HG / QCI Land Use Viewpoints:

Ecological Risk Assessment

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EXECUTIVE SUMMARY

A Land Use planning process has been underway on the Islands of Haida Gwaii since 2003. The Community Planning Forum (CPF) was tasked with making recommendations to the Province and the Haida Nation on a Land Use Plan to guide future land management. As part of the process the LUP CPF committed to incorporating Ecosystem-based Management as a fundamental basis for the plan. Stated goals of EBM on HG / QCI are:

- Protect, maintain and restore ecosystem integrity;
- Maintain spiritual and cultural values;
- Enhance sustainable economic opportunity within the inherent limits of the land to provide opportunity; and
- Foster social and community wellbeing.

A February 2005 Draft Recommendations report was finalised by the CPF and includes consensus recommendations as well as two 'Viewpoints' for areas where agreement was not reached by the CPF. Recommendations were made regarding nine elements that relate to maintaining ecological integrity. For each we have assessed the risk level we hypothesise to result from implementing the consensus and each of the two recommendation Viewpoints. We also compare the risk levels with those projected to result from implementing 'current management'. Defining current management for HG / QCI is complicated by various interim agreements that to date have not been included in timber supply review, so as a result we use two 'Basecase' comparisons – one that reflects Current Management as defined by TSR (BC2) and one that reflects the Current Reality of land use on the Islands (BC3c).

A summary of the results of the analysis is provided here in the Executive Summary. Table 1 provides a summary of protection levels achieved, risk levels and brief rationale for each value.

In the main text of the report, background information and a brief discussion of methods used are presented for each environmental indicator, and risks are addressed in more detail in relation to the individual recommendations. The LUP Recommendations package provides a suite of different recommendations, many of which have implications for a variety of environmental indicators. For example, the old growth recommendations deal directly with representative old forests, but have implications for marbled murrelets, plants, riparian habitats and other values. In each case we attempt to separate out the implications of each individual recommendation from the influence of the broader suite of recommendations. A summary is then presented for each indicator which attempts to sum up the composite effect of the suite of recommendations associated with each Viewpoint.

The key findings are summarised in terms of the risk classes hypothesised to result from each of these four potential land use management regimes. Risk classes are broad designations that aim to categorise the probability of whether a particular recommendation will result in meeting the stated Management Intent . In most cases there is little quantitative information to fully assess this, and the risk classes are based on available information and expert opinion. In addition, where significant uncertainty is associated with a given risk class this is also highlighted. Uncertainty can arise from a number of sources such as lack of information on impacts, lack of understanding of thresholds, lack of certainty around the wording of the recommendation etc. See text on each indicator for additional information.

VIEWPOINTS 1 AND 2: OVERALL RISK LEVEL SUMMARY

Viewpoint 1 combined with the consensus recommendations is hypothesised to result in moderate to high risk overall. Some individual recommendations result in likely low risk to individual values (e.g. for seabirds) and others provide somewhat uncertain medium to low risk levels (e.g. for introduced species, plants, listed species). However the primary factor determining whether ecological integrity will be maintained is the 'coarse filter' protection of ecosystems through protected areas or other protected habitat or unharvested areas (Hunter 1991; Franklin 1993; Noss 1996; Nally et al. 2002; CIT 2004b): this coarse filter maintains ecosystem functions, processes and habitat for countless known and unknown species.

Viewpoint 1 results in an overall high level of protection on the Islands (58% of the forested landbase), but there remain between ¼ and ½ (8-17) of the 32 ecosystem types that are predicted to be at high-moderate or high risk in the future. These higher risk ecosystems tend to be the higher productivity ecosystems, while primarily lower productivity types remain at lower risk. The significant range in terms of the status of higher risk ecosystems in future is because the future status of the unprotected 'non-contributing' (inoperable) landbase is unknown.

Risk status has been defined here using the thresholds defined by the Coast Information Team (CIT 2004a,b), however there remains uncertainty regarding risk thresholds particularly in the 'moderate risk' category. However, given the number and area of ecosystems remaining at 'high-moderate' risk using these thresholds, it would be very difficult to classify Viewpoint 1 as 'precautionary management' even if the thresholds are overly strict. The precautionary principle identifies the need to use caution particularly when the potential outcome is uncertain (i.e. there is a lack of knowledge about potential impacts). Meeting the precautionary principle is an important test of ecosystem-based management particularly at this management scale, in an ecosystem of global significance and where the ability to detect negative impacts in time to change management is technically and logistically very difficult (CIT 2004b, Noss and Cooperider 1994; Mangel et al. 1996; Lindenmayer and Franklin 2002, Peterman and M'Gonigle 2002).

Viewpoint 1 does provide a lower risk approach than Current Management (BC2) overall, with significant reductions in risk for many components such as seabird protection, black bear management, red and blue-listed plant communities. It also provides a lower risk approach to maintenance of the coarse filter because it identifies protection by site series as opposed to variant level protection and has higher levels of protection overall than BC2. However, Viewpoint 1 provides slightly lower protection and therefore a higher level of risk than the 'Current Reality' scenario for some ecosystems.

Viewpoint 2 combined with the consensus recommendations provides a low risk management option for environmental values on HG / QCI. Hypothesised risk levels for almost all indicators are low, though some do not become low until some time in the future (e.g. some old growth ecosystems currently at high risk take time to recover). We are also relatively confident that Viewpoint 2 would result in low risk (i.e. it would have a high probability of maintaining ecological integrity) and is precautionary in the face of unknown or uncertain impacts. Viewpoint 2 provides a low risk management option primarily by allowing ecosystems to deviate from the range of natural variability only to a limited degree. In this way it maintains or recovers values with relatively high certainty. Given the natural disturbance processes in these coastal temperate rainforest ecosystems - which are dominated by low variability and patchy small-scale natural disturbances resulting in large tracts of ancient and old forest ecosystems – this is suggested to be the approach that will provide low risk management with relatively high certainty (CIT 2004a,b).

However, uncertainties do remain under Viewpoint 2. Some old-growth ecosystems are currently at high risk (i.e. have less than 30% of natural levels of old forest remaining) and for these we assume that they can recover full functioning over 250 years; whether this will actually occur is unknown, particularly given uncertainties such as climate change. For other values such as Marbled Murrelet and Northern Goshawk, the recommendations appear to provide relatively high levels of the remaining habitat but the implications to populations of habitat losses to date are unknown, plus it remains unknown how habitat availability and quality will interact with population dynamics into the future. Determining risk levels is further complicated by interactions with introduced species particularly for Northern Goshawks, plant communities, rare and endemic species and seabird populations. Some of the recommendations require considerable cooperation from other parties, (e.g. seabird recommendations), or require considerable and long-term future investment (e.g. introduced species management or developing island-wide site series mapping).

Finally, two additional uncertainties remain: First, adequately managing introduced species poses immense financial, logistical and scientific challenges, but is key to protecting, maintaining and restoring ecological integrity on the Islands. Second, the effects of climate change have not been incorporated into these risk analyses but have the potential to increase risks to ecological integrity on the Islands. As a result Viewpoint 2 likely provides a low risk, relatively certain outcome but this outcome is not guaranteed.

Table 1. Summary of risk classes assigned to each environmental indicator, resulting from two Basecases and two LUP recommendation Viewpoints. BC2 = Current Management Basecase, BC3c = Current Reality Basecase.

Risk Classes: H = high; M = moderate; L = low risk. Square brackets suggest high uncertainty about the outcome. See Summary under each indicator for more detailed discussion. In this table only the final risk level is provided for each value. In the body of the document, individual risks are assigned to each aspect of the recommendations.

Value		BC2	BC3c	Viewpoint 1	Viewpoint 2	Rationale / Comments
Protected Areas	% of Total Land Area Protected	21%	41%	38%*	42%	Protected areas defined as large areas recommended for protection under parks, protected areas or other similar conservation designation.
	% of Total Forest Area Protected in PA's	21%	40.8%	36%	41%	Risk levels are not assigned at this level – see old growth forest retention for risk outcomes from overall retention strategies. Note Viewpoint 1 is uncertain about exactly which areas are included as Protected Areas.
Old Growth Forest Retention	% of Total Forest Area Targeted for Old Growth Retention by LU.	4-28%	4-28%	20-70% [Min. 20% of natural]	30-70% [Min 70% of 'natural']	Targets for Old Growth include contribution from Protected Areas. In BC, targets are applied by BEC variant. In Viewpoints, they recommend applying targets by site series. For analysis targets were applied by site series surrogate (analysis unit by BEC Variant).
	% of Total Forest Area Reserved in Protected Habitat (outside PA's)	11%	12%	22%	42%	Protected Habitat includes areas outside of PA's that are reserved from harvest, including old growth management areas, wildlife habitat areas, riparian reserves and wildlife tree patches
	% of Total Forest Area Protected under All Protected Designations	32%	52.8%	58%	83%	
Ecosystems at Risk Current Condition	# at High # at High-Mod # at Low-Mod # at Low	3 1 4 24	3 1 4 24	3 1 4 24	3 1 4 24	Ecosystem Risk based on CIT (2004a) Framework High = <30% of natural old forest remaining; H-M = 50-70% of natural old forest remaining; L-M = 30-50% and Low = >70% of natural old forest remaining.
Ecosystems at Risk Short to Mid-Term[1]	# at High # at High-Mod # at Low-Mod # at Low	5-16 5-14 13-2 9-0	4-6 3-12 14-11 11-3	3-3 5-14 14-9 10-6	3-3 1-1 6-7 22-21	The range reflects 2 different assumptions regarding the land area included in the assessment, because of the uncertainty as to whether the Non-Contributing Land Base will be harvested or remain unharvested into the future. a. Includes all old forest, including that located in the non-contributing land base b. Includes old forest located within 'protected designations' only.
Ecosystems at Risk: Long-term (250 yrs)	# at High # at High-Mod # at Low-Mod # at Low	4-15 4-13 12-4 12-0	0-3 4-11 11-9 17-9	0-0 4-15 14-7 14-10	0-0 0-0 3-3 29-29	See above re range

[1] This time-frame is defined as the period when all the old-growth has been harvested from the THLB – the exact time it occurs differs for individual ecosystems. See text for more details.

Value		BC2	BC3c	Viewpoint 1	Viewpoint 2	Rationale / Comments
	Overall Old Forest Ecosystem Risk Rating	[H]	[H-M]	[H-M]	L	Overall Viewpoint 2 has considerably more precautionary management, and is close to the low risk management approach suggested by the CIT. Viewpoint 2 has a considerably lower number of ecosystems at high or high-moderate risk compared with Viewpoint 1 (4 compared with between 8 – 17) in the short to mid term. A second key difference in Viewpoint 1 and 2 is in the level of certainty of how many ecosystems are in each risk category over time; this is because of the large area of current non-contributing area that remains unprotected in Viewpoint 1 and which may be harvested if economic conditions allow, whereas in Viewpoint 2 much of this current inoperable forest is clearly identified for protection.
R&B Listed Plants: Overall risk		H	[H]	[L]	[L]	Under Basecase no requirements to protect most of these species; some uncertainty under Current Reality because some management is occurring. Consensus recommendations specify protection of red and blue listed ecosystems within old growth forest reserves. Uncertain because of lack of appropriate information required to implement. Requires significant work upfront to develop strategies, including site series mapping and approaches developed to maintain the values..
Plants Overall Risk		H	[H-M]	[M-L]	[L]	Viewpoint 1 has higher AAC and less riparian protection, so likely results in higher risk (at least in the interim) until strategies are developed for these species. Uncertainty remains due to difficulties in adequately managing introduced species in particular.
Hydroriparian Overall Risk	% of riparian area protected including old growth reserves	52% [M]	65% [M]	67% [M]	97% L	Percent protection is of modeled RFF buffer area – as provided by riparian + old growth recommendations. Old growth protection and Protected Areas under Current Reality (BC3c) and Viewpoint 1 result in higher protection than for just riparian alone (67% versus 52% for Viewpoint 1). Uncertainty as to overall risk levels based on level of protection. Very high level of protection of functional zones under Viewpoint 2. Uncertainty remains due to lack of knowledge of recovery ability of extensive areas that are 'protected' in the Viewpoints but today are already harvested within the hydroriparian zone.
Black Bear Overall Risk		[H-M]	[H-M]	[M-L]	L	Higher, uncertainty risk levels result from both basecases. Unsure of the population links between loss of habitat throughout much of THLB, and future implications of second-growth rotations. Viewpoint 1 lowers risk by providing higher levels of protection, but does not provide many of the specific protection measures seen in Viewpoint 2. Viewpoint 2 results in considerably higher protection of old-growth forests, riparian forests, and consequently a lower AAC. Several risks to black bears and their habitat are reduced through the application of these "coarse filter" and riparian protection measures. Resulting lower open road densities and a reduction in associated human activities over time also likely reduces risk by lowering the likelihood of bear / human encounters. This is in addition to the more stringent measures specifically given for bears under Viewpoint 2. Viewpoint 2 therefore results in low risk management which is strengthened by the additional monitoring that would occur to ensure objectives were being met.

Value		BC2	BC3c	Viewpoint 1	Viewpoint 2	Rationale / Comments
MaMu Habitat Protection	% of **Current** Habitat Remaining over long-term	41-64%	64-79%	73-78%	96%	Range reflects assumptions regarding Landbase included in assessment. a. Protected designations only b. Protected designations and non-contributing landbase
	% of **Historic** Habitat (1800) Remaining over long-term	24-38	37-46%	42-45	55-56%	
Percent decline: Mamu Overall Risk	From **Current** From 1800	59-36% 76-62% H	36-21% 63-54% H-M	27-22% 58-55% H-M	4% 45-44% M-L	MaMu Recovery Team identified that a reduction in habitat of 30% over 30 years from today as being critical They did not assess the longer timeframe, or consider habitat change that has occurred already. Modeling shows that long-term BC2 and BC3c management both exceed the 30% change projection from today, and Viewpoint 1 comes close to it. When considering the ecologically more appropriate timescale (1800 – future) the two BC's and Viewpoint 1 and Viewpoint 2 all exceed (or significantly exceed) the proposed level of change for habitat. Viewpoint 2 provides the most precautionary management, but it remains unclear how this minimum level of change will affect long-term population dynamics.
Northern Goshawk Overall Risk		[H]	[H-M]	[M]	[M-L]	BC3c maintains more old forest than BC, so lower risk. Viewpoint 2 results in considerably higher forest protection; even if not focused at 'nest' sites this will improve habitat quality for NoGo considerably. Viewpoint 1 has much lower old forest retention. Under both Viewpoints, suggest high uncertainty remains due to combination of habitat needs and forage supply in relation to introduced spp. Viewpoint 2 results in higher protection, but unknown effect of retaining potential nest sites. Restoration of habitat has unknown value in specific location. Unknown ability to adequately manage forage in relation to Introduced species.
Seabird Colony Protection Overall Risk	% of Seabird Colonies Protected	88% M (H for some sp)	88% M (H for some sp).	93% [L]	93% [L]	Under Basecase, relatively high level of protection, but concerns raised about efficacy of WHA and WMAs. Consensus recommendations under Viewpoint 1 and 2 should result in low risk, but uncertain because requires extensive cooperation from other agencies/ users etc.
Introduced Species Overall Risk		H	H	[M-L]	[M-L]	BC is high risk because no concerted strategy to manage for Introduced Species, except for a few specific species in some locations. The consensus recommendations could result in low risk, but are difficult to implement (i.e. secure funding / long term planning / consistency required), plus even with concerted effort, adequate management of these species will be difficult and has significant logistical, financial and scientific difficulties.
Total Overall Risk Levels		H	H	[H-M]	[L]	Overall, Viewpoint 1 provides a high to moderate risk level. Individual risk levels for some species are reduced to moderate or low, but overall the coarse filter is the primary determinant of whether ecological integrity will be maintained. Viewpoint 1 results in ¼ to ½ of ecosystems remaining at high-moderate risk in the short-to-midterm. Viewpoint 2 provides a low risk option overall, allowing some individual areas to move to high risk, but maintaining ecosystems at lower risk overall into the future. Uncertainty remains overall and arises from a wide variety of factors, including effects of climate change that may overrule the assumptions made here, or the practical realities of managing introduced species; this will be a fundamental aspect of maintaining ecological integrity in future.

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ACKNOWLEDGEMENTS

This is one document in a series of reports that have examined indicators associated with current and potential future land management on Haida Gwaii / Queen Charlotte Islands. Other reports include:

- A summary of the Current Condition of the Islands which summarises some of the key changes that have occurred over the time period 1800 – 2000, and predicts the additional changes that will likely occur in the future (2004 – 2254) if the current management practices and policies are continued (Holt 2005a).
- A summary of the ecological and timber supply outputs resulting from a wide variety of potential scenarios (Holt 2005c),
- A summary of the potential environmental consequences associated with consensus recommendations and two proposed LUP Viewpoints by the LUP CPF (Holt 2005b: this document).

Reports are available at: http://srmwww.gov.bc.ca/cr/qci/

And at: www.veridianecological.ca

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OVERVIEW

Ecosystems and species of the Haida Gwaii/ Queen Charlotte Islands (HG/ QCI) are recognised as globally significant. Temperate rainforests, endemic species and globally significant seabird populations are some of the elements that make the Islands ecologically unique today. Yet many changes have occurred since the 1800's, including the impacts of harvesting of forests, fish and introductions of many non-native species.

The Haida Gwaii/ Queen Charlotte Island Community Planning Forum (CPF) is tasked with developing a Land Use Plan (LUP) for HG / QCI which will guide future management of the land and its resources. The CPF committed to defining and implementing Ecosystem-Based Management (EBM) as a fundamental basis of the Plan.

This document provides environmental analysis for the HG / QCI Land Use Plan Recommendations, which includes consensus recommendations and two Viewpoints where agreement was not reached (Viewpoint 1 and 2). In addition, it provides results for two comparison scenarios known as 'Basecases'. Basecase 2 reflects 'current management' as defined by MoF TSR2, and Basecase 3c reflects a 'current reality' scenario which includes additional constraints. Both Viewpoints and both Basecases were modeled spatially wherever possible, and the environmental analysis included a projection of values through time.

Full details of the two Viewpoints is available in the February 2005 Recommendations document (Process Management Team: available at http://srmwww.gov.bc.ca/cr/qci/index.htm

A detailed discussion of Basecase results can be found in Holt (2005a) for BC2 and in summary form in Holt (2005c).

Table 2 summarises key elements of each scenario.

Table 2. Key elements of two Viewpoints and two Basecases.

Scenario	Key Details
Basecase 2: Current management	A baseline scenario that is defined by the current legislative framework for land and resource management. Consistent with the MoF Timber Supply Review (II) Process, timber supply modeling assumptions reflect current legal land designations for parks and protected areas and forest practice requirements that are mandated by the Forest Practices Code and FRPA. Also referred to as Base Case 2 in timber supply modeling reports. Reported on in Current Environmental Conditions Report (Holt 2005a).
Basecase 3c: Current Reality	An alternate baseline scenario that reflects current management practices on the Islands, including those that are not legally mandated. Modelling assumptions are consistent with the Current Management scenario, with three key exceptions: 1. The protected landbase includes all 14 Haida Protected Areas. 2. A maximum harvest level of 600,000 m3/yr is applied to Tree Farm License 39 3. Stand level retention requirements are increased by 20%. Also referred to as Base Case 3c in timber supply modelling reports.
LUP Viewpoint 1 LUP Viewpoint 2	Land Use Plan Viewpoints defined by the consensus recommendations and either the Viewpoint 1or Viewpoint 2 recommendations identified in the February 2005 Draft LUP Recommendations Package. Viewpoint 1 and Viewpoint 2 agree on the following management recommendations: - Some elements of black bear management - Red and blue listed wildlife species - Red and blue listed plant/ communities - Seabird management - Introduced species Viewpoint 2 provides different, and in general, more stringent management recommendations than Viewpoint 1 in relation to: - Protected Areas - Old Growth management

Scenario	Key Details
	- Riparian management - Marbled Murrelet - Northern Goshawk

For each of the two Viewpoints and two Basecases, the potential environmental implications are discussed for 10 environmental indicators. The first three indicators are 'coarse filter' indicators and the remaining 7 indicators are species-level and deal with particular species of concern on the Islands. A more detailed discussion of how indicators were chosen and additional commentary on species of concern is found in Chapter 1 of the Environmental Conditions Report (Holt 2005a).

For each indicator, a short introduction summarising the importance of the indicator is given and then the potential implications of each Viewpoint in comparison to the two Basecases is presented. A Summary is provided for each indicator which assesses the potential implications of each Viewpoint against the stated Management Intent (from LUP Recommendations Feb 23rd, 2005). This document focuses specifically on the intent that relates to maintenance of environmental values rather than cultural/ social / economic values.

THE CONTEXT: ASSESSING THE ENVIRONMENTAL IMPLICATIONS OF MANAGEMENT RECOMMENDATIONS

This work attempts to assess the implications to environmental values from different LUP Viewpoints. This is on one hand a simple process – for conservation of environmental values ***more is always better***. It is only when it comes to making trade-offs that it becomes more difficult to assess implications in light of competing values. There are different types of trade-offs that are made: the first trade-offs come between maintaining broad environmental values, social values and economic values. This trade-off sets a 'retention budget' in effect – i.e. how much forest or resources is going to be assigned to 'maintaining biodiversity values'. Once this has been decided then other trade-offs come into play, in particular, how to allocate a fixed budget between the different and perhaps competing elements of biodiversity. In this document, we are dealing with the first decision-making trade-off only, which sets the level of risk deemed appropriate for selected biodiversity indicators in context with maintaining social and economic values.

The LUP CPF committed to undertaking Ecosystem-based management, which sets some baseline requirements for assessing adequacy. Stated goals of EBM on HG / QCI are:

- Protect, maintain and restore ecosystem integrity;
- Maintain spiritual and cultural values;
- Enhance sustainable economic opportunity within the inherent limits of the land to provide opportunity; and
- Foster social and community wellbeing.

This partially clarifies the environmental goal, so the question becomes: 'how sure' do you want to be that ecosystem integrity is being protected, maintained and restored? In assessing the 'adequacy' of recommendations then it is possible to ask: 'is a recommendation likely to maintain a value, and how certain are we that it will?

It is the importance of understanding just how "risky" the broad budget is for environmental values that this work has been undertaken. It is important to identify the difference between knowing whether values are generally being maintained within a 'safe' range but slightly better in one option than other, as opposed to understanding whether one Viewpoint is quite likely to maintain the value and another Viewpoint is quite likely to not maintain the value. Having a clear 'baseline' for comparisons is key to making this distinction (BC MoE 2000).

Any suite of management recommendations will provide differently for different values. Typically in BC the implications of decisions on timber supply has been analysed in detail; this process has seen great effort and has been developed into a highly analytical process. Until recently, analysis of the environmental or social implications has been considerably less well developed. In a series of documents for the HG / QCI Land Use Plan the potential implications of decisions to environmental indicators has been explored in detail. For some of these indicators, such as Old Growth Forests, or Marbled Murrelet habitat, quantitative analyses of trends in habitat supply have been possible. For others, such as plant communities or introduced species, only a qualitative discussion has been possible.

In this document, which assesses the proposed CPF Land Use Plan recommendations, a key task is to assess the consensus recommendations and two Viewpoints in terms of their broad implications to a suite of environmental indicators. In order to provide useful information to the reader, we've presented the results of in terms of simple categories of risk – High, Moderate and Low Risk that the particular environmental value will be maintained.

The framework for determining risk is conceptually simple: the closer a scenario is to the 'natural' the 'lower the risk' to environmental values. This framework has been widely used (e.g. Landres et al. 1999) and is generally accepted. However, identifying the thresholds for different levels of risk is more complex. For some values there are some standards against which assessments can be made, for example for old growth forests an expert panel used available science to identify 'low' and 'high' risk approaches to management for coastal ecosystems (CIT 2004a,b). We used a similar system in this document (see OG methods section). For individual species it is more difficult; the long term goal is presumably to maintain healthy, robust stable populations, but for most species information on population dynamics is just not available. Again, as a surrogate, where feasible, we examine habitat availability compared to natural levels as recommended by others (e.g. MMRT 2003). However, even within this framework identifying whether an option is sufficient to maintain viable long-term populations remains difficult.

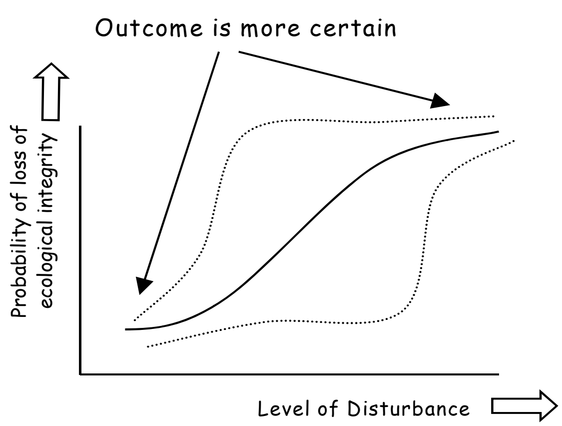


Figure 1. Uncertainty and how to assess potential management risks (from CIT 2004a).

Acknowledging uncertainty is important because all things are uncertain, but some things are much more uncertain than others. Figure 1 shows how certainty usually increases towards the ends of the management spectrum – if the proposed management strategy provides very high protection or very low protection for a value then you can be fairly certain that it will either succeed or fail in maintaining the value. At mid-ranges within the management spectrum the uncertainty increases making it increasingly difficult to predict the outcome for the value. This idea has been captured where possible in the summaries of risks and in the discussion for each indicator.

In this summary therefore, we identify each scenario with a risk rating where possible (high, moderate or low). As Fig. 1 shows, the uncertainty associated with identifying something as 'high' or 'low' risk tends to be less. At the same time, we identify where we are uncertain. Uncertainty can come from various sources, and these areas are discussed in the text. In each case the broad EBM goal of *protect, maintain and restore ecological integrity,* plus the more specific Management Intents provide the objectives that are compared against.

ECOSYSTEM REPRESENTATION AND OLD GROWTH FORESTS

British Columbia coastal forest ecosystems are globally unique and provide habitat assemblages and stand structures that are locally and globally important for maintenance of biodiversity. HG/ QCI is part of the perhumid temperate rainforest, which occurs from S.E. Alaska to the northern tip of Vancouver Island and which differs ecologically from the drier Douglas-fir dominated forests of southern coastal BC and the US. The perhumid temperate rainforests are ancient, structurally complex and act as reservoirs for biological diversity. Studies of arthropod diversity in tree canopies in coastal British Columbia have found that some species rely on microhabitat features that are only found in intact old growth (Winchester and Ring 1999). Animal species associated with old forest tend to rely on habitat requirements such as large diameter snags and trees or an abundance of coarse woody debris; in general, these structural attributes are not readily available in younger forests or managed stands and are not easily or quickly created. On HG/ QCI some coastal endemic and rare species are associated with old growth forests, and the Haida Nation use many attributes of these old forests for a wide variety of cultural uses.

Maintaining representative ecosystems and old forest in suitable abundance and distribution is a coarse filter approach to maintaining the biodiversity and ecological processes that make up ecological integrity (Franklin 1993; Nally et al. 2002). Following the natural disturbance paradigm, landscapes more closely resembling natural landscapes in the abundance and distribution of old forest have a higher probability of maintaining ecological integrity, or in other words, are at a lower risk.

Two different statements of Management Intent relate to ecosystem representation:

<u>Protected Areas:</u>

- A network of protected areas across the Islands that includes:
  - Representative areas of the natural biodiversity of the Islands;
  - Ecologically important areas such as high value habitat for rare, threatened and endangered species;
- Preservation of ecological integrity and sensitive features in all protected areas.
- Provision of a range of cultural, recreational and tourism activities within protected areas.

<u>Old Growth Retention:</u>

- Conservation of the natural biodiversity of the Islands, including the full range of functional ecosystems, over time and at all spatial scales
- Protection of red-listed and locally endangered plant species and communities, and culturally important plant species.
- Maintenance of viable and function blue-listed species populations and locally threatened plant communities within a natural range of variability.

The LUP recommendations include two Viewpoints for a) new Protected Areas and b) the amount of old growth to be reserved by landscape unit. The Recommendations do agree on using site series as the fundamental unit with which to apply the recommendations.

Two indicators of coarse filter ecosystem protection are provided below:

I. Protected Areas Representation Analysis

This analysis is an assessment of ecosystems captured within proposed Protected Areas in each scenario. For this analysis, ecosystems are broadly defined as biogeoclimatic variants within ecosections. This measure is generally used provincially as an approach to assessing Protected Area representation. No risk levels are provided here because this is difficult to assess without considering the broader level of forest protection. Risk levels are provided for the total protection levels under the Ecosystem Risk Assessment.

II. Ecosystem Risk Assessment

This provides a more complex representation analysis that considers ecosystems at a finer scale, and also considers the diversity of different types of ecosystem protection in the landscape. This analysis reports on the number of ecosystems predicted to be in each risk category as a result of the two Basecases and LUP Viewpoints.

I: PROTECTED AREAS ANALYSIS

The Protected Areas analysis summarises the level of protection with legislated Protected Areas resulting from the four scenarios, the details of which are summarised in Table 3 below:

Table 3. Details of Protected Areas assumed to exist under two Basecases and two LUP Viewpoints.

Scenario/ Recommendation	Protected Areas included
Current Management (BC2)	Current legislated protected Areas: = Gwaii Haanas National Park Reserve and Haida Heritage Site, Naikoon Provincial Park and Vladimir Krajina Ecological Reserve
Current Reality (BC3c)	Current legislated PA's (GH, Naikoon, VKR) plus all Haida Protected areas
Viewpoint 1	Current legislated protected areas plus all Haida Protected Areas except Tlell and portions of Duu Guusd (see Appendix 1 map).
Viewpoint 2	Current legislated Protected Areas plus all Haida Protected Areas plus provincial study areas (Appendix 1)

METHODS

This analysis assesses the ecosection representation by Ecosection and biogeoclimatic variant. This is the provincial approach to achieving ecosystem representation in Protected Areas across the province.

COMPARISON OF BASECASE AND VIEWPOINTS

The area and percent under each of the two Basecases and Viewpoints is summarised in Table 4. The percents are of 'total area' on the Islands, not just forested area.

Table 4. Area and percent of Protected Areas under the two Basecases and Viewpoints, within Ecosections and BEC Variants. Minimum size included = 500ha.

Ecosection	BEC Variant	Total Area	Protected under BC2		Protected under BC3c		Protected under Viewpoint 1		Protected under Viewpoint 2	
			Area	%	Area	%	Area	%	Area	%
Queen Charlotte Lowland										
	CWH wh 1	326,928	69,825	21	128,831	39	110,919	34	128,831	39
Queen Charlotte Lowland Total		327,069	69,825	21	128,875	39	110,957	34	128,875	39
Queen Charlotte Ranges										
	AT unp	7,528	2,521	33	3,980	53	3,556	47	3,980	53
	CWH vh 2	302,588	104,777	35	201,340	66	186,125	62	201,340	67
	CWH wh 1	1,000	798	80	974	97	968	97	974	97
	CWH wh 2	3,262	0	0	2,288	70	420	13	2,288	70
	MH wh 1	32,758	8,954	27	17,604	54	14,652	45	17,604	54
Queen Charlotte Ranges Total		347,321	117,051	34	226,235	65	205,763	59	226,235	65
Skidegate Plateau	AT unp	2,439		0	591	24	245	10	591	24

Ecosection	BEC Variant	Total Area	Protected under BC2		Protected under BC3c		Protected under Viewpoint 1		Protected under Viewpoint 2	
	CWH wh 1	227,029	34,153	15	52,192	23	49,823	22	52,192	23
	CWH wh 2	80,742	4,106	5	11,372	14	10,182	13	11,372	14
	MH wh 1	664		0	208	31	175	26	208	31
	MH wh 2	18,890	5	0	2,122	11	1,812	10	2,122	11
Skidegate Plateau Total		330,380	38,270	12	66,563	20	62,311	19	66,563	20
Grand Total		1,004,769	225,147	22	421,673	42	379,031	38	421,673	42

SUMMARY

Under both Basecases and the two Viewpoints the level of ecosystem representation in Protected Areas varies by ecosection and by biogeoclimatic variant. Looking at these together, the total Protected Areas totals vary between 22 – 42% (Table 4). This exceeds the political target of 12% set in the 1990s for protected areas across the province.

Individual biogeoclimatic variants show more variability: under Current Management the CWHwh2 tends to be under-represented (0% in the Queen Charlotte Ranges and 5% in the Skidegate Plateau). Under Viewpoint 1 the lowest level of protection occurs in the in the MHwh2 in the Skidegate Plateau (10%) and in the CWHwh2 which has 13% protection in both the Queen Charlotte Ranges and Skidegate Plateau. Under Viewpoint 2 the lowest level is 11% in the MHwh2 in the Skidegate Plateau and in the CWHwh2 which has 14% protection in the Skidegate Plateau.

The total area of Protected Areas is increased under both Viewpoints from Current Management, though Viewpoint 1 provides slightly lower protection overall than under the Current Reality scenario.

The Coast Information Team (2004a) recommended that an ecosystem-based management approach would require significantly higher levels of retention in coastal ecosystems than the 12% political target for Protected Areas. They do not specify a required level of Protected Areas but recommend overall that 70% of natural levels of old forest are likely to provide low risk management in these ecosystems. Protected Areas form one part of meeting these recommended goals, and the protected Areas summaries will be combined with additional old-growth reserves below to determine overall risk from the different Viewpoints.

II: OLD GROWTH ECOSYSTEM RISK ASSESSMENT

This assessment looks at representation of ecosystems at a finer scale, and in all forms of protection across the landbase. We are focusing on ‘old growth forest’ as a key indicator of the likely functioning of each forested ecosystem on the Islands. This is because old growth forest was historically the prevalent stage of forests on the Islands, and because old growth provides the habitat for many other species and values (see Chapter 2.1 of Environmental Conditions Report Holt 2005a). Forests identified as protected in the Protected Areas analysis are included in the following finer scale analysis.

Old growth forest is defined for the purposes of this analysis as ‘those forests that are at least 250 years old’. We know that many of the natural old forests on the Islands are considerably older than 250 years, but we do not know their exact age. We use this age cut-off because we know that any forests labeled as 250 years old or greater were established naturally (i.e. there is no industrial harvesting on the Islands from that long ago), and so these forests represent true ‘natural’ old forests.

In the recommendation Viewpoints, targets are set for ‘retention of old forest’. However, for some ecosystem types, the current level of old forest is less than the target. In these cases, forest that is not old growth (i.e. areas that have been logged or naturally disturbed) can be allowed to grow through time rather than being harvested in a second rotation. We report out on this ‘recruitment strategy’ for old growth in some of the results, however note that we are not making any assumptions about when, or whether, harvested forests become true old growth forests again.

However, we are saying that at 'some point in the future' forests that are retained and allowed to grow old will eventually become older forests, and will have many, if not all, of the natural characteristics of old growth. Although we don't know when that will be, and it will likely differ for different forest types and different aspects of functioning, we do know it will occur much faster if the stand is not logged in the second rotation.

RECOMMENDATIONS FOR OLD GROWTH

The Old Growth Ecosystem Risk Assessment analysis summarises the implications of following the recommendations under each Basecase and Viewpoint for old growth retention[2] (Table 5).

Table 5. Details of Old Forest requirements assumed to exist under two Basecases and two LUP Viewpoints.

Scenario/ Recommendation	Old Forest Requirements
Current Management (BC2)	4 – 28% old forest retention required, at the level of biogeoclimatic variant. Varies by Biodiversity Emphasis of LU; not yet spatially implemented on HG/ QCI but is intended to be in future.
Current Reality (BC3c)	4 – 28% old forest retention required, at the level of biogeoclimatic variant. Varies by Biodiversity Emphasis of LU. Not yet spatially implemented.
Viewpoint 1	Reserve a minimum of 20% of natural old forest levels by site series, recognising this will not be possible everywhere due to historic harvesting (see Appendix 2).
Viewpoint 2	Reserve a minimum of 70% of natural old forest levels (between 63 – 69%) by site series. At the landscape unit level, allow a minimum level of old growth retention as outlined in detail in Appendix 2.

METHODS AND ASSUMPTIONS

This analysis of environmental trends uses the output of timber supply modeling to examine projected trends for different ecosystems (and other values) over time under different recommendations or land use rules. Many assumptions are made in that process and the understanding of both environmental and timber trends reflects the future reality only as well as future actions can be captured within the modeling process.

In addition to these 'technical' assumptions key 'interpretation' assumptions are summarised below:

DEFINING ECOSYSTEMS

A well accepted approach to maintaining ecological integrity of forest ecosystems is to ensure that representative examples of all ecosystem types are maintained across the land and through time. Therefore a key focus in all of the scenarios explored has been to assess how much of each ecosystem type on the Islands will be protected through time.

We therefore needed a definition of 'ecosystems'. The most appropriate information would have been site series mapping but this was not available for the islands, so the Process Technical Team created a forest ecosystem classification based on a combination of a) dominant tree species and b) productivity of the site which are termed 'Analysis Units' (AUs). This resulted in definition of 32 Analysis Units within biogeoclimatic variants (no unit less than 500ha was included in the analysis). Table 6 summarises the areal extent of each of these ecosystems.

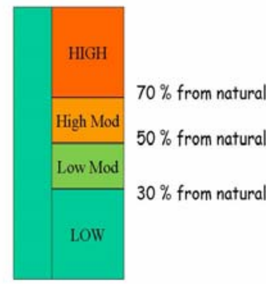
It is important to remember throughout this report that all species of trees can be found within any of the analysis units – e.g. many cedar trees can be found within hemlock-leading stands, or vice versa. This approach to categorising different types of forest identifies the leading species (e.g. 40% hemlock; 35%

[2] Note that these recommendations are inclusive of, not additional to, the recommendations for Protected Areas analysed above.

cedar; 25% spruce = a hemlock-leading stand) but does not suggest that the stands are a single tree species.

ECOLOGICAL RISK

Ecological risk is assessed by determining the amount of old forest remaining on the landbase, relative to the amount of old forest that would have been present under historic conditions estimated for 1800. Consistent with the framework recommended by the Coast Information Team (CIT 2004a, 2004b), high risk is defined as ecosystems having less than 30% of the natural levels of old forest; low risk are ecosystems with greater than 70% of natural levels of old forest, and the moderate risk category (30-70%) is broken into two categories: 30-50% representing low to moderate risk and 50-70% representing moderate to high risk, see adjacent Figure.



Ecological risk is defined here in terms of a change from the 'natural' amount of old-growth found under natural disturbance conditions. For this project, the amount of old-growth present in each ecosystem on the Islands in 1800 was estimated by 'standing up' forest that has been harvested since that time, using a series of assumptions (see Holt 2004a for details). A comparison of these numbers with others developed for coastal ecosystems (e.g. from CIT and MoF) is provided in Holt 2005a Chapter 2.1.

Table 6 summarises for each ecosystem the forested area on the Islands (ecosystems are numbered for cross-referencing other similar tables of results), the percent of the forested landbase that it represents, the percent old growth assumed to be present in 1800. In addition, the final column summarises the Current Condition of the landscape by summarising the percent old growth found in 2003 (when the analysis was undertaken). Units that are considered a high (less than 30% of natural levels) or high-moderate risk (between 30 and 50% of natural levels of old growth) are highlighted in red and yellow respectively.

Table 6. Ecosystem summary: Area and percent forested landbase and percent old growth estimated to be present in 1800. Final column shows percent old growth existing in 2003 (i.e. Current Condition) as a percent of the amount present in 1800. High and high-moderate risk ecosystems are shaded red and yellow respectively.

Ecosystem Ref #	Analysis Unit	BEC Variant	Total Area	% Forested Landbase	Old growth in 1800 (%)	Old growth in 2003 (%) as % of 1800
1	CedarGoodMedium	CWHvh2	3,725	0.5	95	96
2	CedarGoodMedium	CWHwh1	14,340	1.9	99	75
3	CedarGoodMedium	CWHwh2	1,347	0.2	92	96
4	CedarLow	CWHvh2	103,396	13.6	92	96
5	CedarLow	CWHwh1	182,121	24.0	98	84
6	CedarLow	CWHwh2	16,000	2.1	97	91
7	CedarLow	MHwh1	4,404	0.6	94	82
8	CedarLow	MHwh2	2,364	0.3	98	77
9	CedarPoor	CWHvh2	11,545	1.5	96	88
10	CedarPoor	CWHwh1	30,157	4.0	99	71
11	CedarPoor	CWHwh2	3,692	0.5	99	95
12	HemlockGood	CWHvh2	6,326	0.8	88	31
13	HemlockGood	CWHwh1	25,553	3.4	99	22

Ecosystem Ref #	Analysis Unit	BEC Variant	Total Area	% Forested Landbase	Old growth in 1800 (%)	Old growth in 2003 (%) as % of 1800
14	HemlockGood	CWHwh2	1,889	0.2	98	55
15	HemlockMedium	CWHvh2	20,857	2.7	89	71
16	HemlockMedium	CWHwh1	103,483	13.6	99	17
17	HemlockMedium	CWHwh2	16,951	2.2	99	30
18	HemlockMedium	MHwh1	1,064	0.1	95	91
19	HemlockMedium	MHwh2	1,085	0.1	98	53
20	HemlockPoor	CWHvh2	60,496	8.0	88	93
21	HemlockPoor	CWHwh1	51,645	6.8	90	70
22	HemlockPoor	CWHwh2	23,163	3.1	95	95
23	HemlockPoor	MHwh1	6,577	0.9	91	98
24	HemlockPoor	MHwh2	5,072	0.7	94	92
25	SpruceGood	CWHvh2	6,682	0.9	94	64
26	SpruceGood	CWHwh1	12,741	1.7	97	55
27	SpruceGood	CWHwh2	578	0.1	98	76
28	SpruceMediumPoor	CWHvh2	16,466	2.2	91	93
29	SpruceMediumPoor	CWHwh1	19,006	2.5	94	77
30	SpruceMediumPoor	CWHwh2	2,988	0.4	97	95
31	SpruceMediumPoor	MHwh1	891	0.1	92	90
32	SpruceMediumPoor	MHwh2	649	0.1	99	90
	Grand Total		758,753	100.0		71

ASSUMPTIONS ABOUT LANDSTATUS

This report provides an assessment of the forested landbase of HG/ QCI. The forested landbase is defined as all areas that can support productive forest (i.e. areas capable of supporting commercial harvest), though not all those areas have merchantable trees on them today. Areas of rock, water bodies, wetlands, alpine areas etc. are not included in the forested landbase. The area of the islands is 1.003 million hectares, of which approximately 760,000ha is classified as forested landbase.

Across the landbase of HG/ QCI, old growth forest is retained in the landscape in the future for different reasons; as part of Protected Areas, as part of areas maintained within the timber harvesting landbase but identified as Protected Habitat (e.g. old growth management areas, wildlife habitat areas, riparian corridors or wildlife tree patches), as part of the inoperable (non-contributing) landbase and as old forest remaining in the timber harvesting landbase before it is harvested. The implications of the different landstatus relates to the certainty that old forest currently existing there today will remain into the future.

Old forest in Protected Areas is likely to be retained into the future, with the exception of loss due to natural disturbances. It tends to occur with a natural distribution of patch sizes.

Old forest within Protected Habitat is forest within the timber harvesting landbase which is 'excluded' from harvest by policy, (e.g. old growth management areas, riparian management areas, wildlife habitat areas , stand level retention etc.). This forest is likely to be retained from harvesting, but its quality and long-term viability are unknown. Stand level and riparian corridors are likely to exist as smaller patches and may be impacted by windthrow, edge effects and lack of interior forest.

Old forest in the timber harvesting landbase: old forest remains in the THLB today but all the remaining old forest is forecast to be fully harvested in the upcoming decades, until the entire THLB moves to a second rotation (i.e. harvesting forests that have already been harvested).

Old forest in the 'inoperable' (or unprotected non-contributing) landbase tends to exist in larger contiguous patches. It is identified as 'inoperable' as a result of current economic conditions, however there are no constraints from harvesting (i.e. it is not 'protected' except by the current economic climate). Today there is harvesting occurring in areas classed as 'inoperable' (one licensee estimated that 40% of the current Forest Development Plan was in the 'inoperable' landbase, though this varies by licensee on HG / QCI: L. Malkinson pers. comm.). It is likely that this trend will increase in future as large volume old growth becomes scarce and as new markets are developed; this has been the trend to date across BC.

Because the non-contributing (inoperable) landbase is so large on HG/ QCI, the assumptions made about when and if it is harvested become crucial to understanding potential future risks for different ecosystems.

MODELING FOREST TRENDS THROUGH TIME

The results presented in this work are a direct outcome of Timber Supply Analyses. In that process, assumptions are made about how forests will be harvested through time (based on rules and regulations provided from government, or from the CPF in their recommendations), and the impacts on timber supply are modeled through time. This analysis takes the output from that work and interprets it for environmental values, in particular old-growth for this chapter.

In the modeling process, the amount of old-growth forest on the landscape changes in a number of ways:

a) **Old forest is present today and gets harvested sometime in the future.** In the model only forest located in today's THLB is harvested. The time period at which all the old forest in the THLB has been harvested differs for individual ecosystems. Table 3 in the Appendix shows how the amount of old forest is estimated to change through time in the THLB under Current Management to provide an example of when no old forest remains in the THLB. For example, hemlock good in the CHWvh2 already has (almost) no old forest in the THLB already (this occurred sometime between 1950 and 2000), and for others e.g. for cedar low in the CWHwh1, old forest in the THLB is expected to remain until sometime between 2100 and 2150. This pattern will change under the timber supply analysis for each LUP Viewpoint but the pattern expected to stay relatively similar across the different types under each scenario.

b) **Old forest is present today and is never harvested in the model.** Forest that today is considered uneconomic (inoperable or unprotected non-contributing in our results) remains on the landscape into the next 250 years, in the model. As outlined above, for some ecosystems (the least productive) this may be the case into the future, but for others the NC is already being harvested and this trend is very likely to continue in future.

c) **Young forest is present today but is in an area identified as a Protected Area or Protected Habitat.** Over time this forest will 'grow back' towards an old growth state since it won't be harvested again in the model. Here, we assume that once that forest becomes 250 years old it regains 'old forest' status and acts to reduce risk. This is not to suggest that a 250 year old forest is exactly the same as an antique coastal old growth forest, but it is assumed it will be retained 'in perpetuity' and sometime in the future it should become fully functioning old forest.

Understanding trends in old forest over time therefore requires following what is occurring in each of these categories over time. Since each area changes over time, for different ecosystems, and under different assumptions, we use three different reporting periods to try to understand risk over time for different ecosystems.

REPORTING PERIODS

In the analysis below we examine number of ecosystems in each risk class at three time periods:

Current Condition: this describes the number of ecosystems at risk based on the current state of the HG / QCI landbase (year 2003). This analysis is reported on in detail in Holt 2005a.

Short to Mid-Term (S-M-T): this describes the results sometime in the short to mid-term when all the old forest in the THLB has been harvested. The exact date that it occurs will differ for individual ecosystems (see discussion above about THLB and Appendix 3 for examples of change under Current Management). Within this time period of short-to-mid term, two 'book-ends' are given – one that assumes that today's inoperable areas remain fully intact at that time, and the other that assumes that the entire inoperable landbase has been harvested at that time. The reality will be somewhere between the two, and most likely towards the 'intact' status. However, individual higher productivity types may have seen significant harvesting in the NC at that time.

Long-term: this describes the number of ecosystems at risk in 250 years from today. It assumes that the THLB has been fully harvested at that time (as seen in the timber supply model), and that old-growth forest remains in protected areas and habitat. In addition, any areas that are not old-growth today but are designated as 'protected' today will have become old-growth in that timeframe. Similar to the S-M-T, two bookends are also given that make different assumptions about the inoperable landbase:- a) that today's inoperable areas remain fully intact at that time, and the other that assumes that the entire inoperable landbase has been harvested at that time. Again, the reality will be somewhere between the two, and its exact location is very hard to predict. However, over this longer timeperiod the uncertainty is much greater that the non-contributing forest will remain for any ecosystems: for the lowest productivity ecosystems they may remain 'inoperable' into the future however others are already being harvested today and this trend is very likely to increase in future. Past experience shows that as resources become less available previously uneconomic areas become economic and technology allows increasingly difficult areas to be accessed. In the long-term then, the risk to ecosystems is more likely to be represented by assuming that today's inoperable forest will not remain intact in future. Book-ends provide the implications of either solution in the results below.

The timber supply analyses provide slightly different reporting periods – current condition and long-term are the same time periods, but for the environmental analysis we have to use a slightly different definition of 'short-to-mid-term because the exact period when old growth is at its lowest level is too complex to describe for every single ecosystem.

COMPARISON OF BASECASES AND VIEWPOINTS

LANDSTATUS

A summary of the landstatus resulting from the two proposed Land Use Plan Viewpoints is shown in Figure 2. Viewpoint 1 results in approximately 36% in Protected Areas and 22% in Protected Habitat. Viewpoint 2 increases the amount of Protected Area to 41% and Protected Habitat to 42%. The timber harvesting landbase is smaller in Viewpoint 2 (12% compared to 25% in Viewpoint 1), and the unprotected non-contributing landbase is also reduced in Viewpoint 2 (from 15 to 5% of the forested landbase). That is, the conservation gain has come from both the non-contributing landbase and the timber harvesting landbase in order to reach the representation targets.

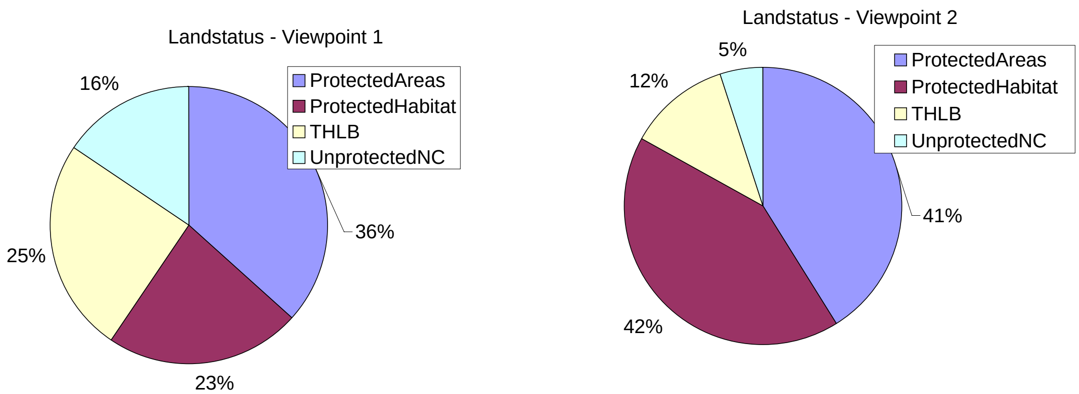


Figure 2. Landstatus resulting from Viewpoint 1 and Viewpoint 2.

In comparison with the two Basecases (see Fig. 3), both Viewpoints have higher levels of Protected Areas and Protected Habitat and primarily see a shift from the large non-contributing landbase under Current Management (38% in BC2 and 25% in BC3c compared with 15% and 5% in Viewpoint 1 and 2 respectively). THLB changes from 38% under BC2, but is 21% in BC3c which is actually smaller than that seen in Viewpoint 1 (25%).

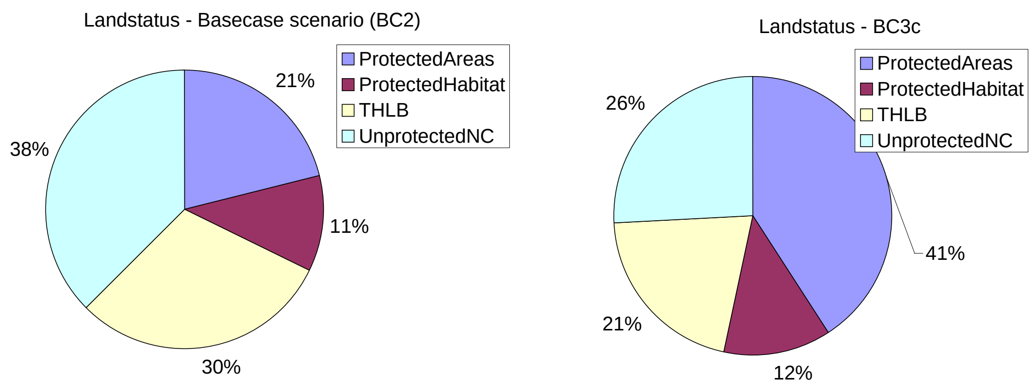


Figure 3. Landstatus of Current Management (BC2) and Current Reality (BC3c).

OLD GROWTH ECOSYSTEMS AT RISK

CURRENT CONDITIONS

Table 6 above summarized the Current Condition of ecosystems today.

Today (2003) summarising all old forest on the landbase in each ecosystem, 24 ecosystems are at low risk, 4 are at low-moderate risk, 1 is at high-moderate risk and 3 are at high risk. The total area identified as high or high-moderate risk is 152,313ha which represents approximately 20% of the forested landbase and approximately 41% of the THLB.

SHORT-TO-MID-TERM

Risk levels for each ecosystem is provided in the short-to-mid-term – as outlined above this period is not a particular point in time, but represents the point at which no old-growth remains in the THLB for each ecosystem. This point is a critical one for risk because it is expected to be the point at which risk will be highest for each ecosystem - after that point the THLB will cycle through a second growth rotation, and any areas protected today which are not old growth will slowly grow back and reduce risk in those areas. This point therefore represents a period of highest risk.

In Table 7 two risk rating 'book-ends' are provided for this time period: the first assumes that the THLB will be fully harvested during this period but that no harvesting occurs in the non-contributing /

inoperable landbase (shown as "+NC"). The second risk level provides the other book-end and assumes that the THLB will be harvested and all forest in the unprotected non-contributing forest will also be harvested (shown as "–NC"). See discussion below.

Table 7. Percent of natural (1800) old growth remaining at the 'Short-to-midterm' (see explanation of time period above) for each Basecase and LUP Viewpoint. High and high-moderate risk ecosystems are highlighted in red and yellow respectively.

					Percent Old Growth After THLB fully Harvested (short-to-midterm). -red shade = high risk; orange shade = high-mod risk							
#	Analysis Unit	BEC Variant	Total Area	Old growth in 1800 (%)*	BC2		BC3c		Viewpoint 1		Viewpoint 2	
					+NC	-NC	+NC	-NC	+NC	-NC	+NC	-NC
1	CedarGoodMedium	CWHvh2	3,725	95	79	60	95	84	94	90	96	95
2	CedarGoodMedium	CWHwh1	14,340	99	49	45	59	56	58	57	71	71
3	CedarGoodMedium	CWHwh2	1,347	92	53	38	64	53	58	49	74	74
4	CedarLow	CWHvh2	103,396	92	94	52	95	80	95	88	96	93
5	CedarLow	CWHwh1	182,121	98	68	28	72	44	70	56	78	72
6	CedarLow	CWHwh2	16,000	97	70	21	75	34	70	40	77	72
7	CedarLow	MHwh1	4,404	94	80	40	81	60	81	67	81	76
8	CedarLow	MHwh2	2,364	98	68	22	70	33	68	34	72	66
9	CedarPoor	CWHvh2	11,545	96	74	44	86	69	85	77	88	85
10	CedarPoor	CWHwh1	30,157	99	37	27	51	44	47	43	69	69
11	CedarPoor	CWHwh2	3,692	99	50	20	62	37	54	36	73	72
12	HemlockGood	CWHvh2	6,326	88	28	18	29	22	31	30	31	31
13	HemlockGood	CWHwh1	25,553	99	18	17	19	18	21	21	22	22
14	HemlockGood	CWHwh2	1,889	98	51	42	52	43	53	51	55	55
15	HemlockMedium	CWHvh2	20,857	89	60	34	69	57	67	61	71	71
16	HemlockMedium	CWHwh1	103,483	99	11	9	13	12	17	17	17	17
17	HemlockMedium	CWHwh2	16,951	99	18	10	21	15	29	28	29	29
18	HemlockMedium	MHwh1	1,064	95	77	34	85	72	82	71	86	82
19	HemlockMedium	MHwh2	1,085	98	29	14	37	24	43	40	53	53
20	HemlockPoor	CWHvh2	60,496	88	82	34	91	66	88	78	93	89
21	HemlockPoor	CWHwh1	51,645	90	36	22	48	39	45	40	69	69
22	HemlockPoor	CWHwh2	23,163	95	54	19	65	35	57	39	74	72
23	HemlockPoor	MHwh1	6,577	91	86	35	92	63	88	69	94	86
24	HemlockPoor	MHwh2	5,072	94	62	20	70	31	64	34	72	71
25	SpruceGood	CWHvh2	6,682	94	56	40	63	58	61	60	64	64
26	SpruceGood	CWHwh1	12,741	97	42	38	47	43	48	46	55	55
27	SpruceGood	CWHwh2	578	98	56	28	64	41	58	47	72	71
28	SpruceMediumPoor	CWHvh2	16,466	91	83	48	91	69	88	79	93	91
29	SpruceMediumPoor	CWHwh1	19,006	94	56	47	66	59	63	56	75	75
30	SpruceMediumPoor	CWHwh2	2,988	97	56	20	68	39	59	38	75	72
31	SpruceMediumPoor	MHwh1	891	92	83	33	89	57	84	61	89	83
32	SpruceMediumPoor	MHwh2	649	99	60	17	66	26	61	34	76	75
	Grand Total		758,753		56	29	61	45	60	52	67	65

LONG-TERM

The long-term risk levels are not shown in detail (but summarised below). In general they show similar trends to those at the short-to-midterm, but sometimes are slightly lower overall because young forest that is protected today becomes old forest in time and reduces risk.

SUMMARY OF RISKS

In addition to the detailed information provided above, the information on ecosystems at risk are summarised by summing the number of ecosystems in each risk category at each time period, in the graphs below. Only those ecosystems at high, or high-moderate risk are graphed – making the graphs easier to read and compare. Full data are provided for current condition (Table 6) and short-to-midterm (Table 7). Note that the total number of ecosystems is always 32.

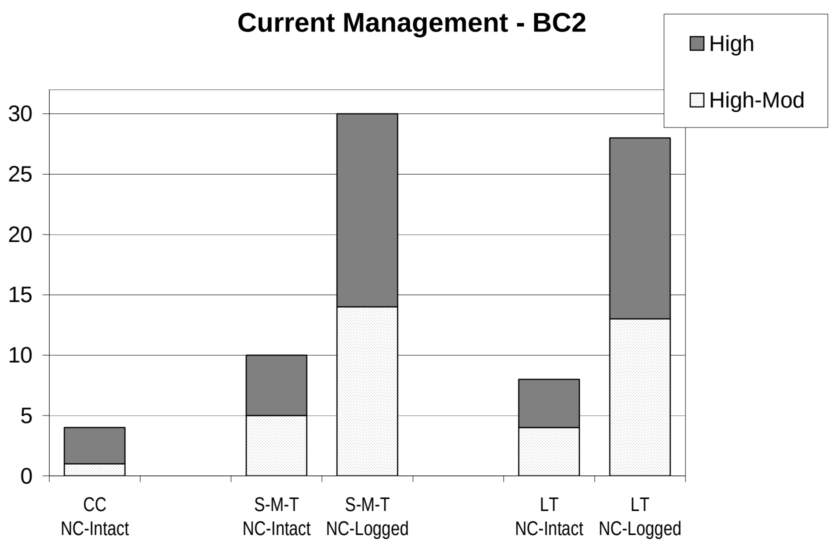


Figure 4. Current Management BC2: Number of ecosystems at high or high-moderate risk at three time periods, and using two different assumptions of the status of the inoperable landbase through time[3].

The Current Condition resulting from management to date shows 4 ecosystems at high or high-moderate risk. These tend to be the most productive ecosystems on the Islands and represent 152,313ha which represents approximately 20% of the forested landbase and approximately 41% of the THLB.

Over the short-to-midterm under Current Management the number of ecosystems at high or high-moderate risk rises from current condition (Figure 4); the extent to which the number rises depends largely on the assumption made about the future of the unprotected non-contributing landbase – the 'bookends' show between 10 and 30 of the 32 ecosystems would be a high or high-moderate risk under that scenario. The 'uncertainty' here is large because the unprotected non-contributing landbase is not identified as protected so the assumption about what happens in this part of the landbase is crucial. Over the long-term (250 years plus) the number of ecosystems at high or high-moderate risk decreases slightly (to between 8 – 28). This is because areas currently identified as protected (parks / riparian areas etc) are not all old-

[3] The following graphs show the trends through time at three different time period: CC = Current Condition; S-M-T = short-to-midterm which is defined above; LT = Long-term and represents 250 years from today. All graphs show the implications of two assumptions: a) that the NC is fully intact (NC_Intact) and b) that the NC is fully harvested (NC-Logged).

growth today but are predicted to have become at least 250 years old (our working definition of old-growth in this work).

The number of ecosystems at risk resulting from Current Reality (BC3c) is shown in Figure 5. Here, the number of ecosystems at high or high-moderate risk is lower than under Current Management because of increased Protected Areas (Figure 5). In the short-to-midterm the number at high or high-moderate risk varies between 7 and 18. This is lower than under BC2 and the uncertainty (the range) is also lower, because BC3c identifies higher number of protected areas in the current unprotected non-contributing landbase, so reducing the future uncertainty of the risk levels for those ecosystems.

Again, in the long-term the number at high or high-moderate risk reduces slightly from short/ mid term because areas currently young forest but protected today have become 250 years old at this time.

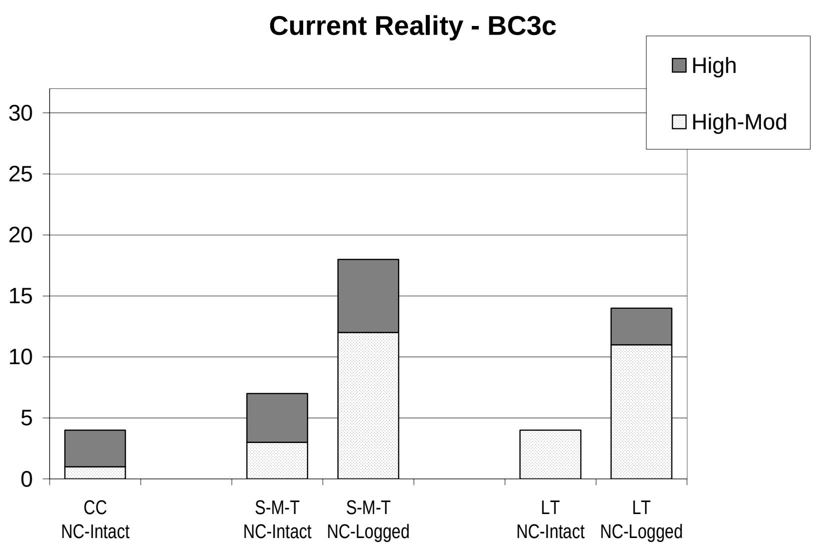


Figure 5. Current Reality BC3c: Number of ecosystems at high or high-moderate risk at three time periods, and using two different assumptions of the status of the inoperable landbase through time.

The number of ecosystems identified as high or high-moderate risk for Viewpoint 1 is shown in Figure 6. The number is less than under Current Management and quite similar to that under Current Reality (BC3c). Again, the uncertainty regarding the non-contributing landbase is lowered because of increased protection of the current inoperable landbase. However, between ¼ and ½ of ecosystems may be at high or high-moderate risk in the short-to-mid term from this option.

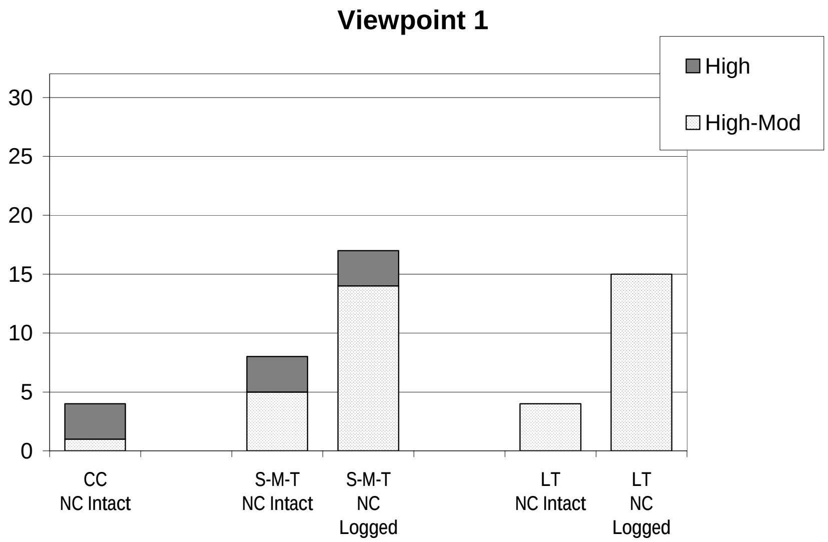


Figure 6. Viewpoint 1: Number of ecosystems at high or high-moderate risk at three time periods, and using two different assumptions of the status of the inoperable landbase through time.

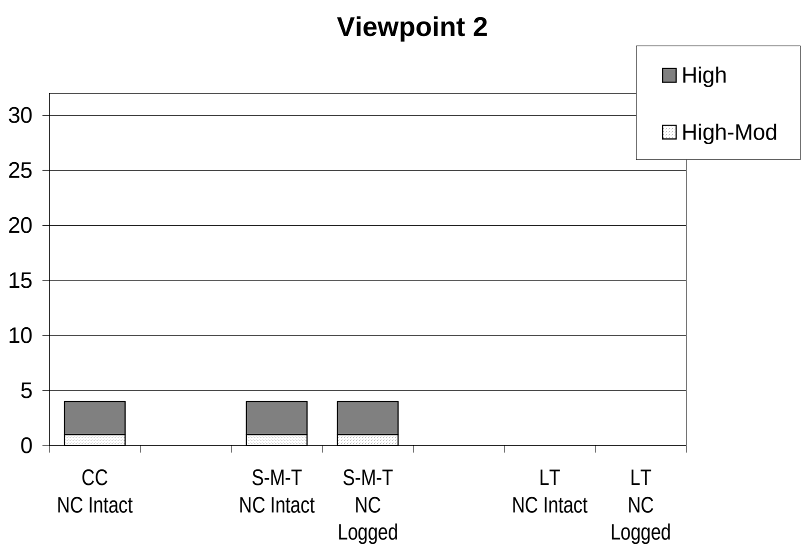


Figure 7. Viewpoint 2: Number of ecosystems at high or high-moderate risk at three time periods, and using two different assumptions of the status of the inoperable landbase through time.

Figure 7 shows the number of ecosystems at high or high-moderate risk resulting from Viewpoint 2. The number of these ecosystems does not increase in the short-to-midterm as a result of this scenario, and the number decreases to zero in the long-term as younger forest protected today attains 250 years old. Note that the uncertainty associated with Viewpoint 2 has also declined (effectively to zero at this scale) because enough of today's unprotected non-contributing forest has been designated as protected areas that making different assumptions about the fate of the remaining unprotected non-contributing landbase does not allow additional ecosystems to become high or high-moderate risk.

The analysis of the basecases and Viewpoints demonstrates that if an area is to contribute to biodiversity values in future ***with any certainty*** it must be explicitly protected as Protected Area or as Protected Habitat.

SUMMARY

Table 8. Summary of risks for old-growth retention recommendations.

		BC2	BC2c	Viewpoint 1	Viewpoint 2
Protected Areas	% of Total Land Area Protected	21%	41%	38%*	42%
	% of Total Forest Area Protected in PA's	21%	40.8%	36%	41%
Old Growth Forest Retention	% of Total Forest Area Targeted for Old Growth Retention by LU.	4-28%	4-28%	20-70% [Min. 20% overall]	30-70% [Min 70% 'natural']
	% of Total Forest Area Reserved in Protected Habitat (outside PA's)	11%	12%	22%	42%
	% of Total Forest Area Protected under All Protected Designations	32%	52.8%	58%	83%
Ecosystems at Risk Current Condition	# at High # at High-Mod # at Low-Mod # at Low	3 1 4 24	3 1 4 24	3 1 4 24	3 1 4 24
Ecosystems at Risk Short to Mid-Term	# at High # at High-Mod # at Low-Mod # at Low	5-16 5-14 13-2 9-0	4-6 3-12 14-11 11-3	3-3 5-14 14-9 10-6	3-3 1-1 6-7 22-21
Ecosystems at Risk: Long-term (250 yrs)	# at High # at High-Mod # at Low-Mod # at Low	4-15 4-13 12-4 12-0	0-3 4-11 11-9 17-9	0-0 4-15 14-7 14-10	0-0 0-0 3-3 29-29
	Overall Old Forest Ecosystem Risk Rating	[H]	[H-M]	[H-M]	L

Overall Risk Levels:

Viewpoint 1 is a high-moderate risk scenario. In the short-to-midterm the number of ecosystems at high or high-moderate risk increases from Current Condition, and the extent to which it increases depends on the assumptions made about the fate of the unprotected non-contributing landbase. However, the number of ecosystems becoming high or high-moderate risk rises from 4 at Current Condition to between 8 and 17 depending on the assumptions made. In the long-term the number of ecosystems at high or high-moderate risk decreases again slightly (again depending on the assumptions about the NC), because forest protected today will attain some old growth characteristics in this time period.

Viewpoint 1 reduces risk over the Current Management Basecase since a lower number of ecosystems are at high risk under Viewpoint 1, and it also includes ecosystem representation by site series which Current Management does not.

Ecosystems Most at Risk

Under Viewpoint 1, in the short-to-midterm the number of ecosystems at high or high-moderate risk increases. Ecosystems at high risk today are the prevalent ecosystems in the timber harvesting landbase, represent the largest areas of the most productive forest on the landbase, and are hemlock-high and hemlock-medium productivity types in the CWHvh2, CWHwh1 and CWHwh2. A wide range of additional ecosystems become high or high-moderate risk over time and includes hemlock, cedar and spruce leading types (see specifics in Table 7). A total area of between 257,941ha and 315,693ha are identified as becoming high or high-moderate risk under Viewpoint 1.

Under Viewpoint 2 in the short-to-midterm the ecosystems which are at high or high-moderate risk as a result of the Current Condition of the landscape remain at high risk. These are the prevalent ecosystems in the timber harvest landbase, represent the largest areas of the most productive forest on the landbase, and are hemlock-high and hemlock-medium productivity types in the CWHvh2, CWHwh1 and CWHwh2. This represents 152,313ha of forested area.

Non-contributing Landbase

In general, the number of ecosystems at high or high-moderate risk greatly depends upon the assumptions regarding the extent of harvest that will occur in the unprotected-non-contributing landbase. This is most true in the Current Management Basecase where this uncertainty is the largest, and least relevant in Viewpoint 2 where there is little uncertainty based on this assumption. This is explained because as the level of Protected Areas increases by protecting forest both currently in the THLB and currently in the NC, under Viewpoint 2 sufficient forest is specifically identified as protected to result in a certain low risk state for most ecosystems, whereas if there is insufficient protected areas then the future state of ecosystems become dependent on unknown factors relating to unknown future economic conditions.

It is very clear from this that certainty around future ecosystem state comes from clearly identifying forest for protection if that is the intended goal. Relying on current unprotected non-contributing forest may or may not result in maintenance of low risk for these ecosystems over time.

Assessment of each Recommendation:

In the two Viewpoints provided, protection of old forest ecosystems is influenced by a variety of different recommendations, some of which are consensus while others are packaged as Viewpoint 1 or Viewpoint 2. The section below itemises the potential impacts of each recommendation. A final summary of overall risks is provided below.

Representation of ecosystems: Both Viewpoint 1 and 2 recommend use of site series for applying old growth retention targets; this will provide for an ecologically relevant definition of ecosystems in the field and will ensure that the full range of upland ecosystems is well represented in old growth protection compared with Basecase management which is applied using a coarse definition of ecosystem (biogeoclimatic variant level). It will require some additional work in order to implement this recommendation; a single coverage of site series mapping would greatly improve efficiency of implementation of this recommendation. Without such resources, implementation may fail to actually represent different ecosystems adequately. Note that site series mapping does not adequately represent wetland and some riparian ecosystems and additional work may be required to ensure these systems are adequately represented.

Level of Protection: knowing exactly how much of an ecosystem is required to maintain functional ecosystems into the future is difficult. The Coast Information Team assessed available science information (CIT 2004b) and recommended old-growth forest retention targets at different scales. They suggested that in the coastal temperate rainforest ecosystems with 70% or more of natural levels of old forest remaining would be at low risk, and ecosystems with 30% or less natural levels of old forest remaining would be at high risk. Using this as a test, each of the two Viewpoints provides significantly different levels of risk: Viewpoint 1 identifies maintaining a minimum of 20% of old forest across the landscape; Viewpoint 2 identifies maintaining a minimum of 70% of the natural levels of old forest (this ranges in actuality between 63% and 69% of each ecosystem). These targets are reflected in having many more ecosystems identified at high and high-moderate risk today and into the future under Viewpoint 1 than under Viewpoint 2, which has no ecosystems at high or high-moderate risk in the long-term.

In comparison with the current management (BC2) Basecase and the Current Reality (BC3c) Basecase, both Viewpoints reduce risk as no ecosystems remain at high risk in either Viewpoint. The minimum level of retention specified in Viewpoint 1 (20%) is in the 'high risk' category as defined by the CIT (2004a,b), and 6 of 26 landscape units have between 20 and 30% protected as a result, but because no ecosystems are limited to individual landscape units the total protection for all ecosystems is greater than 30%, leaving ecosystems at high-moderate but not high risk.

However, Viewpoint 1 does not greatly reduce risk for many intermediate ecosystems compared with BC2 or BC3c: there are similar numbers of ecosystems at high-moderate risk and low-moderate risk with more at low and fewer at high, compared with the more dramatic shift to a large percent of ecosystems at low risk under Viewpoint 2. In Viewpoint 1, up to half the ecosystems may remain at potentially moderate to high risk (17 of 32) in the short-to-midterm. Viewpoint 2 is therefore most likely to meet the definition of EBM as outlined in the CIT Handbook (2004a), in terms of being likely to maintain environmental values maintained on the landscape over time. It is also more likely to meet the Management Intent stated which asks for conservation of functional ecosystems over time and at all spatial scales, though how stand level management combines with landscape level management in meeting the overall goal remains uncertain in this LUP recommendation.

Viewpoint 2 does allow some landscape units to have lower levels of protection (down to a minimum of 30% as opposed to 20% as identified in Viewpoint 1), similarly identifying key landscape units as higher risk to allow more efficient economic activity. However, Viewpoint 2 also requires an overall target of 70% which forces additional retention in some areas to meet that overall Island-wide goal. This overall goal allows the composite plan to be largely low risk, even though individual landscape units may be at high or high-moderate high risk. This approach was identified by the CIT as being a precautionary approach to risk management in these ecosystems.

Neither Viewpoint discusses minimum patch sizes that would be allowed to contribute to these landscape level targets for old forest target, nor do they discuss how benefits gained from variable retention would be implemented within this system.

<u>Location of Protection:</u> Viewpoint 2 addresses the need to identify landscape connectivity corridors to link protection areas. If important connectivity areas are known, then this could be an important component of landscape level planning. Under Current Management there is no extant policy to identify connectivity areas. Similarly, Viewpoint 1 does not include such a requirement, though presumably it would be possible to include such areas during old-growth planning implementation.

Note that there will likely be additional planning considerations that should be taken into account when undertaking implementation of landscape level or regional planning. These would include but not be limited to considering connectivity, patch size, interior habitat, optimising values captured by an old growth value protection area.

<u>Red and Blue-listed Plants and Communities:</u> Both Viewpoints have the same management recommendations in relation to this Management Intent; both require additional work to identify these areas in advance of harvest to ensure they are implemented adequately. In addition, determination of what constitutes the 'natural range' of blue-listed communities requires additional work. Both Viewpoints represent much lower risk than Current Management which requires no maintenance of such plants or communities (FPB Release August 2005).

<u>Overall:</u> Both Viewpoints reduce risks associated with representation over Basecase, because both use site series to apply the targets, and have higher protection levels overall. Viewpoint 2 significantly reduces risk over both basecases, and over Viewpoint 1, by having considerably higher protection levels whose levels are consistent with those suggested as low risk management under the CIT (2004a). In addition, it should be noted that both Viewpoints relating to ecosystem protection are highly dependent on the successful efforts to manage impacts of Introduced Species, otherwise mature trees will be maintained but functional ecosystems and rare plant communities will likely not be maintained. Both Viewpoints represent much lower risk than Current Management in relation to listed and locally important plant species which requires no management of such plants or communities (FPB Release August 2005).

That high levels of retention are required in the coastal temperate rainforest to undertake low risk management simply reflects the ecosystem involved. The temperate rainforest is dominated by natural extensive tracts of old and ancient forests which have been undisturbed for millennia in some if not many locations (e.g. Gavin et al. 2003). Naturally the ecosystem undergoes small-scale patchy disturbances. It is therefore inherently difficult to manage with any certainty to maintain ecological integrity in these ecosystems without substantially altering the rate and the scale of harvest from typical historic practices seen in these ecosystems.

PLANT SPECIES AND COMMUNITIES

Plant species and communities are integral components of ecosystems and they are an expression of ecosystem characteristics as created by soil and topography. Vegetation also modifies soil forming processes and microclimate and creates habitat that other organisms rely on. Changes in plant abundance or species richness can have significant and often hard to predict influences on ecosystem processes and functions. Many plant species are integral with and critical to the culture of the Haida Nation.

The temperate rainforest is highly diverse with respect to plant species and communities. Typically, plant communities are associated with regional climate and geology, and at a site level with conditions of soil moisture and nutrients. Understory plant diversity and abundance, combined with overstory tree species makes up the characteristics of individual ecosystems. They provide food and habitat requirements for other species, they influence soil processes, water transport, microclimate, nutrient cycling and many other ecosystem functions.

An assessment of ecosystem representation is generally assumed to address plant community representation. However, for HG/ QCI there are at least three reasons to consider assessing the condition and risks to plant communities in addition to the Old Forest assessment. The first is that HG/ QCI harbours a large number of rare and/ or endemic plant species; one of these species is found no where else on earth and others are found only in the local area of HG/ QCI and other local coastal islands/ areas. Second, there are a number of plant communities (associations of understory and overstory plants) which exist on the coast of BC but are rare (often as a combination of natural scarcity and impacts of forest harvesting). Thirdly, on HG/ QCI the understory of practically all ecosystems has been significantly altered as a result of browse from introduced deer. This understory typically was responsible for providing habitat for a large number of species, and the Haida have and continue to use many of these historically common plant species for traditional uses. The implications of significant changes to the understory are therefore large. A number of other introduced species are also impacting ecosystems, and in particular the beaver is changing hydrology patterns particularly in lowland areas resulting in flooding and loss of habitat for some species.

These plant species and communities are impacted by a variety of different agents, primarily including forest harvesting and invasive species.

There is no specific section in the package that refers to the broad suite of plant species and communities in the package, but these values will be impacted by Protected Areas and Old Growth recommendations, plus the recommendations for Culturally Important Plant species, and the red-blue listed plant species recommendations. Viewpoint 1 does not agree to or suggest any alternative recommendations regarding Culturally Important Plants.

METHODS

No quantitative analysis of the potential implications of the different LUP Viewpoints and Basecases in relation to plant communities was possible. However, it is possible to qualitatively estimate how the different LUP Viewpoints 1 and 2 may potentially affect management of these values.

SUMMARY

Table 9. Risk summary for red and blue-listed plants, and plants overall.

	BC2	BC3c	Viewpoint 1	Viewpoint 2
R& B listed plants	H	[H]	L	L
Plants Overall	H	[H-M]	[M-L]	[L]

Viewpoint 2, compared with Viewpoint 1 and both Basecases, provides for higher levels of retention of forest as part of Protected Areas, old-growth management and for riparian management. As a result there is a higher probability that plant species and communities will be maintained at natural levels under Viewpoint 2; each of these strategies will increase the probability that rare plants, communities and ecosystems will be maintained. Many of the rare ecosystems on the Islands are riparian associated types, and the higher levels of protection for riparian areas in Viewpoint 2, combined with the strategy for restoration of key riparian areas may be very important in maintaining and restoring these communities. Viewpoint 1 has lower levels of retention under each of these strategies, but could potentially maintain many of these values if operationally the areas are applied in key areas of concern, which adds some level of uncertainty about the risk level outcomes. Again, additional levels of operational planning would be required.

It is likely that Viewpoint 2 would result in meeting Management Intent with a higher certainty, but the extent to which Viewpoint 2 lowers risk compared to Viewpoint 1 is very difficult to determine with any certainty from current knowledge.

<u>Red and blue-listed plant species and communities:</u> There is unanimous agreement to protect all red and endangered species, and to maintain blue-listed and vulnerable species within the natural range. This unanimous recommendation would be an improvement over current management (BC2) which requires no specific protection of listed species and ecosystems and locates old forest protection areas about of the THLB where they might have protected such listed ecosystems (FPB 2005).

<u>Culturally important plants:</u> Viewpoint 2 provides a suite of recommendations to protect areas for culturally important plants. This will lower risk for these and other native plants and communities in some geographic (but as yet unspecified) areas. Viewpoint 1 does not agree, nor does it provide any alternative, so is assumed to result in the same outcome as Current Management, which has no provision for management of these species.

<u>Overall:</u>

All the consensus recommendations lower risk for natural communities, most of which have no specific protection under current management. Old forest retention targets (OGMAs) have to be applied in the non-contributing landbase (LUPG 1999) so are not used to protect areas occurring in the THLB. Some rare ecosystems may be protected in riparian zones as default, but this is not guaranteed under current management.

Viewpoint 2 retains considerably more area in its ‘natural’ state (i.e. ecosystem combined with forest age) so will result in lower risk to these communities over time. This is especially true as climate change has and will likely in future dramatically change growing conditions in these forests; maintaining intact old-growth forests will reduce the short-term impacts of climate change by maintaining resiliency in the forests for now. Significant uncertainty remains due to the difficulties of managing Introduced Species.

HYDRORIPARIAN CONDITION

Hydroriparian ecosystems are created by the movement of water through a watershed, and are important to broader ecosystem functions because they store and move water, filter sediment, stabilise banks and reduce erosion from flooding, and maintain water quality. In addition, they provide habitat for a large number of freshwater aquatic and terrestrial species, contain rare ecosystems, and contain biodiversity hotspots due to high productivity.

In addition, hydroriparian areas provide breeding habitat for salmon. Pacific salmon are keystone species[4] contributing significant marine-derived nutrients to the flora and fauna of riparian, hydroriparian and terrestrial ecosystems. The migration of salmon back to their spawning ground acts as a "nutrient pump" that which provides vital food for everything from herbs to trees to insects to the next generation of salmon to bears and humans. Marine derived nutrients from salmon carcasses have been shown to have far-reaching influences on terrestrial ecosystems. Salmon are also central to the culture of the Haida.

All five species of Pacific salmon, plus three other salmonids inhabit the waters of HG/ QCI: Pink, Chum, Coho, Sockeye, Chinook, Coastal Cutthroat trout, Rainbow/ Steelhead trout and Dolly Varden Char.

Mapping the 'hydroriparian zone' is a difficult task since its exact boundaries vary with many parameters. As a surrogate, for this analysis, a Riparian Fish Forest zone for HG / QCI was identified.

Management intent for the hydroriparian is identified by the LUP is:

- Healthy, fully functioning hydroriparian ecosystems that maintain:
  - Water flows within a natural range of variability;
  - The transport of sediment and debris loads within a natural range of variability;
  - Aquatic habitat features required for fish and other aquatic life;
  - Terrestrial habitat characteristics important for wildlife and biodiversity in general.
- Restoration of degraded hydroriparian ecosystems.

LUP Recommendations include a consensus agreement regarding coastal shoreline buffers. In addition, two Viewpoints are provided regarding general riparian management, with Viewpoint 2 providing more specific and stringent riparian requirements where Viewpoint 1 defaults to FRPA / FPC management. No specific Management Intent is given in the LUP recommendations document in relation to salmonids, but the terrestrial aspects of salmon habitat will be impacted primarily by the hydroriparian recommendations.

METHODS

Potential hydroriparian areas were identified on the basis of being 'Riparian Fish Forest' (J. Broadhead pers. comm.). Different classes of streams were identified using a combination of TRIM streams, TEM floodplain attributes where available, plus information on known fisheries information for the Islands, augmented by information on known barriers within streams which prevent fish movements. Streams were then categorised on the basis of their size and the number of resident or anadromous fish. These definitions were then used to identify 'buffer widths' that identify the likely area of 'riparian fish forest' occurring around that stream. Definitions for each zone are identified in Table 10. Methods for this layer are shown in Chapter 4.4 of Holt 2005a.

[4] Keystone species have a disproportionately large influence on the surrounding ecosystem for their size. Impacting these species can have wide-ranging complex consequences that are difficult to predict.

Table 10. Riparian Fish Forest (RFF) Zone definitions.

Riparian Fish Forest (RFF)	Definition	Buffer width (both sides)**
RFF – 1***	Small streams with no fish	20 m buffer
RFF – 2	Smaller streams with resident fish	30 m buffer
RFF – 3	Moderate sized streams with a few salmon	40 m buffer
RFF – 4	Moderate to large streams with many salmon	60 m buffer
RFF – 5	Large streams with lots of salmon	80 m buffer

** this is the amount of area 'mapped' to create the Riparian Fish Forest (RFF) layer for analysis.
***Note that the RFF-1 category does not identify all small streams on the Islands. Many small streams are not mapped and therefore are not included in this analysis.

COMPARISON OF VIEWPOINTS AND BASECASES

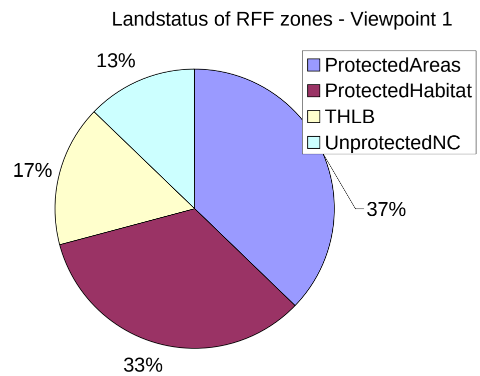
LANDSTATUS

To understand where on the landbase the protection is occurring, the section below summarises the landstatus of the RFF zones under Viewpoint 1 and Viewpoint 2.

Viewpoint 1: Protection of different riparian fish forest zones is summarised in Table 11, and in the adjacent piechart.

Table 11. Landstatus of riparian fish forest zones under Viewpoint 1

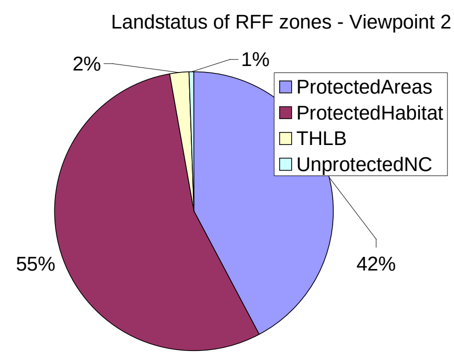
RFF	Total Area	% PA	% PH	% THLB	% NC
RFF_1	19,367	34	33	12	21
RFF_2	20,053	31	35	21	13
RFF_3	46,742	40	34	15	10
RFF_4	14,953	40	33	14	13
RFF_5	27,786	37	32	21	10
Total RFF	128,899	37	33	17	13



Viewpoint 2: Protection of different riparian fish forest zones is summarised in Table 12, and in the adjacent piechart.

Table 12. Landstatus of riparian fish forest zones under Viewpoint 2

RFF	Total Area	% in Protected Areas	% in Protected Habitat	% in THLB	% in NC
RFF_1	19,367	37	56	4	3
RFF_2	20,053	37	63	0	0
RFF_3	46,742	44	56	0	0
RFF_4	14,953	45	53	1	0
RFF_5	27,786	45	49	5	0
Total RFF	128,899	42	55	2	1



Under Viewpoint 1 70% of RFF zones are protected and under Viewpoint 2 97% are protected. Note that these areas may or may not have been harvested to date, so may or may not represent a fully functioning ecosystem at this time.

In addition, under Viewpoint 1 between 10 and 20% of each RFF zone remain in the non-contributing (NC) landbase, but are not specifically 'protected'. Under Viewpoint 2 this number is much reduced, showing that some of the additional protection between the two Viewpoints is created by protecting areas currently considered uneconomic to harvest.

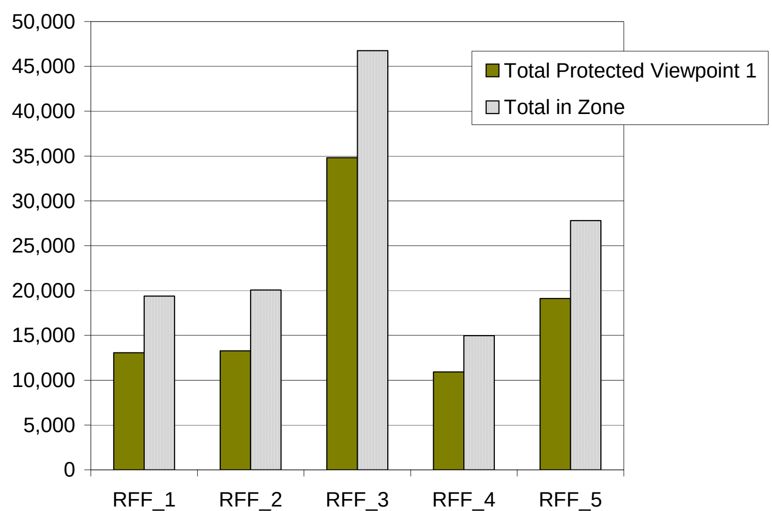
Table 13 shows the level of protection from basecase management. Under Current Management 43% of RFF zones are protected with 29% remaining in the NC. Under the Current Reality basecase, 65% of zones are protected, with an additional 18% in the unprotected NC landbase (this increase comes not from increased riparian protection rules but from higher levels of protected areas).

Table 13. Landstatus of RFF zones under BC2 and BC3c.

		Current Management – BC2				Current Reality – BC3c			
RFF	Total Area	% PA	% PH	% THLB	% NC	% PA	% PH	% THLB	% NC
RFF_1	19,367	23	34	13	31	36	29	10	25
RFF_2	20,053	15	38	23	24	36	28	18	18
RFF_3	46,742	20	34	17	29	44	23	13	20
RFF_4	14,953	18	35	18	29	45	24	12	20
RFF_5	27,786	14	29	28	29	45	20	17	18
Total RFF	128,899	18	34	20	28	42	24	14	20

PROTECTION OF RFF ECOSYSTEMS

The amount of each riparian fish forest zone protected as a result of Viewpoint 1 is shown in Figure 8. Approximately 70% of each zone is protected under this management option, with an additional 13% located in the NCLB. The total amount of each Riparian Fish Forest zone protected as a result of Viewpoint 2 is 97%, as shown in Figure 8, with a range of protection between 93 and 100% for each RFF zone. In both cases the percentage of each RFF zone protected is similar for each of the categories of Riparian Fish Forest zone.



Note that not all the riparian protection seen in Viewpoint 1 actually results from the riparian recommendations – approximately 15% comes from the application of old growth targets into riparian zones, and so would not be guaranteed from the Viewpoint 1 recommendations but would depend on the rule set used for allocating old growth reserves.

Figure 8. Area of each zone, and amount protected in each zone under Viewpoint 1.

In the analysis of RFF zones shown, it should be remembered that these zones are modeled as protected from today onwards, but many areas have already seen varying levels of harvest within these zones (Chapter 2.3 in Current Conditions Report provides detailed summaries of current condition). Protection today therefore does not imply that these areas are all old growth – but does imply that harvested areas will be allowed to recover back into older forest types, barring natural disturbance events.

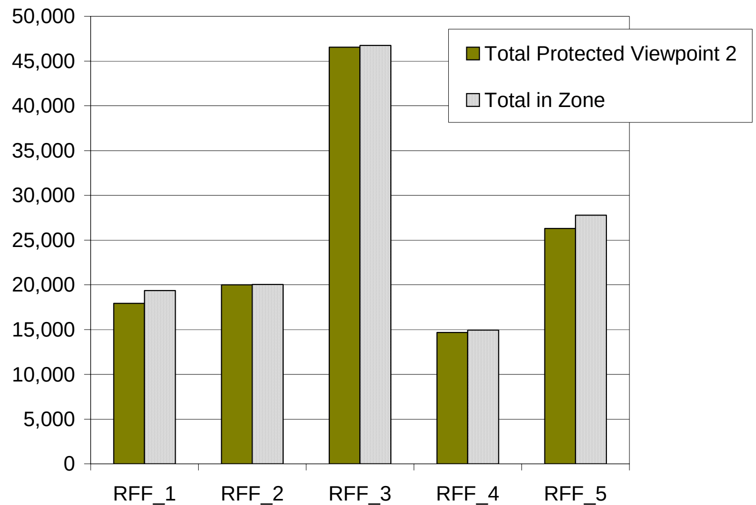


Figure 9. Area of each RFF zone and area protected under Viewpoint 2.

Overall, Viewpoint 1 and Viewpoint 2 apparently result in higher riparian protection than either BC2 or BC3c: BC2 protected 43% of the RFF zones, BC3c protected 65% of the RFF zones, and Viewpoint 1 and Viewpoint 2 protected 70% and 97% respectively (not including the area that may remain forested within the non-contributing landbase). Note though that the riparian management recommendations provided as Viewpoint 1 are effectively the same as the two Basecase scenarios (BC2 and BC3c). The additional RFF protection is observed in BC3c and in Viewpoint 1 is because of the increased old-growth protection required in each of those scenarios, not because the BC3c or Viewpoint 1 specifically requires additional riparian protection. Note that this is simply a function of how the model distributed the old growth retention (representation of all ecosystem types, first from non-contributing landbase and secondly from timber harvesting landbase) primarily in areas that did not influence timber supply, so tended to locate it in riparian retention areas where this could also meet representation targets; this higher protection of riparian areas is therefore not guaranteed unless specific riparian recommendations were included. Viewpoint 2 has considerably more detailed riparian recommendations, and do specifically increase the protection of these zones.

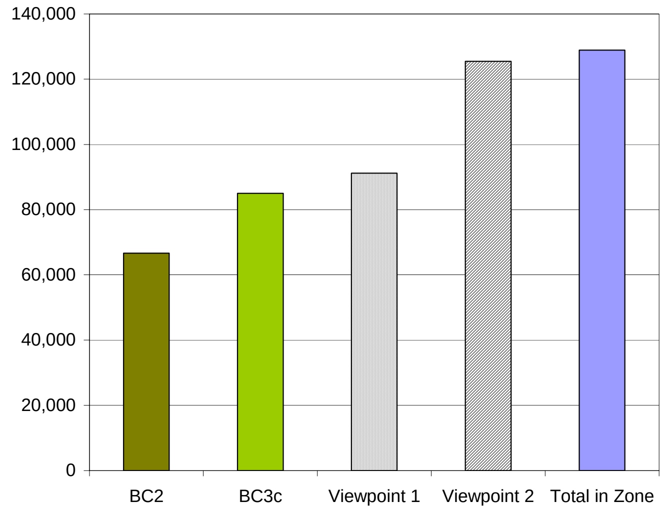


Figure 10. Amount of Total RFF Zones protected as a result of each scenario, and compared to the total amount of RFF zone

SUMMARY

Table 14 provides a summary of risks for hydroriparian values. No specific risk levels are provided for salmonids due to the complexity of factors affecting salmon populations. However it is assumed in the assessment below that risks to salmon will proportional to the level of protection of the terrestrial component of their habitat.

Table 14. Summary of risks for hydroriparian values.

	BC2	BC3c	Viewpoint 1	Viewpoint 2
Hydroriparian – Forest Management	52% [M]	52% [M]	52% [M]	97% L
Hydroriparian – sensitive areas	[M]	[M]	[M- L]	L
Hydroriparian – unstable terrain	[M]	[M]	[M-L]	L
Hydroriparian – watershed assessment	?	?	[H-M-L]	L
Hydroriparian Overall Risks	52% [M]	65% [M]	67% [M]	97% L

Maintaining healthy, fully functioning hydroriparian ecosystems is a complex task; is it thought that in general, forested riparian areas tend to undergo more natural disturbance events than occur over the landscape as a whole – this is because flooding events, debris torrents, unstable terrain collapsing into gullies etc all tend to act within riparian areas. Exact information on natural rates of disturbance within riparian areas are generally lacking, so using levels of undisturbed forest under a natural disturbance regime as a comparison is difficult here. However, these types of events also tend to occur with or without management influences and so additional disturbance is likely to be in addition to natural events.

A great deal of information has been written on how to maintain the functioning of riparian systems which tend to be complex and to differ in the absolute amount of protection suggested as required to maintain functioning systems. However, there are a number of key points that stand out: a) that placement of riparian protection is key – if protection is not in the most critical locations then values may not be maintained irrespective of the level of protection; b) that managing the rate of harvest in watersheds is important.

Forest Management of RFF Zones: Current Management and Current Reality scenarios reflect riparian protection under FRPA: the default requirements (i.e. FPC requirements) were modeled, since no proposed alternatives were available. This policy results in approximately 43% of the RFF zones being protected or recovering (as second-growth), though it uncertain that these protection levels would actually would be implemented since variances to these standards can be given under FRPA. The BC Auditor General stated, in relation to the change from the FPC to FRPA:

> *"We also noted that changing business processes are creating uncertainty. The move from a prescriptive approach to a results-based approach means government will not be in position to identify and fix problems before they occur. " – BC Auditor General 2004.*

Overall, we suggest current riparian management, included in the current management, current reality and Viewpoint 1 scenarios, represents a moderate risk situation, with high uncertainty, based on the fact that the CIT Hydroriparian Planning Guide (CIT 2004c) suggested that considerably more stringent planning was required if a low risk was the goal – this is because riparian systems are key to maintaining a wide variety of processes, and the CIT Guide (2004c) acknowledges the uncertainty around actual thresholds. The CIT proposed a comprehensive adaptive management process under this low risk regime to reduce standards when it becomes more clear that this would not increase risk significantly.

Viewpoint 2 specifically provides higher levels of RFF zone protection than does Viewpoint 1 for all RFF zones. Although Viewpoint 1 appears to have higher riparian protection than either Current Management (BC2) or Current Reality (BC3c), in actual fact this simply reflects the higher old growth retention overall being located in the RFF zones: – riparian management recommendations under Viewpoint 1 are the same the current recommendation under current government policy.

It is important to note that under either Viewpoint 1 or Viewpoint 2, correctly identifying the functional hydroriparian zone in the field will be key to implementation; this may be difficult in relation to identifying the full extent of hydroriparian sensitive areas in particular.

Restoration: Basecase management has incorporated various different restoration schemes over the last decade. The BC Auditor General in his report from 2004 noted that under Current Management there is risk associated with current restoration plans:

> *"Restoring habitat is another way that government can contribute to the sustainability of wild salmon. We found that government has reduced its involvement in habitat restoration. Major programs no longer exist. Also, information on restoration needs is incomplete. There is no single inventory of the work previously completed or a ranking of watersheds and habitat requiring restoration." – BC Auditor General, 2004.*

Viewpoint 1 does not specifically address the need for restoration of key zones, while Viewpoint 2 does have specific restoration guidelines. Viewpoint 1 does identify the need to follow recommendations from watershed level assessment, which does not preclude the possibility of restoration being recommended, but leaves a significant uncertainty.

Hydrologically sensitive areas: Current Management does include some management of sensitive areas, which are being identified through watershed assessment, though under standard application of FRPA requirements these areas are difficult to identify adequately in the field. The overall extent and adequacy of this management is unknown. Viewpoint 2 provides a more specific definition of what may be required to protect these areas; overall the two Viewpoints may provide similar results but depending on interpretation Viewpoint 2 provides higher certainty of protection of sensitive areas than does Viewpoint 1.

Unstable Terrain: Viewpoint 2 takes a lower risk approach to unstable terrain, by identifying protection of all Class 4 and 5 habitat connected to hydroriparian systems, whereas Viewpoint 1 focuses only on areas where the potential impacts are likely to be high. Viewpoint 2 therefore takes the lower risk approach to managing potentially negative impacts on riparian due to unstable terrain.

Watershed Assessment: Viewpoint 2 also adds additional recommendations relating to more detailed planning that should occur at the watershed level whereas Viewpoint 1 advocates the status quo for watershed assessment. The risk levels coming from the current approach is not assessed in this assessment.

Hydroriparian Overall: Viewpoint 2 recommends an additional ‘rate of cut’ modifier of not more than 20% over 20 years. Managing rate of cut has been advocated by others (Church and Eaton 2001; CIT 2004c) as an appropriate approach to managing watershed condition. Viewpoint 1 does not include a ‘rate of cut’ recommendation.

Assessing the adequacy of riparian Viewpoints is complicated by the simultaneous changing of old growth protection levels, which results (in the model) in higher retention within riparian areas. Viewpoint 2 takes a considerably lower risk approach to riparian management, by specifically identifying protection of areas considered to be key by the proponents. Viewpoint 2 is significantly different from Viewpoint 1 and quite closely resembles the recommendations of the CIT in the Hydroriparian Planning Guide (2004c), which they suggest provides management procedures that

> *“ are unlikely to pose significant risk to ecosystem functioning, even though thresholds for substantial change are not known”.*

In other words they are precautionary, and protect the value with relatively high certainty. Viewpoint 2 and CIT recommendations are not exactly comparable however they generally take a similar approach and have similar thresholds for retention. A key difference is an acknowledgement of the uncertainties and a direct building in of an adaptive framework, which is included by the CIT as a significant component of the management strategy.

Overall Risks to Salmonids:

The overall risks to salmonids resulting from each Basecase or Viewpoint cannot be easily quantified because of the complexity of factors affecting salmon populations. Using the surrogate of trends in the condition of RFF zones the analysis is also further complicated because of the interactions between the riparian recommendations themselves and the actual level of protection resulting from the broader old growth retention recommendations.

In relation to overall current management (i.e. from the variety of agencies responsible for managing salmon habitat), the BC Auditor General stated:

> *“Protecting habitat and restoring past problems are essential if our wild salmon are to be sustained. However, existing legislation does not provide adequate protection because some key provisions are either not in force or not being acted upon.” - BC Auditor General 2004.*

In relation to the freshwater component of salmon habitat, Viewpoint 2 provides more precautionary management by identifying specific higher protection levels than Viewpoint 1, and by identifying the need for restoration in key areas. Although reasonable levels of protection were seen under Viewpoint 1 this outcome is not guaranteed by the LUP Viewpoint because the riparian protection was partly a result of FPC riparian requirements and partly a default outcome from the rules in the model which tended to place old growth retention in riparian areas where it could, in order to reduce timber supply impacts. We do not have the information here to separate out these two effects.

Viewpoint 2 provides comprehensive riparian protection guidelines resulting in significant protection of riparian fish forest zones (equated as being the same as the hydroriparian zone in the modeling). There is little debate that higher riparian protection will result in lower probability of loss of riparian values; there is little risk of there becoming ‘too much’ old growth in the riparian zone since natural disturbance events will continue to operate.

BLACK BEAR

Haida Gwaii black bears are an endemic sub-species (*Ursus americanus carlottae*), unique to the Islands. This isolated race is the largest native omnivore on the Islands and forages on a wide variety of foods: berries, salmon, invertebrates, marine life in the intertidal zone etc. The extent to which bears forage on deer on the Islands is unknown but predation of fawns at least is thought likely. Black bears are also considered a "keystone" species: their transport of salmon from spawning channels into adjacent forests is recognized as a critical component of nutrient transfer in some forest ecosystems.

Black bears therefore use a large area and a wide diversity of habitats and so is considered an 'umbrella' species, i.e., by managing for effective habitat for black bears, the habitat requirements of other species may be addressed.

The black bear is widely distributed throughout British Columbia and is the most widely distributed bear found in North America. The subspecies found on HG /QCI is generally larger than its mainland counterparts with a huge skull and molars, and is only found as a black colour phase. These physical differences are thought to result from retaining characteristics after a long period of isolation during the last ice-age.

Black bears have no natural predators on the Islands, except humans. Populations of black bears cannot sustain high kill rates by humans (greater than 6% per year). Roads, which bring people into black bear habitat, and conflicts over human food and garbage, can create situations where bear mortality exceeds natural population growth. Black bears are considered to be secure in BC, and have been assessed but not listed by COSEWIC.

Stated Management Intent from the LUP is:

- A diversity of high quality bear denning and foraging habitat to ensure a viable and healthy black bear population across the Islands
- Improved black bear population and habitat information
- Minimal conflict between bears and humans

Recommendations consist of a set of varied elements that address different aspects of bear habitat quality (some consensus and some as Viewpoints). In addition, the recommendations deal with hunting of bears and future management of viewing opportunities.

COMPARISON OF VIEWPOINTS AND BASECASES

No quantitative analysis of risks to black bears is provided from the different Viewpoints. The risk ratings and rationale in the Summary and Summary Table were reviewed by T. Hamilton (BC, MoE).

SUMMARY

Table 15. Risk summary for black bears.

	BC	BC2c	Viewpoint 1	Viewpoint 2
Black Bear Hunting	L	L	L	L
Black Bear – denning	[H-M]	[H-M]	L	L
Black Bear - escape trees	[H-M]	[H-M]	[L]	L
Black Bear – critical riparian habitat	[H-M]	[H-M]	[M]	L
Black Bear - critical shoreline habitat	[H]	[H]	L	L
Black Bear - access	[H]	[H]	[H]	[L]
Black Bear - viewing / conflict	[H]	[H]	L	L
Black Bear – overall risk	[H-M]	[H-M]	[M-L]	L

Hunting: Both Basecases and Viewpoint 1 are thought to be low risk management, as the province determines they are both well within sustainable limits of human-caused mortality after factoring in illegal unreported and "problem" kill of bears (T. Hamilton pers. comm.). Both Viewpoints call for population monitoring, significantly strengthening the management program as a whole. Viewpoint 2 prevents any hunting pressure and should therefore similarly provide a low level of risk.

Denning habitat: Under Current Management (BC2 or BC3c) there is no specific requirement to identify or manage denning habitat now or as recruitment into the future, however wildlife tree patches and other reserves (particularly monumental cedar identified for cultural purposes) will maintain some of these values. Extensive historic clearcutting will have removed denning sites from some areas of the Islands in cutblocks today, and the long-term availability of den sites is low. We suggest current defacto management may represent high-moderate risk but with significant uncertainty due to the lack of information on the abundance and distribution of den sites through space and time.

The consensus recommendation for protecting bear dens lowers this risk for both Viewpoints.

Escape Trees: Under current management there is no specific provision for managing for bear escape trees. However, wildlife tree patches and riparian reserves may meet this objective to some extent. Again, it is difficult to assess the overall risk level because a detailed analysis of number of adequate trees being maintained through space and time is beyond this analysis – we provide a risk rating of uncertain 'high-moderate' risk because efficacy of wildlife tree patches is unknown, they are not required in every cutblock, and the extent to which wildlife tree patches are affected by blowdown creates uncertainty for the long-term provision of these values.

Viewpoints 1 and 2 specifically require the retention of escape trees within harvested areas, and Viewpoint 2 also requires a minimum distance between these trees so lowering uncertainty about the effectiveness of the recommendation.

Critical Riparian Habitat: Under Current Management there is no specific provision for managing bear security or bedding requirements but there would be *defacto* protection of some of these sites through application of riparian guidelines. However, there is concern that bedding sites may be sufficiently far from the creek sides that they may not be protected using generic FRPA guidelines. Viewpoint 1 also identifies the use of the riparian management guidelines under FRPA (or the FPC) to maintain critical riparian habitat for bears. We suggest this overall risk level is high-moderate but with significant uncertainty about how well riparian management captures these sites and maintains them over the long-term.

Viewpoint 2 has more specific requirements to incorporate existing bear bedding areas around important fishing streams within the riparian requirements. Viewpoint 1 has the potential to incorporate such areas, but it is not required.

Critical Shoreline Habitat: the recommendations for critical habitat outside riparian areas are consensus recommendations, and provide for buffers around important sites which is very important to bears given the seasonal importance of these feeding sites. Such protection is not required under Current Management.

Access Management: No access management for bears is provided under Current Management. This is thought to be a critical factor impacting the viability of bear populations, since contact with humans is the prime factor influencing mortality rates. The two Viewpoints aim to provide areas with a low probability of mortality for bears: Viewpoint 1 uses Protected Areas and Non-contributing (inoperable) areas to meet this goal, which will have little benefit over current management since these areas are rarely roaded. Viewpoint 2 has more detailed recommendations that develop a more comprehensive access management plan across the entire landbase (not just in areas which generally have little access), and requires consideration of broader issues such as required access for deer hunting etc. Quantitative analysis of road density was not undertaken for the LUP, but operable areas on the Islands have sufficiently high road densities to impact bear behavior and mortality (T. Hamilton pers. comm.), so at least in those areas of the landscape these densities may represent high risk for bears. The composite effect for the whole landbase (dominated by highly impacted and zero impact areas) is unknown. We suggest having no access management strategy represents high, but uncertain risk.

Viewing and Communities: there are a series of consensus recommendations regarding bear viewing and bears around communities. Under current management there are no specific guidelines. Given that interactions with humans provide a primary source of mortality we suggest this represents high but uncertain risk.

Overall and Interactions:

Overall risk ratings for bears resulting from current management is really unknown over the long-term. Populations are considered healthy and non-threatened on the Islands, but the long-term effects of changes in riparian areas, forage supply, denning habitat etc are not well understood. here is little information on critical habitat and current bear populations specific to the Islands. In addition the impacts of deer browse on habitats critical for bears is not well understood. We suggest this represents High to Moderate risk, but with significant uncertainty overall. Under the LUP Viewpoints, the recommendations for black bear management interact with other recommendations, particularly old forest protection and riparian management zones. Viewpoint 2 results in considerably lower harvest rates as a result of higher protection of old forest; this should result in lower disturbance and lower density of roads so lower overall risks to bears. In addition, Viewpoint 2 has considerably higher riparian management recommendations that will protect riparian habitats in a more precautionary manner than Viewpoint 1. Overall this would result in lower risks for bears.

MARBLED MURRELET HABITAT

The Marbled Murrelet is a provincially red-listed (endangered) species, as well as COSEWIC (Threatened) listed. Marbled Murrelets are associated with old growth forest for breeding, and the conservation status for BC is derived from concern regarding loss of nesting habitat over the entire coastal range. It is a relatively vulnerable species, being quite long-lived and with a low reproductive rate.

Marbled Murrelet is an unusual seabird which forages and winters at sea but nests inland in canopy nests on old growth trees. The first nest ever found was in California in 1974, and the first in Canada was not found until 1990. To date more than 200 additional nests have been found in BC. Marbled Murrelets occur from California to Alaska and no genetic differentiation across this range is known.

Most of the nests that have been found have been on wide limbs of old growth trees. A very small number of nests have been found in locations other than in old growth trees - a couple on ledges / ground sites and 1 in a deciduous tree (see SFU website[5] for pictures and descriptions of all nests found in their studies). Stand characteristics of forests used for nesting include large trees (must have limbs 15 – 75cm wide), epiphyte mats on branches, an uneven canopy and canopy gaps. In Desolation Sound stands with nests had larger mean basal area of trees and greater vertical canopy complexity compared with other random polygons. Predation is thought to be the primary cause of nest failure, with corvids, small mammals (particularly red squirrels), owls and forest hawks all depredating nests. Murrelets typically lay a single egg, and don't commence breeding until between 3-5 years old. Population recovery potential for this species is therefore relatively low.

The suitability of habitat for Murrelets is thought to be dependent on a number of factors including age of the forest, canopy closure, slope, elevation and distance from ocean. Habitat of 'higher suitability' tends to provide habitat for a higher density of birds, and low suitability habitat may provide some nesting sites but at considerably lower densities. Marbled Murrelet densities are not yet available for HG / QCI though research is on-going. Densities of birds found in other areas varies from 0.3 – 0.7 birds per hectare in areas of the Sunshine Coast, 0.66 birds per hectare in Clayoquot Sound, and 0.6 nests/ ha in valley-bottom habitat of the Carmanah.

LUP Stated Management Intent is:

- Maintain nesting habitat of suitable quality and distribution to support a viable population of marbled murrelets across their natural range on the Islands.

LUP Recommendations agree to undertake further inventory on this species, and additionally provide two viewpoints which provide for murrelet habitat under old-growth provisions (Viewpoint 1) or specifically protect areas of remaining habitat (Viewpoint 2).

METHODS

There are insufficient data on population parameters and population density/ habitat suitability information to determine the robustness and viability of populations across the Islands. As a surrogate we examine trends in habitat suitability as recommended by Burger (2002).

A number of different habitat suitability models have been developed for Marbled Murrelets in BC, and a number of these have been applied on HG/ QCI. Murrelet habitat models tend to focus on forest structure which influences canopy accessibility and potential nest site attributes. Accessibility is an important attribute because Murrelets are relatively weak flyers, and it is considered that access to nest sites is an important attribute of suitable forests for nesting. In this model for HG, (developed by the Process Technical Team and based on previous work by McClellan et al. 2000), key parameters included are forest age, height of the forest, canopy closure, and elevation. Distance to ocean is not included because of the large number of steep inlets and fjords on the Islands making

[5] Website: http://www.sfu.ca/biology/wildberg/species/mamu.html

the parameter difficult to interpret. Slope gradient is not included because data are contradictory on how slope affects habitat quality, and edge variables are not included because a) data are relatively weak, and b) predation risk may be relatively low on the Islands due to low densities of corvid predators. Details of the model are found in Holt 2005a.

Note that on-going research on HG is starting to demonstrate that the model used in this analysis may overestimate the area identified as suitable habitat (A. Cober pers. comm.). In all these analyses it is important to remember that the models are only as good as the science background and inventories. Concern about how well the model reflects reality however generally should not undermine the ability of the model to provide comparisons across Land Use Viewpoints, although the absolute amount of habitat being identified may be uncertain.

COMPARISON OF VIEWPOINTS AND BASECASES

LANDSTATUS

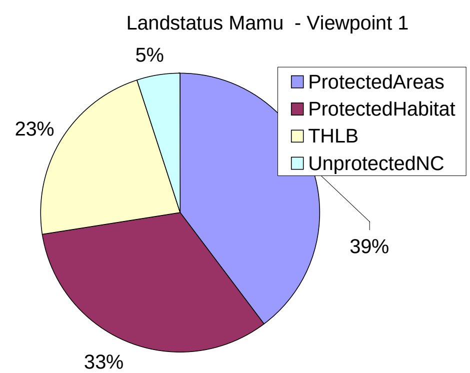
Viewpoint 1: the locations of remaining marbled murrelet habitat on the landbase are summarised in Table 16. In addition, a landstatus summary is shown in the adjacent piechart.

A total of 40% of remaining habitat is captured in Protected Areas, and another 33% captured as Protected Habitat. On average, 23% of remaining Marbled Murrelet habitat is located within the THLB and is unprotected. Very little remains as non-contributing habitat (5%) because the model preferentially located Marbled Murrelet reserves in the non-contributing landbase where possible. The total habitat protected under Viewpoint 1 represents a reduction of 55-58% from the original habitat abundance predicted to have been present in the year 1800, and a reduction of 23-27% - (depending upon the management of the NCLB) from the habitat remaining in 2000.

Viewpoint 1 protects 73% of remaining habitat, and an additional 5% remains in the unprotected non-contributing landbase. However, marbled murrelet habitat has already been harvested and protected murrelet habitat represents 42% of the amount estimated to be present in 1800, and 45% if the unprotected NC is also counted.

Table 16. Landstatus of marbled murrelet habitat – Viewpoint 1.

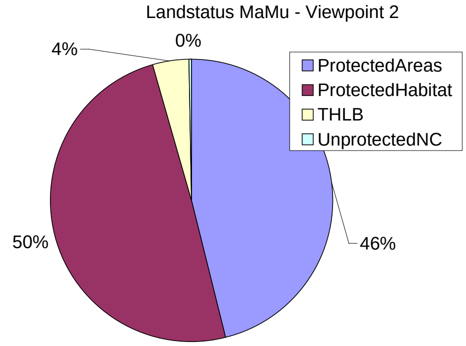
MaMuHab	Total on Islands	% in PA	% in PH	% in THLB	% NC
HighlySuitable	157,657	43	31	22	3
Suitable	56,585	25	40	26	9
Mod- Suitable	24,948	53	24	18	5
Total Mamu	239,191	40	33	23	5



Viewpoint 2: the locations of remaining Marbled Murrelet habitat on the landbase are summarised in Table 17. In addition, a landstatus summary is shown in the adjacent piechart.
A total of 46% of remaining marbled murrelet habitat is captured in Protected Areas, and an additional 50% is captured in Protected Habitat and less than 1% remains in the NC. This total represents a 55% of the habitat abundance predicted to have been present in the year 1800, and a 96% of the habitat remaining in 2000. Only 4% of existing habitat remains in the THLB and all the habitat previously unprotected in the non-contributing landbase is now protected (Table 17).

Table 17. Landstatus of marbled murrelet habitat – Viewpoint 2.

MaMuHab	Total on Islands	% in PA	% in PH	% in THLB	% in NC
HighlySuitable	157,657	50	50	0	0
Suitable	56,585	30	55	14	1
Mod Suitable	24,948	60	32	8	1
Total Mamu	239,191	46	50	4	0



The two Viewpoints identify reasonably similar levels of habitat under old growth protection, even though the levels of protection required are different. This is because a significant area of marbled murrelet habitat is located within Protected Areas, and the non-contributing landbase (23%). To meet Viewpoint 1 the amount of habitat in the THLB reduced from 36% in BC2 to 23% while the area in the non-contributing reduced from 23% to 5% as these areas were identified as protected habitat.

Table 18. Landstatus of Marbled Murrelet habitat – Current Management (BC2) and Current Reality (BC3c).

		Current Management BC2				Current Reality – BC3c			
MaMuHab	Total Area	% PA	%PH	%THLB	% NC	% PA	%PH	%THLB	% NC
HighlySuitable	157,657	26	21	34	18	49	18	21	12
ModeratelySuitable	24,948	8	17	43	32	60	12	15	13
Suitable	56,585	13	19	33	35	29	20	23	27
All Suitable Mamu	239,191	21	20	35	23	46	18	21	15

Under current management (BC2), 41% of remaining habitat is protected and additional 23% is in the unprotected NC. In the long-term then, between 41% and 64% will remain. This represents between 24 – 38% of original habitat estimated for 1800. For Current Reality (BC3c) between 64 – 79% of existing and between 37 – 46% of original habitat remain. This increase over BC2 is largely a result of Marbled Murrelet habitat being located in the Haida Protected Areas which are protected under Current Reality.

HABITAT PROTECTION

Simply totaling protected habitat (i.e. not considering areas in the NC), the total amount of habitat protected for marbled murrelets in each of the Viewpoints is shown, and compared with the amount predicted to have occurred in 1800 and the total remaining on the Islands in year 2000 (Fig. 11).

Both Viewpoint 1 and Viewpoint 2 result in higher protection of Marbled Murrelet habitat over Current Management or Current Reality Basecases, with Viewpoint 1 resulting in about three quarters of the protection obtained through Viewpoint 2. Viewpoint 1 captures about 73% of remaining habitat available in 2000, whereas Viewpoint 2 captured about 96% of remaining habitat. In comparison with the estimate of the 'natural' abundance of habitat (i.e. that predicted to have occurred in 1800) these numbers are much lower: Viewpoint 1 protects about 42% of the habitat existing in 1800 and Viewpoint 2 protects 55% of original suitable habitat.

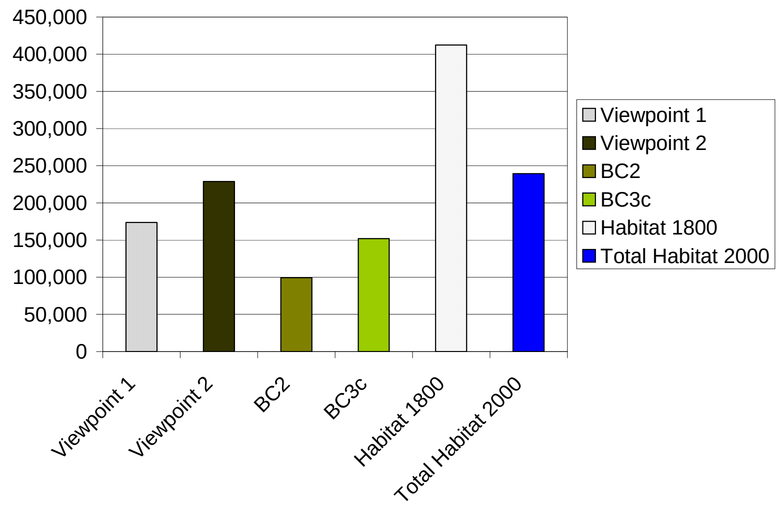


Figure 11. Area of Marbled Murrelet habitat protected in the two Viewpoints and two Basecases, compared to the amount predicted in 1800 and all remaining habitat in 2000.

SUMMARY

Table 19. Risk summary for Marbled Murrelet.

		BC2	BC3c	Viewpoint 1	Viewpoint 2
MAMU Habitat Protection	% of Current Habitat Remaining over long-term	41-64%	64-79%	73-78%	96%
	% of Historic Habitat (1800) Remaining over long-term	24-38	37-46%	42-45	55-56%
Percent decline:	From Current From 1800	59-36% 76-62%	36-21% 63-54%	27-22% 58-55%	4% 45-44%
Mamu - Overall Risk		H	H-M	H-M	M-L

This analysis summarises how old growth retention targets can be located on the landscape to capture both old growth representation AND Marbled Murrelet habitat. The results reflect the absolute levels of old growth targets available in the different Viewpoints and also the allocation of reserves into existing murrelet habitat, locating it first in the non-contributing landbase and then in the THLB in order to minimise timber supply impacts. In order to obtain similar results operationally additional planning to ensure that in fact Marbled Murrelet habitat was being protected would be required.

The link between habitat abundance and population size for Marbled Murrelets is unknown. In Burger (2002) it is recommended to assume that population size is directly related to the amount of habitat available, however, this is interpretation is complicated by 'high quality' and 'low quality' habitat that likely support different densities of birds.

The population status of murrelets on the Islands is currently unknown, but it is assumed that the population is currently viable (not declining to extinction locally) on the Islands as a whole, although populations have likely been significantly reduced in local areas on the Islands as a result of targeted harvesting in some landscape units (A. Cober pers. comm.).

On the Islands, Marbled Murrelet habitat is currently protected in two Wildlife Habitat Areas (379ha), and in Protected Areas; no Old Growth Management Areas have been established on the Islands to date. The Forest Practices Board has criticised current management for murrelets on the coast of BC, including HG / QCI, because the 1% timber cap does not allow for additional protection areas to be established, leaving the populations at risk while sensitive habitat continues to be harvested (FPB 2004).

Viewpoint 2 provides for higher protection of murrelet habitat than Viewpoint 1 directly as a result of old growth retention targets, and Viewpoint 2 also provides specific recommendations to ensure that murrelet habitat is protected (i.e. it applies the old growth targets specifically to protect marbled murrelet habitat which Viewpoint 1 does not).

The two Viewpoints state quite different targets for Marbled Murrelet, as they largely reflect the old growth targets (20% versus 70%). However, the results are not as different as may have been expected because a significant area of Marbled Murrelet habitat is located within the Protected Areas and Protected Habitat under BC2, so is protected reasonably well even though there is a significant difference in the amount of habitat specified to maintain habitat in the Viewpoints.

The analyses of amount of habitat captured under each Viewpoint suggests that both Viewpoints have the potential to protect quite a high percentage of current remaining murrelet habitat (total of 76% versus 93% for Viewpoint 1 and 2 respectively), which is more than is protected under either Basecase (see Fig. 11). Viewpoint 2 therefore has a higher probability or higher certainty of meeting the management intent than does Viewpoint 1. However, it is not known whether Viewpoint 1 provides adequate protection to result in viable populations of Murrelets across the Islands into the future.

The Marbled Murrelet Recovery Team hypothesised that a maximum decline in habitat of 30% over 30 years, from 2002 would result in viable populations for Murrelets (Canadian MMRT 2003). Using this as a comparison, looking at the projected change from today, protection under BC2 results in a decline of 36 - 59% from today, BC3c in a 21 - 36% decline from today, Viewpoint 1 in a 22-27% decline from today and Viewpoint 2 in a 4% decline from today. Again, the range in estimates is created by the uncertainty regarding future status of the unprotected non-contributing landbase. Viewpoint 1 just meets the MMRT threshold. However, the MMRT did not consider how much decline in habitat has already occurred up to 2002, or put their recommendations in the context of the different degrees of change that have already occurred on different areas of the coast. This analysis suggests that protecting habitat as outlined in Viewpoint 1 would actually result in between 55-58% decline from levels of habitat in 1800, and protecting habitat under Viewpoint 2 would result in a 44-45% decline in habitat from 1800. Considering the total change in habitat, not just change from this point forward, is more ecologically relevant, and suggests that both Viewpoint 1 and Viewpoint 2 may continue to put Marbled Murrelets at some risk on the Islands into the future, even though Viewpoint 2 protects practically all the habitat remaining today.

Additional work will be required to understand the implications of such levels of long-term habitat trends to long-term population viability and robustness.

Northern Goshawk

The Northern Goshawk *laingi* subspecies present on HG/ QCI is provincially red-listed (BC CDC; Endangered/ Threatened), and identified as Threatened by COSEWIC. The subspecies is 'listed' primarily because it exists in small populations mostly on islands and is therefore sensitive to habitat change, fragmentation and disturbance. Recent genetic analysis suggests that the population may be genetically distinct from mainland populations, suggesting that there may be very little migration from the mainland to the Islands.

Goshawks inhabit primarily coniferous forested ecosystems, nesting and usually foraging within mature and old forest types. It is a relatively sensitive species due to long lifespan, low reproductive rate and specific habitat requirements. Goshawks defend large territories and within that have specific nesting and foraging areas. Forest harvesting appears to reduce habitat quality overall in a territory if there becomes inadequate mature/ old forest to provide sufficient forage and nesting opportunities. Territories can therefore lose their viability if harvesting occurs extensively within a territory.

On HG/ QCI the diversity and abundance of prey species available for Goshawks is thought to be considerably lower than for mainland populations because typical forage species such as hares and spruce grouse are absent from the Islands. However, the non-native red squirrel has become a significant prey species since its introduction to the Islands. Alternatively however, it is recently being suggested that blue grouse populations may be an important food source for Goshawks and it is suggested that grouse may have declined as a result of competition with introduced deer species (F. Doyle pers. comm.). Predicting Goshawk forage abundance and therefore habitat suitability is therefore highly complex.

Stated Management intent for Goshawks is:

- Protection of Goshawk nesting areas
- Sufficient foraging habitat of suitable quality to maintain a viable population of Northern Goshawks across their natural range on the Islands.

LUP Recommendations include consensus agreement around the need for future study. In addition, two Viewpoints provide different approaches to management and protection of nest and foraging areas, with Viewpoint 1 linking to the outcome of future research and Viewpoint 2 setting strategies upfront for protection of nest sites and foraging habitat immediately.

Methods

For the Basecase analysis (Holt 2005a) a Northern Goshawk model was used to predict how many Goshawk territories may be viable under that management regime. Territories were assessed as being viable depending on the amount of old and mature forest present. Due to uncertainties regarding thresholds two different 'cut-offs' for defining potentially viable territories were used. This model was not however used to predict the outcomes of the LUP Viewpoints because of uncertainties around the model and its interpretation. Instead, a qualitative professional assessment of the LUP Viewpoints is provided.

Comparison of Viewpoints and Basecases

Habitat Protection

Analysis of the Basecase management scenario suggests that historically there may have been between 53 and 58 viable territories on the Islands. Based on the amount of mature / old forest (assumed to be related to suitable foraging habitat) available today this number is predicted to be between 28 and 42 territories that remain viable. As of July 2005, 13 nest sites have been found on the Islands, and in 2005 5 were known to be active. Only two nest sites have been formally protected as wildlife habitat areas under current management, and a third is protected within Gwaii Haanas.

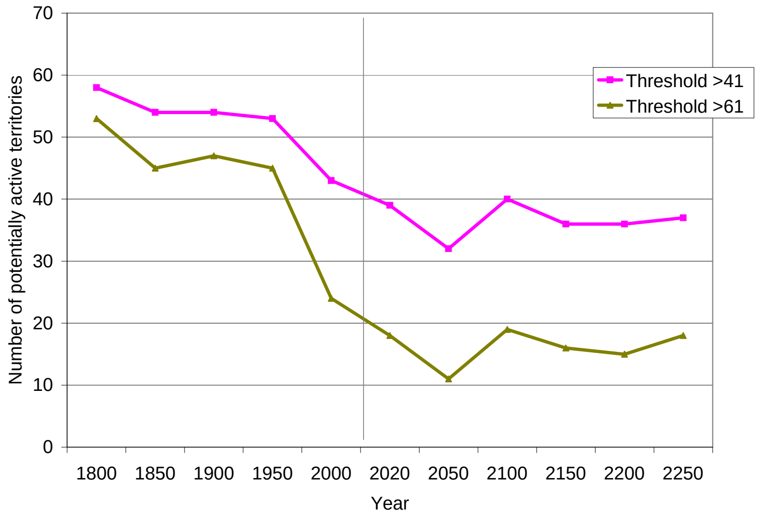


Figure 12. Number of potentially suitable territories predicted over time based on current management, using two thresholds for defining 'suitable' (see Holt 2005a for details).

Viewpoint 2 provides for a higher percentage of old and mature forest now and into the future, and so based on best available knowledge, would likely result in a higher number of territories being potentially viable than would Viewpoint 1. Viewpoint 1 provides more Protected Areas and Protected Habitat which results in a higher percentage of old and mature forests over time than is seen under Current Management , and a slightly higher level than that seen under the Current Reality Basecase.

SUMMARY

Table 20. Risk summary for Northern Goshawks.

	BC2	BC3c	Viewpoint 1	Viewpoint 2
Northern Goshawk Overall and interactions	[H]	[H-M]	[M]	[M-L]

Current Management (BC2) under the Identified Wildlife Management Strategy has the ability to protect only a very small number of territories province and island-wide, due to the 1% timber supply impact cap. We conclude this is a high risk strategy within the timber harvesting landbase because there is no budget to protect even discovered nest sites, irrespective of the need to plan for maintaining suitable foraging habitat over time. Under Current Management 2 nest areas and part of foraging habitat are protected within Wildlife Habitat Areas, and 1 known nest and territory (plus 2 or 3 potential territories are protected within Gwaii Haanas. The majority of potential nest sites occur outside current Protected Areas on the Islands (in more productive forest types) so we suggest this represents high risk, but significant uncertainty remains because of lack of information regarding population dynamics for this population.

Nest Sites: Both Viewpoints specifically protected the known Goshawk nest sites within 200 hectare reserves, so would result in similar levels of risk from that perspective, and would result in lower risk than under the two Basecases. Viewpoint 2 also provides a budget for additional potential nest sites to be protected in the future as they are discovered. The old forest budget (from old growth retention recommendations) available from either Viewpoint 1 or 2 is far in excess of that needed to protect Goshawk nest sites, and Viewpoint 2 simply provides additional guidance as to how to employ this budget to have most efficient conservation gains.

Foraging Areas: Viewpoint 2 provides for a higher percentage of old and mature forest now and into the future, and so based on best available knowledge, would likely result in a higher number of territories being potentially viable and active than would Viewpoint 1. Viewpoint 1 provides more Protected Areas and Protected Habitat which results in a higher percentage of old and mature forests over time than is seen under Current Management, and a slightly higher level than that seen under the Current Reality Basecase. However, the specific parameters affecting overall value and therefore risks for goshawks are unknown due to uncertainties particularly around factors that influence foraging habitat.

The viability of the goshawk population is also likely to be impacted by introduced species management. Both Viewpoints agreed on the same set of broad recommendations in relation to introduced species, and so both would have a similar outcome from this perspective. The effectiveness of the introduced species strategies will be critical as it is believed that prey populations important to goshawks are being significantly affected by introduced species, particularly deer and red squirrels.

In addition, it has been noted (F. Doyle pers. comm.) that site level management can perhaps alter foraging opportunities within stands, and it is likely that on-going work to improve stand level management may improve stand suitability for Goshawks at an operational level.

RARE AND THREATENED (WILDLIFE) SPECIES

The Environmental Conditions report for HG / QCI identified a number of additional species considered to have potential relevance to land use decisions on the Islands. Detailed discussion and modeling for these species was not attempted, either because the information is unavailable or because the species is more appropriate for single-species management strategies which are beyond the scope of this work. The species identified tend to be endemic subspecies, for which HG / QCI holds a large global responsibility. Species also tend to be vertebrates, which reflects a state of knowledge for biodiversity rather than any assumptions that these have higher ecological value than other biological groups. These species were:

- Northern saw-whet owl
- Great blue heron
- Bald eagle
- Stellars Jay
- Hairy woodpecker
- Sandhill Crane
- Peregrine Falcon
- Pine grosbeak
- Haida Gwaii Ermine
- Keen's long-eared myotis
- Marine mammals
- Giant black stickleback
- Haida Gwaii jumping slug

Threats to these species are varied. Some (e.g. owl, heron, jay, woodpecker, falcon, grosbeak, ermine) are all largely endemic subspecies on the Islands or local area. These are automatically of high concern because negative impacts have the potential to cause extinction of a significant part of the global population. Others have seen apparent significant declines (e.g. ermine) and are thought to be at significant risk of extinction. Activities that impact this broad set of species include forestry activities (loss of nest sites for some species, loss of habitat for others, disturbance), and introduced species impacts (including a wide range of potential impacts from predation to increased competition for food and resources).

LUP Stated Management Intent for these species is:

- Increased understanding of the habitat requirements and potential management strategies for all rare and threatened wildlife species on the Islands
- Preservation and restoration of critical habitats to maintain healthy populations of rare and threatened species.

LUP Recommendations include both consensus statements and viewpoints as to future management for this suite of species, but primarily the recommendation is to develop management strategies in future for each species of concern.

SUMMARY

No summary table of risks is provided because the species and threats vary significantly, and each species would be differently impacted by the broad suite of LUP Recommendations and Viewpoints.

Inventories: it is agreed to complete inventories for some / all of these species as part of on-going implementation of the plan. This is a necessary step for management of these species.

Develop Strategies: both Viewpoints agree to develop management strategies for these species, and in addition, Viewpoint 2 requires protection of known saw-whet owl and blue heron nesting sites as identified on HLUV Map 6.

Overall: Habitat for some of these species will be provided largely by the broad recommendations discussed elsewhere in this document (at least until strategies are fully developed). For example, increased Protected Areas and old forest retention will increase available nesting sites for old forest dependent species. Viewpoint 2 has higher levels of both and so would therefore presumably result in lower risk to those species. The population level implications of the differences between Viewpoint 1 and Viewpoint 2 however are unknown for this broad set of species.

Both Viewpoints offer the same approach to introduced species management, so from that perspective should provide equal risk levels to these additional species in relation to potentially reducing impacts from this wide-ranging group of threats.

Overall, timely inventories and development of appropriate, thorough and effective management strategies would be required to meet the Management Intent. This would require additional budget over the '1%' timber impact cap currently limiting management of 'Identified Wildlife' in British Columbia (see FPB 2004 for concerns about the effects of arbitrary limits on single species management).

SEABIRD COLONIES

The HG/ QCI archipelago supports approximately 1.5 million breeding seabirds of 12 different species which nest on more than 200 islets, islands and rocks in the HG/ QCI archipelago. This very large diversity and abundance has additional global significance since it also represents approximately half the global breeding population of Ancient Murrelets, and one fifth of the breeding population of Cassin's Auklets.

In addition to providing critical foraging habitat for breeding birds, the ocean areas surrounding HG/ QCI are also used by millions of seabirds when they are not breeding. This includes providing habitat for maturing juveniles, for over-wintering and as a stop-over area on annual migrations.

There are twelve species of seabirds nesting in the HG / QCI archipelago. Two species of Storm-petrel – Fork-tailed and Leach's Storm-petrel; the Pelagic Cormorant and the Glaucous-winged Gull. Plus eight alcid species - Common Murre, Pigeon Guillemot, Marbled Murrelet, Ancient Murrelet, Cassin's Auklet, Rhinoceros Auklet, Horned Puffin, and Tufted Puffin.

Currently, the vast majority of seabirds nest on the Islands off the northwest coast of Graham Island, and the northwest, south and east coasts of Moresby Island. In addition, islands within Masset and Skidegate inlets also have nesting colonies of gulls and pigeon guillemots. The numbers and distribution of individuals differs greatly across species. Some species are extremely abundant and widespread, representing a high percentage of the total birds in existence while others are locally very rare and localised in distribution.

The stated Management Intent is:

- Healthy populations of seabirds on the Islands
- Protection of seabird breeding and nesting habitat
- Management direction for tourism, recreation, forestry and commercial fishing activities to minimise impacts to seabird populations and habitat
- Increased public awareness about seabird sensitivities and guidelines for appropriate conduct to avoid impacts in seabird habitat areas
- Reduced predation from introduced predators such as rats and raccoons.
- Opportunities for visitors and residents to view seabirds in ways that does not disrupt them.

The consensus LUP recommendations identify specific islands and islets for protection, and list a number of additional management measures necessary to ensure effective protection.

COMPARISON OF VIEWPOINTS AND BASECASES

Table 21 provides an approximate summary of the status of seabird colonies prior to LUP recommendations, and with the LUP Recommendations.

A large percentage of the nesting seabird populations are identified as protected within the LUP recommendations, with only Pigeon Guillemot and Glaucous-winged gull showing a significant percent unprotected. The Islands are thought to provide nesting habitat for 50% of the BC population of Pigeon Guillemots and 6% of the global population; some populations are known to have decreased locally as a result of introduced species. Glaucous-winged gull populations are increasing coast-wide and are thought to be stable or increasing on the Islands as well.

Table 21. Status of Seabird Colonies (as a percent of the estimated total population protected) pre and post LUP recommendations (data summarised by A. Harfenist pers. comm.).

	Status Prior to LUP Recommendations			Potential Status Post LUP
Species	% nesting population protected within Gwaii Haanas or ecological reserves	% nesting population receiving limited protection within WHAs or WMAs	% nesting population with no specific protection	% nesting population protected ***
Storm-petrel species	63	35	2	100
Pelagic Cormorant **	45	22	33	90
Glaucous-winged Gull	59	14	27	80
Pigeon Guillemot	27	16	57	49
Ancient Murrelet	59	37	4	100
Cassin's Auklet	62	38	< 1	100
Rhinoceros Auklet	70	30	< 1	>99
Tufted Puffin	82	18	< 1	100
Horned Puffin	91	9		100
Common Murre	100			100
Total Protected (avg)	88%			93%

** There are two known PECO nest sites that are not currently included as recommended protection areas because their precise location is not known and cannot be mapped. When a location for these nest sites is known, the areas should be reviewed for consideration as Seabird Protection Areas.

***% nesting population protected if LUP recommendations of July 2005 accepted.

SUMMARY

Table 22. Risk summary for seabirds.

		BC2	BC3c	Viewpoint 1	Viewpoint 2
	% of Seabird Colonies Protected	88%	88%	93%	93%
Seabird Colonies	Risk	M (H for some sp)	M (H for some sp).	[L]	[L]

Under Current Management between 27 and 100% of the nesting populations of each seabird species are encompassed by Gwaii Haanas. Additional areas are protected by Wildlife Habitat areas and Wildlife Management Areas, resulting in a total average protection of 88% of the nesting populations. The efficacy of these protection measures has been questioned however, because they usually do not include management of surrounding marine areas, and are difficult to and often poorly enforced. In addition, there remain impacts from fishing lodges, tourism, fisheries (as a result of boats/ nets/ disturbance) and changes to forage supplies all of which are difficult to quantify or regulate under current management.

The two Viewpoints provide consensus recommendations with regard seabird colonies.

Overall, the recommendations outline protection for a significant percentage of the seabird nesting sites on the Islands. The only significant outstanding species is the Pigeon Guillemot; the identified areas protect only 50% of the known nesting sites. This is a common species on the Islands and is not known to be in decline currently, though some historic nesting areas have been significantly impacted by introduced species over the last 50 years.

The package of recommendations is comprehensive and includes direction to a number of different agencies and operators. Full implementation of the recommendations (relating to more than simple land use) will be required if they are to have the intended low risk management implications for these species.

INTRODUCED SPECIES

Non-native species have been introduced to HG / QCI since the mid 1800s and introductions continue to the present day. For HG / QCI a very large number of species are known to have been introduced including rusts, slugs and snails, earthworms, a wide variety of insects, amphibians, birds, mammals, and a large number of plant species. The ecological implications differ by species; with some having relatively small ecological impacts, while others have very severe ecological impacts. In composite, these introduced species have significantly altered the abundance and distribution of native species, native habitat distribution and functioning, and ecosystem functions and processes.

One species in particular, black-tailed deer, also has important social value on the Islands, being an abundant food source for many Island residents.

Non-native or 'introduced' species have impacted the ecosystems of many areas across the globe, but the greatest impacts have been on Island ecosystems. Islands are particularly vulnerable to the impacts of invasive species because they often have relatively few native species (e.g. few large predators or ungulates), so making it easy for other species to invade, and because they often have unusual species or combinations of species, making the overall impacts from invaders of more ecological concern.

More than 23 animal species and approximately 20% of the flora of the Islands are thought to be non-native (approximately 143 of 657 vascular plants, Golumbia 2000). Not all these species are 'invasive', i.e. they don't all have the propensity to spread widely and so some are of lower concern than others. "Invasive" species tend to be those that do well in disturbed habitat types, are often highly competitive species outgrowing the competition under open growing conditions. Fortunately, the natural vegetation of the Islands (old age forested ecosystems) tends not to allow colonisation by this type of species, since there are relatively few naturally disturbed sites in these ecosystems and most typical 'invasive' plants do not tolerate the shade of the forest understory. Most introduced / invasive plant species are therefore confined to roadways (and some are intentionally seeded there as a management strategy), and have colonised associated shorelines, beaches and open forest types, particularly around Tlell. Fortunately, to date there have been no introductions of freshwater fish.

Stated Management Intent of the LUP is:

- Minimal impacts to Island ecosystems, wildlife habitat, and culturally important plants from introduced species.
- A coordinated approach to introduced species management.
- Ongoing monitoring of introduced species impacts.

LUP recommendations are consensus and provide a detailed strategy that aims to enable future management of introduced species.

COMPARISON OF VIEWPOINTS AND BASECASES

No quantitative analysis of the impacts of introduced species recommendations was undertaken. Both LUP Viewpoint 1 and Viewpoint 2 agree to the same suite of recommendations regarding Introduced Species management, so both should result in similar levels of risk to the environmental values on the Islands.

SUMMARY

Table 23. Summary table of risks for Introduced Species

	BC2	BC3c	Viewpoint 1	Viewpoint 2
Introduced Species	H	H	[M-L]	[M-L]

Both Basecases are identified as high risk because there is no concerted strategy to manage introduced species, except for a few specific species in some locations.

The consensus LUP recommendations provide a framework for prioritising and addressing introduced species impacts. This package could result in low risk, but there remains significant uncertainty because the recommendations will be difficult to implement (i.e. they require concerted stable funding, long-term vision and investment). In addition there are significant practical and scientific limitations in being able to manage this complex suite of introduced species in a remote location such as HG / QCI.

However, it cannot be overstated that in order for many of the other recommendations of the LUP to be effective there has to be implementation of effective introduced species management. This is particularly true in relation to old growth forest and plant community management; without adequate management of deer impacts old-growth reserves may protect established trees in the short-term, but will not provide for regeneration (particularly of cedar), nor will it protect natural understory plant communities. Similarly, there appear to be impacts of introduced species on the Goshawk population which are complex and not entirely understood. If the intention is to maintain populations of natural species, introduced species will require some significant management efforts in future.

The broader effects of introduced species are unknown (particularly in relation to all the other species of management concern). Immediate implementation of these recommendations will be important: for instance red-legged frogs are currently undergoing a population explosion on the Islands yet a few years ago there were none present. Ensuring that no additional species come to the Islands is crucial, and prioritising and managing existing impacts should be a high priority.

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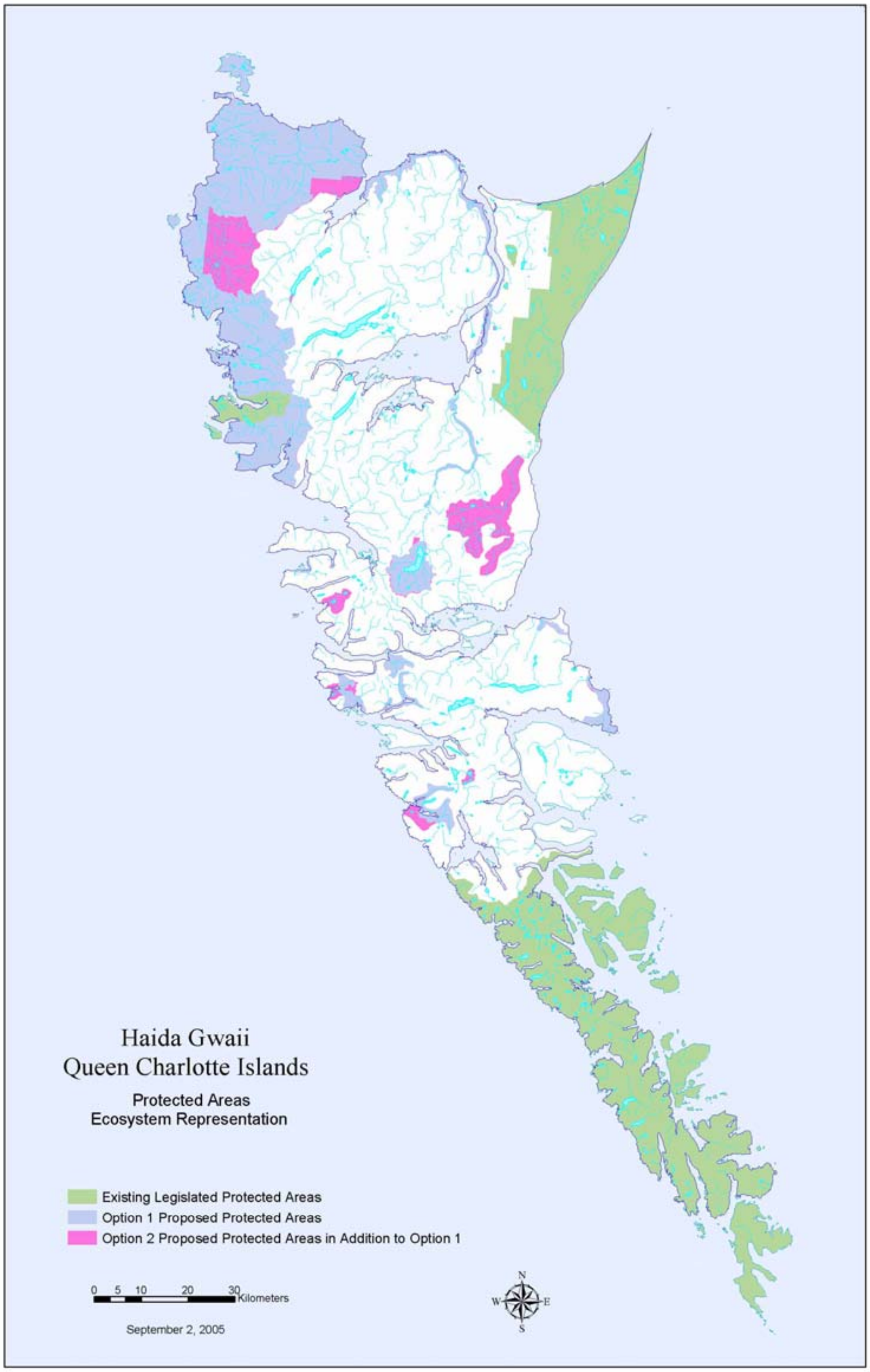
Appendix 1. Map of proposed Protected Areas Viewpoint 1 and Viewpoint 2.



Appendix 2. Old Forest Retention Recommendations for Viewpoint 1 and Viewpoint 2, by Landscape Unit.

#	Landscape Unit	Viewpoint 1 Biodiversity Emphasis	Viewpoint 1 Retention Target (%)[6]	Viewpoint 2 Biodiversity Emphasis	Viewpoint 2 Retention Target (%)[7]
1	Athlow	High	>20%	Haida Protected Area	100%
2	Beresford	High	>20%	Haida Protected Area	100%
3	Jalun	High	>20%	Haida Protected Area	100%
4	Bigsby	Gwaii Haanas	100%	Gwaii Haanas	100%
5	Skincuttle	Gwaii Haanas	100%	Gwaii Haanas	100%
6	Kunghit	Gwaii Haanas	100%	Gwaii Haanas	100%
7	Gowgaia	Gwaii Haanas	100%	Gwaii Haanas	100%
8	Lyell	Gwaii Haanas	100%	Gwaii Haanas	100%
9	Gudal	High	>20%	High	70%
10	Hibben	High	>20%	High	70%
11	Naikoon	High	>20%	High	70%
12	Otun	Moderate	20%	High	70%
13	Tlell	High	>20%	High	70%
14	Yakoun Lake	Moderate	20%	High	70%
15	Rennell	Moderate	20%	Moderate	50%
16	Honna	Moderate	20%	Moderate	50%
17	Ian	Moderate	20%	Moderate	50%
18	Sewell	Low	<20%*	Moderate	50%
19	Lower Yakoun	Low	<20%	Moderate	50%
20	Masset Inlet	Low	<20%	Moderate	50%
21	Louise Island	Low	<20%	Low	30%
22	Skidegate Lake	Low	<20%	Low	30%
23	Tasu	Low	<20%	Low	30%
24	Eden	Low	<20%	Low	30%

[6] Viewpoint 1 targets of <20% are defined as consistent with current management requirements under FRPA.

[7] Viewpoint 2 targets are based on % of natural levels of old forest retention

Appendix 3. Area of old growth in the timber harvesting landbase (THLB) over time, as projected under Current Management (BC2). Shading shows when the amount of old-growth drops below 500ha in each type, providing an estimate of the rate of removal of old growth from each ecosystem within the THLB. Note how the timeframe varies for different ecosystems, e.g. for hemlock good in the CHWvh2 it has already occurred (between 1950 and 2000), and for others e.g. for cedar low in the CWHwh1, it does not occur until sometime between 2100 and 2150.

Analysis Unit	BECv	1800	1850	1900	1950	2000	2020	2050	2100	2150	2200	2250
CedarGoodMedium	CWHvh2	636	635	635	635	604	518	311	45			0
	CWHwh1	5,305	4,306	4,205	4,187	3,835	2,030	683	13	12	13	1
	CWHwh2	543	543	541	541	534	217	28	1	1	1	1
CedarLow	CWHvh2	1,888	1,831	1,814	1,814	1,800	1,189	483	277	9	9	9
	CWHwh1	35,944	31,123	31,016	30,908	30,386	15,987	5,820	1,963	173	160	132
	CWHwh2	3,555	3,488	3,486	3,486	3,469	1,542	267	137	73	73	72
	MHwh1	76	76	76	76	76	69	25	24	5	5	5
	MHwh2	239	239	239	239	237	108	35	11	6	5	5
CedarPoor	CWHvh2	2,320	2,194	2,194	2,194	1,605	1,466	813	170	4	4	5
	CWHwh1	16,001	13,000	12,971	12,860	10,967	6,217	1,954	414	341	335	26
	CWHwh2	1,765	1,765	1,757	1,757	1,703	666	23	12	11	11	11
HemlockGood	CWHvh2	1,701	1,685	1,671	1,669	167	221	90	17	18	18	24
	CWHwh1	11,754	11,507	11,407	9,479	1,111	324	118	3	2	48	328
	CWHwh2	554	554	554	554	76	50	3	3	3	3	4
HemlockMedium	CWHvh2	6,139	6,099	6,098	6,090	2,108	1,755	808	215	36	30	29
	CWHwh1	72,575	72,223	72,046	64,243	7,451	2,443	908	144	72	303	384
	CWHwh2	11,855	11,854	11,827	11,799	2,205	938	103	18	17	17	22
	MHwh1	196	196	196	196	152	117	12	2	1	1	1
	MHwh2	669	669	669	669	285	139	26	2	2	2	3
HemlockPoor	CWHvh2	6,778	6,748	6,744	6,724	6,323	5,085	2,121	110	33	29	30
	CWHwh1	24,950	24,363	24,202	23,557	16,651	7,457	1,943	166	118	147	90
	CWHwh2	9,796	9,703	9,680	9,673	9,232	3,805	368	162	105	107	101
	MHwh1	695	681	681	681	676	442	137	16	12	12	12
	MHwh2	1,571	1,560	1,560	1,560	1,472	506	64	34	30	30	30
SpruceGood	CWHvh2	889	889	864	859	528	318	150	34	16	21	31
	CWHwh1	3,642	3,267	3,133	2,850	1,678	924	450	7	5	6	12
	CWHwh2	164	160	158	157	114	42					
SpruceMediumPoor	CWHvh2	1,547	1,525	1,524	1,524	1,441	1,407	643	50	14	11	6
	CWHwh1	4,255	4,165	4,071	3,981	3,786	2,521	1,107	51	10	12	13
	CWHwh2	1,213	1,213	1,213	1,213	1,158	629	105	5	4	4	4
	MHwh1	60	60	60	60	60	60	37	1	1	1	1
	MHwh2	231	231	231	231	195	87	7	6	6	6	6