

4325

**MIGRATORY BIRD USE OF THE LADYSMITH-  
CHEMAINUS AREA, WINTER 1974-75**

**Prepared for  
Canadian Wildlife Service  
Western Region**

**by  
Donald A. Blood and Associates  
Ecological Research  
and  
Consulting Services  
R.R. #1 Lantzville, B.C.**

SK  
470  
T42  
no.236



**CANADIAN WILDLIFE SERVICE**



36 004 577

MIGRATORY BIRD USE OF THE LADYSMITH-  
CHEMAINUS AREA, WINTER 1974-75

---

Prepared for  
Canadian Wildlife Service, Western Region  
Contract WRO 74-75  
No. 236

Donald A. Blood and Associates  
Ecological Research and Consulting Services  
R.R. #1 Lantzville, B.C.

## CONTENTS

	Page
ABSTRACT .....	1
LIST OF FIGURES AND TABLES .....	4
INTRODUCTION .....	5
METHODS AND LIMITATIONS .....	6
RESULTS	
Bird numbers, trends, and species composition .....	11
Ladysmith Region .....	12
Chemainus Region .....	21
Habitat importance rating .....	29
Ladysmith Region .....	29
Chemainus Region .....	32
DISCUSSION	
Bird numbers, trends, and species composition .....	35
Habitat rating .....	39
Impact of development and human activity .....	40
Existing conditions .....	40
Future developments .....	47
RECOMMENDATIONS .....	49
LITERATURE CITED .....	52
APENDICES I - V .....	53-64

**ABSTRACT**

Weekly ground counts of birds using estuarine and marine habitats were carried out in the Ladysmith-Chemainus area from December 15, 1974, to March 15, 1975. In the Ladysmith region, where individual counts varied from 1159 to 5038 birds, the western grebe was the most abundant species, and scoters the most abundant diving ducks. Ladysmith harbour is little used by dabbling ducks, but supports moderate numbers of divers.

Weekly counts in the Chemainus region varied from 2,292 to 5,343 birds. Mergansers were the most abundant birds in the Chemainus Bay sub-region, and gulls in the Chemainus River estuary sub-region. Up to 1,736 dabblers and 1,750 divers were counted in the estuary area, with pintails the most abundant dabblers (wigeon a close second) and scoters the most numerous divers. A downward trend in dabbler abundance was evident during the survey period.

Habitats were rated on an importance scale of one to four, based on observed bird use. Excellent winter habitat for dabbling ducks occurs at the Chemainus

estuary, and smaller units at the mouths of Bush and Holland Creeks are also important. Best diving duck habitats occur at Kulleet Bay, part of Ladysmith Inner Harbour, Holland Bank, the mouth of Chemainus Bay, and the Shoal Islands area.

Existing and potential adverse effects of development and human activity on important waterfowl habitats are briefly discussed, and recommendations made with respect to habitat protection. Log dumping, sorting and storage activities seem to have had the most significant impact, but this has not been entirely negative. Many species of birds regularly used booms and pilings as loafing sites. Log storage over many years has probably reduced the suitability for wintering waterfowl of intertidal mud flats, e.g. Inner Ladysmith Harbour, but pilings and floats in deeper water may increase waterfowl use by providing an increased surface area of substrate for attachment of marine organisms.

It is concluded that the Chemainus River estuary should be given high priority for protection, since it has high habitat and species diversity and is still in a fairly natural state.

## LIST OF TABLES, FIGURES AND APPENDICES

## TABLES

## Page

Table 1 - Bird observations at Kulleet Bay .....	16
Table 2 - Bird observations in Ladysmith Inner Harbour .....	19
Table 3 - Bird observations in Ladysmith Outer Harbour .....	20
Table 4 - Bird observations at Chemainus Bay .....	23
Table 5 - Birds observed at the Chemainus River Estuary .....	25

## FIGURES

Map No. 1 Census observation points and wintering waterfowl habitat rating in the Ladysmith region .....	30
Map No. 2 Census observation points and wintering waterfowl habitat rating in the Chemainus region .....	34
Figure 1. Trend in total bird observations in Ladysmith Region ...	13
Figure 2. Trend in total bird observations in Chemainus Region ...	14
Figure 3. Trend in numbers of diving ducks by species, Kulleet Bay .....	17
Figure 4. Trend in numbers of dabbling ducks by species, Chemainus River estuary .....	26
Figure 5. Trend in numbers of diving ducks by species, Chemainus River estuary and Shoal Islands .....	27

## APPENDICES

Appendix I Observation points and sub-regions used in enumeration of water birds .....	53
Appendix II Weekly bird observations in the Ladysmith Region .....	55
Appendix III Weekly bird observations in the Chemainus Region .....	59
Appendix IV Species composition of identified diving ducks in the Ladysmith and Chemainus regions .....	63
Appendix V Species composition of identified dabbling ducks in the Ladysmith and Chemainus regions .....	64

Migratory bird use of the Ladysmith - Chemainus area,  
winter 1974-75

INTRODUCTION

It is generally known that the estuaries, inlets, and shallow bays of the Coast of British Columbia are the winter habitat of many species of waterfowl which breed inland, or in the Arctic. However, the relative importance of individual bays or estuaries, and the species composition of the wintering birds, are less well known. This report describes the distribution, species composition, and trends in abundance of water-oriented birds utilizing the Ladysmith - Chemainus area on the south-east coast of Vancouver Island during the period December 15, 1974 - March 15, 1975.

The east coast of Vancouver Island is a rapidly developing region, and particularly attractive for residential and recreational use. There are few sheltered bays or harbours and such areas are thus in demand for industrial, commercial, and recreational use. The sheltered bays also tend to be the habitats most suitable for, and used by, a variety of ducks and other water birds. Undoubtedly, a certain amount of future development, of port facilities for



example, is inevitable along this coastline. Thus it is important to obtain information on the relative use by waterfowl of various sub-units of habitat, maximum and average abundance of birds, seasonal trends, and species composition. Hopefully, this data, together with other environmental inputs, will allow planners to channel necessary developments into areas where ecological damage is least.

#### METHODS AND LIMITATIONS

Thirteen weekly counts were conducted at 8 locations in the Ladysmith Region (Map No. 1) and 7 locations in the Chemainus Region (Map No. 2). Selection of sites was based on a combination of strategic location in relation to the expected distribution of birds; vehicular accessibility; and the view obtained from the particular vantage point. Areas viewed from each observation point are indicated on the maps. Due to poor accessibility and shoreline configuration, it was not possible to survey the entire shoreline, or nearshore area by the ground technique, however, it is felt that the major concentration areas have been covered, and that extrapolations can be made to arrive at estimated totals for the entire study

area. Areas which were not visible during the surveys are indicated on Maps 1 and 2.

For purposes of data analysis, the Ladysmith and Chemainus regions were each divided into sub-regions of relatively uniform physiography and ecology. The observation points and sub-regions are listed in Appendix I.

Observations were usually made at Ladysmith on Wednesdays and Chemainus on Thursdays, although weather conditions sometimes resulted in alteration of this schedule by one or two days. The time interval between counts thus varied from a minimum of 5 days to a maximum of 8 days.

Most observations were made with the aid of spotting scopes. Both Bushnell (with 15 and 25 power eyepieces) and Bausch and Lomb (15 to 60 power zoom) were used, the latter proving to be more versatile. Binoculars (7x35) were used to quickly scan closer areas or identify birds which flushed. The counts are considered quite accurate for the areas observed, but some divers were missed if underwater when the sea surface was scanned. Also, the distance to sea at which birds

could be identified to species or species group, or seen at all, varied greatly according to weather and light conditions. This limitation applies mostly to the open coastline where the outer limit of observation is not defined. Observational limitations included the short daylight period in mid-winter (9 a.m. to 3 p.m. on rainy or overcast days in December and January), fog, and unusual amount of snow which sometimes limited road access to viewpoints and resulted in additional time expenditure in walking. Weather conditions were noted at the time of each count, and are noted on the rough data sheets submitted previously.

The numbers of birds in large flocks sometimes had to be estimated by counting in tens or even hundreds, particularly if they were actively moving about. Both observers (D. Blood and J. Polson) have had considerable experience in estimating numbers of flocked birds. Practice counts of relatively stationary flocks (e.g. western grebes) by both the total count and estimation procedures indicated close correlation,

with the estimates usually being slightly conservative. Gulls, crows, western grebes, and dabbling ducks were the species whose numbers most frequently had to be estimated.

Specific identification was limited by observation conditions and time available to complete the counts. Very coarse grouping such as "unidentified" divers or dabblers usually involved birds seen at great distances. Other species groups such as loons, small grebes, cormorants, gulls and scaup pose many problems in identification, particularly when large and/or mixed flocks in winter plumage are involved, and time did not normally permit a more refined breakdown of them.

Rating of the importance of winter habitat was based largely on observed bird numbers and consistency of use during the survey period. Much of the study area is a strictly marine environment, and few ecologically meaningful criteria, other than water depth, can be used to classify it. Vascular plant cover in the few salt marsh or estuarine situations is best surveyed in the summer when floral development allows proper

identification. While quantitative description and mapping of salt marsh, intertidal and estuarine communities is a desirable objective, this information alone would not be sufficient to apply importance ratings for waterfowl. Regular use by the birds is felt to be the best indication that a particular area is providing significant food and/or "cover" for wintering birds.

It was not possible to break down habitat according to its value for feeding, loafing, cover etc. For the majority of birds the ocean surface provided all of these requirements, and feeding and loafing activities appeared to be carried out intermittently in roughly the same places. Many man-made structures such as piers and log booms were used as loafing sites, and it did not seem appropriate to rate such places highly because of such use. Habitat units were finally rated and mapped for diving ducks and for dabbling ducks on an importance scale of one to four. Despite the small number of categories, this mapping is considered to be considerably more refined than the C.L.I. mapping presently available.

Data obtained and observations made during the field work were supplemented with previously collected information provided by the Canadian Wildlife Service; by discussion with personnel of the B.C. Fish and Wildlife Branch, Lands Branch, Environment and Land Use Secretariat, and Cowichan Regional District; and by reference to published and unpublished reports having applicability to the study area.

## RESULTS

### 1. Bird numbers, trends, and species composition

Species and species-group totals by weeks for all observation points in the Ladysmith and Chemainus regions are presented in Appendices II and III respectively.

Trends in total numbers of birds seen in each of the Ladysmith and Chemainus regions, broken into four major categories, are graphed in Figures 1 and 2. Weekly and average counts for important species and species-groups are presented for each sub-region in Tables 1 to 5.

Species composition of the dabbler group is presented graphically in Figure 3 for the Chemainus River Estuary--the only sub-region of significant dabbler abundance.

Species composition of the diving duck group is also graphed (Figures 4 and 5) for two areas of high abundance (Kulleet Bay and the Chemainus Estuary). Species composition of all identified divers and dabblers is presented in Appendices IV and V respectively.

a). Ladysmith Region

Total weekly counts in the Ladysmith Region varied from 1159 to 5038 birds. Maximum numbers of various bird groups observed in the region during any one count are as follows: loons 174; grebes 3,308; cormorants 88; dabbling ducks 264; diving ducks 1,705; gulls 746; murrelets 108; crows 176. The single most abundant species was the western grebe, observed consistently in large flocks at certain locations.

Trends in numbers during the survey period (Figure 1) suggest a gradual build-up of birds in the region as a whole. The graph also demonstrates the effect of a single species, the western grebe, on total bird numbers. Gull numbers were also fairly variable, but did not influence total counts as much as did western grebes, gulls, and passerines shows a fairly consistent trend over the survey period. It is made up primarily of diving ducks, but

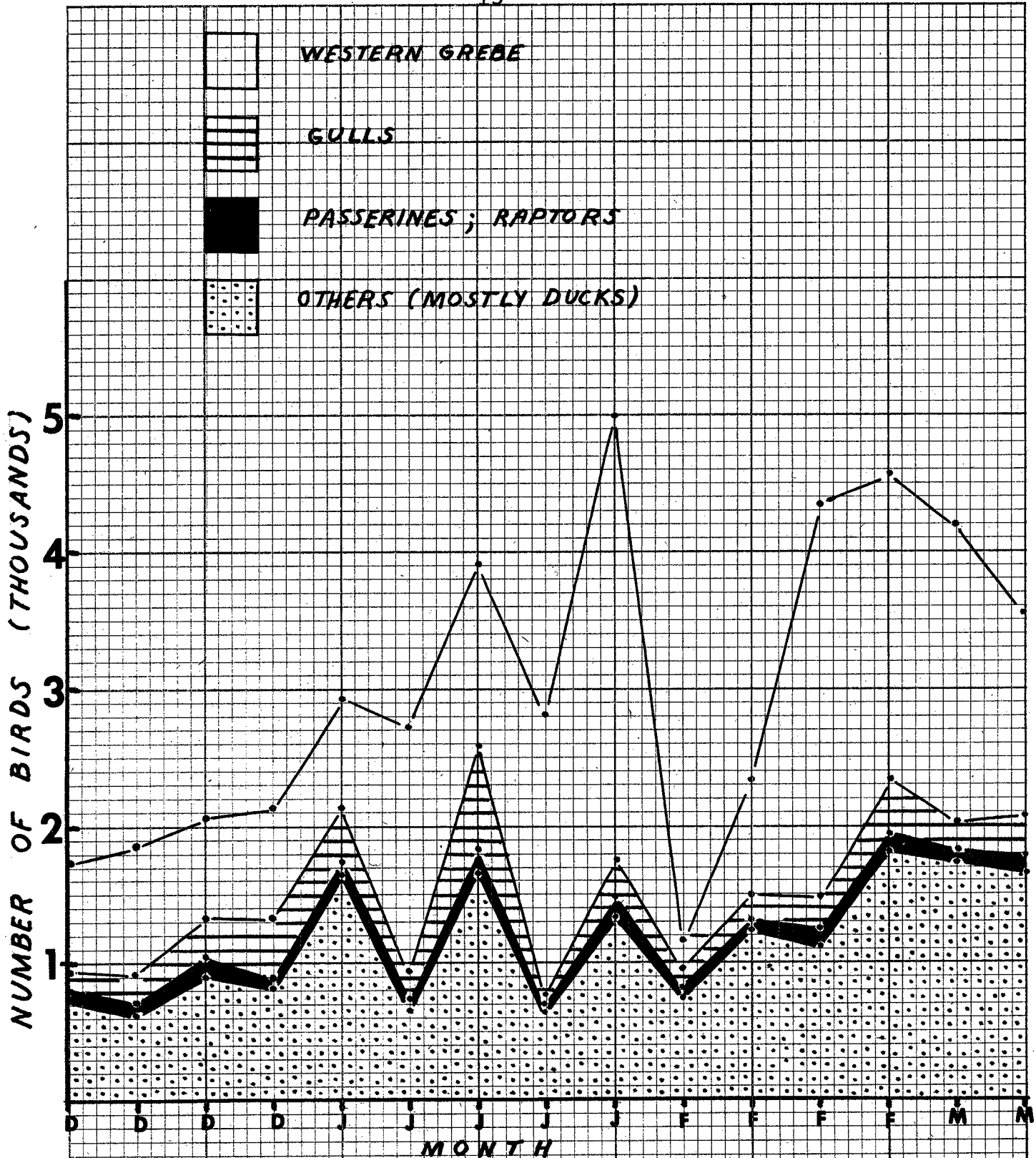


FIGURE I. - Trend in total bird observations in Ladysmith Region



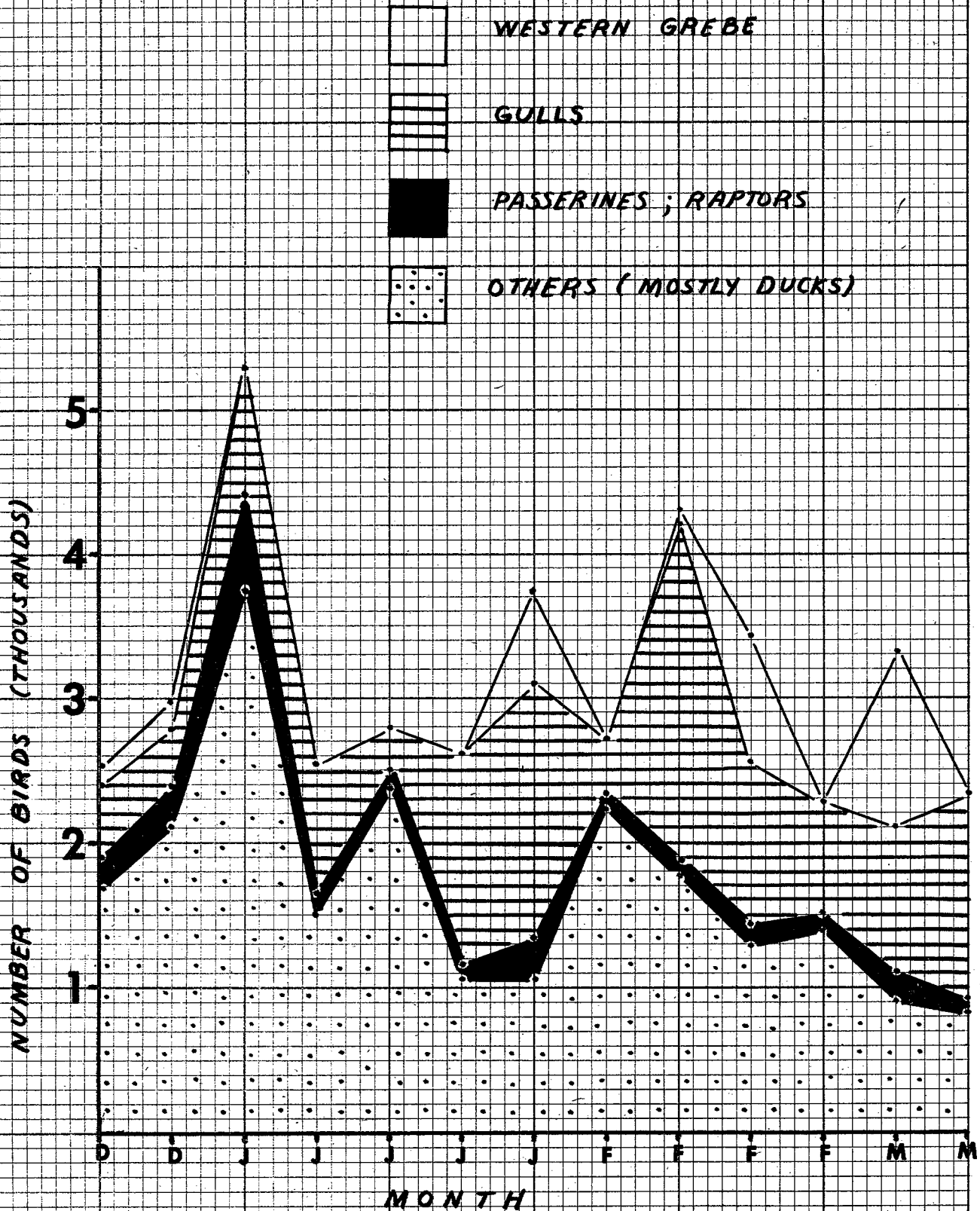


FIGURE 2.

Trend in total bird observations in Chemainus Region

also includes other divers (loons, grebes other than western, cormorants, alcids, and coots), dabbling ducks, herons and shorebirds.

The remaining discussion of numbers, trends, and species composition will be arranged by sub-region.

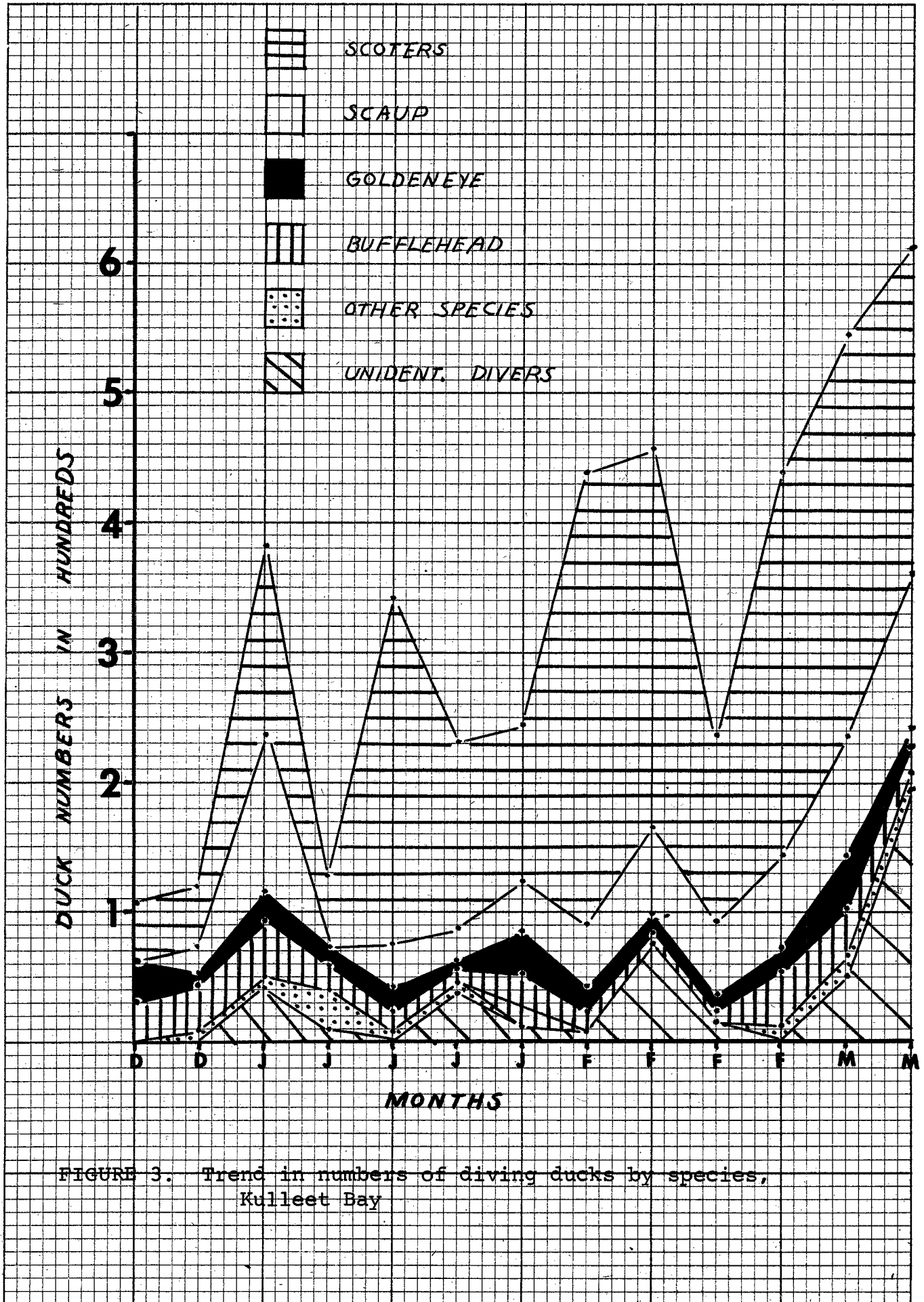
1). Kulleet Bay

Total birds counted at Kulleet Bay varied from 267 to 1,523, and averaged 733 (Table 1). These totals were much influenced by grebe numbers which varied from 55 to 815. Diving ducks and grebes combined made up about 90% of the total.

Species composition of the diving duck group, and the upward trend in numbers over the survey period are evident in Figure 3. Scoters were the dominant group, and the white-winged scoter the most abundant species, followed by scaup (both species), goldeneye (mostly common, but a few Barrows') and bufflehead. Other species were of minor occurrence. Dabbling ducks were virtually non-existent at Kulleet Bay, except for one visit (Jan. 29) when 73 mallards, 34 pintail, and 143 wigeon were present.

Table 1. Bird observations at Kulleet Bay

	D	D	J	J	J	J	J	F	F	F	F	M	M	$\bar{x}$
Dabblers	-	6	-	-	-	250	1	-	-	-	-	-	-	19
Divers	105	125	99	344	208	248	276	496	464	237	441	600	617	328
Unid. ducks	-	-	-	40	-	-	-	-	-	-	-	-	-	3
Loons	2	3	-	13	1	2	3	1	25	1	2	2	1	4
Grebes	142	55	285	471	207	177	171	186	68	122	815	763	770	325
Cormorants	3	5	3	4	-	-	4	-	7	-	1	-	-	2
Coots	-	-	-	5	10	16	-	-	-	-	-	-	-	2
Alcids	-	-	-	-	-	2	-	-	-	-	-	-	1	-
Hérons	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Gulls	12	44	10	5	8	54	12	7	6	8	9	35	64	21
Crows	60	25	10	24	15	18	40	18	4	20	6	17	70	25
Kingfishers	2	4	1	-	-	1	1	-	1	-	-	-	-	1
Eagles	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Misc. birds	-	-	21	2	-	2	-	2	2	-	2	2	-	3
TOTAL	326	267	430	908	449	770	509	710	577	388	1276	1419	1523	733



## 2). Inner Ladysmith Harbour

Bird numbers were not great in the Inner Harbour area, varying from 116 to 685 per count, and averaging only 470 (Table 2). Diving ducks were the predominant group, making up about 56% of the total. Dabbling ducks were regularly seen in small numbers (up to 245), and consisted almost entirely of wigeon. Scaup were the most abundant divers. No western grebes occurred in the Inner Harbour. No consistent trend in bird numbers was evident in this area during the survey period.

## 3). Outer Ladysmith Harbour

Total numbers here varied greatly according to the presence or absence of flocks of western grebes. Counts varied from 259 to 2,486, and averaged 1,518. Up to 2,121 grebes were present at one time, and they comprised 58% of all birds enumerated. Diving ducks made up about 23% of the total and averaged only 350 per count. Scoters were the dominant diving ducks. Dabblers are almost non-existent in

Table 2. Bird observations in Ladysmith Inner Harbour

	D	D	D	D	J	J	J	J	J	F	F	F	F	M	M	X
Dabblers	-	-	6	29	11	13	245	-	200	29	177	36	18	14	11	53
Divers	272	185	245	226	437	188	318	225	419	35	176	279	427	152	352	262
Unid. ducks	-	15	21	-	-	46	-	-	-	-	-	-	-	-	-	5
Loons	13	3	5	3	38	7	6	1	-	2	2	3	3	-	4	6
Grebes	45	8	13	13	10	1	19	11	15	4	1	4	11	14	14	12
Cormorants	15	7	30	19	23	4	4	-	4	3	3	1	-	2	-	8
Coots	-	-	39	37	28	15	41	33	24	22	4	3	1	-	-	17
Shorebirds	25	2	-	51	-	-	-	2	-	1	-	10	1	-	-	6
Herons	3	-	2	-	4	2	1	-	5	-	-	1	1	1	-	1
Gulls	88	42	152	92	123	11	48	18	47	12	19	18	188	140	32	69
Crows	74	67	15	7	7	6	37	5	39	6	13	89	36	22	20	30
Kingfishers	-	-	1	2	4	1	-	-	1	-	-	1	-	-	-	1
Eagles	-	-	-	-	-	1	-	-	-	-	-	2	1	-	-	-
Misc. raptors	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Misc. birds	1	-	-	-	-	-	-	-	2	2	-	-	-	2	-	-
TOTAL	536	329	523	479	685	295	720	295	756	116	395	447	687	347	433	470

Table 3. Bird observations in Ladysmith Outer Harbour

	D	D	D	D	J	J	J	J	J	F	F	F	F	M	M	$\bar{x}$
Dabblers	3	13	50	13	2	22	19	-	15	2	-	-	3	-	-	10
Divers	364	229	426	269	547	134	166	83	480	125	217	185	773	862	393	350
Unid. ducks	-	25	-	-	-	100	-	-	-	-	-	-	-	-	-	8
Loons	7	3	2	3	126	6	8	38	-	1	18	144	64	8	32	31
Grebes	502	935	651	779	601	1502	621	682	1703	5	759	2121	930	960	512	884
Cormorants	11	13	-	5	24	-	9	2	20	-	19	19	23	28	-	12
Coots	-	-	33	-	-	-	-	-	-	-	-	-	-	-	-	2
Shorebirds	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	1
Alcids	-	-	-	-	24	-	8	1	-	-	-	19	-	-	-	4
Hérons	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Gulls	180	157	95	218	232	176	703	39	169	111	140	74	201	29	209	182
Crows	-	14	26	6	75	4	115	4	91	15	23	8	59	15	30	32
Kingfishers	-	2	1	1	1	1	-	-	-	-	1	1	-	-	-	1
Eagles	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Misc. birds	-	-	-	-	16	-	-	-	-	-	-	-	-	-	-	1
TOTAL	1067	1391	1284	1294	1649	1945	1650	849	2486	259	1177	2571	2050	1902	1176	1,518

this area: the few recorded being almost all wigeon.

While diving duck numbers varied considerably, a build up toward the end of the survey period is indicated (Table 3).

b). Chemainus Region

Total weekly counts in the Chemainus Region varied from 2,292 to 5,343 birds. Maximum numbers of various bird groups observed in the region during any one count are as follows: loons 66; grebes 1,266; cormorants 31; herons 64; dabbling ducks 1,736; diving ducks 1,570; gulls 1,752; murreletes 150; crows 463. Western grebe flocks were present intermittently and did not influence total counts as much as at Ladysmith, however, large numbers of gulls had a significant effect on total bird numbers at Chemainus (Figure 2). The most abundant gull was the glaucous-winged gull.

Trends in numbers during the survey period (Figure 2) suggest a gradual decline in the waterfowl component. This is largely due to dispersal of dabbling ducks which were much more numerous than in the Ladysmith region. The graph also suggests a build-up in gull numbers, and possibly western grebes, toward the end of survey period.



1). Chemainus Bay

Counts in Chemainus Bay and closely adjacent offshore waters varied considerably (238 to 2,074 birds) and averaged 786. The variability was mostly due to the intermittent occurrence of large flocks of gulls or western grebes. Diving ducks, gulls, and grebes made up 39, 31, and 21 per cent respectively of the birds counted over the survey period. Dabbling ducks were virtually non-existent in this small sub-region.

Mergansers, both common and red-breasted, were the most abundant species at Chemainus Bay - the former being generally more abundant. Up to 350 mergansers were present at one time. White-winged and surf scoters and scaup made up a high percentage of the remaining birds. A minor build up of red-necked grebes occurred within the bay toward the end of the survey period. Common murres and murrelets appeared in the vicinity after several overnight storms. Occasionally, 35 to 40 great blue herons roosted on booms in the bay, as did large numbers of gulls.

Table 4. Bird observations at Chemainus Bay

	D	D	J	J	J	J	J	F	F	F	F	M	M	$\bar{x}$
Dabblers	11	-	-	-	-	-	-	-	-	-	-	-	-	1
Divers	99	197	195	260	515	379	427	354	342	558	319	199	153	307
Loons	2	1	1	-	37	46	6	1	3	59	16	-	-	13
Grebes	99	178	42	36	15	17	667	33	55	954	29	22	26	167
Cormorants	7	4	7	-	13	11	10	9	18	20	16	19	-	10
Alcids	-	-	2	150	1	-	-	1	46	14	-	-	-	17
Hérons	-	36	-	2	-	3	-	12	37	-	-	-	-	7
Gulls	149	109	260	330	93	224	87	147	971	404	176	114	55	240
Crows	43	37	4	19	13	11	11	11	20	63	43	26	1	23
Kingfishers	-	-	-	1	-	-	-	1	1	2	-	1	3	1
Misc. raptors	-	-	-	-	1	-	-	-	-	-	-	-	-	-
TOTAL	410	562	511	798	688	691	1208	569	1493	2074	599	381	238	786

2). Chemainus River Estuary (Shoal Islands Mud Flats)

Total weekly counts in this sub-region varied from 1,258 to 4,247 and averaged 2,232. Large flocks of western grebes were encountered on only one occasion. Dabbling ducks, diving ducks, and gulls made up 23, 23, and 34 per cent respectively of the birds present. This is the only area in the Ladysmith-Chemainus region of any real significance to dabbling ducks. The outer part of the estuary is also used by many divers.

The glaucous-winged gull may have been the most important single species here, although gulls were usually lumped into one category. The most abundant dabbling duck was the pintail, and scoters were the most abundant divers. A downward trend in numbers of puddle ducks is evident in Figure 4. The relative order of dabbling abundance was pintail, wigeon, mallard, green-winged teal, shoveller. Maximum dabbling numbers seen were about 1,750 in early January.

Diving ducks also exhibited a downward trend in numbers during surveys in this sub-region. Reasons

Table 5. Birds observed at the Chemainus River Estuary

	D	D	J	J	J	J	J	F	F	F	F	M	M	$\bar{x}$
Dabblers	750	541	1733	532	483	135	69	584	460	418	319	200	430	512
Divers	580	1275	746	449	482	409	635	561	364	192	600	386	130	516
Unid. ducks	-	-	240	84	275	-	-	-	-	-	-	-	-	46
Loons	-	-	-	1	1	6	2	2	2	-	2	-	-	1
Grebes	9	-	-	-	6	19	-	72	36	6	6	1224	11	107
Cormorants	2	3	2	-	6	7	-	-	1	5	7	-	1	3
Shorebirds	156	3	-	1	5	252	320	651	429	1	-	-	-	140
Alcids	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Hérons	28	4	56	21	33	25	2	27	27	8	60	64	51	31
Gulls	297	70	847	117	814	1269	1652	159	1316	757	553	605	1301	751
Crows	81	29	409	48	4	22	259	6	30	6	20	127	75	86
Kingfishers	4	4	1	2	1	-	-	-	4	-	2	-	-	1
Eagles	1	2	13	3	7	-	19	12	3	3	-	1	1	5
Misc. raptors	1	-	-	-	1	-	-	-	2	-	-	-	-	-
Misc. birds	115	107	200	-	-	-	1	3	-	-	2	-	-	33
TOTAL	2026	2038	4247	1258	2118	2144	2959	2077	2574	1396	1571	2607	2000	2,232

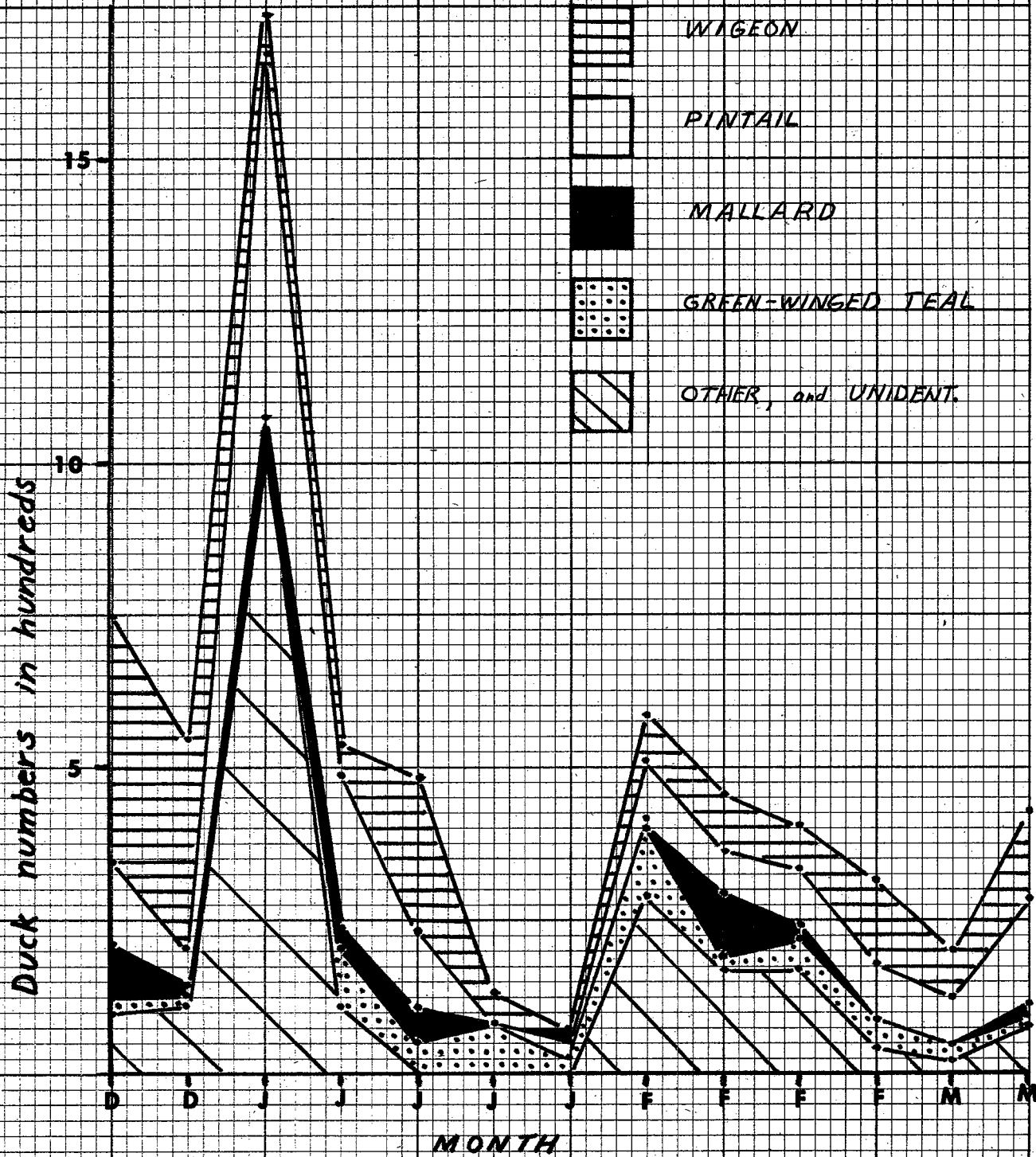


FIGURE 4. Trend in numbers of dabbling ducks by species, Chemainus River estuary

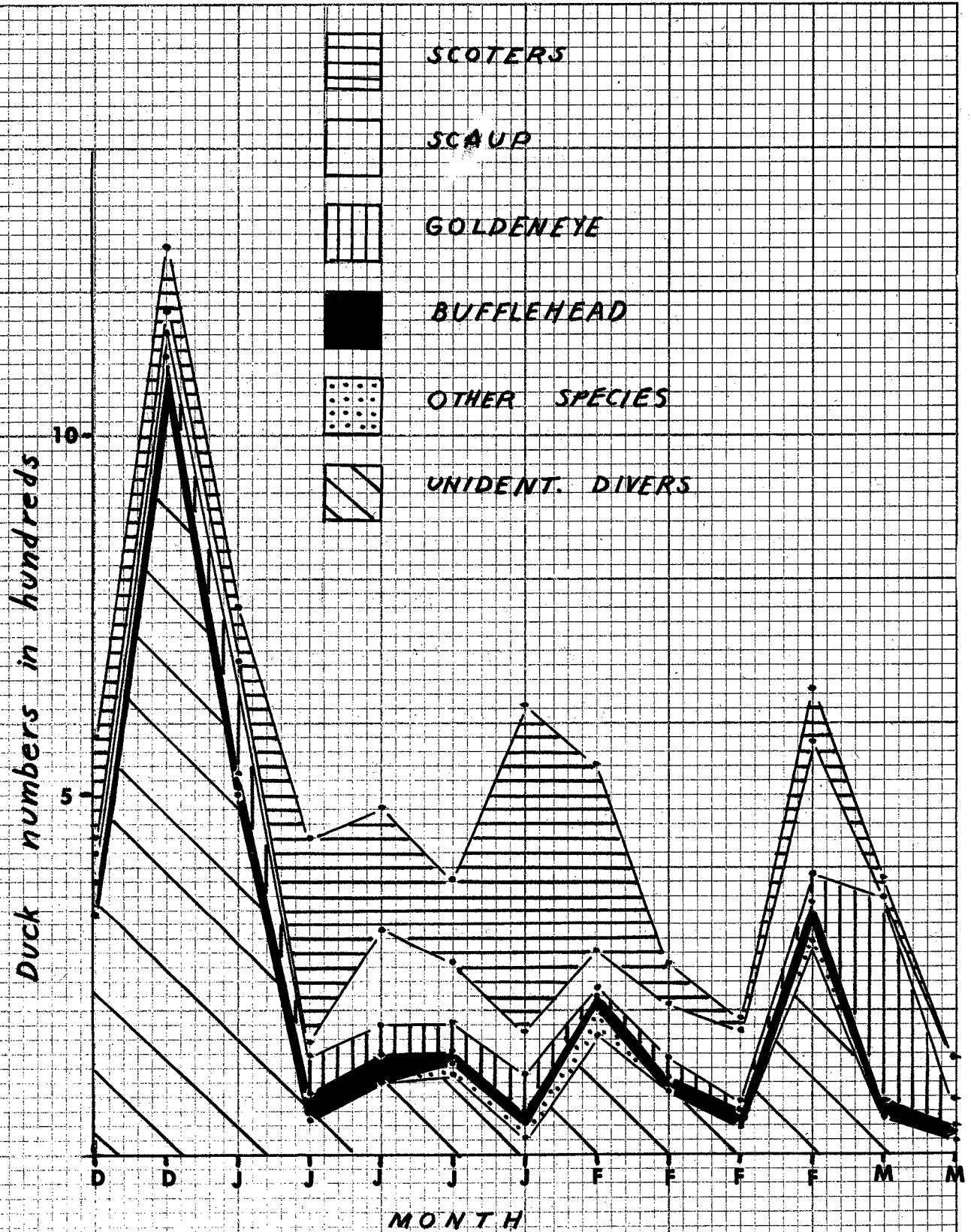


FIGURE 5. Trend in numbers of diving ducks by species, Chemainus River estuary and Shoal Islands

for this are not known, but it may be largely due to the effect of low tides on observability. Low tides during the daylight hours were more common toward the end of the survey period, and during such tides the divers moved into waters outside of the Shoal Islands and were much less visible. Scoters were the most abundant divers, followed by scaup, goldeneye (mostly common), and bufflehead. A noticeable build-up in goldeneyes occurred in late February and March. Hooded mergansers were regularly seen here, but in small numbers. Mergansers in general were uncommon, and alcids virtually non-existent.

Shorebird numbers were small and variable. It was expected that more would be seen on these extensive mud flats. Herons consistently used the area, up to 64 being tallied in one count. These are probably the same birds which occasionally roost in Chemainus Bay. This estuary was the only place in the Ladysmith and Chemainus regions where bald eagles were consistently seen - up to 19 being enumerated in a single count.

## 2. Habitat importance rating

Habitat importance ratings for dabbling and diving ducks are presented as overlays on Maps 1 and 2. They are relative ratings based on bird useage in the entire Ladysmith-Chemainus-Duncan region.

### a). Ladysmith Region

Habitat for dabbling ducks is very poor in the Ladysmith region (Map No. 1). The only places where dabblers were consistently seen were small salt marshes at the mouths of Bush Creek (Ivy Green Park) and Holland Creek. While small, these estuaries are important, attracting a variety of birds. Dabblers were intermittently seen at Kulleet (when flooded fields and lakes in the Cedar area were ice-covered), but this bay is poor dabbler habitat. Dabblers were not observed to use the mud flats at the head of Ladysmith Harbour, although they use similar habitats elsewhere. Perhaps, this is due to the lack of freshwater inflow which may in turn limit the establishment of vascular vegetation. Dabblers seem to prefer either vegetated estuaries with extensive, winding channels, or broad expanses of mud where they can alight and be free of disturbance and out of gunshot



Map No. 1 (following): Census observation points and wintering waterfowl habitat rating in the Ladysmith region.

# LEGEND



Observation points. For explanation of numbers, refer to Appendix I.



Boundary of area surveyed from observation point.

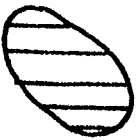
*Da 1, 2, etc.*

Habitat rating for dabbling ducks using scale of 1(best) to 4(poorest). Only habitats having some use were rated.

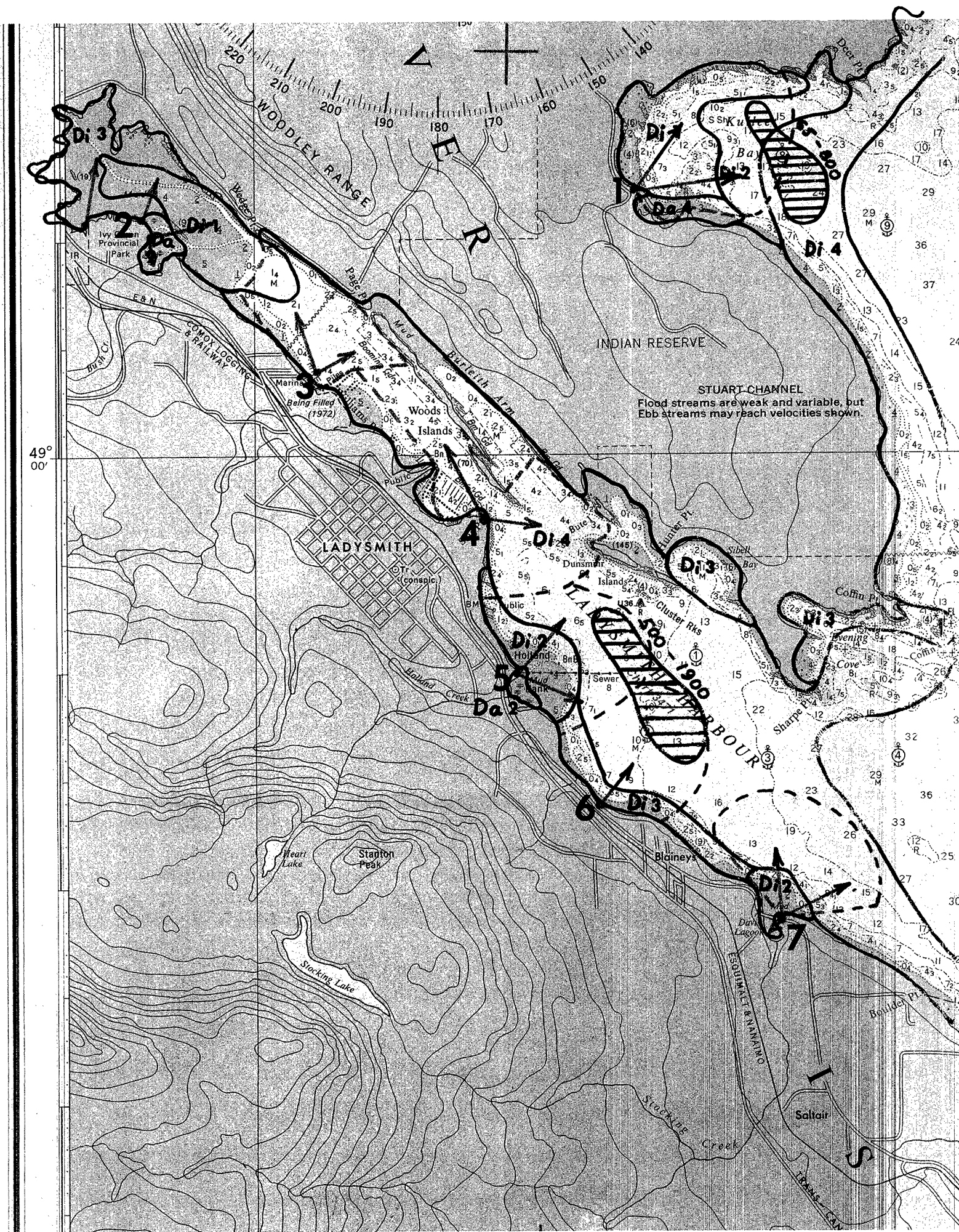
*Di 1, 2, etc.*

Habitat rating for diving ducks using scale of 1(best) to 4(poorest). Only habitats having some use were rated.

*50-100*



Location and size of western grebe flocks.



range. Inner Ladysmith Harbour falls short of meeting these criteria.

Diving duck distribution was influenced by water depth, shelter, and kind of bottom (mud, sand, rock). Diving ducks in the Ladysmith area appeared to prefer shallow water over muddy substrates, e.g. head of Inner Ladysmith Harbour; Holland Bank; although places where the shoreline, and presumably ocean bottom, is predominantly sand, gravel or rock were also heavily used, e.g. Kulleet Bay. Few ducks were ever seen along much of the northeast side of Ladysmith Harbour, where the shoreline drops away steeply. Bufflehead often were <sup>?</sup>observed toward the most sheltered, inshore locations, but were seen in a great variety of habitats from shallowly flooded fields, lakes and lagoons to well offshore. Scaup also preferred shallow water near shore. Golden-eye and scoters seemed to hold an intermediate position, while harlequin and oldsquaw were usually in deepest water.

The species which are primarily fish or plankton feeders (loons, grebes, cormorants, alcids) were not so restricted by water depth and thus were usually quite

widespread and often in deeper water than the bottom feeders. An exception were the mergansers, usually found in fairly shallow, sheltered water. The smaller grebes (eared, horned) also showed a much greater affinity for sheltered bays and shorelines, than the larger western grebes and loons. The alcids seemed to prefer open coastline rather than sheltered bays.

Species with scavenging food habits (gulls; crows) were also widespread, and no habitats of exceptional importance could be delineated, although mud flats, the intertidal zone generally, sewage outfalls, and stream estuaries (mostly at salmon spawning time) were where these birds usually fed. Gulls were most conspicuous when loafing on booms, pilings, abandoned warves etc., but these can scarcely be considered habitats of high importance. Despite the lengthy and fairly varied shoreline in the region, not enough shorebirds were observed to allow delineation of specific shorebird habitats.

b). Chemainus Region

In the Chemainus region, only the Chemainus River estuary was important for dabblers, however this area

is quite extensive, extending from near the base of Bare Point to the Crofton Pulp Mill. Bonsall Creek also empties into this estuary. The flocks of dabblers shifted location with the tide so as to remain in shallow water for feeding. At times they also rafted in flocks in shallow water over the mud flats, usually when the tide was relatively high. Habitats in the middle reaches of the estuary, between the inner and outer row of islands, were used most extensively, and thus received the highest rating. Mud flats further out were occasionally used during very low tides. These birds probably also utilize flooded fields and sloughs at Westholme, and possibly Richards Valley, south of Westholme.

Diving ducks used the Shoal Islands area at the Chemainus estuary quite extensively. They were usually located along the inshore edge of the outer islands (bufflehead, scaup, goldeneye), or outside of the islands (scoter). The Chemainus Bay area was also used by considerable numbers of divers, despite a great amount of industrial development and human activity, but did

Map No. 2 (following): Census observation  
points and wintering waterfowl habitat  
rating in the Chemainus region.

Legend - as for Map No. 1







not rate as highly as the Shoal Island area. Osborn Bay is quite deep and little used by ducks, except the south shoreline. Loons and grebes were the typical birds here.

Fuller Lake was seldom visited, but up to 45 birds were seen there, mostly coots and mergansers. A few small flooded fields in the Chemainus area are also temporarily used by small numbers of dabblers, but such use is much less than in the Cedar (Michaels Lake) or Duncan areas.

The Chemainus River - Bonsall Creek estuary and Shoal Island mud flats is undoubtedly the habitat unit of highest importance in the Ladysmith-Chemainus region. As well as having high duck use, it attracts considerable numbers of great blue herons, and some shorebirds, kingfishers, and bald eagles. While raptors other than eagles were few, two peregrines, two red-tailed hawks, one goshawk and one sharp-shinned hawk were noted.

#### DISCUSSION

##### 1. Bird numbers, trends, and species composition.

Comparisons with data previously collected by Canadian Wildlife Service personnel in 1973 and 1974 are difficult,



because the extent of areas surveyed is not necessarily comparable, even if observation points are similar. However, some rough comparisons have been attempted.

a). Ladysmith Region

Counts carried out in 1973 (Jan. 16 - Mar. 26) were confined to the Inner Harbour, and those in 1974 (Jan. 15 - Mar. 26) included Inner and Outer Harbours. The data permit the following comparisons:

	<u>Inner Harbour</u>		<u>Outer Harbour</u>	<u>Inner and Outer Harbour</u>	
	1973	1974	1975	1974	1975
birds per day	502	470	1,518	1,834	1,988
% ducks	58	68	24	43	35
% gulls	19	15	12	15	13
% crows	17	7	2	6	3
% other	6	10	62	36	49

Average number of birds seen per day was remarkably similar in different years, and species composition was quite similar in the Inner Harbour in 1973 and 1975. In the Outer Harbour the relative proportion of total birds made up by ducks in both 1974 and 1975 was lowered by the inclusion of large numbers of western grebes in the total. No geese or swans were seen in Ladysmith Harbour in 1973,

1974, or 1975. Average dabbler numbers per count were low in all years (Inner Harbour): 1973 - 10; 1974 - 25; 1975 - 53.

b). Chemainus Region

The only previous information available for the Chemainus region was collected at the Chemainus estuary in 1973. It appears that only a part of the total estuary was surveyed. This is not surprising, considering the poor access to the area. An average of only 284 birds was counted per day, compared with 2,232 in 1975. However in both years the glaucous-winged gull was the most abundant species. Dabbling ducks were much less numerous than divers in 1973, but roughly equal in 1975. This difference probably just reflects differences in areas sampled. A major divergence is the dominance of the dabbler group by mallards in 1973, and by wigeon and pintails in 1975. A general downward trend in duck numbers and upward trend in gull use was apparent over the survey period in both years.

c). Other comparisons

Due to lack of published comparative information, it is not possible to make extensive comparisons of waterfowl numbers, trends, or species composition in the Ladysmith and Chemainus areas with other areas. The three most abundant dabbling ducks in our surveys (pintail, American wigeon, mallard) also seem to be the most abundant in other coastal areas, but not necessarily in the same order. Maximum counts presented by Trethewey (1974) for the Duncan area indicate that wigeon, mallard and pintail, in that order, make up the bulk of the wintering dabbling population. Data presented by Tatum (1972) indicate that on southern Vancouver Island generally, American wigeon, mallard, pintail, and green-winged teal, in that order, are the abundant wintering dabblers. Christmas count data for the Vancouver area presented by Campbell et al 1974 indicate a ranking of American wigeon, pintail, mallard and green-winged teal. Hatler et al (1973) noted the same order of abundance in the Tofino area.

Diving ducks surveys by Wick and Jeffrey (1966) in northeastern Puget Sound resulted in the following species composition: Scoters 46%, Scaup 31%, Bufflehead 12%, and Goldeneye 9%. These proportions are relatively similar to ours for the Ladysmith region, but different than at Chemainus where we found large numbers of mergansers.

## 2. Habitat rating

Despite a flexible scale of one to seven, C.L.I. ratings for the entire coastal, estuarine and shoreline area of the Ladysmith-Chemainus region fell into one category - 3M. Perhaps this was necessary to be relative to other parts of Canada, but it suggests a uniformity which is not in fact the case. The general impression of a moderately important migratory or wintering area is correct, but there is considerable variation within the region.

River and stream estuaries are undoubtedly of high importance for dabblers, but the remainder of the shoreline is little used (except by brant, which were not encountered during our counts). The American wigeon seems to be

the most marine-adapted of the dabblers, and able to make use of small, isolated estuaries at creek mouths. Mallards in the general area prefer flooded fields, small lakes, and sloughs, but may temporarily appear in tidal areas in fairly large numbers when fresh-water areas freeze. A few also regularly use the larger estuaries. Pintails appeared to prefer expansive mud flats.

Shallow banks and shoals associated with estuaries were also heavily used by divers, but other shallow areas with no significant fresh-water inflow are important too.

### 3. Impact of development and human activity

#### a). Existing conditions

Developments having potential or actual impact on waterbird habitat vary greatly throughout the Ladysmith-Chemainus region. Assessing the possible adverse effects of such activities is very difficult, since "before" and "after" ecological information is usually not available for the same site. Thus the usual analysis involves comparison of ecologically similar areas with and without a particular development. This too is not easy, since

few areas are ecologically comparable, and virtually none in a small area like that being considered here. Perhaps when intensive studies of large numbers of B.C. estuaries have been completed, a comparative analysis will be more meaningful.

It should also be borne in mind that man-caused change in the coastal zone, as elsewhere, is not necessarily synonymous with ecological damage. Changes which obliterate habitat or otherwise depress total biological productivity will normally be most harmful to the entire ecological system, including waterbirds. In terms of waterfowl, such changes will reduce food production and availability during the critical winter period. However, many waterfowl species are remarkably adaptable to human activity which does not adversely affect their habitat. Some activities and developments appear to cause ecological change, e.g. different species composition or distributional patterns of waterbirds, but harmful effects caused by them are difficult to substantiate.

1. Log dumping, storage and handling.

These activities are carried out primarily in Inner Ladysmith Harbour and Chemainus Bay, but there is also some boom storage at the northwest edge of the Chemainus estuary, and at the Crofton Pulp Mill. Harmful ecological effects caused by log handling have been documented in several studies, and were recently reviewed in terms of waterfowl habitat by Trethewey (1974).

In Ladysmith Harbour, log storage at the head of the inlet over a long period of time does seem to have lowered the amount of use which one would expect to be made of the mud flats by dabbling ducks, probably through a combination of the effects of shading, scouring, and smothering on vegetation and bottom dwelling invertebrates. However, even under optimum conditions, this area could not be expected to support many dabblers. Elsewhere in Ladysmith harbour, log storage in deeper water appears to have had little effect on diving ducks, although a certain amount of water surface is physically removed from them, and in some areas sea bottom productivity may be reduced due to sinking debris. Diving ducks particularly goldeneye and mergansers were frequently observed in spaces between the booms.

Intensive log handling in Chemainus Bay over a period of many years has undoubtedly changed the character of the bay, but it was surprising how many water birds were counted in the Bay and near its mouth. In addition, there is a great deal of other development and activity in this little bay. Only a small creek enters the bay, and there is no significant estuarine or salt marsh habitat, thus it was probably never important to dabbling ducks. However, up to 550 waterbirds, including 350 mergansers, used the area at one time. On a unit-area basis, diving duck use here was considerably greater than many less developed bays.

Log storage areas actually seem to attract some birds due to the availability of roosting sites. Low-profile loafing sites were used by a wide range of species, including mergansers, goldeneye, great blue herons, cormorants, gulls and crows, and the latter three species also used higher structures such as pilings. Thirty-seven herons were counted on the booms in Chemainus Bay on one occasion, and herons were also frequently seen on booms at the Chemainus estuary and Crofton Pulp Mill. Chemainus Bay seems to provide very good merganser



wintering habitat - shelter, loafing areas, and based on the active feeding seen in the harbour, an ample supply of food. Bottom food production for other diving ducks however, is probably less than under undeveloped conditions. It should be noted too, that pilings, floats etc. which are in place for lengthy periods also provide an increased surface area of substrate for the attachment of many marine organisms. Erskine (1971:140) noted that "Areas where pilings and booms provide attachment for invertebrates are favoured by buffleheads in winter."

Log storage at the northwest edge of the Chemainus estuary is not extensive, and does not appear to have had any significant effect on productivity of the general area. This location is not very sheltered, and used mostly as emergency storage. The area affected by booms at the Crofton pulp mill is primarily diving duck habitat. Since these booms are adjacent to quite heavily used diver habitat around the Shoal Islands, they have probably had a locally significant adverse effect on diving ducks.

## 2. Filling

There seems to have been no significant amount of habitat

loss through filling in of intertidal or estuarine habitat in the study area. Small areas of foreshore now occupied by industry below the town of Ladysmith, in Chemainus Bay, and at the Crofton pulp mill have probably been filled in the past. Due to their limited extent, these developments have probably had a very minor impact on waterfowl habitat.

The most extensive and important estuary, Chemainus River-Shoal Islands, has been spared any such alteration to date.

### 3. Harbour development, shipping, marinas etc.

Deep sea ships presently anchor in Outer Ladysmith Harbour, and dock in Chemainus Bay and at the Crofton pulp mill. Facilities developed to date for deep sea shipping are limited, and probably have had no significant effect on waterbird habitat. Marinas for pleasure and fishing craft are present in Inner Ladysmith Harbour, Chemainus Bay, and Osborn Bay (Crofton). These are not extensive, and normally involve floats moored by pilings in fairly deep water. Bird activity seemed normal in such areas, except for scavenging species which are more abundant than normal.

Extensive harbour or marina development involving dredging, particularly in estuarine and mud-flat situations, would be much more detrimental.

#### 4. Pollution

Sewage outfalls at Ladysmith and Chemainus seem to have no adverse effect on waterbirds, other than causing abnormal concentrations of gulls and some diving ducks.

Effluents from the Crofton pulp mill are more difficult to evaluate. Mud flats at the southeast edge of the Chemainus estuary seemed to receive less duck use than other parts of the estuary, and the paucity of shorebirds there was particularly striking. This could be a result of inshore movement and collection of chemical effluents disposed of in the sea, or fallout of airborne particulate matter.

#### 5. Agriculture

Agricultural use of the Chemainus estuary has been minor to date. Small areas near the terminus of Swallowfield Road were formerly diked, but the dikes are now in a state of disrepair. A few cows graze locally in the salt marsh communities as tides permit, but the extent of this grazing

does not appear to have affected plant cover. More detailed study of this situation may be in order.

b). Future developments

Future developments can, of course, follow a variety of courses. Those of greatest significance for waterfowl are ones which usurp or degrade prime habitats such as estuaries, salt marshes and mud-flats. It does not appear that log storage leases beyond those already present will be permitted. Gradual conversion to dry-land sorting should, in fact, reduce the impact of this activity in time.

Due to the marine recreational potential of the Gulf of Georgia, increased demands for marinas and small boat facilities can be expected. These do not appear to be harmful if restricted to waters of sufficient depth that dredging is not required. Construction of breakwaters in more open areas may be preferable to use of small, shallow bays for marina development.

Opportunities for deep sea port development seem limited. Such development at Ladysmith would have least impact on waterbirds if restricted to the northeast side of the Outer

Harbour from Dunsmuir Islands to Sharpe Point. Expansion in Chemainus Bay, if space permits, would probably have little additional effect on birds in that area, and would be much preferable to any development of the estuary area. Development of expanded dock facilities at the village of Crofton has recently begun, involving dredging and some filling for parking. Fortuitously, little bird use of this area was noted, thus any negative impact will likely be limited in extent.

There are no known plans for agricultural expansion at the Chemainus estuary. Some reclamation of agricultural land here would undoubtedly be possible, but would have considerable impact on dabbling duck habitat.

The proposed reservoir on the Chemainus River could affect the ecology of the estuary, particularly if significant volumes of water are diverted or the seasonal flow regime changed. River inflow maintains the salinity gradient and provides nutrients, and, as noted by Copeland (1966), "If river flow is restricted by upstream reservoirs, the salinity

level of the receiving estuary may increase to the detriment of estuarine biological communities." This could in turn affect waterfowl food production.

Residential development of the foreshore can also be expected to increase, but should have little effect on diving ducks or their habitat. Such development adjacent to important estuaries such as the Chemainus River however, could have insidious long term effects through gradual encroachment upon and modification of the estuary - foreshore fringe. Such uplands are better kept in agricultural, green belt, or park-land status. Present residential development adjacent to the Chemainus estuary is scattered, on large acreages, and has had no impact on waterbird habitat, but this situation could change.

#### RECOMMENDATIONS

1. High priority dabbling duck habitats should be reserved from any development or agricultural use and protected from outside modifying influences. This includes small estuaries at the mouths of Bush, Holland and Stocking Lake Creeks, and the large estuary at the mouths of Chemainus River and Bonsall Creek. It is felt that observed use by

the birds themselves is the best criteria upon which to base habitat protection, a view also held by Hartman (1963).

2. The present government policy of phasing out marine sorting and storage of logs should give high priority to mud flats and estuaries of actual or potential importance to waterfowl. This includes the mud flats at the head of Ladysmith Harbour, and at the Chemainus estuary.
3. Port and marina development should be restricted to waters of low importance for waterfowl, and to areas of sufficient depth that bottom dredging is not required.
4. Residential development of the foreshore should be restricted in areas immediately adjacent to productive estuaries which support large numbers of wintering waterfowl.
5. Consideration should be given to acquisition of an upland tract of land adjacent to the Chemainus estuary in order to protect and develop a wildlife management and interpretive area, including a large part of the estuary itself. This is the least modified of the "larger" estuaries along the east coast of Vancouver Island.

Its combination of low-lying adjacent foreshore, salt marsh and mud flat habitats, and offshore islands used by roosting herons and eagles make it a rather unique estuary. While this estuary is not associated with a bay suitable for harbour development such as at the Nanaimo, Cowichan, or Courtney Rivers, it could be dredged if the financial incentive was great enough. Such development would completely ruin this estuary.

6. Additional research should include studies of invertebrate populations in the Chemainus estuary and possible effects of pulp mill pollution on them, and evaluation of possible effects of reservoir development on salinity and productivity of the estuary.



## LITERATURE CITED

- Campbell, R.W. et. al. 1974. Vancouver birds in 1972. Vancouver Natural History Soc. 96 pp.
- Copeland, B.J. 1966. Effects of decreased river flow on estuarine ecology. Jour Water Pollution Control Fed. 38: 1831-1839.
- Erskine, A.J. 1971. Buffleheads. Can. Wildl. Serv. Monogr. Ser., No. 4 240 pp.
- Hartman, F.E. 1963. Estuarine wintering habitat for black ducks. Jour. Wildl. Mgmt. 27(3): 339-347.
- Hatler, D.F. et. al. 1973. Birds of Pacific Rim National Park, B.C. Can. Wildl. Serv., Unpublished Report, 383 pp.
- Tatum, J.B. (Ed.). 1972. Annual bird report for southern Vancouver Island. Victoria Nat. Hist. Soc. 80 pp.
- Trethewey, D.E.C. 1974. An assessment of the impacts on wildlife and wildlife-related recreation of four alternative development proposals for the Cowichan River estuary and flood plains. Can. Wildl. Serv., Manuscript Report, 63 pp.
- Wick, W.Q. and R.G. Jeffrey 1966. Population estimates and hunter harvest of diving ducks in north-eastern Puget Sound, Washington. The Murrelet 47(2): 23-32.

APPENDIX I: Observation points and sub-regions used in enumeration  
of water birds

Region	Sub-region	Observation point	Remarks
Ladysmith	Kulleet Bay	1. Indian Reserve	Access via. Yellow Point, Doole, and Kulleet Roads. Bay viewed from beach.
		2. Ivy Green Park	Observations made from old causeway at Stagecoach Motel on west boundary of the park, and from parking lot area of the park itself.
		3. Ivy Green Marina	Count made from outer float of the marina.
		4. Transfer Beach Park	Observations made from Slag Pt., a fairly high vantage point. Only birds to the northwest fall into the Inner Harbour.
	Outer Harbour	4. Transfer Beach Park	Birds seen to the southwest were included in the Outer Harbour totals.
		5. Sewage plant	Access via entrance to Transfer Beach Park. High viewpoint adjacent to mouth of Holland Creek.
		6. Sandy Beach Motel	Access via Chemainus Rd. (Old Island Highway). Observations made from seawall at motel.
Chemainus	Chemainus Bay	7. Davis Lagoon	Observations made in the lagoon and seaward from shoulder of Chemainus Rd. View restricted to northwest.
		1. Hospital Point	View of Bird Rocks area and Chemainus Harbour from Elliot St. and/or Bird Rd. at boat ramp, and from Hospital Parking lot.
		2. Bare Point	Access from road to Georgia Generating Station.

Region	Sub-region	Observation point	Remarks
	Chemainus R. Estuary (Shoal Isl. mud flats)	3. Murray Cocks Residence	Access from un-named road which runs southeast from road to Georgia Generating Stn. View of northwest edge of mud flats.
		4. N.W. end of "island" at Swallowfield Farm	Access via Swallowfield Rd. Walk from farm buildings east to causeway, on to island, and along island to n.w. end.
		5. Swallowfield Farm	View from low ridge on farm side of causeway to island.
		6. Pulp Mill Park	Access via security gate at Crofton Pulp Mill. View of s.e. end of mud flats, and area seaward from the point.

The following miscellaneous observation points did not fall into a logical sub-region, and in addition, numbers of birds seen were usually quite small.

Ladysmith		Hillside Rd.	Access from Chemainus Rd. Lateral view restricted by trees. Open coastline.
Chemainus		Bare Pt. east	View of region between Bare Pt. and northwest edge of Chemainus estuary, from vicinity of Georgia Generating Stn
		Osborn Bay	View from Saltspring Island Ferry Dock at village of Crofton.

[illegible]

## APPENDIX II (con't)

## LOCATION

## DATE

## AREA

	D	D	D	D	J	J	J	J	J	F	F	F	F	M	M
Diving duck species	100	138	13	101	551	16	229	60	369	56	116	110	147	79	395
redhead															
ring-pecked duck															29
canvasback															1
scaup species			76	95	120	124	186	92	274	67	168	225	665	785	290
greater scaup							23								
lesser scaup	4	6													
goldeneye species			57		56	27	34	30	72	18	16		1		
common goldeneye	238	141	97	75	137	28	51	33	41	33	38	47	69	101	57
Barrow's goldeneye			24	38	18	7	4	21	44	28	42	26	94	13	73
bufflehead	117	14	80	125	95	38	49	86	93	26	35	38	91	87	136
oldsquaw				2				2		4	7		55	20	2
harlequin duck	2	8	4	18	2	12	12	10	8	8	2	11	11		2
scoter species	120	133	84		158	49	304	160	101	48	68	101	101	218	21
white-winged scoter	155	50	168	112	103	70	171	52	126	378	367	253	343	299	332
surf scoter	41	20	74	90	67	52	29	15	37	25	55	32	50	28	68
black scoter	1		4	5		1			2		6		18	3	6
ruddy duck											3	9	10		
hooded merganser				3			5	8	2	10			4	2	1
common merganser	13	4	21	18	5	33	22	3	1				1		
red-breasted merg.	14	9		2	15	9	5	4	14	6	3	5	47	61	4
unidentified duck		43	21				146	40							
Turkey vulture															
osshawk															
Sharpshinned hawk															
Cooper's hawk															
Red-tailed hawk															
Bald eagle		1			1	2							3	3	
Marsh hawk															
Peregrine falcon															
California quail															
Virginia rail															
American coot			72	37	28	15	46	43	40	22	1	3	1		
Black oystercatcher															
Killdeer				1		3	2	2		1	7	6	3		
Black-bellied plover															

Mergansers.

25 1

5

## APPENDIX II (con't)

[illegible]

## APPENDIX II (con't)

[illegible]

APPENDIX III: Weekly bird observations in the Chemainus region

[illegible]



## APPENDIX III (con't)

LOCATION	Chukotka Region													
DATE														
AREA														
	D	D	J	J	J	J	J	F	F	F	F	M	M	
Diving duck species	383	1,161	564	58	218	238	168	187	177	109	360	50	66	
redhead														
ring-pecked duck														
canvasback								21						
scaup species	31	46	12	49	146	120	74	63	97	149	247	47	82	
greater scaup														
lesser scaup														
goldeneye species	39	-	30	51	27	15	41	17	15	3	17	83	26	
common goldeneye	22	54	63	3	25	33	32	15	22	14	25	117	24	
Barrow's goldeneye	4	3	2	17	12	13	30	13	4	20	7	10	10	
bufflehead	35	63	33	36	49	12	16	14	19	26	31	11	24	
oldsquaw										1		3		
harlequin duck	2					1		5		1				
scoter species	146	30	199	278	135		110	235	65	28	40	18	12	
white-winged scoter	-	20	2	6	14	4	23	32	11	13	25	19	28	
surf scoter	3	72	19	12	22		48	42	43	18	38	99	12	
black scoter					2	6	5		2	6	6		3	
ruddy duck	1													
hooded merganser	4	2	5	8	10	17	2	4		7	5	1	3	
common merganser	40		40	18	86	124	-	193	235	197	64	47	45	
red-breasted merg.	14	109	86	11	24	14	62	100	36	170	130	121	6	
unidentified duck			540	82	215									
Turkey vulture														
osprey	1													
Sharpshinned hawk					1									
Cooper's hawk									2					
Red-tailed hawk														
Bald eagle	1	2	13	3	7		19	12	4	3		1		
Marsh hawk														
Peregrine falcon					1			1						
California quail	5													
Virginia rail														
American coot	15													
Black oystercatcher														
Killdeer	6	3		1	5	2		1	9	1				
Black-bellied plover														
Mergansers				34	178	4				9	17			

[illegible]

## APPENDIX III (con't)

[illegible]

APPENDIX IV: Species composition of identified diving ducks in  
the Ladysmith and Chemainus regions\*

Species	Percent of cumulative winter observations		
	LADYSMITH	CHEMAINUS	COMBINED
Ring-necked duck	0.2	-	0.2
Canvasback	-	0.3	0.1
Greater scaup	0.2	-	0.1
Lesser scaup	0.1	-	0.1
Unident. scaup	26.0	16.8	22.6
Common goldeneye	9.7	6.5	8.6
Barrows goldeneye	3.5	2.1	3.0
Unident. goldeneye	2.6	5.3	3.6
Bufflehead	8.5	5.3	7.4
Oldsquaw	0.8	-	0.5
Marlequin	0.9	0.1	0.6
White-winged scoter	24.4	3.0	16.7
Surf scoter	5.6	7.1	6.1
Black scoter	0.4	0.4	0.4
Unident. scoter	13.7	18.7	15.5
Ruddy duck	0.2	-	0.1
Hooded merganser	0.3	1.0	0.5
Common merganser	1.0	17.1	6.8
Red-breasted merganser	1.6	11.1	5.1
Unident. merganser	0.3	5.1	2.0

\* Based on 19,127 observations

APPENDIX V: Species composition of identified dabbling ducks in the  
Ladysmith and Chemainus regions\*

Species	Percent of cumulative winter observations		
	LADYSMITH	CHEMAINUS	COMBINED
Mallard	12.4	11.0	11.2
Gadwall	-	0.1	0.1
Pintail	1.0	44.2	37.8
American wigeon	65.0	31.6	36.6
European wigeon	-	0.3	0.2
Common teal	-	3.2	2.7
Green-winged teal	21.6	8.4	10.3
Northern Shoveler	-	1.4	1.2

\* based on 5,178 observations.