Moose Winter Range Mapping for the Prince Rupert Forest District

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EXECUTIVE SUMMARY

In November 2000, Acer Resource Consulting Ltd. was contracted to map moose winter range within the North Coast Forest District's Land and Resource Management Planning Area. These maps were to be provided as a landscape level interpretive product for table discussions. Moose winter range was defined as those habitats where forage availability and/or snow conditions lend to the concentration of moose populations during adverse winter conditions. Winter range was subdivided into primary or permanent ranges and secondary or transient ranges based on their current and potential suitability. Thirty-one people were polled to determine the level and detail of existing knowledge regarding moose distribution in the study area. Preliminary mapping based on these interviews and appropriate habitats was completed, and then confirmed or adjusted based on aerial overview flights. Final maps were then developed identifying the winter range units and associating the level of use and the confidence in level of use to each polygon. In total, thirty three winter range units were identified including nine primary winter range units and twenty-four secondary winter range units. Current moose distribution in the study area shows high variations in densities. This uneven distribution is likely due to different rates of immigration, variable habitat quality, and difficulties associated with identifying moose in coastal areas in the winter.

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INTRODUCTION

A Land and Resource Management Plan (LRMP) is under development for the North Coast Forest District (NCFD). During table discussions, different land management scenarios will be assessed based on their impacts on biodiversity, economic stability, and sustainability. As with any planning process, the collection of relevant inventory information is the first step in developing a defensible plan. The management of ungulate winter range is one such issue where inadequate inventory information currently limits the confidence of management recommendations. Incidental information is available but there is no coherent summary of existing knowledge.

In November 2000, a contract was developed to summarize existing information and to map moose winter range in the NCFD. The moose winter range maps were required as a stand-alone product for table interpretation, however the reliability of the information and the repeatability of the process required a thorough documentation of the methodology and the results. Moose winter range units are defined as areas with the capability to provide the best available winter forage and thermal cover in the landscape and tend to concentrate moose populations from adjacent areas. These areas were identified and mapped through the integration of background information, habitat quality, historic moose distribution, and winter overview flights. The winter range units were divided into large, self-perpetuating forage areas (primary range) and smaller areas where high forage and thermal qualities exist or could exist within the seral progression (secondary range). Sufficient detail is provided on moose habitat selection to assist with interpretations of management options.

Interpretation of potential impacts of different management scenarios and recommendations for appropriate management of moose winter ranges are beyond the scope of this project. While this project was completed in combination with mountain goat winter range mapping, this report only addresses the moose winter range mapping. This project was managed through the Ministry of Environment Lands and Parks (MELP) office in Smithers, BC.

STUDY AREA

The NCFD LRMP covers an area that includes most of the NCFD with the exception of Princess Royal Island, the Nisga'a Core Lands, and the Municipalities of Prince Rupert and Stewart. The NCFD is located in northwestern British Columbia and forms the western most District in the Prince Rupert Forest Region. It stretches along the western edge of the Coast Mountain Ecoprovince and is bounded to the east by the Coast Range and to the west by the Pacific Ocean. Its northernmost boundary lies at 55^0 55' north latitude and the southern boundary is at $52^0$26' north latitude.

The NCFD is in the Coastal Gap Ecoregion and is covered by the Kitimat Range (KIR), Alaska Panhandle Mountains (APM) and the Hecate Lowland (HEL) Ecosections. Steep mountains rising from flood plains or fiords characterize the mainland, while offshore islands have varying topographical features with limited alpine elements. Sheltered inlets and exposed coastline are also characteristic of the area. The Broad Ecosystems Units covering the study area include: Cedar-Shore Pine Bog, Coastal Hemlock-Western Red Cedar, Amabilis Fir-Western Hemlock, Mountain Hemlock-Amabilis Fir, Sitka Spruce-Cottonwood and Wetlands. The biogeoclimatic zones in the study area include Coastal Western Hemlock (CWH), Mountain Hemlock (MH), and Alpine Tundra (AT). A location map of the study area is provided as Figure 1.

Figure 1: Location map of the study area.

BACKGROUND

Local History

Moose are relative newcomers to the North Coast Forest District. Historic records indicate that the sub-species *andersonii* has moved west from the Alberta Plateau Ecoregion into northwestern British Columbia over the last 200 years. MacKenzie recorded moose in the Peace River valley in 1793, but not west of the Rocky Mountains (Petticrew and Munro, 1979). Evidence from explorers in the early nineteenth century indicates that moose were scarce in the Peace, Parsnip, McGregor, and Fraser Rivers (Ritcey, undated). First Nations in this area reported knowing the animal but seldom encountering it (Rich 1955, in Hatler 1988). Moose were first identified at the mouth of the Stikine River in the 1830's and later confirmed in the 1870's (LeResche et al., 1974). Several authors associate the expansion of the range of moose with the progressive land development of early settlers (Ritcey, undated; Kelsall and Tefler, 1974; and Petticrew and Munro, 1979), but Hatler (1988) proposes that a general warming trend in global climate has influenced available habitat.

Moose moved west along river bottoms into the Coast Range from the Prince George area (Kelsall and Telfer, 1974). High elevation passes and difficult terrain along the Boundary Ranges limited potential southward expansion from the Stikine and Alsek River groups. Banfield (1987) indicates that moose reached the Coast Range mountains in the 1920's. In 1922 and 1924, the first moose were identified in Houston and Telkwa, respectively (Hatler, 1988). Continuing along the Bulkley and Skeena drainages, or through the Telkwa Pass, moose were first seen around Terrace in the early 1940's (Petticrew and Munro, 1979). Further information on their dispersal into the study area is incomplete, but several residents reported moose along the Skeena floodplain in the late 1950's. Because dispersal rates for moose, when accompanied by increasing density, can exceed 10 km/year (LaResche, 1974), it is assumed that the most of the study area has been exposed to moose immigration in the last 40 years. Mainland areas adjacent to the Skeena River, the Nass River and Douglas Channel would likely have received the highest exposure. Moose have been identified on Porcher Island and DeHorsey Island near the mouth of the Skeena River in the last 10 years (S. Hedges, pers. comm.).

Winter Habitat Selection

Literature indicates that preferred winter habitats are primarily low elevation riparian communities, especially along dynamic riverine systems, where much of the riparian vegetation is in a sub-climax seral stage (LaResche et al. 1974). This habitat selection is well documented in coastal ecosystems in Alaska (Kelsall and Telfer 1974, Doerr 1983, Risenhoover 1986, and Modaferri 1992) where information most relevant to the study area has been collected. Even when suitable feeding sites are available adjacent to the riparian zone, the riparian area is still used more heavily (Doerr 1983, Schwab 1985, and Hundertmark et al. 1990). Doerr's (1983) data indicated that at the mouth of the Stikine River less than 1% of winter relocations were greater than 400 m from a riparian area, and most relocations were within the floodplain shrub community or in the adjacent Sitka spruce mature and old forests.

Preferred winter food species vary from ecosystem to ecosystem because of their adaptability to new food sources (Kelsall and Prescott 1971). Moose occupying western ranges show a preference for willows (*Salix spp*.) while those in more continental environments prefer paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), and balsam fir (*Abies balsamea*) (Peek 1974). More specifically, a food preference list for British Columbia identifies willows, falsebox (*Pachistima myrsinites*), fir (*Abies spp*.), serviceberry (*Amelanchier alnifolia*), paper birch, and mountain ash (*Sorbus spp.*) as the preferred winter browse species (Singleton 1976). Besides willow, most of these species are not available in quantity in maritime landscapes. Information developed from studies in coastal sites in Alaska that more closely resemble the study area indicate that willow still occupies the most preferred food category, and, with cottonwood (*Populus balsamifera ssp. trichocarpa*), paper birch, and aspen, makes up 95% of the winter diet (Peek 1974). Red-osier dogwood (*Cornus stolonifera*), red cedar regeneration, highbush-cranberry (*Viburnum edule*), and *Vaccinium spp*. are also noted as important winter food sources (Ritcey undated, Peek 1974, Petticrew and Munro 1979, and pers. observ.). Sweet gale (*Myrica gale*) has been identified as a forage species used in coastal bogs (MacCracken et al. 1997). Use of any particular browse species, however, is contingent on the density of moose populations, the abundance and distribution of preferred browse species, and the season of use. In the study area, it is assumed that during the winter, willow, cottonwood, red-osier dogwood, highbush-cranberry, *Vaccinium spp*., and regenerating cedar are the selected foods in order of preference.

Geist suggests that moose range can be split into either permanent or transient habitats (1966 cited in Hatler 1988). Permanent habitats are shrub communities that are perpetuated within a landscape due to continuous and predictable disturbances. Examples of permanent habitats include riparian areas and avalanche tracts. Transient communities are those shrub communities that exist temporarily within a landscape due to non-continuous and random disturbances such as fire or forest harvesting.

Within the study area there is a significant difference between the capability of subzones of the CWH to produce transient communities. This difference is due to the forage species produced and their duration and density during seral progression. In the very wet hypermaritime subzone (CWHvh), there are few naturally occurring transient habitats due to the lack of fire and significant pest infestations (S. Liepins, pers. comm.). Consequently, before the initiation of large scale commercial harvesting, there were few transient habitats in the NCFD. The rapid growth rates and dense conifer regeneration in CWHvh stands (Banner et al. 1993) also limit the duration of most deciduous components to less than 20 years (pers. observ.). In other, more interior ecosystems, natural disturbances are slightly more common and deciduous components persist longer within the regenerating forest.

In addition, when CWHvh sites are disturbed, the composition of the regenerating stand contains fewer suitable deciduous species than other subzones further from the coast. In coastal areas, deciduous components of regenerating stands are often limited to red alder (*Alnus rubra*). While red alder browsing has been noted, this species appears to be used only under limiting snow conditions (pers. observ.). Alternatively, in the CWHws regenerating stands often contain cottonwood, aspen, willow, and birch, all preferred browse species.

It should also be noted that tidal habitats, while providing the low elevation, low gradient areas known to support wintering moose, rarely have significant browse availability in a mature or climax seral stage. This occurs because the deciduous vegetation is largely composed of alder and consequently produces limited winter browse. Cottonwood and willow rarely occur in these areas due either to the saline influences or the absence of a yearly fluctuating fresh water table. In general, these habitats provide limited winter range except where they intersect with fluvial fans from tributaries or where topography limits alternative winter range habitats. These tidal benches however, likely play an important role in moose winter movement.

The importance of snow interception in moose winter range is a complex issue still much in debate. Several authors have suggested that as long as food is abundant, the need for cover is unnecessary (Kelsall and Prescott 1971, McNicol and Gilbert 1980, and Risenhoover 1986). Other authors suggest that snow cover is a vital part of winter habitat (Thompson and Vukelich 1981, Doerr 1983, Eastman and Ritcey 1987, and Hundertmark et al. 1990). Most authors agree however, that the importance of snow interception increases as the depth of snow increases. Kelsall and Prescott (1971) suggest that winter cover only provides important habitat after snow depths start to restrict moose movement. This limiting depth is generally considered to be between 70 and 100 cm but largely depends on snow hardness (Coady 1974, Kelsall and Prescott 1971, and Doerr 1983).

Studies in similar climatic systems suggest that the most effective snow interception areas have low elevations, southern exposures, and a minimum of 65% crown closure (Nyberg 1990). However, crown closure also influences the relative productivity of the stand for moose browse. Therefore, stands with good snow interception are poor browse producers. This results in a trade-off between the reduced snow depth and the food supply. Thompson and Vukelich (1981) indicate that moose movement away from cover decreases as snow depths increase, from 27 m to an average of 12 m when snow depths increased from 30 cm to 60 cm. Hamilton et al. (1980), however, suggest that as snow depths increase, moose density in covered areas goes up, which causes browsing pressure to increase in a larger radius from the cover. Hamilton et al. (1980) also suggest that most browsing takes place within 80 m of snow shelter under heavy snow conditions.

In addition to snow interception, coniferous forests also provides important protection against wind in cold seasons (Kelsall and Telfer 1974). In a study of winter moose bedding behavior, McNicol and Gilbert's (1978) suggest that moose chose bedding sites that are downwind from dense forest stands. Rasaputra (1994) concurred, and indicated that wind cover is also important in feeding habitat selection because drifting increased food accessibility. Habitat suitable for shelter from the wind includes sheltered slopes, gullies, young coniferous stands and snow bowls adjacent to large trees (McNicol and Gilbert 1978, pers. observ.). The young coniferous stands, especially low density stands, allow for wind protection but also provide exposure to solar radiation (Forbes and Theberge 1993).

METHODOLOGY

Moose winter range mapping was developed through the integration of local information, habitat distribution, and overview flights. Initially, available background information was collected from multiple sources including relevant literature, input from local residents, and discussions with forest consultants and government personnel with experience in the area. Secondly, based on established definitions for habitat quality (to follow) and background information, preliminary winter range units were identified on the 1:50,000 base maps. Thirdly, overview flights were used to confirm or correct habitat quality and distribution. Track density and distribution provided a qualitative measure of moose density. Finally, the preliminary winter range units were reviewed and adjusted as necessary. Once finalized, labeling was added to ensure that the current level of use and confidence was attached to each unit. The final working maps were then provided to the MELP GIS department for final digitization. The following provides a detailed explanation of this methodology and outlines the definitions and assumptions inherent in the mapping.

Background Data

Few pieces of standard literature were found that contained relevant information on winter moose distribution in the study area. The Khutzeymateen grizzly bear reports made incidental comments on moose use of their study area in summer, but no comments regarding winter use were noted (MacHutchen, 1993). Several gray literature sources, such as government and consultants reports, were directly associated with the study area. G. Hazelwood completed the first recorded winter track survey in 1969 during the development of Canada Land Inventory mapping. While a final copy of the inventory map was not available, a copy of the base map was accessed that included the flight lines and the location and distribution of tracks. This survey covered much of the study area. A coastal Skeena moose survey included portions of the Skeena River floodplain within the NCFD (van Drimmelen, 1987). No sampling stratification or sighting location maps were included. Consultant's reports also referenced field based data on moose distribution within selected areas. These data are usually stand-oriented and are consequently discussed in association with applicable areas. Several maps also provided important information on biogeoclimatic and ecosection distribution, forest cover attributes, and topographic information.

Personal interviews were conducted with a total of 31 people, including forest industry personnel, government employees, helicopter and float plane pilots, First Nations, and consultants. Interviews ranged from a short phone call to a detailed discussion of sightings with references to a 1:600,000 map. The relevancy of data varied from specific to very general. All information used as a basis for mapping is referenced in association with the winter range units identified on the accompanying maps. See the personal communication reference list for a complete record of contacts.

Preliminary Mapping

Moose Winter Range Definitions

Before the preliminary winter range units could be mapped, several definitions and assumptions were developed to ensure the results were transparent and repeatable. Generally, moose winter range is defined as those areas where large numbers of wintering moose could or do concentrate due to limited mobility or reduced availability of forage within the remainder of their home ranges. This definition has several implications. Firstly, it implies that those areas with limited current habitat or use could potentially be identified as winter range units because, with appropriate management, or further immigration pressure, these areas could support winter concentrations of moose. Secondly, it implies that even though individuals and small groups are known to winter in a variety of areas, including sub-alpine stream corridors and on the exposed coast, winter range units should define habitats where the majority of moose would concentrate. Consequently, in landscapes where mobility or forage accessibility are not limiting, there is the possibility that moose will not concentrate in a specific winter range. Moose winter habitat selection in these areas may be substantially different and an alternative definition should be used. The impact and importance of this assertion will be discussed in association with the subdivision of the study area.

Moose winter range has been subdivided into primary and secondary winter ranges based primarily on the capability of the landscape to support wintering moose. As Geist suggests, moose range can be split into either permanent or transient habitats, and a similar approach was used to differentiate primary and secondary ranges. Primary range is defined as permanent or self-perpetuating forage communities associated with forested stands in wide, low elevation valley floors with extensive low gradient (<40%) slopes, especially those associated with dynamic river floodplains and fens. Secondary winter range has a similar definition with the exception that it does not contain self-perpetuating forage communities (Type A), or self-perpetuating shrub communities exist but other limitations such as snow depths, poor connectivity or small habitat area limit its functionality as winter range (Type B). These two types of secondary range were differentiated based on input from the project manager because while habitat management will not influence the capability of Type A, forest harvesting has the potential to alter the quality of available habitat in Type B secondary ranges.

These definitions were selected primarily because they meet Geist's definition of permanent and transient habitats but also to capture entire areas where moose winter range should be managed. By including both self perpetuating shrub communities and adjacent low gradient slopes in these definitions, the winter range units include those areas most important for moose management. If stands adjacent to the self-perpetuating shrub community are forested, they provide an important role in security, snow interception, and thermal cover. If forests in winter range units are harvested, the low elevation, receiving sites generally have the highest moose browse production outside of the floodplain. The total value of the area to moose winter range will depend on the spatial arrangement and distribution of the two vegetation types. Consequently, the two habitat types should be considered together in any winter range management strategy.

The use of the 40% gradient as a boundary between winter range and non winter range should be considered as an approximation. Unfortunately, at a 1:50,000 scale some subjectivity is necessary to locate the boundaries of these winter ranges and the toe of the slope. Within the study area, most areas suitable for winter range have a relatively distinct boundary between valley bottoms and upslope areas. The 40% gradient break was included within the definition because it provides some guidance for the origins of the demarcation. On site review is likely necessary to provide a more ecologically supportable boundary.

Finally, the intent of using the "wide and extensive" qualifiers was to avoid including narrow valleys with limited population draw in primary winter range units. Wide valleys generally have higher solar exposure and extensive valleys tend to have a larger population draw. In their migration into winter range, moose use hereditary elevational routes (LaResche 1974 and Modaferri 1994) as snow depths in their fall range increase. These routes are often associated with well-defined riparian zones (Doerr 1983, Modaferri 1994 and MacCraken et al. 1997) and avoid moving across mountain ranges (MacCraken et al. 1997). Consequently, the majority of moose in a watershed are drawn downslope to the lowest and largest suitable winter range within that watershed. The assumption is that small watersheds have a smaller area, and therefore will never support large numbers of wintering moose. These qualifiers add another subjective aspect to the definitions, but this subjectivity provides the flexibility necessary to consider site specific conditions, such as landscape connectivity, in the distribution of the primary and secondary range types.

Study Area Subdivision

It became apparent during the initial background data collection and habitat review that not all areas of the NCFD should be mapped for moose winter range using the above definitions. Firstly, as suggested earlier, only areas where conditions limit available winter habitat should be mapped. Areas on the exposed coast, where snow depths do not limit moose winter habitat selection, should be excluded from this winter range mapping. Without limiting snow conditions, the winter distribution could include a variety of habitats. This is not to suggest that snow depth is the only influence on winter habitat selection, only that it is one of the most obvious influences in winter range selection in high snow montane environments. This is an important consideration because it means that winter range management in non-snow limiting areas should vary significantly from management of those areas where snow forces moose into identifiable concentration centres.

Secondly, the exposed coast does not contain any of the habitats known to support large numbers of wintering moose. Winter moose concentration could occur on the exposed coast, but identifying winter concentration areas using the same habitat requirements would be problematic. Wetland habitats are common on the coast, but they are primarily organic bogs that produce limited winter forage. Large floodplain habitats are rare or absent in coastal areas due to either lake headed or small, low elevation watersheds, or streams with a high gradient. A review of forest cover mapping in the NCFD shows no cottonwood complexes (Data Service Centre, undated), and regenerating stands rarely provide a significant deciduous component.

Finally, the exposed coast is the western extreme of the moose range. It is currently unknown whether low densities in this area reflect sightability factors (not enough snow to track), recent colonization, or lack of suitable habitat. Given these unknowns, and the low likelihood of seasonal concentrations, mapping moose winter range in areas of the exposed coast would provide poor and possibly misleading information. The project manager and several biologists supported this approach (L. Vanderstar, L. Turney, W. Wall, and G. Hazelwood, pers. comm.).

To exclude areas inappropriate for moose winter range mapping, a dividing line was drawn through the study area. This line excludes much of the CWHvh subzone and closely follows the current division between the Kitimat Range ecosection and the Hecate Lowlands ecosection with some adjustment to ensure that complete watersheds were captured. The CWHvh subzone was excluded because it is characterized by very little snow (Banner et al. 1993), with the mean annual maximum snow depths rarely greater than 50 cm (Canada Department of Mines and Technical Surveys, 1957). Several authors have indicated that snow depths must be greater than 70 cm before they restrict moose movement (Coady 1974, Kelsall and Prescot 1971, and Doer 1983), and in mountainous regions, downslope winter migration is initiated when snow depths exceed 40 cm (Modaferri 1992). Coady (1974) adds that there is no significant alteration in moose behavior until the snow exceeds 40 cm in depth. Given the average snow conditions in the CWHvh and other ecosystems further west, it is unlikely that moose would congregate as they do in areas with more limiting snow conditions.

Sub-Regionalization

Based on the background information and habitat information, it was anticipated that several conclusions about the distribution of suitable habitat and moose wintering densities could be drawn about specific areas within the study area. Consequently, the study area was further subdivided to capture adjacent landscapes with similar patterns of moose and moose winter range distributions. Influencing factors included dominant vegetation, topography, snow depths, quality and quantity of growing season habitats, the relative isolation from immigration, and background information on distribution of moose. These subregions also facilitate the presentation of results and the interpretation of the moose distribution within the NCFD. Nine sub-regions were identified. See Table 1 for a summary of the ecological conditions and their distribution by mapsheet. Figure 2 identifies their respective position within the study area.

Table 1: Summary of the subregions identified, their ecological characteristics, and their location on 1:50,000 moose winter range maps.

Sub-region	Ecosection	Biogeoclimatic Sub-Zones	1:50,000 Maps
Alice Arm	APM	CWHws, MHmm, AT	103 P/6, P/11 & P/12
Douglas Channel	HEL	CWHvh, MHmm, AT	103 H/6, H/7, H/10 & H/11
Ecstall-Quaal	KIR (HEL)[1*]	CWHvm, MHmm, AT, (CWHvh)	103 H/11, H/12, H/13,H/14, & I/4
Observatory Inlet	APM	CWHwm, MHmm, AT	103 P/4, P/5, P/12, & P/13
Portland Canal	APM	CWHvm, MHmm, AT	103 O/1, O/9, O/16, P/4, P/5, & P/13
Portland Inlet	KIR	CWHvm, CWHvh, MHmm, AT	103 I/12 I/13, J/9, & J/16
Skeena	KIR	CWHvm, MHmm, AT	103 I/3, I/4, I/5, & I/6
Ursula – Gardener	KIR (HEL)	CWHvm, MHmm, AT, (CWHvh)	103 H/7, H/8, &H/10
Work Channel	KIR (HEL)	CWHvm, MHmm, AT, (CWHvh)	103 I/5, I/12, J/8, & J/9

[1*] brackets indicate a minor component.

Mapping

Once the moose winter range definitions and the limitations on the study area were completed, each 1:50,000 working map was reviewed. These working maps were provided by MELP GIS department and were themed to highlight 20 m contours, forest cover greater than 60%, and included colour coded wetlands and bogs. These features were used to identify habitat characteristics such as slopes, snow interception, and suitable foraging habitat. Slopes were quantified based on a template developed that included the density of lines at 1:50,000 scale necessary to exceed 40% slope. Snow levels in specific areas were estimated based on topography. Physiographic features, such as valley narrowing bluffs and elevation, were also considered to influence snow depths. Areas identified as moose wintering areas were delineated and classified as either primary or secondary range with a reference number established for each information source. It was recognized that these preliminary winter range units would be subject to some changes based on the overview flights.

Overview Flights

Overview flights were completed throughout the NCFD between February 9 and March 8, 2001 with a total of 20 hours flight time. Both moose and mountain goat flights were combined to reduce shuttle times. The intent of these flights was not to establish the demographics of local populations, but to establish the general distribution of animals and confirm habitat quality. Consequently, no specific survey patterns were flown, and no sightability or search effort information was developed. Flight locations were selected based on available information, current development pressure, and the need to coordinate moose and goat areas of interest into the same flights. Areas with limited background or conflicting information were given the highest priority for aerial review. Winter flights were selected under the assumption that the majority of sightings would represent animals in their winter range. Budgets did not allow a thorough review of all locations within the study area.

Two observers were present on each flight. Each area was flown at an approximate elevation of 200-300 m above the ground level and moose tracks and their distribution were noted. One observer acted as navigator and marked moose track densities on the appropriate 1:50,000 National Topographic Series (NTS) maps and used a reference number to identify corresponding notes. The second observer noted the reference number and any relevant information on habitat quality or track density. All flights occurred on relatively clear days with an unlimited ceiling. Snow conditions over the last few days before the flight were visually noted so tracks could be aged. This directly affected the estimation of numbers and also helped identify the habitat selected during varying snow conditions. Sightability within forested habitats was highly limited, but given the delay between recent snows and the weather during the flights, it is believed that this did not significantly influence the estimation of overall use levels. All flights occurred in a Bell Jet Ranger 206. Field maps and associated field notes are available from the author.

Figure 2: Subregions identified within the study area showing similar habitat and moose distribution.

Final Maps and Labeling
The overview flight information was compared to the preliminary mapping and the winter range units were confirmed or corrected. In several cases, winter range units were dropped due to lack of evidence of use and poor quality habitat. Each flight was then given a data source reference number and added to the appropriate map reference list.

The finalized winter range units were marked on the working maps as either red or blue polygons for primary winter range or secondary winter range, respectively. In addition, the hypothesized level of use was identified as text within each moose winter range polygon. These ratings are limited to high, medium and low and are based on historic information and the results of the overview flights. Beneath each rating the level of confidence is provided along with a set of reference numbers indicating the data source. The numbers refer to data sources located in the map legend. Both the level of use and the level of confidence ratings are based on the quality, quantity, and consistency of information. Finalized draft maps were sent to MELP GIS for digitizing.

RESULTS AND DISCUSSION

In total, 33 primary and secondary moose winter range units were identified within the study area. The following outlines these results by sub-region. Included are descriptions of the sub-region, justification for its delineation, and a discussion of the winter range units identified within it. Background information specific to each sub-region is provided to support winter range designations. Table 2, provided at the end of sub-region discussions, summarizes the location, use and confidence of all moose winter range units.

Alice Arm Sub-Region
Location: Tributaries to Alice Arm including the Illiance and Kitsault River drainages.
Landscape Units: Kitsault
Topography: Dominated by steep slopes with isolated basalt columns distributed throughout the area. Peaks vary between 1200 and 1800 m and only the Kitsault River has significant low gradient floodplain/estuarine type habitats. Several mid to upper elevation lake and wetland complexes occur within this sub-region.
Identified Moose Winter Range: Kitsault Estuary primary and Kitsault River secondary ranges (Type B).

This area was designated as a sub-region due to topography, snow depth, immigration influences and its vegetative variation from other sub-regions. The topography is slightly gentler and less weathered than other sub-regions further west. Snow depths would likely reflect the continental influence with deeper and longer lasting snows than adjacent sub-regions. Moose accessibility into this coastal fiord is excellent with two low elevation passes into eastern high quality summer habitat in the Nass Basin ecosection. Vegetation is also substantially different from other sub-regions as is reflected in the occurrence of the CWHws subzone. This subzone produces higher concentrations of preferred winter forage species in its seral progression than other subzones found closer to the coast. This sub-region directly corresponds to the Kitsault landscape unit.

Two moose winter range units were identified during preliminary mapping. Cottonwood-themed mapping indicated high densities of cottonwood within the floodplain of the Kitsault River (Data Service Centre, undated). The Kitsault Estuary primary winter range unit encompasses the estuary, fluvial fans and adjacent forested land of the Illiance, Willauks, and Kitsault Rivers. It extends north up the Kitsault for approximately 4 km until the valley narrows and turns to the east. Beyond this point appropriate habitat occurs but snow could potentially limit winter use. Consequently, the upper floodplains of the Kitsault River were designated as a secondary winter range (Type B).

Very little information was available during original personal interviews concerning the Alice Arm sub-region, likely due to its relative isolation and lack of commercial activities. During the overview flight on February 14, 2001, several recent and older sets of moose tracks were seen within the primary range. Ian Swan (pers. comm.) also indicated that moose were common in this area. Track densities suggested low to moderate use in the primary range. S. Liepins (pers. comm.) indicated that recent ground level reconnaissance identified significant moose winter range values and discussions with local residents suggest regular winter use. In the secondary range, habitat appeared appropriate and disturbances from historic mining and forestry operations provide high densities of suitable forage in the valley bottom. One set of older moose tracks was seen during the overview flight, suggesting rare or occasional use in the last month.

Douglas Channel Sub-Region

Location: Includes Gribbell and the southern half of Hawkesbury Island in Douglas Channel.
Landscape Units: Hawkes South and Gribbell
Topography: Weathered granitic slopes rising to rounded peaks ranging between 800 and 1100 m. Major drainages are U-shaped with organic bogs common within the valley floor. Both islands are a minimum of 1.5 km from the mainland but average approximately 4 km.
Identified Moose Winter Range: None

These islands were originally placed within the same sub-region because of their isolation from the mainland, the dominance of CWHvh, and their occurrence within the Hecate Lowland ecosection. These islands have heavy winter snow packs in all but the mouths of larger valleys. Winter moose habitat is limited to the narrow corridor along the larger streams and in adjacent young seral stage receiving sites.

Initially, two small secondary range units were included in the Cheenis watershed on Hawkesbury Island, and on a larger tributary on the southeastern shore of Gribbell Island. During the February 14th flight no tracks were identified in the Cheenis watershed. A brief aerial review of the secondary range on Gribbell suggested similar habitat conditions. No significant foraging areas were identified in this drainage during coincidental winter fieldwork in 2001. The only preferred browse species noted was high-bush cranberry and no current or historic moose browsing was seen. During pre-mapping interviews, R. Woodman, M. Haworth, G. Hazelwood and the Vancouver Island Helicopter staff indicated they had never seen moose on these islands. Several forestry workers also indicated that they had not seen any evidence of moose on these islands (R. Benzer, D. Coburn, S. Hedges, and I. Smith, pers. comm.). Based on the quality of habitat and the lack of evidence for moose presence, the two secondary ranges originally identified were deleted. The lack of moose on these islands is likely a combination of difficult immigration conditions and lack of winter habitat quality.

Ecstall-Quaal Sub-Region

Location: Drainages flowing into either the Ecstall or Quaal watersheds between Douglas Channel and the Skeena River.
Landscape Units: Brown, Sparkling, Kitkiata, Johnson and portions of Scotia and Big Falls.
Topography: Rugged granitic slopes rising to peaks ranging between 1000 and 1500 m. Major drainages are U-shaped with organic bogs common within the valley floor. Smaller tributary valleys are steep and incised.
Identified Moose Winter Range: Ecstall River, Big Falls, and Quaal primary ranges and the Tidal Ecstall (Type A), Madeline (Type A), Kitkiata (Type B), Sparkling (Type B), Ecstall Lake (Type B), and Upper Ecstall (Type B) secondary ranges.

This sub-region was delineated based on its topography, accessibility to immigration, and the abundance of information that suggest the entire area has significant moose values. The mountains in this sub-region are rugged but show some of the smooth weathered features more common on the exposed coast. There are few gentle slopes, with the exception of valley bottoms, limiting the availability of mid and upper elevation growing season habitats. All areas within this sub-region are well connected to the Skeena River valley. This is an important consideration given that the Skeena is the major immigration route for moose moving to the coast in the NCFD. Finally, most discussions regarding moose habitat in the NCFD indicated high densities of use in the Ecstall-Quaal corridor (S. Liepins, R. Woodman, Vancouver Island Helicopter staff, M. Haworth, pers. comm.). Unfortunately, most of these comments were too general to be directly applied to a specific drainages within the sub-region.

Originally, four primary winter ranges and ten secondary winter ranges were identified in the Ecstall-Quaal sub-region during preliminary mapping. However, after flying the area on February 14 and March 8, one of the primary ranges (Tidal Ecstall) was converted to a secondary range due to forage production limitations in current seral stage distribution. In addition, five of the original secondary ranges were discarded to more closely reflect the potential forage production and the average snow conditions. The boundaries of all ranges were also adjusted to ensure complete inclusion of appropriate habitats and to reflect the track distribution.

The Ecstall River and Quaal primary ranges show a high density of cottonwood floodplain-type habitat (Data Service Centre, undated). This cottonwood habitat is extensive in both ranges and evidence of browsing on shrubs was recognizable from 200 m elevation. During the March 8 flight, track densities suggested that the Ecstall River primary range supported densities similar to the Skeena Islands. Similar densities were also seen in the upper portion of the Quaal area with decreasing densities closer to the tidal areas where cottonwood and other floodplain species were less evident.

In the Big Falls primary range, the habitat is dominated by low elevation wetland habitats associated with continuous variation in impounded water levels. This primary winter range was first located around a dammed lake based on its flat topography, low elevation and wetland habitats. Much of the flooded stands have been harvested, and fen-type riparian vegetation is growing along the shallow shores. During the overview on February 14, two sets of tracks were identified adjacent to the northeastern edge of the lake. No background information indicated evidence of use. However, S. Liepins suggested that appropriate winter habitat was likely to occur. The low elevation and the open valley also suggest low snow depths most winters. In addition, this range would draw animals from the upper Scotia Creek drainage and areas further upstream on Big Falls Creek. With the Skeena corridor being the main source of moose immigration to this area, moderate to high levels of use would be expected.

Most secondary ranges are located between and adjacent to the primary ranges in this sub-region. These include Ecstall Lake, Upper Ecstall, Sparkling, and Kitkiata ranges. In many cases these habitats provide forage production similar to primary ranges, however higher elevations and subsequent snow loads could limit productivity and use. The Madeline and Tidal Ecstall secondary ranges are slightly different due to the lack of cottonwood floodplain habitat. These areas are primarily flat benches directly adjacent to tidal waters with no seasonal flooding. Consequently, riparian forests are dominated by conifers with dense clusters of red alder except near small fluvial habitats associated with tributary streams. Overview flights in these tidal areas were not conclusive due to low snow depths.

Observatory Inlet Sub-Region

Location: Drainages flowing into Observatory Inlet including Stagoo, Anyox, Ohl and Kshwan drainages.
Landscape Units: Kshwan, Anyox, Ohl, Observatory East, Observatory West, and Stagoo.
Topography: Steep and weathered mountains, both metamorphic and igneous in origin, rising from Observatory Inlet or Hastings Arm to peaks ranging between 800 and 1300 m. Major drainages are generally narrow with limited floodplains or estuaries, and organic bogs and wetland complexes are uncommon. Glaciers from the Cambria Ice Sheet play a large part in isolating much of this sub-region from interior areas and creating cold air drainage that influences snow depths.
Identified Moose Winter Range: Anyox (Type A), Stagoo (Type B), and Kshwan (Type B) secondary Range.

This sub-region was delineated due to its limited immigration potential, high snow depths and habitat quality distribution. Any moose moving into this sub-region would be highly limited by steep slopes, exposed rock, and poor habitat. There are no low elevation passes into this sub-region from adjacent, interior sites. Most watersheds initiate in high elevation ice fields, glaciers, or extremely rugged peaks. These glaciers also create pockets of cold air suggesting that snow levels would likely be higher than adjacent sub-regions. Finally, while some isolated pockets of excellent quality habitat do occur, they are often very distant from each other, limiting the rate of moose expansion. No background information was available on the distribution of moose in this sub-region, although cottonwood-themed mapping indicated high densities of cottonwood in the Stagoo and Anyox drainages (Data Service Centre, undated). Personal communications with S. Liepins indicated abundant forage and evidence of winter moose use in the Stagoo but poor quality habitat in the Ohl. She also related that moose appeared to be absent from the Kshwan watershed.

Originally, four secondary ranges were identified within this sub-region but after the overview flights several significant changes were made. Many of the valleys showed appropriate secondary habitat but valley bottoms were quite limiting and vegetation suggested that dominant winter browse would not fall within the preferred species lists for moose. A secondary range in the Salmon Cove area was deleted due to these factors. The Anyox secondary range was significantly adjusted to reflect the findings of the February 13th overview flight. Initially, the secondary range was designed to include the riparian habitats adjacent to the Anyox River upstream from the reservoir. However, the flight indicated that there was limited riparian vegetation and that snow depths increased dramatically as the valley started to close near the north end of the reservoir. The new boundaries for the Anyox secondary range reflect the young forested stands with a high cottonwood component in the low gradient, low slope foreshore areas. These young deciduous forests are the result of fume hill adjacent to an abandoned mine and smelter. Shallow snow limited the tracking opportunities, but the level of use is suspected to be low. The Kshwan secondary range was not flown and no background information was available. The secondary range was placed in the lower portion of this valley due to the suspected high deciduous component and riparian habitats associated with the glacial outwash and estuary. S. Liepins indicated that no moose use was evident in this drainage during two days of fieldwork. The Stagoo secondary range was adjusted to limit the inclusion of upstream areas with high snow depths. This secondary range includes a series or relatively productive wetlands and a wide floodplain with active fluvial processes. Two sets of moose tracks were identified in this drainage during the February 27th overview flight and S. Liepins reports significant moose values, ground based evidence of winter moose use, and local information on historic moose hunting activities.

Portland Canal Sub-Region

Location: All tributaries flowing west into Portland Canal
Landscape Units: Marmot and Belle Bay
Topography: Steep and weathered metamorphic and igneous mountains rising to peaks ranging between 1000 and 1400 m. Major drainages are generally V-shaped and well protected from prevailing weather. Valley bottoms are narrow with very limited floodplain and wetland ecosystems.
Identified Moose Winter Range: None

This sub-region was initially identified due to its topography and distance from possible immigration sources. The valleys in this sub-region are too narrow to provide significant valley bottom foraging habitat and the predominant east-west alignments limit the impact of solar radiation. In addition, the steepness of the mountains, limited drainage size, and adjacency to the Cambria Icefield all suggest that snow levels should be higher in these drainages. This sub-region is as isolated from interior populations of moose as is possible on the mainland. It is predominantly a peninsula with the most northerly end cut off by a series of glaciers. Some immigration from the Stewart area is possible but urbanization at the head of the peninsula would likely limit easy dispersion into this area.

No information on moose use of this area was available. The overview flight on February 12 confirmed that no moose tracks were seen in any of the major tributaries. The flight also confirmed that snow depths were restrictive in all parts of the sub-region except directly adjacent to the major estuaries. Originally, two secondary ranges were identified in Belle Bay and George Creek. These two areas were dropped due to high snow levels, poor habitat quality and lack of evident moose populations.

Portland Inlet Sub-Region

Location: Drainages flowing into Portland Inlet.
Landscape Units: Somerville, Kwinamass, Chambers and Khutzeymateen
Topography: Steep and weathered granitic mountains rising to peaks ranging between 1000 and 1400 m. Major drainages are generally U-shaped with valley bottoms with extensive riparian vegetation and organic bogs. Smaller valleys are generally, narrow and steep.
Identified Moose Winter Range: Khutzeymateen and Kwinamass primary range and the Chambers (Type A) and Mouse (Type A) secondary range.

This sub-region was delineated due to habitat consistency, connectivity to known high density ranges, and similar weather conditions. Excellent habitats occur throughout this sub-region with large and dynamic floodplains in the Khutzeymateen, Kateen and Kwinamass valleys. Its is relatively well connected to interior migration routes with low elevation passes into the Ishkheenickh and Exchamsiks watersheds. In addition, this sub-region includes low elevation passes to suitable habitat further west in the Work Channel sub-region. The predominant alignment in the larger watersheds is northwest and west, providing protection from both the cold winter outflows and the on-shore precipitation events.

Very little information is available about moose wintering patterns or densities in this sub-region. S. Liepins indicated that habitat in the Kwinamass valley was excellent and high moose densities were assumed although no information was available on the patterns of seasonal movement. Incidental sightings within the Khutzeymateen and Kateen drainages indicated that moose were rare with only a few sets of tracks seen over three years of summer field work (MacHutchon et al., 1993). G. Hazelwood indicated that a single moose was seen in a small fluvial delta just southeast of the Chambers drainage in the spring of 1969 (pers. comm.). S. Liepins also indicated that low elevation forests near the mouth of Welda Creek showed evidence of dense browsing and winter use. Themed mapping showed high densities of cottonwood in the Kateen, Khutzeymateen and Kwinamass drainages (Data Service Centre, undated). Consequently, while low densities of moose are believed to utilize the Kwinamass and Khutzeymateen watersheds, the habitat for primary winter range exists and several low elevation passes occur into the Nass and Skeena watersheds.

In the Chambers and Mouse secondary ranges, limited alternative habitats suggest that moose may concentrate in these areas where even small fluvial habitats occur. No area within this sub-region was flown during the current investigation, but it is suspected that low populations occur throughout.

Skeena Sub-Region

Location: Includes the floodplain of the Skeena River and the mouths of small tributaries to the Skeena River.
Landscape Units: Khyex, Khtada, Skeena Islands, and portions of Scotia and Big Falls
Topography: Steep granitic mountains, slightly less weathered than more coastal ranges, rising to peaks ranging between 1000 and 1400 m. The Skeena River is tidal for the majority of the area and the floodplain is between 1.5 and

6 km wide. Extensive cottonwood and willow stands occur on islands, especially in areas not significantly impacted by tides. Smaller tributaries are relatively narrow and contain few wetland habitats. The larger tributaries are U-shaped and contain dynamic floodplains and wetland ecosystems. This sub-region has the best connectivity to known high density wintering areas further east in the Skeena River floodplain.
Identified Moose Winter Range: Skeena, Khyex and Scotia primary ranges and Khtada (Type A), Lachmach (Type B) and Scotia (Type B) secondary ranges.

This sub-region has the most extensive habitat and the highest known densities of wintering moose in the study area. It was delineated to reflect the high density of immigration from more interior portions of the Skeena River floodplain and the quality of suitable moose habitat throughout the area. In addition, information concerning moose use in this area is well-documented and common knowledge to most of those that were polled. Three primary winter range units and six secondary range units were first identified although three of the secondary habitats were dropped due to poor habitat quality and lack of evidence of use.

The primary ranges in this sub-region include the Skeena, the Scotia and the Khyex. The Skeena Range is an extension of primary winter range from the Kalum District. It contains very high value cottonwood and willow dominated islands with high browse production and minimal snow depths. The value of this area has been well documented including several moose density counts by MELP in adjacent habitats in the Kalum District (Van Drimmelin, 1987). S. Liepins, R. Woodman, Vancouver Island Helicopter staff, M Haworth, I. Swan, L. Turney, G. Hazelwood, W. Wall, G. Schultz, and personal observations also support high habitat quality and high densities of moose in this area. Small fluvial fans adjacent to this primary range were included where they contained suitable upland forage producing ecosystems such as in the Kwinitsa and Alder watersheds. The western limit of the Skeena primary range was located where floodplain vegetation ends due to the influence of tidal action.

The Scotia and Khyex primary range provides similar habitat values albeit at a smaller scale. Moose immigration into the Scotia over the last 20 years is well known amongst the forestry personnel who work in the drainage. Further movement from the Skeena River floodplain, through the Scotia watershed, into the Ecstall drainage has been suggested. Use of this area is supported by many of the same contacts identified for the Skeena Range. The Khyex does not show high forage densities in its tidal portion but large areas of cottonwood-dominated floodplain areas and wetland habitats support a relatively large wintering moose population further upstream.

Secondary ranges included areas in the Khtada, Lachmach and Scotia watersheds. Within the Khtada, S. Liepins indicated high densities of pellets and discarded antlers in the Davis Lake area. Given that antlers are generally discarded between December and February (Banfield 1974), this would suggest winter use. The overview flight on February 9 however, showed no moose tracks anywhere within the valley. Habitat is not optimal with a small cottonwood component in a single stand and no floodplain habitats. Wetland habitats were dominated by the organic bogs, which provide little browse or snow interception. G. Hazelwood indicated that this area is not known to support large numbers of wintering moose (pers. comm.). Given previously identified importance and the current observed use, this area was considered to have a moderate density of use with poor confidence.

The Lachmach secondary range was flown on March 8 and no tracks were seen although appropriate habitat did occur and snow levels were relatively low. This area was maintained as a secondary range to reflect its importance as a travel corridor between high value habitat in the Skeena drainage with areas along Work Channel. The Scotia Creek secondary range was maintained for similar reasons. While habitat quality is less than in adjacent primary ranges, these secondary ranges provide important movement corridors from the Skeena and Scotia watersheds into the Big Falls and Ecstall watersheds and the Work Channel sub-regions, respectively.

Ursula – Gardener Sub-Region

Location: All tributaries to Ursula Channel and Gardener Canal within the study area.
Landscape Units: Bishop, Crab, Triumph, and Kiltuish
Topography: Steep and weathered granitic mountains rising to rounded peaks ranging between 850 and 1100 m. Major drainages are generally U-shaped and relatively well protected from prevailing winter weather. Valley bottoms are generally wide with riparian vegetation or organic bogs. This sub-region is poorly connected to interior migration routes with several very steep and rugged watersheds or wide reaches separating it from possible immigration sources.
Identified Moose Winter Range: Paril (Type A), Triumph (Type A), Tag (Type A), Goat (Type A), and Kiltuish (Type A) secondary ranges.

This sub-region was delineated because it had similar weather and topography. Immigration from the mainland along Douglas Channel and west from Kemano and the Kitlope would also give most of the area similar exposure to immigrating moose. Habitat and valley alignment is also similar within the sub-region. During overview flights it was noted that snow depths increased dramatically as the valleys in this sub-region narrow upstream from their estuaries.

The Triumph and Paril drainages are the exceptions to this with very low snow levels throughout, likely due to the width of the main valley and more exposure to coastal precipitation.

Little or no information was available for this area. Local information from a variety of forestry crews suggests moose populations are low or non-existent. Moose have been seen in the Kowesas to the east of the area but on site evidence indicated very little winter use in optimal habitats (Pollard, 1999). S. Liepins and S. Hedges indicated that high densities of pellets were found in the Tag drainage. The February 14 overview flight covering this sub-region failed to identify any moose tracks. This was likely due to no snow in high probability areas and heavy snow in upland sites limiting dispersal. Two sites were also investigated north of Gardener Canal but the limited size and lack of riparian habitats suggested they be excluded. Moose winter range occurs in all identified secondary ranges but it appears that most of these ranges currently have limited use.

Work Channel Sub-Region

Location: All tributaries flowing west or northwest into Work Channel.
Landscape Units: Union and Quottoon
Topography: Steep and weathered granitic mountains rising to mostly rounded peaks between 850 and 1000 m. Larger mountains with permanent ice fields occur in the southern portion of this sub-region adjacent to rugged peaks 1350 m high. Major drainages in Quottoon Inlet are generally U-shaped and relatively well protected from prevailing weather. Valley bottoms are generally wide with extensive riparian vegetation and organic bogs. Watersheds flowing into Work Channel are less protected and are generally narrower with limited floodplains or estuaries.
Identified Moose Winter Range: Toon (Type A), Ensheshese (Type A)and Thulme (Type A) secondary ranges.

This sub-region was identified as a unit because of similarities in topography, weather, and its relative isolation from immigration. Topography in the northern portion of the sub-region is generally low, rounded peaks with a high component of exposed rock and broken-faced steep slopes. This topography is more pronounced in the southern portion of the sub-region, where peaks are higher and more rugged. This sub-region is exposed to most coastal weather events with only the low ridges of the Tsimpsean Peninsula protecting it from the exposed coast. It is connected to interior immigration routes with low elevation passes into the Skeena and Khutzeymateen sub-regions. However, evidence suggests low populations in the Khutzeymateen and difficult dispersal from the Skeena limit the volume of immigration.

Information on moose winter habitat use and distribution in this sub-region unit is very limited. S. Liepins indicates that habitat suitable for wintering moose is available in the Crow Lagoon-Union Inlet area. Overview flights on March 8th indicated no evidence of moose presence in either the Union or Crow lagoon area and no tracks were seen anywhere else within the sub-region. Turney (1997) indicated that there was no evidence of moose in the McShane watershed and suggested ungulate use was limited to mountain goat and deer.

Initially, five secondary ranges were identified in this sub-region. However, two units were dropped due to the lack of suitable low elevation habitats in the Union valley, and the limited habitat and field verification in the McShane drainage. The Ensheshese secondary range had very little snow on the ground and no tracks were seen but habitat quality was high. Riparian vegetation occurred throughout the watershed and harvesting had produced large densities of shrubs. Both the Thulme and Toon secondary ranges were similar with reasonable habitat but inadequate snow depths to develop confidence of actual use levels.

Table 2: Summary of all winter range units in all sub-regions.

Sub-Region	Winter Range Name	Winter Range Type	Mapsheet (s)	Use Level	Confidence
Alice Arm	Kitsault Estuary	Primary	103 P6, P11, & P12	Medium	Moderate
Alice Arm	Kitsault River	Secondary (A)	103 P11 & P12	Low	Poor
Ecstall-Quaal	Big Falls	Primary	103 H13 & I4	Medium	Poor
Ecstall-Quaal	Ecstall River	Primary	103 H13 & H14	High	Good
Ecstall-Quaal	Quaal	Primary	103 H11	High	Moderate
Ecstall-Quaal	Tidal Ecstall	Secondary (A)	103 H13	Low	Moderate
Ecstall-Quaal	Sparkling	Secondary (B)	103 H13	Low	Moderate
Ecstall-Quaal	Madeline	Secondary (A)	103 H13	Low	Poor
Ecstall-Quaal	Ecstall Lake	Secondary (B)	103 H11 & H14	Medium	Moderate
Ecstall-Quaal	Kitkiata	Secondary (B)	103 H11	Medium	Good
Ecstall-Quaal	Upper Ecstall	Secondary (B)	103 H14	Medium	Poor
Observatory Inlet	Anyox	Secondary (A)	103 P5	Low	Poor
Observatory Inlet	Stagoo	Secondary (A)	103 P4 & P5	Medium	Moderate
Observatory Inlet	Kshwan	Secondary (B)	103 P12	Low	Moderate
Portland Inlet	Khutzeymateen	Primary	103 I12	Low	Moderate
Portland Inlet	Kwinamass	Primary	103 I13 & J16	Medium	Poor
Portland Inlet	Kateen	Secondary (B)	103 I12	Low	Moderate
Portland Inlet	Chambers	Secondary (A)	103 I13, J16, O1, &P4	Medium	Poor
Portland Inlet	Mouse	Secondary (A)	103 I12 & J9	Low	Poor
Skeena	Khyex	Primary	103 I4 & I5	High	Good
Skeena	Skeena	Primary	103 I3, I4, I5 & I6	High	Good
Skeena	Scotia	Primary	103 I4	High	Good
Skeena	Khtada	Secondary (A)	103 I4	Medium	Poor
Skeena	Lachmach	Secondary (B)	103 I4 & I5	Low	Poor
Skeena	Scotia	Secondary (B)	103 I4	Medium	Poor
Ursula-Gardener	Kiltuish	Secondary (A)	103 H8	Low	Poor
Ursula-Gardener	Goat	Secondary (A)	103 H7	Low	Poor
Ursula-Gardener	Paril	Secondary (A)	103 H7	Low	Poor
Ursula-Gardener	Triumph	Secondary (A)	103 H7	Low	Poor
Ursula-Gardener	Tag	Secondary (A)	103 H7	Medium	Poor
Work Channel	Toon	Secondary (A)	103 I12	Low	Poor
Work Channel	Thulme	Secondary (A)	103 I5	Low	Poor
Work Channel	Ensheshese	Secondary (A)	103 J9	Low	Poor

CONCLUSIONS

Moose are recent immigrants into the study area and winter habitat selection is poorly documented. The best available information suggests that moose winter range will be associated with low elevation perpetuated shrub communities. This type of habitat occurs within the NCFD but quality varies between subzones due to plant composition and their temporal duration. Densities of immigration, distance and accessibility of immigration sources and the quality of existing habitat influence the current distribution of moose winter use within the study area. As forest harvesting increases and more moose immigrate into this area, it is highly likely that moose densities in this area will continue to increase.

The accompanying maps provide a best guess approach to important moose wintering areas within the study area. Maps should be considered a work in progress however, and be continuously supplemented or edited as better information becomes available. These maps are adequate as tools to aid in regional planning but interpretations for stand level developments should be supplemented with on-site reviews.

RECOMMENDATIONS

1. Areas with poor confidence in use estimates should be given first priority for a field reconnaissance. While on site examination generally provides the most valuable information on density and timing of habitat use, further aerial reviews in areas not seen during this project would be most cost effective.
2. Management of winter ranges should vary by biogeoclimatic subzones due to variations in palatability and temporal duration of browse species.
3. The survey design for this study required that several different factors be considered simultaneously. This resulted in less than standardized aerial survey technique. If further aerial surveys are completed with the intent of establishing firm population estimates, the appropriate R.I.C. Inventory guidelines should be employed.

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