EBMWG DS04

Co Location Project

APPNDIX 1

Summary of Habitat Retention Goals by Focal Species

Taken from EBM Working Group Focal Species Project

Part 2:

Methods for
Strategic Co-Location of Habitats within
Areas of Old Growth Retention

Prepared for
Ecosystem-Based Management Working Group

By
Hannah Horn and Chuck Rumsey

1 Summary of habitat retention targets by focal species

1.1 Black bear

As there was no mapping of black bear habitats to support the analysis, there are no specific targets for habitat retention for the species.

Table 1. Summary of recommended habitat retention targets for black bears.

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best habitats	Habitats locked into final reserve layer	Upper limit of change
Black bear	Sub-regional habitat mapping not available at this time	No mapping available at this time	-	Targets for habitat retention to be determined once habitat mapping is available. Guidelines for capture of black bear habitats includes: • Capture black bear habitats outside of grizzly-occupied areas (e.g., in hypermaritime areas). Determine targets for habitat capture once mapping has been completed. • In areas where there is overlap with grizzly bears, capture a range of habitat values in the CWHvm and CWHwm. • Locate OGRAs to capture stands with high potential to provide den	Not defined at this time	Not defined at this time	-

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best habitats	Habitats locked into final reserve layer	Upper limit of change
				structures. This will augment within-stand retention and help to ensure a supply of denning habitat across landscapes.			

1.2 Coastal black-tailed deer

1.2.1 *Existing management designations and objectives*

GAR Order Ungulate Winter Ranges

Ungulate Winter Ranges (UWRs) have been legally established for the Mid and South Coast under the Government Actions Regulations.

South Coast: There are relatively few deer winter ranges currently designated on the South Coast. The B.C. Ministry of Environment (MOE) has put more effort into designating mountain goat habitats. General Wildlife Measures state that harvesting is not permitted within the UWR except where this will enhance the quality of the winter range.

Mid Coast: General wildlife measures associated with designated deer winter ranges require 20 – 25% retention of winter range, with limits on patch size and distance between patches. Mid Coast UWR polygons do not include the hypermaritime.

North Coast: There are no UWRs proposed for the North Coast. Deer are not thought to be at risk from forestry activities and are a low priority for habitat management. MOE Skeena Region has designated ungulate winter ranges for moose and mountain goats.

1.2.2 Habitat definition

Modelled deer winter habitat suitability

Habitat cut-offs that define moderate and high value habitats for the purposes of co-location are shown in Appendix 3.

1.2.3 Targets for habitat retention

Population objective: To maintain existing populations and a distribution of deer that satisfies both ecological and social objectives.

The risk targets outlined below reflect the risk of not achieving the stated objective. These targets are based on expert opinion and were not derived through a formal risk assessment.

a) Modelled winter habitat suitability

Recommended low risk target: 90% of the area of high value (H) habitat

This can be achieved by capturing a minimum of 70% of High (H) value habitat with the remainder made up of twice the area of Moderate (M) value habitat.

Rationale:

Twice as much M must be captured to be equivalent to H because it is assumed to support approximately half the density of deer supported by H.

Analysis Unit: Landscape Unit to ensure a distribution of habitats across each sub-region.

b) Designated habitat areas

Approved UWRs form a legal requirement for consideration in the focal species co-location project and have been 'locked into' the MARXAN solution.

c) Upper limits of change

Domain experts have identified less than 60% of existing deer winter range within a landscape unit as a high risk scenario. (i.e., more than a 40% reduction in habitat area)

1.2.4 Rationale for targets:

This estimate of an upper limit of change is expert opinion based on the amount of the area currently remaining as functional winter range compared to historic levels. The amount of habitat loss varies across the coastal planning region. The North Coast, for example, has not experienced as much forestry activity as in the Mid and South Coasts and, therefore, the acceptable threshold of change to deer winter habitats may be higher.

1.2.5 Uncertainties and limitations

- Modeling at the scale undertaken in this project has inherent problems including a high likelihood of mis-identifying areas as either high or low value habitat (due to limitations in forest cover and other input variables). There is no substitute for site specific information in making decisions on the designation of critical habitat.

- In general, any issues affecting the reliability of the forest cover layer may compromise the reliability of the deer mapping output. This is an issue for all habitat mapping that uses the forest cover layer as an input.

Table 2. Summary of recommended habitat retention targets for coastal black-tailed deer.

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	Habitats locked into final reserve layer	Upper limit of change
Coastal black-tailed deer **Objective:** Maintain existing	Coast-wide habitat mapping (2008)	Habitat cut-offs vary between sub-regions and between coastal and mountain ecosections	LU	90% of the area of high value habitat (H). This target may be achieved with a mix of H and M habitats if a minimum 70% H is	100% of H habitats captured in the Low Risk solution	-	$\geq$ 40% reduction in existing deer winter range within a

populations and a distribution of deer that satisfies both ecological and social objectives.		(Appendix 3).		retained and 2x the M to make up to H equivalent area.			landscape unit is a high risk
	Approved and proposed Ungulate Winter Ranges	UWR polygons		Approved UWRs in the South Coast are 100% retention Approved UWRs in the Mid Coast have a target of 20 - 25% of age 141+ yr old stands. There are no legal UWR for deer in the North Coast.	Approved and proposed UWRs, as per General Wildlife Measures	Approved and proposed UWRs, as per General Wildlife Measures	

1.3 Grizzly bear

1.3.1 Assumptions

- Habitat ratings for fall habitats (e.g., salmon fishing areas) were not mapped in the South Central and Mid Coast on the assumption that these habitats are expected to be adequately addressed through EBM objectives for areas aquatic habitats (sections 8 – 13). All seasons were considered during the North Coast mapping.

- Due to the regular redefinition of THLB ∕ non-contributing areas, domain experts assume that all productive forested landbase outside of protected areas and other legal reserve is vulnerable to harvest.

1.3.2 Existing management designations and objectives

a. Coastal Land Use Orders

The Coastal Orders for the North and Central and South Central Coasts contain specific objectives to maintain grizzly bear habitat.

- Section 17 in the South Central Coast Order is to maintain 100% of grizzly bear habitats as identified in the Schedule 2 map associated with the Order.

- Section 17 in the Central and North Coast Order is to maintain 100% of Class 1 and 50% of Class 2 grizzly bear habitats as identified in the Schedule 2 map associated with the Order.

b. Designated habitat areas

In the Mid Coast, WHA polygons for grizzly bears make up approximately 25% of the Mid-Coast Class 1 and 2 grizzly polygons. Management within Mid Coast grizzly bear WHAs is 100% retention.

1.3.3 Pre-analysis

- Stratify all habitat layers by landscape unit and BEC variant.

- Stratify Class 2 habitats by season.

- Evaluate the distribution of Class 1 and 2 habitats by landscape unit, BEC variant and season and determine the habitat types that are rare and those that are common.

- Testing of the assumption that fall habitats are adequately addressed through EBM objectives for management of aquatic habitats (sections 8 – 13).

1.3.4 Map inputs

Habitat suitability layer

Consolidated grizzly bear map layer that brings together the various products of habitat suitability mapping products for the coast (see section 3.3.1).

Designated habitat areas

Grizzly bear habitats identified in Schedule 2 of the Central & North and South Central Coastal Orders.

Existing WHAs in the Mid and South Coasts.

1.3.5 Habitat definition

Habitat polygon suitability for grizzly bears was rated according to the provincially accepted 6-class system (RIC 1999).

Class 1 and 2 habitats represent the highest value habitats for grizzly bears.

1.3.6 Targets for habitat retention

Population objective: To ensure grizzly populations that are healthy enough to allow limited consumptive use (e.g., hunter harvest, traditional use) as well as non-consumptive uses (e.g., bear viewing). A healthy population should be relatively stable and sustainable given desired human use, able to maintain its organization and function over time, and resilient to stressors, including human impacts and stochastic environmental and demographic events.

The habitat retention targets below reflect the perceived risk of not achieving the stated population objective. These targets are based on expert opinion and were not derived through a formal risk assessment. Domain experts feel the recommended habitat retention target for EBM implementation is the minimum required to help achieve the population objective with the assumption that a suite of other factors that influence the health of grizzly bear populations are addressed.

a. Habitat suitability layer:

Lowest risk scenario: 100% of Class 1 and 100% of Class 2 habitats

Recommended target for EBM implementation: 100% of Class 1 and 50% of Class 2 habitats, where the Class 2 habitats selected are the most essential Class 2 habitats.

The following Class 2 habitats are a priority for retention in OGRAs:

1. Early and late spring habitats in valley bottoms and at low elevations due to their rarity and lack of seasonal alternatives. Ecosystem units on floodplains or associated with wetlands and estuaries in CWH variants are particularly important.

2. 100% of habitats in hypermaritime BEC subzones (i.e., CWHvh) because the few essential habitats that occur in the hypermaritime are likely to have disproportionate value to resident and transient bears.

3. Fall habitats that protect salmon spawning areas, near where bears fish, if these areas are not already protected by hydro-riparian management.

Summer habitats are more ubiquitous and are therefore a lower priority. Some summer habitats should also be captured, but emphasis should be on capturing the highest value summer habitats first (particularly those ecosystem units on alluvial fans and floodplains in CWH variants). Many other summer habitats are picked up through landscape level objectives for site series representation and seral stage distribution (section 16 of the Coastal Orders).

Focussing on undisturbed habitats at higher elevations (e.g., avalanche chutes) does not replace lost or altered habitat at lower elevations. Even though they have may have the same suitability for grizzly bears (Class 2), they are not necessarily comparable in terms of their relative importance to bears. For example, higher elevation habitats tend to have later phenology, are often much more common and cover a larger total area, and are typically not as vulnerable to development activity because they are often outside of the THLB.

Other considerations:

- The protection of Class 1 and 2 habitats within an LU becomes even more important where there is a high ratio of THLB to total forested and there has been a long history of forestry development (logging and roads).

- Targets in MARXAN may need to be varied by landscape unit and/or BEC variant (i.e., a single set of targets would not be applied over the entire project area). For example targets may need to vary based on:

  - amount of Class 1 and 2 habitat available,

  - status of the grizzly bear population unit,

  - current seral stage distribution in the landscape unit, and

  - location of the grizzly bear population unit with respect to the edge of their distribution and occupancy.

b. Designated habitat areas:

Grizzly bear habitats identified in Schedule 2 of the Coastal Orders and approved WHAs should be locked into the MARXAN solution as 100% retention since they are legally required.

a. Upper limit of habitat change

The retention of old growth is only one component of a suite of factors that influence the health of grizzly bear populations (other factors include mortality risk from human interaction, the health of salmon populations, etc.). Aside from the retention of essential habitat, it is not possible to directly link the retention of forest cover to the conservation of grizzly bear populations or define an upper limit of habitat change that could be expected to compromise their population trend. The magnitude of effects on bear populations depends on the type and level of land use and other human activities and the associated habitat loss and displacement and bear mortality related to human use.

1.3.7 Rationale for targets

- If essential habitats are not provided, bears cannot meet their life requisites therefore individual animal fecundity and survivorship and population trend may be negatively affected.

- Class 1 habitats are the highest suitability and all Class 1 habitats are considered essential to the health of individual grizzly bears or local grizzly bear populations. Class 2 habitats are also high value but they were not considered to have quite the same habitat (primarily foraging) suitability as Class 1 habitats.

1.3.8 Uncertainties and limitations

Targets for strategic co-location are based on the opinion of domain experts, but assumed to reflect the best-available understanding of grizzly bear habitat requirements.

The reliability of outcomes from the MARXAN co-locations for grizzly bears is influenced by limitations in the mapping. Reliability is also influenced by the level of scientific knowledge regarding grizzly bear food habits and habitat use and selection. Current assumptions are based only on a few studies in coastal B.C.

Table 3. Summary of recommended habitat retention targets for grizzly bears.

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	Habitats locked into final reserve layer	Upper limit of change
Grizzly bear **Objective:** Maintain and restore healthy enough populations to allow limited consumptive use (hunter harvest)	Consolidated habitat suitability mapping for the Coast, stratified by BEC.			Lowest risk scenario: 100% of Class 1 and 100% of Class 2 habitats	100% of Class 1 and 50% of Class 2 habitats, where the Class 2 habitats selected are the most important of all Class 2 habitats. The following Class 2 habitats are a	All Class 1 habitats are already legally protected under the Coast Orders, as is 50% of Class 2 under the Central &North Coastal Order.	Not defined. The retention of old growth is only one component of a suite of factors that influence the health of grizzly bear populations (other factors include mortality risk from human interaction, the health of salmon populations, etc.). The

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	Habitats locked into final reserve layer	Upper limit of change
as well as non-consumptive uses (bear viewing).					priority for retention in ORGAs: 1. Early and late spring habitats in valley bottoms and at low elevations, esp ecosystem units on floodplains or associated with wetlands and estuaries in CWH variants. 2. 100% of habitats in Hypermaritime BEC variants (i.e., CWHvh). 3. Fall habitats that protect salmon spawning areas, near where bears fish.		impact on bears depends on the type and amount of changes to habitats and their spatial configuration and whether or not there is also mortality risk from humans.

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	Habitats locked into final reserve layer	Upper limit of change
	Grizzly bear habitats identified in Schedule 2 of the Coastal Orders Approved WHAs for the Mid and South Coasts	Grizzly bear habitat polygons WHA polygons		Legislated habitat polygons are locked into the MARXAN solution as 100% retention.	All legally designated grizzly bear habitats	All legally designated grizzly bear habitats	

1.4 Marbled murrelet

1.4.1 Assumptions

- There is a one-to-to relationship between area of suitable marbled murrelet habitat and populations (Burger and Waterhouse *In press*). By extension, if 69% of suitable habitats are maintained over the long term (CMMRT goal; based on 2002 habitat area), then the assumption is that 69% of marbled murrelet populations will be maintained

- Marbled murrelet are more likely to use of Class 1 and 2 than Class 3 habitats, as defined on air photo interpreted maps.

- A relationship between habitat quality and marbled murrelet density has not been determined but researchers do know that marbled murrelet are more likely to select Class1 and 2 air photo-classed habitats than Class 3 habitats on air photos (Waterhouse et al. 2007, 2008, *In press*). Studies have shown that approximately 10% of marbled murrelet nests occur in poorer habitats in forest greater than 140 years (Class 4 and 5) (Waterhouse et al. 2004, 2007, 2008, *In press*; Burger and Waterhouse *In press*).

- Marbled murrelets are rare >50km inland.

1.4.2 Existing management designations and objectives

Designated habitat areas:

- There are approved and proposed Wildlife Habitat Areas (WHAs) for marbled murrelets in the Mid-Coast.

- WHAs for marbled murrelet and northern goshawk (combined) have been delineated in the North Coast and put forward for approval.

WHAs for marbled murrelets in the Mid and North Coasts are 100% no harvesting.

1.4.3 Pre-analysis

- Stratify map layers by BEC variant and distance to ocean (0 – 30 km; 30 – 50 km). Exclude habitats >50km.

- Assess the distribution of suitable (Class 1 to 3) habitats by landscape unit.

1.4.4 Map inputs

a. Habitat suitability mapping

The best available habitat layer for use in the co-location, at this time, is mapping based on air photo interpretation (Horn 2009b). Unless there are gaps in the air photo-based layer, it is preferable to not combine air photo interpretive mapping with low level aerial assessment; only use the one layer.

Where air photo or low-level aerial mapping is not available, domain experts recommend the use of the Hobbs model (Hobbs 2003) for the purposes of MARXAN analysis.

b. Designated habitat areas

Approved and proposed WHAs for the Mid and North Coasts.

1.4.5 definition

For the purposes of the co-location exercise 'suitable habitats' are defined as

- Class 1 – 3 habitats for air photo and aerial assessment-based mapping

- Superior, Good and Fair habitats for maps derived using the Hobbs model.

A comparison of the Hobbs model with the CMMRT model (Burger et al. 2005) supports the use of habitats ranked as 'Fair' in the co-location exercise, but giving them less priority than 'Superior' and 'Good' habitats (Burger, pers. comm..).

1.4.6 Targets for habitat retention

Objectives:

- To achieve the CCMRT goal of 69% retention of suitable habitat within each sub-region.

- To provide a preferred distribution of Class 1 - 3 habitats.

The risk targets outlined below reflect the risk to marbled murrelets if the stated objectives are not achieved.

a. Habitat suitability mapping

Recommended low risk targets:

- Maintain 62% suitable MaMU habitat within each landscape unit and sub-region. The denominator in calculating 62% is the sum of habitat in Classes 1-3.

    The 62% amount assumes that approximately 10% of marbled murrelet nests are found outside of 'suitable' habitat areas (10% of 69% (CMMRT habitat goal) = 6.9%) (Waterhouse et al. 2008, in press; Burger and Waterhouse *In press*).

- Targets for habitat retention:

    o For habitat mapping with a 6-level ranking system:

    62% of [Classes 1 + 2 + 3]: Capture 100% of Class 1 and 2 habitats (where Class 1 = Class 2) and achieve the remainder with Class 3 where necessary

    o For habitat mapping with a 4-level ranking system (Hobbs model):

    62% of [Superior + Good + Fair habitats]: Capture 100% of Superior and Good habitats (where S = G) and achieve the remainder with Fair where necessary

Analysis units: Distance to ocean class (0 – 30km and 30 – 50km) by sub-region, reported by landscape unit.

The achievement of 62% of suitable habitats is not necessary within individual landscape units, however, if the 62% target is not achieved over an entire sub-region, this will be a move away from the CCMRT goals and there is an increased risk that marbled murrelets will continue to decline over time. The larger the short-fall in habitat conserved (under the 62% target), the more likely it will be that the level of risk assigned to the species will remain static or increase in future.

At the time of preparing this report, the low risk targets using the 4-level ranking system (Hobbs model) had not been tested in MARXAN.

b. Designated habitat areas

Approved WHAs for marbled murrelets form a legal requirement for consideration in the focal species co-location project and should be 'locked into the MARXAN solution.

Assign a 100% retention target to proposed WHAs for marbled murrelets.

1.4.7 Rationale for targets

- The recommended low risk target is based on the CMMRT goal of conserving 69% of suitable habitat in Northern and Central Mainland conservation regions in the long term (CMMRT 2003). The CMMRT goals have been defined based on extensive analysis by marbled murrelet experts over many years.

- There is a greater certainty of use of Class 1 and 2 habitats by marbled murrelets (Waterhouse et al. 2008, *In press*; Burger and Waterhouse *In press*) and any loss of Class 1 and 2 habitats is likely to reduce options for nesting.

- Class 3 habitats are more ubiquitous and are less certain to provide the habitat attributes required for nesting.

1.4.8 Uncertainties and limitations

- Targets for strategic co-location are based on expert opinion supported by best available science related to the habitat requirements of marbled murrelets. There are uncertainties associated with the relationship between murrelets and their terrestrial habitats.

- Mapping of habitat suitability does not always correlate with breeding success, therefore research is needed regarding other influences on breeding productivity such as predators and hierarchical habitat selection. (Waterhouse et al. 2008).

- More research is needed about the relationship between the quality of habitat and density of marbled murrelets (Waterhouse et al. 2008). Although a relationship between habitat quality and murrelet density has not been determined, researchers do know that marbled murrelets are more likely to select Class1 and 2 air photo classed habitats than Class 3 habitats (Waterhouse et al. 2007, 2008).

- More research is required to understand how different map products compare: air photo, aerial, Hobbs method.

- The CMMRT goal is to limit population decline from a baseline year of 2002. The co-location analysis uses post-2002 data in areas where logging has occurred without some corresponding compensation. This likely means that the risk of not attaining the CMMRT goal is higher than estimated in the co-location exercise.

Table 4. Summary of recommended habitat retention targets for marbled murrelets

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change
Marbled murrelet CMMRT short and long-term recovery goals are to slow the decline to the B.C. marbled murrelet population and its nesting habitat to a stable level of 69% of 2002 levels in Northern and Central Mainland conservation regions (CMMRT 2003). Domain experts identified habitat objectives to achieve CMMRT recovery goals, based on the assumption	Air photo interpretation mapping	Class 1 – 3 habitats, , stratified by BEC and distance to ocean class (0 – 30 km; 30 – 50 km)	Sub-region; LU; distance to ocean class	62% of [Classes 1 + 2 + 3]: 100% of Class 1 and 2 and achieve the remainder with Class 3 where necessary	100% of Class 1 and 2 habitats		The larger the short-fall in habitat conserved (under the 62% target), the more likely it will be that the level of risk assigned to the species will remain static or increase in future.
	Where air photo or low-level aerial mapping is not available, use the Hobbs algorithm (Hobbs 2003)	Superior (S), good (G) and fair (F) habitats, stratified by BEC and distance to ocean class (0 – 30 km; 30 – 50 km)	Sub-region; LU; distance to ocean class	62% of [S + G + F habitats]: 100% S + G and achieve the remainder with F where necessary	100% of Superior and Good habitats		

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change
that habitat and nesting population is roughly 1:1 **Objectives:** • To achieve the CCMRT goal of retaining 69% of suitable habitat within the sub-region over the long term • To provide a preferred distribution of Class 1 - 3 habitats.	Approved and proposed WHAs	WHA polygons	LU	Approved WHAs in the Mid Coast have been 'locked into' the MARXAN solution as 100% retention. Proposed WHAs in the Mid and North Coasts have a target of 100% retention but are not locked in.	All approved and proposed WHAs	All approved and proposed WHAs	

1.5 Mountain goats

1.5.1 Assumptions

- Due to the fidelity of mountain goats to their habitats, any loss or reduced functionality of winter habitat complexes will have a direct effect on localized groups or populations.

- The level of habitat disturbance is not directly proportional to the level of impact (i.e., 20% reduction of habitat could equal 50% reduction in use).

1.5.2 Existing management designations and objectives

Designated Ungulate Winter Ranges

Ungulate Winter Ranges (UWRs) have been legally established or are pending for all three coastal sub-regions under the Government Actions Regulation. Legally designated UWRs represent a subset of modelled goat winter range mapping.

North Coast: UWRs for mountain goats are currently proposed for the non-contributing forested areas. A second proposal for the area that overlaps THLB (as defined by TSR II) is being considered but outside of current policy.

Mid Coast: General Wildlife Measures (GWMs) for approved UWRs in the Mid Coast state that up to 10% of a mountain goat UWR can be harvested, with restrictions on the nature and timing of activities and road development. As mountain goats appear to be on a declining trend, MOE Cariboo Region is considering amending the GWMs to prescribe no harvesting within UWRs (K. Dunsworth pers comm).

South Coast: UWRs have been approved for the entire South Coast, with the exception of the Phillips Landscape Unit, where approvals are pending. Harvesting is not permitted within the UWR except where this will enhance the quality of the winter range.

1.5.3 Pre-analysis

Consider stratifying the landbase into mountain blocks ("meta-populations" sec. 8.1) and use these as planning units for goat habitat management. This stratification has been completed for the North Coast.

1.5.4 Map inputs

a. Modelled habitat

North Coast: RSPF habitat suitability mapping as described in Pollard and Keim (2006). Habitats are defined as suitable or not suitable. Polygons rated as 'suitable' represent 90% of the area that mountain goats would select if they are in the area.

Mid Coast: Habitat suitability mapping based on GIS algorithms. Habitat is defined as suitable or not suitable.

South Coast: A Resource Selection Function (RSF) model developed by Taylor et al. (2004) was applied to assess winter habitat suitability. The resulting RSF values reflect relative likelihood of use of winter habitats by mountain goats (ranging from 0 – 1.0) if they are in the area. Type 1 (very high) and Type 2 (high) winter habitat ratings were designated after comparing model output values with known winter goat locations (as determined through telemetry and/or habitat use assessments) as follows:

Type 1 (Very High value):   RSF values 0.185 – 1

Type 2 (High value):   RSF values 0.024 – 0.185

For the South Coast, only the female habitat layer should be used (do not combine with the male habitat layer).

b. Legally designated habitat areas

FRPA (GAR Order) UWRs for the Mid and South Coasts; proposed UWRs for the North Coast

1.5.5 Targets for habitat retention

Population Objective: to sustain healthy populations of mountain goats by preventing localized extirpation.

The risk targets outlined below reflect the risk of not achieving the stated population objective. These targets are based on expert opinion and were not derived through a formal risk assessment.

a. Modelled habitat

<u>North Coast</u>:   Recommended low risk target: 100% suitable habitat

<u>Mid Coast</u>:   Recommended low risk target: 90% suitable habitat

<u>South Coast</u>:

Recommended low risk target: 90% suitable habitat. This could be achieved by capturing:

- the entire 90% as Type 1 habitat; or

- a combination of Type 1 and Type 2 habitats such that a minimum of 70% of the Type 1 habitat is captured and two times the Type 2 habitat to achieve the total % retention.

Analysis unit: Landscape unit. Although this hasn't been tested, an assessment by meta-population level is also recommended for future study.

b. Designated habitat areas

Approved UWRs form a legal requirement for consideration in the focal species co-location project and have been 'locked into' the MARXAN solution.

- In the South Coast, lock in 100% of approved UWRs for mountain goats; retain 100% of proposed UWRs

- In the Mid Coast, lock in 90% of approved UWRs for mountain goats

- In the North Coast, retain 100% of proposed UWRs for mountain goats

b. Upper limit of habitat change

Loss of more than 40% of habitats defined as suitable (North and Mid Coast) or Type 1 (South Coast) within a landscape unit is considered a very high risk to achieving the objective of sustaining local populations of mountain goats and should be avoided as an outcome. At this time, there may be a low probability of exceeding 40% habitat loss, however, the consequences of this loss are considered to be very high.

1.5.6 Rationale for targets

- Goat winter ranges are critical habitats and the proximity of forested cover to escape terrain is a critical habitat feature. With the exception of sub-adult males, mountain goats have high site fidelity and removing any of these habitats incurs a risk.

- Anecdotal information suggests that in some areas, mountain goat populations are currently in decline, including areas where active harvesting is not occurring. The dirth of inventory and monitoring of coastal goat populations increases the need to manage habitats conservatively.

- Considerable uncertainties exist, both in the estimates of habitats that mountain goats use and the effect of removing mountain goat habitat on the localized or larger populations. This is something that needs to be evaluated in relatively strict adaptive management trials.

- The objectives for ecosystem-based management do not apply to other factors that are putting pressure on mountain goats (e.g., heli-skiing, other winter recreation activities in and around goat habitat). There is a need to manage more conservatively to compensate for disturbance due to other factors.

- Legally designated mountain goat habitats were located to minimize impacts to timber supply on the North and Mid Coasts, so many of the areas designated there are in the non-contributing forest. In addition, many high quality habitats at lower elevations may have already been harvested on the Coast. The retention of high quality, low elevation habitats that have not yet been developed can, therefore, be particularly important as these areas often possess attributes such as high timber value and favourable terrain that make them particularly vulnerable to harvesting.

1.5.7 Uncertainties and Limitations

Targets for strategic co-location are based on expert opinion. While the targets for low risk are supported by observed population trends, the upper limit of change is an estimate based on changes to the historic landbase condition and expert knowledge of the distribution and vulnerability of coastal goat populations. This upper estimate of risk may change with increased knowledge of the response of mountain goats to changes in habitat conditions.

Table 5. Summary of recommended habitat retention targets for mountain goats

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change
Mountain goat **Objective**: to sustain healthy populations of goats by preventing localized extirpation.	North Coast: RSPF habitat suitability mapping as described in Pollard and Keim (2006).	Suitable / not suitable	LU	100% of suitable habitat	100% of suitable habitat		Any loss of winter range habitat is considered a risk and the amount of risk increases with the amount of alteration. Loss of more than 40% of habitats defined as suitable (North and Mid Coast) or Type 1 (South Coast) within a landscape unit is considered a very high risk to achieving the objective of sustaining local populations of mountain
	Mid Coast: Habitat suitability mapping based on GIS algorithms.	Suitable / not suitable	LU	90% of suitable habitat	90% of suitable habitat		

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change
	South Coast: RSF habitat suitability mapping completed in 2008/ 2009	Type 1 (Very High value): RSF values 0.185 – 1 Type 2 (High value): RSF values 0.024 – 0.185	LU	90% of the area of Type 1 (VH) habitat. This could be achieved by capturing: • the entire 90% as Type 1 habitat; or • a combination of Type 1 and Type 2 habitats such that a minimum of 70% of the Type 1 habitat is captured and two times the Type 2 habitat to achieve the total % retention.	100% of habitats captured in the Low Risk solution		goats and should be avoided as an outcome. At this time, there may be a low probability of exceeding 40% habitat loss, however, the consequences of this loss are considered to be very high.
	Approved and proposed Ungulate Winter	UWR polygons		Approved UWRs in the South Coast are 100% retention.	All approved and proposed	All approved and	

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change
	Ranges			Approved UWRs in the Mid Coast are 90% retention. Proposed UWRs in the North and South Coasts have a target of 100% retention.	UWRs	proposed UWRs	

1.6 Northern goshawks

1.6.1 Assumptions

- Nesting and foraging habitat suitability models were developed on the assumption that forest cover data is adequate to use at a strategic level but poor at a stand level.

1.6.2 Existing management designations and objectives

Wildlife Habitat Areas:

- There is one approved WHA for goshawks in the North Coast and no other WHAs established throughout the rest of coastal mainland B.C.

- There are 15, 9, and 3 known nest areas for goshawks within the south-coast, mid-coast and north coast planning units of the central-coast land and resource management plan (CCLRMP) area, respectively.

Focal Species:

- Goshawks are identified as one of five focal species in the South Central and Central & North Coastal Orders. As such, the implementation of land use order objectives for ecosystem-based management should overlap, to the extent possible, with goshawk habitat suitability.

1.6.3 Pre-analysis

There are no recommendations for pre-analysis.

1.6.4 Map inputs

a. Habitat mapping

There are three map layers to be used as input to MARXAN:

- Known nest areas, buffered by 800 m to approximate a 200 ha nest area/PFA. If a known next area has been field-mapped e.g., as part of WHA establishment, the buffer may extend beyond 800m.

- Northern Goshawk Recovery Team modelled nesting habitat suitability layer

- Northern Goshawk Recovery Team modelled foraging habitat suitability layer

b. Designated habitat areas

There is one approved wildlife habitat area for goshawks in the North Coast sub-region.

A number of wildlife habitat areas that capture habitats of both goshawks and marbled murrelets are proposed in the North Coast sub-region.

1.6.5 Habitat definition

Mapped nest areas: All forest within the (minimum 800m) buffer around known nest areas/PFAs.

Modelled nesting layer: Nesting 1 (N1) (high value habitat) = [0.75 - 1.0];
Nesting 2 (N2) (moderate and high value habitat) = [0.5 - 1.0]
To ensure that a proportion of high quality nesting habitat was selected in the solution, we had to include a combination of moderate and high in N2.

Modelled foraging layer: Forage 1 (F1) (high value habitat) = [0.75 - 1.0];
Forage 2 (F2) (moderate and high value habitat) = [0.5 - 1.0]
To ensure that a proportion of high quality foraging habitat was selected in the solution, we had to include a combination of moderate and high in N2.

1.6.6 Scenarios for habitat retention

a. Habitat mapping

Northern Goshawks should be addressed in MARXAN with three separate, but linked, scenarios for known nesting areas, modelled nesting habitat and foraging habitat.

Known nest areas/PFAs need to be protected as essential habitat. Protection of the viability of nest areas involves:

- Maintaining the integrity of the 200 ha nest area/PFA. This area can be approximated by applying an 800 m buffer around the centroid of known nest locations; and

- Ensuring that the nest area is within a forest matrix that will provide adequate habitat quality and quantity for foraging over time. A nest area should not be an isolated patch surrounded by young seral forest.

The Northern Goshawk Recovery Team has insufficient information at this time to set measurable habitat and population goals for recovery (Northern Goshawk *A. g. laingi* Recovery Team 2008). However, for the purpose of this co-location work, domain experts identified low risk scenarios associated with amounts of nesting and foraging habitat recommended for retention within old growth reserves.

These low risk scenarios were developed based on the assumption that foraging habitat will not be met entirely within OGRAs and other reserves. Foraging areas are far too large for a fine-filter management approach and need to be managed using a dynamic coarse-filter landscape approach.

i.   Nest areas + PFAs

Recommended low risk scenario: 100% of nest areas/PFAs (all forested habitat within a minimum 200 ha buffer centered on nest areas);

Due to the species' strong territoriality and high fidelity to their nest areas goshawk nest areas/PFAs should be included in all old-growth reserve area solutions.

ii.   Modelled nesting habitat

Recommended low risk scenario: 60% [N1 + N2] with at least half (30%) of this scenario comprised of N1

Analysis unit: Landscape unit

iii.   Modelled foraging areas

Recommended low risk scenario: 60% [F1 + F2] with at least half (30%) of this scenario comprised of F1

Analysis unit: Landscape unit

b. *Designated habitat areas*

The approved WHA for goshawks forms a legal requirement for consideration in the focal species co-location project and should be 'locked into` the MARXAN solution.

Assign a 100% retention target to proposed WHAs for goshawks.

c. *Upper limits of change*

We are unable to set an upper limit of change at this time, due to our lack of knowledge around factors influencing populations at these upper limits.

1.6.7 Rationale for scenarios

Studies have demonstrated a positive relationship between amount of mature forest within goshawk home ranges and nest area occupancy and productivity (see northern goshawk chapter in Horn 2009a). Most studies suggest between 40 - 60% of suitable foraging habitat within goshawk home ranges will support pairs over time. The Northern Goshawk *A. g. laingi* Recovery Team and Habitat RIG have identified three thresholds of foraging habitat abundance within goshawk home ranges and associated probabilities of continued occupancy, using the precautionary principle:

20 - 40%   low probability of occupancy

40 - 60%   medium probability of occupancy

> 60%   high probability of occupancy

1.6.8 Parameters to incorporate into Spatially Explicit Landscape Event Simulator (SELES)

Northern goshawks require large areas of mature and old forest over time. This requires maintaining habitat inside and outside of OGRAs. To properly assess the overall functionality of goshawk habitat across the landbase it is necessary to (a) assess OGRAs in the context of the overall landscape; and (b) look at estimated changes in forest cover (distribution and total amounts of mature & old) over time. Time series should be run in 10 year increments (an approximate goshawk lifespan; Squires and Reynolds 1997) over a 50 year planning horizon.

The Northern Goshawk Recovery Team/Habitat RIG territory model should be used to estimate the potential number and distribution of goshawk pairs that could be supported at each time step over the next 50 years.

1.6.9 Uncertainties and limitations

We are unable to assess how much goshawk high and moderate nesting and foraging habitats would be captured in other focal species low risk target scenarios at this time (because some species models are incomplete and we haven't reviewed these outputs).

The cost layer is modelled over a 400 year time frame whereas focal species models are reflections of current suitability. Therefore, it is difficult to determine how our objective to minimize cost, may affect our overall OGRA strategy, over time.

Table 6. Summary of recommended habitat retention targets for northern goshawks

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change
Northern goshawk **Objective:** Maintain sufficient habitat to maintain viable breeding territories and, therefore, populations	NGRT modelled foraging habitat	M habitat = [0.5 - 1.0]; H habitat = [0.75 - 1.0]	LU	60% of M or H [= 0.5 - 1.0]; at least half of this to be H [= 0.75 - 1.0]	33% of low risk solution (20% foraging habitat overall)		Domain experts were unable to set an upper limit of change at this time, due to lack of knowledge around factors influencing populations at the upper limits.
	NGRT modelled nesting habitat	M habitat = [0.5 - 1.0]; H habitat = [0.75 - 1.0]	LU	60% of M or H [= 0.5 - 1.0]; at least half of this to be H [= 0.75 - 1.0]	100% of low risk solution		
	Known nest sites buffered by 800m mature/old forest	nest area polygons = nest site + 800m buffer		100% of 800m-buffered nest area polygons (all age classes)	All known nest sites and surrounding nest area	All known nest sites and surrounding nest area	
	Approved and proposed WHAs	WHA polygon		The approved WHA in the North Coast has been 'locked into' the MARXAN solution as 100% retention. Proposed WHAs in the North Coast have a	All approved and proposed WHAs	All approved and proposed WHAs	

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change
				target of 100% retention but are not locked in.			

1.7 Coastal tailed frog

1.7.1 Assumptions

- The tailed frog habitat model captures close to all suitable tailed frog streams. There may be occurrences in gentle (<30%) basins and very steep (>120%) basins, but these will be few. In gentle basins it is likely that fisheries management will offer protection; while very step basins may be largely inoperable.

- Stream buffers are more important than protecting the remainder of a tailed frog basin.

- More rugged tailed frog basins (the basin surrounding the buffered stream) are more sensitive to disturbance than less rugged basins.

- Both mature (>100 years of age) and old growth forests are equally important for retention.

- The spatial configuration of retention areas is important at the scale of basins and landscape units.

- As the Central North and South Central Coastal Orders do not provide direct protection to tailed frog streams via streamside buffers, the objectives for upland streams (s12) are assumed to not contribute to *A. truei* habitat.

1.7.2 Existing Management Designations and Objectives

Wildlife Habitat Areas

Mid Coast: A number of areas proposed as 'Tier 1 specified areas' for tailed frogs (formerly proposed WHAs) are to be designated as no-harvesting areas. These areas consist of a core area (Class 1 and 2 stream segment) and buffer.

South Coast: Nine WHAs are established, each consisting of a core area (100% netdown) and buffer area (80% netdown).

Coastal Orders

Section12 in the Central & North and South Central Coastal Orders (Objectives for Upland Streams) requires the maintenance of "70% or more of the forest, in the portion of the watershed where upland streams occur, as functional riparian forest". There may be quite different outcomes for upland stream management, depending on whether this objective is applied to the stream buffer or the entire contributing sub-basin.

There are no defined buffers for S5 and S6 streams under the Coastal Orders. The co-location of tailed frog stream segments within OGRAs is even more important in the absence of defined stream buffers.

1.7.3 Pre-analysis

To prepare the tailed frog map layer for co-location:

- Buffer all suitable tailed frogs streams by 50m to either side.

- Separate the basins associated with each stream into the buffered reaches and the remaining basin.

- Remove habitat having forest cover of age class = 0 to drive the capture of forested habitats.

1.7.4 Map inputs

Modelled habitat

MARXAN used a tailed frog model that was developed in 2008 based on basin size and ruggedness class (see section 7.3.1). The model has been applied to the entire coastal planning area.

Designated habitat areas

WHAs or equivalent for the Mid and South Coasts

1.7.5 Habitat definition

These habitat definitions are based on the assumptions listed in section 7.5.1. There are two habitats that are treated separately in the analysis: tailed frog streams and the contributing basins to those streams.

Class 1 habitat = buffered streams, ruggedness 30 - 70%;

Class 2 habitat = buffered streams, ruggedness 71 - 120%;

Class 3 habitat = remaining basin area, ruggedness 30 - 70%;

Class 4 habitat = remaining basin area, ruggedness 71-120%

1.7.6 2.2.7.6 Targets for habitat retention

a. Biological habitat layer

Experimental low risk scenario: Retention: 50% Class 1; 45% Class 2; 30% Class 3; 40% Class 4.

                                            Fragmentation: low

Experimental high risk scenario: Retention: 20% Class 1; 20% Class 2; 20% Class 3; 20% Class 4.

                                            Fragmentation: moderate

Analysis unit: Landscape unit

Due to lack of inventory it is not possible at this time to provide absolute targets for habitat retention. The above targets are based on expert opinion and are suggested as a starting point for experimenting with co-location. Targets will be better defined as inventory and research improves understanding of coastal tailed frogs and their response to changes in habitat.

b. Designated habitat areas

WHAs are treated as follows in the MARXAN analyses:

- Approved WHAs in the South Coast are locked in their entirety (core + buffer area) as part of the designated 'reserve' layer.

- Proposed Tier 1 Specified Areas on the Mid Coast are assigned a 100% retention target within core areas.

1.7.7 Rationale for co-location targets

- Stream buffers have the highest retention targets because maintaining forested cover on either side of stream segments has been shown to be the most important factor in maintaining the quality and function of both the aquatic and riparian components of tailed frog habitat (Dupuis and Steventon 1999).

  Domain experts assume that a disproportional amount of ecological benefit (around 80%) is gained through provision of adequate streamside buffers, and that the remaining ecological benefit (20%) is gained through watershed level measures.

- Stream buffers allow for within-basin connectivity, which is important for dispersal of tailed frogs within watersheds. As there is no requirement to buffer S5 and S6 streams under FRPA, it is important to consider buffering them within OGRAs.

- The 45% - 50% targets for capture of stream buffers in the experimental low risk scenario are based on inventory results (Dupuis and Friele 2003, Frid et. al. 2003, Michelfelder and Dunsworth 2007).

- Class 4 contributing basins have a slightly higher target than Class 3 basins because Class 4 basins are steeper and more fragile and are therefore more vulnerable to disturbance. In addition, these basins harbour lower tailed frog densities and populations are more vulnerable to stream impacts.

- Although it is less critical for basin areas outside of the stream buffers to be captured in OGRAs, the more overall area that is captured within a watershed, the greater the potential conservation value for tailed frogs and the greater the dispersal capability between watersheds. Within the contributing basin, appropriate management with regard to hydrological green-up and road development and maintenance will contribute to the conservation of tailed frog habitat within buffered streams.

- 20% conservation of Class 1 to 4 habitats would be insufficient to protect this species (i.e., be a high risk level) because: (1) tailed frog breeding habitats are too dynamic and unpredictable, and they lack resiliency in some settings; and (2) they have poor terrestrial dispersal capabilities particularly when the risk of desiccation from sun and wind is high (e.g., in the latter half of their short growing season – especially in the absence of shade and wind screening).

1.7.8 Uncertainties and limitations

Since little to no data exists on tailed frog population levels, targets established for strategic
co-location are based on expert opinion and subject to change.

As the co-location experiments in Phase 2 (Horn and Rumsey 2009b) did not appropriately capture tailed frog habitats, domain experts were unable to assess the different targets for risk and their implications. As a priority, future efforts at spatial design should include an assessment of the implications of different targets for co-location of tailed frog habitat.

Table 7. Summary of recommended habitat retention targets for coastal tailed frogs

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change
Tailed frog **Precautionary objective:** To capture the full range of habitat variability across each landscape unit	Updated tailed frog model - based on basin size and ruggedness class. Streams are buffered by 50m to each side	There are two habitats that are treated separately in the analysis: tailed frog streams and the contributing basins to those streams. Class 1 habitat = buffered streams, ruggedness 30 - 70%; Class 2 habitat = buffered streams, ruggedness 71 - 120%; Class 3 habitat = remaining basin area, ruggedness 30 - 70%; Class 4 habitat = remaining basin	LU	Experimental low risk scenario: 50% Class 1 45% Class 2 30% Class 3 40% Class 4 Capture 100% of Class 1 and 2 streams that overlap know tailed frog occurrences. Fragmentation: moderate The more overall area that is captured within a watershed (stream buffers and basins), the greater the potential conservation value for tailed frogs and the greater the dispersal capability between watersheds.	100% of low risk solution for Class 1 and 2 habitats (stream buffers)	100% of buffered streams having known tailed frog occurrences	Experimental high risk scenario: 20% Class 1 20% Class 2 20% Class 3 20% Class 4 Fragmentation: low

Focal species	Description of layers	Description of habitat for analysis	Analysis Unit	Low risk goal	Best Habitats	100% capture in OGRAs or other reserves	Upper limit of change
		area, ruggedness 71-120%					
Tailed frog	Approved and proposed WHAs	WHA polygon		Approved WHAs in the South Coast are 100% retention (core + buffer area). Core areas of proposed WHAs in the Mid Coast have a target of 100% retention	All approved WHAs

Core areas of proposed WHAs in the Mid Coast | All approved WHAs

Core areas of proposed WHAs in the Mid Coast | - |