

A critical assessment of protection for key wildlife and salmon habitats under the proposed British Columbia Central Coast Land and Resource Management Plan

March 2004



Paul C. Paquet², C.T. Darimont^{3,4}, R. John Nelson^{1,3}, and Katrina Bennett⁵

¹Raincoast Conservation Society PO Box 26. Bella Bella, B.C. Canada, V0T 1B0

²Faculty of Environmental Design, University of Calgary, Calgary, Alberta, Canada, T2N 1N4

³Department of Biology, University of Victoria, PO Box 3020, Victoria, B.C. Canada, V8W 3N5

⁴Darimont Environmental. 165 Barkley Terrace. Victoria, B.C. Canada V8S 2J5

⁵Geostreams Consulting. 674 Monterey Avenue, Victoria, B.C. Canada V8S 4T9



© Raincoast Conservation Society. Suggested citation: Paquet, P.C., C.T. Darimont, R. J. Nelson, and K. Bennett. 2004. A critical assessment of protection for key wildlife and salmon habitats under the proposed British Columbia Central Coast Land and Resource Management Plan. Raincoast Conservation Society.

Executive Summary

The Central Coast Land and Resource Management Plan (CCLRMP) table recently declared a consensus¹ on proposed protected areas for British Columbia's Central Coast. This region is recognized for its globally rare and largely intact mainland and island ecosystems and land use decisions should reflect this importance. We evaluated the efficacy of this proposal using a spatial assessment of habitat. We focus on protected areas in the context of the overall CCLRMP.

75% of chum and chinook runs, 74% of coho, 72% of pink, and 67% of sockeye runs are not afforded protection under the proposed CCLRMP plan

We examined the level of protection provided by the CCLRMP in three key coastal habitats: deer winter range, wolf reproductive habitat, and salmon reproductive and rearing habitat. Assessment of deer winter range was limited to Heiltsuk Territory, which comprises a large proportion of the CCLRMP region.

We found that proposed protected areas fail to provide sufficient long-term protection of secure habitat for deer, wolves, and salmon. Seventy percent (70%) of deer winter range, a non-renewable natural resource under current forestry management regimes, remains unprotected. Likewise, protection of wolf habitat important for successful reproduction is seriously deficient. Only six of 13 known homesites occur in proposed protected areas. Moreover, only 34% of 5 km buffers and 27% of 15 km buffers around wolf dens are included in protected areas. The buffers represent areas that denning wolves depend on to support newborn and growing pups.

The proposed protected areas plan does not prohibit the sport hunting of carnivores. Failure to include such fundamental conservation measures indicates that these areas are not in fact protected.

Analysis of salmon spawning and rearing habitat shows that 75% of chum and chinook, 74% of coho, 72% of pink, and 67% of sockeye populations are not protected under the plan. Because we lack complete information regarding distribution of salmon populations, the number of unprotected salmon runs is likely much higher than analyses show. Moreover, conservation priority of salmon populations has not been sufficiently considered by proposed protected areas. The CCLRMP fails to acknowledge the importance of genetic structure of salmon

¹ Pending further consultation and negotiation with First Nations

populations. Because of this, the lack of watershed protection could result in lost habitat for unique salmon populations.

Coastal islands overall, and outer islands in particular, are poorly protected by the proposed CCLRMP. Yet, ecologists regard islands among the most fragile of all environments. Considering that the Central Coast is largely an archipelago ecosystem, such a fundamental error in conservation planning is difficult to understand.

Ecosystem Based Management in the context of industrial forestry is an unproven and potentially dangerous strategy to preserve biodiversity outside of protected areas.

Remarkably, the proposed protected areas do not prohibit the killing of carnivores for sport and profit. Consequently, these areas provide little or no protection for wolves, black bears, grizzly bears or smaller carnivores. Failure to include these measures indicates that these areas are not in fact protected.

The CCLRMP is relying on Ecosystem Based Management (EBM) to compensate for the low level of protection provided by the plan. Although we support the theory behind EBM and the need for ecologically sound management across the landscape, we cannot endorse EBM as a surrogate for protected areas. There is simply too much uncertainty as to how EBM will be implemented on the ground. EBM in the context of industrial forestry is an unproven and potentially dangerous strategy to preserve biodiversity outside of protected areas.

"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

Aldo Leopold (1949)

Introduction

Although not commonly recognized, the earth is experiencing an extinction crisis. Following five natural mass extinctions, this human-induced “sixth extinction” is unparalleled in rate and extent (Leakey and Lewin 1995). Many stresses beset today’s biota, such as habitat destruction and fragmentation, over-exploitation, and invasive species. In addition, species are susceptible to trophic cascades, which can destabilize them from the top down (by removing predators and other consumers) or from the bottom up (by removing or replacing primary producers) (Soulé and Terborgh 1999, Carroll et al. 2001). One response by conservationists has been to increase the number of protected areas (Newmark 1987). Most assessments, however, clearly demonstrate that without careful planning the approach often falls short of affording adequate protection to species and ecological/evolutionary processes (e.g. Noss and Cooperrider 1994, Newmark 1995, Noss et al. 1997, Woodroffe and Ginsberg 1998, Paquet et al. 1999, Carroll et al. 2001, 2003, In press). Thus, exposing gaps in proposed conservation networks has become a common strategy in nature-reserve design (Soulé and Terborgh 1999, R. Noss pers. comm.). The challenge facing contemporary conservation practice is to design reserves that effectively preserve natural landscapes representative of a larger, regionalized landscape, and yet still maintain the integrity of ecosystem function, heterogeneity, and biological diversity.

To establish biological priorities for conservation, we need a firm understanding of how geography shapes evolution. For this reason, the few remaining large-scale geographic blocks of relatively unmodified landscapes are precious. These areas harbour our last opportunities for studying long-term evolutionary processes on a geographic scale and preserve the highly specialized and coevolved interactions that are being replaced elsewhere with weedy species or managed landscapes. No amount of money or efforts in restoration ecology can recapture the geographic mosaics of these long-term experiments in evolution.

The Central Coast of British Columbia (BC) is part of the largest remaining expanse of temperate rainforest in the world. Historically, the area has been remote and comparatively free from human disturbance. Now, however, the Central Coast faces a variety of ecological threats, including industrial forestry, over-exploitation of salmon, mineral extraction, introduction of exotic Atlantic salmon (*Salmo salar*), transmission of salmon diseases via aquaculture, development of oil and gas resources, increased numbers of visitors, and outside disturbances such as global climate change. Future ecological impoverishment will likely occur as the intensity of human activity increases.

Given the global significance of this region, a protected areas strategy that was expected to transcend traditional approaches to resource management was initiated by government and non-government agencies. A paucity of scientific information, however, seriously compromised this effort. The most daunting obstacle was the lack of anything close to a full accounting of present-day biodiversity. Research on ecology and life history has begun for only a few Central Coast species, most notably the black-tailed deer (*Odocoileus hemionus sitkensis*), grizzly bear (*Ursus arctos*), black bear (*U. americanus*), and gray wolf (*Canis lupus*). In contrast to the handful of species investigated, more than 100 bird and mammal species on the Central Coast have not been studied or their presence and habitat use studied in a very cursory manner (Paquet et al. 1999). Even less information is available for genetically distinct populations. Although many of these species have been studied outside coastal BC, unique features of old growth and coastal ecosystems might not permit extrapolation of information from other regions. This lack of information regarding coastal ecosystems argues for either a moratorium on industrial development while more information is collected, or a very robust conservation plan that buffers reliably against the inherent uncertainties. Nevertheless, on 11 December 2003 the Central Coast Land and Resource Management Plan (CCLRMP) declared a consensus agreement on a conservation strategy for the Central Coast of BC (Province of British Columbia, 2003) that falls well below the most basic requirements deemed necessary to protect ecological integrity of the Central Coast (Rumsey et al. 2003).

Consequently, we saw the need to assess critically the efficacy of the CCLRMP recommendations. For example, are ecologically important habitats adequately represented? Are wildlife protected from sport hunting and industrial activities? Are proposed protected areas large and connected

enough to maintain populations of wide ranging animals over the long term, or to perpetuate natural processes such as disturbance regimes and predator-prey systems?

Herein, we provide a critical examination of the CCLRMP's protected areas strategy by focusing on the first question: are ecologically important habitats adequately represented? We then ask, are wildlife protected from sport hunting and industrial activities within protected areas?

Our approach addresses three key habitats for the following taxa for which we have research experience and field data (a rarity for the central coast): black-tailed deer, gray wolves, and five species of salmon (*Onchorhynchus* spp.). All are appropriate focal species around which coastal land-use planning should be designed, owing to their keystone, flagship, and/or umbrella species characteristics (Jeo et al. 1999; Paquet et al. 1999, Darimont and Paquet 2000). We used a Geographic Information System (GIS) to assess quantitatively the extent to which the protected area strategy affords protection to the following ecologically important habitats:

1. *Deer Winter Range* - During deep snow, deer require old, high-volume forests on gentle to moderate slopes at low elevations. Often, industrial forestry targets these “deer winter ranges” and their forest characteristics.
2. *Wolf Reproductive Habitat* - Wolf homesites are important and comparatively small areas where wolves reproduce. Wolves maintain natal and secondary den sites, a series of rendezvous sites, and surrounding areas between April and October. Important reproductive and rearing activities occur in an area of about 15 km² within an annual home range of 250 km² or more. Re-use of established home sites over several years has been observed in many studies, suggesting the value of these areas for reproduction.
3. *Salmon Reproductive and Rearing Habitat* - Salmon are extremely important agents in ecological processes on the Central Coast, from their importance in terrestrial predator-prey systems (i.e. Darimont et al. 2003) to their role in fertilizing riparian vegetation and shaping the life history strategies of organisms with which they co-evolved (Reimchen 2000). The five species of salmon examined in this report have varied life histories but are

similarly affected by disturbance in freshwater habitat. Although intact hydroriparian zones are critical for salmon, land use impacts throughout a watershed can change stream conditions in such a way that resident salmon populations experience conditions for which they are not adapted. This can lead to stress and population declines. To avert these negative impacts on salmon productivity, and to allow for continued evolution of salmon in the unique stream conditions they inhabit, the entire watershed should be afforded protection.

Summary of protection provided by the CCLRMP

The CCLRMP includes land within several proposed protected areas classifications. The main category, candidate protection areas (CPA), describes those areas proposed for protection by the April 04, 2001 or December 09, 2003 planning meetings. The remaining areas were protected before the CCLRMP planning process or fit within a separate class (Table 1). In this analysis, we do not consider restoration areas (logged), First Nations lead areas, and other non-designated areas as protected. Accordingly, we excluded them from the analysis.

Table 1. Protected area (PA) designations and descriptions

Protected Areas Strategy	Description
Used in Analysis	
<i>New CPA</i>	• Proposed in the December 9th meeting
<i>CPA</i>	• Proposed in the April 4th, 2001 decision meeting
<i>CPA – Goal 2</i>	• Proposed in the April 4th, 2001 decision meeting
<i>Existing PA</i>	• PA in existence before planning meetings
Excluded from Analysis	
<i>New CPA - Restoration</i>	• Restoration-to-protection areas are considered by government to be the same as new CPAs. Separated out into this category based on the amount of logging they have received to date.
<i>First Nations Lead Areas and other areas excluded from analysis</i>	• Areas pending resolution.

Methods

We used ESRI's ArcView 8.3 Geographic Information System (GIS) for spatial analyses. We obtained the GIS data from the Rainforest Solutions Project on which we overlaid critical winter habitat for deer (Darimont et al. 2002), wolf homesites (Darimont and Paquet 2000, 2002; Paquet and Darimont 2002; Darimont et al. unpublished data), and salmon reproductive and rearing habitat (Appendix 1).

Analysis of Deer Winter Range

We limit our current examination to Heiltsuk Territory because deer habitat has not been systematically assessed throughout CCLRMP areas. We identified polygons where deer winter range and proposed protected areas overlap. We then calculated the proportion of deer winter range within each protected area designation (CPA, New CPA, CPA Goal II, and Existing PA) in Heiltsuk Territory.

Analysis of Wolf Reproductive Habitat

We assessed the level of protection from proposed protected areas at three scales: the central or den location (i.e. specific location of the den, often the natal tree), as well as five km and 15 km buffers surrounding the den site. The buffers reflect core activity areas for wolves during the denning period and are therefore appropriate spatial scales for considering geographic locations important for reproductive success (Paquet and Darimont 2002). We excluded islands or landmasses separated by a body of water greater than two km from these buffers.

Analysis of Salmon Conservation Priority in Protected Areas

We analyzed salmon data by combining several sources of data, which were merged into a watershed-based data layer and summarized by values that incorporated the level of protection for each watershed. Data from the Escapement Salmon Database (ESC), the Fisheries Information Summary System (FISS), and the Raincoast Conservation Observational (RCO) database were overlaid on the watershed atlas polygons. We selected watersheds that included presence of salmon. All higher-order and sub-order watersheds above or below the observed site location were merged to form single watersheds that represent salmon populations. We completed this analysis for sockeye (*Onchorhynchus nerka*), coho (*O. kisutch*), chinook (*O. tshawytscha*), chum (*O. keta*),

and pink (*O. gorbuscha*) salmon. Watersheds were summarized by count and then analysed in relation to the protected areas data layer. The protected areas layer was overlaid onto the watershed data for each species. If the protected areas layer captured a complete watershed, we classified the population supported by the watershed as protected.

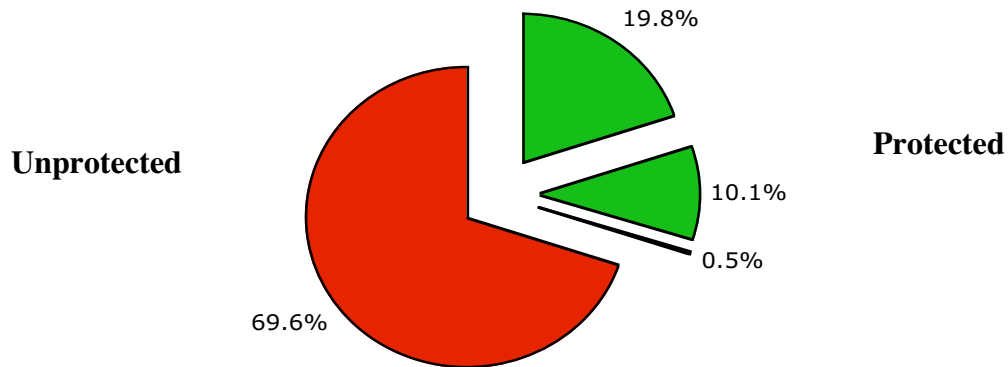
We then completed a second analysis to review and present watershed data compiled by the Nature Conservancy of Canada (Appendix 1). The Nature Conservancy model ranked conservation concern for salmon watersheds. Conservation priority (low, medium, high), a single variable that accounted for the range in escapement trend and biomass (declining-to-stable escapement trend and high-to-low biomass), was calculated by area for all watersheds by species within the CCLRMP. Our analysis examined those rankings for watersheds located in the CCLRMP to determine if the proposed protected areas strategy protects watershed area of salmon populations of ranked conservation concern.

Results and Discussion

Analysis of Deer Winter Range

Nearly seventy percent (70%) of deer winter range in Heiltsuk Territory remains unprotected under recently proposed CCLRMP protected areas (Figure 1). Twenty percent (20%) was protected by the 04 April 2001 agreement. Additional protected areas proposed in the 09 December 2003 meeting cover approximately 10% additional deer winter range. Goal II and existing protected areas protect a combined 0.5%.

Figure 1. Overall protection for deer winter range in Heiltsuk territory provided by CCLRMP protected areas strategy, 2003.



Once converted to industrial tree plantations and entered into rotation schedules, deer winter ranges will likely never regain structural characteristics important for deer. Thus, we consider this habitat non-renewable under current forestry models (Alaback 1982, Schoen et al. 1984). Under the proposed protected areas strategy, we predict serious negative consequences for the region's carnivores (wolves, cougars [*Felis concolor*], wolverines [*Gulo gulo*], bears [*Ursus* spp.]), as well as scavengers and subsistence hunters of deer.

Recently, we cautioned planners about considerable conflict between deer winter range and areas targeted for forestry (Darimont et al. 2002). Analyses using GIS showed that deer winter range and the Timber Harvest Land Base (THLB) covered small portions of Heiltsuk Territory (eight and 11% respectively). Notably, convergence between winter habitat for deer and the THLB was considerable. Nearly 50% of deer winter range occurred in the THLB and was thus potentially targeted for removal. We recommended that these areas be given special consideration in conservation planning (Darimont et al. 2002). Clearly, the CCLRMP failed to consider adequately this important habitat in the CCLRMP.

Analysis of Wolf Reproductive Habitat

The proposed strategy does not protect reproductive areas for wolves. At the smallest spatial scale, which is the central den location, only six of 13 homesites occur within a proposed protected area. Moreover, under the proposal wolves can still be hunted, meaning the strategy provides no security from human disturbance or human-caused mortality. The proportion of five and 15 km buffer

zones provided protection around den sites ranges from zero to 100%. Averaged across sites, only 34% and 27% of habitat is protected in the five and 15 km buffers respectively (Table 2).

Table 2. Wolf homesites and levels of protection afforded in CCLRMP protected areas strategy, British Columbia, 2003. Note: Homesites assigned generic names to protect sensitive geographic information.

<i>Home Site Locations</i>	<i>Central Den Location Protected?</i>	<i>Proportion Protected 5km Buffer</i>	<i>Proportion protected 15km buffer</i>
Site 1	No	14%	49%
Site 2	Yes	100%	100%
Site 3	No	0%	11%
Site 4	Yes	74%	29%
Site 5	No	0%	13%
Site 6	Yes	8%	5%
Site 7	Yes	87%	34%
Site 8	No	0%	13%
Site 9	No	1%	0%
Site 10	No	0%	1%
Site 11	No	0%	34%
Site 12	Yes	69%	39%
Site 13	Yes	88%	29%
Average:		34%	27%

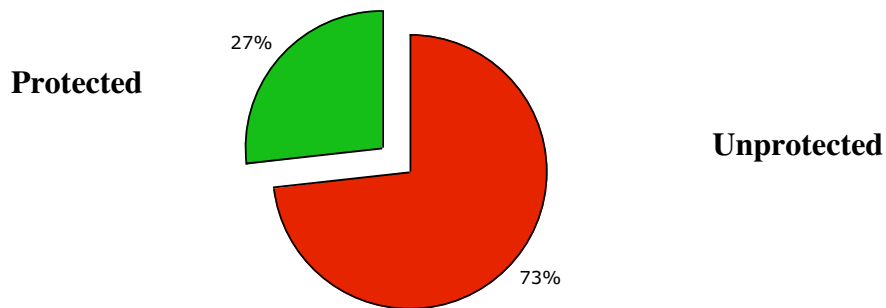
Recently, we cautioned that wolf home sites are not resilient to habitat modification by logging. Furthermore, we emphasized that homesites encompass the central den location and an area of intense use surrounding the natal tree or other den formation (Paquet and Darimont 2002). Clearly, the proposed protected areas strategy affords protection at neither spatial scale.

Due to the nature, frequency and intensity of disturbance, logging at or near homesites will affect wolves at the individual and population level (Paquet and Darimont 2002). Loss of a productive site may reduce reproductive output and consequently fitness. Conversely, because of strong site attachment, wolves may be less willing to abandon the area (immediately). Remaining at the site could elevate the risk of mortality due to road access (vehicular collisions, hunting, and poaching); disturbance factors we now observe on Yeo Island where logging is encroaching on a homesite.

Analysis of Salmon Reproductive and Rearing Habitat

Altered stream flows and siltation due to human land use have significant negative effects on salmon. Therefore, to ensure protection of habitat for salmon populations, watersheds surrounding spawning and rearing areas should be protected in their entirety. We used this criterion as a benchmark to assess how well the CCLRMP protects salmon in the Central Coast region. Our analyses shows that 75% of chum and chinook, 74% of coho, 72% of pink, and 67% of sockeye populations are not provided protection under the proposed protected areas. Overall, 73% of all salmon populations are unprotected by the CCLRMP (Figure 2).

Figure 2. Protection for salmon populations provided by CCLRMP proposed protected areas



The number of unprotected salmon runs is likely much higher than suggested above. Stream surveys conducted by Raincoast and the Heiltsuk fisheries program show that government databases incompletely document salmon presence on the Central Coast. In addition, 11% of the protected land base is designated as “no logging zones” in which other industrial activities such as mining may occur. Combined, this suggests that the percentage of unprotected salmon populations in the region is actually higher than indicated from our present analysis.

Conservation priority for salmon populations has not been sufficiently considered in determining watershed protection in the CCLRMP proposed protected areas. Salmon populations with high conservation priority should be given a greater degree of protection than populations with a low conservation priority. An inadequate level of watershed protection has been proposed for chum, coho, and pink populations of high conservation concern (Table 3). Remarkably, only nine per cent of watershed area used by chum populations of high conservation priority is protected. Out of the five species of salmon, only sockeye populations of high conservation priority have been

afforded proportionally greater protection than populations of lower conservation priority. However, even the extirpation of a single sockeye population is likely to result in the loss of irreplaceable genetic diversity (Nelson et al. 2003). Over the long term, a population's ability to respond adaptively to environmental change depends on the level of genetic variability it contains. Given that most watersheds used by salmon are not protected, the long-term viability of all populations will be diminished by the proposed strategy.

Our analysis shows that only a small proportion of salmon populations within the region are protected overall, and that priority within the protected areas has not been given to salmon populations of conservation concern. Taken together, these results suggest the CCLRMP has not given sufficient attention to salmon conservation. Clearly, if the proposed protected areas strategy is enacted, specific populations will be at risk as the result of increased isolation and habitat degradation. Patterns of population exchange, which serve to maintain small populations (Routledge and Irvine 1999), could also be disrupted. This can result in region-wide declines even greater than is suggested by our analyses.

Most biologists agree that each salmon species consists of a collection of unique populations. These populations contain genetic adaptations essential for short-term productivity and for long-term persistence. Therefore, a fundamental component of salmon conservation is the identification and protection of these unique populations (Waples 1994). Currently no comprehensive description of genetically unique salmon populations exists for the Central Coast. Land use plans designed without this information likely will deplete this essential reservoir of genetic diversity.

Table 3. Percentage of protection afforded to salmon populations ranked by conservation priority under proposed CCLRMP protected areas strategy, 2003.

	Conservation priority		
	high	medium	low
Chinook	27%	21%	44%
Chum	9%	32%	34%
Coho	20%	32%	45%
Pink	18%	25%	40%
Sockeye	36%	30%	11%

The Paradox: Sport Hunting and Industrial Activity permitted in Protected Areas

We have difficulty resolving a disturbing paradox. Specifically, the CCLRMP allows sport hunting, and in some cases industrial activities such as mining, within the proposed protected areas. Consequently, these areas may provide little or no protection of individuals and populations therein. Although the BC provincial government has been planning preservation areas for wolves for many years, we see no indication of these protective measures occurring. Fifteen years ago provincial wildlife officials advocated the creation of “preservation areas” that are “remote and of sufficient size to ensure the long-term viability of wolves”. In these areas, wolves were not to be killed, and the primary objective was to “maintain viable populations of wolves in their natural state” (Archibald 1989). Moreover, another government publication noted, “the ecosystems that offer the best opportunities for the continued existence of these wolf - ungulate populations are those which have not yet been substantially altered by human development...” (Blower and Demarchi 1994). Accordingly, we are surprised that prohibition of sport hunting in protected areas is not central to the proposed CCLRMP strategy.

Conclusions

Ecological systems are characterized by the species that inhabit them and the ecological functions and processes that link species with their environment. Although our assessment has not addressed the broad spectrum of taxa or other ecological considerations important for comprehensive land-use planning (i.e. representation, connectivity, ecological processes, etc.), we have explicitly shown that seven species, widely considered as having ecologically unique and important roles in coastal systems, will be inadequately protected by the proposed CCLRMP strategy. In addition, our assessment, and notably, the CCLRMP has neglected the integrated nature of marine and terrestrial ecosystems.

We found that the vast majority of deer winter range and wolf reproductive habitat is not protected. Likewise, most watersheds that support reproductive and rearing habitat for salmon remain unprotected. Surprisingly, watersheds previously ranked of high conservation concern also show poor protection. We remind planners, government, and industry that the influence of forestry on wildlife populations can be disproportionately larger than the area affected by logging (Darimont et al. 2002).

Coastal islands overall, and outer islands in particular, are poorly protected by the CCLRMP. Yet, ecologists regard islands among the most fragile of all environments. Considering that the Central Coast is largely an archipelago ecosystem, such a fundamental error in conservation planning is difficult to understand. On a continental scale, the variability of the islands and their geographical relationship to an ecologically distinct mainland are the primary reasons the coast is a biodiverse environment that harbours endemic taxa. Our limited knowledge of island ecology, the contribution of islands to evolutionary and ecological processes, and the restricted resilience of island systems demand a precautionary approach to protection.

In short, the protected areas strategy is woefully inadequate in its current manifestation. More research is needed to establish with greater certainty a full and permanent set of measures that will ensure viable wildlife and salmon populations on the Central Coast. Finally, we are dismayed that protected areas strategies do not prohibit mining activities or the killing of carnivores for sport and profit. Consequently, neither habitat nor the species that rely on secure habitat for their survival are protected.

To date, inaccessibility has protected the Central Coast from the large-scale, industrial logging that has severely altered landscapes in adjacent southeast Alaska, south coastal BC, and the Pacific Northwest. Because the “Great Bear Rainforest” is mostly undeveloped and sparsely populated, the original biota remains largely intact. Moreover, most scientists believe that natural ecological and evolutionary processes on the Central Coast operate much as they have throughout recent history. This is a modern rarity anywhere on the planet. A decade or two of industrial large scale landscape change could very well unravel the ecological and evolutionary relationships that evolved and supported this system over millennia. Proponents of the CCLRMP recommendations argue that implementation of Ecosystem Based Management (EBM) outside of protected areas will provide additional and adequate protection for species. We support the theory behind EBM and the need to implement ecologically sound management across the entire landscape. We cannot, however, endorse EBM as a surrogate for protection given the dismantling of provincial environmental regulations, the poor track record of the coastal forest industry, and the level of old growth forest already liquidated throughout coastal BC. EBM within this context represents a dangerous experiment in coastal rainforests.

We fully recognize the difficulties inherent in conservation planning on the Central Coast of BC, including the largely unaddressed ecological issues associated with the discontinuous distribution of wildlife in this archipelago-dominated landscape. The complexity of habitats and frequency of subspecies with limited distribution provide a daunting challenge to maintain biological diversity within the context of ongoing land management. Because of natural and human caused factors affecting the Central Coast, species are confronted with a heightened risk of local or regional extirpation. These factors include: forest fragmentation; natural barriers to dispersal and interaction among individuals; the concentration of past logging in “high volume” old growth stands; low population numbers of some endemics; and the relatively small number of old growth-associated species for which basic research has been conducted. In theory, these risk factors lead to the potential for great impact from relatively little additional habitat alteration.

We believe a science-based approach is the most effective way to conserve individual species, populations, communities, and ecosystems. Such an approach emphasizes the need to address problems at different scales and consider relationships among species and their habitats. Accordingly, the overarching conservation objective for BC’s Central Coast should be a comprehensive strategy that assures habitat is maintained for well-distributed and viable populations of all existing native species. Four fundamental objectives are consistent with the goal of maintaining the native biodiversity of the Central Coast in perpetuity (Noss et al. 1997, Paquet et al. 1999).

- Represent, in a system of protected areas, all native ecosystem types and seral stages across their natural range of variation
- Maintain viable populations of all native species in natural patterns of abundance and distribution
- Maintain secure from human influence ecological and evolutionary processes, such as disturbance regimes, hydrological processes, nutrient cycles, and biotic interactions, including predation
- Design and manage the system to be responsive to short-term and long-term environmental change and to maintain the evolutionary potential of lineages

Clearly, the CCLRMP has not identified or adequately addressed these objectives. We hope our assessment and recommendations will become important contributions to ongoing government-to-government planning and EBM deliberations. Notably, we provide a permanent record of easily identified and serious shortcomings of the proposed protected areas strategy, for which decision-makers will be responsible. We remind readers that analysis provided to the CCLRMP by the Coast Information Team identified 44-50% protection as a minimum for protecting biodiversity (Rumsey et al. 2003). Recognizing that the Central Coast of BC is a biological legacy of global importance, our conclusions reflect a sense of urgency and need for a strategy that has protection as the primary goal. That this objective has been lost to compromise and expediency is unfortunate. Ultimately, conservation efforts on the Central Coast must focus on sustaining species and processes, restoration of degraded habitat, and sustaining human needs.

About the Authors

Dr. Paul Paquet - Paul is an internationally recognized authority on mammalian carnivores, especially wolves. He is currently a Senior Ecologist with Conservation Science, Inc., a fellow with the Conservation Biology Institute, an international consultant and lecturer, and co-director of the Central Rockies Wolf Project. He is an Adjunct Professor of Environmental Design at the University of Calgary, at Brandon University, University of Manitoba, University of New Brunswick, and a Faculty Associate at Guelph University in Ontario. Dr. Paquet has written more than 90 scientific articles and reports and was co-editor of the book *Wolves of the World*.

Chris Darimont - Chris is the Principal Investigator with Dr. Paul Paquet on the Rainforest Wolf Project, a collaboration among researchers, several universities, First Nations, and the Raincoast Conservation Society. Chris is a PhD student at the University of Victoria and author of several scientific articles and reports on wolves and their prey in coastal rainforests. He works closely with local communities, presents at local and regional planning processes and educates via appearances in internationally distributed documentary nature films. He has studied other elusive and threatened wildlife species including Canada Lynx, Northern Goshawks, and Marbled Murrelets.

Dr. R. John Nelson - John is a research scientist with the Raincoast Conservation Society and has published over 30 scientific articles on the genetics and evolution of a wide range of species. He holds a PhD in molecular biology from the University of Wisconsin –Madison. He is an Adjunct Assistant Professor at the University of Victoria teaching conservation biology and molecular evolution. John is also an Associate Researcher at the Catholic University of Goias in Brazil and was previously a Conservation Geneticist with Fisheries and Oceans Canada.

Katrina Bennett - Katrina is the president of Geostreams Consulting and a Masters candidate at the University of Victoria's Water and Climate Impacts Research Centre. Katrina has eight years of experience working with Geographic Information Systems, and has been involved with two successful start-up GIS consulting firms: she co-founded Latitude Geographics Group Ltd. in 1999 and started her current initiative, Geostreams Consulting, in 2002.

LITERATURE CITED

Alaback, P.B. 1982. Dynamics of understory biomass in Sitka spruce-western hemlock forests of southeast Alaska. *Ecology* 63:1932-1948.

Archibald, W.R. 1989. Wolf Management in British Columbia. *In* Wolf-prey dynamics and management proceedings. British Columbia Ministry of Environment. Wildlife Working Report No. WR-40. Victoria, BC.

Blower, D., and R. Demarchi. 1994. Large predator - prey ecosystems. Wildlife distribution mapping. BC Wildlife and Habitat Protection Branch. Victoria, BC.

Carroll, C., Noss, R.F., and P.C. Paquet. 2001. Carnivores as focal species for conservation planning in the Rocky Mountain region. *Ecological Applications* 11:961-980.

Carroll, C., Noss, R.F., Paquet, P.C., and Schumaker, N.H. 2003. Use of population viability analysis and reserve selection algorithms in regional conservation plans. *Ecological Applications* 13:1773-1789.

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

Darimont, C.T., and P.C. Paquet. 2000 The gray wolves of British Columbia's coastal rainforests: Findings from Year 2000 pilot study and conservation assessment. Technical Report prepared for the Raincoast Conservation Foundation. Victoria, B.C. 62 pp.

Darimont, C.T. and P.C. Paquet. 2002. The gray wolves, *Canis lupus*, of British Columbia's Central and North Coast: distribution and conservation assessment. *Canadian Field-Naturalist* 116:416-422.

- Darimont, C.T., T.E. Reimchen, and P.C. Paquet. 2003. Foraging behaviour by gray wolves on salmon streams in coastal British Columbia. *Canadian Journal of Zoology* 81:349-353.
- Darimont, C.T., K. Gerwing, P.C. Paquet, B. Reid, W. McCrory, and B. Cross. 2002. Preliminary modeling of deer winter range in Heiltsuk Territory on the Central Coast of British Columbia. Technical report prepared for the Heiltsuk Nation and the Raincoast Conservation Society.
- Jeo, R.M., Sanjayan, M.A., and D. Sizemore. 1999. A conservation area design for the Central Coast region of British Columbia, Canada. *Round River Conservation Studies*. Salt Lake City, UT.
- Leakey, R., and R. Lewin. 1995. The Sixth Extinction. Doubleday Press. N.Y.
- Nelson, R. J., Wood, C. C., Cooper, G. A., Smith, C. T., Koop, B. F. 2003: Population Structure of Sockeye Salmon of the Central Coast of British Columbia: Implications for Recovery Planning. *North American Journal of Fisheries Management*: Vol. 23, No. 3, pp. 703–720
- Newmark, W.D. 1987. A land-bridge island perspective on mammalian extinctions in western North American parks. *Nature* 325:430-432.
- Newmark, W. D. 1995. Extinction of mammal populations in western North American national parks. *Conservation Biology* 9: 512-26.
- Noss, R.F. and A.Y. Cooperrider. 1994. *Saving nature's legacy: protecting and restoring biodiversity*. Island Press, Washington, D.C.
- Noss, R.F., M.A. O'Connell, and D.D. Murphy. 1997. *The science of conservation planning: Habitat conservation under the Endangered Species Act*. Island Press. Washington, D.C.

- Paquet, P.C., Noss, R.F., Carroll, C., and S. Alexander. 1999. Conservation biology primer and carnivores as conservation species. Prepared for Sierra Club of British Columbia and Central Coast LRMP.
- Paquet, P.C., and C.T. Darimont. 2002. Yeo Island wolf home site recommendation: a proposed solution to the conflict between the home site requirements of wolves and areas targeted for timber harvest. Technical Report prepared for Raincoast Conservation Society, the Heiltsuk Nation, and Western Forest Products.
- Province of British Columbia. Central Coast Land and Resource Management Plan Consensus Agreement Announcement, Dec 11, 2003. Press Release, Ministry of Sustainable Resource Management
- Reimchen, T.E. 2000. Some ecological and evolutionary aspects of bear-salmon interactions in coastal BC. *Canadian Journal of Zoology* 78:448-457.
- Routledge, R. D. and J. R. Irvine. 1999. Chance fluctuations and the survival of small salmon stocks. *Canadian Journal of Fisheries and Aquatic Science* 56:1512-1519.
- Rumsey, C., J. Ardon, C. Ciruna, T. Curtis, F. Doyle, Z. Ferdana, T. Hamilton, K. Heinemeyer, P. Iachetti, R. Jeo, G. Kaiser, D. Narver, R. Noss, D. Sizemore, A. Tautz, R. Tingey, and K. Vance-Borland. 2003. An Ecosystem Spatial Analysis for Haida Gwaii, Central Coast and North Coast of British Columbia. Prepared for the Coast Information Team as part of the CCLRMP process.
- Schoen, J.W., M.D. Kirchhoff, and O.C. Wallmo. 1984. Sitka black-tailed deer/old-growth relationships in southeast Alaska: implications for management. *In* W.R.Meacham, T.R. Merrell, and T.A. Hanley (*Eds.*). Proceedings of the symposium on fish and wildlife relationships in old growth forests (1982). American Institute of Fisheries Research Biologists. Juneau, AK.

Soulé M.E. & Terborgh J. 1999. Continental Conservation: Scientific Foundations of Regional Reserve Networks. The Wildlands Project, Island Press, Washington, D.C.

Terborgh J., Estes J.A., Paquet P., Ralls K., Boyd-Heger D., Miller B.J. & Noss R.F. 1999. The role of top carnivores in regulating terrestrial ecosystems. In: Continental Conservation: Scientific Foundations of Regional Reserve Networks (eds Soulé M.E. & Terborgh J.), pp. 39-64. The Wildlands Project, Island Press, Washington, D.C.

Waples, R. S. 1994. Genetic considerations in recovery efforts for Pacific salmon. *Conservation Biology* 8:884-886.

Woodroffe, R., and J.R. Ginsberg. 1998. Edge effects and the extinction of populations inside protected areas. *Science* 280:2126-2128.

Appendix 1

Data Sets Applied in Analysis

Base Data Layers:

cc_dec9_solution_jan15: Sierra Club/Rainforest Solutions Protected Area polygons.

lwsg_bc: BC Watersheds Atlas watershed polygons (1:50,000).

mr_coast: Macro-reach mapping, streams. FISS linework (1:50,000).

cc_lrm_boundaries: CCLRMP boundaries BC Government (1:250,000).

Deer winter range: Ecotrust Canada and Raincoast Conservation Society. Deer winter range habitat polygons.

Wolf data: Raincoast Conservation Society. Please contact Chris Darimont (cdarimon@uvic.ca) for more information.

Salmon Data:

Escapement database. Coast Information Team. CCLRMP.

FISS salmon database. BC Provincial Government.

Biomass/Escapement Trends: Nature Conservancy Canada watersheds: please contact Kristine Ciruna, Nature Conservancy of Canada, (250) 479-3703 for more information.