

Field Report  
Fall Migration of Waterbirds in  
the Columbia Valley, 1979

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## Preface

The Columbia Valley Environmental Project, part of which is described in this report, was a Job Corps Project designed and sponsored by the Migratory Birds Populations Section of the Canadian Wildlife Service and the Job Creation Branch of the Department of Employment and Immigration.

## Introduction

Although the Columbia Valley is one of the major migration corridors for birds in British Columbia it has received little attention from waterfowl biologists. The only previous inventory to cover the whole fall migration period was a set of aerial surveys flown in 1976 and 1977 (G. Kaiser et al 1978, M.S.). While aerial surveys are useful in locating concentrations of birds they are limited in their success in estimating numbers and identifying species. The purpose of the Columbia Valley Environmental Project was to inventory migrant waterbirds in the Columbia Valley Study Area (fig. 1) and to compare the bird's use of various parts of the valley. Separate reports detail the results of the spring surveys (Kaiser et al 1980, M.S.) and a study of raptor nesting (Pringle 1979, M.S.).

Much of the waterfowl habitat currently used is threatened by recreational development and a proposal to divert part of the flow of the Kootenay River through the marshes of the upper Columbia River. This report summarizes observations made in the fall of 1979 and identifies the areas of heaviest waterfowl use.

## Methods

The project involved the survey of accessible marshes and lakes between Canal Flats and Golden (fig. 1). In this area the Rocky Mountain Trench forms a flat bottomed valley which holds two large shallow lakes and roughly 90 km<sup>2</sup> of marshlands. The Columbia River meanders northward through a complex of oxbows, old channels and lagoons. It is fed by several large glacial creeks and the occasional hot spring. Dense stands of cottonwoods are often found on the levees around the large shallow lagoons. Beavers and muskrat thrive in the area and provide alterations to the habitat that are important to many species of waterfowl.

The area is so large and access so restricted by terrain and vegetation that sample areas (fig. 2) were selected on the basis of the aerial surveys flown in 1977 (G. Kaiser 1977, M.S.). The sections from Brisco to Spillimacheen and between Wilmer and Radium were omitted because of the limited amount of time and manpower available and because there was no perceived difference between them and the habitat that was more accessible to the north and south. Mud Lake and Tatley Slough lack good vantage points and even though they are thought to be good waterfowl habitat they were omitted so that less time-consuming areas could be included. The south central portion of Columbia Lake was also omitted because the great distances from the vantage points to the far side of the lake made observation and identification unreliable.

The study area was divided into units based on vantage points and available manpower. We made an attempt to keep the observations standardized by using the same observers for each survey and using similar equipment (binoculars and spotting scopes). All members of the survey team had participated in earlier breeding waterfowl surveys and banding operations in the same area and had no

difficulty in locating and identifying the subtle geographic features that defined the boundaries of the survey units.

In order to cover all of the selected survey routes it was necessary that some receive less than the planned twice-weekly count. The northernmost route, from Spillimacheen to Golden was surveyed only once per week.

Birds were recorded as "feeding" and "resting" since we felt that some areas served as roosts and perhaps were not productive or desirable as feeding areas. We specified the feeding areas because the proposed diversion of cold water from the Kootenay River may decrease plant production and thus reduce the value of the habitat to the birds.

In the surveys in the Columbia Valley we have found ourselves working at great distances from the birds or else flushing birds that quickly disappeared behind dense vegetation. As a result there were large numbers of unidentified birds that were lumped into the general classes of dabblers, divers or unidentified ducks.

In addition to expected problems of distance and cover, autumn surveys faced the problems of fog and glare. The spring surveys involved small groups of birds on the smaller waterbodies; in the fall, we were counting large groups across open lakes where glare was a real problem. While we attempted to use the vantage points with the sun at our backs, morning fogs frequently prevented this. Fog had seriously impaired the aerial surveys (G. Kaiser, pers. comm.) but we were able to wait until it lifted or we changed the sequence of the survey routes.

The size of the study area was estimated by a dot grid and extrapolation factors were determined for each survey unit. This gave us a coarse but practical method of comparing density of use and establishing the relative values of the different units.



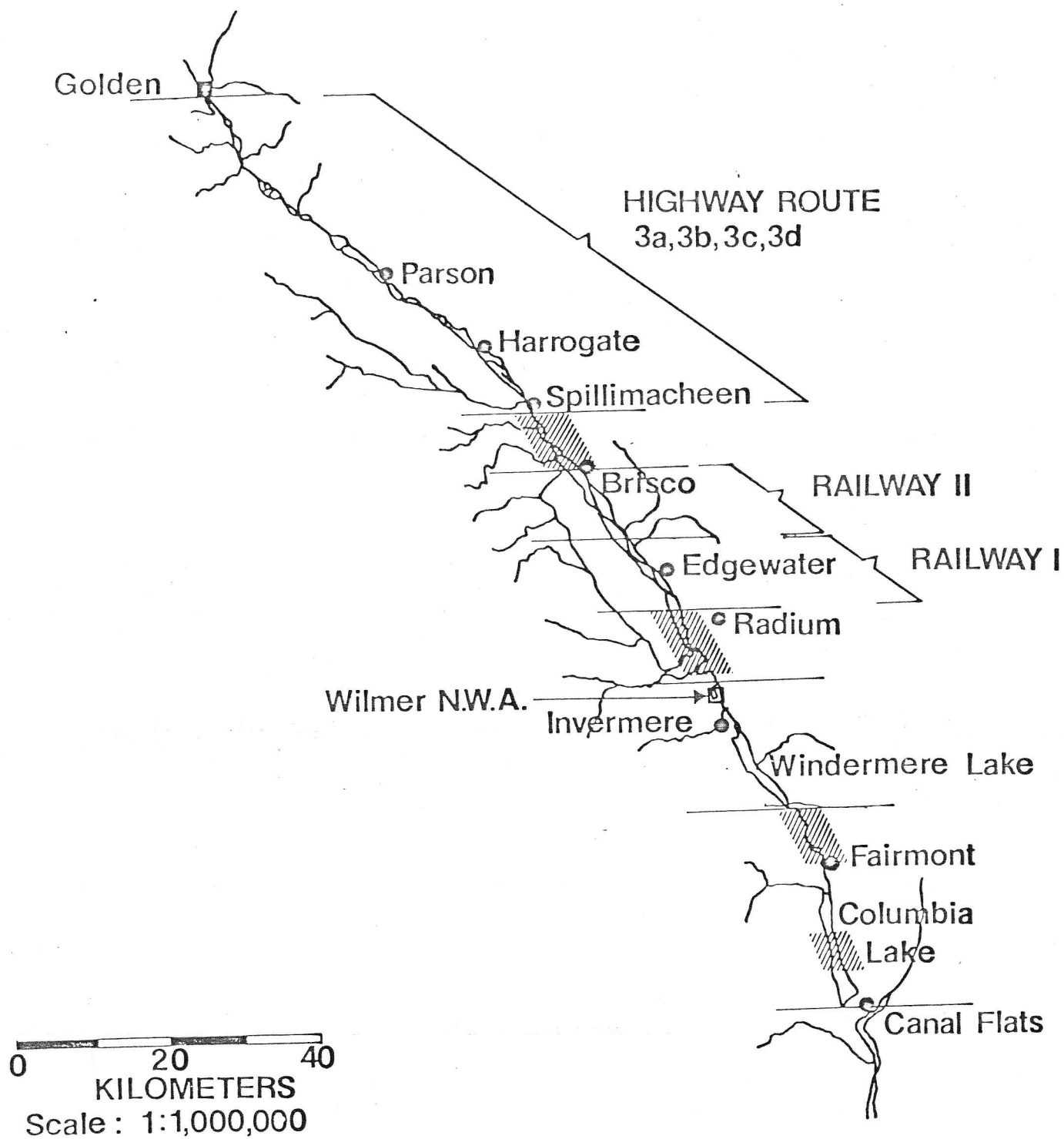


Figure 1. Survey Sections referred to in the text. The hatched areas were not surveyed.

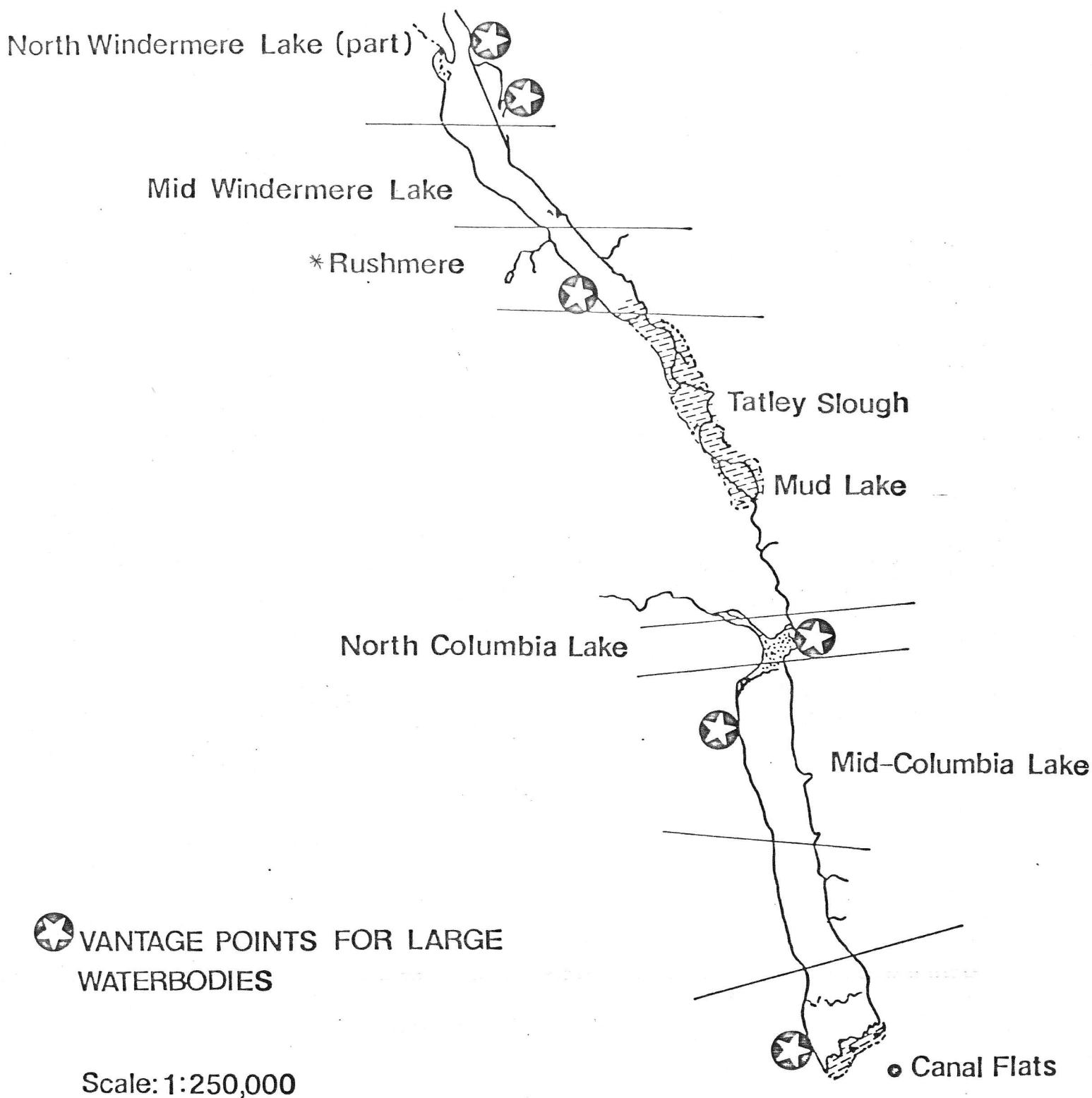


Figure 2a. Survey units from Canal Flats to Invermere.

★ VANTAGE POINTS FOR LARGE WATERBODIES

Scale: 1:250,000

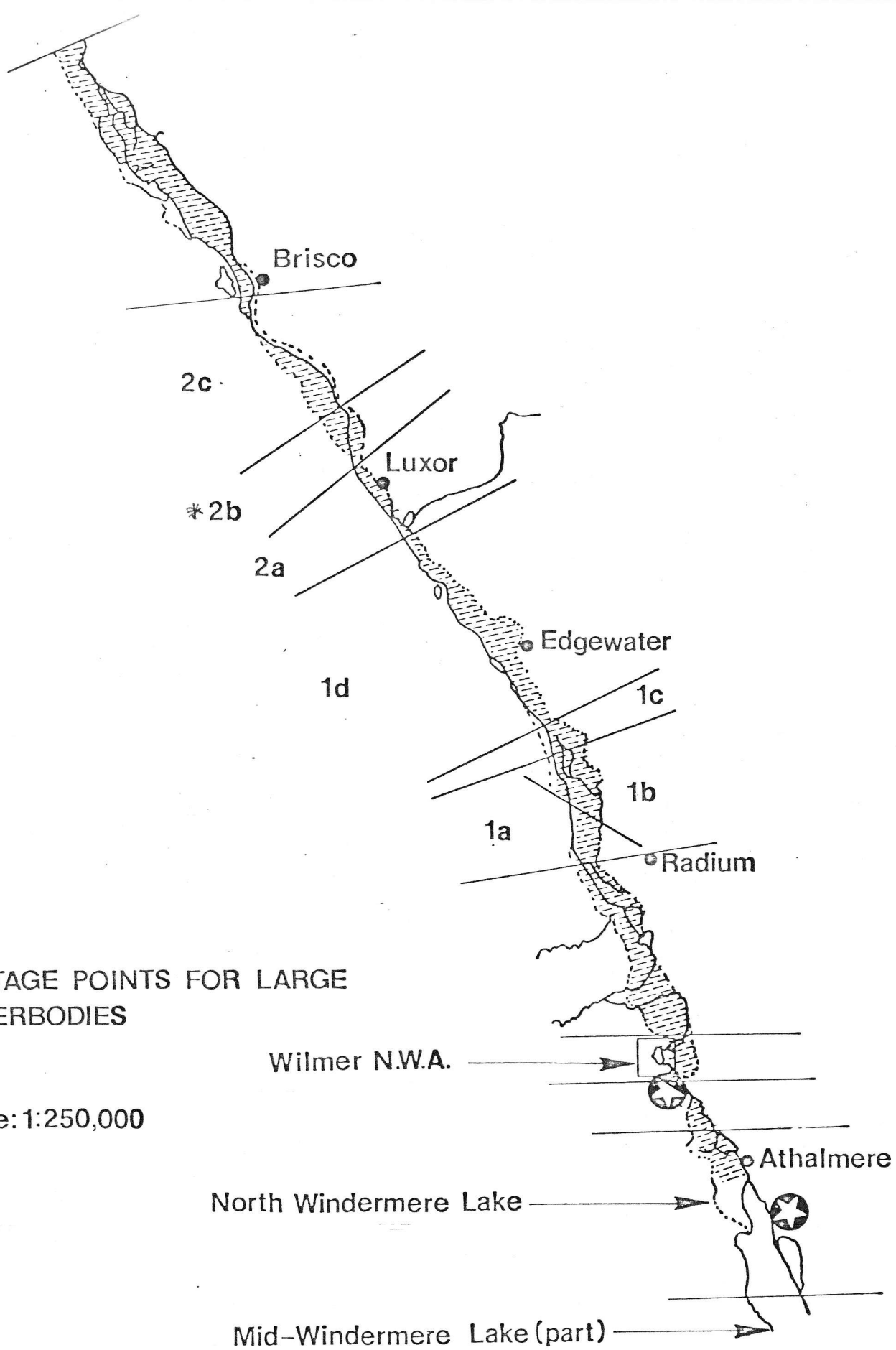


Figure 2b. Survey units from Windermere Lake to Brisco.

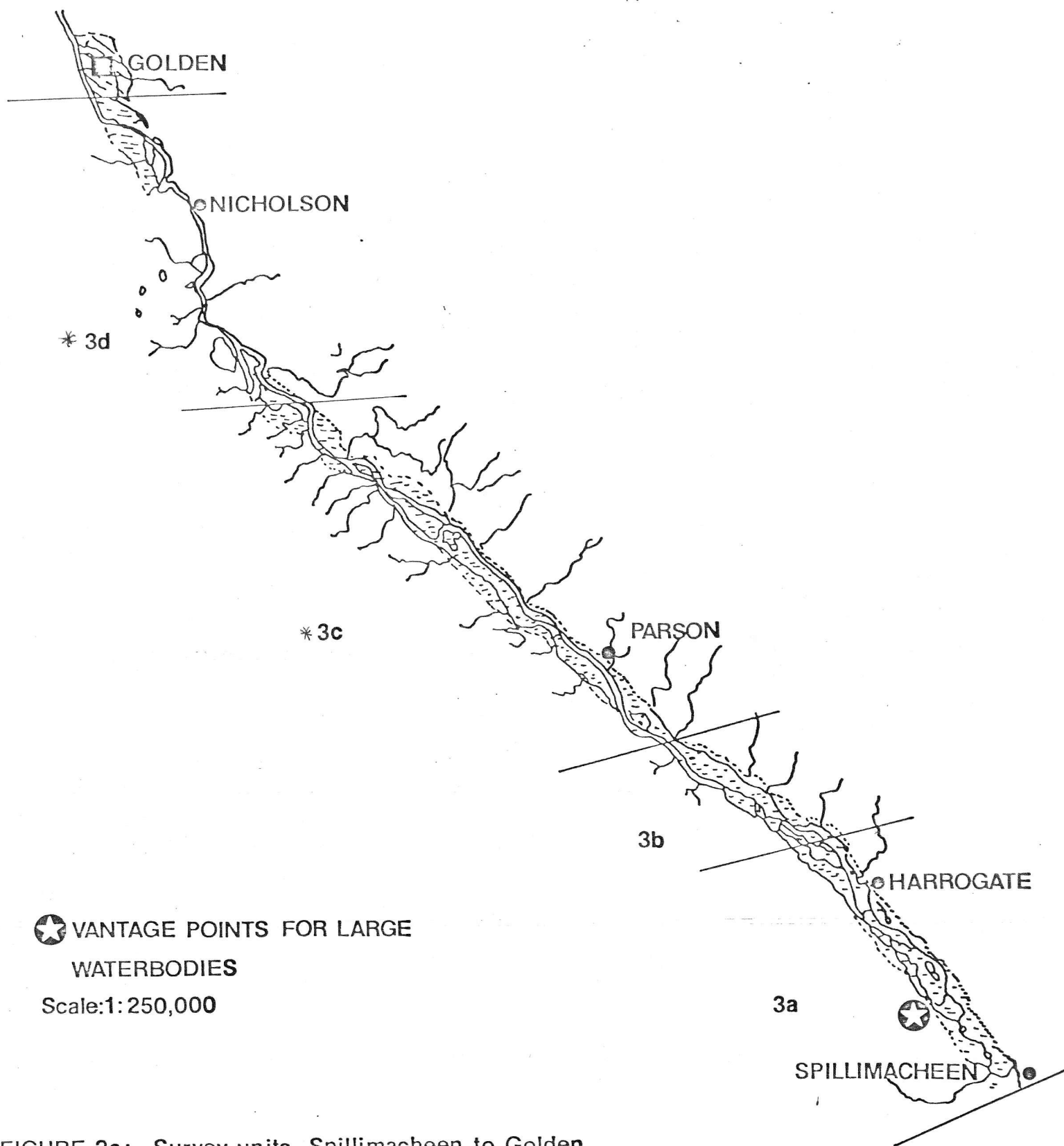


FIGURE 2c: Survey units, Spillimacheen to Golden.

## Results

### Observation of Dabbling Ducks

The total number of dabbling ducks counted remained about 6000 until a slight increase at the end of October. About the middle of October, there was a gradual change in the species composition from one that was predominantly Mallards (Anas platyrhynchos) to one of nearly equal numbers of Mallards and American Wigeon (A. americana). Green-winged Teal (A. crecca) were the only other dabbling duck that occurred in large numbers. Pintail (A. acuta) and Wood Duck (Aix sponsa) made only incidental appearances (Appendix 1).

Freeze-up occurred in the middle of November. In the preceding weeks the number of dabblers declined markedly but did not entirely disappear. Some flocks of Mallards were seen as long as any open water remained. Wigeon and Green-winged Teal responded to freeze-up more dramatically and only a few incidental sightings were made after November 16 (Figure 1 and Appendix 2).

The outlet of Windermere Lake at Athalmer remained ice-free longer than most other areas. It had not drawn large numbers of ducks previously but it held 95 Mallard on December 11 and 43 on December 18.

## Results

### Observation of Diving Ducks

The study of migration of diving ducks in the Columbia Valley is complicated by the local production of some species and the seasonal movement of others. Individual surveys (Appendix 1) were made difficult by the tendency of these birds to raft-up in large flocks. Not only are large rafts difficult to count but frequently numbers of birds were underwater. At Rushmere and Canal Flats the water favoured by these species was on the side furthest from the vantage points.

Redhead (Aythya americana) made the most spectacular migration of the diving ducks (fig. 3). At least 1700 birds appeared on Windermere Lake in October and many stayed for three weeks or so. They were a difficult species to count both because so many of them fed during the day and they tended to concentrate along the eastern edge of the lake. At various times the Redheads mixed with the Coots (Fulica americana) and Wigeon that also use the area.

Other species of diving ducks were much less numerous. Sixty-two was the largest number of Canvasback (Aythya valisineria) seen at one time. Goldeneye (Bucephala clangula and B. islandica) and Bufflehead, (B. albeola) which breed in the valley reached 183 and 261 respectively. Scaup and Ring-necked duck (Aythya marila and A. collaris) which proved too difficult to separate never exceeded 198 birds in total (fig. 4).

While Scaup and Ring-necked never exceeded the high count of cycle I (18-21 September), they came close in cycle XI (23-26 October) when 184 were seen. These species may have made up a large portion of the unidentified diving ducks because the females are so nondescript at a distance. If the unidentified diving ducks are included with the scaup the cycle XI peak becomes the result of a gradual build-up during the whole survey period and was followed by a gradual decline that extended beyond the end of the survey on 13 November (Appendix I).

Goldeneye followed a different pattern. A peak of 183 were counted in cycle II (20-24 September) after which a hundred or so were seen until freeze-up began in November. Only small numbers of Bufflehead (27 to 85) were seen until 261 were counted in cycle XII (25-29 October). These left quickly in the ensuing weeks and were gone by freeze-up (fig. 4).

Mergansers reached surprisingly large numbers. Through most of the year small flocks and family groups can be found in the lagoons and on river but a wave of Hooded Mergansers (Lophodytes cucullatus) arrived in cycle IX (16-19 October)

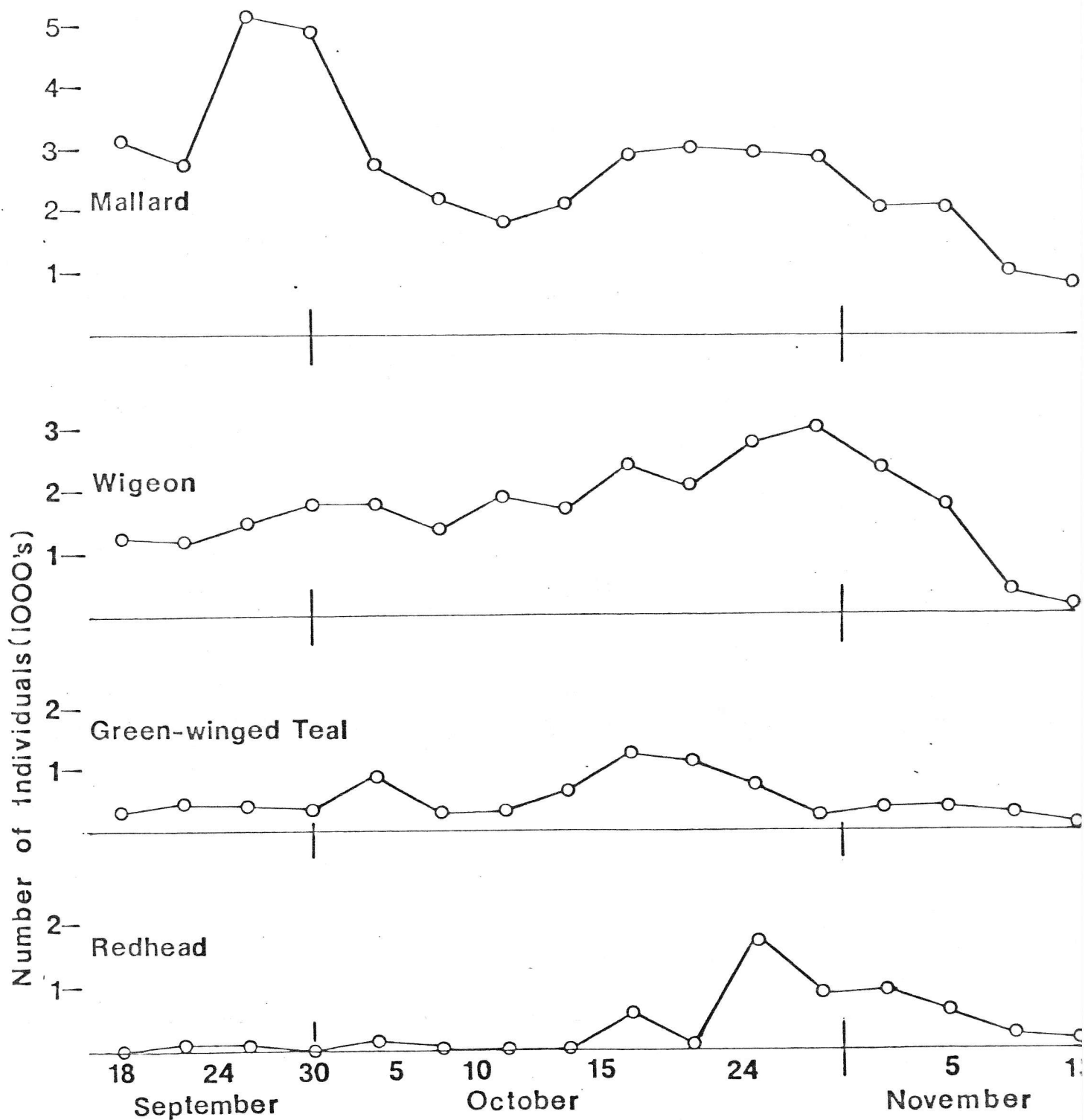


Figure 3. Estimated number of ducks using the Columbia Valley Study Area during fall migration (1979) (species exceeding 1000 individuals).

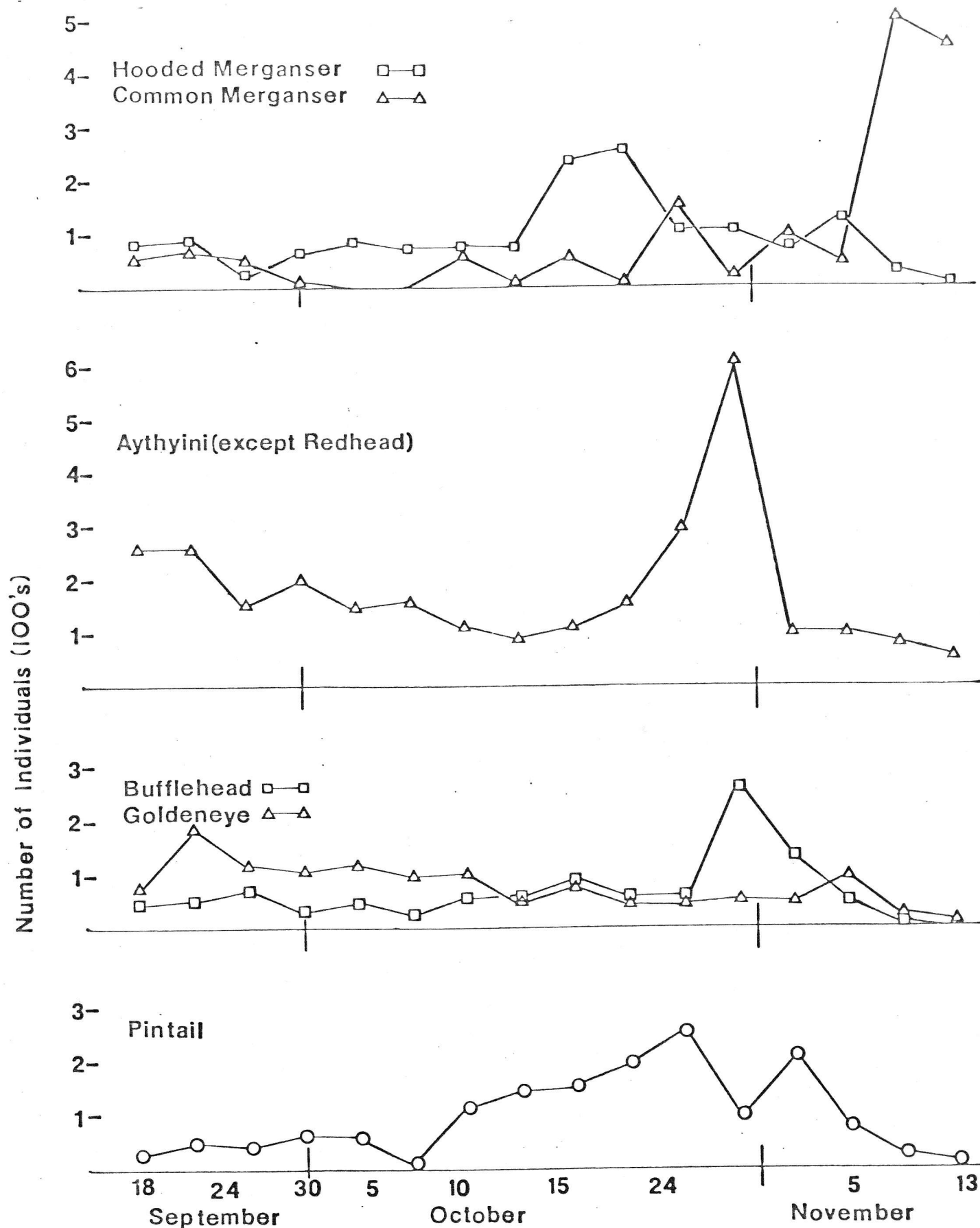


Figure 4. Estimated number of ducks using the Columbia Valley Study Area during fall migration (1979) (species not exceeding 1000 individuals).



and cycle X (18-22 October). The peak of 259 individuals declined rapidly but there were still a few present so long as there was some open water. Common Mergansers (Mergus merganser) seemed to wait until the last minute to migrate. Until mid-October only small numbers were seen but two small waves seemed to pass through in cycle XI (23-26 October) and cycle XIII (30 October to 1 November). Just before freeze-up, in cycle XV (6-9 November) and cycle XVI (8-13 November) 518 and 466 respectively, were counted. This made them the most numerous diving duck at that time and second only to mallards among all the ducks (Fig. 4).

Mallards and to a lesser extent Wigeon and Green-winged Teal seemed to be distributed throughout the study area (Table 2). The diving ducks seemed to be more concentrated with each species in a particular unit. Redhead and Canvasback were not observed outside Windermere Lake. Goldeneye preferred Windermere Lake, Wilmer National Wildlife area and some of the deep lagoons north of Radium in units 1c and 1d (Fig. 2). Nearly all of the sightings of Bufflehead occurred on the Wilmer Unit. Only Scaup seemed to have the general distribution characteristic of the dabbling ducks.

Mergansers were widely distributed when they were in small groups but the large flocks of Common Merganser were among the few birds to use the deep water of the Columbia Lake Units.

#### Observations of Swans

No swans breed in the valley but there are spectacular spring and fall migrations (G. Kaiser, pers comm.). The fall peak was reached on surveys between October 18 and 22. At that time 186 were observed after an influx of birds that started on October 10. A second peak occurred a few weeks later when 100 were observed between November 6 and 9 just prior to freeze-up.

Swans were concentrated at the north end of Columbia Lake with smaller numbers occurring near Radium and along the lagoons north to Golden. Most of these were too distant to determine the species but G. Kaiser (pers. comm.) carefully examined all of the birds near Fairmont. He identified one pair of adult Trumpeter Swans (Olor buccinator) with 5 young and 51 Whistling Swans (Olor columbianus) of which one pair had 3 young. There was a distinct difference in the habitat use by the two species there. The Trumpeters preferred the deeper, open water at the very beginning of the Columbia River channel while the Whistlers preferred the very shallow marsh where they did not have to tip up to feed. Some of these birds remained so long as there was open water on part of the marsh and did not leave until the river channel was the last unfrozen space on December 8.

#### Canada Geese

Only Canada Geese (Branta canadensis moffiti) occurred in large numbers during migration (Table 1) but White-fronted Geese (Anser albifrons) and Snow Geese (A. caerulescens) occurred incidentally (Table 3). There is a large breeding population of Canada Geese in the valley but most of these local birds seem to leave in August and only a few flocks stay through the middle of October. The peak value of 230 was reached on October 12 with other flocks appearing in the northern portions of the study area at later dates. After freeze-up small numbers clustered on the remaining open water at Athalmer and the north end of Columbia Lake where they remained until the end of the survey.

#### Loons, Grebes and Coots

There were minor movements of Common loons (Gavia immer.) and Western Grebes (Aechmophorus occidentalis) that preceded freeze-up. A group of Red-

Table 1 Estimated Waterbird Populations in the Columbia Valley study Area during fall migration, 1979.

Survey Cycle	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI
Species Group	Sept. 18-21	Sept. 20-24	Sept. 25-28	Sept. 27 -Oct. 1	Oct. 2-5	Oct. 4-9	Oct. 10-12	Oct. 12-15	Oct. 16-19	Oct. 18-22	Oct. 23-26	Oct. 25-29	Oct. 30 -Nov. 1	Nov. 1-5	Nov. 6-9	Nov. 8-13
Total Ducks	5808	5713	7819	7573	6811	5537	6544	6187	8423	7506	9676	8946	6592	5915	2743	1777
Total Dabblers	4947	4747	7257	7116	6266	5105	6127	5801	7202	6878	7313	6900	5158	4567	1799	1051
Total Divers	507	680	471	418	530	380	424	300	1165	548	2356	1900	1354	1003	902	711
Swans	1			1		9	5	6	6	47	81	186	96	23	100	28
Canada Geese	141	110	95	129	78	101	223	233	185	99	141	112	129	174	58	139
American Coot	1734	11350	8248	5399	13001	7886	12502	7847	8322	11530	9402	9528	5839	912	515	235

Table 2 Estimates of occupancy of waterfowl habitats (thousands of bird-days) in the Columbia Valley Study Area during fall migration, 1979.

Species Group	Canal Flats	Mid Columbia Lake	North Columbia Lake	Rushmere	Mid Windermere Lake	North Windermere Lake	Wilmer N.W.A.	Radium to Kindersley Creek to Brisco Golden										Total	
								1a	1b	1c	1d	2a	2b	2c	3a	3b	3c		3d
Ducks	13.7	12.7	11.3	28.8	43.0	2.8	12.2	12.1	2.3	18.1	7.9	16.4	33.1	8.3	23.6	11.7	58.8	44.0	316.2
Dabblers	13.2	6.3	10.8	25.5	19.4	1.4	7.0	10.6	2.0	14.1	7.4	15.7	33.0	7.3	20.2	10.1	55.7	42.9	307.6
Divers	0.3	6.2	0.5	3.1	22.3	1.4	5.0	0.8	0.3	2.1	0.5	0.7	0.1	1.0	3.1	0.8	1.3	1.0	50.5
Coots	26.1	0.1	0	328.2	48.4	0.3	0.4	0	0	1.7	0	0	1.6	0	0.3	0.1	0	0.1	407.3

Table 3. Estimates of total occupancy of habitats in terms of bird-days for species other than ducks. Columbia Valley Study Area, fall 1979.

Survey Units

Species Group	Wilmer N.W.A.												
	Canal Flats	Mid-Columbia Lake	North Columbia Lake	Rushmere	Mid-Windermere Lake	North Windermere Lake	Kindersley Creek Spillimacheen to Golden						
							Radium to Kindersley Creek			to Brisco			Golden
	1a	1b	1c	1d	2a	2b	2c	3a	3b	3c	3d	Total	
Swans	189	546	436	38	123	25	24	155	276	118	91	17	2038
Canada Geese	802	802	1170	267	180	180	99	281	535	689	562	916	6355
Snow Geese			2										2
White-fronted Geese								16		10			26
Total Grebes	42	501		231	406	891	714	88	6	5	2	2	3270
Western Grebe	25	410		120	105	587	188	19			2	7	1612
Red-necked Grebe		18		102	79	121	190		6	5	12	58	684
Pied-billed Grebe				4		18	64	51				7	152
Common Loon		49		5	45	100						8	199

Table 4 - Intensity or waterfowl occupancy (bird-days/km<sup>2</sup>) in the survey units of the Columbia River Valley (fall, 1979)

Species Group	Wilmer N.W.A.																	
	Canal Flats				Mid-Columbia Lake		North Columbia Lake		Rushmere		Mid-Windermere Lake		North Windermere Lake					

Table 5 Percent of the total observations of each species in which the birds were feeding as opposed to roosting, flying etc. Columbia River Valley Fall, 1979.

Species Group	Canal Flats	Mid-Columbia Lake	North Columbia Lake	Rushmere	Mid-Windermere Lake	North Windermere Lake	Wilmer N.W.A.	Radium to Kindersley Creek				Kindersley Creek to Brisco			Spillimacheen to Golden			
								1a	1b	1c	1d	2a	2b	2c	3a	3b	3c	3d
Dabblers	67	86	85	90	55	80	63	76	84	61	7	48	61	48	44	70	92	91
Mallard	60	86	81	24	45	78	62	67	16	34	7	35	71	4	45	58	78	91
Wigeon	69	96	89	99	75	86	74	87	87	81	14	64	60	0	35	93	86	64
G.W. Teal	81	90	94	100	15	13	53	90	25	7	7	42	58	60	87	65	96	80
Divers	40	94	88	37	26	17	60	67	17	32	16	29	55	23	58	56	51	61
Scaup - RND	72			69	50	20	40	72	13	25	20				58	70	11	63
Redhead				21	22													
Goldeneye	83			92	60	100	67	69	26	20	13	39	66	19	40	83	100	7
Bufflehead	19			50	47		65	34										
Swans	75	75	75	100	38	100	39	97	0	24	0	16	0	0	36			6
Coots	87	100		88	41	94	91			80			85	100	100	100		77

necked Grebes (Podiceps grisegena) that may nest at the nearby Wilmer National Wildlife Area, were seen on the open water at the outlet of Windermere Lake. In some years they become trapped and survive only if rescued by concerned people.

The migration of coots is more spectacular than that of other waterfowl. Only small numbers of coots breed in the area but tens of thousands congregate at the southern end of Windermere Lake prior to freeze-up. This large flock further added to the difficulty in counting the Redheads and Wigeon in the area (Table 1 and Figure 3).

#### Data Summations

The population estimates for the study area are presented in figures 3 and 4. The totals of the various counts over the migration period are in Appendix 1. Because the whole valley was not surveyed and we could not derive a meaningful extrapolation, these numbers should be taken as an index of abundance rather than an absolute value. Since it was not possible to cover all eighteen units twice in each week we maintained the integrity of the data artificially. This was done by using each of the weekly northern counts twice, once for each of the two consecutive surveys in that week. In this way each figure still represents the sum of eighteen units.

Where there were very large concentrations of birds, single counts would not have been accurate. The components of the numbers used in figures 3 and 4 are the means of two or three simultaneous counts.

The objective of these surveys was to develop an index of use rather than an estimate of the instantaneous population. The first of these indices is summarized in Table 2. Each count in each unit was assumed to hold until replaced by succeeding surveys. The product of the unit counts and the intervening days is the number of bird-days which we used as an index of



occupancy. This index gave us a method for comparing the gross importance of the units. The relative quality of each unit can then be derived from an index of intensity of use in terms of bird-days/km<sup>2</sup> (Table 5). (Duck-days for each species are presented in Table 2 of Appendix 1).

Only three units exceeded 40 thousand duck-days of use. Of these the Rushmore unit may have been the most important. When combined with the contiguous Windermere unit, the 70 thousand duck days exceed the counts for any other unit and the coot-days exceed the duck counts for the whole valley by 20 percent (Table 1). It was also the site of a large concentration of Redheads and other diving ducks unique to the study area. The relatively low intensity of use (Table 4) reflects the large expanse of the lake more than its relative value as waterfowl habitat.

Units 3c and 3d between Parson and Golden were also heavily used (Tables 1 and 4). In this case a large number of ducks-days is accompanied by a high intensity of use. The shallow lagoons of this area supported growth of Polygonum sp. and Equisetum sp. as well as submergent vegetation valuable as duck food. Similar conditions existed in unit 2b, a small area south of Brisco which had the highest intensity of use.

Units 1c, 1d and 2a also showed a high intensity of use. Units 1c and 1d consisted of a collection of lagoons along the railroad tracks north of Radium. There are no public roads into this area and disturbance by hunters was infrequent. Unit 2a was further north at the mouth of Kindersley Creek and Luxor Creek. It was relatively inaccessible also and was adjacent to large tracts of irrigated farmland. However these three units were all less than 0.6 km<sup>2</sup> (Table 4) and their small size reduced their importance as duck habitat.

However duck days are only one measure of use. Both 1c and 2a were frequented by large numbers of Canada Geese (Table 3). Both of these areas had

grasslands adjacent to the water that offered grazing for geese and the poor access for hunters left them relatively undisturbed. Canada Goose distribution further north was more sporadic and irregular. This led to numbers of Goose-days/km<sup>2</sup> that were too low to be recorded in Table 4.

To the south, Canada Geese took advantage of an area at the north end of Columbia Lake which was closed to hunting. This was in the Columbia Lake and River Wildlife Sanctuary established by the province and was one of the areas most heavily used by swans. Nearby, the fan of Dutch Creek and the outlet of Columbia Lake form a large flat marsh with an extensive growth of Scirpus sp. There are larger marshes at Canal Flats but these were not as heavily used. Possibly the proximity of the highway, the boat launching ramp and occasional hunters reduced the value of that area. In the spring, however, more swans use the south end than use the north end of the lake (G. Kaiser pers. comm.).

In the same way that Swans characterized the north end of Columbia Lake and Redheads and Coots characterized the Windermere-Rushmere Area, Wigeon and Green-winged Teal characterized the duck population in unit 2b between Kindersley Creek and Brisco. The Wilmer National Wildlife Area, with its deep lagoons supported larger numbers of Bufflehead, Goldeneye and Hooded Mergansers than other areas, while most of the Scaup/ring-necked Duck sightings were further north on unit 1c. This variation suggests that there are several different types of habitat in the area, some of which are only superficially similar.

Taking into consideration that some species may have been doing most of their feeding outside of the regular survey hours, table 5 shows that the birds concentrated in areas where they were observed feeding. In many areas where small numbers of birds were counted, small percentages of those birds were

feeding which may indicate that their occurrence was accidental and not necessarily related to habitat quality.

### Industrial and Recreational Developments

The impact of the Kootenay Diversion on all the waterfowl habitats in the valley may be fairly subtle and too little is understood about the habitat requirements to speculate on cumulative and synergistic impacts on waterfowl. The proposed by-pass or ditch to carry the excess flow is bound to have the truncated ecological characteristics typical of human constructions. It is bound to have a smaller littoral zone, fewer backwaters, less flow change and less species diversity than the natural system that it will partially supplant. Its edges will offer fewer nest sites to raptors and easier access to hunters and other traffic. The spoil will fill marshes and dredging will change sedimentation patterns and hydrology. Until specific details of the proposal are available detailed costs to migratory birds cannot be evaluated.

Recreation is becoming the major industry of the valley. Fortunately much of this is related to skiing and winter sports that have a limited impact on migrant flocks of birds. However the encroachment of condominiums along the east and west shore of Windermere Lake will gradually increase the amount of disturbance that the birds have to tolerate. Noise, petroleum products, plastic artifacts dangerous to birds (six-pack holders), all-terrain vehicles, power boats and possible domestic effluent will gradually reduce the quality of Windermere Lake as bird habitat.

Elsewhere in the valley recreation is limited to low impact activities such as canoeing, hunting and hang gliding. In many ways the natural density of the vegetation and mosquitoes make this area poor for recreation. So long as it is

surrounded by agricultural activities it will probably be able to maintain its importance as migration habitat.

### Conclusions

The numbers of birds observed during these surveys, confirm that the study area is a major stopover location in the Rock Mountain Trench migration corridor. The extensive marshes provide important and perhaps critical habitat for large populations of ducks, geese, coots and swans. Some survey units stand out as being of particular importance.

The huge number of Coots and the unique concentration of Redhead and other diving ducks at the southern end of Windermere Lake constitute one of the most amazing wildlife spectacles in British Columbia. However, all of the adjacent property is in private hands and the pressure of condominium and recreational development will destroy this area within the next few years. It will also receive the direct impact of increased water flow and depth from the Kootenay Diversion Project.

The shallow marshes at the north end of Columbia Lake, already protected by their inclusion in the Wildlife Sanctuary offer one of the best places in British Columbia for swan observations and is one of the few places where swans concentrate on their southward migration. Similarly the Wilmer National Wildlife Area, offers a good opportunity to view Goldeneye, Bufflehead and many other species but it is only moderately important to most migrant groups. In spite of their official status both of these areas could be adversely affected by increased recreational use and the Kootenay River Diversion Scheme.

The lagoons from Radium to Golden are valuable and the spectacular concentrations of dabbling ducks in a few of the survey units deserve special attention. All of the lagoons would be affected by increased water levels and

decreased water temperatures if these were a projected result of the Kootenay Diversion scheme. However it is unlikely that the dabbling ducks would suffer from a shortage of habitat in the northern part of the valley. Many of the lagoons are dry during the migration period and would simply be wet under the new water regime.

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## Appendix I

### Estimated Waterbird Populations on the Columbia Valley Study Area during fall migration, 1979

Table 1 Estimated Waterbird Populations in the Columbia Valley during fall migration, 1979

Survey Cycle	I Sept. 18-21	II Sept. 20-24	III Sept. 25-28	IV Sept.27 -Oct.1	V Oct. 2-5	VI Oct. 4-9	VII Oct. 10-12	VIII Oct. 12-15	IX Oct. 16-19	X Oct. 18-22	XI Oct. 23-26	XII Oct. 25-29	XIII Oct.30 -Nov.1	XIV Nov. 1-5	XV Nov. 6-9	XVI Nov. 8-13
Species Group																
Total Ducks	5808	5713	7819	7573	6811	5537	6544	6187	8423	7506	9676	8946	6592	5915	2743	1777
Total Dabblers	4947	4747	7257	7116	6266	5105	6127	5801	7202	6878	7313	6900	5158	4567	1799	1051
Mallards	3078	2684	5055	4881	2732	2379	1800	2112	2886	3030	2867	2761	2028	2042	1014	827
Wigeon	1240	1202	1456	1658	1704	1298	1800	1635	2403	2012	2726	3023	2317	1730	370	155
G-W Teal	373	476	428	372	934	320	340	647	1234	1109	724	266	343	385	273	56
Pintail	27	53	42	70	66	13	116	147	157	195	260	105	216	77	34	9
Wood Duck	31	31	27	21	12	9	14	15	9	6	13	9	2		1	
Shoveler							3	5	5	13	20	7		3		
Total Divers	507	680	471	418	530	380	424	300	1165	548	2356	1900	1354	1003	902	711
Scaup & Ring-neck	198	193	137	151	130	90	100	41	112	150	184	97	26	40	4	4
Redhead		37	19		118	25	2	16	578		1683	809	893	575	225	163
Canvasback	2					29					52	25	62	3		
Goldeneye	74	183	120	106	123	92	101	47	72	44	46	55	56	93	29	14
Bufflehead	45	49	66	35	46	27	62	62	85	59	61	261	134	49	7	1
C. Merganser	43	58	45	15	2	1	64	19	58	24	165	32	105	52	518	466
H. Merganser	74	83	43	61	86	72	78	72	243	259	102	109	77	131	37	10
Swans	1			1		9	5	6	6	47	81	186	96	23	100	28
Canada Geese	141	110	95	129	78	101	223	233	185	99	141	112	129	174	58	139
American Coot	1734	11350	8248	5399	13001	7886	12502	7847	8322	11530	9402	9528	5839	912	515	235



Estimates of total occupancy of habitats in thousands of bird days

Table 2

Species Group	Wilmer N.W.A.										North Windermere Lake	Mid Windermere Lake	Rushmere	North Columbia Lake	Mid Columbia Lake	Canal Flats			
	Radium to Kindersley Creek				Kindersley Creek to Brisco			Spillimacheen to Golden											
	1a	1b	1c	1d	2a	2b	2c	3a	3b	3c							3d	Total	
Ducks	13.7	12.7	11.3	28.8	43.0	2.8	12.2	12.1	2.3	18.1	7.9	16.4	33.1	8.3	23.6	11.7	58.8	44.0	316.2
Dabblers	13.2	6.3	10.8	25.5	19.4	1.4	7.0	10.6	2.0	14.1	7.4	15.7	33.0	7.3	20.2	10.1	55.7	42.9	307.6
Mallard	3.9	1.9	6.3	2.5	2.8	0.9	5.1	6.8	1.9	6.1	5.7	6.1	6.0	7.2	14.7	5.3	24.3	34.9	142.4
Wigeon	1.1	0.5	1.4	13.7	11.2	0.3	1.2	1.6		6.1	0.3	4.5	21.1	0.1	4.8	4.6	15.0	3.6	91.2
G.W. Teal	4.1	1.0	1.8	0.4	3.3	0.05	0.3	1.8	0.1	0.1	1.3	0.3	4.8		0.3	0.2	7.5	0.3	27.7
Pintail	2.4				1.8	0.1			0.4										4.7
Shoveller			0.2																.2
Divers	0.3	6.2	0.5	3.1	22.3	1.4	5.0	0.8	0.3	2.1	0.5	0.7	0.1	1.0	3.1	0.8	1.3	1.0	50.5
Scaup/RN Duck				0.3	0.5		0.9	0.5	0.2	1.6					0.2	0.1	0.5	0.9	5.7
Redhead				1.5	19.6	0.2													21.3
Canvasback				0.6	0.1														.7
Goldeneye					1.6	0.1	0.6		0.1	0.3	0.2	0.2	0.1	0.6	0.1	0.1		0.1	4.1
Bufflehead				0.1	0.4		2.8												3.3
Common Merganser	0.1	5.5	0.2		0.1	0.1					0.1				0.4	0.1	0.1		6.7
Hooded Merganser	0.1		0.1	0.4			0.3	0.2		0.2	0.2	0.4		0.1	2.0	0.4	0.7		4.9
Coots	26.1	0.1	0	328.2	48.4	0.3	0.4	0	0	1.7	0	0	1.6	0	0.3	0.1	0	0.1	407.3

## APPENDIX II

Table 1. Phenology of Freeze-Up in the Columbia River Valley Study Area

Survey Section	First Ice	Closed by Ice	Status to December 31
Highway Route 3a,3b,3c,3d.	Oct. 18	Nov. 8	frozen
Railway 11 (2a,2b,2c)	" "	" "	"
Railway 1 (1a,1b,1c,1d)	" "	" "	"
Wilmer N.W. Area	" 22	" 13	"
North Windermere Lake	Nov. 13	N/A	outlet remained open
Mid Windermere Lake	" "	" 13	frozen
Rushmere	" "	" "	"
North Columbia Lake	" "	N/A	outlet remained open
Mid Columbia Lake	" "	" 13	frozen
Canal Flats	" 7	N/A	inlet remained open
other areas			
Athalmer	N/A	N/A	outlet and river remained open
Mud Lake	N/A	N/A	remained open

Table 2.Observations of waterfowl on ice-free areas after the end of the fall surveys on 13 November 1979.(N.S.-no survey)

Location	Species Group	November		December	
		16	27	11	18
Athalmer and the river	Mallard	N.S.	N.S.	95	43
	Common Goldeneye	"	"	16	30
	Canada Goose	"	"	40	19
	Wigeon	"	"	1	0
	Unid.ducks	"	55	0	0
Windermere Lake outlet	Mallard	42	37	13	15
	Common Goldeneye	2	3	3	1
Mud Lake	Mallard	N.S.	N.S.	540	322
	Common Goldeneye	"	"	0	3
	Common Merganser	"	"	0	2
Columbia Lake outlet	Mallard	510	0	17	39
	Common Goldeneye	0	2	5	14
	Canada Goose	55	0	0	1
	Wigeon	20	0	0	0
	Trumpeter Swan	4	4	1	0
Canal Flats	Mallard	N.S.	N.S.	79	35
TOTAL	Mallard	552	37	744	454
	Common Goldeneye	2	5	24	48
	Canada Goose	55	0	40	20
	Wigeon	20	0	1	0
	Trumpeter Swan	4	4	1	0
	Unid.ducks	0	55	0	0