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# **Bird use of the Tahsis River and Leiner River estuaries, Vancouver Island, British Columbia 1981 - 1982**

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**Neil K. Dawe**

**Ron Buechert**

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Pacific and Yukon Region 1998

Canadian Wildlife Service

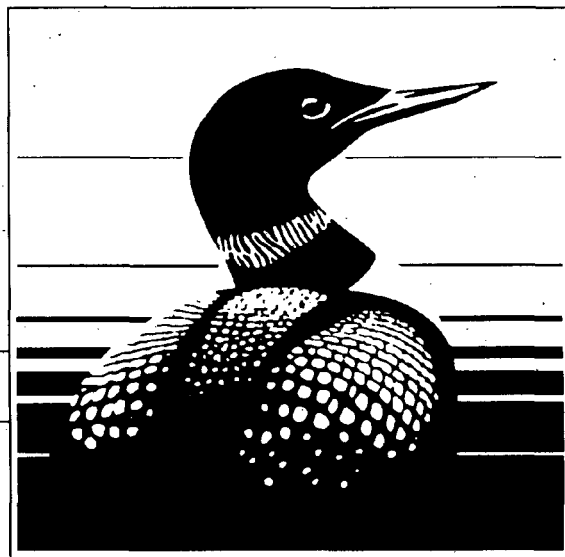
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BIRD USE OF THE TAHSIS RIVER AND LEINER RIVER ESTUARIES  
VANCOUVER ISLAND, BRITISH COLUMBIA  
1981-1982

Neil K. Dawe  
and Ron Buechert

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## Abstract

The estuaries of the Tahsis and Leiner Rivers are located 2 kilometres apart near the head of a long narrow fiord on the west coast of Vancouver Island, British Columbia. Most of the Tahsis River estuary has been filled in or modified by urban and industrial development. Most of the Leiner River estuary is in a natural state. To determine the abundance and distribution of migratory and resident birds on the 2 estuaries, weekly surveys were conducted from 17 November 1981 through 28 May 1982.

Twenty-six species were tallied at the Tahsis River estuary and 51 species at the Leiner River estuary; the total number of bird species recorded using the entire study site was 57. This number includes 20 species of waterfowl and 6 other species of diving birds, 15 species of passerines, 3 species of raptors and 3 species of gulls. One group of waterfowl, the dabbling ducks, was completely absent from Tahsis River estuary even though Mallards had been present in the past and were thought to have been nesting.

The study area supported a minimum of 1511 birds in at least one stage of their life history during the study period; at least 443 birds were supported by the estuary of the Tahsis River and 1295 birds were supported by the estuary of the Leiner River. It appears that, although there was obvious movement of birds between the 2 estuaries, the majority of birds focused most or all of their use on one estuary or the other.

The total number of birds observed using the Leiner River estuary was approximately 2.5 times the number on the Tahsis River estuary in autumn, 3 times the number in winter and 4.5 times the number in spring.

The numbers of birds in each species group using the 2 estuaries was different over the seasons. On the Tahsis River estuary, waterfowl was the largest user group in the autumn whereas in winter and spring gulls dominated. On the Leiner River estuary, the proportion of waterfowl shared highest ranking with the gulls in autumn, but in winter and spring waterfowl were by far the most numerous bird group.

Birds used the study area in the winter (1981-1982) more than in the autumn or the spring. Waterfowl (mostly diving ducks) used the area in the largest numbers, passerines ranked a distant second followed by shorebirds and gulls.

An annotated species list discusses arrival and departure dates, highest number seen in one day, differences in use of the 2 estuaries and other details for each of the species.

Concluding comments note human impacts ranging from direct disturbance as result of recreational activities to habitat destruction and discuss possible implications of future decisions. Suggestions are also made for further study of the avifauna that would complete the picture of bird use of the estuaries of the Tahsis and Leiner Rivers.

## Résumé

Les estuaires des rivières Tahsis et Leiner se trouvent à deux kilomètres l'un de l'autre, près de l'embouchure d'un fjord long et étroit situé sur la côte ouest de l'île de Vancouver, en Colombie-Britannique. La plus grande partie de l'estuaire de la rivière Tahsis a été remblayée ou modifiée par des aménagements industriels et urbains, alors que l'estuaire de la rivière Leiner se trouve presque entièrement à l'état naturel. Pour déterminer le taux d'abondance et le schéma de répartition des oiseaux migrateurs et des oiseaux résidents dans ces deux estuaires, une campagne de recensements hebdomadaires a été effectuée entre le 17 novembre 1981 et le 28 mai 1982.

Vingt-six espèces d'oiseaux ont été recensées dans l'estuaire de la rivière Tahsis et 51 espèces dans l'estuaire de la rivière Leiner; le nombre total d'espèces dénombrées dans l'aire d'observation a été de 57 : 20 espèces d'oiseaux aquatiques, 6 espèces de plongeurs, 15 espèces de passereaux, 3 espèces de rapaces et 3 espèces de goélands. Parmi les oiseaux aquatiques, le canard de surface était complètement absent de l'estuaire de la Tahsis, endroit où il nichait auparavant.

L'aire d'observation abritait au moins 1 511 oiseaux arrivés à divers stades de leur cycle biologique; au moins 443 individus fréquentaient l'estuaire de la rivière Tahsis et 1 295 individus celui de la rivière Leiner. Bien qu'on ait observé un certain mouvement entre les 2 estuaires, la majorité des individus se cantonnait dans un estuaire en particulier.

Comparativement à l'estuaire de la Tahsis, le nombre total d'oiseaux observés dans l'estuaire de la rivière Leiner était d'environ 2,5 fois supérieur en automne, 3 fois supérieur en hiver et 4,5 fois supérieur au printemps.

Le nombre d'oiseaux pour chaque espèce ayant été observé dans les deux estuaires était différent selon les saisons. Dans l'estuaire de la Tahsis, les oiseaux aquatiques représentaient le groupe le plus nombreux en automne, alors qu'en hiver et au printemps, ce sont les goélands qui prédominaient. Dans l'estuaire de la Leiner, ce sont les oiseaux aquatiques et les goélands qui prédominaient en automne, alors qu'en hiver et au printemps le nombre d'oiseaux aquatiques était nettement supérieur à celui de tous les autres groupes.

Le nombre d'oiseaux observé dans l'ensemble de l'aire d'observation était plus élevé en hiver (1981-1982) qu'en automne ou au printemps. Les oiseaux aquatiques (en majeure partie des canards plongeurs) étaient le groupe le plus nombreux, les passereaux arrivant loin derrière, puis les oiseaux de rivage et les goélands.

Un inventaire annoté des espèces observées fait état des dates d'arrivée et de départ, du nombre le plus élevé observé au cours d'une journée, des distinctions d'usage des deux estuaires et autres détails concernant chaque espèce.

La conclusion fait état de l'impact de l'homme sur le milieu, depuis les perturbations résultant directement des activités récréatives jusqu'à la destruction de l'habitat. Elle fait également état des conséquences éventuelles des décisions d'aménagement qui se prendront dans l'avenir. Enfin, les auteurs suggèrent d'autres études avifauniques qui permettraient de compléter les connaissances sur l'usage que font les oiseaux des estuaires de la Tahsis et de la Leiner.

## Table of Contents

Abstract . . . . .	iii
Résumé . . . . .	iv
Table of Contents . . . . .	v
List of Tables . . . . .	vii
List of Figures . . . . .	viii
List of Appendices . . . . .	x
Acknowledgements . . . . .	xi
Introduction . . . . .	1
The Study Area . . . . .	2
Methods and Limitations . . . . .	8
Results and Discussion . . . . .	9
Bird Use of the Study Area . . . . .	9
Seasonal Numbers . . . . .	11
Species Composition . . . . .	15
Loons . . . . .	15
Grebes . . . . .	15
Cormorants . . . . .	15
Hérons . . . . .	16
Swans . . . . .	16
Geese . . . . .	16
Dabbling Ducks . . . . .	16
Diving Ducks . . . . .	17
Raptors . . . . .	22
Coots and Rails . . . . .	23
Shorebirds . . . . .	23
Gulls . . . . .	23
Alcids . . . . .	26
Pigeons . . . . .	26
Kingfishers . . . . .	26
Woodpeckers . . . . .	26
Passerines . . . . .	26
Swallows . . . . .	26
Crows and Jays . . . . .	27
Creepers . . . . .	27
Wrens . . . . .	27
Dippers . . . . .	27
Kinglets and Thrushes . . . . .	27
Starlings . . . . .	29

<i>Wood Warblers, Sparrows and Blackbirds</i> . . . . .	29
Warblers . . . . .	29
Sparrows . . . . .	29
Blackbirds . . . . .	29
<i>Finches</i> . . . . .	29
Conclusions . . . . .	30
Bird Use and Recreational Activities . . . . .	30
A Comparison of the Tahsis and Leiner River Estuaries . . . . .	30
Management Recommendations . . . . .	31
Future Studies . . . . .	32
Literature Cited . . . . .	33
Appendices . . . . .	35



## List of Tables

Table 1.	<i>Descriptions of habitat zones on the Tahsis River estuary, 1981 (from Envirocon 1981). . . . .</i>	5
Table 2.	<i>Descriptions of habitat zones on the Leiner River estuary, 1981 (from Envirocon 1981). . . . .</i>	7
Table 3.	<i>Estimated minimum numbers of birds dependent on the Tahsis River estuary and Leiner River estuary combined, 17 November 1981 through 28 May 1982, based on the maximum number of each species observed during bird surveys on a single day at both estuaries. For species names, see Appendix II. . . . .</i>	9
Table 4.	<i>Estimated minimum numbers of birds dependent on the Tahsis River estuary, 17 November 1981 through 28 May 1982, based on the maximum number of each species observed on bird surveys. For species names, see Appendix II. . . . .</i>	10
Table 5.	<i>Estimated minimum numbers of birds dependent on the Leiner River estuary, 17 November 1981 through 28 May 1982, based on the maximum number of each species observed on bird surveys. For species names, see Appendix II. . . . .</i>	10

## List of Figures

Figure 1.	<i>Location of the study area showing the estuaries of the Tahsis River and the Leiner River (from Western Canada Hydraulic Laboratories and Envirocon 1981, Preliminary Report).</i>	3
Figure 2.	<i>Habitat zones on the Tahsis River estuary, 1981 (from Envirocon 1981).</i>	4
Figure 3.	<i>Habitat zones on the Leiner River estuary, 1981 (from Envirocon 1981).</i>	6
Figure 4.	<i>Proportions of bird use by species groups on the estuary of the Tahsis River, autumn 1981.</i>	12
Figure 5.	<i>Proportions of bird use by species groups on the estuary of the Leiner River, autumn 1981.</i>	12
Figure 6.	<i>Proportions of bird use by species groups on the estuary of the Tahsis River, winter 1981-1982.</i>	13
Figure 7.	<i>Proportions of bird use by species groups on the estuary of the Leiner River, winter 1981-1982.</i>	13
Figure 8.	<i>Proportions of bird use by species groups on the estuary of the Tahsis River, spring 1982.</i>	14
Figure 9.	<i>Proportions of bird use by species groups on the estuary of the Leiner River, spring 1982.</i>	14
Figure 10.	<i>Seasonal fluctuations in numbers of dabbling ducks (solid lines) and Mallards (dashed lines) on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.</i>	18
Figure 11.	<i>Seasonal fluctuations in numbers of diving ducks (solid lines) and Bufflehead (dashed lines) on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.</i>	20
Figure 12.	<i>Seasonal fluctuations in numbers of scoters (solid lines) and goldeneye (dashed lines) on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.</i>	21
Figure 13.	<i>Seasonal fluctuations in numbers of shorebirds on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.</i>	24

Figure 14. *Seasonal fluctuations in numbers of all gulls combined (solid lines) and Mew Gulls (dashed lines) on the Tahsis River estuary (top row) and the Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982. . . . .* 25

Figure 15. *Seasonal fluctuations in numbers of all passerines combined (solid lines), Northwestern Crows (dashed lines) and American Robins (dotted lines) on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982. . . . .* 28

## List of Appendices

Appendix I.	<i>Bird check-list for the estuaries of the Tahsis and Leiner Rivers . . . . .</i>	36
Appendix II.	<i>Survey dates, approximate tidal levels and sundry remarks for the estuaries of the Tahsis and Leiner Rivers, 17 November 1981 to 28 May 1982. . . . .</i>	38
Appendix III.	<i>Tahsis River estuary bird surveys: Seasonal bird numbers, 17 November 1981 to 28 May 1982. . . . .</i>	42
Appendix IV	<i>Leiner River estuary bird surveys: Seasonal bird numbers, 17 November 1981 to 28 May 1982. . . . .</i>	47

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## Introduction

Estuaries along coastal British Columbia are important to a diverse wildlife fauna, particularly resident and migratory birds (Dawe 1976, 1980, Dawe and Lang 1980, Dawe et al. 1994, Butler and Cannings 1989, Butler et al. 1989, Vermeer et al. 1992). This diverse fauna occurs as a result of two major factors: the variety of habitats that meet on these systems and the productivity of those habitats.

Habitats often associated with typical estuarine ecosystems include marine deep water areas, intertidal sand and gravel flats, cobble beaches, mudflats, spits, river and associated riparian habitats, brackish and saline estuarine marshes with their accompanying dendritic channels, and upland grass, forb, and shrub areas that grade to coastal forests.

This concentration of habitats with its accompanying edges and niches supports a tremendous diversity and abundance of wildlife. For example, inventories from the Little Qualicum River estuary, with an upland area of less than 40 ha, have reported minimums of 14 species of algae, 55 species of fungi, 22 species of bryophytes, 234 species of vascular plants, 29 species of molluscs, 62 families of arthropods, 15 species of fishes, 4 species of amphibians, 4 species of reptiles, 220 species of birds, and 20 species of mammals (Dawe 1976, 1980, unpublished).

Nutrients and sediments brought down from the watersheds by the rivers are deposited on the deltas providing rich substrates and growing conditions for estuarine marsh plants that, along with marine vegetation such as eelgrass (*Zostera* sp.) and algae, drive the detritus-based estuarine food web. Net primary production of these systems with their attendant marshes and algal beds rival, and in some cases exceed, the production of the tropical rain forests (Ricklefs 1979).

These estuarine ecosystems are important to the survival of both resident and migratory birds. Estuaries act as stepping stones to the millions of birds that migrate along our coast each year providing areas where they can rest and feed during their northern and southern journeys.

In addition, British Columbia's estuaries support Canada's largest wintering populations of waterbirds. Estuaries, in concert with farmlands and freshwater wetlands, form part of a wetlands complex (Eamer 1985) that supports hundreds of thousands of wintering waterbirds. During periods of freezing, however, when farmlands and freshwater marshes are no longer accessible, estuaries become critical habitat to the birds' survival (see Dawe 1980 and Eamer 1985). They are the only ice free areas that have enough food to support the birds over the freezing periods.

In British Columbia, most efforts to document bird-use of estuaries have focused on the larger systems such as the Fraser, Squamish, and Cowichan (Butler and Campbell 1987, Butler and Cannings 1989, Trethewey 1985, Blood et al. 1976); however, the importance of the smaller British Columbia estuaries should not be overlooked (see Butler et al. 1989). Collectively, these smaller systems contribute significantly to the maintenance of our migratory and resident bird populations.

The Canadian Wildlife Service (CWS) has long recognized the importance of these areas and over the past 15 years has gathered data on the bird use of many of our smaller estuaries. This report documents bird use and numbers on the estuaries of the Tahsis and Leiner rivers, British Columbia, over the period 17 November 1981 through 28 May 1982. The purpose of the report is to provide information for wildlife managers and others involved in the management and decision-making process. The intention is that it will assist them in maintaining the migratory birds resources of their districts and communities.

## The Study Area

The Tahsis River and the Leiner River enter tidal water separately at the head of Tahsis Inlet (49°55'N, 126°39'W), a narrow fiord which extends 29 kilometres north from Nootka Sound on the Pacific west coast of Vancouver Island (Figure 1). The topography is mountainous and often steep except in the narrow valleys which contain glacial and fluvial deposits. The study area consists of the estuary of the Tahsis River and the estuary of the Leiner River which are approximately 2 kilometres apart. Observations also included the visible parts of Tahsis Inlet which can be up to 55 meters deep because the benthic zone slopes steeply beyond the active fluvial deposition zone. At the Tahsis estuary, deposition of sand and gravel adds 1 to 2 meters to the delta each year (Western Canada Hydraulic Laboratories and Envirocon, October 1981, Preliminary Report).

The mean daily temperature at Tahsis ranges from a monthly average of 4.5°C in January to 14°C in August; the yearly average is 9°C. The mean annual precipitation at Estevan Point on the open coast 56 kilometres to the south of Tahsis is 3741 mm which includes an average of 72 cm of snow each year (Environment Canada AES records 1941-1970).

The Tahsis River drains an area of 76 square kilometres including the watershed of its main tributary, McKelvie Creek to the east. The Leiner River is larger; together with its southern tributary the Perry River, it drains approximately 105 square kilometres. (Some literature refers to the estuary of the Leiner River as the estuary of the Perry River.) Long term stream flow data were not available for these 2 rivers but measurements were made by Western Canada Hydraulic Laboratories (1981) from 20 March to 24 June, 1981. On the Tahsis River a mean discharge of 12 cubic meters per second was recorded whereas the mean discharge on the Leiner River was 14.2 cubic meters per second during the same period. Although the Tahsis River is partially fed by glacial melt water and the Leiner River drains several lakes, both rivers are characterized by rapid fluctuations in the instantaneous discharge (flow rate); the ratio of low and high flows often exceed a factor of 10 only hours or days apart (Western Canada Hydraulic Laboratories and Envirocon, 1981).

The study area is in the Coastal Western Hemlock Biogeoclimatic Zone. Mitchell (1959) reported Douglas Fir, Sitka Spruce, Western Red Cedar, Western Hemlock and Yellow Cedar to be among the forest species present. A patch of wetland forest that once existed on the Tahsis River delta is no longer present. Envirocon (October 1981, Draft Report) describes the shorezones of the Tahsis River estuary based on various combinations of *Zostera marina*, *Enteromorpha* spp., *Fucus distichus*, *Carex lyngbyei* and *Potentilla anserina* (Figure 2 and Table 1). Similar vegetation zones were identified on the Leiner River (Figure 3 and

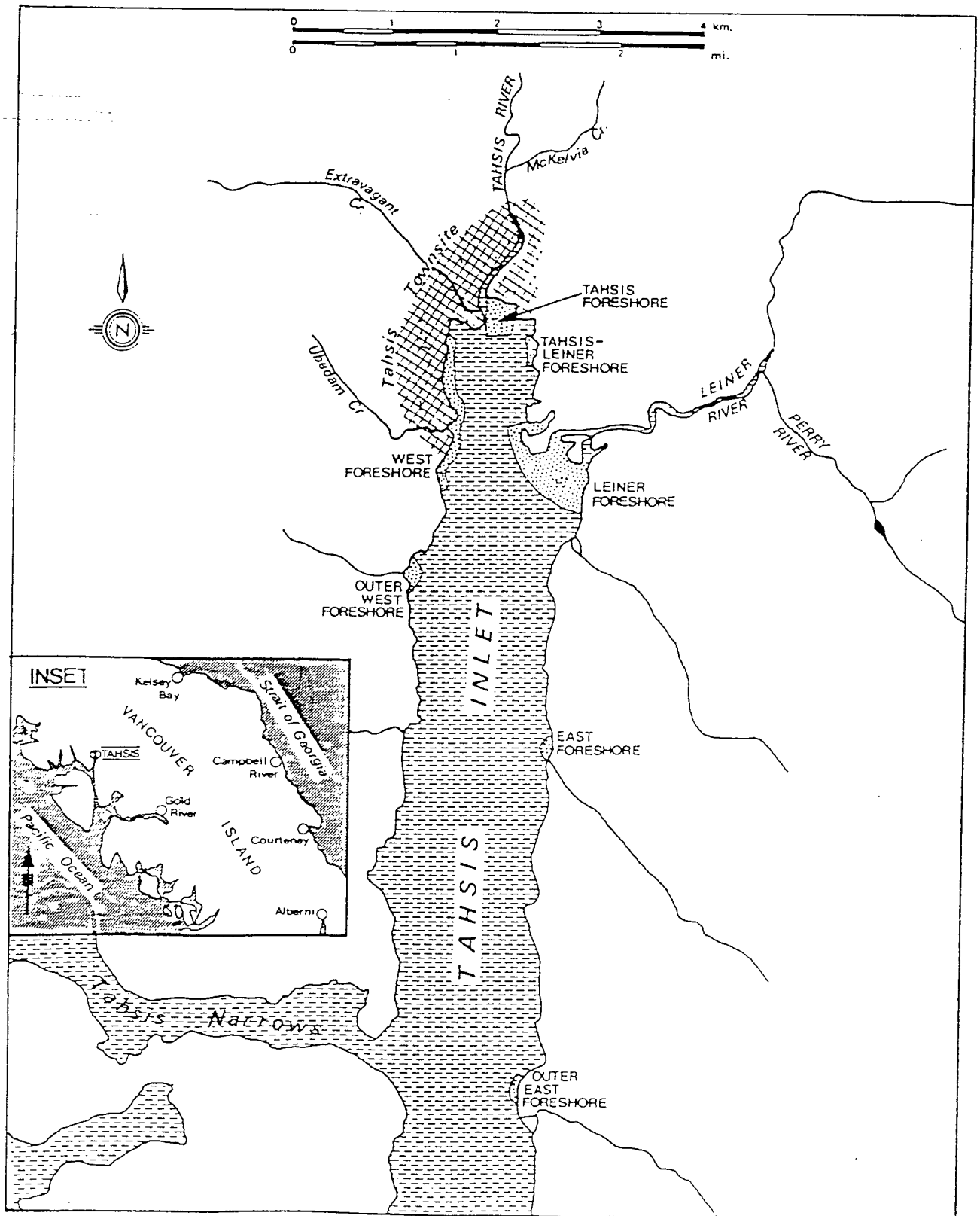


Figure 1. Location of the study area showing the estuaries of the Tahsis River and the Leiner River (from Western Canada Hydraulic Laboratories and Envirocon 1981, Preliminary Report).



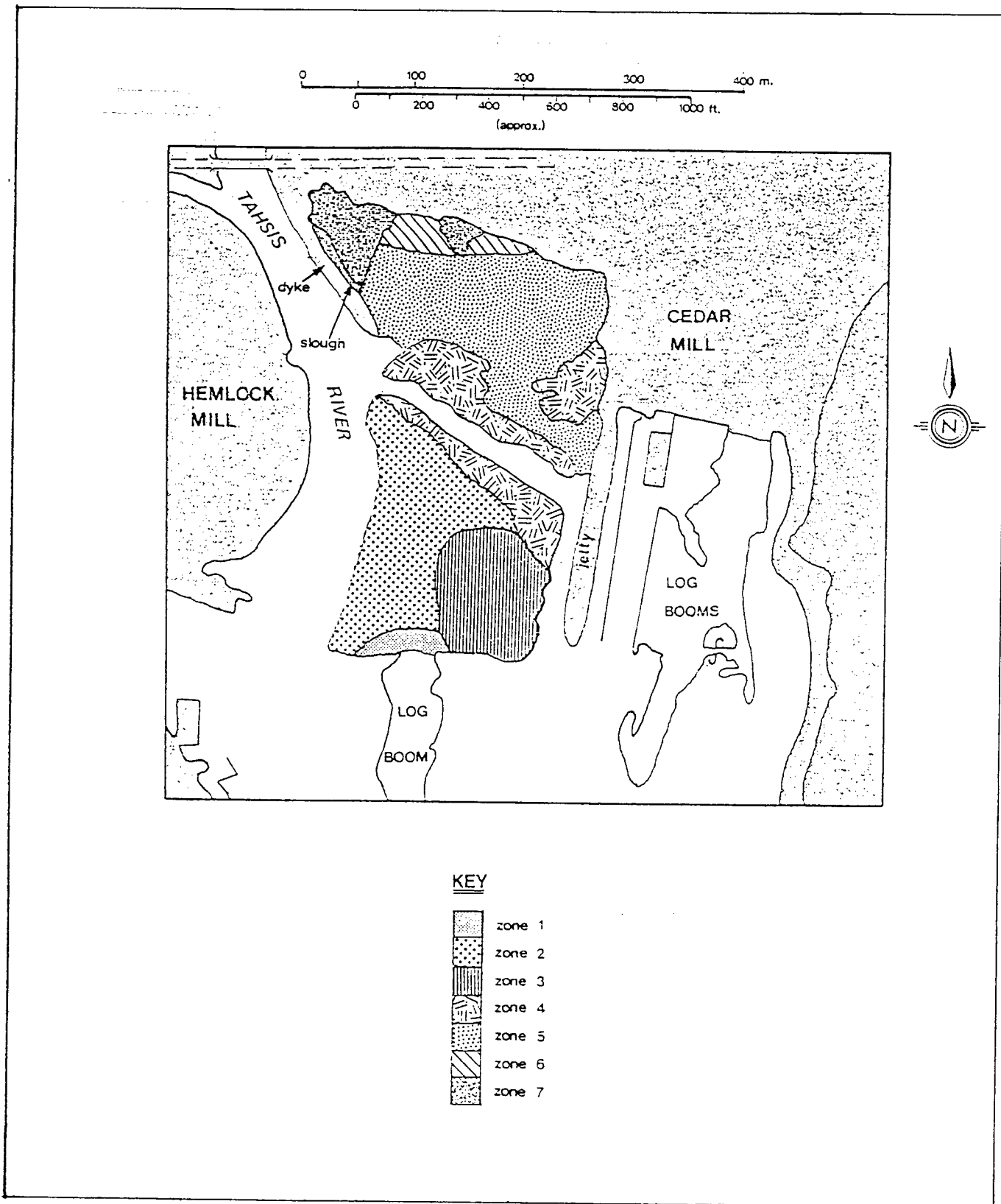


Figure 2. Habitat zones on the Tahsis River estuary, 1981 (from *Envirocon* 1981).

#	Position	Area (ha)	Dominant Vegetation	Comments	Other Species	Substrate
1	Subtidal & Lower Intertidal	0.1	- <i>Zostera marina</i>	- moderate, patchy distribution	- <i>Enteromorpha</i> spp. - filamentous brown algae	- fine silt & sand
2	Lower Intertidal	1.7	- <i>Enteromorpha</i> spp.	- sparse distribution	- <i>Fucus distichus</i> - filamentous brown algae	- sand - some gravel
3	Lower Intertidal	1.1	- <i>Fucus distichus</i>	- sparse distribution	- <i>Enteromorpha</i> spp.	- sand
4	Lower Intertidal	1.2	- <i>Enteromorpha</i> spp.	- dense patches sparsely distributed	- <i>Fucus distichus</i> - filamentous brown algae	- gravel
5	Nearshore Intertidal	2.3	- <i>Zostera marina</i> - <i>Fucus distichus</i>	- undulating channels - dense patches of eelgrass in low areas - rockweed & other algae in higher areas	- <i>Enteromorpha</i> spp. - filamentous brown algae	- sand, silt & hog fuel in low areas - fine gravel & mussels in high areas
6	Nearshore Intertidal	0.4	- <i>Fucus distichus</i> - filamentous brown algae	- moderate distribution		- hog fuel - bark mulch, - sand
7	Marsh	0.6	- <i>Carex lyngbyei</i>	- dense sedges - slough with eelgrass	- <i>Zostera marina</i> - <i>Fucus distichus</i> - <i>Potentilla anserina</i>	- sand - fine gravel

Table 1. Descriptions of habitat zones on the Tahsis River estuary, 1981 (modified from Envirocon 1981).

Table 2) but in addition, one zone is typified by *Salicornia virginica* and *Plantago maritima* and in another zone *Calamagrostis* spp. is present with the *Potentilla*. The Envirocon (1981) study should be consulted for a detailed description.

Tahsis Inlet supports all 5 local species of salmon as well as Steelhead, Cutthroat Trout and Dolly Varden char. Resident marine fish include Pacific Herring, Pile Perch, Shiner Perch and a variety of sculpins (Western Hydraulic Laboratories and Envirocon (October 1981-Preliminary Report). All of the salmonid species listed spawned in both the Tahsis and Leiner Rivers during the period 1976 to 1980 but most of the spawners in the Tahsis were Chum whereas Chum and Pink were present in equivalent numbers in the Leiner. The numbers of adult Chum returning to the 2 rivers fluctuated. Escapement on the Tahsis River was as high as 35,000 Chum in 1950 and 1960, and 25,000 Chum in 1974; on the Leiner River a peak of 18,000 Chum was recorded in 1973 (Brown et al. 1979, cited by Envirocon, 1981).

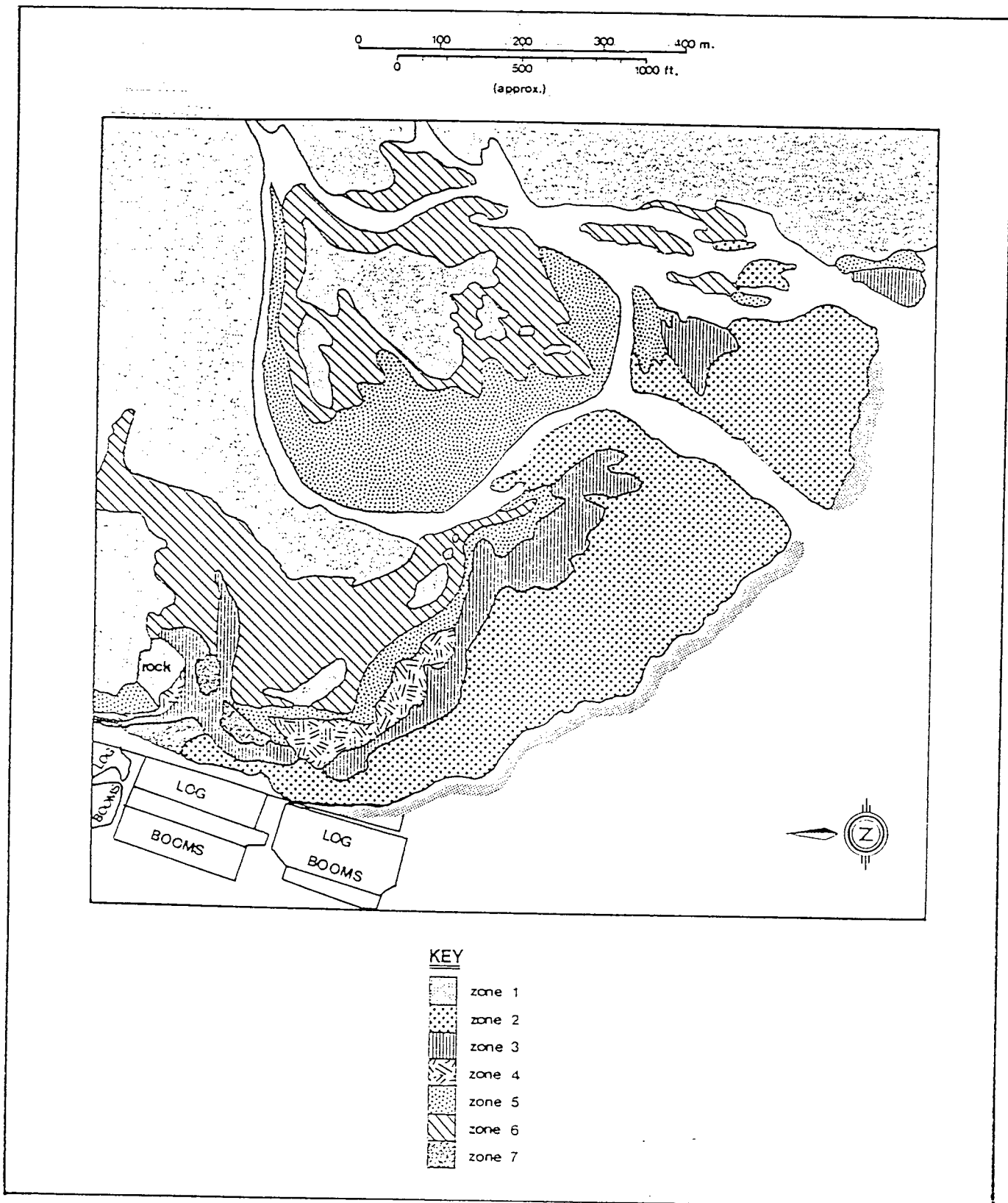


Figure 3. *Habitat zones on the Leiner River estuary, 1981 (from Envirocon 1981).*

#	Position	Area (ha)	Dominant Vegetation	Comments	Other Species	Substrate
1	Subtidal	1.3	- <i>Zostera marina</i>	-patchy to dense distribution		-sand & silt
2	Lower Intertidal	7.4	- <i>Enteromorpha</i> spp.	-sparse distribution	- <i>Fucus distichus</i> - <i>Leathesia difformis</i>	-large gravel -mussels & barnacles
3	Middle Intertidal	5.5	- <i>Fucus distichus</i>	-moderate distribution	- <i>Enteromorpha</i> spp. - <i>Leathesia difformis</i>	-sand & large gravel -barnacles
4	Salt Marsh	1.2	- <i>Salicornia virginica</i> - <i>Plantago maritima</i>	-moderately vegetated	- <i>Carex lyngbyei</i> - <i>Poa</i> spp. - <i>Triglochin maritima</i>	-sand & fine gravel
5	Marsh	6.5	- <i>Carex lyngbyei</i>	-dense	- <i>Calamagrostis</i> spp. - <i>Potentilla anserina</i> - <i>Fucus distichus</i>	-fine gravel, sand & silt
6	Terrestrial	1.4	- <i>Calamagrostis</i> spp. - <i>Potentilla anserina</i>	-dense	- <i>Carex lyngbyei</i>	
7	Lower Intertidal	0.4	- <i>Fucus distichus</i> - <i>Enteromorpha</i> spp.	-sparse distribution		-silt -hog fuel -wood chips

Table 2. Descriptions of habitat zones on the Leiner River estuary, 1981 (modified from Envirocon 1981).

The Village of Tahsis was founded in 1949, a few years after the opening of a sawmill which today is referred to as the Hemlock Mill (Figure 2). By 1981, the population of the village was 1739 people. On the waterfront of Tahsis Inlet a deep-water port loads the products of the sawmills onto ships for export. Facilities are also present for loading wood chips and hog fuel onto barges.

The creation of both the village and the mill used fill materials to convert portions of the Tahsis River estuary into flat, dry land because space for development is scarce. This process has continued in increments ever since. In 1970, a second sawmill, referred to as the Cedar Mill, was built almost entirely on filled land that was alienated from the eastern side of the estuary. By 1980, approximately 9 hectares of the Tahsis River estuary remained (Western Canada Hydraulic Laboratories and Envirocon, October 1981-Preliminary Report), including at least 2.5 hectares that was covered with woody debris (bark mulch and hog fuel) from industrial activity and scarred by tracked machinery. Dykes and filled industrial lands effectively contained the lower 1.4 kilometres of the river in a channel 30 to 40 meters wide (Western Canada Hydraulic Laboratories Ltd., 1981-Interim Report).

Years of development on the Tahsis River estuary had left the Leiner River estuary relatively intact and in a more natural state. By 1980, the Leiner River estuary still had an approximate area of 23.7 hectares (Envirocon, 1981), more than twice the size of the remaining estuarine habitat of the Tahsis River. The major industrial activity at that time was log storage and booming on approximately 5 hectares within 3 crown leases at the Leiner River delta.

In 1981, a proposal by the Tahsis Company Limited for expansion of their mill operations included filling of an additional 5.1 hectares of the estuarine habitat at the mouth of the Tahsis River, dredging a 1.3 hectare area for the creation of a log loading and booming facility and construction of a sediment exclusion dyke and other engineered works for the management of Tahsis River flows. It also included modification and continuing management of 2.8 hectares of estuarine habitat on Tahsis River as a replacement for habitat lost in the project. The cessation of log storage at the Leiner River delta was also discussed.

## Methods and Limitations

In response to a request from CWS, the Tahsis Company Limited arranged for weekly surveys to be conducted on the study area from 17 November 1981 through 28 May 1982. Survey participants covered the study area on foot or by boat, and using binoculars and telescopes, counted and recorded all birds observed on each of the 2 estuaries separately in order to compare bird use. Bill Dowding acted as the survey leader, initially under the direction of the senior author. It should be noted that the survey participants provided by the Tahsis Company Limited, while experienced outdoorsmen, were not professional biologists or birders used to conducting surveys of migratory birds. Thus some identifications must be used with caution and where this applies it has been mentioned in the text (e.g. Table 3 footnotes). For a full list of participants, see the Acknowledgements section above. Their remarks are summarized in Appendix II. Survey dates and data are presented in Appendix III and IV.

The numbers of birds recorded are considered to be generally accurate for the areas surveyed but are undoubtedly conservative due to inherent limitations (see Dawe 1982). Poor visibility due to weather, and birds underwater or shielded by vegetation during the period of observation would lead to an underestimation of the numbers of birds present. The data are based on observations at a particular point in time and do not necessarily reflect the total bird use of the area under observation. For example, birds dependent on the estuary for a few days during migration could be missed altogether if observations were made on either side of their arrival and departure. Also, data were not collected at night even though, during the winter months, low tides occur mostly at night. Thus, observations in winter were not made at times when the intertidal areas and algal beds were most often exposed. At these times, the highest use by birds such as dabbling ducks might have occurred.

Survey data were summarized using BASIC programs written by Allan Keller, CWS, and modified for seasonal summaries and statistics by the senior author (see Appendices III and IV). The summarized data were analyzed and much of the first draft of the report written by Ron Buechert under contract to the Mid Island Wildlife Watch Society. His contribution was reviewed and edited by the senior author.

## Results and Discussion

### Bird Use of the Study Area

Over the study period, a total of 57 species of birds was identified, 26 species on the estuary of the Tahsis River and 51 species on the estuary of the Leiner River. This means 31 species, more than half of the combined total, were recorded only on the Leiner River estuary. On the Tahsis River estuary, all but 6 of the species were also seen at the Leiner River estuary. Thus, the observed diversity of birds was much higher on the Leiner River estuary.

A combined total of 12,210 birds was recorded over the study period, 2808 birds on the Tahsis River estuary and 9402 birds on the Leiner river estuary. Any individual bird that was seen again on a subsequent survey at either of the two estuaries would be tallied more than once during the study. Nevertheless, these numbers are useful in comparing the two estuaries because observer effort was equivalent; observed bird use was more than 3 times greater on the Leiner River estuary than on the Tahsis River estuary.

To estimate the minimum number of birds that are dependent on the Tahsis River estuary, the Leiner River estuary, or both, the maximum single day bird numbers for each species on both estuaries were summed (Table 3). A minimum of 1511 birds depended on the estuaries of the Tahsis River or the Leiner River for some aspect of their life history.

Species	Number	Season	Species	Number	Season	Species	Number	Season
COLO	6	Spr 82	GRSC	36	Win 81	BTPI	5	Spr 82
RNGR	6	Spr 82	HADU	7	Spr 82	BEKI	3	Win 81
EAGR <sup>1</sup>	2	Aut 81	OLDS	1	Win 81	NOFL	1	Win 81
WEGR	16	Win 81	SUSC	101	Aut 81	SWAL	50	Spr 82
DCCO <sup>2</sup>	3	Win 81	WWSC	2	Win 81	STJA	2	Win 81
AMBI <sup>3</sup>	1	Spr 82	GOLD	50	Aut 81	NOCR	75	Win 81
GBHE	5	Win 81	BUFF	167	Aut 81	CORA	5	Win 81
GRHE <sup>3</sup>	1	Spr 82	HOME	9	Aut 81	BRCR	1	Spr 82
TUSW	4	Win 81	COME	34	Aut 81	WIWR	2	Win 81
TRUS	22	Spr 82	BAEA	5	Win 81	AMDI	2	Aut 81
GWFG	39	Spr 82	SSHA <sup>4</sup>	2	Aut 81	AMRO	31	Spr 82
CAGO	31	Spr 82	RTHA	2	Aut 81	VATH	9	Spr 82
GWTE	31	Spr 82	VIRA	1	Aut 81	EUST	17	Win 81
MALL	76	Spr 82	AMCO	5	Aut 81	WARB	1	Spr 82
NOPI	8	Spr 82	BLTU	32	Win 81	SOSP	9	Spr 82
NOSL	4	Spr 82	COSN	4	Spr 82	WCSP	7	Spr 82
BWTE	2	Spr 82	GULL	482	Aut 81	WEME	1	Spr 82
AMWI	10	Spr 82	MAMU	4	Win 81	PISI	70	Spr 82
							Total	1511

<sup>1</sup> Possibly Horned Grebes.

<sup>2</sup> Possibly Pelagic or Brandt's cormorants.

<sup>3</sup> Observation unsupported by adequate field notes.

<sup>4</sup> Possibly Cooper's Hawks.

Table 3. Estimated minimum numbers of birds dependent on the Tahsis River estuary and Leiner River estuary combined, 17 November 1981 through 28 May 1982, based on the maximum number of each species observed during bird surveys on a single day at both estuaries. For species names, see Appendix I.

For comparison of the two estuaries under study, the same calculation was performed separately for the Tahsis and Leiner River estuaries. The results (Table 4 and Table 5) highlight the differences.

Species	Number	Season	Species	Number	Season	Species	Number	Season
COLO	3	Win 81	GRSC	36	Win 81	SHOR	4	Spr 82
RNGR	2	Spr 82	OLDS	1	Win 81	GULL	140	Win 81
WEGR	6	Spr 82	SUSC	24	Aut 81	MAMU	2	Win 81
DCCO <sup>1</sup>	1	Win 81	GOLD	43	Aut 81	BEKI	1	Spr 82
AMBI <sup>2</sup>	1	Spr 82	BUFF	64	Aut 81	NOCR	71	Win 81
GBHE	1	Aut 81	HOME	1	Win 81	CORA	2	Win 81
GRHE <sup>2</sup>	1	Spr 82	COME	16	Aut 81	AMRO	9	Spr 82
TUSW	4	Win 81	BAEA	1	Win 81			
TRUS	4	Win 81	AMCO	5	Aut 81			
						Total	443	

<sup>1</sup> Possibly Pelagic or Brandt's cormorants.

<sup>2</sup> Observation unsupported by adequate field notes.

Table 4. *Estimated minimum numbers of birds dependent on the Tahsis River estuary, 17 November 1981 through 28 May 1982, based on the maximum number of each species observed on bird surveys. For species names, see Appendix I.*

Species	Number	Season	Species	Number	Season	Species	Number	Season
COLO	4	Spr 82	HADU	7	Spr 82	BEKI	3	Win 81
RNGR	4	Spr 82	OLDS	1	Win 81	NOFL	1	Win 81
EAGR <sup>1</sup>	2	Aut 81	SUSC	86	Win 81	SWAL	50	Spr 82
WEGR	16	Win 81	WWSO	2	Spr 82	STJA	2	Win 81
DCCO <sup>2</sup>	2	Win 81	GOLD	37	Spr 82	NOCR	43	Win 81
GBHE	4	Win 81	BUFF	103	Aut 81	CORA	5	Win 81
GRHE <sup>3</sup>	1	Spr 82	HOME	9	Aut 81	BRCR	1	Spr 82
TRUS	22	Win 81	COME	18	Aut 81	WIWR	2	Win 81
GWFG	39	Spr 82	BAEA	5	Win 81	AMDI	2	Aut 81
CAGO	31	Spr 82	SSHA <sup>4</sup>	2	Aut 81	AMRO	31	Spr 82
GWTE	31	Spr 82	RTHA	2	Aut 81	VATH	9	Spr 82
MALL	76	Spr 82	VIRA	1	Aut 81	EUST	17	Win 81
NOPI	8	Spr 82	BLTU	32	Win 81	WARB	1	Spr 82
BWTE	2	Spr 82	COSN	4	Spr 82	SOSP	9	Spr 82
NOSL	4	Spr 82	GULL	440	Aut 81	WCSP	7	Spr 82
AMWI	10	Spr 82	MAMU	4	Win 81	WEME	1	Spr 82
GRSC	21	Win 81	BTPI	5	Spr 82	PISI	70	Spr 82
						Total	1295	

<sup>1</sup> Possibly Horned Grebes.

<sup>2</sup> Possibly Pelagic or Brandt's cormorants.

<sup>3</sup> Observation unsupported by adequate field notes.

<sup>4</sup> Possibly Cooper's Hawks.

Table 5. *Estimated minimum numbers of birds dependent on the Leiner River estuary, 17 November 1981 through 28 May 1982, based on the maximum number of each species observed on bird surveys. For species names, see Appendix I.*

## Seasonal Numbers

On both estuaries the numbers of birds recorded were highest in winter, roughly 3 times as high as in autumn. In spring on the Tahsis River estuary the numbers dropped to roughly the same level that was recorded in autumn, but on the Leiner River estuary the numbers remained relatively high through the spring.

Autumn: Figures 4 and 5 show the proportions of species group use on each of the 2 estuaries in the autumn of 1981. Waterfowl and gulls accounted for a large majority of all of the birds seen on the study area in that season but there were differences between the 2 estuaries. On the Tahsis estuary the waterfowl were more numerous than the gulls; on the Leiner estuary the numbers of these 2 groups were nearly equal. All the waterfowl seen at the Tahsis were diving ducks but at the Leiner a small proportion (7%) of the waterfowl were dabbling ducks. In autumn, the total of all birds observed at the Leiner (1592 birds) was more than 2.5 times larger than at the Tahsis (584 birds).

Winter: Figures 6 and 7 shows the proportions of species group use on each of the 2 estuaries in the winter of 1981-1982. Again, the differences were noteworthy. Half the birds at the Tahsis estuary were gulls; the second most abundant group was waterfowl (98% diving ducks). At the Leiner estuary, half of all the birds seen in winter were waterfowl (66% diving ducks and 29% dabbling ducks). In numbers, the gulls ranked second on the Leiner in winter. On both estuaries, the passerines (mostly crows) accounted for a similar proportion of the total and ranked third overall. Other bird groups further highlighted the differences; more shorebirds and grebes were seen at the Leiner whereas the Tahsis had a higher proportion of rails. The total number of birds seen on the Leiner River in winter (4710 birds) was more than 3 times higher than on the Tahsis River (1542 birds).

Spring: Figure 8 and 9 show the proportions of species group use on each of the 2 estuaries in the spring of 1982. Gulls were the highest user group at the Tahsis River estuary with the waterfowl (99% diving ducks) ranking second and the passerines third. In contrast, the Leiner river estuary had a diversity of waterfowl species which together accounted for more than half of all the birds seen there in spring. For example, throughout this study geese were seen only in spring and only on the Leiner estuary. In numbers, passerines ranked second on the Leiner and gulls were third. The seasonal total of all birds in spring at the Leiner (3100 birds) was more than 4.5 times greater than at the Tahsis (682 birds).



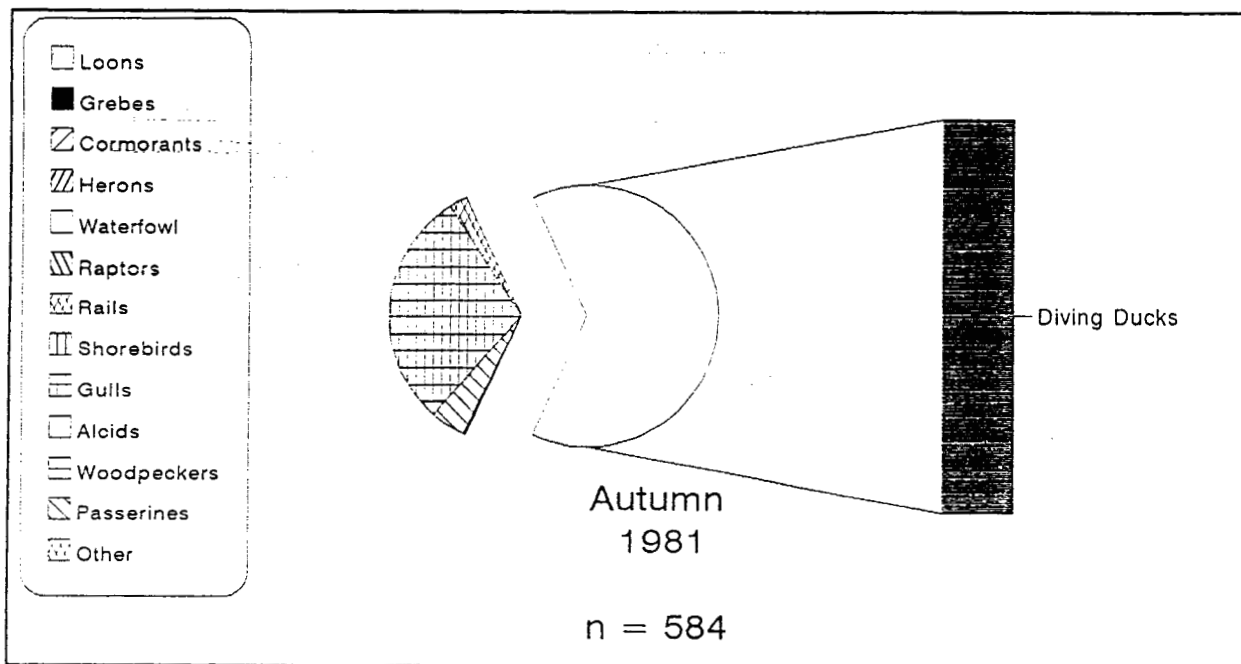


Figure 4. Proportions of bird use by species groups on the estuary of the Tahsis River, autumn 1981.

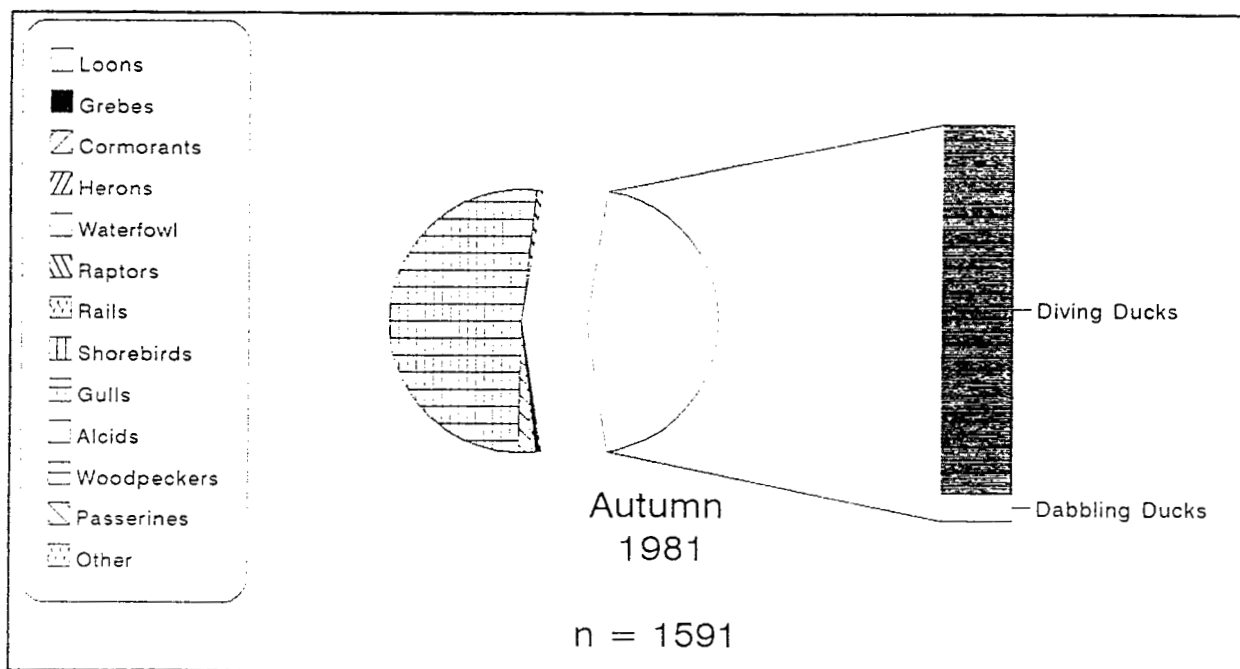


Figure 5. Proportions of bird use by species groups on the estuary of the Leiner River, autumn 1981.

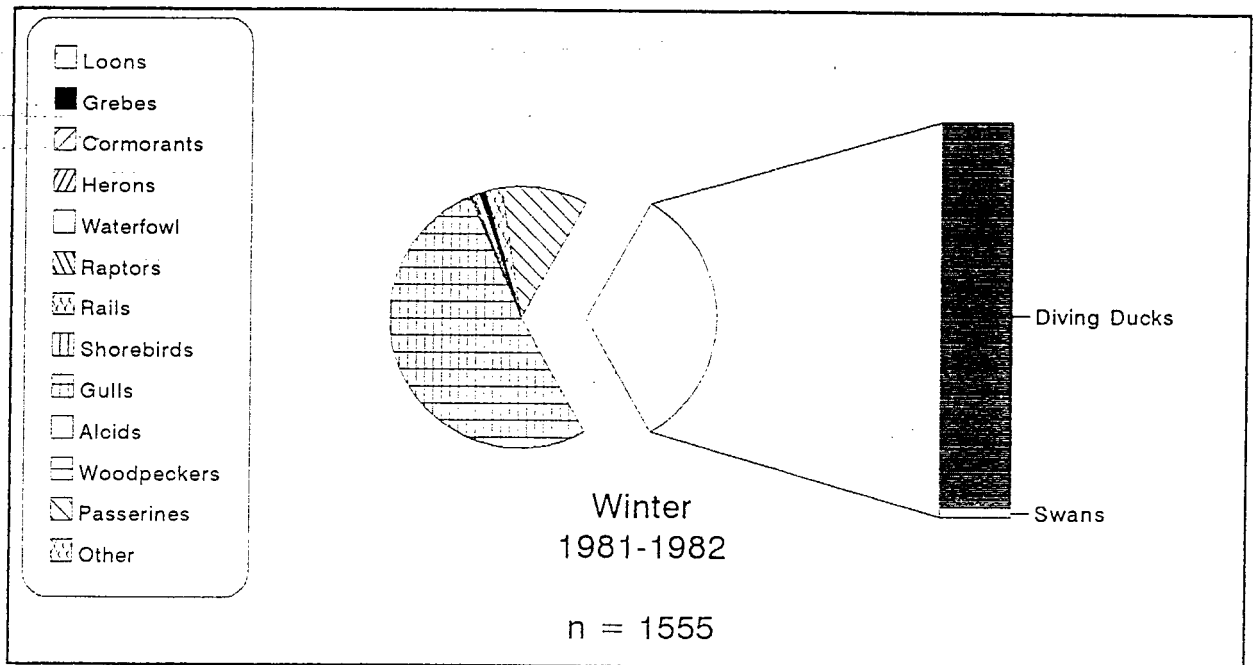


Figure 6. Proportions of bird use by species groups on the estuary of the Tahsis River, winter 1981-1982.

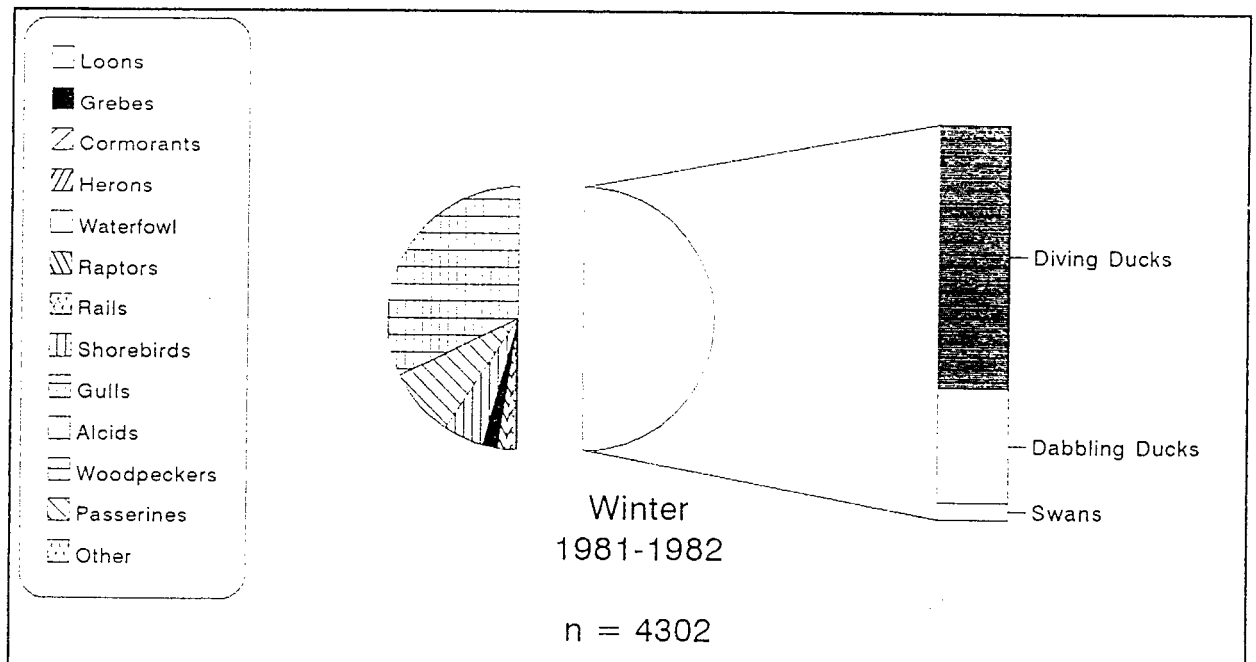


Figure 7. Proportions of bird use by species groups on the estuary of the Leiner River, winter 1981-1982.

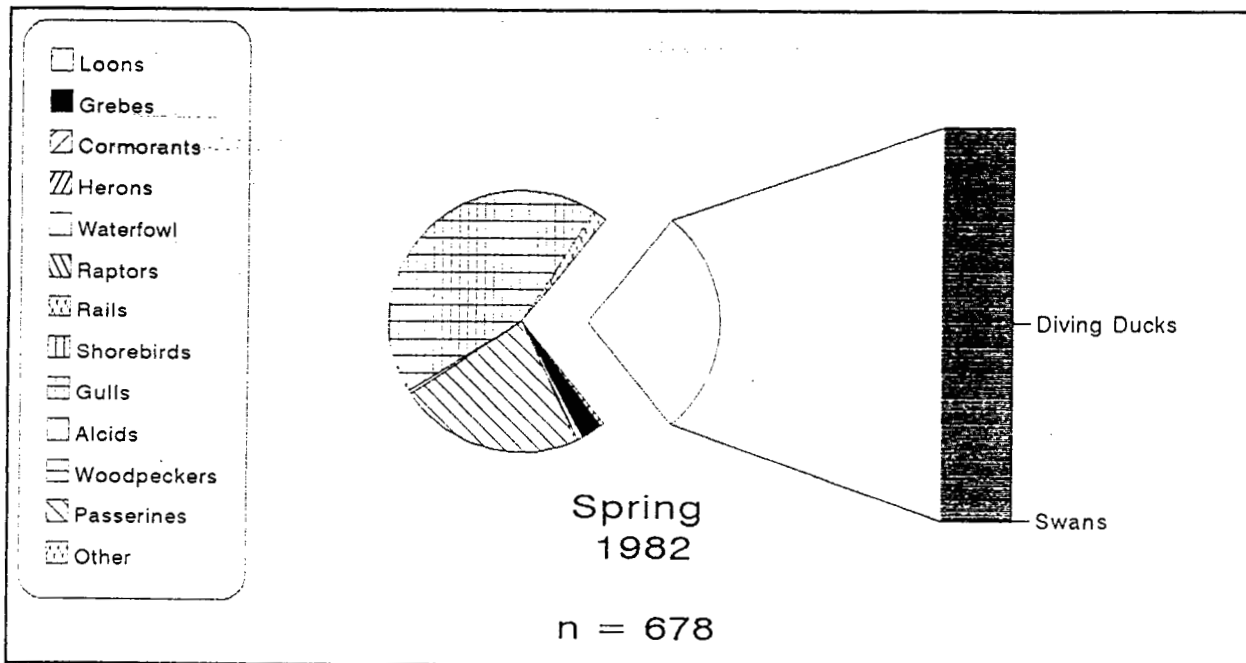


Figure 8. Proportions of bird use by species groups on the estuary of the Tahsis River, spring 1982.

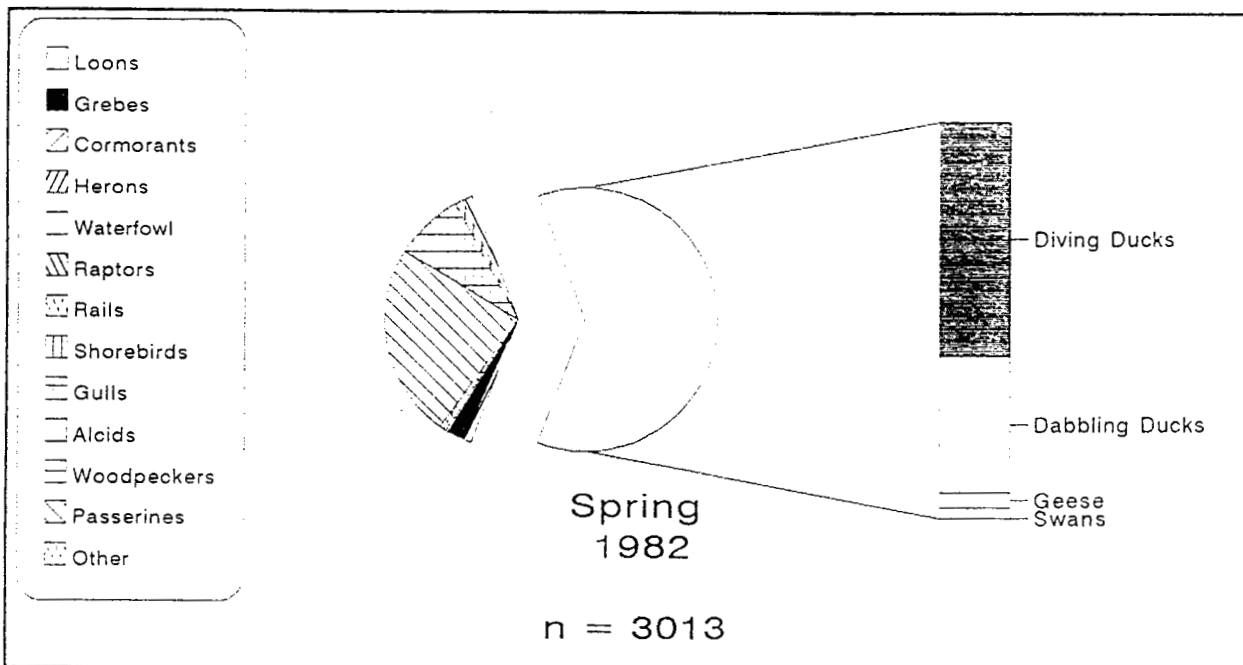


Figure 9. Proportions of bird use by species groups on the estuary of the Leiner River, spring 1982.

## Species Composition

The following annotated species list includes summarized data from the survey period. Species groups are presented in taxonomic sequence. Within each group or subgroup, species are discussed in decreasing order of highest use of the estuaries during the survey.

**Loons:** A total of 27 loons were observed over the study period (<1% of the total birds); all of them were Common Loons. The presence of loons in the area was sporadic with the highest frequency of occurrence at 50% in winter on the Leiner River estuary. Most of the birds were tallied in December (11 birds) and May (9 birds). For any one day, the total count for both estuaries reached a maximum of 6 birds on 12 May. The number of loons seen at the Leiner estuary was exactly twice the number seen at the Tahsis estuary.

**Grebes:** Three species of grebes were recorded: Western, Red-necked and Eared (see footnote to Table 3). The combined total of 182 grebes (1% of all birds) includes 52 birds that were identified simply as grebe species.

The Western Grebe was the most abundant of the grebes with a total of 116 birds seen (64% of all grebes). Although the tallies for winter and spring were equivalent, the numbers of Western Grebes fluctuated. Most of the birds were seen in the periods from 1 December to 7 January and from 1 April to 28 May; in contrast, only 1 bird was recorded in February and none at all in November. Peaks occurred on 14 December (16 birds) and 10 April (13 birds). Far more Western Grebes were seen at the Leiner estuary than at the Tahsis estuary; the ratio was almost 10:1.

A total of 10 Red-necked Grebes was seen, all of them during the spring: 1 bird on 1 April, 1 bird on 15 April, 6 birds on 5 May and 2 birds on 12 May. Three birds were seen at the Tahsis River estuary and the other 7 birds occurred at the Leiner river estuary.

Eared Grebes (see footnote to Table 3), 4 in total, were recorded only at the Leiner River estuary: 2 birds on 17 November, 1 bird on 24 November and 1 bird on 27 November. Mitchell (1959) saw no Eared Grebes on the estuaries of the Tahsis and Leiner Rivers but he noted a number of Horned Grebes from February to April 1949.

**Cormorants:** Eight Double-crested Cormorants were reported: 1 bird on 17 November, 1 bird on 20 November, 1 bird on 1 December, 3 birds on 14 December and 2 birds on 29 December. All but one of the birds were seen at the Leiner River estuary. The fact that Double-crested Cormorants were seen and that Pelagic Cormorants and Brandt's Cormorants were not seen during this study represents a reversal of the situation observed by Mitchell (1959) during the period from December to May 1949. Double-crested cormorants are "uncommon in winter and rare in summer along the outer coast" of Vancouver Island (Campbell et al. 1990-a); it is therefore probable that these cormorants were actually Pelagic or Brandt's cormorants that were incorrectly identified.

**Hérons and Bitterns:** The Great Blue Heron was the most abundant species in this group; a total of 65 birds were seen (<1% of all birds). The numbers of Great Blue Herons showed little fluctuation; the maximum number surveyed was 5 birds seen on 29 December. The frequency of occurrence was high throughout the study period (between 75% and 90%). Observed use by the Great Blue Heron of the Leiner River estuary was almost 10 times the use of the Tahsis estuary, based on the total count over the study period.

One Green-backed Heron was reported on 12 May 1982 at the Tahsis River estuary (see footnote to Table 3).

Also at the Tahsis estuary on 12 May 1982, an American Bittern was seen (see footnote to Table 3).

**Swans:** A total of 177 swans (1% of all birds) was reported during the study period: 172 Trumpeters and 5 Tundra Swans.

The earliest arrival of the Trumpeter Swan was 22 November. The peak number of 22 swans was seen at the Leiner River estuary on 24 February, 5 March and again on 10 March. The latter date would have been the latest record of departure but for reports of a single straggler that stayed on through May. During the period of their stay, the frequency of occurrence was high. Most of the Trumpeter Swans in this study were seen in winter (71%); the majority were on the Leiner estuary. Observed use of the Tahsis estuary by Trumpeter Swans was limited to 2 consecutive counts of 4 birds each: on 7 January and 15 January. Use of both these estuaries by Trumpeter Swans during the period from 28 December to 7 March dates back to 1949, at least (Mitchell, 1959).

In contrast the Tundra Swan was seen only on the Tahsis River estuary. The total was 5 Tundra Swans: 4 birds on 29 December 1981 and 1 bird on 22 March 1982.

**Geese:** Two goose species with a combined total of 70 birds (<1% of all birds) were recorded. All the geese in this study occurred on the Leiner River estuary. Some geese seen in the air in the vicinity of the Tahsis estuary were not unidentified or counted.

A total of 39 Greater White-fronted Geese were seen feeding on the flats of the Leiner River estuary on 12 May 1982.

Only 1 other survey reported geese; 31 Canada Geese were seen on 22 March on the Leiner estuary. Mitchell (1959) recorded up to 100 Canada Geese briefly stopping or in flight over the study area during April 1949.

**Dabbling Ducks:** Six species of dabbling ducks were recorded representing a combined total of 1409 birds (12% of all birds). Mallards accounted for 86% of all Dabbling Ducks. The Green-winged Teal ranked a distant second followed by the American Wigeon. A few Northern Pintails, Northern Shovellers and Blue-winged Teal were also seen, all on a single survey in spring. Figure 10 shows seasonal fluctuations in the numbers of all dabbling ducks combined and the numbers of Mallards for comparison. Mallards clearly dominate the numbers of dabbling ducks from the earliest arrival at or before the date that the study began through to late April. By May the majority of the Mallards had departed

ahead of the Green-winged Teal. The peak number of dabbling ducks during the study was 86 birds on 22 March. The numbers of dabbling ducks seen in winter and spring were equivalent; far fewer were seen in autumn. All of the dabbling ducks occurred at the Leiner estuary.

A total of 1206 Mallards was seen (86% of dabbling ducks). At least 3 Mallards were seen on every survey in the study period except the last, but the numbers fluctuated as shown in Figure 10. Most were seen in winter when the median was 57 birds. The peak was 76 birds observed on 22 March 1982. In 1949, the Mallard was "a winter resident and probably nests in the marshy areas of the Tahsis and Perry (i.e. Leiner) Rivers" (Mitchell, 1959) but no dabbling ducks of any kind were observed on the Tahsis estuary during this 1981-1982 study.

The Green-winged Teal was the second most abundant dabbling duck with a total of 103 birds (7% of dabbling ducks). The only record in autumn was of 2 birds on 27 November and the only record in winter was of 5 birds on 7 January. The remainder of the tallied birds (93%) were spring migrants seen between 10 April and 22 May. The peak of 31 birds occurred on 29 April 1982. Teal were not observed using the study area in 1949 (Mitchell, 1959).

A total of 86 American Wigeon were seen over the study period (6% of dabbling ducks). From the earliest arrival on 22 December to the latest departure on 29 April, the frequency of occurrence was 100%. The peak of 10 birds was observed on 22 March 1982. The total counts for winter and spring were almost the same. Although wigeon were seen in 1949, they were not known to winter in the study area at that time (Mitchell, 1959).

Eight Northern Pintails were seen on 12 May 1982.

Four Northern Shovellers were observed on 12 May 1982.

On 12 May 1982, the same survey that recorded the only pintails and shovellers in the study period, 2 Blue-winged Teal were seen.

**Diving Ducks:** Ten species of diving ducks were recorded with a combined total of 4424 diving ducks (36% of all birds) over the study period. The most abundant were the Bufflehead, Surf Scoter, Common Goldeneye, Greater Scaup and Common Merganser, in decreasing order. The Hooded Merganser, Barrow's Goldeneye, Harlequin Duck, Oldsquaw and White-winged Scoter were also seen but in smaller numbers. In Figure 11, seasonal fluctuations in the numbers of all diving ducks combined are shown for the Tahsis River estuary and the Leiner River estuary. On both estuaries, the numbers were high as the surveys started in autumn but they declined gradually through the winter. The use of the Tahsis estuary by diving ducks in spring showed little or no increase but on the Leiner in spring there was a migrational pulse which peaked at 171 birds observed on 22 March 1982. This pulse was due to the arrival of scoters (Figure 12) and other diving ducks rather than Bufflehead (Figure 11). Through April, the observed numbers of ducks dropped rapidly as the main migration period passed; as a result, total use of the 2 estuaries by diving ducks was higher over the winter season than during the following spring.

Over the study period, approximately 3 times as much use by diving ducks occurred on the Leiner as on the Tahsis. The Leiner estuary also revealed a

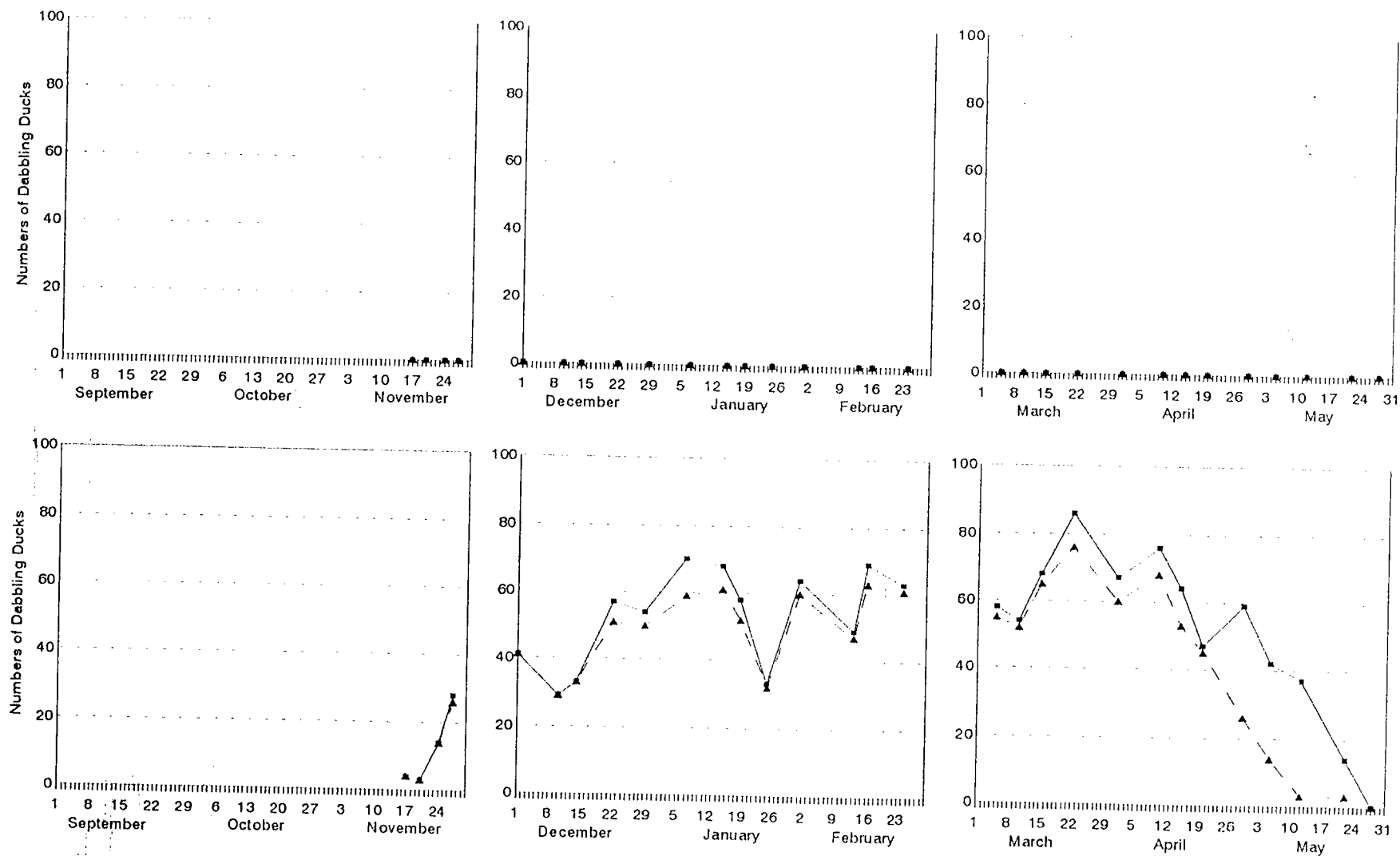


Figure 10. Seasonal fluctuations in numbers of dabbling ducks (solid lines) and Mallards (dashed lines) on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.

higher species diversity. Surveyors at the Leiner listed all 7 of the diving duck species seen at the Tahsis estuary plus 3 additional species: the Harlequin Duck, White-winged Scoter and Barrow's Goldeneye.

A total of 1724 Bufflehead was seen during the survey (39% of all diving ducks). Bufflehead were seen at both estuaries on every survey until the latest date of departure on 22 May. Prior to departure, Bufflehead numbers remained relatively constant at approximately 50 birds on the whole study area; a peak of 167 birds was observed on 17 November and another peak of 84 birds on 15 March (Figure 11). The Leiner River estuary received consistently higher use than the Tahsis River estuary, often by a factor of 3 or 4 times. In 1949, "usually only three or four [Bufflehead] were recorded on each field trip between January 23 and early April" (Mitchell, 1959); the maximum one-day count was 34 Bufflehead at that time. Mitchell's methodology is not available for comparison, but if it is comparable, the numbers suggest that use of the study area by Bufflehead has increased over the 33 year period from 1949 to 1982.

A total of 1357 scoters was seen including 71 birds that were recorded simply as scoter species. The Surf Scoter accounted for almost all of the scoters identified; it was the second most abundant diving duck with a total of 1283 birds recorded. The observed use of the 2 estuaries by Surf Scoters differed. On the Tahsis River estuary, the numbers seen were lower but stable throughout winter whereas the numbers of Surf Scoters on the Leiner were far greater but decreasing through most of the study period. Seasonal fluctuations in the numbers of all scoter species combined are shown separately for the estuaries of the Tahsis and Leiner Rivers in Figure 12. A peak of 86 birds was observed on 1 December 1981 and a spring peak of 55 birds occurred on 1 April 1982; all of these birds were seen on the Leiner estuary.

Three White-winged Scoters were seen in total, all of them occurred at the Leiner River estuary: 1 bird on 5 May and 2 birds on 22 May. The low abundance of White-winged Scoters in the study area has hardly changed since 1949. However, at that time Mitchell (1959) recorded small numbers of Black Scoters [formerly known as "Common Scoters"] during the winter and a one-day count of 32 birds on 9 April. This might represent a change in the use of the study area over time because no Black Scoters were seen during the 1981-1982 study.

The two species of goldeneye had a combined tally of 603 birds. The Common Goldeneye was the third most abundant diving duck; it was 25 times more numerous than the Barrow's Goldeneye. Throughout most of the study period the numbers of goldeneye ranged from 15 to 20 birds but there were 2 exceptions. A peak of 43 birds identified simply as goldeneye species was observed on 17 November on the Tahsis estuary and a peak of 37 Common Goldeneye occurred on 15 April on the Leiner estuary. Seasonal fluctuations in the numbers of all goldeneye combined are shown separately for the estuaries of the Tahsis and Leiner Rivers in Figure 12.

A total of 21 Barrow's Goldeneye was seen in the spring on the Leiner River estuary. The frequency of occurrence was above 50% during that season, but there were never more than 4 birds recorded on any survey. The earliest arrival was 15 March and the latest date the species was recorded in this study was 28 May, the last date surveyed.



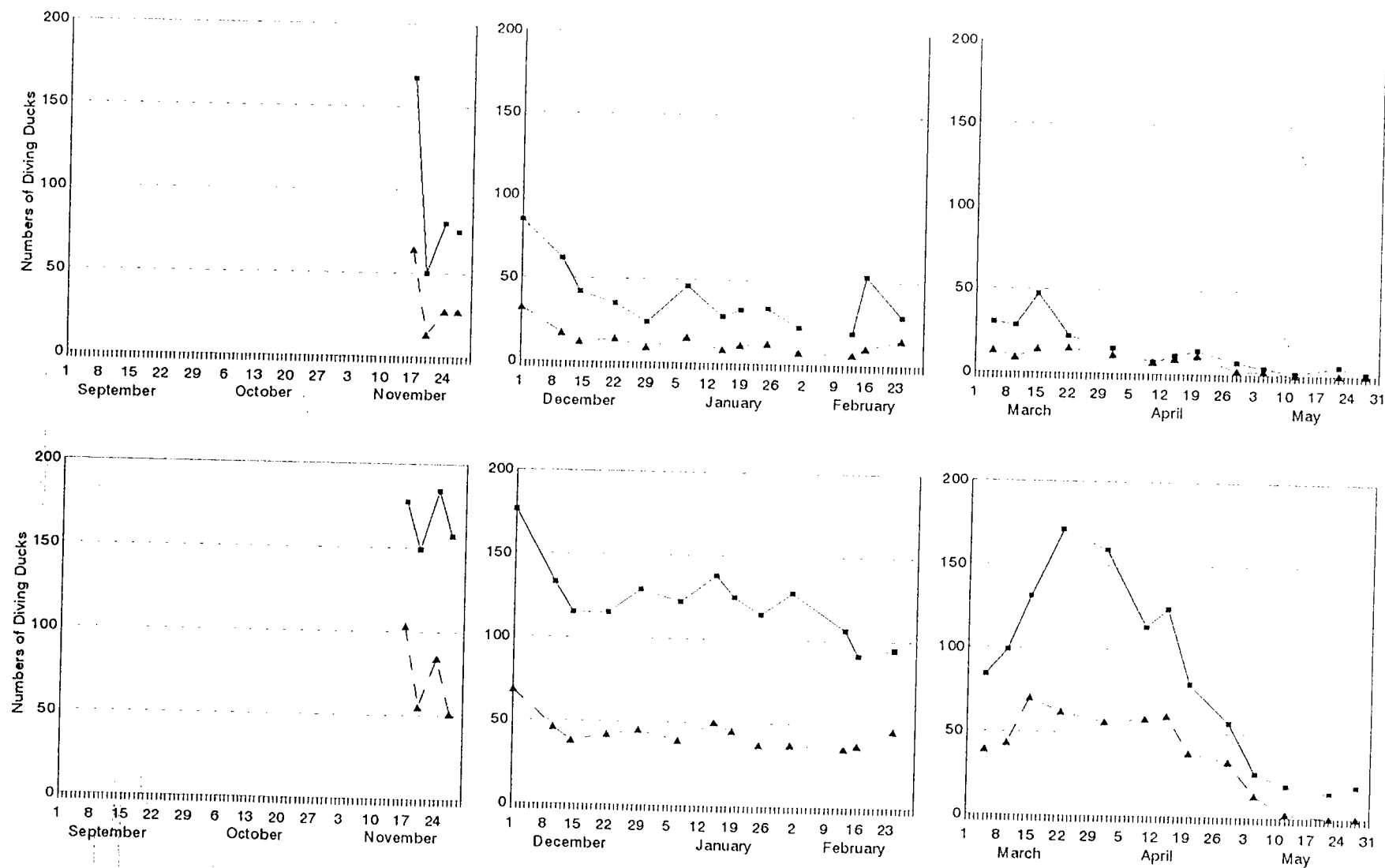


Figure 11. Seasonal fluctuations in numbers of diving ducks (solid lines) and Bufflehead (dashed lines) on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.

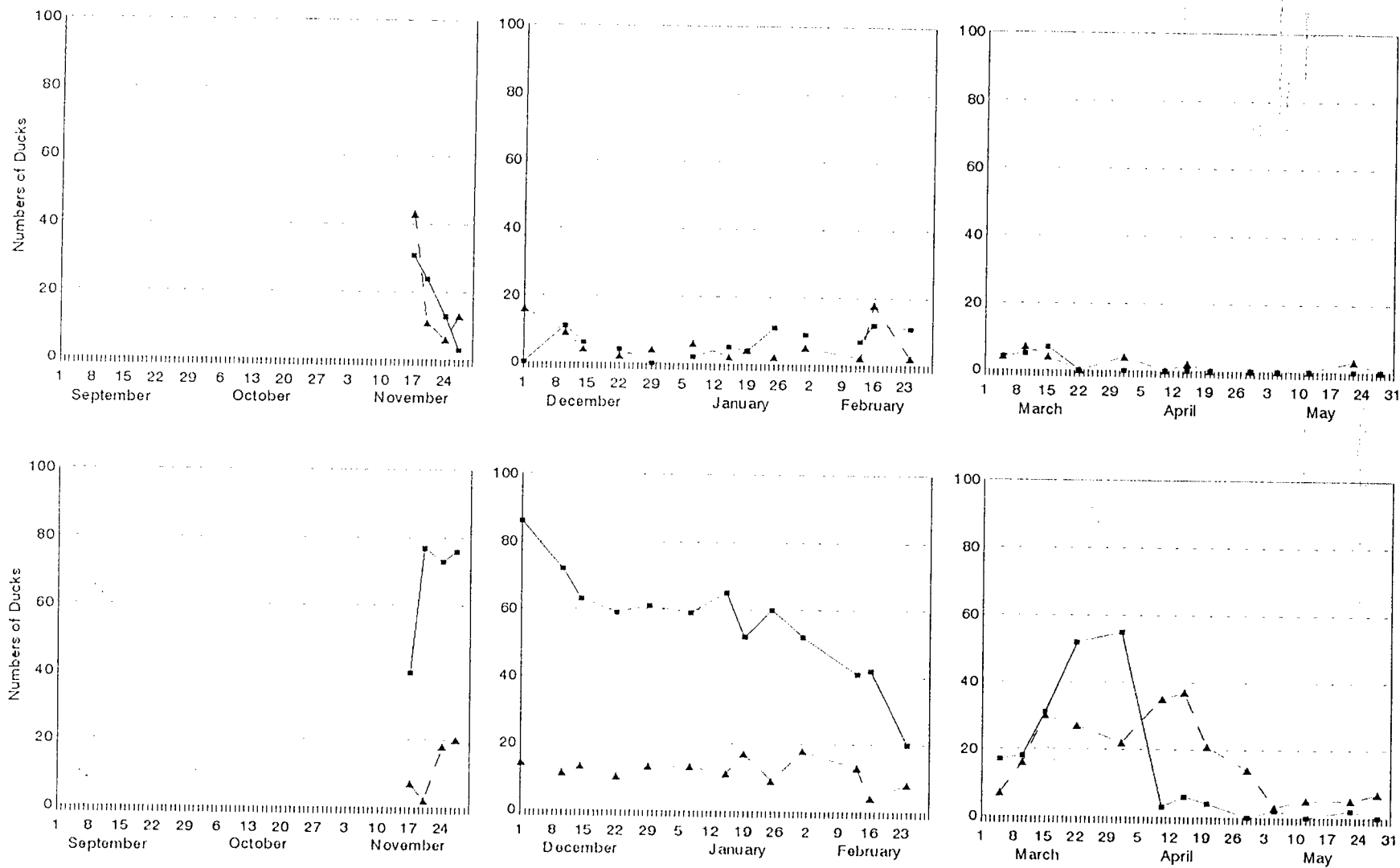


Figure 12. Seasonal fluctuations in numbers of scoters (solid lines) and goldeneye (dashed lines) on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.

The tally of Greater Scaup was 491 birds. They were seen on most of the surveys throughout the study period but not evenly distributed. Scaup were not observed on the Leiner estuary until 22 December whereas the birds were almost gone from the Tahsis estuary by the end of March. It is likely that both estuaries were used by at least some of the same birds because whenever the numbers were high at one estuary, the birds were few or absent on the other estuary. For example, a peak of 36 birds was seen 1 December at the Tahsis estuary but there were no scaup seen on that day at the Leiner. Unlike the utilization by most of the other birds in this study, scaup use of the Tahsis estuary was equivalent or slightly higher than scaup use of the Leiner estuary.

The Common Merganser and the Hooded Merganser were seen at both estuaries but the former species was more abundant; 202 Common Mergansers were seen in total. The frequency of occurrence of the Common Merganser was high throughout the study period; the highest observed use was on the Leiner estuary in autumn and spring. A peak of 34 birds was recorded on 17 November when 18 Common Mergansers were seen at the Leiner estuary and 16 birds at the Tahsis estuary. If the surveys had continued into summer it is likely that we would have observed immature birds on the Leiner River estuary as Mitchell (1959) did in 1949, evidence of breeding in the study area.

A total of 24 Hooded Mergansers were seen; 23 of them were counted at the Leiner estuary and 17 of those occurred in autumn during just 4 surveys. The peak was 9 birds on 17 November.

A total of 17 Harlequin Ducks were counted, all on the Leiner estuary. Two birds were seen on 1 April and the remainder occurred in May. The peak was 7 birds on the 28 May, which was the last day surveyed. Mitchell (1959) observed what he interpreted as courtship behaviour on the Tahsis River and speculated that Harlequin Ducks were probably nesting on the upper reaches of that river.

Five surveys recorded 1 Oldsquaw each on the Tahsis estuary from 22 December to 1 February and 1 bird was seen on the Leiner estuary on 1 December.

**Raptors:** Three species of raptors were observed for a combined total of 93 birds (<1% of all birds); most of them were Bald Eagles (84%). Although the frequency of occurrence for Bald Eagles was high at the Leiner River estuary throughout the survey period, there was never more than 6 birds spotted on a single day. Raptor use of the Tahsis River estuary was low; there was a total of 2 observations of a single Bald Eagle each.

A total of 8 Red-tailed Hawks were counted on the Leiner estuary. Two birds were seen on 20 November and 6 other sightings recorded 1 bird each during the months of December, January and February.

The remaining 7 raptors counted over the study period were recorded as Sharp-shinned Hawks seen at the Leiner estuary: 1 bird 24 November, 2 birds 27 November, 1 bird 29 December, 1 bird 29 April and 2 birds on 22 May. Since this species is not known to occur on the outer coast of Vancouver Island between Long Beach and Cape Scott (Campbell et al. 1990-b), it is likely that the raptors seen were actually Cooper's Hawks.

**Coots and Rails:** A total of 57 American Coots was tallied; all were seen on the Tahsis River estuary during the period from the beginning of the study until the latest departure on 22 March. The maximum of 5 birds was recorded on a number of surveys. During the winter on the Tahsis River estuary, the frequency of occurrence was 75%.

One Virginia Rail was observed 27 November on the Leiner river estuary.

**Shorebirds:** During the study period, a total of 323 shorebirds (3% of all birds) were counted including Black Turnstones, Common Snipes and 75 birds that were identified simply as shorebird species. Surprisingly, Mitchell (1959) did not observe turnstones or snipes during 9 months in 1948 and 1949. Seasonal fluctuations in the combined numbers of all shorebirds on the Tahsis River estuary and the Leiner river estuary are shown in Figure 13. Only 4 shorebirds occurred on the Tahsis River estuary and none were identified to species.

Black Turnstones at the Leiner estuary accounted for most (69%) of the shorebirds seen. The birds were observed frequently in autumn and winter when the numbers peaked at 32 birds on 29 December and on 7 January. There were no Black Turnstones seen in spring until 5 birds were recorded on 29 April and 5 birds again on 12 May.

A total of 25 Common Snipes were seen on the Leiner estuary. From the earliest arrival on 13 February until the end of the study period, the frequency of occurrence was high (above 70%). The latest departure observed was 12 May, 2 weeks before the surveys ended. The maximum number seen in 1 day was 4 Common Snipes on 22 March 1982.

**Gulls:** Over the study period, the gulls had a combined total of 3858 birds (32% of all birds) which includes Mew Gulls, Glaucous-winged Gulls and a single Bonaparte's Gull plus a total of 2916 birds identified simply as gull species. Seasonal fluctuations in the numbers of all gulls combined are shown separately for estuaries of the Tahsis and Leiner Rivers in Figure 14. Although the most abundant of the identified gulls was the Mew Gull, it is likely that a number of the gulls not identified to species were Glaucous-winged Gulls or another species not listed. The total number of gulls tallied on the Leiner River estuary was twice the number on the Tahsis.

In total, 867 Mew Gulls were tallied over the study period. Mew Gulls were seen on almost every survey from the earliest arrival on 1 December through to the end of the surveys (frequency of occurrence = 96%; Figure 14). Nevertheless, the observed numbers were 4 times higher in winter than in spring. A peak of 106 birds was recorded on 1 December. Over the study period, Mew Gulls were more than 3 times more abundant on the Leiner River estuary than on estuary of the Tahsis River.

A total of 34 Glaucous-winged Gulls were tallied over the study period but this number may be an underestimate due to the number of gulls identified simply as gull species. All of the birds identified as Glaucous-winged Gulls were seen on the Tahsis River estuary.

One Bonaparte's Gull was seen on 12 May on the Tahsis River Estuary.

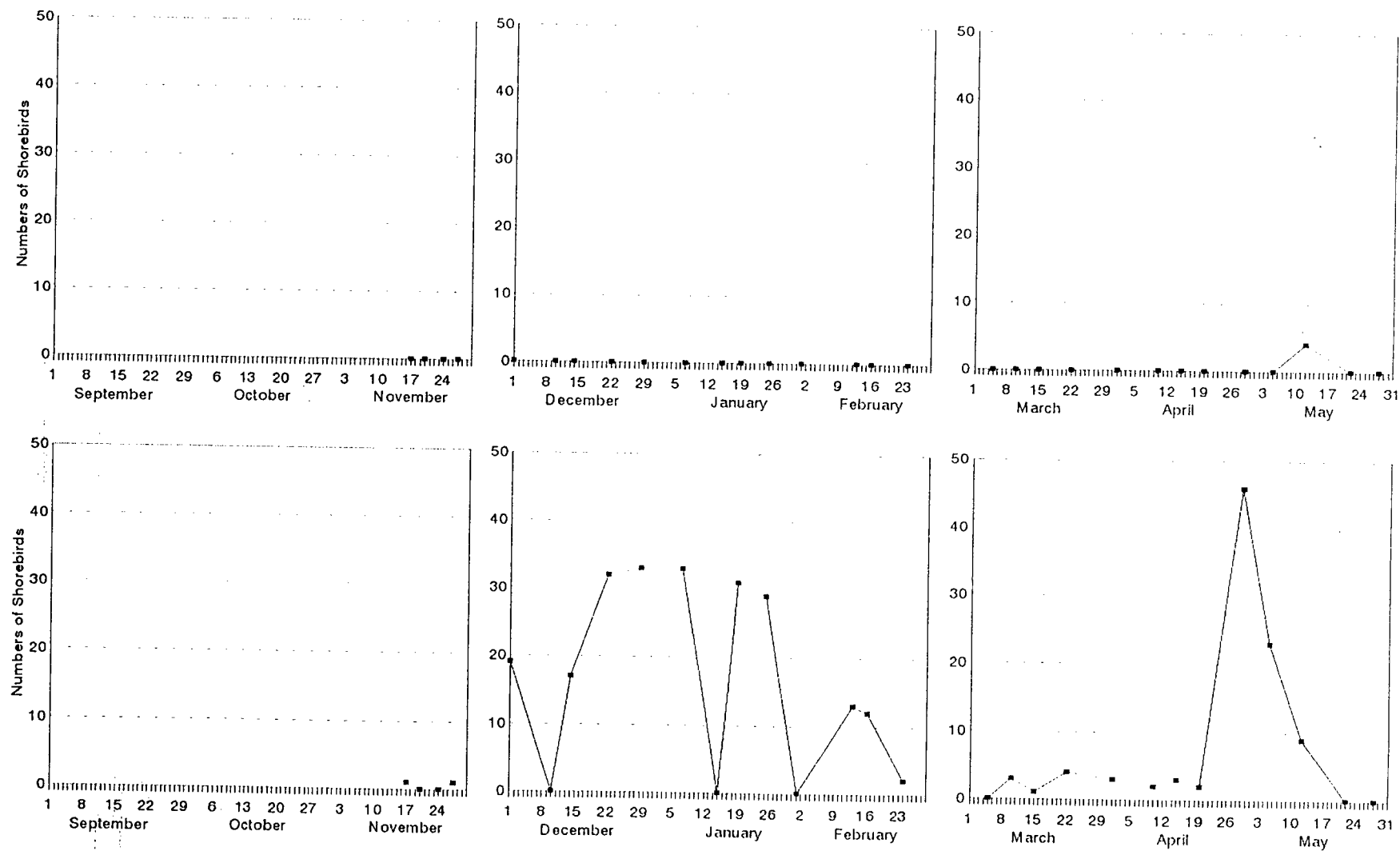


Figure 13. Seasonal fluctuations in numbers of shorebirds on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.

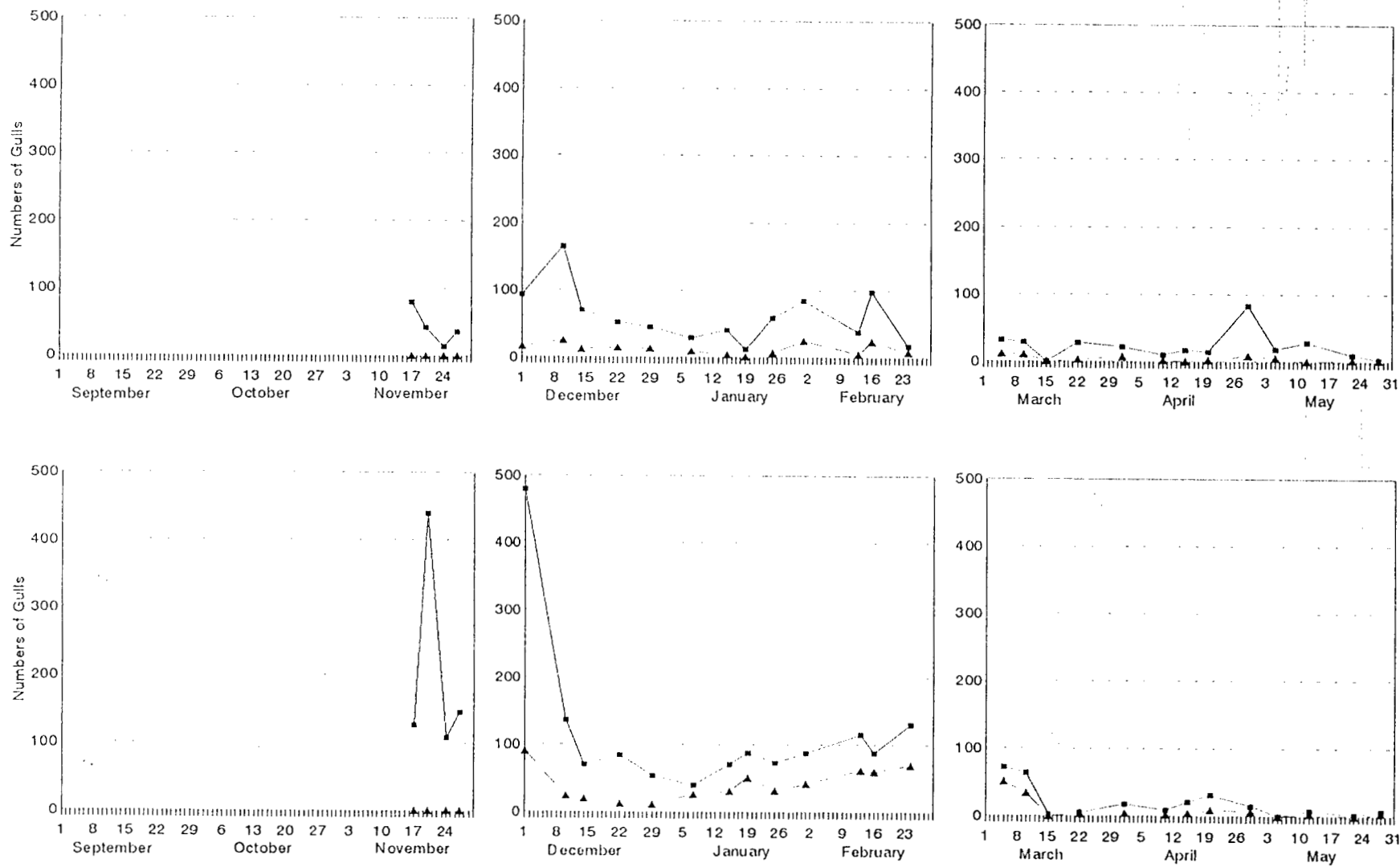


Figure 14. Seasonal fluctuations in numbers of all gulls combined (solid lines) and Mew Gulls (dashed lines) on the Tahsis River estuary (top row) and the Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.

**Alcids:** The only species of alcid was the Marbled Murrelet; in total 14 of the birds were seen. The birds appeared first on the Leiner estuary: 4 birds on 1 December and 2 birds on 29 December. Later the species began to show up at the Tahsis estuary: 1 bird on 19 January, 1 bird on 1 February, 1 bird on 13 February, 2 birds on 16 February, 2 birds 5 March and 1 bird on 15 March, which was the latest date of departure.

**Pigeons:** Nine Band-tailed Pigeons were tallied: 5 birds on 12 May and 4 birds on 28 May. All of them were seen at the Leiner River estuary.

**Kingfishers:** The total number of Belted Kingfishers recorded was 42 birds: 40 birds at the Leiner estuary and 2 birds at the Tahsis estuary. Although the frequency of occurrence was high (above 85%) there was never more than 2 birds recorded on a single survey.

**Woodpeckers:** One Northern Flicker was seen on 7 January on the Leiner River estuary.

**Passerines:** Although some forested land within the study area was surveyed, the focus of the study was primarily to determine water bird use, so passerine information is limited. Furthermore, there were no surveys done during the summer when passerine use would likely be highest. Therefore over the course of the study, recorded numbers of songbirds were lower than would otherwise be expected, with many of the family groups scantily represented or missing entirely from the species list, such as the flycatchers, chickadees, warblers and blackbirds. Mitchell (1959) provides a more comprehensive overview of passerine presence in the study area as it was in 1949 (see the checklist of species in Appendix II); additional studies would help to complete the picture of passerine use on the 2 estuaries.

Nevertheless, 11 families, 15 species and 1448 birds were tallied (12% of all the birds seen during the study) which ranks the passerines behind the diving ducks and the gulls in abundance and just ahead of the dabbling ducks. Seasonal fluctuations in the numbers of passerines are shown separately for the estuaries of the Tahsis and Leiner Rivers in Figure 15. The numbers of Northwestern Crows generally dominated the passerines in the winter but in spring the American Robin and the swallows were more numerous. The peak of 123 passerines occurred on 22 March; it included 70 Pine Siskins counted on that day on the Leiner River estuary. On most of the surveys, the Leiner River estuary had higher numbers of passerines; an exception occurred on 1 February when 71 crows were seen on the Tahsis River estuary.

**Swallows:** Two species of swallows were seen on the Leiner River estuary starting with the earliest arrival on 10 April. Unfortunately the birds were not identified to species until May; the combined total over the study period was 210 birds including 159 birds that were recorded simply as swallow species. No swallows were seen at the Tahsis estuary.

Violet-green Swallows were identified at the Leiner River estuary on the last two surveys: 13 birds on 22 May and 27 birds on 28 May.

A total of 11 Barn Swallows were recognized on the Leiner River estuary towards the end of the survey period: 2 birds on 12 May, 4 birds on 22 May and 5 birds on 28 May

*Crows and Jays:* Three species of corvids with a combined total of 611 birds accounted for 42% of the passerine total, ranking them as the most abundant passerine family. The Northwestern Crow accounted for almost all of the corvids (593 crows; 97% of the corvid total). Crows were present in every season surveyed with the highest numbers recorded during winter when crow activity on the Leiner and Tahsis estuaries was equivalent. In spring, the numbers of crows seen on the Tahsis remained high but on the Leiner estuary the numbers and the frequency of occurrence dropped to a lower level. Figure 15 shows that crows were the only passerines observed on the Tahsis River estuary much of the time. Numbers of Northwestern Crows peaked on 1 February when 75 were counted; 71 of the birds were on the Tahsis River estuary.

Sightings of Common Ravens were not regular over the study period; the total was 12 birds: 2 birds on 19 January (Tahsis estuary), 5 birds on 13 February (Leiner estuary), 2 birds on 5 March (Leiner estuary), and 3 birds on 1 April (Leiner estuary).

A total of 6 Steller's Jays were observed, all at the Leiner River estuary. Four surveys in winter and spring recorded 1 bird each and on 16 February 2 Steller's Jays were observed.

*Creepers:* One Brown Creeper was seen on 12 May on the Leiner River estuary.

*Wrens:* Counts of 1 or 2 Winter Wrens were made on a number of surveys in winter (frequency of occurrence = 46%) and spring (frequency of occurrence = 23%); over the study period the total was 11 birds.

*Dippers:* A total of 10 American Dippers was tallied during November and December at the Leiner River estuary but, like the Winter Wren, there was never more than 2 birds counted on any single survey. In 1949, Mitchell (1959) observed juvenile dippers in the study area in August.

*Kinglets and Thrushes:* This group was represented by 2 species, the American Robin and the Varied Thrush, which had a combined total of 247 birds (22% of all passerines).

Over the study period, a total of 212 American Robins were counted, which ranked the species as the second most abundant passerine after the Northwestern Crow. Most of the birds (97% of all robins) were seen in spring when the frequency of occurrence was high (85%). The peak of 31 birds was observed on 5 May; all of the birds were on the Leiner estuary. Seven robins were seen in autumn, all on 20 November on the Leiner estuary; no robins were observed in winter. Seasonal fluctuations in the numbers of American Robins are shown separately for the estuaries of the Tahsis and Leiner Rivers in Figure 15. Only 9 robins were seen using the Tahsis estuary, all on 1 April.



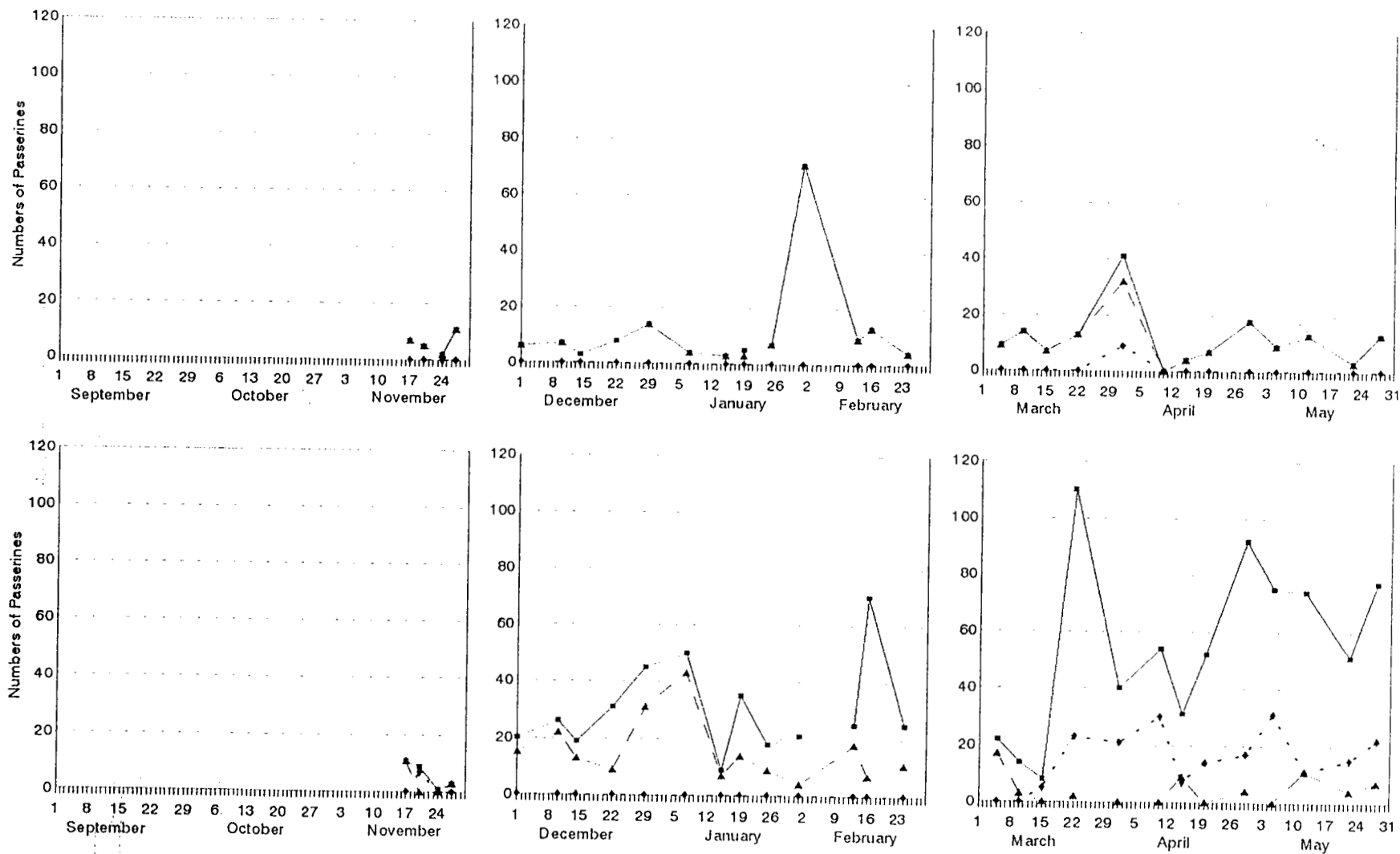


Figure 15. Seasonal fluctuations in numbers of all passerines combined (solid lines), Northwestern Crows (dashed lines) and American Robins (dotted lines) on the Tahsis River estuary (top row) and Leiner River estuary (bottom row), 17 November 1981 to 28 May 1982.

Observers totalled 35 Varied Thrushes; all were at the Leiner River estuary during winter and spring. Surveys in which at least one Varied Thrush was recorded were intermittent; the frequency of occurrence was 30% in both seasons. A peak of 9 birds was seen on 22 March 1982.

**Starlings:** The gregarious European Starling is often seen in huge numbers around estuaries on Vancouver Island. On the Campbell River estuary it was the most abundant passerine species (Dawe et al. 1995-b) whereas on the Fanny Bay wetlands and on the Cluxewe River estuary it ranked second (Dawe et al. 1995-a; Dawe et al. 1995-c). The European Starling was not recorded on the Tahsis River estuary but at the Leiner estuary a tally of 144 birds over the entire survey (13% of all passerines) ranked it third or fourth in abundance among the passerine species. The frequency of occurrence was nearly 75% and the peak for any one survey was 17 birds seen on 1 February 1982. In 1949, this introduced species was notable in its absence (Mitchell, 1959); some of the earliest records on Vancouver Island were not until 1951 at Victoria and 1954 at Port Hardy (Campbell et al. 1997).

**Wood Warblers, Sparrows and Blackbirds:** The emberizids are a large and diverse group that was not well represented in these surveys. One warbler, 2 species of sparrows and 1 species of blackbird were recorded with a combined total of 101 birds (9% of all passerines) over the study period. The sparrows were by far the most abundant of the sub-groups in this family.

**Warblers:** The only warbler recorded was identified simply as warbler species. It was seen on 22 March on the Leiner River estuary.

**Sparrows:** The more abundant of the 2 species of sparrows reported was the Song Sparrow; a total of 79 birds were seen on the Leiner River estuary over the study period. The numbers were usually low, the maximum was 9 birds seen on 22 May, but the frequency of occurrence was high (almost 100% in winter and spring).

A total of 19 White-crowned Sparrows were tallied, all on the Leiner River estuary. The species was seen frequently from the earliest arrival on 10 April until the end of the surveys. The peak was 7 birds on 29 April.

**Blackbirds:** Two sightings recorded 1 Western Meadowlark each on 29 April and 12 May at the Leiner River estuary.

**Finches:** The only species observed in this group was the Pine Siskin. Sightings were sporadic: 43 birds were seen on 16 February and 70 birds were seen on 22 March. All the birds occurred at the Leiner River estuary.

Mitchell (1959) described the introduced House Sparrow as resident and very abundant in the study area in 1949 but none were recorded by the surveyors during the study period in 1981 to 1982.

## Conclusions

### Bird Use and Recreational Activities

Some field notes about hunting appear in Appendix II; these may be of use to wildlife managers. Surveyors noted that the numbers of ducks appeared to be higher than usual on the Tahsis River estuary and lower on the Leiner River estuary during hunting season. It might be that hunting activity at the Leiner River estuary encourages some birds to spend more time utilizing the poorer quality habitat of the Tahsis River and the Village of Tahsis during hunting season.

### A Comparison of the Tahsis and Leiner River Estuaries

The total numbers of birds using the Leiner River estuary were just over 3 times the numbers using the Tahsis River estuary during the 1981-1982 study period. At that time, the habitat area remaining on the Leiner River estuary was 2.6 times the area of habitat remaining in the Tahsis River estuary, without adjusting for differences in the quality of the habitat. If bird use is roughly proportional to the area of the estuarine habitat that remains, then any filling of the Leiner River estuary or further filling of the Tahsis River estuary would likely reduce the bird population of the area. However, the limitations of this study and in particular the absence of data for summer and for much of the autumn migration period precludes certainty about this conclusion.

During the study period, the observed minimum numbers of birds dependant on the Leiner River estuary were also approximately 3 times the minimum numbers dependant on the Tahsis River estuary. The statistic that is used to determine this relationship counts only the highest observed number on each estuary on a single day; other counts that are as high or nearly as high are not considered. For example, a flock of 100 wintering ducks that is seen weekly on the Leiner estuary need only be seen once on the Tahsis estuary to be counted as equal. Therefore, it is significant that this statistic (minimum numbers of birds dependant on each estuary) is so different between the 2 estuaries. It suggests that, although bird movement between the 2 estuaries is obviously occurring, the majority of birds on the estuaries of the Tahsis and Leiner Rivers are using one or the other estuary, but not both. Again, further research would be needed to draw a conclusion.

It is clear, however, that a permanent loss of habitat on 1 of the 2 estuaries would undoubtedly have an effect on the total numbers of birds in the study area. Among the species that use both estuaries, the resources available would be diminished and the numbers would likely fall, if habitat was the limiting factor in their populations. Among the majority of birds, those that focus most of their use on 1 of the 2 estuaries, a reduction in the total amount of habitat would be a crisis for those individuals of any species that depended upon the habitat. This study provides no evidence to support the idea that many birds would be able to transfer their activities from permanently damaged habitat in 1 estuary to an area in the other estuary which remained intact, even though the 2 estuaries are a short flight apart.

Species diversity was also much higher on the Leiner River estuary. Of the 57 species of birds identified, 26 species occurred on the estuary of the Tahsis River and 51 species occurred on the estuary of the Leiner River.

Since the major difference between these two nearby estuaries is the degree of human alteration, the observed differences in the numbers and diversity of birds can likely be attributed to this factor.

### Management Recommendations

The rugged terrain on the west coast of Vancouver Island allows only a small area of estuarine habitat in total. From this small area, a variety of wildlife must obtain their basic needs, as discussed in the introductory section of this report. Limited estuarine habitat means that the estuary of the Tahsis River and the estuary of the Leiner River are particularly important to the wildlife resources of the area (this report and R. Cerenzia, District Habitat Officer, B.C. Ministry of Environment, Lands and Parks, pers. comm.).

Filling in the majority of the Tahsis River estuary had, by 1982, reduced the migratory bird habitat at the head of the Tahsis Inlet. This study indicates that the alterations made to the Tahsis River delta have probably caused a decrease in both the numbers and the diversity of migratory birds using it. In addition, we have no evidence that the nearby Leiner River estuary has provided a permanent place for wildlife "refugees" displaced from the Tahsis River estuary. Therefore, further reduction or degradation of the habitat on the estuaries of the Tahsis River or the Leiner River cannot be done without knowing that this action would affect the remaining migratory bird populations. If Canada and British Columbia are to meet their legislated mandates to ensure existing migratory bird populations, important local and regional bird habitats must be maintained.

- 1) Today, the estuary of the Leiner River is in a relatively natural state but it has little protection from the kind of alterations that the Tahsis River estuary has undergone. If we are to maintain the migratory birds resource in the Tahsis area, the Leiner River estuary must be secured and given legislative or other protection to keep intact the remaining migratory bird habitat of this area.

- 2) The Tahsis River and estuary still help to meet the needs of a considerably reduced wildlife fauna. Further filling of estuarine lands on the lower flood plain of the Tahsis River must stop if continuing degradation of this valuable community resource is to be avoided.

### Future Studies

This study focused mainly on water birds during the period from 17 November through 28 May. Another survey that recorded both terrestrial and aquatic bird activity for an entire year would help to complete the picture of bird use of the estuaries of the Tahsis and Leiner Rivers. Understanding of the

ecological functioning of the area would be enhanced if the study recorded where the birds were seen. Each estuary would need to be divided into habitat or shorezone units that are easily recognizable in the field. As an alternative, surveyors might record on field maps of the study area the approximate locations of notable congregations of birds whenever they occurred (see example in Dawe et al. 1995-a).

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## Appendices



Appendix I. Bird check-list for the estuaries of the Tahsis and Leiner Rivers

T = Species that appeared on the Tahsis River estuary in 1981-1982

L = Species that appeared on the Leiner River estuary in 1981-1982

M = Species that appeared at either estuary in 1949 (Mitchell, 1959)

Species Code	Species Name	Location	Scientific Name
COLO	Common Loon	T L M	<i>Gavia immer</i>
RNGR	Red-necked Grebe	T L M	<i>Podiceps grisegena</i>
EAGR	Eared Grebe	L	<i>Podiceps nigricollis</i>
HOGH	Horned Grebe	M	<i>Podiceps auritus</i>
WEGR	Western Grebe	T L M	<i>Aechmophorus occidentalis</i>
DCCO	Double-crested Cormorant	T L	<i>Phalacrocorax auritus</i>
BRCO	Brandt's Cormorant	M	<i>Phalacrocorax penicillatus</i>
PECO	Pelagic Cormorant	M	<i>Phalacrocorax pelagicus</i>
AMBI	American Bittern	T	<i>Botaurus lentiginosus</i>
GBHE	Great Blue Heron	T L M	<i>Ardea herodias</i>
GRHE	Green-backed Heron	T	<i>Butorides striatus</i>
TUSW	Tundra Swan	T	<i>Cygnus columbianus</i>
TRUS	Trumpeter Swan	T L M	<i>Cygnus buccinator</i>
GWFG	Greater White-fronted Goose	L	<i>Anser albifrons</i>
CAGO	Canada Goose	L M	<i>Branta canadensis</i>
GWTE	Green-winged Teal	L	<i>Anas crecca</i>
MALL	Mallard	L M	<i>Anas platyrhynchos</i>
NOPI	Northern Pintail	L	<i>Anas acuta</i>
BWTE	Blue-winged Teal	L	<i>Anas discors</i>
NOSL	Northern Shoveler	L	<i>Anas clypeata</i>
AMWI	American Wigeon	L M	<i>Anas americana</i>
GRSC	Greater Scaup	T L M	<i>Aythya marila</i>
HADU	Harlequin Duck	L M	<i>Histrionicus histrionicus</i>
OLDS	Oldsquaw	T L	<i>Clangula hyemalis</i>
BLSC	Black Scoter	M	<i>Melanitta nigra</i>
SUSC	Surf Scoter	T L M	<i>Melanitta perspicillata</i>
WWSC	White-winged Scoter	L M	<i>Melanitta fusca</i>
COGO	Common Goldeneye	T L M	<i>Bucephala clangula</i>
BAGO	Barrow's Goldeneye	L	<i>Bucephala islandica</i>
BUFF	Bufflehead	T L M	<i>Bucephala albeola</i>
HOME	Hooded Merganser	T L M	<i>Lophodytes cucullatus</i>
COME	Common Merganser	T L M	<i>Mergus merganser</i>
RBME	Red-breasted Merganser	M	<i>Mergus serrator</i>
BAEA	Bald Eagle	T L M	<i>Haliaeetus leucocephalus</i>
SSHA	Sharp-shinned Hawk	L	<i>Accipiter striatus</i>
RTHA	Red-tailed Hawk	L	<i>Buteo jamaicensis</i>
RUGR	Ruffed Grouse	M	<i>Bonasa umbellus</i>
VIRA	Virginia Rail	L	<i>Rallus limicola</i>
AMCO	American Coot	T M	<i>Fulica americana</i>

*Bird checklist (continued).*

Species Code	Species Name	Location	Scientific Name
GRYE	Greater Yellowlegs	M	<i>Tringa melanoleuca</i>
SPSA	Spotted Sandpiper	M	<i>Actitis macularia</i>
BLTU	Black Turnstone	L	<i>Arenaria melanocephala</i>
COSN	Common Snipe	L	<i>Gallinago gallinago</i>
BOGU	Bonaparte's Gull	T	<i>Larus philadelphia</i>
MEGU	Mew Gull	T L	<i>Larus canus</i>
GWGU	Glaucous-winged Gull	T M	<i>Larus glaucescens</i>
GLGU	Glaucous Gull	M	<i>Larus hyperboreus</i>
MAMU	Marblet Murrelet	T L	<i>Brachyramphus marmoratus</i>
BTPI	Band-tailed Pigeon	L M	<i>Columba fasciata</i>
RUHU	Rufous Hummingbird	M	<i>Selasphorus rufous</i>
BEKI	Belted Kingfisher	T L M	<i>Ceryle alcyon</i>
NOFL	Northern Flicker	L M	<i>Colaptes auratus</i>
RBSA	Red-breasted Sapsucker	M	<i>Sphyrapicus ruber</i>
HAWO	Hairy Woodpecker	M	<i>Picoides villosus</i>
VGSW	Violet-green Swallow	L M	<i>Tachycineta thalassina</i>
BASW	Barn Swallow	L M	<i>Hirundo rustica</i>
STJA	Steller's Jay	L M	<i>Cyanocitta stelleri</i>
NOCR	Northwestern Crow	T L M	<i>Corvus caurinus</i>
CORA	Common Raven	T L M	<i>Corvus corax</i>
CBCH	Chestnut-backed Chickadee	M	<i>Parus rufescens</i>
BRCR	Brown Creeper	L	<i>Certhia americana</i>
WIWR	Winter Wren	L M	<i>Troglodytes troglodytes</i>
AMDI	American Dipper	L M	<i>Cinclus mexicanus</i>
AMRO	American Robin	T L M	<i>Turdus migratorius</i>
VATH	Varied Thrush	L M	<i>Ixoreus naevius</i>
CEWA	Cedar Waxwing	M	<i>Bombycilla cedrorum</i>
EUST	European Starling	L	<i>Sturnus vulgarus</i>
RSTO	Rufous-sided Towhee	M	<i>Pipilo erythrophthalmus</i>
MGWA	MacGillivray's Warbler	M	<i>Oporornis tolmiei</i>
FOSP	Fox Sparrow	M	<i>Passerella iliaca</i>
SOSP	Song Sparrow	L M	<i>Melospiza melodia</i>
GCSP	Golden-crowned Sparrow	M	<i>Zonotrichia atricapilla</i>
WCSP	White-crowned Sparrow	M	<i>Zonotrichia leucophrys</i>
WCSP	White-crowned Sparrow	L	<i>Zonotrichia leucophrys</i>
DEJU	Dark-eyed Junco	M	<i>Junco hyemalis</i>
WEME	Western Meadowlark	L	<i>Sturnella neglecta</i>
BRBL	Brewer's Blackbird	M	<i>Euphagus cyanocephalus</i>
PISI	Pine Siskin	L	<i>Carduelis pinus</i>
HOSP	House Sparrow	M	<i>Passer domesticus</i>

Appendix II. Survey dates, approximate tidal levels and sundry remarks for the estuaries of the Tahsis and Leiner Rivers, 17 November 1981 to 28 May 1982. Surveyors refer to diving ducks as "divers".

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Remarks - Autumn 1981

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17 November 1981 at noon

Tahsis River estuary at noon: *Most gulls were around edge of flats resting. Diving duck were feeding on mud flat area which was under water.*

Leiner River estuary at 12:30pm: *...a few Bufflehead left and went to Leiner so (they were probably) counted in both estuar(ies). Did not identify the species of Goldeneye and Scoter; will do so next count. Most diving ducks were on mud flats which were covered with water...(they were) diving and feeding. dead salmon. The gulls were on grass flat & river bank, most were just resting.*

20 November 1981

Tahsis River estuary at 8'0" tide: *Gulls resting around edge of flats (having) come down river from feeding. Most diving ducks were feeding over mud flats. Having trouble getting close to Goldeneye to ID between Common and Barrow's but most seem to be Common.*

Leiner River estuary at 7'0": *Aprox. 150 gulls feeding in lower river; others resting on logs and grass flats. Most diving ducks feeding on mud flat area. Three mallard feeding at edge of grass flats.*

24 November 1981

Tahsis River estuary at 10'8" tide: *Diving Ducks all feeding over tide flats. Gulls resting on logs and shoreline.*

Leiner River estuary at 11'9" tide: *Mallard were all feeding on grass area which was mostly under water. Diving Duck(s) were feeding over mud flats*

27 November 1981

Tahsis River estuary at 6'6" tide: *Diving Ducks feeding over mud flats. Gulls resting on shoreline & in water.*

Leiner River estuary at 7'0" tide: *Mallards feeding on dead salmon along river edge. Diving ducks feeding...over mud flat (which is mostly) under water. Gulls feed on dead salmon in lower river or rest on shore line.*

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Remarks - Winter 1981-1982

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1 December 1981

Tahsis River estuary at 8:30am: *Diving Ducks feeding over mud flats. Gulls resting along shoreline.*

Leiner River estuary at 6'5" tide: *Mallards feed on dead salmon on river bank. Diving duck feeding over mud flats (which are mostly) under water. Western Grebe resting in deep water. Gull(s:) some rest but most feed in river on dead salmon. About 100 gulls resting on log boom.*

10 December 1981

Tahsis River estuary at 9'0" tide: *Most divers in river mouth & over mud flats. Coots always on small grass area left near river. Gulls resting on shoreline and boom sticks.*

Leiner River estuary at 9:30am: *Diving duck feeding over mud flats. Mallard most in lower river and grass flat. Eagles in tree on shoreline & river bank.*

**14 December 1981**

Tahsis River estuary at 6'2" tide: *Diving ducks along edge of drop off & in lower river areas. Some gulls on mud flat feeding on the few remaining salmon. The one unidentified diver was with three surf scoter. I'm 95% sure it was drake Steller's Eider.*

Leiner River estuary: *Mallard feeding in lower river & grass flats. Scoter feeding along dropoff. Most duck were quite wild as there had been lot of shooting on weekend.*

**22 December 1981**

Tahsis River estuary at 9'0" tide: *Lot of diving ducks are now in staying in river channel. Gulls resting on gravel bar and boom. Female Oldsquaw sitting alone (on) tidal flat.*

Leiner River estuary at noon: *Dabbling duck seem to be settled at about 50 (birds) for the winter; (they are) mostly mallard. They are feeding on grass flat at high water & mud flat when tide is low. Divers not (changing) much in number or feeding habits. One adult swan today.*

**29 December 1981**

Tahsis River estuary at 6'6" tide: *Most divers in river channel feeding. No dead salmon left now. First swans this year...1 adult & 3 young. Most gulls resting on shoreline.*

Leiner River estuary at 7'0" tide: *This unidentified shorebird is like a small sandpiper but acts much like a dipper in actions. Family of 7 swans, 2 adults & 5 young. Had good look at mallards today, seems to be about 4 drakes to 1 hen. No dead salmon left now.*

**7 January 1982**

Tahsis River estuary at 10'6" tide: *(Numbers) of diving ducks and gulls seem to be going down as salmon carcasses disappear. Most divers and swans in river channel.*

Leiner River estuary at 11'0" tide: *Very cold with ice on shorelines. Bird seem to be much tamer. Swan family seems to be...(staying).*

**15 January 1982**

Tahsis River estuary at 5'8" tide: *Swan feed(ing) on mud flats. Divers mostly in lower river area. Gulls resting on shoreline and river bank.*

Leiner River estuary at 6'0" tide: *Swan feeding on mudflat, think they (are) feeding on eelgrass. Duck population...(continuing steady). Gulls are mostly up at the Tahsis dump.*

**19 January 1982**

Tahsis River estuary at 7'2" tide: *The 4 swan have moved to Leiner River.*

Leiner River estuary at 6'8" tide: */*

**25 January 1982**

Tahsis River estuary at 10'0" tide: */*

Leiner River estuary at 10'9" tide: *Count down in most species due to heavy hunting on last weekend of duck season. Both swan family seem to have move to Leiner. Eight of the 11 swans are young birds.*

**1 February 1982**

Tahsis River estuary at 4'4" tide: *Very few diving duck...could be cause of lower tide. Mud flat...dry today. 71 crow were feeding on flats.*

Leiner River estuary at 1:30pm: *Count up as hunting now closed; mallards much tamer already after only one week. Five new swan...three young & two old.*

**13 February 1982**

Tahsis River estuary at 9:00am: *Count still very low. It seems the divers are staying at Leiner now as (they are) not being bothered by hunters.*

Leiner River estuary at 4'10" tide: *Very little change in count. Mew Gull (count) higher then usual.*

**16 February 1982**

Tahsis River estuary at 6'0" tide: *...The count is up what the Leiner is down this week.*

Leiner River estuary at 11:30am: *Overall count about the same, divers down a few but Tahsis diver count up. Scoter (count) down last two week(s). They have moved down the inlet about 2 miles. I have noticed that the common goldeneyes stay in river estuary and the Barrow's in deep water along edge of inlet. There are over 200 Barrow's along Tahsis Inlet.*

**24 February 1982**

Tahsis River estuary at 6'6" tide: *Divers and Gulls count down from last week. Most birds sleeping in sun.*

Leiner River estuary at 7'0" tide: *little change in duck count. Gull count up; more Mew gulls then usual. Six new swans this week: 4 adults & 2 young.*

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**Remarks - Spring 1982**

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**5 March 1982**

Tahsis River estuary at 11'0" tide: /

Leiner River estuary at 10'9" tide: *Six new swans still here.*

**10 March 1982**

Tahsis River estuary at 8'9" tide: /

Leiner River estuary at 9'0" tide: /

**15 March 1982**

Tahsis River estuary at 4'0" tide: *...the greater scaup were back in Tahsis flat*

Leiner River estuary at 3'9" tide: *Diver & dabbling ducks about the same (as before) except Scaup (have moved to) Tahsis River. There were no swans... I think they started north yesterday (because) I watched them from home early in the morning. Only two gull on whole flats today; I think most are at the dump.*

**22 March 1982**

Tahsis River estuary at 6'2" tide: *Very few bird today. One young swan (does not) look healthy.*

Leiner River estuary at 6'6" tide: *Most of (ducks) are paired off now. The 31 Canada geese circled the flat four times but did not land. Mallard are very tame now; (I) have trouble getting them to fly to make count.*

1 April 1982

Tahsis River estuary at 7'0" tide: *Very few ducks using estuary now. Seems most have moved to Leiner since hunting season closed.*

Leiner River estuary at 6'8" tide: *More robins showing up each week; most duck sitting enjoying sun.*

10 April 1982

Tahsis River estuary at 2'0" tide: *Just about deserted.*

Leiner River estuary at 2'4" tide: *The gulls and scoter seem to have left area. (This was the) first time I haven't seen any crows on flat.*

15 April 1982

Tahsis River estuary at 6'6" tide: *Very few birds again today.*

Leiner River estuary at 6'0" tide: *Duck are paired off now and breeding.*

20 April 1982

Tahsis River estuary at 9'6" tide: *Very few birds again today.*

Leiner River estuary at 10'0" tide: *Both (diving & dabbling) duck are starting to leave for the north. More swallows and robins every week.*

29 April 1982

Tahsis River estuary at 6'0" tide: *Very few duck again today (but the) most gulls I've seen for along time. All resting on gravel bar.*

Leiner River estuary at 5'6" tide: *Less ducks this week...half mallard count. Lot of shorebird going north now.*

5 May 1982

Tahsis River estuary at 10'2" tide: *Very little to report on Tahsis flats.*

Leiner River estuary at 10'0" tide: *(Diving) duck less; lot of geese flying over Tahsis but not stopping. Still lot of shorebird flying through but not stopping; mostly sandpipers of some kind.*

12 May 1982

Tahsis River estuary at 4'0" tide: *Bird not use area any more.*

Leiner River estuary at 3'10" tide: *Some different (dabbling ducks) today as marked on count sheet. Only three mallards left now. Thirty nine (Greater White-fronted Geese) feeding on flats. Very few divers left now.*

22 May 1982

Tahsis River estuary at 8'6" tide: *Very little to count today.*

Leiner River estuary at 9'0" tide: *Very few duck left now. Most gull have left the area now.*

28 May 1982 at 3'0" tide

Tahsis River estuary: *Only one merganser today.*

Leiner River estuary at 2.6" tide: *The one young swan that is left seems to be in good shape. It flies around the inlet just about every day.*

### Appendix III.

*Tahsis River estuary bird surveys: Seasonal bird numbers, 17  
November 1981 to 28 May 1982.*

Note: In this Appendix, the mean has been calculated as the total number of birds of species-x counted over the season, divided by the total number of counts where species-x occurred. Counts of zero have not been included in the total number of counts nor are they included as minimum values. Thus the last 7 columns in the Appendix summarize the species occurrence on the study area. For example, the probability of seeing a Greater Scaup in winter on the Tahsis Rivers estuary is about 85%. If you see the species, you are likely to see an average of about 13 or 14 birds and more than 36 would be exceptional.

Bird Surveys of Tahsis River estuary for Autumn 1981

Date	17Nov	20Nov	24Nov	27Nov	Total	Max	Min	Mean	SD	%Freq	Median
#GRE	0	0	1	0	1	1	1	1.0	-	25.0	1.0
GREB	0	0	1	0	1	1	1	1.0	-	25.0	1.0
#HER	1	0	0	0	1	1	1	1.0	-	25.0	1.0
GBHE	1	0	0	0	1	1	1	1.0	-	25.0	1.0
#DIV	167	50	80	75	372	167	50	93.0	51.0	100.0	77.5
GRSC	13	0	28	30	71	30	13	23.7	9.3	75.0	28.0
SCOT	31	0	0	0	31	31	31	31.0	-	25.0	31.0
SUSC	0	24	13	3	40	24	3	13.3	10.5	75.0	13.0
GOLD	43	0	0	0	43	43	43	43.0	-	25.0	43.0
COGO	0	11	6	13	30	13	6	10.0	3.6	75.0	11.0
BUFF	64	13	27	27	131	64	13	32.8	21.9	100.0	27.0
COME	16	2	6	2	26	16	2	6.5	6.6	100.0	4.0
#RAI	0	5	5	3	13	5	3	4.3	1.2	75.0	5.0
AMCO	0	5	5	3	13	5	3	4.3	1.2	75.0	5.0
#GUL	80	42	14	36	172	80	14	43.0	27.4	100.0	39.0
GULL	80	42	14	36	172	80	14	43.0	27.4	100.0	39.0
#PAS	7	5	2	11	25	11	2	6.3	3.8	100.0	6.0
NOCR	7	5	2	11	25	11	2	6.3	3.8	100.0	6.0
#TOT	255	102	102	125	584	255	102	146.0	73.5	100.0	113.5

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Bird Surveys of Tahsis River estuary for Winter 1981-1982

Date	01Dec	10Dec	14Dec	22Dec	29Dec	07Jan	15Jan	19Jan	25Jan	01Feb	13Feb	16Feb	24Feb	Total	Max	Min	Mean	SD	%Freq	Median
#LOO	0	0	0	3	1	1	0	0	0	0	0	0	0	5	3	1	1.7	1.2	23.1	1.0
COLO	0	0	0	3	1	1	0	0	0	0	0	0	0	5	3	1	1.7	1.2	23.1	1.0
#GRE	0	2	0	0	3	5	0	1	0	1	0	1	0	13	5	1	2.2	1.6	46.2	1.5
GREB	0	2	0	0	3	3	0	1	0	0	0	1	0	10	3	1	2.0	1.0	38.5	2.0
WEGR	0	0	0	0	0	2	0	0	0	1	0	0	0	3	2	1	1.5	0.7	15.4	1.5
#COR	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
DCCO	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
#HER	1	0	1	0	1	0	0	0	0	0	0	0	1	4	1	1	1.0	-	30.8	1.0
GBHE	1	0	1	0	1	0	0	0	0	0	0	0	1	4	1	1	1.0	-	30.8	1.0
#SWA	0	0	0	0	4	4	4	0	0	0	0	0	0	12	4	4	4.0	-	23.1	4.0
TUSW	0	0	0	0	4	0	0	0	0	0	0	0	0	4	4	4	4.0	-	7.7	4.0
TRUS	0	0	0	0	0	4	4	0	0	0	0	0	0	8	4	4	4.0	-	15.4	4.0
#DIV	85	62	42	35	24	46	28	32	33	22	19	53	29	510	85	19	39.2	18.6	100.0	33.0
GRSC	36	23	15	14	8	21	5	9	6	0	3	9	0	149	36	3	13.5	9.8	84.6	9.0
OLDS	0	0	0	1	0	0	1	1	1	1	0	0	0	5	1	1	1.0	-	38.5	1.0
SUSC	0	11	6	4	0	2	5	4	11	9	7	12	11	82	12	2	7.5	3.5	84.6	7.0
COGO	16	9	4	2	4	6	2	4	2	5	2	18	2	76	18	2	5.8	5.4	100.0	4.0
BUFF	32	17	12	14	9	15	8	11	12	7	6	10	15	168	32	6	12.9	6.6	100.0	12.0
HOME	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
COME	1	2	5	0	3	2	6	3	1	0	1	4	1	29	6	1	2.6	1.7	84.6	2.0
#RAP	0	0	1	0	0	1	0	0	0	0	0	0	0	2	1	1	1.0	-	15.4	1.0
BAEA	0	0	1	0	0	1	0	0	0	0	0	0	0	2	1	1	1.0	-	15.4	1.0
#RAI	3	5	5	3	0	2	2	3	3	0	0	3	3	32	5	2	3.2	1.0	76.9	3.0
ANCO	3	5	5	3	0	2	2	3	3	0	0	3	3	32	5	2	3.2	1.0	76.9	3.0
#GUL	93	165	70	52	45	29	41	12	59	85	38	98	17	804	165	12	61.8	41.3	100.0	52.0
GULL	77	140	58	38	32	20	37	11	52	60	33	74	9	641	140	9	49.3	34.9	100.0	38.0
MEGU	16	25	12	14	13	9	4	1	7	25	5	24	8	163	25	1	12.5	8.1	100.0	12.0
#ALC	0	0	0	0	0	0	0	1	0	1	1	2	0	5	2	1	1.3	0.5	30.8	1.0
MANU	0	0	0	0	0	0	0	1	0	1	1	2	0	5	2	1	1.3	0.5	30.8	1.0
#PAS	6	7	3	8	14	4	3	5	7	71	9	13	4	154	71	3	11.8	18.1	100.0	7.0
NOCR	6	7	3	8	14	4	3	3	7	71	9	13	4	152	71	3	11.7	18.2	100.0	7.0
CORA	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2	2	2.0	-	7.7	2.0
#TOT	188	241	123	101	92	92	78	54	102	180	67	170	54	1542	241	54	118.6	58.4	100.0	101.0
***																				

Bird Surveys of Tahsis River estuary for Spring 1982

Date	05Mar	10Mar	15Mar	22Mar	01Apr	10Apr	15Apr	20Apr	29Apr	05May	12May	22May	28May	Total	Max	Min	Mean	SD	%Freq	Median
#LOO	0	0	0	0	0	1	0	0	0	0	2	0	1	4	2	1	1.3	0.6	23.1	1.0
COLO	0	0	0	0	0	1	0	0	0	0	2	0	1	4	2	1	1.3	0.6	23.1	1.0
#GRE	2	1	0	0	2	0	7	0	4	2	0	0	0	18	7	1	3.0	2.2	45.2	2.0
GREB	0	1	0	0	2	0	0	0	4	0	0	0	0	7	4	1	2.3	1.5	23.1	2.0
RNGR	0	0	0	0	0	0	1	0	0	2	0	0	0	3	2	1	1.5	0.7	15.4	1.5
WEGR	2	0	0	0	0	0	6	0	0	0	0	0	0	8	6	2	4.0	2.8	15.4	4.0
#HER	0	0	0	1	0	0	0	0	0	0	2	0	0	3	2	1	1.5	0.7	15.4	1.5
AMBI	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1.0	-	7.7	1.0
GBHE	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
GRHE	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1.0	-	7.7	1.0
#SWA	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
TUSW	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
#DIV	30	28	47	22	15	7	11	14	7	4	1	5	1	192	47	1	14.8	13.6	100.0	11.0
GRSC	7	6	22	7	0	0	0	0	2	0	0	0	0	44	22	2	8.8	7.7	39.5	7.0
SUSC	4	5	7	0	0	0	0	0	0	0	0	0	0	16	7	4	5.3	1.5	23.1	5.0
COCO	4	7	4	0	4	0	2	0	0	0	0	3	0	24	7	2	4.0	1.7	45.2	4.0
BUFF	13	9	14	15	11	7	9	11	2	2	0	0	0	93	15	2	9.3	4.5	76.9	10.0
COME	2	1	0	0	0	0	0	3	3	2	1	2	1	15	3	1	1.9	0.8	61.5	2.0
#RAI	3	3	3	3	0	0	0	0	0	0	0	0	0	12	3	3	3.0	-	30.8	3.0
AMCO	3	3	3	3	0	0	0	0	0	0	0	0	0	12	3	3	3.0	-	30.8	3.0
#SHO	0	0	0	0	0	0	0	0	0	0	4	0	0	4	4	4	4.0	-	7.7	4.0
SHOR	0	0	0	0	0	0	0	0	0	0	4	0	0	4	4	4	4.0	-	7.7	4.0
#GUL	32	29	0	28	22	10	17	14	83	18	28	9	2	292	83	2	24.3	20.7	92.3	20.0
GULL	21	19	0	25	15	8	17	12	75	13	0	0	0	235	75	8	22.8	20.2	69.2	17.0
BOGU	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1.0	-	7.7	1.0
MEGU	11	10	0	3	7	2	0	2	8	5	0	2	2	52	11	2	5.2	3.6	76.9	4.0
GWGU	0	0	0	0	0	0	0	0	0	0	27	7	0	34	27	7	17.0	14.1	15.4	17.0
#ALC	2	0	1	0	0	0	0	0	0	0	0	0	0	3	2	1	1.5	0.7	15.4	1.5
MANU	2	0	1	0	0	0	0	0	0	0	0	0	0	3	2	1	1.5	0.7	15.4	1.5
BEKI	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	1	1.0	-	15.4	1.0
#PAS	9	14	7	13	41	0	4	7	18	9	13	3	13	151	41	3	12.6	10.0	92.3	11.0
NOCR	9	14	7	13	32	0	4	7	18	9	13	3	13	142	32	3	11.8	7.7	92.3	11.0
AMRO	0	0	0	0	9	0	0	0	0	0	0	0	0	9	9	9	9.0	-	7.7	9.0
#TOT	78	75	53	68	80	18	39	35	112	34	50	17	18	632	112	17	52.5	29.2	100.0	50.0

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# Summary Report for Tahsis River estuary

Date	Aut81	Win81	Spr82	Total
#LOO	0	5	4	9
COLO	0	5	4	9
#GRE	1	13	18	32
GREB	1	10	7	18
RYGR	0	0	3	3
WEGR	0	3	8	11
#COR	0	1	0	1
DCCO	0	1	0	1
#HER	1	4	3	8
AMBI	0	0	1	1
GBHE	1	4	1	6
GRHE	0	0	1	1
#SWA	0	12	1	13
TUSW	0	4	1	5
TRUS	0	8	0	8
#DIV	372	510	192	1074
GRSC	71	149	44	264
OLDS	0	5	0	5
SCOT	31	0	0	31
SUSC	40	82	16	138
GOLD	43	0	0	43
COGO	30	76	24	130
BUFF	131	163	93	392
HOME	0	1	0	1
COME	26	29	15	70
#RAP	0	2	0	2
BAEA	0	2	0	2
#RAI	13	32	12	57
AMCO	13	32	12	57
#SHO	0	0	4	4
SHOR	0	0	4	4
#GUL	172	804	292	1268
GULL	172	641	205	1018
BOGU	0	0	1	1
MEGU	0	163	52	215
GWGU	0	0	34	34
#ALC	0	5	3	8
MAVU	0	5	3	8
BEKI	0	0	2	2
#PAS	25	154	151	330
NOCR	25	152	142	319
CORA	0	2	0	2
AMRO	0	0	9	9
#TOT	584	1542	682	2308

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#### Appendix IV

*Leiner River estuary birds surveys: Seasonal bird numbers, 17  
November 1981 to 28 May 1982.*

Note: In this Appendix, the mean has been calculated as the total number of birds of species-x counted over the season, divided by the total number of counts where species-x occurred. Counts of zero have not been included in the total number of counts nor are they included as minimum values. Thus the last 7 columns in the Appendix summarize the species occurrence on the study area. For example, the probability of seeing a Trumpeter Swan in winter at the Leiner River estuary is about 77%. If you see the species, you are likely to see an average of about 11 birds and more than 22 would be exceptional.

Bird Surveys of Leiner River estuary for Autumn 1981

Date	17Nov	20Nov	24Nov	27Nov	Total	Max	Min	Mean	SD	%Freq	Median
#GRE	2	0	3	1	6	3	1	2.0	1.0	75.0	2.0
GREB	0	0	2	0	2	2	2	2.0	-	25.0	2.0
EAGR	2	0	1	1	4	2	1	1.3	0.6	75.0	1.0
#COR	1	1	0	0	2	1	1	1.0	-	50.0	1.0
DCCO	1	1	0	0	2	1	1	1.0	-	50.0	1.0
#HER	1	0	1	2	4	2	1	1.3	0.6	75.0	1.0
GBHE	1	0	1	2	4	2	1	1.3	0.6	75.0	1.0
#DAB	4	3	14	28	49	28	3	12.3	11.6	100.0	9.0
GWTE	0	0	0	2	2	2	2	2.0	-	25.0	2.0
MALL	4	3	14	26	47	26	3	11.8	10.7	100.0	9.0
#DIV	177	149	184	157	667	184	149	166.8	16.5	100.0	167.0
SCOT	40	0	0	0	40	40	40	40.0	-	25.0	40.0
SUSC	0	77	73	76	226	77	73	75.3	2.1	75.0	76.0
GOLD	7	0	0	0	7	7	7	7.0	-	25.0	7.0
COGO	0	2	18	20	40	20	2	13.3	9.9	75.0	18.0
BUFF	103	55	84	51	293	103	51	73.3	24.7	100.0	69.5
HOME	9	7	0	1	17	9	1	5.7	4.2	75.0	7.0
COME	18	8	9	9	44	18	8	11.0	4.7	100.0	9.0
#RAP	0	2	6	3	11	6	2	3.7	2.1	75.0	3.0
BAEA	0	0	4	1	5	4	1	2.5	2.1	50.0	2.5
SSHA	0	0	1	2	3	2	1	1.5	0.7	50.0	1.5
RTHA	0	2	1	0	3	2	1	1.5	0.7	50.0	1.5
#RAI	0	0	0	1	1	1	1	1.0	-	25.0	1.0
VIRA	0	0	0	1	1	1	1	1.0	-	25.0	1.0
#SHO	1	0	0	1	2	1	1	1.0	-	50.0	1.0
BLTU	1	0	0	0	1	1	1	1.0	-	25.0	1.0
SHOR	0	0	0	1	1	1	1	1.0	-	25.0	1.0
#GUL	126	440	108	145	819	440	108	204.8	157.6	100.0	135.5
GULL	126	440	108	145	819	440	108	204.8	157.6	100.0	135.5
BEKI	2	1	2	2	7	2	1	1.8	0.5	100.0	2.0
#PAS	11	9	1	3	24	11	1	6.0	4.8	100.0	6.0
NOCR	11	0	0	3	14	11	3	7.0	5.7	50.0	7.0
AMDI	0	2	1	0	3	2	1	1.5	0.7	50.0	1.5
AMRO	0	7	0	0	7	7	7	7.0	-	25.0	7.0
#TOT	325	605	319	343	1592	605	319	398.0	138.4	100.0	334.0

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Bird Surveys of Leiner River estuary for Winter 1981-1982

Date	01Dec	10Dec	14Dec	22Dec	29Dec	07Jan	15Jan	19Jan	25Jan	01Feb	13Feb	16Feb	24Feb	Total	Max	Min	Mean	SD	%Freq	Median
#LOO	2	0	1	1	3	1	1	1	0	0	0	0	0	10	3	1	1.4	0.8	53.8	1.0
COLO	2	0	1	1	3	1	1	1	0	0	0	0	0	10	3	1	1.4	0.8	53.8	1.0
#GRE	14	11	16	6	11	7	2	3	1	1	3	3	2	80	16	1	6.2	5.2	100.0	3.0
GREB	2	2	0	2	2	2	2	3	1	1	3	3	2	25	3	1	2.1	0.7	92.3	2.0
WEGR	12	9	16	4	9	5	0	0	0	0	0	0	0	55	16	4	9.2	4.4	46.2	9.0
#COR	1	0	2	0	2	0	0	0	0	0	0	0	0	5	2	1	1.7	0.6	23.1	2.0
DCCO	1	0	2	0	2	0	0	0	0	0	0	0	0	5	2	1	1.7	0.6	23.1	2.0
#HER	1	2	2	3	4	0	3	2	1	3	0	4	1	26	4	1	2.4	1.1	84.6	2.0
GBHE	1	2	2	3	4	0	3	2	1	3	0	4	1	26	4	1	2.4	1.1	84.6	2.0
#SWA	0	0	0	1	7	7	7	11	11	16	16	16	22	114	22	1	11.4	6.2	76.9	11.0
TRUS	0	0	0	1	7	7	7	11	11	16	16	16	22	114	22	1	11.4	6.2	76.9	11.0
#DAB	41	29	33	57	54	70	68	58	33	64	49	69	63	688	70	29	52.9	14.6	100.0	57.0
G*TE	0	0	0	0	0	5	0	0	0	0	0	0	0	5	5	5	5.0	-	7.7	5.0
MALL	41	29	33	51	50	59	61	52	32	60	47	63	61	639	63	29	49.2	12.0	100.0	51.0
AM*I	0	0	0	6	4	6	7	6	1	4	2	6	2	44	7	1	4.4	2.1	76.9	5.0
#DIV	176	133	115	115	129	122	138	125	115	128	106	91	95	1588	176	91	122.2	21.4	100.0	122.0
GRSC	0	0	0	4	7	10	12	6	9	21	17	7	16	109	21	4	10.9	5.5	76.9	9.5
OLDS	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
SUSC	86	72	63	59	61	59	65	52	60	52	41	42	20	732	86	20	56.3	16.1	100.0	59.0
COGO	14	11	13	10	13	13	11	17	9	18	13	4	8	154	18	4	11.8	3.7	100.0	13.0
BLFF	68	46	38	42	45	39	50	45	37	37	35	37	46	565	68	35	43.5	8.7	100.0	42.0
HOME	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2.0	-	7.7	2.0
COME	7	4	1	0	3	1	0	5	0	0	0	1	3	25	7	1	3.1	2.2	61.5	3.0
#RAP	6	2	5	1	4	3	4	3	1	4	4	4	3	44	6	1	3.4	1.4	100.0	4.0
BAEA	5	2	4	1	3	3	3	2	1	3	4	4	3	38	5	1	2.9	1.2	100.0	3.0
SSHA	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
RTHA	1	0	1	0	0	0	1	1	0	1	0	0	0	5	1	1	1.0	-	38.5	1.0
#SHO	19	0	17	32	33	33	0	31	29	0	13	12	2	221	33	2	22.1	11.0	76.9	24.0
BLTU	19	0	17	31	32	32	0	31	29	0	10	11	0	212	32	10	23.6	9.3	69.2	29.0
COSN	0	0	0	0	0	0	0	0	0	0	2	1	2	5	2	1	1.7	0.6	23.1	2.0
SHOR	0	0	0	1	1	1	0	0	0	0	1	0	0	4	1	1	1.0	-	30.8	1.0
#GUL	480	136	70	84	54	40	71	88	73	87	115	88	130	1516	480	40	116.6	112.6	100.0	87.0
GULL	390	112	50	72	43	14	40	37	41	45	53	28	60	985	390	14	75.8	97.3	100.0	45.0
MEGU	90	24	20	12	11	26	31	51	32	42	62	60	70	531	90	11	40.8	24.2	100.0	32.0
#ALC	4	0	0	0	2	0	0	0	0	0	0	0	0	6	4	2	3.0	1.4	15.4	3.0
MAMU	4	0	0	0	2	0	0	0	0	0	0	0	0	6	4	2	3.0	1.4	15.4	3.0
BEKI	3	1	2	1	3	1	0	1	2	1	1	0	1	17	3	1	1.5	0.8	84.6	1.0
#WCO	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
NOFL	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
#PAS	20	26	19	31	45	50	9	35	18	21	25	70	25	394	70	9	30.3	16.3	100.0	25.0
STJA	1	0	0	0	0	0	0	0	0	0	0	2	0	3	2	1	1.5	0.7	15.4	1.5
NOCR	15	22	13	9	31	43	7	14	9	4	18	7	11	203	43	4	15.6	10.9	100.0	13.0
CORA	0	0	0	0	0	0	0	0	0	0	5	0	0	5	5	5	5.0	-	7.7	5.0
WWR	1	2	0	1	1	0	1	0	0	0	0	0	2	8	2	1	1.3	0.5	46.2	1.0
AMDI	2	1	2	2	0	0	0	0	0	0	0	0	0	7	2	1	1.8	0.5	30.8	2.0
VATH	0	0	0	5	2	2	0	3	0	0	0	0	0	12	5	2	3.0	1.4	30.8	2.5
EUST	0	0	2	11	6	2	0	14	7	17	1	15	11	86	17	1	8.6	5.8	76.9	9.0
SOSP	1	1	2	3	5	3	1	4	2	0	1	3	1	27	5	1	2.3	1.4	92.3	2.0
PISI	0	0	0	0	0	0	0	0	0	0	0	43	0	43	43	43	43.0	-	7.7	43.0
#TOT	767	340	282	332	351	335	303	358	284	325	332	357	344	4710	767	282	362.3	124.1	100.0	335.0

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Bird Surveys of Leiner River estuary for Spring 1982

Date	05Mar	10Mar	15Mar	22Mar	01Apr	10Apr	15Apr	20Apr	29Apr	05May	12May	22May	28May	Total	Max	Min	Mean	SD	%Freq	Median
#LOO	0	1	0	0	0	0	0	0	1	0	4	0	2	8	4	1	2.0	1.4	30.8	1.5
COLO	0	1	0	0	0	0	0	0	1	0	4	0	2	8	4	1	2.0	1.4	30.8	1.5
#GRE	1	0	4	2	7	13	7	4	3	7	4	8	4	64	13	1	5.3	3.3	92.3	4.0
GREB	1	0	1	2	0	0	1	2	0	0	0	0	0	7	2	1	1.4	0.5	38.5	1.0
RYGR	0	0	0	0	1	0	0	0	0	4	2	0	0	7	4	1	2.3	1.5	23.1	2.0
WEGR	0	0	3	0	6	13	6	2	3	3	2	8	4	50	13	2	5.0	3.4	76.9	3.5
#HER	3	2	2	1	4	4	3	2	0	1	3	1	3	29	4	1	2.4	1.1	92.3	2.5
GBHE	3	2	2	1	4	4	3	2	0	1	3	1	3	29	4	1	2.4	1.1	92.3	2.5
#SWA	22	22	0	0	1	0	0	1	1	1	1	0	1	50	22	1	6.3	9.7	61.5	1.0
TRUS	22	22	0	0	1	0	0	1	1	1	1	0	1	50	22	1	6.3	9.7	61.5	1.0
#GEE	0	0	0	31	0	0	0	0	0	0	39	0	0	70	39	31	35.0	5.7	15.4	35.0
GWFC	0	0	0	0	0	0	0	0	0	0	39	0	0	39	39	39	39.0	-	7.7	39.0
CAGO	0	0	0	31	0	0	0	0	0	0	0	0	0	31	31	31	31.0	-	7.7	31.0
#DAB	58	54	68	86	67	76	64	47	59	42	37	14	0	672	86	14	56.0	19.2	92.3	58.5
GWTE	0	0	0	0	0	2	4	0	31	28	20	11	0	96	31	2	16.0	12.2	46.2	15.5
MALL	55	52	65	76	60	68	53	45	26	14	3	3	0	520	76	3	43.3	25.5	92.3	52.5
NOPI	0	0	0	0	0	0	0	0	0	0	8	0	0	8	8	8	8.0	-	7.7	8.0
BWTE	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	2	2.0	-	7.7	2.0
NOSL	0	0	0	0	0	0	0	0	0	0	4	0	0	4	4	4	4.0	-	7.7	4.0
AWWI	3	2	3	10	7	6	7	2	2	0	0	0	0	42	10	2	4.7	2.9	69.2	3.0
#DIV	84	99	131	171	159	113	124	79	56	26	19	15	19	1095	171	15	84.2	54.4	100.0	84.0
GRSC	17	14	0	21	17	12	16	9	4	0	6	2	0	118	21	2	11.8	6.3	76.9	13.0
HADU	0	0	0	0	2	0	0	0	0	2	2	4	7	17	7	2	3.4	2.2	38.5	2.0
SUSC	17	18	31	52	55	3	6	4	0	1	0	0	0	187	55	1	20.8	20.9	69.2	17.0
WASC	0	0	0	0	0	0	0	0	0	1	0	2	0	3	2	1	1.5	0.7	15.4	1.5
COGO	7	16	28	23	18	35	37	21	12	3	2	3	3	208	37	2	16.0	12.3	100.0	16.0
BAGO	0	0	2	4	4	0	0	0	2	0	3	2	4	21	4	2	3.0	1.0	53.8	3.0
BUFF	39	43	70	62	56	58	60	38	33	13	2	0	0	474	70	2	43.1	21.2	84.6	43.0
HONE	0	0	0	0	0	0	0	2	0	0	2	0	0	4	2	2	2.0	-	15.4	2.0
COME	4	8	0	9	7	5	5	5	5	6	2	2	5	63	9	2	5.3	2.1	92.3	5.0
#RAP	4	3	3	5	3	3	4	2	2	0	2	3	2	36	5	2	3.0	1.0	92.3	3.0
BAEA	4	3	3	5	3	3	4	2	1	0	2	1	2	33	5	1	2.8	1.2	92.3	3.0
SSHA	0	0	0	0	0	0	0	0	1	0	0	2	0	3	2	1	1.5	0.7	15.4	1.5
#SHO	0	3	1	4	3	2	3	2	46	23	9	0	0	96	46	1	9.6	14.4	76.9	3.0
BLTU	0	0	0	0	0	0	0	0	5	0	5	0	0	10	5	5	5.0	-	15.4	5.0
COSV	0	3	1	4	3	2	3	2	1	0	1	0	0	20	4	1	2.2	1.1	69.2	2.0
SHOR	0	0	0	0	0	0	0	0	40	23	3	0	0	66	40	3	22.0	18.5	23.1	23.0
#GUL	72	64	2	5	18	9	21	32	15	0	8	2	7	255	72	2	21.3	23.6	92.3	12.0
GULL	21	30	2	2	14	7	17	23	8	0	5	2	3	134	30	2	11.2	9.6	92.3	7.5
MEGU	51	34	0	3	4	2	4	9	7	0	3	0	4	121	51	2	12.1	16.6	76.9	4.0
BTP1	0	0	0	0	0	0	0	0	0	0	5	0	4	9	5	4	4.5	0.7	15.4	4.5
BEKI	2	1	1	2	2	1	1	2	2	0	1	0	1	16	2	1	1.5	0.5	84.6	1.0
#PAS	22	14	8	110	40	54	31	52	92	75	74	51	77	700	110	8	53.8	30.9	100.0	52.0
SWAL	0	0	0	0	0	9	0	31	50	32	37	0	0	159	50	9	31.8	14.8	38.5	32.0
VGSW	0	0	0	0	0	0	0	0	0	0	0	13	27	40	27	13	20.0	9.9	15.4	20.0
BASW	0	0	0	0	0	0	0	0	0	0	2	4	5	11	5	2	3.7	1.5	23.1	4.0
STJA	0	0	0	0	0	1	0	0	0	1	0	1	0	3	1	1	1.0	-	23.1	1.0
NOCR	17	3	0	2	0	0	9	0	4	0	11	4	7	57	17	2	7.1	5.1	61.5	5.5
CORA	2	0	0	0	3	0	0	0	0	0	0	0	0	5	3	2	2.5	0.7	15.4	2.5
BROR	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1.0	-	7.7	1.0
WYWR	0	0	0	1	0	0	1	0	1	0	0	0	0	3	1	1	1.0	-	23.1	1.0
AMRO	0	0	5	23	21	30	7	14	17	31	11	15	22	196	31	5	17.8	8.5	84.6	17.0

Bird Surveys of Leiner River estuary for Spring 1982 (continued)

Date	05Mar	10Mar	15Mar	22Mar	01Apr	10Apr	15Apr	20Apr	29Apr	05May	12May	22May	28May	Total	Max	Min	Mean	SD	%Freq	Median
VATH	0	7	0	9	0	0	0	0	5	0	0	2	0	23	9	2	5.8	3.0	30.8	6.0
EUST	0	3	0	2	13	8	9	0	4	0	7	3	9	58	13	2	6.4	3.7	69.2	7.0
WARB	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1.0	-	7.7	1.0
SOSP	3	1	3	2	3	4	5	3	3	7	4	9	5	52	9	1	4.0	2.1	100.0	3.0
WCSP	0	0	0	0	0	2	0	4	7	4	0	0	2	19	7	2	3.8	2.0	38.5	4.0
WEME	0	0	0	0	0	0	0	0	1	0	1	0	0	2	1	1	1.0	-	15.4	1.0
PISI	0	0	0	70	0	0	0	0	0	0	0	0	0	70	70	70	70.0	-	7.7	70.0
#TOT	268	263	220	417	304	275	258	223	277	175	206	94	120	3100	417	94	238.5	82.4	100.0	258.0
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Summary Report for Leiner River estuary

Date	Aut81	Win81	Spr82	Total
#LOO	0	10	8	18
COLO	0	10	8	18
#GRE	6	80	64	150
GREB	2	25	7	34
RNGR	0	0	7	7
EAGR	4	0	0	4
WEGR	0	55	50	105
#COR	2	5	0	7
DCCO	2	5	0	7
#HER	4	26	29	59
GBHE	4	26	29	59
#SWA	0	114	50	164
TRUS	0	114	50	164
#GEE	0	0	70	70
GWFG	0	0	39	39
CAGO	0	0	31	31
#DAB	49	638	672	1409
GWTE	2	5	96	103
MALL	47	639	520	1206
NOPI	0	0	8	8
BWTE	0	0	2	2
NOSL	0	0	4	4
AMWI	0	44	42	86
#DIV	667	1588	1095	3350
GRSC	0	109	118	227
HADU	0	0	17	17
OLDS	0	1	0	1
SCOT	40	0	0	40
SUSC	226	732	187	1145
WWSC	0	0	3	3
GOLD	7	0	0	7
COCO	40	154	208	402
BAGO	0	0	21	21
BUFF	293	555	474	1332
HOME	17	2	4	23
COME	44	25	63	132



Summary Report for Leiner River estuary (continued)

Date	Aut81	Win81	Spr82	Total
#RAP	11	44	36	91
BAEA	5	38	33	76
SSHA	3	1	3	7
RTHA	3	5	0	8
#RAI	1	0	0	1
VIRA	1	0	0	1
#SHO	2	221	96	319
BLTU	1	212	10	223
COSV	0	5	20	25
SHOR	1	4	66	71
#GUL	819	1516	255	2590
GULL	819	985	134	1938
MEGU	0	531	121	652
#ALC	0	6	0	6
MAMU	0	6	0	6
BTPI	0	0	9	9
BEKI	7	17	16	40
#WOO	0	1	0	1
NOFL	0	1	0	1
#PAS	24	394	700	1118
SWAL	0	0	159	159
VCSW	0	0	40	40
BASW	0	0	11	11
STJA	0	3	3	6
NOCR	14	203	57	274
CORA	0	5	5	10
BRCR	0	0	1	1
WIWR	0	8	3	11
AMDI	3	7	0	10
AMRO	7	0	196	203
VATH	0	12	23	35
EUST	0	86	58	144
WARB	0	0	1	1
SOSP	0	27	52	79
WCSP	0	0	19	19
WEME	0	0	2	2
PISI	0	43	70	113
#TOT	1592	4710	3100	9402

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