



Estimated Impact of the Identified Wildlife Management Strategy (Vol. 1) on Provincial Timber Supply

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November 1997 (revised May 1998)



Acknowledgement

I owe many thanks to Dr. Victoria Stevens for patiently helping me understand the accounts, procedures, and measures in the Identified Wildlife Management Strategy, and for her hard work in finding information needed on individual species. Thanks also are owed to Chris Fletcher for providing many helpful suggestions that improved the report.

Any errors, however, are entirely my responsibility.

JST

November 1997

Editorial Note

This version of the report differs from the November 1997 version only in that minor typographical errors in Tables 1, 2, and 3 have been corrected.

JST

May 1998



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Introduction

The Identified Wildlife Management Strategy (IWMS) is one of the Forest Practices Code provisions for conserving biological diversity in British Columbia. Two other provisions, the *Biodiversity Guidebook* (BG) and the *Riparian Management Areas Guidebook* (RMAG), are designed to maintain the critical habitat requirements of the majority of wildlife. The provisions of the IWMS are meant to supplement the recommendations in the RMAG and BG to protect wildlife that are not adequately protected by either the guidebooks or protected areas.

Identified wildlife are *species at risk* that the Deputy Minister of Environment, Lands and Parks and the Chief Forester agree will be managed through a higher level plan, a *wildlife habitat area* (WHA), and/or a *general wildlife measure* (GWM). Species at risk include any wildlife species that is threatened, endangered, sensitive, or vulnerable; any threatened or endangered plants or plant communities requiring protection; and regionally important wildlife.

The IWMS consists of three publications — *Species and Plant Community Accounts for Identified Wildlife*, *General Wildlife Measures for Identified Wildlife*, and *Procedures for Establishing Wildlife Habitat Areas*. They present biology and distribution; specific measures for the conservation of habitat within wildlife habitat areas; and details about how to locate and establish boundaries for wildlife habitat areas.

As part of the process of developing the IWMS, the Ministry of Forests and the Ministry of Environment, Lands and Parks undertook a study to estimate how applying the IWMS would affect provincial timber supply. This report describes the results of that study.

Caution is required in interpreting the results presented in this report. A considerable part of the work in this study was the interpretation of measures that have not yet been applied. Empirical experience will probably lead to different interpretations, and to changes to the GWMs and to the procedures for establishing WHAs. Volume 1 of the IWMS includes only about a third of the vertebrate species, four plant communities, and no plant species. The remaining species at risk will be included in Volume 2. Information about range and population sizes is far from complete for the species and plant communities included in Volume 1. Overlap of WHAs with other management areas is an important factor when evaluating impact on timber supply, but was very difficult to assess — if WHAs are designed according to the IWMS planning process, or are included in landscape planning, then timber supply impacts can be reduced.

While this report estimates how applying the IWMS would change provincial timber supply, the changes would not occur until WHAs and measures have actually been applied in the field, and AACs been re-determined.



Purpose

This study was undertaken to estimate the magnitude of the timber supply effects of implementing the IWMS.

Method

In this study, the application of general wildlife measures was taken to affect timber supply by changing either the area of forest land available for harvest, or by changing the growth of timber on that land. The effect of landbase changes can be long-term, short-term, or both, depending on whether there is mature or immature timber on the area of land removed. In the long-term, the annual harvest cannot exceed total annual growth of the forest. Therefore long-term harvest levels can be estimated (m^3/yr) by multiplying predicted growth ($\text{m}^3/\text{ha}/\text{yr}$) by area of land (ha). In the short-term, however (meaning the next two decades), the harvest can only come from available mature timber. Therefore any change in the area of mature timber has a direct and sometimes disproportionate effect on the short-term timber supply.

These principles were used to develop the following approaches for approximating changes in harvest levels that would result from implementing the IWMS. If applying a WHA or wildlife measure will exclude land with mature timber from the timber harvesting landbase, an immediate (short-term) reduction of timber supply was calculated equivalent to the proportion of the area removed relative to the total area of mature timber. For example, a 2% reduction in the area of harvestable mature timber causes an immediate 2% reduction in timber supply. If the WHA or measure causes exclusion of land with immature timber, a long-term harvest level reduction was calculated in proportion to the area removed relative to the entire timber harvesting landbase. If the measure causes a reduction in the yield per unit area (m^3/ha) of harvested timber, then short-term or long-term timber supply, or both, were reduced, depending on whether the yield reduction applies to the first harvest, or only to growth of future stands.

Database

A database was assembled that included the following data for each TSA in the province:

- area of the timber harvesting landbase
- proportion of this landbase currently having mature timber (the short-term landbase)
- annual harvest volume in the short-term (1995 AAC)
- annual harvest volume in long-term (long-run sustained yield).

These areas and volumes were based primarily on data in Timber Supply Review timber supply analysis reports. The provisions for each species or plant community were interpreted to determine the changes in management practice that would be required by applying the general wildlife measures, and the extent to which those changes might affect the timber harvesting landbase (*landbase-effect volume reductions*) and harvest yields (*yield-effect volume reductions*).



Landbase-effect volume reduction

The landbase reduction attributed to each species or plant community was expressed as a proportion of the timber harvesting landbase for each TSA in the range of the species or plant community. This proportion was multiplied by the short- and long-term harvest levels for each TSA to obtain the corresponding landbase-effect volume reductions attributable to the species provisions.

For example, the provisions for the ferruginous hawk (*Buteo regalis*) specify that no harvesting activity is permitted within 150 m of a nest site. Therefore, each occurrence of a nest site protected by a WHA requires removing area from the timber harvesting landbase equivalent to the area of a circle with a radius of 150 m, or about 7.1 ha. In addition, the equivalent of about 10.1 ha should be removed for maintaining nesting trees and snags in an 850 m buffer surrounding the nest site circle. This total area (17.2 ha) is converted to a landbase-effect volume reduction by taking it as a percent of the mature (short-term) and total (long-term) timber harvesting landbase areas in the TSAs falling within the range of the ferruginous hawk (986 650 ha and 1 462 421 ha respectively). The estimated short-term impact is 0.0017% ($17.2/986\,650$) and long-term impact is 0.0012% ($17.2/1\,462\,421$) on the TSAs in the range of the hawk. Multiplying by the short- and long-term harvest volumes for those areas (3 819 250 m³/yr, and 2 947 000 m³/yr) gives an estimate of the volume reduction impact of each WHA on the TSAs in the hawk's range (66.6 and 34.7 m³/yr).

Yield-effect volume reduction

Yield-effect volume reductions attributable to a species or plant community were estimated by calculating the change in either harvest yield or mean annual increment (MAI) required by applying the provisions for it. For example, the general wildlife measures for northern goshawk (*Accipiter gentilis atricapillus*) specify that mature timber must be retained in part of the post fledging areas. This practice was estimated to reduce yields by about 9%.

Provincial impacts

The sum of the landbase-effect volume reductions and yield-effect volume reductions (in m³/ha) gave the *per-WHA volume reduction* attributable to the species or plant community for each TSA in its range. The per-WHA volume reductions were expressed as a percent of the provincial short- and long-term harvest levels¹, called the *provincial per-WHA impact*. This is the reduction in provincial timber supply attributable to each WHA established for the identified species or plant community. Using the example of the ferruginous hawk, the per-WHA volume reductions (66.6 and 34.7 m³/yr) are divided by the total provincial harvest from TSAs (53,354,842 m³/yr) and projected long-term harvest level (43,907,735 m³/yr) to arrive at the *provincial per-WHA impact* estimates of 0.0001% (short-term) and 0.00007% (long-term). This means that every occurrence of ferruginous hawk requiring application of a WHA will reduce timber supply by about 67 m³/yr (equivalent to

¹ as of December 1995



0.0001% of the provincial cut) in the first decade, and slightly less in the long run.

The *total provincial impact* for each species or plant community was calculated by multiplying provincial per-WHA impact by the estimated number of WHAs that would be established for each species or plant community. For species or plant communities where the total habitat area affected by the measures could be estimated (e.g., white-headed woodpecker foraging area), it was possible to calculate total provincial impact directly.

Precision and scale

While the impact estimates derived in this study seem to be very precise (i.e., five decimal places), such is definitely not the case. The difference in area between a single occurrence and the size of the provincial forest simply requires the use of very small numbers. A reduction of area on the order of tens or even hundreds of hectares is so small compared to the provincial timber harvesting landbase (about 19 million ha in Timber Supply Areas) that it is necessary to use five decimal places to show any effect at all.

Estimates of impact and the allowable annual cut

The calculations of short- and long-term impacts reported in this study represent changes to available timber inventory and long-term timber production, adjusted for current harvest levels and projected long-term productivity. However, determining the allowable annual cut is the responsibility of the Chief Forester of British Columbia. The impacts estimated in this study will not necessarily be implemented by the Chief Forester.



Accounts

Volume 1 of the IWMS includes GWMs for 38 species and plant communities. Of these, 25 could affect forest practices. Accounts that affect only range practices have not been considered in this study, because they are not anticipated to affect timber supply. Still, not all of the accounts that could affect forest practices outside of range areas have been dealt with here, as explained in the following paragraph.

Although provisions for marbled murrelet could affect timber supply, the general wildlife measures were written so that marbled murrelet's requirements are met by full implementation of the BG. For instance, in intermediate and higher biodiversity emphasis landscape units marbled murrelet habitat requirements can be met by the BG with careful planning. A higher-level plan decision will be required in lower biodiversity emphasis landscape units if maintenance of this species is an objective and old seral stage requirements are planned to be met over three rotations. Thus, the effect of this species account on timber supply will not exceed that already accrued to the BG.

This study assessed those accounts that affect forest practices, and thus timber supply. These species and plant community accounts are listed below:

1. Ancient murrelet (*Synthliboramphus antiquus*)
2. Bighorn sheep (*Ovis canadensis californiana*)
3. Bighorn sheep (*Ovis canadensis canadensis*)
4. Bull trout (*Salvelinus confluentus*)
5. Cassin's auklet (*Ptychoramphus aleuticus*)
6. Ferruginous hawk (*Buteo regalis*)
7. Grizzly bear (*Ursus arctos*)
8. Keen's long-eared myotis (*Myotis keenii*)
9. Lewis' woodpecker (*Melanerpes lewis*)
10. Mountain goat (*Oreamnos americanus*)
11. Northern goshawk (*Accipiter gentilis atricapillus*)
12. Northern goshawk (*Accipiter gentilis laingi*)
13. Pacific water shrew (*Sorex bendirii*)
14. Prairie falcon (*Falco mexicanus*)
15. Sandhill crane (*Grus canadensis*)
16. Tailed frog (*Ascaphus truei*)
17. Trumpeter swan (*Cygnus buccinator*)
18. Turkey vulture (*Cathartes aura*)
19. Vancouver Island marmot (*Marmota vancouverensis*)
20. White-headed woodpecker (*Picoides albolarvatus*)
21. *Betula occidentalis* - *Cornus stolonifera*
22. *Pseudotsuga menziesii* / *Quercus garryana* - *Melica subulata*
23. *Pinus ponderosa*-*Populus balsamifera* ssp. *trichocarpa* -*Rhus radicans*
24. *Pinus ponderosa* -*Populus balsamifera* ssp. *trichocarpa*-*Symphoricarpos albus*



**Accounts for which no
impact is expected**

Very little or no timber supply impact is expected for some accounts: ancient murrelet, both sub-species of bighorn sheep, Cassin's auklet, mountain goat, and turkey vulture. No impact is expected for ancient murrelet and Cassin's auklet, because the entire known habitat is already protected. The forest habitat needs of bighorn sheep and mountain goat can be accommodated within the requirements of the BG and RMAG, and therefore will not further reduce timber supply. No timber supply impact is expected for turkey vulture, because the roosting areas that could be in forest are not on Crown land or Provincial Forest.

**Accounts for which the
number of occurrences is
expected to be greater in
10 years**

Over the next 10 years the number of known occurrences is expected to increase for the following accounts (Table 1). Only accounts having a non-zero impact are shown:

- Ferruginous hawk
- Keen's long-eared myotis
- Lewis' woodpecker
- Northern goshawk (*atricapillus*)
- Northern goshawk (*laingi*)
- Pacific water shrew
- Prairie falcon
- Tailed frog
- Trumpeter swan
- White-headed woodpecker (nest sites)

The detailed calculations for these accounts are shown in Appendix 2.

**Accounts for which the
number of occurrences is
known or estimated**

For some accounts, the number of occurrences is known or roughly estimated. Such is the case for the four plant communities, white-headed woodpecker (foraging areas), sandhill crane, grizzly bear, and Vancouver Island marmot. White-headed woodpecker was treated uniquely in that a per-WHA impact was calculated for part of the account (nest site), and a total impact was calculated for another part of the account (foraging areas). Detailed calculations for these accounts are shown in Appendix 2. Total provincial impact for these accounts is shown in Table 2.



Results

This study assessed the impacts on timber supply of provisions for species and plant community accounts in Volume 1 of the Identified Wildlife Management Strategy. The detailed calculation of impact for each species or plant community having a non-zero impact is presented in Appendix 2.

Table 1 shows the accounts for which the known number of occurrences protected by a WHA, and thus the total effect on provincial timber supply, is projected to increase over the next 10 years (as more occurrences are recorded). Not every occurrence of an identified wildlife will be marked by a WHA. Some will be in parks or private land, and some may be in habitat already too modified to warrant protection. The per-WHA impact of each account is shown in columns 2 and 3. The short-term impact (column 2) is the reduction in the first-decade provincial timber supply expected for each WHA for the species. The long-term impact (column 3) is the reduction in long-run sustained yield (LRSY) expected for each WHA for the species.

Total impact was calculated for three estimates of occurrences protected by WHAs: current, a 10-year projection, and a 100-year projection. Columns 4 through 6 (Number of WHAs) show either the number of occurrences recorded in the Conservation Data Centre database, or the best estimate available². Column 4 (Current) shows the number of currently known occurrences of the species. Column 5 (10-yr projected) shows the number of WHAs projected for 10 years from now. Column 6 (100-yr projected) shows either the number of WHAs projected for 100 years from now, or the number of WHAs above which the species will be de-listed or the account will be modified.

Columns 7 through 9 show total impact, calculated as the per-WHA impact multiplied by the number of WHAs. Short-term and long-term impacts were based on the corresponding WHA projections (columns 4 through 6).

Table 2 shows impacts for accounts for which total provincial impact could be calculated, because the total area affected by the account was known or could be estimated (in the case of the plant community accounts, the area estimates are rough approximations).

Table 3 shows total provincial impact (sum of Tables 1 and 2) for current, 10-year, and 100-year WHA projections, presented in order of increasing short-term (10-yr) impact. These figures therefore reflect the expected aggregate provincial impact of the provisions for species and plant communities in the IWMS Volume 1.

² Estimates of current and projected occurrences for many species were developed by MELP staff.



Table 1 Summary of provincial timber supply impacts of species accounts for which the number of occurrences is expected to increase over the next 10 years.

Account	Per-WHA impact (%)		Number of WHAs ³			Short-term impact		Long-term impact
	Short-term	Long-term	Current	10-yr projected	100-yr projected	Current	10-yr projected	100-yr projected
Ancient murrelet	0.00%	0.00%				0.00%	0.00%	0.00%
Bighorn sheep ssp. <i>californiana</i>	0.00%	0.00%				0.00%	0.00%	0.00%
Bighorn sheep ssp. <i>canadensis</i>	0.00%	0.00%				0.00%	0.00%	0.00%
Bull trout	0.00%	0.00%				0.00%	0.00%	0.00%
Cassin's auklet	0.00%	0.00%				0.00%	0.00%	0.00%
Ferruginous hawk	0.00010%	0.00007%	1	2	4	0.00010%	0.00021%	0.00030%
Keen's long-eared myotis	0.00026%	0.00011%	0	5	10	0.000000%	0.00128%	0.00108%
Lewis' woodpecker	0.00008%	0.00004%	4	6	10	0.00032%	0.00048%	0.00042%
Mountain goat	0.00%	0.00%				0.00%	0.00%	0.00%
Northern goshawk ssp. <i>atricapillus</i>	0.00076%	0.00046%	10	50	100	0.00765%	0.03824%	0.04610%
Northern goshawk ssp. <i>laingi</i> ¹	0.01792%	0.00759%	15	30	40	0.26880%	0.44800%	0.22755%
Pacific water shrew	0.00067%	0.00024%	8	10	10	0.00534%	0.00668%	0.00241%
Prairie falcon	0.00012%	0.00007%	4	10	25	0.00047%	0.00117%	0.00170%
Tailed frog	0.00010%	0.00004%	5	100	100	0.00049%	0.00975%	0.00364%
Trumpeter swan ²	0.00017%	0.00012%	2	8	10	0.00035%	0.00139%	0.00118%
Turkey vulture	0.00%	0.00%				0.00%	0.00%	0.00%
White-headed woodpecker (nest site)	0.00024%	0.00014%	8	10	15	0.00195%	0.00244%	0.00205%
Sub-total						0.29%	0.51%	0.29%

¹ Northern goshawk *laingi*: When number of occurrences exceeds 20 assume a 50% overlap with other constrained areas.

(e.g., deer winter range, old-growth required by Biodiversity Guidebook, other WHAs).

² Most trumpeter swan wetlands are in non-merchantable timber. The numbers above include those that might be in merchantable timber.

³ Projected occurrences were prepared by MELP staff.



Table 2 Summary of provincial timber supply impacts of species and plant community accounts for which the number of occurrences is known or estimated.

Account	Short-term Impact	Long-term Impact
<i>Betula occidentalis</i> – <i>Cornus stolonifera</i>	0.00000%	0.00000%
Grizzly bear	0.07841%	0.16404%
<i>Pinus ponderosa</i> – <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> - <i>Rhus radicans</i>	0.00110%	0.00070%
<i>Pinus ponderosa</i> – <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> - <i>Symphoricarpos albus</i>	0.00008%	0.00005%
<i>Pseudotsuga menziesii</i> / <i>Quercus garryana</i> - <i>Melica subulata</i>	0.00069%	0.00035%
Sandhill crane	0.00812%	0.00421%
Vancouver Island marmot	0.01454%	0.00551%
White-headed woodpecker (foraging area)	0.00463%	0.00450%
Sub-total	0.11%	0.18%



Conclusions

In summary, this study indicates that provisions for species and plant communities in the Identified Wildlife Management Strategy Volume 1 will reduce provincial short-term timber supply (10-yr projected WHAs) by about 0.62%, and long-term timber supply by about 0.47% (Table 3). These findings suggest that reductions to harvest levels due to implementing the IWMS should be less than 1%.

Two of the accounts, northern goshawk (ssp. *laingi*) and grizzly bear, make up 85% of the short-term impact (10-yr projected WHAs) shown in Table 3. It should be noted that for these species there is very little information available on the amount of habitat required in addition to that already accounted for in landscape unit planning, or already removed from the timber harvesting landbase.

Table 3 Summary of timber supply impacts of accounts in the IWMS Vol I .

Species or plant community	Short-term Impact		Long-term impact
	Current occurrences	10-yr projection	100-yr projection
Ancient murrelet	0.00000%	0.00000%	0.00000%
<i>Betula occidentalis</i> - <i>Cornus stolonifera</i>	0.00000%	0.00000%	0.00000%
Bighorn sheep ssp. <i>californiana</i>	0.00000%	0.00000%	0.00000%
Bighorn sheep ssp. <i>canadensis</i>	0.00000%	0.00000%	0.00000%
Bull trout	0.00000%	0.00000%	0.00000%
Cassin's auklet	0.00000%	0.00000%	0.00000%
Mountain goat	0.00000%	0.00000%	0.00000%
Turkey vulture	0.00000%	0.00000%	0.00000%
<i>Pinus ponderosa</i> - <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> - <i>Rhus radicans</i>	0.00008%	0.00008%	0.00005%
Ferruginous hawk	0.00010%	0.00021%	0.00030%
Lewis' woodpecker	0.00032%	0.00048%	0.00042%
<i>Pseudotsuga menziesii</i> / <i>Quercus garryana</i> - <i>Melica subulata</i>	0.00069%	0.00069%	0.00035%
<i>Pinus ponderosa</i> - <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> - <i>Symphoricarpos albus</i>	0.00110%	0.00110%	0.00070%
Prairie falcon	0.00047%	0.00117%	0.00170%
Trumpeter swan	0.00035%	0.00139%	0.00118%
Keen's long-eared myotis	0.00000%	0.00128%	0.00108%
Sandhill crane	0.00812%	0.00812%	0.00421%
Pacific water shrew	0.00534%	0.00668%	0.00241%
White-headed woodpecker (nest, foraging areas)	0.00658%	0.00706%	0.00655%
Tailed frog	0.00049%	0.00975%	0.00364%
Vancouver Island marmot	0.01454%	0.01454%	0.00551%
Northern goshawk ssp. <i>atricapillus</i>	0.00765%	0.03824%	0.04610%
Grizzly bear	0.07841%	0.07841%	0.16404%
Northern goshawk ssp. <i>laingi</i>	0.26880%	0.44800%	0.22755%
Total Provincial Impact	0.39%	0.62%	0.47%



Estimated Impact of the Identified Wildlife Management Strategy (Vol. 1) on Provincial Timber Supply

Species Accounts

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November 1997 (revised May 1998)

Account **Ancient murrelet (*Synthliboramphus antiquus*)**

Breeding Range: Queen Charlotte
 QCI archipelago - 31 colonies known

Account elements:	THLB impact
WHA - no harvesting or development permitted on colony islands	0 ha

	Queen Charlotte	Total
Short-term landbase (ha)	46,159	46,159 ha
Long-term landbase (ha)	60,358	60,358 ha
1st-decade cut (m ³ /yr)	442,000	442,000 m ³ /yr
Long-term cut (m ³ /yr)	248,000	248,000 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.000000%	0.00	0.00000%
Long-term	0.000000%	0.00	0.00000%

Ancient murrelet

202.7 ha of habitat (on 4 islands) is unprotected (pers comm, BCE staff, April 9, 1996), but it is unlikely that it will be harvested.

Account **Bighorn sheep ssp. *californiana* (*Ovis canadensis californiana*)**
Breeding Range: Okanagan Williams Lake

Account elements:		THLB impact
WHA	- while a WHA is prescribed, its requirements are achievable without reducing timber supply through careful planning	0 ha

	Okanagan	Williams Lake	Total
Short-term landbase (ha)	607,268	979,793	1,587,060 ha
Long-term landbase (ha)	971,628	1,632,988	2,604,616 ha
1st-decade cut (m ³ /yr)	2,615,000	3,095,000	5,710,000 m ³ /yr
Long-term cut (m ³ /yr)	2,022,000	2,469,000	4,491,000 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.000000%	0.00	0.00000%
Long-term	0.000000%	0.00	0.00000%

Account **Bighorn sheep ssp. canadensis (*Ovis canadensis canadensis*)**
Breeding Range: Boundary Cranbrook Invermere Kamloops

Account elements:	THLB impact
WHA	- while a WHA is prescribed, its requirements are achievable without reducing timber supply through careful planning 0 ha

	Boundary	Cranbrook	Invermere	Kamloops	Total
Short-term landbase (ha)	110,627	121,034	105,833	551,984	889,476 ha
Long-term landbase (ha)	298,991	403,445	215,985	890,296	1,808,717 ha
1st-decade cut (m ³ /yr)	700,000	806,000	568,000	2,393,180	4,467,180 m ³ /yr
Long-term cut (m ³ /yr)	560,000	633,000	360,000	1,958,000	3,511,000 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA &TFL) Impact
Short-term	0.000000%	0.00	0.00000%
LRSY	0.000000%	0.00	0.00000%

Account	Bull trout (<i>Salvelinus confluentus</i>)					
Breeding Range:	BC	except	Vancouver Region	North Coast	Queen Charlotte	Okanagan 50%

Account elements:	THLB impact
WHA	- WHAs should be established on known spawning, rearing, and overwintering streams - WHA should extend 500 m from the stream, but careful planning should allow harvesting

	BC	except	Vancouver Region	North Coast	Queen Charlotte	Okanagan	Total
Short-term landbase (ha)	11,506,025		583,870	88,063	46,159	303,634	10,484,299 ha
Long-term landbase (ha)	19,282,978		1,305,973	106,100	60,358	485,814	17,324,733 ha
1st-decade cut (m ³ /yr)	53,354,842		7,588,835	600,000	442,000	1,307,500	43,416,507 m ³ /ha
Long-term cut (m ³ /yr)	43,907,735		5,913,835	301,000	248,000	1,011,000	36,433,900 m ³ /ha

Impact per WHA	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.000000%	0.00	0.00000%
Long-term	0.000000%	0.00	0.00000%

Bulltrout**Guideline**

Management techniques specified for bull trout are aimed at preventing degradation of habitat, and at restricting access to spawning and juvenile rearing habitat. The guidelines for this species state that WHAs should be established on known spawning, rearing, and overwintering streams. The WHA should extend 500 m from the stream. Roads should not be located within the WHA. Where roads are necessary, road access should be restricted during spawning and staging. Roads should be deactivated following logging.

Analysis

Restrictions on road access are meant to reduce fishing pressure. While they are likely to increase the cost of harvesting, they don't necessarily preclude logging. Special logging techniques could be used to extract timber from the WHA management zone at appropriate times of year, and roads will have to be deactivated more promptly than would otherwise be the case.

As long as it is feasible to log the 500 m management zone without roads, harvest volume should not be reduced.

Account **Cassin's auklet (*Ptychoramphus aleuticus*)**
Breeding Range: - all known colonies are already protected

Account elements:	THLB impact
WHA	0 ha
- complete protection of all breeding colonies	
- all known colonies are already protected	
- no action required	

	Arrowsmith	Kingcome	Queen Charlotte	Total
Short-term landbase (ha)	37,962	87,064	46,159	171,185 ha
Long-term landbase (ha)	74,436	185,242	60,358	320,036 ha
1st-decade cut (m ³ /yr)	469,000	1,068,635	442,000	1,979,635 m ³ /yr
Long-term cut (m ³ /yr)	385,000	902,635	248,000	1,535,635 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.0000%	0.0	0.00000%
LRSY	0.0000%	0.0	0.00000%

Account Ferruginous hawk (*Buteo regalis*)
Breeding Range: Merritt

Account elements:	THLB impact
WHA (1000 m around nest) - core: no activity within 150 m of nest site	core 7.1 ha
- buffer: remaining 850 m	buffer area 307.1 ha
- maintain a selection of mature trees for nesting and snags for perching throughout WHA	buffer reduction 10.2 ha
	total reduction 17.3 ha

	Merritt	Total
Short-term landbase (ha)	379,383	379,383 ha
Long-term landbase (ha)	490,793	490,793 ha
1st-decade cut (m ³ /yr)	1,204,250	1,204,250 m ³ /yr
Long-term cut (m ³ /yr)	925,000	925,000 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.0046%	54.9	0.00010%
Long-term	0.0035%	32.6	0.00007%

Ferruginous hawk

The WHA required around nest sites must be 314.2 ha (circle with radius 1000 m).

Core (no activity) area is 7.1 ha (circle with radius 150 m).

Therefore the remainder of the WHA (the buffer area) is a torus of area 307.1 ha (314.2 ha - 7.1 ha).

Assume that in the buffer area there are 300 trees/ha, and management requirements to maintain a selection of mature trees for nesting and snags for perching will reserve 10 trees/ha, i.e., $10/300 = 3.33\%$.

If the buffer area = 307.1 ha, the equivalent reduction in landbase = $.0333 \times 307.1 = 10.2$ ha.

Total reduction is therefore 17.3 ha (7.1 + 10.2).

Account	Grizzly bear (<i>Ursus arctos</i>)							
Breeding Range:	BC	except	Arrowsmith	Strathcona	Kingcome 40%	Queen Charlotte		
Account elements:							THLB impact	
Protection WHA	- 6.4 ha buffer (timbered)					Protection WHA	6.4 ha	
Mitigation WHA	- selection silviculture systems; lower crop tree density; hardwoods					Mitigation WHA	3.0 ha	
	- mitigation WHAs will cover 10 ha; 10% ha for WTP; 20% for silviculture							
	BC	except	Arrowsmith	Strathcona	Kingcome	Queen Charlotte	Total	
Short-term landbase (ha)	11,506,025		37,962	85,733	34,825	46,159	11,301,345 ha	Protection
Long-term landbase (ha)	19,282,978		74,436	229,920	74,097	60,358	18,844,167 ha	Protection
1st-decade cut (m³/yr)	53,354,842		469,000	1,450,000	427,454	442,000	50,566,388 m³/yr	Mitigation
Long-term cut (m³/yr)	43,907,735		385,000	1,088,300	361,054	248,000	41,825,381 m³/yr	Mitigation
Impact per WHA			%	Protect (m³/yr)	Mitigate (m³/yr)	Provincial (TSA &TFL) Impact		
Short-term			0.000057%	29	13	0.07841%		
Long-term			0.000034%	14	7	0.16404%		
	# WHAs		10-yr	100-yr				
estimated total number of protection WHA's			1750	5500	Short-term (m³/yr)	41835		
half the buffers are already netted out of the THLB			0.5	0.5	Long-term (m³/yr)	72024		
net number of protection WHAs in THLB			875	2750				
# of mitigation WHAs			1250	4950				

Grizzly bear**Protection WHAs**

There are 1100 landscape units (LU) occupied by grizzly bears. Assume that eventually there will be an average of 5 Protection WHAs per LU. Therefore, 1100 LU * 5 WHA = 5500 WHAs.

Protection WHAs are non-forested habitat (e.g., wetlands, estuaries). Assume that half of the forested buffers required for the Protection WHAs are on area already netted out of the timber harvesting landbase for other reasons.

Therefore, 2750 WHA buffers are needed. However, we expect that in the next 10 years it will be possible to install only about 1750 WHAs. Each buffer must be 50 m wide. Assume that the average Protection WHAs will be 10 ha. The area of the WHA (10 ha) is equivalent to a circle with radius 178 m, so the WHA and 50 m buffer comprise a circle with radius 228 m and area 16.4 ha. Therefore the 50 m buffer amounts to 6.4 ha.

Mitigation WHAs

Assume no Mitigation WHAs will be required in intermediate or higher biodiversity emphasis LUs, and 45% of LUs will be lower biodiversity emphasis. Therefore, there will be 1100 LU * 45% = 495 lower biodiversity emphasis LUs.

Assuming that there will be an average of 10 Mitigation WHAs per lower biodiversity emphasis LU, there will be 4950 Mitigation WHAs. However, in the next 10 years we expect to be able to install no more than 1250 Mitigation WHAs. Mitigation WHAs require non-clearcutting silvicultural systems designed to ensure constant forage production, (i.e., open canopy), hardwood components, and lower than usual stocking standards. Required wildlife tree patches should be located within blocks. Wildlife tree patches should be at least 1ha. These statements imply significant harvesting permitted, but at least 1 ha patches left.

If each WHA is 10 ha, and wildlife tree patch (WTP) is 1ha, there is at least a 10% impact for the WTP. Non-clearcut harvesting designed to leave an open canopy and encourage browse production should entail removing 75% of the stems. Therefore the impact is to reduce production by another 25%. Total impact on mitigation WHA is 35% (10% + 20% * 0.9 ha = 28%. This is not a precise estimate—say 30%).

Account	Keen's long-eared myotis (<i>Myotis keenii</i>)					
Breeding Range:	Queen Charlotte	Kingcome	Strathcona	Fraser	Sunshine Coast	Mid Coast

Account elements:	THLB impact
WHA	- (see text box, below) 10.5 ha

	Queen Charlotte	Kingcome	Strathcona	Fraser	Sunshine Coast	Mid Coast	Total
Short-term landbase (ha)	46,159	87,064	85,733	107,282	81,024	100,022	507,284 ha
Long-term landbase (ha)	60,358	185,242	229,920	275,083	218,983	155,580	1,125,166 ha
1st-decade cut (m ³ /yr)	442,000	1,068,635	1,450,000	1,553,200	1,100,000	1,000,000	6,613,835 m ³ /yr
Long-term (m ³ /yr)	248,000	902,635	1,088,300	1,182,500	985,400	680,000	5,086,835 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.002070%	136.90	0.00026%
Long-term	0.000933%	47.47	0.00011%

Keen's long-eared myotis (*Myotis keenii*)

There is very little information concerning the distribution and habitat requirements of this species. Currently, the only known aggregation of this species is protected within South Moresby National Park Reserve (Queen Charlotte Islands).

Guideline

Around all known hibernaculum sites, maternity colonies and major roosting sites, a WHA with a total radius of 300 m and a core area of radius 100 m should be established. No harvesting should take place within the core area. In the remainder of the WHA, selection harvesting which retains large green trees, snags, logs on the forest floor, and canopy gaps is recommended. In addition, WHAs must also be created that provide a 20 m reserve zone adjacent to riparian areas within 500 m of each occurrence (e.g., hibernaculum).

Analysis

The core area in the WHA is about 3 ha (circle with radius 100 m). Outside the core area, the WHA includes an additional 25 ha. The benchmark study estimates were based on about 75% of the timber volume being available from selection harvest systems. Therefore, the additional 25 ha is equivalent to removing an area of 6.25 ha (25 ha * (1-0.75)) from the harvesting land base. If a stream within 500 m of an occurrence is S1, S2, or S3, a riparian reserve is already specified in the RMAG, so this species-account guideline will have no additional impact. If the stream is S4, S5, or S6, the impact would be the volume of timber that would be available in the RMZ required by the RMAG.

The RMAG requires a 30 m RMZ for S4 and S5 streams, and no reserve for S6--the average for the three classes is therefore 20 m.

The longest riparian reserve area will be required where the occurrence is immediately adjacent to the stream, while the shortest will be required when the occurrence is 500 m from the stream. Assuming a distance of 250 m between the occurrence and stream, the riparian reserve should extend about 866 m along each side of the stream (433 m in each direction along the stream from the point closest to the occurrence [(5002 - 2502)/0.5]), for a total reserve area of about 3.5 ha (866 m * 20 m * 2 sides of the stream).

Assuming that in half the WHAs the stream involved is class S1, S2, or S3 (no additional reserve needed) and that in the case of S4, S5, or S6 streams 75% of the volume would be available under the RMAG, this part of the measures will have an average impact equivalent to applying a reserve of 1.3 ha [= 0.5 * .75 * 3.5 ha].

In total the WHA for each such occurrence entails the equivalent of removing about 10.5 ha from the harvesting land base (3 + 6.25 + 1.3).

Account **Lewis' woodpecker (*Melanerpes lewis*)**
Breeding Range: Nelson Region Kamloops Okanagan Merritt Williams Lake

Account elements:	THLB impact
WHA	10.0 ha
- required for aggregations of five or more nesting pairs, each within 250 m of another	
- include a 100-m buffer	
- no logging in WHA	

	Nelson Region	Kamloops	Okanagan	Merritt	Williams Lake	Total
Short-term landbase (ha)	657,551	551,984	607,268	379,383	979,793	3,175,978 ha
Long-term landbase (ha)	1,615,387	890,296	971,628	490,793	1,632,988	5,601,092 ha
1st-decade cut (m ³ /yr)	4,355,000	2,393,180	2,615,000	1,204,250	3,095,000	13,662,430 m ³ /yr
Long-term cut (m ³ /yr)	2,872,000	1,958,000	2,022,000	925,000	2,469,000	10,246,000 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA &TFL) Impact
Short-term	0.0003%	43.0	0.00008%
Long-term	0.0002%	18.3	0.00004%

Lewis' woodpecker

If the WHA is a 5-sided figure (pentangle) with vertices 250 m apart and a buffer 100 m wide around the perimeter, the total area is:

Pentangle area = 12.3 ha

Buffer area = 14.6

Total WHA area = 26.9 ha.

If the trees are grouped close together, the WHA could be less than 1 ha.

If the nests are arranged in a line, say one tree-length apart, the WHA will about 6.4 ha.

For this estimate, something in the middle was used: 10 ha.

Account **Mountain goat (*Oreamnos americanus*)**
Breeding Range: Coastal TSAs, excluding Vancouver Island, Queen Charlotte Islands. Many Interior TSAs. See list below.

Account elements:	THLB impact
WHA	0.0 ha
- while a WHA is prescribed, its requirements are achievable without reducing timber supply through careful planning	

	Coastal TSAs	Interior TSAs	Total
Short-term landbase (ha)	953,904	8,645,620	9,599,524 ha
Long-term landbase (ha)	1,533,193	14,464,464	15,997,657 ha
1st-decade cut (m ³ /yr)	8,327,835	39,400,407	47,728,242 m ³ /yr
Long-term cut (m ³ /yr)	5,313,535	32,528,900	37,842,435 m ³ /yr

Total Impact	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.000000%	0.00	0.000000%
Long-term	0.000000%	0.00	0.000000%

Coastal TSAs in range	Interior TSAs in range
<u>TSA</u>	<u>TSA</u>
Fraser	Quesnel
North Coast	Okanagan
Kalum	Merritt
Kingcome	Fort St. John
Mid-Coast	Fort Nelson
Soo	Kamloops
Sunshine Coast	Prince George
	Williams Lake
	Cranbrook
	Dawson Creek
	Morice
	Robson Valley
	<u>Boundary</u>

Account Northern goshawk (*Accipiter gentilis laingi*)
Breeding Range: Queen Charlotte Strathcona Arrowsmith Kingcome
 40%

Account elements:	THLB impact
nest area	- 72 ha excluded from THLB 72.0 ha
post-fledging area	- 20% of the post-fledging and foraging areas must be old-growth 465.6 ha
and foraging area	- 40% of remaining post-fledging and foraging area landbase must be mature timber (yield reduction of 8.8%) 164.22 ha
	701.8 ha

	Queen Charlotte	Strathcona	Arrowsmith	Kingcome	Total
Short-term landbase (ha)	46,159	85,733	37,962	34,825	204,680 ha
Long-term landbase (ha)	60,358	229,920	74,436	74,097	438,811 ha
1st-decade cut (m ³ /yr)	442,000	1,450,000	469,000	427,454	2,788,454 m ³ /yr
Long-term cut (m ³ /yr)	248,000	1,088,300	385,000	361,054	2,082,354 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.3429%	9561	Short-term 0.01792%
Long-term	0.1599%	3330	Long-term 0.00759%

Northern goshawk ssp. *laingi*

I removed 20% of the WHA land base [$0.2 \times (2400 - 72) = 465.6$ ha] to account for the 20% old growth requirement in the PFA. The alternative approach is to reduce yields according to the change in effective rotation age. This was tested using an average regenerated stand yield table for Strathcona TSA: the yield reduction was about 43%. Therefore the better approach is to take the 20% out of the landbase.

I calculated another ERA for the remainder of the PFA, on which the guideline specifies 40% mature timber must be maintained.

$ERA = 100(1 - 0.4 \times 0.8) = 147$ yr on remaining 80% of forest (after 20% removed for old growth constraint).

This ERA reduces MAI by 0.446 m³/ha/yr (based on average managed stand yield tables for Strathcona TSA), assuming a change from CMAI at 100 yr.

Therefore, $0.446/5.058 = 8.8\%$ reduction on yields from the PFA.

Account	Northern goshawk (<i>Accipiter gentilis atricapillus</i>)						
Breeding Range:	BC	<i>except</i>	Arrowsmith	Strathcona	Queen Charlotte	Kingcome 40%	
<hr/>							
Account elements:							THLB impact
nest area	- Three 12-ha nest sites excluded from harvesting						36.0 ha
post-fledging area	- 20% of the remainder of the post-fledging area must be old-growth						40.8 ha
	- 40% of remaining post-fledging landbase must be mature timber (yield reduction of 8.8%)						14.39 ha
							91.2 ha
<hr/>							
	BC	<i>except</i>	Arrowsmith	Strathcona	Queen Charlotte	Kingcome	Total
Short-term landbase (ha)	11,506,025		37,962	85,733	46,159	34,825	11,301,345 ha
Long-term landbase (ha)	19,282,978		74,436	229,920	60,358	74,097	18,844,167 ha
1st-decade cut (m³/yr)	53,354,842		469,000	1,450,000	442,000	427,454	50,566,388 m³/yr
Long-term cut (m³/yr)	43,907,735		385,000	1,088,300	248,000	361,054	41,825,381 m³/yr
<hr/>							
Impact per WHA			%			Provincial (TSA & TFL) Impact	
			m³/yr				
Short-term			408			0.00076%	
LRSY			202			0.00046%	

Northern goshawk ssp. *atricapillus*

I removed 20% of the WHA land base [$0.2 \times (240-36) = 40.8$ ha] to account for the 20% old-growth requirement in the PFA. The alternative approach is to reduce yields according to the change in effective rotation age. This was tested using an average regenerated stand yield table for Strathcona TSA: the yield reduction was about 43%. Therefore the better approach is to take the 20% out of the landbase.

I calculated another ERA for the remainder of the PFA, on which the guideline specifies 40% mature timber must be maintained.

$ERA = 100(1 - 0.4 \times 0.8) = 147$ yr on remaining 80% of forest (after 20% removed for old growth constraint). This ERA reduces MAI by 0.446 m³/ha/yr (based on average managed stand yield tables for Strathcona TSA), assuming a change from CMAI at 100 yr. Therefore, $0.446/5.058 = 8.8\%$ reduction on yields from the PFA.

Account Pacific water shrew (*Sorex bendirii*)
Breeding Range: Fraser

Account elements:	THLB impact
WHA	39.6 ha
- 30 m no-activity reserve zone, and a 45 m management zone with 80% retention	
- the RMAG requirements for S3 streams: 20 m reserve zone, and 20 m management zone, with maximum 25% retention	-15.0 ha
	24.6 ha

	Fraser	Total
Short-term landbase (ha)	107,282	107,282 ha
Long-term landbase (ha)	275,083	275,083 ha
1st-decade cut (m ³ /yr)	1,553,200	1,553,200 m ³ /yr
Long-term cut (m ³ /yr)	1,182,500	1,182,500 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA &TFL) Impact
Short-term	0.022930%	356.15	0.00067%
LRSY	0.008943%	105.75	0.00024%

Pacific water shrew

WHA

The area of the 30-m no-activity riparian reserve zone (RZ) depends on the length of stream occupied.

The 45-m management zone (RMZ) involves retaining 80% of the basal area.

Each occurrence of Pacific water shrew involves about 3 km of stream reach (pers comm Kathy Paige (via Tory Stevens) April 9, 1996).

Treating basal area retention as land area for simplicity

Average retention for WHA is: 2 sides of stream * (30m + 45 m *.80) * 3000 m/10000 m²/ha = 39.6 ha retained

Average retention for RMAG (assuming average habitat for this species involves S3 streams) is maximum 25% retention, therefore: 2 sides of stream * (20+ 0.25 * 20 m)

* 3000 m /10000m²/ha = 15 ha retained

Therefore the incremental difference is 39.6 ha - 15 ha = 24.6 ha

Account **Prairie falcon (*Falco mexicanus*)**
Breeding Range: Okanagan Williams Lake

Account elements:		THLB impact	
WHA	- core: no activity within 150 m of nest site	core	7.1 ha
(1000 m around nest)	- buffer: remaining 850 m	buffer area	307.1 ha
	- maintain a selection of mature trees for nesting and snags for perching throughout WHA	buffer reduction	10.2 ha
		total reduction=	17.3 ha

	Okanagan	Williams Lake	Total
Short-term landbase (ha)	607,268	979,793	1,587,060 ha
Long-term landbase (ha)	971,628	1,632,988	2,604,616 ha
1st-decade cut (m ³ /yr)	2,615,000	3,095,000	5,710,000 m ³ /yr
Long-term cut (m ³ /yr)	2,022,000	2,469,000	4,491,000 m ³ /yr

Impact per WHA	%	m ³ /yr
Short-term	0.001090%	62.22
Long-term	0.000664%	29.82

Provincial (TSA & TFL) Impact
0.00012%
0.00007%

Prairie falcon

The WHA required around nest sites must be 314.2 ha (circle with radius 1000 m).

Core (no activity) area is 7.1 ha (circle with radius 150 m).

Therefore the remainder of the WHA (the buffer area) is a torus of area 307.1 ha (314.2 ha - 7.1 ha).

Assume that in the buffer area there are 300 trees/ha, and management requirements to maintain a selection of mature trees for nesting and snags for perching will reserve 10 trees/ha, i.e., $10/300 = 3.33\%$.

If the buffer area = 307.1 ha, the equivalent reduction in landbase = $.0333 * 307.1 = 10.2$ ha.

Total reduction is therefore 17.3 ha (7.1 + 10.2).

Account	Sandhill crane (<i>Grus canadensis</i>)							
Breeding Range:	Invermere	Cranbrook	Kamloops	Okanagan	Ft Nelson	Con	Quesnel	Williams Lake
# Wetlands unprotected			100 ³				800 ⁸	
ratio to LT-THLB	0.000625 ¹	0.000625 ²	0.000625 ⁴	0.000625 ⁵	0.0016842 ⁶		0.0016842 ⁷	0.0016842 ⁹
Total impact								THLB impact
TSA area in range (ha)	70,000	70,000	160,000	675,000	248,000		475,000	1,717,600
wetland area to be protected	88	88	200	844	835		1600	5786
								3,415,600 ha ¹⁰
								9,440 ha ¹¹
								944.0

	Invermere	Cranbrook	Kamloops	Okanagan	Ft Nelson	Con	Quesnel	Williams Lake	Total
Short-term landbase (ha)	105,833	121,034	551,984	607,268	107,282		424,361	979,793	2,897,553 ha
Long-term landbase (ha)	215,985	403,445	890,296	971,628	275,083		1,010,383	1,632,988	5,399,808 ha
1st-decade cut (m ³ /yr)	568,000	806,000	2,393,180	2,615,000	1,553,200		2,265,500	3,095,000	13,295,880 m ³ /yr
Long-term cut (m ³ /yr)	360,000	633,000	1,958,000	2,022,000	1,182,500		1,955,500	2,469,000	10,580,000 m ³ /yr

Total impact (WHA)	%	m ³ /yr
Short-term	0.032578%	4332
Long-term	0.017482%	1850

Total provincial (TSA & TFL) Impact
0.008118%
0.004212%

1. Pers comm, BCE staff April 9, 1996 - use the Kamloops ratio of unprotected wetlands to area of range in TSA
2. Pers comm, BCE staff April 9, 1996 - use the Kamloops ratio of unprotected wetlands to area of range in TSA
3. Pers comm, BCE staff April 9, 1996 - there are about 100 unprotected wetlands suitable for sandhill crane in the Kamloops TSA
4. This is the ratio of unprotected wetlands to the area of sandhill crane range in the TSA
5. Pers comm, BCE staff April 9, 1996 - use the Kamloops ratio of unprotected wetlands to area of range in TSA
6. Pers comm, BCE staff April 9, 1996 - use the Quesnel ratio of unprotected wetlands to area of range in TSA
7. This is the ratio of unprotected wetlands to the area of sandhill crane range in the TSA
8. Pers comm, BCE staff April 9, 1996 - there are about 800 unprotected wetlands suitable for sandhill crane in Quesnel TSA
9. Pers comm, BCE staff April 9, 1996 - use the Quesnel ratio of unprotected wetlands to area of range in TSA
10. sum of (ratio * area of TSA in spp. range * 2 ha for each wetland)
11. I estimate a 10% reduction in MAI on affected hectares - I am treating this as a landbase removal, which isn't perfectly correct, but close enough for this purpose.

Account	Tailed frog (<i>Ascaphus truei</i>)					
Breeding Range:	Fraser	Kingcome	Mid Coast	Soo	Sunshine	Cranbrook

Account elements:						THLB impact
core	20 m core	20 m * 500 m * 2 sides of stream/ 10,000 sq.m./ha = 2.0 ha				2.0 ha
buffer	30 m buffer	80% retention: (.8 * 30m * 500 m * 2 sides of stream /10,000 sq.m.) =				2.4 ha
						4.4 ha

	Fraser	Kingcome	Mid Coast	Soo	Sunshine	Cranbrook	Total
Short-term landbase (ha)	107,282	87,064	100,022	38,624	85,733	121,034	539759 ha
Long-term landbase (ha)	275,083	185,242	155,580	106,371	229,920	403,445	1355641 ha
1st-decade cut (m ³ /yr)	1,553,200	1,068,635	1,000,000	506,000	1,450,000	806,000	6383835 m ³ /yr
Long-term cut (m ³ /yr)	1,182,500	902,635	680,000	442,000	1,088,300	633,000	4928435 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA &TFL) Impact
Short-term	0.0008%	52.0	0.00010%
Long-term	0.0003%	16.0	0.00004%

Tailed frog

A reserve length (along the stream reach) of 500 m is specified: an average of 400 m was used.

Core area (20 m) : 20 m * 500 m * 2 sides of stream/ 10,000 sq.m./ha = 2.0 ha.

Buffer area (30 m): 80% retention: (.8 * 30m * 500 m * 2 sides of stream /10,000 sq.m.) = 2.4 ha.

Account	Trumpeter swan (<i>Cygnus buccinator</i>)	
Breeding Range:	Pr. George Region	Pr. Rupert Region

Account elements:	THLB impact
WHA	22.1 ha
- 200 m no-activity zone	
- additional 300 m of buffer	0.0 ha
	<u>22.1 ha</u>

	Pr. George Region	Pr. Rupert Region	Total
Short-term landbase (ha)	4,708,987	1,942,647	6,651,633 ha
Long-term landbase (ha)	7,724,604	2,613,633	10,338,237 ha
1st-decade cut (m ³ /yr)	19,304,677	8,646,400	27,951,077 m ³ /yr
Long-term cut (m ³ /yr)	18,098,000	6,057,400	24,155,400 m ³ /yr

Impact per WHA	%	m ³ /yr	Total provincial (TSA & TFL) Impact
Short-term	0.000332%	92.87	0.00017%
Long-term	0.000214%	51.64	0.00012%

Trumpeter Swan

Secluded wetlands surrounded by forest are critical for breeding. The primary habitat management objective for trumpeter swan is to prevent disturbance by humans during the breeding season. This is most easily achieved by preventing access.

A WHA may be required at each nesting site. The WHA should include the nesting wetland and a 500 m buffer. Limit road building within the WHA and deactivate after use. No roads or trails of any kind within 200 m of the lake edge. No activity within the WHA during the nesting season (April - August). Harvesting can take place within the WHA (outside the 200 m buffer) at other times.

Analysis

Assume that the wetland is a W2 class wetland, with average area of 2.5 ha. Therefore, it is a circle with radius 89 m (square root of 25000/pi). Therefore, the outside of the 200 m no-activity zone has a radius of 289 m (200+89).

The total area to the outside of the no activity zone is 26.2 ha, and the area of the no activity zone is 26.2 - 2.5 = 23.7 ha.

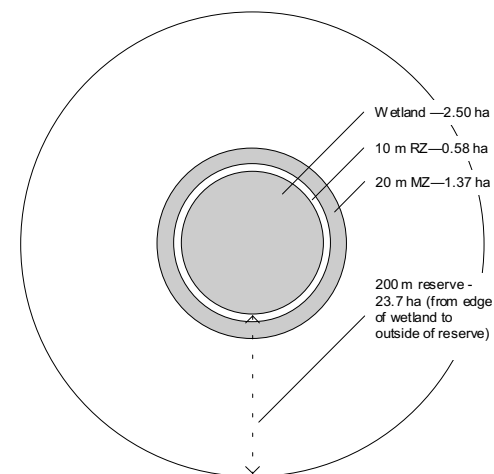
The RMA guidebook for W2 wetlands prescribes a 10 m reserve and 20 m management zone. Therefore the impact of this spp. account is:

1. adding 170 metres of reserve.
2. adding the difference between the reserve and the management zone on 20 meters.

Area of 170 m reserve = [Area of a circle with r=289 m]-[area of circle with r=119 m] = 26.2 ha - 4.5 ha = 21.7 ha.

Change from management zone to reserve on 20 m buffer: 1.37 ha * 30% yield = 0.4 ha.

Therefore, the total incremental impact of the 200 m no activity reserve is 22.1 ha.



Account	Turkey vulture (<i>Cathartes aura</i>)				
Breeding Range:	Arrowsmith	Fraser	Okanagan	Strathcona	Sunshine Coast

Account elements:	THLB impact
WHA	0.0 ha
- 150 m around cliff or cave nest site, with logging prohibited April - August: no impact - 150 m around forest nest site (7 ha), logging prohibited. - while some of the nest sites might be in forest, currently known staging areas are not on provincial forest	

	Arrowsmith	Fraser	Okanagan	Strathcona	Sunshine Coast	Total
Short-term landbase (ha)	37,962	107,282	607,268	85,733	81,024	919,269 ha
Long-term landbase (ha)	74,436	275,083	971,628	229,920	218,983	1,770,050 ha
1st-decade cut (m ³ /yr)	469,000	1,553,200	2,615,000	1,450,000	1,100,000	7,187,200 m ³ /yr
Long-term cut (m ³ /yr)	385,000	1,182,500	2,022,000	1,088,300	985,400	5,663,200 m ³ /yr

Impact per WHA	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.000000%	0.00	0.000000%
Long-term	0.000000%	0.00	0.000000%

Account Vancouver Island marmot (*Marmota vancouverensis*)
Breeding Range: Arrowsmith Strathcona

Account elements:	THLB impact
WHA	500
- requiring complete protection of core colony area	
- 75% of known population is in core area - 2000 ha	
- reduce impact by 3/4 because much of it will be in non-timbered area	

	Arrowsmith	Strathcona	Total
Short-term landbase (ha)	37,962	85,733	123,695 ha
Long-term landbase (ha)	74,436	229,920	304,356 ha
1st-decade cut (m ³ /yr)	469,000	1,450,000	1,919,000 m ³ /yr
Long-term cut (m ³ /yr)	385,000	1,088,300	1,473,300 m ³ /yr

Impact per WHA	%	m ³ /yr	Total provincial (TSA & TFL) Impact
Short-term	0.404219%	7756.97	0.01454%
Long-term	0.164281%	2420.36	0.00551%

Marmot

For this account, total impact is calculated.

Some important information about marmot was not available:

1. It is not clear whether the known colonies are on Crown land. I have assumed they are, but if not, then impact is zero.
2. There may be work going on to introduce marmot into new areas, which would increase impact. No information was available.

Account White-headed woodpecker (*Picoides albolarvatus*)**Breeding Range:** Okanagan Boundary Merritt

Account elements:		THLB impact
Foraging WHA	- Where selection system is used:	0.0 m ³ /ha
	- Where even-aged systems are used, lose 25 m ³ /ha for foraging WHA	25.0 m ³ /ha
Nest Site WHA	- retain all large Py and Fd live and dead trees	30.0 ha

White-headed Woodpecker

The foraging WHA reduces yield only on hectares not managed under selection system. Only on Boundary TSA are dry belt fir/Py stands managed under even-aged management (43% of the dry-belt fir/Py stands in the TSA). On these hectares, yield will be reduced by about 25 m³/ha (@ 1 m³/tree) or about 10% (assuming about 250 m³/ha at harvest).

---TSA Landbase Data---				----Woodpecker Habitat Landbase----				
	Okanagan	Boundary	Merritt				Total	
Short-term landbase (ha)	607,268	110,627	379,383	43,723	9,071	14,417	67,211 (ST ha)	Foraging WHA- total impact
Long-term landbase (ha)	971,628	298,991	490,793	69,957	24,517	18,650	113,125 (LT ha)	Foraging WHA- total impact
1st-decade cut (m ³ /yr)	2,615,000	700,000	1,204,250	188,280	57,400	45,762	291,442 (ST m ³ /yr)	Nest Site per-WHA impact
Long-term cut (m ³ /yr)	2,022,000	560,000	925,000	145,584	45,920	35,150	226,654 (LT m ³ /yr)	Nest Site per-WHA impact

Impact per WHA	%	m ³ /yr		Provincial (TSA & TFL) Impact	
Short-term	10.0%	2468.20	General	0.00463%	Short-term Total impact
Long-term	10.0%	1974.56	General	0.00450%	Long-term Total impact
Short-term	0.044635%	130.09	Nest Site	0.00024%	Short-term Per-WHA impact
Long-term	0.026519%	60.11	Nest Site	0.00014%	Long-term Per-WHA impact

White-headed Woodpecker-Okanagan TSA

While about 12% (111 864 ha) of the THLB in Okanagan TSA is in dry fir/ponderosa pine, and it is managed by selection system, only 1% of the current cut is taken from those types. See pages 19 and 43 of the TSR analysis report.

The range of the white-headed woodpecker is about 60% in Okanagan TSA, and 20% in each of Boundary and Merritt TSAs, hence the adjustment of 0.72 [.6*.12] in the woodpecker habitat landbase calculations.

White-headed Woodpecker - Boundary TSA

About 41% (125 043 ha) of the THLB in Boundary TSA is dry belt fir/ponderosa pine.

- 71 472 (57%) of the dry belt fir/ponderosa pine in the THLB is zoned for uneven-aged management - this 71 472 ha makes up 24% of the total THLB. Therefore, about 18% of the THLB is dry belt fir/Py not managed under selection system.

The range of the woodpecker is about 20% in Boundary TSA, hence the adjustment of 0.82 [.2*.41] in the woodpecker habitat landbase calculations.

White-headed woodpecker - Merritt TSA

About 19% (97 598 ha) of the THLB in Merritt TSA is in dry fir/ponderosa pine types managed by selection system.

The current harvest profile is that 14% of the total harvest volume is taken from dry belt fir and Py.

See pages 44 and 54 of the TSR analysis report.

The range of the woodpecker is about 20% in Merritt TSA, hence the adjustment of 0.38 [.2*.19] in the woodpecker habitat landbase calculations.

Account *Betula occidentalis* - *Cornus stolonifera*
Range: Okanagan

Account elements:	THLB impact
There are no merchantable trees in this community, and therefore no impact on timber supply	0.0 ha

	Okanagan	Total
Short-term landbase (ha)	607,268	607,268 ha
Long-term landbase (ha)	971,628	971,628 ha
1st-decade cut (m ³ /yr)	2,615,000	2,615,000 m ³ /yr
Long-term cut (m ³ /yr)	2,022,000	2,022,000 m ³ /yr

Total impact	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.000000%	0.00	0.00000%
Long-term	0.000000%	0.00	0.00000%

Account *Pinus ponderosa* - *Populus balsamifera* ssp. *trichocarpa* - *Rhus radicans*
Range: Okanagan

Account elements:	THLB impact
WHA	- the entire population should be protected
	- about 32 ha of this community has been mapped on Crown land
	- the objective of the account is to restore this community until 30% of it is in mature and old seral stages
	total area 32.0 ha
	30% 9.6 ha

	Okanagan	Total
Short-term landbase (ha)	607,268	607,268 ha
Long-term landbase (ha)	971,628	971,628 ha
1st-decade cut (m ³ /yr)	2,615,000	2,615,000 m ³ /yr
Long-term cut (m ³ /yr)	2,022,000	2,022,000 m ³ /yr

Total impact	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.001581%	41.34	0.00008%
LRSY	0.000988%	19.98	0.00005%

Account *Pinus ponderosa - Populus balsamifera ssp. trichocarpa - Symphoricarpos albus*
Range: Boundary

Account elements:			THLB impact
WHA	- no harvesting in 30% of this community plus 250 m buffer	rough estimate:	100.0 ha

	Boundary	Total
Short-term landbase (ha)	110,627	110,627 ha
Long-term landbase (ha)	298,991	298,991 ha
1st-decade cut (m ³ /yr)	700,000	700,000 m ³ /yr
Long-term cut (m ³ /yr)	560,000	560,000 m ³ /yr

Total impact	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.090394%	632.76	0.00110%
LRSY	0.033446%	187.30	0.00070%

***Pinus ponderosa - Populus balsamifera ssp. trichocarpa - Symphoricarpos albus* community**

There may be about 300 ha in total (pers. comm., Conservation Data Centre staff).

The objective is to restore occurrences until at least 30% is in mature (>100 yrs) and old (>250 yrs) seral stages,

There is no reliable estimate of the area involved here, so 100 ha has been used for the area of the WHA and buffer. While there may not currently be 100 ha of mature timber (which would reduce the short-term impact), the area involved is so small and the information so tenuous, that it seemed pointless to refine the estimate further.

Account *Pseudotsuga menziesii* / *Quercus garryana* - *Melica subulata*
Range: Arrowsmith

Account elements:		THLB impact	
WHA	- all remaining old forest occurrences of this community should be designated WHAs	Total area	100.0 ha
	- the objective is to restore this community until at least 30% is mature and old		
	- there is probably about 100 ha of this community on Crown land (pers. comm., S. Flynn)	WHA (30%)	30.0 ha

	Arrowsmith	Total
Short-term landbase (ha)	37,962	37,962 ha
Long-term landbase (ha)	74,436	74,436 ha
1st-decade cut (m ³ /yr)	469,000	469,000 m ³ /yr
Long-term cut (m ³ /yr)	385,000	385,000 m ³ /yr

Total impact	%	m ³ /yr	Provincial (TSA & TFL) Impact
Short-term	0.079026%	370.63	0.00069%
Long-term	0.040303%	155.17	0.00035%

***Pseudotsuga menziesii* / *Quercus garryana* - *Melica subulata* community**

There might be 100 ha of this community on Crown land (pers. comm., Conservation Data Centre staff).

TSA Name	Region	LT THLB	ST %	ST CUT	LRSY
100 Mile House	Kamloops	744099	60.0%	1237000	1237000
Arrow	Nelson	200869	33.0%	619000	422000
Arrowsmith	Vancouver	74436	51.0%	469000	385000
BC		19282978	59.7%	53354842	43907735
Boundary	Nelson	298991	37.0%	700000	560000
Bulkley	Prince Rupert	262268	73.0%	895000	424000
Cariboo Region		3387470	54.6%	6597500	5661500
Cassiar	Prince Rupert	366641	53.3%	842400	867400
Cranberry	Prince Rupert	0	0.0%	0	0
Cranbrook	Nelson	403445	30.0%	806000	633000
Dawson Creek Conif	Prince George	738621	53.1%	1706300	1266000
Fort Nelson Conif	Prince George	1116837	75.5%	1746000	1551000
Fort St. John Conif	Prince George	1119131	53.9%	2675000	2490000
Fraser	Vancouver	275083	39.0%	1553200	1182500
Golden	Nelson	164174	41.0%	605000	309000
Invermere	Nelson	215985	49.0%	568000	360000
Kalum North	Prince Rupert	242917	93.0%	1250000	410000
Kalum South (Nass)	Prince Rupert	99136	50.4%	464000	400000
Kamloops	Kamloops	890296	62.0%	2393180	1958000
Kamloops Region		2635911	66.9%	6862430	5305000
Kingcome	Vancouver	185242	47.0%	1068635	902635
Kispiox	Prince Rupert	309090	79.0%	1100000	600000
Kootenay Lake	Nelson	273580	56.0%	803000	490000
Lakes	Prince Rupert	634487	83.0%	1500000	1441000
Lillooet	Kamloops	283194	79.0%	650000	400000
Mackenzie	Prince George	1098962	77.0%	2951000	2810000
Merritt	Kamloops	490793	77.3%	1204250	925000
Mid Coast	Vancouver	155580	64.3%	1000000	680000
Morice	Prince Rupert	592994	71.0%	1995000	1614000
Nelson Region		1615387	40.7%	4355000	2872000
North Coast	Prince Rupert	106100	83.0%	600000	301000
Okanagan	Kamloops	971628	62.5%	2615000	2022000
Pr. George Region		7724604	61.0%	19304677	18098000
Pr. Rupert Region		2613633	74.3%	8646400	6057400
Prince George	Prince George	3450712	63.0%	9630000	9630000
Queen Charlotte	Vancouver	60358	76.5%	442000	248000
Quesnel	Kamloops	1010383	42.0%	2265500	1955500
Revelstoke	Nelson	58343	57.0%	254000	98000
Robson Valley	Prince George	200341	71.0%	596377	351000
Soo	Vancouver	106371	36.3%	506000	442000
Strathcona	Vancouver	229920	37.3%	1450000	1088300
Sunshine Coast	Vancouver	218983	37.0%	1100000	985400
Vancouver Region		1305973	44.7%	7588835	5913835
Williams Lake	Kamloops	1632988	60.0%	3095000	2469000
LT THLB	Long-term timber harvesting land base (ha)				
ST%	Short-term timber harvesting land base (% of LT THLB)				
ST Cut	Short-term harvest volume (m3/yr)				
LRSY	Long-run sustained yield (m3/yr)				

Total provincial timber harvesting landbase	19,282,978	53,354,842	43,907,735
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