribbell is unvegetated rock and unsuited for bears. Much of this includes the higher rugged peaks of the Kitimat Ranges. The remaining 67% (13,870 ha) was considered to be suitable as vegetation feeding habitat, such as for berries, grasses, sedges, and forbs found largely in small, forested wetlands or open areas such as avalanche chutes or small open wet meadows, bogs, and fens. Bears on the coast feed on over 50 different plant foods. Overall, our field surveys indicate that much of Gribbell is of generally low quality habitat when compared to other Kermode islands, such as Pooley Island or south Princess Royal Island. Productive marine intertidal salt meadows, such as estuaries, are also generally lacking, limiting the availability of Lyngby's sedge (*Carex lyngbyei*), a popular spring bear food in coastal areas. The extensive marine foreshore of Gribbell does provide large areas where benthic invertebrates, such as the blue

mussel and barnacle species, provide important foods for Kermode bears. Observations of Kermodes feeding on marine invertebrates are now common.

White Kermode cub feeding on barnacles and mussels on Gribbell. [Photo: Trish Boyum]

The island has only two small salmon spawning streams and was found to have a relatively low salmon biomass over the landscape (0-5 kg/ha) when compared to other Kermode areas, such as Laredo Inlet on south Princess Royal Island, where nine salmon streams occur. The low salmon biomass on Gribbell limits its productivity for Kermode bears, wolves, and other species that depend on salmon at spawning creeks in the fall.

Our GIS Kermode denning habitat model shows that ample old forests still provide a supply of large old trees suitable for winter hibernation. Some 4,484 ha or approximately 22% of the island has a high bear den potential for the 100-140 bears.

Overall, other than good denning habitat availability, the constrained bear food productivity of Gribbell Island makes it vulnerable to population stress and survival during years of natural food shortages, such as combined berry failure and salmon declines. The insular nature of the bear population magnifies this vulnerability.

Black mother Kermode and 3 cubs fishing in Riorden Creek below Gitga'at viewing platform. Although black, the bears could carry the gene for the white coat that could produce white young if the mate also carried the same gene. [Photo: W. McCrory]

Cumulative Effects Review

"Cumulative effects" is the accrual, gradual or rapid, of all impacts on a species from human activities and natural events, quite often obscured in space and time due to lack of monitoring or our tendency to just look at one man-made impact and consider it not very important.

In summary, of the five man-caused influences we examined, early fur trapping for white bear pelts and early 20th century hide hunting/collection of bears with a white pelage for museum specimens has likely reduced the white bear gene in the small distinct Gribbell Island Kermode bear population. Forestry practices (clearcut logging and associated roading) combined with mismanagement of small salmon stocks in the commercial fisheries has had the greatest influence on reducing overall food productivity for Kermode bears on Gribbell Island; with effects magnified by the generally poor natural productivity, the small size of the island and the small insular bear population. The diminishing salmon runs may already be having a negative effect on the ratio of white versus black Kermodes since white bears feed more on salmon. Climate change is expected to exacerbate this drop in productivity. Effects of bear-viewing tourism and research have had little or no effect. Although being examined in an adjunct chapter to this report that is still being completed, the proposed Enbridge oil tanker traffic in the adjacent marine channels and the risk of a spill is considered a new and very serious threat to this genetically unique and vulnerable Kermode population.

In terms of forestry practices, our review shows that old-growth deer winter range and prime Kermode denning habitats have been little affected by clearcut logging, but that a combination of clearcut logging and ocean mismanagement of small salmon runs has had the largest cumulative effect resulting in a net loss of overall productivity of food resources for Kermode bears on Gribbell. Our GIS map overlays of past clearcutting show that about 7% (927 hectares) of the old forest habitats of Gribbell have been logged, with some additional (unmapped) heli-logging in 2004. Some of the larger logged areas involved roading and clearcutting of the more productive valley bottom riparian forests, including the only two salmon watersheds. While those bears that venture into cutblocks may have benefitted from increased berry and forb production in the early seral stages for about 25 years after logging, the overall long-term result of conversion of old forests to tree plantations is negative for bears due to second-growth forests filling in and shading out bear foods so that a virtual desert occurs for bears on sites where once stood productive old-growth forests. Food declines are already happening on the large cutover lands in Riorden Creek and Gribbell Island Creek. Field surveys also showed extensive blowdowns in riparian areas; logging-caused debris torrents have also impacted bear habitats, including salmon runs.

2002 logging of unnamed watershed on s.e. Gribbell. Note the extensive blowdowns around the wetlands caused by the clearcut, making some of this habitat unusable to bears. [2003 photo, W. McCrory, VWS]

Overall, salmon runs on Gribbell Island have suffered significant declines from the 1950s as a result of the two main fish-bearing streams being heavily clearcut and their small salmon populations being subject to oceanic over-harvest and by-catch mortality by commercial fisheries of small pink, chum, and coho salmon runs; such drastic declines have been typical of many small salmon runs on the BC central and north coasts. Department of Fisheries and Ocean (DFO) escapement data from 1983-1992 showed an annual average escapement of only 2,360 fish for both streams on Gribbell, mainly pinks and chums. These are often the most preferred salmon by bears, wolves, and other predators since they spawn in small streams where they are easier to catch. More recent anecdotal evidence indicates fish runs are continuing to decline on Gribbell to the point where there are only a few salmon in some years, despite claims by DFO that it has enacted stronger conservation measures.

Poor salmon returns combined with declines in berry and forb productivity as large older clearcuts grow back indicate carrying capacity is well below historic levels and may already be having a cumulative impact on the survival of Kermode bears on Gribbell Island, particularly since coastal bears are reliant on the salmon resource for stored winter fats for winter survival in hibernation. There is also some anecdotal evidence that bears may be foraging more on marine invertebrates during years of combined low salmon returns and low berry productivity. Several bears have been observed in poor condition.

In the future, changes to vegetation patterns and sea level from climate change are also expected to lower food resources for bears, including salmon.

We found that the Gitga'at bear viewing and tourism program in Riorden Creek is likely not having any cumulative effect on the bears on Gribbell Island since viewing is confined to two fixed platforms, with viewing done for only several months in the fall. The rest of Riorden Creek is off limits to bear viewing and human visitation. Visitors are tightly controlled by trained guides when at the sites. The other salmon stream is generally off limits to human visitation and tourism use, and should remain that way. A small amount of vessel-based bear viewing is also done with guidelines to minimise disturbances.

The several small observation-type Kermode research projects were not considered to have any impacts other than minor and transitory.

Conclusions and recommendations

Our review underscores the vulnerability and threats to small island populations of large mammals and a rare evolutionary genotype of bear as found on Gribbell Island from man-made changes that may be masked by wrong assumptions, lack of adequate baseline research, and wrong management prescriptions that ignore cumulative effects.

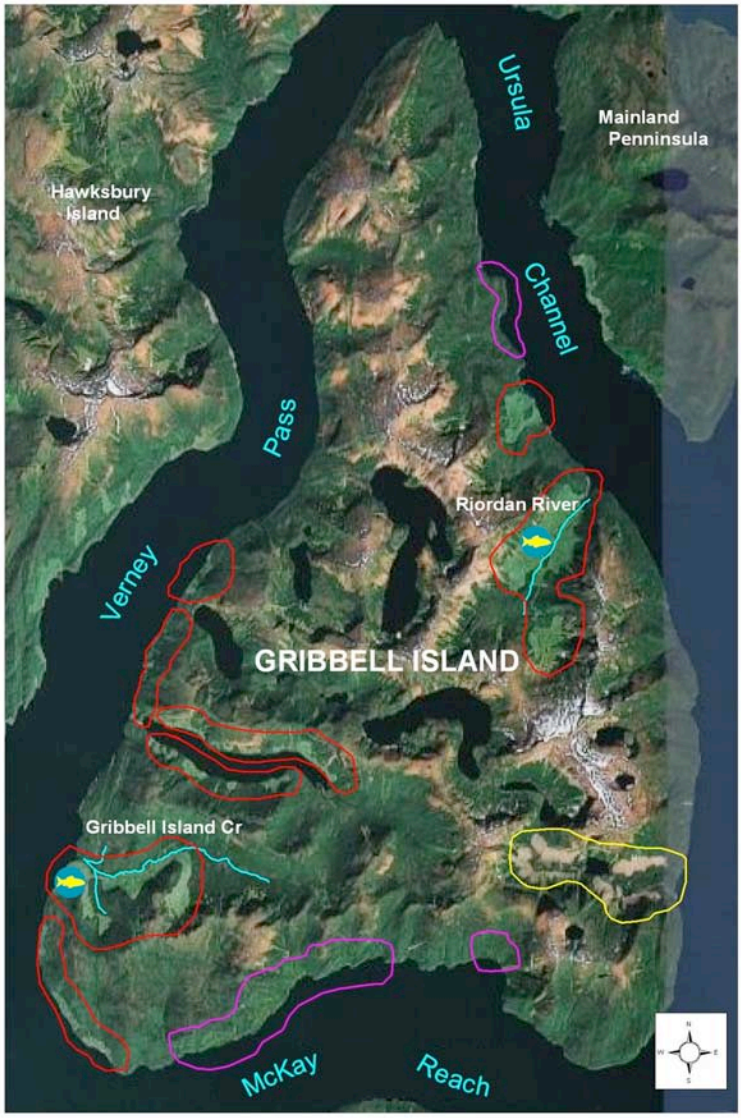
The limited and declining salmon resource on Gribbell Island underscores the need to preserve as much of the surviving native forests and productive vegetation habitat as possible so bears still have viable alternative berry foods in years of continued poor salmon numbers, or while salmon stocks, hopefully, are recovering. We agree with Darimont et al. (2010) that limitations must be imposed on exploitation of small salmon runs in areas and during periods through which salmon bound for important terrestrial areas can migrate. Gribbell Island is one such area.

While further studies are needed to understand the evolution of the Kermode bear and its genetic structure and population needs before we cross critical thresholds of extinction and cause changes that are irreversible, it is urgent that we preserve what we have based on what we already know, since it is not ours to destroy or alter.

To these ends, we are recommending to the Gitga'at First Nation government and the provincial government that no further industrial exploitation be allowed on Gribbell Island and that it be recognized as an part of an Evolutionary Significant Unit and be fully protected as a provincial conservancy, perhaps with a respected Gitga'at name as a Tribal Park.

This report will also be used as the basis for the Valhalla Society's yet to be completed review of the environmental study done for the Northern Gateway Pipeline, with specific reference to the potential effects of a major oil spill on Gribbell Island and its rare and unique white bear. Never, in our opinion, has the Kermode bear and its evolution been so threatened, but as we say, this latest study requires more investigation and careful documentation.

It is our hope that protecting Gribbell Island will continue to bring international recognition to what is truly part of Canada's Galapagos and, in turn, help turn the tide against the federal government's endorsement of Enbridge and the oil tankers.



Map 1. Satellite image showing extent of clearcutting on Gribbell, including extensive logging of the only two salmon spawning streams. Such small islands with small isolated populations like the Kermode bears are much more vulnerable to man-made disturbances than larger islands or mainland habitats. Enbridge-related bitumen oil tankers will pass down Verney Pass, making the imminent threat of a major oil spill an extreme danger to Gribbell's world-unique bear population.

1.0 **INTRODUCTION**

In 1987, the Valhalla Wilderness Society embarked on a project to establish a large preserve on BC's central coast for the Kermode bear subspecies of black bear, also called the "spirit bear," after reconnaissance-level field surveys showed large intact salmon-bear habitats on Princess Royal Island and adjacent mainland valleys. After much study and consultation with First Nations, the preserve proposal evolved into what became known as the 262,000 ha (647,140 acre) Spirit Bear Conservancy Proposal.

This proposal, plus extensive NGO-sponsored inventory and research, as well as that by government and industry, sparked a widespread Canadian and international debate on the need to protect large areas of what was referred to as the "Great Bear Rainforest." Eventually, Land Use Plans (LUPs) by the province and First Nations resulted in various protection proposals being put forward along with proposed improvements to coastal logging called Ecological Based Management or EBM. In February 2006, 19 years after Valhalla Society biologists drew the boundaries for the first Kermode reserve proposal on a map, the province and Coastal First Nations announced a major land-use agreement that added to the province's existing parks system some 108 new protection areas (conservancies) of temperate rainforest in the central and north coast planning areas. Included was protection of 212,415 ha (516,168 acres) of core island and mainland habitats in 11 large and small conservancies within Valhalla's Spirit Bear Conservancy Proposal. Such protection would never have happened without the strong support of the Kitasoo Xai'xais and Gitga'at First Nations, who incorporated protection of the spirit bear as a priority in their respective land-use plans (LUPs). Hereditary chiefs, such as Archie Robinson of Klemtu and the late John Clifton of Hartley Bay, were strong supporters along with their respective communities to protect the white bear. In the end, over 80% of the Valhalla Wilderness Society's original 262,000 ha spirit bear proposal received conservancy protection. However, several key ecological and/or genetically significant areas were not protected, including Gribbell Island and the Green Inlet–Valley on the mainland. Both areas are considered so significant that Valhalla and other organizations are hoping to eventually add them to the protected matrix of the spirit bear.

Green Inlet–Valley is an outstanding salmon-bear area featured in a major Discovery Channel documentary, with probably the largest intact forest of giant Sitka spruce left on the outer mainland coast. Its protection values are addressed in a separate document (McCrory 1998).

Gribbell Island is a small mountainous island of some 20,690 hectares (50,932 acres) lying off the northern tip of Princess Royal Island. The nearest community is Hartley Bay, some 10 km away. This village is home and headquarters to the Gitga'at First Nation government, who have resided in the region for thousands of years. The late John Clifton was the last hereditary chief on the BC coast to have the right to wear a white bear robe for ceremonial purposes (Clifton interview notes, *In File*. July 26. 1998). For the Gitga'at, Gribbell Island has always been regarded as the island of the white bear (Marven Robinson, pers. comm.).

Despite a strong case for protection, especially a 2001 University of British Columbia genetics study that showed that Gribbell had the highest incidence of white-phase Kermodes of anywhere studied on the BC coast (Ritland et al. 2001), Gribbell Island was not part of the protected network of new conservancies established in the 2006 land use agreement. Instead, it was designated a "Kermode Stewardship Area" where logging and other industrial development would be allowed, but with special guidelines.

Some years prior to the historic 2006 land use decision for the north and central BC coasts, Valhalla Society biologists began working with the Gitga'at First Nation on further assessments of bear habitat values in logged and intact areas on Gribbell. We surveyed many of the previously logged areas documenting bear habitat values, debris torrents and landslides, blowdowns, and other features. After 2006, this work morphed into a GIS bear habitat mapping analysis. We also continued to gather more information on the biological values of Gribbell Island, including Gitga'at white bear viewing areas and habitat use information from Gitga'at ecotour operator Marven Robinson, other tour operators, and scientists. As well, we reviewed the genetics and evolutionary importance of Gribbell to the Kermode bear through further evaluation of more recent studies on the white bear and through discussions with Dr. T. Reimchen of the University of Victoria, Dr. Bristol Foster (evolutionary biologist and former head of the BC Ecological Reserves program), Dr. Kermit Ritland (white bear genetics expert, University of British Columbia) and noted carnivore biologist Dr. Paul Paquet.

In this report, we have combined this information and perspectives into what we feel is a revised and compellingly stronger case for the protection of Gribbell Island. We believe Gribbell needs to be protected from logging so as to protect its ecological integrity, particularly given the uncertainty of how habitat alterations from roading and clearcutting could affect this globally unique gene pool of the white bear. However, while completing this research, an even larger threat loomed on the horizon; the proposed Enbridge Pipeline that would carry bitumen from the Alberta Tar Sands to the BC coast at Kitimat, where some 2000 tankers per year would carry the oil to markets in Asia. The tanker route goes right by Gribbell Island and carries with it the ominous threat of another Exxon Valdez type oil spill with attendant short- and long-term effects on terrestrial and marine ecosystems, including the habitats of the Kermode bear. Our environmental review on the potential effects of the Enbridge tankers on the Kermode bears of Gribbell Island will be completed at a later day.

2.0 METHODS & APPROACH

2.1 Estimates of numbers of bears, wolves, grizzly bears, Sitka deer, and salmon on Gribbell Island

For mammal species, we used population estimates based on densities of animals from other studies. This information was generated previously for the Spirit Bear Conservancy Proposal (McCrory et al. 2003a).

For Kermode bears, we used a different density estimate for the island systems than the mainland. For islands, rather than use BC Wildlife Branch crude estimates of coastal black bear populations, we used density data from intensive black bear studies in two rainforest areas in southeast Alaska that were ecologically similar to the BC central coast. For the low end of our estimate, we used the estimate of 50 black bears/1000 km^2 for Prince William Sound (Modafferi 1982), and for the high end of our estimate, 73 bears/1000 km^2 for Mitkof Island (Hanson 1988).

For salmon numbers and population trends, some information was obtained from a review of Department of Fisheries and Oceans (DFO) escapement data done for the Spirit Bear Conservancy Proposal by Bergdahl (1995a, 1995b). Comparative research was also obtained from Dr. T. Reimchen (pers. comm.). More recent anecdotal observations of very low annual salmon numbers in Riorden Creek were obtained from Marven Robinson (pers. comm.) and others.

2.2 Estimates of number of white versus black bears

We then used the Ritland et al. (2001) frequency estimates for black and white alleles on Gribbell and applied this to the total population estimate to determine approximate numbers of black and white individuals that might be found on the island. Dr. Ritland kindly reviewed these estimates for us.

2.3 Habitat map models

Geographic Information System (GIS) habitat models for bears were generated for the island by GIS analyst Baden Cross of Applied Conservation GIS. Models were done for potential Kermode bear winter den habitats and for higher value vegetated habitat feeding areas. A Sitka deer winter habitat model was also developed. The map models followed the methods generated for the Spirit Bear Conservancy Proposal as described in McCrory et al. (2003). The vegetative feeding habitat model was based on considerable ground-truthing, mostly on Princess Royal Island, but the bear den habitat model still requires considerable ground-truthing. The Sitka deer habitat model also requires ground-truthing.

A survey of estuarine habitats was made by circumnavigating the island. Ground surveys were done of any vegetated intertidal habitats, including an assessment of bear plant foods.

Salmon streams were mapped based on DFO information and local knowledge.

2.4 Ground surveys of bear habitats, including logged areas

In 2003 and 2004, VWS biologist Wayne McCrory and Gitga'at wildlife specialist Marven Robinson carried out field surveys of logged and unlogged areas on select areas of Gribbell Island. Dan Cardinal, a resource consultant for the Gitga'at, also participated in one field survey. Further field surveys were done over the next 3-4 years, including a shoreline assessment of small estuarine habitats, as well as surveys of two salmon streams (Riorden and Kwa) and one potential salmon stream. All of these habitat surveys were done using the transect method as described in McCrory et al. (2001).

2.5 GIS map overlays of habitat models with logged areas

Previously clearcut areas were crudely defined from air photos and other information. We did not include heli-blocks done on the east side of Gribbell in 2004. A GIS sublayer was developed for clearcut areas. The clearcut template was overlain onto the bear vegetation feeding habitat map model and the bear denning habitat map model to determine approximately what proportion of these old forest habitats had been altered by industrial activity.

Since field surveys indicated that riparian forests in the different watershed systems had some of the better green vegetation feeding habitat, we developed a separate overlay to see how much logging had altered these areas.

The map overlays were used to assess the impacts of logging on Gribbell Island biota, particularly bears, as well as a previous extensive literature search (McCrory et al. 2003) and professional opinion.

2.6 Review of Kermode bear genetics and evolutionary theory for the white bears of Gribbell Island

We obtained several additional bear studies done on Gribbell by Dr. Tom Reimchen and research students, and also obtained the expert input of Dr. Reimchen on whether or not Gribbell warranted protection. We also worked with genetics expert Dr. Kermit Ritland of the University of British Columbia to interpret, for this briefing document, how important Gribbell Island is in terms of white bear evolution. This included a recent paper published in *Evolution* (Hedric and Ritland 2012). All of our interpretation was reviewed and approved by Dr. Ritland. Dr. Bristol Foster was also consulted for his views on island biogeography and evolution of subspecies.

3.0 RESULTS & DISCUSSION

3.1 Population estimates for bears and some other Gribbell mammals

As with many other central coast islands, a full inventory of mammalian and other species has not been done. Our limited results indicate that not only does Gribbell have a genetically unique subpopulation of Kermode bears, but also represents an incredibly rich diversity of different island fauna, which have a disjunct distribution between islands and between the adjacent mainland. As noted by Foster (1965), "islands always have a fractional sample of the

organisms that live on the nearby mainland, but the reasons for the faunal hiati are often obscure or involved." In a study of island biogeography theory of 178 islands along the coast of British Columbia, Craig (1990) points out the difficulty in establishing nature reserves for islands. Craig concluded that the varied distribution of mammals on the islands of BC "is most likely a result of a combination of dispersal ability, life history traits and competitive effects, as well as environmental effects. Therefore, until more is known about the population dynamics and competition of mammals in isolated situations, I suggest that it is best to err on the side of caution and keep reserve sizes as large as possible."

3.1.1 **Kermode bears**

Our crude population estimates (McCrory et al. 2003) confirm that the Kermode bear subpopulation on Gribbell is relatively small, between 100-140 individuals. Exchange of numbers between the adjacent mainland and the northern tip of Princess Royal Island is unknown, but the genetics study by Ritland et al. (2001) indicates this subpopulation is relatively isolated. The stark contrast between the high frequency of white bear gene "A893G" and high occurrence of white bears on Gribbell Island compared to the very low frequency of the white bear gene and near absence of white individuals on adjacent Hawkesbury Island, with a mere 3-4 kilometre wide Verney Passage marine channel separating the two islands, is strong evidence for small, isolated island bear populations.

3.1.2 **Grizzly bears**

In general, the forested islands off the coast of British Columbia and Southeast Alaska are almost the exclusive domain of black bears. North of Frederick Sound in coastal Alaska, this reverses and the islands become the exclusive domain of grizzly bears for reasons that are not fully understood. Our background review indicates that a few grizzly bears occur on the near-shore islands on the BC central coast, such as Princess Royal (McCrory et al. 2003), but we found no records for Gribbell. We tested the hypothesis that because of extensive lowlands, the lack of grizzly bear denning habitat restricts their numbers on these islands. Grizzlies prefer to den in much higher country than black bears. We applied our grizzly bear den habitat model for Princess Royal Island and found that ample potential den habitat occurred on the northern area, where the high elevation Kitimat Ranges upswell on the landscape. The high Kitimat Ranges also upswell on Gribbell. We concluded that denning habitat was not restricting the occurrence of grizzly bears on central coast near-shore islands.

We also found no records for grizzlies on the outer-coast islands further from the mainland (e.g., Aristazabal to the west of Princess Royal Island). In the Queen Charlotte Islands, much further to the west and offshore (separated from Aristazabal and Princess Royal by the 70-kilometre wide Hecate Strait), the differences become even greater with a unique black bear subspecies (*Ursus americanus carlottae*), and no known records of grizzly bears (Foster 1965); although the Haidas have grizzly bears in some of their cultural icons, which is believed to have come from their journeys to the mainland.

On the mainland peninsula adjacent to Gribbell and other near-shore Kermode islands, we have crudely estimated the population of black bears versus grizzly bears to be approximately 50:50 in terms of relative numbers (McCrory et al. 2003).

3.1.3 **Gray wolf**

Although wolves and their sign have been observed on Gribbell, they likely occur in very low numbers. We estimate the island would support about 1/8 of the estimated home range size of one pack of wolves (McCrory et al. 2003), which means they would likely swim back and forth to adjacent land masses to meet their annual requirements, particularly as the salmon and deer biomass is very low on Gribbell.

Our understanding of BC coastal biogeography and evolution has been recently enhanced by a new study that demonstrates that BC coastal wolves are genetically distinct from wolves in the BC Interior, having their own unique haplotype (Muñoz-Fuentes et al. 2009). Besides this, the authors concluded that coastal wolves have a unique prey base heavily influenced by marine resources such as salmon, exhibit distinct behaviours such as swimming in the open ocean between landmasses, and are distinct in their darker colour, smaller size, and cranial and dental morphology. They suggest that these behavioural and morphological characteristics indicate that the ecology of these animals is not equivalent to other neighbouring wolves, and therefore, they are ecologically non-exchangeable. All of this demonstrates that the coastal wolf population is largely isolated and uniquely adapted to the coastal temperate rainforest. The authors suggest that these factors support the classification of coastal wolves as an Evolutionary Significant Unit (ESU), as proposed by Moritz (1994) and consequently warrants conservation status. The ESU designation would recognize and protect the functioning of evolution.

3.1.4 **Wolverine and pine marten**

I observed one pine marten on a salmon stream on Gribbell and several wolverine have been photographed hunting for salmon carcasses (Marven Robinson pers. comm.). No morphological or genetic studies have been done to determine if these species have become isolated and developed distinctive island differences like the Kermode bear.

3.1.5 **Sitka black-tailed deer**

We estimated there is habitat to support 389-622 Sitka deer on Gribbell Island. Besides salmon, Sitka deer are an important survival food for the coastal wolf, so we considered the winter range of deer also important wolf habitat. Deer also provide a supplemental food for Kermode bears. Predation by bears on fawns may be significant.

3.2 Genetics studies of the Kermode bear on Gribbell Island

3.2.1 **Gribbell Island – evolutionary mother island of the white bear**

> *North America is the land of bears. No other country approaches it. In fact, all bears known from all other parts of the world together fall far short of the numbers in this continent. And here the greatest bear center, both as to species and individuals, is an area in the Northwest embracing Alaska, Yukon and British Columbia. Hence, so far as to living species are concerned, the development of the bear tribe is without parallel.*
> C. H. Merriam. 1932. The Bears of the World. Pp. 135-145: *In* P.N. Gray (ed.), Big Game. New York Zool. Soc., New York, NY. Reprinted in 1990 by Derrydale Press, Lyon, Mississippi.

And nowhere else is the diversity of black bears as varied as it is on the BC coast.

Once considered its own species, the spirit bear is now recognized as a subspecies -- *Ursus americanus kermodei* -- of the North American black bear; although some taxonomists question the validity of naming a subspecies based on coat colour variation. It is also called the Kermode bear. To the coastal Tsimshian, it is known as "Mosgm'ol" and to the local Gitga'at people of Hartley Bay, in whose traditional territory lies Gribbell Island, the white bear is called "Mis-aula."

The loosely defined range of this subspecies occurs over much of central and part of north coastal BC and as far inland along the Skeena River as Hazelton, BC. A tiny number of white-phase black bears have also been recorded elsewhere in North America. DNA testing of a white-phase black bear from Minnesota showed it did not have the same variant for the white coat as the Kermode bear (Ritland et al. 2001).

Whether the Kermode or spirit bear is a subspecies or not, anecdotal information and specimen collections show this form of the black bear to be unique for the relatively high incidence of white-phase individuals in some parts of its range. Based on observational data, two genetic ecocentres have been crudely identified where white individuals appear to be more common, one in the Terrace-Hazelton area and the other on the coast centred on Gribbell and Princess Royal islands. Just to the south, Pooley and Roderick islands are the last in a chain of four recognized near-shore "Kermode islands." However, some white bears have also been documented on Swindle Island. A few white-phase Kermodes also likely occur on some of the other islands in the archipelago, such as Sarah, Price, and Aristazabal, but biodiversity surveys have not been carried out. The genetic study by Ritland et al. (2001) also found a very low occurrence of the white bear allele southward on the Don Peninsula and Yeo Island. Hawkesbury Island, just to the west of Gribbell, was also shown to have a very low incidence of the white bear allele (Ritland et al. 2001).

As part of a University of British Columbia genetics study, Kermode hair samples were collected from known Kermode habitats for a 3-year period (1997-1999) in August and September to coincide with salmon runs. The genetic studies were not carried out over the entire range of the Kermode bear but rather concentrated in areas of the central coast

around Princess Royal Island and adjacent areas, including Gribbell Island. Some hairs were collected randomly, but most were obtained from setting up small hair snares that involved a strand of barbed wire across a trail or around salmon bait. Hair samples were analysed at the genetics lab of Dr. Kermit Ritland at the University of British Columbia, School of Forestry. Using microsatellite profiles, the genetics team identified 220 separate bear hair samples, of which 22 were white-phase (Ritland et al. 2001).

The genetic study confirmed what the Gitga'at First Nations have known for centuries, that Gribbell Island is unique because of the high incidence of white-phase Kermodes. The DNA analysis concluded that Gribbell Island was not only *the island richest in white bears* but *exhibited substantial genetic isolation*. The authors concluded that *Kermodism was established and is maintained in populations by a combination of genetic isolation and somewhat reduced population sizes in insular habitat* (Ritland et al. 2001). Kermit Ritland, the UBC scientist who discovered the single recessive gene "A893G" that creates the white coat variant, also considers that the Kermode bear has "untold value" as to its uniqueness because the spirit bear genetic variant has not been found in any other mammal (Ritland 2011). In a more recent analysis, Hedrick and Ritland (2011) suggest that the Spirit Bear could be an example of incipient speciation and a *model for evolutionary biology* where the white genetic mutation likely originated on Princess Royal or Gribbell Island. Another authority, Dr. Bristol Foster, who studied the evolution of mammals on Haida Gwaii (or the Queen Charlotte Islands), also firmly believes that Gribbell Island may have been where white bears evolved within the central coast black bear gene pool. Dr. Foster considers the BC central coast archipelago "Canada's Galapagos." Today, some scientists strongly consider Gribbell the "mother island of the white bear."

Interestingly, no white individuals have been reported within the isolated black bear population on the Queen Charlotte Islands, some 70 km west of Gribbell. The black bears on Haida Gwaii are considered a totally different subspecies, having a larger body size and larger molars for eating marine invertebrates.

3.2.2 **Gribbell Island compared to other "Kermode Islands" and adjacent mainland**

Following is our analysis of an approximate number of white versus black Kermodes on the four known central coast spirit bear islands and adjacent mainland, as well as Hawkesbury Island. These number estimates have been reviewed and approved by Dr. Ritland at UBC, who heads the genetics research lab that looked at Kermode bears. Until much more detailed population and white versus black Kermode sampling is done, this is the best information we have to go on.

Of the total number of bears sampled, the DNA results indicate an estimate only of the following percentage of bears in each area that would be white: Hawkesbury 0%, Gribbell Island 43%, Princess Royal Island 17%, Roderick-Pooley Islands 10%, and adjacent mainland of this core area 3%. The starkest contrast in occurrence of the white bear allele to Gribbell is Hawkesbury Island, separated from Gribbell on the west by only a narrow marine channel 5 km wide. Of the 25 hair samples from Hawkesbury analysed by Ritland et al. (2001), only one that belonged to a black bear had the allele for the white coat. Hawkesbury is nearly twice the size of Gribbell with an estimated 180 – 270 Kermodes, nearly all of which would be black if the 25 hair samples analysed from there are reflective of the overall

island subpopulation. Only 4% of the bears on Hawkesbury would carry the white bear allele, similar to the 3% of the Kermodes on the mainland opposite the four core Kermode Islands. Long time resident Marven Robinson (pers. comm.) has never observed a white bear on Hawkesbury, but knows of one sighting by a pilot from King Pacific Lodge, who observed a white bear in the high country. There are more salmon streams on Hawkesbury (seven) than on Gribbell. One late fall, Marven counted a dozen black bears up one of the salmon creeks on Hawkesbury.

For Gribbell Island, which has an estimated 100-150 Kermodes, an estimated 45-65 would be white. In the total core genetics area (excluding Hawkesbury), we estimate and average of 220-310 (17%) white bears out of a total population of 1,290-1,820 Kermodes.

Table A. Occurrence/Frequency of white-phase and black-phase Kermodes carrying the recessive white allele for the spirit bear core genetics area comprised of Gribbell-Princess Royal & Roderick-Pooley islands and the adjacent mainland. Also included is Hawksebury Island. These results must be considered crude estimates because of low sample sizes in some instances, lack of sampling spread evenly across the landscape, and lack of statistical comparison. Some differences may not be that valid as they are based on small sample sizes. However, the data is the best available to date and until more detailed research is done, provides at least a very useful guide to geographic differences in the recessive white allele of the Kermode bear (Frequency data derived from Table 1 in Ritland et al. 2001).

We then combined the frequency data with our different total population estimates for different sub areas to estimate the approximate number of white individuals that might be found in the spirit bear region. Numbers over 10 are rounded off to the nearest 5.

Area, subpopulation	Total white (GG)* out of total number sampled	% of total that are white phase	Total black with recessive white alleles (AG)** out of total sample of black	% of total black phase carrying the white allele (AG)	% of total carrying white allele (AG and GG)
Gribbell Island	10/23	43%	6/13	46%	70%
Princess Royal Island	9/52	17%	17/43	39%	50%
Roderick-Pooley Islands	2/20	10%	3/20	15%	25%
Mainland area opposite these islands	1/37	3%	1/37	3%	5%
Hawkesbury Island	0/25	0%	1/25	4%	4%

[*G is the allele or single-nucleotide A893G bearing the white coat colour. **A is the allele that does not carry the white coat colour. It takes two GGs to make a white bear.]

Area	Est. Kermode numbers, black & white	Est. # white bears	Est. # black bears with white allele	Est. # black bears with no white allele
1. CORE WHITE BEAR AREA				
Gribbell Island (20,680 ha)	100 - 150 bears	45 - 65	To be done	
Princess Royal	890 - 1,245 bears	150 - 210		
Roderick	110 - 160 bears	10 - 15		
Pooley	80 - 120 bears	8 - 12		
Mainland adjacent to these islands	110 - 145 bears	3 - 4		
TOTAL IN CORE GENETICS AREA	1,290 - 1,820 bears	220 - 310		
2. NORTH OF CORE AREA				
Hawkesbury Island (36,670 ha)	180 - 270	0	7 - 11	175 - 255
Adjacent Mainland to West	N/A			

Since areas of known white bear occurrences were often spot-sampled in the hair-snagging program, one of the field researchers feels that the proportion of white phase bears to black phase bears may be skewed (Davis 1998). Because of this possible sample bias, Davis recommended that the proportion of white to black hair samples not be construed as a true representation of the population. She recommended a systematic DNA grid-based sampling method would be necessary if an accurate ratio of white to black bears was required. The researcher also questioned whether Gribbell Island actually has the highest incidence of white-phase Kermodes on the central coast (Helen Davis pers. comm.).

All of this said, it may be a long time before we can obtain a more definitive answer since the intensive type of population study Davis recommends is very expensive; even the population estimates derived from grid-sampling method of hair collection for DNA analysis has some questionable statistical accuracy (Dr. M. Gibeau, pers. comm.).

Strong anecdotal evidence supports the genetic results for Gribbell as having a high ratio of white versus black individuals. For example, as noted previously, it is no accident that early collectors and hide hunters focused their interests in white bear specimens on Gribbell Island. For example, a total of 10 white bears were killed on Gribbell for specimens sold to various museums and others over one ten-year period (1904-1913). In addition, a considerable body of First Nations traditional ecological knowledge strongly indicates a high ratio of white versus black Kermodes on Gribbell. This includes not only historic but more recent observations made by the Gitga'at bear-viewing guides, who annually focus the band's

bear viewing tourism on the island (Marven Robinson pers. comm.). In September 2008 or 2009, Marven and his colleagues counted 17 white bears in one survey that included the two salmon creeks as well as the marine foreshore between Riorden Creek and Cummins Point. Of these, 9-10 different white bears were using the intertidal.

During some of my last 20 years of habitat and conservation work on the spirit bear, including working on documentaries with film crews, locating white bears on Princess Royal Island in the fall was often difficult. Sometimes a trip to the Gitga'at bear viewing platforms on Gribbell was the only guarantee of seeing and photographing white bears. Many of the current tour operators who have permits to conduct boat-based bear viewing on the central coast book a day or two with Gitga'at Tourism on Gribbell in order to guarantee their clients the sighting of a white bear or two. This all speaks to the high number of white bears on Gribbell compared to other known Kermode areas.

3.3 Historic and recent Kermode bear mortality due to early fur trapping, museum specimen collecting, First Nations sustenance hunting, and trophy hunting

During the 1800s, first the Russian-American Fur Company and then the Hudson's Bay Company (HBC) carried out extensive fur trading operations on the Pacific Coast. Eventually, the sea otter and elephant seal were extirpated from most of the area (Cowan & Guiget 1985). During this first century or more of fairly intensive commercial marine fur exploitation on the BC coast, there was also uncontrolled commercial trapping and hunting of terrestrial mammals, including both bear species (black bears and grizzlies). As an example of the degree of fur take of black bears on the BC coast by the HBC, Cowan (1938) noted that the trading post at Fort Simpson on the north coast recorded 13,320 black bears and 960 brown bears between 1824 and 1852. This was based on a notebook kept by HBC chief factor James Douglas that Cowan had researched in the BC Provincial Archives. A review of HBC fur records still needs to be done to see how many white bears were taken over this extensive period of early fur exploitation. This aspect was not fully reviewed by Cowan. Seton (1929) notes that according to the official reports of the fur production of Canada, in the season 1921-22, 11 white bears were contributed by British Columbia, one in the following year, and none in the next. He believed that all of these were *kermodei*, but that none were taken after this because the government had declared an absolutely "close period."

More recent records indicate that after the turn of the 20th century, the reputation of the prevalence of white bears on Gribbell Island led to the island being targeted by fur hunters/trappers and museum collectors (see Corley-Smith 1989). The type specimen used to define the new scientific description of what became known as the Kermode bear "species" was an all-white bear killed on Gribbell Island in 1904 (Hornaday 1905). Collecting of white-phase Kermode bears for museum specimens began in the early 1900s (Corley-Smith 1989), and even as late as the 1960s when the Edmonton Zoological Society attempted to catch live white Kermodes on Princess Royal Island without success (David Hancock, pers. comm.). Their culvert traps were left behind to rust in the undergrowth as a reminder of these questionable efforts. In 1960, the Kansas City Museum, after three collecting trips to the northwestern coast of BC, killed a white bear for their museum exhibit while at the same time noting that white bears were now protected from hunters with "a stiff

penalty of $1,000 assessed against any person found molesting them" (Yokum 1961). They shot the bear on a salmon stream but did not divulge the location.

Dr. William Hornaday of the New York Zoological Society learned of the white bears on the BC coast from a fur trader who acquired a pelt. He contacted a fur dealer in Port Essington and found that white bear skins were traded by native people every year, with most coming from the Douglas Channel area, including Gribbell Island (Hornaday 1905). Blood (1997) documented locations of white bears killed for specimens from historic records and anecdotal sightings. In Appendix I, he shows that, for Gribbell Island, a total of 11 white bears were killed for specimens sold to various museums and others over the 15-year period, 1898/99-1913. He notes that Hornaday reported that the man who shot the type specimen on Gribbell Island in 1904 knew of 18 other white bears taken from the same region along Douglas Channel.

Beyond this early fur trapping and museum-collecting era, we have no idea what the hunting mortality of white phase Kermodes would have been until hunting of white individuals was banned in the 1950s (Cowan and Guiget 1985). No records of the numbers of white bears killed for trophies appear to have been kept, including the high likelihood of concentrated kill rates in certain areas, such as Gribbell. Hunters often go to the areas where past known success has occurred and target those that bring the highest trophy value, like a white bear. However, we have somewhere in our Valhalla Society research files the bizarre magazine account of a US trophy hunter who shot a white Kermode on the coast and then had it dyed black.

For the Spirit Bear Conservancy Proposal, McCrory et al. (1993) documented that between 1981 and 1993, a total of 34 black-phase Kermode bears were legally killed by non-resident guided hunters (BC Wildlife Branch hunter statistics, Smithers, BC). In some years, kills were concentrated. For example, of the 10 bears killed in 1986, eight were shot in the Aaltanhash Inlet and watershed on the mainland across from Princess Royal Island. Of the three killed in 1992, all were from the Khutze Inlet on the mainland. No records were kept of resident hunter kills. Although some of this reflects the guide-outfitter territory on the mainland, the data nonetheless indicates the degree to which black bear hunter kills can be concentrated in some years.

The Raincoast Conservation Society, under an agreement with the province to curtail any non-resident bear hunting here, is currently purchasing this guide-outfitter territory. However, black-phase Kermodes will still be open to hunting by BC residents, except for two new closed areas: Gribbell Island and the new Kitasoo Spirit Bear Conservancy on south Princess Royal Island (see the BC Hunting and Trapping Regulations Synopsis 2011-2012). This came about as a result of strong pressure to end all bear trophy hunting on the BC central coast by the Kitasoo Xai'xais and Gitga'at First Nations and conservation groups.

We have no idea of the numbers of black-phase Kermode bears previously killed by local First Nations for food. We know this was done in Klemtu up until several years ago. Gitga'at people from Hartley Bay also shot the occasional black Kermode for food, but generally stopped doing this several years ago when they became more aware of the significance of the gene pool that has some black individuals carrying the recessive gene for the white coat (Marven Robinson, pers. comm.).

Illegal kills of white-phase Kermodes remains a strong concern and an unknown factor. In 2002, we received information from an anonymous but reliable source indicating a high-end poaching ring existed in the Princess Royal Island area for white Kermodes. Today, poaching of grizzly and white-phase Kermode bears is still considered to be a potentially serious problem because, due to government cutbacks, there is a general lack of patrols by BC conservation officers of the thousands of kilometres of marine shoreline, bays and inlets that provide easy boat and aircraft access by illegal hunters to remote areas. Valhalla Society sponsored a poaching report by the Craighead Institute and put in place a reward program for successful prosecution of poaching white spirit bears and grizzly bears on the BC coast. However, over a ten-year period, no poaching was brought to court. That is not to say that it wasn't happening, or that it still is.

Specimen collecting of white bears was allowed for white Kermodes until the 1960s. In 1960 the Kansas City Museum shot a white bear somewhere on the BC coast for its display. In the early 1960s Al Oeming Game Farm from Edmonton set up these culvert traps on Princess Royal Island to catch live white bears but was unsuccessful (David Hancock, pers. comm.). Indiscriminate specimen collecting in the early 1900s along with hunting likely reduced the white bear gene on Gribbell Island.

3.4 *Assessment of marine shoreline habitats for Kermode bears on Gribbell Island*

Terrestrial bear habitat values based on our GIS habitat models and some ground-truthing are discussed in the cumulative effects section.

The coastline of British Columbia has had little research in terms of utilization by terrestrial mammals including bears. Bear use of sedges, grasses and other vegetative foods in the upper and middle intertidal zones has been fairly well researched in coastal BC and Alaska (McCrory and Paquet 2009) but utilization of the whole host of marine invertebrate communities that live in the littoral zone with potentially rich foods for bears has barely been looked at. In itself, the intertidal zone represents a very complex mix of marine and terrestrial plant and animal associations and stratifications. Ricketts et al. (2005) considered the study of the complex arrangement of plants and animals (e.g., mussels, clams, crabs, barnacles, etc.) of the shore and shallow seas in horizontal belts as the oldest and most "durable" concern of marine biology.

The interesting aspect of the intertidal zone for bears is that the rich food resources of this specialized habitat are only temporally available twice a day with receding and/or low tides, depending on whether the food is in the upper, middle or lower littoral zone.

Marine salt marshes in the form of estuary meadows at creek and river mouths, and linear beach fringe meadows along foreshore areas provide excellent spring bear habitats for both bear species on the BC coast. In particular, Lyngby's sedge (*Carex lyngbyei*) is a much-preferred food for bears in spring due to its high protein value, which is similar to salmon (McCrory and Paquet 2009). In 2006, our field surveys along the entire Gribbell shoreline showed intertidal grass and sedge meadows to be very limited in space and abundance when compared to other spirit bear areas having extensive estuarine habitat, such as Laredo Inlet on south Princess Royal Island. The lack of productive intertidal meadows along the Gribbell marine zone is a serious constraint on the overall habitat productivity for bears on Gribbell Island, putting more pressure on terrestrial wetlands and other green food habitats for critical spring feeding after bears emerge from their dens.

While salt-tolerant green vegetation is generally lacking, field observations indicate a richly productive but spotty intertidal zone on Gribbell Island that is dominated in some bedrock and boulder locations by Pacific blue mussels (*Mytilus edulis*) and barnacles (*Semibalanus* spp.) of varying densities, depending on the strata of the littoral zone. Due to shoreline steepness, there are many areas that would be inaccessible to bears; however, no detailed assessment was done of usable and unusable shoreline.

Over the past 15 years, both black and white Kermode bears have been documented feeding extensively on Pacific blue mussels (*Mytilus edulis*) and barnacles (*Semibalanus spp.*) along some of the more accessible rocky shorelines of Gribbell Island. We suspect they are utilizing other nutritious marine life as well. Anecdotal observations by several tour operators and the Gitga'at suggest feeding on mussels and barnacles is combined with feeding on the berries of mountain ash, huckleberries, blueberries, and wild crabapples that grow along the upper fringe of the intertidal zone. They suggest these would be important to the diet of some of

the bear family groups and subadults on Gribbell that may be forced out of better inland habitats by more dominant bears or when salmon runs are low.

Empirical information and a small number of studies suggest that the rich availability of marine invertebrates is important to the annual diet of coastal bears in British Columbia. Howes (1999) analyzed black bear activities and intertidal food sources for the Pacific Northwest and concluded that intertidal habitats are an integral habitat component for coastal black bears. Common intertidal animal food items include barnacles (*Balanus* spp., *Chthamalus* spp.), clams (*Siliqua* spp.), mussels (*Mytilus* spp.), and crabs (*Hemigrapus nudus*); intertidal plant food sources were considered more limited, but included fucus (*Fucus gardneri*), grasses, and sedges. The researcher concluded that that bears commonly forage at low tides in mid and lower intertidal environments characterized by low to moderate wave exposures and cobble-boulder substrates. These conditions provide favourable habitat for larger invertebrates, which are found under larger cobbles and boulders that can be overturned by bears. In our opinion, this is somewhat misleading since mussels and barnacles fed on by black bears are often in dense communities on the surface where they can be eaten on the spot as has been observed by different observers on Gribbell Island. In Clayoquot Sound on Vancouver Island shoreline foods such as sedges and grasses, horsetail, crabs, and mussels were common in black bear scats (MacHutchon 1999, Oldershaw 1994). In Glacier Bay, Alaska, barnacles were found to be an important spring food item for black bears. Bears were quite often observed in the intertidal zone scraping barnacles off rocks with their paws and teeth (Lee 1985).

For grizzly bears, MacHutchon et al. (1993) and more recent observations (Elmeligi 2008) indicate that some grizzlies in the Khutzeymateen (north of Prince Rupert) feed opportunistically on marine invertebrates in the intertidal zone, including use of the mud flats off the main estuary and in several areas along the inlet, during periods of low tides. MacHutchon et al. (1993) observed grizzly bears feeding on barnacles, mussels, and clams. Elmeligi (2008) observed a small number of grizzlies foraging in Khutzeymateen Inlet in spring on pacific razor clams, giant Pacific cockles, Pacific blue mussels, and various species of barnacles. However, their main food in the spring from the marine zone is Lyngby's sedge.

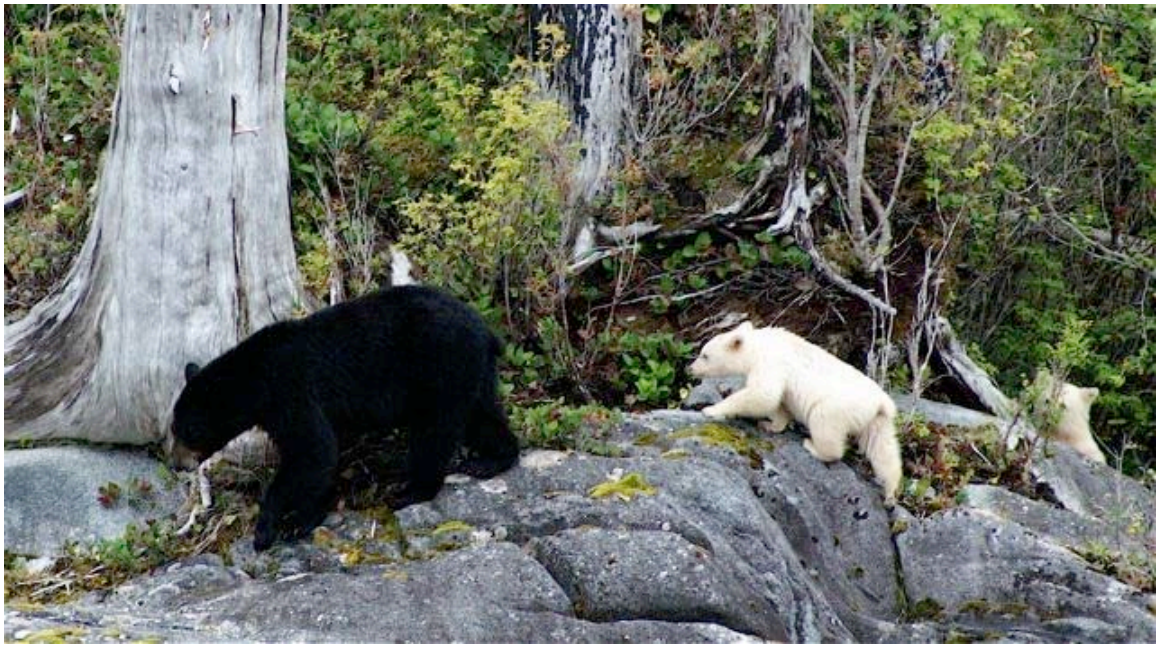
Some of the main Kermode bear intertidal feeding areas identified to date include Gribbell shoreline that fronts the oil tanker route of the proposed Enbridge project through Verney Passage and Wright Sound on the west and southwest of Gribbell. One reliable observer who has travelled this section of Gribbell shoreline every year since 1999, has observed 8 different white bears feeding on marine invertebrates and berries along the shoreline zone, and possibly a total of 15 different bears if black individuals are included. This includes three sets of white cubs, all of which appeared to have a different black mother. One black mother was observed with a white cub in 2004, and another set of black twins in 2010. Last fall (2011) was an extremely poor year for both salmon and berries, and at least one of the older white adult females was observed to spend much of her time foraging on marine invertebrates, more than she had in previous years. She also appeared thin (Anon. pers. comm.). Gitga'at bear-viewing guide Marven Robinson (pers. comm.) estimated that over the past 15 years he has observed at least 15-20 different black and white Kermodes foraging on the intertidal between Riorden Creek and Cummins Point. In 2008 or 2009, he and his colleagues counted 9-10 different white bears using the intertidal between Riorden Creek

and Cummins Point. He observed one white cub that was in poor shape. Six years ago, I observed one juvenile white Kermode bear along the same Gribbell shoreline that appeared to be foraging for salmon carcasses that had washed down from an adjacent spawning stream – another important type of intertidal foraging that can be important in some years. On Princess Royal Island during a low year of pink salmon runs, we observed two different white-phased adult bears forage for salmon carcasses along the intertidal for up to one kilometre from the main salmon river.

These observations strongly suggest that during years of combined low salmon and berry availability, Kermode bears are more dependent on rich intertidal foods to build up necessary stored fats for their long winter hibernation. This is similar to increases in grizzly bear fall use of root foods during years when berry crops or combined berry/salmon availability is low.

The other value of the marine zone where the shoreline is not too precipitous is as a travel route for bears and other wildlife (when the tides are lower), something we have observed repeatedly in both species in many areas of the coast, including during the spring mating season.

Although the seasonal diet and habitat use by Kermode bears on the BC central coast has never been studied, it would be safe to say that all bears on small island systems such as Gribbell would frequent the marine shoreline for some period during each annual cycle, whether for feeding on marine invertebrates, small salt marsh habitats, dead salmon, dead marine mammals or traveling between terrestrial feeding habitats or traveling in search of a mate during the breeding season. A study of grizzlies in the Khutzeymateen (K'tzim-a-deen) Grizzly Sanctuary some 200 km to the north of Gribbell, showed a highly disproportionate use by bears of low elevation areas and the marine environment compared to the overall extent of the landscape: 17 collared bears were found to largely confine most of their activity to a narrow elevational band between sea level and 100 metres ASL [87% of all locations and 90% of aerial locations, respectively]. Yet the areas below 100 m represented less than 5% of the total landscape (MacHutchon et al. (1993)



Black mother with white cubs using upper intertidal zone of Gribbell for travel to feed on berries and marine invertebrates. (Photo: Trish Boyum).

3.5 Cumulative effects & threats to the survival of the Kermode bear and its unique gene pool on Gribbell Island

The Canadian Environmental Assessment Agency (CEAA 2009) guidance document on cumulative effects assessment states:

> *Cumulative Effects Assessment (CEA) is done to ensure the incremental effects resulting from the combined influences of various actions are assessed. These incremental effects may be significant even though the effects of each action, when independently assessed, are considered insignificant.*

"Cumulative effects" is the accrual, gradual or rapid, of all impacts on a species from human activities and natural events, quite often obscured in space and time due to lack of monitoring or our tendency to just look at one man-made impact and consider it not very important. As the level of human development and activity or natural changes increases, cumulative effects occur from influences that may individually be minor, but collectively are significant. This can be exacerbated when "insignificant" project level impacts are not carried forward to cumulative assessment, as occurs throughout much of the Enbridge Northern Gateway Pipeline (ENGP) Environmental Social Assessment (ESA 2010); for example, such as where the report concludes that as the effect on Kermode bears of a tanker spill on the coast would be "isolated to a few individuals."

Although the North American black bear is generally recognized as more resilient and adaptable to human-induced mortality and combined habitat losses and displacement than the grizzly bear, we have strong reasons to believe that the small isolated island populations of the Kermode bear are much more vulnerable to human disturbances than adjacent

mainland populations. Additionally, Kermode bears are long lived and are omnivorous feeders at the top of the food chain, which makes them good indicators of ecosystem changes.

In order to make an informed assessment of threats and further management options for Gribbell Island, we took a general cumulative effects approach, and identified and analyzed six man-made influences to the ecological integrity of Gribbell Island and its unique, but small and vulnerable, Kermode bear gene pool. Five of these are as follows:

- Early fur trade influences: Potential effects of early 20th century hide hunting/collection of bears with a white pelage for museum specimens.
- Forestry practices: clearcut logging and associated roading.
- Changes (generally reduced numbers) to Pacific salmon stocks through logging and ocean harvest of small salmon runs.
- Effects of bear-viewing/tourism and research activities.
- Climate change, including ocean rise.

Although the proposed Enbridge oil tanker traffic in the adjacent marine channels and the risk of a spill is a new and serious threat, we address this in a separate report that is being completed.

We looked at these individually in the following sections and then summarized them together at the end of this report.

3.5.1 **Potential impacts on the Kermode bear gene pool on Gribbell Island from fur trapping, museum collecting, and sustenance and trophy hunting**

A number of scientists have raised concerns regarding the impacts of human influences, including select hunting and collecting of white bears, on the small gene pool on Gribbell Island and elsewhere. For example, Cowan (1938), while discounting the separate species designation *kermodei* for the white bear as being erroneous, and himself (erroneously) calling this bear albinistic, first raised concerns about the selective removal of white individuals from the BC coast as follows: "The resulting publicity led to a selective removal of the albinos, with the result that white individuals are now no more abundant in the range of kermodei than elsewhere in British Columbia." Of course, while we know today that this is not the case of white bear distribution in coastal British Columbia, his comments on the selective removal of white individuals from the coast may have some validity. In a more recent review of the Kermode bear, Blood (1997) also raised similar concerns that hunting and collecting activity in the first half of the 20th century, when there were few regulations, may have had a long-term impact on the ratio of white versus black phases in some areas. Ritland and Marshall (2002) also acknowledge that differential hunting pressure could affect white-phase frequency, but mistakenly state that the Kermode bear has been protected from hunting since the early 20th century; whereas the white-phase was not protected from hunting until the 1950s (Cowan and Guiget 1985).

Thus far, the only substantive data we have on the systematic removal of white-phase Kermodes from Gribbell is the 11 bears removed for specimens over the 15-year period

from 1898/99-1913 (Blood 1997), although it is obvious from the sporadic records that many more white bears were likely taken from Gribbell until they were protected in the 1950s. We consider 11 to be a minimum estimate, since Hornaday (1905) mentions that the man who shot the Kermode type specimen on Gribbell Island in 1904 reported that he knew of 18 other white bears taken from the same region along Douglas Channel that includes Gribbell Island. Most likely some of these also came from Gribbell.

Discounting natural mortality of these 11 white bear removals, which might have occurred over this period, the unnatural removal represented 7-11% of the estimated small population of 100-150 individuals, and removal of some 17-24% of the estimated 45-65 white bears with the double recessive gene ("GG") from the gene pool. Even if we factor in the natural mortality rate of some of these bears, given that another 18 white bears were known to have been killed by 1904 from the same general coastal area as Gribbell, this would be a conservative estimate of draining the white bear morph from this small gene pool. Certainly this high a rate of selective mortality of white bears likely played a role in reducing the incidence of white-phase individuals to below historic levels.

3.5.2 **Effects of logging**

3.5.2.1 Background on clearcut logging of Gribbell

Data on the impacts of logging on bears are inadequate to make precise predictions of clearcut logging and associated road construction on Gribbell Island. However, our generalized analysis suggests that the impacts could be high, particularly as the fauna on small island systems are more vulnerable to human-induced changes than on larger islands or mainland areas. What also must be kept in mind is that nearly all logging on coastal islands like Gribbell has involved the felling and removal of very old primeval forests rich in plant variety and that are then replaced with second-growth closed canopy forests that have little plant diversity.

While we have no exact dates on earlier clearcutting, the only prominent valleys with salmon runs, Riorden River and Gribbell Island Creek, were both heavily roaded and clearcut some 25 or more years ago, including with main haul roads and oceanside log dumps. In October 2003, the Gitga'at First Nation signed a logging revenue-sharing agreement with the provincial government. The agreement provided the 650-member band with $1.57 million and access to 125,000 cubic metres of timber over a five-year period from their traditional territory. The province promised another 165,000 cubic metres the next year as part of the "take-back" the province was negotiating with forest companies at the time (*Vancouver Sun*, Oct. 16, 2000). Gribbell Island was one of the areas negotiated for timber access. About this time, commercial timber areas on Gribbell Island were also apportioned to four different timber interests: Thompson Ind., Biport, West Fraser, and Small Business (SBFEP), even though, in our opinion, most of the easily accessible and commercially viable forests on the island had already been high-graded. In about 2003, Triumph Timber roaded and clearcut another large valley on southeastern Gribbell Island. Also, about 2004 several SBFEP areas on the east side of Gribbell Island were selection-logged by helicopter.

In 2003 and 2004, VWS biologist Wayne McCrory carried out field surveys of logged and unlogged areas on select areas of Gribbell Island with Gitga'at representative Marven Robinson. Surveys included some of the proposed heli-blocks on east Gribbell. One field survey was also carried out with both Marven Robinson and Dan Cardinal, a resource consultant for the Gitga'at. Further field surveys were done over the next few years, including a shoreline assessment to inventory estuarine habitats.

At this time, our field surveys showed that earlier logged areas in Riorden and Gribbell Island creeks were reaching the more advanced seral state where, due to the new forest canopy growing in, bear foods would become a diminishing resource. However, evidence of some bear activity was still noted in some of the cutover areas and roadways. Gitga'at hereditary chief John Clifton (pers. comm. 2000) attributed an increase in the previous decade in white bear sightings on Gribbell Island by boaters and people from Hartley Bay to berry feeding in cutblocks, where the bears were also more visible. Since then, tour operators have continued to see a small number of black and white Kermodes using the same area, although the new forest is now growing in.

Large blowdowns and a number of logging-related landslides were also observed in our previous surveys. For example, our 2004 surveys showed extensive blowdowns in riparian areas in the watershed on southeastern Gribbell that had been recently logged by Triumph Timber. All of the blowdowns appeared to be the result of leave strips of tall trees around riparian areas being made vulnerable to blowdowns because of adjacent cutblocks. Windstorms in these areas are known to be very severe.

Starting in 2004 several areas on the east side of Gribbell Island were selection logged by helicopter. In September 2004, VWS documented a large "debris island" of trees and stumps floating in Ursula Channel that likely resulted from a landslide that started above one of the heli-logged blocks on southeastern Gribbell Island, which we believe was logging related.

Such slope failures and blowdowns are causing further degradation of bear and other habitats on Gribbell Island.

In order to gain a landscape perspective on the overall effects of logging activities on Kermode bears (and black-tailed deer) on Gribbell, we developed a number of GIS habitat models and determined how much old-growth habitat had been altered by logging activities.

Although selection logging by helicopter is more benign, this landslide occurred on s.e. Gribbell in the fall after this slope was heli-logged in 2004. A large "debris island" full of stumps and broken trees floated along Ursula Channel, becoming a marine hazard. This demonstrates how highly unstable the steep terrain is to any man-made disturbance. [Photo: W. McCrory. VWS files].

3.5.2.2 Effects of logging on Kermode vegetation feeding habitat

The primary component of the annual diet of bears on the central coast is vegetation, primarily green plants and berries, with salmon being very important in the late summer and fall months. Our list of coastal bear plant foods is over 50 species (McCrory et al. 2003a), most of which would be found on Gribbell.

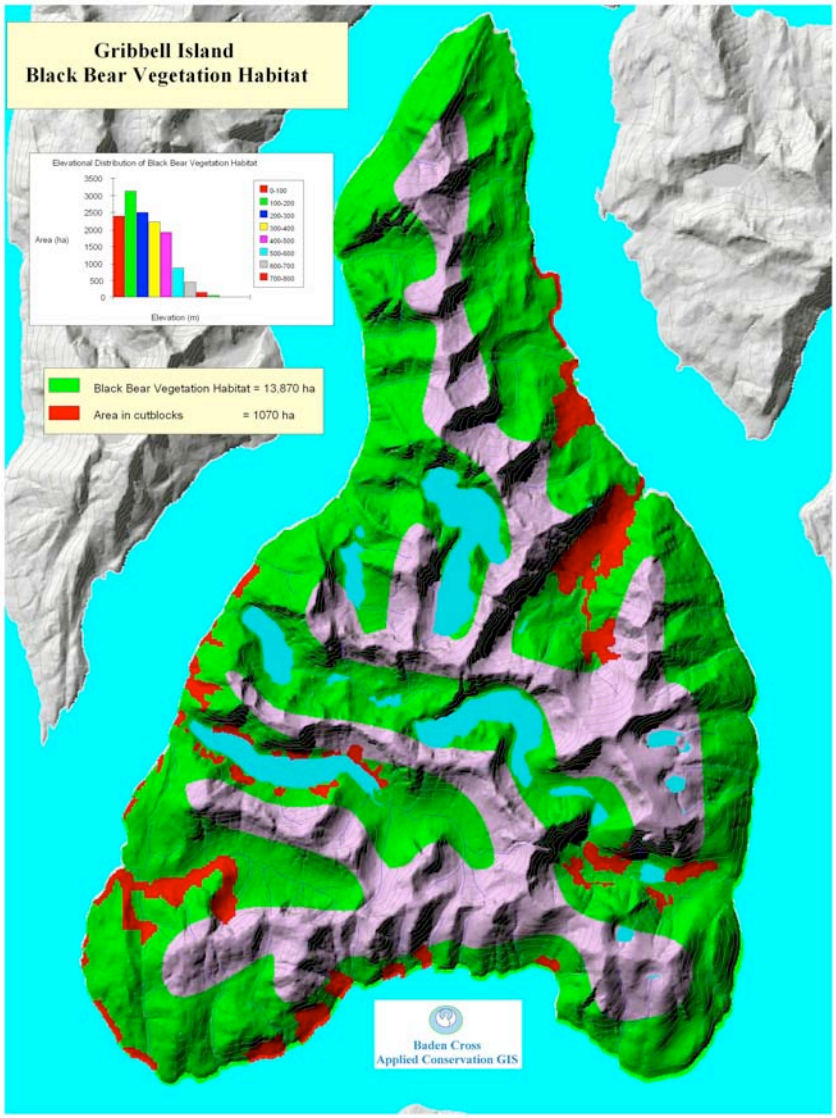
Since Gribbell Island (20,690 ha) is very mountainous, with high barren peaks or long reaches of ocean channel where steep cliffs rise straight up out of the sea, we did a simplistic GIS bear habitat model by segregating identifiable rock areas from vegetated areas, and assumed that all vegetated areas had some values to the diet of Kermode bears. Map 1 indicates that a fairly high proportion, 33% or 6,820 ha, of Gribbell is unsuited for bears. Much of this includes the higher rock dome and rugged peaks of the Kitimat Ranges that occur on Gribbell. The remaining 67% (13,870 ha) was considered to be suitable as vegetation feeding habitat, such as for berries, grasses, sedges, and forbs found largely in small, forested wetlands or open areas, such as avalanche chutes or small open wet meadows, bogs, and fens. Overall, our field surveys indicated that much of Gribbell was of generally low quality habitat when compared to more richly endowed Kermode areas like south Princess Royal Island.

Large riparian forests along long deeply incised valley bottoms that provide higher quality feeding habitat for coastal bears, as are found on the mainland, were limited on Gribbell to

small interior valleys. For example, we found particularly good riparian areas mid-valley in the unnamed creek on southeast Gribbell, along the next creek north of Riorden, and some in mid- and upper Gribbell Island Creek.

It is well recognized in coastal bear populations that if a high proportion of the rainforest landscape becomes dominated by mid-successional closed canopy forest from logging, then its ability to support a viable black bear population is in jeopardy. We believe the effect is magnified for small island bear populations. Our map 2 overlay shows that approximately 6.7% (927 ha) of forested (in green) areas of Gribbell Island have already been clearcut. This may not appear significant until one considers that a high proportion of the cutover lands are in the better quality riparian forests. Secondly, the benefits to bears of increased berry and green plant foods in new clearcuts lasts only about 25 years, after which the regenerating forest begins canopy closure, choking off the growth of foods for bears. The dense even-aged forest then becomes a habitat desert of little or no value to bears for several centuries, or until the next forest rotation. This longer-term conversion of once-productive old forests to dense plantation forests that are of no value to bears thus negates the short-term benefits of early seral cutblocks. Clearcutting also negates viable old forest habitat for those bears that avoid clearcuts. A black bear study on Mitkoff Island in Alaska found that not all black bears used clearcuts (Hanson 1988). Females avoided logged areas, while adult males and subadults concentrated feeding near the perimeter of artificial forest openings, close to escape cover. From this perspective then, the 6.7% of old forest removal becomes a cumulative habitat loss and causes population stress for those bears that avoid cutblocks, and for all bears as the regenerating forests enter the closed canopy stage.

Black kermode bear feeding on salmon berries and green plants in cutblock on s.e. Gribbell. Studies show that not all bears use cutblocks and mothers with young may be vulnerable to increased predation by larger bears and wolves due to lack of escape trees. 2003.



Map 2 shows green mostly forested, vegetated areas of Gribbell and (purple) high Rock mountains, representing 1/3 of Gribbell of little or no use to Kermode bears. The remaining confined, available landscape to Gribbell's 100-150 isolated Kermode population makes them much more vulnerable to man-made changes than bears on the mainland or the larger islands. The red areas are clearcuts. Nearly 7% of the productive old forests of this small island have been removed by logging, which over time reduces habitat values for bears in critical areas, including the major logging of the only two salmon streams on Gribbell. This only adds stress to the bears.

We also believe that where some females with young venture into clearcuts for feeding and travel they may be more vulnerable to predation by adult male bears or wolves as they venture away from suitable escape trees. On Vancouver Island, two incidents were observed where male bears treed females and cubs at the edges of cutovers in the spring (Davis and Harestad 1996). In 1994, they recorded a high rate of cannabalism, three involving cubs and the other a subadult female. They attributed this to logging causing habitat alteration and a reduction of the availability of suitable den sites.

Logging-caused population stress on Kermode bears on Gribbell, combined with the generally low landscape habitat productivity, lack of marine salt marsh habitat, and small salmon biomass, would be magnified by the insular nature of the bear population there.

3.5.2.3 Effects of logging on Kermode bear winter den habitat

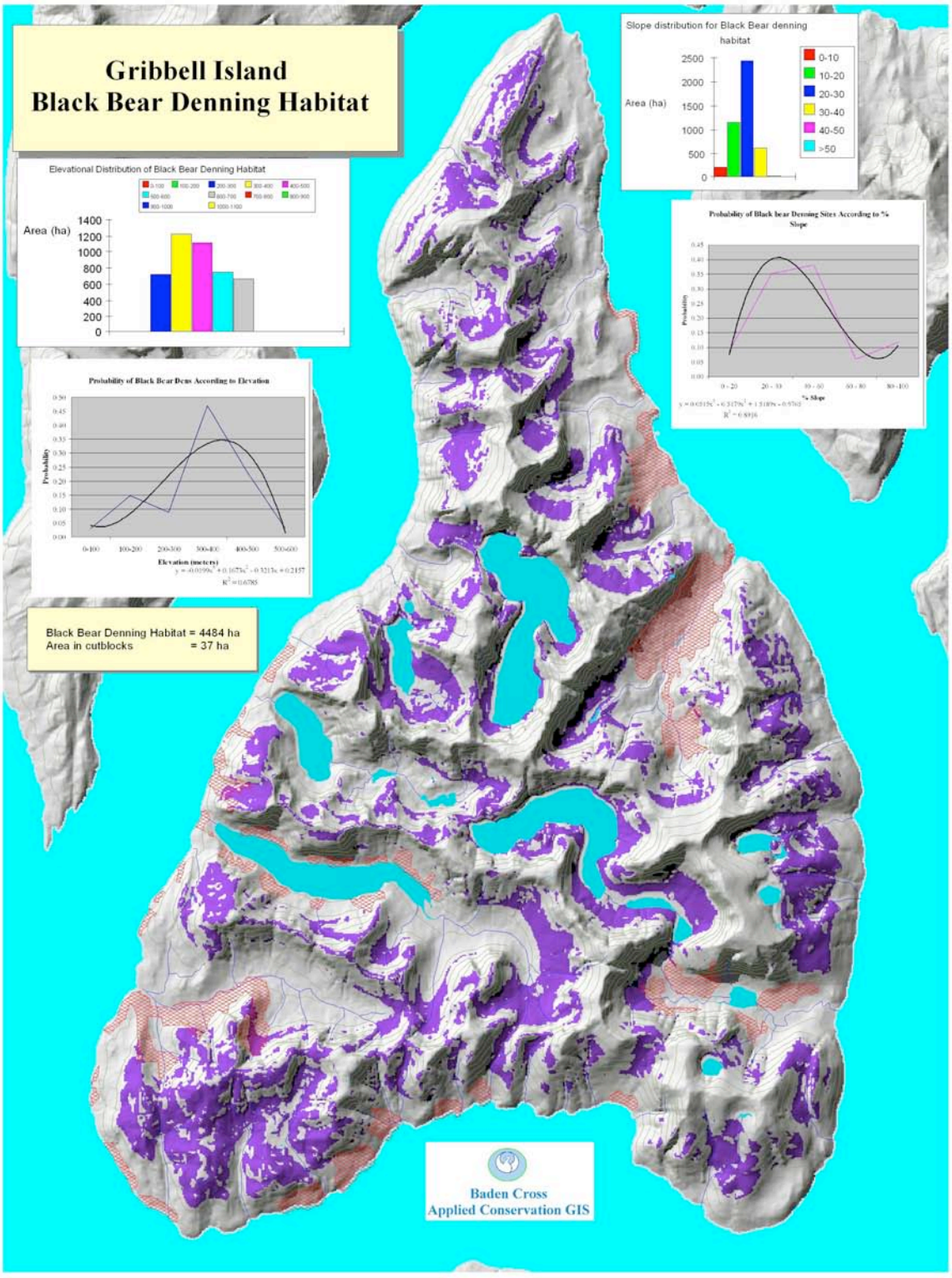
Conversion of old forests to younger even-aged stands is considered detrimental to the supply of dens for black bears in coastal British Columbia (Davis 2011).

Our background review of Kermode bear ecology on the central coast (McCrory et al. 2003a) indicates that this bear species most likely relies on the hollow interiors or basal cavities of very old trees that are at least one metre across and are an estimated 300-500 + years old, depending on the growing site. Stumps and large residual trees may also be used. Since there has never been a black bear den study on the BC mainland coast, we used a number of mapping attributes (slope, age of forest type, and elevation) from den studies in Alaska and on Vancouver Island to model old-growth where Kermode bear dens would most likely be found.

Dens are most likely to occur on well-drained slopes where large, old trees grow, at about low to middle elevations along the island and mainland faces. Since the redcedar species appears to be more common, grows to large diameters, and appears to have a high rate of heart rot when older, we are assuming these may provide the best winter dens on Gribbell.

We have done only limited ground-truthing of our GIS den habitat model. On June 24, 2003, biologist Wayne McCrory did wildlife habitat transects of proposed heli-blocks on the northeast side of Gribbell Island. Marven Robinson and Dan Cardinal, representing the Gitga'at, were part of these surveys. We looked at proposed logging Block 2, B-2, Block 1, Block C, and Block D-D, which were within our high value den habitat areas. Although we found many old redcedars of sufficient diameter to be den sites, we did not locate any dens. This underscores the difficulty in locating denning trees through ground surveys and the need for a radio-telemetry study on Gribbell Island to define denning and other important habitats.

Mother black bear with 2 new cubs outside winter den under old-growth roots. South BC coast area. Cubs are born very small in the den, about February. [Photo: Drake Stevens].



Map 3. Dark purple shows high potential old-growth areas for Kermode winter den sites. To date, logging (pink areas) has had a limited impact. Further logging, such as heli-logging for the hi-grading of cedar, as is happening elsewhere on the coast, would have a greater impact.

The coastal winters are very long and extremely wet with high intensity storm after high intensity storm continually sweeping in from the Pacific, interspersed with periods of colder outflow winds or "williwas," bringing colder, hurricane-force Arctic winds through the high mountain ranges from the east. According to Environment Canada, on 13 March 2012, winds in this area reached 187 km/hr. (M. Paquet, pers. comm.) Studies of coastal black bear dens on Vancouver Island (Davis 1996) and Mitkoff Island in Alaska (Hanson 1988) indicate that coastal bears are entirely dependent on old tree structures for over-wintering for five months, including birthing and rearing by pregnant females during the later part of the winter. Davis (1996) concluded that: "the use by black bears of den structures other than those originating from trees does not appear likely in wet coastal environments."

We believe logging of old forests that provide winter den habitats is a significant conservation threat to Kermode bears. In a study of black bears in the Nimpkish Valley on Vancouver Island, Davis (1996) concluded that decreasing habitat supply caused by a low density of preferred den elements may result in higher mortality and lower reproductive success because bears may have to rely on thermally sub-optimal and less secure den sites. Davis and Harestad (1996) suggest that removal of high-quality den trees by logging may be one of the factors that increases the vulnerability of female black bears with cubs to predaceous attacks by male bears.

Recent den studies using radio-collared bears on Prince of Wales Island in south-east Alaska have confirmed the use of mostly old-growth structures for winter dens. Interestingly, bears will use 2-3 different dens over a winter, waking up to travel to another. Loss of winter den habitat to on-going clearcut logging and roading is a major concern. (Boyd Porter, Wildlife Management Biologist, Alaska Fish & Game. pers. comm.).

We used our Kermode den habitat model to examine existing and potential losses of winter den habitat on Pooley Island and found that 20% had already been impacted by roading and logging, with another 60% to be impacted by planned logging (McCrory et al. 2008, in press).

The denning map 3 shows areas that would have a high potential for old-growth Kermode dens on Gribbell, covering some 4,484 ha, or approximately 22% of the island. The map also shows that less than 1% (37 ha) of the potential high value den habitats on Gribbell Island have been removed by clearcuts. This is because most of the logging has targeted the best, most accessible timber growing in lower quality den habitat, such as along the ocean or in the valley bottoms and lower slopes of the interior valleys where the cost of building access roads has not been prohibitive; i.e. island sites where denning is much less likely to occur.

However, if further logging were to occur, such as high-grading of old-growth redcedar by heli-logging of more inaccessible sites, which are in high potential denning habitat as has been documented on the BC south coast (McCrory 2010), denning habitat losses would start to occur.

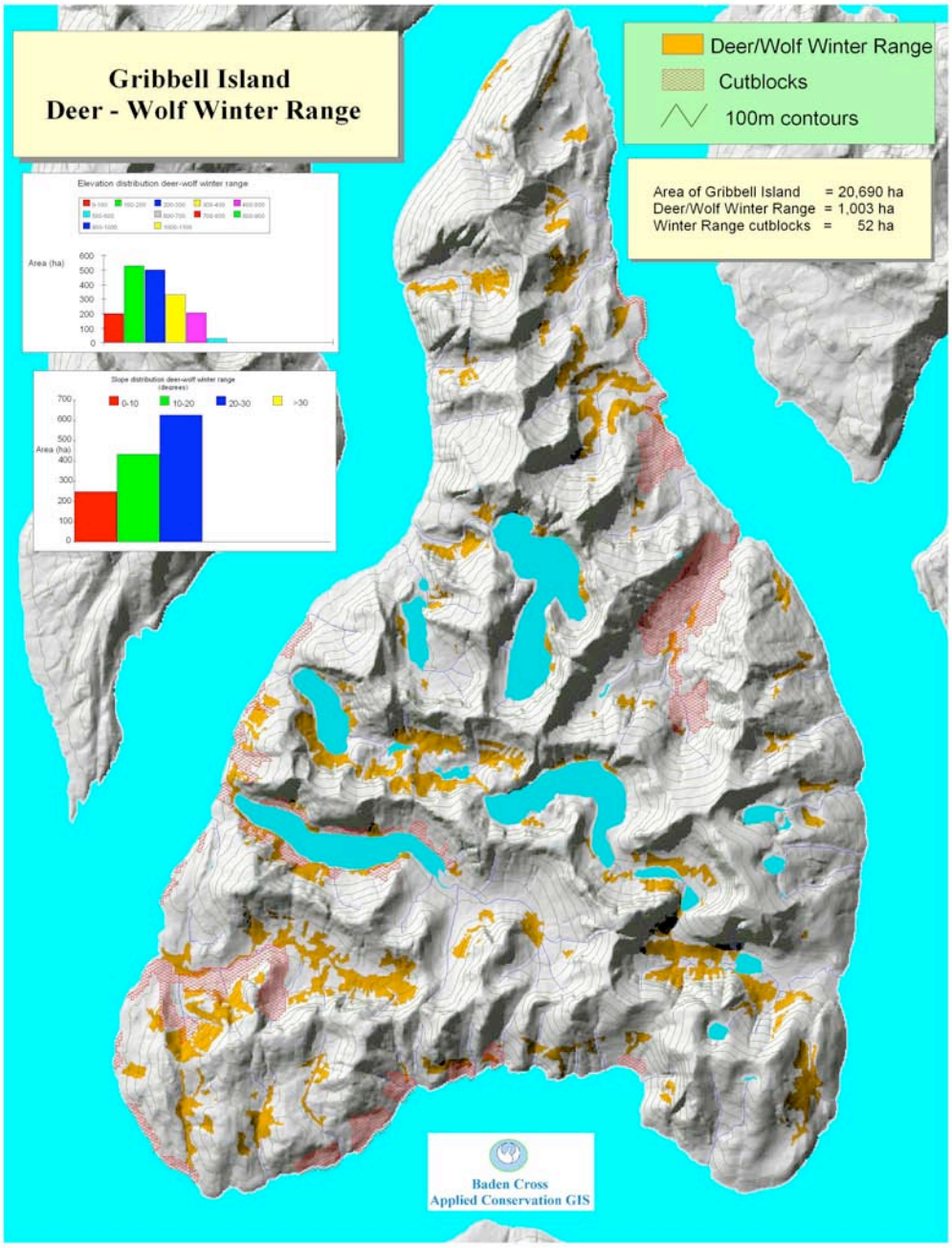
Active den 12 meters up in old cedar tree on Prince of Wales Island, Alaska. [Boyd Porter photo].

3.5.2.4 Effects of logging on high value black-tailed deer (and wolf) winter habitat

During winter periods of deep and prolonged snow, studies have shown that coastal black-tailed deer are dependent for survival on old forests, particularly high-volume stands of Western-hemlock-dominated forest types. Our deer winter range habitat model focused on this forest type, with slope steepness and elevation as other variables. We included this as important wolf winter habitat since this predator is primarily dependent on deer in the winter. Background information is provided in our extensive Sitka deer and gray wolf report for the spirit bear conservancy proposal (McCrory et al. 2003).

Map 4 shows that high value winter range (again, old-growth) for deer comprises only about 4.8% of the total island area. These are small pockets of often-discontinuous old forests around the island. On northern Princess Royal Island, our den habitat model showed twice this amount of deer winter range in proportion to the overall landscape. Only a small portion (52 ha) has been clearcut logged, so at this point there are no concerns.

Deer may form an important survival food for Kermode bears on Gribbell Island. A recent study on Prince of Wales Island in south-east Alaska showed that 60 % of newborn Sitka deer fawns are killed and eaten by black bears (not wolves) in the first three weeks after being born (Boyd Porter, pers. comm.).



Map 4 shows high quality Sitka deer winter range (yellow-orange) on Gribbell. It occurs in disconnected isolated patches due to the rugged topography and comprises less than 5% of the island. These limitations reduce the viability of the island to support coastal deer and their main predator, the gray wolf. Our map model indicates that only a small portion (red areas) has been affected by logging.

3.5.3 **Assessment of Pacific wild salmon runs on Gribbell Island**

Our review suggests that drastic declines in the only two salmon streams on Gribbell have been caused by extensive clearcutting of the forests in these sensitive watersheds, combined

with over-fishing on the high seas to the extent that the carrying capacity for salmon is well below historic levels. Pink salmon, which have the least reliance of the five coastal salmon species on fresh water, appear least affected by logging when compared to chinook and coho (Harvey and MacDuffee 2002), and therefore their documented declines may be more related to the commercial fishery. The commercial net fishery, unfortunately, makes no distinction between catch of large and small vulnerable runs—when the nets come in, they all look the same, with dire consequences to small specific salmon runs. Currently, there is a large pink salmon fishery that throws away chum salmon as a by-catch, therefore causing a high mortality to both species that originate from small runs. This is of particular concern for bears and other species that utilize salmon since Gribbell Island has been shown to have a relatively small biomass of salmon over the landscape (0-5 kg/ha) when compared to other Kermode areas, such as Laredo Inlet on south Princess Royal Island, where nine salmon streams occur (McCrory et al. 2003b).

Gribbell has numerous watersheds with stream flows adequate to support anadromous wild salmon, but there appear to be only two salmon spawning watersheds. Due to the very rugged nature of the island, many of the other streams have very steep gradients and precipitous outfalls towards the ocean, past which salmon cannot navigate.

The two small salmon-bearing streams are Riorden Creek (River) on the northeast side, and Gribbell Island Creek (known locally as the "Kwa") on the southwest side, almost directly across from Hartley Bay. During our field studies with Marven Robinson, we examined a third possibility, the next small stream north of Riorden, but observed no salmon, even though Mr. Robinson had observed at least one salmon during a previous survey.

The main species are typically pink salmon (*Oncorhynchus gorbuscha*) and chum salmon (*Oncorhynchus keta*), but include some coho salmon (*Oncorhynchus kisutch*). Most salmon spawn within several kilometres of tidewater. For pink and chum, spawning usually begins in early September and is complete in middle or late October, with coho generally arriving later in the fall during heavier rainfalls that create high water conditions more suited for them to migrate higher up the creeks.

Pink salmon, the smallest of the Pacific wild species, have a two-year cycle from the eggs in the parent stream, rearing into small fry, traveling far out to sea to grow on the rich phytoplankton in the Gulf of Alaska, and returning as adults to spawn in the same section of the stream in which they were born. For reasons that are not understood, pink salmon have alternating high and low years. Chum salmon, like their larger cousins (e.g., chinook), have a 4-5 year cycle from the egg stage to returning as a spawning adult.

DFO escapement data from 1983-1992 showed an annual average escapement of only 2,360 fish for both streams (McCrory et al. 2003), mainly pinks and chums. [Escapement is defined as the number of adult salmon returning to their natal spawning ground. It refers to the number of adult fish that escape through the various fisheries to arrive at their spawning areas]. This is a very small number of spawning adult salmon to be able to support the island's large and small predators, including an estimated 100-150 Kermode bears.

Salmon restoration efforts in the Pacific Northwest have shown that a healthy riparian habitat–those areas along streams where salmon spawn and where the hatched young feed

and rear before going out to sea–is essential to the health of the fishery. If the habitat required for these life stages is compromised, depleted salmon populations cannot recover. There is strong evidence that salmon runs in the area, including on Gribbell, have been on the decline for some time and are not recovering.

Besides habitat degradation from logging, mismanagement of the commercial fish harvest by DFO, and their failure to implement promised conservation measures for small endangered runs, appears to be at the root of the problem.

Klinka and Reimchen (2009) noted that salmon returns for Riorden Creek for the 10 years previous to Klinka's 2000-2002 research on Gribbell Island, averaged only 800, 100, and 20 individuals, respectively. They considered these approximately one-third the numbers counted in the 1950s (DFO escapement data: 1950–2000, unpub. data). More recent anecdotal observations by myself, Marven Robinson, ecotour operators, and others suggest that pink and chum salmon have continued to decline at an alarming rate on Gribbell Island in some years, concomitant with declines on many other central coast salmon streams. In 2008, only a few pinks and chums showed up at the Gitga'at bear viewing platforms on Riorden, and bears were described as very hungry (Marven Robinson, pers. comm.). A recent survey by Spilsted and Pestal (2009a) indicated that wild chum salmon are depressed for DFO Areas 5 and 6, noting that: *The declining trends and current low escapements for Areas 5 and 6 are of particular concern.* Over-fishing and DFO writing off small stocks are one side of the problem. According to a recent report by the SkeenaWild Conservation Trust et al. (2011):

> *The major obstacles to sustainability in BC's commercial pink salmon fisheries include significant problems associated with the bycatch and discarding of sockeye, coho, chum, chinook, and steelhead. This paper provides evidence that bycatch and discards may be impeding the rebuilding and recovery of salmon stocks.*

This includes an unknown number of salmon stocks that DFO has defined as being of special conservation concern. In another independent review, Darimont et al. (2010) concluded that high rates of commercial fishing limits the important contribution of Pacific salmon to species and processes that terrestrial protected areas on the BC coast were designed to protect.

We consider stream degradation by earlier clearcutting on Gribbell the other reason for the persistent low salmon returns. Our habitat surveys showed that much of lower Riorden and Gribbell Island Creek were clearcut several decades ago over large areas and right down to the edges of the main salmon spawning areas. While we can't prove that logging-caused hydrological and sediment changes combined with slope de-stabilization (and some debris torrents, as is evident in Riorden) have contributed to the serious salmon declines, the evidence is strong that logging has had a negative effect. Dr. Tom Reimchen (pers. comm.) compared DFO salmon escapement values for two unlogged salmon streams in Laredo Inlet on Princess Royal Island to the two logged streams on Gribbell for the same period and found that the unlogged streams showed little or no declines but the logged ones showed considerable declines. In the Queen Charlotte Islands (Haida Gwaii), drastic declines in salmon abundance and local extinctions of 29 stream populations were attributed to a combination of "severe habitat degradation and over-fishing" (Northcote et al. 1989).

Due to the limited fish supply for the whole semi-isolated island, the often small runs of salmon attract a high number of Kermode bears and some wolves, wolverines, and pine martens during September and October. Marven Robinson (pers. comm.) has photographed wolverines feeding on salmon at Riorden Creek.

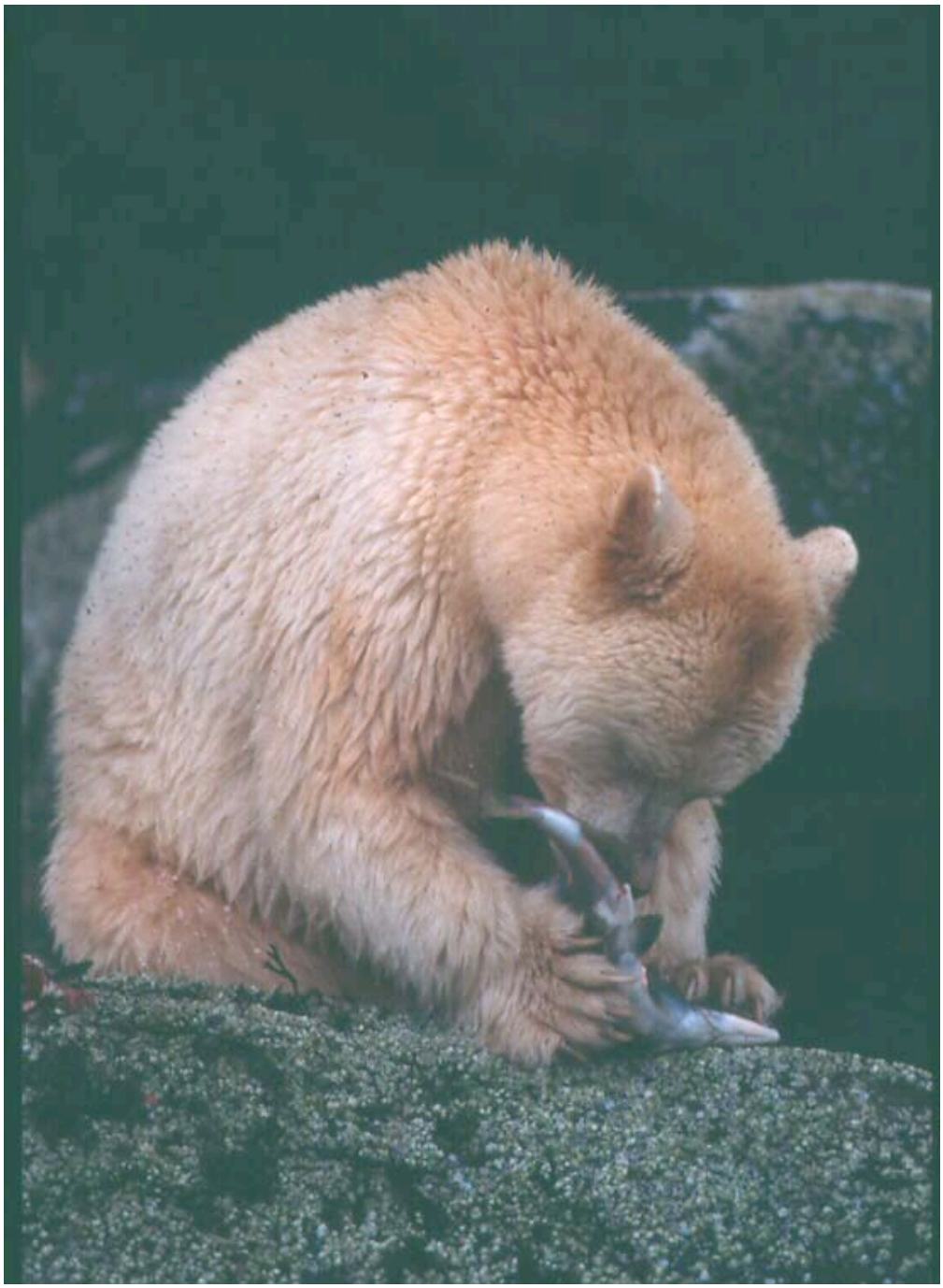
Given the small insular island populations of Kermode bears, wolves, and other carnivores that depend on salmon at critical times of the year, further depletion and lack of recovery of salmon stocks on Gribbell is of serious conservation concern related to a reduced over-winter survival and reproductive success of this small insular bear population, particularly during years of very low salmon returns concomitant with poor berry (*Vaccinium* spp.) production. Multiple studies of bears in coastal British Columbia and Alaska show that salmon are an important part of the yearly intake of dietary protein (Gilbert & Lanner 1995, Hildebrand et al. 1999). Where salmon are part of the diet, the population density of coastal bears can be 20 times greater than Interior bears (Gilbert & Lanner 1995). In grizzly bears, individuals and populations with greater access to salmon had greater litter and body sizes, as well as population density and productivity (Hildebrand et al. 1999, Mowat & Heard 2006); the same likely holds true for Kermode bears.

The much-decreased salmon runs could also have a long-term influence on the ratio of white versus black individuals since recent studies (Klinka and Reimchen 2009a, 2009b) demonstrated that white-coated bears have a distinct advantage over black individuals in catching salmon and thus obtaining more for food. A stable isotope analysis of bears on Gribbell Island indicated that white Kermode bears utilize salmon and marine invertebrates at a greater rate than black individuals (T. Reimchen pers. comm.). We agree with the following conclusions of Klinka and Reimchen (2009) that a combination of clearcut logging and commercial over-fishing is the reason why chum and pink salmon on Gribbell have taken nosedives in escapement numbers from earlier times, adding stress to the vulnerable bear population:

> *Because salmon may be particularly important for the white morph, the ecological persistence of this seasonal resource becomes an essential conservation consideration. Recent and ongoing industrial deforestation of the riparian zones on Gribbell Island and Princess Royal Island, where the white morph reaches its highest frequency, as well as major historical declines in salmon numbers returning to streams of the east Pacific (Gresh, Lichatowich & Schoonmaker, 2000), continue to compromise the integrity of this striking polymorphism.*

Additionally, the decline in salmon has also negatively affected bear viewing and filming success for the Gitga'at bear-viewing tourism program at Riorden Creek (Marven Robinson, pers. comm.).

The decline of the salmon would also affect the livelihood of many other animals that live on Gribbell. Bears are a keystone species that transfer salmon carcasses to the adjacent riparian zone and forests where the remains of carcasses are utilized by gulls, ravens, crows, eagles, pine martens, insects, and other species. It is also well known that bears contribute to the health of adjacent riparian forests and vegetation by distributing nitrogen and other nutrients through dispersal of salmon via carcasses or through urine and faeces.



[Photo: Wayne McCrory, Valhalla Society]

3.5.4 **Review of bear-viewing and research activities on Gribbell Island and potential effects on bears**

Human activity in bear habitat, including bear viewing, may result in negative impacts on bears, which may become obvious through patterns of human avoidance, wariness, or unrest behaviour, or adverse bear-human interactions (Smith 2002).

In 2002, the Gitga'at commenced a commercial bear-viewing program for their tourism project. Over the past decade, limited tourism development has turned Gribbell into a very lucrative bear-viewing site for Gitga'at Tourism. The Gitga'at built and exclusively control two bear-viewing platforms on Riorden Creek, the only salmon stream on the central coast, where in fall, sighting a white bear can be guaranteed almost on a daily basis. Most central coast tourism businesses and film crews book the Gitga'at viewing structures on a consistent basis in September and October. While we do not have economic numbers, we would guess that the long-term bear-viewing revenue and employment derived by the Gitga'at Development Corporation likely supersedes any values that would be derived from further logging of Gribbell Island, particularly as we have demonstrated that further logging may continue to have long-term negative impacts on survival of Kermodes on that island.

The Gitga'at have been very proactive in minimizing effects of bear viewing on Kermodes. In 2002, they developed a sound set of bear-viewing guidelines for their tourism business, as well as for other people viewing bears within their traditional territory. The two viewing platforms at Riorden Creek are approximately 0.5 km from the ocean and are accessed via an old logging road that avoids any disturbances to bears on the lower reaches of the salmon stream. Many of the bears that are viewed are habituated to the viewing platforms and the presence of people. All viewing is controlled by trained Gitga'at bear-viewing guides, with viewing restricted to the two platforms situated about 150 m apart. Visitor numbers are limited on a daily basis during the prime viewing season when bears gather to feed on spawning salmon in September and October. The rest of Riorden Creek is off limits to bear viewing and human visitation. The other salmon stream on Gribbell is generally off limits to human visitation and tourism use, and should remain that way, although a limited amount of research and filming has been allowed there. A small amount of vessel-based bear viewing is also done along the marine foreshore of Gribbell, with guidelines to minimize disturbances.

The Gitga'at bear-viewing program is thus consistent with various recent studies elsewhere that recommend some areas be off limits to human activities and viewing so that warier bears will be able to obtain an adequate food supply when displaced by viewing activities (McCrory and Paquet 2009; Rode et al. 2006a, 2006b, 2007; Chi and Gilbert 1999; Smith 2002; and Tollefson et al. 2005). For example, research at the Anan Creek Wildlife Observatory in Southeast Alaska by Chi and Gilbert (1999) showed that about half of all black bears of both sexes fished exclusively at the upper falls (control area) away from the viewing site, with nearly three-quarters spending over 75% of their time there. Only 8% of their sample of bears (2 females) restricted their use to only the lower falls where the observatory was located. The researchers felt that the upper falls provided a refuge from visitor disturbance as well as superior fishing opportunities. They felt it was important to have alternate foraging refugia where bears would be able to catch fish in the absence of human disturbance or distraction.

Having the Gitga'at bear-viewing program confined to a small area of Riorden Creek, with the other salmon creek off limits to viewing, is also consistent with the recommendations of a recent review of bear viewing for the BC central coast (Davis 2008). This study proposed that a number of watersheds be off limits to bear viewing to coincide with bear home ranges, fish availability, escapement numbers, viewability/public safety, and other factors. To implement this, the study recommended having a system of one watershed open for bear viewing and an adjacent one functioning as a temporal/spatial refugia from bear-viewing

activities. The Gitga'at have already done that. In a recent bear-viewing plan for Mussel and Poison Cove estuaries in Fiordland Conservancy, a joint BC Parks-Kitasoo/Xai'xais bear-viewing plan includes zones where no bear viewing or public access is allowed (McCrory 2009a, 2009b).

One concern related to habituation of bears from bear viewing is the fact that habituated bears are more susceptible to hunting, including black individuals on Gribbell that carried the recessive gene. The recent closure of hunting black Kermodes on Gribbell Island eliminated this concern.

Overall, we believe bear viewing on Gribbell is having a negligible effect on the bear population. In fact, survival of habituated females with young might be increased. A study by Nevin and Gilbert (2005a, 2005b) suggests that by displacing large males, viewing activities create a temporal refuge, enhancing feeding opportunities for subordinate age/sex classes. With the strong positive relationships between mean female mass and litter size, they felt this may, in turn, increase population productivity.

The several small observation-type Kermode research projects on Gribbell were not considered to have any impact other than minor and transitory.

3.5.5 **Cumulative ecosystem effects of climate change on Gribbell Island Biota**

It is our intent to touch on only a few aspects of climate change that have implications to central coast bear habitats and bear numbers, such as on Gribbell Island. The following is by no means a comprehensive review.

The climate of the BC central coast and Gribbell Island is shaped by its proximity to the Pacific Ocean and by its steep, mountainous topography. In general, the climate is wet and mild, one of the wettest places in Canada. Climate change is expected to accentuate both of these characteristics over the next century. According to local First Nation residents and scientists, the changes have already begun.

According to a report on climate change and biodiversity by the Intergovernmental Panel on Climate Change (IPCC 2002), climate change will exert additional pressure on biodiversity. This includes a 20% loss of marine wetlands by 2080, depending on the habitat type and local circumstances, as well as the risk of extinction of many species that are already vulnerable.

Climate is one of the primary influences on the composition, distribution, and abundance of plant and animal communities. For example, Kermode bears on Gribbell Island go into a state of semi-hibernation inside the hollow interiors of large old trees to avoid the five months of hostile winter weather and lack of adequate food resources. Placing additional demands on vulnerable ecosystems, particularly those that already have reduced capacity and resiliency due to cumulative effects of man-made developments, or small island systems, is going to further cause ecosystem degradation and loss of species. For example, current management practices, such as clearcut logging, can exacerbate climate effects (IPCC 2002). Old growth forests can buffer climate change better than cutover lands (Lerner 2011).

Maintaining large areas of intact forests offers the greatest chance for resiliency and adaptation to climate change by plants and wild animals. Clearcuts offer the least resiliency and carbon storage values. Intact forests provide greater value for carbon sequestration and storage than cutover forests (Wilson and Hebda 2008). In this regard, the loss of about 7% of the old forest cover of Gribbell Island to clearcut logging and roading is a significant loss in terms of weakening the buffering effect of forests on climate change on this small island system. This weakened effect will also influence the two salmon-bearing watersheds, which already appear to have been impacted by logging-caused degradation. Climate change in coastal watersheds is expected to lead to increasing freshwater temperatures and decreasing stream water levels in summer. Increased storm events are expected to significantly impact coastal flooding and erosion (Lerner 2011), which in turn will exacerbate effects for sensitive species such as spawning salmon.

An even greater impact is expected on marine ecosystems (IPCC 2002). Marine ecosystems are more dynamic than terrestrial ecosystems with a wider array of influences affecting their functioning. Sea surface water has become warmer all along the BC coast over the last 50 years, with increases of up to 0.9°C in water temperature at the warmest locations. Deep water in inlets also shows a warming trend of 0.5 to 1.0°C over the past 50 years (BC Ministry of Environment. 2007). The temperature of the ocean affects coastal weather and climate, as well as salmon. Besides temperature, changes in sea level rise, changes in ocean chemistry, including increases in dissolved carbon dioxide causing acidification, changes to oceanographic currents, and other aspects lead to a high certainty that the marine systems will change significantly from their current patterns, and that this will affect the abundance and distribution of certain species (Lerner 2011). For example, predicted rising water temperatures will thermally stress salmon throughout the state of Washington, becoming increasingly severe later in the twenty-first century (IPCC 2002). These same effects can be expected for BC central and north coast salmon, including the small runs that spawn on Gribbell Island. Variations in ocean pH also affect the composition of marine organisms along the coastline; acidification (decreased pH) is generally expected to affect organisms that have calcium carbonate structures, such as bivalves (Ianson and Flostrand 2010, Noakes and Jamieson 1990). This would include marine invertebrates that Kermode bears utilize on Gribbell, including the Pacific blue mussel (a bivalve) and barnacle species. It could also have a negative impact on other seasonal food supplies for bears.

We reiterate the warnings of the Intergovernmental Panel on Climate Change (IPCC 2002) that species with limited climatic ranges and/or restricted habitat requirements are typically the most vulnerable to extinction. According to the following, this includes species on small islands:

> *The risk of extinction will increase for many species, especially those that are already at risk due to factors such as low population numbers, restricted or patchy habitats, limited climatic ranges, or occurrence of low-lying islands or near the top of mountains (p. 22). Biota restricted to islands are listed as susceptible...the probability of species going extinct increases when ranges are restricted, habitat decreases, and population numbers decline. In contrast, species with wide non-patchy ranges, rapid dispersal mechanisms, and large populations are at less risk of extinction.*

In other words, the small and isolated Kermode bear population on Gribbell Island has much greater likelihood of being affected by climate change than mainland populations.

While we don't expect climate change to cause the Kermode bears on Gribbell to go extinct, at least not in the near term, their resiliency and survival rate will likely be considerably decreased. Further reductions of the salmon resource could also influence the unique ratio of white versus black bears due to white bears, which behaviourally depend on catching more salmon, having reduced survival rates.

4.0 SUMMARY OF CUMULATIVE EFFECTS & RECOMMENDATIONS

"Cumulative effects" is the accrual, gradual or rapid, of all impacts on a species from human activities and natural events, quite often obscured in space and time due to lack of monitoring or our tendency to just look at one man-made impact and consider it not very important.

In summary, of the five man-caused influences we examined, early fur trapping for white bear pelts and early 20th century hide hunting/collection of bears with a white pelage for museum specimens have likely reduced the white bear gene in the small distinct Gribbell Island Kermode bear population. Forestry practices (clearcut logging and associated roading) combined with mismanagement of small salmon stocks in the commercial fisheries has had the greatest influence on reducing overall food productivity for Kermode bears on Gribbell Island with effects magnified by the generally poor natural productivity, the small size of the island and the small insular bear population. The diminishing salmon runs may already be having a negative effect on the ratio of white versus black Kermodes since white bears feed more on salmon. Climate change is expected to exacerbate this drop in productivity. Effects of bear-viewing tourism and research have had little or no effect. Although being examined in an adjunct chapter to this report that is still being completed, the proposed Enbridge oil tanker traffic in the adjacent marine channels and the risk of a spill is considered a new and very serious threat to this genetically unique and vulnerable Kermode population.

Our review underscores the vulnerability and threats to small island populations of large mammals and a rare evolutionary genotype of bear as found on Gribbell Island from man-made changes that may be masked by wrong assumptions, lack of adequate baseline research, and wrong management prescriptions that ignore cumulative effects.

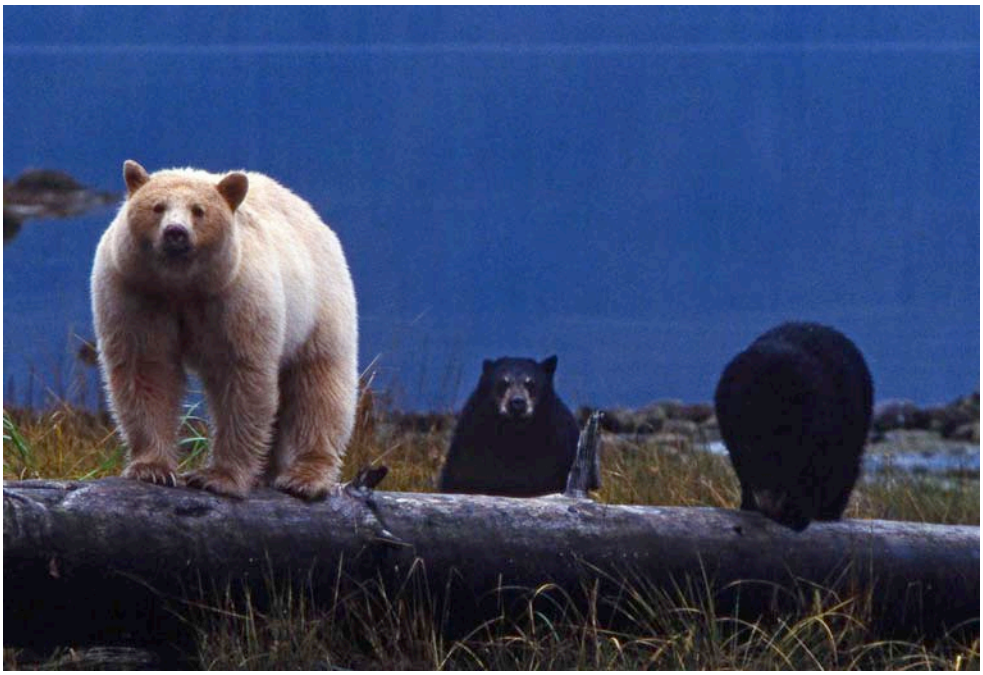
The limited and declining salmon resource on Gribbell Island underscores the need to preserve as much of the surviving native forests and productive vegetation habitat as possible so bears still have viable alternative berry foods in years of continued poor salmon numbers, or while salmon stocks, hopefully, are recovering. We agree with Darimont et al. (2010) that limitations must be imposed on exploitation of small salmon runs in areas and during periods through which salmon bound for important terrestrial areas can migrate. Gribbell Island is one such area.

While further studies are needed to understand the evolution of the Kermode bear and its genetic structure and population needs before we cross critical thresholds of extinction and cause changes that are irreversible, it is urgent that we preserve what we have based on what we already know, since it is not ours to destroy or alter.

To these ends, we are recommending to the Gitga'at First Nation government and the provincial government that no further industrial exploitation be allowed on Gribbell Island and that it be recognized as an part of an Evolutionary Significant Unit and be fully protected as a provincial conservancy, perhaps with a respected Gitga'at name as a Tribal Park.

This report will also be used as the basis for the Valhalla Society's yet to be completed review of the environmental study done for the Northern Gateway Pipeline, with specific reference to the potential effects of a major oil spill on Gribbell Island and its rare and unique white bear. Never, in our opinion, has the Kermode bear and its evolution been so threatened, but as we say, this latest study requires more investigation and careful documentation.

It is our hope that protecting Gribbell Island will continue to bring international recognition to what is truly part of Canada's Galapagos and, in turn, help turn the tide against the federal government's endorsement of Enbridge and the oil tankers.



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