Waterfowl and Wetlands in the Mealy Mountains National Park Study Area of southern Labrador

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1. EXECUTIVE SUMMARY

As part of Contract No. 45115224, Harlequin Enterprises reviewed an extensive amount of published, unpublished and anecdotal information on waterfowl and wetlands in southern and central Labrador. This information was compiled and interpreted in relation to the Mealy Mountain National Park 21,682 km^2 study area. We undertook preliminary air photo and topographic map analyses, and utilized a Geographic Information System to provide preliminary classifications and coverage of wetland types in the Eagle Plateau ecoregion component (11,149 km^2) of the study area. Other ecoregions encompassed in the study area include Paradise River (3,081 km^2), Lake Melville (1,958 km^2), Mecatina River (1,452 km^2), Mealy Mountains (2,963 km^2), and Porcupine Strand (1,079 km^2). The Eagle Plateau ecoregion supports very extensive wetlands comprising up to 65% of some ecotypes. The study area supports an estimated 3170 breeding pairs of dabbling ducks, 1,000 breeding pairs of bay ducks, 3,540 breeding pairs of sea ducks, and 2380 breeding pairs of Canada Geese but these estimates wide confidence intervals. We highlight the relative importance of this general area to breeding populations of sea ducks as this group of waterfowl are currently the focus of the Sea Duck Joint Venture under the North American Waterfowl Management Plan. More precise information on waterfowl species composition, distribution and population sizes is needed for conservation purposes.

Extensive peatlands on the Eagle Plateau are enriched by their juxtaposition to extensive fluvial systems associated with the many lakes, ponds, tributaries and streams of numerous watersheds, such as Eagle River, Paradise River, North River, English River, and others that originate on this extensive plateau of low relief. Seasonal inundation of adjacent peatlands and shorelines results in enrichment, and supports the extensive development of marsh and marsh-peatland complexes. The influences of the fluvial systems and underlying glacial deposits result in the presence of many small deeper water bodies than usually associated with string bogs and patterned fens. This diversity supports suitable wetland habitats for dabbling, diving ducks, sea ducks and Canada Geese making the general area among the most important ecological areas for breeding

waterfowl in eastern Canada. A more complete wetland classification of the Mealy Mountain National Park study area is required for conservation purposes.

Coastline habitat associated with Lake Melville and Groswater Bay supports many areas of Saltmarsh Cordgrass (*Spartina alterniflora*), a habitat important for staging waterfowl (dabbling ducks and geese) and breeding Common Eiders. This habitat is sensitive to perturbations, stabilizes sand/silt backshores, and is relatively rare in the Newfoundland and Labrador region. Large tidal amplitudes, deep glaciofluvial and fluvial deposits, outwash areas, and shallow water in Sandwich Bay, Table Bay and especially inner Groswater Bay result in extensive intertidal flats rich in invertebrates, and important to large aggregations of waterfowl. Sand dune is abundant along the Porcupine Strand and the potential for breeding Piping Plover (*Charadrius melodus*) currently listed as *Threatened* warrants further investigation.

We reviewed an extensive data set arising from the Black Duck Joint Venture under the international North American Waterfowl Management Plan, and from effects monitoring studies under the Department of National Defence. We conclude that these surveys, although long term and expensive to implement, are not sufficiently robust to monitor breeding population of key waterfowl species. The apparent methodological shortfalls relate to the lack of within-year replication that would provide a measure of precision. We speculate that wide variation in annual estimates of breeding pairs (e.g. orders of magnitude) of waterfowl on plots are not attributable to natural population dynamics of the species, and must represent confounding error from variation in abilities of observers to detect waterfowl, or most likely, variation in arrival of breeding pairs of waterfowl on plots due to spring chronology or related environmental influences. We recommend that trend analyses resulting from these databases be viewed with caution.

Waterfowl species of special conservation concern that breed extensively in the Mealy Mountain National Park study area include the Black Duck (*Anas rubripes*), and the Surf Scoter (*Melanitta perspicilatta*) and Black Scoter (*M. nigra*) that are the focus of the Black Duck Joint Venture and Sea Duck Joint Venture, respectively, under the international North American Waterfowl Management Plan. The scoters are among the most poorly studied waterfowl species in the Northern Hemisphere. Lesser Scaup (*Aythya affinis*) are also common in the study area, and, although technically not a sea duck, are receiving increasing conservation attention under the SDJV because of continental declines in populations.

The eastern population of the Harlequin Duck (*Histrionicus histrionicus*) was listed as *endangered* (1990-2001) and currently as a *Species of Special Concern* under the *Species At Risk Act* of Environment Canada. This small sea duck is specialized to breeding along fast moving rivers and streams, and likely breeds in low numbers on the Double Brook, English River, the upper St. Paul River, upper Eagle River and upper Little Mecatina River in or adjacent to the Mealy Mountain National Park study area. Moulting locations are documented for Tumledowndick Island and Stag Islands in Groswater Bay, and are recommended for inclusion in the Mealy Mountain National Park study area. Confirmation of its status in the study area is needed because previous surveys have not been exhaustive. The eastern population of Barrow's Goldeneye (*Bucephala islandica*), a *Species of Special Concern*, is not known to breed in the study area but its occurrence to the south of the study area in Quebec has been confirmed using radio-telemetry. Further examination of goldeneye in the study area is warranted because of the difficulty in separating this *Species of Special Concern* from the more ubiquitous Common Goldeneye (*B. clangula*) in aerial surveys.

We noted the presence of several aeries of the *Threatened* Peregrine Flacon (*Falco peregrinus*) in Table Bay where large and diverse colonies of Alcids and Common Eiders (*Somateria mollissima*) breed, and some of the largest moulting and staging aggregations of sea ducks (notably scoters) have been documented. Extensive migrations of shorebirds occur in this area, and historically included the *endangered* Eskimo Curlew which may now be extinct. This area is arguably the most biologically rich marine zone in coastal Newfoundland and Labrador yet has no formal conservation protection.

The overall examination of the Mealy Mountain National Park study area highlighted the inclusion of extensive coastlines along Lake Melville and Groswater Bay. In some cases, some islands have been included (e.g. George Island) but we are unaware of the rationale for this. The inclusion of the coastline results in potential protection of some biologically unique and rich areas, including the southern limit of Palsa Bogs along Porcupine Strand, and the moulting concentrations of Black Ducks in rich fluvial marshes of Flatwater Brook.

Some of the most significant waterfowl resources in Labrador lie adjacent to or immediately outside the current study area boundaries, and we highlight the significance of the Backway (Lake Melville) and inner Groswater Bay to moulting scoters and other sea ducks, and migrating shorebirds. The largest breeding colonies of the Common Eider in Newfoundland and Labrador occur in inner Groswater Bay and Table Bay, and these sites support large aggregations of spring and fall staging waterfowl, notably Canada Geese and Black Ducks. Coupled with the large diverse colonies of Alcids, these coastal sites are clearly of national significance and vulnerable to perturbations because of lack of any formal protection.

Other ecological features deserving of consideration for inclusion within the Mealy Mountain National Park study area that were noted during this review were:

(i) coastal components in Groswater Bay and Table Bay to include breeding eiders, staging and moulting waterfowl, breeding seabirds (alcids) and migrating shorebirds. This approach would better integrate components of the life history of some waterfowl species breeding within the current study area by linking inland breeding with coastal moulting and staging.

(i) the Kenamu River valley for its pristine old growth conferous forests and associated diverse and unstudied flora, large runs of anadromous Atlantic Salmon (*Salmo salar*) and Brook Trout (*Salvelinus fontinalis*), as well its first class potential as a river for wilderness canoeing / kayaking, and

(ii) (ii) the Lake Melville ecoregion adjacent to Mud Lake (BDJV Plot # 24) where relatively high densities of breeding Surf Scoters suggest unique qualities to water chemistry and biota among the numerous small lakes associated with heavily kettled terraces of this area. The northern breeding range limit for the Hooded Merganser (*Lophodytes cucullatus*), American Wigeon (*Anas americana*) and Northern Shovellor (*A. clypeata*) likely occur in this ecoregion.

2. BACKGROUND

On 8 September 2003, Harlequin Enterprises was retained by Parks Canada to compile information and data on waterfowl and wetlands in the Mealy Mountains National Park study area (MMNP). The present study area encompasses approximately 21,682 km^2 of southern Labrador, and encompasses the hinterland areas of some 7ecoregions including the extensive Eagle River Plateau that is renown for its diverse wetlands and waterfowl populations (Goudie and Whitman 1987, Bateman and Hicks 1999). More recently, the general study area has been the subject of an environmental impact assessment by the Department of Works Services and Transportation of the Government of Newfoundland and Labrador to study the effects of a proposed Trans Labrador Highway (TLH) connecting Cartwright in southern Labrador to the commercial centre of Goose Bay.

The Mealy Mountains represent an important proposed area in the systems plans of Parks Canada. Ecological integrity is a very important component of the mandate of Parks Canada, and can be maximized by defining sound ecological boundaries for the park such that natural processes can unfold within, and not be compromised by adjacent anthropomorphic influences.

The defined Terms of Reference (TOR) for Contract No. 45115224 required a compilation of data and overall interpretation of information on waterfowl and wetlands in the MMNP. The following report addresses this requirement.

3. INTRODUCTION

3.1 Waterfowl

3.1.1 Sources of information

Knowledge of waterfowl populations and wetland habitats in Labrador is fragmentary. The majority of work undertaken there has focused on assessing population trends and/or overall population sizes, i.e., their contribution to the Atlantic Flyway waterfowl stocks. Coverages by surveys are based on small sample sizes that are not replicated within a given year. Hence sources of potential variation are many, and include observer variability, weather, aircraft type, spring chronology, etc. There is very little published information on waterfowl and wetlands in Labrador, and data that do exist are contained in internal government reports (Canadian Wildlife Service), and consultant reports. To a great extent, the understanding of the waterfowl and wetland resource in Labrador resides as a knowledge base with key individuals in Governments, private consultants, and academic institutions. This report integrates existing published, unpublished and anecdotal information with available knowledge of waterfowl and wetlands in Labrador in order to provide a comprehensive overview of these resources in the Mealy Mountain National Park Study Area.

3.1.2 Definitions of terms

For management purposes, waterfowl are usually subdivided into 4 components, namely:

i. The dabbling ducks, such as Black Ducks (*Anas rubripes*) and Green-winged Teal (*A. crecca*) that feed in shallow emergent wetlands by "tipping-up".

ii. The bay ducks[1], such as scaup (*Aythya marina, A. affinis*) and Ring-necked Ducks (*A. collaris*) that feed by diving in shallow wetlands for aquatic insects and seeds.
iii. The sea ducks[1], such as scoters (*Melanitta nigra, M. perspicilatta*) and Goldeneye (*Bucephala clangula, B. islandica*) that feed by diving in deeper lentic waters for mollusks and crustaceans. The sea ducks include the Harlequin Duck (*Histrionicus histrionicus*) that is a unique species specialized to breeding along fast-moving rivers and streams.
iv. Canada Geese (*Branta canadensis*) that breed on peatland and fluvial wetlands.

Information on waterfowl in Labrador have been presented in respect to 3 components of their life history, namely:

i. Breeding – generally related to the early arrival of waterfowl on wetlands as mated pairs. During an optimal time window of several weeks, pairs, lone males and females are considered to represent pairs.
ii. Moulting – during mid to late summer adult waterfowl aggregate to undergo the annual feather moult. At this time, unisex flocks, especially males and immatures can be concentrated on selected wetlands.
iii. Staging – Especially during early ice-out in spring, and sometimes in early fall, waterfowl gather at ice-free and/or selected rich wetlands to aggregate before migrating to breeding or wintering sites. In Labrador, the early open water areas or *Ashkui* are important traditional sites for subsistence hunting by Innu people in spring.

3.1.3 Waterfowl Distribution and Populations

Origins of Data: Data on waterfowl have been collected primarily by the Canadian Wildlife Service of Environment Canada through aerial surveys supported under the

[1] many of the information sources group the bay ducks and sea ducks into the category of diving ducks

Black Duck Joint Venture (BDJV) of the North American Waterfowl Management Plan (NAWMP) (Gilliland 2003, Gilliland 2004 submitted). These surveys included helicopter coverages of 6 fixed plots of 10 x 10 km (100 km^2) in Labrador for 1990-1995 and coverage of 10 rotating plots of 5 x 5 km. (25 km^2) for 1996 to 2000; and from 2001 to present, coverage of 20 rotating plots of 5 x 5 km. (25 km^2). There has been additional coverage of 9 'DND' plots 10 x 10 km (100 km^2) in Labrador associated with effects-monitoring studies related to military low level flight training (Turner and Hicks 2002). Of these, DND plot # 9 is within the MMNP and samples the wetland-rich Eagle Plateau ecoregion. The current BDJV plots have included the northeast 5 x 5 km quadrat in 4 of these 100 km^2 plots, namely DND 3A (= 45) (this study), and DND 8A (= 46), 10A (= 47), DND (western Labrador 10A (= 48). Plot 48 replicated the coverage of a 100 km^2 plot E2 surveyed by (Lidster1992a, b). In addition to plot surveys, there have been fixed-wing transects of a more exploratory nature, especially to assess the distribution of Canada Geese (Bateman and Hicks 1995, 1999).

Commencing in 1987, there were 25 plots (10 x 10 km or100 km^2) established in Newfoundland (19) and Labrador (6) under the BDJV. Of the six plots established in Labrador, four are within or proximate to the MMNP study area. In 1995, the sample size was reduced to 13 plots due to budget restrictions. In 1996 the survey design was modified by reducing plot size to 5 x 5 km. (25 km^2), a quarter of their original coverage, and increasing the number of plots from 25 to 38 with a rotating sample in which about 19 plots are surveyed each year. In 2001, an additional10 plots were added to Labrador to improve the BDJV coverage for the North American population of Canada Geese. (Gilliland 2004, submitted). BDJV plots that are within the MMNP are plot nos. BDJV 21 (The Backway) and BDJV 36 (White Bear River) which are outside the fertile Eagle Plateau (Figure 2, Appendix 1).

Goudie and Whitman (1987) provided data for 3 ground plots surveyed in the Eagle Plateau ecoregions (Figure 1).

In 1993 to present, Canadian Wildlife Service initiated a study of waterfowl trends in the Military Training Area of Labrador (Bateman *et al.* 1999a,b, Turner and Hicks 2000, 2002). The design consisting of 3 control plots, 3 high frequency jet over-flight plots, and 3 before-after plots encompassing some of the Eagle Plateau Ecoregion, and plot no. DND 9 is within, and 2 other plots are proximate to the MMNP study area (Figure 1, Appendix 1).

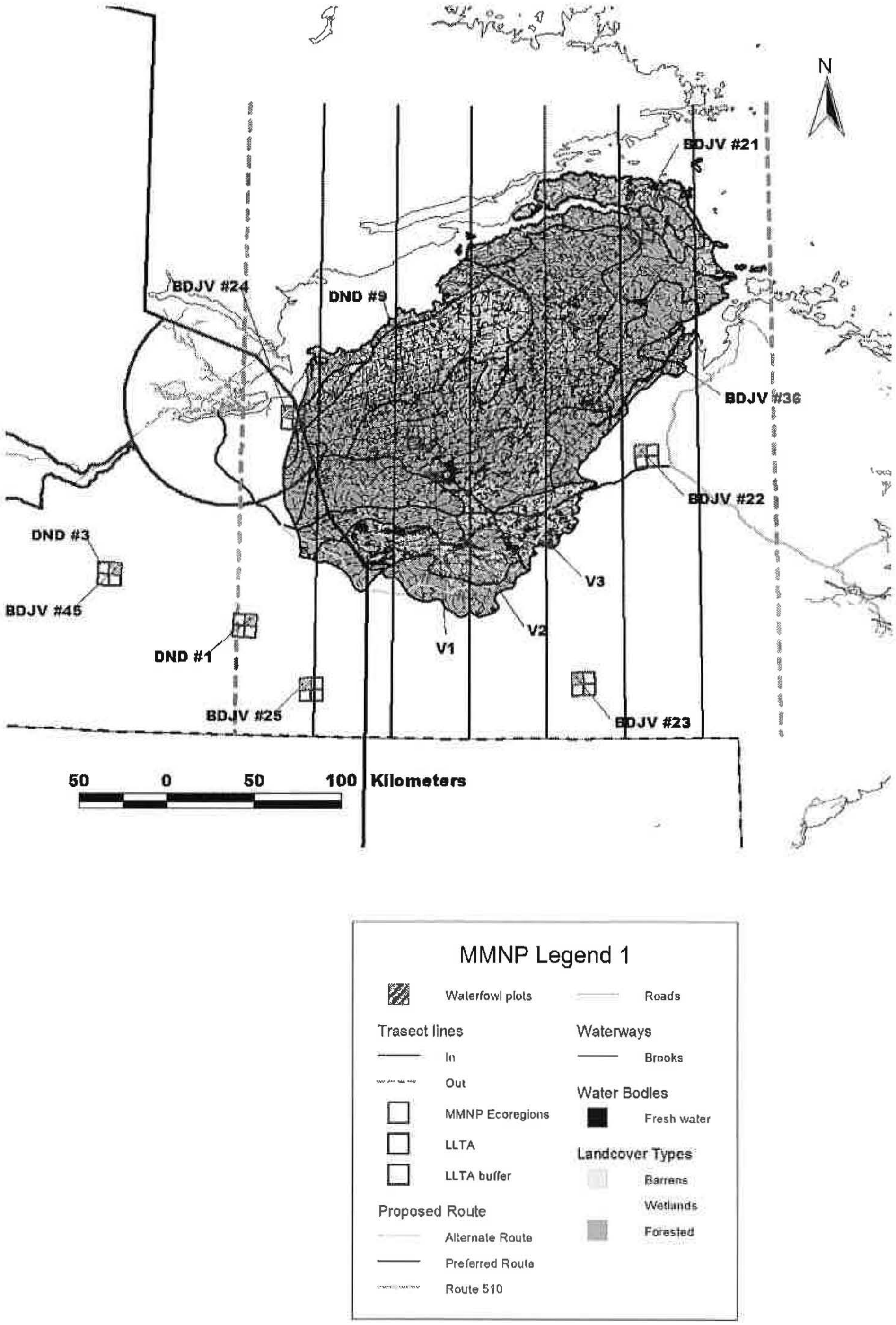

Figure 1. Location of waterfowl survey plots and habitat types in the Mealy Mountain National Park study area.

For plots, all wetlands are searched for waterfowl following Standard Operating Procedures (SOP) whereas transects are flown in a less rigorous manner, and may vary by aircraft type, altitude and assumed survey coverage. These data are generated through operational funding under the Black Duck Joint Venture (BDJV) of the North American Waterfowl Management Plan (NAWMP), and/or the Atlantic Flyway council (Finney 2003). This international agreement between Canada and the United States has a number of joint ventures aimed at specific areas needing conservation action.

Transect coverage of Labrador in fixed wing aircraft has been more sporadic and generally aimed at establishing a general knowledge of waterfowl diversity and distribution over large geographic areas, e.g. Goudie and Whitman (1987). More recently transects have been the primary approach to surveying extensive areas of Labrador for Canada Geese (Bateman and Hicks 1999). Because of their large size, visibility of geese is less affected by aircraft type relative to the smaller dabbling and diving ducks.

There had been intermittent efforts to determine and assess areas used by staging waterfowl, particularly in spring. In general this coverage has been north and west of the study area except for recent work by Jacques Whitford Environment Ltd. (2003, waterfowl component study draft) in relation to the environmental assessment work for the Trans Labrador Highway (TLH). Unfortunately the 2002 surveys to quantify spring staging along the 'preferred route' were undertaken too early to be of any value for this compilation, i.e., virtually all wetlands were frozen. Lidster *et al.* (1992) completed some fall staging surveys of the coastal areas of Lake Melville, Porcupine Strand, and Sandwich and Table Bays. Lock et al (1994) compiled coastal migratory waterfowl and seabird data for this general region, and included much of the unpublished and published information. There has been virtually no effort to quantify use of the general area by moulting waterfowl. In mid to late summer, some species of waterfowl form moulting aggregations, and these concentrations are usually indicative of enriched wetlands. Similar to spring staging, there were problems with timing of surveys to identify moulting aggregations of waterfowl in the TLH study area. Some limited information on possible groupings of adult male Ring-necked Ducks are indicated in JWEL (2003, draft).

Goudie (1981) identified a significant aggregation of possibly hundreds of moulting adult male Black Ducks in the extensive fluvial marshes of Flatwater Brook, Groswater Bay. It is one of only a few sites for moulting Black Ducks identified in Labrador. Many others surely exist because post-pair male Black Ducks migrate north to moult, and tens-of-thousands breed in other provinces of Atlantic Canada where no males are known to moult south of Labrador and northern Quebec.

The Institute for Environmental Monitoring and Research (IEMR) was established following the Environmental Impact Statement (EIS) of military training in Labrador (DND 1994) with a mandate to study the effects of military training on the environment. Part of that program has included reviews and support of waterfowl research. In 2001, the IEMR contracted a review of various published and unpublished waterfowl manuscripts (Société Duvetnor Ltée 2001) to assess their adequacy in addressing the impact of low-level military jet over-flights on waterfowl populations, notably Bateman and Hicks (1999), Turner and Hicks (2000).

Limitations imposed by survey timings: Across the four waterfowl groups there is wide variation in breeding chronology, life history and habitat use. Past surveys have been focused on species of special conservation interest, such as Black Ducks, Harlequin Ducks and/or Canada Geese. Black Ducks and Canada Geese nest early in the annual cycle. Therefore the quality of data on other species, especially sea ducks such as scoters, is limited because of their later breeding phenologies.

Ecoregion based approach: The Mealy Mountain National Park study area encompasses 21, 682 km^2 and supports 2 major ecozones, namely the Boreal Shield and Taiga Shield, and they are comprised of components of six ecoregions (Fig. 1) (Table 1a from Lopoukhine *et al.* 1977, and Meades 1989, 1990). The original classification of ecoregions in Labrador by Lopoukhine *et al.* (1977) was mainly physiographic in delineation. The biogeoclimatic approach used by Meades (1989, 1990) results in fewer divisions, and tends to support a more direct relationship to fauna and flora.

Table 1a. Ecoregions within the Mealy Mountain National Park study area of Labrador.

Ecozone	Ecoregion	No. of ecodistricts	No. of ecotypes	Area (km^2)
Taiga Shield	Eagle Plateau	2	4	11,149
Boreal Shield	Paradise River	1	4	3,081
Taiga Shield	Mealy Mountains	1	1	2, 963
Boreal Shield	Lake Melville	2	7	1, 958
Boreal Shield	Mecatina River	1	3	1, 452
Taiga Shield	Porcupine Strand	3	5	1, 079

Bajzak (1973) undertook a biophysical classification of the southern backshore area of Lake Melville from Long Point to Mud Lake. He identified 5 land districts that were subdivided into 34 land systems (Table 1b).

Table 1b. Land districts along the south shore of Lake Melville identified by Bazak (1973).

Land District	Description
Mealy Mountain	Rock and heath barrens
Long Point	Rolling low-lying with parallel ridges of fractured bedrock
Traverspine River	Craig and tail topography of thin to medium thickness till
Kenamu River	A plain with deep moraine deposits and lineated with raised beach ridges. Also kettled terraces, emerged deltas, outwash and flow slides
Carter Basin	Very large depression underlaid by clay near to surface near the shore of Lake Melville. A plain with lineated beach ridges that are further subdivided into (i) ridges widely spaced with boggy swales, (ii) ridges closely spaced, and (iii) ridge pattern disturbed by development of kettles.

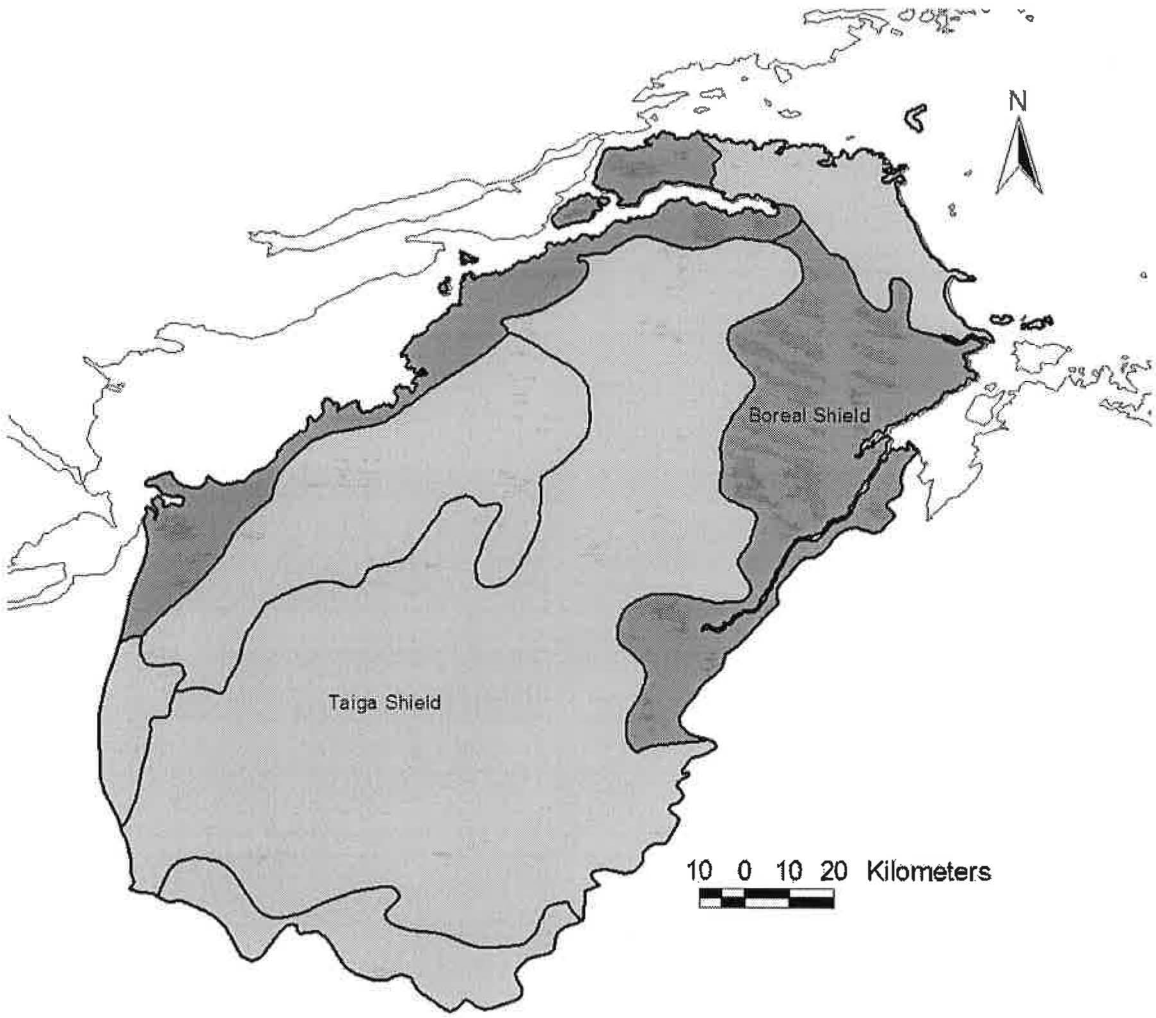

Figure 2a. Ecozones of the Mealy Mountain National Park Study area of Labrador.

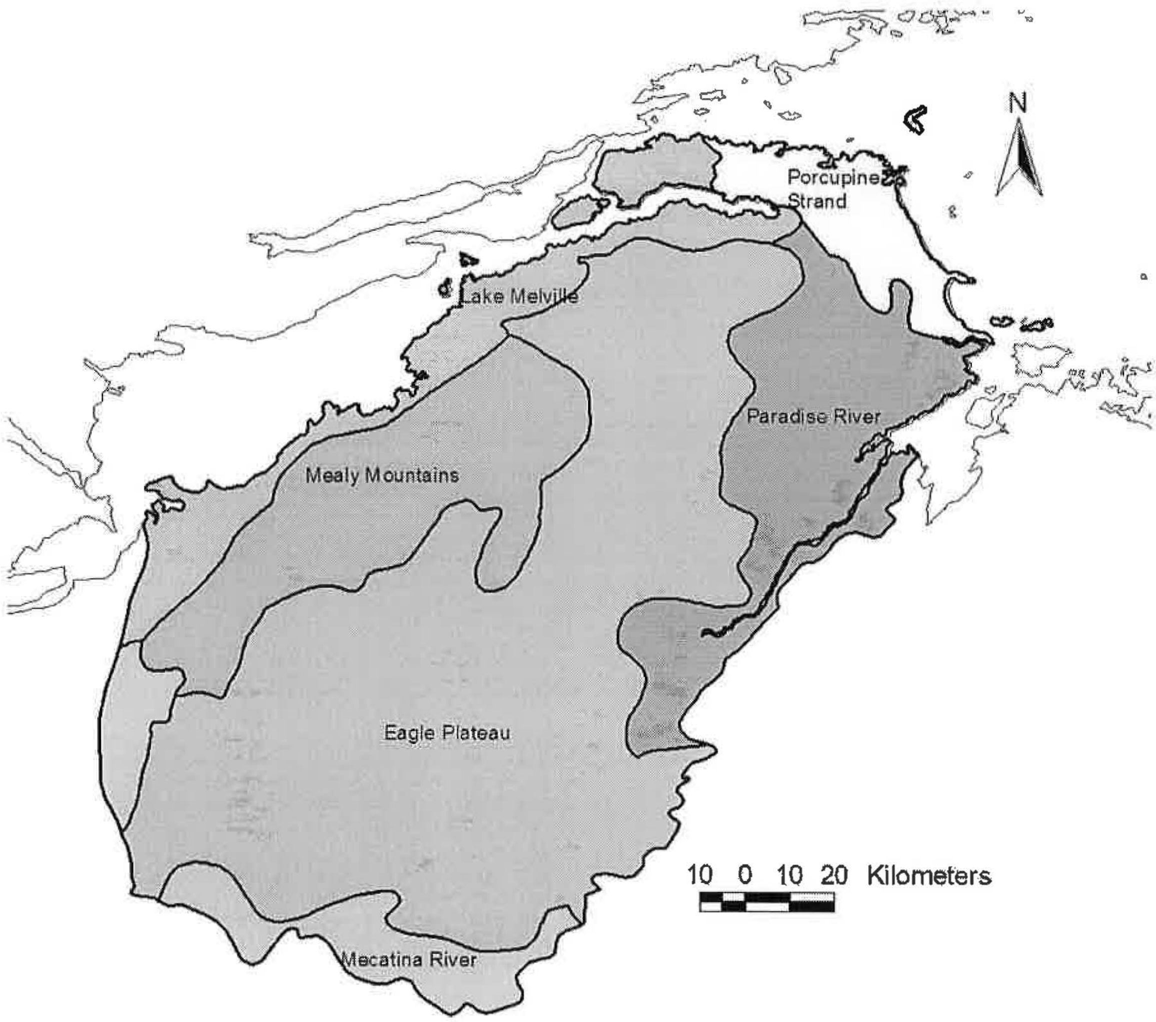

Figure 2b. Ecodistricts of the Mealy Mountain National Park Study area of Labrador.

Goudie (1987) and Goudie and Whitman (1987) introduced an approach to stratification of results of aerial surveys of waterfowl based on ecoregion classification. Conceptually, ecoregions reflect patterns in biological communities resulting from common climatic and geomorphological influences. In a general way, this approach is helpful such as confirming the relative productivity of wetlands from boreal shield relative to the taiga (subarctic) shield but its usefulness as a broad-brush management or conservation tool is questionable. Despite these concerns, this approach has continued to be applied to waterfowl in Labrador (e.g. Batemen and Hicks 1999).

The problems that arise with an ecosystem approach to waterfowl conservation are related to the fact that productive wetlands represent enriched sites, and by their nature are not predictable at a gross ecological classification level. For example, the Postville Ecoregion is a very sterile zone for waterfowl yet within the 18,140 km^2 area there are extremely rich river deltas supporting extensive fluvial marshes with breeding and moulting waterfowl, notably Snegamook Lake delta. Because sampling for waterfowl has been biased to these productive sites, extrapolation to the entire ecoregion is grossly inaccurate (see Bateman and Hicks 1999), and we recommend that density estimates for this site be viewed cautiously and more conservative numbers are recommended (see Table 2a). The application of an ecosystem-based overview is especially problematic when applied to an effects monitoring study, such as the designation of areas for avoidance by low-level military jet over-flights, because enriched wetlands and associated wildlife are not 'avoided' by this method (see Bateman and Hicks 1997, Société Duvetnor Ltée 2001, Giroux *et al.* 2003).

Société Duvetnor Ltée (2001) and Giroux *et al.* (2003) were very critical of an ecosystem-based approach to waterfowl and wetland conservation. They stated that no studies have shown a link between waterfowl habitat and the land regions of Lopoukhine *et al.* (1977). Rather they felt that each ecoregion includes a variety of habitats suitable to various species of waterfowl. Furthermore, estimated densities were mostly related to the number and extent of suitable habitats, i.e., not stratified, and not the overall ecological features of a land region. They felt that, in the context of avoidance from disturbance, a highly prized and unique habitat maybe lost or degraded through disturbance only because it was classified in a land region with an overall lower bird density.

They concluded that a real northern wetland habitat classification is needed, and that it should be developed in relation to the major species groups because the ecological requirements are different for each community component, e.g. dabbling ducks versus diving ducks. We concur with Société Duvetnor Ltée (2001) and Giroux *et al.* 2003) that the ecoregion concept does not reflect the capacity of the habitat to support populations of wildfowl. They further noted that the use of GIS tools would be a valuable asset in the future to locate key waterfowl habitats. Nevertheless, we suggest that for ecoregions such as the Eagle Plateau where there is a predominance of wetland habitat that is distributed homogeneously, extrapolation of detected densities in order to project an overall potential population is justified.

3.1.4 Population Estimation

Importance of Eagle Plateau: The Eagle Plateau Ecoregion contains extensive areas of diverse wetlands, and supports some of the highest densities of breeding dabbling and diving ducks in Labrador (Table 2a) (Bateman and Hicks 1999). In contrast, the other ecoregions in the MMNP study area support much lower densities and diversities of breeding waterfowl but support significant staging and moulting waterfowl, e.g. Lake Melville ecoregion, and/or waterfowl of special conservation concern such as Harlequin Ducks and scoters.

These densities should be interpreted cautiously because most samples are small, i.e., 1 to 2% of ecoregion, and within ecoregions are not stratified. This means that fertile wetlands may comprise a very small proportion of an ecoregion yet support relatively high densities of breeding waterfowl. When extrapolated to the ecoregion such samples given the mistaken impression that an entire ecoregion is very productive for waterfowl because in some cases only wetlands of high potential are sampled, for example on the proposed Trans Labrador Highway. Nevertheless, wetlands comprise a very large proportion of the Eagle Plateau ecoregion. Therefore, in general, its contribution to fall migration flights in the North Atlantic flyway is considerable.

Within ecoregions, the distribution of waterfowl and associated wetlands is often clumped. The net effect of this is that there is a wide variance in samples relative to detection of specific waterfowl. Estimates of variance (standard deviation) are often not provided because sampling is not replicated, and this is a serious shortfall of much survey work for waterfowl in Labrador. Estimates of density and extrapolated populations are imprecise because associated standard deviations are usually greater than 50% of the magnitude of the mean densities. This also indicates that distribution across plots is very heterogeneous, and are not measuring the within plot error.

In general, the reader should be very aware of the miniscule nature of the sample sizes in relation to the extensive Labrador hinterlands, and the fact that most samples are not repeated within a year making a statistical estimate of variance impossible. This could account for some of the wide range of extrapolated densities that have been presented by researchers because in some cases they vary by many order of magnitudes, e.g. Canada Geese breeding in the Mealy Mountains Ecoregion (Table 3). If sampling on plots such as BDJV or DND was replicated within a year a clearer understanding of error associated with variation in observer skills, time of day, weather, spring chronology, etc. would emerge. For example, Bourget and Bordage (1989) conducted replicated surveys of variable size plots to detect pairs of Black Ducks in spring in Quebec and demonstrated that (i) 10 x 10 km plots generated data that approached a normal distribution and (ii) on average, a single survey only detected about half of the indicated pairs that were present. The latter finding is very important because all plot surveys in Labrador are surveyed only once, and yet analyses for trends using regression assume that these variables are measured error free (Smith 2003). Current reported measures relate to variance between plots, which is also considerable. There is no measure of variance within plots yet in any year, the spring chronology could have marked effect on the rate of detection of waterfowl on a plot, and the lack of replication would result in wide variance in numbers not attributable to true population change.

Overall, the available information would suggest that the 21,635 km^2 MMNP supports a very large population of breeding waterfowl. The bulk of the breeding pairs estimated at 3,138 dabbling ducks, 4,509 diving ducks and 2,339 Canada Geese nest within the 11,149 km^2 of the Eagle Plateau ecoregion that is contained within this study area (Table 2b). We point out the high uncertainty of these estimates, and that the true numbers could be as high as 5,000 pairs of dabbling ducks, 7,000 pairs of diving ducks and 4,000 pairs of geese.

Table 2a. Densities of breeding dabbling ducks[2] and diving ducks[3] extrapolated to pairs/100 km^2 of ecoregions in Labrador. (Data sources: Goudie and Whitman 1987, Bateman and Hicks 1999, based on helicopter plot surveys).

ECOREGION	DABBLING DUCKS[1] (Pairs $\pm$ SD)	DIVING DUCKS[1] (Pairs $\pm$ SD)
St. Paul	26.15 $\pm$ 12.30	24.00 $\pm$ na
Eagle Plateau	20.38 $\pm$ 20.09	27.63 $\pm$ 17.46
Churchill Falls	14.22 $\pm$ 6.16	19.78 $\pm$ 10.88
Seahorse	12.67 $\pm$ 2.49	12.33 $\pm$ 2.06
Postville	12.20 $\pm$ 6.49	39.20 $\pm$ 13.53[2]
Smallwood Reservoir	12.05 $\pm$ 6.58	16.16 $\pm$ 10.42
Harbour	12.00 $\pm$ na	24.00 $\pm$ na[2]
Nipisish Lake	9.63 $\pm$ 3.90	9.50 $\pm$ 4.58
Lake Melville	7.71 $\pm$ 4.03	41.57 $\pm$ 20.90
Paradise River	3.38 $\pm$ 3.08	6.19 $\pm$ 3.17
Mecatina River	26.15 $\pm$ 12.30	24.00 $\pm$ 8.35
Porcupine Strand	21.8 $\pm$ 14.1	7.80 $\pm$ 3.40

[1]Larger estimate of 2 published sources presented here

[2]Estimate suspect due to bias in sampling and/or lack of replication. For population projection the density estimates from Goudie and Whitman (1987) were used, namely Postville: 22.5 $\pm$ 9.9.

Table 2b. Estimate population of pairs of waterfowl in the MMNP study area.

Ecoregion	Area (km^2)	Dabbling Ducks	Bay Ducks	Sea Ducks	Canada Goose
Eagle Plateau	11, 149	2, 300	730	2,360	1, 750
Paradise River	3,081	110	30	170	110
Mealy Mountains	2, 963	unsurveyed	---	---	200
Lake Melville	1, 935	150	60	750	110
Mecatina River	1, 452	380	150	200	60
Coastal Barrens	1, 055	230	30	60	150
Total	21, 635	3, 170	1,000	3,540	2, 380

[2] Dabbling Ducks include Black Ducks, Green-winged Teal, Mallard, American Wigeon and Gadwall
[3] Bay Ducks include Ring-necked Duck, Greater and Lesser Scaup
Sea Ducks include Common and Red-breasted Merganser, Hooded Merganser, Common and Barrow's Goldeneye, Bufflehead, Black Scoter, Surf Scoter, White-winged Scoter, Long-tailed Duck, and Harlequin Duck.

The Canada Goose (*Branta canadensis*) is ubiquitous in Labrador, and its wide breeding range there contributes very large proportions of the North Atlantic Flyway fall flight (Erskine 1987). The Eagle Plateau and St. Paul Ecoregions support relatively high densities of breeding geese (Table 3).

Table 3. Densities of Canada Geese extrapolated to pairs/100 km^2 of ecoregions in Labrador. (Data sources: Bateman and Hicks 1999, based on fixed-wing transects and Goudie and Whitman 1987 presented in brackets when higher).

Ecoregion	Sample size (km^2) (1993-94)	Pairs per 100 km^2	Sample size (km^2) (1998)	Pairs per 100 km^2
Eagle Plateau	10.8	18.5	108.1	15.7
St. Paul	140.0	11.5	79.2	15.2
Paradise River	238.0	3.8 (8.0 $\pm$ 6.5)	121.4	3.3
Churchill Falls	298.0	5.0	155.0	13.6
Lake Melville	247.0	1.7 (4.0 $\pm$ 3.3)	129.4	5.4
Porcupine Strand	24.0	4.3 (14.0 $\pm$ 11.4)	16.3	6.1
Mealy Mountains	36.0	0.0	16.9	5.9
Postville	180.0	1.6 (7.0)	108.4	4.6
Smallwood Reservoir	468.0	8.5 (12.4)	229.6	11.3
Mistastin Lake	116.0	7.0	131.9	17.4

A more detailed examination of species composition in the Eagle Plateau ecoregion indicated that American Black Ducks and American Green-winged Teal were the main dabbling duck species, while scaup (mostly *Aythya affinis*) and Ring-necked Ducks were the main diving ducks. Surf Scoters (*Melanitta perspicilatta*), and Common and Red-breasted Mergansers (*Mergus merganser, M. serrator*) were the more abundant breeding sea ducks (Table 4).

Low-level helicopter surveys along the proposed route of the proposed Trans Labrador Highway Phase III (Jacques Whitford Environment Ltd. (2004, draft) generally yielded higher estimated densities of waterfowl than previous work. This result was somewhat expected result because the earlier surveys were by fixed-wing that has a lower inherent detection rate, and the TLH work was restricted to habitat potentially suitable for waterfowl (Table 5).

Table 4. Species composition of waterfowl breeding in Ecoregion in and adjacent to the Mealy Mountain National Park study area. (Data sources: Goudie and Whitman 1987, Bateman and Hicks 1999, based on helicopter plot surveys).

SPECIES (%)	EAGLE PLATEAU	PARADISE RIVER	ST. PAUL	LAKE MELVILLE	CHURCHILL FALLS
Dabbling Ducks					
Black Duck	71.1	63.0	61.9	67.3	67.5
Mallard	2.8	0.0	0.3	0.1	1.6
Northern Pintail	0.6	0.0	3.2	0.1	5.2
Green-winged Teal	25.4	37.0	34.5	32.4	25.3
American Wigeon	0.1	0.0	0.1	0.1	0.1

SPECIES (%)	EAGLE PLATEAU	PARADISE RIVER	ST. PAUL	LAKE MELVILLE	CHURCHILL FALLS
Diving Ducks					
Ring-necked Duck	8.0	12.2	32.2	3.9	2.0
Scaup	15.6	2.2	9.4	3.4	18.4
Total Bay Ducks	**23.6**	**14.4**	**41.6**	**7.3**	**20.4**
Common Merganser	10.8	30.0	11.1	3.4	5.2
Red-breasted Merganser	15.6	20.0	5.0	1.9	21.4
Hooded Merganser	0.0	1.1	1.7	1.4	1.2
Goldeneye	7.5	24.5	24.5	68.5	20.4
Bufflehead	0.0	0.0	0.0	0.0	0.7
Black Scoter	2.4	0.0	0.3	0.5	7.4
Surf Scoter	39.6	3.3	13.4	15.5	20.9
White-winged Scoter	0.1	0.0	0.0	0.0	0.2
Harlequin Duck	0.1	0.0	0.1	0.1	1.0
Total Sea Ducks	**76.4**	**85.6**	**58.4**	**92.7**	**79.6**

Table 5. Densities of waterfowl detected in ecodistricts and ecoregions sampled under environmental assessment work related to the Trans Labrador Highway.

Ecodistrict	Coverage (km^2)		CAGO No./km^2		Dabblers No./km^2		Divers No./km^2	
	2002	2003	2002	2003	2002	2003	2002	2003
Eagle Plateau								
V1	47.8	1.8	0.5	0	0	0	0.9	0.6
V2	17.6	102.1	0.6	0.73	0	0.02	0.5	0.8
V3	55.0	0	1.0	-	0.3	-	1.1	-
V5	105.9	0	0.8	-	0.2	-	0.8	-
V6	157.0	68.3	0.7	1.2	0.3	0.2	0.5	0.4
V7	0	24.0	-	1.2	-	0	-	0.7
V8	0	11.6	-	0.9	-	0.5	-	0.2
Wt Average	**383.3**	**207.8**	**0.736**	**0.942**	**0.221**	**0.104**	**0.719**	**0.621**
Paradise River								
Y8	**92.8**	**0**	**0.30**	-	**0**	-	**0.40**	-
Lake Melville								
T1	24.5	0	0	-	0	-	0.245	-
T2	10.7	0	0	-	0	-	0	-
T4	36.8	0	0.13	-	0	-	0.207	-
T8	3.2	0	0	-	0	-	0	-
Wt Average	**75.2**	**0**	**0.064**	-	**0**	-	**0.181**	**0**

3.1.5 Listed Species

Notable *Species of Special Concern* have been the Harlequin Duck (*Histrionicus histrionicus*) (COSEWIC 2001) that breeds along rivers in south-central Labrador. Many of the data on Harlequin Ducks has been assimilated in related effects monitoring and avoidance program work of the Department of National Defence, notably Jacques Whitford Environment Ltd. 1999a, and Jacques Whitford Environment Ltd. 1999b. These references include some of the observations of Harlequin Ducks in the MMNP study area reported by Goudie *et al.* 1994 and AGRA Earth and Environmental Ltd. and Harlequin Enterprises (1999). Harlequin Ducks likely breed on English River, Double Brook (Goudie 1990), and possibly in the very upper reaches of the Little Mecatina River, St. Paul River, and upper Eagle River watershed because pairs or lone females have been observed in these reaches during the breeding season. Overall, the MMNP is immediately south of the main distribution of breeding Harlequin Ducks in central Labrador.

Moulting Harlequin Ducks aggregate annually at traditional coastal sites, and Tumbledowndick Island and Stag Islands in Groswater Bay are reasonably well documented as are the Gannet Clusters in Table Bay (Thomas and Robert 2001). Anecdotal information indicates that the inner coastal area adjacent to Porcupine Strand in Groswater Bay maybe important to fall staging aggregations of Harlequin Ducks (W. Lethbridge, Pers. Comm.).

The Barrow's Goldeneye in eastern Canada is a *Species of Special Concern* (Robert and Bordage 2000) that is poorly studied. Recently, radio-telemetry studies have supported that it breeds in the boreal hinterland zone north of the St. Lawrence estuary and Quebec North Shore. Barrow's Goldeneye moult in northern coastal Labrador but their status as a breeder remains uncertain. The recent telemetry studies may support the notion that some pairs of this rare sea duck breed in southern-central Labrador. This species is rarely discriminated from the more ubiquitous Common Goldeneye during aerial surveys.

The extensive sand dunes and beaches of the Porcupine Strand ecoregion warrant further investigation for the *Threatened* Piping Plover (*Charadrius melodus*). The Groswater

Bay - Sandwich Bay - Table Bay coastal zone of the study area supports significant aggregations of shorebirds (e.g. Whimbrels, Lesser Golden Plovers, Black-bellied Plovers) during late summer-fall migration, and is part of then historical range of the *endangered* Eskimo Curlew which may now be extinct.

3.1.6 Trends in numbers

Gilliland 2003, 2004 submitted) provided trend analyses assuming an underlying negative binomial distribution because of high frequencies of 0 counts inherent in using 5 x 5 km plots (see Bourget and Bordage 1989). In general, all numbers of indicated pairs appeared to be increasing on the BDJV plots, averaging about a 5 % per year growth rate. The only waterfowl species reported to be declining were scaup, and these would likely be mostly Lesser Scaup (Lambda = 0.93 $\pm$ 0.046 SE). Most of these trends detected for sea ducks (except Common Merganser) were not statistically significant. Turner and Hicks (2002) reported no consistent pattern in trend for Canada Geese and dabbling ducks, and an increasing trend for diving ducks. Specific to DND plot # 9 (within the MMNP) there was wide annual variation and the positive trend in dabbling ducks or diving ducks or Canada Geese was not supported statistically.

The ability of these aerial plot data to detect population trends in pairs of waterfowl could be compromised by a known yet undefined error in rate of detection that fluctuates depending on observers, pilot, and weather vagaries. Bordage and Bouget (1989) demonstrated that from 50 to 60% of potential pairs of Black Ducks are detected on a single helicopter survey. Without replication within years there is no means to estimate variance associated with this error. Further complications arise because the magnitudes of these errors may not be standard (see Stott and Olson 1972; Savard 1982) meaning that single point aerial survey results may not even be a functional index of population status. This may explain some of the wide range of values presented in Gilliland (2004, submitted) where, for example, the annual mean number of pairs of waterfowl can vary by orders of magnitude from one year to the next (Table 6). Even within years there is a very large inherent variance in numbers across plots that might suggest that sampling is not sufficient to estimate a centering point.

The important question that arises is whether the spring populations of these waterfowl truly vary in spring on wetlands in Newfoundland and Labrador by these wide magnitudes, and this seems doubtful. For some species, such as sea ducks like Surf Scoters and Black Scoters, it is clear that variance in numbers must be primarily driven by changes in detection rates because the BDJV and DND plot surveys are aimed toward the breeding phenology of the dabbling duck – Canada Goose group, and late-nesting species, i.e., diving ducks and sea ducks, may not be detected in some years because of late spring chronology. We seem to know less (or acknowledge less) about the implications of these climatic influences on detection of dabbling ducks and Canada Geese on plots. For example, It seems unlikely that the number of breeding pairs of Blacks Ducks would double on wetlands/plots from one year to the next (Table 6).

Smith (2003) noted that the BDJV methodology assumes that all ducks within plots are detected because helicopters are used but this assumption is questionable. Perhaps the detection rate of 50% to 60% per survey quantified by Bourget and Bordage (1989) was attributable to chronology of spring and variance in arrival of pairs on the northern breeding grounds. Regardless of its underlying cause, the error associated with estimating the breeding pair population on plots based on a single survey is considerable, and likely masks any ability to detect trends. We conclude that any trend information for waterfowl in the MMNP based on the BDJV and DND plot surveys be viewed cautiously.

Larger scale continental surveys for breeding waterfowl in North America are more robust (Smith 2003), and although not relevant to dabbling ducks in eastern North America, they do support that most sea duck species have been in a long term declines, and these were the basis for the structuring of a Sea Duck Joint Venture (SDJV) under the North American Waterfowl Management Plan (NAWMP) (Finney 2003). Similarly the Black Duck Joint Venture was structured under NAWMP because of long-term declines in numbers of Black Ducks wintering in eastern North America. Consideration for a more robust sampling and statistical design of the BDJV may be necessary because the current design is more dictated by budget constraints than biological reality.

Table 6. Mean number of indicated pairs (± 1 SD) of select species of waterfowl detected on BDJV surveys in Newfoundland and Labrador, 1990-2002 (From Gilliland 2004, submitted).

Year	CAGO	ABDU	SUSC	BLSC
1990	1.6 ± 1.7	2.3 ± 3.2	0.56 ± 2.3	0.0 ± 0.0
1991	2.0 ± 2.1	2.4 ± 3.0	0.48 ± 1.5	0.04 ± 0.2
1992	1.4 ± 1.6	2.3 ± 2.4	0.27 ± 0.87	0.0 ± 0.0
1993	2.3 ±2.7	1.3 ± 1.8	0.44 ± 1.6	0.0 ± 0.0
1994	2.2 ± 2.7	2.2 ± 3.4	0.31 ± 1.1	0.0 ± 0.0
1995	1.8 ± 2.0	2.3 ± 1.9	0.47 ± 1.3	0.1 ± 0.24
1996	2.8 ± 2.7	2.4 ± 1.8	1.0 ± 2.2	0.0 ± 0.0
1997	3.2 ± 2.9	2.1 ± 1.8	0.57 ± 1.3	0.04 ± 0.21
1998	3.8 ± 4.5	2.4 ± 2.1	0.83 ± 2.4	0.04 ± 0.21
1999	3.3 ± 2.4	4.2 ± 5.2	0.25 ± 0.74	0.0 ± 0.0
2000	4.0 ± 5.3	4.3 ± 3.3	1.1 ± 2.9	0.0 ± 0.0
2001	2.0 ± 2.5	2.2 ± 3.1	0.88 ± 2.8	0.0 ± 0.0
2002	2.2 ± 2.4	2.9 ± 4.9	0.4 ± 2.0	0.0 ± 0.0

3.2 Habitat Use

Our knowledge of habitat use by waterfowl in Labrador is fragmentary. Goudie and Whitman (1987) noted that Canada Geese primarily used peatlands for breeding, especially patterned fens and fen-marsh complexes. They further noted that dabbling ducks generally exploited peatlands although Black Ducks were more diverse in habitat selection and included fringed lakes or encroachment areas (Gillespie and Wetmore 1974) because shallow water and emergent vegetation were present. Ring-necked Ducks and Lesser Scaup, i.e., the bay ducks, selected wetlands with emergent (sedge) cover also (Goudie and Whitman 1987, Decarie *et al.* 1995). Goudie and Whitman (1987) noted that most sea ducks were absent from peatlands, and that most scoters, mergansers and goldeneye frequented rocky-shored lakes and ponds with little or no emergent cover, and thus were ecologically segregated from the dabbling ducks.

Virtually nothing is known of the habitat use by Surf Scoters and Black Scoters during breeding, and both species are currently of international conservation concern under the SDJV. Limited information indicates that Black Scoters may select relatively small shallow lakes and ponds that support some emergent vegetation (Decarie *et al.* 1995, Savard and Lamothe 1991) compared to the deeper rocky-shored lakes preferred by Surf Scoters. The White-winged Scoter is suspected to breed in Labrador but its numbers are incidental (Goudie and Whitman 1987).

We highlighted an area in the Lake Melville ecoregion adjacent to Mud Lake (BDJV Plot # 24) where relatively high densities of breeding Surf Scoters suggest unique qualities to water chemistry and biota among the numerous small lakes associated with underlying terraces of this area. Bajzak (1973) classified this area as the Squires Land System, and it is an area with extensive kettled terraces with widely scattered sand ridges. He noted that floating bogs (= fringed lakes) were developing in kettles. The areas of high-density kettling obscures the origin of the initial surface but the outwash origin of many sediments in the area could account for wetlands potentially high in nutrient content. He noted that the south shoreline adjacent to Lake Melville was basically a plain lineated with raised beach ridges that were: (i) widely spaced with boggy swales, (ii) closely spaced on flanks of kettled terraces, or (iii) have ridge pattern disturbed by the development of kettles.

The northern breeding range limits for the Hooded Merganser (*Lophodytes cucullatus*), American Wigeon (*Anas americana*) and Northern Shovellor (*A. clypeata*) likely occur in this ecoregion but need confirmation.

Common Goldeneye and Common Mergansers prefer tree cavities for nesting, and these species (especially goldeneye) maybe limited in distribution by productive tree cover with potential cavities.

Ostrofsky and Duthie (1975) demonstrated that productivity for phytoplankton within the Michikamau Lake (now part of Smallwood Reservoir) watershed was limited by the availability of phosphorus. Goudie and Whitman (1987) corroborated that diving duck populations maybe limited by the availability of this essential nutrient in open water systems in central Labrador.

3.3 Wetlands

3.3.1 Types of Peatlands

Peatlands in Labrador vary greatly, from raised bogs of no value to waterfowl, to string bogs, ribbed fens, and unpatterned fen-marsh complexes that may be relatively productive habitats for geese and dabbling ducks (Goudie and Whitman 1987). Information and data on wetlands in Labrador is much more limited relative to waterfowl populations. The MMNP study area has been classified in the Eastern Atlantic Boreal region of Atlantic Canada typified by extensive areas of string bogs and Atlantic ribbed fens with average peat depth of 1.5 m. A large portion of the MMNP has 26 to 50% wetland coverage (Wells and Hirvonen 1988). Ribbed fens are more productive than string bogs and typically support higher diversity and densities of waterfowl (Goudie and Whitman 1987).

Although the concepts of bog and fen are generally understood and accepted throughout the world, the definition and classification of both ecosystems are sometimes difficult. Bogs and fens may form in the same manner, i.e., through the annual growth and accumulation of vegetation remains on poorly drained soils. Bogs are nutrient-poor (ombrotrophic), receiving their nutrition solely from atmospheric sources (e.g. precipitation and atmospheric dust). Fens are nutrient-rich because they receive additional nutrients via seepage waters from adjacent or surrounding upland soils or directly through abundant fluvial influences. The dominant vegetation on bogs consists of *Sphagnum* mosses, dwarf shrubs and lichens. Bog pools (flashets) often have no vegetation but occasionally Buckbean (*Menyanthes trifoliata*), *Carex limosa* amd *C. oligosperma* whereas fens support sedges and grasses with some *Sphagnum* mosses, and have minerotrophic indicators such as *Betula michauxii, B. pumila, Myrica gale, Lonicera villosa, Rubu acaulis, Sanguisorba canadensis, Aster novibelgii, Selaginella selaginoides*. Pool vegetation in fens (also mostly *Carex limosa* amd *C. oligosperma*) is usually more extensive and includes more marsh-type plants such as the Yellow Waterlily (*Nuphar variegatum*) and Bladderwort (*Utricularia vulgaris*) (Goudie and

Whitman 1987, Wells and Hirvonen 1988). More complete descriptions of associated flora and vegetation communities are provided by Wells (1996).

Sedges and grasses are important fodder for Canada Geese that graze large volumes of vegetation. In many cases, bogs and fens can be distinguished from one another on the basis of vegetational features (and nutrient parameters) but classification can be complex when bog and fen types are intermixed such as string bog and ribbed fens in the Eagle Plateau ecoregion. In Labrador, many of the string or ribbed peatland complexes also consist of both bog and fen elements (Foster and King 1984, Foster and Glaser 1986, Wells 1996). Hence site and hydrological influence may have a large effect on whether the peatland is biologically rich or not.

The continuance of a fen ecosystem for a long period of time suggests a balance between plant production and plant decomposition. However, if rates of plant production exceed rates of plant decomposition, the level of the surface vegetation increases in elevation to a height above the influence of the nutrient-enriched seepage water, and the fen eventually develops into a bog. Deposition rates can average 1 – 2 mm/yr. Consequently, peat deposits in string bogs (1.0 – 2.0 m) tend to be deeper than those in ribbed fens (0.5 – 1.5 m). Overall, annual vegetation production increases the mass of peat eventually leading to a change in hydrological and nutrient regime, consequently changing the composition of surface vegetation. In ecological times, there is a succession from marsh to fen to bog as the site conditions move from minerotrophic to ombrotrophic (Wells and Hirvonen 1988). Fen habitats are more extensive north of Smallwood reservoir in Labrador. This area also contains extensive unpatterned fen-marsh complexes that appear to represent early succession toward ribbed fens and/or string bog, and is very important to all waterfowl groups because of the juxtaposition of deeper lentic waters with shallow peatlands. Pond and lake are enriched where peatlands encroach around margins and form fringe marshes or fens (Goudie and Whitman 1987).

3.3.2 Peatlands in MMNP

In the MMNP, low rainfall, high snowfall, a short growing season, and cool temperatures influence the development of extensive peatlands. The string bogs and ribbed fens are characterized by high water tables and, in spring, an abundance of surface water from snowmelt. Expanses of peatlands often occur on relatively flat and poorly drained basins. Altogether, these factors produce wet soil conditions for long periods of time (Wells and Hirvonen 1988).

String bogs and fens are extensive in the MMNP, and near the coast there is the southern limit for palsa bogs (Roberts and Robertson 1980), although the latter are not important for waterfowl. Palsas are found in peatlands near the southern limit of the permafrost zone, and are surrounded by unfrozen peatland, and pools and open water are common. Palsas have very low trafficability tolerance, and disturbance can disturb the insulating lichen layer and cause melting and collapse.

Podzolization is the main soil-forming process south of the continuous permafrost zone, and often there is a hardpan formation within a metre or so of the surface. This impervious layer impedes drainage and allows the development of wetlands, even when the soils are coarse-textured and permeable above and below this layer. In areas such as Porcupine Strand ecoregion these hardpans are over a metre thick, and this is a unique feature of the Labrador podzolic soils (Hirvonen 1984).

Our examination of the MMNP revealed that while patterned peatlands were present, there were also extensive amounts of unpatterned peatlands that appeared to be fen-marsh complexes because the appearance is more a random array of shallow ponds amid sedge marshes. These areas develop around fluvial influences of the many tributary streams and rivers in the low relief of the Eagle Plateau that supports the headwaters of the Eagle River, White Bear River, North River, English River and others.

Frequent seasonal inundation from these rivers and streams enrich adjacent peatlands and maintain the open meadow-like cover. Willow-alder-dwarf birch swamps frequently line the edges of river in floodplain areas, and are interspersed with sedge swamps. Goudie and Whitman (1987) noted that fen-marsh complexes maybe as important to geese and dabbling ducks as patterned fens, and more important to diving ducks (than ribbed fens) because the associated water bodies are larger and deeper. These findings could largely explain the relative importance of the Eagle Plateau in Labrador to most species of waterfowl.

3.3.3 Marshes and Swamps

The large network of lakes, ponds and peatlands on the eagle plateau, and along fluvial systems of the other ecoregions in the MMNP, such as Paradise River, result in extensive areas of shrub swamp dominated by willows (*Salix* spp.), alders (*Alnus rugosa*) and sometimes dwraf Birch (*Betula sp.)*. These shrub swamps are interspersed with fluvial sedge (*Carex* spp.) marshes, and can be very extensive at deltas of lakes and along meander reaches of rivers. Where water levels remain high into summer, those areas support relatively few breeding dabbling ducks, but where the flats are drier in summer the sedge-shrub (*Carex-Myrica*) marshes may be important to breeding and moulting waterfowl. These habitats are restricted in Labrador but important along the large rivers of the Postville and Eagle Plateau ecoregions (e.g. Lake 1155). These sites support rich habitat for waterfowl and other waterfowl (Goudie and Whitman 1987). Low relief brooks, especially in the Lake Melville and Porcupine Strand ecoregions, frequently support stable and often extensive sedge (*Carex* spp., especially *C. oligosperma*) marsh (e.g. Flatwater Brook), and are often enhanced by beaver activity (Goudie and Whitman 1987). Some of these marshes support concentrations of moulting waterfowl.

There are relatively few substantial intertidal marshes along the southeast coast of Labrador (Roberts and Robertson 1980). The nutritional value of the intertidal flora is much higher than any other wetland or terrestrial ecosystems. The intertidal marshes of southeastern Labrador are delta complexes (Reinson et al. 1979) that have been divided into 3 distinct vegetation zones:

I. Tidal mudflats – gently sloping zone between high and low tide with circular lenses on the upper slopes dominated by halophytes, notably the south shore of Groswater Bay.

II. Panne communities – shallow depressions among the sward communities frequently inundated by storm tides, the pools consist of estuarine and saline water, notably the south shore of Groswater Bay.

III. Sward communities – formed by delta sedimentation, and there is gentle upriver influence creating brackish water. Vegetation is a mosaic of halophytic and non-halophytic plant communities, notably the south shore of Groswater Bay.

The common plants of these intertidal marshes have been described by Roberts and Robertson (1980) among others. The unique flora of these marshes in southeastern Labrador is composed of temperate, circumpolar arctic and amphiarctic species. The Saltmarsh Cordgrass (*Spartina alterniflora*) reaches its northern range limit in southeastern Labrador and is important in stabilizing shoreline especially because of the predominance of sand and silt in many areas of Groswater Bay, Sandwich Bay, and Table Bay. These intertidal marshes are extremely fragile ecosystems and sensitive to environmental perturbations including trails, oil contamination and changes in tidal flow (Roberts and Robertson 1980).

3.3.4 Rivers and Streams

Rivers and streams and associated lakes and ponds abound in the MMNP with up to 30% of ecodistricts (e.g. V6 in Eagle Plateau) being covered in water. Some of the more significant rivers in Labrador occur here. Most notable is the Eagle River, the fifth largest river in Labrador with 81 tributaries and a drainage area of 10,824 km^2 originating in the maze of string bogs, ribbed fens and steadies located on the extensive plateau south of Mealy Mountains. Eagle River is considered one of them last great reserves for Atlantic Salmon (*Salmo salar*) and Brook Trout (*Salvelinus fontinalis*) in North America (Anderson 1985). It is well known for world class angling of Atlantic Salmon, and the large lakes at the headwaters such as Parke Lake, Lake 1155, and No Name Lake have had seasonal outfitting camps for the world-class Brook Trout fishing (as well as traditional use by Innu notably for waterfowl resources concentrated at *ashkui* in spring).

Also emptying in Sandwich Bay near Cartwright, the adjacent Paradise River is large with a 5,276 km^2 drainage area included in the study area yet this system is relatively unproductive for waterfowl and fish. There are extensive shrub swamps on this river as large portions are low gradient and a maze of small ponds and peatlands. The North River (2,234 km^2) is low-gradient with 60 tributaries with its source in the Mealy Mountains. The Kenamu River (4,403 km^2) is deserving special mention as it is the third largest river entering Lake Melville, and due to its pristine nature with large old growth Balsam Fir (*Abies balsamea*) Forests up to 60 cm dbh. A world-class watershed for canoeing and kayaking, and supporting large anadromous Salmonid populations and may support Atlantic Sturgeon (*Acipenser oxyrhynchus*), a rare species at or near its northern range limit. Also the northern Redhorse (*Moxostoma aureolum*) had been reported here (Riche 1965) but later not accepted as occurring in Labrador (Scott and Crossman 1973). There are likely these and other rarities in this watershed as the flora are diverse and unstudied, and soils and sites are rich.

Small watersheds of special mention include Flatwater Brook (299 $km^{2)}$, English River (640 km^2), and Kenemich River (699 km^2).

3.3.5 Classification of Wetlands

There have been only limited attempts at classification of wetlands in Labrador. Meades (1991) identified a large number of productive wetlands in Labrador. How exhaustive this inventory is remains uncertain, and it did not encompass the 1:250,000 NTS maps south of Lake Melville. Hunter and Associates (mid 1980's), under contract to Department of Forest and Lands, completed a full ecological classification of the 1:250,000 NTS Goose Bay map sheet, including wetlands and peatlands. This information was never published, and the whereabouts of this detailed work remains obscure. Reports and maps are apparently archived with Hunter and Associates Ltd. in

Mississauga, Ontario, and could still be accessed (G. Hunter, Pers. Comm.). Bazak (1973) undertook a biophysical classification of the Lake Melville area, and provided good ecological classification of the backshore area along the south side that is within the current proposed MMNP. He identified: Balsam Fir-White Birch forests -5 types, Black Spruce forests – 3 types, Larch forests – 1 type, Bogs and Fens – 4 bog types as ericaceous bogs, *Cladonia* bogs, sedge bogs, and floating bogs, and 1 fen type as Myrica fens along the flooded shoreline of Lake Melville, heath barrens, and alder thickets. Sedge bogs and floating bogs (equivalent to fringed lakes and ponds of Goudie and Whitman (1987) are the more important types for waterfowl.

3.3.6 Innu Knowledge

Some basic tradition aboriginal knowledge of wetlands has been amassed (e.g. Armitage 1996), and many of these areas are important *Ashkui* or open water areas used traditionally exploited for staging waterfowl in early spring. Armitage (2003) demonstrated the importance of using aboriginal knowledge to mapping important waterfowl habitat across landscapes. Armitage (2001, 2003) and Armitage and Stopp (2003) identified an extensive area in the upper Eagle River watershed area of *Akamiuapishku* (MMNP) where traditional harvesting of waterfowl were undertaken by Innu (Table 7). Waterfowl species observed and/or harvested by the Innu in the *Akamiuapishku* (MMNP) include Canada Geese, American Black Duck, scoters, Common Loon, Red-throated Loon, Northern Pintail, Common Goldeneye, Harlequin Duck, Long-tailed Duck, Red-breasted Merganser, scaup and gulls (Armitage and Stopp 2003). During aspects of the Environmental Impact Statement of Low level military jet training in Labrador (DND 1994) and the subsequent avoidance monitoring program, some wetland areas were identified for special consideration through examination of NTS map sheets (RRCS Ltd. 1993, 1994).

In the early 1990's, Environment Canada undertook some preliminary research to develop a protocol for wetland classification using landsat imagery. The outcome of this research remains somewhat ambivalent, and it may have suffered from not having the expertise within the Canadian Wildlife Service to oversee and implement a full comprehensive wetland classification prototype. Critical to a wetland classification system in Labrador is the potential to remotely classify wetlands, and notably discriminate string bog from patterned fen from marsh. The general opinion of experts that we consulted was that this is entirely possible using current satellite imagery technology (Pomeroy 2003).

Table 7. Some Innu locations traditionally used in the Mealy Mountain National Park study area[4].

Innu name	English name	Translation
Akamiuapishk	Mealy Mountains	White mountain across
Akaneshau-shipu	English River	English River
Amatshuatakan-shipiss		Ascending trail brook
Enakapeshakamau	Pants Lake	Pants Lake – shaped like pants
Eshkanat katshipukutiniht		**Where hanging antlers block the trail**
Iatuekupau	**Parke Lake**	**Row of willows**
Iku-shipiss		Louise Brook
Kamishikamat		Big Lake
Kanutaikant		Shooting-in-the-air place
Kaupashit		Small neck place
Mashku-nipi		**Bear Lake**
Mishta-masseku		Big Marsh
Mishtashini	**Rocky Pond**	**Big rock**
Misht-utshashku		Giant muskrat
Mitshishutshishtun		Eagle's nest
Nekanakau	**Lake 1155**	**Sandy Island**
Pepauakamau	**Crooks Lake**	**?**
Pishiu-nipi		Lynx Lake
Tshenuamiu-shipu	Kenamu River	Long river
Tshishkuepeu-shipiss		Silly drinking brook
Uapanatsheu-nipi	Noname Lake	Sneaking creature lake
Uinikush	Banana Lake	Sleepwalking (or tonsils?)
Ukaumau-nipi		Mother lake

Source: Armitage and Stopp (2003)

[4] Areas in bold are known by the Innu as important areas for migratory waterfowl

3.3.6 Environmental Assessments

Commencing in 1998, the Trans Labrador Highway (TLH) has been under planning and construction, and registered under the Environmental Assessment Act of the Government of Newfoundland and Labrador. Goudie (1998) undertook some air photo analyses of wetlands of the then proposed route between Cartwright and Goose Bay. More recently the area has been surveyed for waterfowl, and been subjected to further assessment of wetlands. However the initial draft EIS, and specifically the waterfowl Component Study, have not met the defined Terms of Reference (TOR) (Jacques Whitford Environment Ltd. 2003: Draft EIS: Trans Labrador Highway). No wetland classification was undertaken but they demonstrated curvilinear relationship of number of pairs of breeding waterfowl in relation to area of wetlands. Preliminary data arising from this work are available through the released draft EIS.

In 2003, further fieldwork was undertaken by JWEL on behalf of the proponent (Dept. of Works, Services and Transportation) in order to address the deficiencies of the submitted EIS. This work appears not to have addressed the defined deficiencies. Data arising from this work are integrated into this review of information on waterfowl and wetlands in the MMNP study area. Despite its deficiencies, this work represents the most extensive fieldwork to be conducted on waterfowl and wetlands in the MMNP study area, especially the extensive wetlands of the Eagle Plateau ecoregion.

3.3.7 Coastal Wetlands

In the coastal zone of the MMNP study area there have been some ecological classifications of the salt marsh and peatland habitats, notably Bajzak (1973 – *Myrica* fens), Roberts and Robertson (1980, 1986) and Scott *et al.* (1988). In the mid to late 1980's, the work of Hunter and associates referred to above may have relevance for wetland classification for the Goose Bay 1:250,000 NTS map sheet. This material is unpublished but still accessible through a few individuals, and provides very detailed biophysical information on some areas in the northern portion of the MMNP study area.

Coastline habitat associated with Lake Melville and Groswater Bay supports many areas of Saltmarsh Cordgrass (*Spartina alterniflora*), a habitat important for staging waterfowl (dabbling ducks and geese) and breeding Common Eiders. This habitat is relatively rare in the Newfoundland and Labrador. Large tidal amplitudes, deep glaciofluvial and fluvial deposits, and shallow water in Sandwich Bay, Table Bay and especially inner Groswater Bay result in extensive intertidal flats rich in invertebrates, and these are important to large aggregations of waterfowl. Sand dune is abundant along the Porcupine Strand and the potential for breeding Piping Plover (*Charadrius melodus*) currently listed as *Threatened* warrants further investigation there.

3.4 GIS Assessment

In order to provide biologically meaningful results we further assessed the MMNP by ecodistricts and ecotypes (Fig. 3). We undertook a preliminary GIS analysis of wetland habitat in the MMNP. For the purposes of this study, we examined NTS 1:50,000 scale monochrome maps and 1: 35,000 black and white air photos in order to undertake a preliminary classification of wetlands in the MMNP. We restricted our examination to 13B/15 and 13 G/9 because these areas support the extensive peatland-wetland-freshwater mazes that typify the Eagle Plateau ecoregion. At least in this ecoregion, the available GIS classification through the NTS includes shape files for forested habitat and non-forested habitat. Our examination supported that once the subarctic barrens and bare rock habitat of the Mealy Mountains ecoregion were removed, the remaining non-forested habitat was essentially wetlands comprised of peatlands, marsh, and inundated shorelines.

We quantified wetlands and lakes, ponds, river and brooks in the ecotypes of MMNP (Table 8). Wetlands important to waterfowl included peatlands (stringbogs and patterned fens), sedge marshes, fen-marsh complexes, shrub swamps, lakes, ponds, and rivers. For some ecotypes in the Eagle Plateau ecoregion (namely 239 & 241), wetlands comprised up to 65% of the coverage (Fig.4). This estimate is likely to be conservative because the data for brooks and streams is only available as a linear quantity and comprise some 4,977 km of the Eagle Plateau ecoregion. We highlight the significance of ecodistrict 323 for its predominance of wetlands, and by association waterfowl populations. We also noted that this is the general ecological area implicated in the proposed Trans Labrador Highway Phase III.

Brooks and streams in the Lake Melville and Porcupine Strand ecoregions frequently support rich fluvial marshes, important to staging, breeding and moulting waterfowl (e.g. Flatwater Brook, Groswater Bay; Lower Brook, Churchill River).

We provide some crude estimates of coverage of saltmarsh-coastal meadow habitats for the Lake Melville and Porcupine Strand ecoregions (~ 1% to 2%). We concur with Roberts and Robertson (1980) on the relative rarity (and sensitivity) of these sites in coastal southeast Labrador.

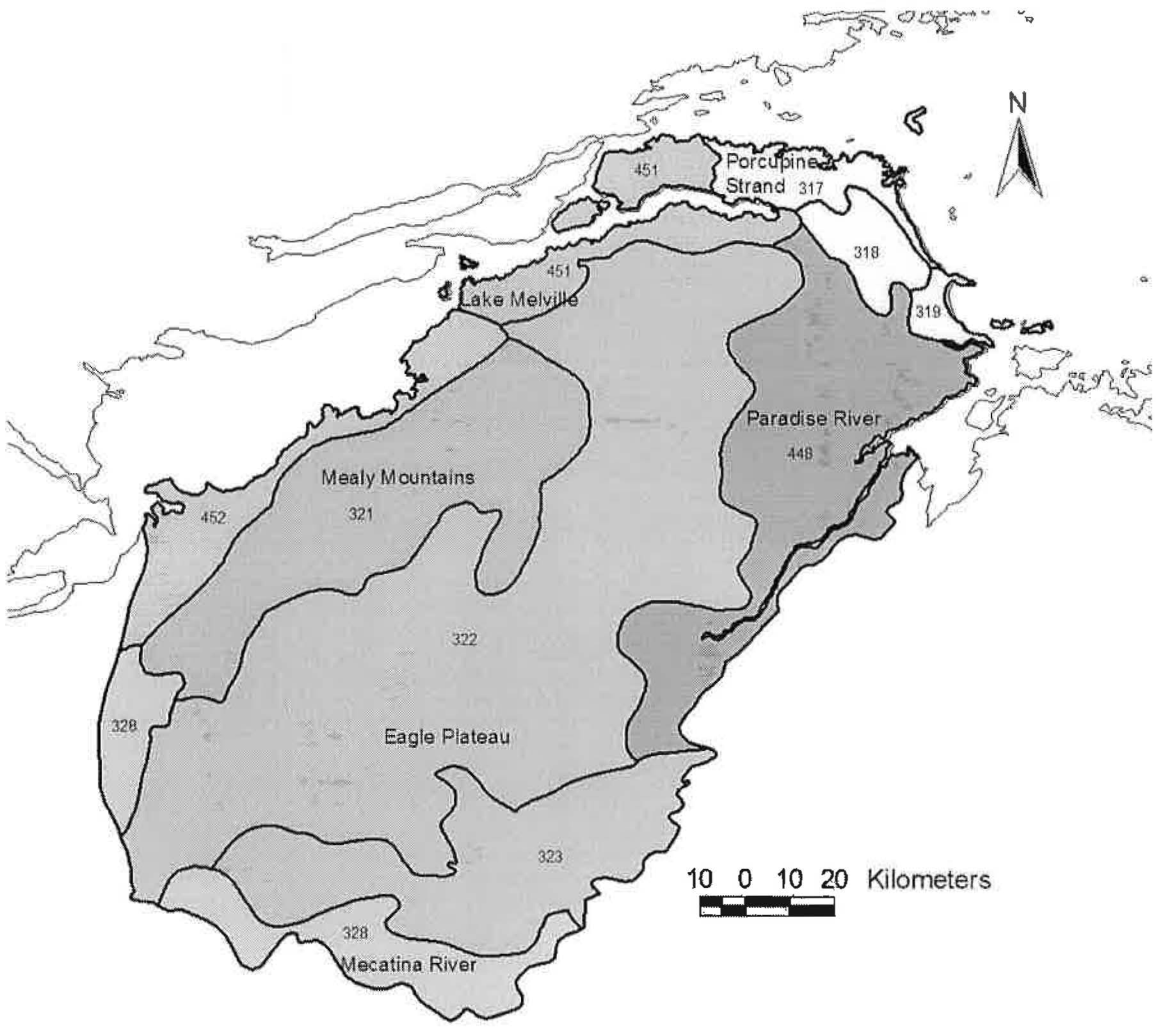

Figure 3a. Ecodistricts the Mealy Mountain National Park study area of Labrador.

Figure 3b. Ecotypes in the Mealy Mountain National Park study area of Labrador.

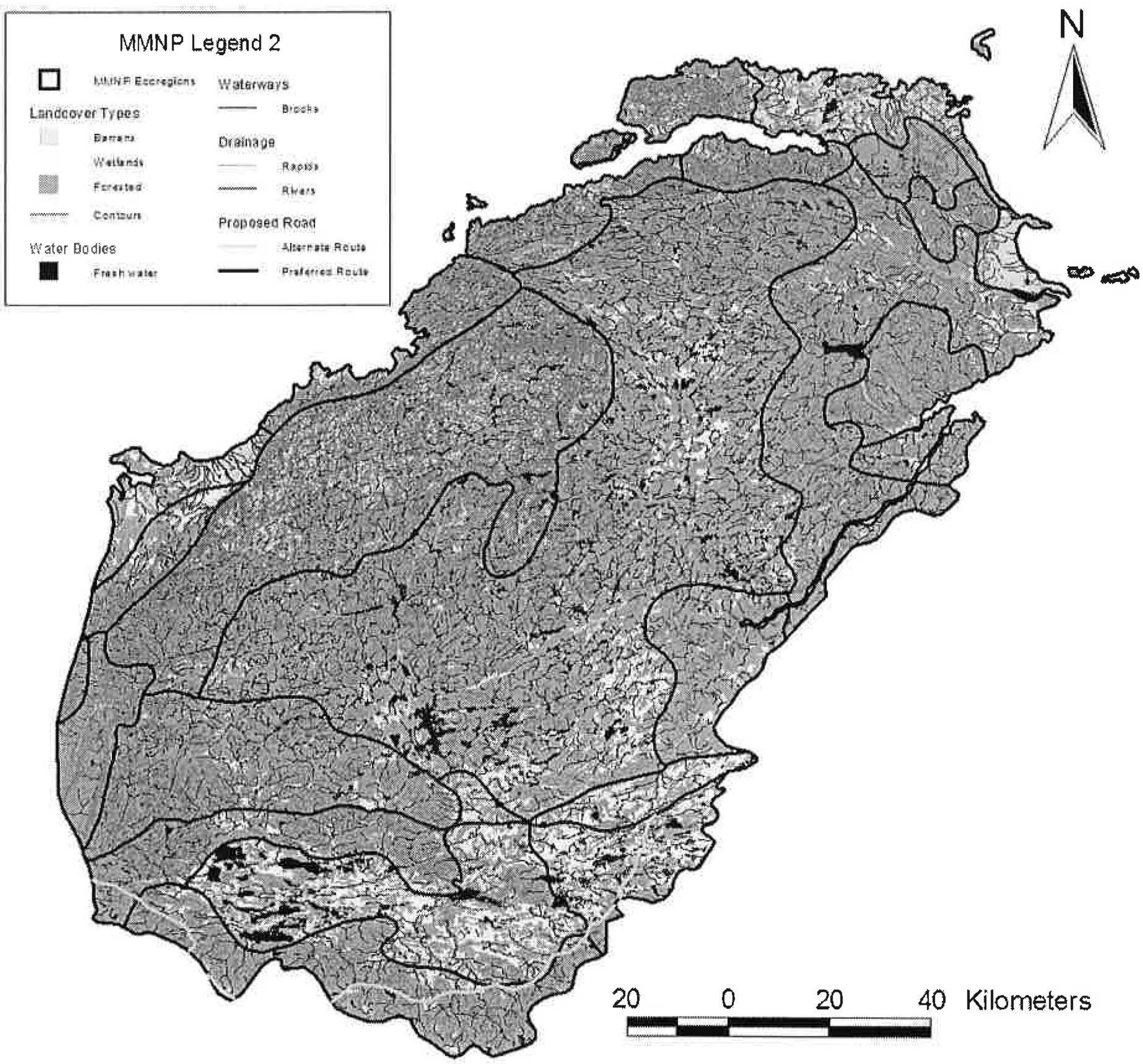

Figure 4. Habitat types in the Mealy Mountain National Park study area.

Table 8. Habitat composition of ecoregions and ecotypes in the Mealy Mountain National Park study area.

Ecoregion & Ecodistricts	km²	Forested (km²)	%	Peatland & Marsh (km²)	%	Lakes & Ponds (km²)	%	Rivers (km²)	%	Brooks (km)	Salt Marsh (km²)	%
Eagle Plateau	**11149**	**8,483**	**76.1%**	**2,676**	**24.0%**	**941**	**8.4%**	**82**	**0.7%**	**4,977**		
187	6772	5,519	81.5%	1,255	18.5%	595	8.8%	46	0.7%	3,134		
234	2048	1,831	89.4%	219	10.7%	69	3.4%	8	0.4%	1,078		
239	830	385	46.4%	450	54.2%	90	10.8%	1	0.1%	253		
241	1499	748	49.9%	752	50.2%	187	12.5%	27	1.8%	512		
Paradise River	**3081**	**2,754**	**89.4%**	**286**	**9.3%**	**75**	**2.4%**	**28**	**0.9%**	**1,586**		
185	1630	1,433	87.9%	163	10.0%	52	3.2%	14	0.9%	849		
200	478	445	93.1%	28	5.9%	5	1.0%	3	2.9%	216		
206	85	78	91.8%	6	7.1%	1	1.2%	0	0	58		
207	130	118	90.8%	11	8.5%	2	1.5%	1	0.8%	86		
212	146	136	93.2%	9	6.2%	5	3.4%	1	0.7%	67		
217	612	544	88.9%	69	11.3%	10	1.6%	9	1.5%	310		
Mecatina River	**1452**	**1,336**	**92.0%**	**111**	**7.6%**	**22**	**1.5%**	**6**	**0.4%**	**752**		
228	368	358	97.3%	4	1.1%	2	0.5%	5	1.4%	190		
229	51	49	96.1%	1	2.0%	1	2.0%	0	0	35		
246	1033	929	89.9%	106	10.3%	19	1.8%	1	0.1%	527		
Lake Melville	**1958**	**1,461**	**74.6%**	**280**	**14.3%**	**25**	**1.3%**	**15**	**0.8%**	**1,245**	**15**	**0.8%**
173	284	186	65.5%	28	9.9%	3	1.1%	0	0	133	2	0.7%
181	41	21	51.2%	3	7.3%	1	2.4%	0	0	5	1	2.4%
182	249	226	90.8%	16	6.4%	1	0.4%	0	0	159	5	2.0%
183	377	303	80.4%	42	11.1%	4	1.1%	4	1.1%	238	2	0.5%
195	402	303	75.4%	66	16.4%	12	3.0%	1	0.3%	267	3	0.7%
204	317	200	63.1%	70	22.1%	2	0.6%	5	1.6%	217	2	0.6%
213	287	221	77.0%	55	19.2%	2	0.7%	5	1.7%	226	0	0.0%
224	1	1	100%	0	0.0%	0	0.0%	0	0	0	0	0.0%
Porcupine Strand	**1079**	**652**	**60.4%**	**84**	**7.8%**	**33**	**3.1%**	**3**	**0.3%**	**464**	**16**	**1.5%**
168	497	228	45.9%	59	11.9%	18	3.6%	2	0.4%	223	15	3.0%
179	249	225	90.4%	12	4.8%	10	4.0%	0	0	91	0	0.0%
184	11	6	54.5%	0	0.0%	0	0.0%	0	0	0	0	0.0%
188	173	160	92.5%	10	5.8%	2	1.2%	0	0	83	0	0.0%
191	149	33	22.1%	3	2.0%	3	2.0%	1	0.7%	67	1	0.7%

Overall, there are a large number of sites of importance for waterfowl and wetlands in and adjacent to the MMNP (Fig. 5).

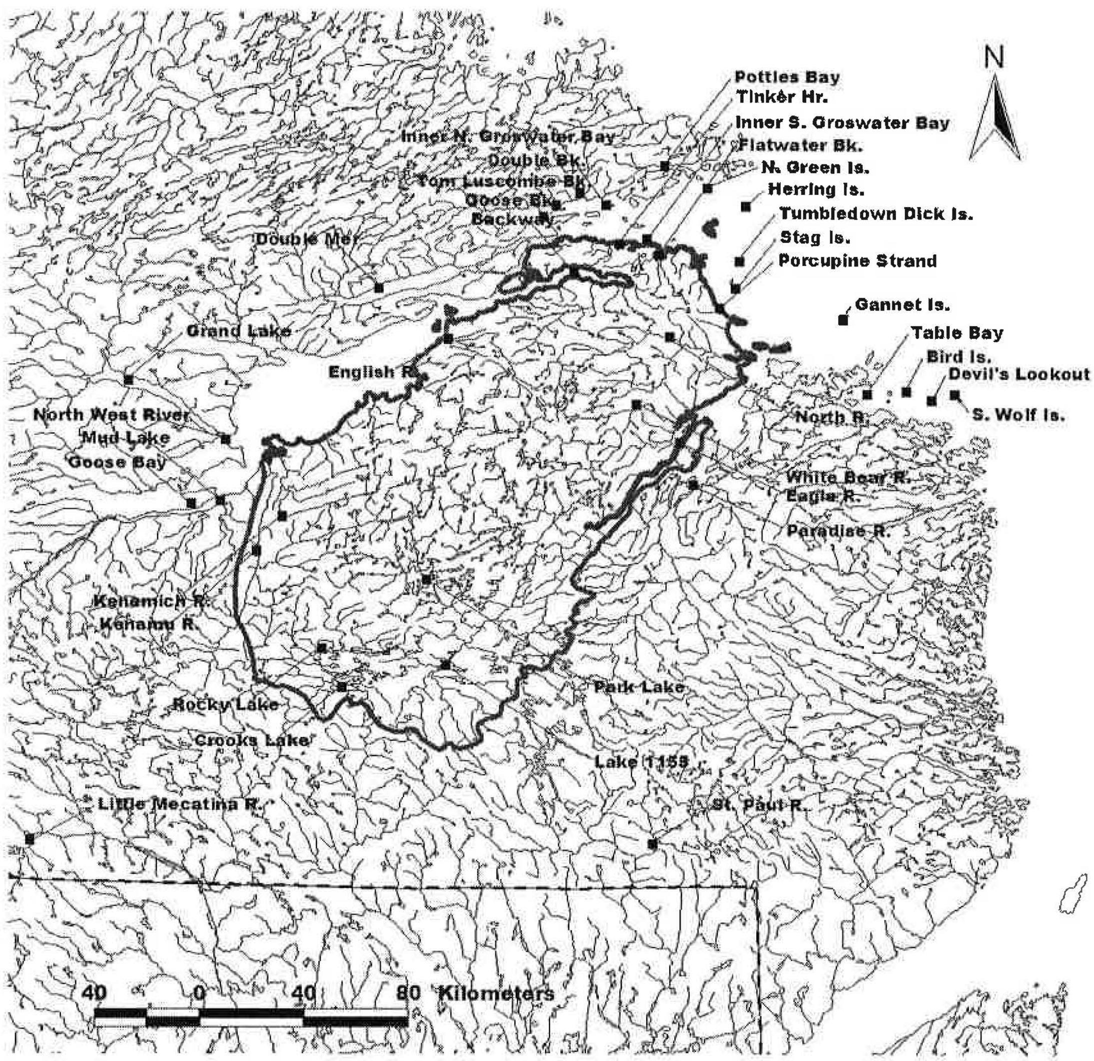

Figure 5. Sites of importance and place names in the Mealy Mountain National Park study area.

4. CONCLUSIONS AND RECOMMENDATIONS

The Mealy Mountain National Park study area is a vast 21,682 km^2 hinterland that supports taiga and boreal ecozones. Of 6 ecoregions described for the study area, the Eagle Plateau stands out for its extensive wetlands and associated waterfowl populations. While some fragmentary knowledge of waterfowl exists for the general area, we conclude that data are insufficient to make concluding statements about status of populations vis-à-vis numbers or trends or even distribution. Ongoing and past studies of waterfowl and wetlands are compromised by the large geographic expanse of Labrador, and the considerable inherent cost to undertake surveys. Confidence in generated density and population estimates is very low. In some cases we question whether current approaches attempting to measure population trends are providing any meaningful information.

As a political unit, Labrador is the most important area sustaining breeding waterfowl that supply the fall flights into the north Atlantic Flyway. The Eagle Plateau ecoregion is one of the most important ecological units contributing to these populations. In particular, Labrador supports the bulk of breeding sea ducks that are currently of international conservation concern.

Some of the most significant waterfowl resources in Labrador lie adjacent to or immediately outside the current study area boundaries, and we highlight the significance of the Backway (Lake Melville) and inner Groswater Bay to moulting scoters and other sea ducks, and migrating shorebirds. The largest breeding colonies of the Common Eider in Newfoundland and Labrador occur in inner Groswater Bay and Table Bay, and along with Sandwich Bay, these sites support extensive intertidal flats and the Saltmarsh Cordgrass reaches its northern limit of distribution in this region of Labrador. Aggregations of staging waterfowl in spring and especially fall are among the largest recorded for the province of Newfoundland and Labrador (e.g. 6,000 to 10,000 Canada Geese at Goose Brook in inner Groswater Bay). More offshore in Groswater Bay and

Table Bay are large diverse colonies of Alcids that are clearly of national significance, and vulnerable to perturbations because of lack of any formal protection.

The Kenamu River watershed is a pristine wilderness River with very high productivity, and the old growth softwood forests may offer unique flora and associated fauna. Rare species of fish or species at risk are likely in this watershed. The highly kettled topography of terraces and ridges near Mud Lake appear to offer unique habitat features that result in relatively high concentrations of breeding sea ducks, notably Surf Scoters, and this area warrants further examination (Fig. 6).

We provide a number of general recommendations to improve the knowledge base and potential conservation measures for these resources:

1. We recommend that the Mealy Mountain National Park study area be expanded to more holistically encompass coastal components in Groswater Bay and Table Bay because the study area lies adjacent to waterfowl, seabird, and other migratory bird resources and habitats of regional, national and international significance. A more integrated review of these populations could help link breeding populations of some waterfowl with staging and moulting aggregations on the adjacent coasts.

2. We recommend the inclusion of the Kenamu River watershed, and important wetlands/coastal areas of Lake Melville (e.g. Backway).

3. Waterfowl and wetland resources within the Mealy Mountain National Park study area need a more focused inventory, and application of a validated monitoring program that would provide precise estimates of population trends.

4. We consider that the Mealy Mountain National Park study area could be encompassed in a biophysical classification resolving habitats (e.g. wetlands, and forests) to ecological site classifications, and that this could be completed by combining landsat imagery with an integrated ground-truthing program.

5. An accurate ecological classification would provide an excellent base against which waterfowl and wetlands inventories and monitoring programs could be stratified and designed, and applied.

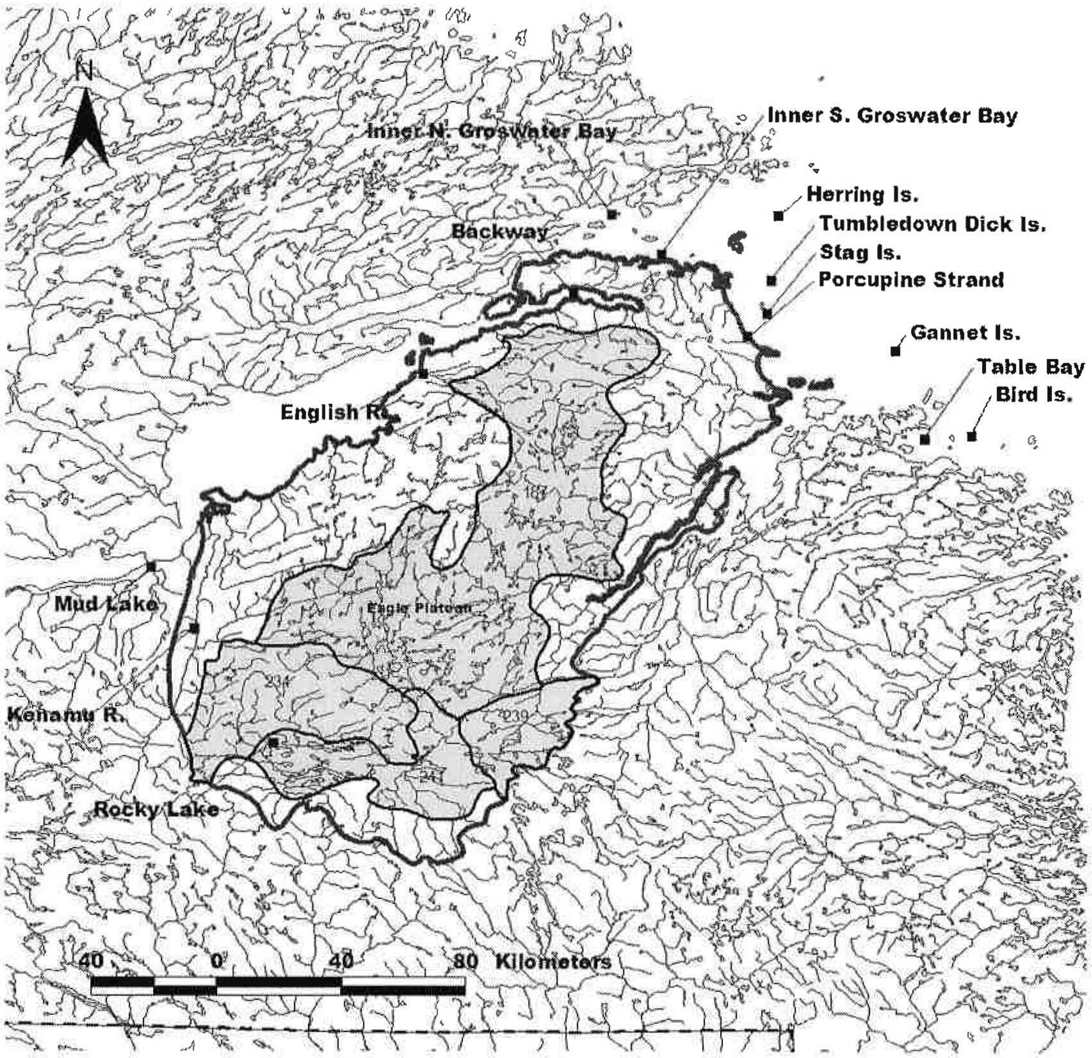

Figure 6. Wetland and waterfowl areas of regional, national and international significance in and adjacent to the Mealy Mountain National Park study area.

6. ACKNOWLEDGEMENTS

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Appendix 1. Waterfowl detected on annual surveys by plot.

Plots within the MMNP

BDJV#21

Species	1990	1991	1992	1993	1994	1996	1998	2000	2002
AMBL	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
AGWT	0 (0)	0 (0)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (1)	0 (0)
Dabblers	0 (0)	0 (0)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (1)	0 (0)
RNDU	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
COGO	4 (2)	2 (1)	0 (0)	2 (1)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)
COME	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	0 (0)	0 (0)
RBME	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SUSC	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Divers	4 (2)	2 (1)	0 (0)	2 (1)	1 (0)	0 (0)	2 (1)	0 (0)	0 (0)
CAGO	13 (3)	10 (5)	0 (0)	6 (5)	1 (1)	4 (2)	2 (1)	5 (3)	1 (1)

BDJV#36

Species	1996	1997	2000	2001
AMBL	1 (1)	0 (0)	0 (0)	5 (3)
AGWT	1 (2)	0 (0)	0 (1)	5 (0)
Dabblers	2 (3)	0 (0)	0 (1)	10 (3)
RNDU	0 (0)	0 (0)	0 (0)	11 (0)
COGO	0 (0)	2 (1)	2 (1)	0 (0)
COME	0 (0)	0 (0)	0 (0)	0 (0)
RBME	0 (0)	0 (0)	0 (0)	0 (0)
SUSC	0 (0)	0 (0)	0 (0)	2 (2)
Divers	0 (0)	2 (1)	2 (1)	13 (2)
CAGO	6 (4)	2 (1)	4 (2)	1 (1)

Plot: DND9

Species	1995	1995	1997	1998	1999	2000
ABDU	0	0	0	2	8	8
MALL	4	0	0	0	2	0
AGWT	0	2	2	4	6	4
Dabblers	4	2	2	6	16	12
RNDU	2	0	0	0	2	6
Scaup	0	0	0	0	2	4
COGO	10	4	0	4	0	2
COME	2	14	6	20	2	26
HOME	0	0	0	0	2	2
RBME	25	0	22	24	36	16
BLSC	0	0	0	0	0	0
SUSC	0	2	4	0	2	0
Divers	39	20	32	48	46	56
CAGO	6	29	16	12	12	2

Plots near boundary of MMNP

BDJV#22

Species	1990	1991	1992	1993	1994	1995	1998	1999	2002
AMBL	2 (1)	0 (0)	0 (0)	2 (1)	1 (1)	0 (0)	0 (0)	2 (1)	0 (0)
AGWT	2 (0)	0 (0)	0 (0)	2 (1)	1 (2)	0 (1)	0 (0)	2 (0)	0 (0)
Dabblers	4 (1)	0 (0)	0 (0)	2 (1)	2 (3)	0 (1)	0 (0)	4 (1)	0 (0)
RNDU	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
COGO	2 (1)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
COME	0 (0)	3 (2)	1 (0)	0 (0)	1 (1)	2 (2)	2 (1)	3 (3)	0 (0)
RBME	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SUSC	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Divers	2 (1)	5 (3)	1 (0)	0 (0)	1 (1)	2 (2)	2 (1)	3 (3)	0 (0)
CAGO	1 (1)	0 (0)	0 (0)	2 (2)	7 (4)	2 (1)	6 (2)	4 (2)	0 (0)

BDJV#24

Species	1990	1991	1992	1993	1994	1996	1998	2000
AMBL	0 (0)	6 (3)	6 (3)	11 (3)	7 (4)	7 (1)	1 (1)	2 (1)
AGWT	0 (3)	6 (1)	6 (2)	11 (2)	7 (2)	7 (0)	1 (0)	2 (1)
Dabblers	0 (3)	12 (4)	12 (5)	22 (5)	14 (6)	14 (1)	2 (1)	4 (2)
RNDU	2 (1)	4 (2)	0 (0)	0 (0)	0 (0)	0 (0)	10 (1)	3 (2)
COGO	80 (8)	56 (15)	24 (13)	51 (12)	38 (11)	30 (11)	31 (14)	23 (9)
COME	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
RBME	0 (0)	0 (0)	0 (0)	4 (2)	0 (0)	0 (0)	0 (0)	0 (0)
SUSC	37 (3)	22 (7)	2 (1)	21 (7)	16 (4)	15 (4)	18 (10)	22 (11)
Divers	119 (12)	82 (24)	26 (14)	76 (21)	54 (15)	45 (15)	59 (25)	48 (22)
CAGO	2 (2)	7 (4)	1 (1)	4 (0)	3 (2)	2 (2)	8 (5)	5 (3)

Plots Proximate SE to SW of the MMNP

BDJV #23

Species	1990	1991	1992	1993	1994	1995	1998	1999	2002
AMBL	4 (3)	6 (3)	3 (2)	0 (0)	11 (5)	7 (3)	1 (1)	5 (3)	0 (0)
AGWT	4 (1)	6 (1)	3 (1)	0 (0)	11 (0)	7 (4)	1 (3)	5 (1)	0 (2)
Dabblers	8 (4)	12 (4)	6 (3)	0 (0)	22 (5)	14 (7)	2 (4)	10 (4)	0 (2)
RNDU	3 (2)	4 (2)	0 (0)	2 (1)	0 (0)	2 (1)	0 (0)	0 (0)	2 (1)
COGO	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	2 (1)
COME	0 (0)	2 (1)	2 (1)	2 (1)	0 (0)	6 (3)	0 (0)	0 (0)	0 (0)
RBME	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)
SUSC	0 (0)	4 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Divers	3 (2)	10 (6)	2 (1)	4 (2)	0 (0)	10 (4)	0 (0)	1 (1)	2 (1)
CAGO	7 (5)	3 (2)	0 (0)	5 (3)	3 (2)	2 (2)	4 (4)	4 (2)	5 (3)

BDJV #25

Species	1990	1991	1992	1993	1994	1997	1999	2001	2002
AMBL	21 (9)	19 (12)	16 (8)	4 (0)	9 (3)	12 (3)	13 (8)	16 (8)	21 (9)
AGWT	21 (1)	19 (6)	16 (2)	4 (0)	9 (3)	12 (4)	13 (3)	16 (5)	21 (6)
Dabblers	42 (10)	38 (18)	32 (10)	8 (0)	18 (6)	24 (7)	26 (11)	21 (13)	42 (15)
RNDU	9 (4)	5 (3)	13 (1)	0 (0)	12 (5)	0 (0)	0 (0)	3 (1)	14 (7)
COGO	5 (2)	5 (3)	33 (4)	9 (0)	6 (0)	6 (3)	4 (2)	9 (6)	1 (1)
COME	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	2 (1)	2 (1)	3 (2)	0 (0)
RBME	2 (1)	4 (2)	2 (1)	0 (0)	2 (1)	2 (2)	0 (0)	0 (0)	0 (0)
SUSC	18 (11)	21 (2)	36 (4)	20 (4)	19 (4)	2 (1)	5 (1)	25 (13)	18 (10)
Divers	34 (18)	35 (10)	84 (10)	29 (4)	41 (11)	12 (7)	11 (4)	40 (22)	33 (18)
CAGO	0 (0)	8 (2)	2 (1)	10 (7)	4 (3)	3 (2)	12 (6)	11 (7)	9 (6)

BDJV #45

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002
AMBL	0 (0)	6 (4)	2 (1)	1 (1)	0 (0)	4 (2)	5 (3)	6 (1)	2 (2)
AGWT	0 (1)	6 (0)	2 (1)	1 (0)	0 (0)	4 (0)	5 (2)	6 (1)	2 (0)
Dabblers	0 (1)	12 (4)	4 (2)	2 (1)	0 (0)	8 (2)	10 (5)	12 (2)	4 (2)
RNDU	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
COGO	0 (0)	5 (4)	3 (2)	2 (1)	1 (1)	15 (1)	41 (1)	2 (2)	7 (4)
COME	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (2)
RBME	0 (0)	0 (0)	0 (0)	0 (0)	9 (8)	5 (0)	1 (1)	2 (1)	0 (0)
SUSC	0 (0)	0 (0)	2 (1)	0 (0)	2 (1)	1 (0)	2 (1)	0 (0)	0 (0)
Divers	0 (0)	5 (4)	5 (3)	2 (1)	12 (10)	21 (1)	44 (3)	4 (3)	11 (6)
CAGO	1 (1)	2 (2)	6 (3)	3 (2)	2 (1)	3 (2)	0 (0)	0 (0)	6 (1)

BDJV #38

Species	1996	1998	2000
AMBL	2 (1)	10 (0)	17 (9)
AGWT	2 (1)	10 (1)	17 (2)
Dabblers	4 (2)	20 (1)	34 (11)
RNDU	0 (0)	0 (0)	6 (1)
COGO	1 (1)	5 (3)	1 (0)
COME	0 (0)	0 (0)	0 (0)
RBME	0 (0)	0 (0)	0 (0)
SUSC	0 (0)	0 (0)	0 (0)
Divers	1 (1)	5 (3)	7 (1)
CAGO	4 (2)	2 (1)	3 (1)

DND #3

Species	1994	1995	1996	1997	1998	1999	2000
ABDU	24	28	44	19	26	17	14
MALL	4	0	2	0	0	0	0
AGWT	6	2	2	0	0	2	14
NOPI	0	2	4	0	0	0	0
Dabblers	34	32	52	19	26	19	28
RNDU	0	2	0	0	0	0	0
Scaup	2	2	0	0	0	0	6
COGO	25	22	20	31	6	15	47
COME	4	2	8	12	4	0	4
HOME	4	0	2	0	4	3	0
RBME	0	4	0	4	26	12	16
BLSC	0	0	0	0	0	2	0
SUSC	2	12	16	22	4	5	30
HARD	0	0	0	4	2	0	8
Divers	37	44	46	73	46	37	111
CAGO	6	9	16	18	6	13	8

DND#1

Species	1994	1996	1997	1998	1999	2000
ABDU	62	108	62	122	172	150
MALL	0	2	4	6	2	6
AGWT	38	38	27	20	52	76
NOPI	2	2	0	0	4	4
Dabblers	102	150	93	148	230	236
RNDU	10	11	6	15	50	26
Scaup	31	38	31	2	6	29
COGO	23	18	15	16	32	22
COME	2	12	0	10	0	2
RBME	6	0	2	4	10	4
BLSC	0	4	7	4	6	2
SUSC	40	82	64	42	67	60
Divers	112	165	125	93	171	145
CAGO	30	49	60	78	91	60