
APPENDIX 2
Kitsault Mine Project Grizzly Bear Habitat Mapping

Kitsault Mine Project Grizzly Bear Habitat Mapping

AMEC
4445 Lougheed Highway, Suite 600
Burnaby, BC V5C 0E4

Prepared by:

A. Grant MacHutchon
Wildlife Biologist, M.Sc., R.P.Bio.
817 Mill Street
Nelson, BC V1L 4S8
250-505-5083 Telephone
machutchon@uniserve.com Email

July 4, 2011

TABLE OF CONTENTS

Table of Contents	i
List of Figures	i
List of Tables	i
1 Introduction	1
1.1 Existing Data	1
1.2 Experience of G. MacHutchon	1
2 Methods	2
2.1 Pre-Field Mapping	2
2.1.1 Polygon Delineation	2
2.1.2 Polygon Ecosystem Units	3
2.1.3 Polygon Suitability Ratings	4
2.1.4 Data Management	5
2.1.5 Field Assessments	7
2.1.5.1 Ground Assessments	7
2.1.5.2 Aerial Assessments	7
3 Results & Discussion	8
4 Literature Cited	12

LIST OF FIGURES

Figure 1. Class 1 to 4 grizzly bear habitat polygons within or near the Kitimat Mine Project wildlife Regional Study Area.	9
Figure 2. Class 1 to 4 grizzly bear habitat polygons within the Kitimat Mine Project Local Study Area.	11

LIST OF TABLES

Table 1. Biogeoclimatic Ecosystem Classification (BEC) Zones, Subzones, and Variants within the Kitimat Mine Project RSA or along the KMP access road to the Nass River bridge.	3
Table 2. Wetlands and related ecosystems in B.C. (MacKenzie and Moran 2004).	4
Table 3. Relative suitability classes assigned to grizzly bear habitat polygons (RIC 1999).	5
Table 4. Database fields for data capture in the mapping of important grizzly bear habitat, KMP area. Provincial digital data capture standards were used whenever possible (adapted from RIC 2000 & 2004 where appropriate).	5
Table 5. Form fields used to systematically document information at ground assessment sites.	8

1 INTRODUCTION

I was contracted by AMEC, Burnaby to map and field assess important grizzly bear habitat polygons in the wildlife Regional Study Area (RSA) for the proposed Kitsault Mine Project and along the KMP access road eastward as far as the Nass River bridge. Important grizzly bear habitat in most of the KMP RSA was already mapped in 2008 (see section _ below). Consequently, I mapped grizzly bear habitat polygons that were additional to or complemented the habitat mapping done in 2008. I also field assessed several polygons in the vicinity of the KMP that were not field assessed in 2008. My mapping and assessment methods largely followed the methods of MacHutchon (2007a, 2008).

1.1 Existing Data

In 2008 the B.C. Ministry of Environment and the Ecosystem Based Management Working Group (EBMWG) did a three phase project to map important grizzly bear habitat polygons in the North Coast LRMP area (MacHutchon 2008). All class 1 and 2 grizzly bear habitat polygons that could be discerned on air photos were mapped. Class 3 and 4 polygons were only mapped if there was some question about their suitability to grizzly bears during air photo interpretation that required field verification, if possible. All class 3 and 4 polygons that were mapped were retained in the final master ecological map whether they were assessed in the field in 2008 or not.

In 2009 & 2010, the above mapping was combined with other grizzly bear habitat mapping on the central and south central coast to create a seamless map of important grizzly bear habitat for the Central and North Coast (CNC) Land Use Order (LUO) and the South Central Coast (SCC) LUO (MacHutchon 2010). The end product of this process in the North Coast was a corrected and updated master ecological map of important grizzly bear habitat and a subset map of polygons for which the CNC LUO applied. For example, only class 1 and 2 polygons were retained for the CNC LUO map even though the master ecological map included some class 3 and 4 (RIC 1999) habitat polygons. In addition the CNC LUO did not apply to previously established Wildlife Habitat Areas (WHAs), Biodiversity, Mining & Tourism Areas (BTMA), protected areas (e.g., provincial parks, ecological reserves, conservancies), Indian Reserves, Crown woodlots, Community Forest Agreements (CFA), private land, and everything extending into the ocean below the high water line. Consequently, although polygons or portions of polygons in these areas were retained within the master ecological map, they were dropped from the CNC LUO map. The master ecological map of grizzly bear habitat for the coast covers most of the KMP wildlife RSA and is comprehensive at a scale of 1:20,000.

1.2 Experience of G. MacHutchon

Grant MacHutchon, M.Sc., R.P.Bio., has been sole proprietor of a wildlife biology consulting company based in British Columbia since 1989. He specializes in bear research and management, including habitat ecology, population biology, and bear and human conflict management. Grant has worked with grizzly bears or black bears for 25 years of his 30 year professional career and has done research or management work on

grizzly bears in four of the five jurisdictions they occur in Canada, including B.C., Alberta, Yukon, and N.W.T.

G. MacHutchon did three years of grizzly bear research in the Khutzeymateen River Valley of north coastal B.C. (MacHutchon et al. 1993, 1998) and the Khutzeymateen River Valley is now considered the provincial benchmark for coastal grizzly bear habitat (RIC 1999). Grant also did five years of mapping, rating, and field evaluating grizzly bear habitat polygons on the B.C. central and north coast (MacHutchon 2000, 2001, 2007a&b, 2008, 2009, 2010).

2 METHODS

2.1 Pre-Field Mapping

2.1.1 Polygon Delineation

I assessed available high resolution digital imagery within the KMP RSA (1:20,000 map sheets 103P043, 044, 053, 054) to see if any grizzly bear habitat polygons were missed during 2008 mapping (MacHutchon 2008, 2010) or were east of the 2008 mapping area in the Nass River drainage along the KMP access road. East of the above high resolution imagery, I used available SPOT imagery to map polygons along the access road to the Nass River bridge.

Potentially important early spring (April), late spring (May), summer (June, July, August), and fall (September, October) (RIC 1999) grizzly bear habitat polygon boundaries were drawn digitally around distinct ecosystem units or complexes of two or three ecosystem units using ArcMap GIS. Polygons often were complexes of two or three ecosystem units because of the spatial distribution of habitats on the landscape. Polygon boundaries were based on terrain and vegetation features such as slope breaks, other natural landscape breaks, changes in forest cover type, and edges between non-forested and forested habitat.

Buffers were delineated around non-forested or open forested feeding habitats as part of a polygon whenever that polygon was not adjacent to another typed polygon. Many important feeding areas for grizzly bears include open habitat. In order for these sites to retain their ecological integrity and value to grizzly bears, the maintenance of adjacent forest is essential as grizzly bears use these forests for travel, security cover, and thermal cover. Forests adjacent to feeding areas can include important wildlife habitat features for grizzly bears, such as bedding sites, trails, mark trees, or wallows (Himmer and Powers 2003), escape trees (i.e., trees for cubs to climb), and provide important microclimatic conditions (e.g., cover from rain, reduced localized temperature and shade in hot weather). In the absence of travel areas and security and thermal cover, the value of an open feeding area for grizzly bears is significantly reduced or lost. Although 50 m is sometimes used as a conceptual target for habitat buffers (Hamilton and Horn 2003, Pollard and Buchanan 2006), there is no standard or limit, therefore buffer widths varied according to site-specific conditions (e.g., terrain type, forest cover type).

2.1.2 Polygon Ecosystem Units

Up to three ecosystem units were designated per polygon in the map unit database. Worksheet lists of the forested and non-forested ecosystem units or habitats likely to occur in the KMP area were compiled as follows:

- Forested site series in relevant Biogeoclimatic Ecosystem Classification (BEC) Coastal Western Hemlock (CWH), Interior Cedar Hemlock (ICH), and Mountain Hemlock (MH) variants (Table 1).
- Wetlands and related ecosystems that might occur in the project area. MacKenzie and Moran (2004) provided a hierarchical system for describing and identifying wetlands and related ecosystems in B.C. that included site realm, group, class, and association (Table 2). Site associations as described in MacKenzie and Moran (2004) were a classification of wetlands and related ecosystems into groups of sites with similar ecological function. However, most wetlands and riparian areas are complexes of ecosystems, where mapping site associations would be difficult at 1:20,000 scale. For this reason, entire wetlands are often typed as a single unit. The WREC project proposed a landscape-level unit called the “Ecocomplex” to describe reoccurring spatial patterns of classes or groups within a hydrogeomorphic system for use in mapping wetlands (MacKenzie and Banner 2001). Since non-forested or forested wetlands are often only one ecosystem component of grizzly bear habitat polygons and because wetlands often are a complex of wetland classes, MacHutchon (2007a) suggested naming these as class “wetland complex (Wc)” and listing the individual class components of these complexes in a separate data field (“Wet_Comple”) in decreasing order of aerial extent (e.g., “Wb/Wf/Wa”). This protocol was used in this project.
- Avalanche chute ecosystem units.
- Open forest or non-forested MH parkland ecosystem units.
- Non-forested alpine (CMA) ecosystem units.
- Non-vegetated, sparsely vegetated or anthropogenic ecosystem units.

Table 1. Biogeoclimatic Ecosystem Classification (BEC) Zones, Subzones, and Variants within the Kitimat Mine Project RSA or along the KMP access road to the Nass River bridge.

BEC Zone	BEC Subzone	BEC Variant	BEC Subzone & Variant Description
CWH	wm		Wet Maritime
CWH	ws	1	Submontane Wet Submaritime
CWH	ws	2	Montane Wet Submaritime
MH	mm	1	Windward Moist Maritime
MH	mm	2	Leeward Moist Maritime
MH	mmp		Moist Maritime Parkland
ICH	mc	1	Moist Cold Subzone, Nass Variant
CMA	un		Undifferentiated

Table 2. Wetlands and related ecosystems in B.C. (MacKenzie and Moran 2004).

Site Realm	Site Group	Site Class	Code
Wetland		Bog	Wb
		Fen	Wf
		Marsh	Wm
		Swamp	Ws
		Shallow water	Wa
Estuarine		Estuarine marsh	Em
		Estuarine meadow	Ed
Terrestrial	Flood	High bench	Fh
		Mid bench	Fm
		Low bench	Fl
Terrestrial	Transition	Shrub-carr	Sc
		Saline meadow	Gs

Ecosystem units within a polygon were classified to the level of site series (i.e., Banner et al. 1993), site class (i.e., wetlands and related ecosystems, MacKenzie and Moran 2004), or other non-forested ecosystem units. The emphasis of mapping was ecosystem units considered particularly important to grizzly bears, such as:

- non-forested wetlands (e.g., fen, swamp, marsh, or shallow water site class (MacKenzie and Moran 2004)),
- estuaries (e.g., estuarine marsh or estuarine meadow site class (MacKenzie and Moran 2004)),
- forested or wooded wetlands (e.g., skunk cabbage swamps),
- ocean foreshore areas with sedges,
- herb and shrub dominated avalanche chutes,
- berry producing forests such as riparian floodplain forests and alluvial fan forests,
- salmon movement and spawning areas,
- sub-alpine parkland meadows.

2.1.3 Polygon Suitability Ratings

The seasonal suitability of habitat polygons for grizzly bears was rated for four seasons, early spring (April), late spring (May), summer (June, July, August), and fall (September, October) using the provincially accepted 6-class rating scheme (Table 3, RIC 1999). RIC (1999) defines suitability as the ability of a habitat in its current condition to provide the life requisites of a species. Each polygon was rated based on the collective contribution of each of ecosystem units within it rather than the specific rating of any one habitat.

A significant grizzly bear habitat use research study was completed in the Khutzeymateen Valley in 1993 (MacHutchon et al. 1993, 1998). The Khutzeymateen grizzly bear study was largely responsible for our current understanding of the seasonal importance of various ecosystem units to grizzly bears on the North Coast therefore the Khutzeymateen study results helped inform the seasonal ratings of ecosystem units. In addition to the Khutzeymateen study, other grizzly bear habitat use studies on the B.C. coast have given insights into seasonal habitat values, including projects in the Kimsquit River Valley (Hamilton 1984&1987, Hamilton et al. 1986), Atnarko and Talchako river

valleys (Himmer and Gallagher 1995), and upper Knight Inlet (Russell 1974, Lloyd 1979). It is now accepted that some ecosystem units, such as avalanche chutes, open forested alluvial fans, and forested and wooded swamps have higher seasonal values than were reflected in the Khutzeymateen study results. Consequently, these research results also informed the seasonal ratings of ecosystem units.

Table 3. Relative suitability classes assigned to grizzly bear habitat polygons (RIC 1999).

Class	Suitability	Lower Limit (%)	Upper Limit (%)	Relative Quality
1	High	>75	≤100	Equivalent
2	Mod. High	>50	≤75	Slightly less
3	Moderate	>25	≤50	Moderately less
4	Low	>5	≤25	Substantially less
5	Very Low	>0	≤5	Much less
6	Nil	0	0	Habitat or attribute is absent

As much as possible, other factors than food or cover value were considered that could influence the suitability of a habitat polygon to grizzly bears such as the polygon's position on the landscape and proximity to other habitat polygons, the availability of animal foods such as salmon, intraspecific and interspecific competition among bears for habitats, and local human influences.

2.1.4 Data Management

Habitat polygon ecological attribute and suitability rating data were entered in to a database file (*.dbf) attached to the grizzly bear polygon spatial shape file with the fields listed in Table 4. Fields and field names compatible with the TEM standards (RIC 2000 & 2004) were used whenever possible. Many of the same data fields used by MacHutchon (2008) were used in this project.

Table 4. Database fields for data capture in the mapping of important grizzly bear habitat, KMP area. Provincial digital data capture standards were used whenever possible (adapted from RIC 2000 & 2004 where appropriate).

Field	Name	Description
Project	Project Name	North Coast grizzly bear habitat mapping = NCgbh; Kitsault Mine Project grizzly bear habitat mapping = KMPgbh
NCgbh_Nbr	Unique Project Polygon Number	A unique identifying number within each of the two mapping projects above (i.e., NCgbh & KMPgbh).
Poly_Nbr	Project Polygon Number	A unique identifying number within the entire coastal master ecological database of grizzly bear habitat polygons.
MURAR_PE	Early Spring Suitability	Polygon suitability for grizzly bears in early spring (April)

Field	Name	Description
MURAR_PL	Late Spring Suitability	Polygon suitability for grizzly bears in late spring (May)
MURAR_S	Summer Suitability	Polygon suitability for grizzly bears in summer (June, July, August)
MURAR_F	Fall Suitability	Polygon suitability for grizzly bears in fall (September, October)
MURAR_Class	Overall Suitability	The highest suitability rating assigned in any one season.
Eco_Sec	Ecosection	A 3-letter code for ecosection. A component of the hierarchical Ecoregion Classification System of British Columbia (see section 1, pg. 38 in BC MELP & BC MOF 1998).
Land_Unit	Landscape Unit	Landscape Unit name
Mapsh_Nbr	TRIM Map sheet Number	If the polygon did not fall entirely within the bounds of one map sheet, then the number is for the map sheet containing most of the polygon.
Typed	Person polygon typed by	The person who delineated polygons, classified the ecosystem units, and assigned grizzly bear suitability ratings using either air photo interpretation, digital imagery interpretation, or field assessment. BP = Brad Pollard, GM = Grant MacHutchon
Bgc_Zone	Biogeoclimatic Zone	First-rank unit in the hierarchical Biogeoclimatic Ecosystem Classification (BEC) system of B.C. (see section 1, pg. 31 in BC MELP & BC MOF 1998).
Bgc_Subzon	Biogeoclimatic Subzone	Second-rank unit in the BEC system (see section 1, pg. 31 in BC MELP & BC MOF 1998).
Bgc_Vrt	Biogeoclimatic Variant	Third-rank unit in the BEC system (see section 1, pg. 31 in BC MELP & BC MOF 1998).
Sdec_1 to Sdec_3	Ecosystem Decile, Components 1 - 3	The proportion of the polygon covered by components 1 to 3 in deciles.
Realm_1 to Realm_3	Site Realm 1 - 3	The Realm is the broadest level of distinction within the ecosystem component and it delineates major biotic types that reflect gross differences in water abundance, quality, and source (see MacKenzie and Moran 2004 or section 1, pg. 19 in BC MELP & BC MOF 1998).
Class_1 to Class_3	Site Class 1 - 3	Class are ecosystems that have broadly similar vegetation physiognomy, hydrology, and water quality (see MacKenzie and Moran 2004 or section 1, pg. 19 in BC MELP & BC MOF 1998).
Site_S1 to Site_S3	Site Series Number, Components 1 - 3	Categorises a site based on its ability to produce specific climax vegetation within a particular Biogeoclimatic variant (see Banner et al. 1993).
SiteMC_S1 to SiteMC_S3	Site Series Map Code, Components 1 - 3	Map code for the corresponding site series number and BEC variant.
Strct_S1 to Strct_S3	Structural Stage, Components 1 - 3	Structure of the vegetation cover at the time of mapping. The structure of a plant community changes over time, progressing from a pioneer stage to a climax stage (see Table 3.3 in RIC 1998 or section 1, page 16 in BC MELP & BC MOF 1998)
Site_M1a to Site_M3a	Site Modifier, Components 1 - 3	Describes atypical occurrences of the site series in the landscape, including variations in topography, moisture, and site characteristics (see Table 3.2 in RIC 1998).
Distcls_1 to	Site Disturbance	The history of a particular site or ecological unit based on

Field	Name	Description
Distcls_3	Class, Components 1 - 3	the processes leading to the current successional stage (see section 1, pg. 22 in BC MELP & BC MOF 1998).
Distscls_1 to Distscls_3	Site Disturbance Subclass	Modifiers for site disturbance class (see section 1, pg. 22 in BC MELP & BC MOF 1998).
Wet_Comple	Wetland Complex	The wetland class components of the wetland complex ordered by their abundance within the polygon and separated by a "/" character.
Salmon	Salmon?	Polygons adjacent to watercourses with salmon. 1 = Yes, 0 = No, Blank = No data
Poly_Com	Polygon Specific Comments	Pertinent information regarding the polygon.
Aerial_Ass	Aerial field assessment?	Whether a field aerial assessment was done or not. 1 = Yes, 0 = No
Aerial_No	Aerial field assessment number	The field number corresponding to an aerial assessment.
Grnd_Ass	Ground field assessment?	Whether a field ground assessment was done or not. 1 = Yes, 0 = No
Grnd_No	Ground field assessment number	The field number(s) corresponding to ground assessments.
Field_Note	Field Notes	Notes taken during aerial field assessments primarily.

2.1.5 Field Assessments

Field assessments were done on the ground or from the air during two days in late June, 2011.

2.1.5.1 Ground Assessments

I did ground assessments selectively to gather more detailed information on the characteristics of specific ecosystem units and their relative suitability for grizzly bears in the KMP area using a data form with the fields outlined in Table 5. I based grizzly bear habitat potential within each ecosystem unit on actual sign of use of the area by grizzly bears, including activity sign and foods eaten, as well as, the probable use of the area by grizzly bears, including foods present and the habitat's apparent suitability for grizzly bears for different seasons. Subsequent to field work, an Excel spreadsheet was used to document ground assessment data.

2.1.5.2 Aerial Assessments

Aerial assessments were done after I gained local experience with different ecosystem units or habitats during ground assessments. Entire polygons were evaluated from the air, not just individual ecosystem units. I used a hard copy subset of the polygon mapping database to record changes to the data or relevant notes.

Table 5. Form fields used to systematically document information at ground assessment sites.

Field	Full Name	Description
Poly_Nbr	Project Polygon Number	A unique identifying number within each of the two mapping projects (i.e., NCgbh & KMPgbh).
Wpt	Waypoint	Hand-held GPS waypoint name for the Universal Transverse Mercator (UTM) co-ordinates of ground assessment sites
SMR	Soil Moisture Regime	Largely based on environmental factors and indicator plants
SNR	Soil Nutrient Regime	Largely based on environmental factors and indicator plants
Class/ Wet	Site or Wetland Class	The Class is a more refined division of Realm & Group reflecting ecosystems that have broadly similar vegetation physiognomy, hydrology, and water quality.
Site_S	Site Series	Categorises a site based on its ability to produce specific climax vegetation within a particular BEC variant.
SiteMC	Site Series Map Code	Map code for the corresponding site series number and BEC variant.
Strct_S	Structural Stage	Structure of the vegetation cover.
Distcls	Site Disturbance Class	The history of a particular site or ecological unit based on the processes leading to the current succession stage.
Salmon	Salmon?	Polygons adjacent to watercourses with salmon. 1 = Yes, 0 = No, Blank = No data
Photos	Photos	Digital photo numbers
Dominant Plants/ Bear Foods	Dominant Plants/ Bear Foods	Plant species used to characterise the site series or map code and prominent bear food plants; various codes were used to record plants quickly
Sp	Bear Species	Bear species using the ecosystem unit if it could be determined
Bear Sign	Bear Sign	Evidence of bear use; various codes were used to record bear sign quickly
Bear Activity	Bear Activity	How an ecosystem was used by a bear, if it could be determined from bear sign; various codes were used to record bear activity quickly
Notes	Notes	Other relevant information about the site.

3 RESULTS & DISCUSSION

Two hundred and nineteen grizzly bear habitat polygons from the 2008 Northcoast mapping project (MacHutchon 2008) and the 2010 seamless coastal master ecological map were within or near the KMP RSA, therefore retained in the KMP project shape file (KMP_RSA_Grizzly_Polygons.shp). I added another 50 polygons to the shape file so the final project map has 269 polygons (Figure _). I added the 50 polygons for several reasons, including:

- They were class 1 or 2 habitat polygons that were missed during the 2008 mapping,
- I felt they were likely class 3 habitat polygons at best based on the digital imagery, but they were in the KMP Local Study Area (LSA) so I wanted to field assess and verify their seasonal suitability, or
- They appeared to be class 1 or 2 habitat polygons and were along the KMP access road in the Nass River valley, which is east of the area mapped in 2008

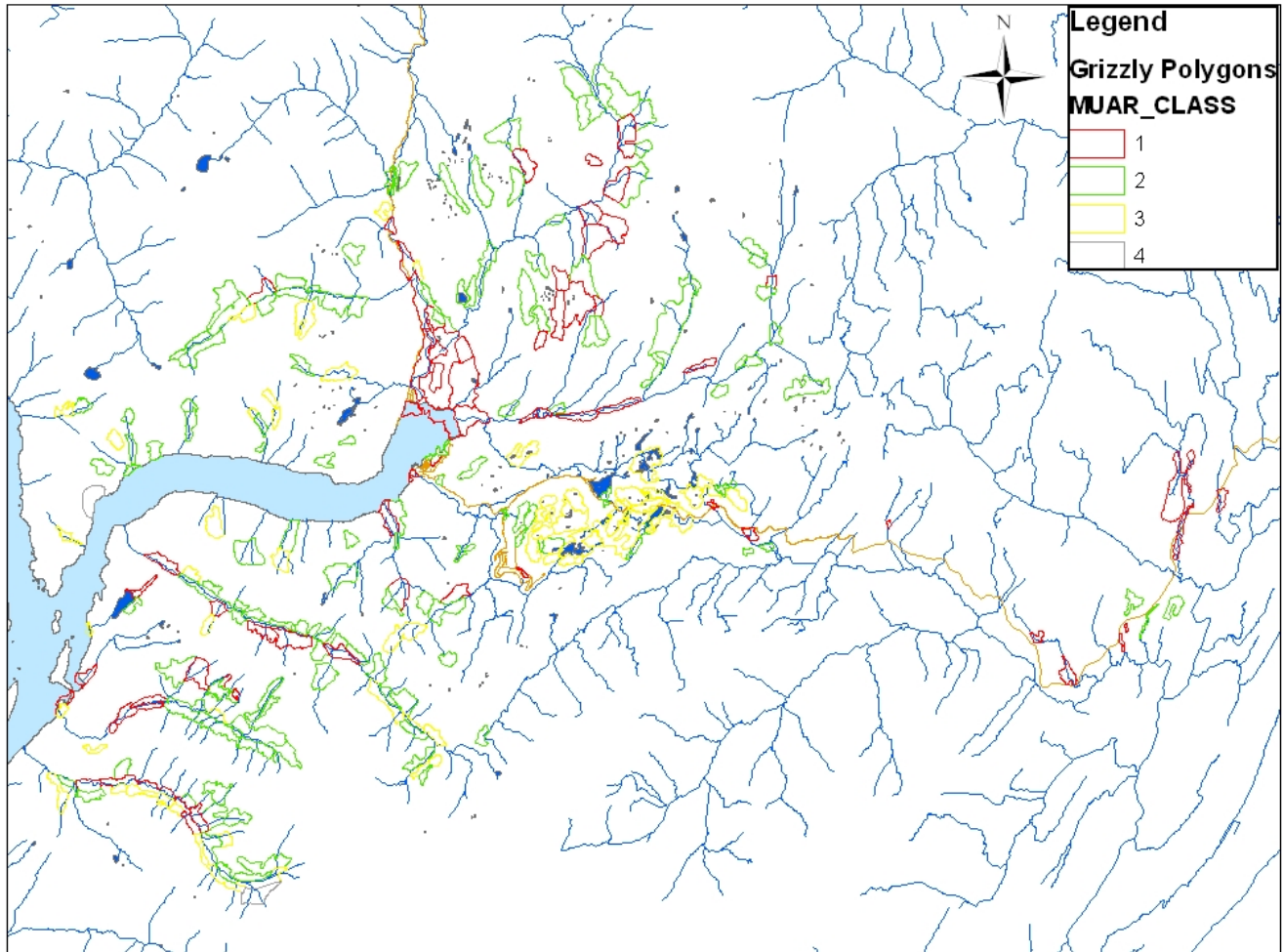


Figure 1. Class 1 to 4 grizzly bear habitat polygons within or near the Kitimat Mine Project wildlife Regional Study Area.

During two days of field work, 40 polygons were assessed from the air, including 9 polygons not field assessed in 2008 and 31 of the 50 polygons mapped in 2011. An additional four polygons mapped in 2011 were assessed from the ground only so a total of 35 or 70% of the 2011 polygons were field assessed. Twenty-nine ground assessment sites were done in 11 polygons; two from the 2008 mapping and nine from the 2011 mapping, including the four polygons only ground assessed.

In addition to polygons mapped in 2008, I drew a number of new polygons within the KMP LSA. However, I only considered a few of these polygons as class 1 or 2 grizzly bear habitat; most I considered class 3 suitability (Figure 2). Much of this class 3 habitat is the large bog/ fen wetland complexes on the plateau northeast of the old Kitsault mine. There are other expanses of this type of bog/ fen complex that I only partially mapped such as on the upper crest of Mohawk Mountain east of the old Kitsault mine or the area north of the KMP access road. Nevertheless, the bog/ fen complexes northeast of the old Kitsault mine represent an extensive area of these wetlands regionally, which would be significantly impacted by different aspects of the KMP proposal.

From a grizzly bear habitat perspective, the bog/ fen complexes northeast of the old Kitsault mine are only moderate suitability. It appears this area is primarily used by black bears and only in the most productive portions. My expectation is that this area is only occasionally used by grizzly bears, most likely in the late summer or fall when food availability declines at low elevations and some bears move to higher elevations to feed on late phenology graminoids and forbs or huckleberries and blueberries. There may also be seasonal movement through the area in spring as some grizzly bears, particularly adult males, move between the Kitsault River and the Nass River valley.

There are two significant human-created bear habitats within the KMP LSA and RSA that were not mapped. The old Kitsault mine pit was seeded with grass, clover and alfalfa when the mine was shut down. These seeded areas are now well-used by black bears for feeding on the graminoids and forbs, particularly in spring. There is a cleared power transmission line right-of-way (ROW) for the old Kitsault mine that goes over the divide between Alice Arm and the Nass River valley. This ROW, in places, is thick with berry-producing shrubs used by both black bears and grizzly bears. Consequently, I expect that portions of the ROW are well-used for berry feeding by both species in summer and fall.

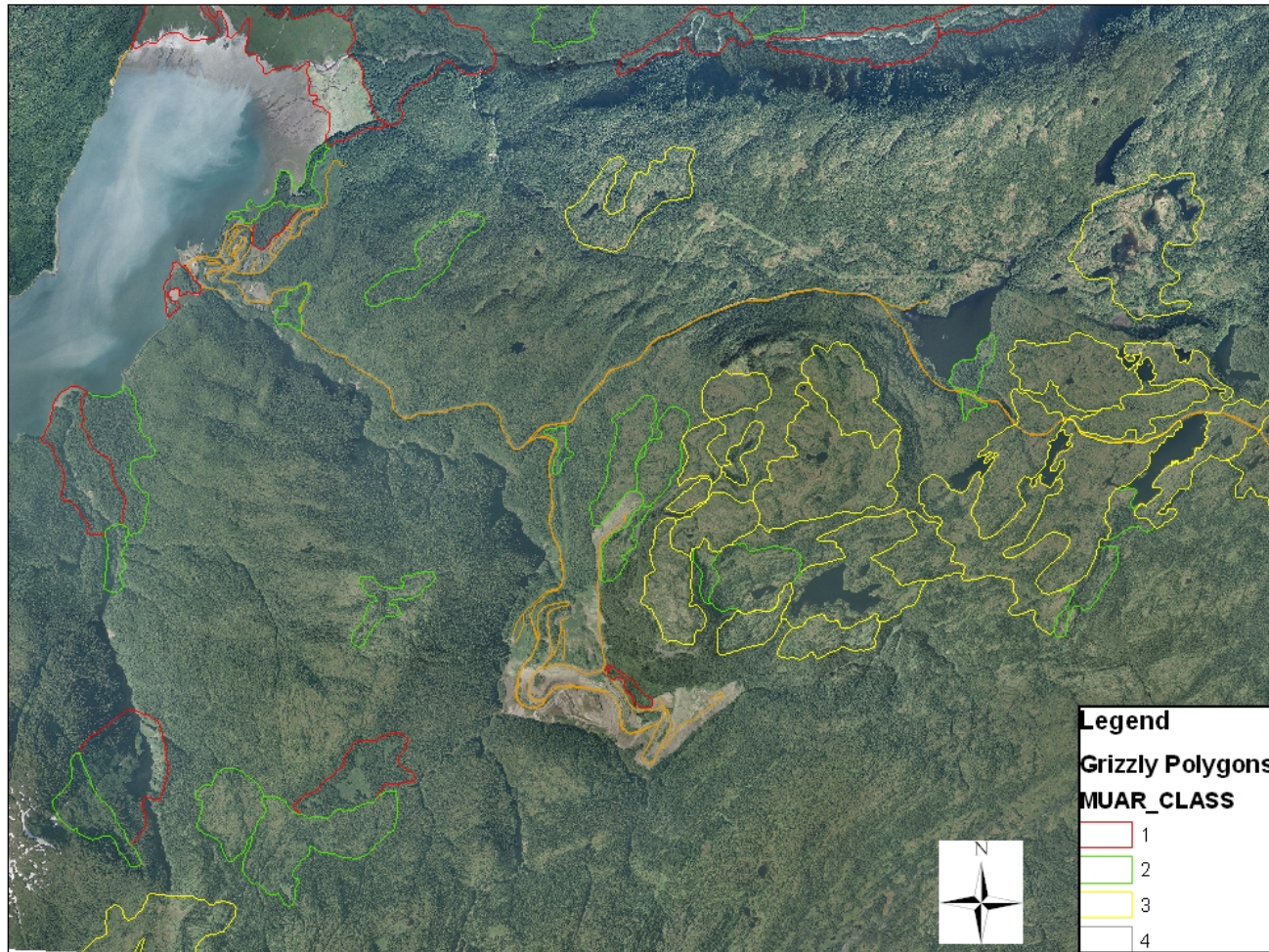


Figure 2. Class 1 to 4 grizzly bear habitat polygons within the Kitimat Mine Project Local Study Area.

4 LITERATURE CITED

- Banner, A., W. MacKenzie, S. Haeussler, S. Thomson, J. Pojar, and R. Trowbridge. 1993. A field guide to site identification and interpretation for the Prince Rupert Forest Region. B.C. Ministry of Forests, Land Management Handbook No. 26, Smithers, B.C.
- BC MELP and BC MOF. 1998. Field manual for describing terrestrial ecosystems. Land Management Handbook Number 25, B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forests, Victoria.
- Hamilton, A.N. 1984. Coastal Grizzly Research Project. Progress Report - Year 1 - 1982. B.C. Ministry of Environment, Wildlife Working Report No. WR-1 and B.C. Ministry of Forests, Wildlife Habitat Research Report No. WHR-9. 43pp.
- Hamilton, A.N. 1987. Classification of coastal grizzly bear habitat for forestry interpretations and the role of food in habitat use by coastal grizzly bears. M.Sc.(Forestry) thesis. University of B.C., Vancouver. 86pp.
- Hamilton, A.N., W.R. Archibald, and E. Lofroth. 1986. Coastal Grizzly Research Project. Progress report - Year 4 - 1985, Working plan - Year 5 - 1986. B.C. Ministry of Environment, Wildlife Working Report No. WR-22, B.C. Ministry of Forests, Wildlife Habitat Research Report No. WHR-26. 30pp.
- Hamilton, T., and H. Horn. 2003. Grizzly bears: benchmark scenario analysis. Environmental risk assessment report, North Coast Land and Resource Management Planning, British Columbia. 76 pp.
- Himmer, S., and M. Gallagher. 1995. Tweedsmuir/ Atnarko grizzly bear study final report, Part 1. B.C. Ministry of Environment, Lands and Parks, Victoria, Williams Lake, and Prince George, British Columbia. 107 pp.
- Himmer, S., and D. Powers. 2003. A guidebook for grizzly bear wildlife habitat features in coastal British Columbia. B.C. Ministry of Water, Land, and Air Protection and B.C. Ministry of Sustainable Resource Management, Hagensborg and Williams Lake, British Columbia. 37 pp.
- Lloyd, K.A. 1979. Aspects of the ecology of black and grizzly bears in coastal British Columbia. M.Sc. thesis, University of B.C., Vancouver. 150pp.
- MacHutchon, A.G. 2000. Grizzly bear habitat mapping, Central Coast, B.C. B.C. Ministry of Environment, Lands and Parks, Nanaimo, B.C. 94 pp.
- MacHutchon, A.G. 2001. Grizzly bear habitat mapping, Central Coast, B.C. – 2000. B.C. Ministry of Environment, Lands and Parks, Nanaimo, B.C. 100 pp.
- MacHutchon, A.G. 2007a. Coastal grizzly bear habitat mapping methods, draft 2. B.C. Ministry of Environment, Victoria and Black Creek, B.C. 35 pp.
- MacHutchon, A.G. 2007b. South Central Coast grizzly bear habitat mapping 2007. B.C. Ministry of Environment, Black Creek & B.C. Ministry of Agriculture and Lands, Nanaimo, B.C. 32 pp.

- MacHutchon, A.G. 2008. North Coast, B.C. grizzly bear habitat mapping. B.C. Ministry of Environment, Smithers and Ecosystem Based Management Working Group. 28 pp.
- MacHutchon, A.G. 2009. Phillips & Fulmore Landscape Units, grizzly bear habitat mapping. B.C. Ministry of Environment, Victoria. 11 pp.
- MacHutchon, A.G. 2010. Coastal grizzly bear habitat mapping and review methods. Grizzly Bear Habitat Mapping Technical Review Team, B.C. Ministry of Environment, Victoria and B.C. Ministry of Forests and Range, Nanaimo. 29 pp.
- MacHutchon, A.G., S. Himmer, and C.A. Bryden. 1993. Khutzeymateen Valley grizzly bear study: final report. B.C. Ministry of Forests, Wildlife Habitat Research Report WHR-31 and B.C. Ministry of Environment, Lands and Parks, Wildlife Report R-25. 107 pp.
- MacHutchon, A.G., S. Himmer, H. Davis, and M. Gallagher. 1998. Temporal and spatial activity patterns among coastal bear populations. *Ursus* 10:539-546.
- MacKenzie, W.H., and A. Banner. 2001. A classification framework for wetlands and related ecosystems in British Columbia: third approximation. Research Branch, B.C. Ministry of Forests, Victoria, B.C. Web document.
<http://www.for.gov.bc.ca/hre/becweb/resources/classificationreports/wetlands/>
- MacKenzie, W.H., and J.R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Research Branch, B.C. Ministry of Forests, Land Management Handbook 52, Victoria, British Columbia.
- Pollard, B.T., and S. Buchanan. 2006. Grizzly bear candidate Wildlife Habitat Area (WHA) submission: Kalum Landscape Unit. B.C. Ministry of Environment, Smithers, B.C. 29 pp.
- RIC, Resources Inventory Committee. 1998. Standard for Terrestrial Ecosystem Mapping in British Columbia. Terrestrial Ecosystems Task Force, Resources Inventory Committee, Victoria. 100 pp.
- RIC, Resources Inventory Committee. 1999. British Columbia wildlife habitat rating standards. Version 2.0. Terrestrial Ecosystems Task Force, Resources Inventory Committee, Victoria. 97 pp.
- RIC, Resources Inventory Committee. 2000. Standard for Terrestrial Ecosystem Mapping (TEM) – digital data capture in British Columbia. Ecosystem technical standards and database manual. Version 3.0. Ecological Data Committee, Terrestrial Ecosystems Task Force, Resources Inventory Committee, Victoria. 69 pp.
- RIC, Resources Inventory Committee. 2004. Standard for Terrestrial Ecosystem Mapping (TEM) digital data capture in British Columbia. Version 3.0 (2000), Errata No. 1.0. Ministry of Sustainable Resource Management, Resource Information Branch & Resources Information Standards Committee, Victoria. 9 pp.
- Russell, D. 1974. Grizzly bear - mountain goat investigations in Knight Inlet, B.C.; Project report. B.C. Ministry of Environment, Nanaimo. 93pp.