In the footsteps of J.A. Munro

Waterbirds and wetlands in the Cariboo parklands, British Columbia
A comparative study: 1938, 1958, 2001

Neil K. Dawe
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Abstract

In the late 1930's, James A. Munro described 54 wetlands or wetland complexes and the associated waterbird fauna in the Cariboo parklands region of central British Columbia. Concerned about the potential loss of these wetlands through increasing population growth and economic development, he revisited these same wetlands in 1958 and recorded the changes he observed both in the habitat and the bird numbers. Following in Munro's footsteps, we re-sampled 35 (65%) of these wetland areas in 2001 and compared our results with his earlier inventories. For the purpose of future comparison, we described some aspects of the physical and chemical characteristics of these wetlands and photo documented each of them. We also document the other wetland birds associated with these areas, which were omitted from Munro's earlier inventories.

In general, we found Munro's qualitative descriptions of these wetlands to be remarkably similar to what we observed in 2001. Nearly half (46%) of the 35 wetlands or wetland complexes we examined had been enhanced for waterfowl by Ducks Unlimited Canada. Wetland haying was less prevalent than what Munro described in 1958, as were sawmill developments and logging on the adjacent uplands. Cattle grazing seemed to occur at similar or slightly higher levels than before, although access to some wetlands by livestock was more restricted than in Munro's time. However, several wetlands showed evidence of eutrophication due to intensive cattle grazing on the adjacent uplands. Bordering residential and cottage developments were also more widespread than during Munro's surveys. A few sites were also degraded by infilling as a result of transportation or light industrial developments.

On the wetlands where comparison was valid, waterbird diversity and numbers were generally higher than or similar to what Munro had observed in the late 1930's and 1950's. In 2001, we recorded all 23 loon, grebe, and waterfowl species documented by Munro; 16 species showed higher abundance levels than before, including the Common Loon, Pied-billed Grebe, Red-necked Grebe, Eared Grebe, Canada Goose, Mallard, Blue-winged Teal, Cinnamon Teal, Northern Shoveler, American Wigeon, Redhead, Ring-necked Duck, Lesser Scaup, Hooded Merganser, Ruddy Duck and American Coot. Seven species were less abundant (Horned Grebe, Green-winged Teal, Northern Pintail, Canvasback, White-winged Scoter, Bufflehead, Barrow's Goldeneye). We also recorded 5 new species that were not reported by Munro, including the Western Grebe, Wood Duck, Gadwall, Surf Scoter, and Common Goldeneye; Gadwall and Common Goldeneye comprised a significant component of the breeding avifauna. Although very scarce during Munro's time, the Canada Goose was also among the most abundant and widespread of the waterbirds in 2001.

We found that many of Munro's concerns had not materialized over the period under review. The region has seen comparatively low population and economic growth since Munro's time. Waterfowl hunting in the region has decreased dramatically in recent years and has proven to be much less a threat to waterfowl populations than was predicted by Munro. Concern over logging that was considered "exploitation" by Munro now has more stringent regulations.

We close by recommending some modifications to forestry and ranching practices, as well as recreational activities, that could further help reduce impacts to the wetlands and the waterbirds in the region.

Résumé

À la fin des années 1930, James A. Munro a décrit 54 milieux humides ou complexes de milieux humides ainsi que l'avifaune aquatique des parcs de la région de Cariboo, située au centre de la Colombie-Britannique. Inquiet de l'éventuelle disparition de ces milieux en raison de la croissance démographique et du développement économique, il les a revisités en 1958 pour noter les changements dans les caractéristiques de l'habitat et dans le nombre d'oiseaux. En 2001, suivant les traces de Munro, nous avons rééchantillonné 35 (65 %) de ces milieux humides ou complexes de milieux humides, puis nous avons comparé nos résultats avec ceux des relevés de Munro. À des fins de comparaison future, nous avons décrit certains aspects des caractéristiques physiques et chimiques de ces milieux humides. Chaque milieu a été appuyé de photographies. Nous avons aussi documenté d'autres espèces d'oiseaux aquatiques de la région, non mentionnées dans les relevés de Munro.

En général, les descriptions qualitatives tirées des études de 1958 de Munro sont étonnamment semblables à ce que nous avons observé en 2001. Près de la moitié (46 %) des 35 milieux humides ou complexes de milieux humides examinés avaient été améliorés pour les oiseaux aquatiques par Canards Illimités Canada. Par ailleurs, la récolte du foin en milieux humides, de même que les activités des scieries et l'exploitation forestière en milieux secs, était moins pratiquée en 2001 qu'en 1958. Le broutage était de même intensité ou légèrement plus intense qu'à l'époque de Munro, et ce, même si l'accès du bétail à certains milieux humides était plus limité en 2001. En fait, l'eutrophisation évidente de plusieurs milieux humides était probablement due au broutage intense dans des milieux secs voisins. Les zones adjacentes de résidences et de chalets étaient également plus nombreuses que lors des relevés de Munro. Quelques sites ont aussi été détériorés par le remblayage effectué pour l'aménagement des routes et l'installation d'industries légères.

Dans les milieux humides que nous avons pu comparer, la diversité et le nombre d'oiseaux aquatiques étaient généralement semblables ou plus importants que ceux observés par Munro à la fin des années 1930 et 1950. En 2001, nous avons observé les 23 espèces de plongeons, de grèbes et d'autres oiseaux aquatiques répertoriés par Munro. Seize espèces (70 %) étaient plus abondantes qu'avant, dont le Plongeon huard, le Grèbe à bec bigarré, le Grèbe jougris, le Grèbe à cou noir, la Bernache du Canada, le Canard colvert, la Sarcelle à ailes bleues, la Sarcelle cannelle, le Canard souchet, le Canard d'Amérique, le Fuligule à tête rouge, le Fuligule à collier, le Harle couronné et l'Érismature rousse. Sept espèces étaient moins abondantes (Grèbe esclavon, Sarcelle d'hiver, Canard pilet, Fuligule à dos blanc, Macreuse brune, Petit Garrot et Garrot d'Islande). Nous avons aussi dénombré cinq nouvelles espèces dans les zones de nidification échantillonnées, qui n'avaient pas été signalées par Munro : le Grèbe élégant, le Canard branchu, le Canard chipeau, la Macreuse à front blanc et le Garrot à œil d'or. Le Canard chipeau et le Garrot à œil d'or étaient des espèces importantes pour la reproduction de l'avifaune en 2001. La Bernache du Canada, très rare à l'époque de Munro, était l'une des espèces d'oiseaux aquatiques les plus abondantes et les plus répandues dans la région d'étude.

Nous avons constaté que nombre des inquiétudes de Munro ne se sont pas réalisées. Depuis l'époque de Munro, la région a connu une croissance démographique et économique relativement faible. Ayant considérablement diminué au cours des dernières années, la chasse à la sauvagine représente une menace moins grande pour les populations d'oiseaux aquatiques que l'avait prédit Munro. L'industrie forestière que Munro considérait comme une « exploitation » doit maintenant se conformer à des règlements plus stricts. Par contre, l'élevage, aux effets mineurs selon Munro, a eu un impact plus grave sur l'environnement.

Pour conclure, nous recommandons des modifications aux pratiques forestières et d'élevage ainsi que des mesures de gestion des activités récréatives, qui aideraient à réduire les impacts sur les milieux humides et les oiseaux aquatiques des parcs de la région de Cariboo.

Preface

The late J.A. Munro was the first Chief Federal Migratory Bird Officer for British Columbia, where he worked from 1920 until his retirement in 1949. During that time, he wrote over 175 publications including 16 monographs on some of the waterbirds of the province, 6 regional faunistic studies, and his 1947 *Review of the bird fauna of British Columbia*, authored together with Ian McTaggart-Cowan (Campbell et al. 1990a). Munro and Cowan (1947) was *the* "bible" for those wishing to know about the distribution of birds in the province and remained so for 43 years, until the publication of *The Birds of British Columbia* in 1990.

Munro spent much of his field time in the Cariboo parklands and over the years had become concerned about the impacts humans were causing to the most concentrated waterfowl nesting-habitat in the province. He had seen a hard surfaced highway replace the winding gravel road, motels and lodges replace the few lumber camps, forests criss-crossed by a myriad of logging roads allowing hunter access to formerly inaccessible waterfowl habitat, and the human population of the area grow considerably.

Munro recognized the potential effects that economic expansion and population growth might have on the migratory birds of the area (Munro 1945, 1958). His concern prompted additional field studies in 1958, a year before his death, that resulted in an unpublished work comparing the wetlands and waterbird numbers of that year with similar work he had carried out on the same wetlands between 1937 and 1943 (Munro 1958).

This study follows in his footsteps.

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Air photos were used in this report courtesy of Government of British Columbia. Krista Amey scanned the image of J.A. Munro.

Doug, Lorraine, and Kathy Whitesell, Crystal Springs Historical Resort, Lac la Hache, helped us locate some of the colloquially named wetlands that Munro mentioned and provided us with contacts for the area. Their thoughtfulness made our stay at Crystal Springs most enjoyable.

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Introduction

The Cariboo parklands hold some of the finest waterbird nesting habitat in British Columbia. A myriad of wetlands scattered across the pine-fir-aspen forests and rangeland landscape draws significant populations of waterfowl, loons, grebes, rails and other birds dependent on these breeding and rearing sites. It was these features that brought J.A. Munro back to the Cariboo time and time again. And it was his concern over the potential loss of this natural wonder that caused him to document the wildlife values of this rich biotic area. As he notes in his 1945 review of the bird fauna of the Cariboo parklands (Munro 1945):

> *The future of wildlife, a self-renewing resource derived from the land and entirely dependent on it, is directly involved with human expansion in space. This being so, and because wildlife is a source of wealth in the fullest sense of the term, it is a matter of some importance to take stock from time to time, to record the results of such stock-taking, and to put on record also what can be learned of past conditions before the memories of these have passed with those who held them.*

Later, in his 1958 report he notes:

> *…the resident human population has grown proportionately and modern villages complete with supermarkets replace the more primitive settlements of 20 years ago.*
>
> *To what extent, if any, these developments have affected waterfowl populations has been a matter of increasing speculation and it has seemed desirable that an attempt be made to answer this question.*

This report, following in the footsteps of Munro (1958), is our attempt to answer a similar question: to what extent over the past 40 years have wetlands of the Cariboo parklands and the waterbirds dependent on them changed when compared with Munro's (1958) findings?

Study Area

The study area extends from 70 Mile House in the south to Williams Lake in the north and from Fawn Lake in the east to Westwick Lakes in the west (Figure 1). The area lies within the Cariboo Plateau and Chilcotin-Cariboo Basin ecosections of the Fraser Plateau Ecoregion in the Central Interior Ecoprovince. All but one of the nesting areas are in the Interior

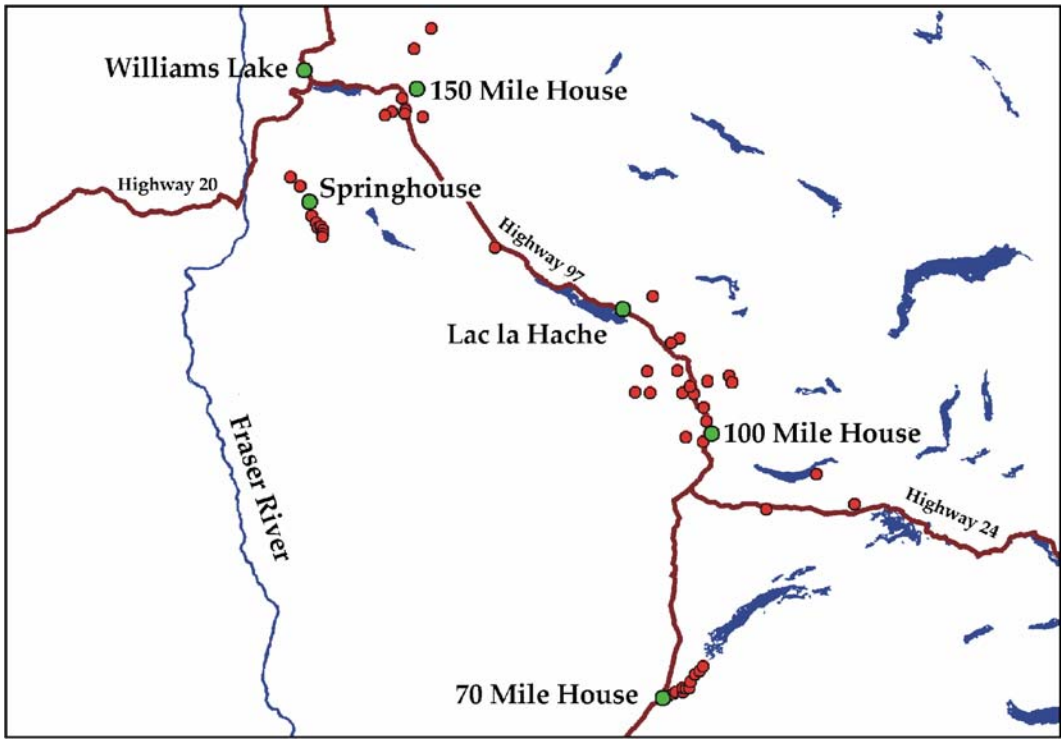

Figure 1. Map of the study area in the Cariboo Parklands. The nesting areas under review are shown as small circles.

Table 1. Nesting areas surveyed in the Cariboo parklands by Munro (1958) and this study, showing dates of the breeding waterbird bird surveys.

Location	Survey Date			Location	Survey Date		
	Munro		This Study		Munro		This Study
	1938	1958	2001		1938	1958	2001
Abel Lake	23-Jul	27-Jul	14-Jun	Sepa Lake	21-Jul	29-Jul	14-Jun
Anthony Lake	30-Jul	25-Jul	NS[1]	**70 Mile House sloughs**[5]	6-Jun	5-Jun	5-Jun
Boitano Lake	12-Jun	24-Jun	5-Jun	70 Mile House slough 1			5-Jun
Clinton Lakes[2]	30-Jun	30-Jun	NS	70 Mile House slough 2			5-Jun
Cummings Lake	9-Jun	16-Jun	12-Jun	70 Mile House slough 3			5-Jun
Dewar Lake	14-Aug	14-Aug	16-Jun	70 Mile House slough 4			5-Jun
Disaster Lake	18-Jul	16-Jul	NS	70 Mile House slough 5			5-Jun
Dugan Lake	14-Aug	14-Aug	16-Jun	70 Mile House slough 6			5-Jun
Elliot Lake	13-Jun	9-Jun	6-Jun	70 Mile House slough 7			5-Jun
Exeter Lake	7-Jul	5-Jul	31-May & 20-Jun	70 Mile House slough 8			5-Jun
Fawn Lake	17-Aug	12-Aug	15-Jun	70 Mile House slough 9			5-Jun
Goose Lake	23-Jul	29-Jul	NS	70 Mile House slough 10			5-Jun
Irish Lake	26-Jul	12-Aug	15-Jun	70 Mile House slough 11			5-Jun
Jones Lake	29-Jun	7-Jul	18-Jun	Simon Lake	15-Jul	14-Jul	8-Jun
Larum's Bay, Horse Lake	18-Aug	12-Aug	15-Jun	Slough 3 mi. S of Springhouse	23-Jun	24-Jun	19-Jun
Lily Pad Lake	1-Jun	4-Jun	4-Jun	Soda Lake	13-Jul	22-Jun	17-Jun
Lost Creek Dam Lake	NS	14-Jul	NS	Soda Sloughs	13-Jul	22-Jun	17-Jun
McArthur's Slough	18-Jun	17-Jun	NS	**Springhouse sloughs**[6]	10-Jun	24-Jun	7-Jun
McKinlay Lake	20-Jul	21-Jul	NS	Springhouse slough 1			7-Jun
Mirage Lake	1-Aug	21-Jul	NS	Springhouse slough 2			7-Jun
Mirage Lake Slough	20-Jul	21-Jul	NS	Springhouse slough 3			7-Jun
Mission Ponds, slough 1[3]	12-Jun	12-Jun	13-Jun	Springhouse slough 4			7-Jun
Mission Ponds, slough 3[4]	19-Jul	12-Jul	13-Jun	Springhouse slough 5			7-Jun
Murphy Lake	22-Jun	18-Jun	NS	Springhouse slough 6			7-Jun
93 Mile Lake	2-Jun	19-Jun	NS	Straight Lake	15-Jul	14-Jul	8-Jun
100 Mile Slough	-	18-Jun	17-Jun	Tad Lake	1-Aug	29-Jul	14-Jun
101 Mile Lake	7-Jul	19-Jun	20-Jun	Tatton Lake	11-Jun	9-Jun	6-Jun
102 Mile Slough	23-Jul	19-Jun	NS	Watson Lake	13-Jun	7-Jun	6 & 18-Jun
103 Mile Lake	2-Jun	3-Jun	1-Jun	Watson Meadow Lake	20-Jul	12-Aug	NS
105 Mile Lake	4-Jun	6-Jun	6-Jun	Well Meadow Slough	1-Aug	29-Jul	NS
130 Mile Lake	15-Jun	14-Jun	9-Jun	Westwick Lakes (east)[7]	9-Jul	9-Jul	19-Jun
142 Mile Slough	12-Jun	18-Jun	NS	Westwick Lakes (west)[8]	9-Jul	9-Jul	19-Jun
148 Mile Sloughs	22-Jul	19-Jul	NS	Whitehorse Lake	27-Jul	25-Jul	12-Jun
150 Mile Lake	22-Jul	19-Jul	13-Jun	Williams Lake – e end	5-Jun	10-Jun	NS
Pete Kitchen Lake	18-Jul	16-Jul	NS	Willow Slough	18-Jul	16-Jul	NS
Rush Lake	23-Jun	24-Jun	7-Jun				

[1] Not surveyed
[2] In 2001, surveyed once during migration (May) but not during the nesting season (June).
[3] 149 Mile Lake in Munro (1958).
[4] Slough ¼ mile west of 149 Mile Lake in Munro (1958).
[5] Combined as wetland complexes for some comparisons (see Methods).
[6] Springhouse sloughs 2,3 and 4,5 were combined as wetland complexes for some comparisons (see Methods).
[7] Westwick Lake in Munro (1958)
[8] Sorenson Lake in Munro (1958)

Douglas-fir biogeoclimatic zone (IDFsK3; dry, cool Fraser variant subzone). Fawn Lake is in the Sub-Boreal Pine-Spruce zone (SBPSmK; moist, cool subzone).

The study area lies in the rainshadow of the Coast Mountains; it has a continental climate characterized by warm, dry summers, a fairly long growing season, and cool winters (Hope et al. 1991).

The physiography of the area is relatively flat or gently rolling with large areas of undissected upland ranging between 670 m and 1,200 m elevation. There are many wetlands and lakes in the area created by meandering streams and depressions.

Most of the landscape in the study area is dominated by Douglas-fir or lodgepole pine forests and in both, trembling aspen stands occur locally. Undergrowth vegetation is dominated by pinegrass and red-stemmed feathermoss. On drier sites, bluebunch wheatgrass, common juniper, and kinnikinnick occur with lesser amounts of pinegrass. Hybrid white spruce is more prevalent as sites become wetter and spruce dominates the wettest sites. Non-forested sites are common and include shrub-carrs bordering the forests and fens and marshes in wetter areas. Small grasslands occur locally on south-facing slopes (Steen and Coupé 1997). The dominant emergent vegetation includes great bulrush and cattail; aquatic vegetation is dominated by pondweeds, water-milfoil, bladderworts, muskgrass, pond lily, and waterweed. Riparian vegetation includes shrubs such as willow, red-osier dogwood and scrub birch.

The Central Interior Ecoprovince supports 64% of all bird species known to breed in the province (Cowan et al. 2001). It is the centre of breeding abundance for Barrow's Goldeneye and Yellow-headed Blackbird and holds large breeding populations of Eared Grebes and Black Terns.

Methods

Prior to arriving in the field, we located most of the nesting areas on topographical maps and forest development plans with the assistance of local biologists and conservation officers. Munro (1958) appears to have used colloquial names for some of the breeding areas, thus we had difficulty in knowing with certainty whether or not some of the sites were the same ones Munro surveyed. We excluded these from our study. For others, access roads had degraded to such an extent that, even with a 4-wheel drive vehicle, they were impassable; they were excluded as well. Other breeding sites, such as the east end of Williams Lake, were not well defined by Munro and were not surveyed. Table 1 shows the Munro (1958) nesting areas and the 50 sites we were able to resurvey along with their survey dates.

Munro (1958) gives little indication as to how he sampled the nesting areas (lakes, sloughs, ponds) other than to say that:

> *In addition to making a general survey of all accessible nesting areas a number of "key lakes", viz.; those which best illustrate the general picture and which in the past had been studied systematically, were visited twice or oftener on the same days of the month or on a date approximate to that on which counts were made earlier - the year of reference being 1938 in most instances.*

We attempted to survey the nesting areas as close to Munro's reference dates as we could but this was not always possible. We visited 32 of the 50 wetlands, on or about the same date as did Munro; 18 wetlands were surveyed earlier than Munro's dates. Of the 18 wetlands, 5 (Irish, Fawn, Dugan and Dewar lakes and Larum's Bay) were surveyed by Munro in mid-August. We have excluded these areas from the tables of our comparison of species numbers, beginning on page 124. We also considered some wetlands as wetland complexes where appropriate, to make valid comparisons (Table 1); either Munro did not differentiate between the individual wetlands or he failed to describe them adequately enough to allow the determination of a particular nesting area. Thus, although we surveyed 50 individual wetlands, the species numbers were only compared between a total of 30 wetlands or wetland complexes.

With the exception of loons, grebes, waterfowl, and American Coot, Munro (1958) is inconsistent in his reporting of species. For example, he notes 15 Black Tern pairs on 130 Mile Lake on 15 June 1942, but he does not report terns from any other nesting area. However, Munro (1945) does report Black Terns from Lily Pad Lake, Tatton Lake, Straight Lake, and Simon Lake, in each case for the same dates under review in his 1958 report. A similar situation occurs for some of the shorebirds. Thus, any comparisons we make in numbers of birds or species diversity are restricted for the most part to the loons, grebes, waterfowl, and coots (American Ornithologists' Union 1998).

Initially we visited each nesting area in May to gather waterbird migration data. Upon arrival we would position ourselves at an observation point where we could see most or all of the water body. All birds we observed using the water body were recorded. A Kowa® telescope (70 mm; 15x-60x) was used to scan the open water and edges; various types of binoculars (7-8x30-42) were also used. On some of the areas where the landscape precluded observation of the entire lake or slough, we set up a second observation point or made observations from a canoe in order to cover the entire water body.

Following the bird survey, we gathered physical and chemical data (e.g. pH, conductivity, depth at or near the centre of the lake or slough, secchi disk depth) for each nesting area. We also recorded a general description of the lake or slough including its surrounds, dominant vegetation and any anthropogenic changes that were obvious. Sundry detections of other animals, including passerines, found at or near the wetland, were also recorded. For the most part, these observations have not been included in the report.

Digital archival photographs of each nesting area were taken with a Canon® PowerShot Pro 90IS camera, including panoramas and specific habitat images. Wildlife photographs were also taken opportunistically. At the end of each day, all images were downloaded from the camera to a laptop computer and subsequently burned onto a CD for archival purposes and for use in reports and presentations. The digital images were archived at the Canadian Wildlife Service main office in Delta. Unless otherwise noted, all photographs in this report were taken by the senior author. Data from field notebooks were entered to Microsoft® Excel or Access files at the end of each day in the field, depending on the type of data.

In June we again visited each nesting area and surveyed the waterbird use beginning with an initial scan of the water body as noted above. On all but the smallest of the areas, we also canoed the perimeter of the waterbody searching for nests. For some

of the nesting areas that had extensive *Scirpus* or *Typha* marshes, we waded parts of the marsh recording all the nests we saw (103 Mile Lake, Soda Lake, 130 Mile Lake, Westwick Lakes (East) and all of Soda Sloughs and 101 Mile Lake). Wherever possible, we geo-referenced the nests we found using a Garmen® 12XL GPS unit.

Nest locations were plotted on digital orthophotos with ArcView®. We also used ArcView® and recent digital orthophotos to map and calculate the areas and perimeters of the nesting sites; areas of associated emergent marshes and sedge meadows were also calculated. The wetland area we report in the tables of attributes includes both the waterbody, along with its attendant emergent vegetation, and any adjoining *Carex* meadows.

To better show the surrounding forest land use, we have included air photographs of each breeding area on which we note the position from which the archival photographs were taken. A summary of the surrounding land use based on Forest Development Plan maps (100 Mile House and Williams Lake Forest Districts) is given. These maps indicate the land use and harvest history along with information on forest species composition (in order of predominance), age class, crown closure class, and site index—a measure of forest site productivity expressed as the average height of the tallest trees in the stand at a defined index age (Dunster and Dunster 1996), here based on the age and height of the leading species.

Results and Discussion

Single counts of birds, such as our surveys of bird use of wetlands in the Cariboo parklands in 2001, are simply a snapshot in time and cannot be used to determine trends. Indeed, we could not know with certainty whether or not bird numbers were, in fact, higher or if 2001 simply happened to be an anomaly for waterbirds and their use of the particular Cariboo wetlands we studied.

Nevertheless, based on Munro's wetland descriptions and our survey results, coupled with corroborative data from other studies (e.g. Sauer et al. 2002; Breault and Watts 2001) we believe our findings reflect at least similar wetland quality and higher waterbird numbers in the study area than Munro (1958) found in his surveys some 40 and 60 years ago.

Study Limitations

In order to better judge the conclusions we have drawn from our results, we note the following study limitations for consideration.

Differences in Methodologies

As we have previously noted, Munro (1958) does not describe in any detail the methods he used to gather his data, thus we cannot know with certainty whether observer effort between our surveys and those Munro carried out were roughly equivalent. Ian McTaggart-Cowan (pers. comm.), who had spent some time in the field with Munro, believes that he would have roughly followed the same protocol that we did in surveying the wetlands. That is, he would have scanned the wetland with field glasses or telescope, noting all the waterbirds he observed, and then would have canoed the wetland in search of any nests or broods that might be hidden amongst the reeds. He was an excellent field-biologist and quite proficient at locating waterbird nests. Whether he looked as intensely as we did or as consistently as we did, we cannot say. Thus, observer effort may have been different between years and this should be taken into consideration. In addition, the quality of optical field equipment has improved considerably since Munro's time, which adds another factor to consider.

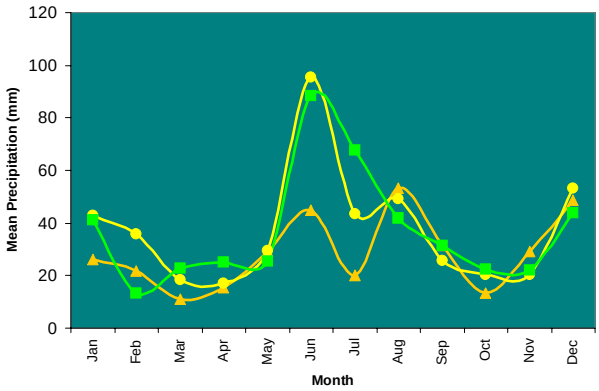

Figure 2. Mean precipitation in the Cariboo parklands: 1936-38 data (triangles) from Climate Station 1098939 at Williams Lake; 1956-58 data (circles) from Climate Station 1095820 at 150 Mile House; 1998-2000 data (squares) from Climate Station 109E7R6 at Abel Lake near 100 Mile House (Source: Environment Canada 2000). Mean precipitation in 1998-2000 is more comparable to the 1955-58 data than to the 1936-38 data.

Influence of climate

Climate influences the timing of migration and the availability and suitability of the habitat for the birds when they arrive. For example, differences in wetland quality was noted by Munro (1958), which he relates to the dry years prior to his late 1930s-early 1940s surveys and the wetter years prior to his 1958 surveys.

Historical climate records show that precipitation leading up to each of the survey years was similar for the 1955-58 and 1998-2000 periods with both having higher precipitation than the 1936-38 period (Figure 2). This tends to support our contention that the wetlands in 2001 were more comparable to Munro's 1958 wetland descriptions than to his 1938 descriptions.

It is also likely that global warming is playing a role as well (Parmesan and Yohe 2003; Root et al. 2003), however, we only touch briefly on it in this report.

Timing of the 2001 surveys

Munro's breeding waterbird surveys ranged between 1 June and 18 August while our breeding surveys only ran from 1 June through 17 June, due to time constraints (we also conducted migration surveys on the wetlands from 8-29 May). Of the 50 breeding areas we visited in 2001, 38 (64%) were surveyed on or about the same month and day as did Munro, while 18 were surveyed earlier (i.e., Munro also surveyed in late June (1 survey), July (12), and August (5). This would have affected our comparative results because we would have missed

many broods of the later-nesting waterfowl, such as Ruddy Duck. Since broods are easier to detect than nests with eggs, our total bird numbers would likely have been higher had we been able to visit all the breeding areas on the day and month of Munro's visits.

The Wetlands

Wetlands in the study area appeared to be, with few exceptions, at least similar to Munro's wetlands in 1958, which was the year he found the highest wetland quality. Munro notes in the Summary and Conclusions to his 1958 report:

> *Nesting habitat in the Cariboo Parklands has improved in quality and is more extensive, probably as much as 40 percent greater, than was so twenty years ago.*

despite the fact that

> *The period 1937-1942 was less favourable to waterfowl production than was 1958, nevertheless nesting population and increase figures are higher for those* [earlier] *years.*

In some cases the wetlands in 2001 were likely of higher quality (e.g. a number of the 70 Mile House sloughs, 101 Mile Lake), primarily the result of specific management practices by Ducks Unlimited Canada in cooperation with the landowners. These practices have maintained sufficient and stable water levels which, in turn, have resulted in extensive areas of emergent vegetation and healthy riparian edges, important nesting requirements for many species.

In other cases, we noted negative impacts to the nesting areas. For example, although water levels of most of the nesting areas were relatively high, some (e.g. Westwick Lakes east) had low water levels resulting from a combination climatic effects and agricultural irrigation. Overgrazing of the adjacent rangeland resulting in the apparent eutrophication of the wetland was noticed at Soda Lake and may have played a role on some of the other wetlands that had considerable amounts of algae (e.g. Westwick lakes east, 105 Mile Lake). In other nesting areas, cattle access to the wetland was evident through bank erosion or overgrazing and trampling of the associated *Carex* meadows (e.g. Watson, Simon, Abel, and Dugan lakes). Some wetlands that once had abundant amphipod populations were subsequently stocked with fish and appear to no longer have amphipods at all (e.g. Irish and Fawn lakes).

In some cases, the wetlands appeared in good shape; however, the adjacent uplands had been impaired. For example, on 4 of the 70 Mile House sloughs (4, 6, 7, and 8), the forested buffer was either removed completely following logging, or any buffer that remained was not sufficient in width to ensure adequate buffer functions. On other nesting areas, residential development was extensive along the lakeshore (e.g. Watson, 105 Mile, Sepa, and Boitano lakes), which likely resulted in a loss of nesting habitat for the birds.

The 50 wetlands in our study area covered much of the wide variety of nesting areas that occur in the Cariboo parklands (Table 2). They ranged from large breeding sites, such as Exeter Lake and its associated wetlands and meadows at 159 ha to small sloughs of about 0.7 ha in area. Larum's Bay was the only portion of Horse Lake (1,230 ha) that was surveyed. Emergent marshes, principally *Scirpus lacustris* and *Typha latifolia*, are important habitat components for nesting waterbirds. Of the wetlands we surveyed, emergent marshes ranged in size from 64 ha (130 Mile Lake) to about 0.1 ha (Soda Lake). A number of other nesting areas, such as Boitano and Cummings lakes, had areas of emergent vegetation too small or narrow to map from orthophotos. Open water areas of the wetlands ranged from 108 ha (Watson Lake) to less than 0.1 ha (Springhouse slough 2). All of the wetlands were alkaline; pH values ranged from 8.2 (Springhouse Slough 1) to 10 (70 Mile House slough 5 and Mission Ponds 1). Conductivity of the nesting area waters ranged from 82 $\mu mhos \cdot cm^{-1}$ (Springhouse Sloughs) to 5,885 $\mu mhos \cdot cm^{-1}$ (Soda Lake). Each wetland, along with its attendant characteristics and waterbird use has been summarized in Table 2. A detailed discussion of the wetlands follows.

70 Mile House Sloughs

Munro (1958) discusses the 70 Mile House sloughs generally, grouping them together along with their bird numbers. Moreover, he does not state how many sloughs he included in his surveys or how far on either side of the North Bonaparte Road he travelled other than to say he looked at a "series of sloughs adjacent to North Bonaparte Road." Thus, the reader is cautioned that, in the case of the 70 Mile House sloughs, we may not be making an accurate comparison with the Munro data.

Nevertheless, Munro's general description of the sloughs still holds true today:

> *they are typical sloughs of the lodgepole pine, aspen and grassland complex that characterize much of the Cariboo.... Some have hard shores with little emergent*

vegetation, others contain substantial amounts of roundstem bulrush which in several constitute extensive marshes; in still others sedges, rushes and grasses dominate shallow shoreline areas subject to seasonal evaporation. Submerged aquatics comprise those endemics wide-spread through the region, chiefly pondweeds Potamogeton *sps.,* [sic] *water milfoil* Myriophyllum *sps., charaphytes and others. Amphipods are present in some.*

This habitat shows considerable improvement [in 1958]. *The water-level is much higher than in 1937, so much so that sloughs which then were isolated are now confluent. How recently this took place is not known to me but there has been sufficient time to permit a substantial increase in the acreage of round-stem bulrush. In short it can be said that the increase in water surface and in emergent vegetation has been so great as to alter much of the territory almost beyond recognition.*

Table 2. Attributes of waterbird nesting areas recorded during surveys in the Cariboo parklands, 2001.

Breeding Area	Elevation (m)	pH	Temperature (C)	Conductivity (µmhos·cm^{-1})	Depth (m)	Secchi Disk (m)	Area (ha)	Perimeter (m)	Emergent Vegetation (ha)	Open Water (ha)
100 Mile Lake	928	8.7	12	820	1	1	11.1	1304	3.6	7.5
101 Mile Lake	961	8.6	11	1800	1.5	1.5	5.7	988	3.5	2.2
103 Mile Lake	893	9.3	13	550	3.5	2.3	45.7	3566	5.2	40.5
105 Mile Lake	884	8.8	12	720	5.3	4.3	46.7	4407	1.7	45.2
130 Mile Lake	779	8.5	15	260	1.5	1.5	116	8557	64.4	51.5
150 Mile Lake	763	8.6	13	240	1.7	1.7	9.8	1689	2.8	7
3 km S Sprnghouse	990	8.8	21	1300	1	1	1.7	517	0	1.7
70 Mile House										
Slough 1	1082	9.8	17	3600	1	1	2.4	625	0	2.4
Slough 2	1082	9.7	17	4400	1	0.3	1.3	429	0	1.3
Slough 3	1082	9.6	21	5000	1	1	2.2	558	0	2.2
Slough 4	1080	9.4	18	2100	1.5	1.5	17.4	4101	8.7	9.7
Slough 5	1080	10	19	3400	1.5	1.5	6.8	1423	1.5	5.2
Slough 6	1079	9.2	15	1400	1.5	1.5	4.7	1702	3	1.8
Slough 7	1080	8.8	15	920	2.5	2.2	17.6	3258	9.1	8.6
Slough 8	1080	8.9	19	1600			14.3	2381	8.6	5.7
Slough 9	1076	9.2	15	1800			13.1	2545	3.1	10
Slough 10	1071	9	16	1380	2	2	11.6	1532	7.7	3.9
Slough 11	1071	9.9	16	2400	1.9	1.9	12	2431	0.5	11.4
Abel Lake	939	8.7	11	370	4.7	2	45.1	3060	2.4	29.9
Boitano Lake	970	9.9	10.5	5800	2.5	2.5	69.1	4539		69.1
Cummings Lake	672	9.5	16	780	15	5.6	47	4287	0.1	47
Dewar Lake	988	9.6	11.5	525	3	1.5	46	3459	6.7	39.3
Dugan Lake	922	8.9	11	360	15	2.2	112.5	4972	6.7	96
Elliot Lake	886	9.1	13	720	2.6	0.5	13.3	3309	1.3	12
Exeter Lake	919	8.7	15	280	4.5	3.3	159.2	8076	7.9	44.5
Fawn Lake	1102	8.8	15	200	3.5	1.5	79.9	7359	4.8	51.7
Irish Lake	1174	9	13.5	560	6.3	3.2	35.7	3277	2.8	32.9
Jones Lake	735	9	17.5	250	1.6	1.2	64.7	6530	2.2	25
Larum's Lake	993	8.6	13.5	170	2.5	2	50.1	3885	4.9	26.3
Lily Pad Lake	929	8.9	17	370	3	3	105.5	8251	27.1	78.3
Mission Pond 1	698	10	24.5	460			13.5	3093	0.1	13.5
Mission Pond 3	686						9.8	2325	0.1	9.8
Rush Lake	972	8.8	18.5	2600			16.7	2569	5.6	11.1
Sepa Lake	883	8.9	11	645	6	2.6	20.7	2282	4.2	16.5
Simon Lake	938	8.8	11	480	5.5	1.3	82.5	7078	8.1	72.8
Soda Lake	908	9.6	12	5885	5	0.2	60.3	4821	0.1	60.2
Soda Sloughs	900	9	12	2000	1.3	1.3	9.3	2953	2.4	8.2
Springhouse										
Slough 1	986	8.2	17	250			4.4	1087	3.2	1.1
Slough 2	994	9.2	20	82	0.5		1.3	668	1.2	0.1
Slough 3	983	8.6	19.5	98	0.5		0.7	443	0.5	0.1
Slough 4	972	8.3	19	580			3	995	2.7	0.3
Slough 5	989	8.6	19	1200			1.1	415	0.5	0.6
Slough 6	974	9.1	20	450			4.5	811	2	2.5
Straight Lake	920	8.5	13	455	3	1	52.3	8118	28.3	18.9
Tad Lake	940	8.6	11	360	6	2.7	54.3	4573	1.3	33.5
Tatton Lake	902	8.8	12	1280	3.3	0.6	46.2	5942	13.5	32.7
Watson Lake	893	9.3	10	860	4	1.6	120.2	8018	10.3	107.7
Westwick Lakes (e)	902	9.1	12	2000	1.3	1.3	52.2	5310	13.7	38.5
Westwick Lakes (w)	902						18.1	2926	6.5	11.6
Whitehorse Lake	902	8.8	15.5	180	3.6	2.6	54.3	5068	14.2	40.1

Continued on page 8 ▶

Table 2 (Cont'd). Attributes of waterbird nesting areas recorded during surveys in the Cariboo parklands, 2001.

◀ Continued from page 7

Breeding area	Fish	Cattle access	Nest boxes present	DUC Project	Residences near wetland	Recreation Area near wetland	Light Industry near wetland	Partially filled	Boat launch	Number of birds	Number of species
100 Mile Lake			✓	✓	✓	✓	✓	✓		76	10
101 Mile Lake		✓	✓	✓						104	19
103 Mile Lake		✓			✓	✓			✓	148	18
105 Mile Lake		✓	✓		✓		✓			454	18
130 Mile Lake	✓	✓		✓	✓			✓		67	16
150 Mile Lake	✓	✓			✓		✓			49	13
3 km S Springhouse		✓								37	9
70 Mile House											
Slough 1		✓			✓					10	7
Slough 2		✓			✓		✓			14	7
Slough 3		✓			✓					3	3
Slough 4		✓		✓						89	17
Slough 5		✓					✓			16	5
Slough 6		✓	✓	✓						20	9
Slough 7		✓	✓	✓						78	15
Slough 8		✓		✓						65	14
Slough 9		✓		✓						26	10
Slough 10		✓	✓	✓						34	12
Slough 11		✓	✓	✓						25	8
Abel Lake	✓	✓		✓	✓					64	9
Boitano Lake		✓			✓		✓			154	8
Cummings Lake		✓								217	14
Dewar Lake	✓				✓	✓			✓	71	13
Dugan Lake	✓	✓			✓	✓			✓	89	17
Elliot Lake		✓			✓	✓	✓	✓		379	19
Exeter Lake	✓	✓	✓	✓			✓			80	14
Fawn Lake	✓				✓	✓			✓	11	5
Irish Lake	✓				✓	✓			✓	22	9
Jones Lake	✓	✓	✓	✓	✓				✓	32	11
Larum's Lake	✓				✓	✓			✓	22	9
Lily Pad Lake	✓	✓			✓					79	14
Mission Pond 1		✓	✓	✓						139	15
Mission Pond 3		✓	✓	✓	✓					141	14
Rush Lake		✓			✓					161	13
Sepa Lake	✓				✓	✓				14	7
Simon Lake	✓	✓	✓	✓	✓					147	19
Soda Lake		✓	✓	✓		✓			✓	170	17
Soda Sloughs		✓	✓	✓		✓				152	17
Springhouse											
Slough 1		✓								57	14
Slough 2		✓								4	2
Slough 3		✓								37	9
Slough 4		✓								39	6
Slough 5		✓								5	5
Slough 6		✓			✓					76	13
Straight Lake		✓	✓	✓	✓					128	16
Tad Lake	✓	✓	✓	✓	✓					57	13
Tatton Lake		✓	✓	✓	✓					287	21
Watson Lake	✓	✓	✓	✓	✓		✓			370	20
Westwick Lakes (e)		✓	✓		✓	✓				733	18
Westwick Lakes (w)	✓	✓			✓					414	13
Whitehorse Lake	✓	✓	✓			✓			✓	5	3

We surveyed a total of 11 sloughs that could be seen from some point immediately adjacent to North Bonaparte Road (Figure 3). For comparative purposes, we have combined all the data from our surveys; however, for future comparison we also present data for each slough starting with those closest to 70 Mile House and moving east to the last slough in the vicinity of the junction of North Bonaparte and Green Lake roads.

There appears to have been little in the way of changes to the sloughs since Munro's time with the exception of logging proximate to some of them.

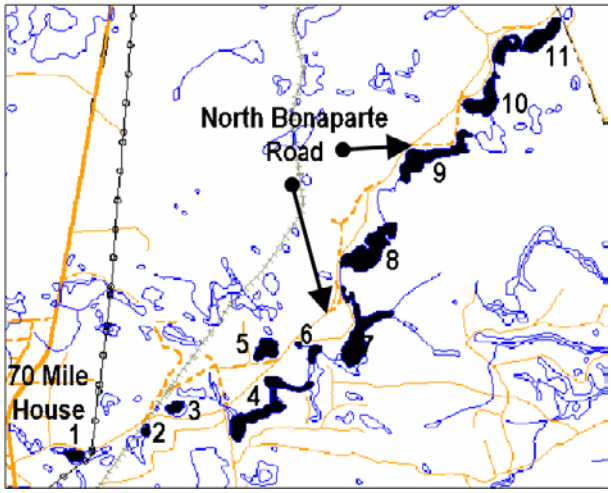

Figure 3. 70 Mile House sloughs.

Another exception is the work that Ducks Unlimited Canada (DUC) has undertaken in managing some of the water bodies to ensure that water levels are stabilized and no future drainage can occur (Brad Arner pers. comm.). As a result of their activities, DUC acquired the water license to the sloughs, thereby also having control over use of the water (I.M. Barnett pers. comm.). A number of the 70 Mile House sloughs appear to have been naturally connected during periods of high water. Berms have been constructed at the outlets of many of the sloughs, which prevent the interchange of water between them except, perhaps, during periods of high water. These management activities appear to have been effective as we found high water levels and extensive areas of *Scirpus* marsh. We comment on this aspect further in our discussions of each individual slough below.

Sloughs numbered 1 through 5 are located on private lands while sloughs 6 through 11 are on Crown lands. All the sloughs lie within the Agricultural Land Reserve.

Comparative breeding waterbird numbers are shown in Table 3. Numbers were up 349% from 1937 and nearly 100% from 1958. Much of the increase was due to new species reported in 2001 that had only one observation or were not recorded at all in the 2 early years: Pied-billed Grebe, Eared Grebe, Canada Goose, Cinnamon Teal, Northern Shoveler, Gadwall and Ring-necked Duck. In addition, some waterbird numbers were considerably higher in 2001: Mallard (numbers up 71%); Bufflehead and American Coot (up over 170%). Only 2 species, Horned Grebe and Blue-winged Teal, had lower numbers in 2001 than in Munro's day. However, one must keep in mind our introductory caution.

Table 3. Birds observed during breeding waterbird surveys at 70 Mile House sloughs: 1937, 1958 and 2001.

	70 Mile House sloughs		
Species[1]	6 Jun 37	5 Jun 58	5 Jun 01
COLO			2
PBGR			13
HOGR-PR[2]	9	6	0
EAGR		1	21
CAGO			6
CAGO-PR			9
CAGO-Y			15
GWTE-♂			7
GWTE-PR	1	2	0
MALL-PR	1	5	3
MALL-♂	19	9	24
MALL-♀			6
NOPI-PR		2	0
NOPI-♂			3
BWTE-PR	5	20	6
BWTE-♂			15
CITE-PR			1
CITE-♂			8
NOSL-PR			4
NOSL-♂			1
GADW-PR			3
GADW-♂			3
AMWI-PR	2	2	2
AMWI-♂			2
AMWI-♀			1
CANV-PR		2	0
CANV-♀			1
REDH-PR		3	0
REDH-♂		2	5
REDH-♀		1	1
RNDU-PR		1	4
RNDU-♂			5
LESC		47	0
LESC-PR	3		22
LESC-♂			9
LESC-♀			3
BAGO-PR	1	1	2
BAGO-♂			1
BAGO-F		2	5
BAGO-J	7		0
BUFF			2
BUFF-PR	2	4	4
BUFF-JPR			2
BUFF-♂		2	7
BUFF-J♂			3
BUFF-♀		1	10
HOME	5		0
RUDU		19	0
RUDU-PR	1		1
RUDU-♂			19
RUDU-♀			6
RUDU-Y	1		0
AMCO		21	61
AMCO-PR	3		0
AMCO-N			4
Sub-total	**88**	**201**	**395**
SORA			1
SACR			1
SACR-N			1
KILL			1
COSN			3
TOTALS	**88**	**201**	**402**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 4. 70 Mile House slough 1 showing surrounding land use. Disc is location where archival photographs were taken.

70 Mile House slough 1

70 Mile House slough 1 (Figure 4), the first small slough about 0.7 km east of 70 Mile House, is bounded on the north by the North Bonaparte Road, on the southwest by forested lands, and on the southeast by a transmission corridor. Residential properties lie on the north side of the road and to the west of the slough.

The slough is fenced along the north shore, but the fencing was in disrepair. A partially submerged fence at the east and west ends suggests that the slough experiences fluctuating water levels. Horses have access to the wetland on the south shore (Figure 5).

The forest on the southwest side of the slough is dominated by lodgepole pine with some trembling aspen (aspen is visually dominant along the forest edge facing the slough; an adjacent forest, similar in appearance, is between 121 and 140 years old with 56-65% crown closure and a Site Index of 15). Small areas of grassland or formerly wetted areas occur to the east and west. This small slough consists of about 2.3 ha of shallow, open water surrounded by a narrow band of rushes. We noted no submergents, and little in the way of emergent marsh plants that would attract and provide cover for nesting birds. Some slough attributes are given in Table 4. Birds noted on the wetland are shown in Table 5.

Table 4. Some attributes of 70 Mile House slough 1.

Attributes	70 Mile House slough 1 5-Jun-01
UTM 10	612385 5684875
Elevation (m)	1082
pH	9.8
Temperature (ºC)	17
Conductivity (µmhos·cm^{-1})	3600
Depth (m)	1.0
Secchi Disk (m)	1.0
Area (ha)	2.4
Perimeter (m)	625
Emergent marsh area (ha)	0
Open water or submergent vegetation area (ha)	2.4
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	No
Light Industry near	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

Figure 5. Horses grazing the fringe marsh of 70 Mile House slough 1, 5 June 2001.

Table 5. Birds observed during breeding waterbird surveys at 70 Mile House slough 1.

Species[1]	70 Mile House slough 1 5-Jun-01
MALL-♀[2]	1
NOPI-♂	2
BWTE-PR	1
NOSL-PR	1
GADW-PR	1
BAGO♂	1
Sub-total	**10**
WISN	1
TOTAL	**11**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

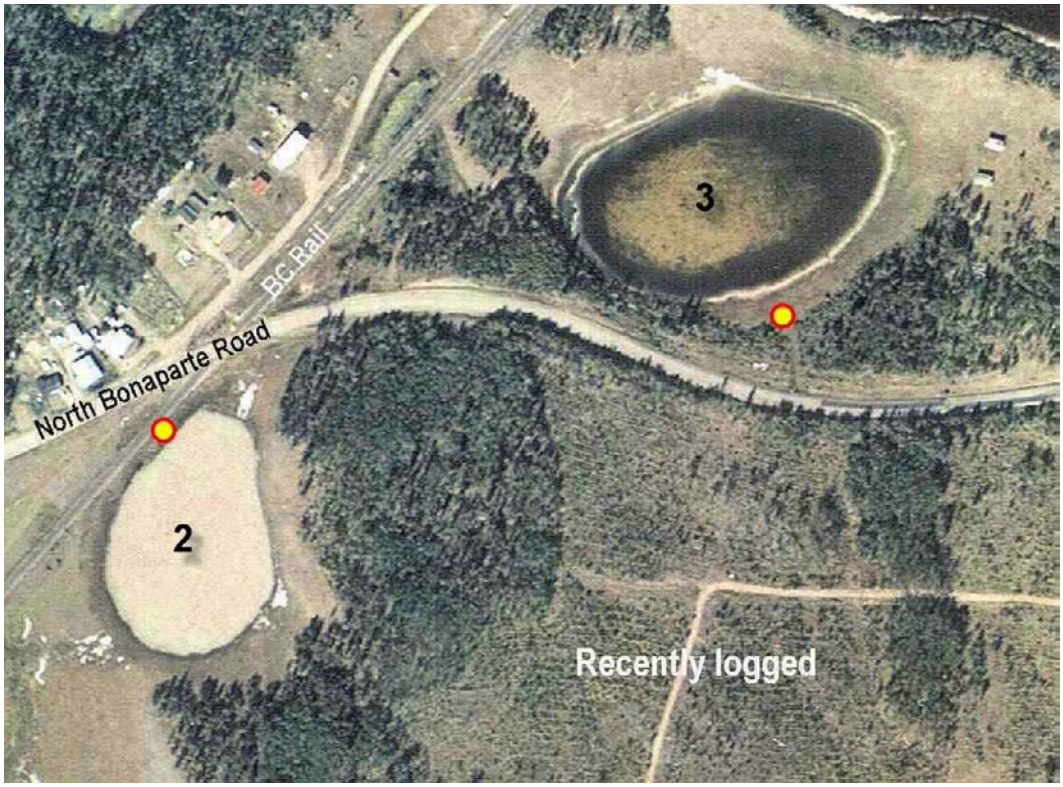

Figure 6. 70 Mile House sloughs 2 and 3 showing surrounding land use. Discs are locations where archival photographs were taken.

70 Mile House slough 2

This small, shallow open water slough (Figures 6 and 7) lies on the south side of North Bonaparte Road, about 1.6 km east of 70 Mile House. There is a small residential area on the north side of the road opposite the slough.

The slough is bordered on the west by the BC Rail line; to the east and southeast, the slough grades into a narrow band of rangeland and then a band of remnant forest similar in age and structure to the forest description for slough 1. The forest also has an aspen-dominant western edge. Southwest of the slough is a larger area of rangeland. A fence in disrepair lies parallel to the rail line on the west shore; another fence bisects the slough in an east-west direction. A cattle trail was noted along the east shore; however, cattle were not observed near the slough.

Figure 7. 70 Mile House slough 2 looking east.

Table 6. Some attributes of 70 Mile House slough 2.

Attributes	70 Mile House slough 2 24-May-01
UTM 10	613182
	5685106
Elevation	1082
pH	9.7
Temperature (ºC)	17
Conductivity (µmhos·cm^{-1})	4400
Depth (m)	1.0
Secchi Disk (m)	0.3
Area (ha)	1.3
Perimeter (m)	429
Emergent marsh area (ha)	0
Open water or submergent vegetation area (ha)	1.3
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area Near	No
Light Industry	Yes
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

Table 7. Birds observed during breeding waterbird surveys at 70 Mile House sloughs 2 and 3.

Species[1]	70 Mile House slough 2 5-Jun-01	70 Mile House slough 3 5-Jun-01
GWTE-♂[2]	2	1
MALL-♂	3	
MALL-♀	2	
BWTE-♂	2	
NOSL-PR	1	
GADW-PR		1
GADW-♂	2	
BUFF-♂	1	
Sub-total	**14**	**3**
KILL		1
TOTALS	**14**	**4**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

The slough covers just over 1 ha and consists primarily of milky, shallow open water. We could only see to a depth of 0.3 m. Submergent vegetation was not noted. The slough also lacked any significant beds of emergent vegetation that would provide cover thus reducing its value to nesting waterbirds. A band of *Juncus* with some *Triglochin* grew along the perimeter. Slough attributes are given in Table 5; birds noted on a survey of the slough are shown in Table 6.

Table 8. Some attributes of 70 Mile House slough 3.

Attributes	70 Mile House slough 3 24-May-01
UTM 10	613501
	5685343
Elevation (m)	1082
pH	9.6
Temperature (ºC)	21
Conductivity (µmhos·cm^{-1})	5000
Depth (m)	1.0
Secchi Disk (m)	1.0
Area (ha)	2.2
Perimeter (m)	558
Emergent marsh area (ha)	0
Open water or submergent vegetation area (ha)	2.2
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area Near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

70 Mile House slough 3

70 Mile House slough 3 (Figure 6) lies about 1.9 km east of 70 Mile House on the north side of North Bonaparte Road. The slough can be seen through a small opening in the trees and shrubs bordering the road, and access can be found at that point.

This slough is bounded on the south by a narrow band of trees and shrubs and the road, on the north by rangeland and another tree band; some buildings lie to the east. Cattle have access to the slough, although none were seen during our surveys.

This slough is another shallow, open water area with little in the way of emergent vegetation and thus of marginal use to nesting waterbirds. Rushes, seaside arrow-grass, and silverweed are present along the perimeter, which grades to rolling rangeland towards the north (~40–50 m wide) followed by forest of aspen and lodgepole pine. A fence line has been erected just before the trees. A 20 m band of wet grasses lies to the south of the slough grading into riparian scrub birch and willow then mixed lodgepole pine with some aspen and spruce. Slough attributes are given in Table 8; result of our breeding waterbird survey of the slough are shown in Table 9.

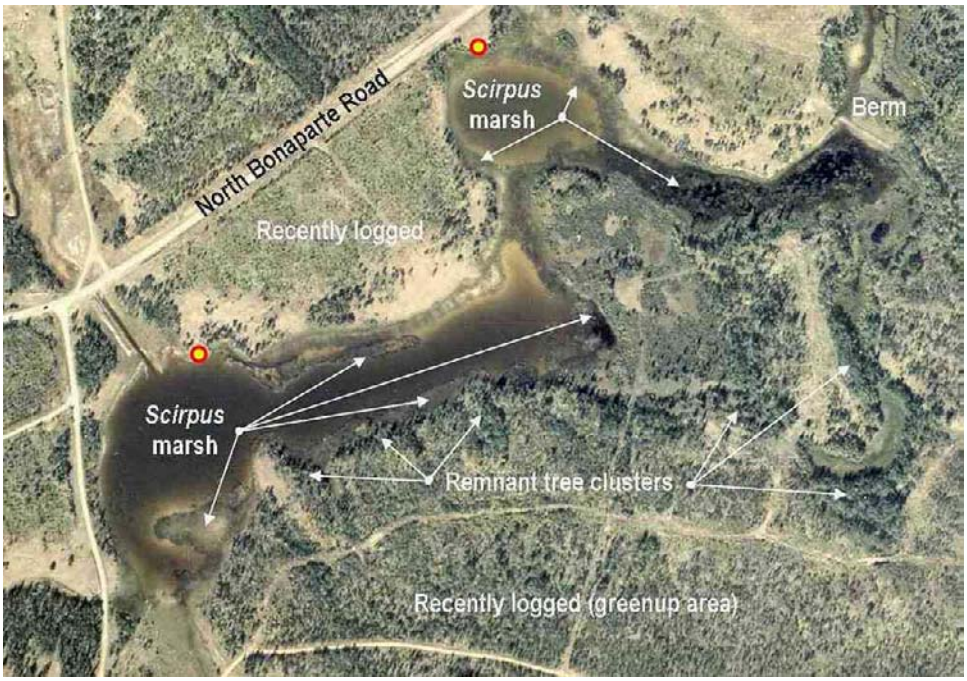

Figure 8. 70 Mile House slough 4 showing habitat characteristics and surrounding land use. Discs are locations where archival photographs were taken.

70 Mile House slough 4

70 Mile House slough 4 (Figure 8) lies on the south side of North Bonaparte Road about 2.5 km east of 70 Mile House. The main slough to the south is around 11 ha in area; a constriction at its north end leads to 3 ha of open, tea-coloured water that is edged with riparian shrubs; a narrow band of *Scirpus* marsh also occurs around a significant part of this small slough's perimeter. At the northeast end of the slough, a 4 ha *Scirpus* marsh extends toward the southeast.

Extensive areas of *Scirpus* marsh occur along the south edge of the main slough and about half way along the central portion of its north edge. Rushes grow around most of the slough perimeter shoreward of the *Scirpus*. Much of the rest of the area moves abruptly from slough edge to mixed, regenerating forest, older tree clusters or riparian shrubs and rangeland. For example, the main slough is bounded on the northwest and southeast by forested lands, most of which have been recently logged and restocked. Trembling aspen, lodgepole pine, and some spruce occur on the north side and similar green-up areas occur to the south (logged in 1971-72 and now up to 10 m high with 6-15% crown closure). Scattered clusters of remnant trees occur (primarily trembling aspen and lodgepole pine), particularly on the southern edge of the slough. Although we didn't search for cavities, there is little doubt that the leaving of the older aspens would provide nest sites for a number of species.

A gravel road lies to the west of the main slough and provides easy canoe access to the water body. A fence in the water at this end suggests fluctuating or formerly lower water levels (Figure 9). However,

Figure 9. Fencing at 70 Mile House slough 4 indicating fluctuating water levels.

there is a drainage ditch at the northwest end of the main slough and a berm at the northeast end of the northernmost *Scirpus* marsh, which suggest that water levels in the slough are now managed.

Some attributes of slough 4 are shown in Table 9. Results of our breeding bird survey of the slough are shown in Table 10. Of all the 70 Mile House sloughs, this slough had the highest numbers of waterbirds, likely due to the extensive areas of emergent vegetation.

70 Mile House slough 5

70 Mile House slough 5 (Figures 10 and 11) is located on the north side of North Bonaparte Road, about 3.3 km east of 70 Mile House. A small *Scirpus* marsh lies immediately to the north and likely connects with the slough during high water levels. To the northeast, the slough grades into a narrow band of rangeland with an aspen copse and a few scattered conifers moving to an older forest (>121 years, with 46-55% crown closure and a Site Index of 15). To the northwest and west the slough is edged with rushes, seaside arrow-grass and small patches of *Scirpus* moving into an older, aspen-dominant, treed edge. Behind the trees is a logged area that is now greening up. To the southwest is a treed edge, primarily of aspen backing onto a logged green-up area.

Table 9. Some attributes of 70 Mile House slough 4.

Attributes	70 Mile House slough 4 5-Jun-01
UTM 10	614601
	5685369
Elevation (m)	1080
PH	9.4
Temperature (ºC)	18
Conductivity (µmhos·cm^{-1})	2100
Depth (m)	1.5
Secchi Disk (m)	1.5
Area (ha)	18.4
Perimeter (m)	4101
Emergent marsh area (ha)	8.7
Open water or submergent vegetation area (ha)	9.7
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	Yes
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

Table 10. Birds observed during breeding waterbird surveys at 70 Mile House slough 4.

Species[1]	70 Mile House slough 4 5-Jun-01
PBGR	2
EAGR	16
CAGO	4
CAGO-PR[2]	2
CAGO-Y	5
GWTE-♂	3
MALL-PR	2
MALL-♂	3
MALL-♀	1
NOPI-♂	1
BWTE-♂	1
CITE-♂	3
NOSL-PR	2
NOSL-♂	1
AMWI-PR	1
AMWI-♀	1
REDH-♂	1
RNDU-♂	2
LESC-PR	2
LESC-♂	3
BUFF-PR	1
BUFF-♂	2
BUFF-J♂	1
BUFF-♀	3
RUDU-♂	9
RUDU-♀	1
AMCO	11
Sub-total	94
WISN	1
TOTALS	**95**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 10. 70 Mile House slough 5 panorama looking northwest .

Figure 11. 70 Mile House sloughs 5 (left) and 6 (right) showing some habitat characteristics and surrounding land use. Discs are locations where archival photographs were taken.

The slough is bounded on the south by a few conifers and rangeland and then a gravel road; the road leads to an old sawmill site. Scattered patches of rushes backed by an alkali saltgrass meadow occur along the east and southeast shore adjacent to North Bonaparte Road. To the west there is a fairly extensive *Carex* meadow fronted by a small patch of *Scirpus* marsh. Some seaside arrow-grass with rushes and small patches of bulrush occur along the north shore. A small island lies near the east side of the slough.

Some attributes of slough 5 are shown in Table 11. Results of our breeding bird survey of the slough are shown in Table 12.

Table 11. Some attributes of 70 Mile House slough 5.

Attributes	70 Mile House slough 5 24-May-01
UTM 10	614533 5685953
Elevation (m)	1080
pH	10.0
Temperature (ºC)	19
Conductivity (µmhos·cm^{-1})	3400
Depth (m)	1.5
Secchi Disk (m)	1.5
Area (ha)	6.8
Perimeter (m)	1423
Emergent marsh area (ha)	1.5
Open water or submergent vegetation area (ha)	5.2
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	No
Recreation Area near	No
Light Industry near	Yes
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

70 Mile House slough 6

This slough is a smaller wetland on the east side of North Bonaparte Road a short distance east of slough 5 (Figures 11 and 12). It consists of a small area of open, tea-coloured water adjacent to the road connected by a constriction to a larger open water body to the east. Access to the main slough can be gained from a road that runs east off the North Bonaparte Road approximately 3.5 km from 70 Mile House. Forested lands with small areas of grassland surround the slough. There are both restocked and green-up areas. Much of the forested area is regen-

Table 12. Birds observed during breeding waterbird surveys at 70 Mile House slough 5.

Species[1]	70 Mile House slough 5 5-Jun-01
EAGR	5
CAGO	1
CAGO-PR[2]	4
CAGO-Y	8
BWTE-♂	1
BUFF-♂	1
TOTALS	**24**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

erating aspen (primarily) with scattered lodgepole pine.

This slough contains extensive beds of emergent vegetation. Generally, the slough perimeter is edged with rushes adjacent to the shore followed by varying amounts of open water and then bands of bulrush of differing widths further out into the slough. Toward the southeast, lies a large *Scirpus* marsh backed by a *Carex* meadow that appears connected to 70 Mile House slough 7; a berm is separating the 2 sloughs. There is a *Carex* meadow behind the *Scirpus* to the south, as well, where a berm separates slough 6 from slough 4. Bladderwort and Sago pondweed were noted in the water column. A beaver lodge was found on the slough.

Some attributes of slough 6 are shown in Table 13. Results of our breeding bird survey of the slough are shown in Table 14.

Table 13. Some attributes of 70 Mile House slough 6.

Attributes	70 Mile House slough 6 5-Jun-01
UTM 10	615004 5685983
Elevation (m)	1079
pH	9.2
Temperature (ºC)	15
Conductivity (µmhos·cm^{-1})	1400
Depth (m)	1.5
Secchi Disk (m)	1.5
Area (ha)	4.7
Perimeter (m)	1702
Emergent marsh area (ha)	3.0
Open water or submergent vegetation area (ha)	1.8
Fish	No
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

70 Mile House slough 7

70 Mile House slough 7 (Figures 13 and 14) lies on the east side of North Bonaparte Road just east of slough 6. Access to the slough can be found from a road that runs east off the main road leading to slough 6.

Slough 7 is shaped much like a "Y" with a bulbous base. Rangeland occurs on the north and west shores, with forestlands surrounding the slough.

Figure 12. East end of 70 Mile House slough 6.

Table 14. Birds observed during breeding waterbird surveys at 70 Mile House slough 6.

Species[1]	70 Mile House slough 6 5 Jun 01
PBGR	1
BWTE-PR[2]	1
BWTE-♂	1
GADW-PR	1
AMWI-♂	1
LESC-PR	2
LESC-♂	1
BUFF-♂	1
RUDU-♂	1
AMCO	6
TOTALS	**20**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 13. 70 Mile House slough 7 showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

Occasional scattered riparian shrubs were noted along the slough edge.

At the north and western sides of the slough are restocked forest areas; to the east lies a mature lodgepole pine and trembling aspen forest (>101 years old, with 36-45% crown closure, and a Site Index ranging from 10 to 15). A regenerating forest lies at the south end of the slough.

An extensive *Scirpus* marsh circumscribes most of the perimeter of the slough with some *Juncus* and *Carex* occurring closer to the shore. The southwest end of the slough formerly joined slough 6 through a *Carex* meadow; however, a berm has since been constructed across the constricted wetland that joined the 2 sloughs. A *Carex* meadow also occurs at the south end of the slough.

A considerable amount of bladderwort was noted in the water column and amphipods were abundant; we saw no sign of fish in the slough. Two beaver lodges were also observed. Some attributes of slough 7 are shown in Table 15. Results of our breeding bird survey of the slough are shown in Table 16. Slough 7 held the second highest waterbird numbers of all the 70 Mile House sloughs and, again, the extensive emergent vegetation there likely played a significant role. One provincially blue-listed species, the Sandhill Crane, was found nesting on slough 7 (Figures 15, 16, and 18).

Figure 14. 70 Mile House slough 7 looking south.

Table 15. Some attributes of 70 Mile House slough 7.

Attributes	70 Mile House slough 7 5-Jun-01
UTM 10	615518 5685972
Elevation (m)	1080
pH	8.8
Temperature (ºC)	15
Conductivity (µmhos·cm^{-1})	920
Depth (m)	2.5
Secchi Disk (m)	2.2
Area (ha)	17.6
Perimeter (m)	3258
Emergent marsh area (ha)	9.1
Open water or submergent vegetation area (ha)	8.6
Fish	No
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

Figure 16. Sandhill Crane nest site at 70 Mile slough 7, 5 June 2001. Arrow points to nest location.

Figure 15. Andy Stewart checking nest of Sandhill Crane (inset) at 70 Mile House slough 7, 5 June 2001.

Table 16. Birds observed during breeding waterbird surveys at 70 Mile House slough 7.

Species[1]	70 Mile House slough 7 5-Jun-01
COLO	1
PBGR	2
CAGO-PR[2]	1
CAGO-Y	1
GWTE-♂	1
MALL-PR	1
MALL-♂	10
BWTE-PR	2
BWTE-♂	2
CITE-PR	1
CITE-♂	2
AMWI-♂	1
REDH-♂	1
RNDU-PR	2
RNDU-♂	1
LESC-PR	6
LESC-♀	1
BUFF	2
RUDU-♂	3
RUDU-♀	1
AMCO	20
AMCO-N[1]	3
Subtotal	**78**
SACR	1
SACR-N	1
WISN	1
TOTALS	**81**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 17. 70 Mile House slough 8 showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

70 Mile House slough 8

Slough 8 (Figures 17 and 19))is on the east side of North Bonaparte Road, about 4.7 km east of 70 Mile House. It is oriented roughly from the southwest to the northeast. A narrow band of mixed lodgepole pine and trembling aspen forest (>100 years with more than 76 trees/ha and 56-65% crown closure; Site Index=17) occurs around most of the slough. Along the northwest edge, a narrow band of rangeland is situated between the slough and the forest. To the east and south of the forest are regenerating areas.

The slough has an alkali saltgrass and rush band along the northwest edge, with sparse *Scirpus* marsh scattered around the northern edge in the deeper water. The slough contains 2 small islands, one near the centre of the slough with 4 conifers and one near the southwest end of the slough with a number of conifers. A berm lies at the outlet at the northwestern end of the slough, which appears to help maintain water levels.

There is a thick and extensive *Scirpus* marsh growing throughout much of the southern third of the slough. One beaver lodge was noted; no fish were seen. Some attributes of slough 8 are shown in Table 17. Results of our breeding bird survey of the slough are shown in Table 18.

The extensive emergent vegetation beds in slough 8 provide favourable nesting areas for a number of species and, as a result, this slough held the third highest waterbird numbers of all the 70 Mile House sloughs.

Figure 18. Sandhill Crane on the nest incubating 2-eggs, 70 Mile House slough 7, 5 June 2001.

Figure 19. 70 Mile House slough 8 looking toward the south, 24 May 2001. Note the two, treed islands and the extensive *Scirpus* stands that provide good nesting cover for waterbirds.

Table 17. Some attributes of 70 Mile House Slough 8.

Attribute	70 Mile House slough 8 24-May-01
UTM 10	615708
	5686909
Elevation (m)	1080
pH	8.9
Temperature (ºC)	19
Conductivity (µmhos·cm^{-1})	1600
Depth (m)	Nr[1]
Secchi Disk (m)	Nr
Area (ha)	14.3
Perimeter (m)	2381
Emergent marsh area (ha)	8.6
Open water or submergent vegetation area (ha)	5.7
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	Yes
Residences adjacent to wetland	No
Recreation Area near	No
Light Industry	No
Partially Filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

[1] Not recorded

Table 18. Birds observed during breeding waterbird surveys at 70 Mile House slough 8.

Species[1]	70 Mile House slough 8 5-Jun-01
PBGR	4
CAGO-PR[2]	1
CAGO-Y	1
MALL-♂	2
BWTE-PR	1
BWTE-♂	6
CITE-♂	2
GADW-♂	1
REDH-♂	3
REDH-♀	1
RNDU-PR	2
RNDU-♂	2
LESC-PR	4
LESC-♂	4
LESC-♀	2
BAGO-PR	2
BAGO-♀	1
BUFF-PR	1
BUFF-♀	1
RUDU-♂	4
AMCO	10
TOTALS	**66**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

70 Mile House slough 9

70 Mile House slough 9 (Figures 20 and 21) is a long, narrow, open water wetland on the south side of North Bonaparte Road. An access road about a third way along the slough begins about 6.1 km east of 70 Mile House and continues along the north shore of the slough ultimately returning to the main road near the south end of slough 10.

Coniferous forest with scattered aspen surrounds much of the slough. A proposed Old Growth Management Area lies on the south shore and consists mainly of mature lodgepole pine and trembling aspen (contains 2 age classes: 1] >101-years, with 56-61% crown closure with a Site Index of 14 and 2] >141-years with 26-35% crown closure and a Site Index of 17). There is a small amount of rangeland with lodgepole pine-trembling aspen forest stands on the north shore (>121-years, with 56-61% crown closure and a Site Index of 15).

A 1-2 m band of *Scirpus marsh* occurs around most of the shoreline; the band appears to be nar-

Figure 20. 70 Mile House sloughs 9 (lower left) and 10 (upper right) showing some habitat characteristics and surrounding land use. Discs are locations where archival photographs were taken.

Table 19. Some attributes of 70 Mile House slough 9.

Attributes	70 Mile House slough 9 28-May-01
UTM 10	616357 5687934
Elevation (m)	1076
pH	9.2
Temperature (ºC)	15
Conductivity (µmhos·cm^{-1})	1800
Depth (m)	Nr[1]
Secchi Disk (m)	Nr
Area (ha)	13.1
Perimeter (m)	2545
Emergent marsh area (ha)	3.1
Open water or submergent vegetation area (ha)	10.0
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	Yes
Residences adjacent to wetland	No
Recreation Area Near	No
Light Industry	No
Partially Filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

[1] Not recorded

rower along the north shore with some bare spots and scattered *Juncus* clumps shoreward of the *Scirpus*. A few, scattered riparian birch grew along the shoreline.

At least one beaver lodge was found on the slough; fish were not seen. Some attributes of slough 9 are shown in Table 19. Results of our breeding bird survey of the slough are shown in Table 20.

Table 20. Birds observed during breeding waterbird surveys at 70 Mile House slough 9.

Species[1]	70 Mile House slough 9 5-Jun-01
PBGR	2
MALL-M	1
BWTE-PR	1
AMWI-PR	1
LESC-PR	2
BAGO-F	3
BUFF-M	1
BUFF-F	3
RUDU-M	1
AMCO	7
TOTAL	**26**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 21. The central portion of 70 Mile House slough 9, looking toward the southeast, 24 May 2001.

70 Mile House slough 10

70 Mile House slough 10 (Figures 20 and 22) lies about 6.9 km east of 70 Mile House on the south side of North Bonaparte Road. An access road swings to the east from the main road and runs along the western side of the slough. At the north end of the slough is a berm that was constructed by DUC. The berm has a swale, which may allow connection to slough 11 during periods of higher water.

The slough has a reverse "L" shape with the base of the "L" running in roughly an east-west direction. The main slough runs in roughly a north-south direction.

Surrounding most of the slough is a mature lodgepole pine, trembling aspen forest (>121 years with 46 - 55% crown closure and a Site Index of 15). Trembling aspen dominates the pine in 2 areas: at the southeast and northeast ends of the main slough. On the western edge of the slough is a small area of rangeland.

A band of *Scirpus* about 5 m wide, occurs around most of the perimeter of the main slough area outside a *Juncus* band along the edge of the shore; occasionally, *Hordeum* and *Agropyron* were noted.

Table 21. Some attributes of 70 Mile House slough 10.

Attributes	70 Mile House slough 10 28-May-01
UTM 10	617056 5688500
Elevation (m)	1071
pH	9.0
Temperature (ºC)	16
Conductivity (µmhos·cm^{-1})	1380
Depth (m)	2.0
Secchi Disk (m)	2.0
Area (ha)	11.6
Perimeter (ha)	1532
Emergent marsh area (ha)	7.7
Open water or submergent vegetation area (ha)	3.9
Fish	No
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences adjacent to wetland	No
Recreation Area near	No
Light Industry	No
Partially Filled (including roadway)	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

Figure 22. The southwest leg of 70 Mile House slough 10, 24 May 2001. Note the extensive *Scirpus* marsh.

Table 22. Birds observed during breeding waterbird surveys at 70 Mile House slough 10.

Species[1]	70 Mile House slough 10 5-Jun-01
COLO	1
PBGR	1
CAGO	1
CAGO-PR[2]	1
MALL-♂	2
MALL-♀	1
CITE-♂	1
CANV-♀	1
LESC-PR	4
BAGO-♀	1
BUFF-♀	1
BUFF-N[1]	1
RUDU-♂	1
RUDU-♀	4
AMCO	6
AMCO-N[1]	1
TOTALS	**33**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

The smaller, east-west slough (Figures 20 and 22) has an extensive *Scirpus* marsh surrounding an area of open water; *Carex* with some *Juncus* and scattered riparian birch border it shoreward. Rangeland with scattered aspen and conifers occur on the adjacent upland. There are a number of mature aspen with cavities suitable for nesting waterbirds. (During one of our visits, a strong wind came up and blew the top off an aspen. We saw a hen Bufflehead flying from the direction of the damaged tree and upon investigating, found evidence of a nest (Figure 23). Later, during our breeding bird survey, we found a Bufflehead on eggs in an aspen cavity a few metres from the wind-damaged tree.) The smaller leg of the slough abuts the North Bonaparte Road to the west and has an extensive FRBC range research plot fenced off on the north shore, which includes both the upland and the marsh. Cattle have browsed or otherwise altered the riparian habitat.

An abundance of bladderwort was noted in the slough along with a low density of amphipods. Two western toads were seen along the western edge of the slough. There were also 2 beaver lodges on the eastern side of the main slough. Some attributes of slough 10 are shown in Table 21. Results of our breeding bird survey of the slough are shown in Table 22.

Figure 23. The top of a trembling aspen at 70 Mile House slough 10 that blew down during high winds on 24 May 2001. The break occurred at a weak point in the trunk where a nest cavity had been excavated. The cavity was occupied by a hen Bufflehead when the break occurred.

70 Mile House slough 11

This slough (Figure 24) is about 7.6 km east of 70 Mile House, situated just south of the Green Lake information sign and rest area on the south side of North Bonaparte Road. It is bounded along its northwest edge by North Bonaparte road and a small area of grassland (alkali saltgrass and silverweed with some rushes) (Figure 25). On the southeast edge

Figure 24. 70 Mile House slough 11 showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

Table 23. Some attributes of 70 Mile House slough 11.

Attributes	70 Mile House slough 11 28 May 01
UTM 10	0617554 5689116
Elevation (m)	1071
pH	9.9
Temperature (ºC)	16
Conductivity (µmhos·cm^{-1})	2400
Depth (m)	<2
Secchi Disk (m)	<2
Area (ha)	12.0
Perimeter (m)	2431
Emergent marsh area (ha)	0.5
Open water or submergent vegetation area (ha)	11.4
Fish	?
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences adjacent to wetland	No
Recreation Area near	No
Light Industry	No
Partially Filled (including roadway)	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

of the slough is a mature, mixed forest with lodgepole pine and trembling aspen as the dominant species (> 81 years with 56-65% crown closure and a Site Index of 16). A pipeline runs just beyond the northeastern shore.

The slough is primarily open water although a *Juncus* edge occurs around much of the perimeter; there is a small band of *Scirpus* marsh at the southwest end. A berm separates this slough from slough 10. Cattle were not seen during our visits; however, manure and hoof prints were noted along the grassy northern shore. Some attributes of slough 11 are shown in Table 23. Results of our breeding bird survey of the slough are shown in Table 24.

Table 24. Birds observed during breeding waterbird surveys at 70 Mile House slough 11.

Species[1]	70 Mile House slough 11 5-Jun-01
PBGR	1
MALL-♂[2]	3
MALL-♀	1
BWTE-♂	2
LESC-PR	2
LESC-♂	1
BUFF-PR	2
BUFF-JPR	2
BUFF-♂	1
BUFF-J♂	2
BUFF-♀	1
RUDU-PR	1
AMCO	1
Sub-total	27
SORA	1
TOTAL	**28**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Irish Lake

Irish Lake is situated about 12 km east of Highway 97 on Highway 24, about 2 km east of Lone Butte (Figure 26). Munro (1958) notes the breeding area as:

> *a shallow, alkaline lake of approximately 160 acres with hard shores and bottom; aquatics limited to sago pondweed, and round-stem bulrush in isolated clumps; amphipods are abundant.*

The lake, with a depth of 6.3 m, is, however, relatively deep and its 35.7 ha is considerably less than Munro's areal estimate (Table 25). *Scirpus* marsh grows out into the lake along much of the northern shore and the northern half of the east shore. Small patches of *Scirpus* also occur along the northern portions of the western shore.

Figure 25. 70 Mile House Slough 11 looking south.

Figure 26. Irish Lake showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

Table 25. Some attributes of Irish Lake.

Attributes	Irish Lake 23-May-01
UTM 10	626879 5712391
Elevation (m)	1174
pH	9.0
Temperature (ºC)	13.5
Conductivity (µmhos·cm^{1})	560
Depth (m)	6.3
Secchi Disk (m)	3.2
Area (ha)	35.7
Perimeter (m)	3277
Emergent marsh area (ha)	2.8
Open water or submergent vegetation area (ha)	32.9
Fish	Yes (stocked 1986)
Cattle access	No
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	Yes
Biogeoclimatic Unit	IDF dk3

In the northeastern corner, a patch of *Typha* was noted; *Typha* also occurred along the shoreline of a small bay north of the boat launch. Submergents, principally pondweed and water-milfoil, were observed in the shallower, near-shore waters. Some drowned aspen were found along the western and northern shores. Munro (1958) notes that a planing mill and drying kiln had established on the lake by 1958; however, the light industry appears to have been replaced by residential properties, which now occur on the east and south shores.

Irish Lake has been stocked with rainbow trout and the Ministry of Water, Land and Air Protection (formerly Environment, Lands and Parks) has established an aeration program on the lake. During our visits, large numbers of trout were observed in the shallows and rising or jumping from the deeper waters. This lake is a popular fishing spot with local anglers and a few were on the lake in a variety of watercraft (some with electric motors) during each of our visits.

Figure 27. Irish Lake looking northwest from boat launch site.

Table 26. Birds observed during breeding water-bird surveys at Irish Lake: 1937, 1958 and 2001.

	Irish Lake		
Species[1]	26-Jul-37	12-Aug-58	15-Jun-01
COLO			2
COLO-PR[2]		1	
COLO-N			1
COLO-Y		2	
PBGR			1
RNGR		1	1
RNGR-PR			1
RNGR-F	1		
RNGR-N			1
RNGR-Y	3	2	
GWTE-M			1
GWTE-F			1
MALL		9	
MALL-M			1
MALL-F			4
RNDU-PR			1
RNDU-F			1
LESC	3	2	
LESC-Y	27	16	
WWSC-M	1		
HOME-M			3
AMCO			1
Sub-total	**35**	**34**	**22**
GBHE			1
OSPR			1
BAEA			1
SORA			2
SPSA			4
HEGU			1
BLTE			1
TOTALS	**35**	**34**	**33**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 29. Bald Eagle in trembling aspen at Irish Lake, 15 June 2001. This bird is perched directly above a Common Loon nest (bottom left foreground) and was causing much distress to the adult loon.

Amphipods, not surprisingly, were *not* noted in the water column.

Irish Lake is bounded on the north by a band of trembling aspen-dominated, mixed forest (> 81 yr with 56-65% canopy closure; Site Index = 12) and the BC Rail line. The northern half of the eastern shore has been cleared and supports at least 3 buildings. The southern half of the east shore is forested to the lake edge (mixed forest with lodgepole pine and trembling aspen dominant; >101 yr with a crown closure of 46-55%; Site Index = 21); a residence with outbuildings occurs to the north and a public boat launch to the south. The southern edge of the lake is partly residential, where the forest has been cleared, and partly forested (lodgepole pine, trembling aspen dominant; >101 yr with 26 - 35% crown closure; Site Index = 14). The western shoreline is forested and is similar in composition to that of the north shore. There are many snags along the shoreline. Some lake attributes are given in Table 25.

Figure 28. Common Loon nest with one egg, Irish Lake, 15 June 2001.

During both our May (Appendix III) and June (Table 26) surveys, we noted one blue-listed species, the Great Blue Heron, on Irish Lake. A pair of Common Loons nested on the lake (Figures 28 and 29). On 15 June, 2 loons were involved in a long-running chase that continued from our arrival until we put the canoe in the water and paddled across the lake, a period of over 20 minutes. Finally, the defending bird routed the intruder. Our breeding bird numbers for Irish Lake (Table 26) are not directly comparable with Munro

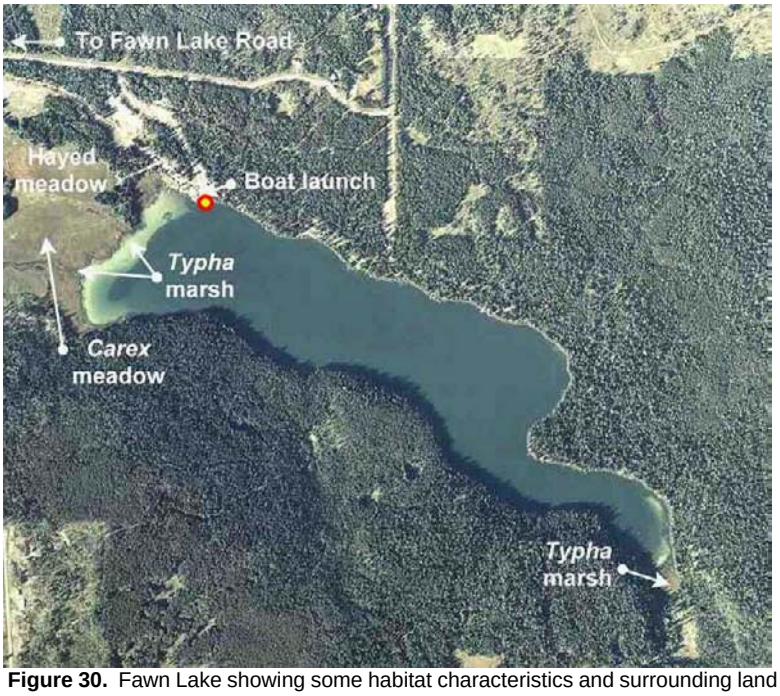

Figure 30. Fawn Lake showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

(1958) as he visited this area in late July or early August and would be reporting not only breeding birds but likely autumn migrants as well.

Fawn Lake

Fawn Lake is a relatively large, open water lake (Figure 30). The turn-off to the lake is about 14 km east of Lone Butte on Highway 24 and the lake is another 4 km north. Fawn Lake Resort, which was developed sometime between 1936 and 1958, lies at its northwestern end. The lake is a popular fishing spot with a productive rainbow trout population; lake chub also occurs. Boats are limited to those powered by electric motors or human effort only. There were a number of fishermen on the water during both our visits.

A few residences, primarily summer cottages, are scattered along the north shore, east of the resort. One other residence lies at the southeastern end of the lake. Munro (1958) does not mention any residences in his review, although he notes at least one sawmill was operated. He goes on to say:

> *At the west end is an extensive cattail marsh giving onto a wide hay meadow. Here, and at the east end, where the lake's width is much constricted, the bottom is soft ooze and the water shallow. Elsewhere the lake is deep with hard bottom and rocky, forested shores steeply sloping in some places. At the east end is a smaller cattail marsh. Otherwise there is little aquatic*

Table 27. Some attributes of Fawn Lake.

	Fawn Lake
Attributes	23-May-01
UTM 10	639880
	5713190
Elevation (m)	1102
pH	8.8
Temperature (ºC)	15
Conductivity (µmhos·cm^{1})	200
Depth (m)	3.5
Secchi Disk (m)	1.5
Area (ha)	79.9
Perimeter (m)	7359
Emergent marsh area (ha)	4.8
Open water or submergent vegetation area (ha)	51.7
Fish	Yes (stocked 1979)
Cattle access	No
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	Yes
Biogeoclimatic Unit	SBPS mk

Figure 31. *Typha* marsh at the west end of Fawn Lake, 15 June 2001. Behind the *Typha* marsh lies an extensive *Carex* meadow that, in past years, has been hayed. A blue-listed American Bittern was heard calling from this marsh during a May visit and a Common Loon nested along the *Typha* marsh edge just to the right of where the photo was taken.

vegetation in the lake except chara which is the dominant bottom growth. In the shallow portions a few small specimens of the pondweeds, Potamogeton pectinatus *and* Potamogeton pusillus *occur and there is some water smartweed* Polygonum amphibium *along the shore. Amphipods and the snails* Lymnea, Planorbis, *and* Physa *were noted.*

Today, heavy forest cover still surrounds much of the lake. The forest on the northwestern edge of the lake is dominated by lodgepole pine and aspen (>61 yr old; 46-55% crown closure; Site Index=19) which grades into an old growth Douglas-fir and lodgepole pine dominated stand (>141 years old; 36-45% crown closure; Site Index=13) further to the east. The forest along the southwestern shore is dominated by old growth Douglas-fir, lodgepole pine and spruce (>141 years; 56-65% crown closure; Site Index=15) grading into a spruce, lodgepole pine, birch and Douglas-fir dominated stand (>101 years; 46-55% crown closure; Site Index=16) alder and paper birch riparian occurs along the south shoreline.

Figure 32. Common Loon on the nest at Fawn lake, 23 May 2001. The bird was incubating 2 eggs. Note the black flies (*likely Simulium euryadminiculum)* on the head and bill of the bird.

At the western end of the lake (Figure 31), the edge is still bordered by a band (~ 5-10 m) of *Typha* marsh (in some cases a floating mat) and backing that lies an extensive *Carex* meadow. There was no indication during our visit that the *Carex* meadow was being hayed; however, we could determine from 1995 air photos that the meadow directly behind the *Typha* marsh had previously been hayed, although apparently not within the year before which the photo was taken; meadow areas further to the north had been recently hayed. A Common Loon nested along the lake edge of the *Typha* marsh. This bird was being attacked by ornithophilic black flies (*Simulium euryadminiculum*, or perhaps a related species in the *Simulium annulus* Species-Group) (Figure 32). As Doug Currie notes in an e-mail to Rob Cannings (pers. comm.):

> *Several authors have claimed that* S. euryadminiculum *is the only species of black fly that bloodfeeds upon birds. The only caveat is that* S. euryadminiculum *has not previously been reported from B.C. (although it may well occur there given it's presence in Alberta).*

The small *Typha* marsh at the eastern end of the lake was still extant and a Common Loon was also found nesting there (Figure 33). Some lake attributes are given in Table 27.

Appendix III lists the birds we recorded during a May survey at Fawn Lake. Two Blue-listed species, the American Bittern and Great Blue Heron, were noted. Herons were also reported during the June

Figure 33. Common Loon at the start of its Penguin Posture display, Fawn Lake, 15 June 2001. This bird was defending its nest of two eggs at the east end of the lake.

Figure 34. Great Blue Heron at Fawn Lake, 15 June 2001. Two individuals of this blue-listed species were observed in June and the species was also seen during our May visit.

Table 28. Birds observed during breeding waterbird surveys at Fawn Lake: 1936, 1958 and 2001.

	Fawn Lake		
Species[1]	17-Aug-36	12-Aug-58	15-Jun-01
COLO			1
COLO-PR[2]	2		1
COLO-N			1
COLO-Y			2
CAGO-PR			2
CAGO-Y			8
LESC-F	7		
LESC-Y	39		
BAGO		5	
BAGO-JM			1
BAGO-Y	3		
BUFF-F	3		
BUFF-Y	10		
HOME-F			2
Sub-total	**66**	**5**	**21**
GBHE			2
SORA			1
WISN			1
HEGU			1
BLTE			6
TOTALS	**66**	**5**	**32**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

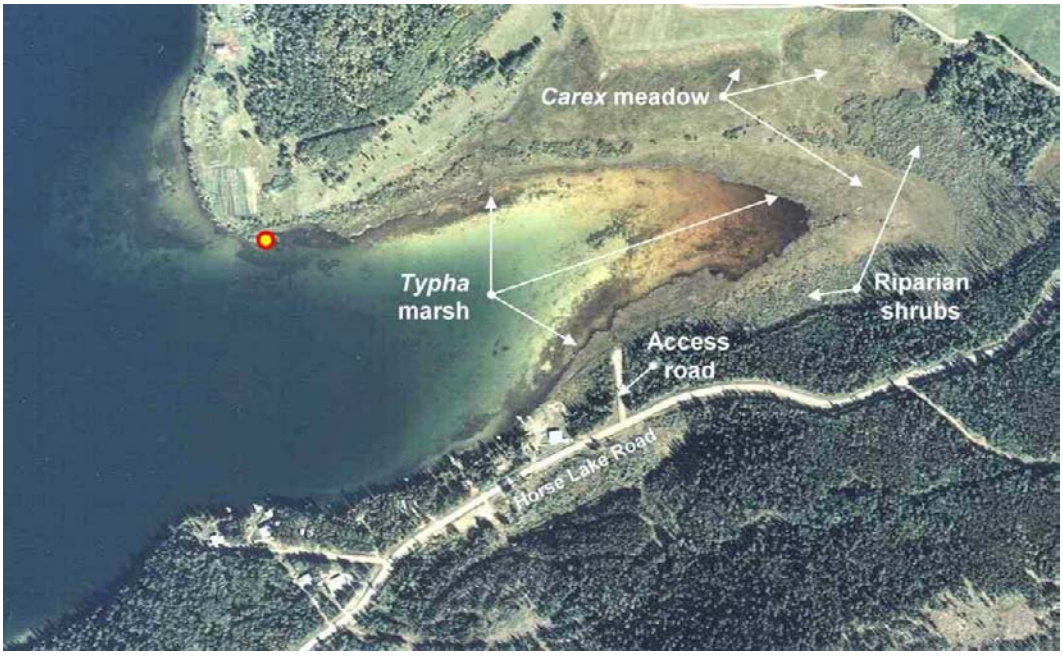

Figure 35. Larum's Bay, Horse Lake showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

survey (Figure 34; Table 28). Our breeding bird numbers for Fawn Lake (Table 28) are not directly comparable with Munro (1958) as he visited this area in early to mid-August and would have reported not only breeding birds but post-breeding birds as well.

Larum's Bay, Horse Lake

Larum's Bay is the local name used by J.A. Munro to describe the long, shallow, open water area at the southeast end of Horse Lake, some 24 km east of 100 Mile House on the Horse Lake Road (Figure 35). Munro (1958) noted the site as:

> *... a shallow bay of fifty acres or so on the south side of the lake near its east end with dense bottom flora of pondweeds and a shore marsh of cattail-bulrush-sedge combination.*
>
> *In recent years logging operations, intensified tourist business and motor boating seem to have reduced the bay's productivity to zero.*

Today, the shore of the bay consists of a tall, dense band of *Typha* (small amounts of *Carex* grew amongst the *Typha*), backed by a band of *Carex*, and then a deciduous riparian shrub strip, primarily red-osier dogwood and willow (Figure 37). Some scattered bulrush occurred to the bay side of the *Typha* marsh. Toward the east end of the bay, the *Carex* increases its areal extent and becomes a wider meadow as does the riparian shrub zone, then narrows again along the southern shore.

Table 29. Some attributes of Larum's Bay.

Attributes	Larum's Bay 23-May-01
UTM 10	633997 5717755
Elevation (m)	993
pH	8.6
Temperature (ºC)	13.5
Conductivity (μmhos·cm^{1})	170
Depth (m)	2.5
Secchi Disk (m)	2.0
Area (ha)	50.1
Perimeter (m)	3885
Emergent marsh area (ha)	4.9
Open water or submergent vegetation area (ha)	26.3
Fish	Yes (stocked 1940)
Cattle access	No
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	Yes
Biogeoclimatic Unit	IDF dk3

On the north side of the bay, agricultural fields and trembling aspen forest (81-100 yr, 36-45% crown closure, Site Index=21) lie behind the riparian shrub and marsh areas; a mature, primarily Douglas-fir-lodgepole pine forest, with some spruce and trembling aspen (>141 years old, 36-45% crown closure; Site Index=11), backs the riparian shrubs on the south edge of the bay.

Figure 36. Canada Goose on the nest at Larum's Bay, Horse Lake, 15 June 2001.

There are a number of residences along the south edge of the bay, many with docks extending into the lake. When the easternmost residence was established, some of the marsh and riparian habitats along the lakeshore appear to have been filled. During both visits, our canoe was the only boat in the bay.

A beaver lodge was found at the northwest corner of the mouth of the bay and river otter scat was noted there. Pondweeds and algae were found in the shallower waters. Some bay attributes are given in Table 29.

Our bird numbers for Larum's Bay are not directly comparable with Munro (1958) as he visited the area in early to mid-August. Common Loon, Red-necked Grebe, and Canada Goose (Figure 36) nests were found during this study (Table 30).

Table 30. Birds observed during breeding waterbird surveys at Larum's Bay, Horse Lake: 1937, 1958 and 2001.

	Larum's Bay	Larum's Bay	Larum's Bay
Species[1]	18-Aug-37	12-Aug-58	15-Jun-01
COLO			1
COLO-PR[2]	1		
COLO-N			1
COLO-Y			1
RNGR			1
RNGR-PR	2		
RNGR-N			2
RNGR-Y	2		
CAGO-N			1
GWTE & Y	12		
GWTE-♂			2
GWTE-♂	1		
GWTE-Y	6		
MALL-♂			2
MALL-♀			1
NOPI-♀	1		
CITE-♂			1
RNDU-PR			3
RNDU-♂			3
COGO-F			1
BAGO & Y	17		
BUFF-J♀	2		
BUFF-♀	1		
BUFF-Y	7		
COME-♀	1		1
COME-Y	7		
AMCO	2		
Sub-total	**65**	**0**	**24**
OSPR			3
BAEA			1
VIRA			1
SPSA			1
KILL			2
KILL-Y			3
WISN			2
BOGU			1
BLTE			126
TOTALS	**65**	**0**	**164**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 37. Larum's Bay, Horse Lake looking east, 23 May 2001. The photograph was taken from a beaver lodge at the northwest end of the bay. A *Typha* marsh bands the shoreline; small clusters of *Scirpus* extend on the water side of the *Typha* and riparian shrub habitat occurs shoreward.

Figure 38. 100 Mile House marsh showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

100 Mile House marsh

This approximately 12 ha marsh is situated near the centre of 100 Mile House (Figure 38). It is bounded on the east by the Highway 97 and the town, to the north by the airport, to the west by municipal buildings and to the south by light industry. A nature trail runs along the south shore. Munro (1958) describes this breeding area as

> *A 25 acre slough, of which the central four-fifths is roundstem bulrush marsh, on the margin of 100 Mile village. In 1938 and thereabouts the slough was mostly dry and hay was cut there. It was considered to be of no value as nesting habitat. It does have value now* [1958] *but appears to be little used. On June 18, 1958, a pair of pied-billed grebe, black terns, yellow-headed blackbirds and red-winged blackbirds were nesting.*

The emergent vegetation has changed from Munro's 1958 description to a continuous *Typha* marsh, with varying amounts of *Scirpus*, around the perimeter of the water body (Figure 39). The *Typha* band is thickest on the south shore, which has a forested edge. Nest boxes have been placed along the south shore. Much of the north and west shoreline has been planted to lawn. Some attributes of the breeding area are shown in Table 31.

DUC has undertaken management activities on 100 Mile House marsh to improve water levels and regime, increase depth and improve aquatic vegetation growth. Some nesting islands were constructed.

Waterbird use is now up over 600% since Munro's 1958 visit (Table 32). Canada Goose (Figure 40), Mallard, Barrow's Goldeneye and American Coot all had broods on the wetland and we also recorded Yellow-headed and Red-winged blackbirds nesting in the marsh.

Table 31. Some attributes of 100 Mile House marsh.

Attributes	100 Mile House marsh 14-May-01
UTM 10	618015 5722458
Elevation (m)	928
pH	8.7
Temperature (ºC)	12
Conductivity (µmhos·cm^{-1})	820
Depth (m)	1.0
Secchi Disk (m)	1.0
Area (ha)	11.1
Perimeter (m)	1304
Emergent marsh area (ha)	3.6
Open water or submergent vegetation area (ha)	7.5
Fish	No
Cattle access	No
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	Yes
Partially filled	Yes
Boat launch	No
Biogeoclimatic Unit	IDF dk3

This marsh is now a productive breeding area and is particularly important, especially from a wildlife viewing and educational perspective, because it is situated within the community of 100 Mile House close to public, schools, and the Tourist Information Centre. It is an excellent example of wetland habitat with significant breeding waterbird numbers being maintained in a highly populated area. Where birds are not directly harassed and their habitat is in good shape, many acclimatise to the people and traffic. That would not apply to all species, of course; many need wild habitats and it's unlikely, for example, that Sandhill Cranes would nest under such circumstances.

Figure 39. *Typha* marsh along the north side of 100 Mile House marsh, 14 May 2001.

Figure 40. Canada Goose with brood of 5 young at 100 Mile House marsh, 14 May 2001.

Table 32. Birds observed during breeding waterbird surveys at 100 Mile House marsh: 1958 and 2001.

	100 Mile House marsh	
Species[1]	18-Jun-58	17-Jun-01
PBGR	2	1
CAGO		16
CAGO-Y		28
MALL-♂[2]		1
MALL-♀		2
MALL-Y		14
BWTE-PR	2	
CITE-PR		1
NOSL-♂		1
LESC-PR		2
LESC-♂		8
LESC-♀		1
BAGO-♀		1
BAGO-Y		9
RUDU-PR	2	5
AMCO	3	29
AMCO-Y	10	25
Sub-total	**23**	**152**
BLTE[3]		6
TOTALS	**23**	**158**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II
[3] Munro (1958) mentions Black Terns nesting

Exeter Lake

Exeter Lake (Figure 41) is located within the municipal boundaries of 100 Mile House approximately 3 km west of the town centre. Its open water covers an area of approximately 46 ha and there are extensive wetland areas adjacent to the lake, particularly at its eastern end. In 1938, Munro described Exeter Lake as being

> *situated in a wide open valley between timbered hills about 2 miles west of 100 Mile. The bottom is soft marl and hydrophytes limited to yellow pond lily* Nuphar *sp. and water milfoil, neither very abundant, with roundstem bulrush and sedges in a narrow belt along shore beyond the prevailing willow margin. Cattail is present at the east end and where boggy conditions prevail along the sides of a shallow creek, its outlet, and an adjacent narrow bay. A spruce swamp on the south side has the characteristic edge of sedges succeeded by roundstem bulrush.*

In 1958, Munro noted that his 1938 description was applicable to what he was observing with the exception that the lake no longer contributed much to waterfowl production, which he attributed to the continuing disturbance caused by a concentration of the logging and milling industry near the lake and the attendant population growth in the area. Munro (1958) noted that traffic on the road to Exeter Station, which served 4 mills in 1958, was not "greatly less than that on the Cariboo Highway."

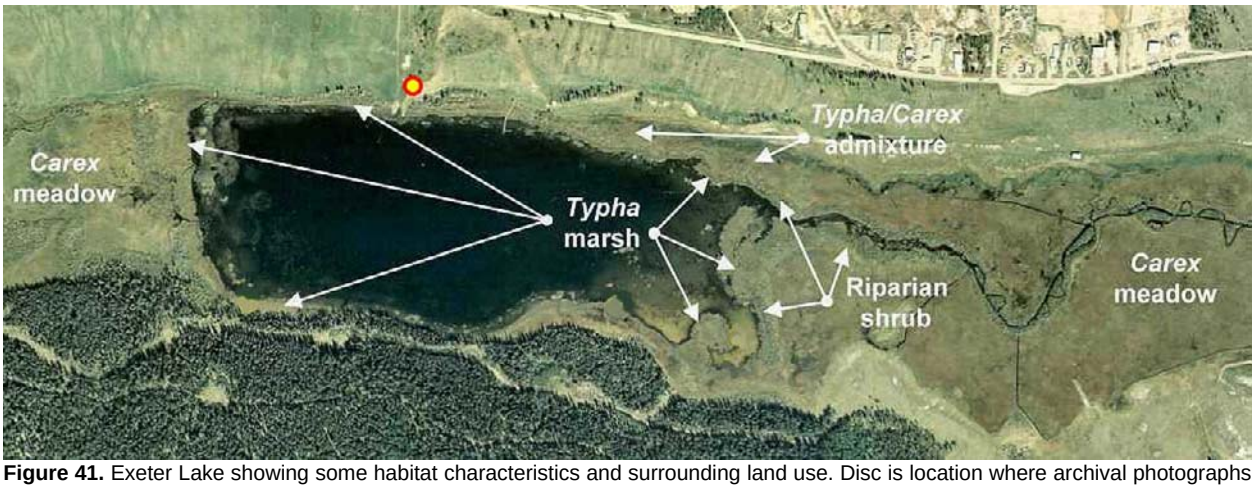

Figure 41. Exeter Lake showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

Table 33. Some attributes of Exeter Lake.

Attributes	Exeter Lake 31-May-01
UTM 10	614996
	5723056
Elevation (m)	919
pH	8.7
Temperature (ºC)	15
Conductivity (µmhos·cm^{-1})	280
Depth (m)	4.5
Secchi Disk (m)	3.3
Area (ha)	159.2
Perimeter (m)	8076
Emergent marsh area (ha)	7.9
Open water or submergent vegetation area (ha)	44.5
Fish	Yes
Cattle access[1]	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	No
Recreation Area near	No
Light Industry	Yes
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

[1] Cattle have only limited access to the lake.

Figure 43. Common Loon nest location (top) and close-up of eggs, Exeter Lake, 31 May 2001. This was one of three nests found along the south shore of the lake; all nests held two eggs.

Today, Exeter Lake is much the way Munro described it, with few exceptions. There are now agricultural fields northwest of the lake, where forage crops are grown. Cattle have access to much of the area northeast of the lake; however, through good stewardship practices, cattle access to the lake is now restricted by fencing, which also protects a riparian willow band that occurs along much of the north side of the lake. Another agricultural field lies at the southeast corner, adjacent to an extensive *Carex* meadow. There is a light industrial area near the lake to the north of Exeter Road.

The southern shore is backed by a coniferous forest; Douglas-fir and varying amounts of both spruce and trembling aspen are the dominant species (141 - 250 yr with 56 - 65% crown closure and a Site Index range of 13 - 16).

A narrow *Typha* marsh occurs along most of the shoreline with sporadic stands of *Scirpus* at the outer margin of the *Typha*. In most areas, the *Typha* band

Figure 42. Exeter Lake looking southeast, 14 May 2001. In the foreground is an admixture of *Typha* and *Carex* and some riparian shrub habitat. The lake outlet (Little Bridge Creek) can be seen (left centre).

is 1 - 5 m wide (narrowest along the south shore), except where the marsh becomes more prominent at the west and particularly at the east end of the lake. *Carex* was usually found growing amongst the *Typha*. Shoreward of the *Typha* marsh where there are low moist areas, *Typha* grades into *Carex* meadows which are extensive, particularly at the west end of the lake. In some places, such as the northeast shoreline, admixtures of the *Typha* and *Carex* occur (Figure 42). Large mats of Canadian waterweed were noted, particularly at the west end and along the north side of lake; yellow waterlily occurs around the shore perimeter and was starting to bloom by mid-May. Snail and freshwater mussel shells were fairly common. Some other attributes of Exeter Lake can be found in Table 33.

Little Bridge Creek enters the lake at the west end with its outlet at the east end. The creek meanders through the extensive *Carex* meadow east of the lake; there, it is lined on both sides by a riparian willow band. Yellow waterlily and Canadian waterweed were also noted in the creek along with 2 active beaver dams. We did not wander through the meadow; however, we heard many ducks and rails as we paddled the creek. Our estimates of bird use in this area would have to be considered low (Table 34.).

At the end of May we paddled the lake perimeter checking for nests and also surveyed the eastern portion of Little Bridge Creek (Table 34). The declining bird use of Exeter Lake that Munro reported in 1958 appears to have reversed itself and bird numbers in 2001 were about half those reported in 1938 (Table 34). Species diversity was higher in 2001, with 6 additional species observed—Red-

Figure 44. Red-necked Grebe nest with four eggs, Exeter Lake, 31 May 2001. This nest was built on a floating bed of *Elodea*, and consisted primarily of *Nuphar* and *Elodea* stems and leaves and decaying aquatic vegetation.

Table 34. Birds observed during breeding waterbird surveys at Exeter Lake: 1938, 1958 and 2001.

	Exeter Lake		Exeter Lake	Exeter Creek	Exeter Lake
Species[1]	7-Jul-38	5-Jul-58	31-May-01	31-May-01	20-Jun-01
COLO	1		2		2
COLO-PR[2]		1			1
COLO-N			3		
COLO-Y		1			1
RNGR			1		1
RNGR-PR					1
RNGR-N			1		1
CAGO			1		
CAGO-PR			6		5
CAGO-Y			20		15
DABB-U				6	
GWTE-PR				2	
GWTE-♂	5		1		2
GWTE-♀	3				
GWTE-Y	19				
MALL-PR			1	1	
MALL-♂	50		5	1	5
MALL-♀	4				1
MALL-Y	28				4
BWTE-PR	1			1	
BWTE-♂	3		1	2	3
BWTE-♀	1				
CITE-PR			2		2
CITE-♂			2		1
NOSL-PR				1	
NOSL-♂				1	
GADW-PR			5	1	2
GADW-♂			3		2
GADW-♀			1		1
AMWI					13
AMWI-PR			1		4
AMWI-♂			5		
AMWI-♀	1				
AMWI-Y	12				
REDH-PR				1	
RNDU-PR					1
RNDU-♂		2	7		1
RNDU-♀	1		1		
RNDU-Y	15				
LESC-PR	1		2	9	
LESC-♂	15				2
COGO-J♂			1		
BAGO-♀	2				
BAGO-Y	15				
BUFF-J♀	1				
AMCO			11		5
Sub-total	**180**	**5**	**100**	**42**	**92**
VIRA			1	3	2
SORA			3	5	6
SORA-Y	1				
SHOR-U			1		
SPSA					2
KILL			1		1
WISN			1		1
HEGU			3		
BLTE			33	20	20
TOTALS	**181**	**5**	**143**	**70**	**124**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

necked Grebe (Figure 44), Canada Goose, Cinnamon Teal, Gadwall, Common Goldeneye, and American Coot—that were not reported by Munro in 1938. Two species, Barrow's Goldeneye and Bufflehead, were reported in 1938 but not in 2001. Our Mallard numbers, in particular, were considerably lower than Munro's 1938 counts. However, our latest count in June was about 2 weeks earlier than Munro's surveys and thus we likely missed a number of broods that had not yet appeared.

Bridge Creek Estate manages this breeding area and has worked together with the former Ministry of Environment, Lands and Parks; Canadian Wildlife Service, Environment Canada; and Ducks Unlimited Canada, as part of the Fraser River Action Plan, to ensure that the extensive wetlands and riparian habitat, important for many wildlife species, are maintained while still ensuring that the economic viability of the ranch was not compromised. In 2001, Bridge Creek Estate won an environmental award from the British Columbia Cattlemen's Association for their stewardship activities (Figure 46). According to Ranch and Property Manager, Don Savjord (pers. comm.), it has turned out to be a win-win situation for both the cattle and the waterbirds that depend on these important nesting areas.

101 Mile Lake

This productive little wetland is located on the west side of Highway 97, a few kilometres north of 100 Mile House. Munro (1958) notes that the lake was:

> *described in 1938 as a round-stem bulrush, cattail and* Juncus *marsh of 6 to 7 acres, the first chiefly in the centre and in the form of isolated clumps. Duckweed* Lemna minor *was noted as the most abundant food plant. In 1958 it may best be described as a marshy lake of approximately 20 acres of which about half is round-stem bulrush cut through by narrow channels. The nesting value is perhaps three times as great as in 1938.*

Today the approximately 6 ha slough appears to be much as it was in 1958; about 40% open water and 60% *Scirpus* marsh (Figure 43). Shoreward of the *Scirpus* is a band of rushes of varying widths. Further to

Figure 45. 101 Mile Lake showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

Figure 46. Don Savjord, Ranch and Property Manager and the newly acquired award given by the British Columbia Cattlemen's Association to Bridge Creek Estate for their Environmental Stewardship practices on Exeter Lake and 101 Mile Lake (20 June 2001).

Table 35. Some attributes of 101 Mile Lake.

Attributes	101 Mile Lake 11-May-01
UTM 10	618025 5725450
Elevation (m)	961
pH	8.6
Temperature (ºC)	11
Conductivity (µmhos·cm^{-1})	1800
Depth (m)	1.5
Secchi Disk (m)	1.5
Area (ha)	5.7
Perimeter (m)	988
Emergent marsh area (ha)	3.5
Open water or submergent vegetation area (ha)	2.2
Fish	No
Cattle access[1]	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Power boats allowed	No
Biogeoclimatic Unit	IDF dk3

[1] Cattle have limited access to wetland (see text).

the east lies a *Distichlis-Puccinellia* meadow and Highway 97. The wetland is bordered on the south by a *Distichlis-Puccinellia* meadow and rangeland, and on the west and north by the *Distichlis-Puccinellia* meadow which grades into a band of rangeland of varying width and then to a mixed forest of Douglas-fir, lodgepole pine and trembling aspen. Around the slough there are scattered open patches of highly saline, bare ground, occasionally with Seablite eking out an existence. Some attributes of the slough are shown in Table 35.

Despite Munro's (1958) comments that the nesting value in 1958 was 3 times as great as in 1938, his waterbird numbers don't reflect that. Bird numbers in 2001, however, were significantly higher than in either of Munro's years (Table 36).

There was also greater bird diversity in 2001 with 10 species reported that were not found during Munro's earlier surveys. These included Pied-billed Grebe (Figure 47), Eared Grebe, Canada Goose, Northern Pintail, Cinnamon Teal, Northern Shoveler, Gadwall, Redhead, Lesser Scaup and Common Goldeneye. In this study, Mallard and Barrow's Goldeneye numbers were down from previous

Figure 47. Pied-billed Grebe chick at 101 Mile Lake, 20 June 2001.

Table 36. Birds observed during breeding waterbird surveys at 101 Mile Lake: 1938, 1958 and 2001.

	101 Mile Lake			
Species[1]	7-Jul-38	19-Jun-58	30-May-01	20-Jun-01
PBGR			1	1
PBGR-N[2]				1
PBGR-PR				1
EAGR			1	2
CAGO			15	1
CAGO-PR			2	
CAGO-Y			7	
GWTE-♂		1		4
GWTE-F				1
MALL-PR			1	2
MALL-♂			1	1
MALL-♀	3	1		4
MALL-Y	12			
NOPI-♂				1
BWTE-PR		1		
BWTE-♂	4	1	1	3
BWTE-♀	3			4
CITE-♂				1
NOSL				5
NOSL-♂				5
NOSL-♀				1
GADW-PR			1	
GADW-♂			1	4
AMWI-PR			1	1
AMWI-♂		1		1
AMWI-Y			5	
REDH-PR				1
REDH-♂			1	
REDH-♀				2
REDH-N				2
LESC-PR			2	2
LESC-♂			1	2
LESC-N				1
COGO-♀			1	3
BAGO-♂			1	
BAGO-♀	1	1		1
BAGO-J♀	1			
BAGO-Y	5			
BUFF-♂			3	
BUFF-J♂			1	
BUFF-♀		1		1
RUDU	6			
RUDU-PR		1		6
RUDU-♂			4	3
RUDU-♀			3	
RUDU-N				1
AMCO			10	14
AMCO-PR		3		
AMCO-♀	3			
AMCO-N			1	8
AMCO-Y	4			16
Sub-total	**42**	**13**	**72**	**120**
SORA			3	
SORA-PR				1
SPSA			1	1
GRYE-PR		1		
KILL			1	2
WISN			1	
BLTE			28	20
BLTE-N				20
BLTE-Y				9
TOTALS	**42**	**15**	**106**	**174**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 48. American Coot nest with eggs (note two are piping) and chick at 101 Mile Lake, 1 June 2001. Twenty-seven coot nests (8 still containing eggs or young) were found in the lake.

years; however, Ruddy Duck and American Coot (Figure 48) numbers were up.

We conducted a complete nest survey of the slough and found nests with either eggs or young of 8 species of waterbirds, including Black Tern (Figures 49 and 50b). We noted an Eared Grebe nest platform amongst the *Scirpus*; however, the water was too deep to enable us to reach the nest in our waders, so we could not check its contents. We also located a number of Yellow-headed and Red-winged blackbird nests (Figures 50c, 52 and 53). A total of 113 Yellow-headed Blackbird nests were found which included 22 nests with eggs (1E=4; 2E=3; 3E=11; 4E=4), 24 nests with nestlings (1Y=13; 2Y=7; 3Y=4), 2 nests each containing 1 egg and 2 young, 52 nests with evidence of having successfully fledged young (Figure 54), 6 newly constructed nests; and the remaining 9 nests had either been preyed upon or we could not determine their outcome. Eight infertile eggs and 10 dead young were found either in the nest or in the water below a nest. This is one of only a few Yellow-headed Blackbird colonies reported from the province with over 100 nests (Campbell et al. 2001).

Bridge Creek Estate also worked with partners, such as Ducks Unlimited Canada and the Canadian Wildlife Service, on this project. The Estate manages the area for both waterbirds and cattle. The slough has been entirely fenced; water for the cattle is pumped from the slough to a trough outside the fenced area (Figure 54). Cattle have access to the slough once a year for 5 or 6 days in late summer after the waterbirds are off their nests (Don Savjord,

Figure 49. Black Tern colony at 101 Mile Lake, 20 June 2001. Clockwise from directly above: Black Tern nest with eggs (photograph taken on 31 May 2001); Black Tern nesting habitat (arrow points to nest); Neil Dawe checking Black Tern nest (Photo: J.M. Cooper); Black Tern nest with chicks (Photo: J.M. Cooper); and John Cooper being harassed by a pair of Black Terns as he checks their nest.

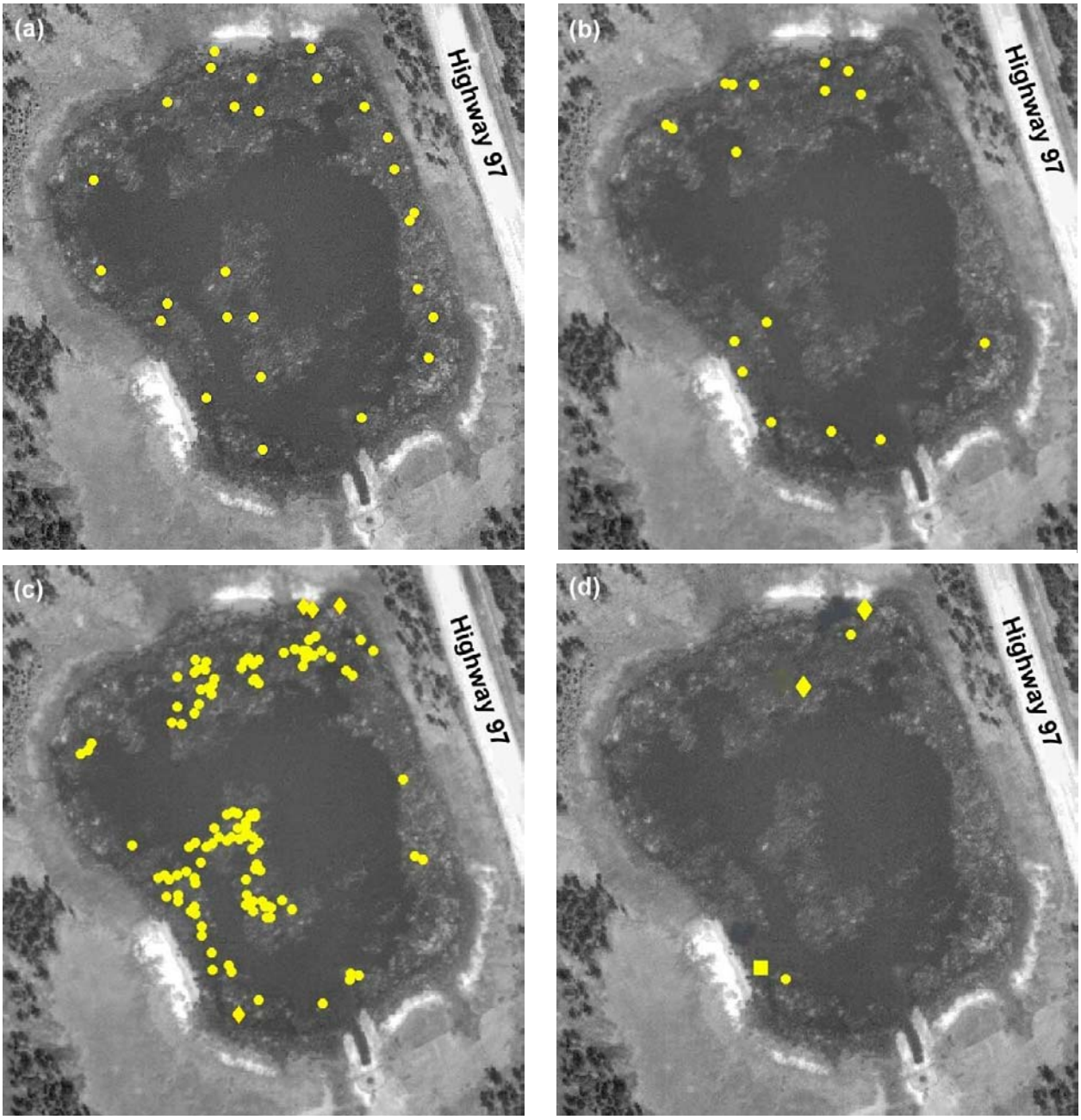

Figure 50. Nest distributions of 8 species on 101 Mile Lake, 20 June 2001. Nest locations were geo-referenced with a hand-held GPS unit. Species include (a) American Coot, (b) Black Tern, (c) Yellow-headed Blackbird (circles) and Red-winged Blackbird (diamonds), and (d) Pied-billed Grebe (circles), Redhead (diamonds), and Lesser Scaup (square). A Ruddy Duck egg was found in the one scaup nest.

Figure 51. 101 Mile Lake looking northwest, 30 May 2001.

Figure 52. John Cooper checking contents of Yellow-headed Blackbird nest at 101 Mile Lake, 20 June 2001.

Figure 53. Yellow-headed Blackbird fledgling at 101 Mile Lake, 20 June 2001.

pers. comm.). This project, similar to the one at Exeter Lake, is another example of good wetland stewardship that helps to maintain the ecosystem services that wetlands such as 101 Mile Lake provide. The value of this type of management can not be overemphasized.

Figure 54. Exclusion fencing and cattle trough at 101 Mile Lake, 1 June 2001.

103 Mile Lake

103 Mile Lake is located about 5 km north of 100 Mile House and 1 km east of Highway 97. It covers an area of approximately 46 ha. In the late 1930s, Munro 1958) describes it as:

> *…a hard-shored lake, 3/4 M. X 1/4 M., with semi-open range on three sides and a wooded hillside on the other. It contains open marshes of round-stem bulrush at either end and isolated stands of this rush along the west shore. Water smartweed covers large areas of the surface near shore and there is a heavy submerged flora, mainly sago pondweed* Potamogeton pectinatus, *and the pondweeds* P. pusillus, P. panormitanus *var.* major *and water milfoil* Myriophyllum spicatum. *The last which is dominant over much of the lake bottom, is of great importance in the economy of the lake. It is used as nesting material by grebes and to a lesser extent by coots; its branches and seeds constitute an important item in the food of American Widgeon* [sic] *and coot and the masses of growing plants harbour the larvae of aquatic insects upon which waterfowl feed. Amphipods are enormously abundant and although eaten by all diving waterfowl seem to maintain a high density of population. In common with many other local lakes*

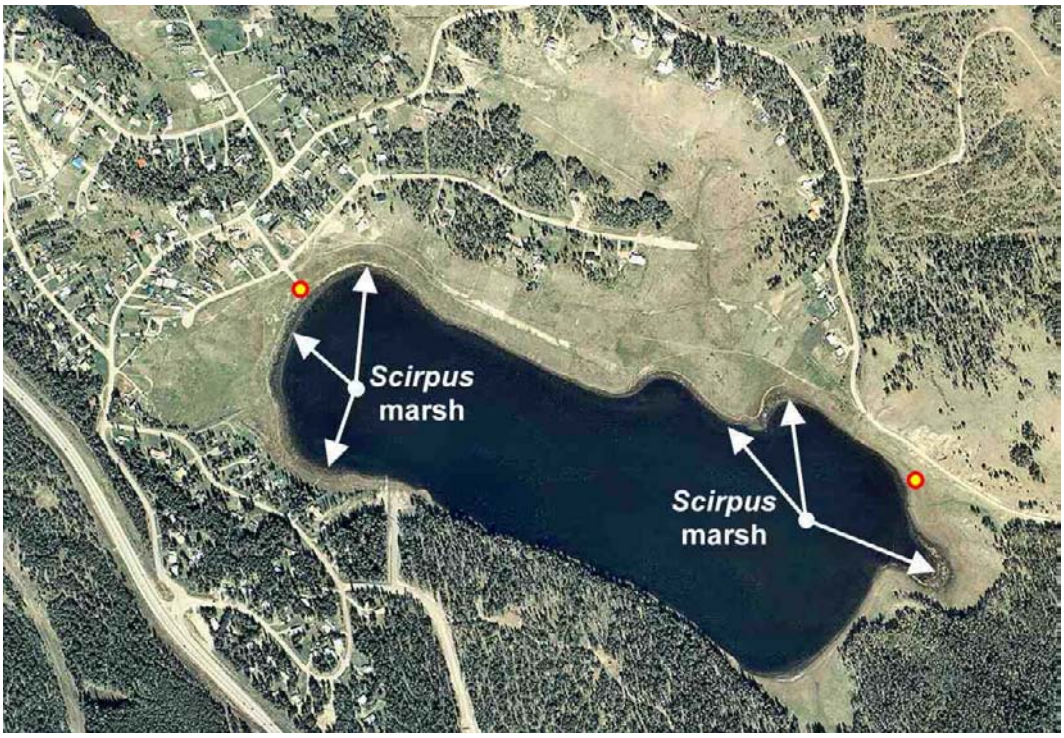

Figure 55. 103 Mile Lake showing some habitat characteristics and surrounding land use. Discs are locations where archival photographs were taken.

filamentous algae blankets much of the inshore areas from June until autumn.

On June 3, 1958, except for the prevailing high water that had flooded the spruces at the base of the wooded hillside, no change from the conditions prevailing in earlier years was detected. The lake is not now visible from the Cariboo Highway that has been re-routed several hundred yards west of the old road.

There has been some significant changes to the 103 Mile Lake surrounds since 1958 (Figure 55). There are now a number of year-round and summer residences adjacent to the lake, primarily at its western end. A few residential properties are scattered along the south shore which is still mainly forested to the lake edge with mature Douglas-fir and lodgepole pine as the dominants with varying amounts of trembling aspen (mainly 101 - 120 yr old with a crown closure of 36 - 65% and a site index of 17) except for its western quarter, which is residential. Water birch and soopolalie occur along the shore. The eastern shore has rangeland at the north and south corners and lodgepole pine and Douglas-fir forest with an aspen dominant edge in the remainder. Cattle have access to at least the east end of the lake. A shallow bay lies at the northeast corner of the lake with a small area of *Scirpus* marsh. Most of the north shore is fronted by rangeland with resi-

Table 37. Some attributes of 103 Mile Lake.

Attributes	103 Mile Lake 13-May-01
UTM 10	617624 5727403
Elevation (m)	893
pH	9.3
Temperature (ºC)	13
Conductivity (µmhos·cm^{-1})	550
Depth (m)	3.5
Secchi Disk (m)	2.3
Area (ha)	45.7
Perimeter (m)	3566
Emergent marsh area (ha)	5.2
Open water or submergent vegetation area (ha)	40.5
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	Yes
Biogeoclimatic Unit	IDF dk3

Table 38. Birds observed during breeding waterbird surveys at 103 Mile Lake: 1937, 1958 and 2001.

	103 Mile Lake			
Species[1]	2-Jun-37	3-Jun-58	1-Jun-01	4-Jun-01[2]
COLO-PR[3]	1			
PBGR-N		1	R[4]	
PBGR-PR		1		
HOGR-PR	2			
RNGR			8	
RNGR-PR		3		
RNGR-N		2	1	6
EAGR			8	
CAGO			10	
CAGO-PR			1	
CAGO-Y			7	10
GWTE-PR	RM[5]		1	
MALL-PR		1	3	
MALL-N				1
MALL-♂		10	4	
MALL-♀		2		
MALL-Y		15		
BWTE-PR	1		1	
BWTE-♂			2	
CITE-♂			1	
NOSL-PR		RM	1	
GADW-PR			1	
AMWI		7		
AMWI-PR	3		2	
AMWI-♂			1	
CANV		14	R	
LESC	44	31		
LESC-PR			4	
LESC-♂			4	
LESC-♀			2	
WWSC		19	3	
WWSC-PR			1	
WWSC-♂	30		3	
WWSC-♀	6			
GOLD-♀			3	
COGO-PR			4	
COGO-♀			1	
BAGO-PR			3	
BAGO-J♂		2	1	
BAGO-♀	2		1	
BAGO-J♀		41		
BAGO-N		1		
BUFF	40			
BUFF-PR			3	
BUFF-♂			3	
BUFF-♀			5	
RUDU-N	RM	RM		1
AMCO	10		37	
AMCO-PR		12		
AMCO-N		10		20
Sub-total	**146**	**177**	**155**	**38**
VIRA-N				1
SORA			1	
SORA-PR			1	
SPSA			2	
KILL			1	
BLTE			12	
BLTE-N				1
TOTALS	**146**	**177**	**173**	**41**

[1] For a key to species codes see Appendix I
[2] Nest survey only
[3] For a key to species code modifiers see Appendix II
[4] Recorded on 13 May 2001 (Appendix III)
[5] Recorded by Munro (1958) on a later survey

Figure 56. From top to bottom, American Coot (this clutch is one of the largest known from the province (Campbell et al. 1990b), Ruddy Duck (photo: A.C. Stewart), and Virginia Rail (photo: A.C. Stewart) nests at 103 Mile Lake, 4 June 2001.

Figure 57. Nest distributions of 8 species on 103 Mile Lake, 4 June 2001. Nest locations were geo-referenced with a hand-held GPS unit. Species included (a) Red-necked Grebe (circle), Black Tern (ellipse), Virginia Rail (diamond), Mallard (triangle), and Ruddy Duck (square); (b) American Coot, and (c) Yellow-headed Blackbird (circles) and Red-winged Blackbird (squares).

dences situated about 100 m back from the shoreline. *Scirpus* marsh occurs along much of the north and west shores in various widths. A boat launch is situated at the western end of the lake and residential properties occur some 50 to 100 m from the shore. At the southwest corner, residential properties occur right at the lakeshore.

Figure 58. Andy Stewart gathering Yellow-headed Blackbird nest data at 103 Mile Lake, 4 June 2001.

We noted abundant beds of Sago pondweed, floating-leaved pondweed and water-milfoil. The lake was stocked (unsuccessfully) with Eastern Brook Trout in 1968 (BC Fisheries 2002). Other attributes of 103 Mile Lake can be found in Table 37.

In 2001, waterbird numbers were about the same as those of Munro's (1958) earlier surveys (Table 38). Munro (1958) reported 2 species which were not seen on the lake during our surveys (Common Loon and Horned Grebe) and we noted 5 species that were not reported by Munro (Eared Grebe, Canada Goose, Cinnamon Teal, Gadwall, and Common Goldeneye). Numbers of Canvasback, White-winged Scoter, Barrow's Goldeneye, and Bufflehead in this study were down somewhat from the earlier surveys.

As did Munro, we spent time searching for nests by wading the *Scirpus* marsh or canoeing the perimeter of the lake; however, a complete nest search was not made. A total of 9 species was found nesting on the lake: Red-necked Grebe - 6 nests; Canada Goose - 3 broods; Mallard - 1 nest; Ruddy Duck - 1 nest (Figure 56); Virginia Rail - 1 nest (Figure 56); American Coot - 22 nests (Figure 56); Black Tern - 1 nest; Red-winged Blackbird - 3 nests; Yellow-headed Blackbird - 27 nests (Figure 58). Figure 57 shows the nest distribution of the various species.

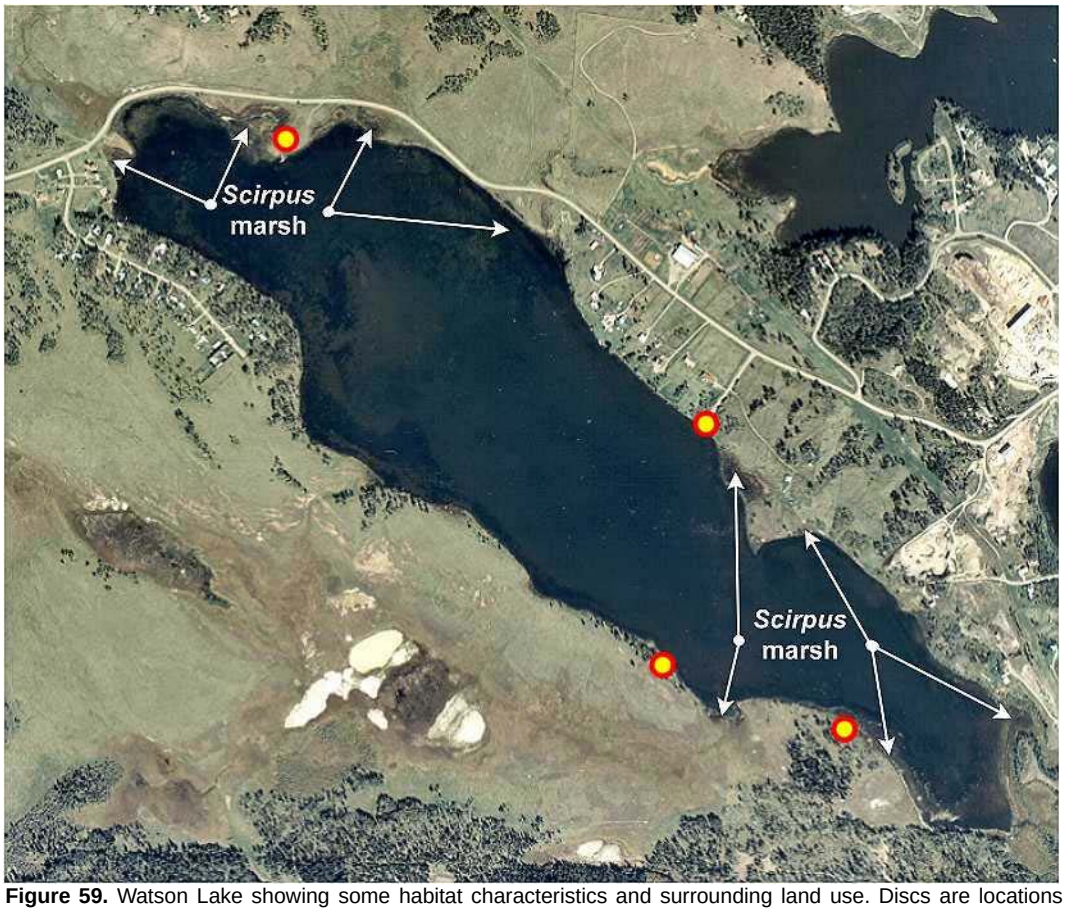

Figure 59. Watson Lake showing some habitat characteristics and surrounding land use. Discs are locations where archival photographs were taken.

Watson Lake

Watson Lake (Figure 59) is located approximately 9 km northwest of 100 Mile House, just west of Elliot Lake. It runs southeast to northwest and covers an area of approximately 120 ha. It is 2.7 km long and about 760 m at its widest point. Munro (1958) notes that Watson Lake is:

> *a shallow lake surrounded by grassy hills dotted with aspen bluffs and open woods in which aspen predominates. It contains areas of round-stem bulrush marsh alongshore and at the north end a marsh of this growth is succeeded inshore by rivergrass* Fluminea festucacea, *rushes, chiefly the rush* Juncus balticus, *and sedges. Submerged flora is restricted to certain portions and there are large areas of muddy bottom completely bare of vegetation. Amphipods are not plentiful.*
>
> *In 1936 Watson Lake was considered to have little value as a nesting ground; there was little shoreline emergent vegetation and this chiefly on the north side.... Conditions had improved by 1939, marginal growth of round-stem bulrush was then almost continuous and in some places heavy enough to provide good nesting cover.*

Figure 60. Residential properties along the southwest shore of Watson Lake, 6 June 2001.

Figure 61. South shore of Watson Lake, 11 May 2001. Cattle have access to much of this area and, as a result, the banks along a considerable portion of the shoreline have been degraded and there is little in the way of regenerating aspen that would normally replace the older trees (left). Where cattle have been excluded the banks are in good shape and regenerating aspen are common; ground cover for upland nesting waterfowl is also much superior in the ungrazed areas (right).

> *The only physical modification observed in 1958 was due to the higher water level that had flooded stands of shoreline aspens. For several years past the lake has been used by the owner of the property as a landing place for his aeroplane and it is reportedly used in emergencies by other aircraft. What effect such disturbance may have on the waterfowl is not clear.*

Since 1958 there has been considerable modification of the lakeshore (Figures 59, 60 and 62). Along the southwest shore, many residential properties have lawns right to the lake edge and cover about 700 m of the shoreline (Figure 60). A few landowners, however, have maintained some trees and shrubs, including older aspen (Figure 62); float planes still use the lake as they did when Munro visited the site.

The south shore is mainly heavily grazed pasture and groves of aspen with some lodgepole pine and spruce. In areas where cattle have free access to the lakeshore the banks have been degraded and there we saw no regenerating aspen to replace the older, dying trees, important to cavity nesting waterbirds such as goldeneye and Bufflehead. In addition, much of the nesting cover from emergent vegetation has been reduced in size or is non-existent.

Figure 62. Residential properties along the southwest shore of Watson Lake, 6 June 2001 (note the float planes to the right of the houses).

Table 39. Some attributes of Watson Lake.

Attributes	Watson Lake 11-May-01
UTM 10	614150 5730050
Elevation (m)	893
pH	9.3
Temperature (ºC)	10
Conductivity (µmhos·cm^{-1})	860
Depth (m)	4.0
Secchi Disk (m)	1.6
Area (ha)	120.2
Perimeter (m)	8018
Emergent marsh area (ha)	10.3
Open water or submergent vegetation area (ha)	107.7
Fish	Yes
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	Yes
Recreation Area near	No
Light Industry	Yes
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

Table 40. Birds observed during breeding waterbird surveys at Watson Lake: 1942, 1958 and 2001.

Species[1]	Watson Lake 13-Jun-42	7-Jun-58	6-Jun-01	18-Jun-01
COLO			2	4
PBGR			2	2
PBGR-N				1
PBGR-Y				2
HOGR-PR[2]	1	1	1	
RNGR			4	
RNGR-N				6
EAGR			14	
EAGR-PR			4	
WEGR				1
CAGO			25	51
CAGO-PR			2	
CAGO-Y			28	28
DABB-U				11
WODU-♂			1	
GWTE-PR	6	1		
GWTE-♂	2		2	7
MALL-PR				1
MALL-♂	21	3	11	13
MALL-♀	1	1	3	
MALL-Y		8	15	22
BWTE-PR	1	1	2	6
BWTE-♂	3		6	12
CITE-PR				1
CITE-♂			3	6
NOSL-PR	1			
NOSL-♂	7		1	
GADW-PR			4	4
GADW-♂			1	3
AMWI-PR	1	2	2	1
AMWI-♂	2			4
AMWI-♀	1		1	2
CANV-PR				1
CANV-♂			2	1
CANV-♀	3	1	2	6
CANV-N				1
CANV-Y	22	9		7
REDH-PR			2	
REDH-♂			2	
RNDU-PR				1
RNDU-♂				5
RNDU-♀	1			

◀ Watson Lake (Cont'd)

Species	13-Jun-42	7-Jun-58	6-Jun-01	18-Jun-01
LESC		34		
LESC-PR	17		10	27
LESC-♂			30	24
LESC-♀				2
LESC-J	75			
SUSC-PR			2	
SUSC-♀			1	
WWSC		9		
WWSC-♂			1	1
GOLD-♀			4	
COGO-U				4
COGO-♂				2
COGO-JG			1	
COGO-♀			4	16
COGO-Y				42
BAGO-♂			2	11
BAGO-J♂		2	2	
BAGO-♀	5	5	4	10
BAGO-J♀		4		
BAGO-Y	39	15		
BUFF-PR		6	3	
BUFF-♂	4	6	9	2
BUFF-J♂	1	2	2	
BUFF-J♀	4	2		
BUFF-♀			5	4
BUFF-Y				15
RUDU				14
RUDU-PR	8		5	3
RUDU-♂	25	1	9	6
RUDU-♀				3
AMCO	7	1	20	45
AMCO-PR			1	
AMCO-N				12
AMCO-Y				11
Sub-total	**293**	**125**	**294**	**509**
SORA				1
SPSA				5
WIPH-♂				1
WIPH-♀			4	
KILL			1	5
WISN			1	
BLTE			15	7
TOTALS	**293**	**125**	**315**	**528**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

DUC holds some of the water rights for Watson Lake in an attempt to secure the water for downstream marsh use by avoiding losses to other intensive uses such as irrigation.

Where cattle have been fenced out of the area (e.g. the southeast corner), there is a healthy marsh and lake edge that provide good nesting cover. Regenerating aspen, with some lodgepole pine and spruce in this area, also suggests that the fencing has had a positive effect in maintaining the natural values that are conducive to breeding waterbirds (Figure 61).

Figure 63. South shore of Watson Lake, 11 May 2001 looking north across the lake.

Figure 64. Hen Bufflehead and brood on Watson Lake, 18 June 2001, at the eastern end of the lake.

Larger waterfront lots occur along the north central shore (Figures 59 and 63) and extend along the shoreline for about a kilometre. Many have been cleared and planted to lawn. There is a small gravel pit and another residence at the northeastern end of the lake. The remaining lakeshore is bounded by Tatton Road on the north and rangeland to the south.

A number of nest boxes were scattered around the lake. Some additional attributes of Watson Lake are shown in Table 39.

Comparative bird numbers are shown in Table 40. Total numbers reported in 2001 were significantly higher than in either of Munro's early years. Species reported in at least 3 of the years that had a significant increase in numbers in our study included Blue-winged Teal and American Coot. There were only a few species showing a slight decrease such as Northern Shoveler and White-winged Scoter.

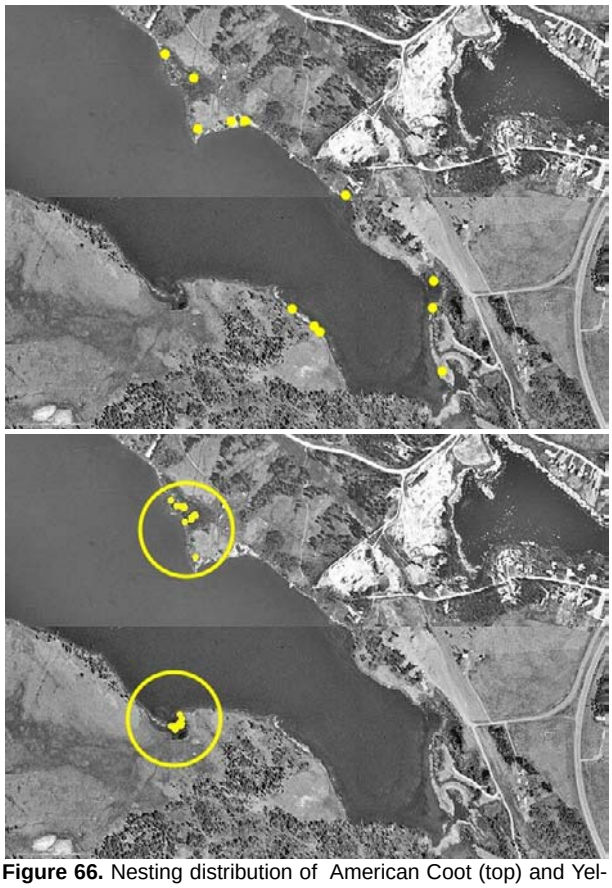

Figure 66. Nesting distribution of American Coot (top) and Yellow-headed Blackbird (bottom) at the southeastern end of Watson Lake, 18 June 2001.

As with many of the other breeding areas we studied, the avian biodiversity of Watson Lake was higher in 2001 with 12 species reported that did not appear in either of Munro's 2 years (Common Loon, Pied-billed Grebe, Red-necked Grebe, Eared Grebe,

Figure 65. Elliot Lake-A, 11 May 2001, with *Phalaris* and a small amount of *Scirpus* in the foregound; the light industrial site is to the upper left background. The photo is taken from the playing field (off the right edge of the image) looking southwest. The playing field and the industrial site (right background) were constructed by infilling the lake.

Figure 67. Elliot Lake showing some habitat characteristics and surrounding land use. The lake has been reduced by some 3 ha. through infilling due to roads and recreational and industrial development. There has also been considerable residential development around the shoreline. The various parts of the lake now cover A) 8.2 ha, B) 0.3 ha, C) 1.5 ha, and D) 2.2 ha. Discs are locations where archival photographs were taken.

Western Grebe, Canada Goose, Wood Duck, Cinnamon Teal, Gadwall, Redhead, Surf Scoter, and Common Goldeneye).

Documented nesting species were higher in 2001 and included Pied-billed Grebe, Red-necked Grebe, Canada Goose, Canvasback, Common Goldeneye, Bufflehead (Figure 64), and American Coot (Figure 66). There were others as well, based on the numbers of lone drakes we recorded (e.g. Blue-winged and Cinnamon Teal) or the fact that we were likely too early to document nesting for some species such as Gadwall, Lesser Scaup, or Barrow's Goldeneye where the majority of their young dates are later in June or July (Campbell et al. 1990a).

On 18 June 2001, in addition to conducting a survey of the lake from our observation points, we also canoed the southern half in order to search for nests. The distribution of American Coot and Yellow-headed Blackbirds in that area is shown in Figure 66. These blackbirds are concentrated in areas of fairly extensive emergent *Scirpus* marsh. A total of 31 Yellow-headed Blackbird nests were found including 15 nests with eggs (1E=2; 2E=3; 3E=5; 4E=5), 6 with nestlings (1Y=1; 2Y=4; 3Y=1), 1 containing 1 egg and 2 young, 1 containing 2 eggs and 2 young, 6 with evidence of having successfully fledged young and 2 newly constructed nests.

Elliot Lake

Elliot Lake is situated on both sides of Highway 97, some 8 km north of 100 Mile House. It formerly covered an area of just over 15 ha but has since been reduced by some 3 ha through infill. Munro (1958) describes the lake as:

> *a small freshwater lake 1/3 X 1/8 M., now divided by the Cariboo Highway, on the 105 Mile Ranch, adjacent to 105 Mile Lake. The shores are boggy and carry a light growth of round-stem bulrush. At the north end this growth and carex* [sic] *form a small marsh much larger in 1958 than formerly.*

Today much appears to have changed around the lake. It now has 2 additional roads cutting through, dividing it into one large, 2 medium and one small area (Figure 67). A number of residential properties occur along much of the north and south shores of the larger waterbody. Homes on the south shore are sprinkled amongst a forested area consisting mainly of aspen and lodgepole pine, which occurs down to the water edge. The homes along the north shore have maintained lawns essentially to the water's edge. Residential properties are also found adjacent to Elliot Lake-C and D.

A recreation field and log home manufacturing plant (Figure 65) occur on the western lakeshore;

Figure 68. Elliot Lake-B looking north with the Cariboo Highway on the right, 13 May 2001.

there is another log home facility directly across the road. The field and light-industrial site appear to have been placed on fill when they were built.

In the main part of the lake there is very little emergent marsh; some reed canary grass occurs along the shore by the playing field. A culvert runs underneath Carlson Road connecting the largest portion of the lake to the smallest watered area (0.3 ha) to the east (Figure 68). A 1- m band of *Typha* marsh lines the perimeter of most of this little slough. On the east side of Highway 97 is what we have termed Elliot Lake-C (1.5 ha). There, a 2-3 m band of *Typha* marsh, with some *Scirpus*, occurs along most of the south shore (Figure 69) becoming narrower on the west and north shores.

Table 41. Some attributes of Elliot Lake.

Attributes	Elliot Lake 11-May-01
UTM 10	616195 5729431
Elevation (m)	886
pH	9.1
Temperature (ºC)	13
Conductivity (µmhos·cm^{-1})	720
Depth (m)	2.6
Secchi Disk (m)	0.5
Area (ha)	13.3
Perimeter (m)	3309
Emergent marsh area (ha)	1.3
Open water or submergent vegetation area (ha)	12.0
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	Yes
Partially filled	Yes
Boat launch	No
Biogeoclimatic Unit	IDF dk3

Cattle appear to have some access to this portion of the lake. The water body is separated by a gravel road, but joined by culvert, to Elliot Lake-D, the last portion of the lake that lies further to the east (Figure 70). There, a large area of *Typha* marsh surrounds the open water; small amounts of bulrush can be found on the outer margins of the marsh. An aspen and pine forest grows on most of south shore to the southeast corner with rangeland on the north shore. Some attributes of Elliot Lake are shown in Table 41.

Figure 69. Elliot Lake-C looking west with Highway 97 in the right background, 13 May 2001.

Figure 70. Elliot Lake-D looking east toward the extensive *Typha* marsh at this end of the lake, 13 May 2001.

Table 42. Birds observed during breeding waterbird surveys at Elliot Lake: 1942, 1958 and 2001.

	Elliot Lake		
Species[1]	13-Jun-42	9-Jun-58	6-Jun-01
HOGR			2
HOGR-PR[2]			2
RNGR-PR	1	2	
EAGR			7
WODU-♂			1
GWTE-PR	1		
MALL-♂	11		11
MALL-♀			5
NOPI-♀	1		
NOPI-Y	8		
BWTE-PR	1	1	
BWTE-♂			14
CITE-♂			3
NOSL-PR	1		1
NOSL-♂			6
GADW-PR			4
GADW-♂			5
GADW-♀			1
AMWI			1
AMWI-PR	1		1
AMWI-♂	18		6
DIVER-U			1
CANV-PR			1
CANV-♀			1
REDH-PR			8
REDH-♂			16
RNDU-♂			1
LESC		25	
LESC-PR	4		26
LESC-♂			92
LESC-F♀			4
GOLD-♀			7
COGO-♂			3
COGO-♀			5
BAGO-PR			1
BAGO-♂			7
BAGO-♀			14
BUFF-PR			2
BUFF-♂			6
BUFF-♀	1	3	2
BUFF-Y	8		
RUDU-PR		2	10
RUDU-♂			22
RUDU-♀			1
AMCO		1	25
TOTALS	**65**	**39**	**381**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Table 43. Birds observed during breeding waterbird surveys at each section of Elliot Lake in 2001.

	Elliot -A	Elliot -B	Elliot -C	Elliot -D
Species[1]	6-Jun-01	6-Jun-01	6-Jun-01	6-Jun-01
HOGR			2	
HOGR-PR[2]		2		
EAGR	7			
WODU-♂	1			
MALL-♂	7		4	
MALL-♀	4		1	
BWTE-♂	11			3
CITE-♂	1		2	
NOSL-PR	1			
NOSL-♂	3		2	1
GADW-PR	4			
GADW-♂	4		1	
GADW-♀	1			
AMWI	1			
AMWI-PR	1			
AMWI-♂	5		1	
DIVER-U	1			
CANV-PR				1
CANV-♀				1
REDH-PR	6			2
REDH-♂	15		1	
RNDU-♂	1			
LESC-PR	19		2	5
LESC-♂	82		8	2
LESC-♀	4			
GOLD-♀	7			
COGO-♂	3			
COGO-♀	5			
BAGO-PR	1			
BAGO-♂	7			
BAGO-♀	12		2	
BUFF-PR	2			
BUFF-♂	5			1
BUFF-♀				2
BUFF-Y				
RUDU-PR	3		2	5
RUDU-♂	14		5	3
RUDU-♀				1
AMCO	5	3	10	7
TOTALS	**280**	**7**	**47**	**47**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 71. Abel Lake showing some habitat characteristics and surrounding land use. Note the nesting islands created by Ducks Unlimited Canada. Disc is location where archival photographs were taken.

Figure 73. John Cooper searching for nests in *the Carex* meadow at Abel Lake, 14 June 2001. Towards the lake, *Carex* grades into *Typha* and then *Scirpus* (right).

Bird use of the lake was between 6 and 10 times higher in 2001 than in the earlier years when Munro (1958) surveyed this lake (Table 42). For future comparative work, we have also shown bird use of the four sections of the lake in Table 43. Species with significantly higher numbers included Blue-winged Teal, Lesser Scaup, Ruddy Duck, and American Coot.

Although Munro (1958) reports 3 species that we did not record (Red-necked Grebe, Green-winged Teal, Northern Pintail) we recorded 9 species not mentioned by Munro on this lake (Horned Grebe, Eared Grebe, Wood Duck, Cinnamon Teal, Gadwall, Canvasback, Redhead, Common Goldeneye, Barrow's Goldeneye).

Abel Lake

Abel Lake (Figures 71 and 72) is located west of Watson Lake. It is about 4.8 km by road from the north end of Watson Lake to the Chrome Heart Ranch driveway where we gained access to the lake. Abel Lake is about 30 ha in area, including the emergent

Figure 72. Abel Lake looking northeast from Chrome Heart Ranch, 17 May 2001.

Table 44. Some attributes of Abel Lake.

Attributes	Abel Lake 17-May-01
UTM 10	609700
	5729700
Elevation (m)	939
pH	8.7
Temperature (ºC)	11
Conductivity (µmhos·cm^{-1})	370
Depth (m)	4.7
Secchi Disk (m)	2.0
Area (ha)	45.1
Perimeter (m)	3060
Emergent marsh area (ha)	2.4
Open water or submergent vegetation area (ha)	29.9
Fish	Yes (stocked 1945)
Cattle access	Yes
Nest boxes present	No
DU Project	Yes
Residences near wetland	Yes
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

Table 45. Birds observed during breeding waterbird surveys at Abel Lake: 1938, 1958 and 2001.

Species[1]	Abel Lake 23-Jul-38	27-Jul-58	14-Jun-01
COLO	2	1	
COLO-PR			1
COLO-Y			2
RNGR	2		1
RNGR-PR			2
RNGR-N			1
RNGR-Y			3
CAGO			20
CAGO-Y			39
MALL-♂			2
MALL-♀			1
BWTE-PR			1
BWTE-♂			1
RNDU-PR			1
LESC-PR			10
LESC-♂			2
LESC-♀	4		
LESC-Y	30		
AMCO			3
AMCO-N			3
Sub-total	**38**	**1**	**108**
NOHA-♀			1
SORA			1
SORA-N			1
SORA-Y			1
SACR			2
WIPH-PR			1
KILL			3
TOTALS	**38**	**1**	**119**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

marsh but excluding the surrounding sedge meadows. Munro (1958) describes the lake:

> *…in 1938 as similar to the adjacent Tad Lake and comprising about 120 acres surrounded by sloping hay lands with forest in background. Round-stem bulrush or sedges are continuous along the boggy shore, and beyond is a belt of yellow pond lily. Water milfoil is dominant in the shallows and there is some sago pondweed. Amphipods are abundant.*
>
> *No perceptible difference in 1958.*

Today, not much has changed. Four ranches or residences now occur around the lake but the lake is still primarily surrounded by extensive *Carex* meadows (Figure 73) backed by hayfields and forested lands (Figure 72). A number of nesting islands had been constructed around the lake by Ducks Unlimited Canada (Figure 71). Cattle were seen grazing the *Carex* at the southwest end of the lake.

The forested areas consist principally of Douglas-fir, trembling aspen and lodgepole pine (these areas range from 61 - 120 yr of age and have a crown closure ranging from 10% to 45%; site index ranges from 14 to 18).

Figure 74. Common Loon nest with eggs (left) (17 May 2001), and Sora chick (14 June 2001) at Abel Lake.

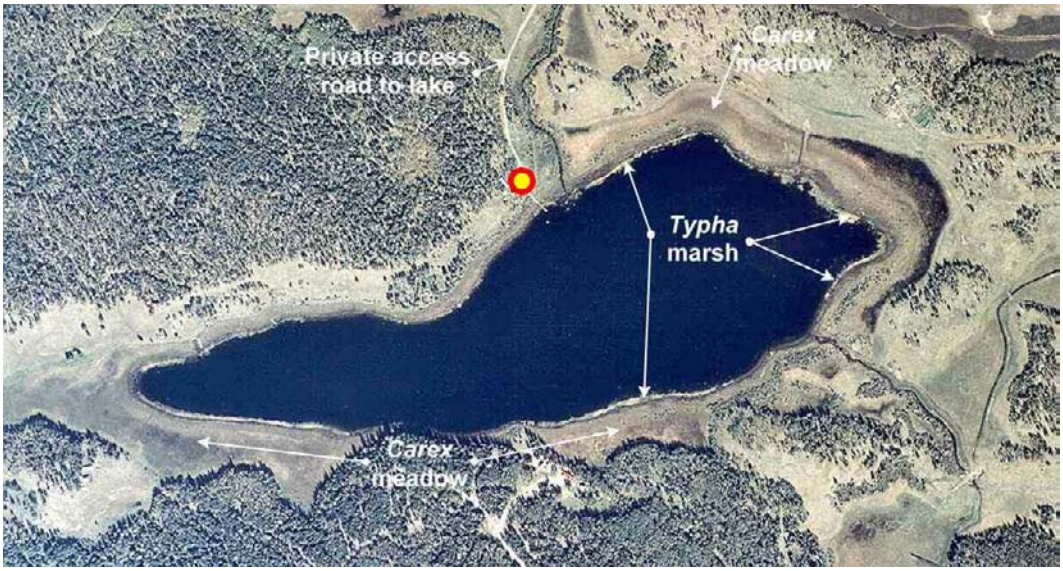

Figure 75. Tad Lake showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

The lake has a *Typha* marsh margin with some bulrush extending into the lake. Yellow pondlily still grows throughout and aquatic vegetation included both water-milfoil and bladderwort. We also noted some large amphipods and small, unidentified fish. Some attributes of Abel Lake are shown in Table 44.

Bird numbers for Abel Lake (Table 45) are not directly comparable as Munro (1958) conducted his surveys in late July while our surveys were in mid-June. Nevertheless, there are significant differences in both numbers of birds and diversity of species. In 1938, Munro noted only 3-species and a total of 38 birds while we recorded 8-species and 108 total birds. Species not reported by Munro but observed during our survey included Canada Goose, Mallard, Blue-winged Teal, Ring-necked Duck, and American Coot.

We recorded 5 nesting species , including Common Loon and Sora (Figure 74) and, based on the number of paired Lesser Scaup we observed, there is little doubt that they still breed at this site.

Tad Lake

Tad Lake is located about 1.5 km west of Abel Lake. The lake is 1300 m long by 425 m wide and covers nearly 34 ha. In 1938, Munro (1958) described the lake as:

> *...surrounded partly by hay meadows and partly by forest. The water is deep and cold, the shores boggy with cover growth of sedges, roundstem-bulrush and*

Figure 76. Tad Lake viewed from Ernie and Grace Mills-Hodgins property on the north shore looking to the east, 17 May 2001. Note the Typha along the shoreline backed by a small area of Carex meadow.

cattail, the latter chiefly along the south shore. Outward from the shore, growth is a belt of yellow pond lily; plants observed in the shallower, shoreward areas are water milfoil and sago pondweed, all slimed with a filamentous algae; the duckweed Lemna trisulca *is abundant.*

In 1958, Munro noted "little perceptible change other than a higher water level and the presence of a large beaver lodge."

During our visit, a number of changes were noted that differ from Munro's description. There are now 3 residences on acreages adjacent to the lake; 2 to the north and one on the south shore. During Munro's visits there would have only been one cabin along the north shore, now owned by Ernie and Grace Mills-Hodgins. A band of *Typha* ranging from 5 m to 10 m wide, and at the northeast end of the lake exceeding 20 m in width, now all but encircles the lake (Figures 75 and 76). Some bulrush was also noted.

Out from the *Typha* and *Scirpus*, a band of yellow pondlily occurred and in some areas, a thick growth of muskgrass was noted; pondweed, bladderwort, and water-milfoil were also found. The lake was thick with tiny crustaceans and many small fish were noted.

There are extensive, lush *Carex* meadows inshore from the *Typha* marsh, particularly at the eastern and western ends of the lake. These meadows are likely the "hay meadows" Munro mentions but they have not been hayed for a number of years

Figure 77. John Cooper canoeing toward the east end of Tad Lake, 14 June 2001. Note the cattle on the rangeland and near the lake edge.

Table 46. Some attributes of Tad Lake.

	Tad Lake
Attributes	17-May-01
UTM 10	607620
	5729735
Elevation (m)	940
pH	8.6
Temperature (ºC)	11
Conductivity (µmhos·cm^{-1})	360
Depth (m)	6.0
Secchi Disk (m)	2.7
Area (ha)	54.3
Perimeter (m)	4573
Emergent marsh area (ha)	1.3
Open water or submergent vegetation area (ha)	33.5
Fish	Yes (stocked in 1945)
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	Yes
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk 3

Table 47. Birds observed during breeding waterbird surveys at Tad Lake: 1938, 1958 and 2001.

	Tad Lake		
Species[1]	1-Aug-38	29-Jul-58	14-Jun-01
COLO			2
COLO-N[2]	1		1
PBGR-N			1
RNGR	1		4
RNGR-PR		1	
RNGR-N			4
RNGR-Y		4	
CAGO-PR			2
CAGO-Y			5
GWTE	2		
MALL	4	4	
MALL-♀			3
BWTE-PR			3
BWTE-♂			1
CITE-PR			1
CITE-♂			2
GADW-PR			2
GADW-♂			1
RNDU-PR			2
RNDU-♀	2	1	
RNDU-Y	14	8	
LESC-PR			4
LESC-♀		1	1
LESC-Y		8	
BAGO-♀	1		
BAGO-Y	18		
RUDU-PR			2
RUDU-♂			2
AMCO			1
AMCO-N			2
AMCO-Y		4	3
Sub-total	**43**	**32**	**65**
AMBI			1
VIRA			4
SORA			3
WIPH-PR			1
TOTALS	**43**	**32**	**75**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 78. Neil Dawe checking Common Loon nest at Tad Lake, 14 June 2001 (Photo: J.M. Cooper).

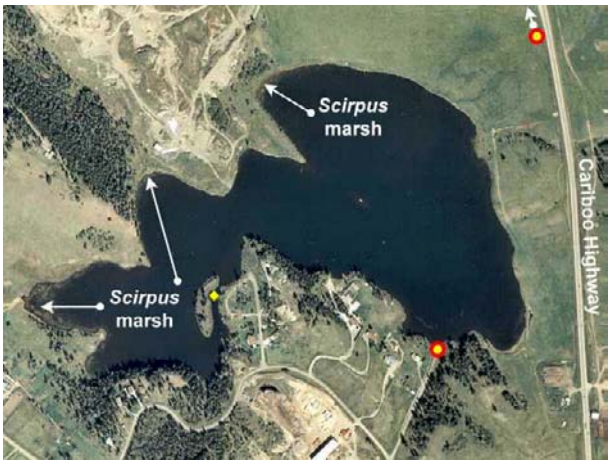

Figure 80. 105 Mile Lake showing some habitat characteristics and surrounding land use. Discs are locations where archival photographs were taken.

(E. Mills-Hodgins, pers. comm.). Cattle do have access to the *Carex* meadows (Figure 77; however, we saw no evidence of overgrazing.

Much of the rest of the backshore is forested, particularly along the northwestern and southern sides of the lake. The northwestern forest consisted primarily of trembling aspen and lodgepole pine (121-140 yr old with a crown closure of 16-25% and a Site Index of 11). The forest on the south side of the lake had Douglas-fir, trembling aspen and spruce as dominants with some lodgepole pine (> 141 yr old with up to 35% crown closure and a site index of 11). Some other attributes of Tad Lake are shown in Table 46.

As we noted for Abel Lake, bird numbers between Munro's (1958) surveys and this study are not directly comparable. Nevertheless, higher avian diversity and larger numbers were found in 2001 (Table 47).

Figure 79. Red-necked Grebe at Tad Lake, 14 June 2001. Four pairs were found nesting on the lake.

Munro (1958) reported 2 species that were not observed during this study (Green-winged Teal and Barrow's Goldeneye). We observed 6 species on the lake that Munro failed to report (Pied-billed Grebe, Canada Goose, Blue-winged Teal, Cinnamon Teal, Gadwall, and Ruddy Duck).

Five species were found nesting in 2001 including Common Loon (Figure 78), Red-necked Grebe (Figure 79), Pied-billed Grebe, Canada Goose, and American Coot; in addition, Lesser Scaup had more pairs in 2001 than in either of the earlier years and likely still nests on the lake.

105 Mile Lake

105 Mile Lake (Figure 80) lies about 0.5 km north of Elliot Lake; access is gained from Tatton Road. The lake is about 1200 m x 880 m at its widest point and covers an area of about 47 ha. Munro (1958) describes 105 Mile lake during his early visit as:

> *a fairly deep lake. … Encompassing it on the south are low, grassy knolls covered with aspens and Douglas-fir, and at one place a steep, timbered and partly rocky hill rises abruptly from the margin. Elsewhere are open grasslands and aspen groves, and wooded slopes. There is a rich submerged flora in which sago pondweed and bushy pondweed* Najas *sp. are dominants. Amphipods are plentiful. Much of the shoreline is margined by round-stem bulrush and the west end terminates in a marsh of this species intermixed with cattails. In mid-summer the water becomes turbid with algal bloom and filamentous algae covers inshore areas. There is one small boulder island circled by round-stem bulrush on which plant cover, chiefly silverweed* Potentilla anserina *and loco-weed* Astragalus *sp. provide nesting cover. For many successive years one pair of Canada geese nested there.*

Figure 81. Eared Grebe colony location at 105 Mile Lake, 6 June 2001. The birds were using the branches of the fallen spruce trees as a foundation for their nests. The tree in the foreground held only 2 nests; the tree in the background (arrow), held a concentration of 21 nests.

The only modifications of habitat noted on June 5, 1958, were (1) an increased amount of inshore cover, chiefly willow Salix *sp. and silverberry* Eleagnus [sic] argentea *(2) increased height of aspens (3) the higher water level which has created an island from what formerly was a wooded peninsula of an acre or so; this island carries good nesting cover, chiefly low wax-berry* Symphoricarpos racemosa *and service berry* Amelanchier *sp., and (4) submerging all of the boulder island save the highest portion an area of approximately 40 X 30 feet. Canada geese did not nest here in 1958 but the usual nest site had been occupied probably as late as 1957.*

In August, 1958, 105 Mile Lake was less used by diving ducks than was Watson lake or 103 Mile Lake, probably because of continuing machine excavation of a gravel pit by the lake side.

Table 48. Some attributes of 105 Mile Lake.

Attributes	105 Mile Lake 11-May-01
UTM 10	615577 5730586
Elevation (m)	884
pH	8.8
Temperature (ºC)	12
Conductivity	720
Depth (m)	5.3
Secchi Disk (m)	4.3
Area (ha)	46.7
Perimeter (m)	4407
Emergent marsh area (ha)	1.7
Open water or submergent vegetation area (ha)	45.2
Fish	No (stocked 1950)
Cattle access	Yes
Nest boxes present	Yes
DU Project	No
Residences near wetland	Yes
Recreation Area near	No
Light Industry	Yes
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

In 2001, the low, grassy knolls covered with aspens and Douglas-fir were still extant but scattered amongst the trees now are at least 15 houses. The eastern and northeastern shores of the lake as well as the northwestern shore are backed by rangeland with some scattered groves of fir and aspen. Cattle have access to the lake edge. On the north-central shore the gravel pit is still in operation and to the west a steep ridge rises from the lake. It is wooded on its north-facing slope with aspen and fir dominant and some lodgepole pine.

The small boulder island was not visible during our 2 visits to the lake; however, the treed island

Figure 82. Eared Grebe colony location at 105 Mile Lake, 6 June 2001. The birds were using the branches of this fallen spruce tree as a foundation for their nests. The treed island is in the background.

Munro mentions in his 1958 comments was still an island, which now provides some protection for an Eared Grebe colony (see below). This would suggest that the water levels in 2001 were similar to those of 1958.

Unfortunately time constraints did not allow us to paddle the entire shoreline of the lake, thus we have little information on the distribution of the submergent and emergent vegetation. We did note some small areas of emergent *Scirpus* marsh (Figure 80) and the marsh at the western end of the lake was still extant. Some attributes of 105 Mile Lake are shown in Table 48.

Comparative waterbird numbers are shown in Table 49. Numbers in 2001 were up between 430 and

Figure 83. Eared Grebes tending their nests at a colony on 105 Mile Lake, 6 June 2001 (top) and a nest with two eggs based on the branches of a fallen spruce tree (bottom). The nests were constructed primarily of filamentous algae with small amounts of *dead Scirpus* stems.

Table 49. Birds observed during breeding waterbird surveys at 105 Mile Lake: 1937, 1958 and 2001.

	105 Mile Lake		
Species[1]	4-Jun-37	6-Jun-58	6-Jun-01
COLO	1	1	
RNGR-PR[2]	6	6	
RNGR-N		5	
EAGR			136
EAGR-N			23
CAGO			9
CAGO-PR			1
CAGO-Y			3
DUCK-U			2
GWTE-PR		1	
GWTE-♂			5
MALL-PR	1	1	2
MALL-♂			23
MALL-♀			1
NOPI-PR		1	
NOPI-♂			2
BWTE-PR	1	1	1
BWTE-♂			7
CITE-♂			3
NOSL-♂			1
GADW-PR			5
GADW-♂			5
GADW-♀			1
AMWI-PR	1	1	1
AMWI-♂			3
AMWI-♀			2
CANV-PR	1		
CANV-♂			1
CANV-♀		1	2
CANV-N		1	
LESC-PR	6		13
LESC-♂		15	42
LESC-♀		12	2
WWSC	24	10	
GOLD-♀			4
BAGO-♂			2
BAGO-♀	3	3	2
BAGO-J♀		3	
BUFF			3
BUFF-PR	5	3	5
BUFF-♂			15
BUFF-J♂		3	
BUFF-♀			12
RUDU			2
RUDU-PR			8
RUDU-♂			29
RUDU-♀			4
AMCO	6	4	31
Sub-total	**76**	**86**	**459**
SORA			1
SPSA			3
WIPH			2
WIPH-PR			2
WIPH-♀			1
BLTE			2
TOTALS	**76**	**86**	**472**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 84. Straight Lake showing surrounding land use. Simon Lake is the water body at the top of the photograph. Discs are locations where archival photographs were taken.

500 percent in comparison with Munro's numbers in 1958 and 1937 respectively. Much of that increase was due to our observing 6 species that Munro did not report, including Eared Grebe, with a population of 129 birds that had recently established a nesting colony on the lake (Figures 81, 82 and 83). The other species were Canada Goose, Cinnamon Teal, Northern Shoveler, Gadwall, and Ruddy Duck. Species with significantly higher numbers in 2001 than in the earlier years included Mallard, Lesser Scaup and American Coot. Munro found 3 species that we did not observe in 2001: Common Loon, Red-necked Grebe and White-winged Scoter.

The Eared Grebe colony was located in a small channel between the shore and the treed island at the southwest end of the lake (Figures 81, 82 and 83). Two spruce trees, one from the south shore and one from the island, had fallen into the water. Both trees were used as the foundation for the grebe nests, although the tree nearest the island held 21 of the 23 nests.

Straight Lake

Straight Lake is located some 9 km northeast of 100 Mile House. Access is gained along Simon Lake Road which lies about 600 m north of the Watson Lake turnoff at Tatton Lake Road and Highway 97. Straight Lake is east along the road about 4.6 km from the highway. The lake runs in an east-west direction; it is about 3.5 km long by 190 m wide at its widest point (Figure 84) and covers an area of 44 ha. Munro (1958) notes that:

> *…Much of the lake is covered with round-stem bulrush with lesser amounts of cattail; in some of the open places are limited amounts of vegetation, chiefly yellow pond lily, water milfoil and sago pondweed; the easterly portion is covered in places by chara meadows. Elsewhere are marl areas on which there is no vegetation. Snails* Planorbis *sp. and* Lymnea *sp. are present.*
>
> *Very likely it is the presence of the chara meadows in combination with the heavy round-stem bulrush cover that gives the lake the value it possesses. Com-*

Figure 85. Straight Lake showing some of the extensive emergent marsh at the western end of the lake, 8 June 2001. Close to shore is a narrow band of *Carex* with some *Typha*; patches of open water and *Scirpus* marsh occur further out into the lake (centre). The background marshes are primarily *Typha* with some *Carex*.

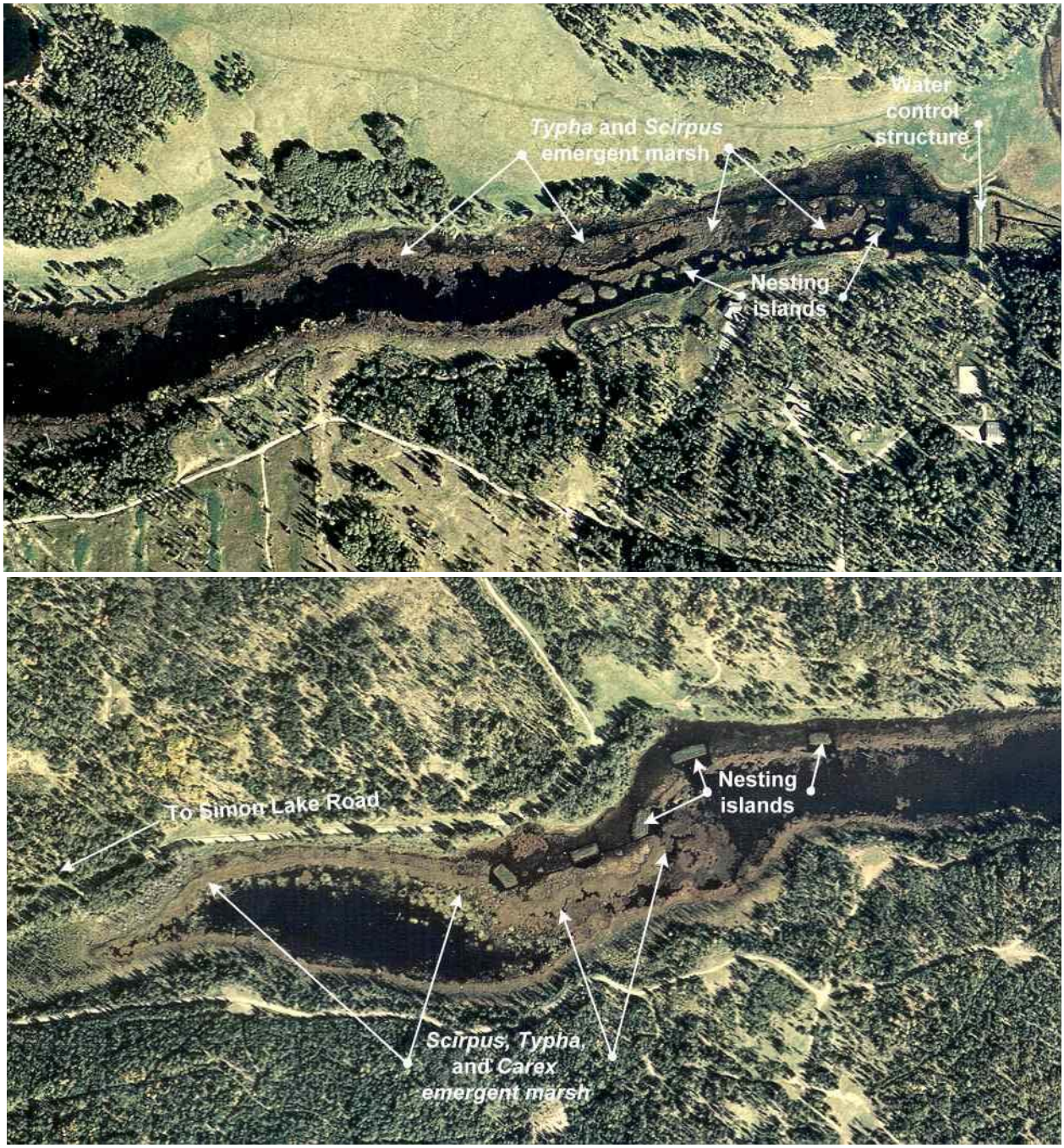

Figure 86. Straight Lake showing some habitat characteristics and surrounding land use of the east end of the lake (top) and the west end of the lake (bottom).

monly charaphytes do not grow in marl-bottomed lakes that produce so few food plants as to render them submarginal nesting grounds.

This description was written in 1938; at the present time, July 19, 1958, the only noted difference was a higher water level that had increased the amount of open water.

In 2001, Straight Lake appeared to be much the same as it was in 1958, with some exceptions. For example, in 2001, *Typha* was the dominant emergent marsh that occurred around most of the shoreline. Moving east from the western end of the lake, about the first 1.5 km held extensive areas of emergent

Table 50. Some attributes of Straight Lake.

Attributes	Straight Lake 15-May-01
UTM 10	622032 5731217
Elevation (m)	920
pH	8.5
Temperature (ºC)	13
Conductivity (µmhos·cm^{-1})	455
Depth (m)	3.0
Secchi Disk (m)	1.0
Area (ha)	52.3
Perimeter (m)	8118
Emergent marsh area (ha)	28.3
Open water or submergent vegetation area (ha)	18.9
Fish	?
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	Yes
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

Figure 87. Common Loon nest and egg at Straight Lake, 15 May 2001 (top). A second egg was found in the water below the nest. A single young was seen with the adult on 8 June 2001 (bottom).

Figure 88. Canada Goose on the nest at the east end of Straight Lake, 8 June 2001.

marsh (Figures 85 and 86). In some places, there was a 1-2 m band of open water from the bank then an admixture of *Typha* and *Carex*, with *Scirpus* extending across most of the lake to meet a *Typha* band along the opposite shore. Where the canoe was launched, there was also some *Carex* and *Typha* close to shore with an extensive area of *Scirpus* marsh and varying amounts of open water followed by extensive areas of *Typha* and *Carex* as you move south across the lake (Figure 85). The next 1.5 km east along the lake is primarily open water with a narrow (5 - 25 m) band of *Typha,* mainly along the northern shore with smaller amounts of *Typha* along the south shore. Where the lake narrows at its eastern end *Typha* marsh dominates with lesser amounts of *Scirpus* marsh (Figure 86).

Muskweed meadows and water-milfoil beds were noted along with some yellow pondlily and Bladderwort. The lake was filled with large amphipods. Caddisfly, damselfly, and dragonfly were flying during our June visit.

DUC has constructed some nesting islands at both ends of the lake and a weir and water control structure occur at the eastern end that helps secure water for conservation and manage levels to improve waterfowl nesting cover. A number of nest boxes were observed around the lake.

Horses had access to the lake along the north shore. On the southern shore there is one private residence near the eastern end of the lake.

Straight Lake is bounded by forested lands on its southern shore and along three-quarters of the northern shore. The north shore has varying amounts of rangeland where the forest is more parkland-like, except at the northeast end of the lake where the rangeland predominates.

Table 51. Birds observed during breeding waterbird surveys at Straight Lake: 1938, 1958 and 2001.

	Straight Lake		
Species[1]	15-Jul-38	14-Jul-58	8-Jun-01
COLO			1
COLO-PR[2]	1	1	1
COLO-Y			1
PBGR			2
RNGR-PR	1		
CAGO			3
CAGO-PR			7
CAGO-Y			37
DABB-U			1
MALL-PR			3
MALL-♂	2		
MALL-♀	1		2
MALL-Y[3]	?		
NOPI-♂	2		
NOPI-♀	2		
BWTE-PR			1
BWTE-♂	2		4
BWTE-♀			2
BWTE x CITE			1
CITE-♂			4
AMWI-PR			1
AMWI-♂	3		
CANV-♀	1		
CANV-Y	9		
RNDU-PR			3
RNDU-♂			7
RNDU-♀	2		1
RNDU-Y	12		
LESC-PR			16
LESC-♂			11
LESC-♀	7	2	4
LESC-Y	78	13	
GOLD-♀			2
COGO-♀			1
COGO-Y			6
BAGO-♀	1	1	
BAGO-Y	8	4	
BUFF-PR			1
BUFF-♂			3
BUFF-♀	1		6
BUFF-Y	10		
HOME-♂			1
HOME-♀			3
HOME-Y			3
RUDU-♂			2
RUDU-♀			1
RUDU-Y	6		
AMCO	1		2
AMCO-Y	3		
Sub-total	**155**	**22**	**177**
SORA			2
KILL			1
BLTE			17
TOTALS	**155**	**22**	**197**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II
[3] Number of young for 1938 is noted by Munro only as "hidden brood"

Figure 89. Common Goldeneye hen and brood at Straight Lake, 8 June 2001. Note, as part of the brood, two Hooded Merganser chicks (far left).

The surrounding forest consists of various admixtures of trembling aspen and Douglas-fir, which are dominant, with lesser amounts of spruce, lodgepole pine, and birch (ranging in age from 21 to 120 yr with most sites between 81 and 100 yr of age and a dominant crown closure class of 36 to 45%; site indices were between 12 and 23 with most ≥18). Some attributes of Straight Lake can be found in Table 50.

Bird numbers in 2001 were slightly higher than Munro's (1958) 1938 numbers and 8-times greater than his 1958 numbers (Table 51). We saw 5 species that Munro did not report (Pied-billed Grebe, Canada Goose, Cinnamon Teal, Common Goldeneye, and Hooded Merganser); however, Munro (1958) reports 4 species that we failed to document (Red-necked Grebe, Northern Pintail, Canvasback, and Barrow's Goldeneye).

In 1938, Munro found 7 nesting species (Canvasback, Ring-necked Duck, Lesser Scaup, Barrows Goldeneye, Bufflehead, Ruddy Duck, and American Coot) none of which were found in 2001 Our survey was about one month earlier than that of Munro and we were likely too early to find broods on the water for some of the diving ducks. However, at least 5 of those species were using the lake and still probably breed there. We found 4 nesting species including Common Loon (Figure 87), Canada Goose (Figure 88), Common Goldeneye, and Hooded Merganser. Three Hooded Merganser young were associated with a brood of Common Goldeneye (Figure 89).

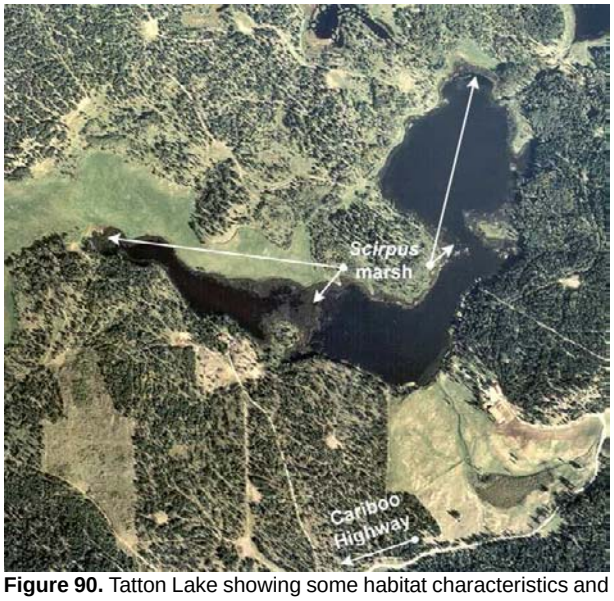

Figure 90. Tatton Lake showing some habitat characteristics and surrounding land use. Disc is location where archival photographs were taken.

Table 52. Some attributes of Tatton Lake.

Attributes	Tatton Lake 15-May-01
UTM 10	618189
	5731379
Elevation (m)	902 m
pH	8.8
Temperature (ºC)	12
Conductivity (µmhos·cm^{-1})	1280
Depth (m)	3.3
Secchi Disk (m)	0.6
Area (ha)	46.2
Perimeter (m)	5942
Emergent marsh area (ha)	13.5
Open water or submergent vegetation area (ha)	32.7
Fish	?
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	Yes
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

Tatton Lake

Tatton Lake is located about 2.9 km east of Highway 97 on Simon Lake Road, less than 2 km west of Simon and Straight lakes. In 1938, Munro (1958) described Tatton Lake as:

> *three lakes separated by round-stem bulrush marshes which are navigable by canoe. This cover is general also along the shores. The entire length is approximately one and one-half miles and the maximum width three-eighths of a mile. The surroundings are partly open range, partly lodgepole pine and aspen forest; filamentous algae blankets the marshes and the shore areas. The bottom is covered with dense* Chara *and* Nitella *meadows. This is the dominant growth, next in abundance are water milfoil and bladderwort* Utricularia. *The combination of charaphytes and round-stem bulrush is one conducive to a dense waterfowl population, the* Chara *providing an abundance of food in itself and in the various organisms it harbours; the bulrush providing the best kind of nesting cover and nesting material.*

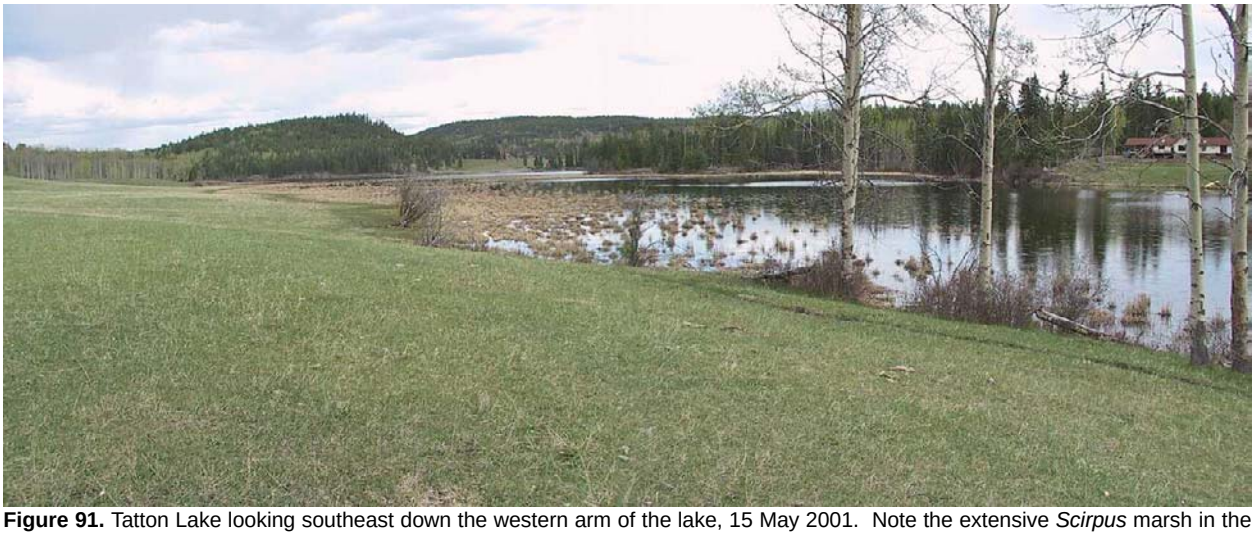

Figure 91. Tatton Lake looking southeast down the western arm of the lake, 15 May 2001. Note the extensive *Scirpus* marsh in the centre of the image.

Figure 92. Tatton Lake looking toward the west end of the western arm, 15 May 2001. Stephen Hureau (far left) is recording some of the attributes of the lake.

> *On June 9, 1958, the water level was approximately two feet higher than in 1938, and the outlet creek was running. High water in recent years has killed many of the shore-line willows and small aspens and probably also is responsible for a thinning of the bulrush marshes. These do not currently provide heavy enough cover for the nesting requirements of canvasback. Filamentous algae still blankets much of the surface.*

In 2001, the water levels in the lake appeared to be similar to those found in 1958, although the *Scirpus* marsh areas that separated the "three lakes" of 1938 were still extant (Figures 90 and 91). From the southernmost point on the lake, the west arm is just over 1.2 km long and about 250 m across at its widest point. The, north arm is about 1 km in length and 414 m across.

The lands surrounding Tatton Lake are primarily mixed forest and rangeland. The eastern shore of the north arm of the lake is primarily Douglas-fir and trembling aspen with varying amounts of spruce and lodgepole pine (between 80 and 120 yr of age with 20-40% crown closure and a site index between 14 and 19). To the west of the north arm, much of the forest has been logged and is fairly open compared with the forest to the east. It is primarily Douglas-fir and trembling aspen with spruce and lodgepole pine. The forest on the south side of the west arm of the lake has also been logged in the past and is predominantly open lodgepole pine and Douglas-fir (21-40 yr with crown closure of 6 to 15% and a site index of 11).

A large area of rangeland occurs along much of the northwest shore of the west arm (Figures 91 and 92) and cattle can gain some access to the lake (Fig-

Figure 93. Cattle have access to the lakeshore and the *Scirpus* marshes at Tatton Lake, 6 June 2001. There was, however, little evidence of cattle intrusion or damage to the marshes. At least six waterbird species nested amongst the *Scirpus*.

Figure 94. Yellow-headed Blackbirds nested in the *Scirpus* marshes at Tatton Lake, 6 June 2001.

Figure 95. Horned Grebe nest (top) and close-up of eggs (bottom) at Tatton Lake, 6 June 2001.

ure 93). The rangeland grades into a parkland-type edge which follows the lakeshore roughly to the lake's northern end. There are 2 small open parkland areas on the eastern shore; grassy fields used by sheep occur at the southeastern corner of the lake. One ranch and a residence lie along the southern shore of the lake (Figure 90).

There was a large *Scirpus* marsh about halfway along the western arm of the lake, and a smaller marsh at a constriction in the northern arm of the lake. *Scirpus* marshes occurred at both the north and west ends of the lake. We noted a small amount of discontinuous *Typha* along the perimeter of the lake.

Large beds of water-milfoil were noted in the lake and yellow pondlily and sago pondweed were also observed. Amphipods were found in the water column and there were 2 beaver lodges on the lake. Some attributes of Tatton Lake are shown in Table 52.

Table 53. Birds observed during breeding waterbird surveys at Tatton Lake: 1940, 1958 and 2001.

	Tatton Lake		
Species[1]	11-Jun-40	9-Jun-58	6-Jun-01
COLO			1
COLO-PR[2]	2		
PBGR			3
HOGR			1
HOGR-PR	2	1	
HOGR-N			1
RNGR			1
RNGR-PR	1	6	
RNGR-N			1
CAGO			18
CAGO-PR			3
CAGO-N			1
CAGO-Y			30
GWTE-♂	4		1
MALL-PR	1		1
MALL-♂			7
MALL-♀		3	1
MALL-Y		17	8
BWTE-PR	4		
BWTE-♂	3		7
BWTE-♀	1		
GADW-♂			1
AMWI-PR	1	3	2
AMWI-♂			6
CANV-PR	1	1	
CANV-♀	2		3
CANV-Y	11		
REDH-PR			2
REDH-♂			1
RNDU-PR		2	
RNDU-♂			5
LESC		33	
LESC-PR	16	7	39
LESC-♂			48
LESC-♀			9
WWSC	15	8	
WWSC-PR			2
WWSC-♀			1
COGO-♂			1
BAGO-♂			5
BAGO-♀	1	1	10
BAGO-Y	6	8	11
BUFF-PR		1	1
BUFF-♂			11
BUFF-♀	3	3	4
BUFF-J	12		
BUFF-Y	18		
RUDU-PR			2
RUDU-♂			6
AMCO			27
AMCO-PR	8		
AMCO-N			2
AMCO-Y[3]	?		
Sub-total	**148**	**115**	**336**
SPSA			1
BLTE			30
BLTE-N			4
TOTALS	**148**	**115**	**371**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II
[3] Number of young for 1938 is noted by Munro only as "young"

Figure 96. Black Tern nest (top) and close-up of eggs (bottom) at Tatton Lake, 6 June 2001.

DUC holds some of the water rights on Tatton Lake, which allows them to secure water for conservation and manage levels to improve waterbird nesting cover.

Comparative bird use of Tatton Lake is shown in Table 53. Numbers were about 2.5 and 3 times higher during this study than in 1940 and 1958 respectively. We observed 6 species that Munro did not record at all (Pied-billed Grebe, Canada Goose, Gadwall, Ruddy Duck, Redhead, Common Goldeneye). These additional species and higher numbers of Lesser Scaup, Barrow's Goldeneye, and American Coot account for most of the difference in numbers between the early years and this study.

Munro (1958) documented 4 nesting species of waterbirds (Mallard, Canvasback, Barrow's Goldeneye, Bufflehead) while we reported 6 nesting species (Red-necked Grebe, Horned Grebe [Figure 95], Canada Goose, Mallard, Barrow's Goldeneye and American Coot). In addition, Black Tern (Figure 96) and Yellow-headed Blackbird (Figure 94) were also found nesting at Tatton Lake .

Simon Lake

Simon Lake is located 4.7 km east of Highway 97 along Simon Lake Road. It lies about 260 m north of Straight Lake at their nearest points. The lake is about 2.4 km long from east to west (Figure 97) and is about 500 m across at its widest point. Munro (1958) notes that Simon Lake's

> *south side is forested, the north side chiefly grassland. A round-stem bulrush marsh extends out from the shoreline in some places, in others a strip of open water separates shore and marsh. Shores and bottom are chiefly hard clay, sand and boulders. There is an abundance of yellow pond lily, water milfoil and pondweeds. Amphipods and molluscs are plentiful. This description is applicable in 1958 as it was in 1938.*

Today, there are 3 residential properties or ranches along the northwestern shore intermingled with open rangeland and mixed forest patches (principally Douglas-fir, trembling aspen and spruce, mostly between 100 and 120 yr old and a site index ≥18) at times down to the bank. There is one residence on the northeast shore. Rangeland, backed by mixed forest (trembling aspen and Douglas-fir with spruce, mostly between 80 and 120 yr old with a crown closure of ~60% with a Site Index of ≥18), dominates to the lakeshore. Cattle and horses have direct access to the marshy areas along the shore.

A band of *Typha* and *Scirpus* marsh, ranging between 15 and 25 m wide at the western end and

Table 54. Some attributes of Simon Lake.

Attributes	Simon Lake 15-May-01
UTM 10	621414 5732062
Elevation (m)	938
pH	8.8
Temperature (ºC)	11
Conductivity (µmhos·cm^{-1})	480
Depth (m)[3]	5.5
Secchi Disk (m)	1.3
Area (ha)	82.5
Perimeter (m)	7078
Emergent marsh area (ha)	8.1
Open water or submergent vegetation area (ha)	72.8
Fish	Yes (stocked 1984)
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	Yes
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

[3] Sample depth in the western half of the lake; the eastern half has a depth of over 10 m (BC Fisheries 2002)

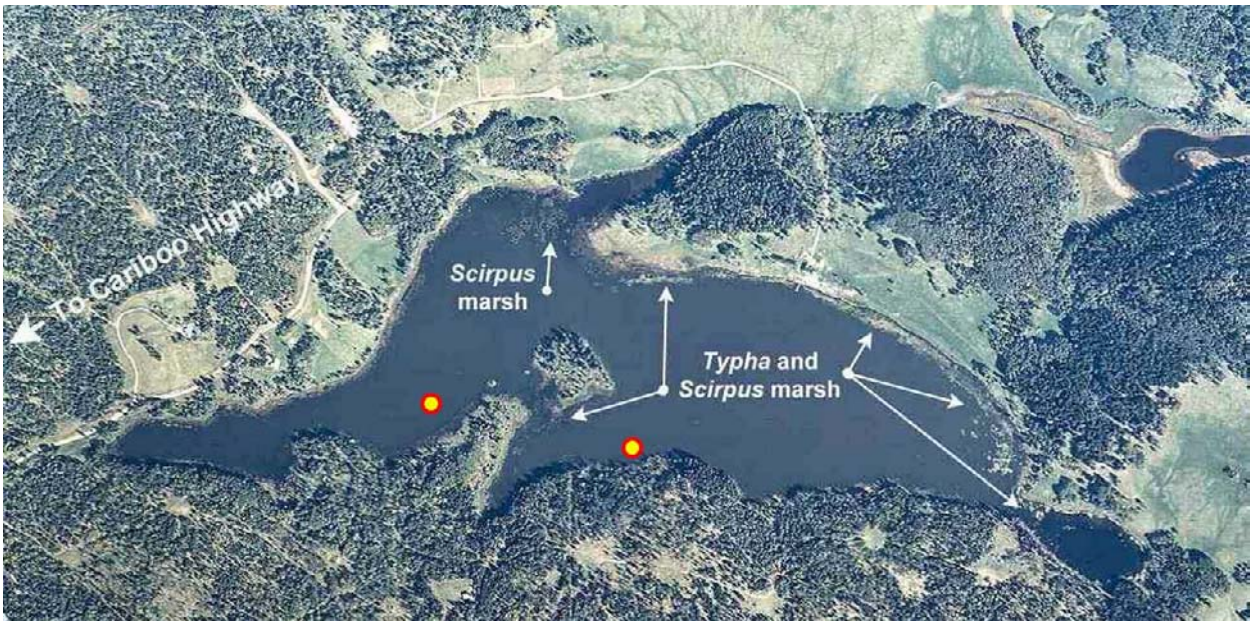

Figure 97. Simon Lake showing some habitat characteristics and surrounding land use. Discs show locations where archival photographs were taken.

between 30 and 40 m wide at the eastern end, occurs along the entire north shore, although it is discontinuous. In the north-central portion of the lake a *Scirpus* marsh extends about 150 m into the lake (Figure 98); it supports a colony of Yellow-headed Blackbirds and some Black Terns.

At the south end of the lake, another patch of *Scirpus* marsh, extends into the entrance of a small bay; some *Typha* occurs closer to the shore. Rangeland meets the lake edge on the bay's north side; there, cattle have access to the lake and some bank erosion was noted (Figure 99).

Figure 98. *Scirpus* marsh at Simon Lake, 8 June 2001. This marsh held a small Yellow-headed Blackbird colony and some nesting Black Terns.

The entire south shore of the lake is forested to the bank (dominated by Douglas-fir and trembling aspen with some spruce, mainly between 81 and 120 yr of age with a crown closure between 45 and 75%—Site Index ≥18); scattered patches of mixed *Scirpus* and *Typha* marsh occur along its length. A forested island lies in the central southern portion of the lake. There, the *Typha* and *Scirpus* marsh extends along its south shore and runs west until it meets the south shore of the lake. A small bay lies southwest of the island and some small marsh areas occur there as well.

Extensive muskgrass meadows and watermilfoil beds were found in the lake and some floating-leaved pondweed was noted along with an abundance of amphipods, 2 genera of snails (*Planorbis* and *Lymnaea)* and some leeches. Small numbers of fish were seen at the west end of the lake which has been stocked with 34,000 rainbow trout over the period 2000-2001 (BC Fisheries 2002).

DUC has constructed a berm with a water control structure at the west end of the lake to secure water for conservation and manage levels to improve waterbird nesting cover. There were a number of nestboxes along the north shoreline. Some attributes of Simon Lake can be found in Table 54.

Comparative bird numbers are given in Table 55. Bird numbers for this study were double those of 1938 and the number of species was also higher. We recorded 8 species that Munro (1958) did not

Figure 99. Cattle have access to the *Scirpus* marsh at Simon Lake, 8 June 2001 (top). In a small bay at the west end of the lake, the lakeshore has suffered some erosion from cattle access (bottom).

report (Pied-billed Grebe, Green-winged Teal, Blue-winged Teal, Gadwall, Ring-necked Duck, White-winged Scoter, Common Goldeneye, Hooded Merganser) while he reported 2 species that we failed to note (Canvasback, Barrow's Goldeneye).

We found evidence of 4 nesting waterbird species at Simon Lake (Red-necked Grebe [Figure 100], Canada Goose, Common Goldeneye [Figure 101], American Coot). Munro (1958) did not report Common Goldeneye at all, but does report the other 3 species plus 4 additional nesting species (Canvasback, Lesser Scaup, Barrow's Goldeneye, Bufflehead); however, that may be explained by the fact that his surveys were conducted about 6-weeks later than ours. Pairs or lone hens of 2 species Munro reports, Lesser Scaup and Bufflehead, were found during our survey and both likely still nest on the lake.

Table 55. Birds observed during breeding waterbird surveys at Simon Lake: 1938, 1958 and 2001.

	Simon Lake		
Species[1]	**15-Jul-38**	**14-Jul-58**	**8-Jun-01**
COLO		7	2
COLO-PR[2]	2		1
PBGR			2
RNGR	3		5
RNGR-N			6
RNGR-Y	4		1
CAGO			22
CAGO-PR		1	1
CAGO-Y		7	6
GWTE-PR			1
MALL-♂	1		8
MALL-♀	4		3
BWTE-M			1
GADW-PR			1
AMWI			1
AMWI-PR			2
AMWI-♂	2		
CANV-Y	3		
RNDU-PR			1
RNDU-♂			1
LESC-PR			16
LESC-♀	4		
LESC-Y	27		
WWSC			10
WWSC-PR			1
GOLD-♀			7
COGO-♂			1
COGO-♀			4
COGO-Y			23
BAGO-♀	1		
BAGO-Y	13		
BUFF-♀	2		2
BUFF-Y	13		
HOME-♂			1
HOME-♀			4
RUDU-♂	1		
RUDU-♀			1
AMCO	8		13
AMCO-Y	5		
AMCO-N			5
Sub-total	**95**	**16**	**178**
SPSA			4
BLTE			20
BLTE-N			1
TOTALS	**95**	**16**	**203**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 100. Red-necked Grebe eggs and hatchling at Simon Lake, 8 June 2001.

Figure 101. Common Goldeneye brood at Simon Lake, 8 June 2001.

Figure 103. Yellow pondlily was just starting to bloom during our visit to Lily Pad Lake visit, 4 June 2001.

Lily Pad Lake

Lily Pad Lake is located about 1.6 km due north of Abel Lake and about 4 km north on Lily Pad Lake Road from its intersection with Tatton Road. The lake lies in a southeast–northwest direction (Figure 102) and is about 2.6 km in length and over 500 m across at its widest point; it covers an area of just over 105 ha. In 1938, Munro (1958) noted that the lake was

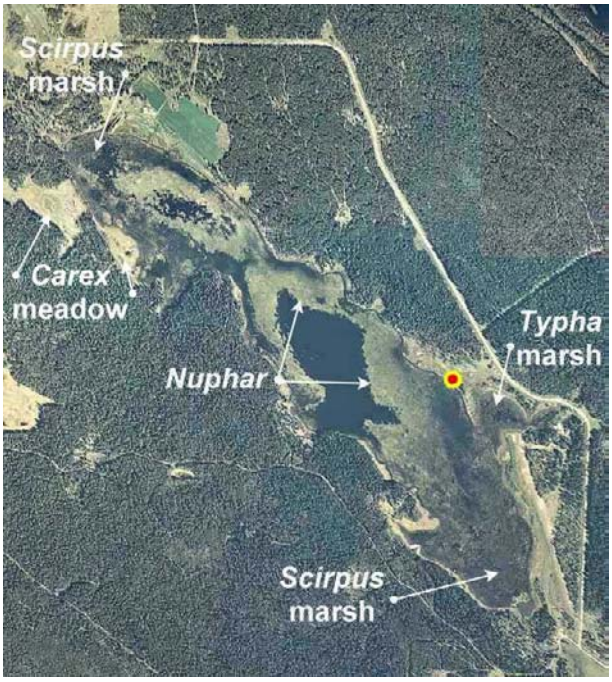

Figure 102. Lily Pad Lake showing some habitat characteristics and surrounding land use. Disc shows location where archival photographs were taken.

… used as an irrigation reservoir for the Clarke Ranch and a high water level is maintained by a dam at the outlet. The water, stained brown from desiccated vegetation, and in most places deep to the shoreline growth of dwarf birch, willow, spruce and lodge-pole pine. [sic] *The bottom is hard and the shores stony. Yellow pond lily dominates much of the surface. At the south end is an open marsh of round-stem bulrush and cattail; at the north end is a larger marsh exclusively round-stem bulrush with several deep channels through it. Here and there are stony ridges parallel with the shore and carrying low vegetative cover; these are used as nesting places by lesser scaups. Aquatic flora, other than yellow pond lily, reaches maximum abundance in these bays and in the marshes referred to; dominant species are water milfoil, pondweeds and water smartweed. The most plentiful animal food is an amphipod; leeches, snails* Lymnaea *sp.,* Planorbis *sp. also are abundant. Lake shiner* Richardsonius balteatus *is the only fish present. It was thus described in 1938.*

On June 4, 1958, the lake level was approximately a foot higher than the former early summer maximum. As a result, perhaps, of this condition round-stem bulrush had not reached the surface and what was formerly a dense marsh at the north end was entirely open. Two sawmills have been operating on the west side and it is possible there has been interference with the waterfowl population. It may be significant that the Clarke family, who attempted to protect the bird life on the area, no longer are in residence there. At any rate waterfowl appear to be considerably reduced in numbers…

On July 11, 1958, the round-stem bulrush at the north end had developed since June 4 but afforded a minimum of nesting cover. A surface efflorescence of Potamogeton natans *and sago pondweed flora was impressive in its extent.*

Figure 104. Lily Pad Lake looking northeast towards the sparse *Scirpus* marsh at the north end of the lake, 4 June 2001. The ranch house and outbuildings can be seen in the background.

In 2001, water levels at Lily Pad Lake appeared to be similar to those in 1958, judging from Munro's description. The *Scirpus* marsh at the north end of the lake covered a fairly large area; however, the *Scirpus* was still very sparse and open (Figure 104), much as Munro found it in 1958. It became denser as it neared the shore.

At the northwest corner of the lake, some *Typha* and a large *Carex* meadow were noted; a sparse *Scirpus* marsh also extended out into the lake in this area. We noted scattered bladderwort and thick beds of muskgrass amongst the *Scirpus* in about 1 m of water. Pondweed and thick beds of bladderwort also occurred in some areas such as the small bay that lies along the southwest shore, about 700 m from the north end of the lake; *Typha* edged the bay and a small band of *Carex* meadow occurred shoreward south of the bay.

At the southern end of the lake a large, relatively dense *Scirpus* marsh (Figure 105) had established; *Typha* occurred on the margins. About 800 m north of the south end of the lake, a *Typha*–dominant marsh had formed (Figure 106) east of the main body of the lake with some *Carex* occurring further inland.

Along much of the remainder of the northeast and southwest shorelines, small patches of *Scirpus* marsh grew sporadically, but seldom were these patches of a size that would be considered favourable to nesting waterbirds. The extensive pondlily that Munro (1958) noted as dominating the water surface was just reaching the surface with a few plants beginning to bloom during our last visit on 4 June (Figure 103) ; however, an abundance of the plants and their characteristic rootstocks were noted below the surface.

Figure 105. Lily Pad Lake looking towards the extensive *Scirpus* marsh at the south end, 4 June 2001. The "stony ridge" or relict landform that occurs around much of the lake can be seen (arrows).

Figure 106. *Typha* marsh at the southeast end of Lily Pad Lake, 4 June 2001.

Around the perimeter of much of the lake, but particularly noticeable along the northeast shore, geological processes have created what at first glance resembles a dyke—the "stony ridges"—mentioned by Munro (1958) (Figure 105). John Clague (pers. comm.) provides a possible explanation:

> *I have no firsthand knowledge of this site, but what you describe sounds very much* [like] *the "donut" rings that are common on the Prairies. The general explanation for these features is that they formed during deglaciation at the end of the Pleistocene due to melt out of debris from blocks of dead ice. The lakes might represent shallow kettles once occupied by dead ice. The elevated rims might be material that has slid off the surface of the ice blocks and accumulated at their periphery. A second possible explanation is that the elevated rims were squeezed up as the dead ice blocks exerted downward pressure on underlying till. Whatever the explanation, they are definitely late–glacial and are essentially relict landforms.*

Most of the surrounding landscape is mixed or coniferous forest. On the northeast side of the lake is a Douglas-fir dominant forest with varying amounts of trembling aspen, lodgepole pine and spruce (mostly ≥ 81 yr with a dominant crown closure of between 46 and 55% and a site index ranging from 11 to 20). Water birch lines much of the lakeshore and grades towards spruce with some aspen and a water birch edge in the lower, moist sites and Douglas-fir in the drier sites. At the southeast end of the lake, east of the *Scirpus* marsh, is a small area along the shore dominated by trembling aspen ranging in age classes from between greater than 20 to less than 120 yr old.

Southwest of the lake, the forest is also predominantly Douglas–fir with admixtures of lodgepole pine and some trembling aspen, the latter particularly by the lakeshore. To the west of the south end of the lake is a proposed Old Growth Management Area dominated by Douglas–fir and lodgepole pine. The trees in this area are in excess of 140 yr of age with a crown closure between 36 and 55% and a site index of 11. The forest to the northwest is younger at between 41 and 60 yr with a dominant crown closure of between 36 and 45% and site indices ranging from 11 to 14.

The sawmills Munro (1958) mentions were no longer extant although we could see evidence of their activities; most of the clearings in which they were situated have since been over taken by younger forest.

Along the central portions of the northeast shore a few summer cottages including a mobile, a cabin and a small house were noted. Another home lies near the southeast end of the lake and a ranch house and outbuildings still stand at the northeast end of the lake; the ranch currently draws water from the lake for irrigation purposes.

Table 56. Some attributes of Lily Pad Lake.

Attributes	Lily Pad Lake 17-May-01
UTM 10	609278 5732707
Elevation (m)	929
pH	8.9
Temperature (ºC)	17
Conductivity (µmhos·cm^{-1})	370
Depth (m)	3.0
Secchi Disk (m)	3.0
Area (ha)	105.5
Perimeter (m)	8251
Emergent marsh area (ha)	27.1
Open water or submergent vegetation area (ha)	78.3
Fish	Yes
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

Figure 107. One of two pairs of Common Loons at Lily Pad Lake, 4 June 2001.

Some additional attributes of Lily Pad Lake are shown in Table 56. On our June visit, we noted "lots of minnows" in the lake and a few large amphipods; caddisflies were emerging and characteristically bouncing along the water surface.

Bird use of Lily Pad Lake is shown in Table 57. While bird numbers in 2001 were down from the 1942 counts, they were up compared to Munro's early–June 1958 counts. Most of the difference in numbers between 1942 and 2001 was due to the larger numbers in the former year of 2 species, Lesser Scaup and American Coot. We found 5 species using the lake that were not reported by Munro (1958) in June 1942 including Canada Goose, Ring-necked Duck, Barrow's Goldeneye, Bufflehead, and Ruddy Duck; however, counts he conducted in July, 1938, reported all but Canada Goose. Munro (1958) reported 4 species at the site that we did not find: Blue-winged Teal, Cinnamon Teal, Northern Shoveler, and Redhead.

At least 3 species used the lake for nesting including Red-necked Grebe, Canada Goose and Black Tern. Two pair of Common Loons (Figure 107) were on the lake during our June survey; however, a search of much of the shoreline did not reveal any nests. We spent little time searching the extensive marsh areas at both ends of the lake which could have provided suitable nest areas for loons and other waterbirds.

Table 57. Birds observed during breeding waterbird surveys at Lily Pad Lake: 1942, 1958 and 2001.

	Lily Pad Lake		
Species[1]	1-Jun-42	4-Jun-58	4-Jun-01
COLO-PR[2]	1		2
PBGR			4
PBGR-PR	2		
RNGR			4
RNGR-PR	1	2	2
RNGR-N		2	3
CAGO			4
CAGO-PR			1
CAGO-Y			2
MALL-PR			2
MALL-♂	7		2
MALL-♀			2
BWTE-PR	1		
CITE-PR	1		
NOSL-♀		1	
CANV-♀	2		2
CANV-N	2		
REDH-♂	1		
RNDU-PR			1
RNDU-♂			1
LESC-PR	36	17	9
LESC-♂	3		9
LESC-♀			1
WWSC		14	
WWSC-PR			3
BAGO-♀			1
BUFF-♀			1
RUDU-♂			1
AMCO	58		4
Sub-total	**157**	**55**	**81**
AMBI			1
SORA			1
KILL			2
WISN			1
BLTE			20
BLTE-N			3
TOTALS	**157**	**55**	**109**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Sepa Lake

Sepa Lake lies near the southern end of 108 Mile Lake. Easy access may be gained to the western shore of the lake by taking Kallum Drive about 2.3 km west of Highway 97. Sepa is connected to the larger lake by a small channel. In 1938, Munro (1958) described the lake as

> *a muddy, alkaline slough of twenty acres south of 108 Mile Lake in rolling prairie. A scum of filamentous algae along shore covered much of the bottom plant life which seemed to be restricted to sago pondweed. The only shore cover is a small stand of round-stem bulrush on the east end of the lake. It is probable that crustaceans are plentiful as this is a feeding ground for post-breeding and non-breeding diving ducks.*
>
> *In 1958 the lake was twice its former size, and the water less alkaline; the composition of the duck population had changed from one composed entirely of diving ducks to one composed entirely of Canada Geese and post-breeding adult pond ducks.*

Table 58. Some attributes of Sepa Lake.

Attributes	Sepa Lake 15-May-01
UTM 10	613750
	5732784
Elevation (m)	883
pH	8.9
Temperature (ºC)	11
Conductivity((µmhos·cm^{-1}))	645
Depth (m)	6.0
Secchi Disk (m)	2.6
Area (ha)	20.7
Perimeter (m)	2282
Emergent marsh area (ha)	4.2
Open water or submergent vegetation area (ha)	16.5
Fish	Yes (stocked 1977)
Cattle access	No
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

Figure 108. Sepa Lake showing some habitat characteristics and surrounding land use. 108 Mile Lake is at the top of the image. Disc shows location where archival photographs were taken.

The lake covers an area of about 20 ha. It consists mainly of open water but does have an extensive area of *Scirpus* marsh at its southern end, interspersed with channels and pockets of open water. *Scirpus* pockets also occur in the small bays at the northern end of the lake (Figure 108). DUC has installed a water control structure on the Sepa Lake outlet to 108 Mile Lake the administration of which is the responsibility of the 108 Mile Property Association.

A narrow band of *Scirpus* occurs along much of the lakeshore occasionally interspersed with patches of *Typha.* We noted extensive water-milfoil beds, sago pondweed and other pondweed species, and some bladderwort.

A golf course lies along much of the eastern edge of the lake with private residential properties, small parks or common areas around the rest of the lake (Figure 109). Only on the southwestern shore of the lake do the residential properties extend right to the lakeshore. A public footpath extends around the lake and during our 2 visits it appeared to receive significant use by walkers (alone and with dogs) and cyclists. The banks are mainly grass, with young willow stands and the occasional single willow and small fir.

Some mature, mixed aspen, lodgepole pine, Douglas-fir forest grows at the south end of the lake (81 - 100 yr; 46 - 55% crown closure with a site index of 15) with a Douglas-fir—lodgepole pine dominant forest (101 - 120 yr; 16-25% crown closure with a Site Index of 11) at the northern end.

Figure 109. Sepa Lake looking northeast from the west shore, 15 May 2001. Note the *band of Scirpus* marsh in the foreground; the golf course is in the upper right of the image.

Figure 110. Breeding waterbirds recorded at Sepa Lake, 14 June 2001. Clockwise from upper left: Common Loon with downy young, American Coot pair with young (Photo: J.M. Cooper), John Cooper and agitated Black Terns at colony, and Red-necked Grebe with downy young.

Some attributes of Sepa Lake are given in Table 58. Suckers and Rainbow trout were noted in the lake. Bird use of Sepa Lake is shown in Table 59. While we reported fewer numbers than did Munro, his surveys were conducted in late July when birds had begun staging prior to migration thus his numbers are not directly comparable.

Sepa Lake is one of only 2 wetlands where Munro reported Canada Geese and one of the few where we failed to record this species on at least one of our visits. This is particularly surprising considering the nearby golf course.

Waterbird species that we documented breeding on the lake in 2001 included Common Loon, Red-necked Grebe, American Coot, and Black Tern (Figure 110).

Soda Sloughs

Soda Sloughs lie only about 900 m northeast of Highway 97; however, a direct route is not available. Access to Soda Sloughs and Soda Lake may be gained by turning east onto a rough spur-road just south of 108 Mile Ranch (the road may be known as Archie Meadow Road or Cariboo Drive). This road and its connectors can become very "greasy" after a sudden rain so caution should be used; access to the lake and sloughs may require the use of a 4-wheel drive vehicle. Approximately 600 m after leaving Highway 97 there is a backroad heading north that if followed for about 2.2 km will lead to Soda Lake and the sloughs. When Soda Lake comes into view to the east, the sloughs lie about 260 m west of the road, across the rangeland.

Table 59. Birds observed during breeding waterbird surveys at Sepa Lake: 1938, 1958 and 2001.

Species[1]	Sepa Lake		
	21-Jul-38	29-Jul-58	14-Jun-01
COLO-PR[2]			1
COLO-Y			2
PBGR			1
RNGR-PR			1
RNGR-Y			2
CAGO		19	
GWTE		35	
MALL		15	
MALL-PR			1
MALL-F			2
NOPI		15	
BWTE		32	
LESC	125		
BAGO-F	1		
BAGO-JF	18		
BAGO-Y	8		
BUFF-JF	20		
BUFF-F	1		
BUFF-Y	7		
RUDU-M			1
AMCO			3
AMCO-N			1
AMCO-Y	4	4	3
Sub-total	**184**	**120**	**21**
SORA			1
BLTE			31
BLTE-N			3
TOTALS	**184**	**120**	**56**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Munro (1958) describes the east slough as having an area of

> *...2 acres in 1930, in 1958 double in size...with large amount of round-stem bulrush.*

In 1938, the west slough was about

> *(5 acres) shore cover round-stem bulrush; no change* [in 1958] *except for increased size, now approx. 10 acres.*

Figure 112. The extensive *Scirpus* marsh at the west end of Soda Sloughs, 17 June 2001. Note John Cooper checking for nests (right of centre) and the water control structure (lower left).

Today, Soda Sloughs are a complex of 2 small sloughs that together average about 800 m long by about 120 m wide (Figure 113); they cover a collective area of about 9 ha which is nearly twice the area of Munro's 1958 estimate. The sloughs have a good mix of emergent marsh and open water and were well used by waterbirds during our visit.

Although Soda Sloughs and the surrounding habitat appear to have changed little since Munro's time (Figure 111), there have been a number of "improvements." DUC has secured the water rights and manages the water levels to benefit the growth of aquatic vegetation (Figure 112). DUC also constructed a ditch that connects Soda Lake to the sloughs but there was no water in the ditch during our 2 visits. We surmise that an exchange of water from the lake to the sloughs would only occur during periods of extreme high water. Judging from the

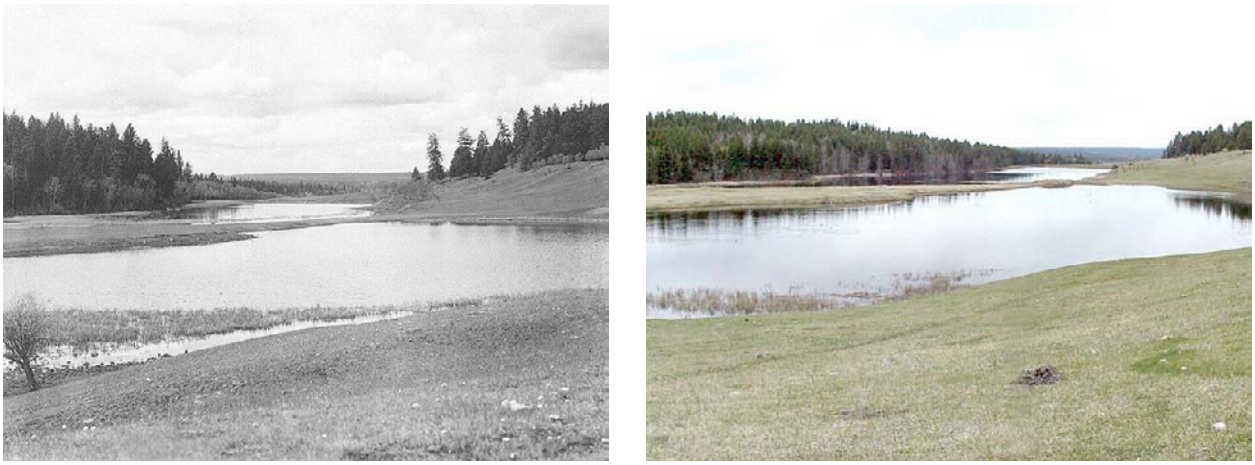

Figure 111. Soda Sloughs and their surrounds have changed little since Munro's time: (left) 1946 (Photo: J.A. Munro) and (right) 2001.

Figure 113. Soda Sloughs showing some habitat characteristics and surrounding land use. Soda Lake is in the upper right corner. Discs show locations where archival photographs were taken.

opaqueness of the lake water it would likely reduce the value of the sloughs if they were connected to the lake. Ditching was carried out to connect the sloughs to each other which also resulted in the creation of an island near the eastern end of the complex. However, a complete walk and search of the island did not reveal one nest.

The sloughs have a combination of *Scirpus* and *Typha* marshes associated with them (Figures 112 and 113) . At the east end and around much of the southern shore of the island is an extensive *Typha* marsh; *Scirpus* marsh occurs in varying amounts around the remaining edges of the water bodies with a fairly extensive emergent *Scirpus* marsh at the west end by the water control structure (Figure 112).

To the north of the sloughs is a band of rangeland on a steep slope varying in width from about 40 m to 160 m and grading into a conifer dominated or mixed forest of Douglas-fir, lodgepole pine and trembling aspen (Figures 113 and 114). Some of the forest is relatively young (21-40 yr); however, there are stands of older forest ranging in age between 81 and at least 121 yr (crown closure ranges between 6 and 15 percent in the younger sites to >38% in the older sites.

The east end of the sloughs is similar to the north side with rangeland and an older mixed forest of fir and aspen (>101 yr with a crown closure >56% and a site index of 15).

South of the sloughs, Douglas-fir and lodgepole pine-dominant forest reaches the slough edge. It includes a mix of younger (21-40 yr) and older (>121 yr) stands (crown closure ranging from 6 to 26%; site index of 14-16).

The adjacent rangeland appears to be heavily grazed and cattle have direct access to the wetlands. Some attributes of Soda Sloughs are given in Table 60. Comparative bird numbers are shown in Table 61.

Figure 114. Soda Sloughs and their surrounds looking west, 10 May 2001.

Table 60. Some attributes of Soda Sloughs.

	Soda Sloughs
Attributes	10-May-01
UTM 10	612782
	5736980
Elevation (m)	900
pH	9.0
Temperature (ºC)	12
Conductivity (µmhos·cm^{-1})	2000
Depth (m)	1.3
Secchi Disk (m)	1.3
Area (ha)	9.3
Perimeter (m)	2953
Emergent marsh area (ha)	2.4
Open water or submergent vegetation area (ha)	8.2
Fish	?
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	No
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

We recorded at least 2.5-times more breeding waterbirds on Soda Sloughs than did Munro in either 1938 or 1958 and we would probably have noted more broods had our timing been closer to Munro's earliest survey dates. Some of that difference resulted from species that Munro did not report. For example, 8 species that Munro failed to observe on the sloughs included Eared Grebe, Canada Goose, Cinnamon Teal, Gadwall, Redhead, Ring-necked Duck, Common Goldeneye, and Hooded Merganser. Munro noted 2 species on the sloughs that we failed to observe (Green-winged Teal, Northern Pintail).

Figure 115. Canada Goose on the nest at Soda Sloughs, 10 May 2001. The nest, built on a muskrat lodge, held 6 eggs.

Table 61. Birds observed during breeding waterbird surveys at Soda Sloughs: 1938, 1958 and 2001.

	Soda Sloughs		
Species[1]	13-Jul-38	22-Jun-58	17-Jun-01
EAGR			14
EAGR-N[2]			14
CAGO			10
CAGO-Y			22
GWTE-♂	1		
GWTE-♀	2		
MALL-♀		2	3
MALL-Y		15	
NOPI-♀		1	
NOPI-Y		9	
TEAL-N			1
BWTE-PR			1
BWTE-♂	2	6	10
BWTE-♀	1	1	2
BWTE-Y	8		
CITE-PR			2
CITE-♂			2
GADW-♂			5
GADW-♀			1
AMWI-PR			4
AMWI-♂			4
AMWI-♀		2	
AMWI-Y		14	
CANV-PR			1
CANV-♀	3	1	1
CANV-Y	13	9	3
REDH-PR			1
REDH-♂			1
RNDU-♂			2
LESC-PR	1	1	3
LESC-♂			3
COGO-♀			6
COGO-Y			3
BAGO-♀	2	1	2
BAGO-Y	14	14	
BUFF-J♀	4		
BUFF-♀			6
BUFF-Y			4
HOME-Y			1
RUDU			15
RUDU-♂	7		
RUDU-N			3
AMCO	7		10
AMCO-PR			1
AMCO-N			15
AMCO-Y	6		4
Sub-total	**72**	**77**	**193**
BAEA			1
SPSA			2
KILL			2
TOTALS	**72**	**77**	**198**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 116. Eared Grebes have established a nesting colony on Soda Sloughs since Munro's visits to the area: (left) John Cooper checking the egg stage of an Eared Grebe nest; (above) Eared Grebe nest with four eggs. The eggs were covered by the adult bird before it left the nest; (below) Soda Sloughs looking south toward the Eared Grebe colony. The colony was located in the Typha marsh near the center of the image.

Figure 117. Some nesting waterbirds at Soda Sloughs, 17 June 2001. (Upper left) active nest locations at Soda Sloughs (circles: American Coot; square: Eared Grebe colony; diamond: Ruddy Duck). (Upper right) Dump clutch of teal eggs in a Ruddy Duck nest (note the one Ruddy Duck egg on the left side of the clutch). (Lower left) Canvasback nest (note dead Hooded Merganser chick on the lower edge). (Lower right) American Coot likely killed on the nest as she brooded the young. Note the dead young and the feather evidence left behind by the "culprit," a Great Horned Owl.

Since Munro visited the area, Eared Grebes have established a small colony in the *Typha* marsh just south of the island (Figures 116 and 117). In addition, we recorded nests with either eggs or young for 8 other species including Canada Goose, teal sp., Canvasback, Common Goldeneye, Bufflehead, Hooded Merganser, Ruddy Duck, and American Coot (Figure 117). One of 2 Hooded Merganser chicks we saw was found dead at the edge of a severely disturbed Canvasback nest. An American Coot was also found dead on the nest along with one dead chick. The coot was apparently killed on the nest by a Great Horned Owl. We also found Marsh Wren, Song Sparrow, and Red-winged Blackbird nesting in the sloughs.

Munro reported 6 nesting species including Mallard, Blue-winged Teal, American Wigeon, Canvasback, Barrow's Goldeneye, and American Coot.

Soda Lake

Soda Lake (Figure 118) is located just east of Soda Sloughs. It is about 1.5 km long and 440 m wide and covers an area of about 60 ha. Munro (1958) has a brief description where he notes that

> *one shore of this mile-long, narrow lake is open as are the ends; on the other side mixed forest reaches the water's edge. It is a clear lake with hard shores containing little bottom flora and no emergent growth. Except for greater dimensions it is exactly as in 1938 and the small nesting population is comparable.*

The most significant difference between Munro's description and what we found was the pea-soup-like quality of the water, laden with algae and particulate matter such that visibility in the water column was reduced to a depth of 20 cm (Table 62); "clear lake" is no longer an apt description.

Figure 118. Soda Lake showing some habitat characteristics and surrounding land use. Disc shows location where the archival photographs were taken.

We wondered if the cattle use of the area has increased (Figure 119), as the rangeland appears to be overgrazed, and whether such an increase in cattle use and the attendant increase in cattle dung pats could account for the decline in water quality.

Individual cows produce an average of 750 kg of manure each month (Holter, 1996), which increases the concentration of nitrogen and phosphorous in the soil. According to Coote and Hore (1978), this can have an adverse affect when the land is at or near its carrying capacity. In conjunction with a heavy rainfall and saturated soils, this could cause the contents of the dung and urea to be washed into the lake with the runoff, as the slope of the rangeland would direct surface flows directly to Soda Lake. Because the lake has no outlet the concentrations would increase. High amounts of nitrogen and phosphorous in the lake water could lead to eutrophication and algal blooms.

Table 62. Some attributes of Soda Lake.

Attributes	Soda Lake 10-May-01
UTM 10	614060 5737562
Elevation (m)	908
pH	9.6
Temperature (ºC)	12
Conductivity (µmhos·cm^{-1})	5885
Depth (m)	5.0
Secchi Disk (m)	0.2
Area (ha)	60.3
Perimeter (m)	4821
Emergent marsh area (ha)	0.1
Open water or submergent vegetation area (ha)	60.2
Fish	?
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	No
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	Yes
Biogeoclimatic Unit	IDF dk3

Figure 119. Looking west from Soda Lake to the adjacent rangeland backed by mixed forest, 17 June 2001. Note the cattle and their ease of access to the lake.

Other changes we noted were a small Scirpus marsh that had formed in the short arm at the northeast end of the lake (Figure 120) and an apparent increase in recreational use of the area since Munro's time. On one of our visits, 2 all-terrain vehicles motored by on the access road and "four by four" vehicle use was evident. An old boat launch ramp was also evident although in disrepair, and had likely not seen much, if any, use in recent years.

There is a small patch of mature (> 121 yr), open, Douglas-fir dominant forest just west of the north-

Figure 120. John Cooper checking the small Scirpus marsh in the northeast arm of Soda Lake, 17 June 2001.

Table 63. Birds observed during breeding waterbird surveys at Soda Lake: 1938, 1958 and 2001.

	Soda Lake		
Species[1]	13-Jul-38	22-Jun-58	17-Jun-01
COLO-PR[2]			1
EAGR			2
CAGO			18
CAGO-Y			31
GWTE-PR			3
GWTE-♂			5
MALL-♂			2
CITE-PR			2
CITE-♂			2
CITE-♀			2
NOSL			6
NOSL-PR			1
NOSL-♂			1
GADW			15
GADW-PR			2
GADW-♂			4
AMWI-PR			2
CANV-♀			1
RNDU-PR			1
RNDU-♂			2
LESC			30
LESC-PR			14
LESC-♂			1
COGO-♀			3
COGO-Y			11
BAGO-♂			2
BAGO-F	2	2	3
BAGO-Y	12	14	
BUFF-♂			6
BUFF-♀	1	2	6
BUFF-Y	8		
RUDU-PR			1
RUDU-♂			5
Sub-total	**23**	**18**	**212**
SPSA			8
WIPH-M			2
WIPH-F			2
KILL			14
KILL-Y			1
BLTE			2
TOTALS	**23**	**18**	**241**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

east arm. A lodgepole pine—Douglas-fir dominant forest (21 - 40 yr) that was not satisfactorily restocked lies at the head of the arm.

Mature mixed-forest still adjoins the southern shore of the lake. Lodgepole pine, spruce, trembling aspen, and Douglas-fir are dominant in varying admixtures. The western half of the shore is dominated by older spruce and lodgepole pine of at least 141 yr (crown closure between 56% and 88% and a site index of 10 to 14). Spruce tends to fade out as one moves further east and fir and pine become dominant along with aspen. The eastern forested shore is also younger, ranging between 61 and 140 yr (crown closure between 26% and 55% and a site index between 14 and 21).

Figure 121. John Cooper with recently-fledged Red-winged Blackbird at Soda Lake, 17 June 2001..

DUC has dug a connecting ditch between Soda Lake and the marshes to the west that appears to be non-functional (and, in our opinion, should remain that way); a number of nest boxes were noted along the south shore.

Some other attributes of Soda Lake can be found in Table 62; comparative breeding bird use of the lake can be found in Table 63.

Bird numbers on the lake were up 10-fold from Munro's times. We recorded 14 waterbird species that Munro (1958) did not report, as well as the 2, Barrow's Goldeneye and Bufflehead, that he did report. We also found Canada Goose and Common Goldeneye broods on the lake and were likely just a bit early to find Barrow's Goldeneye or Bufflehead broods, although undoubtedly they still nested there based on the behaviour of the adult birds we did see.

We walked the only marsh extensive enough to hold waterbird nests but found only Red-winged Blackbirds nesting there (Figure 121). Some of the dabbling ducks were likely using the surrounding forest edge as nesting habitat; however, any birds that rely on sight to locate their prey, such as the Common Loon, would find hunting in the lake difficult due to the lack of water clarity. A complete transit of the shoreline did not reveal a loon nest on this lake.

Whitehorse Lake

Whitehorse lake is located about 5.6 km east along the Timothy Lake Road from its intersection with Highway 97 at Lac la Hache. From there, a private drive turns south and leads some 1.2 km to a residence on the lake.

In 2001, Whitehorse Lake (Figures 122 and 123) appeared to be much the same as it was when Munro visited the area in 1958, with minor exceptions.

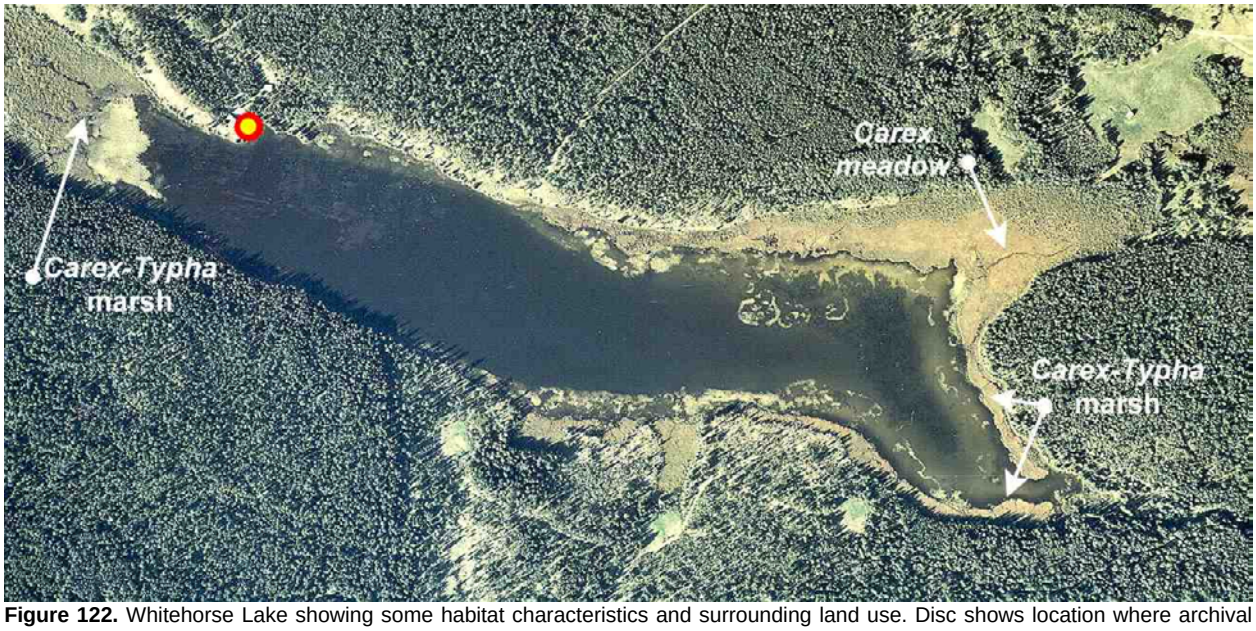

Figure 122. Whitehorse Lake showing some habitat characteristics and surrounding land use. Disc shows location where archival photographs were taken.

Munro (1958) describes the lake in 1938 as:

approximately one and a half miles by three to five hundred yards and lies east and west. About five years ago (i.e., about 1933) beaver came into the lake and constructed a solid dam across the outlet at the east end. The beaver have not been trapped out in the interval and at present there is a large and solidly built lodge close to the dam. The damming of the lake raised the water level at least four feet so that the original shoreline was flooded. On the north side where aspen predominates along shore, succeeded by lodgepole pine and aspen further inland, the willow margin of the old shore is under water and the trees dead and brittle with age. Many of the large aspens have been felled by beavers. A section of sedge meadow is isolated and forms a long island separated from the present shoreline by a channel twenty yards or so wide. This channel is grown up with water milfoil, water smartweed, hornwort and bladderwort, the latter dominant. On the south shore which is covered with spruce on a mossy floor the water reaches to the butts of the trees. About one-third of the lake's length at the easterly end is encircled by a narrow marsh belt of cattail, sedge, small willows and dwarf birch on muskeg. At either end of the lake, the inlet and outlet respectively, of Railroad Creek, is a swampy willow bottom through which the creek flows. The lake bottom is part soft humus and part sand and gravel. In addition to the food plants noted above are: Lemna minor, Lemna trisulca, *and chara; yellow pond lily is general along shore and at the west end where the lake narrows covers the entire surface. There is no round-stem bulrush. Snails* Planorbis *and* Lymnaea *are abundant; no amphipods were observed.*

Thus with a variety of food in abundance and a fair amount of cover Whitehorse Lake provides good nesting ground and probably will improve if the beaver population is maintained.

Whitehorse Lake [in 1958] *has changed little: the beaver population has been maintained—probably has increased judging by the number of lodges. The island*

Figure 123. Whitehorse Lake at the west end looking east, 12 June 2001.

referred to [above] *is now submerged, chara meadows dominate all but the inshore shallows; there is some round-stem bulrush (absent in 1938) and the dead willows on the shore have long since disintegrated and disappeared. A sawmill operated here for several years but is now abandoned.*

Today a younger forest of predominately Douglas-fir and lodgepole pine occurs on the north side of the lake ranging in age from at least 21 yr to less than 100 yr of age (16 - 45% crown closure with a site index of between 12 and 19). The eastern end of the lake has a small area with trembling aspen and lodgepole pine as dominants backed by Douglas-fir and pine. The forest here and along the south shore is older, ranging in age from at least 81 yr near the east end to between 141 and 250 yr further west along the south shore. The south shore is dominated by fir and pine with a lesser amount of aspen (crown closure ranges from at least 16% to over 66% and the site index ranges from 11 to 21). At the west end of the lake is a large willow swamp. Water birch, alder, and willow occur in varying amounts immediate to the shore.

A narrow band (2-5 m) of *Carex* lines much of the north shore of the lake. Toward the eastern end the *Carex* band widens and becomes an extensive meadow extending nearly 300 m in a northeasterly direction from the lake ; the meadow is about 150 m wide. As it continues south, the *Carex* band narrows again (15-30 m wide) and then runs west along the southern shore for about a kilometre. Near the lake edge, the *Carex* has a varying admixture of *Typha*, which decreases along the south shore. There is a small amount of *Scirpus* amongst the *Carex* along the southeast shore of the lake. Submergents included bladderwort, yellow pondlily, pondweeds and extensive muskgrass beds; small amounts of duckweed and horsetail were also found. The western end of the lake was filled with yellow pondlily.

Table 64. Some attributes of Whitehorse Lake.

Attributes	Whitehorse Lake 12-Jun-01
UTM 10	610155
	5743845
Elevation (m)	902
pH	8.8
Temperature (ºC)	15.5
Conductivity (µmhos·cm^{-1})	180
Depth (m)	3.6
Secchi Disk (m)	2.6
Area (ha)	54.3
Perimeter (m)	5068
Emergent marsh area (ha)	14.2
Open water or submergent vegetation area (ha)	40.1
Fish	Yes
Cattle access	Yes
Nest boxes present	Yes
DU Project	No
Residences near wetland	No
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	Yes
Biogeoclimatic Unit	IDF dk3

Table 65. Birds observed during breeding waterbird surveys at Whitehorse Lake: 1938, 1958 and 2001.

Species[1]	Whitehorse Lake 27-Jul-38	25-Jul-58	12-Jun-01
COLO		1	2
COLO-PR[2]	2		
COLO-N			2
COLO-Y	2		
RNGR-PR	1		
DABB-U			1
GWTE-♂	3		
MALL-♂	5		
MALL-♀	2		
MALL-Y	13		
AMWI-♀	2		
AMWI-Y	9		
RNDU-♂			1
RNDU-Y		8	
LESC-♀	1		
LESC-J♀	3		
BAGO-♀	1		
BAGO-Y	6		
BUFF-♀	1		
BUFF-Y	9		
HOME-♀	1		
Sub-total	**64**	**9**	**6**
GBHE			1
AMBI		2	
TOTALS	**64**	**11**	**7**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 124. Common Loon at the east end of Whitehorse Lake, 12 June 2001. Loons have nested at Whitehorse Lake for at least 63 years.

Figure 125. Common Loon nests and eggs at Whitehorse Lake, 12 June 2001; (clockwise from above) nest and eggs at east end of lake; closeup of eggs (note egg on right is pipping); and nest and eggs at west end of lake.

Snails (both *Planorbis* and *Lymnaea*) and freshwater clams were observed. Northern pikeminnow (formerly northern squawfish), peamouth chub, rainbow trout, redside shiner, and sucker are known to inhabit the lake (BC Fisheries 2002). Two beaver lodges were also noted. Some attributes of Whitehorse Lake are given in Table 64.

Comparative bird use of Whitehorse Lake is given in Table 65. Bird numbers were similar to those Munro found in 1958, but nowhere near the numbers of his 1938 visit. In the earliest year, major changes had occurred on the lake as a result of beaver activity and are not likely comparable.

Two pairs of Common Loons (Figure 124) nested on the lake and both nests held 2 eggs (Figure 125). The nests were visible to one another at least early in the season; however, they were about 1.7 km apart and we saw no territorial defence or aggression between the 2 pair. Common Loons have been using this lake for at least 63 years.

A Bald Eagle nest was observed on the north shore of the lake. The nest was in a live Douglas-fir. It is likely that Ring-necked Duck and perhaps Mallard were also nesting on Whitehorse Lake. The blue-listed Great Blue Heron was also recorded during our visit (Table 65).

Slough 5 km S of Springhouse

This small, unnamed slough lies about 4.8 km south of the southernmost of the Springhouse Sloughs on the west side of Dog Creek Road (Figure 126). It is a shallow, open water slough covering an area of about 1.7 ha. There is little tall cover (e.g. *Scirpus* or *Typha)* for nesting waterbirds, although this slough has a band of *Carex* around the perimeter ranging in width from 5 m to 30 m. This small slough is surrounded by grassland. Beyond the proximate area of the slough is mixed forest to the northeast and southwest (Douglas-fir is dominant with varying admixtures of lodgepole pine, trembling aspen and spruce; most of the timber was selectively logged in the late 1970s and early 1980s), rangeland and smaller wetlands to the northwest and Dog Creek Road to

Figure 126. Slough 5 km south of Springhouse showing some habitat characteristics and surrounding land use. Disc shows location where archival photographs were taken.

the southeast (Figures 126 and 127). Cattle were not found in the area during our 2 visits; however, it appears they do have direct access to the slough. Some attributes of the slough are given in Table 66.

Comparative bird use of the slough is given in Table 67. Numbers in 2001 were comparable to those of 1958 and about 30% less than Munro's 1941 survey. We recorded 3 species (Eared Grebe, Gadwall, Lesser Scaup) that were not reported by Munro (1958). On the other hand, Munro reported 4 species (Horned Grebe, Northern Shoveler, American Wigeon, Barrow's Goldeneye) that we did not get, although 2 of them (Horned Grebe, American Wigeon) were found on the slough during our May surveys (Appendix ???). We also found a Canada Goose on a nest during our May visit; however, geese were not observed there in June.

130 Mile Lake

130 Mile Lake (Figure 128) lies on the west side of Highway 97, about 20 km north of downtown Lac la Hache (about 6 km north of the north end of Lac la Hache).

Table 66. Some attributes of Slough 5 km south of Springhouse.

Attributes	5 km S Springhouse 19-Jun-01
UTM 10	559888 5748265
Elevation (m)	990
pH	8.8
Temperature (ºC)	21
Conductivity	1300
Depth (m)	1.0
Secchi Disk (m)	1.0
Area (ha)	1.7
Perimeter (m)	517
Emergent marsh area (ha)	0.0
Open water or submergent vegetation area (ha)	1.7
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

As Munro (1958) notes, 130 Mile Lake

is an expansion of the San Jose River between Lac la Hache and Williams Lake. Much of the surface is covered with leaves of yellow pondlily; the lake bed is mostly marl and what little submerged vegetation grows on it is plainly visible in the clear shallow water. Round-stem bulrush, in places intermixed with cattail, spike rush Eleocharis *sp., and various grasses and sedges make up the shore growth which is extensive at the south end. This is good nesting cover and continues to be so in 1958, high water not having scoured the bulrush stands as has taken place in some other lakes. The food potential is low consequently the lake is classified as marginal nesting ground.*

It has frequently been observed that when a waterfowl population is declining in numbers marginal nesting grounds attract few birds or none at all. This was so at 130 Mile Lake in 1958.

Figure 127. Slough 5 km south of Springhouse, 9 May 2001.

Figure 128. 130 Mile Lake showing some habitat characteristics and surrounding land use. Discs show locations where archival photographs were taken.

Table 67. Birds observed during breeding waterbird surveys at small slough 5 km south of Springhouse: 1941, 1958 and 2001.

	5 km S Springhouse		
Species[1]	23-Jun-41	24-Jun-58	19-Jun-01
HOGR-PR[2]	1		
EAGR			2
GWTE-PR	2		
MALL	3		1
MALL-F		1	
MALL-Y		5	
BWTE-PR	2	1	1
NOSL-F	2		
NOSL-Y	13		
GADW-PR			1
AMWI-F	1		
LESC-PR			1
BAGO-F		1	
BAGO-Y		4	
BUFF-M			1
BUFF-F	1		1
BUFF-Y	4		
RUDU-PR		2	5
RUDU-M			2
RUDU-F	1		
RUDU-Y	7		
AMCO	4	8	14
AMCO-Y	7	10	
Sub-total	**53**	**35**	**37**
SORA			1
TOTALS	**53**	**35**	**38**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

There have been some changes since Munro's (1958) visit, but much of his description still applies. 130 Mile Lake is a large (116 ha), long, shallow open water lake along the course of the San Jose River.

The east side of the lake, bounded by Highway 97, is mostly sloping rangeland. At its northeastern end there is a dense and diverse riparian edge of large spruce, aspen, birch, willow and saskatoon (Figure 130). There are extensive riparian shrubs (willow, birch) along the central portions of the eastern shore moving into a *Juncus* and *Carex* band beside the lake.

Figure 129. The north end of 130 Mile Lake looking northeast to the riparian woods on the eastern shore (far right), 29 May 2001.

Figure 130. 130 Mile Lake, 29 May 2001; (upper) the main water body looking southwest. In the foreground is the rangeland and near the lake edge, the riparian birch-willow shrubs can be seen. Beyond the riparian shrub zone lies a small band of *Juncus* and *Carex.* The San Jose River can be seen entering the lake in the upper left side of the image.

A pumphouse, situated on the east edge of the lake where we launched the canoe, takes water from the San Jose River and fills a reservoir that was built on the ranch property east of Highway 97. Cattle have direct access to the marshes adjacent to the lake and we would be surprised if cattle were not here in 1958 as well, although Munro (1958) makes no mention of them or the BC Rail line, whose track lies along the entire western shore.

The current landowners of 130 Mile Ranch, Lee Hoim and Wendy Braim, have worked together with DUC and Environment Canada to manage their lands east of Highway 97 in a way that benefits both wildlife and ranching (see page 161). They now have plans to fence the cattle away from the San Jose River and the emergent marshes of 130 Mile Lake (W. Braim, pers. comm.).

West of the BC Rail line is mature coniferous forest with a few aspens. Some time ago, the rail line cut through some of the marshland at the southern end of the wetland; however, that area has since been recovered and made into nesting islands (Figure 128).

Between the rail line and lake lies extensive riparian willow and birch habitat leading to *Carex* and finally *Typha* where the land slopes gently into the lake or a band of *Typha* where the land slopes more abruptly to the lake

At the southern boundary of the wetland area we surveyed, there is a rangeland knoll and a logjam has built up in the river over the years.

Typha is prevalent, growing in a band of varying widths around the perimeter of the lake. *Scirpus* marsh extends into the lake in most places, which also grows in clusters farther from the lakeshore, especially near the south end of the main water body.

The marsh also contains bands and patches of *Carex* and *Juncus,* especially along the non-forested portions of the east shore.

There are extensive *Carex* meadows on both sides of the river at the south end of the lake before it enters the main water body. DUC has created nesting islands along the southeast shore south of the main water body which did not appear to have any waterbird use. Patches of willow and *Typha* grow in the *Carex* meadow. At the extreme northeast corner are extensive *Juncus* areas.

Typha borders the river edge south of the lake, then grades into the *Carex* meadows; wherever open water occurs in the meadows, the edge seems to be banded by *Typha.*

In the northwest portion of the lake, *Scirpus* grows from the shore where *Typha* is less prevalent.

Yellow pondlily covers much of the lake surface with the highest densities at the south end of the lake. The characteristic rootstocks were preva-

Table 68. Some attributes of 130 Mile Lake.

Attributes	130 Mile Lake 29-May-01
UTM 10	586923 5751056
Elevation (m)	779
pH	8.5
Temperature (ºC)	15
Conductivity (µmhos·cm^{-1})	260
Depth (m)	1.5
Secchi Disk (m)	1.5
Area (ha)	116.0
Perimeter (m)	8557
Emergent marsh area (ha)	64.4
Open water or submergent vegetation area (ha)	51.5
Fish	Yes
Cattle access	Yes
Nest boxes present	No
DU Project	Yes
Residences near wetland	Yes
Recreation Area near	No
Light Industry	No
Partially filled	Yes
Boat launch	No
Biogeoclimatic Unit	IDF dk3

Figure 131. Black Tern nests and nesting habitat at 130 Mile Lake, 9 June 2001; (clockwise from bottom left) adult Black Tern on a *Typha* and *Scirpus* nest. This bird was incubating two eggs. *Carex* meadow, important habitat for the nesting terns (note the nest in the lower right corner); well-constructed *Carex* nest with 3-eggs; crudely-constructed Black Tern nest with one egg. Many nests, such as this one, consisted of little more than an accumulation of *Scirpus* stems.

lent around most of the shoreline. Extensive Muskgrass meadows were noted primarily on the western side of the lake; water-milfoil was found though much of lake as well as in the river. We also noted floating-leaved pondweed, common duckweed, ivy-leaved duckweed, and bladderwort.

Some attributes of 130 Mile Lake are given in Table 68.

Snails (*Lymnaea* sp.) and unidentified clam shells were noted. Two coyotes were observed on the rangeland just south of the lake. Comparative bird use of the lake over the 3 years is given in Table 69.

We recorded nearly 4-times the bird numbers of Munro's 1942 counts and 11-times his 1958 counts (Table 67). We also noted 10 species in 2001 that were not reported by Munro (Canada Goose, Wood Duck, Cinnamon Teal, Northern Shoveler, Gadwall, American Wigeon, Lesser Scaup, Common Goldeneye, Ruddy Duck, American Coot) while Munro reported Green-winged Teal at this site, which we failed to record.

Nesting was documented for 4 species: a Red-necked Grebe nest with 2-eggs was found on 29 May 2001 and eggs or young of Common Loon, Canada Goose, and Black Tern (Figure 131) were recorded

Table 69. Birds observed during breeding waterbird surveys at 130 Mile Lake: 1942, 1958 and 2001.

	130 Mile Lake		
Species[1]	15-Jun-42	14-Jun-58	9-Jun-01
COLO		1	
COLO-PR[2]	1		1
COLO-Y			2
PBGR			2
PBGR-PR	1		
RNGR			1
RNGR-PR		1	
RNGR-N		1	
CAGO-PR			5
CAGO-Y			19
WODU-♂			2
GWTE-PR	1		
MALL-PR			2
MALL-♂	2	4	8
MALL-♀	1		4
BWTE-PR	2		
BWTE-♂			3
CITE-PR			1
NOSL-♂			1
GADW-PR			1
GADW-♀			1
AMWI-PR			1
AMWI-♂			4
RNDU-PR	6		5
LESC-PR			3
LESC-♂			1
COGO-♂			1
RUDU-♂			1
AMCO			2
Sub-total	**25**	**8**	**90**
GBHE			2
AMBI			1
VIRA			2
SORA			2
WIPH-♀			1
WISN			1
BLTE	30		28
BLTE-N			12
TOTALS	**55**	**8**	**139**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

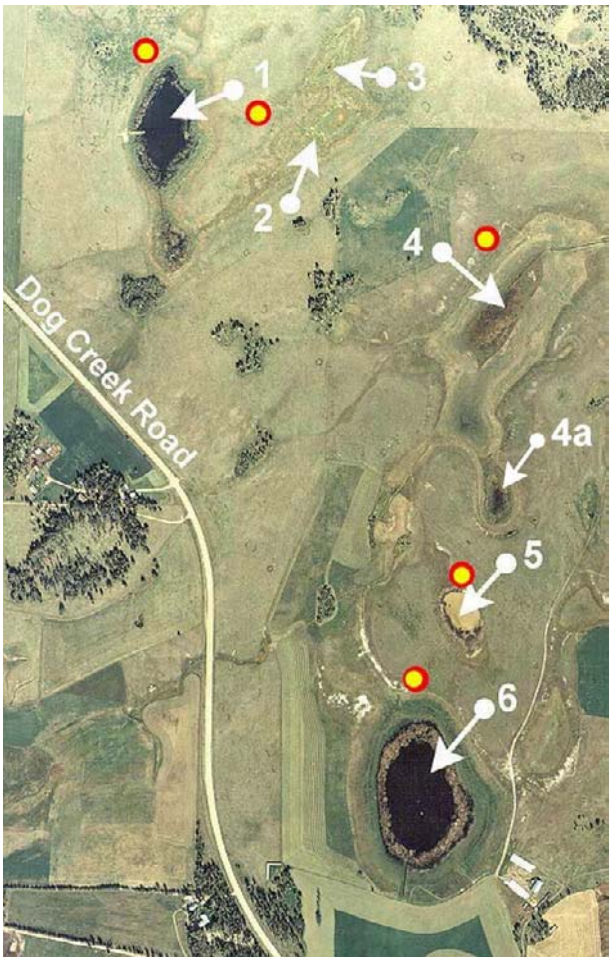

Figure 132. Springhouse sloughs showing some habitat characteristics and surrounding land use. Discs show locations where archival photographs were taken.

in June. Most of the birds we recorded on the June survey are likely nesting at this site.

This was one of the lakes where Munro did report Black Terns in 1942 (Table 69), and we observed about the same number of birds using the breeding site in 2001.

Two provincial blue-listed species, Great Blue Heron and American Bittern, were observed at 130 Mile Lake in 2001 (Table 69). Also, this spring for the first time in recent memory, between 30 and 40 red-listed American White Pelicans staged on the lake in early May for about a week (W. Braim and L. Hoium, pers. comm.).

Springhouse sloughs

Springhouse sloughs are located on Springhouse Prairie (Figure 132), about 27 km southwest of Williams Lake along Dog Creek Road. About 3.8 km south of Springhouse is a gate that provides access to the first of the sloughs which lie just south of Rush Lake; permission to access the sloughs must be obtained from the landowner at the ranch, 2 km further south along the road (Clarke Tucker Jr.).

The Springhouse sloughs are similar to the 70 Mile Sloughs in that we could not tell with certainty which sloughs Munro (1958) visited, although he does state "the localities are presented from south to north." Some of his descriptions are also lacking. To

Table 70. Birds observed during breeding waterbird surveys at Springhouse sloughs: 1941, 1958 and 2001.

Species[1]	Springhouse Sloughs 12-Jun-41	24-Jun-58	7-Jun-01	◀ Springhouse Sloughs (Cont'd) Species[1]	12-Jun-41	24-Jun-58	7-Jun-01
PBGR			2	CANV-Y	24	14	
EAGR			28	REDH		20	
EAGR-PR	15	15	0	REDH-PR			1
CAGO			35	REDH-♂	2		
CAGO-PR			1	REDH-♀			2
CAGO-Y			5	RNDU-♂			4
GWTE-♂			1	RNDU-♀			1
MALL-PR			2	LESC		3	
MALL-♂	35		22	LESC-PR	2		11
MALL-♀	1		7	LESC-♂			7
NOPI-PR			1	LESC-♀			1
NOPI-N	1			LESC-J	50		
NOPI-♂	3			BAGO	12		
NOPI-♀	2			BAGO-♀	2	1	2
NOPI-N	2			BAGO-Y	14	15	
BWTE	8			BUFF	20		
BWTE-PR	4	2	1	BUFF-♂			2
BWTE-♂		15	5	BUFF-J♂			1
BWTE-♀		1		BUFF-♀	2		
BWTE-Y		7		BUFF-J			
CITE-PR	1			BUFF-Y	17		
CITE-♂			2	RUDU	18	1	
CITE-N	1			RUDU-PR			2
NOSL	10			RUDU-♂			1
NOSL-PR	4			RUDU-♀			1
NOSL-♂		8	4	AMCO	20	36	21
NOSL-N	1			AMCO-PR	3		
NOSL-♀	1	1	1	Sub-total	351	252	200
NOSL-Y	10	11		NOHA-♀			1
GADW-♂			3	SORA			1
AMWI	15			WIPH-PR			1
AMWI-♂		70	4	WIPH-♀			8
AMWI-♀	2	1		KILL			4
AMWI-Y	16	11		COSN			4
CANV-PR		1		BLTE			2
CANV-♂	1						
CANV-♀	3	1					
▶				**TOTALS**	**351**	**252**	**222**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

alleviate the problem, we combined the bird data for comparative purposes. We then describe each slough we surveyed in more detail for future researchers. Based on its size, one slough, east of the Tucker home, may have been visited by Munro; however, we did not gain access and it was excluded from our survey.

Munro (1958) describes the area as comprising

> *several thousand acres of level grassland containing a number of ponds, sloughs and a lake one and one-quarter miles long* [Boitano Lake]. *Hill-slopes to the east and west are forested with Douglas fir, lodgepole pine and aspen. In early June, 1941, water levels were low and became progressively lower as summer advanced; by early July all ponds were much reduced in size, and one grass-bordered meadow slough was dry. Nevertheless waterfowl were more plentiful here than in other sections of the Cariboo. Contrastingly in 1958 all sloughs were filled; one of some 10 acres had become established since I last visited Springhouse in 1942; hydrophytes, grasses and forbs have provided generous amounts of nesting cover.*

In 2001, the Springhouse sloughs appeared to be much the same as Munro (1958) found them, still surrounded by gently rolling grassland and forested land. Water levels more closely resembled his 1958 descriptions than those of his 1941 visit. The surrounding area, however, has seen considerable change. Virtually all the forested lands to the east of the sloughs were selectively logged in the late 1970s. The regenerating forest is dominated by Douglas-fir with varying amounts of lodgepole pine and trembling aspen. A transmission corridor now runs along the eastern edge of the prairie. Some of the forest adjacent to the grassland has been cleared to provide additional areas for forage crops (Figure 125). To the southwest, the forest has been logged as well, although there are still some older stands principally of Douglas-fir and lodgepole pine. Additional grassland and forage crops lie to the west of the sloughs and Dog Creek Road. At least 2 of the sloughs (4 and 6) are used to irrigate the fields.

Bird survey numbers are given in Table 70. While they are not directly comparable because of the points mentioned above, they do suggest that bird numbers in 2001 were similar to those found in 1958 although the species composition differed; our numbers were about 1.8-times less than numbers Munro reported in the early 1940s. We reported 4 species that Munro (1958) did not report at all on the Springhouse sloughs: Pied-billed Grebe, Canada Goose, Green-winged Teal, and Ring-necked Duck. At least 271 Canada Geese were observed during our May visit to the area, 23 of which were young of the year (Appendix III). Munro reported some Canvasback use of the sloughs which we did not observe. In 2001, numbers were down for most species with the exception of Eared Grebe, Mallard, Cinnamon Teal, and American Coot. Munro reported a number of species with either nests or young; however, time constraints precluded our searching for nests.

Table 71. Some attributes of Springhouse slough 1.

Attributes	Springhouse slough 1 25-May-01
UTM 10	560804 5754006
Elevation (m)	986
pH	8.2
Temperature (ºC)	17
Conductivity (µmhos·cm^{1})	250
Depth (m)	NR[1]
Secchi Disk (m)	NR
Area (ha)	4.4
Perimeter (m)	1087
Emergent marsh area (ha)	3.2
Open water or submergent vegetation area (ha)	1.1
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Power boats allowed	No
Biogeoclimatic Unit	IDF dk3

[1] Not recorded.

Springhouse slough 1

Springhouse slough 1 (Figures 132 and 133) lies just south of Rush Lake. At about 4.4 ha in size, it is the second largest slough on the prairie, depending on the drought conditions. The slough has about a hectare of open water; a band of *Scirpus* grows around its perimeter. There are patches of *Typha* at the south end of the slough. Surrounding the wetland is a wet margin of silverweed, baltic rush, sedge, smartweed and common mare's-tail. Cattle have open access to the slough but none were seen during our visit. Some attributes of the slough can be found in Table 71; Bird use of the slough is given in Table 72.

Figure 133. Springhouse Slough 1 looking southeast, 25 May 2001.

Table 72. Birds observed during breeding waterbird surveys at Springhouse slough 1.

Species[1]	Springhouse slough 1 7-Jun-01
EAGR	5
GWTE-♂[2]	1
MALL-♂	9
MALL-♀	5
MALL-Y[3]	
BWTE-PR	1
BWTE-♂	5
CITE-♂	1
NOSL-♂	2
NOSL-♀	1
GADW-♂	2
AMWI-♂	1
RNDU-♂	4
RNDU-♀	1
LESC-PR	2
LESC-♀	1
BUFF-J♂	1
RUDU-PR	2
AMCO	8
Sub-total	**57**
WIPH-♀	4
TOTALS	**61**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II
[3] Number of young for 1938 is noted by Munro only as "brood"

Table 73. Some attributes of Springhouse sloughs 2 and 3.

Attributes	Springhouse slough 2 25-May-01	Springhouse slough 3 25-May-01
UTM 10	0561165	0561006
	5754035	5753090
Elevation (m)	994	983
pH	9.2	8.6
Temperature (ºC)	20	19.5
Conductivity (µmhos·cm[1])	82	98
Depth (m)	<1	<1
Secchi Disk (m)	NR[1]	NR
Area (ha)	1.3	0.7
Perimeter (m)	668	443
Emergent marsh area (ha)	1.2	0.5
Open water or submergent vegetation area (ha)	0.1	0.1
Fish	No	No
Cattle access	Yes	Yes
Nest boxes present	No	No
DU Project	No	No
Residences near wetland	No	No
Recreation Area near	No	No
Light Industry	No	No
Partially filled	No	No
Boat launch	No	No
Biogeoclimatic Unit	IDF dk3	IDF dk3

[1] Not recorded

Springhouse sloughs 2 & 3

Springhouse sloughs 2 and 3 (Figure 132) are about 350 m northeast of slough 1. Both sloughs held little water by the time of our June visit. Sloughs 2 and 3 are very small (1.3 ha and 0.7 ha, respectively) surrounded completely by rangeland. There was little in the way of emergent vegetation that would provide cover for nesting waterbirds except for small patches of *Scirpus* at the north side of slough 2 and the southwest side of slough 3. These 2 sloughs are likely connected during periods of higher water. Some attributes of the sloughs are given in Table 73; Bird use of the sloughs is given in Table 74.

Table 74. Birds observed during breeding waterbird surveys at Springhouse sloughs 2 and 3: 2001.

Species[1]	Springhouse slough 2 7-Jun-01	Springhouse slough 3 7-Jun-01
CAGO	4	
NOPI-PR		1
Sub-total	**4**	**2**
KILL	2	
WISN	1	
TOTALS	**7**	**2**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 134. The eastern end of Springhouse slough 4 looking southeast, 25 May 2001.

Figure 135. A pair of Sandhill Cranes foraging in the *Carex* meadow at the western end of Springhouse slough 4, 25 May 2001. A male Yellow-headed Blackbird can be seen in the dead *Scirpus* stems just below the cranes. The brownish-coloured vegetation behind the cranes is *Juncus*.

Table 76. Birds observed during breeding waterbird surveys at Springhouse slough 4, 4a and 5.

	Springhouse		
	slough 4	slough 4a	slough 5
Species[1]	7-Jun-01	7-Jun-01	7-Jun-01
EAGR		4	
CAGO	30		
MALL-PR[2]		1	
MALL-♂	1	2	
MALL-♀		1	
GADW-♂			1
LESC-PR	2	1	
LESC-♂	1		
BAGO-♀			2
BUFF-♂			1
RUDU-♀	1		
AMCO	2	1	1
Sub-total	**39**	**12**	**5**
NODA-♀			1
SORA			1
KILL		2	
WISN		2	1
WIPH-PR	1		
WIPH-♂	4		
BLTE	2		
TOTALS	**47**	**16**	**8**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Springhouse sloughs 4 & 4a

Springhouse slough 4 lies about 500 m southeast of slough 2 (Figures 132 and 134) and is separated from the first 3 sloughs by a cattle fence. Slough 4 is the third largest slough on the prairie. Rangeland surrounded the slough. A band of *Scirpus* marsh extended around the perimeter of the open water and grew in toward the centre of the slough in places (Figure 134). This slough is used for irrigation purposes and, based on aerial photographs, the open water, which may exceed an area of 2.5 ha, appears to be reduced considerably later in the year to the point where much of it has been covered by *Scirpus* and perhaps some reed canary grass (see Figure 132). A wet area that surrounds the slough extends approximately 25 metres out from the water's edge. This area supports varying bands of rush and silverweed, then a mix of reed canary grass, spike rush, smartweed, and shore buttercup. A small slough appears to be connected during high water at the south end of slough 4 (designated 4a); it has been combined with slough 4 in the attribute summary given in Table 75. Bird use of the 2 areas is shown in Table 76. A pair of blue-listed Sandhill Cranes was seen foraging here during our May visit (Figure 135).

Table 75. Some attributes of Springhouse sloughs 4, 4a, and 5.

	Springhouse	
	sloughs 4 & 4a	slough 5
Attributes	25-May-01	25-May-01
UTM 10	561537 5753651	561483 5753017
Elevation (m)	972	989
pH	8.3	8.6
Temperature (ºC)	19	19
Conductivity (µmhos·cm^{-1})	580	1200
Depth (m)	NR[1]	NR
Secchi Disk (m)	NR	NR
Area (ha)	3.0	1.1
Perimeter (m)	995	415
Emergent marsh area (ha)	2.7	0.5
Open water or submergent vegetation area (ha)	0.3	0.6
Fish	No	No
Cattle access	Yes	Yes
Nest boxes present	No	No
DU Project	No	No
Residences near wetland	No	No
Recreation Area near	No	No
Light Industry	No	No
Partially filled	No	No
Boat launch	No	No
Biogeoclimatic Unit	IDF dk3	IDF dk3

[1] Not recorded

Springhouse slough 5

Springhouse slough 5 (Figure 132 and 136) is located about 550 m south of slough 4. It is a small (1.1 ha) slough with a band of discontinuous *Scirpus* around the shore, widest along the western edge. Baltic rush grows away from the slough to meet the surrounding grassland. The area was grazed up to the *Scirpus*. Mosquito larvae were abundant in the water. Some attributes of slough 5 are given in Table 75; bird use of the slough is shown in Table 76.

Figure 136. Springhouse sloughs 5 (top) and 6 (bottom), 25 May 2001.

Table 77. Some attributes of Springhouse slough 6.

Attributes	Springhouse slough 6 25-May-01
UTM 10	561400 5752632
Elevation (m)	974
pH	9.1
Temperature (ºC)	20
Conductivity (µmhos·cm[1])	450
Depth (m)	NR[1]
Secchi Disk (m)	NR
Area (ha)	4.5
Perimeter (m)	811
Emergent marsh area (ha)	2.0
Open water or submergent vegetation area (ha)	2.5
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

Table 78. Birds observed during breeding waterbird surveys at Springhouse slough 6.

Species[1]	Springhouse slough 6 7-Jun-01
PBGR	2
EAGR	19
CAGO	1
CAGO-PR	1
CAGO-Y	5
MALL-PR	1
MALL-♂	10
MALL-♀	1
CITE-♂	1
NOSL-♂	2
AMWI-M	3
REDH-PR	1
REDH-♀	2
LESC-PR	6
LESC-♂	6
BUFF-♂	1
RUDU-♂	1
AMCO	9
Sub-total	**81**
TOTALS	**81**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 137. Rush Lake showing some habitat characteristics and surrounding land use. Disc shows location where archival photographs were taken.

Table 79. Some attributes of Rush Lake.

Attributes	Rush Lake 25-May-01
UTM 10	560534 5754729
Elevation (m)	972
pH	8.8
Temperature (ºC)	18.5
Conductivity (µmhos·cm^{-1})	2600
Depth (m)	NR[1]
Secchi Disk (m)	NR
Area (ha)	16.7
Perimeter (m)	2569
Emergent marsh area (ha)	5.6
Open water or submergent vegetation area (ha)	11.1
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

[1] Not Recorded

Springhouse slough 6

Slough 6 (Figures 132 and 136) is the largest of the Springhouse sloughs we surveyed, covering an area of about 4.5 ha. It also held the highest bird numbers of all the Springhouse sloughs. Slough 6 has an extensive area of open water with a wide band of *Scirpus* around the perimeter. There is also a band of *Carex* shoreward of *Scirpus* in some spots. This slough is also used for irrigation purposes. Some attributes of Springhouse slough 6 are given in Table 77; bird use of the slough is given in Table 78.

Rush Lake

Rush Lake (Figures 137 and 138) is located on Springhouse Prairie some 350 m northwest of Springhouse slough 1. Munro (1958) describes the lake in 1941 as

> *approximately 25 acres* [10 ha] *fringed on two sides by roundstem bulrush marsh, the remainder of the shoreline hard clay and boulders. Near centre is an island of bulrush several acres in extent. The marsh on the east side had been eaten down by stock. Invertebrates included amphipods, a large daphnae and abundant insect lar-*

Figure 138. Rush Lake looking northwest, 25 May 2001.

> *vae. Bottom vegetation, restricted to bushy pondweed, is scarce. In addition to being a valuable nesting place this lake was frequented by lesser scaups, chiefly yearlings, and post-breeding ducks of other species which came daily to feed and, if distributed, moved to Boitano Lake and other of the smaller sloughs in the vicinity.*

On 24 June 1958, Munro notes that the water level was

> *higher than formerly and at one place was only 100 yards* [91 m] *or so from an arm of Boitano Lake that had also increased greatly in size. The central isolated bulrush marsh was much thinned out; the shoreline bulrush marsh has spread over a greater area and is in most places separated from the shore by open water.*

During our visits in 2001, Rush Lake appeared much as Munro had described it in 1958, with the exception that the central isolated bulrush marsh was no longer extant. The lake covered an area of about 17 ha and water levels seemed comparable to Munro's 1958 description.

Rush Lake is completely surrounded by rangeland (Figure 130). There is still a varying band of *Scirpus* around the perimeter of the lake ranging from 1 to 2 m in width to over 50 m in width; however, it now grows right up to the shore except at the highest water levels. Some attributes of the lake are given in Table 79.

Comparative bird use of Rush lake is shown in Table 80. Bird numbers in 2001 were similar to those in 1958 but only about half those reported by Munro in 1941. Our visit to this breeding area was about 2 weeks earlier than Munro's visits and many species would not have had young on the water. Some of the difference in numbers between 2001 and 1941 was also due to a decrease diving duck numbers, especially 3 species that we did not record at all (Canvasback, Barrow's Goldeneye, and Bufflehead). Another species we failed to observe, but that Munro reported, was American Wigeon. However, we did record 3 species that Munro (1958) did not note (Canada Goose, Cinnamon Teal, Gadwall). There is a small colony, likely of around 40 Eared Grebes nesting on the lake.

Table 80. Birds observed during breeding waterbird surveys at Rush Lake: 1941, 1958, and 2001.

	Rush Lake		
Species[1]	23-Jun-41	24-Jun-58	7-Jun-01
EAGR			40
EAGR-PR[2]	15	15	
EAGR-N			1
CAGO			2
MALL-♂	35		3
MALL-♀			2
NOPI-♂	3		2
NOPI-♀			1
BWTE	8		
BWTE-PR			1
BWTE-♂		15	
BWTE-♀		1	
BWTE-Y		7	
CITE-♂			1
NOSL	10		
NOSL-♂		8	1
NOSL-♀	1		
NOSL-Y	10		
GADW-PR			1
GADW-♂			4
AMWI	15		
AMWI-♂		70	
AMWI-♀	1	1	
AMWI-Y	8	11	
CANV-PR		1	
CANV-♂	1		
CANV-♀	3		
CANV-Y	24		
REDH		20	
REDH-♂	2		5
LESC-PR	2		4
LESC-♂			44
LESC-J	50		
BAGO	12		
BAGO-♀	2		
BAGO-Y	14		
BUFF	20		
BUFF-♀	2		
BUFF-Y	17		
RUDU	18	1	
RUDU-♂			11
RUDU-♀			3
AMCO	20		28
AMCO-N			**1**
Sub-total	**310**	**166**	**161**
NOHA-♀			1
SORA			1
WIPH-♀			4
KILL			1
WISN			1
TOTALS	**310**	**166**	**169**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 139. Boitano Lake showing the eastern shore looking west across the lake, 20 May 2001.

Figure 140. Boitano Lake showing some habitat characteristics and surrounding land use. Five pairs of Canada Geese nested on the small island at the south end of the lake. Part of Rush lake appears just below and to the right of Boitano Lake. Disc shows location where archival photograph was taken.

Boitano Lake

Boitano Lake (Figure 139 and 140) is a fairly large waterbody covering some 69 ha at the northern end of Springhouse Prairie. The lake is about 1.7 km in length and nearly 0.5 km wide; it is the 7th largest nesting area we surveyed. The turn-off to the lake is roughly 24 km from the start of Dog Creek Road at Williams Lake. Access is another 2.2 km to the eastern side of the lake (Figure 140).

Table 81. Some attributes of Boitano Lake.

Attributes	Boitano Lake 20-May-01
UTM 10	559837 5755717
Elevation (m)	970
pH	9.9
Temperature (ºC)	10.5
Conductivity (µmhos·cm^{-1})	5800
Depth (m)	2.5
Secchi Disk (m)	2.5
Area (ha)	69.1
Perimeter (m)	4539
Emergent marsh area (ha)	T[1]
Open water or submergent vegetation area (ha)	69.1
Fish	No
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	No
Light Industry	Yes
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

[1] Trace

Table 82. Birds observed during breeding waterbird surveys at Boitano Lake: 1941, 1958, and 2001.

Species[1]	Boitano Lake 23-Jun-41	24-Jun-58	7-Jun-01
COLO-PR[2]	1		
RNGR-PR		1	
EAGR			126
CAGO			11
CAGO-PR			4
CAGO-Y			48
GWTE-♀			1
MALL-♀		1	
MALL-Y		5	
NOPI-♀	1	1	
NOPI-N	1		
NOPI-Y		6	
GADW-PR			1
AMWI-PR	1		1
AMWI-♀		1	
AMWI-Y		9	
CANV-♀		1	
CANV-Y		8	
LESC	60		
LESC-PR		10	
LESC-J		20	
BAGO-♂	5	1	1
BAGO-♀	1	3	
BAGO-J♀	20	18	
BAGO-Y	7	25	
BUFF-♂	4	1	3
BUFF-J♀		5	
BUFF-♀	1	1	
BUFF-J	10		
BUFF-Y		6	
BUFF-N	1		
RUDU-PR	1		
Sub-total	**117**	**134**	**202**
SPSA			20
KILL			24
KILL-Y			35
WIPH			3
TOTALS	**117**	**134**	**284**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

In 1941, Munro (1958) described the lake as

> *a "soda lake" with hard, boulder-strewn shores except on portions of the west side where there is a narrow belt of round-stem bulrush that was partly dry in early June. The water is clear and contains numerous phyllopods, and other invertebrates in smaller numbers. There appears to be no bottom vegetation.*
>
> *In June, 1958, this description was still valid; the only difference being an increase in the dimensions of the lake.*

In 2001, as well, Munro's general description of the lake is still valid. Boitano Lake is surrounded by rangeland or agricultural lands. A small community has developed around the lake, and houses occur along much of the eastern and western shores. There is also a small airstrip with upwards of 20 aircraft maintained near the strip.

Along the eastern shore, *Scirpus* occurred in small, scattered patches right to the south end of the lake. At the southeast corner a larger *Scirpus* stand occurred but, on 20 May 2001, it was perched above the existing water level.

Small areas of *Scirpus* marsh grew on the southwestern shore but there it was not very dense and was mostly above the level of the lake. Further north along the western shore a band of *Scirpus* about 5 m in width grew though much of it, too, was above the lake level. The *Scirpus* band extended along the central two-thirds of the western shore, including a bank adjacent to a stand of trembling aspen. We found no submergent vegetation.

A small island at the south end of the lake (Figure 141), composed primarily of boulders and cobble, covered an area of just over 1,000 m^2. On 20 May 2001, we found 5 Canada Goose nests there (Figure 141). One nest had fledged at least 3 young; the remaining 4 nests had 9, 6, 5 (pipping), and 5 eggs respectively. No marsh occurs on the island; the dominant cover is alkali saltgrass.

Some attributes of Boitano lake are given in Table 81; comparative bird use of the lake is given in Table 82.

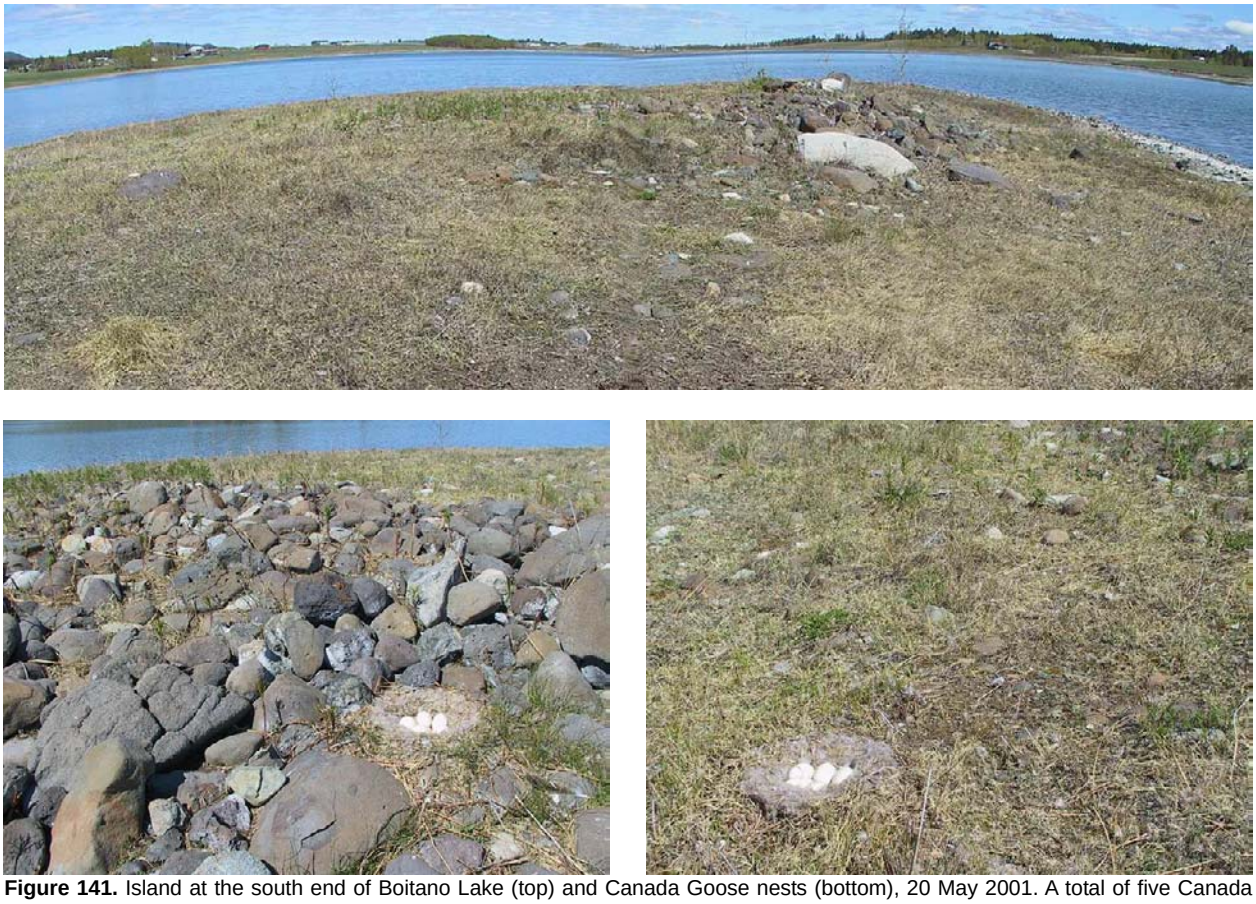

Figure 141. Island at the south end of Boitano Lake (top) and Canada Goose nests (bottom), 20 May 2001. A total of five Canada Goose nests were found on the island.

Figure 142. Killdeer adult (left) and young (right) at Boitano Lake, 7 June 2001. At least 24 pairs of Killdeer were recorded around the lake.

There was a significant change in the bird use of Boitano Lake since Munro's (1958) study. Numbers of birds were up at least 1.5 times in 2001 and waterbird diversity was about the same; however, species composition and numbers were radically different. The earlier surveys had more (4 species versus 2 species) and higher numbers of diving ducks than we found in 2001. The larger numbers on the lake during our surveys were attributable to 2 species, Eared Grebe and Canada Goose, which Munro (1958) did not report at all. We recorded but 4 individual diving ducks on the lake during a complete canoe trip around the lake perimeter.

The large numbers of Eared Grebes using the lake may have been late migrants or possibly birds from Westwick or Rush lakes. They certainly were not breeding on Boitano Lake as suitable habitat was lacking.

Some of the difference in numbers may also be explained by Munro's surveys being about 2-weeks later than our surveys. He did get a significant number of broods in 1958 while, of the waterbirds, only Canada Geese were found nesting on the lake during our visit.

In 2001, Boitano Lake supported fairly large populations of Killdeer (Figure 142). We found 12 broods around the lake shore (2 young - 3; 3 young - 7; 4 young - 2). Large numbers of Spotted Sandpipers were also observed.

Westwick Lakes (east)

Westwick Lakes (east) lies about 4 km north of Boitano Lake on the east side of Dog Creek Road. The main water body is about 1.7 km in length and 240 m wide. Near the north end of the lake it constricts into an area of *Scirpus* marsh approximately 200 m long by at least 50 m wide. It opens up again further to the north to an area of about 450 m by 160 m. The entire lake covers an area of about 52 ha. In 1938, Munro (1958) noted that the lake had

> *boggy shores on the west side supporting a nearly continuous, narrow belt of round-stem bulrush and several stands of three-square bulrush* Scirpus robustus. *At the south end this growth broadens into a marsh of about 20 acres* [8 ha]. *The east shore is mostly rocky*

Figure 143. The eastern third of Westwick Lakes (east), 20 May 2001. Two colonial nesting species, the Eared Grebe and the Yellow-headed Blackbird were found nesting in the *Scirpus* marsh at the southeast end of the lake.

Figure 144. Westwick Lakes (east) showing some habitat characteristics and surrounding land use. Discs show locations where archival photographs were taken.

> *without emergent growth. Near the northern end the waters are constricted to a width of thirty-yards* {27 m] *or so forming a channel that in midsummer may dry out and isolate the upper one-fifth of the lake. The lake is rich in submerged aquatics of which sago pondweed and bushy pondweed are dominants. Amphipods, molluscs and aquatic insect nymphs and larvae are abundant.*
>
> *In some seasons, e.g., 1938, filamentous algae blankets the shoreline to a width of thirty yards* [27 m] *in places, completely covers the channel referred to above and penetrates the bulrush marshes and the beds of submerged aquatics. Under these conditions, the waterfowl population is below normal.*
>
> *Water level was high in 1958 and there was little filamentous algae, otherwise the above description applies. Bulrush marshes had deep foundations of debris and were in the best condition for nesting waterfowl.*

Westwick Lakes (east) appeared to be much as it was during Munro's (1958) visits with the exception of lower water levels. There is still a continuous *Scirpus* band along the western shore of the lake and this band now extends along the eastern shore that Munro describes as lacking emergent growth. The perimeter *Scirpus* marsh ranges from 1 m to over 30 m wide. There are 2 areas where the *Scirpus* marsh is more extensive, one where the lake constricts near its northern end and one at the south end of the lake. Part of this wetland is now an Ecological Reserve.

The lake has an organic bottom. It is surrounded mainly by rangeland which is backed by forested lands. To the east of the rangeland, mixed lodgepole pine, Douglas-fir, trembling aspen forest

Figure 145. Browsed *Scirpus* marsh along the east shore of Westwick Lakes (east), 19 June 2001. Note the thick, filamentous algal growth in the lower left of the image.

Figure 146. Extensive *Scirpus* marsh at the south end of Westwick Lakes (east), 19 June 2001. The small dock in the centre of the photo was built over 20 years ago when the water levels of the lake were much higher and the large area of *Scirpus* marsh beyond the dock did not exist.

occurs (between 81 and 120 yr with a crown closure of 56 to 65% and a site index of between 14 and 17).

The northwestern third of the lake is bounded by Dog Creek Road and forested lands to the west, dominated by older Douglas-fir forest with varying amounts of lodgepole pine and trembling aspen. Between the lake and road, narrow forested strips with older trembling aspen trees occur.

Sago pondweed, which we found throughout much of the open water area, is still the dominant submergent; water-milfoil was also noted. During our 19 June visit, filamentous algae blanketed much of the open area of the lake immediately south of the constriction (Figure 145). It was extremely difficult to paddle through this algal mat and was very heavy and hard to lift a paddle-full out of the water. It is unlikely that ducklings, or even adult ducks for that matter, would be able to surface for air, if they came up under these extensive algal areas.

There are no residences directly along the lake although farmhouses and buildings lie just across from the north end of the lake and Springhouse Trails Ranch lies near the south end of the lake. Livestock were not seen, although they obviously have access to the marsh (Figure 145).

Apparently, the water levels of Westwick Lakes (east) have been dropping every year for the past few years (S. Moessner, pers. comm.). When the Moessners acquired Springhouse Trails Ranch, they built a small dock into the lake the remains of which is now well back from the open water area of the lake (Figure 146). An "island" of *Scirpus* just out from the dock was not there when they came to the area. Susan Moessner (pers. comm.) believes it is a

Table 83. Some attributes of Westwick Lakes (east).

Attributes	Westwick Lakes (east) 20-May-01
UTM 10	558200 5760117
Elevation (m)	902
pH	9.1
Temperature (ºC)	12
Conductivity (μmhos·cm^{-1})	2000
Depth (m)	1.3[1]
Secchi Disk (m)	1.3
Area (ha)	52.2
Perimeter (m)	5310
Emergent marsh area (ha)	13.7
Open water or submergent vegetation area (ha)	38.5
Fish	No
Cattle access	Yes
Nest boxes present	Yes
DU Project	No
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

[1] Depth taken at the north end of the lake; depths of 2.7 m have been reported from the lake (BC Fisheries 2002)

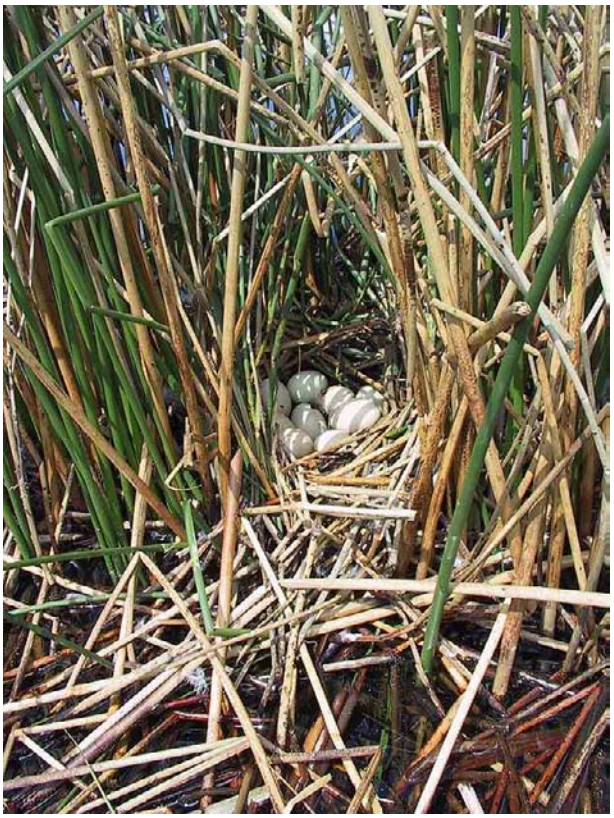

Figure 147. Redhead nest at Westwick Lakes (east), 19 June 2001.

Table 84. Birds observed during breeding waterbird surveys at Westwick Lakes (east): 1938, 1958, and 2001.

Species[1]	Westwick Lakes (east) 9-Jul-38	9-Jul-58	19-Jun-01
RNGR-PR[2]		1	
RNGR-Y		3	
EAGR			340
EAGR-PR	60	65	
CAGO			24
CAGO-Y			35
GWTE-♂		4	
MALL			3
MALL-♂		21	2
MALL-♀	1	3	
MALL-Y	5	21	
NOPI-♂	8	7	
NOPI-♀	2	1	
NPOI-Y[3]	?		
BWTE			10
BWTE-PR			2
BWTE-♂		10	
CITE			6
NOSL			8
GADW			10
GADW-PR			5
GADW-♂			1
AMWI-♂			2
CANV-♀	1		1
CANV-Y	7		
REDH-PR			3
REDH-♂			1
REDH-♀		4	
REDH-N			3
REDH-Y		13	
LESC-PR	1		17
LESC-♂	4		10
LESC-♀		2	
WWSC-♂			1
COGO-♀			2
BAGO-♀	4	8	9
BAGO-J♀	13	5	
BAGO-Y	32	81	16
BUFF-♂			2
BUFF-J♀	14		
BUFF-♀			2
BUFF-Y			4
RUDU-PR			8
RUDU-♂	8	3	9
RUDU-J♂			
RUDU-♀	1	2	2
RUDU-N			1
AMCO	20	24	194
AMCO-Y	30	73	23
AMCO-N			20
Sub-total	**272**	**417**	**811**
SORA			1
WIPH-♀			3
KILL			2
BLTE			12
TOTALS	**272**	**417**	**829**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II
[3] Number of young for 1938 is noted by Munro only as "broods"

combination of the recent dry seasons and irrigation use of the lake.

Some attributes of Westwick Lakes (east) are given in Table 83; Comparative bird use of the lake is shown in Table 84.

Bird numbers using Westwick Lakes (East) were over 2.9 times higher in 2001 than in 1938 and 1.9-times higher than in 1958. Nearly every species had higher numbers but especially Eared Grebes, up 2.5-times from the earlier surveys, Lesser Scaup (up at least 7-fold), Ruddy Duck (up at least 3-fold) and American Coot (up at least 2-fold). While Munro (1958) recorded 3 species that we did not observe (Red-necked Grebe, Green-winged Teal, Northern Pintail), we noted 7 species that Munro failed to report (Canada Goose, Cinnamon Teal, Northern Shoveler, Gadwall, American Wigeon, White-winged Scoter, Common Goldeneye).

In 2001, 7 breeding species were documented including Eared Grebe, Canada Goose, Barrow's Goldeneye, Redhead (Figure 147), Bufflehead, Ruddy Duck, and American Coot (Figure 148).

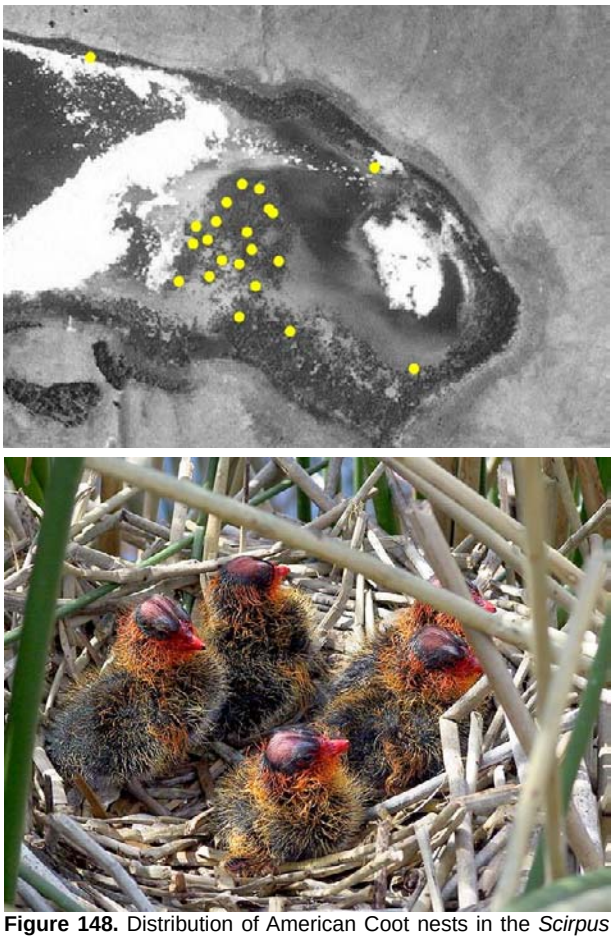

Figure 148. Distribution of American Coot nests in the *Scirpus* marsh at the south end of Westwick Lake (top) and coot chicks ready to leave the nest (bottom), Westwick Lake, 19 June 2001.

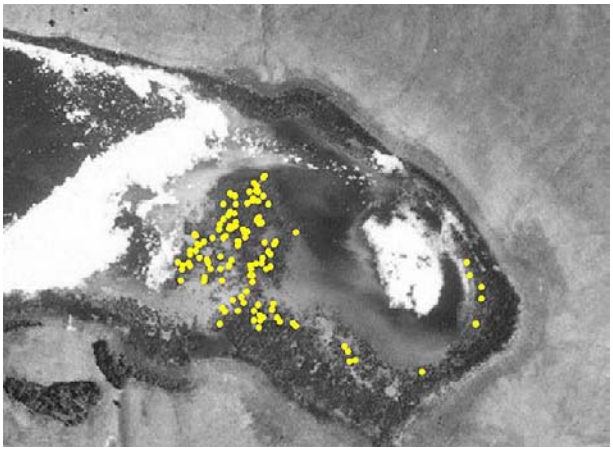

Figure 149. Distribution of Yellow-headed Blackbird nests in the *Scirpus* marsh at the south end of Westwick Lakes (East), 19 June 2001.

Eared Grebes seemed to be nesting late at the lake. While we found a number of platforms, they were not substantial and may have just been copulatory platforms. We did find one whole egg and some egg shells in the water beneath one platform which suggests the possibility that the colony may have suffered some sort of catastrophe and the birds were in the midst of rebuilding.

Yellow-headed Blackbirds were also documented as a breeding species on the lake; we mapped the nests in the colony at the south end of the lake (Figure 149).

Westwick Lakes (west)

Westwick Lakes (west)—Sorenson Lake in the Munro (1958) report—lies just north of Dog Creek Road across from the north end of Westwick Lakes (east) (Figures 150 and 151) Originally, both lakes were connected (Munro 1958). It is a smaller water body than its eastern counterpart, covering an area of about 18 ha; it is roughly 1.3 km long and 200 m wide.

Munro (1958) notes that the ecological features of Sorenson Lake are

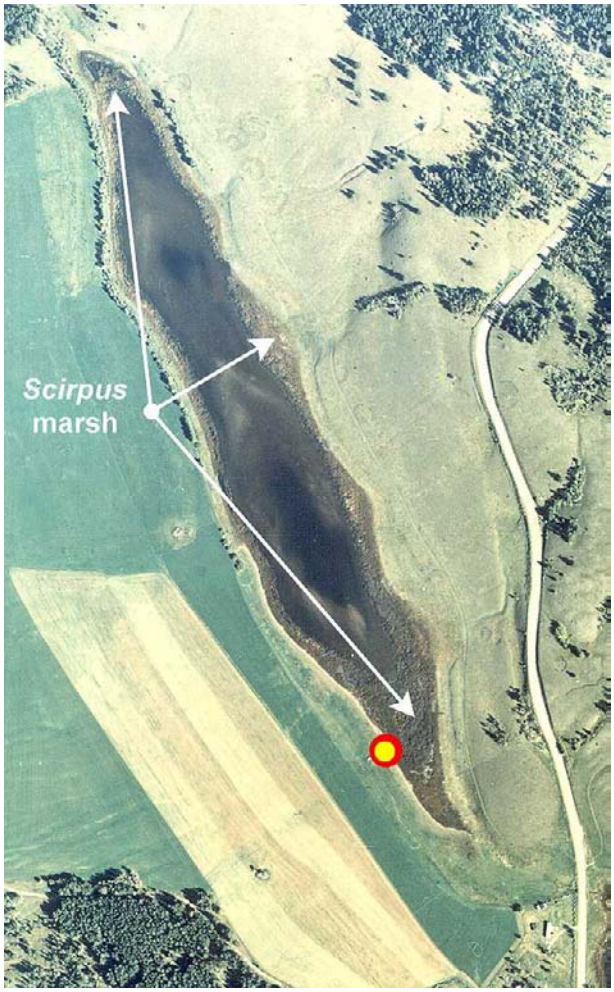

Figure 151. Westwick Lakes (west) showing some habitat characteristics and surrounding land use. Disc shows location where archival photographs were taken.

different in some respects from the larger body of water. It extends ... along a narrow valley bottom and is surrounded by sloping pasture and hayland on one side and by cultivated slopes on the other.

The entire area is surrounded by a vigorous growth of round-stem bulrush; at the south end the two shoreline belts converge and form a marsh several acres in

Figure 150. Westwick Lakes (West) from the west shore looking northeast, 19 May 2001. Note the extensive *Scirpus* marsh along the lake perimeter.

Table 85. Some attributes of Westwick Lakes (west).

Attributes	Westwick Lakes (west) 19-May-01
UTM 10	556760
	5761419
Elevation (m)	902
pH	NR[1]
Temperature (ºC)	NR
Conductivity (µmhos·cm[1])	NR
Depth (m)	NR
Secchi Disk (m)	NR
Area (ha)	18.1
Perimeter (m)	2926
Emergent marsh area (ha)	6.5
Open water or submergent vegetation area (ha)	11.6
Fish	Yes (stocked 1968)
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

[1] Not recorded

extent. The dominant bottom vegetation is sago pondweed; water milfoil is second in importance. Filamentous algae is much less in evidence here than it is on Westwick Lake.

In 2001, little in the way of change had occurred to Westwick Lakes (west) when compared with Munro's (1958) description taken from his earlier visits.

There is an irrigation pumphouse on the southwest shore and the fields to the west were being irrigated during our visit.

A thick *Scirpus* marsh still grows around the entire perimeter of the lake; it is fenced off to prevent cattle or other livestock access to the forage crops at least along its western shore. This also ensures the integrity of the *Scirpus* marsh along the lakeshore which is beneficial to nesting waterbirds.

Unfortunately, circumstances prevented us from paddling the perimeter of this lake so we were unable to search for nests. This lake was stocked in 1968 and 1970 with brook trout (BC Fisheries 2002).

Some attributes of Westwick Lakes (west) are given in Table 85; bird use of the lake is shown in Table 86.

In 2001, bird numbers were about the same as those Munro (1958) found in 1938; however, they were up 3-fold from Munro's counts in 1958. Munro reported 4 species that we did not see on the breeding area (Green-winged Teal, Northern Pintail, Ring-necked Duck, Barrow's Goldeneye) while we reported one species, Gadwall, that Munro did not record.

Table 86. Birds observed during breeding waterbird surveys at Westwick Lakes (West): 1938, 1958, and 2001.

Species[1]	Westwick Lakes (west) 9-Jul-38	9-Jul-58	19-Jun-01
EAGR		1	16
EAGR-PR[2]	45		
GWTE-♂	1		
GWTE-♀	3		
GWTE-Y[3]	?		
MALL			10
MALL-♂	5		3
MALL-♀	3		
NOPI-♂	1		
NOPI-♀	3	2	
NOPI-Y[3]	?	16	
BWTE-♂	7		1
BWTE-♀	6		
NOSL-PR			1
NOSL-♂	6	3	1
GADW			41
GADW-PR			74
GADW-♂			5
AMWI			24
AMWI-PR			3
AMWI-♂	71		6
AMWI-♀	3	4	
AMWI-Y		17	
CANV-♂	10	2	
CANV-♀	13	1	1
CANV-Y	46		
REDH-PR			9
REDH-♂			10
REDH-♀			1
REDH-N	1		
RNDU-♂	1		
LESC-PR			7
LESC-♂			6
LESC-♀		1	
LESC-Y		8	
BAGO-♂	10		
BAGO-♀	5	4	
BAGO-J♀	13		
BAGO-J		8	
BAGO-Y	31	26	
BUFF-PR		1	
BUFF-♂		5	
BUFF-♀	4		1
BUFF-J	30		
RUDU			8
RUDU-PR			11
RUDU-♂	10		10
AMCO	8	16	60
AMCO-Y	28	19	1
Sub-total	**409**	**135**	**415**
SORA			1
TOTALS	**409**	**135**	**416**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II
[3] Number of young for 1938 is noted by Munro only as "hidden brood"

Gadwall numbers made up nearly half the bird population on the lake in 2001. For those species reported on all 3 surveys, most bird numbers , e.g., Redhead, Lesser Scaup, Ruddy Duck, and American Coot, were higher in 2001 than in the earlier years. Numbers for 3 species, American Wigeon, Canvasback, and Bufflehead, were down considerably.

Figure 152. Jones Lake showing some habitat characteristics and surrounding land use. Disc shows location where archival photographs were taken.

Jones Lake

The access road to Jones Lake is about 2.5 km south of 150 Mile House (500 m south of the large Mission slough beside Highway 97). The road runs east off the Highway 97 another 2.7 km to the lake access.

Jones Lake (Figure 152) is about 500 m by 425 m excluding 3 narrow arms at the north and west sides. The breeding area covers about 65 ha, which includes the adjoining *Carex* meadows.

In 1942, Munro (1958) described the lake as shallow

> *with marl bottom completely encircled by cattail marsh ... in surroundings of parkland-forest and grassland draining through Jones Creek to the San Jose River. The outlet is dammed to retain water for irrigation and above the dam the creek winds through a marshy meadow of twenty acres* [8 ha] *or so. Cover plants in the marsh include cattail, round-stem bulrush* Scirpus acutus *and* S. validus, *three square bulrush* Scirpus americanus *and* S. paludosus*; river grass, burreed* Sparganium simplex *and various sedges including* Carex atherodes *and* C. rostrata. *The bottom vegetation in the creek and in the lake is dominated by muskgrass, widgeon grass, hornwort, water milfoil, and water buttercup. Water smartweed covers parts of the surface. The waters are rich in animal life including kamloops trout, molluscs, lake shiners, amphipods and aquatic insect nymphs and larvae.*
>
> *In 1958 the above description applies in every particular.*

Much of Munro's description still applies today. For example, *Typha* still encircles the lake edge in a relatively narrow band ranging from 1-3 m wide (occasional stretches reach a greater width). Behind the *Typha* is a wider band of *Carex* (Figure 153) that ranges from 5 m to over 70 m in width. Scattered around the lake behind the *Typha*, small patches Scirpus also occur. A narrow band of reed canary grass grows between the *Carex* and riparian trees and shrubs. At the northwestern and southeastern ends of the lake, the reed canary grass covers fairly extensive areas, some of which are cut for hay each year (Figure 152). We did not walk these meadows to determine their other constituents. The riparian band that occurs around much of the north side of the lake includes trembling aspen, red osier dogwood, willow spp., saskatoon and lone conifers.

Figure 153. Jones Lake from the north shore looking southwest, 18 June 2001. *Typha* marsh occurs furthest into the lake backed by a wider band of *Carex* that extends around the lake perimeter.

Further to the north, a mixture of open grassland and scattered copses of Douglas-fir and trembling aspen dot the landscape. Two residences are situated along this side of the lake.

South of the lake, older, mixed forest, dominated by the fir and aspen backs the breeding area (between 101 and 250 yr with a crown closure of 36 to 55%; site index 18).

Submergent vegetation includes extensive areas of water-milfoil with lesser amounts of bladderwort, widgeon grass, and duckweed. Submergents, especially the milfoil, extend from shore in thick beds for a considerable distance into the lake. By 18 June 2001, the water levels had dropped noticeably since our 22 May visit.

Some attributes of Jones Lake are given in Table 87; comparative bird use of the lake is shown in Table 88.

Bird numbers at Jones Lake in 2001 were down from Munro's 1942 survey but up from his 1958 work. We recorded 5 species that were not seen by Munro (Green-winged Teal, Blue-winged Teal, Cinnamon Teal, Gadwall, Ring-necked Duck) while Munro (1958) noted 4 species that we did not observe (Pied-billed Grebe, American Wigeon, Canvasback, Ruddy Duck).

This appears to be a suitable loon lake, complete with fish; however, a survey of the shoreline both in May and June did not reveal any nests, although a pair was on the lake during our May visit and a pair flew in and landed on the lake on our June visit. It is possible we missed a nest; however, it could also be that the thick submergent beds deter loons from nesting. It would be difficult for a bird to slip off the nest and make its way underwater to the open areas of the lake through the mass of submergent vegetation near the shore. This dense vegetation may also have negatively influenced coot and diving duck numbers.

The only waterbird nests we found were those of the Red-necked Grebe out from the shore (Figure 155), although many of the species we observed were likely nesting in the area. A pair of Bald Eagles also nested here (Figure 154).

Table 87. Some attributes of Jones Lake.

Attributes	Jones Lake 22-May-01
UTM 10	576217 5770371
Elevation (m)	735
pH	9.0
Temperature (ºC)	17.5
Conductivity (µmhos·cm^{-1})	250
Depth (m)	1.6
Secchi Disk (m)	1.2
Area (ha)	64.7
Perimeter (m)	6530
Emergent marsh area (ha)	2.2
Open water or submergent vegetation area (ha)	25.0
Fish	Yes (stocked 1926)
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	Yes
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	Yes
Biogeoclimatic Unit	IDF dk3

Table 88. Birds observed during breeding waterbird surveys at Jones Lake: 1938, 1958, and 2001.

	Jones Lake		
Species[1]	29-Jun-42	7-Jul-58	18-Jun-01
COLO			2
COLO-PR[2]	1		
COLO-Y	2		
PBGR-PR	1		
PBGR-Y[3]	?		
RNGR			4
RNGR-PR	3	3	
RNGR-N		2	3
RNGR-Y	4	3	
GWTE-♂			2
MALL-♂	2		3
MALL-♀		1	2
MALL-Y		16	
BWTE-PR			1
BWTE-♂			4
CITE-♂			1
GADW-PR			1
AMWI-♀		1	
AMWI-Y		3	
CANV-♀	3		
CANV-Y	21		
RNDU-♂			2
LESC-PR	10		1
LESC-Y		7	
RUDU-♂	7		
RUDU-J♂	5		
AMCO			3
AMCO-PR	10		
Sub-total	**84**	**39**	**32**
BAEA			2
BAEA-Y			1
SORA			10
BLTE			2
TOTALS	**84**	**39**	**47**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II
[3] Number of young for 1942 is noted by Munro only as "young"

Figure 154. A pair of Bald Eagles beside their Jones Lake nest site, 18 June 2001. The nest contained one young.

Figure 155. John Cooper (top) photographing a Red-necked Grebe nest, 18 June 2001. Close-up of Red-necked Grebe nest (middle) and eggs (bottom). The nest was composed almost entirely of water-milfoil.

Figure 156. Cummings Lake (left) and Mission Sloughs (right) showing some habitat characteristics and surrounding land use. Numbers on the Mission Ponds indicate the following: 1) Munro's 149 Mile Lake, 2) small slough that was connected to slough 3, and 3) Munro's Slough 1/4 mile west of 149 Mile Lake. Discs show locations where archival photographs were taken; photos were also taken from the island.

Cummings Lake

Cummings Lake (Figures 156 and 157) is located about 430 m west of the Mission Ponds at their nearest point. However, direct access is difficult and must be attained from Mission Road which leaves Highway 97 about 2.5 km south of Mission Ponds (2 km south of the Jones Lake turn-off). The turn-off to Cummings Lake is along Mission Road, about 5.4 km west of the highway and the lake is a further 2 km across rangeland to the northeast. Cummings Lake is about 1.3 km long by nearly 500 m wide at its wid-

Figure 157. Cummings Lake and the small island from the south side of the lake looking northeast, 12 June 2001.

Table 89. Some attributes of Cummings Lake.

Attributes	Cummings Lake 12-Jun-01
UTM 10	571653 5771147
Elevation (m)	672
pH	9.5
Temperature (ºC)	16
Conductivity (µmhos·cm^{-1})	780
Depth (m)	15
Secchi Disk (m)	5.6
Area (ha)	47.0
Perimeter (m)	4287
Emergent marsh area (ha)	TR[1]
Open water or submergent vegetation area (ha)	47.0
Fish	?
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

[1] Trace

Figure 158. Cummings Lake looking towards the mixed forest on the south shore, 12 June 2001. This photograph was taken from the small island in the lake.

est point and covers an area of about 47 ha. There is a small (1435 m^2) island in the lake (Figures 156, 157, and 158).

Munro (1958) notes that

> *On the south side thick forest growth reaches the lake shore and here are many Douglas fir stubs standing both in the water and on land above the high water mark. These would seem to have been killed many years ago and now, barked and partly hollow, they serve as nesting places for various birds. Along the north side is open, hilly prairie and narrow channels have made islands of three small grassy hills on which grow some brush and aspen. There are several small, round-stem bulrush marshes, where the plants are tall and vigorous. The waters contain a dense bottom flora, including musk grass, sago pondweed, water milfoil* Myriophyllum exalbescens *and hornwort; in late summer, enormous numbers of a cladoceran* Daphnia magna *darken the water.*
>
> *On June 9, 1941, the bulrush cover, both old and new, had been eaten off by stock, except on a small area at the east end of the lake. On June 16, 1958, this cover was in good condition as was the vegetation on the dry, lakeside slopes. The water level was at normal height. The only visible modification of habitat was in the forested hillside on the south side which logging operations have devastated.*

In 2001, the water levels appeared to be higher than those during Munro's (1958) visits. A number of dead stubs were still standing in the lake and some of the fencing into the lake was under or near the surface of the water.

These higher water levels likely eliminated much of the emergent vegetation; almost no emergents were noted. A narrow band of *Juncus* occurred by the lake edge in some spots and 2 small clusters of *Typha* were noted. Large amounts of Sago pondweed were also found.

Table 90. Birds observed during breeding waterbird surveys at Cummings Lake: 1941, 1958, and 2001.

	Cummings Lake		
Species[1]	9-Jun-41	16-Jun-58	12-Jun-01
COLO			1
HOGR-PR[2]		1	
EAGR			18
EAGR-PR	2	1	
CAGO			5
WODU-♂			1
GWTE-♂		2	3
GWTE-♀		1	
MALL-PR			2
MALL-♂	3		20
MALL-♀	1		3
MALL-Y	8		7
BWTE-PR			2
GADW-PR			5
GADW-♂			1
AMWI			30
AMWI-PR	11		4
AMWI-♂		1	2
CANV-♀	1	2	
CANV-Y	8	16	
REDH-PR	4	3	
REDH-♂		2	
LESC			45
LESC-♂	16	20	
LESC-♀	5	12	
SUSC-♂			1
COGO-U			1
COGO-PR			1
COGO-♀			4
COGO-Y			3
BAGO			18
BAGO-PR			2
BAGO-♀	1	3	9
BAGO-J♀		8	
BAGO-Y	5	21	
BUFF-PR	2		
BUFF-♂			13
BUFF-♀	1		6
BUFF-Y	12		
RUDU	12	9	
RUDU-♂			6
AMCO	15	23	
Sub-total	**126**	**130**	**229**
SPSA			15
TOTALS	**126**	**130**	**244**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 159. John Cooper and Suzanne Beauchesne checking for nests on a small island in Cummings Lake; the northern shore is in the background, 12 June 2001.

The south side of the lake is now open forest dominated by Douglas-fir with some trembling aspen and juniper (Figure 158).

On the north side of the lake (Figure 159), rangeland occurs down to the lake shore; it appeared to be in fair condition. Cattle were present and have access to lake. They may occasionally swim or wade during periods of low water out to the small island or, if there is winter grazing, access the island over the frozen lake. There, they have essentially ruined the island vegetation, making it a low quality site for nesting waterfowl. We did find 3 unsuccessful Canada Goose nests that had been preyed upon, likely by coyotes. Much of the island was covered with prickly-pear cactus, small shrubs and a few small trees (Figure 159). The south end of the island was sparsely vegetated (Figure 158).

An irrigation pumphouse was in operation at the west end of the lake during our visit.

Some attributes of Cummings Lake are given in Table 89; Bird use of the lake is shown in Table 90. On 12 June, we noted 9 painted turtles mainly along the south shore of the lake.

Bird numbers in 2001 were nearly double those of the earlier years (Table 90). Munro (1958) found 4 species on the lake that we did not record: Horned Grebe, Canvasback, Redhead, and American Coot. The almost nonexistent emergent marshes around the lake likely had played a significant role in the absence of these birds from the lake.

On the other hand, we recorded 7 species that Munro did not report: Common Loon, Canada Goose, Wood Duck, Blue-winged Teal, Gadwall, Surf Scoter, and Common Goldeneye.

Birds we documented nesting on the lake included Mallard, Common Goldeneye and an unsuccessful attempt by Canada Geese as noted above.

Mission Ponds slough 1 (149 Mile Lake)

The Mission Ponds (*149 Mile Lake* and *slough 1/4 mile west of 149 Mile Lake* in Munro 1958) are located alongside Highway 97, about 2 km south of 150 Mile House. They consist of about 13 ponds and sloughs lying between the highway and Cummings Lake to the west (Figures 156, 160 and 161). Munro notes that the largest of these (149 Mile Lake)

> *was separated by a low stony ridge into two sections, the smaller encircled by a continuous belt of round-stem bulrush that was present also in isolated clumps on the larger section which has a generally open and boulder-strewn shore. In June of* [1942] *horses had eaten off the round-stem bulrush to water level for a maximum distance of 50 feet from shore; the surrounding dry slopes also had been denuded of vegetation and the eggs of four duck nests thus made vulnerable had been eaten by crows. The only remaining nesting cover comprised the isolated round-stem bulrush clumps growing in water too deep for stock to reach.*

Figure 160. Mission Ponds, Slough-1 (149 Mile Lake) looking southwest from edge of Cariboo Highway, 22 May 2001.

Figure 161. John Cooper and Suzanne Beauchesne counting waterbirds at Mission Ponds, slough 1 (149 Mile Lake), 13 June 2001. The image is looking towards the northwest.

Table 91. Some attributes of Mission Ponds, slough 1 (149 Mile Lake).

Attributes	Mission Ponds slough 1 22-May-01
UTM 10	573711
	5771390
Elevation (m)	698
pH	10.0
Temperature (ºC)	24.5
Conductivity	460
Depth (m)	NR[1]
Secchi Disk (m)	NR
Area (ha)	13.5
Perimeter (m)	3093
Emergent marsh area (ha)	Tr[2]
Open water or submergent vegetation area (ha)	13.5
Fish	?
Cattle access	Yes
Nest boxes present	Yes
DU Project	Yes
Residences near wetland	No
Recreation Area near	No
Light Industry	No
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

[1] Not recorded
[2] Trace

Table 92. Birds observed during breeding waterbird surveys at Mission Ponds, slough 1 (149 Mile Lake): 1941, 1958, and 2001.

Species[1]	Mission Ponds slough 1 12-Jun-42	12-Jun-58	13-Jun-01
COLO		1	
HOGR-PR		1	
EAGR			3
EAGR-PR	3	1	
CAGO			18
CAGO-Y			14
GWTE-PR	2		1
GWTE-♂	1		7
GWTE-♀			2
MALL-PR	1		
MALL-♂	2		5
MALL-♀			8
MALL-Y			32
NOPI			
BWTE-PR	2	3	2
BWTE-♂	4		7
CITE-PR	2		
NOSL-PR	3		
NOSL-♂	9		
NOSL-N	1		
GADW-PR			2
GADW-♀			1
AMWI-PR	1	3	
AMWI-♂			7
AMWI-♀			2
AMWI-Y		7	
CANV-♀	3		
CANV-Y	21		
REDH-PR		1	2
REDH-♂	3	2	2
REDH-♀		3	
REDH-Y		16	
RNDU-♂			2
LESC-J	20		
BAGO-♂		4	
BAGO-♀	2		3
BAGO-J♀		4	
BUFF-PR		1	1
BUFF-♂	1	1	6
BUFF-J♀		4	
BUFF-♀	2		4
RUDU-PR			1
RUDU-♂	7	3	4
RUDU-♀	5	2	2
AMCO	34	8	21
AMCO-N			3
AMCO-Y	11		
Sub-total	**154**	**75**	**171**
WIPH-♀			1
KILL			2
TOTALS	**154**	**75**	**174**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Nevertheless a duck population continued to occupy the lake which is rich in aquatic flora and its associated invertebrates.

In June, 1958, conditions were quite different. High water had extended the water acreage into all the swales leading to it but had increased the depth only slightly though sufficient to submerge most of the low intervening ridge. An adjacent slough, encircled by three-square bulrush Scirpus paludosus, *is now joined to the lake. Round-stem bulrush was in vigorous growth through the old debris that is an essential component in this type of nesting cover. The surrounding range was heavily grassed. The present owner told me he used this pasture for early grazing only, so these favourable conditions are likely to continue. The duck species which nest in this type of cover were less common in 1958 than they were in 1942.*

Figure 162. Some nesting birds of the Mission Ponds, 13 June 2001. Clockwise from lower left: Ruddy Duck nest and eggs; Killdeer nest and eggs; Pied-billed Grebe nest and eggs; hen Bufflehead with brood of 6-young; and Clay-colored Sparrow nest with 4-sparrow eggs and a Brown-headed Cowbird egg.

Today this lake is about 770 m long by over 340 m at its widest point; it covers an area of about 13 ha.

In 2001, water levels of "149 Mile Lake" were likely higher than they were in 1958. There was little in the way of marsh species present except for small amounts of *Scirpus* edging the lake and occasional patches scattered around the perimeter. *Scirpus* was also noted around the perimeter of the pond that forms the southern end of the wetland. In some areas, *Carex* marsh grew along the lake edge, much of which had been browsed by cattle. A significant amount of algae was evident.

The lake is bounded on the east by Highway 97 and is surrounded by rolling grasslands with scattered Douglas-fir and trembling aspen. Patches of rose and snowberry shrubs also occurred in depressions.

Some attributes of Mission Ponds slough 1 are given in Table 91. Bird use of the lake is shown in Table 92. We noted 2 painted turtles at this lake on 22 May.

Bird numbers in 2001 were slightly higher than those of 1942 and over twice Munro's 1958 numbers. We found 3 species that were not reported by Munro (1958) including Canada Goose, Gadwall, and Ring-necked Duck. Munro, on the other hand, reported 6 species that we failed to note on the breeding area: Common Loon, Horned Grebe, Cinnamon Teal, Northern Shoveler, Canvasback, and Lesser Scaup. The latter 4 species were recorded by Munro in 1942 when there was substantially more *Scirpus* marsh, which may account for their absence in 2001.

We documented 3 species nesting at this site, including Canada Goose, Mallard, and American Coot, compared with Munro's 5 species: Northern Shoveler, American Wigeon, Canvasback, Redhead, and American Coot. We also found Killdeer, Clay-coloured Sparrow, and Brown-headed Cowbird (Figure 162) nesting in the area in 2001.

Figure 163. Mission Ponds slough 2 looking towards the south-east, 13 June 2001.

Mission Ponds slough 2 and slough 3 (slough west of 149 Mile Lake)

Mission Ponds slough 2 lies some 115 m southeast of the slough 3 (Figures 156 and 163). We are not certain if this is the "small pond" that Munro (1958) mentions but we rather doubt it. Nevertheless, we have included it separately for future comparisons.

Slough 2 is connected to slough 3 (Munro's "slough west of 149 Mile Lake") by a *Typha* marsh that has grown up as a result of the higher water levels through the constricted connector between the 2 water bodies (Figures 156 and 164). Slough 2 is about 257 m by 125 m and covers an area of approximately 2.9 ha.

There is a band of varying widths of *Scirpus* around this wetland with areas of *Typha* marsh at the south end of the slough in a small bay. Water-milfoil, floating-leaved pondweed, and algae were also noted in this slough.

Some attributes of Mission Ponds: slough 2 and slough 3 are given in Table 93. Bird use of slough 2 is shown in Table 94 and of slough 3 in Table 95.

Munro's visits to slough 3 were about one month later than our surveys, which likely accounts for the 6 species with broods (40 young in 1939 and 18 young in 1958) that Munro reported. Despite our failing to record any young, we still reported a few more birds than did Munro in 1939 and nearly 5-times as many as he did in 1958.

Figure 164. The north end of Mission Ponds slough 2 and the *Typha* marsh that connects to Slough 3, 22 May 2001.

Table 93. Some attributes of Mission Ponds, sloughs 2 and 3.

	Mission Ponds	
	slough 2	slough 3
Attributes	22-May-01	22-May-01
UTM 10	573495	573184
	5770875	5771150
Elevation (m)	686	686
pH	9.2	NR[1]
Temperature (ºC)	19	NR
Conductivity (µmhos·cm^{-1})	520	NR
Depth (m)	NR	NR
Secchi Disk (m)	NR	NR
Area (ha)	2.9	9.8
Perimeter (m)	963	2325
Emergent marsh area (ha)	1.2	Tr[1]
Open water or submergent vegetation area (ha)	1.7	9.8
Fish	No	No
Cattle access	Yes	Yes
Nest boxes present	Yes	Yes
DU Project	Yes	Yes
Residences near wetland	No	Yes
Recreation Area near	No	No
Light Industry	No	No
Partially filled	No	No
Boat launch	No	No
Biogeoclimatic Unit	IDF dk3	IDF dk3

[1] Not recorded
[2] Trace

Table 94. Birds observed during breeding waterbird surveys at Mission Ponds, slough 2: 2001.

	Mission Ponds slough 2
Species[1]	13-Jun-01
PBGR	1
PBGR-N[2]	1
BWTE-PR	1
CITE-M	1
REDH-PR	1
REDH-N	1
RNDU-PR	1
LESC-PR	3
BUFF-PR	1
BUFF-♀	1
BUFF-Y	6
RUDU-PR	4
RUDU-♂	2
RUDU-N	2
AMCO	6
AMCO-N	1
AMCO-Y	2
Sub-total	**46**
SORA	1
TOTAL	**47**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

In the smaller slough 2, we walked the shoreline (Figure 165) and found a number of nesting species including Pied-billed Grebe, Redhead, Bufflehead, and Ruddy Duck (Figure 162), as well as American Coot, Red-winged Blackbird, Yellow-headed Blackbird, and Bullock's Oriole.

Slough 3, the second largest of the "ponds," lies about 230 m west of "149 Mile Lake" (Figures 156 and 166). It is about 440 m by 400 m and covers an area of nearly 10 ha.

In 1939, Munro (1958) described this slough as

> *a long narrow lake of irregular shape in open rolling country. The shore is hard clay, gravel and boulders without cover vegetation. The prevailing growth on the dry littoral is short grass and salicornia* [sic]. *Close by is a small pond completely encircled by tall round-stem bulrush.*
>
> *In 1958 the lake is barely recognizable so much has its contours and its extent been altered by the high water; the scirpus pond has been absorbed. Cover of grasses and forbs on the littoral is luxuriant.*

Figure 165. John Cooper checking for nest in the *Typha* marsh at the north end of Mission Ponds, slough 2, 13 June 2001.

Difficulty of access and shortage of time precluded a thorough investigation of this wetland; however, we did survey the area by telescope from a nearby hill south of the slough.

Slough 3 was situated in similar landscape surroundings as was "149 Mile Lake," among the rolling grasslands. There was a discontinuous, narrow band of *Scirpus* around much of the slough perimeter (Figure 167); *Typha* occasionally occurred as well.

Water levels were high during our study, which turned a 170 m peninsula at the southern end of the slough (obvious in Figure 156) into 3 islands (Figure 166). This large slough was used for the past 2 years by American White Pelicans as a spring staging area (Jack Telfer, pers. comm.) before they moved to Williams Lake and ultimately Stum lake where they nest. In 2000, the pelicans stayed for about 3-weeks; however, this year they only stopped for 2-days because the islands were essentially non-existent due to the high water.

Figure 166. Mission Ponds, slough 3 looking northwest, 22 May 2001. This slough was used by American White Pelicans as a spring staging area in 2000 and 2001.

Table 95. Birds observed during breeding waterbird surveys at Mission Ponds, slough 3: 1939, 1958, and 2001.

	Mission Ponds slough 3		
Species[1]	19-Jul-39	12-Jul-58	13-Jun-01
EAGR			10
GWTE	8		
GWTE-♂[2]			1
GWTE-♀	2	1	
GWTE-Y	13	9	
MALL	20		
MALL-PR			2
MALL-♂			17
MALL-♀			2
NOPI	22		
NOPI-♀	2		
NOPI-Y	12		
BWTE-PR			2
NOSL-♀		1	
GADW-♂			1
AMWI-PR			3
AMWI-♂			12
AMWI-♀		1	8
AMWI-Y		3	
REDH-PR			1
REDH-♂			1
RNDU-♂			1
LESC-PR			2
LESC-♂			32
LESC-♀			5
BAGO-PR			1
BAGO-♀	1	2	
BAGO-J♀	7		
BAGO-Y	8		
BUFF-♂			1
BUFF-J♀	9	6	
BUFF-♀	1	1	7
BUFF-Y	7	6	
RUDU-PR			2
RUDU-♂			3
RUDU-♀	1		
RUDU-Y	5		
AMCO	2		14
Sub-total	**120**	**30**	**141**
KILL			1
TOTALS	**120**	**30**	**142**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

150 Mile Lake

150 Mile Lake lies just west of the community of 150 Mile House (Figure 168). It is about 600 m long by 160 m at its widest point and covers an area of about 9.8 ha. In 1938, Munro (1958) described this breeding area as

> *an irrigation reservoir of approximately 30 acres* [12 hectares] *on the 150 Mile Ranch. It contains much heavy round-stem bulrush marsh chiefly at the north end; sago pondweed and other submerged aquatics are in abundance as are amphipods, and gastropods of several species. It was observed in 1958 that these features had not changed. However the local human population has increased and such enterprises as a new service station, a reconditioned hotel and beer parlour, and a picnic ground would seemed to have lessened the lake's attractiveness to waterfowl….*

Figure 167. *Scirpus* margin of Mission Ponds slough 3, 13 June 2001. This slough connects to slough 2 off to the right of the image.

Figure 168. 150 Mile Lake showing habitat characteristics and surrounding land use. Disk shows location where archival photographs were taken.

Table 96. Some attributes of 150 Mile Lake.

Attributes	150 Mile Lake 18-May-01
UTM 10	573195
	5773104
Elevation (m)	763
pH	8.6
Temperature (ºC)	13
Conductivity (µmhos·cm^{-1})	240
Depth (m)	1.7
Secchi Disk (m)	1.7
Area (ha)	9.8
Perimeter (m)	1689
Emergent marsh area (ha)	2.8
Open water or submergent vegetation area (ha)	7.0
Fish	Yes
Cattle or horse access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	No
Light Industry	Yes
Partially filled	No
Boat launch	No
Biogeoclimatic Unit	IDF dk3

This lake and its surroundings have changed somewhat since Munro visited in the late 1930s and the late 1950s. The hotel and pub still exist, the gas station has closed and there are now 4 residential properties, some with outbuildings for horses, on both sides of the lake. There is a dyke at the north end of the lake complete with a control structure in the northwest corner. At the north end of the lake is also a light industrial site and at the southwest end there are 2 more residences. Most of the western shore is open fields backed by forested lands.

There are some large areas of *Scirpus* marsh at the northern end of the lake with occasional patches of *Typha* (Figure 169). A narrow band of *Scirpus* extends along the western shore to the south end of the lake. Ivy-leaved duckweed and large amounts of algae were also noted.

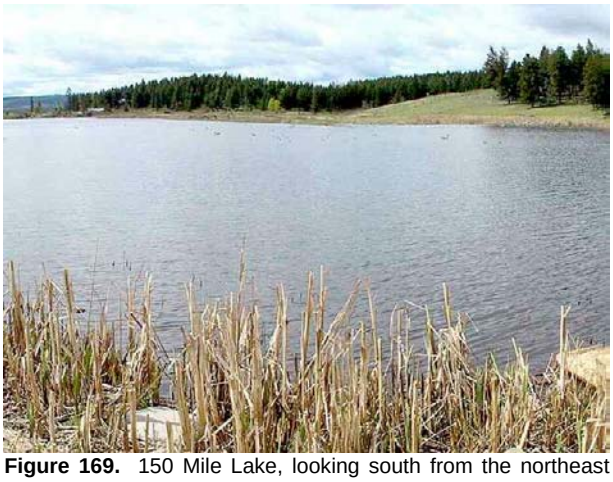

Figure 169. 150 Mile Lake, looking south from the northeast shore, 18 May 2001. Small areas of *Typha* marsh occur (foreground); however, the dominant marsh on the lake is *Scirpus* (far shore).

We noted amounts of litter that had been tossed into the reservoir such as soccer balls, baseballs and scrap metal, particularly at the south end of the lake.

Amphipods and both *Planorbis* and *Lymnaea* snails were fairly common.

Some attributes of 150 Mile Lake are shown in Table 96; bird use of the lake is given in Table 97.

Numbers of birds using this wetland in 2001 were down even when compared only with Munro's 1958 counts. Some of the difference has to do with the fact that our count was over a month earlier than the Munro surveys, so broods from the later-nesting waterfowl such as Lesser Scaup and goldeneye, may not have been out yet. However, there has also been more development and other activities that are now associated with the breeding site.

Munro also reported 4 species that we did not record (Pied-billed Grebe, Green-winged Teal, Northern Pintail, Northern Shoveler); however, we recorded 3 species that Munro did not observe (Canada Goose, Gadwall, Redhead).

Munro reported 9 nesting species, 8 of which were from his 1938 count and 5 from his 1958 count; we recorded 4 nesting species (Table 97).

Dugan Lake

The turn-off to Dugan Lake is about 7.2 east of the Highway 97 along Horsefly Road (about 1.2 km from 150 Mile House). The lake is about 500 m south of Horsefly Road. The lake consists of 2 open water ar-

Table 97. Birds observed during breeding waterbird surveys at 150 Mile Lake: 1938, 1958, and 2001.

	150 Mile Lake		
Species[1]	22-Jul-38	19-Jul-58	13-Jun-01
PBGR-PR[2]		1	
PBGR-Y		2	
RNGR	2	1	1
RNGR-N			1
RNGR-Y	1	1	
CAGO			4
CAGO-PR			2
CAGO-Y			7
GWTE-♂	2		
MALL-♂			7
MALL-♀	2	1	1
MALL-A & Y			
MALL-Y	7	10	2
NOPI-♂	1		
BWTE		1	
BWTE-♂			1
BWTE-F	3		
BWTE-Y	20		
NOSL-♂	1		
GADW-PR			1
AMWI-PR			1
AMWI-♂	1		1
AMWI-♀	1		
AMWI-Y	5		
REDH-PR			1
LESC-PR			1
LESC-♀	9	2	
LESC-A & J	34		
LESC-Y	85	9	
BAGO-♀		1	5
BAGO-J♀	4		
BUFF-♀	1		3
BUFF-Y	9		
RUDU-♂	7	1	1
RUDU-♀	1		
RUDU-Y	6		
AMCO	24	16	8
AMCO-PR			1
AMCO-N			2
AMCO-Y	37	34	4
Sub-total	**263**	**81**	**61**
SPSA			2
LEYE	4		
GRYE	16		
KILL			2
WISN			1
TOTALS	**283**	**81**	**66**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

eas (Figure 171). The largest is about 1.4 km long and 1.1 km wide at the widest points; the smaller is about 310 m long and 260 m wide. The entire lake and wetland complex covers an area of about 112 ha. In 1938, Munro (1958) described the lake as

> *approximately 250 acres... In 1938 the water-level was low, and a belt of skunk grass and other grasses extended from high water mark (indicated by willows at the edge of the timber) to a muddy margin of recently exposed lake bottom. Here and there close to shore are beds of round-stem bulrush; the dominant plant in the shallows was water buttercup.*
>
> *In 1958, the lake was full to high water mark; the round-stem bulrush marshes appeared to be more extensive; a bulrush-margined cattail marsh in a bay on the west side is conspicuous. There is now more cultivation than formerly, more settlers, and two abandoned mill sites.*

In 2001, Dugan Lake appeared in similar condition to Munro's 1958 description. There is now a Ministry of Forests recreation site along the southwest shore with campsites and a boat launch (Figure 170). During both of our visits there were many people camping and fishing on the lake in small boats; this is now a very popular recreation site.

There are now 4 residences on the western shore and 3, what appear to be horse ranches, on the eastern shore with a working farm at the northern end of the lake. Small docks extend into the lake from some of the properties; a floatplane was docked on marsh margin at the northwest corner of the lake.

Agricultural lands make up most of the backshore along the northeast and east sides of the lake. The southern shore is forested (mainly Douglas-fir with some spruce and lodgepole pine ranging between 101 and 250 yr with a crown closure of 56-65% and a site index of between 15 and 18) among which are located a number of campsites.

Figure 170. Campground and boat launch at Dugan lake, 17 May 2001.

Figure 171. Dugan Lake showing habitat characteristics and surrounding land use.

There is a 40-50 m band of *Scirpus* marsh backed by a narrow *Typha* band along much of the western shore of the lake; on the northeastern shore, a similar band narrows to a 10 to 20 m width. In some areas, a *Carex* band of varying width extends shoreward of the *Typha*. Both cattle (Figure 172) and horses were seen feeding in the *Scirpus* marsh and *Carex* meadow. Along the south shore, there are only patchy and sparse clumps of *Scirpus* due to the rocky nature of the lakeshore. A large *Carex* meadow covering an area of about 10 ha surrounds the smaller open water area to the east and separates it from the main, larger portion of the lake.

There is a narrow band of *Scirpus* with some *Typha* around most of the perimeter of the smaller

Figure 172. Cattle grazing the *Carex* meadow at Dugan Lake, 16 June 2001. Horses were also seen directly in the marshes.

Table 98. Some attributes of Dugan lake.

Attributes	Dugan Lake 18-May-01
UTM 10	574942 5780446
Elevation (m)	922
pH	8.9
Temperature (ºC)	11
Conductivity (µmhos·cm^{-1})	360
Depth (m)	15
Secchi Disk (m)	2.2
Area (ha)	112.5
Perimeter (m)	4972
Emergent marsh area (ha)	6.7
Open water or submergent vegetation area (ha)	96.0
Fish	Yes (stocked in 1976)
Cattle access	Yes
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	Yes
Biogeoclimatic Unit	IDF dk3

Table 99. Birds observed during breeding waterbird surveys at Dugan Lake: 1938, 1958, and 2001. The data between years are not comparable because of the 2-month difference in the survey times.

	Dugan Lake		
Species[1]	14-Aug-38	14-Aug-58	16-Jun-01
COLO			4
COLO-N[2]			1
PBGR-PR			1
PBGR-Y			3
RNGR			10
RNGR-N			7
RNGR-Y			3
CAGO			10
MALL-♀			2
MALL-Y			16
BWTE-♂			1
CITE-PR			1
GADW-PR			1
AMWI-PR			1
AMWI-♂			1
CANV-♀			1
CANV-Y			8
RNDU-PR			4
RNDU-♀			2
LESC	184		
LESC-A & Y		140	
WWSC-PR			2
WWSC-♂			1
GOLD-♀			1
GOLD-Y			8
COGO-♀			1
COGO-Y			5
BAGO	120	83	
BUFF	170		
HOME-Y			1
RUDU-A & Y		20	
RUDU-♂			2
RUDU-♀			1
AMCO	600	155	15
AMCO-N			1
Sub-total	**1074**	**398**	**125**
OSPR			1
VIRA			1
SORA			6
SPSA			1
HEGU			2
BLTE			14
TOTALS	**1074**	**398**	**150**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 173. Some nesting birds of Dugan Lake, 16 June 2001. From top: Red-necked Grebe and young; hen Canvasback and young; Common Goldeneye young; and American Coot nest and eggs.

water body. Submergents included water-milfoil and pondweeds. We also noted amphipods in lake.

Some attributes of Dugan Lake are given in Table 98; bird use of the lake is shown in Table 99.

Munro did not survey the lake until mid-August and as a result would mainly have been recording post breeding birds. Thus there is little point in directly comparing numbers between his counts and ours in 2001.

We recorded a total of 16 species of waterbirds using the lake during the breeding season in 2001. Munro found Lesser Scaup, Barrow's Goldeneye, and Bufflehead in large numbers in August; however, they were recorded only during our early (18 May) visit and not during our breeding bird

Figure 174. Common Loon nest and eggs on edge of Carex meadow, Dugan Lake, 16 June 2001.

survey. We found evidence of nesting for at least 8 species of waterbirds including Common Loon (Figure 174), Pied-billed Grebe, Red-necked Grebe (Figure 173), Mallard, Canvasback (Figure 173), Common Goldeneye (Figure 173), Hooded Merganser, and American Coot (Figure 173).

The one Common Loon nest we found was built on the shore of the smaller waterbody (Figure 171) near the connecting channel to the main part of the lake. The nest held 2 eggs. Shortly after we located this nest, a thunderstorm approached the lake so we did not complete a check of the perimeter of the smaller water body.

Dewar Lake

Dewar Lake is situated along Horsefly Road (Figure 175) about 5 km further east from Dugan Lake. It is about 1.2 km long and 500 m wide and covers an area of about 46 ha. Munro notes that Dewar lake is

> *similar to Dugan Lake but more secluded. In 1928 a wide margin of exposed lake bottom lay between the water's edge and the forest; in 1958 it was full to high water mark.*

In 2001 we found water levels similar to what Munro found in 1958. There are now a number of residences between Horsefly Road and the western edge of the lake. The houses have direct access to the lake and a number have small docks. A Ministry of Forests Recreation Site has been built at the northern end of the lake where canoe or small-boat access can be gained. The lake appears to be a popular fishing spot, though not as popular as Dugan Lake. Dewar Lake is aerated during the winter months.

Figure 175. Dewar Lake showing habitat characteristics and surrounding land use.

Table 100 Some attributes of Dewar Lake.

Attributes	Dewar Lake 18-May-01
UTM 10	577446
	5783444
Elevation (m)	988
pH	9.6
Temperature (ºC)	11.5
Conductivity (µmhos·cm^{1})	525
Depth (m)	3
Secchi Disk (m)	1.5
Area (ha)	46.0
Perimeter (m)	3459
Emergent marsh area (ha)	6.7
Open water or submergent vegetation area (ha)	39.3
Fish	Yes (stocked in 1998)
Cattle access	No
Nest boxes present	No
DU Project	No
Residences near wetland	Yes
Recreation Area near	Yes
Light Industry	No
Partially filled	No
Boat launch	Yes
Biogeoclimatic Unit	IDF dk3

Table 101. Birds observed during breeding waterbird surveys at Dewar Lake: 1938, 1958, and 2001. The data between years are not comparable because of the 2-month difference in the survey times.

	Dewar Lake		
Species[1]	14-Aug-38	14-Aug-58	16-Jun-01
COLO			1
COLO-PR[2]			1
PBGR			1
RNGR			14
RNGR-PR			1
RNGR-N			14
RNGR-Y			5
CAGO			18
CAGO-Y			24
GWTE-♂			1
MALL	2	10	
MALL-PR			1
MALL-♀			2
MALL-Y			8
AMWI			1
CANV-♀			1
RNDU-PR			2
RNDU-♂			2
LESC	57	80	
GOLD-♀			1
BAGO	50	50	
BUFF	40	10	
RUDU-♂			1
AMCO	200	125	3
Sub-total	**349**	**275**	**107**
GBHE			2
SORA			2
KILL			4
HEGU			1
BLTE			2
TOTALS	**349**	**275**	**118**

[1] For a key to species codes see Appendix I
[2] For a key to species code modifiers see Appendix II

Figure 176. Some nesting birds of Dewar Lake, 18 May 2001. Common Loon nest and egg (top) and Canada Goose on nest (bottom).

The east shore of the lake is forested with some drowned trees. Forest occurs along the northwest and south shores as well. Along the northeast shore the forest is dominated by Douglas-fir with some trembling aspen and lodgepole pine (81 -100 yr old with a crown closure of 56-75% and a site index between 19 and 21). At the southeast end of the lake, spruce and Douglas-fir are the dominants with some lodgepole pine. This forest is somewhat younger (21-40 yr with a crown closure of 46-65% and site index of 15).

There is a relatively narrow band of *Scirpus* marsh with areas of *Typha* backed by a wider band of *Carex* around the perimeter of the lake. Some clusters of spike rush were also noted. More extensive marsh areas occur at the southeast end (with some *Carex*) and along portions of the east shore (with *Carex* and *Typha*). Sago pondweed was also noted.

Some attributes of Dewar Lake are given in Table 100; breeding bird use of the lake is shown in Table 101.

Because Munro visited this lake about 2-months later than we did in 2001, there is little point in discussing differences in the bird surveys.

On our June visit it was apparent that many of the grebes and perhaps the pair of loons had lost their first nests, we can only surmise by storm. The Common Loon nest we found during our May visit (Figure 176) had obviously been disturbed and neither the eggs nor any young were found, although a pair of Common Loons and a single adult were still on the lake.

We found a number of empty Red-necked Grebe nest platforms often near a fresh nest with eggs. In all we found 14 active grebe nests with 9 containing eggs. Six of these were along the east shore of the lake suggesting the birds have fairly adapted to the activity around the residential area and the fishing activity on the lake. Canada Goose (Figure 176), Mallard, and Red-winged Blackbirds were also found nesting on Dewar Lake.

The Birds

Waterfowl and waterbird numbers from our study area in the Cariboo parklands were higher for most species in 2001 than in either of Munro's early years, including both breeding and migrant numbers. For example, Munro (1958) includes a table of May counts of ducks and notes that

> *In each instance the lakes used in this sampling are: Clinton lakes, 101 Mile, 103 Mile, 105 Mile, Elliott* [sic], *Watson, 149 Mile* [Mission Ponds 1], *150 Mile. These represent a typical cross section of the Cariboo parklands, several carry the largest concentrations, others represent less populated waters.*

The table has been repeated here with the addition of the 2001 data for the wetlands noted above (Table 102; see also, Appendix III). In addition to the 13 species Munro found on these wetlands, we reported an additional 6 species for the May counts. With the exception of Northern Pintail, Blue-winged Teal, Canvasback and White-winged Scoter, all May duck numbers on these select wetlands were higher in 2001. Total duck numbers were up by 86% from Munro's 1942 numbers and up 237% from his 1958 numbers.

Table 102. May counts of ducks on select wetlands in the Cariboo parklands from 1942, 1958, and 2001. See text for a description of the wetlands selected.

Species[1]	1942	1958	2001
MALL	27	15	82
NOPI	44	16	2
GWTE	8	3	15
BWTE	11	26	16
AMWI	84	8	107
NOSL	20	0	62
REDH	26	28	64
CANV	45	21	23
LESC	667	224	761
BAGO	85	121	145
BUFF	48	82	253
WWSC	3	37	2
RUDU	45	45	268
UNID	20	0	8
Subtotal	**1133**	**626**	**1808**
CITE	0	0	20
GADW	0	0	155
RNDU	0	0	22
SUSC	0	0	35
COGO	0	0	64
HOME	0	0	4
Total	**1133**	**626**	**2108**

[1] For a key to species codes see Appendix 1

Table 103. Comparative numbers of adult waterbird on wetlands in the Cariboo parklands from the late 1930s-early 1940s (shown as 1938), 1958, and 2001. Only species with a total of ≥10 individuals are shown; highlighted species have lower numbers in 2001 compared to Munro's highest counts. The table is ordered by 2001 totals.

	Total[1]		
Species[2]	1938	1958	2001
LESC	734	338	992
EAGR	274	196	811
AMCO	295	201	766
CAGO	0	21	375
GADW	0	0	359
RUDU	145	56	347
MALL	256	96	325
BUFF	271	81	210
AMWI	180	182	207
BWTE	97	147	181
BAGO	168	142	144
REDH	14	68	111
RNDU	19	9	87
COGO	0	0	69
CITE	5	0	68
RNGR	36	65	67
GWTE	77	52	60
NOSL	52	22	59
COLO	30	16	41
PBGR	8	5	38
WWSC	75	60	33
CANV	60	35	28
NOPI	64	33	11
HOME	6	0	9
HOGR	30	20	9

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).
[2] For a key to species codes see Appendix 1

Most adult waterbird numbers from the June breeding counts were also higher in 2001. Seven species showed declines from the higher of the 2 Munro counts, including Horned Grebe, Green-winged Teal, Northern Pintail, Canvasback, White-winged Scoter, Barrow's Goldeneye, and Bufflehead (Table 103). All these species are also showing declines in British Columbia based on other data (e.g. Breault, In prep; Sauer et al. 1996; Breault and Watts 2001; Sauer et al. 2002), which suggests that the declines on our study area are real.

In terms of abundance, 8 of the top-11 species were about the same between all years, although their order changed through time (Table 103). Two species not reported in the top-11 for either of Munro's years, Canada Goose (recorded only twice by Munro) and Gadwall (reported only once in Munro [1958] and not at all from the comparative wetlands), had reached postions 4 and 5 respectively in 2001.

The most widely distributed species, i.e. the number of species reported from more than half of the wetlands, increased significantly in 2001 with a total of 13, compared with 8 in the late 1930s-early 1940s and 2 in 1958 (Table 104). The most notable change was the more widespread distribution of

Figure 177. Common Loon and downy young on nest, Larum's Bay, Horse Lake, 15 June 2001. The adult was sitting on an egg that was pipping.

Table 104. Comparative statistics for species reported from over half of the 30 wetlands and wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

1938		1958		2001	
Species[1]	Wetlands[2]	Species	Wetlands	Species	Wetlands
BAGO	23	BAGO	18	MALL	28
BUFF	23	LESC	17	LESC	27
LESC	22			AMCO	26
MALL	22			RUDU	25
AMCO	21			BWTE	24
AMWI	18			GADW	24
BWTE	17			CAGO	23
RUDU	16			AMWI	21
				BUFF	21
				RNDU	18
				BAGO	18
				CITE	17
				EAGR	16

[1] For a key to species codes see Appendix 1
[2] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Gadwall (not recorded by Munro), Canada Goose, Ring-necked Duck, Cinnamon Teal, and Eared Grebe.

Species diversity was also higher in 2001, with Western Grebe, Wood Duck, Gadwall, Surf Scoter, and Common Goldeneye added to Munro's list for the wetlands under review; Gadwall and Common Goldeneye formed a significant component of the breeding avifauna of the study area in 2001.

In the following species accounts, we discuss comparative numbers between our June waterbird surveys and Munro's (1958) earlier surveys as well as aspects of the birds' life history and conservation requirements. Also included are accounts for the provincially designated Red- or Blue-listed species we encountered.

Note: Because Munro's counts from Fawn, Irish, Dugan and Dewar lakes and Larum's Bay were held in August and included post breeding flocks, counts from these areas have been excluded from all of the comparative tables that follow.

Table 105. Comparative statistics for the Common Loon on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Common Loon[1]	1938	1958	2001
Number of Wetlands with adults	14	8	15
Total Adults	30	16	41
Number of Wetlands with nests or young	3	1	7
Total Nests	1	0	9
Total Young	4	1	8

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Common Loon

Gavia immer (Brünnich)

More Common Loons (Figure 177) were observed in 2001 than in 1938 or 1958 (Table 105); numbers of adult loons were up 37% from 1938, Munro's highest count year. In addition, more wetlands held loons in 2001 than in either of the early years.

Figure 178. Most Common Loon nests were found on the edges of *Typha* marshes (top). This nest with two eggs was one of three nests found on Exeter Lake, 31 May 2001. The remaining nests were found on small, marshy islets (bottom) (130 Mile Lake, 29 May 2001).

Exeter Lake, near 100 Mile House, where 3 active nests were found (Figure 178), supported the highest numbers of nesting loons in 2001. In 1938, Munro reported but a single bird at Exeter Lake although he noted a pair with 1 young there in 1958. Exeter Lake is apparently more attractive to loons as a nesting area now, which may be due to the improved wetland management practices of the landowner.

We found 2 nesting pairs of loons on Whitehorse Lake in 2001; Munro also found 2 pairs there in 1938. There is only one residence on Whitehorse Lake and other human access is quite restricted so conditions for breeding loons remain relatively undisturbed.

We did not record any loons on 103 Mile Lake (although we saw one overfly the lake), whereas Munro noted a pair there in 1937, but none in 1958. On Tatton Lake, we found one loon in both May and June whereas Munro found 2 pairs there in 1940, but none in 1958. Both these lakes now have a number of residences around their shores, which may have too much disturbance for nesting loons.

In 2001, we observed 2 pairs of loons on Lily Pad Lake; however, a nest was not found. Munro found a pair there in 1942 but none in 1958.

Simon Lake may be a good fishing lake for loons as Munro reported 7 loons there in 1958, and we found 4 loons there in 2001; neither we nor Munro discovered any nests on the lake. Conditions may have changed at Simon Lake since 1938 as Munro did not record loons there that year. Nearby Straight Lake held 1 pair of loons in both of the early years and 2001 and as far as we could determine there are no fish is Straight Lake, although large amphipods were common and Simon Lake is but a short flight away.

Jones Lake held a pair of loons with young in 1942. In 2001, we observed a pair of loons flying into the lake to fish but we found no evidence of nesting. The thick submergent vegetation that extended from the shore out into the lake some 20-30 m may now be a deterrent to nesting loons.

Irish Lake held a pair with young in 1958 and we found 1 nest there in 2001. Irish Lake apparently is only large enough for 1 pair of loons even though large numbers of fish are available. We observed a single loon land on the lake during our June visit and it was chased vigorously over much of the lake for at least 20 min by the resident male loon.

Fawn Lake held 2 pairs of loons in 2001, and we located both nests; Munro found 2 pairs there in

1936, but none in 1958. 130 Mile Lake contained 1 nesting pair in 2001 and 1942, and a single loon in 1958. Cummings Lake was apparently not suitable for breeding loons in the 1940s, 1958 or in 2001.

The number of nests found and the number of young recorded in 2001 were also higher than either of Munro's years (Table 105). Considering all 50 nesting areas we surveyed in 2001, 12 of the 15 loon nests we found were right on the marsh edge with direct access to open water; the other 3 nests were on small, marshy islets (Figure 178). Ten nests were located in *Typha* marshes and *Typha* formed the main nest component; 3 were in *Scirpus* marshes and 2 were built predominately with *Carex*. Water depth at 5 nests ranged from 0.08 - 0.41 m with a mean depth of 0.22 m ± 0.13 m SD.

In Ontario, lakes <80 ha did not support more than one pair of breeding loons; average territory size there was 70.4 ha, though the range was between 7 and 200 ha (McIntyre and Barr 1997). Munro (1945) notes that only larger lakes such as Horse Lake or Lac la Hache supported 3 or 4 pairs of loons. However, in 2001, at least 3 lakes smaller than 80 ha held more than 1 nesting pair of loons. Exeter Lake, with an open water area of 44.5 ha, contained 3 nests with eggs. Whitehorse Lake (54 ha) and Fawn Lake (32 ha) each supported 2 nests.

Across Canada and in British Columbia the numbers of Common Loons on Breeding Bird Surveys over the period 1966 to 2001 have increased at an average annual rate of 3.1% and 3.2% respectively (P<0.0 in both cases) (Sauer et al. 2002).

The Common Loon can remain a significant symbol of wilderness in the Cariboo parklands with careful planning of lakeshore developments that avoids harmful impacts to the loon's nesting requirements. For example, degradation of habitat through development of shorelines for summer homes, marinas and campsites may pre-empt optimal nest sites and force the birds into marginal areas where nesting success can be reduced (McIntyre and Barr 1997). Recreational use of lakes can affect nesting loons significantly and has been tied to population declines in some areas. The "most threatening disturbance factor" today on many breeding lakes is jet skis which are fast, highly manoeuvrable and can run in shallow water, which includes nest and nursery areas (McIntyre and Barr 1997).

During the period of our surveys, we did not record any significant power boat or jet ski activity, with the exception of both on Lac la Hache where our base camp was located. The lake was not one of our survey breeding sites; however, we did note at least 3 pairs of loons using the lake, one of which we know successfully hatched at least one chick. Horse Lake has both power boat and jet ski activity (R. Packham, pers. comm.), although we did not record either during our 2 visits to Larum's Bay.

In the late 1960s and early 1970s, there were concerns about the status of the Common Loon in a number of survey areas in North America. The advent of breeding conservation programs that instigated nest and nursery safeguards, habitat preservation and water level stability programs, and the introduction of artificial nesting platforms where necessary, have helped improve loon numbers throughout much of those survey areas (McIntyre and Barr 1997).

Nevertheless, with the increasing popularity of the Cariboo as an important recreational area, the potential for impacts to nesting loons will increase. Any disturbance that forces an incubating adult off the nest, separates the adults from the young or affects the nursery area could have an effect on loon populations in the Cariboo parklands. This is important because, although the Common Loon nests across much of Canada, British Columbia and the Cariboo parklands, in particular, support one of the 2 or 3 highest known concentrations of nesting loons in the country (Sauer et al. 2002). As McIntyre and Barr (1997) note, "Loons can remain productive if overt human disturbance is minimal and benign."

Pied-billed Grebe

Podilymbus podiceps (Linnaeus)

Numbers of Pied-billed Grebes were significantly higher in 2001 than in either 1938 or 1958, up 375% from Munro's highest count (Table 106). We also recorded them on 4-times as many wetlands. Munro surveyed a number of the wetlands later in the summer than our surveys when these grebes are more difficult to detect, which could account for his lower numbers.

Table 106. Comparative statistics for the Pied-billed Grebe on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Pied-billed Grebe[1]	1938	1958	2001
Number of wetlands with adults	3	2	12
Total Adults	8	5	38
Number of wetlands with nests or young	1	2	5
Total Nests	0	1	4
Total Young[2]	?	2	3

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

[2] Number of young for 1938 is unknown, although Munro (1958) notes a pair "with young.

Figure 179. Pied-billed Grebe nest and eggs, 101 Mile Lake, 30 May 2001.

We found relatively few nests or young (Figures 179 and 180) in 2001, compared to the number of wetlands where we noted grebes present. Pied-billed Grebe nests are difficult to detect as they are seldom visible from open water or the shore, and must usually be located by wading through the emergent vegetation.

The 11 wetlands that comprise the 70 Mile House slough complex contained the most Pied-billed Grebes. In May 2001, we found 11 adult grebes in 6 of the 11 wetlands, and in June we found 13 adult grebes in 7 wetlands. Munro did not record Pied-billed Grebes there in 1937 or 1958.

The 70 Mile sloughs are now ideal habitat for the Pied-billed Grebe since they contain substantial amounts of emergent vegetation, are relatively small wetlands, yet most have sufficient space for at least 1 breeding pair of grebes each. From Munro's description, these wetlands were in much poorer shape for waterbirds during the period of at least his early visits and they may have been unsuitable for nesting Pied-billed Grebes at that time.

Figure 180. Pied-billed Grebe young just out of nest, 101 Mile Lake, 20 June 2001.

In 2001, all 4 nests were located in dense *Scirpus* or mixed *Scirpus* and *Typha* marshes and consisted of a floating platform of partially decomposed vegetation. Water depth at the nests ranged from 0.32-0.71 m with a mean depth of 0.51 m ± 0.17 m SD. Muller and Storer (1999) note that 2 factors affect nest-site selection in emergent vegetation: water depth >0.25 m and an emergent vegetation density of 10 cm^2 or more of stem basal area/m^2.

Breeding Bird Surveys in British Columbia over the period 1980-2001, suggest this grebe has experienced an average annual decline of 10.8% ($P<0.07$); however, the data have deficiencies, such as small sample size or low abundance, which should be considered (Sauer et al. 2002).

Horned Grebe

Podiceps auritus (Linnaeus)

Numbers for the Horned Grebe were lower in 2001 than in 1938 or 1958, down 70% from Munro's highest count and seen on fewer numbers of breeding sites (Table 107).

Munro (1945) notes this species as a "common summer visitant," although he points out that local populations fluctuate from year to year. Munro (1958) found most Horned Grebes on the 70 Mile House sloughs where he recorded 18 in 1937 and 12 in 1958; we found only 1 pair there in 2001. Conditions seem to have changed, for the 70 Mile House sloughs seem less suitable for Horned Grebes now.

Watson Lake held 2 pairs in 1938, and 1 pair in each of 1958 and 2001. We found 2 pairs at Elliot Lake whereas Munro did not record Horned Grebes there in any year. Conversely, Munro recorded 2 pairs at 103 Mile Lake but we did not record any there in 2001.

Table 107. Comparative statistics for the Horned Grebe on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Horned Grebe[1]	1938	1958	2001
Number of wetlands with adults	5	5	2
Total Adults	30	20	9
Number of wetlands with nests or young	0	0	1
Total Nests	0	0	1
Total Young	0	0	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Figure 181. Red-necked Grebe on 103 Mile Lake, 4 June 2001.

Tatton Lake also held 1 or 2 pairs of Horned Grebes in Munro's time, as well as in 2001; there we also found our only Horned Grebe nest. Munro did not report any nests although he did record 1 young at 148 Mile lake in 1958.

Numbers appear to be lower than expected based on the Horned Grebe's status as a *fairly common* breeder in the Cariboo region (Roberts and Gebauer 1992) or *uncommon* to *fairly common* in summer east of the coast ranges (Campbell et al. 1990a).

In British Columbia, Breeding Bird Surveys have not been rigorous enough to detect any trends; however, Canada-wide surveys suggests that over the period 1966 - 2001 the Horned Grebe experienced an average annual decline of 3.0% ($P<0.06$); over the period 1980 - 2001 this grebe experienced an average annual decline of 4.7% ($P<0.01$) (Sauer et al. 2002). In addition, both Christmas Bird Count (CBC) and Breeding Bird Survey (BBS) data show negative trends continent-wide trends (Stedman 2000). These trends tend to support our impressions that Horned Grebes are less common in the Cariboo parklands than they once were. The Horned Grebe competes with fish for invertebrate prey, thus fish introductions to areas where they did not occur naturally could have had a negative effect on this grebe.

The Horned Grebe is a yellow-listed species in British Columbia—*apparently secure and not at risk of extinction.* Because of this grebe's contracting breeding range and the negative trends on CBCs and BBSs (Stedman 2000), as well as the apparent declines in the Cariboo parklands, perhaps it is now appropriate to reassess the status of the Horned Grebe in British Columbia.

Table 108. Comparative statistics for the Red-necked Grebe on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Red-necked Grebe[1]	1938	1958	2001
Number of wetlands with adults	11	11	12
Total Adults	36	65	67
Number of wetlands with nests or young	4	8	11
Total Nests		12	30
Total Young	9	11	6

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Red-necked Grebe

Podiceps grisegena (Boddaert)

Red-necked Grebe (Figures 181 and 182) numbers were higher in 2001 than in the late 1930s-early 1940s but about the same as Munro's 1958 numbers (Table 108). The number of wetlands holding Red-necked Grebes was about the same as Munro found. We also

Table 109. Wetlands with multiple nests of the Red-necked Grebe in the Cariboo parklands, 2001.

Wetland	No. of Nests	Date Surveyed
Dewar Lake	14	16 June
Duggan Lake	7	16 June
Watson Lake	6	18 June
103 Mile Lake	6	4 June
Simon Lake	6	8 June
Tad Lake	4	14 June
Lily Pad Lake	3	4 June
Jones Lake	3	18 June
Larum's Bay (Horse Lake)	2	15 June

found a significantly higher number of nests than did Munro, although numbers of young reported were down about half.

Multiple nests were found on 9 wetlands (Table 109). Dewar Lake contained the most breeding pairs. Nests were typically constructed of decaying emergent vegetation and pondweeds placed near at least some emergent vegetation. At Exeter and Jones lakes, nests were composed mainly of algae and submergent vegetation (water-milfoil, yellow pondlily), and were situated over the submergent beds in open areas of the wetland removed from the emergent vegetation.

We found 6 nests at Watson Lake, whereas Munro found none in 1958 or 1942. We failed to find a nest at 105 Mile Lake, whereas Munro found 5 nests there in 1958. We both found breeding Red-necked Grebes at 103 Mile Lake. In 2001, Simon Lake held 6 nests, but only 3 birds were reported in 1938 and none in 1958. Tatton Lake held 6 pairs in 1958 but we found only 1 nest there in 2001.

We found 14 and 7 nests respectively on Dewar and Dugan Lakes in 2001; whereas Munro did not record any grebes on those lakes in mid-August. Most of the breeding activity would have been over by that time and the grebes had likely left those lakes by the time Munro conducted his surveys. Jones and Irish lakes seem to have maintained their small numbers (1-3 pairs) of breeding grebes.

In 2001, most Red-necked Grebe nests (34; n=50) were built in *Scirpus* marshes (Figure 182), 10 in *Typha* marshes, 5 in open water on dense beds of submergent vegetation such as water-milfoil or Canadian waterweed and 1 in a common spike-rush marsh. The nests were relatively compact, floating platforms made from living and partially decomposed vegetation including common spike-rush, Canadian waterweed, yellow pondlily, pondweed, water-milfoil, cattail, bulrush, bladderwort, musk grass and algae (Figure 183). Most nests had a *Scirpus* base or *Scirpus* as a nest component. Water depth for 43 nests ranged from 0.35-1.35 m with a mean of 0.68 m ± 0.29 m SD. Water depth at the nest is rarely <0.20 m (Stout and Nuechterlein 1999).

Breeding Bird Surveys in British Columbia over the period 1966-2001 suggest a relatively stable population (Sauer et al. 2002).

Habitat loss or degradation could have a significant impact on breeding Red-necked Grebe numbers in the Cariboo parklands. Draining of sloughs, destruction of emergent vegetation by cattle or by lakeshore property owners, and fluctuating water levels caused by forestry or agricultural activities that change the hydrology of an area are all of concern. Although recreational activities have been blamed for reduced Red-necked Grebe productivity,

Figure 182. Red-necked Grebe on nest, 103 Mile Lake, 4 June 2001.

Figure 183. Red-necked Grebe nest and eggs at 130 Mile Lake, 29 May 2001. The nest is composed primarily of water-milfoil and yellow pondlily stems.

Stout and Nuechterlein (1999) note that

> *if disturbance to nesting birds is minimized, especially during incubation and early in brood rearing, Red-necked Grebes can and do become acclimated to human presence and recreational activities on lakes. However, boat traffic in and near nesting areas should be minimized, to avoid nest-damaging wakes and disturbance of incubating or brooding adults.*

Appropriate care taken to maintain wetland hydrology and functions, including especially the protection of the emergent marshes, will help to ensure that Red-necked Grebe numbers are maintained in the Cariboo parklands of British Columbia.

Eared Grebe

Podiceps nigricollis Brehm

Eared Grebe numbers were substantially higher in 2001 than in the late 1930s-early 1940s or 1958, up 196% from Munro's (1958) highest counts (Table 110). The grebes also had a far more widespread distribution in 2001 than in either of the earlier years and ranked 2nd in abundance of all the wetland birds we surveyed.

We found 39 nests with eggs on 3 wetlands, and evidence of breeding on 2 other wetlands. Munro (1958) does not mention any nests, although his 1945 report describes the colony on Westwick Lakes (east), where he found 23 nests on 20 May 1942, most with eggs.

We discovered a new breeding locality for Eared Grebes in British Columbia; 23 nests were found on 105 Mile Lake. An inspection of the nests suggested the birds were in the early stages of the egg laying. Courtship displays were also noted (Figure 184). The nests were composed primarily of algae with some grass stems. This colony was the largest that we observed. It was associated with 2 large spruce trees that had toppled into the lake. The trees provided numerous anchor spots for nests along its branches (Figure 184). Water depth at the colony was 0.3 m.

At Soda Sloughs, we found 14 nests, most with eggs, which is more than the 5 estimated in 1986

Table 110. Comparative statistics for the Eared Grebe on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Eared Grebe	1938	1958	2001
Number of wetlands with adults	5	7	18
Total Adults	274	196	811
Wetlands with nests or young			5
Total Nests			39
Total Young			

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Figure 184. Eared Grebes (top) on 70 Mile House slough 5, 24 May 2001; (middle) in their courtship Discovery Display (here at the Penguin Dance stage) on 105 Mile Lake 6 June 2001; and (bottom) adult building nest at second fallen spruce tree away from the main colony, 105 Mile Lake, 6 June 2001.

(Breault et al. 1988). The nests were in a dense *Typha* marsh and were composed primarily of decomposing cattail and live bladderwort. Water depths at the nests ranged from 0.30-0.54 m with an mean depth of 0.36 m ± 0.08 m SD.

We found another colony at Rush Lake; however, we could not access the colony to count the nests. We could see one bird on a nest at the edge of a *Scirpus* marsh and another 40 birds were on the lake. A pair of Eared Grebes with a nest was also found at 101 Mile Lake, but we were unable to check the nest contents.

Westwick Lakes has contained one of the most significant breeding colonies of Eared Grebes in British Columbia ever since Munro's time. Munro reported 60 pairs in 1938 and 65 pairs in 1958; we found 340 adults there in 2001. Nests were just being built at Westwick Lakes (east) when we surveyed the *Scirpus* marsh at the east end of the lake on 19 June 2001. It appeared that a recent catastrophic event had impacted the colony, as a number of damaged nests were observed and a few eggs were found in the water below the nests. Some pairs were in the process of building new nests. High counts for Westwick Lakes occurred in 1978 (469 nests) and 1986 (212 nests) (Campbell et al. 1990a).

In 2001, we also found a number of birds on wetlands where nesting was not known to take place, e.g. 70 Mile House slough 5 (Figure 182) and Boitano Lake.

Breeding Bird Survey data in British Columbia are not rigorous enough to allow the determination of trends nor are recent Canada-wide data. However, Canada-wide data for the period 1966-1979 suggest an average annual increase of 23.2% ($P<0.01$) (Sauer et al. 2002). This increase could explain the higher Eared Grebe numbers we noted in 2001, compared with those of Munro's earlier years.

A potential threat to Eared Grebes in the Cariboo parklands is loss of habitat through wetland drainage, use of marshes by cattle, and water drawdown for irrigation of agricultural fields.

Western Grebe

Aechmophorus occidentalis (Lawrence)

On 18 June 2001, a solitary Western Grebe was seen on Watson Lake just east of the first access road on the north side of the lake. The bird was loafing about 5 m out from an extensive area of emergent *Scirpus* marsh. A search of the marsh did not reveal another bird or any evidence of nesting. Munro (1958) did not report any Western Grebes on the wetlands we surveyed, either in the late 1930s-early 1940s or in 1958, although he did record them at Williams Lake in 1938 and 1942 but not in 1958 (Munro 1958).

The Western Grebe formerly nested at Williams Lake, but none have been known to nest there since 1964 (Campbell et al. 1990a). During Munro's time, about 50 pairs nested at Williams Lake (Munro 1941) but he did not find this grebe nesting elsewhere in the Cariboo parklands (Munro 1945).

The Western Grebe is on the provincial Red List of vertebrate animals as *critically imperilled* during the breeding season and *vulnerable to extirpation* during the nonbreeding season (Fraser et al. 1999; B.C. Conservation Data Centre 2002).

American White Pelican

Pelecanus erythrorhynchos Gmelin

Neither we nor Munro (1958) recorded the American White Pelican on any of the wetlands under consideration. We did observe small numbers loafing at the east end of Williams Lake (9 May-15; 17 May-6; 18 May-6; 4 June-6), which was an area that Munro (1958) did survey; however, he does not report any pelicans in his 1958 report.

Local ranchers told us, however, that prior to our arrival in the study area, pelicans used 2 of the wetlands as staging areas: in early May, 30-40 birds spent a week on 130 Mile Lake (W. Braim and L. Hoium, pers. comm.) and pelicans staged on Mission Ponds 3 in mid-May for 3-5 days both in 2000 and this year (J. Telfer pers.comm.).

The American White Pelican is considered "NOT AT RISK" nationally by COSEWIC (2002); in British Columbia, it is on the provincial Red List as *critically imperilled* during the breeding season (Fraser et al. 1999; B.C. Conservation Data Centre 2002).

American Bittern

Botaurus lentiginosus (Rackett)

The American Bittern is an uncommon summer visitor to the Cariboo parklands (Roberts and Gebauer 1992). It is on the provincial Blue List as a species that is particularly sensitive or vulnerable to human activities or natural events (Fraser et al. 1999; B.C. Conservation Data Centre 2002). In British Columbia, Breeding Bird Surveys over the period 1980-2001 suggest the American Bittern is declining at an average annual rate of 14% ($P<0.01$); however, the data have important deficiencies and should be used with caution (Sauer et al. 2002).

We recorded the American Bittern on 4 different wetlands, 1 of which was during our migration surveys and 3 during our breeding surveys (Fawn

Lake 23 May-2 birds heard at the west end of the lake, Lily Pad Lake 4 June-1 bird heard at the south-east end of the lake, 130 Mile Lake 29 May-1 heard in marsh and 9 June-1 heard and later flushed from a *Typha* marsh as we canoed south up San Jose River and Tad Lake 14 June-1 flushed from *Typha* marsh as we canoed along the lake edge).

One of the biggest direct threats to this secretive heron is the draining and filling of the emergent marshes on which it depends. It has already suffered population declines in the Okanagan valley through such destructive activities (Ministry of Environment, Lands and Parks 1998) and without vigilance, Cariboo populations could suffer the same fate.

The American Bittern will continue to be a component of the avifauna of the Cariboo parklands only if wetlands and their adjacent upland habitat are secure. Maintaining the integrity of larger (>10 ha) wetlands and their emergent marshes (Gibbs et al. 1992), water levels, and wetland functions as well as minimizing direct human disturbance will help ensure that the "booming" of the bittern persists as a familiar sound of the Cariboo wetlands.

Great Blue Heron

Ardea herodias Linnaeus

The Great Blue Heron was not reported by Munro (1958) on any of the wetlands he surveyed, although he does note "eight sight records for localities along the Cariboo Highway [Highway 97] between 100 Mile and 122 Mile" in his 1945 report.

During our June surveys, we recorded this species on 7 wetlands [Irish Lake (1), Fawn Lake (2), Whitehorse Lake (1), 130 Mile Lake (2), and Dewar Lake (2)]. We also recorded 2 herons at Lac la Hache on 11 May, 1 at Dugan Lake on 18 May, 2 at Jones Lake on 22 May, 1 at Fawn Lake on 23 May and 1 at Irish Lake on 23 May.

The Great Blue Heron is a recent addition to the nesting avifauna of the Cariboo. It is not reported as a nesting species in Campbell et al. (1990) but Roberts and Gebauer (1992) note that it nests.

The Great Blue Heron is on the provincial Blue List as *vulnerable to extirpation or extinction* in the breeding season and apparently *secure* in the nonbreeding season (Fraser et al. 1999; B.C. Conservation Data Centre 2002).

Canada Goose

Branta canadensis (Linnaeus)

Canada Goose numbers were substantially higher in 2001, up over 1,700% from Munro's highest figures in 1958. In fact, the Canada Goose was one of the most abundant waterfowl species in our study area, second only to the Lesser Scaup.

We observed a total of 1,012 adults in May 2001 (Appendix III) and 408 adults in June 2001 on counts from all nesting areas. Munro reported only 21 adult geese on 2 wetlands in 1958 and none in the late 1930s or early 1940s (Table 111), although these geese were in the Cariboo parklands at that time (see below).

Of the 30 wetlands or wetland complexes we compared, 25 had evidence of nesting Canada Geese in 2001 (Table 112). Their widespread distribution was 2nd highest of all the waterfowl (similar to Lesser Scaup and Ruddy Duck). Munro reported only 1 nesting record: a brood of 7 young at Simon Lake in 1958.

These comparisons may be somewhat misleading, however, as Munro (1945) notes the Canada Goose as a "common summer visitant" in the area. He further states that

> *It nests in many localities and shows preference for sites on the small islands that feature many of the lakes in this district. Certain islands are occupied each season and sometimes the exact site is used in successive years.*

Munro goes on to describe nests on 105 Mile Lake, Westwick Lakes (east), and a brood on Watson Lake. The discrepancy between Munro (1945) and Munro (1958) may simply be a result of the years Munro chose for his comparative work of 1958. Later, in the early 1960s, Erskine and Stein (1964) note that Canada Goose numbers had probably declined since 1945, "at least in accessible areas," and attributed the decline to disturbance. Nevertheless, there is little doubt that Canada Goose numbers today in the Cariboo parklands have increased significantly since Munro's and Erskine and Stein's time.

Table 112. Comparative statistics for the Canada Goose on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Canada Goose[1]	1938	1958	2001
Number of wetlands with adults		2	25
Total Adults		21	375
Wetlands with nests or young		1	20
Total Nests			3
Total Young		7	406

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Table 111. Some Cariboo wetlands supporting nesting Canada Geese in 2001. The wetlands are listed in order of the highest numbers of young that were found.

Wetland	No. nests	Date	No. young	Date
Boitano Lake	5	20 May	48	7 June
Abel Lake	4	17 May	3	17 May
			39	14 June
Straight Lake	2	15 May	37	8 June
Westwick Lakes (East)	5	20 May	5	20 May
			35	19 June
Soda Lake			31	17 June
Tatton Lake	4	15 May	30	6 June
	1	6 June		
100 Mile Marsh	2	14 May	22	14 May
			28	17 June
Watson Lake			4	11 May
			28	18 June
70 Mile Sloughs	3	24 May	24	24 May
			15	5 June
Dewar Lake	2	18 May	24	16 June
Springhouse Sloughs			23	25 May
			5	7 June
Soda Sloughs	2	10 May	22	17 June
Exeter Lake	3	14 May	20	31 May
			15	20 June
130 Mile Lake			19	9 June
Mission Ponds-1		22 May	15	22 May
			14	13 June
103 Mile Lake	1	13 May	7	13 May
			10	4 June
Fawn Lake			8	15 June
101 Mile Lake	2	11 May	7	30 May
150 Mile Lake	1	18 May	2	18 May
			7	13 June
Simon Lake	1	15 May	6	8 June
Mission Ponds-3	2	22 May	6	22 May
Tad Lake			5	14 June
5 km s Spring-house	1	8 May	5	7 June
105 Mile Lake	1	11 May	3	6 June
Lily Pad Lake	1	17 May	2	4 June
Jones Lake	2	22 May		
Larum's Bay	1	23 May		
	1	15 June		

We located a total of 28 nests, 89% of which were found in May, prior to our breeding surveys. Wetlands containing the highest numbers of goslings included Boitano Lake (48 goslings), Abel Lake (39), Straight Lake (37), Westwick Lakes (east) (35), Soda Lake (31), Tatton Lake (30), 100 Mile House marsh (28) (Figure 185), 70 Mile House sloughs (24), Dewar Lake (24), Springhouse sloughs (23) and Soda Sloughs (22). Our earliest brood date was 11 May 2001.

Relatively large numbers of nonbreeders were found at Springhouse sloughs (238 birds), 130 Mile Lake (155) Jones Lake (55), Simon Lake (45) Tatton Lake (37), 150 Mile Lake (27) and Westwick Lakes (west) (26).

Figure 185. Canada Goose and 7 of 10 chicks, 100 Mile Slough, 14 May 2001.

Munro found 19 Canada Geese on Sepa Lake on 29 July 1958; these birds were likely gathered during the post-breeding moult period. We did not record any Canada Geese on Sepa Lake in May or June 2001, which was surprising considering the adjacent golf links.

In 2001, most Canada Goose nests were located on the top of muskrat lodges built of bulrush (Figure 186). Five nests were found amongst boulders on a small island in Boitano Lake and 2 other nests were found on small islands as well. Other nest sites included the edges of both *Typha* and *Scirpus* marshes and 1 nest was found on a grass sod on a wooden raft (Figure 186).

Clearly, the Canada Goose has increased its numbers in the Cariboo significantly since Munro's time. This expansion has likely resulted from the natural adaptability of the species and numerous transplants of flightless young and adults which occurred from the late 1960s through the 1980s (Sterling and Munro 1988; Campbell et al. 1990a). Breault and Watts (2001) note that counts of Canada Geese in 2001 at their trend wetlands in the interior of the province showed that numbers of total geese were 52% higher than the long term average, but that breeding pairs were 36% lower.


Figure 186. Nesting Canada Goose on muskrat lodge in *Scirpus* marsh, Westwick Lakes (left), and Canada Goose nest on grass sod on wooden raft, Simon Lake, 14 May 2001 (right).

Wood Duck

Aix sponsa (Linnaeus)

We recorded a total of 4 Wood Ducks on 3 of the 30 wetlands or complexes: Elliot Lake, Watson Lake, and 130 Mile Lake. Munro (1958) did not record Wood Ducks in either of his study periods.

The Wood Duck has recently expanded its breeding range northward into the Cariboo region of British Columbia (Hepp and Bellrose 1995). However, Wood Ducks appear to remain rare and locally distributed there, similar to their status in the 1980s (Campbell et al. 1990a), early 1990s (Roberts and Gebauer 1992), and 2001 (Breault and Watts 2001).

Green-winged Teal

Anas crecca Linnaeus

Numbers of Green-winged Teal on the breeding wetlands were down in abundance some 22% in 2001 compared to the highest of Munro's early years, although the number of wetlands we found them on was about the same as Munro's 1938 numbers (Table 113). Breault (In prep.) notes the Green-winged Teal in British Columbia as 1 of 4 species of dabbling duck whose populations are declining. Breault and Watts (2001) note that on their trend wetlands, Green-winged Teal numbers are down about 40% from their long-term (1987-2001) average.

Table 113. Comparative statistics for the Green-winged Teal on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Green-winged Teal[1]	1938	1958	2001
Number of wetlands with adults	14	8	15
Total Adults	77	52	60
Wetlands with nests or young	6	1	
Total Nests			
Total Young	48	9	

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

The largest numbers of adults reported from our June surveys were from Soda Lake (17 June-11) and Mission Ponds 1 [149 Mile Lake] (13 June-11).

The Green-winged Teal is ranked as the 5th most abundant waterfowl species in the Central Interior Ecoprovince (A. Breault pers. comm.); however, it was the 15th most abundant waterfowl on the wetlands in our study area.

Munro reported young in both of his survey years; however, we did not find any young during our surveys in 2001. This is not surprising as the Green-winged Teal is a relatively late nester in the province. Most broods from British Columbia have not been reported until after 3 July (Campbell et al. 1990).

We observed 1 hybrid Green-winged Teal X Northern Pintail at Elliot Lake on 13 May 2001. Hybrids in the wild are rare but have been reported between Green-winged Teal and Northern Pintail, Mallard, American Wigeon, and Northern Shoveler (Johnson 1995).

Mallard

Anas platyrhynchos Linnaeus

In 2001, Mallard numbers were up 27% from the highest of Munro's (1958) counts (Table 114). The number of young we reported was down from

Table 114. Comparative statistics for the Mallard on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Mallard[1]	1938	1958	2001
Number of wetlands with adults	23	15	30
Total Adults	256	96	325
Wetlands with nests or young	7	9	7
Total Nests			2
Total Young[2]	109	112	89

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).
[2] Number of young for 1938 is >109 as Munro (1958) notes "hidden broods" in some cases.

Munro's numbers. The Mallard was the most widely distributed species throughout our study area occurring on all of the 30 wetlands and associated complexes.

Largest numbers of adults recorded during our June surveys were from 105 Mile Lake (6 June-28), Cummings Lake (12 June-27), and Mission Pond 1 [149 Mile Lake] (13 Jun-23).

We recorded 1 nest and 14 broods (2Y-1, 4Y-2, 5Y-1, 7Y-5, 8Y-4, 9Y-1, 11Y-2) from 10 wetlands (Table 114).

The Mallard is ranked as the 3rd most abundant waterfowl species in the Central Interior Ecoprovince (A. Breault, pers. comm.); however, it was the 5th most abundant waterfowl on our wetlands. According to Breault (In prep.), Mallard populations in British Columbia are relatively stable, although their numbers are down some 10% from their long-term (1987-2001) average on trend wetlands (Breault and Watts 2001).

Northern Pintail

Anas acuta Linnaeus

Numbers of Northern Pintail were lower in 2001, down 83% from Munro's (1958) highest counts in the late 1930s-early 1940s. In addition, we found no evidence of breeding, whereas Munro found both young and nests in his surveys during the late 1930s-early 1940s and young in 1958 (Table 115).

Small numbers of adult pintail recorded on our June surveys were found only on 70 Mile House sloughs 1 and 4, 101 Mile Lake, 105 Mile Lake, Springhouse slough 3, and Rush Lake.

The Northern Pintail is subject to population declines and recoveries (Austin and Miller 1995). Continental populations of the species suffered a severe decline between the early 1970s and the early 1990s, dropping from an estimated 6.8 million in 1972 to 2.8 million in 1994 (Austin and Miller 1995). In addition, when drought conditions occur on the Canadian prairies, these birds are known to move to areas further north. Coupled with global warming, these factors may be affecting Northern Pintail numbers in the Cariboo. Breault and Watts (2001) note that on their trend wetlands in interior British Columbia, Northern Pintail numbers are down 58% from their long term (1987-2001) average.

Although the Northern Pintail is listed as a *common* migrant and *fairly common* breeder in the Cariboo (Roberts and Gebauer 1992) the species in our study area was better described as *uncommon*.

Blue-winged Teal

Anas discors Linnaeus

Blue-winged Teal numbers in 2001 were up about 23% compared with Munro's 1958 numbers, the year of his highest counts (Table 116). This duck also had a more widespread distribution in 2001 than in either of the early years.

The largest numbers of adults recorded on our June surveys were from Watson Lake (18 June-24), 70 Mile sloughs (5 June-18), Soda Sloughs (17 June-14) (interestingly, we found 14 Blue-winged Teal but no Green-winged Teal on Soda Sloughs, yet found 11 Green-winged Teal on adjacent Soda Lake but no

Table 115. Comparative statistics for the Northern Pintail on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Northern Pintail[1]	1938	1958	2001
Number of wetlands with adults	12	7	5
Total Adults	64	33	11
Wetlands with nests or young	3	3	0
Total Nests	4	0	0
Total Young	43	31	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Table 116. Comparative statistics for the Blue-winged Teal on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Blue-winged Teal[1]	1938	1958	2001
Number of wetlands with adults	19	16	24
Total Adults	97	147	181
Wetlands with nests or young	2	2	0
Total Nests	0	0	0
Total Young	28	14	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Blue-winged Teal), Elliot Lake 6 June-14, and Mission Ponds-1 [149 Mile Lake] (13 June-11).

The Blue-winged Teal is a *common* breeder in the Cariboo region (Roberts and Gebauer 1992). In 1980 and 1981, Blue-winged Teal were the most abundant dabbling duck species in the Cariboo/Chilcotin (Cooper and Graham 1985).

Breault (pers. comm.) found the Blue-winged Teal to be the 8th most abundant breeding waterfowl in the Central Interior Ecoprovince; in 2001, it had the same ranking in our study area. Breault and Watts (2001) note that on their trend wetlands in interior British Columbia, Blue-winged Teal numbers are up 20% from their long-term (1987-2001) average. In North America, this species has replaced Lesser Scaup as the second most abundant duck (Rohwer et al. 2002).

We recorded 1 Blue-winged Teal X Cinnamon Teal hybrid at Straight Lake on 8 June 2001. Hybrid Blue-winged X Cinnamon Teal have been previously documented in the Cariboo region; hybrid males were found near 100 Mile House and at Puntzi Lake in 1980 (Cooper and Graham 1985). Hybrids of these 2 teal species are not uncommon in areas where the breeding ranges overlap (Gammonley 1996).

Cinnamon Teal

Anas cyanoptera Vieillot

The Cinnamon Teal is far more numerous now in the Cariboo region than it was during Munro's time, with adult numbers up over 1,200% from his highest counts (Table 117). In 2001, it also had a fairly widespread distribution occurring on 18 of the 30 wetlands and complexes we compared as opposed to only 2 during Munro's time.

The Cinnamon Teal is listed as a *fairly common* breeder in the Cariboo parklands (Roberts and Gebauer 1992), and that status seems to apply to our study area in 2001, as well. Breault (pers. comm.) found the Cinnamon Teal the 11th most abundant breeding waterfowl species in the Central Interior Ecoprovince; during our surveys it was ranked number 12 in abundance among the waterfowl. Its numbers may be declining somewhat, however. Breault and Watts (2001) note that on their trend wetlands in interior British Columbia in 2001, Cinnamon Teal numbers had declined 37% from their long-term (1987-2001) average.

The largest adult numbers on our June surveys were found at 70 Mile House sloughs (5 June-10), Watson Lake (18 June-8, Soda Lake (17 June-6), and Exeter Lake (31 May-6).

Munro (1958) also reports 1 hybrid Cinnamon Teal X Northern Shoveler. These hybrids are less common than the Cinnamon X Blue-winged teal we recorded at Straight Lake on 8 June 2001 (Gammonley 1996).

Northern Shoveler

Anas clypeata Linnaeus

In 2001, numbers of Northern Shoveler were up only slightly from those of Munro's highest counts in 1938, but were up 168% from his 1958 numbers (Table 118). The shoveler also had a more widespread distribution in 2001 than in Munro's early years.

The Northern Shoveler is listed as *fairly common* breeder in the Cariboo region (Roberts and Gebauer 1992), and this status was essentially what we found on our study area. Breault (pers. comm.) found the Northern Shoveler the 9th most abundant breeding waterfowl in the Central Interior Ecoprovince; however, on our June surveys, the Northern Shoveler was 15th in abundance amongst the waterfowl.

The Northern Shoveler occurred only in small numbers at most of our wetlands. Largest adult numbers were found at 105 Mile Lake (11 May-28), Elliot Lake (6 June-15), Mission Ponds 1 [149 Mile Lake] (22 May -13), and 70 Mile House sloughs (28 May-11).

Table 117. Comparative statistics for the Cinnamon Teal on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Cinnamon Teal[1]	1938	1958	2001
Number of wetlands with adults	2	0	18
Total Adults	5	0	68
Wetlands with nests or young	1	0	0
Total Nests	1	0	0
Total Young	0	0	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Table 118. Comparative statistics for the Northern Shoveler on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Northern Shoveler[1]	1938	1958	2001
Number of wetlands with adults	9	6	13
Total Adults	52	22	59
Wetlands with nests or young	5	1	0
Total Nests	1	0	0
Total Young	64	11	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Gadwall

Anas strepera Linnaeus

The Gadwall was reported only 4-times by Munro (1945), and one record from Williams Lake is included in his 1958 report. It is not noted in Munro (1958) from any of the comparative wetlands that form part of this study (Table 119); however, he does report it from Tatton Lake in Munro (1945). Later, he reports this species in 1946 near Alkali Lake, some 20 km south of Springhouse and at other locations in the Williams Lake region (Munro 1955). Erskine and Stein (1964) summarize additional early records: in 1952, it was reported from 150 Mile House and in 1954 a nest was found at Cummings Lake. Still, the species must have been very rare even in the late 1950s, as Munro (1958) makes no mention of it. In 2001, however, not only was the Gadwall the most abundant dabbling duck we recorded but it was second in distribution only to the Mallard among the wetlands we studied (tied with the Blue-winged Teal).

These high numbers appear to coincide with a general population increase and range expansion of the Gadwall in the early 1960s. A further increase in population numbers occurred more recently, beginning in the early 1990s (Leschack et al. 1997). In addition, Breault and Watts (2001) note that Gadwall numbers in 2001 were up 41% from their long term (1987-2001) average on trend wetlands in interior British Columbia.

We did not find any nests or broods which is not surprising as the Gadwall typically nests later than other dabbling ducks (Leschack et al. 1997). In British Columbia, most broods are not out until 1 July (Campbell et al. 1990).

Breault (pers. comm.) found the Gadwall the 7th most abundant breeding waterfowl in the Central Interior Ecoprovince; on our June surveys, the Gadwall was 3rd in abundance amongst the waterfowl in our study area.

Largest numbers of adult Gadwall on the nesting areas were found at Westwick Lakes [west] 19 June-194, Soda lake 17 June-23, Westwick Lakes [east] 19 June-21, 105 Mile Lake 6 June-16, Elliot Lake 6 June-14, and Exeter Lake 31 May-14.

Eurasian Wigeon

Anas penelope Linnaeus

We did not record the Eurasian Wigeon on any of our breeding waterbird surveys. However, on 17 May we did observe one male in breeding plumage on a small pond at Roland Fowler's ranch on the road to Tad Lake. The pond was simply a small, open water body with no emergent vegetation and evidence of considerable cattle use. There were a number of other dabbling ducks there, as well as Canada Geese, Lesser Scaup, and some shorebirds. The Eurasian Wigeon is *rare* in the Cariboo (Roberts and Gebauer 1992) although it seems to be increasing its numbers on interior wetlands during the breeding season (Breault and Watts 2001). It was not mentioned as part of the summer avifauna of the Cariboo parklands either by Munro (1945, 1955, 1958), Erskine and Stein (1963), or Campbell et al. (1990).

American Wigeon

Anas americana Gmelin

American Wigeon numbers in 2001 were up about 14% from Munro's counts. As well, this dabbling duck had a more widespread distribution, occurring on 22 of the 30 wetlands and complexes we compared, an increase of over 15% from Munro's earliest surveys (Table 120).

Largest numbers of adults recorded during our June surveys were from Cummings Lake (12 Jun-40), Westwick Lakes (west) (19 Jun-36), Mission Ponds 3 (13 Jun-26), and Exeter Lake (20 Jun-21).

The American Wigeon was the 4th most abundant waterfowl species on Breault's (pers.comm) sur-

Table 119. Comparative statistics for the Gadwall on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Gadwall[1]	1938	1958	2001
Number of wetlands with adults	0	0	25
Total Adults	0	0	359
Wetlands with nests or young	0	0	0
Total Nests	0	0	0
Total Young	0	0	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page122).

Table 120. Comparative statistics for the American Wigeon on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

American Wigeon	1938	1958	2001
Number of wetlands with adults	19	15	22
Total Adults	180	182	207
Wetlands with nests or young	7	8	0
Total Nests	0	0	0
Total Young	50	75	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

veys in the Central Interior Ecoprovince. On surveys in our Cariboo study area, it was the 6th most abundant waterfowl species.

Breault and Watts (2001) note that wigeon numbers on their trend wetlands in interior British Columbia in 2001, are down 13% from their long-term (1987-2001) average. However, that does not appear to be the situation throughout most of the species' range (Mowbray 1999).

Canvasback

Aythya valisineria (Wilson)

Canvasback numbers in 2001 were down 53% from Munro's highest counts in 1938 (Table 121). This bird's distribution over the 30 wetlands and complexes we compared was also down.

In 2001, we recorded 1 nest with eggs (constructed principally of *Scirpus* stems over 68 cm of water; contained 11 eggs) and 4 broods (3Y-2, 4Y-1, 8Y-1) (Figure 187) totalling 18 young. On the comparative wetlands (Table 121), numbers of young were also down some 96% and 82% between 1938 and 1958 respectively. In addition, young were reported from far fewer wetlands than in either of Munro's (1958) study years. The earlier dates of our study likely played some role in the difference between our brood counts and those of Munro. However, there is little doubt the Canvasback is not as common a bird on Cariboo wetlands as it once was.

Canvasback numbers in British Columbia appear to be declining (Breault In prep.), although their 2001 numbers on trend wetlands in the interior of the province were up 18% from their long-term (1987-2001) average (Breault and Watts 2001). An apparent decline has also been noted continent-wide. Over the period 1955 through 1993, in spite of management efforts, their numbers declined at an average annual rate of 0.6% (Hohman et al. 1995). The Canvasback was the 15th most abundant waterfowl species on Breault's (pers. comm.) surveys in the Central Interior Ecoprovince; on our study area, the Canvasback ranked 17th.

Largest numbers of adults recorded during our June surveys were from Watson Lake (18 June-10), Tatton Lake (6 June-3), Soda Sloughs (17 June-3), Elliot Lake (6 June-3), and 105 Mile Lake (6 June-3).

Table 121. Comparative statistics for the Canvasback on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Canvasback[1]	1938	1958	2001
Number of wetlands with adults	14	12	10
Total Adults	60	35	28
Wetlands with nests or young	14	6	2
Total Nests	2	1	1
Total Young	234	56	10

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Figure 187. Canvasback hen and young on Dugan Lake, 16 June 2001.

Redhead

Aythya americana (Eyton)

Erskine and Stein (1964) note that "Munro's data (1958) suggest an increase in the past 20 years; other observations support that impression." The increase has apparently continued. In 2001, Redhead numbers were up 63% from Munro's highest year (1958) and we recorded this diving duck on twice as many wetlands as did Munro (Table 122).

Ducks Unlimited Canada's wetland management activities in the Cariboo parklands have likely played a role in the continued increase of Redhead

Table 122. Comparative statistics for the Redhead on 33 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Redhead[1]	1938	1958	2001
Number of wetlands with adults	5	6	12
Total Adults	14	68	111
Wetlands with nests or young	1	2	2
Total Nests	1	0	6
Total Young	0	29	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

numbers and other species, such as Ring-necked and Ruddy ducks and Black Tern, that depend upon wetlands with stable water levels and their associated emergent marsh fringes.

Based on Breeding Bird Surveys, Redhead numbers continent-wide have increased at an average annual rate of 2.7% over the period 1966-2001 (Sauer et al. 2002). In British Columbia, Redhead populations appear to be relatively stable (Breault In prep.) although their 2001 numbers on trend wetlands in the interior of the province were down 22% from the long-term (1987-2001) average (Breault and Watts 2001). The Redhead is ranked as the 12th most abundant waterfowl species in the Central Interior Ecoprovince of British Columbia (A. Breault pers. comm.); on our study area it ranked 11th.

Largest numbers of adult Redheads recorded during our June surveys were from Westwick Lakes (west) (Munro's Sorenson Lake) 19 June-29, Elliot Lake 6 June-27, and Westwick Lakes (east) 19 June-10.

We located 5 Redhead nests with clutches of 11, 9, 4, 3, and 2 eggs; another nest was in water too deep (over 105 cm) to check; however, we could see at least 1 egg. Five of the nests were constructed primarily of *Scirpus* stems, the other was built mainly from *Typha* stems. Nest height above water ranged from 2-14 cm; water depth below the nest ranged from 25 to over 105 cm.

Ring-necked Duck

Aythya collaris (Donovan)

Ring-necked Duck numbers in 2001 increased by over 350% on the study area when compared with Munro's highest counts in 1938; the species also has a far more widespread distribution, occurring on 18 of the 30 wetlands and complexes we studied (Table 123).

Table 123. Comparative statistics for the Ring-necked Duck on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Ring-necked Duck[1]	1938	1958	2001
Number of wetlands with adults	6	4	18
Total Adults	19	9	87
Wetlands with nests or young	3	2	0
Total Nests	0	0	0
Total Young	41	16	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Breeding Bird Surveys suggest that continent-wide numbers of this duck have had an average annual increase of 3.7% over the period 1966-2001 (Sauer et al. 2002). In interior British Columbia in 2001, numbers of Ring-necked Ducks on trend wetlands were also up (12%) from the long-term (1987-2001) average (Breault and Watts (2001) .

Largest numbers of adults reported from our June surveys were from Straight Lake (8 June-14), 130 Mile Lake (9 June-10), and Dugan Lake (16 June-10).

We failed to record broods for this species, which is not surprising in that most broods in British Columbia do not appear until early July (Campbell et al. 1990).

Breault (pers. comm.) notes that, in the Central Interior Ecoprovince, this species is ranked 10th in abundance of all the waterfowl; it had the same ranking on our study area.

Figure 188. Lesser Scaup pair (top) loafing at Watson Lake, 16 June 2001 (Photo: A.C. Stewart). Lesser Scaup nest and eggs (bottom) at 101 Mile Lake, 20 June 2001.

Table 124. Comparative statistics for the Lesser Scaup on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Lesser Scaup[1]	1938	1958	2001
Number of wetlands with adults	22	17	29
Total Adults[1]	734	338	992
Wetlands with nests or young	5	5	1
Total Nests	0	0	1
Total Young	220	45	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Table 125. Comparative statistics for the White-winged Scoter on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

White-winged Scoter[1]	1938	1958	2001
Number of wetlands with adults	3	5	6
Total Adults	75	60	33
Wetlands with nests or young	0	0	0
Total Nests	0	0	0
Total Young	0	0	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Lesser Scaup

Aythya affinis (Eyton)

In 2001, Lesser Scaup numbers were 33% higher than those of Munro's highest year of 1938 (Table 124); the bird's widespread distribution over the wetlands was second amongst the waterfowl, tied with Canada Goose and Ruddy Duck.

The Lesser Scaup (Figure 188), the most abundant diving duck in North America (Austin et al. 1998), was also the most abundant of all the waterfowl in our study area. Munro (1958) states that the "lesser scaup is probably the most abundant duck in the Cariboo Parklands…." However, Breault (pers. comm.) notes that, of the waterfowl in the Central Interior Ecoprovince, the Lesser Scaup is 6th in abundance.

In June 2001, the largest numbers of adults were reported from Tatton Lake (6 June-135), Elliot Lake (6 June-124), Watson lake (18 June-80), and 105 Mile Lake (6 June-70). Most of these birds were likely yearling nonbreeders. Munro (1958) mentions congregations on 103 Mile lake, 105 Mile Lake, and Watson Lake the numbers of which varied from day to day.

We were surprised, after checking what appeared to be suitable Lesser Scaup nesting habitat on a number of wetlands, to find only one nest (Figure 188). Most Lesser Scaup broods in British Columbia were reported after 18 July (Campbell et al. 1990a), which no doubt accounts for our lack of brood observations in 2001.

Breault (In prep.) notes that Lesser Scaup populations in British Columbia are declining. Continent-wide trends based on Breeding Bird Surveys suggest a stable population (Sauer et al. 2002). Global warming may be having an effect on this species (Breault pers. comm.).

Surf Scoter

Melanitta perspicillata (Linnaeus)

Munro (1958) did not report the Surf Scoter on any of his June counts, although in an earlier paper (Munro 1945), he does note a young female on 10 July 1941, at Boitano Lake, adding that the bird was not there in June. In 2001, we recorded the Surf Scoter twice: Watson Lake (6 June-5) and Cummings Lake (12 June-1).

We also recorded this scoter from 9 different lakes during our spring migration surveys: Lac la Hache 10 May-26 and 30 May-10, Soda Lake 10 May-8, 105 Mile Lake 11 May-7, Watson Lake 11 May-28, Exeter Lake 14 May-2, Simon Lake 15 May-2, Tad Lake 17 May-8, Dugan Lake 18 May-113, and Boitano Lake 20 May-14.

Breault and Watts (2001) note that Surf Scoter numbers on their interior trend wetlands were up 80% from the long-term (1987-2001) average.

The Surf Scoter is on the provincial Blue List specifically because of the small provincial breeding population and their declining trends in western North America (Fraser et al. 1999; B.C. Conservation Data Centre 2002).

White-winged Scoter

Melanitta fusca (Linnaeus)

White-winged Scoter numbers were down 56% from Munro's highest counts; they were found on 1 additional wetland (Table 125).

Goudie et al. (1994) note that the current 10-year population trend for this species is "possibly unchanged in North America." However, in 2001, surveys numbers from trend wetlands in British Columbia were down 24% from the long-term (1987-2001)

Table 126. Comparative statistics for the Bufflehead on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Bufflehead	1938	1958	2001
Number of wetlands with adults	23	11	23
Total Adults[1]	271	81	210
Wetlands with nests or young	14	2	4
Total Nests	1	0	2
Total Young	151	12	23

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

average (Breault and Watts 2001). In addition, British Columbia wintering numbers based on Christmas Bird Counts, show an average annual decline of 4% (P<0.10) (Sauer et al. 1996).

Munro (1958) reports White-winged Scoter broods from 103 Mile Lake and 105 Mile Lake, but not for the seasonal time period under comparison.

This scoter was the 16th most abundant of the waterfowl in our study area. A. Breault (pers. comm.) notes that this species is 19th in abundance of the waterfowl in the Central Interior Ecoprovince.

Largest numbers in 2001 were reported from Simon lake (8 June-12) and 103 Mile Lake (1 June-8).

Bufflehead

Bucephala albeola (Linnaeus)

In 2001, Bufflehead numbers were down 23% from Munro's highest count in 1938, although their distribution was similar to what Munro found that year; our numbers were up 159% from his 1958 surveys (Table 126).

Erskine and Stein (1964) note the Bufflehead had possibly "decreased in numbers since Munro's studies," which seems correct in that Munro's 1958 numbers are down 81% from his 1938 counts. Breault and Watts (2001) found Bufflehead numbers on their trend wetlands up 17% from the long-term (1987-2001) average. Breeding Bird Survey trends from British Columbia over the period 1966-2001 suggest populations are stable (Sauer et al 2002).

The Bufflehead was 7th in abundance of all the waterfowl on our study area; in the Central Interior Ecoprovince, it is 2nd in abundance (Breault pers. comm.)

We found 2 nests, both in cavities in trembling aspen and both likely used by the same female. The first cavity was 10 m from the ground and was discovered after a strong wind blew the top off the aspen, splitting the trunk at the cavity entrance (see page 23). A female Bufflehead was seen flying from the area of the nest tree and fresh down was found around the cavity entrance. The second nest, a few metres away from the first, was active several weeks later, and was in a cavity with the entrance 2.24 m above the ground; the cavity entrance was 7 cm in diameter.

Young numbers were down 86% from Munro's high count of 1938 (Table 126); some of that difference could be attributed to the fact that 18 of our 50 wetlands were surveyed earlier than Munro's survey dates. Most Bufflehead young in British Columbia are not on the water until 24 June (Campbell et al. 1990a). We recorded a total of 5-broods (4Y-2, 5Y-2, 6Y-1) on 5 wetlands.

Highest adult numbers in June were reported from 105 Mile Lake (6 June-40), Watson Lake (6 June-20), and Cummings Lake (12 June-19).

Logging and agricultural clearing have eliminated nesting habitat throughout much of western North America (Gauthier 1993). As an obligate cavity nester, the Bufflehead is limited in distribution by lack of nest sites. Nest site availability is related to density of Northern Flickers (*Colaptes auratus*), durability of cavities, and competition with other cavity nesters (Gauthier 1993).

Trembling aspen is the most important nest tree for Bufflehead in British Columbia (Campbell et al. 1990a). Because their nest cavities average about 15 cm in diameter, trees with a Diameter at Breast Height of at least 19 cm are necessary and should be retained around lakes and wetlands. Best management practices, such as those outlined in the Riparian Management Area Guidebook (Ministry of Forests 1995), should be followed as a minimum, which requires riparian buffers ranging from 10 to 50 m depending on the type of lake or wetland.

Nests boxes are quickly adopted by Bufflehead and can be an effective management tool where nesting habitat has been destroyed by human activities; however, see Barrow's Goldeneye, p. 141.

Table 127. Comparative statistics for the Common Goldeneye on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Common Goldeneye[1]	1938	1958	2001
Number of wetlands with adults	0	0	13
Total Adults	0	0	69
Wetlands with nests or young	0	0	6
Total Nests	0	0	0
Total Young	0	0	93

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Figure 189. Common Goldeneye with brood at Simon Lake, 8 June 2001.

Figure 190. Barrow's Goldeneye pair at Simon Lake, 8 June 2001.

Common Goldeneye

Bucephala clangula (Linnaeus)

The Common Goldeneye was not reported at all by Munro (1958) (Table 127) but was our 13th most abundant waterfowl species. In the Central Interior Ecoprovince, it is ranked 16th in abundance of all the waterfowl (Breault pers. comm.).

Munro (1945) notes the species as a regular transient in early spring and late autumn. His latest spring record was an adult male at Springhouse Prairie on 18 May 1942. He notes only one summer record, that of a moulting drake on 105 Mile Lake, 28 June 1941. In Erskine and Stein's (1964) re-evaluation of the Cariboo avifauna, they note only an adult drake Common X Barrow's goldeneye taken at Westwick Lakes on 13 May 1954.

The species was not known as a component of the breeding avifauna of the Cariboo parklands until the early 1980s (Campbell et al. 1990a). In the late 1980s, J. Eadie found the Common and Barrow's goldeneye occurring in a ratio of about 1:3 on his study area between 100 Mile House and 148 Mile House (Campbell et al. 1990a). The ratio of adult Common to Barrow's goldeneye on our study area was about 1:2.

While Common Goldeneye numbers in the Cariboo parklands have increased since Munro's (1958) work, Breault (In prep) notes that across British Columbia, their numbers are apparently decreasing. Numbers in 2001 on trend wetlands in the interior were down over 70% from their long-term (1987-2001) average (Breault and Watts 2001) and the species has shown a decline each year since their numbers peaked in 1996 (Breault and Watts 2001). However, continent-wide populations are apparently stable (Eadie et al. 1995).

Largest numbers of adults reported in June were from Watson Lake (18 June-22), 103 Mile Lake (4 June-9) Elliot Lake (6 June-8), and Cummings Lake (12 June-7).

We recorded a total of 15 broods (Figure 189) with 93 young (2Y-3, 3Y-2, 5Y-1, 6Y-3, 7Y-1, 8Y-1, 9Y-1, 10Y-1, 11Y-1, 13Y-1) from 7 wetlands (Table 127). Two Common Goldeneye broods also contained Hooded Merganser young. In an Ontario study, 20% of nest boxes used by Common Goldeneyes were parasitized by the Hooded Merganser and 7% of goldeneye broods contained merganser ducklings (Eadie and Lumsden 1985).

Barrow's Goldeneye

Bucephala islandica (Gmelin)

Barrow's Goldeneye (Figure 190) numbers were down 14% from the highest counts Munro (1958) made and the distribution of this species was somewhat reduced, although they were similar to Mun-

Table 128. Comparative statistics for the Barrow's Goldeneye on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Barrow's Goldeneye[1]	1938	1958	2001
Number of wetlands with adults	23	18	18
Total Adults	168	142	144
Wetlands with nests or young	18	12	3
Total Nests	0	1	0
Total Young	289	227	36

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

ro's counts in 1958. This goldeneye was found on 23 of the 30 wetlands and complexes in 1938 compared to its presence on 18 in 1958 and 2001 (Table 128).

We found 6 broods (4Y-1, 5Y-2, 6Y-1, 7Y-1, 9Y-1) from 3 wetlands (Table 128). Numbers of young were down 87% from the highest counts Munro reported (1938). Some of that decrease could be attributed to the fact that all our surveys ended in late June while 35% of the comparative surveys Munro completed were conducted well into July when more broods would be on the water.

Breault and Watts (2001) note that Barrow's Goldeneye numbers on trend wetlands in the interior of the province in 2001 were down 21% from their long-term (1987-2001) average. Breault (pers. comm.) suggests that this apparent decline may simply be an artefact of the numerous studies that took place in the 1980s and the accompanying increase in nest boxes that were added as a habitat component over that period. No longer maintained, the boxes have fallen into disrepair and the Barrow's Goldeneye population is simply returning to its pre-1980 levels.

However, our study shows that there are smaller numbers of this goldeneye in 2001 compared with Munro's earliest years, at least within our study area and suggests the decline may be real, which could be grounds for concern.

Recreational development on nesting lakes and loss or degradation of nesting habitat, including the lowering of water levels, filling of wetlands or removal of older nest trees through logging activities are potential threats to this species and the other cavity nesting waterbirds of the Cariboo parklands.

What effect the recent arrival of the Common Goldeneye has had on Barrow's Goldeneye numbers in the Cariboo parklands is not known. Although both goldeneyes appear to exclude all congeners from their territories (Eadie et al. 1995; Eadie et al. 2000), the Barrow's Goldeneye is apparently the more aggressive of the 2 species (Savard 1987; Eadie et al. 1995). On the other hand, the earliest Common Goldeneye nest initiation date in the Cariboo parklands was 5-days earlier than the earliest Barrow's Goldeneye date (Edie et al. 1995; Edie et al. 2000). With a scarcity of available nest sites and an added competitor, the Common Goldeneye, it seems likely that the Barrow's Goldeneye would suffer; however, this is an area for further study.

The restricted distribution of this species, with over 60% of the world population breeding and wintering in British Columbia (Savard 1987), means that negative activities affecting goldeneye habitat on the British Columbia breeding grounds could have significant repercussions to the relatively small global population. As Eadie et al. (2000) point out, the fact that females breed only after their second year, are highly philopatric to the natal area and normally do not re-nest following nest loss, make potential recovery of local populations slow if adult numbers are severely reduced.

The Barrow's Goldeneye readily uses nest boxes (Eadie et al. 2000). However, populations dependent on nest boxes are only as secure as the people willing to manage them. We believe that the ultimate goal in the Cariboo parklands should be the restoration and protection of the nesting habitat of this goldeneye and, indeed, all the waterbirds of the region.

Studies in the Cariboo parklands have shown that Barrow's Goldeneye using natural cavities nest, on average, 13.7 m ± 19.9 m SD (range: 0-103 m) from the forest edge (M. Evans pers. comm.). This would suggest that to ensure the protection of most of the goldeneye's natural cavities, a forested buffer of at least 75 m is required. Current Best Management Practices recommend riparian buffers ranging from 10 to 50 m depending on the type of lake or wetland (Ministry of Forests 1995). Since forest management practices in British Columbia can have an effect on the world population of this particular species, a larger buffer than the range recommended is warranted.

Despite over 20 yr of concentrated study of this goldeneye, numbers still appear to be down from Munro's earliest surveys. We wonder how many study recommendations from the research have yet to be applied on the ground. As Hilborn (1992) notes, "If you cannot respond to what you have learned, you really have not learned at all."

Table 129. Comparative statistics for the Hooded Merganser on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Hooded Merganser[1]	1938	1958	2001
Number of wetlands with adults	2	0	2
Total Adults	6	0	9
Wetlands with nests or young	0	0	2
Total Nests	0	0	0
Total Young	0	0	4

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Hooded Merganser

Lophodytes cucullatus (Linnaeus)

Hooded Merganser numbers were up slightly in 2001 compared with the Munro early years (Table 129); however, this is not a common species on the study area nor anywhere in the Cariboo (Roberts and Gebauer 1992). Hoodies were 18th in abundance of the water-

Figure 191. One of 2 downy Hooded Merganser young that were found dead at Soda Sloughs, 8 June 2001. This bird was lying on the edge of a Canvasback nest.

fowl on our study area; in the Central Interior Ecoprovince they are 17th in abundance (Breault pers. comm.).

We found 5 living and 2 dead young (Figure 191) on 3 different wetlands. Three young and one young were attached to Common Goldeneye broods of 6 and 5 respectively. One young was found on its own at Soda Sloughs along with 2 dead siblings.

Highest numbers of June adults were reported from 2 widely separate locations within the study area: Straight (4 birds) and Simon (5) lakes and Irish (2) and Fawn (3) lakes. We did not record any adults on Soda Sloughs.

Breault and Watts (2001) note that on their trend wetlands, Hooded Merganser numbers were down 40% from the long-term (1987-2001) average.

Common Merganser

Mergus merganser Linnaeus

Although Roberts and Gebauer (1992) note this merganser as fairly common in the Cariboo during the summer, we recorded the species only once: Larum's Bay, Horse Lake 15 June-1 female. Young were not found.

Munro (1958) only recorded this merganser once as well: a female with 7 young, also at Larum's Bay, on 18 August 1937. In our study area, the Common Merganser does not appear to be a significant component of the nesting waterfowl population.

The long-term (1987-2001) average from trend wetlands in British Columbia was 2 birds; none was reported from those wetlands in 2001 (Breault and Watts 2001).

Table 130. Comparative statistics for the Ruddy Duck on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

Ruddy Duck[1]	1938	1958	2001
Number of wetlands with adults	16	12	27
Total Adults	145	56	347
Wetlands with nests or young	6	0	4
Total Nests	0	0	9
Total Young	31	0	0

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Ruddy Duck

Oxyura jamaicensis (Gmelin)

Ruddy Duck numbers were up nearly 140% from Munro's highest counts and we found this "stifftail" on 81% more of the wetlands than did Munro (Table 131). In fact, the Ruddy Duck was the 4th most abundant waterfowl on our study site. Breault and Watts (2001) also found this duck's numbers up 30% from the long-term (1987-2001) average on their trend wetlands in the province. Global warming may be playing a role here.

We recorded 9 nests with eggs (1E-2 [1 with 11 Lesser Scaup eggs], 3E-1 [with 9 unidentified teal eggs], 6E-1, 7E-1 [with 3 Redhead eggs, Figure 192], 9E-1, 11E-2, 12E-1). The nest with 9 eggs was built directly on top of another nest with 11 eggs. Nests were found over water depths ranging from 9-50 cm; mean water depth was 36 cm ± 0.14 cm SD.

Figure 192. Ruddy Duck nest and eggs at Mission Ponds slough 2, 8 June 2001. The nest held 7 Ruddy Duck eggs and 3 Redhead eggs; the 2 eggs on the far right of the clutch are Redhead eggs.

We failed to record any Ruddy Duck young. However, most young in British Columbia will not seen until August (A. Breault, pers. comm.), which is a change from even that reported in Campbell et al. (1990a).

Highest numbers were reported from 105 Mile Lake (4 June-51, Westwick Lakes (west) (19 June-40), Westwick Lakes (east) (19 June-29), Watson Lake (18 June-29), and Elliot Lake (6 June-20).

Peregrine Falcon

Falco peregrinus Bonaparte

We recorded the Peregrine Falcon only twice during our fieldwork: on 22 May, 1 bird was seen flying over pastureland adjacent to Highway 97 south of Mission Ponds and on 7 June, 1 flew across Boitano Lake and perched in trees on the western shore. The latter bird had a full crop.

In the 1940s, Munro (1945) reported this bird only "occasionally in late summer and autumn," and it was not known to nest in the region. Nesting has since been documented for the Cariboo region (Roberts and Gebauer 1992).

The *anatum* subspecies of this falcon is on the COSEWIC list as Threatened (COSEWIC 2002). It is also on the provincial Red List due to its small breeding population (Fraser et al. 1999; B.C. Conservation Data Centre 2002).

Prairie Falcon

Falco mexicanus Schlegel

We recorded this species only once during the field season. On 1 June, at 101 Mile Lake, Yellow-headed Blackbirds and then Black Terns began to give warning calls long before we saw the falcon. The falcon appeared directly over the lake and made 1 stoop at some terns before flying off.

In the Springhouse region, Munro (1945) reports what he believed to be the same bird on 3 separate occasions. They were his only reports of this species. It is now known to breed in the Cariboo region (Campbell et al. 1990b).

The Prairie Falcon is on the provincial Red list due to its small, sparse breeding population (Fraser et al. 1999; B.C. Conservation Data Centre 2002).

Figure 193. Sora skittering across a mat of floating, residual *Scirpus* stems at 101 Mile Lake, 20 June 2001.

Virginia Rail

Rallus limicola Vieillot

Munro (1945) notes this rail as "less common than the Sora," and our results suggest that has not changed. Roberts and Gebauer (1992) list the Virginia Rail as rare.

This secretive rail was recorded 9-times from 5 wetlands; however, specific attempts to locate rails at each of the 50 wetland we surveyed were not made.

We found 1 nest with 3 eggs at 103 Mile Lake (see Figure 56, page 43). The nest was located in a Scirpus marsh and consisted of a *Scirpus* "basket" with the eggs situated about 6 cm above the water.

Current trends based on Breeding Bird Surveys suggest increasing numbers both across Canada and continent-wide; however, these data have important deficiencies (Sauer et al. 2002). There are no data, of which we are aware, regarding Virginia Rail populations and trends from British Columbia generally and the Cariboo parklands in particular. Our highest numbers were from Tad Lake (14 June-4).

Nevertheless, in areas where this rail has been studied, researchers have found that managing habitat for waterfowl is compatible with the breeding habitat requirements of the Virginia Rail (Johnson and Dinsmore 1986). It prefers wetlands with 50% upright emergent vegetation and the remainder a combination of flooded openings (which increase insect abundance), mudflats, and matted vegetation (Conway 1995).

Sora

Porzana carolina (Linnaeus)

We recorded the Sora (Figure 193) on 22 of the 38 wetlands or complexes a total of 48 times, although specific attempts to locate this rail at each wetland were not made. Highest numbers on our June surveys were from Jones Lake (18 June-10), Dugan lake (16 June-6), and Exeter Lake (20 June-6). On 14 June, we found a nest containing 6-eggs and 1-young in a *Carex* meadow at Abel Lake (see Figure 74, page 53).

Figure 194. Examples of variation in American Coot nests in the Cariboo parklands: (a) typical *Scirpus* nest in fairly dense *Scirpus* marsh with a "ramp" extending from the water to the nest [103 Mile Lake, 13 May 2001]; (b) a few nests, such as this one, were fairly open [103 Mile Lake, 4 June 2001]; (c) on a number of nests, the coots had bent adjacent *Scirpus* stems down over the top of the nest, presumably for concealment [Dugan Lake, 16 June 2001]; (d) nest built at the base of a birch cluster with pine needles as a part of the nest materials [Watson Lake, 18 June 2001]; (e) hazards of incubation: a predator, likely a Great-horned Owl, had killed the incubating bird and eaten it on the nest (note the feathers in the foreground and bones in the upper left) [70 Mile House slough 7, 5 June 2001]; (f) *Typha* nest containing eggs and a recently hatched young [Mission Ponds, slough 2, 13 June 2001].

Breeding Bird Survey data indicate a stable population in British Columbia; however, there are important deficiencies in the data, which should be taken into consideration (Sauer et al. 2002).

Highest breeding densities of the Sora have been found in the shallow edge portions of wetlands where the fluctuating water levels provide a variety of fine and robust emergent vegetation (Melvin and Gibbs 1996), such as that found at Jones Lake.

We are unaware of any population data for this species in British Columbia. As with all marsh-dependent species, preservation of wetlands and their attendant functions, especially those with diverse stands of *Carex* meadows and *Scirpus* or *Typha* marshes, is a prerequisite to the maintenance of healthy Sora populations in the province.

American Coot

Fulica americana Gmelin

The American Coot was the 3*rd* most abundant of the waterbirds we surveyed. Adult numbers on our June surveys were up 160% from Munro's highest counts (Table 132). The coot had a widespread distribution on our study area, second only to the Mallard; it occurred on 28 of the 30 wetlands and complexes we surveyed.

We also reported far more nests than did Munro (1958), although young numbers were down likely because Munro surveyed 18 of the wetlands later than we were able to do. Nevertheless, nests or young were found on 57% of the 30 comparative wetlands in 2001 compared to 43% in 1938 (Table 132).

By the end of May, we had recorded 8 nests with eggs (4E-1, 5E-2, 6E-1, 9E-2, 11E-2). In our June breeding bird surveys, we recorded 91 nests with eggs (1E-7, 2E-10, 3E-6, 4E-5, 5E-11, 6E-15, 7E-12, 8E-10, 9E-6, 11E-5, 12E-3, 16E-1); 11 nests with both eggs and young (1E1Y-2, 1E3Y-2, 1E5Y-2, 2E1Y-1, 2E3Y-1, 3E1Y-2, 4E1Y-1); 6 nests with young only (1Y-2, 3Y-4); and an additional 21 nests that were either new or the young had fledged. A total of 88 fledged young were observed.

Table 131. Comparative statistics for the American Coot on 30 wetlands or wetland complexes in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938), 1958, and 2001.

American Coot	1938	1958	2001
Number of wetlands with adults	22	16	28
Total Adults[1]	295	201	766
Wetlands with nests or young	13	8	17
Total Nests	0	10	102
Total Young	147	154	94

[1] Irish, Fawn, Dugan and Dewar lakes and Larum's Bay surveys have been excluded from this table (see note on page 122).

Of 119 nests, 107 were found in *Scirpus* marshes, 7 in *Typha* marshes, 2 in mixed *Typha-Salix* marsh-riparian, 2 in mixed *Typha-Scirpus* marsh and 1 in an area of flooded *Betula*-riparian habitat. Nests (Figure 194) (n=108) were constructed primarily of *Scirpus*, occasionally with some *Carex*, grasses, sago pondweed, and 1 nest contained pine needles; 11 nests were composed of *Typha.* Of 70 nests where complete descriptions were recorded, 66 had a ramp running from the water to the nest (Figure 194a). A number of nests had the adjacent *Scirpus* pulled over or "domed" for concealment (Figure 194c).

Nest height above water (n=111) ranged from 1 cm–35 cm with a mean height of 10 cm ± 5 cm SD. Water depth under the nest ranged from 18 cm–133 cm with a mean depth of 60 cm ± 23 cm SD.

Breeding Bird Surveys suggests that continent-wide, American Coot populations appear to be stable (Sauer et al. 2002).

Sandhill Crane

Grus canadensis (Linnaeus)

In spring, the main crane migration moves through the Cariboo in late April and early May (Campbell et al. 1990b), thus we were not in the area during the main period of movement. In 2001, we recorded birds from 4 different wetlands: Simon Lake (15 May-1, Figure

Figure 195. Sandhill Crane along the south shore of Simon Lake, 15 May 2001. The bird acted in an agitated manner; however, a nest was not found.

Figure 196. Sandhill Crane nest and eggs (left) and close-up of incubating bird (right), 70 Mile House slough 7, 5 June 2001.

195 and 8 June-4 flying high over the lake), Springhouse slough 4 (8 May-1 and 25 May-2), 70 Mile House slough 7 (5 June-2 heard southwest of slough), and Abel Lake (14 June-2).

The 2 birds at 70 Mile House slough 7 were nesting (Figure 196). The nest, which held 2 eggs, was a large mound composed of dead *Scirpus* stems with fine *Scirpus* stems lining the nest; water depth at the nest was 46 cm.

Munro (1958) does not mention this crane; however, it is mentioned in his earlier (1945) work. There he describes it as a "summer visitant ... nesting in the more remote swamps between Chimney Creek Valley and Lac la Hache, east of that lake and elsewhere on both sides of the Fraser River Valley." He also notes that in 1942, up to 5 birds were seen a number of times at Springhouse Prairie.

Today, the Sandhill Crane is considered *fairly common* in summer and *common* during migration in the Cariboo parklands (Roberts and Gebauer 1992). Evidence suggests that the Cariboo birds form part of a small population of around 6,000 Greater Sandhill Cranes (*G.C. tabida*) that winters in the Central Valley of California and breeds in California, Oregon, and British Columbia. If so, the Cariboo birds represent a disjunct population of around 2,000 birds of this race (Campbell et al. 1990b). The evidence for the origins of this small population could be corroborated or refuted by further study.

In British Columbia, Breeding Bird Surveys indicate that for the period 1966-2001, the Sandhill Crane increased its numbers at an average annual rate of nearly 14% ($P<0.02$); however, this figure is based on a sample size of only 9.

The Sandhill Crane is on the provincial Blue List as a species of Special Concern (Fraser et al. 1999; B.C. Conservation Data Centre 2002).

The Sandhill Crane is particularly sensitive or vulnerable to human activities, such as logging to the shoreline of nesting marshes and haying of wetland

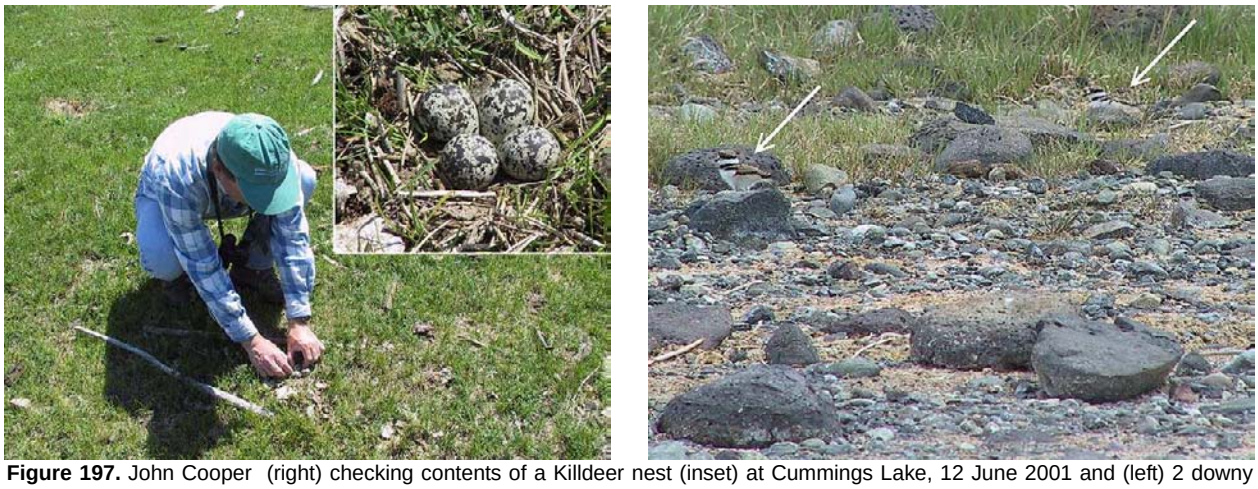

Figure 197. John Cooper (right) checking contents of a Killdeer nest (inset) at Cummings Lake, 12 June 2001 and (left) 2 downy Killdeer young (arrows) at Boitano Lake, 7 June 2001.

Figure 198. Spotted Sandpiper foraging along the shores of Boitano Lake, 7 June 2001.

meadows (Cooper 1995), or natural events. Tacha et al. (1992) note that "should population declines occur, low annual recruitment rates limit the ability of this species to recover quickly."

Killdeer

Charadrius vociferous Linneaus

We recorded 75 adult Killdeer from 20 wetlands or complexes on our June surveys. We also recorded 2 nests (Figures 162 and 197) and 16 broods totalling 39 young, which were associated with 5 wetlands. Largest numbers were reported from Boitano Lake (7 June-24 adults, 35 young) and Soda Lake (17 June-14 adults, 1 young).

As Killdeer are not known to feed their chicks, they must lead them to a feeding area soon after the eggs have hatched (Jackson and Jackson 2000). Boitano Lake (see page 97) appears to be an important rearing area; adult Killdeer with young occurred, on average, about every 380 m around the lake shore.

Breeding Bird Surveys over the period 1980-2001 suggest that Killdeer numbers in British Columbia have declined at an average annual rate of 1.8% (P<0.08). Over the same period across Canada, the species showed declines at an average annual rate of 3.6% (P<0.0); declines have also been detected continent-wide (Sauer et al. 2002).

Munro (1945) described the Killdeer as a common summer visitant and that status does not appear to have changed based on our observations.

Spotted Sandpiper

Actitis macularia (Linnaeus)

We recorded 69 Spotted Sandpipers from 14 wetlands or complexes. Largest numbers were reported from Boitano Lake (7 June-20) (Figure 198) and Cummings Lake (12 June-15).

Breeding Bird Surveys in British Columbia, suggest that Spotted Sandpiper populations in the province are relatively stable (Sauer et al 2002). Across Canada, these surveys suggest that populations of this sandpiper have declined at an average annual rate of more than 2% (P<0.07) over the period 1980-2001.

Long-billed Curlew

Numenius americanus Bechstein

We have one observation of a Long-billed Curlew. On 8 May a solitary bird was seen chasing a Red-tailed Hawk and then a Northern Harrier before landing in the agricultural fields just west of Boitano Lake.

The long-billed Curlew is listed by COSEWIC as a species of Special Concern (COSEWIC 2002). It is also on the provincial Blue List (Fraser et al. 1999; B.C. Conservation Data Centre 2002).

Caspian Tern

Sterna caspia Pallas

We recorded the Caspian Tern on only 2 occasions during our fieldwork. On 3 June, a single bird was seen near the intersection of Bullack Lake Road and Highway 97 flying west and on 8 June, 2 birds were seen flying south near the north end of Lac la Hache.

The Caspian Tern is on the provincial Blue List (Fraser et al. 1999; B.C. Conservation Data Centre 2002). It was designated a species of Special Concern by COSEWIC in April 1978; however, it was de-listed (Not at Risk) in April 1999 (COSEWIC 2002).

Black Tern

Chlidonias niger (Linnaeus)

A total of 436 adult Black Terns were recorded from 21 wetlands or complexes on our June surveys. In addition, we recorded 44 nests and 9 young from 8 wetlands.

Although Munro (1958) did not include this semicolonial nester in with his bird comparisons, he does describe the known colonies in the Cariboo parklands in his 1945 work. For comparative purposes, we have included his maximum counts for the wetlands in our study area in Table 132. We recorded 9 new locations where Munro (1945) failed to observe the species; 4 locations showed increased tern numbers in 2001 while 3 locations showed decreased numbers. While these terns are known for their low fidelity to nesting areas, and thus move around from year to year depending on the

Table 132. Comparative adult counts and colony locations for the Black Tern on wetlands in the Cariboo parklands from the late 1930s or early 1940s (shown as 1938) and 2001.

Location	1938[1]		2001	
	Date	Numbers of adults	Date	Numbers of adults
Horse Lake (Larum's Bay)	26 May 1937	60	15 June	126
130 Mile Lake	26 June 1941	50	9 June	40
101 Mile Lake			20 June	40
Tatton Lake	13 July 1941	24	6 June	34
Sepa Lake			14 June	34
Exeter Lake			31 May	33
Lily Pad Lake	6 July 1938	40	4 June	23
Simon Lake	15 July 1938	12	8 June	21
Straight Lake	15 July 1938	8	8 June	17
Watson Lake			6 June	15
Dugan Lake			16 June	14
103 Mile Lake			4 June	13
Westwick Lakes (east)			19 June	12
Fawn Lake			15 June	6
100 Mile House marsh			17 June	6
Jones Lake	22 July 1943	6	18 June	2

[1] Data are from Munro (1945)

suitability of the habitat, tern numbers in 2001 appear to be up compared with the early Munro years.

In 1979, a Black Tern colony consisting of about 30 pairs nested on 150 Mile House Lake but by 1996 it had disappeared. Human development activities around this wetland were believed to be the cause of abandonment (Cooper and Campbell 1997).

In 2001, we found a total of 41 Black Tern nests at various stages in the nesting cycle, from nest construction to nests with both eggs and young (0E-2, 1E-13, 1E2Y-1, 2E1Y-1, 2E-11, 3E-13).

Most nests (34; n=41) were built in *Scirpus* marshes; 6 were found in a *Carex* meadow and 1 in a *Typha* marsh. The flimsy nests were constructed primarily of dead and often rotting *Scirpus* stems, although *Carex* was also used (Figure 131; see page 88). The platform was usually built on floating *Scirpus* stems (Figure 199) or on a clump of *Carex;* occasionally other materials were used, such as *Myriophyllum*, *Typha* and algae. The nests are easily destroyed by high winds or fluctuating water levels (Dunn and Agro 1995).

The height of the eggs above water ranged from 1-10 cm with a mean height of 3 cm ± 2 cm SD (n=36). Water depth over which the nests were positioned ranged from 20-120 cm with a mean water depth of 61 cm ± 27 cm SD.

The nest location is apparently more dependent on the density of emergent vegetation and the amount of nesting substrate that is available than on the type of plants or depth of the water (Dunn and Agro 1995).

The Black Tern has undergone an increase in numbers and distribution throughout much of interior British Columbia (Cooper and Campbell 1997), which reflects the findings from our study area. Cooper and Campbell (1997) believe the number of wetlands suitable for nesting has increased due largely to wetland enhancement activities by Ducks Unlimited Canada.

Figure 199. Black Tern nest built on a base of dead *Scirpus* stems with eggs and newly hatched chick at 101 Mile Lake, 20 June 2001 and incubating adult at Lily Pad Lake, 4 June 2001.

Breeding Bird Surveys suggest that, over the period 1968-1993, Black Tern populations in the interior of the province increased at an average annual rate of nearly 14% (Cowan et al. 2001). That trend may have stabilized beginning sometime in the 1980s (see Sauer et al. 2002).

Concerns were expressed over the continual decline of Black Tern populations throughout much of North America between 1967 and 1993 (Dunn and Agro 1995). Today, their numbers appear to be increasing in the continental United States; however, numbers in Canada over the period 1980-2001 declined at an average annual rate of nearly 3% (P<0.07) which may still be cause for concern (Sauer et al. 2002).

Short-eared Owl

Asio flammeus (Pontoppidan)

On 7 June, we found one bird roosting in an agricultural field near Springhouse slough 2. The Short-eared Owl is listed by COSEWIC as a species of Special Concern (COSEWIC 2002). It is also included on the provincial Blue List (Fraser et al. 1999; B.C. Conservation Data Centre 2002).

Yellow-headed Blackbird

Xanthocephalus xanthocephalus (Bonaparte)

The Yellow-headed Blackbird (Figure 200) was recorded from 23 of the 35 wetlands and complexes in our study area (Table 133). This is another of the wetland species not covered in Munro (1958); however, we have included it here because of the nesting data we were able to gather.

On some of the wetlands, we spent time locating blackbird nests and describing their contents. We geo-referenced nest sites in those colonies and the colony locations can be seen in relation to the wetland habitat in Figures 51(c), 58(c), and 149. We also encountered nests as we surveyed the wetlands and have included those data here as well.

We recorded 334 Yellow-headed Blackbird nests from 12 wetlands. Most of the nests (91%) were constructed in stands of emergent *Scirpus* vegetation; the remainder were in *Typha* stands. Nest materials were predominantly shredded *Scirpus* or *Typha* stems, depending on the type of marsh in which the colony was located. In some of the nests constructed of *Scirpus*, we noted occasional use of grasses and *Carex* in the nest lining.

Nests were located only over water, which agrees with Twedt and Crawford (1995); nest height above the water ranged from 2-65 cm with a mean height of 24 cm ± 11 cm SD. Water depth below the nests ranged from 13-153 cm with a mean water depth of 71 ± 19 cm SD. This is a far greater range than other studies have reported from the province (e.g., 50-110 cm in Twedt and Crawford 1995).

Of the 334 nests we found, 222 held eggs or young, 55 had evidence of successfully fledging young, 31 nests were under construction, 2 had been preyed upon, and the remaining nests were empty but we were unable to determine their status.

The 222 nests with eggs or young were found in various stages of the nesting cycle: 1E-22, 1E2Y-5, 1E3Y-3, 2E-13, 2E1Y-2, 2E2Y-3, 3E-34, 3E1Y-3, 4E-34, 1Y-37, 2Y-35, 3Y-27, 4Y-3, 5Y-1.

Breeding Bird Survey data from British Columbia are not sufficient to determine trends. Numbers across Canada over the period 1980-2001 have declined at an average annual rate of 3% (P=0.0) (Sauer et al 2002). Although local populations fluctuate with wetland conditions (Twedt and Crawford 1995), the decline across Canada could be an indicator of what is happening in British Columbia and may be grounds for further study.

Table 133. Wetlands, including wetlands from complexes, where Yellow-headed Blackbirds were recorded in 2001.

Location	
100 Mile House marsh	Elliot Lake
101 Mile Lake*	Lily Pad Lake
103 Mile Lake*	Mission Ponds, slough 1*
105 Mile Lake	Rush Lake*
130 Mile Lake	Sepa Lake*
150 Mile Lake	Simon Lake*
70 Mile slough 4	Soda Lake
70 Mile slough 5	Sorenson Lake
70 Mile slough 6	Springhouse slough 4
70 Mile slough 7	Straight Lake*
70 Mile slough 8	Tad Lake
70 Mile slough 9	Tatton Lake*
70 Mile slough 10*	Watson Lake*
Boitano Lake	Westwick Lakes*
Dugan Lake*	

* Nesting documented

Figure 200. Female Yellow-headed Blackbird at breeding colony on Westwick Lakes (east), 19 June 2001.

Munro's concerns

Munro (1945; 1958) expressed a number of concerns about what might affect the wetlands and future waterfowl numbers in the Cariboo parklands. We have addressed these concerns below under the following headings: population and economic growth, hunting, forestry, and ranching.

Population and economic growth

Munro was, if nothing else, a man of vision. He could see clearly the potential effects of an increasing population and a growing economy on the wildlife of a region. In 1945, he wrote:

> *British Columbia, in the process of an economic expansion that involved increasing exploitation of natural resources, has undergone profound modification of a physical and social character during the past 50 years. The tempo of change, slow at first, gradually accelerated through the years and has attained a speed in accord with that which impels the enormous vigour of the war effort. In the years that follow the achievement of peace, in order to accomodate the needs of a growing population and Canada's importance in a world economy, provincial resources will be exploited at an even greater rate.*

and he noted, rightly so, that "the future of wildlife …is directly involved with human expansion in space" (Munro 1945).

Today, wildlife biologists are beginning to realize that the driving force of "human expansion in space" is primarily economic growth. Some biologists now consider economic growth to be a limiting factor to wildlife conservation (Czech 2000). This is primarily because neoclassical economics has no connectivity to the biosphere (Daly 1996) and as such, places little value on natural capital such as wetlands and waterbirds. Yet, as Munro (1945) points out, "wildlife is a source of wealth in the fullest sense of the term."

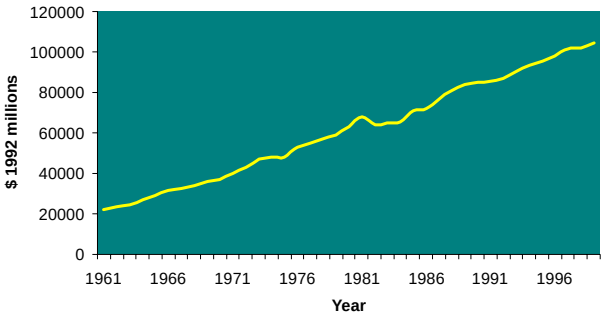

Figure 201. British Columbia real Gross Domestic Product at market prices (1961-1999) (Source: BC Stats).

Although there were obviously more lakeside developments in 2001 than in Munro's years, we saw relatively few instances of direct wetland loss or degradation resulting from these developments. Houses with lawns to the water's edge were found on a few lakes (e.g. Watson, Elliot, and Dewar lakes). In some cases, portions of the breeding site (e.g. Elliot Lake) were infilled which resulted in a direct loss of habitat.

Although we believe Munro was correct in relating economic and population growth of an area to deteriorating habitat and wildlife numbers (See Dawe et al. 2001), he could not have foreseen the relatively low population and economic growth that has generally taken place in the region. This is not to say that the area hasn't had significant economic growth spurts. For example, over the period 1956-1961, the Williams Lake and Chilcotin area ranked 15th among 80 areas in the province and economic indicators over the same period had percentage increases among the highest in the province (Government of British Columbia 1966).

Nevertheless, despite the economic and population growth since Munro's time, the population density of the study area today, away from the major centres of 100 Mile House and Williams Lake, is only 1.3 persons/km^2 (Stats Canada 2002). Coupled with the low population density is the low overall economic growth of the region. For example, despite an increase in real Gross Domestic Product for the province in excess of 370% over the period 1961-1999 (Figure 201), the current Index of Economic Hardship ranks the Cariboo Regional District as the 6th worst of the 26 regional districts in the province (BC Stats 2002). This cannot have hurt the waterbirds or their habitat.

For example, in the Williams Lake and 100 Mile House Forest Districts, a total of 19 species of birds are currently on the provincial Red (9 species) or Blue (10 species) lists (Table 134). However 14 of these are peripheral species, occurring at or near the western or northern limits of their ranges. Their populations are naturally small but they are of concern due to their importance in the genetic change that accumulates in marginal populations (Cowan et al. 2001).

Only the American Bittern, Great Blue Heron, Peregrine Falcon, Sandhill Crane, and Short-eared Owl have a more widespread distribution and of these, perhaps only the American Bittern and Sandhill Crane have traditionally occurred in any numbers in the Cariboo parklands (Munro 1945).

Waterfowl do not appear on the provincial Red or Blue lists and, with the exception of a few species, such as Northern Pintail and Canvasback that are showing continent-wide declines, only the Barrow's

Table 134. Red and Blue listed bird species in the Williams Lake and 100 Mile House Forest Districts. Wetland or riparian dependent species are in bold.

Scientific Name	English Name	COSEWIC[1] Status	BC Status
Aechmophorus occidentalis	**Western Grebe**		**RED**
Aeronautes saxatalis	White-throated Swift		BLUE
Ardea herodias herodias	**Great Blue heron, *herodias* subspecies**		**BLUE**
Asio flammeus	Short-eared Owl	SC[2] (1994)	BLUE
Bartramia longicauda	Upland Sandpiper		RED
Botaurus lentiginosus	**American Bittern**		**BLUE**
Buteo swainsoni	Swainson's Hawk		RED
Dolichonyx oryzivorus	Bobolink		BLUE
Falco mexicanus	Prairie Falcon	NAR[3] (1996)	RED
Falco peregrinus anatum	Peregrine Falcon, *anatum* subspecies	T[4] (MAY 2000)	RED
Grus canadensis	**Sandhill Crane**	**NAR (1979) *G. canadensis tabida* assessed**	**BLUE**
Icteria virens	**Yellow-breasted Chat**	**E[5] (Nov 2000)**	**RED**
Melanerpes lewis	Lewis's Woodpecker	SC (NOV 2001)	BLUE
Numenius americanus	Long-billed Curlew	SC (1992)	BLUE
Otus flammeolus	Flammulated Owl	SC (NOV 2001)	BLUE
Pelecanus erythrorhynchos	**American White Pelican**	**NAR (1987)**	**RED**
Recurvirostra americana	**American Avocet**		**RED**
Spizella breweri breweri	Brewer's Sparrow, *breweri* subspecies		RED
Tympanuchus phasianellus columbianus	Sharp-tailed Grouse, *columbianus* subspecies		BLUE

[1] Committee On the Status of Endangered Wildlife In Canada
[2] Special Concern
[3] Not at risk
[4] Threatened
[5] Endangered

Goldeneye is of special concern in the study area (see page 141 and below).

This does not mean to say that future increased economic and population growth in the region won't impact the wetlands and waterbirds in a negative manner. But it doesn't have to. Judicious planning, coupled with a recognition of the value of these nesting areas and the ecosystem services they provide, can ensure that the wetlands and their attendant wildlife will continue to be important components of life in the Cariboo parklands.

Hunting

Munro (1958) was concerned about what he thought to be excessive hunting on the nesting grounds and the potential for that to increase. He believed that a reduction in the numbers of ducks nesting in the Cariboo parklands was not due to the numbers being shot in the western United States but rather to the large kill taking place "on the nesting grounds during the first week of the hunting season when ducks are reltively unsuspicious" (Munro 1958).

His explanation for the lower numbers of waterfowl in 1958, compared to the earlier years, despite improved wetland habitat was as follows:

> *It might be well to note that ducks appear to be under compulsion to return and nest on their natal lake or marsh; therefore should a population of any such lake or marsh be extirpated that particular area will not be occupied immediately because all other populations are governed by a similar compulsion and return to where their ancestors nested. Only when the general population is expanding is this habit modified to any notable degree and it is at such times that marginal nesting areas are occupied.*
>
> *The overall picture, then, is one of an improved habitat occupied by a declining waterfowl population. These facts indicate that the seasonal increase in waterfowl is not sufficient to absorb an increasing local hunting pressure, a condition that is likely to worsen with the years.*

Apparently Munro need not have worried about hunting, at least over the long-term. Changes in societal values and habits have caused waterfowl hunter populations to decline drastically, unlike most of the species they hunt. For example, many young people brought up in rural areas with a waterfowl hunting tradition began to seek work in the new economy by moving to urban areas. At the same time, urban growth ate up wetlands and firearms discharge bylaws were enacted, both of which reduced or eliminated hunting opportunities there. In addition, anti-hunting groups have gained prominence over the years and along with it, considerable influence. As the human population continues to become more urbanized, waterfowl hunting pressure will decrease (Banks and Springer 1994).These and other factors, such as the changing demographics in the hunter population, have resulted in a reduction in the numbers of hunters across the province, including the

study area (Figure 202). Hunting appears to be a declining factor affecting waterfowl numbers in the Cariboo parklands.

Forestry

Munro (1958) didn't pull any punches when it came to his concerns about the forest industry and its effects on waterfowl in the Cariboo:

> *The change from an economy in which cattle-raising was the chief dynamic to one dominated by the logging industry—one husbandry, the other exploitation—has had a profound effect in the attitude of the present majority toward wildlife. In comparison with the members of a ranching community many of those who follow the logging industry derive from a social strata less law-abiding, less interested in wildlife for its own sake and for the most part insensitive to values other than those connected with board measure. Duck hunting seems to have been pursued with the same disregard for the amenities of civilized behaviour as is apparent in their current logging methods.*
>
> *To the people of British Columbia the logging operators have bequeathed a legacy of forest slums including abandoned mill-sites in a dismal squalor of rubbish heaps and sawdust piles. To be acknowledged also are the venerable Douglas firs which have been felled and left as of no commercial value, to become nurseries for bark beetles. These ancient trees, the giants of the parkland forest held values to which loggers appear to be insensible. To early settlers, and to many who followed, some served as land marks and as such were objects of affection. In some which stood near water Barrow goldeneye* [sic] *and bufflehead nested for as far back as anyone could remember; generations of crossbills and pine siskins had harvested their seeds, and in their long lives they had harboured countless thousands of other birds.*
>
> *As with the forests so with the waterfowl. There is convincing evidence that the main responsibility for the present decline of nesting waterfowl in the Cariboo Parklands—manifest particularly in the disappearance of individual units of population—can be attributed in large part to excesssive exploitation. The general public is perhaps unaware of, or indifferent to, the social and biological consequences of such exploitation—the enlightenment of this public would appear to be a necessary aspect of game management.*

While some of this may have been true in the past, considerable changes have occurred since Munro's time. More stringent regulations have been a part of the industry at least over the last 10 years through such instruments as the *Forest Practices Code of British Columbia Act* (Ministry of Forests 2001), the proposed *Forest and Range Practices Act* (Ministry of Forests 2002) and the best management practices of the *Riparian Management Area Guidebook* (Ministry of Forests 1995). Depending on the wetland characteristics, buffers have been required to protect the riparian shore as well as the older, large diameter trees on Crown lands and some private lands in a tree farm licence or woodlot licence.

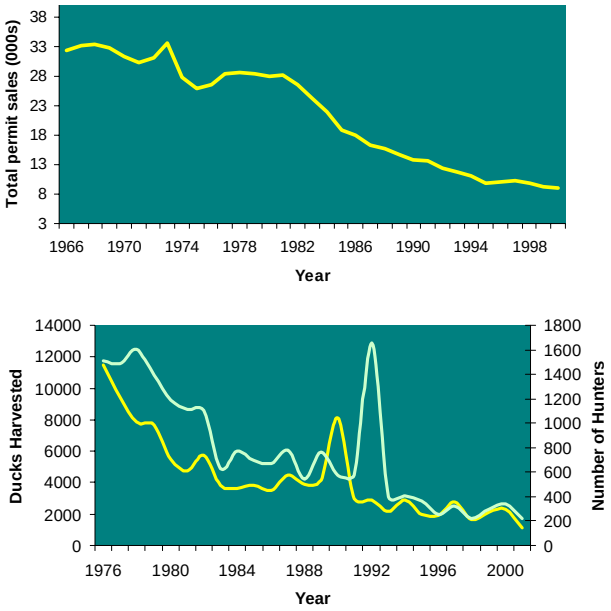

Figure 202. The number of (top) migratory game bird permits sold in British Columbia and (bottom) hunters (green line) and ducks harvested (yellow line) in the Cariboo parklands (Ministry of Water, land and Air Protection 2001).

Most of the wetlands we studied were on private lands rather on Crown lands. Only 70 Mile House sloughs 6 to 11 were completely surrounded by Crown lands. Other breeding sites have partial Crown land adjacent to them, e.g. Dewar Lake (all but northwest shore), Dugan Lake (south end), Westwick Lakes (west) (north end), 130 Mile Lake (all Crown lands except for eastern end), Whitehorse Lake (extreme south end), and Exeter Lake (Crown lands on the north and south shores).

Even on private forest lands, however, environmental stewardship is now encouraged. The Private Forest Landowners Association, together with the provincial government, has worked to provide a regulatory model for private forest lands in the province (Government of British Columbia 1999). The model includes environmental standards and best management practices to help protect key environmental values including wetland and riparian habitats.

This is not to say that all is well with our provincial forests; we are still harvesting them above long-term sustainable levels (Marchak et al. 1999;

Global Forest Watch Canada 2000) which does not bode well for wildlife or humans. Nevertheless, while wetland and riparian impacts from logging appear to have lessened considerably since Munro's time, they can certainly be further reduced as we discuss below.

Ranching

Although Munro (1958) praised the ranching community, cattle can and have negatively affected the wetlands and their surrounds in a number of ways. As Wuerthner and Matteson (2002) point out:

> *by raising domestic animals that demand large quantities of water and forage in a place that is dry, and by favoring slow-moving, heavy, and relatively defenseless livestock in terrain that is rugged, vast, and inhabited by native predators, ranchers have put themselves in a position of constant warfare with the land. They funnel most of the grass into their own animals, at the expense of the wild herbivores. They divert water from rivers to grow hay and other crops to feed cows, leaving fish and other aquatic life with hot, shallow trickles. They allow their cattle to graze and trample riparian areas—habitat on which 75 to 80 percent of all wild animal species in the West depend—polluting waterways with manure and adding excessive sediments to the water as they denude the land. And although "beauty is in the eye of the beholder," it's arguable whether most people would prefer a place where the grass is chewed down to stubs and the ground is littered with cow pies, over a grassland of tall and waving stems, dotted with wildflowers.*

Figure 203. The Common Loon is one of the species susceptible to having their nests swamped by speeding watercraft and even slow moving watercraft, such as canoes, can cause the birds to leave their nests, exposing the eggs to predators (Fawn Lake, 23 May 2001).

According to Belsky et al. (1999) livestock grazing has damamged about 80% of stream and riparian ecosystems in the western United States.

We did see a number of negative effects of cattle on the Cariboo wetlands, such as the heavy grazing of the *Carex* meadow at Dugan Lake (Figure 203), the damaged banks at the south end of Simon Lake, the grazed emergent *Scirpus* marsh at Westwick Lakes (east), and the apparent nutrient loading in Soda Lake and Wetwick Lakes (east).

However, we also saw wetlands and riparian habitat that had been fenced from cattle such as those at Exeter and 101 Mile lakes and the rotational grazing and alternative watering sites at 130 Mile Ranch. In fact, many of the wetlands that had cattle grazing around them appeared in fairly good shape. We must quickly point out, however, that our fieldwork ended on 20 June and we did not have an opportunity to observe the wetlands during the later summer months when the rangeland would be dry and the cattle more likely to make direct use of the wetlands and riparian habitats.

Other impacts to waterbirds

Outside of hunting, Munro (1958) did not address, nor apparently did he anticipate, potential impacts of increased recreational activities on waterfowl in the Cariboo parklands. Water-borne recreation has undoubtedly increased in this region since the late 1950's, though mostly on the larger, deeper lakes.

Wakes created by watercraft, especially fast moving powerboats and jet-skis can cause disturbance to nesting birds and swamp low or floating nests. In this study, grebes and the Common Loon would be the most susceptible to having their nests swamped by the wakes of speeding watercraft. Because of their speed and ability to access shallow water, jet-skis are recognized as the greatest potential watercraft threat to nests and chicks of the Common Loon (McIntyre and Barr 1997). However, in the majority of wetlands we sampled, nesting typically occurred in water too shallow and vegetation-choked for these watercraft.

Slower moving watercraft, such as fishing boats with electric motors and canoes, can disturb birds and cause them to leave their nests, exposing eggs to predation. The Common Loon (Figure 204), Red-necked Grebe, and American Coot were the most vulnerable to these types of disturbances. However, when a disturbance is noted and the adult bird has enough time, some birds, such as the grebes and waterfowl, typically cover their eggs with vegetation

before leaving the nest. In the case of the Red-necked Grebe, eggs can survive without incubation for periods as long as 7-8 hr (Nuechterlein and Buitron 2002).

During our study we saw little direct evidence of water-borne recreation activity and observed no nesting disturbance on any of the wetlands we surveyed other than the direct disturbance we may have caused when checking the nests. On several lakes, including Fawn, Irish, and Dugan, we did observe recreational fishing. However, only about 35% of the wetlands we visited were known to contain fish. Other than our survey canoe, many of the wetlands we visited were unlikely to have experienced any watercraft use in 2001.

The introduction of sports fish could be considered a potential indirect impact of recreation on waterbirds. For example, stocking fish in waterbodies that were either historically barren of fish or which already contained native fish fauna could drastically change the foraging opportunities for some waterbird species. Sports fish introductions can negatively impact native fishes, as well as amphibians and aquatic invertebrates. Breeding waterbird species that rely on invertebrates, such as the Horned Grebe and Barrow's Goldeneye, or eat native fish, such as the Common Loon, could be negatively impacted by fish stocking. The Barrow's Goldeneye, for example, is known to avoid fish-bearing lakes in an apparent attempt to lessen competition for food for themselves and their broods (Savard 1987; Eadie et al. 2000). Fish introductions to non fish-bearing waters could reduce the available habitat of this goldeneye.

Although our study was not sensitive or rigorous enough to detect these types of changes, we did note that some earlier fish introductions seemed inappropriate. For example, the stocking of eastern brook trout into Westwick (west) and 103 Mile lakes (BC Fisheries 2002); both waterbodies were unsuited for this alien fish species and the fish almost certainly would have died out soon after they were introduced. What impacts they may have had on the other aquatic creatures and the waterbirds before their demise is not known.

Of the 50 individual wetlands we surveyed, 22 (45%) had been stocked with sportsfish on at least one occasion. These introductions included the rainbow trout, kokanee, eastern brook trout, and brown trout (BC Fisheries 2002).

Another potential indirect impact of recreation on waterbirds includes lead poisoning resulting from hunting and fishing activities. Since the late 1800's, ingestion of spent lead shot has been recognized as an important source of mortality in waterfowl (e.g. Grinnell 1894). Munro himself was the first to document lead poisoning of waterfowl in Canada (Munro 1925). Lead shot ingestion by waterfowl is primarily a problem on waterfowl wintering areas and probably of less concern on breeding areas such as the Cariboo parklands. In 1999, the use of lead shot for hunting migratory birds was banned across Canada. However, residual shot can remain deadly to waterfowl long after its use is discontinued.

Lead sinkers used in fishing have also poisoned waterbirds. In New England for example, up to 50% of Common Loon mortalities were attributed to the ingestion of lead sinkers (Pokras and Chafel 1992). We had no way to determine if this was a significant problem in the Cariboo parklands.

There are other factors likely affecting the wetlands and waterbirds of the Cariboo parklands, such as global warming and continental trends in species abundance; however, these are also beyond the scope of this study.

Conclusions

In 2001, the wetlands that Munro (1958) reported were in fairly good shape and, for the most part, comparable to when he last visited them in 1958. Most appeared to have sufficiently high water levels, although a few, such as Westwick lakes (east), had obviously lower water levels than in the past (see Figure 146). Many of the wetlands also held significant areas of emergent marsh and *Carex* meadow. While most of the emergent marshes appeared to be relatively undisturbed, a number of the *Carex* meadows were obviously suffering from cattle grazing and trampling or haying activities. Some nesting areas had suffered from infilling (e.g. Elliot Lake) while in others, some eutrophication was evident (e.g. Soda Lake). Nevertheless, many high quality nesting areas are still extant in the Cariboo parklands study area.

The nesting areas in this study provided suitable habitat to support healthy populations of waterbirds. These local populations, for the most part, occurred in higher numbers than when Munro conducted his surveys in either the late 1930s -early 1940s or in 1958.

We believe that a number of factors have contributed to the current state of most of the wetlands in our study area. First, a relatively sparse human population and slow economic growth in the region, has played a positive role in terms of maintaining bird habitat. Second, there seemed to be a higher ecological awareness on the part of those people dependent on the landscape for their livelihood, and the importance of wetlands had not been lost to them. Third, hunting activities on the wetlands have been much reduced since Munro's time. Finally, and perhaps most importantly, Ducks Unlimited Canada (DUC) has been a significant presence in the region since the early 1980s, and has secured management control and water rights on many of the wetlands. For those wetlands, it has resulted in high, stable water levels and the attendant extensive emergent marshes and meadows that go with them. In addition, DUC has continued to bring attention to the wetlands and their significance to both wildlife and people. This has helped contribute to a better understanding of why we must protect these important systems.

Recommendations

The Cariboo parklands (Figure 204) is an exceptional area for wildlife. For example, at least 288 species of birds have been recorded there (Roberts and Gebauer 1992) and the myriad lakes and sloughs scattered throughout the region comprise some of the finest waterbird breeding habitat in the province.

These wetland ecosystems (Figure 205) are not just important areas for wildlife, however. The ecosystem services that wetlands provide have, until recently, gone relatively unnoticed (Daily et al. 1997). For example, aside from acting as refugia for waterbirds, fish, snails, cattails, and other organisms, wetlands purify our water by removing high levels of nitrogen, phosphorous and toxic chemicals; they mitigate the impacts of droughts and floods (0.4 ha of wetland can store over 6,000 m^3 of floodwater (Ramsar Bureau 2001). They help recharge groundwater supplies and mitigate the effects of climate change by sequestering carbon. Wetlands treat waste, process toxic residues and slow water flows so that suspended sediments are deposited thus reducing the downstream costs of lower water quality and siltation. As Daily et al. (1997) note, "These services are so fundamental to life that they are easy to take for granted …"; however, they are "… essential to civilization." Because these ecosystem services lie outside of market forces we often fail to recognize their value and opt for short-term economic benefits that may degrade the wetlands rather than recognize their true value. As Costanza et al. (1997) point out, "If significant irreversible thresholds are passed for irreplacable ecosystem services, their value may quickly jump to infinity."

Figure 205. Healthy wetlands and their attendant forested buffers purify our water, remove toxic residues, mitigate drought impacts, recharge groundwater supplies and provide refugia for many plants and animals. Because these services lie outside of market forces, their values are often not recognized despite the fact that they are essential to life (101 Mile Lake, 21 May 2001).

Following are recommendations along with supporting rationale, that, if implemented, will help maintain the Cariboo wetlands and the services they provide to both humans and wildlife. We hasten to add that the *choice* to act or not is ours.

Wetland buffers

Activities adjacent to wetlands can have severe consequences to the riparian habitat, the wetlands themselves, and their functions. While guidelines have been set in some cases (e.g. Ministry of Forests 1995;

Figure 204. The Cariboo parklands is an exceptional area for wildlife with its myriad wetlands scattered across a rolling rangeland that is punctuated by Douglas-fir, lodgepole pine and trembling aspen copses and forest (Mission Ponds, 21 May 2001).

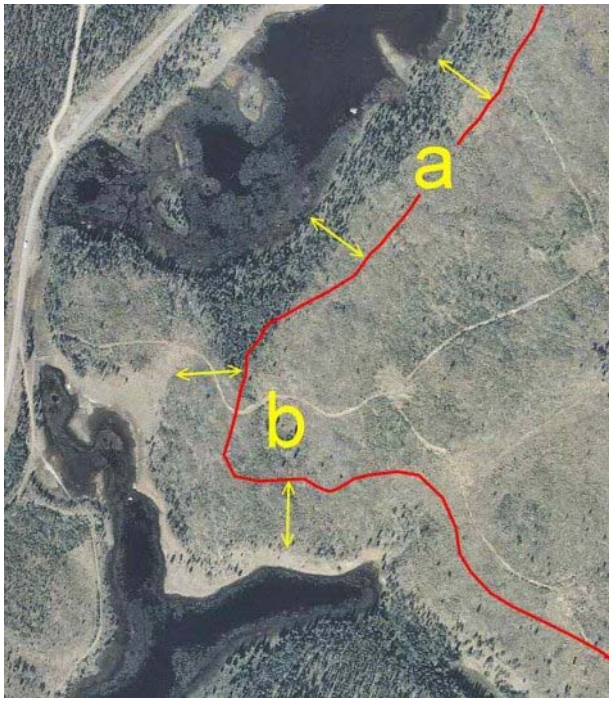

Figure 206. In order to maintain wetland ecosystem services and sufficient nesting habitat for cavity nesters, such as Barrow's Goldeneye, forested buffers should be retained around wetlands 100 m from the forest-wetland edge (a) or 100 m from the forest rangeland edge where bands of rangeland lie between the wetland and forested habitats.

Ministry of Forests 2001), the lake and wetland buffers suggested are not sufficient for the long-term maintenance of ecosystem services or of some species. **We recommend that forested buffers of at least 100 m in width be retained as reserve zones around all lakes and wetlands in the Cariboo parklands.** The value of the role such buffers play on the quality of the wetlands cannot be overemphasized. These buffers should be no less than 100 m wide, excluding any bands of rangeland that lie between the wetland and the forested lands (Figure 206). Buffers of this width should, in our opinion, be encouraged on both private and public lands. The justification for this buffer size follows.

Figure 207. Forested buffers help remove pollutants from rangeland, such as the contents of cattle dung and urea that are released during heavy rains. Overland flow infiltrates the buffer zone rather than entering the water directly.

Buffer functions

Recent studies have shown that riparian buffers can function, "often simultaneously as filters, sources, transformers and sinks." Buffer size requirements can vary widely depending on the specific functions being addressed such as areas of refugia for a wide variety of organisms; protecting or improving water quality, including sediment removal; erosion control; reducing stormwater runoff; and moderating water temperature (Fischer et al. 2000). Buffers may also be important as wildlife movement corridors.

Wetland buffer size is dependent on the functional value of the resource, the slope of the land, intensity of adjacent land use, the buffer characteristics themselves, and the specific buffer functions required (WAC4 2001). Generally, smaller buffers are adequate when a wetland is of low functional value; larger buffers are necessary for high value wetlands, such as most of those in the Cariboo parklands study area.

Ecological concerns

Ecological concerns require the largest buffer widths and a number of studies of bird and reptile/amphibian requirements suggest suitable buffer widths at least equal to or in excess of 100 m (Fischer et al. 2000). Some studies recommend buffer widths up to 1600 m for birds and 1000 m for reptiles and amphibians.

Protect or improve water quality

Wetland buffers help remove pollutants as over-land flow infiltrates the buffer zones rather than directly entering the wetlands (Figure 207). Nutrients (e.g. nitrogen and phosphorous) and microbes can be altered, along with other pollutants. Pesticides can be reduced or trapped and converted into non-toxic forms through microbial decomposition, oxidation, reduction and other biodegrading forces of the buffer. Buffer widths required for water quality functions range from 15-85m (WAC4 2001).

Sediment removal and erosion control

Buffers tend to turn channelized flow into both sheet flow and subsurface flow and remove sediments from stormwater runoff as the water infiltrates the soil (NYCWMS 2000). Vegetated buffers control ero-

Figure 208. Nestboxes can be an effective management tool to help increase declining populations of cavity-nesting waterfowl. However, because they must be maintained, any waterfowl population dependent on nestboxes is only as secure as is the human commitment to maintaining the boxes. Adequate forested buffers secured adjacent to wetlands would ensure sustainable nesting cavities for these species. Note the Tree Swallow at nestbox entrance (Soda Sloughs 17 June 2001).

sion by obstructing the flow of sediments and debris, by allowing infiltration and by stabilizing wetland edges (WAC4 2001). Since most available phosphorous is attached to small soil particles in the sediment, it is also reduced by the filtering action of the buffer. While small buffers remove small amounts of sediments, disproportionately wider buffers are required for incrementally greater sediment removal (WAC4 2001). Buffer widths required for sediment removal functions range from 12-70 m .

Stormwater runoff and temperature moderation

Riparian buffer zones tend to haveincreased storage and infiltration capacity and thus enhance the land's ability to reduce the serverity of stormwater flows. Forested buffers proximate to the wetland shore often shade the wetland for some part of each day and, in so doing, may have a substantial effect on water temperature (NYCWMS 2000). This can affect the dissolved oxygen content of the water and thus the organisms in the water body. Buffer widths required for water temperature moderation range from 10-45 m.

Protection of Barrow's Goldeneye habitat

Over 60% of the world poplulation of Barrow's Goldeneye nests and winters in British Columbia. Thus, it is the activities we carry out here in the province that could directly affect the population of this duck; for the most part, we do not have to look elsewhere for the source of any problems that may arise, with perhaps the exception of the Yukon moulting areas.

Nest boxes (Figure 208) have been shown to be acceptable substitutes for natural cavities; however, they must be maintained, therefore any waterbird population dependent on artificial cavities, such as bufflehead or the goldeneyes, is only as secure as is the human commitment to maintain the nest boxes. To ensure sustainable nest sites for Barrow's Goldeneye and other cavity nesters in the Cariboo parklands, a sufficient quantity of mature nest trees must be secured and protected around the wetlands.

Recent studies have shown that the Barrow's Goldeneye nests farther into the forest than previously thought (Evans et al. 2002). The average distance of the nest cavity from water was 89.7 m (13.0 m SE); the average distance from the forest edge was 13.7 m (SD = 19.9 m; range: 0-103 m; n = 41)[1]. This suggests that to ensure most nests are included within a proposed buffer, at least 73 m (mean + 3 SD) of forested habitat should be left intact for Barrow's Goldeneye nesting habitat in addition to any rangeland between the forest lands and the buffer.

Most natural goldeneye nest cavities (72%) were found in trembling aspen, although a significant number (23%) were found in Douglas-fir (Evans et al. 2002). Since Barrows Goldeneye nest cavities had an average floor area of 299 cm^2 ± 16 cm^2 SE at an average height of 12.0 m ± 0.8 m SE, the diameter of the tree at nest height would have to be in the neighborhood of at least 25 cm. This suggests that the stand would have to hold aspen in the range of 50-60 yr of age and Douglas-fir at about 150+ yr to be suitable for goldeneye use (S.M. Davis pers. comm.).

The Barrow's Goldeneye usually nests on fishless lakes that lack streams. On these systems, current Forest Practices Code regulations allow logging right to the wetland edge. Such practices could be affecting Barrow's Goldeneye productivity, and should be changed, for availability of nesting cavi-

[1] An error occurred in the Evans et al. (2002) data set that went unnoticed until after publication: a nest that was 103 m from the forest edge was incorrectly entered as 1,030 m. The correct mean distance from the forest edge (see Evans et al. 2002, Table 2, p 613) is 13.7 m (SD = 19.9, SE = 3.1 m) (M.R. Evans, pers. comm.)

ties is undoubtedly a limiting factor to Barrow's Goldeneye production in the Cariboo parklands.

Livestock, riparian buffers, and wetlands

Another major impact to wetlands and their associated riparian areas are the influences livestock has on these sensitive ecosystems (Figure 209). Cattle seek water and shade in riparian habitats, graze riparian vegetation, disturb soils, destabilize shores and streambanks, deposit manure and urine, and churn up channel sediments reducing water quality and creating drier conditions. All these activities affect the ecosystem functions of the riparian buffer we discussed above. **We recommend that an effort be made to exclude livestock entirely from riparian areas and wetlands where possible and to provide only one, small access point to the wetland where livestock watering is necessary.** Aside from removing or reducing the damage domestic livestock inflicts on these habitats, and thus improving the habitats for wildlife, benefits also accrue to the livestock themselves and thus the rancher.

Riparian grazing, the land, and water flows

In areas that are "heavily grazed," by livestock, upland and riparian vegetation is removed and the soil is sheared and compacted by their hooves. This allows less rainwater to enter the soil and more to flow overland, which results in increased runoff and erosion, decreased soil organic matter, increased sedimentation to streams and wetlands, and larger peak flows (Belsky et al. 1999).

There are landscape and regional effects to riparian grazing because lowlands are connected to uplands through streams which act as migration corridors for many species and a water source; they also channel sediments, nutrients, and pollutants downstream.

Figure 209. Cattle in the Carex meadow at Dugan lake, 16 June 2001. Livestock grazing in the wetland removes the cover for nesting waterbirds, disturbs wetland soils and deposits manure and urine directly into the wet meadow. The integrity of the meadow could be maintained simply through maintenance of the fencing which has fallen into disrepair.

Riparian grazing and biodiversity

Grazing in riparian habitats often results in a decline in some vegetation species, usually native plants, and an increase in other species, usually exotic weeds, which can alter ecosystem processes that native species have come to rely upon over the millenia (Belsky et al. 1999). Bird and fish populations have also been shown to be differentially affected by livestock grazing in riparian habitats. In fact, Flather et al. (1994) found livestock grazing to be the 4th major cause of animal species endangerment in the United States and the 2nd major cause for plant species endangerment.

Riparian grazing and water quality

Livestock can be a significant non-point source of water polution through bacterial contamination of drinking and surface water. Oganisms such as *Cryptosporidium*, *Giardia*, and *Salmonella* as well as enteric viruses are carried by cattle and the probability of disease-causing organisms contaminating human water supplies increases with intensity of cattle use (Belsky et al. 1999).

Benefits of riparian grazing to wetlands

Supporters of livestock grazing of riparian habitat often declare that the practice sometimes benefits streams and riparian communities; however, virtually all scientific studies refute this claim (Belsky et al. 1999). Livestock damage to riparian habitat, streams, and wetlands can be much reduced, however, through improved grazing methods, fencing cattle away from riparian and wetland habitats and increasing the period of rest from grazing.

Changes in livestock grazing practices

There are a number of changes taking place on rangelands throughout western North America. As Cheney et al. (1993) note:

> *Today, one of the most powerful forces of change on the range is society's growing awareness of the value and vulnerability of western rangeland riparian areas and wetlands. This awareness is being translated into*

a growing body of laws, policies, and regulations. These require changes in rangeland grazing practices necessary to protect and enhance ecosystem diversity and water quality on rangeland watersheds.

Chaney et al. (1993) offer 3 basic ways to treat riparian grazing problems: 1) exclude livestock from the riparian area through fencing, 2) put riparian areas into separate pastures to control intensity of livestock use of riparian areas, and 3) limit the season, duration and intensity of grazing in riparian areas. They also offer suggestions for proper management of livestock grazing on riparian areas.

Benefits of managing for healthy riparian habitat

Aside from the benefits to waterfowl and the other organisms dependent on healthy riparian and wetland ecosystems, including human society, benefits also accrue to ranchers that manage these areas together with the rangeland, as integrated ecosystems .

For example, a recent study in the Canadian Prairies (Chorney and Josephson 2000) found that the majority of ranchers that used rotational grazing and managed their riparian areas reported 1) a greater average weight gain per cow, 2) better pasture forage quantity and quality, and 3) decreased or similar costs per animal. While their labour and management requirements increased they were offset by 1) increased over-all net returns per animal and 2) increased overall net returns for their operation. Other reported changes were 1) improved herd health and condition, 2) better wildlife cover, and 3) better wetland quality. The ranchers rated the new production system with their old system which typically involved season-long grazing and free access to water sources.

At 130 Mile Ranch, in the Cariboo study area, Environment Canada, Ducks Unlimited Canada, and the BC Ministry of Agriculture and Food (Fraser River Action Plan), have worked together with the landowners to help manage the ranch for the benefit of both cattle and wildlife. There, rotational grazing is used along with fencing that excludes the cattle from wetlands and their associated riparian areas, treed areas, and the steep hillsides. Alternative watering sites for the cattle, including limited direct access and dugout or spring-fed gravity feed systems, fill troughs across the ranch. Benefits of this management regime include a healthier range, nearly twice the number of cattle on the land, healthier and more aesthetically pleasing riparian and wetland areas, increased nesting areas for waterbirds, and in some of the wetlands water levels appear to remain higher for longer periods (W. Braim, pers. comm.).

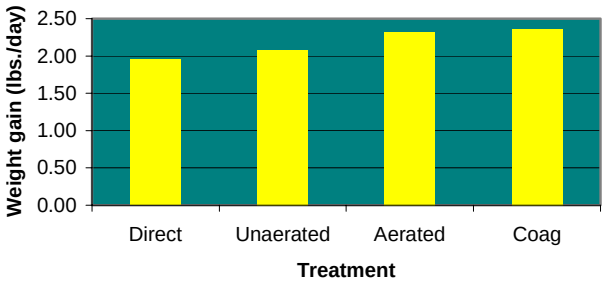

Figure 210. Average daily weight gain in yearling cattle in relation to water treatment at Lanigan, SK (1999). *Direct* refers to direct cattle access to dugout, *Unaerated* refers to dugout water pumped to a trough, *Aerated* refers to treating water by aeration, and *Coag* refers to treating water by precipitating suspended solids (coagulation) with chlorination. Modified from Willms et al. 2000.

Willms et al (2000, 2002) found that clean water was important to maximize cattle weight gains on summer rangeland (Figure 210); cattle accessing clean water spent more time grazing and less time loafing. Since cattle will avoid water contaminated by manure when given a choice and will refuse it when the concentrations are too high, water quality can be improved simply by preventing cattle from having direct access to the water source.

Recreational activities and wetlands

In the Cariboo parklands, recreational activities associated with lakes, sloughs, and their attendant wetlands range from simply enjoying the sights and sounds of the habitats and their surrounds to consumptive and so-called non-consumptive activities such as angling, hunting, photography, and birdwatching, to water sports such as canoeing, sailing, water skiing, power boating, and jet skiing. Not all these activities are compatible, either with each other or with every lake, slough, or wetland, the ecosystem services they provide, or the wildlife values associated with them (Figure 211).

We recommend that a systematic, long-term study of the lakes, sloughs, and wetlands of the Cariboo parklands be instigated to determine the recreational activities that are appropriate to each.

Figure 211. Recreational activities associated with lakes and wetlands in the Cariboo parklands should be compatible with the ecological values of the wetland. For example, wetlands used by colonial nesting birds, such as the nesting Black Tern shown here, can have wildlife viewing from a distance but would not support activities such as power boating or jet skiing that could swamp the nests or directly harass the birds (Lily Pad Lake 4 June 2001).

The study should consider the ecological values as the highest priority, for it is those values that have the most benefit to both humans and wildlife.

Knowing the important ecological values of the myriad lakes and wetlands will help the land manager avoid impacts to the ecosystems while allowing compatible recreational use of these sites that are appropriate to their ecological attributes.

Attracting recreationalists is a way of diversifying a community's or region's economic base. While activities such as recreational boating, angling, and hunting have been recognized as important to the Cariboo economy, other activities have not played as significant a role.

Birdwatching is one example. It is the fastest growing outdoor recreational activity in the United States (Outdoor Recreational Coalition of America 1996) and likely in all North America. In the United States, for example, 66 million people classified themselves as wildlife watchers (USDI 2002). They spent a total of US$38.4 billion, which included US$ 23.5 billion on equipment and US$ 8.2 billion on trips. Of those 66 million people, 18 million went on trips away from home especially to watch birds.

Given the exceptional bird life of the Cariboo parklands coupled with the natural beauty of the area, the region could become an important destination for bird and other wildlife watchers. However, the main requirement for having healthy wildlife populations to view is having healthy habitat for those populations and all too often that is what carelessly planned, human activities destroy.

In the past we have often marginalized the importance of wildlife and the ecosystems upon which they and we depend. We have considered our economic interest foremost, forgetting that the ecosystems, and the wildlife that are a part of them, are the source of the services that keep us alive; they are the foundation of any social well-being and economic benefits we're fortunate enough to achieve. The decision-makers in the Cariboo parklands, unlike those in many places, still have the opportunity to ensure that healthy wetlands will be a legacy. With careful planning, these aquatic ecosystems, the ecosystem services they provide, and the wildlife dependent on them, will be here for generations to come.

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Appendices

Appendix I (a)

Appendix I (a). List of birds reported from the Cariboo parklands ordered taxonomically.

Species Code	English Name	Scientific Name
COLO	Common Loon	*Gavia immer*
YBLO	Yellow-billed Loon	*Gavia adamsii*
PBGR	Pied-billed Grebe	*Podilymbus podiceps*
HOGR	Horned Grebe	*Podiceps auritus*
RNGR	Red-necked Grebe	*Podiceps grisegena*
EAGR	Eared Grebe	*Podiceps nigricollis*
WEGR	Western Grebe	*Aechmophorus occidentalis*
AWPE	American White Pelican	*Pelecanus erythrorhynchos*
AMBI	American Bittern	*Botaurus lentiginosus*
GBHE	Great Blue Heron	*Ardea herodias*
CAGO	Canada Goose	*Branta canadensis*
WODU	Wood Duck	*Aix sponsa*
GADW	Gadwall.	*Anas strepera*
EUWI	Eurasian Wigeon	*Anas penelope*
AMWI	American Wigeon	*Anas americana*
MALL	Mallard.	*Anas platyrhynchos*
BWTE	Blue-winged Teal	*Anas discors*
CITE	Cinnamon Teal	*Anas cyanoptera*
NOSL	Northern Shoveler	*Anas clypeata*
NOPI	Northern Pintail	*Anas acuta*
GWTE	Green-winged Teal	*Anas crecca*
CANV	Canvasback.	*Aythya valisineria*
REDH	Redhead.	*Aythya americana*
RNDU	Ring-necked Duck	*Aythya collaris*
LESC	Lesser Scaup	*Aythya affinis*
SUSC	Surf Scoter	*Melanitta perspicillata*
WWSC	White-winged Scoter	*Melanitta fusca*
BUFF	Bufflehead.	*Bucephala albeola*
COGO	Common Goldeneye	*Bucephala clangula*
BAGO	Barrow's Goldeneye	*Bucephala islandica*
HOME	Hooded Merganser	*Lophodytes cucullatus*
COME	Common Merganser	*Mergus merganser*
RUDU	Ruddy Duck	*Oxyura jamaicensis*
OSPR	Osprey.	*Pandion haliaetus*
BAEA	Bald Eagle	*Haliaeetus leucocephalus*
NOHA	Northern Harrier	*Circus cyaneus*
SSHA	Sharp-shinned Hawk	*Accipiter striatus*
COHA	Cooper's Hawk	*Accipiter cooperii*
NOGO	Northern Goshawk	*Accipiter gentilis*
RTHA	Red-tailed Hawk	*Buteo jamaicensis*
AMKE	American Kestrel	*Falco sparverius*
MERL	Merlin.	*Falco columbarius*
PEFA	Peregrine Falcon	*Falco peregrinus*
PRFA	Prairie Falcon	*Falco mexicanus*
VIRA	Virginia Rail	*Rallus limicola*
SORA	Sora.	*Porzana carolina*
AMCO	American Coot	*Fulica americana*
SACR	Sandhill Crane	*Grus canadensis*
KILL	Killdeer.	*Charadrius vociferus*
GRYE	Greater Yellowlegs	*Tringa melanoleuca*
LEYE	Lesser Yellowlegs	*Tringa flavipes*
SOSA	Solitary Sandpiper	*Tringa solitaria*
SPSA	Spotted Sandpiper	*Actitis macularia*
LBCU	Long-billed Curlew	*Numenius americanus*
LESA	Least Sandpiper	*Calidris minutilla*
WISN	Wilson’s Snipe	*Gallinago delicata*
WIPH	Wilson's Phalarope	*Phalaropus tricolor*
BOGU	Bonaparte's Gull	*Larus philadelphia*
MEGU	Mew Gull	*Larus canus*
RBGU	Ring-billed Gull	*Larus delawarensis*
HEGU	Herring Gull	*Larus argentatus*
BLTE	Black Tern	*Chlidonias niger*

Appendix I (b)

Appendix I (b). List of birds reported from the Cariboo parklands ordered by species code.

Species Code	English name	Scientific Name
AMBI	American Bittern	*Botaurus lentiginosus*
AMCO	American Coot	*Fulica americana*
AMKE	American Kestrel	*Falco sparverius*
AMWI	American Wigeon	*Anas americana*
AWPE	American White Pelican	*Pelecanus erythrorhynchos*
BAEA	Bald Eagle	*Haliaeetus leucocephalus*
BAGO	Barrow's Goldeneye	*Bucephala islandica*
BLTE	Black Tern	*Chlidonias niger*
BOGU	Bonaparte's Gull	*Larus philadelphia*
BUFF	Bufflehead.	*Bucephala albeola*
BWTE	Blue-winged Teal	*Anas discors*
CAGO	Canada Goose	*Branta canadensis*
CANV	Canvasback.	*Aythya valisineria*
CITE	Cinnamon Teal	*Anas cyanoptera*
COGO	Common Goldeneye	*Bucephala clangula*
COHA	Cooper's Hawk	*Accipiter cooperii*
COLO	Common Loon	*Gavia immer*
COME	Common Merganser	*Mergus merganser*
EAGR	Eared Grebe	*Podiceps nigricollis*
EUWI	Eurasian Wigeon	*Anas penelope*
GADW	Gadwall.	*Anas strepera*
GBHE	Great Blue Heron	*Ardea herodias*
GRYE	Greater Yellowlegs	*Tringa melanoleuca*
GWTE	Green-winged Teal	*Anas crecca*
HEGU	Herring Gull	*Larus argentatus*
HOGR	Horned Grebe	*Podiceps auritus*
HOME	Hooded Merganser	*Lophodytes cucullatus*
KILL	Killdeer.	*Charadrius vociferus*
LBCU	Long-billed Curlew	*Numenius americanus*
LESA	Least Sandpiper	*Calidris minutilla*
LESC	Lesser Scaup	*Aythya affinis*
LEYE	Lesser Yellowlegs	*Tringa flavipes*
MALL	Mallard.	*Anas platyrhynchos*
MEGU	Mew Gull	*Larus canus*
MERL	Merlin.	*Falco columbarius*
NOGO	Northern Goshawk	*Accipiter gentilis*
NOHA	Northern Harrier	*Circus cyaneus*
NOPI	Northern Pintail	*Anas acuta*
NOSL	Northern Shoveler	*Anas clypeata*
OSPR	Osprey.	*Pandion haliaetus*
PBGR	Pied-billed Grebe	*Podilymbus podiceps*
PEFA	Peregrine Falcon	*Falco peregrinus*
PRFA	Prairie Falcon	*Falco mexicanus*
RBGU	Ring-billed Gull	*Larus delawarensis*
REDH	Redhead.	*Aythya americana*
RNDU	Ring-necked Duck	*Aythya collaris*
RNGR	Red-necked Grebe	*Podiceps grisegena*
RTHA	Red-tailed Hawk	*Buteo jamaicensis*
RUDU	Ruddy Duck	*Oxyura jamaicensis*
SACR	Sandhill Crane	*Grus canadensis*
SORA	Sora.	*Porzana carolina*
SOSA	Solitary Sandpiper	*Tringa solitaria*
SPSA	Spotted Sandpiper	*Actitis macularia*
SSHA	Sharp-shinned Hawk	*Accipiter striatus*
SUSC	Surf Scoter	*Melanitta perspicillata*
VIRA	Virginia Rail	*Rallus limicola*
WEGR	Western Grebe	*Aechmophorus occidentalis*
WIPH	Wilson's Phalarope	*Phalaropus tricolor*
WISN	Wilson's Snipe	*Gallinago delicata*
WODU	Wood Duck	*Aix sponsa*
WWSC	White-winged Scoter	*Melanitta fusca*
YBLO	Yellow-billed Loon	*Gavia adamsii*

Appendix I (c)

Appendix I (c). List of birds reported from the Cariboo parklands ordered by English name.

Species Code	English name	Scientific Name
AMBI	American Bittern	*Botaurus lentiginosus*
AMCO	American Coot	*Fulica americana*
AMKE	American Kestrel	*Falco sparverius*
AWPE	American White Pelican	*Pelecanus erythrorhynchos*
AMWI	American Wigeon	*Anas americana*
BAEA	Bald Eagle	*Haliaeetus leucocephalus*
BAGO	Barrow's Goldeneye	*Bucephala islandica*
BLTE	Black Tern	*Chlidonias niger*
BWTE	Blue-winged Teal	*Anas discors*
BOGU	Bonaparte's Gull	*Larus philadelphia*
BUFF	Bufflehead.	*Bucephala albeola*
CAGO	Canada Goose	*Branta canadensis*
CANV	Canvasback.	*Aythya valisineria*
CITE	Cinnamon Teal	*Anas cyanoptera*
COGO	Common Goldeneye	*Bucephala clangula*
COLO	Common Loon	*Gavia immer*
COME	Common Merganser	*Mergus merganser*
COHA	Cooper's Hawk	*Accipiter cooperii*
EAGR	Eared Grebe	*Podiceps nigricollis*
EUWI	Eurasian Wigeon	*Anas penelope*
GADW	Gadwall.	*Anas strepera*
GBHE	Great Blue Heron	*Ardea herodias*
GRYE	Greater Yellowlegs	*Tringa melanoleuca*
GWTE	Green-winged Teal	*Anas crecca*
HEGU	Herring Gull	*Larus argentatus*
HOME	Hooded Merganser	*Lophodytes cucullatus*
HOGR	Horned Grebe	*Podiceps auritus*
KILL	Killdeer.	*Charadrius vociferus*
LESA	Least Sandpiper	*Calidris minutilla*
LESC	Lesser Scaup	*Aythya affinis*
LEYE	Lesser Yellowlegs	*Tringa flavipes*
LBCU	Long-billed Curlew	*Numenius americanus*
MALL	Mallard.	*Anas platyrhynchos*
MERL	Merlin.	*Falco columbarius*
MEGU	Mew Gull	*Larus canus*
NOGO	Northern Goshawk	*Accipiter gentilis*
NOHA	Northern Harrier	*Circus cyaneus*
NOPI	Northern Pintail	*Anas acuta*
NOSL	Northern Shoveler	*Anas clypeata*
OSPR	Osprey.	*Pandion haliaetus*
PEFA	Peregrine Falcon	*Falco peregrinus*
PBGR	Pied-billed Grebe	*Podilymbus podiceps*
PRFA	Prairie Falcon	*Falco mexicanus*
REDH	Redhead.	*Aythya americana*
RNGR	Red-necked Grebe	*Podiceps grisegena*
RTHA	Red-tailed Hawk	*Buteo jamaicensis*
RBGU	Ring-billed Gull	*Larus delawarensis*
RNDU	Ring-necked Duck	*Aythya collaris*
RUDU	Ruddy Duck	*Oxyura jamaicensis*
SACR	Sandhill Crane	*Grus canadensis*
SSHA	Sharp-shinned Hawk	*Accipiter striatus*
SOSA	Solitary Sandpiper	*Tringa solitaria*
SORA	Sora.	*Porzana carolina*
SPSA	Spotted Sandpiper	*Actitis macularia*
SUSC	Surf Scoter	*Melanitta perspicillata*
VIRA	Virginia Rail	*Rallus limicola*
WEGR	Western Grebe	*Aechmophorus occidentalis*
WWSC	White-winged Scoter	*Melanitta fusca*
WISN	Wilson’s Snipe	*Gallinago delicata*
WIPH	Wilson's Phalarope	*Phalaropus tricolor*
WODU	Wood Duck	*Aix sponsa*
YBLO	Yellow-billed Loon	*Gavia adamsii*

Appendix II

Appendix II. Species code modifiers.

Code	Modifier
A	Adult
♀	Female
J	Juvenile
♂	Male
N	Female or bird on nest
PR	Pair
U	Unidentified to species
Y	Young of the year

Appendix III

Appendix III. Migration surveys of nesting areas in the Cariboo parklands, May 2001.

	3 mi s Springhouse	Soda Lake	Soda Marshes	Watson Lake	Elliot Lake	105 Mile Lake	101 Mile Marsh	Whitehorse Lake
	08-May-01	10-May-01	10-May-01	11-May-01	11-May-01	11-May-01	11-May-01	12-May-01
COLO[1]								
COLO-PR[2]								1
COLO-N								
PBGR	1		1	1			1	
PBGR-PR				1				
HOGR				1				
HOGR-PR	1			2				
RNGR				3				
RNGR-PR				1				
RNGR-N								
EAGR	1		1	13		4	1	
EAGR-PR		1	5	11		17		
GBHE								
AMBI								
CAGO			15	24		3	1	
CAGO-PR				8		1		
CAGO-N	1		2			1	2	
CAGO-Y				4				
DABB-U								
WODU-M								
GWTE-PR			2		1	1	1	
GWTE-M		1				5	1	
GWTE-F								
GWTE x NOPI								
MALL								
MALL-PR			1	8	1	2	1	
MALL-N								
MALL-M		2	2	3		3	4	
MALL-F								
NOPI-PR								
NOPI-N								
NOPI-M						2		
NOPI-F								
BWTE-PR				2	3	1		
BWTE-M				3		3		
CITE-PR			2	4	1			
CITE-M								
NOSL-PR		4	1	1	2	8	3	
NOSL-M						12		
NOSL-F								
GADW-PR			8	19	2	17	1	
GADW-M				7		7	1	
GADW-F								
EUWI								
AMWI-PR	1	2	6	20		5	1	
AMWI-M	1		3	2				
AMWI-F								
DIVER-U								
CANV-PR		1	2	5				
CANV-M		1	3	6	1			
CANV-F								
REDH-PR	4		1	8	8		2	
REDH-M	3			1		1	1	
REDH-F								
RNDU-PR				3			2	
RNDU-M	5		1			1		
RNDU-F	2							
GRSC								
LESC								
LESC-PR		12	16	167	9	45	2	

[1] For a key to species codes see Appendix I

[2] For a key to species code modifiers see Appendix II

▶

Appendix III (con't)

	3 mi s Springhouse	Soda Lake	Soda Marshes	Watson Lake	Elliot Lake	105 Mile Lake	101 Mile Marsh	Whitehorse Lake
	08-May-01	10-May-01	10-May-01	11-May-01	11-May-01	11-May-01	11-May-01	12-May-01
LESC-M		9	8	57	4	26		
LESC-F	2			2				
LTDU								
SUSC		8		2				
SUSC-PR				13		2		
SUSC-M						3		
SUSC-F								
WWSC								
WWSC-PR				1				
WWSC-M								
GOLD-U								
GOLD-F				1				
COGO-PR		1		9	2	3		
COGO-M		1		5	1		1	
COGO-JM								
COGO-F				3		3		
BAGO								
BAGO-PR		4	1	7	1	8		
BAGO-M		5		6		3	1	
BAGO-JM								
BAGO-F		5		1		1		
BUFF					55			
BUFF-PR	1	2	2	14	7	16	6	
BUFF-JPR								
BUFF-M	1	2	1	13		2		
BUFF-JM						20		
BUFF-F		1		9		14	2	
HOME-PR				1				
HOME-F								
COME								
RBME								
RUDU						71		
RUDU-PR		1	5	16	8	18	4	
RUDU-M	3	5		38	4	5	4	
RUDU-JM								
RUDU-F	2	3						
AMCO	9		21	173	4	43	13	
AMCO-N								
OSPR								
NOHA-F								
VIRA								
SORA								
SACR								
SPSA		1		1		2		
SOSA			1		1			
LEYE				1				
GRYE				1				
LESA		13		4				
DUNL								
WIPH					3			
WIPH-PR	1					3		
WIPH-F					2			
KILL						2	1	
KILL-Y								
WISN								
RBGU								
BOGU								
HEGU								
BLTE								
TOTALS	**41**	**94**	**128**	**763**	**178**	**479**	**62**	**1**

Appendix III (con't)

◄	Elliot Lake-1	Elliot Lake-2	Elliot Lake - 3	Elliot Lake-4	103 Mile Lake	Exeter Lake	100 Mile Marsh	Sepa Lake
	13-May-01	13-May-01	13-May-01	13-May-01	13-May-01	14-May-01	14-May-01	15-May-01
COLO						5		
COLO-PR								1
COLO-N						3		
PBGR				1	1			1
PBGR-PR								
HOGR								
HOGR-PR								
RNGR					10	3		1
RNGR-PR					1			
RNGR-N								
EAGR						1		
EAGR-PR					1	1		
GBHE								
AMBI								
CAGO					13	19	20	
CAGO-PR					1	3	4	
CAGO-N					1	3	2	
CAGO-Y					7		22	
DABB-U								
WODU-M								
GWTE-PR	1							
GWTE-M						1		
GWTE-F								
GWTE x NOPI	1							
MALL								
MALL-PR	1		1		1	8		1
MALL-N								
MALL-M					4	9		1
MALL-F				1				
NOPI-PR								
NOPI-N								
NOPI-M								
NOPI-F								
BWTE-PR						1		
BWTE-M	2		1					
CITE-PR	1					3	1	
CITE-M						1		
NOSL-PR	5		1	2		3	1	
NOSL-M	5		1				3	1
NOSL-F								
GADW-PR	2				4	3		
GADW-M			1			12		
GADW-F								
EUWI								
AMWI-PR					2	15	2	
AMWI-M	1			1	1	7		
AMWI-F						4		
DIVER-U								
CANV-PR					2			
CANV-M				1	1		2	
CANV-F								
REDH-PR	5			1	1	4	2	
REDH-M	2				1	1		
REDH-F								
RNDU-PR	2					7	1	
RNDU-M	1					13	2	
RNDU-F						2		
GRSC								
LESC								
LESC-PR	19		2		22	1	10	

►

Appendix III (con't)

◄	Elliot Lake-1	Elliot Lake-2	Elliot Lake - 3	Elliot Lake-4	103 Mile Lake	Exeter Lake	100 Mile Marsh	Sepa Lake
	13-May-01	13-May-01	13-May-01	13-May-01	13-May-01	14-May-01	14-May-01	15-May-01
LESC-M	17		3		21	1	5	
LESC-F	2		1		8			
LTDU								
SUSC								
SUSC-PR						1		
SUSC-M								
SUSC-F								
WWSC								
WWSC-PR								
WWSC-M								
GOLD-U								
GOLD-F					2			
COGO-PR	3				1			
COGO-M	9							
COGO-JM					1			
COGO-F	4				1		1	
BAGO								
BAGO-PR	8				4			
BAGO-M	6				5		1	
BAGO-JM	10				8			
BAGO-F	5				6		1	
BUFF								
BUFF-PR	17		1	2	2			
BUFF-JPR								
BUFF-M	10		1	2	1		1	
BUFF-JM	10		1		4			
BUFF-F	17		1		3		1	
HOME-PR								
HOME-F								
COME								
RBME								
RUDU	7							
RUDU-PR	6				6			
RUDU-M	9				1		2	
RUDU-JM								
RUDU-F	3				1		1	
AMCO	1	3	8	13	55	33	32	11
AMCO-N					3			
OSPR								
NOHA-F						1		
VIRA						2		
SORA				1		6	2	1
SACR								
SPSA								1
SOSA								
LEYE								
GRYE						1		
LESA								
DUNL								
WIPH								
WIPH-PR								
WIPH-F								
KILL			1			1		
KILL-Y								
WISN						1		
RBGU							3	
BOGU					2			
HEGU								
BLTE					28			9
TOTALS	**218**	**3**	**26**	**27**	**266**	**209**	**143**	**30**

►

Appendix III (con't)

◄	Simon Lake	Straight Lake	Tatton Lake	Lily Pad Lake	Tad Lake	Abel Lake	150 Mile Lake	Dugan Lake
	15-May-01	15-May-01	15-May-01	17-May-01	17-May-01	17-May-01	18-May-01	18-May-01
COLO	3	1	1	2	2	1		1
COLO-PR								
COLO-N		1				1		
PBGR		1	1					
PBGR-PR								
HOGR						1		
HOGR-PR								
RNGR	1		1	3	1	1	1	4
RNGR-PR	3		1	1				2
RNGR-N	2							2
EAGR								1
EAGR-PR								
GBHE								1
AMBI								
CAGO	45	15	37	13		19	27	1
CAGO-PR		4		5	1	11	3	
CAGO-N	1	2	4	1		4	1	
CAGO-Y						3	2	
DABB-U								
WODU-M								
GWTE-PR								
GWTE-M		1	1					
GWTE-F								
GWTE x NOPI								
MALL								
MALL-PR		2	1	1			1	
MALL-N					1			
MALL-M		2		4	1	2	1	
MALL-F				1				
NOPI-PR								
NOPI-N								
NOPI-M								
NOPI-F								
BWTE-PR								3
BWTE-M		1						
CITE-PR		1						1
CITE-M		1						
NOSL-PR								
NOSL-M								
NOSL-F								
GADW-PR			1		1		2	
GADW-M							2	
GADW-F								
EUWI								
AMWI-PR		2	5	1			4	
AMWI-M			5				1	
AMWI-F			1					
DIVER-U			150					3
CANV-PR								
CANV-M				1				
CANV-F								
REDH-PR		1	1				1	
REDH-M							1	
REDH-F							1	
RNDU-PR	3	4	1	1				4
RNDU-M	1	2	2		1			
RNDU-F								
GRSC								
LESC	180		126					
LESC-PR		9	24	12	1	17	7	1

►

Appendix III (con't)

◄	Simon Lake	Straight Lake	Tatton Lake	Lily Pad Lake	Tad Lake	Abel Lake	150 Mile Lake	Dugan Lake
	15-May-01	15-May-01	15-May-01	17-May-01	17-May-01	17-May-01	18-May-01	18-May-01
LESC-M		2	24	4	5	2	14	
LESC-F		1	2	1	1		3	
LTDU								
SUSC					1			49
SUSC-PR	1				2			23
SUSC-M					3	1		14
SUSC-F					2			4
WWSC				18				29
WWSC-PR						3		
WWSC-M				1		5		
GOLD-U	15							1
GOLD-F								
COGO-PR	2			3				
COGO-M	6			3				4
COGO-JM								
COGO-F	3		1	4				
BAGO								14
BAGO-PR	2		5					4
BAGO-M	8		8	1			4	3
BAGO-JM	2		6				1	5
BAGO-F			2	2				2
BUFF	3							
BUFF-PR	3		1				3	2
BUFF-JPR								
BUFF-M	6	1	1	1			3	
BUFF-JM	2		3				9	
BUFF-F	14			1			1	
HOME-PR								
HOME-F		1						
COME								
RBME								
RUDU	5							
RUDU-PR	5	1	1	1				
RUDU-M	9		1	1	5	1		
RUDU-JM								
RUDU-F	2							1
AMCO	10	3	7	15	8	8	11	9
AMCO-N								
OSPR								
NOHA-F		1			1	1		
VIRA		1						
SORA	1	2		2	1	3		1
SACR	1							
SPSA	1	1	1				1	
SOSA								
LEYE								
GRYE								
LESA								
DUNL								
WIPH								
WIPH-PR								
WIPH-F								
KILL				2		1	1	
KILL-Y								
WISN								1
RBGU								
BOGU								1
HEGU								
BLTE			13	1				2
TOTALS	**591**	**83**	**755**	**145**	**42**	**107**	**136**	**295**

►

Appendix III (con't)

	Dewar Lake	Slough 5 km S Springhouse	Boitano Lake	Westwick Lakes (east) north end	Westwick Lakes (east) south end	Westwick Lakes (west)	Jones Lake	149 Mile Lake-1
	18-May-01	19-May-01	20-May-01	20-May-01	20-May-01	19-May-01	22-May-01	22-May-01
COLO	1							
COLO-PR							1	
COLO-N	1							
PBGR								
PBGR-PR								
HOGR								
HOGR-PR								
RNGR	2							
RNGR-PR	1		1				2	
RNGR-N								
EAGR			41	58	214	41		1
EAGR-PR			22					
GBHE							2	
AMBI								
CAGO	19	1	13		7	26	55	6
CAGO-PR			1		1	2	3	4
CAGO-N	2	1	5				2	
CAGO-Y					5			15
DABB-U							1	1
WODU-M								
GWTE-PR							1	
GWTE-M								
GWTE-F								
GWTE x NOPI								
MALL	1							
MALL-PR				1				3
MALL-N								
MALL-M								12
MALL-F								3
NOPI-PR			1					
NOPI-N								
NOPI-M								
NOPI-F								
BWTE-PR		1					1	
BWTE-M				2	1			1
CITE-PR								
CITE-M								
NOSL-PR			1			1		
NOSL-M						2		1
NOSL-F								1
GADW-PR			2	11	7	1		6
GADW-M				3	6			6
GADW-F				1	3			2
EUWI								
AMWI-PR	1	1	1	4	1			3
AMWI-M		1		2	1			3
AMWI-F								1
DIVER-U			1					
CANV-PR								
CANV-M								1
CANV-F								
REDH-PR		2		3	21	2	1	4
REDH-M					5	2		6
REDH-F					4	1		
RNDU-PR								
RNDU-M								4
RNDU-F								
GRSC								
LESC								
LESC-PR		3	10	7	35	7		9

Appendix III (con't)

	Dewar Lake	Slough 5 km S Springhouse	Boitano Lake	Westwick Lakes (east) north end	Westwick Lakes (east) south end	Westwick Lakes (west)	Jones Lake	Mission Pond 1
	18-May-01	19-May-01	20-May-01	20-May-01	20-May-01	19-May-01	22-May-01	22-May-01
LESC-M		2	13	9	35	12		23
LESC-F			3	1	9	3		
LTDU								
SUSC								
SUSC-PR			2					
SUSC-M			7					
SUSC-F			3					
WWSC								
WWSC-PR			1					
WWSC-M								
GOLD-U								1
GOLD-F								
COGO-PR								
COGO-M								
COGO-JM								
COGO-F								
BAGO			7					
BAGO-PR			3	1	1	1		
BAGO-M			7		4	7		3
BAGO-JM			2		4			
BAGO-F			1			1		2
BUFF								3
BUFF-PR		5	2			1		2
BUFF-JPR								
BUFF-M			2		3	3		4
BUFF-JM		4	2		1	9		5
BUFF-F		1			1	4		7
HOME-PR								
HOME-F								
COME								
RBME								
RUDU		1						
RUDU-PR			2		6	1		3
RUDU-M				1	14	10	1	7
RUDU-JM					1			
RUDU-F				1	10	2		1
AMCO	2	13		37	312	77	9	9
AMCO-N				1				
OSPR								
NOHA-F				1				
VIRA								
SORA				2		1	6	
SACR								
SPSA			11					
SOSA								
LEYE								
GRYE								
LESA								
DUNL			8					
WIPH			3					
WIPH-PR								
WIPH-F								
KILL			4				3	
KILL-Y								
WISN							4	
RBGU								
BOGU								
HEGU								
BLTE							1	
TOTALS	**53**	**39**	**247**	**206**	**939**	**289**	**148**	**185**

Appendix III (con't)

◄	Mission Pond 2	Mission Pond 3	Irish Lake	Fawn Lake	Larum's Bay	70 Mile House slough 1	70 Mile House slough 2	70 Mile House slough 3
	22-May-01	22-May-01	23-May-01	23-May-01	23-May-01	24-May-01	24-May-01	24-May-01
COLO				1				
COLO-PR			1					
COLO-N				1	1			
PBGR	1		1					
PBGR-PR								
HOGR								
HOGR-PR								
RNGR			2					
RNGR-PR					2			
RNGR-N								
EAGR								
EAGR-PR		1						
GBHE			1	1				
AMBI				2				
CAGO		12	5		1			
CAGO-PR		3	1					
CAGO-N		2			1			
CAGO-Y		6						
DABB-U		1						
WODU-M								
GWTE-PR						1		
GWTE-M		3						3
GWTE-F								1
GWTE x NOPI								
MALL								
MALL-PR							1	4
MALL-N								
MALL-M		2	1				1	8
MALL-F						1		
NOPI-PR		1				1		1
NOPI-N								
NOPI-M					2			3
NOPI-F							1	
BWTE-PR						1		2
BWTE-M						2	1	2
CITE-PR		3			2		1	
CITE-M	1				2			
NOSL-PR		2						1
NOSL-M		9					2	
NOSL-F							1	
GADW-PR		6				1		2
GADW-M		3						
GADW-F								
EUWI								
AMWI-PR		5					1	
AMWI-M		1					1	
AMWI-F		1						
DIVER-U		4			2			
CANV-PR								
CANV-M								
CANV-F								
REDH-PR	1	1						
REDH-M	1							
REDH-F								
RNDU-PR				1	5			
RNDU-M					2			
RNDU-F								
GRSC								
LESC								
LESC-PR		1			2			

►

Appendix III (con't)

◄	Mission Pond 2	Mission Pond 3	Irish Lake	Fawn Lake	Larum's Bay	70 Mile House slough 1	70 Mile House slough 2	70 Mile House slough 3
	22-May-01	22-May-01	23-May-01	23-May-01	23-May-01	24-May-01	24-May-01	24-May-01
LESC-M		14						
LESC-F		4						
LTDU								
SUSC								
SUSC-PR								
SUSC-M								
SUSC-F								
WWSC								
WWSC-PR								
WWSC-M								
GOLD-U		1						
GOLD-F		5						
COGO-PR								
COGO-M		2			1			
COGO-JM								
COGO-F		2						
BAGO								
BAGO-PR								
BAGO-M		5				1		
BAGO-JM								
BAGO-F		5						
BUFF								
BUFF-PR	1							
BUFF-JPR								
BUFF-M		9					1	
BUFF-JM	1	5						
BUFF-F	1	8						
HOME-PR								
HOME-F					1			
COME								
RBME								
RUDU								
RUDU-PR	2							
RUDU-M	2	1						
RUDU-JM								
RUDU-F								
AMCO	5	36	1					
AMCO-N								
OSPR								
NOHA-F								
VIRA					1			
SORA					2			
SACR								
SPSA			5		1			
SOSA								
LEYE								
GRYE						1		
LESA								
DUNL								
WIPH								
WIPH-PR		1						
WIPH-F								
KILL						1		
KILL-Y								
WISN				1	1			
RBGU								
BOGU								
HEGU			1					
BLTE				8	36			
TOTALS	**19**	**194**	**27**	**16**	**70**	**13**	**14**	**29**

►

Appendix III (con't)

◄	70 Mile House slough 4	70 Mile House slough 5	70 Mile House slough 6	70 Mile House slough 7	70 Mile House slough 8	70 Mile House slough 9	70 Mile House slough 10	70 Mile House slough 11
	24-May-01	24-May-01	24-May-01	24-May-01	24-May-01	28-May-01	28-May-01	28-May-01
COLO				1			1	
COLO-PR								
COLO-N								
PBGR	1		2	2	2		3	1
PBGR-PR								
HOGR								
HOGR-PR								1
RNGR								
RNGR-PR								
RNGR-N								
EAGR	5	7						
EAGR-PR								
GBHE								
AMBI								
CAGO	4			2			6	1
CAGO-PR	6	3	3		2			4
CAGO-N	2			1				
CAGO-Y	14				6			4
DABB-U	1							
WODU-M								
GWTE-PR		1						
GWTE-M	1	1			2			
GWTE-F								
GWTE x NOPI								
MALL								
MALL-PR	1		1	1	1			
MALL-N								
MALL-M	5				1	1	2	
MALL-F	1				1			
NOPI-PR								
NOPI-N								
NOPI-M								
NOPI-F								
BWTE-PR		2						
BWTE-M	1				2		1	
CITE-PR			1		1			
CITE-M	1				1			
NOSL-PR	1							
NOSL-M	4							
NOSL-F								
GADW-PR	3							
GADW-M	1							
GADW-F								
EUWI								
AMWI-PR	1				1	1		1
AMWI-M	3		1					1
AMWI-F	2							
DIVER-U	1							
CANV-PR								
CANV-M								
CANV-F							1	
REDH-PR	1		1		1		4	
REDH-M					2		2	
REDH-F								
RNDU-PR	1			2		1		
RNDU-M	1					1		
RNDU-F								
GRSC								
LESC								
LESC-PR	2			7	2		2	5

►

Appendix III (con't)

◄	70 Mile House slough 4	70 Mile House slough 5	70 Mile House slough 6	70 Mile House slough 7	70 Mile House slough 8	70 Mile House slough 9	70 Mile House slough 10	70 Mile House slough 11
	24-May-01	24-May-01	24-May-01	24-May-01	24-May-01	28-May-01	28-May-01	28-May-01
LESC-M	1			2	2		1	9
LESC-F								1
LTDU								
SUSC								
SUSC-PR								
SUSC-M								
SUSC-F								
WWSC								
WWSC-PR								
WWSC-M								
GOLD-U								
GOLD-F	1							
COGO-PR								
COGO-M								
COGO-JM								
COGO-F								
BAGO								
BAGO-PR	1					1		
BAGO-M	1				3	2		
BAGO-JM								2
BAGO-F						1		
BUFF	3							4
BUFF-PR	5		1			1		2
BUFF-JPR	4	1						1
BUFF-M	5	1	1	1	1	1	2	2
BUFF-JM	2	2						
BUFF-F	4	1			1			3
HOME-PR								
HOME-F								
COME								
RBME								
RUDU								
RUDU-PR	2	2		3				1
RUDU-M	3	3		5			2	1
RUDU-JM								
RUDU-F							5	
AMCO	29	2	10	11	10	1	2	
AMCO-N				1			1	
OSPR								
NOHA-F								
VIRA							1	
SORA								1
SACR								
SPSA								
SOSA								
LEYE								
GRYE								
LESA								
DUNL								
WIPH								
WIPH-PR								
WIPH-F								
KILL		2						
KILL-Y								
WISN								
RBGU								
BOGU								
HEGU								
BLTE								
TOTALS	**147**	**36**	**23**	**44**	**49**	**11**	**48**	**54**

►

Appendix III (con't)

◄	Rush Lake	Springhouse Slough 1	Springhouse Slough 2	Springhouse Slough 3	Springhouse Slough 4	Springhouse Slough 5	Springhouse Slough 6	130 Mile Lake
	25-May-01	25-May-01	25-May-01	25-May-01	25-May-01	25-May-01	25-May-01	29-May-01
COLO								1
COLO-PR								
COLO-N								1
PBGR								2
PBGR-PR								
HOGR								
HOGR-PR								
RNGR								1
RNGR-PR								
RNGR-N								
EAGR	80	3				1	21	
EAGR-PR								
GBHE								
AMBI								1
CAGO	2				78		160	155
CAGO-PR	1	1			3		1	3
CAGO-N								
CAGO-Y		5			14		4	
DABB-U								
WODU-M								1
GWTE-PR								
GWTE-M								
GWTE-F								
GWTE x NOPI								
MALL								
MALL-PR		1	1				2	
MALL-N			1	2				
MALL-M	12	1			2		2	15
MALL-F								1
NOPI-PR								
NOPI-N								
NOPI-M								
NOPI-F								
BWTE-PR							1	
BWTE-M	4	5		1	1		4	7
CITE-PR		1					2	
CITE-M		6					1	1
NOSL-PR					1	1		1
NOSL-M	3	1					5	2
NOSL-F		1					1	
GADW-PR				1		1	6	1
GADW-M		2					1	
GADW-F							2	
EUWI								
AMWI-PR							2	6
AMWI-M	1	2			1		2	3
AMWI-F							1	
DIVER-U								1
CANV-PR								
CANV-M								
CANV-F								
REDH-PR	4	1			1		1	
REDH-M	3	1						
REDH-F								
RNDU-PR		1						3
RNDU-M	1	3						1
RNDU-F								
GRSC								
LESC								
LESC-PR	5	5			1		3	3

►

Appendix III (con't)

	Rush Lake	Springhouse Slough 1	Springhouse Slough 2	Springhouse Slough 3	Springhouse Slough 4	Springhouse Slough 5	Springhouse Slough 6	130 Mile Lake
	25-May-01	25-May-01	25-May-01	25-May-01	25-May-01	25-May-01	25-May-01	29-May-01
LESC-M	15	1					1	
LESC-F	2							
LTDU								
SUSC								
SUSC-PR								
SUSC-M								
SUSC-F								
WWSC								
WWSC-PR								
WWSC-M								
GOLD-U								
GOLD-F								
COGO-PR								
COGO-M								
COGO-JM								
COGO-F								
BAGO								
BAGO-PR								
BAGO-M							1	
BAGO-JM								
BAGO-F								
BUFF								
BUFF-PR	1				1		1	
BUFF-JPR								
BUFF-M	1	1				1		
BUFF-JM	2					1	3	
BUFF-F						5	2	
HOME-PR								
HOME-F								
COME								
RBME								
RUDU								
RUDU-PR	11	3			4			
RUDU-M	29	1			1	3	1	
RUDU-JM	4							
RUDU-F								
AMCO	49	9			5		8	5
AMCO-N								
OSPR								2
NOHA-F		1						
VIRA								1
SORA	2					1		6
SACR					2			
SPSA								
SOSA								
LEYE								
GRYE			1		1			
LESA								
DUNL								
WIPH	1				14		1	
WIPH-PR								
WIPH-F								
KILL	1				2			
KILL-Y								
WISN								1
RBGU								
BOGU								
HEGU								
BLTE					2			72
TOTALS	**321**	**71**	**3**	**5**	**227**	**20**	**430**	**467**

Appendix III (con't)

◄	Total number of birds
COLO	21
COLO-PR	4
COLO-N	9
PBGR	24
PBGR-PR	1
HOGR	2
HOGR-PR	4
RNGR	34
RNGR-PR	15
RNGR-N	4
EAGR	494
EAGR-PR	59
GBHE	5
AMBI	3
CAGO	805
CAGO-PR	83
CAGO-N	41
CAGO-Y	111
DABB-U	4
WODU-M	1
GWTE-PR	9
GWTE-M	20
GWTE-F	1
GWTE x NOPI	1
MALL	1
MALL-PR	47
MALL-N	4
MALL-M	103
MALL-F	9
NOPI-PR	4
NOPI-N	0
NOPI-M	7
NOPI-F	1
BWTE-PR	18
BWTE-M	45
CITE-PR	25
CITE-M	15
NOSL-PR	40
NOSL-M	51
NOSL-F	4
GADW-PR	108
GADW-M	52
GADW-F	8
EUWI	0
AMWI-PR	95
AMWI-M	45
AMWI-F	10
DIVER-U	162
CANV-PR	10
CANV-M	17
CANV-F	1
REDH-PR	88
REDH-M	33
REDH-F	6
RNDU-PR	42
RNDU-M	42
RNDU-F	4
GRSC	0
LESC	306
LESC-PR	485

◄	Total number of birds
LESC-M	342
LESC-F	46
LTDU	0
SUSC	60
SUSC-PR	44
SUSC-M	28
SUSC-F	9
WWSC	47
WWSC-PR	5
WWSC-M	6
GOLD-U	18
GOLD-F	9
COGO-PR	24
COGO-M	33
COGO-JM	1
COGO-F	22
BAGO	21
BAGO-PR	52
BAGO-M	85
BAGO-JM	40
BAGO-F	35
BUFF	68
BUFF-PR	102
BUFF-JPR	6
BUFF-M	85
BUFF-JM	86
BUFF-F	102
HOME-PR	1
HOME-F	2
COME	0
RBME	0
RUDU	84
RUDU-PR	112
RUDU-M	173
RUDU-JM	5
RUDU-F	32
AMCO	1132
AMCO-N	6
OSPR	2
NOHA-F	6
VIRA	6
SORA	41
SACR	3
SPSA	26
SOSA	2
LEYE	1
GRYE	5
LESA	17
DUNL	8
WIPH	22
WIPH-PR	5
WIPH-F	2
KILL	22
KILL-Y	0
WISN	9
RBGU	3
BOGU	3
HEGU	1
BLTE	172
TOTALS	**9266**

Appendix IV

Appendix IV. Common and scientific names of plants mentioned in the text sorted by common name (left) and by scientific name (right).

Common Name	Scientific Name
alkali saltgrass	*Distichlis stricta*
Baltic rush	*Juncus balticus*
Baltic rush	*Juncus balticus*
barley	*Hordeum* sp.
bladderwort	*Utricularia* spp.
bluebunch wheatgrass	*Agropyron spicatum*
brittlewort	*Nitella* sp.
bulrush	*Scirpus* spp.
buttercup	*Ranunculus* sp.
Canadian waterweed	*Elodea Canadensis*
cattail	*Typha* sp.
common duckweed	*Lemna minor*
common juniper	*Juniperus communis*
common mare's-tail	*Hippuris vulgaris*
common spike-rush	*Eleocharis palustris*
Douglas-fir	*Pseudotsuga menziesii*
duckweed	*Lemna* spp.
fennel-leaved pondweed	*Potamogeton pectinatus*
floating-leaved pondweed	*Potamogeton natans*
great bulrush	*Scirpus lacustris*
horsetail	*Equisetum* spp.
ivy-leaved duckweed	*Lemna trisulca*
kinnikinnick	*Arctostaphylos uva-ursi*
lodgepole pine	*Pinus contorta*
muskgrass	*Chara* spp.
Nuttall's alkaligrass	*Puccinellia nuttalliana*
paper birch	*Betula papyifera*
pinegrass	*Calamagrostis rubescens*
pondweed	*Potamogeton* spp.
prickly-pear cactus	*Opuntia fragilis*
quackgrass	*Agropyron repens*
red-osier dogwood	*Cornus stolonifera*
red-stemmed feathermoss	*Pleurozium schreberi*
reed canary grass	*Phalaris arundinaceae*
round-stem bulrush	*Scirpus lacustris*
rush	*Juncus* spp.
sago pondweed	*Potamogeton pectinatus*
saskatoon	*Amelanchier alnifolia*
scrub birch	*Betula glandulosa*
seablite	*Suaeda depressa*
seaside arrow-grass	*Triglochin maritimum*
sedge	*Carex spp.*
sedge	*Carex* sp.
shore buttercup	*Ranunculus cymbalaria*
silverweed	*Potentilla anserine*
soopolalli	*Sheperdia canadensis*
spruce	*Picea*
trembling aspen	*Populus tremuloides*
water birch	*Betula occidentalis*
water smartweed	*Polygonum amphibium*
water-milfoil	*Myriophyllum*
waterweed	*Elodea* spp.
white spruce	*Picea glauca*
widgeon grass	*Ruppia maratima*
willow	*Salix spp.*
yellow waterlily	*Nuphar polysepalum*

Scientific Name	Common Name
Agropyron repens	quackgrass
Agropyron spicatum	bluebunch wheatgrass
Amelanchier alnifolia	saskatoon
Arctostaphylos uva-ursi	kinnikinnick
Betula glandulosa	scrub birch
Betula occidentalis	water birch
Betula papyifera	paper birch
Calamagrostis rubescens	pinegrass
Carex sp.	sedge
Carex spp.	sedge
Chara spp.	muskgrass
Cornus stolonifera	red-osier dogwood
Distichlis stricta	alkali saltgrass
Eleocharis palustris	common spike-rush
Elodea Canadensis	Canadian waterweed
Elodea spp.	waterweed
Equisetum spp.	horsetail
Hippuris vulgaris	common mare's-tail
Hordeum sp.	barley
Juncus balticus	Baltic rush
Juncus balticus	Baltic rush
Juncus spp.	rush
Juniperus communis	common juniper
Lemna minor	common duckweed
Lemna spp.	duckweed
Lemna trisulca	ivy-leaved duckweed
Myriophyllum	water-milfoil
Nitella sp.	brittlewort
Nuphar polysepalum	yellow waterlily
Opuntia fragilis	prickly-pear cactus
Phalaris arundinaceae	reed canary grass
Picea	spruce
Picea glauca	white spruce
Pinus contorta	lodgepole pine
Pleurozium schreberi	red-stemmed feathermoss
Polygonum amphibium	water smartweed
Populus tremuloides	trembling aspen
Potamogeton spp.	pondweed
Potamogeton natans	floating-leaved pondweed
Potamogeton pectinatus	fennel-leaved pondweed
Potamogeton pectinatus	sago pondweed
Potentilla anserine	silverweed
Pseudotsuga menziesii	Douglas-fir
Puccinellia nuttalliana	Nuttall's alkaligrass
Ranunculus cymbalaria	shore buttercup
Ranunculus sp.	buttercup
Ruppia maratima	widgeon grass
Salix spp.	willow
Scirpus lacustris	great bulrush
Scirpus lacustris	round-stem bulrush
Scirpus spp.	bulrush
Sheperdia canadensis	soopolalli
Suaeda depressa	seablite
Triglochin maritimum	seaside arrow-grass
Typha sp.	cattail
Utricularia spp.	bladderwort

Appendix V

Appendix V. Common and scientific names of animals (excluding birds) mentioned in the text ordered by common name (left) and scientific name (right).

Common name	Scientific name
beaver	*Castor canadensis*
coyote	*Canis latrans*
lake chub	*Couesius plumbeus*
lake shiner	*Richardsonius balteatus*
northern pikeminnow	*Ptychocheilus oregonensis*
painted turtle	*Chrysemys picta*
peamouth chub	*Mylocheilus caurinus*
rainbow trout	*Onchorhynchus mykiss*
redside shiner	*Richardsonius balteatus*
river otter	*Lontra canadensis*
sucker	*Catostomus* spp.
western toad	*Bufo boreas*

Scientific name	Common name
Bufo boreas	western toad
Canis latrans	coyote
Castor canadensis	beaver
Catostomus spp.	sucker
Chrysemys picta	painted turtle
Couesius plumbeus	lake chub
Lontra canadensis	river otter
Mylocheilus caurinus	peamouth chub
Onchorhynchus mykiss	rainbow trout
Ptychocheilus oregonensis	northern pikeminnow
Richardsonius balteatus	lake shiner
Richardsonius balteatus	redside shiner

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