OVERVIEW OF MIGRANT WATERFOWL USE OF THE GREAT LAKES AREAS OF CONCERN AND OTHER SELECTED COASTAL SECTORS IN SOUTHERN ONTARIO

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Canadian Wildlife Service Technical Report Series No. 261

This series may be cited as:

Mullie, A.; Ross, R. K.; Dennis, D. G.; 1996. Overview of Migrant Waterfowl Use of the Great Lakes Areas of Concern and Other Selected Coastal Sectors in Southern Ontario. Technical Report Series No. 261, Canadian Wildlife Service.

Issued under the Authority of the
Minister of Environment
Canadian Wildlife Service

Catalogue No. CW 69-5/261E
ISBN 0-662-25030-3

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ABSTRACT

The shoreline of the southern Great Lakes is extremely important to migrant waterfowl; as well, it is among the areas most heavily impacted by human activities in North America. The International Joint Commission, which is charged with improving the environmental quality of the Great Lakes, has designated for specific remedial actions 43 Areas of Concern (AOC's) where the aquatic environment has been most severely degraded. Seven of these are found along the Canadian shore of the southern Great Lakes. Aerial surveys of migrant waterfowl use of much of this shore have been routinely undertaken since 1968 by the Canadian Wildlife Service, and subsets of these data are summarized for each AOC. Similar information for other coastal sectors of particular importance to waterfowl are included for comparative purposes. The total number of waterfowl days in each survey season, the composition of the waterfowl present (by species or larger taxonomic group), and the timing of migrational peaks were calculated to illustrate the timing and intensity of use by waterfowl of each area.

Total waterfowl use in each study site varied considerably among seasons and years. In general however, during spring migrations, the total number of waterfowl days in each study site either remained relatively stable or declined between survey years with the lowest points tending to occur during the early to mid 1980's. Patterns in waterfowl abundance during fall migrations were not as clear and estimates of total waterfowl use fluctuated without any clear trends across study sites. Estimates of use generally increased over time in the Bay of Quinte AOC, Hamilton Harbour AOC, St. Lawrence River AOC, and Lake St. Clair; remained relatively steady in Metro Toronto AOC, Niagara River AOC, Long Point and Dunnville; but dropped in the Detroit River AOC, Oshawa Second Marsh and Rondeau Bay areas.

In most study sites, estimates of use by swans, geese, and Mallards increased over the survey period, conforming with known increases in numbers throughout eastern North America. Similarly, estimates of use by American Black Ducks and scaup followed known downward trends in population numbers. Estimates of use by other ducks show no clear trends across study sites. However when possible, site-specific hypotheses for changes in abundance were offered.

RÉSUMÉ

Le rivage de la partie sud des Grands Lacs est extrêmement important pour la sauvagine au moment de ses migrations. C'est aussi l'une des régions les plus lourdement affectées par les activités humaines en Amérique du Nord. La Commission mixte internationale, chargée d'améliorer la qualité de l'environnement des Grands Lacs, a désigné secteurs préoccupants (SP) nécessitant des mesures correctrices spéciales 43 endroits où l'environnement aquatique a été des plus gravement dégradés. Sept de ces secteurs se trouvent dans la partie sud canadienne des Grands Lacs. Depuis 1968, le Service canadien de la faune y effectue régulièrement des relevés aériens de l'utilisation du rivage par la sauvagine. Les données, qui couvrent la majeure partie de la portion canadienne du sud des Grands Lacs, sont résumées pour chaque SP, et des renseignements similaires pour d'autres secteurs riverains d'importance particulière pour la sauvagine sont présentés à des fins de comparison. Afin de mieux voir le moment et l'intensité de l'utilisation pour chaque secteur, le nombre total de jours de l'utilisation durant chaque saison des relevés, la composition de la sauvagine présente (par espèce ou groupe taxonomique plus important) et le moment des pics migratoires ont été déterminés.

L'utilisation totale dans chaque site d'étude varie considérablement d'une saison et d'une année à l'autre. En général, toutefois, durant les migrations printanières, le nombre total de jours d'utilisation de chaque site est demeuré relativement stable ou a diminué, les minimums tendant à être atteints entre le début et le milieu des années 80. Dans le cas des migrations automnales, les tendances sont moins claires; les estimations de l'utilisation totale par la sauvagine fluctuent mais sans présenter de tendances nettes pour l'ensemble des sites d'étude. En général, les estimations de l'utilisation ont augmenté au fil des ans dans les SP de la baie de Quinte, du port de Hamilton et du fleuve Saint-Laurent de même que dans le lac Sainte-Claire; elles sont demeurées relativement stables dans les SP du Grand Toronto et de la rivière Niagara ainsi qu'à Long Point et Dunnville; par contre, elles ont diminué dans le SP de la rivière Détroit et les zones du marais Second d'Oshawa et du port Rondeau.

À la plupart des sites d'étude, les estimations de l'utilisation par les cygnes, les oies (et bernaches) et les canards colverts ont augmenté durant la période des relevés, reflétant les augmentations des effectifs observées dans tout l'est de l'Amérique du Nord. De même, les estimations de l'utilisation par les canards noirs et les grands et petits morillons ont suivi les tendances connues de baisse des populations. Les estimations pour d'autres canards ne présentent pas de tendances claires. Toutefois, lorsque s'était possible, des hypothèses ont été formulées pour expliquer les changements de l'abondance à des endroits particuliers.

ACKNOWLEDGEMENTS

We thank B. Campbell, N. North and J. Vanos for extracting and collecting the relevant survey data. B. Campbell also undertook the considerable task of figure preparation and layout of the manuscript. We are also very grateful to the various observers who participated in the aerial surveys, especially R. Chandler, D. Fillman, G. McCullough, and N. North. Funding was provided in part by the Canadian Wildlife Services' Great Lakes Program.

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1.0 INTRODUCTION

Migrating waterfowl require sites, known as staging areas, along their routes at which they rest and feed, thus replenishing their fat reserves. These reserves provide the energy to fuel the next stage of migration; failure to store sufficient fat can lead to greater mortality of the birds both during migration and while over-wintering (Haramis et al. 1982, Conroy et al. 1989, Dufour et al. 1993). Furthermore, failure to acquire sufficient energy reserves during spring migration may impair reproductive performance (e.g. Ankney and MacInnes 1978). Clearly, maintaining a sufficient amount of quality staging area is essential to healthy waterfowl populations. Moreover, because the waterfowl require rich sources of food on these areas, they tend to react quickly to changes in habitat quality by shifting their distribution, thus acting as bioindicators of environmental quality of wetland and nearshore habitats.

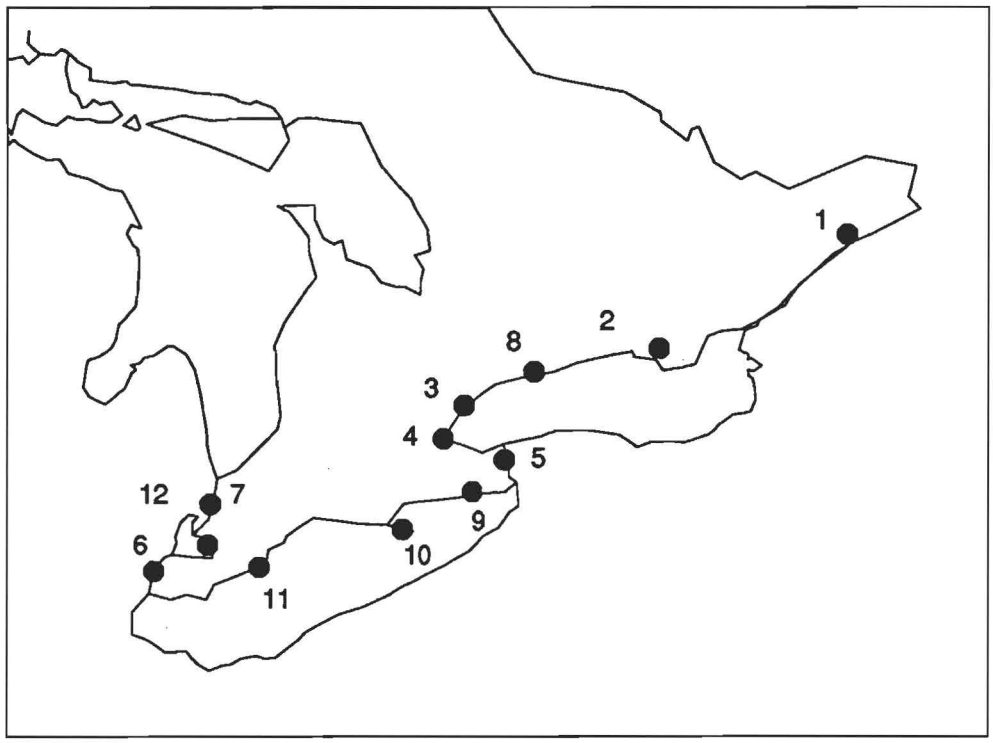
Ontario contains valuable staging areas for many of the 3 million waterfowl (divided among 28 species - see Table 1) which migrate through the Great Lakes Region annually (Bookhout et al. 1989). In southern Ontario specifically, the shoreline of the Great Lakes from Lake St. Clair to western Lake Ontario averages approximately 9 million days of waterfowl use (hereafter waterfowl days) during spring migration and 25 million waterfowl days during fall (Dennis et al. 1984). Eastern Lake Ontario and the St. Lawrence River receive a further 9 million waterfowl days each year (Ross 1989). This whole shoreline bounds the most densely populated part of Canada, and is subject to considerable ecological stress and environmental degradation. Starting in 1987, the International Joint Commission of the United States and Canada, which is charged with improving the environmental quality throughout the Great Lakes, has designated 43 Areas of Concern (AOC's) where the aquatic environment has been most severely degraded. These areas receive highest priority for environmental improvements through the Remedial Action Plan (RAP) process. Seventeen of these AOC's are found in Canada of which nine occur along the southern Great Lakes; seven of these contain important habitat for staging waterfowl. This report summarizes information, gathered by the Canadian Wildlife Service over the past 28 years, on the amount and timing of use by waterfowl in these seven AOC's, and provides comparable information from other important areas along that shore (see Figure 1). As well, a brief description of the nutritional and other habitat requirements of staging waterfowl is included. Our aim is to provide information on waterfowl to workers on individual AOC's who are not expert on waterfowl biology, and thus allow them to consider this group in the RAP planning and particularly the assessment process. As most of the survey data were collected prior to the RAP implementation activities, the numbers and trends presented here should be viewed as pre-RAP baselines from which responses to environmental improvements resulting from the RAPs can be assessed.

2.0 SURVEY METHODS

Aerial surveys were undertaken in the spring and fall of various years between 1968 and 1994. Results presented here are sub-sets of survey information collected during flights along sections of shoreline from the Bruce Peninsula to the Quebec border. Methods are described in detail in Dennis et al. (1984) for the southern Great Lakes, Ross (1989) for areas east of Presqu'ile, and Dennis and North

Table 1. Common waterfowl species of southern Ontario by taxonomic group.

GROUP	SUB-GROUP	SPECIES	SCIENTIFIC NAME
Swans		Tundra Swan	*Cygnus columbianus*
		Mute Swan	*Cygnus olor*
Geese		Canada Goose	*Branta canadensis*
		Snow Goose	*Chen caerulescens*
Dabblers	Large Dabblers	Mallard	*Anas platyrhynchos*
		American Black Duck	*Anas rubripes*
		Gadwall	*Anas strepera*
		Northern Pintail	*Anas acuta*
	Small Dabblers	Green-winged Teal	*Anas crecca*
		Blue-winged Teal	*Anas discors*
		American Wigeon	*Anas americana*
		Northern Shoveler	*Anas clypeata*
		Wood Duck	*Aix sponsa*
Bay Ducks		Redhead	*Aythya americana*
		Ring-necked Duck	*Aythya collaris*
		Canvasback	*Aythya valisineria*
	Scaup spp.	Greater Scaup	*Aythya marila*
		Lesser Scaup	*Aythya affinis*
Bucephala spp.		Common Goldeneye	*Bucephala clangula*
		Bufflehead	*Bucephala albeola*
Mergansers		Hooded Merganser	*Lophodytes cucullatus*
	Large Mergansers	Common Merganser	*Mergus merganser*
		Red-breasted Merganser	*Mergus serrator*
Sea Ducks		Oldsquaw	*Clangula hyemalis*
	Scoter spp.	White-winged Scoter	*Melanitta fusca*
		Surf Scoter	*Melanitta perspicillata*
		Black Scoter	*Melanitta nigra*
Stiff-tailed Diver		Ruddy Duck	*Oxyura jamaicensis*



Areas of Concern

1. St. Lawrence River
2. Bay of Quinte
3. Metro Toronto
4. Hamilton Harbour
5. Niagara River
6. Detroit River
7. St. Clair River

Other Areas of Interest

8. Oshawa Second Marsh
9. Dunnville
10. Long Point
11. Rondeau Harbour
12. Lake St. Clair

Fig. 1. Map of southern Ontario showing locations of areas described in this report. The Wheatley Harbour and Port Hope AOC's are not included as they have no important staging habitat for waterfowl.

for Lake St. Clair marshes. Essentially, two observers recorded numbers of waterfowl visible from each side of an aircraft which followed a standardized route over most of the appropriate habitat in each sector. The spring survey period extended from 1 March and 1 June, and the fall survey period occurred between 15 August and 1 January. Flight dates are listed in sections specific to each area.

When possible, birds were identified to species, otherwise they were identified into groups, or subgroups (Table 1). If identified species totals were relatively low, these broader groups were sometimes used to facilitate analysis.

Attractiveness of an area to waterfowl is measured in waterfowl days (Boyd 1974). This measure is calculated by averaging duck numbers from each successive pair of surveys, multiplying by the number of days separating the two surveys, and summing these values over the full duration of the survey season. The first and last day of each survey season are assigned baseline numbers of waterfowl. Baseline numbers are waterfowl already present in the area as migration begins or those remaining when migration ends and are assumed equal to values determined from the closest available survey date. Survey dates used to assign baseline numbers are listed in sections specific to each area. This method takes into account both number of waterfowl and length of staging time, which gives a better indication of an area's importance than numbers alone; it should not, however, be considered an index of the total numbers of waterfowl using the area as turnover rates of migrating birds have not been established.

2.1 Survey Limitations and Biases

Every effort was made to restrict sources of variability by standardizing as many aspects of the survey as possible. This includes using standard routes, employing a limited number of experienced observers, only flying in weather conditions which were suitable for detecting waterfowl (e.g. avoiding high winds, heavy rain, fog), restricting surveys to between 0830 and 1630 h to avoid dusk and dawn activity periods, and using only high-wing aircraft with good visibility and capable of relatively slow flight (approx. 160 km/h).

There are, however, characteristics of individual waterfowl groups that affect their detectability when surveyed from the air (Ross 1989). Bay ducks, *Bucephala* spp., and mergansers form large flocks in open water nearshore, and so are quite visible and effectively counted. Oldsquaw and scoters can be less gregarious, and more dispersed further offshore; a greater proportion may therefore be missed during a survey. Dabblers and geese may forage inland or in denser stands of emergent vegetation and are usually under-represented on these shoreline surveys. Geese, particularly, are affected by weather in the timing of their roosting activities. On overcast days, they tend to forage longer on land and thus are detected in smaller numbers on roosting sites around the open water covered by the survey. Lastly, if an individual species was not recorded in an area during the aerial surveys, it should not be assumed that it does not occur there.

Finally, estimates of total waterfowl days may fluctuate considerably over seasons and years. Although these fluctuations may result from actual changes in number of waterfowl using the area, sampling variability also plays a role given that migrant waterfowl move through in unpredictable waves and that the number of survey flights are necessarily limited (Ross 1989).

3.0 RESULTS BY SITE

3.1 Great Lakes Areas of Concern

3.1.1 St. Lawrence River AOC

This section on the St. Lawrence Seaway extends from the Moses-Saunders Power Dam at Cornwall to the Beauharnois Dam in Quebec and includes all of Lake St. Francis. Locally produced environmental contaminants include PCB's and mercury from factories on both sides of the river.

3.1.1.1 Survey Area and Sampling Dates

The surveyed area, which covered only part of the AOC, included the Ontario shoreline from the Quebec border to Moses-Saunders Power Dam and was divided into 3 sections (Fig. 2) as follows: Section 1 from the border to Raisin River; Section 2 from Raisin River to Glen Walter; Section 3 from Glen Walter to the dam.

Surveys were flown in spring and fall of 1976, 1977 and 1985 (Fig. 3). Baseline dates for waterfowl day calculations are listed in Table 2.

Table 2. Baseline dates used in waterfowl day calculations for the St. Lawrence River AOC.

	Entering Fall	End of Season	Entering Spring	End of Season
1976	3 June 1977	20 Jan. 1977	10 March 1976	20 May 1976
1977	3 June 1977	20 Jan. 1977	9 March 1977	3 June 1977
1985	29 Aug. 1985	2 Jan. 1986	14 March 1985	7 June 1985

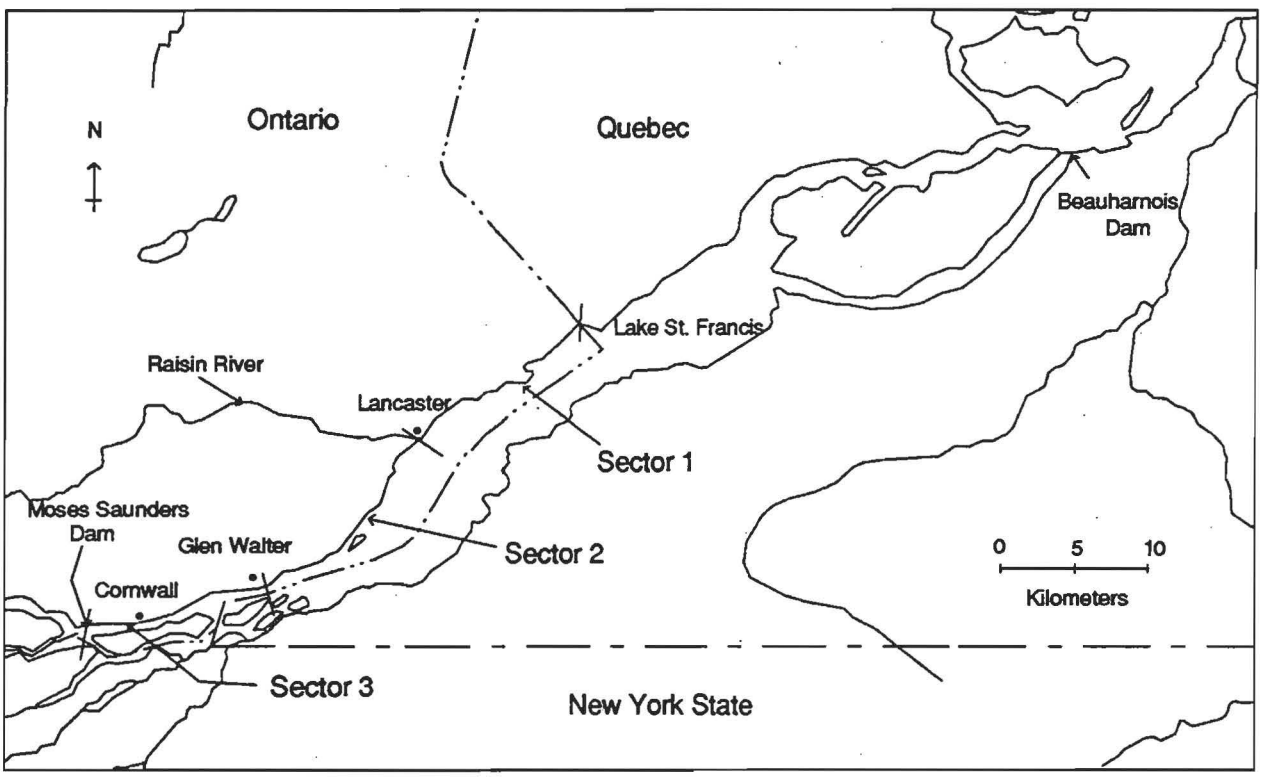


Fig. 2. Map of St. Lawrence River AOC showing survey sectors.

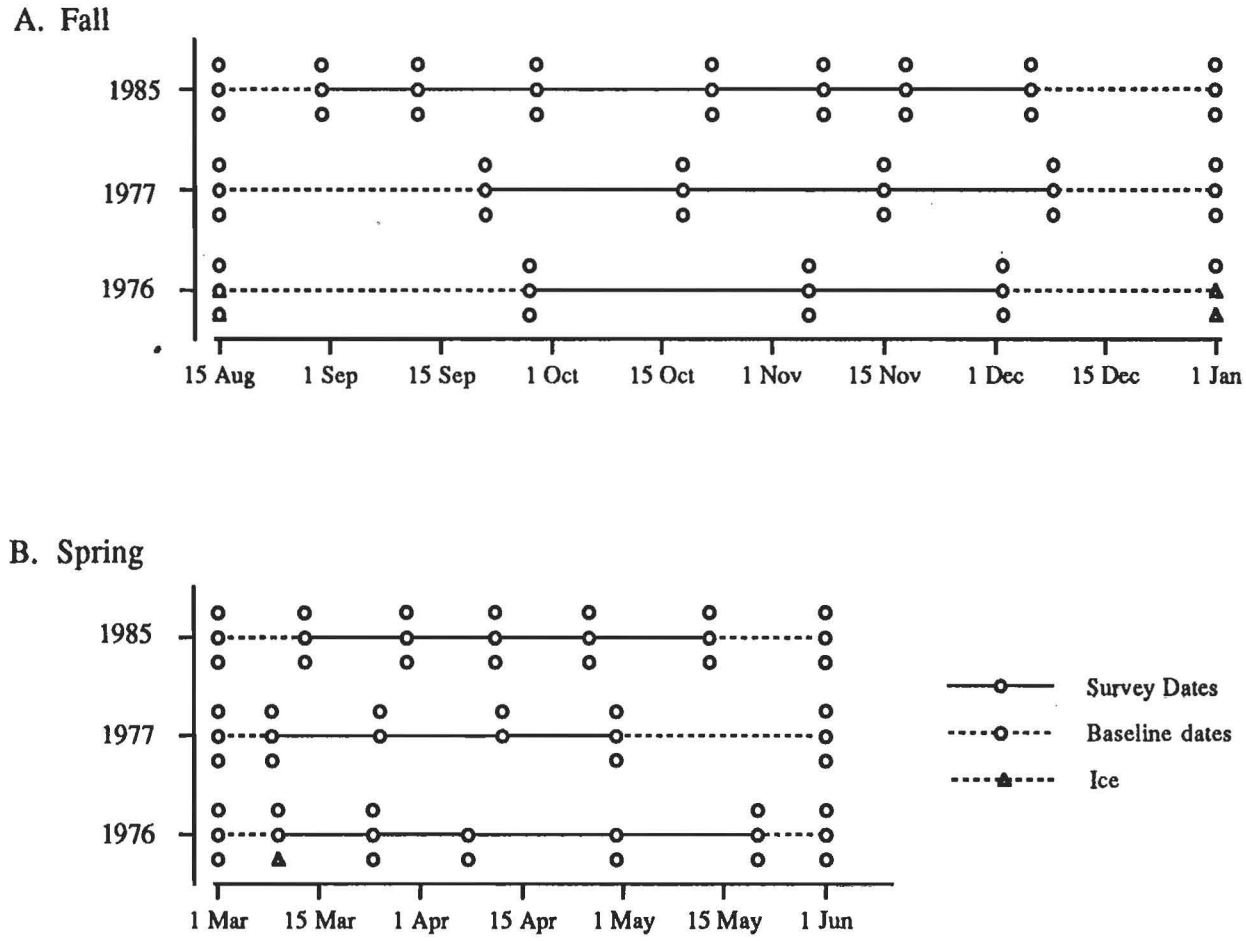


Fig. 3. Dates of aerial surveys in the St. Lawrence River AOC.

3.1.1.2 St. Lawrence River - Overall Trends

During spring, waterfowl use averaged 400,000 waterfowl days but total use declined with each survey year (Fig. 4). During fall, average use was roughly the same as in spring (350,000 waterfowl days). However, the trend, if any, was toward increasing use. Total waterfowl days were greatest in 1985 and least in 1977. The species composition remained relatively stable between years (Fig. 5) except in fall 1977 when the number of bay ducks was low (Fig. 6), a likely result of the small number of surveys.

3.1.1.3 St. Lawrence River - Results by Taxonomic Group

3.1.1.3.1 Bay Ducks

In spring, bay ducks always comprised over 70% of the total waterfowl. In fall, their proportion was lower, particularly in 1977 (Fig. 5). In both seasons of every year, scaup made up over 85% of the bay ducks, the rest being composed of Redheads, Ring-necked Ducks and Canvasbacks.

3.1.1.3.2 *Bucephala* spp.

During spring, *Bucephala* spp. use averaged 40,000 waterfowl days but has declined each survey year (Fig. 6). During fall, use has remained relatively stable, averaging 90,000 waterfowl days. Common Goldeneye were more abundant than Bufflehead, always comprising more than 95% of the group.

3.1.1.3.3 Mergansers

In spring, Common and Red-breasted Merganser use dropped from roughly 50,000 waterfowl days from 1977 to 2000 days in 1985 (Fig. 6). Fall use, however, remained stable, averaging 25,000 waterfowl days. A few Hooded Mergansers were noted only in spring 1985.

3.1.1.3.4 Geese

There was an average of 3,000 and 12,000 waterfowl days attributed to geese in spring and fall respectively (Fig. 6). Canada Geese always comprised over 98% of total geese numbers. Only small numbers of Snow Geese were reported in 1976 and 1977 and none in 1985, even though the recent trend in eastern Ontario has been toward increasing numbers of Snow Geese.

3.1.1.3.5 Dabblers

Dabbler use averaged to 16,000 waterfowl days in spring and 4,500 in fall (Fig. 6). The most common species were Mallards and Black Ducks although there were also Gadwall, American Wigeon, and Northern Pintail recorded during surveys (Fig. 7). A high proportion of dabblers were not identified to species.

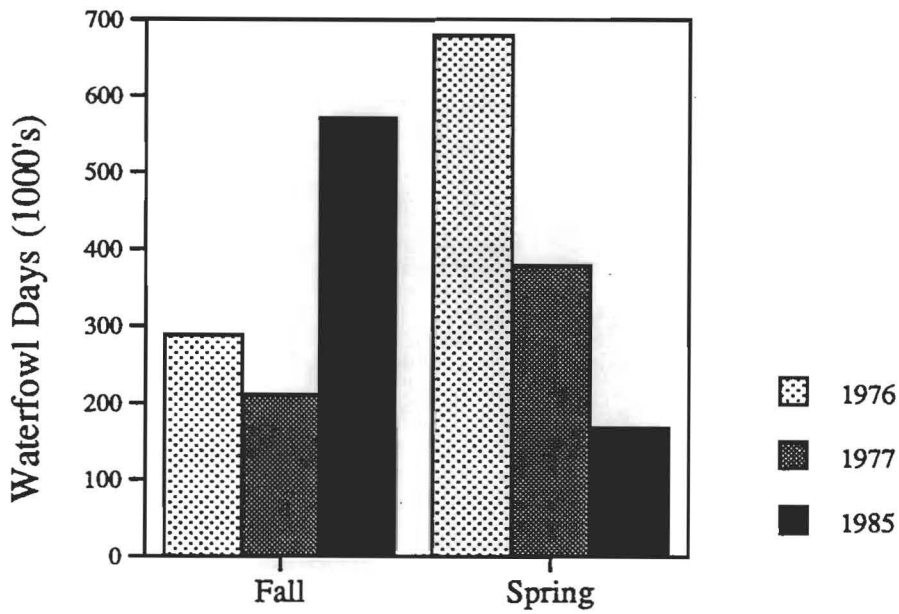


Fig. 4. Total waterfowl use of the St. Lawrence River AOC during fall and spring migrations.

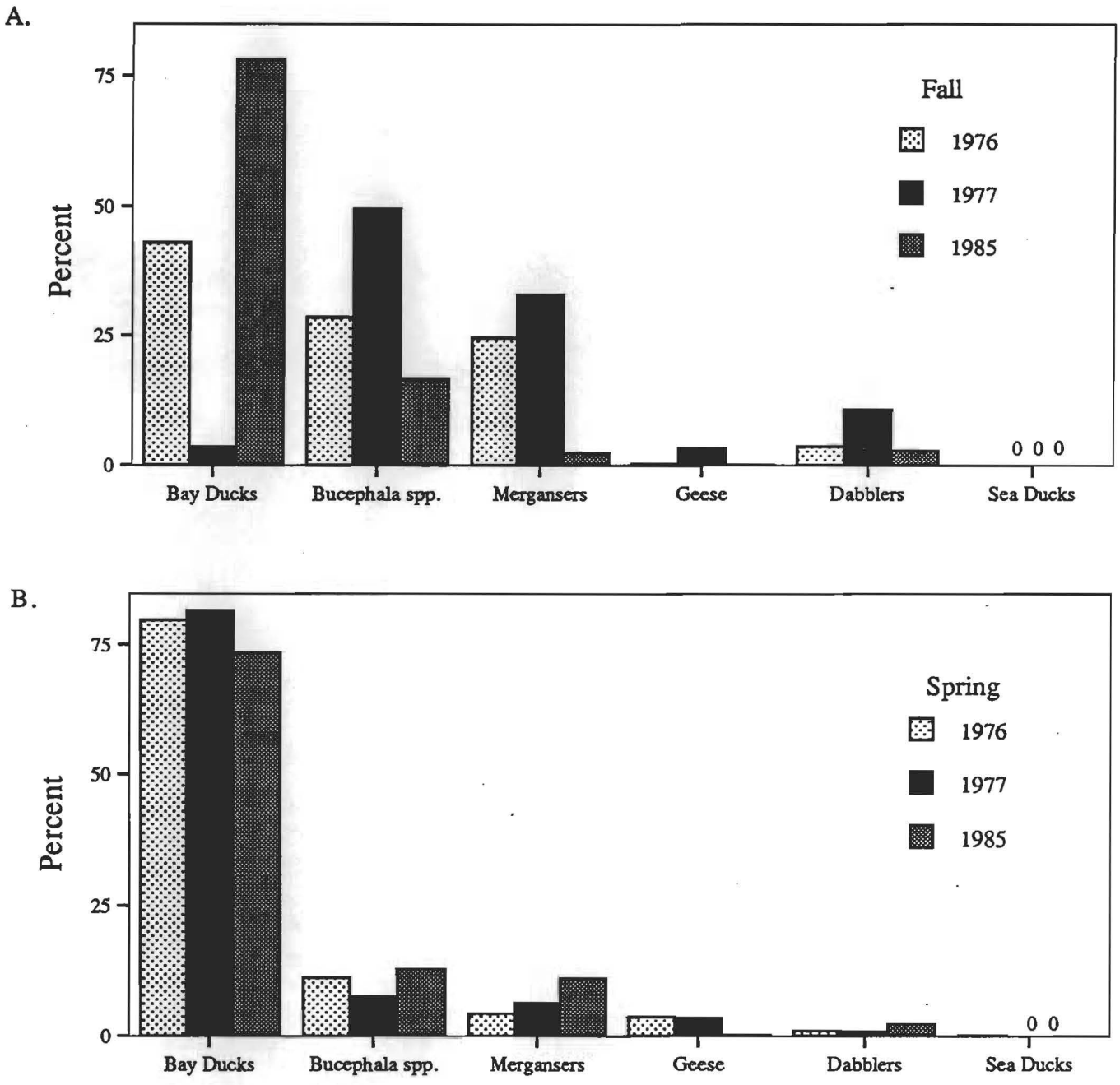


Fig. 5. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in the St. Lawrence River AOC.

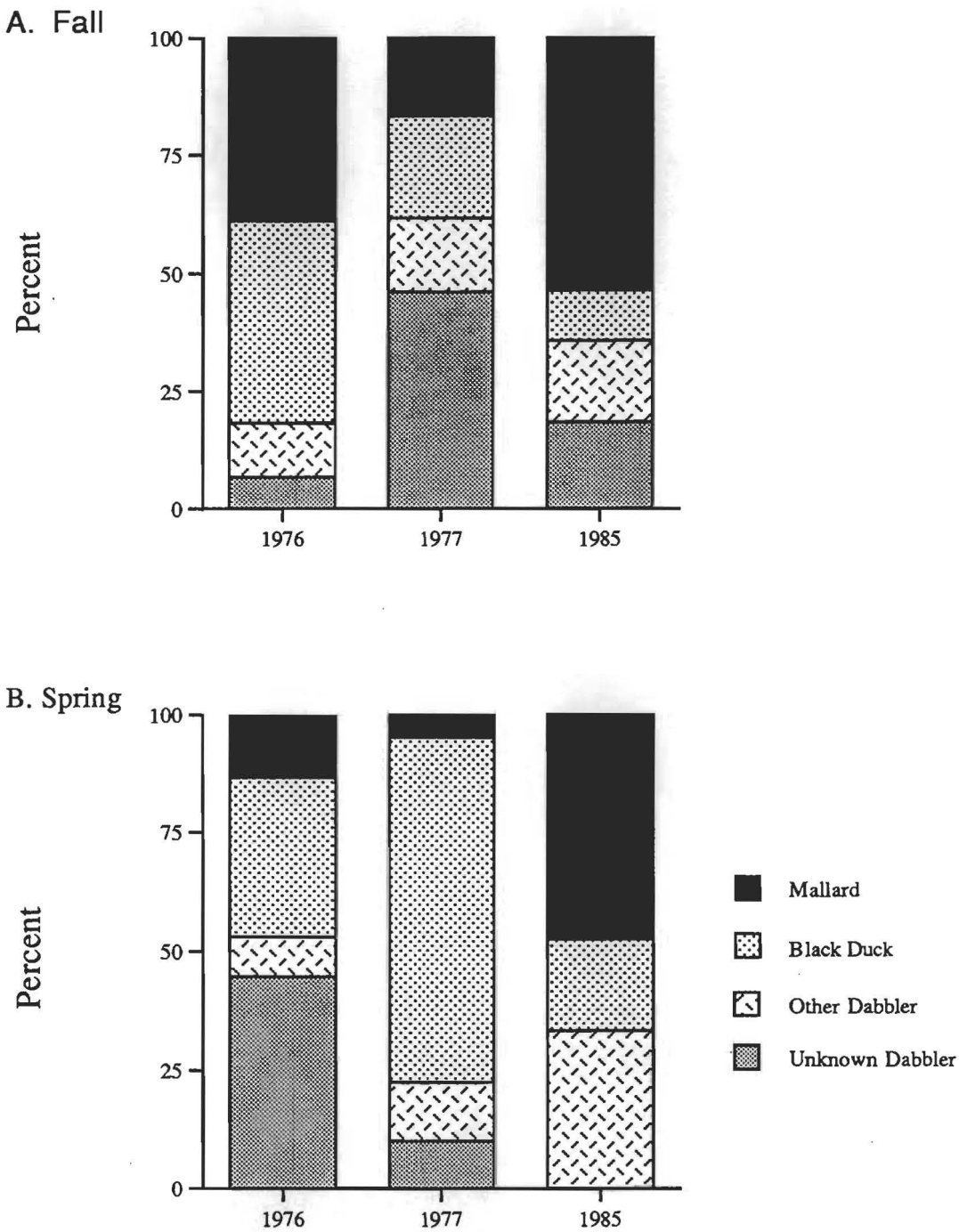


Fig. 7. Percent species composition of dabblers during (A) fall and (B) spring migrations in the St. Lawrence River AOC.

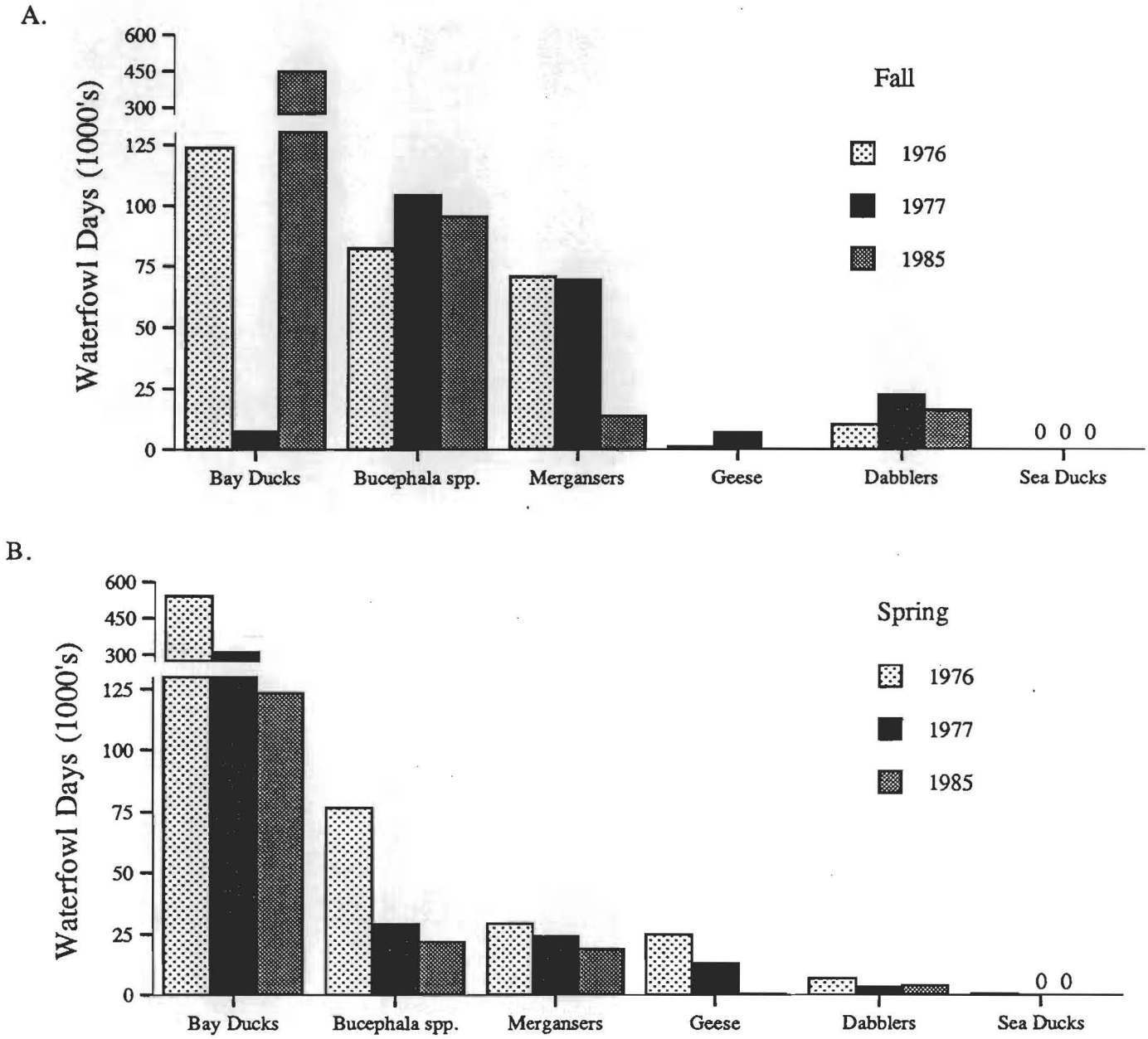


Fig. 6. Waterfowl use, by taxonomic group, of the St. Lawrence River AOC during (A) fall and (B) spring migrations.

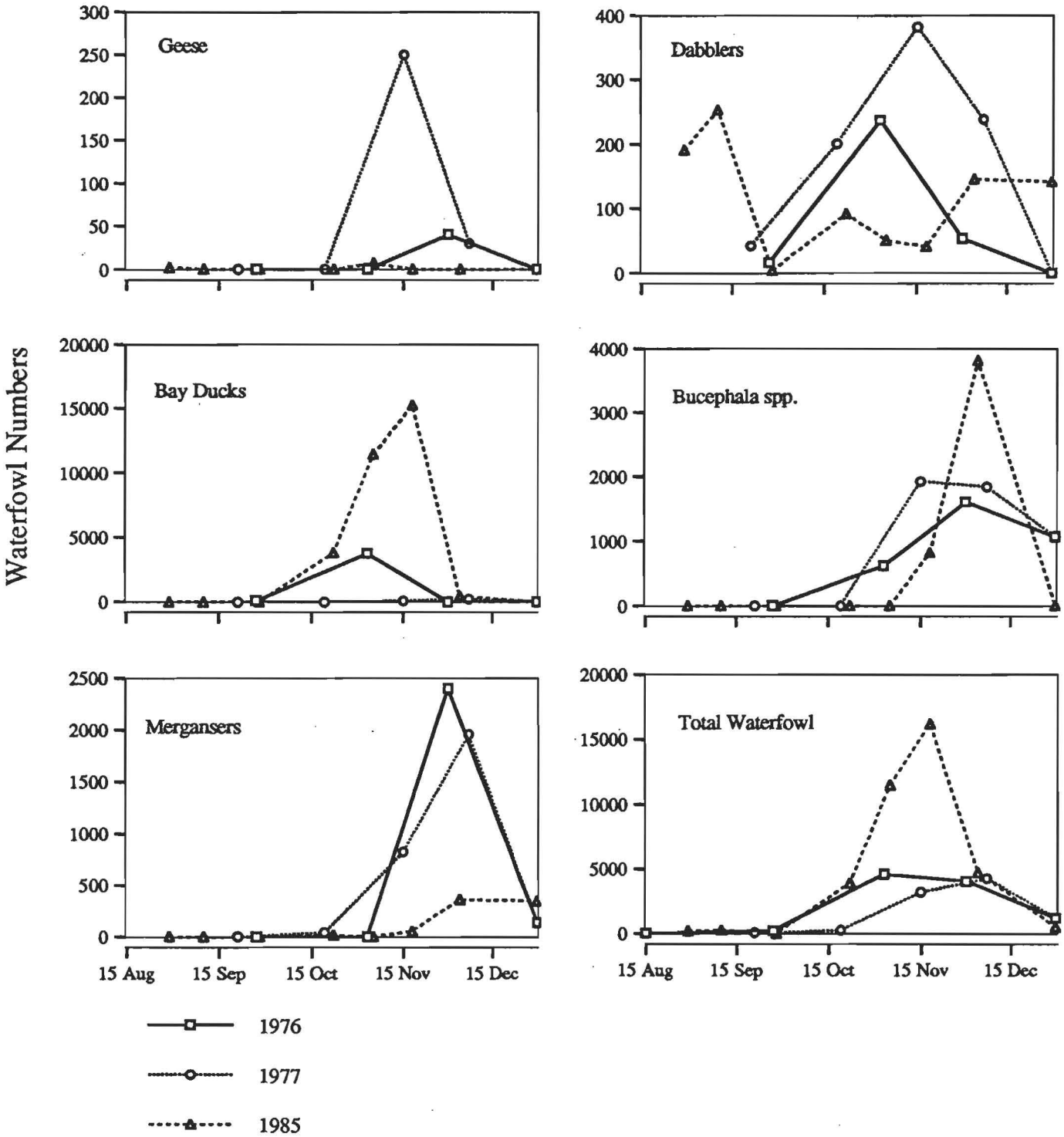


Fig. 8. Waterfowl counts in the St. Lawrence River AOC during fall surveys.

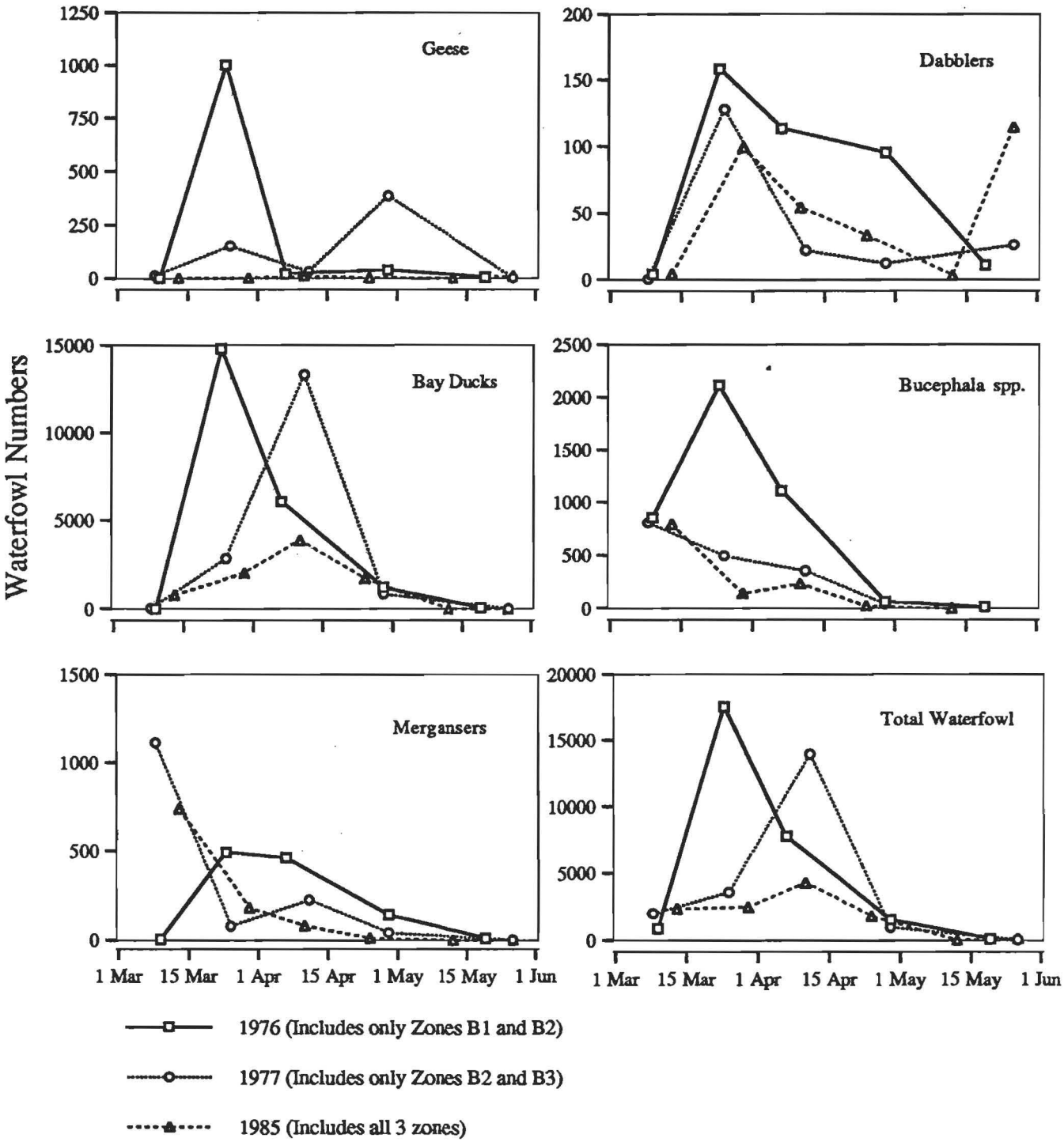


Fig. 9. Waterfowl counts in the St. Lawrence River AOC during spring surveys.

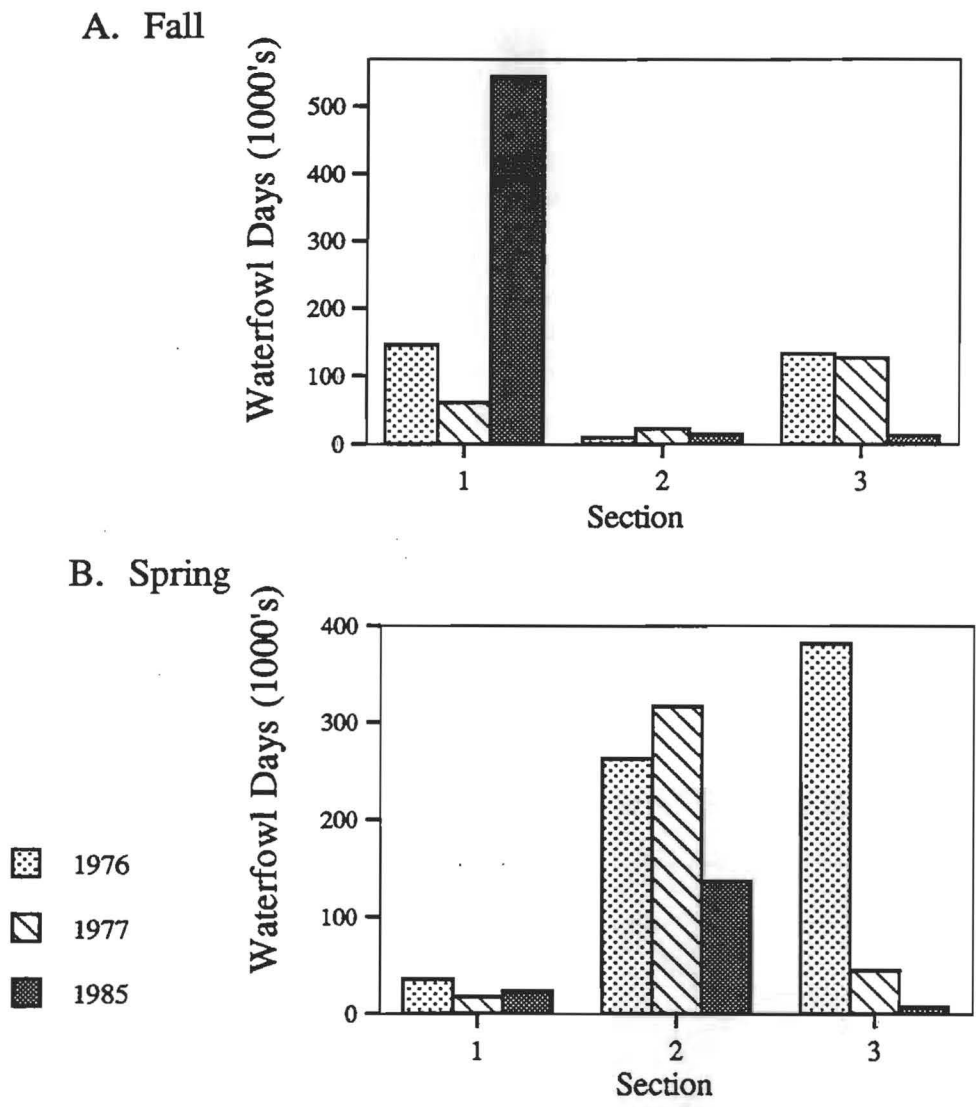


Fig. 10. Waterfowl use of each survey section of the St. Lawrence River AOC during (A) fall and (B) spring migrations.

3.1.1.3.6 Sea Ducks

In spring 1976, 11 scoters were reported.

3.1.1.3.7 Timing

In fall, peak numbers of waterfowl occurred in mid to late November (Fig. 8). The exception was dabblers whose numbers peaked either in early September (1985) or early November (1976). In spring 1976, total waterfowl numbers peaked at the end of March (Fig. 9), and in mid-April in 1977 and 1985 respectively. *Bucephala* spp. and merganser numbers were greatest in March when survey flights began and declined as the season progressed indicating the departure of overwintering birds. In 1977, goose numbers peaked in early May which probably reflects the staging of migrant Canada Geese heading for northern Quebec.

3.1.1.3.8 Distribution of Waterfowl Use

During fall, Section 2 consistently received the least amount of use; the other two sections received roughly equal use except in 1985 when waterfowl concentrated in Section 1 (Fig. 10). During spring migration, the reverse was true. Waterfowl concentrations were greatest in Section 2 because of its early thawing and shallow water. Sections 1 and 3 again received roughly equal use, except in 1976 when waterfowl concentrated in Section 3.

3.1.2 Bay of Quinte AOC

This is a long embayment (approx. 100 km) on the northeast side of Lake Ontario (Fig. 11). Its water quality has been impaired over the years by a diverse input of pollutants including agricultural runoff, sediments, sewage overflow, industrial discharges, and atmospheric deposition. Phosphorus inputs were causing extensive eutrophication which led to implementation of a major control program in the late 70's. Water quality has improved considerably in that regard in recent years. The other major impact has been shoreline development which has been deleterious to littoral habitat used by both fish and wildlife.

3.1.2.1 Survey Area and Sampling Dates

The survey area in the Bay of Quinte included shoreline from the Trenton River east to Sandhurst and was divided into 4 sections (Fig. 11). Section 1 included all shoreline from west of the Belleville bridge, Section 2 covered the area from Belleville to Deseronto, Section 3 from Deseronto to Woodville, and Section 4 covered from Woodville to Sandhurst. However, all four sections were not always sampled on the same day and did not receive equal coverage (Fig. 12). In 1976, there is no data for Section 1 during fall, and on 3 March and 1 December, the water in two of the four sections was frozen and so waterfowl numbers were assumed to be zero there. Baseline dates for waterfowl day calculations are listed in Table 3.

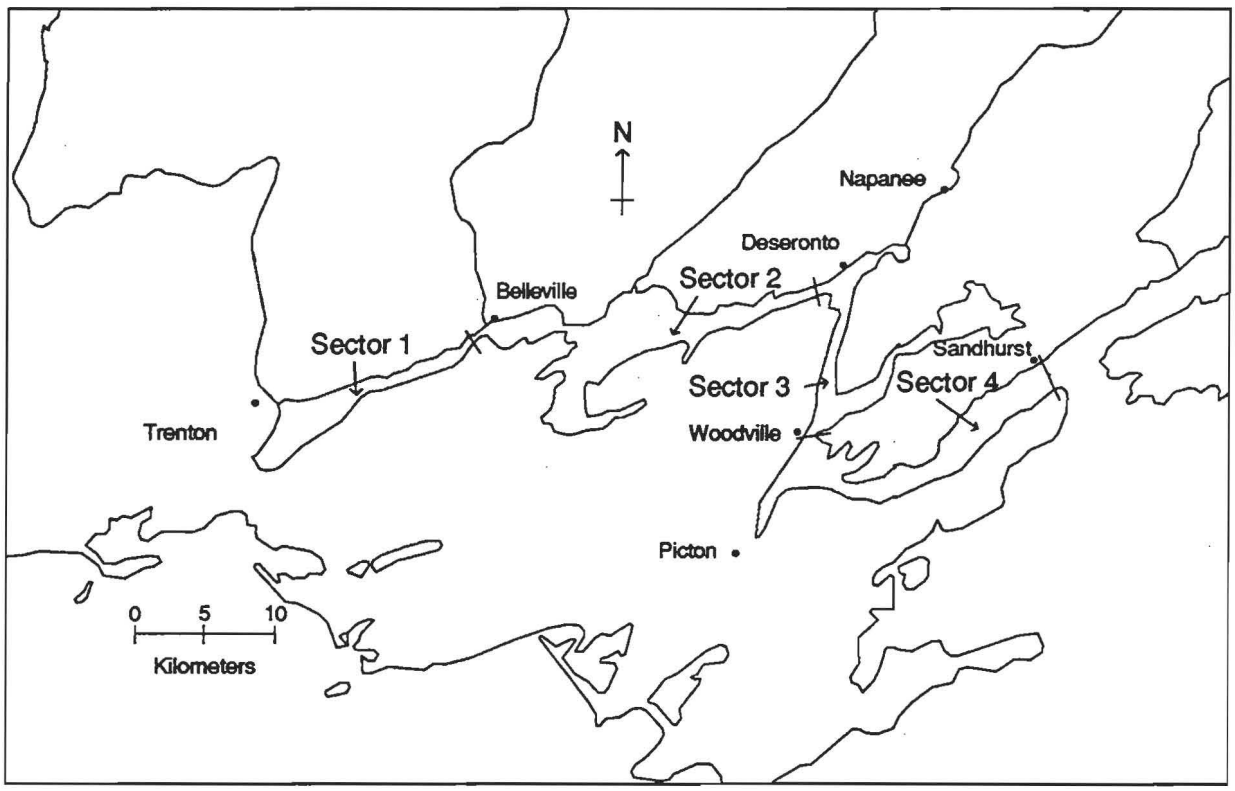


Fig. 11. Map of Bay of Quinte AOC showing survey sectors.

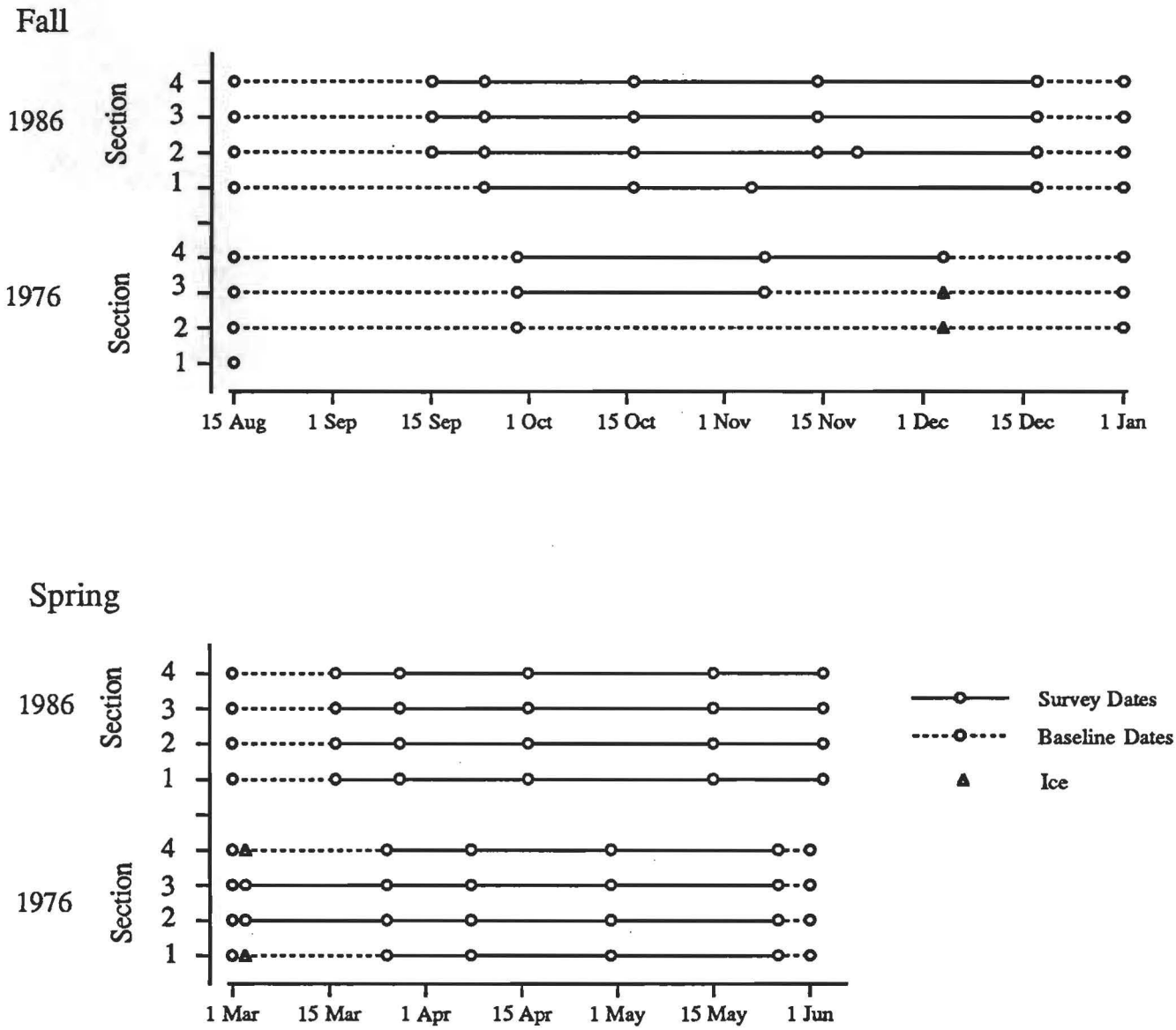


Fig. 12. Dates of aerial surveys in the Bay of Quinte AOC.

Table 3. Baseline dates used in waterfowl day calculations for the Bay of Quinte AOC.

	Entering Spring	End of Season	Entering Fall	End of Season
1976	11 March 1976	25 May 1976	29 Sept. 1976	20 Jan. 1977
1986	17 March 1986	3 June 1986	3 June 1986	17 Dec. 1986

3.1.2.2 Bay of Quinte - Overall Trends

Total waterfowl use averaged 80,500 waterfowl days in fall and 300,000 waterfowl days in spring (Fig. 13). Although the 1986 fall estimate was much larger than the 1976 estimate, sampling effort was limited in fall 1976 (Fig. 12) which could have led to a reduced value due to sampling error.

The proportions of each taxonomic group within the waterfowl total remained relatively stable between the two spring surveys (Fig. 14). However, the species composition of fall migrants differed between the two survey years. The proportion of mergansers in the 1976 sample was lower than in 1986 while the reverse was true for *Bucephala* spp. was high but the reverse was true in 1986.

3.1.2.3 Bay of Quinte - Results by Taxonomic Group

3.1.2.3.1 Mergansers

All species have been recorded during surveys, and together they average 50,000 waterfowl days during spring migration. During fall 1986, merganser days reached 68,000 but in fall 1976, were considerably lower (130 waterfowl days - Fig. 15). As noted earlier, sampling error may have played a role in this difference although changing size and availability of fish could have influenced use (Ross 1989).

3.1.2.3.2 *Bucephala* spp.

Both Common Goldeneye and Bufflehead were present, together averaging 18,000 waterfowl days during both spring and fall migrations. Common Goldeneye represented, on average, 70% of the *Bucephala* spp..

3.1.2.3.3 Dabblers

During fall, average dabbler use increased from 3,000 to 23,000 from 1976 to 1986 (Fig. 15). During spring, dabbler use was relatively constant, averaging 3,000 waterfowl days. Although all of the dabbler species have been reported in the Bay of Quinte, species composition is uncertain as most were not identified to species (Fig. 16).

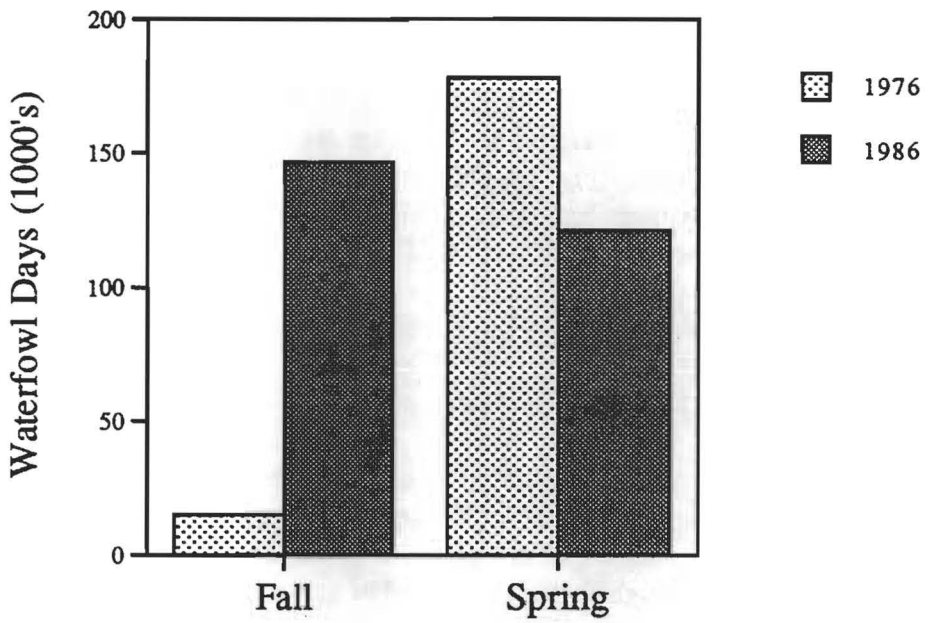


Fig. 13. Total waterfowl use of the Bay of Quinte AOC during fall and spring migrations.

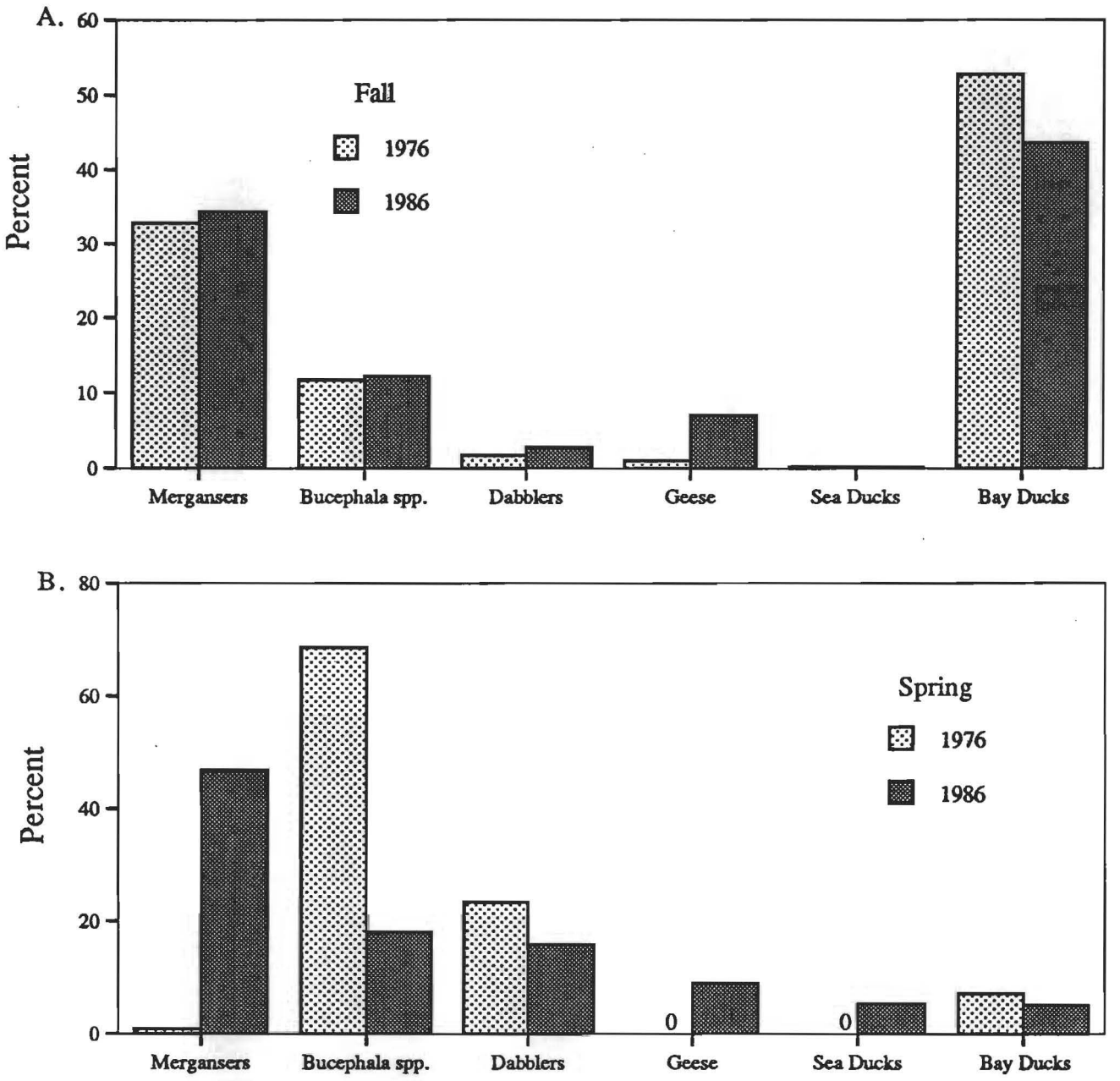


Fig. 14. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in the Bay of Quinte AOC.

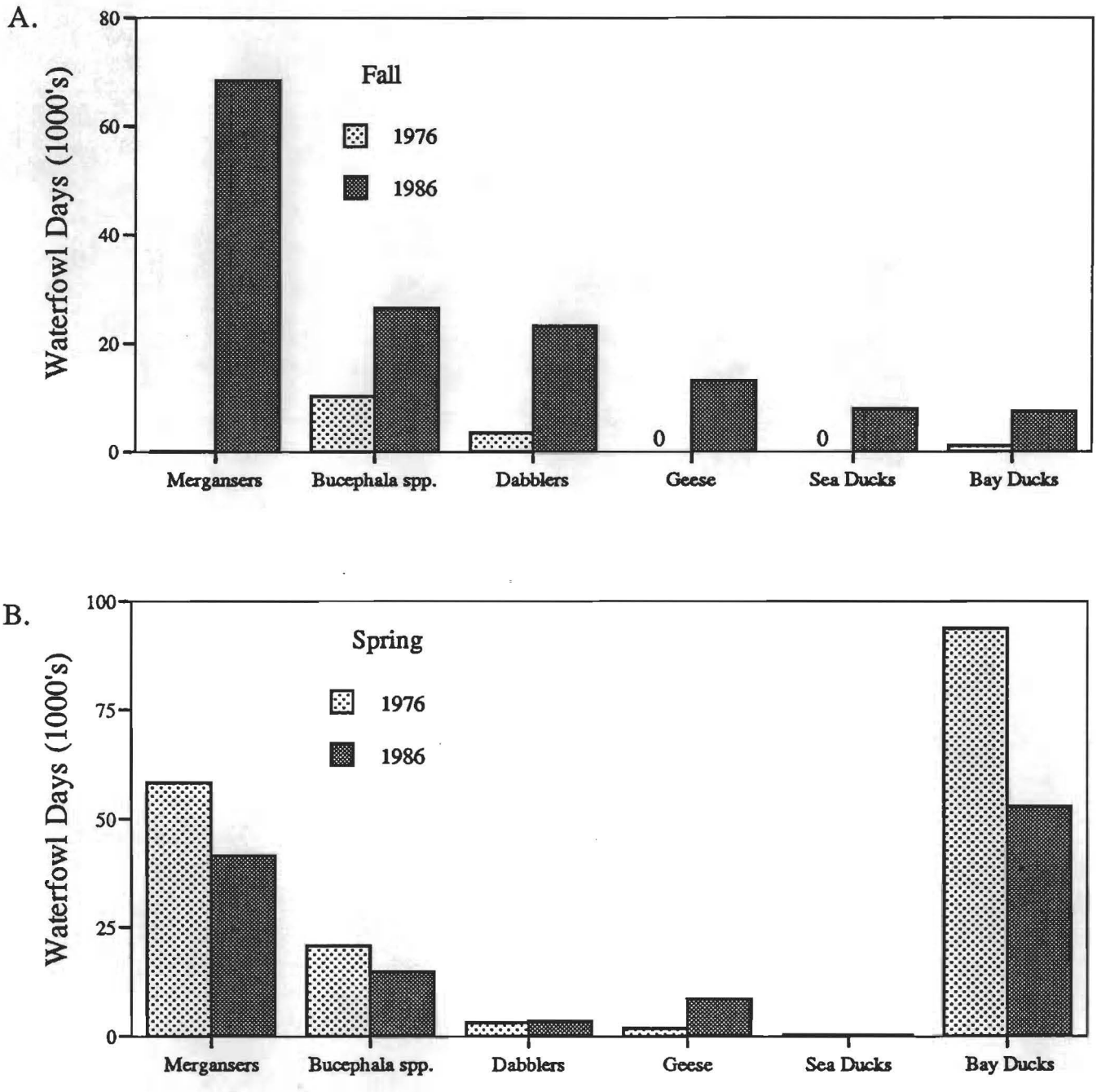


Fig. 15. Waterfowl use, by taxonomic group, of the Bay of Quinte AOC during (A) fall and (B) spring migrations.

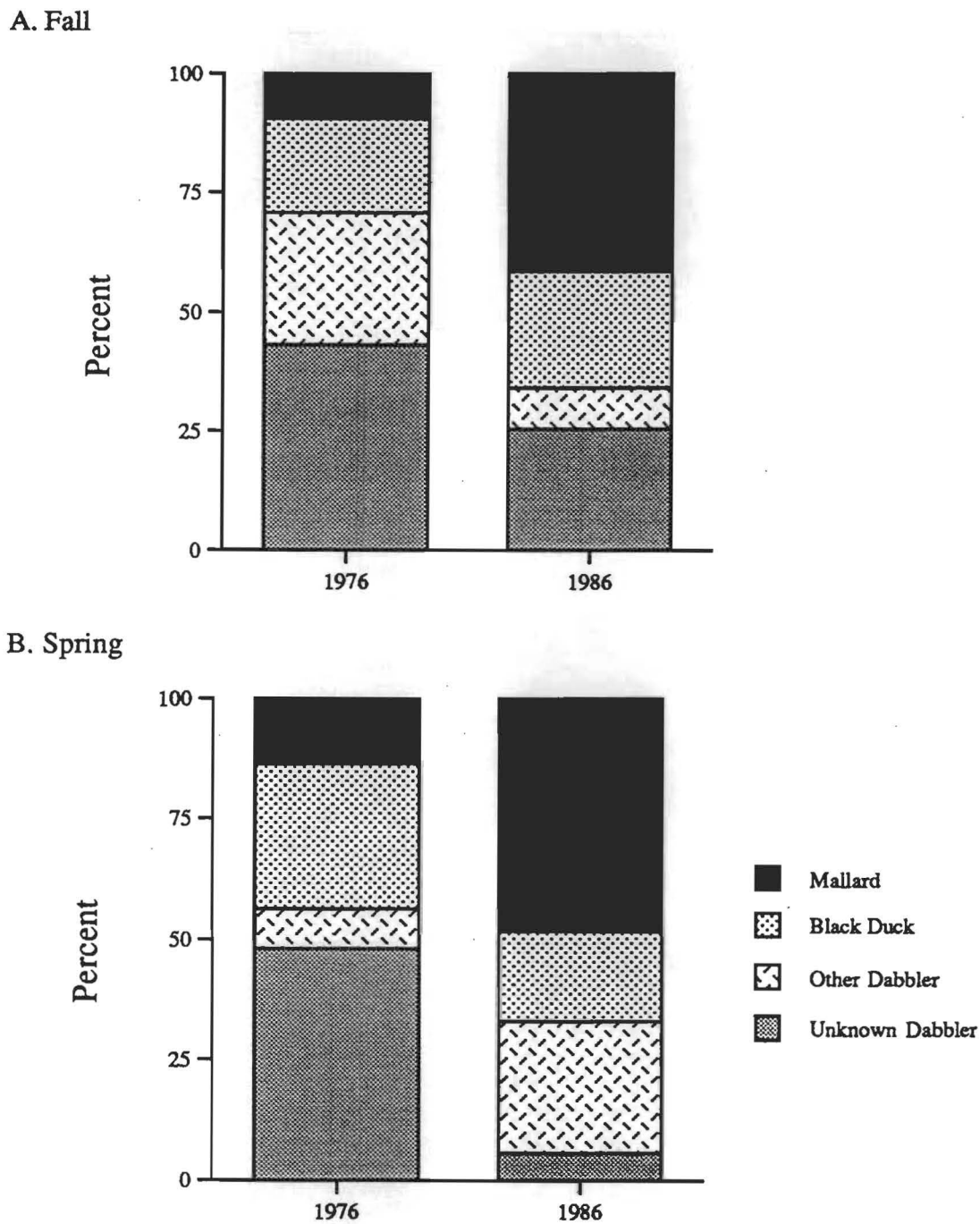


Fig. 16. Percent species of dabblers during (A) fall and (B) spring migrations in the Bay of Quinte AOC.

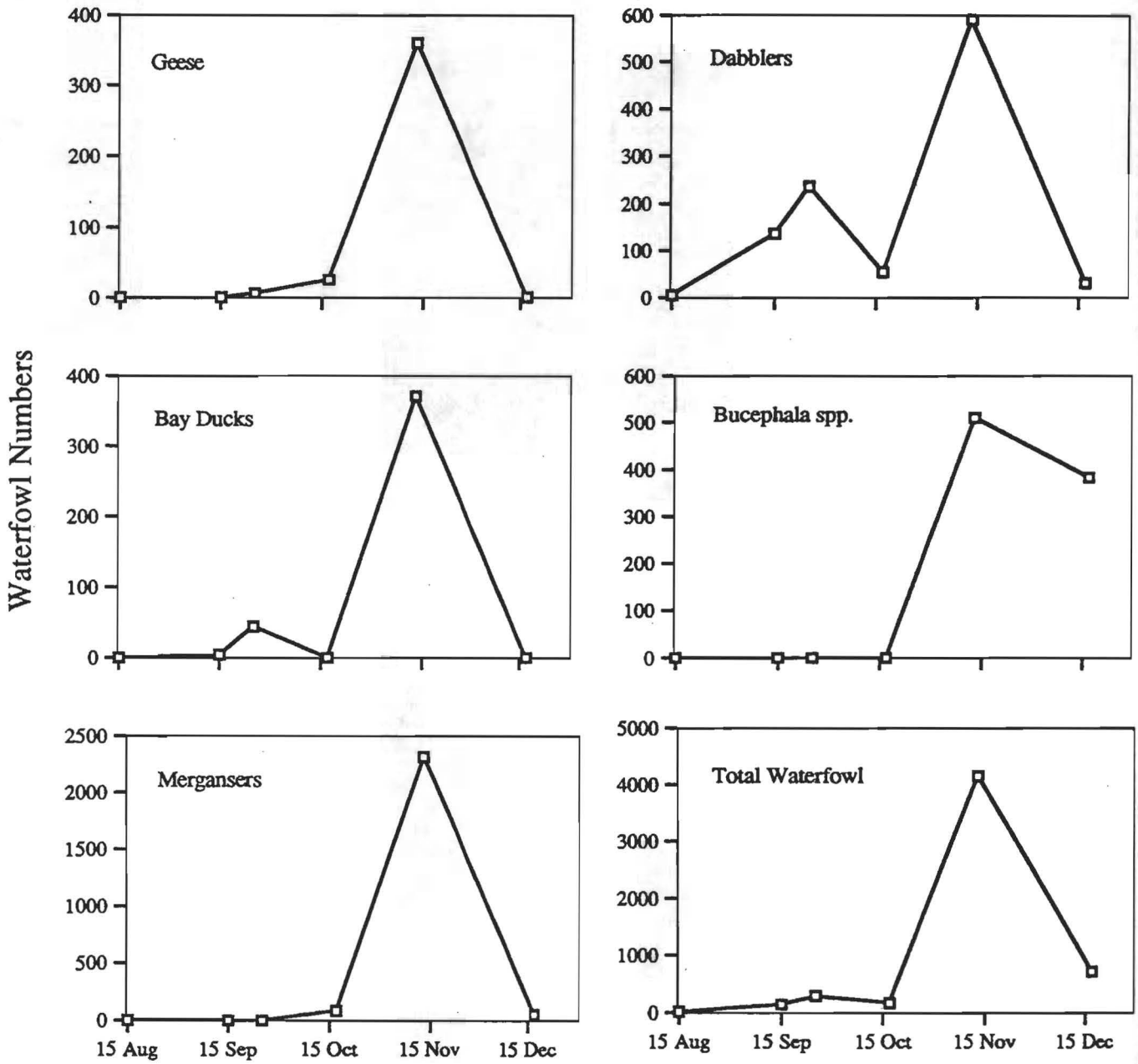


Fig. 17. Waterfowl counts in the Bay of Quinte AOC during fall surveys 1986.

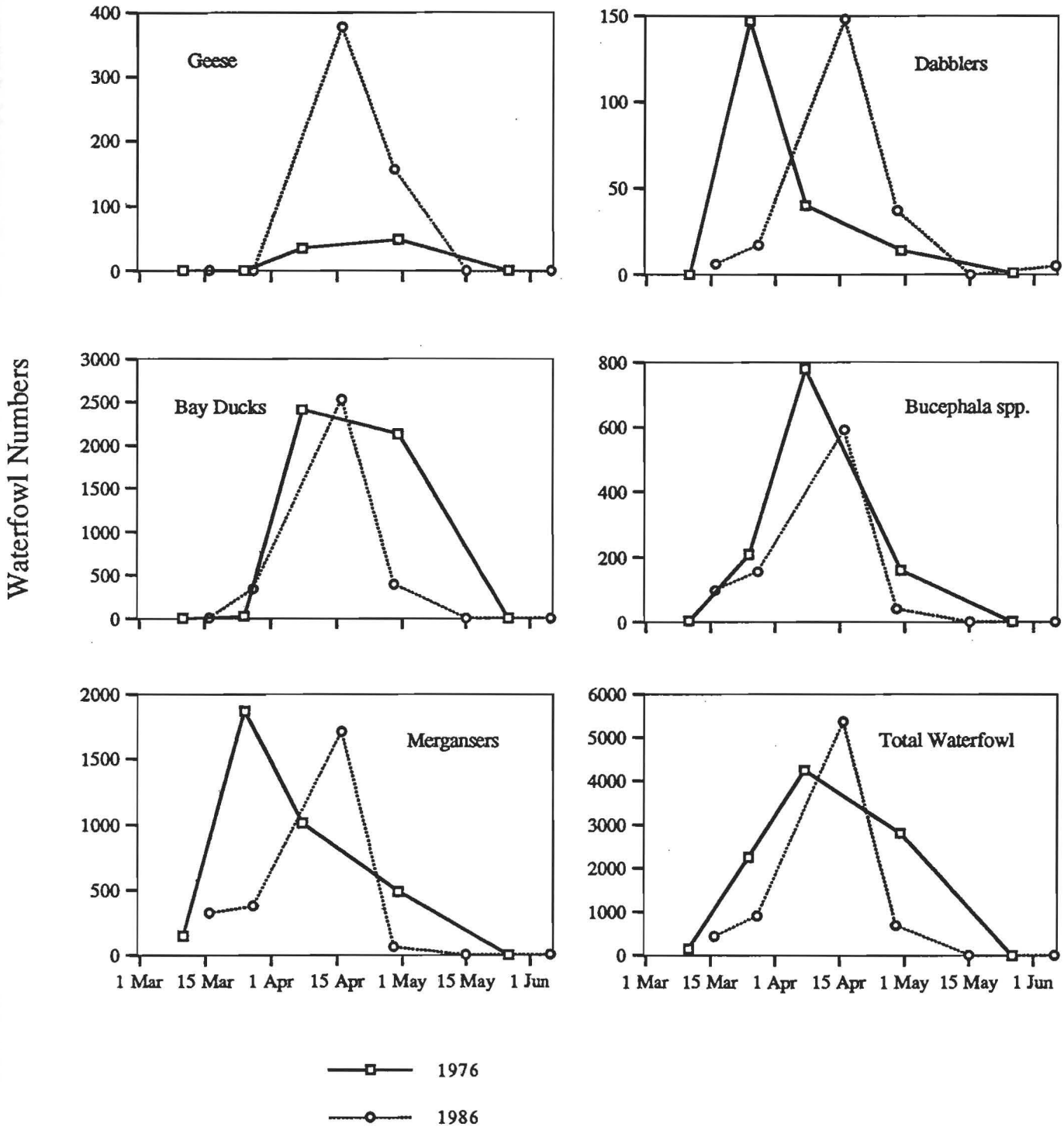


Fig. 18. Waterfowl counts in the Bay of Quinte AOC during spring surveys.

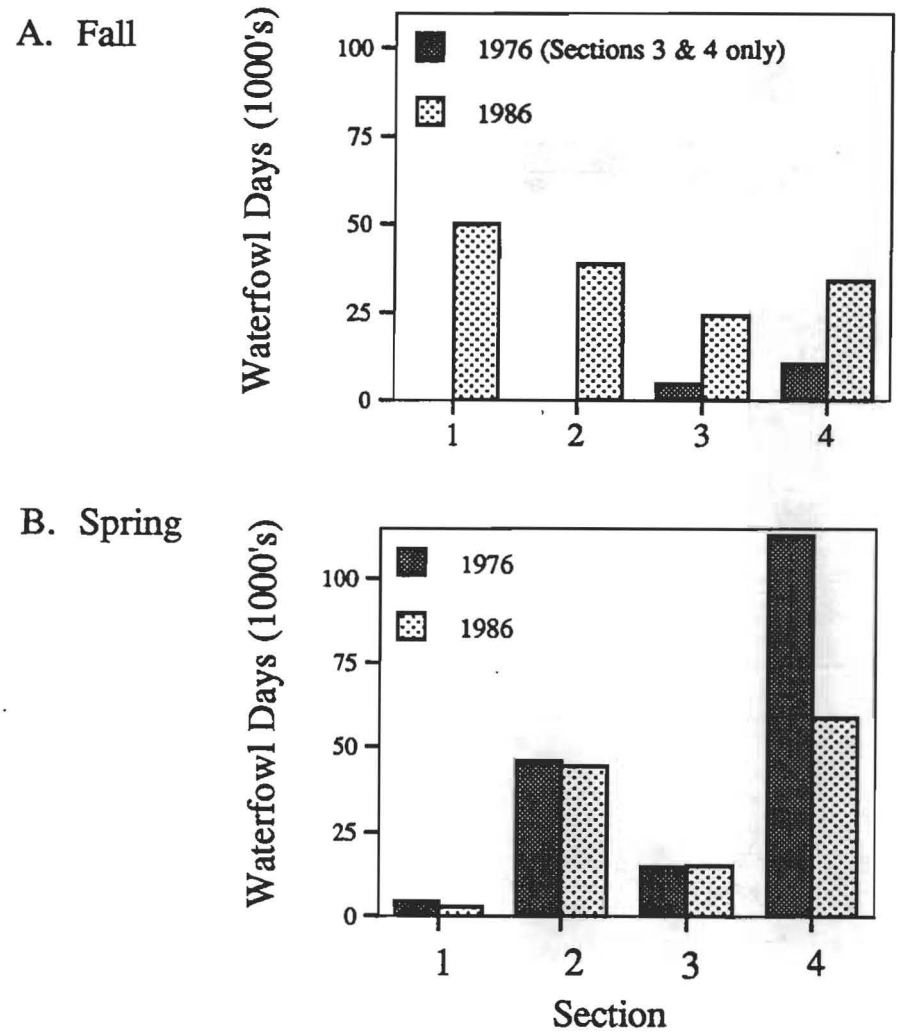


Fig. 19. Waterfowl use of each survey section of the Bay of Quinte AOC during (A) fall and (B) spring migrations.

3.1.2.3.4 Geese

Only Canada Geese were reported. During fall, none were seen in 1976 but in 1986 there were 13,000 waterfowl days attributed to geese. During spring, use was higher in 1986, but averaged only 4,000 waterfowl days.

3.1.2.3.5 Sea Ducks

During fall 1976, no sea ducks were reported and during all other surveys only Oldsquaw were reported. There were 7,000 waterfowl days attributed to Oldsquaw in fall 1986 and an average of 250 waterfowl days during spring migrations.

3.1.2.3.6 Bay Ducks

Bay duck use averaged 4,000 waterfowl days in fall and 73,000 waterfowl days in spring. Although Ring-necked Ducks, Canvasbacks, and Redheads have all been reported in the Bay of Quinte, scaup represented over 98% of the identified species in the bay duck group.

3.1.2.3.7 Timing

During fall 1986, the highest numbers of waterfowl occurred in the Quinte area in mid-November (Fig. 17). During spring, the 1986 peak occurred roughly two weeks later than the 1976 peak, probably due to differences in ice cover (Fig. 18). Most waterfowl moved through in April but in 1976 merganser and dabbler numbers peaked in late March.

3.1.2.3.8 Distribution of Waterfowl Use

During fall 1986, each section averaged 35,000 waterfowl days with Section 1 receiving the most use and Section 3 the least (Fig. 19). During spring, the distribution of waterfowl use was not as even. Section 1 received relatively little use and in Section 4 use was quite high reflecting the availability of open water early in the spring.

3.1.3 Metro Toronto AOC

The Lake Ontario shore of Metro Toronto (Fig. 20) is under intense pressure from urbanization and other impacts of rapid population growth. Problems include polluted stormwater runoff, sewage overflows, and industrial discharge, all of which have led to very impaired fish and wildlife habitat.

3.1.3.1 Survey Area and Sampling Dates

The 1971/72 survey area covered the shoreline from Port Union to Burlington. The 1980/81 survey covered from Port Union to Oakville (Fig. 20). In 1980/81 the area was divided into 3 sections. Section 20 covered the area from Oakville to the Toronto Island Airport, Section 21 covered from

airport to Greenwood Racetrack, and Section 22 covered from the racetrack to Port Union.

Surveys were undertaken in spring and fall of 1971/72 and 1980/81 (Fig. 21). Baseline dates for waterfowl use calculations are listed in Table 4.

Table 4. Baseline dates used in waterfowl day calculations for the Metro Toronto AOC.

	Entering Fall	End of Season	Entering Spring	End of Season
1971/72	1 Sept. 1971	12 Dec. 1971	10 Feb. 1972	5 June 1972
1980/81	3 Sept. 1980	15 Dec. 1980	19 March 1981	25 May 1981

3.1.3.2 Metro Toronto - Overall Trends

The Metro Toronto AOC was used by waterfowl more during fall than during spring migrations, but the total number of waterfowl days was roughly equal between years, averaging to 690,000 waterfowl days in fall and 179,000 in spring (Fig. 22). The species composition changed between years; the proportions of sea ducks, geese, mergansers and swans increased, while those of dabblers, bay ducks and *Bucephala* spp. decreased (Fig. 23). Goose and swan use increases are probably a result of population increases. However, reasons for the other changes are unknown.

3.1.3.3 Metro Toronto - Results by Taxonomic Group

3.1.3.3.1 Dabblers

Dabbler use was lower in 1980/81 than in 1971/72 (Fig. 24). There have been small numbers of Gadwall, Green-winged Teal, Blue-winged Teal, American Wigeon, and Wood Duck reported. However, the most common species were Mallards and Black Ducks, together always comprising more than 96% of dabbler waterfowl days (Fig. 25). The proportion of Black Ducks in the dabbler group declined while the proportion of Mallards increased.

3.1.3.3.2 Bay Ducks and Ruddy Ducks

Use by this group was lower in 1980/81 than in 1971/72 (Fig. 24). During both spring and fall, scaup made up over 90% of the group. As well as scaup, small numbers of Redheads, Ring-necked Ducks, and Canvasbacks were reported during the fall of 1971, and only Redheads in fall 1980. During

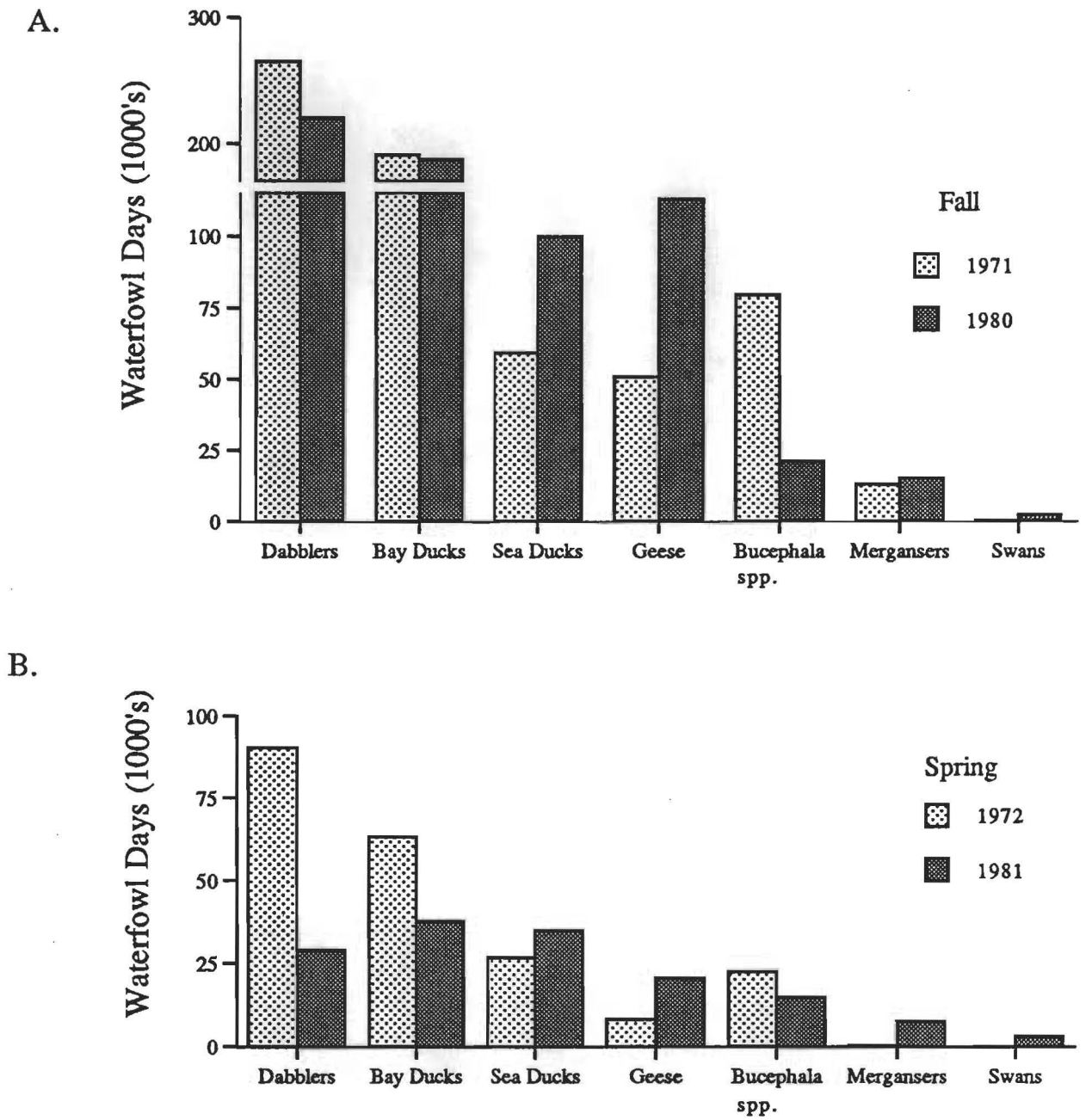


Fig. 24. Waterfowl use, by taxonomic group, of the Metro Toronto AOC during (A) fall and (B) spring migrations.

spring 1972, both Redhead and Canvasback were also seen while in spring 1981, Ruddy Ducks were the only additional species recorded.

3.1.3.3.3 Sea Ducks

The sea ducks were represented almost entirely by Oldsquaw, with scoters always comprising less than 0.2% of the group. Oldsquaw used the area more in 1980/81 than in 1971/72 (Fig. 24). More recently, White-winged Scoters in particular have increased in abundance in this area, possibly as a result of invasion of Zebra Mussels.

3.1.3.3.4 Geese

Canada Geese used the area more in 1980/81 than in 1971/72 (Fig. 24) and numbers have continued to increase. No other goose species were sighted during the surveys.

3.1.3.3.3 Mergansers

Large mergansers used the area more in 1980/81 than in 1971/72 (Fig. 24) although the breakdown by species is not available.

3.1.3.3.4 *Bucephala* spp.

Bucephala spp. used the area less in 1980/81 than in 1971/72 (Fig. 24). Common Goldeneye were usually more abundant than Bufflehead, always comprising greater than 60% of the group except in spring 1981 when they comprised only 45%.

3.1.3.3.5 Swans

The number of waterfowl days attributed to swans was greater in 1980/81 than in 1971/72 (Fig. 24). Mute Swans were seen during all four surveys and were the only species of swan seen in fall 1980 and spring 1972. This species also comprised 74% of the swans in fall 1971 and 30% in spring 1981, 30% were Mute Swans. Tundra Swans were present only in fall 1971 and in spring 1981.

3.1.3.3.6 Timing

In fall, most of the waterfowl species peaked in numbers from early to mid-November (Fig. 26). One exception was in 1971; bay duck numbers continued to increase through to mid-December at which time survey flights were stopped. A second exception was geese in 1971; numbers were highest in early September.

In spring, waterfowl numbers peaked in March and declined as the season progressed (Fig. 27). The exceptions occurred in 1981 when swan numbers peaked in early April, and goose numbers showed a second peak at the end of May which was probably a result of a moult migration into the area.

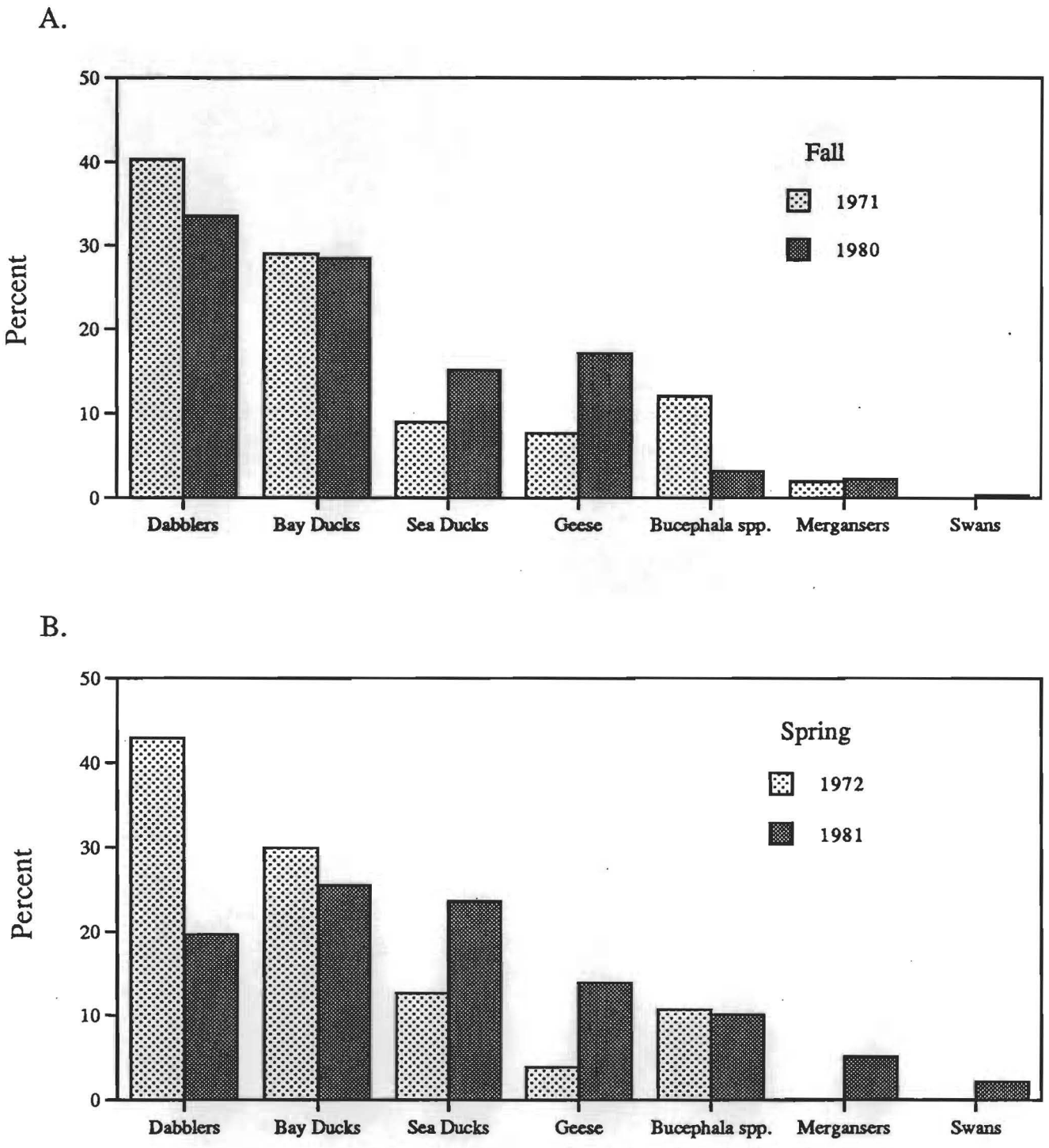


Fig. 23. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in the Metro Toronto AOC.

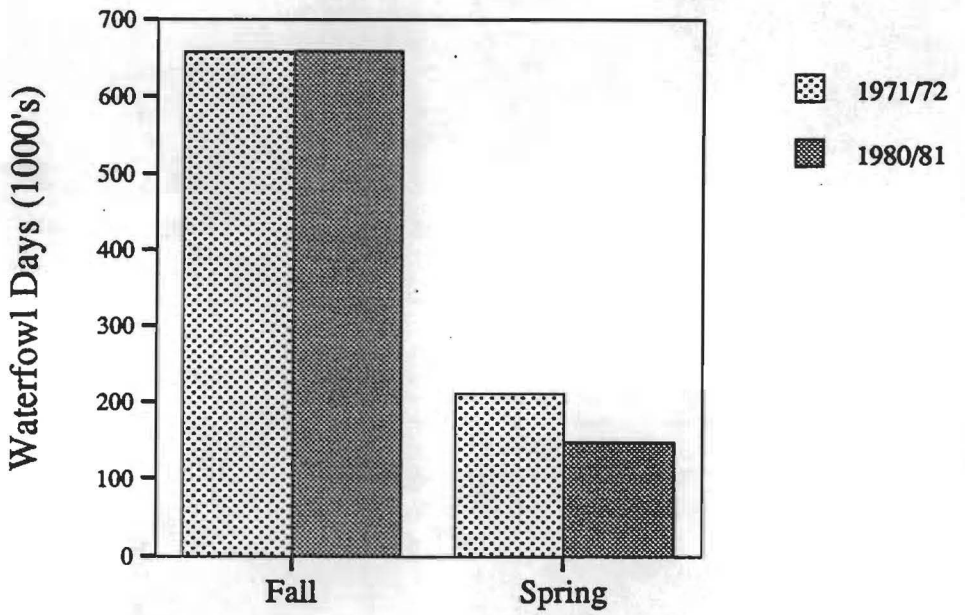


Fig 22. Total waterfowl use of the Metro Toronto AOC during fall and spring migrations.

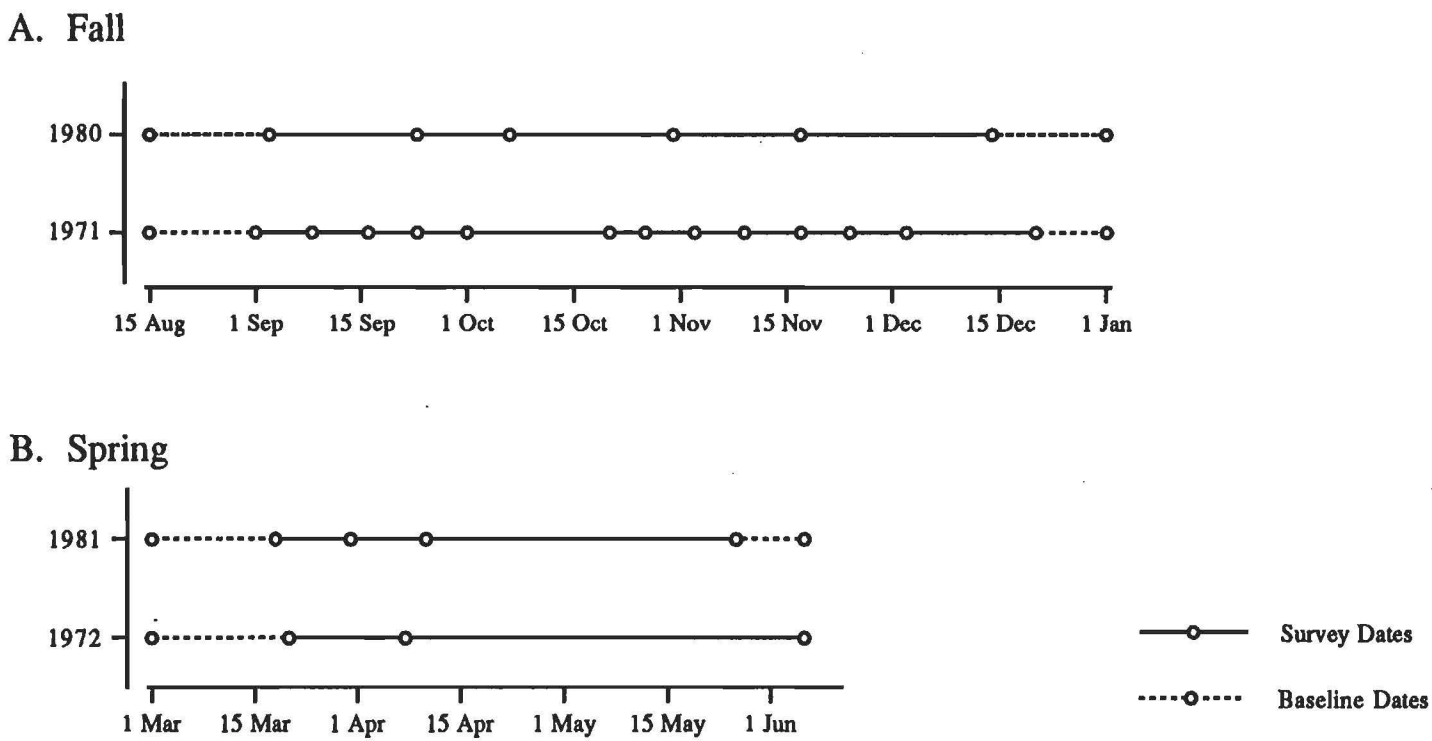


Fig. 21. Dates of aerial surveys in the Metro Toronto AOC.

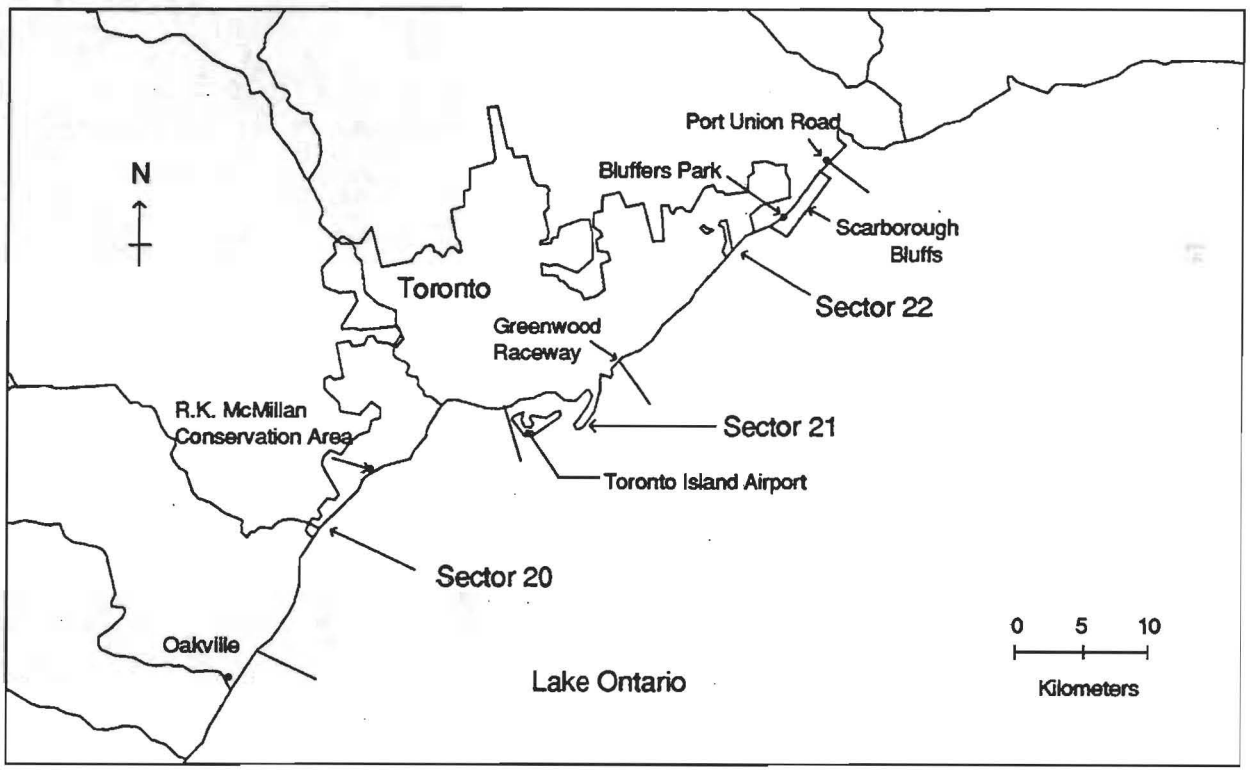


Fig. 20. Metro Toronto AOC showing survey sectors.

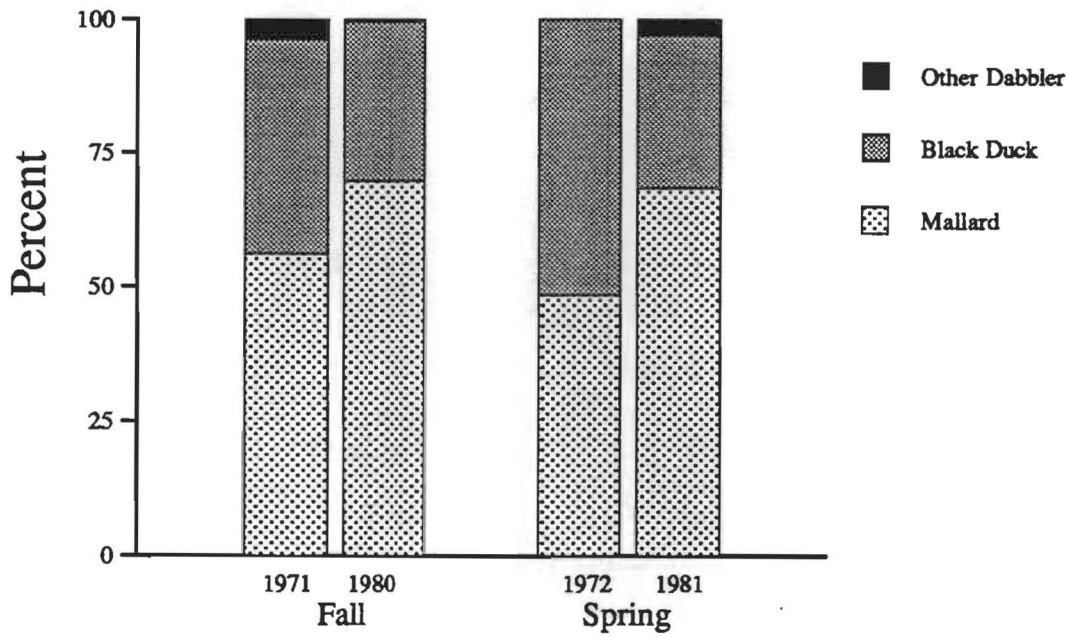


Fig. 25. Percent species composition of dabblers during fall and spring migrations in the Metro Toronto AOC.

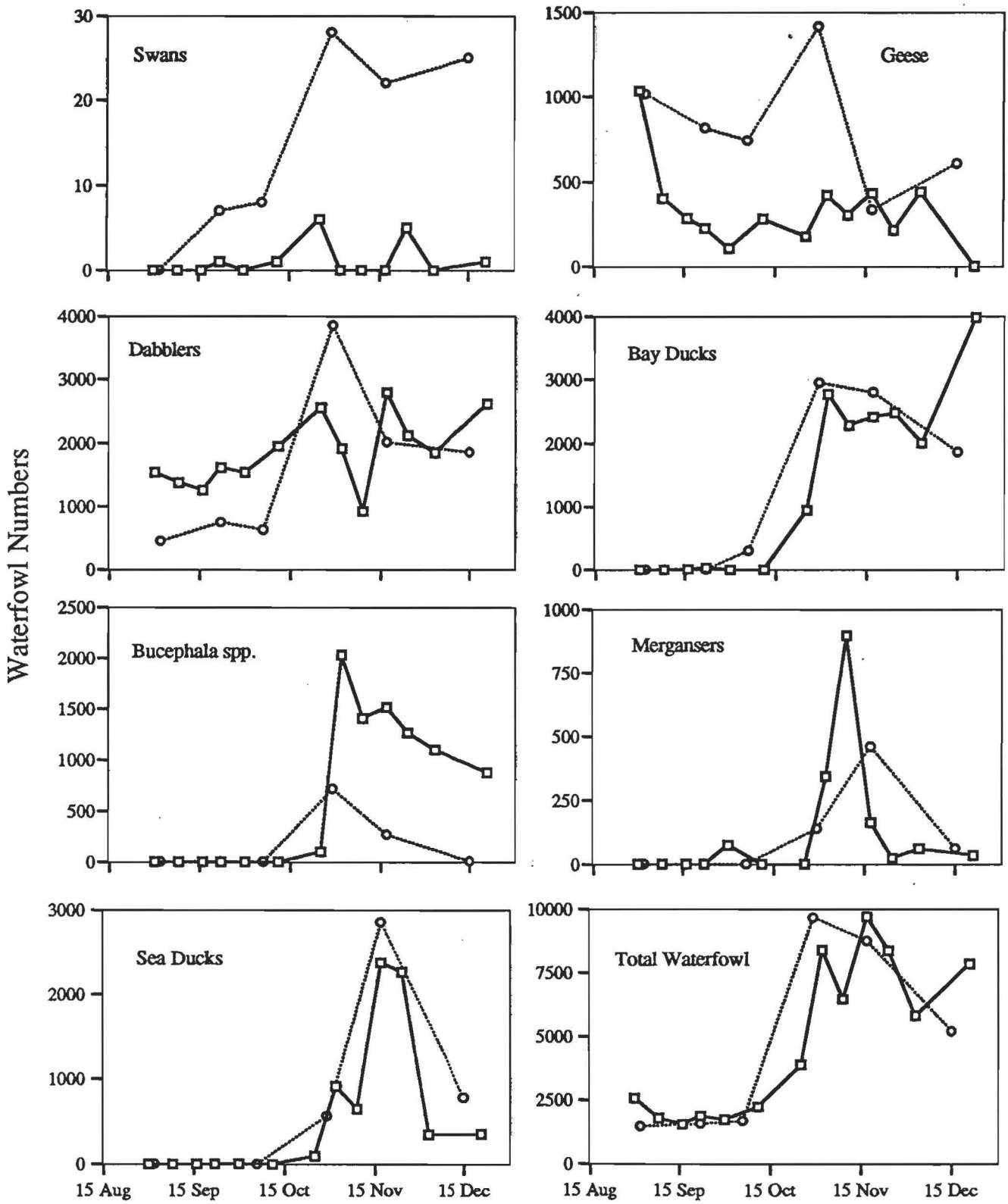


Fig. 26. Waterfowl counts in the Metro Toronto AOC during fall surveys.

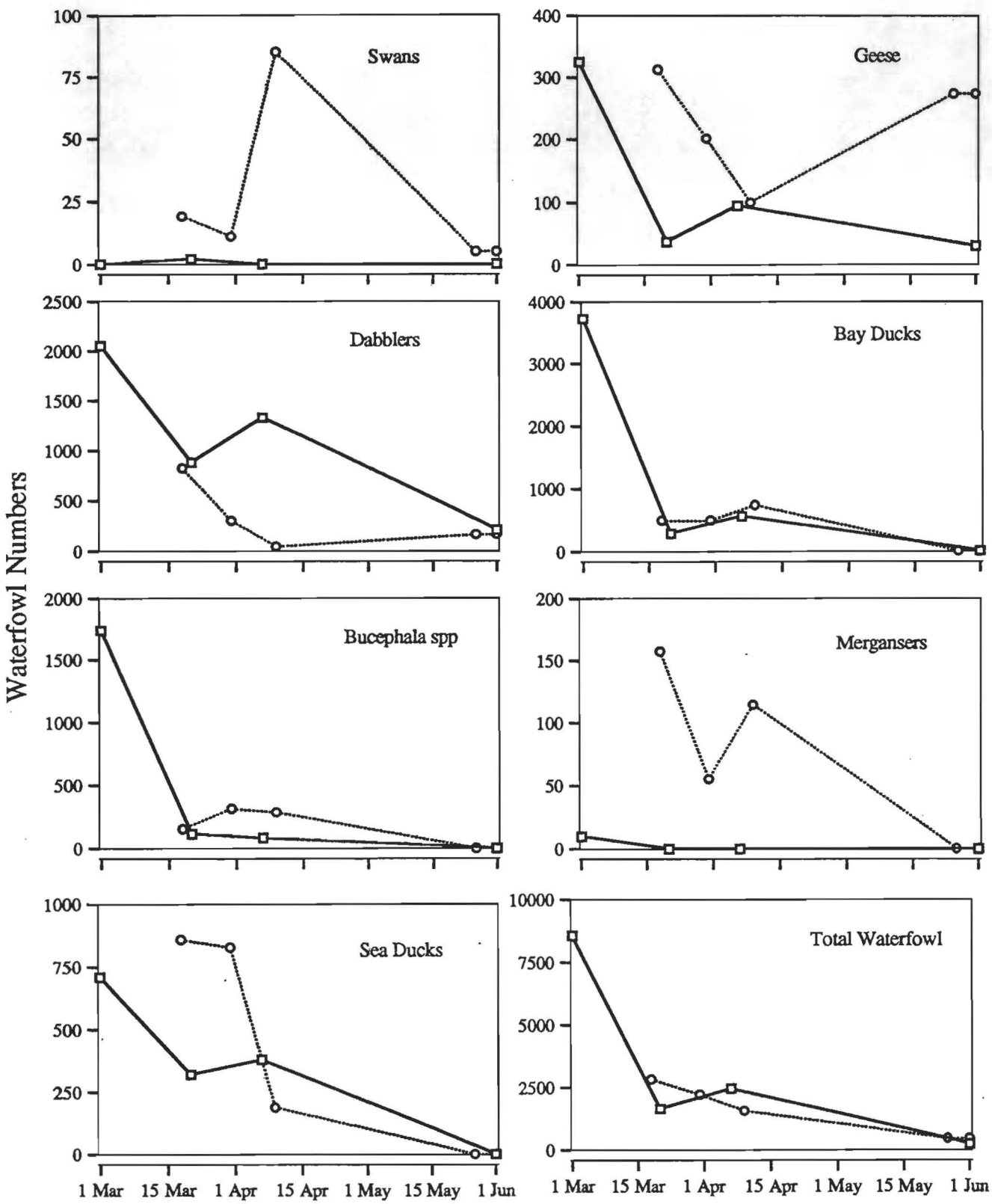


Fig. 27. Waterfowl counts in the Metro Toronto AOC during spring surveys.

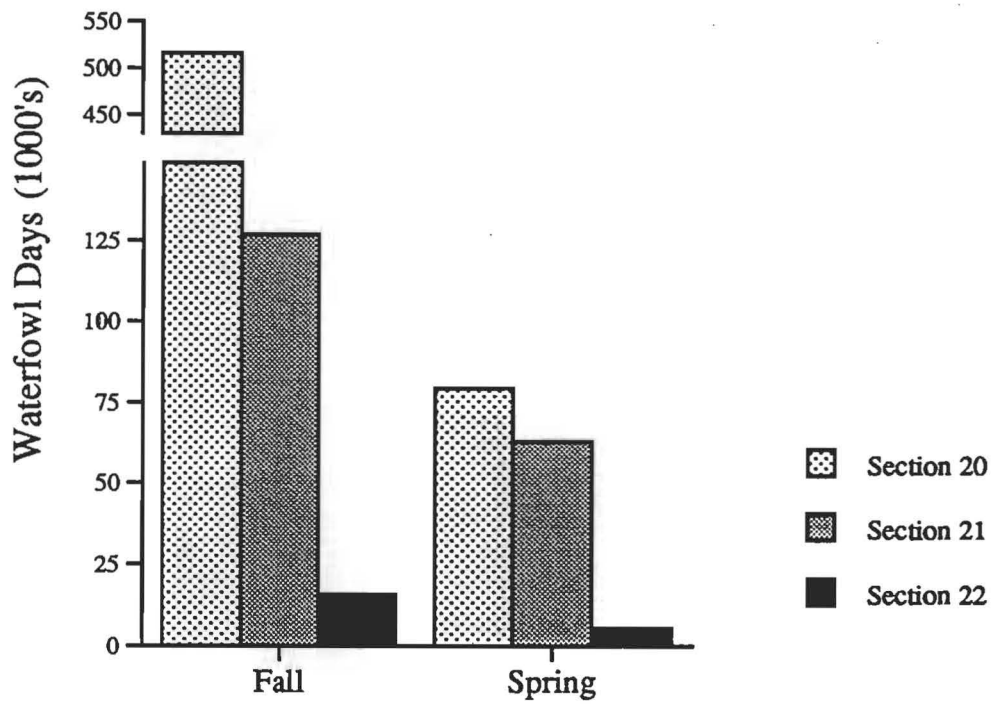


Fig. 28. Waterfowl use of each survey section of the Metro Toronto AOC during fall and spring migrations 1981.

3.1.3.3.7 Distribution of Waterfowl Use

During both seasons of 1980/81, Section 20 received the most use and Section 22 the least (Fig. 28). In Section 20, dabblers and geese were more or less uniformly distributed along the shore with concentrations around parks. Large numbers of scaup concentrated off the R.K. McMillan Conservation Area, especially in fall. Section 21 harbours relatively large concentrations of sea ducks, particularly Oldsquaw, which congregated around Toronto Island. This area also has relatively high numbers of geese and dabblers. Section 22 contains the Scarborough Bluffs which provide relatively poor waterfowl habitat although geese and dabblers do concentrate around the Bluffers Park area.

3.1.4 Hamilton Harbour AOC

This area is centered on a sheltered embayment (Hamilton Harbour) at the west end of Lake Ontario. Environmental impairment is caused by urbanization, pollution from heavy industry and the associated deepwater port, shoreline development, contaminated sediments, and sewer overflows. 75% of wetlands, inlets and shallow water areas have been lost to infilling and canal development.

3.1.4.1 Survey Area and Sampling Dates

The survey area included Hamilton Harbour from Windermere Basin to Indian Point plus Cootes Paradise (Fig. 29). The surveys took place in fall and spring 1971/72, 1980/81 and 1993/94 (Fig. 30). Baseline dates used in waterfowl day calculations are listed in Table 5.

Table 5. Baseline dates used in waterfowl day calculations for the Hamilton Harbour AOC.

	Entering Fall	End of Season	Entering Spring	End of Season
1971/72	1 Sept. 1971	21 Dec. 1971	10 Feb. 1972	5 June 1972
1980/81	3 Sept. 1980	15 Dec. 1980	19 March 1981	25 May 1981
1993/94	1 Sept. 1993	23 Dec. 1993	17 March 1994	31 May 1994

3.1.4.2 Hamilton Harbour - Overall Trends

Hamilton Harbour was used by waterfowl more during fall than spring migrations in two of three years (Fig. 31). Total number of waterfowl days during fall migrations increased each survey year from 9,500 in 1971, to over 450,000 in 1993. Spring migration use showed no clear trends, averaging 63,000 waterfowl days each year.

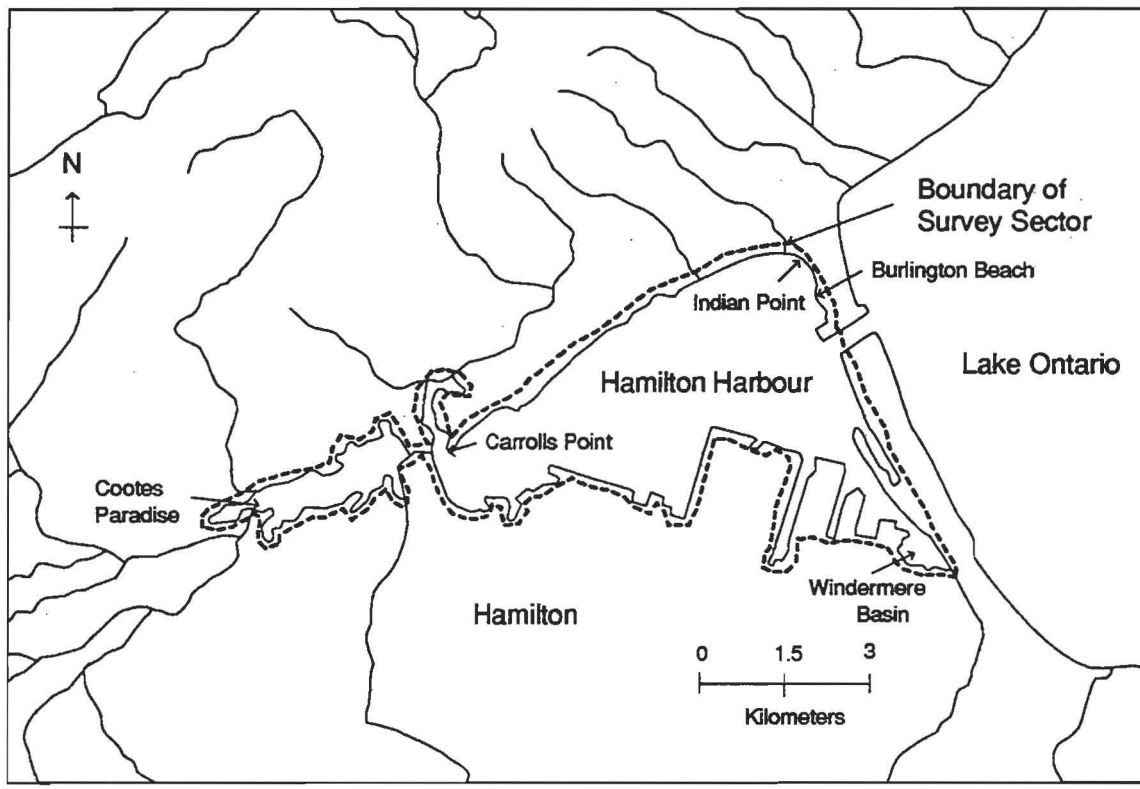
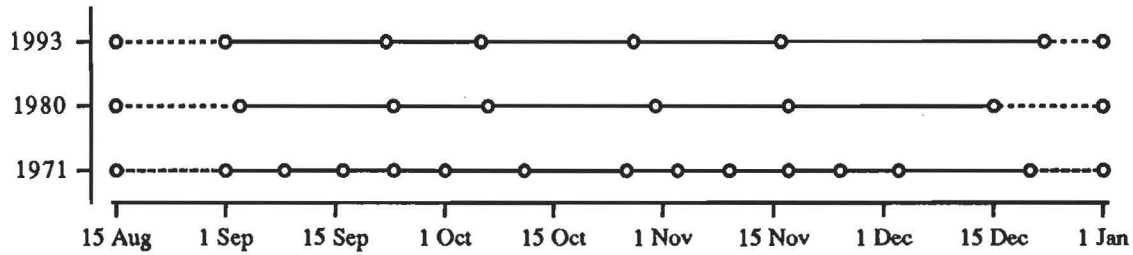


Fig. 29. Map of Hamilton Harbour showing survey sector.

A. Fall



B. Spring

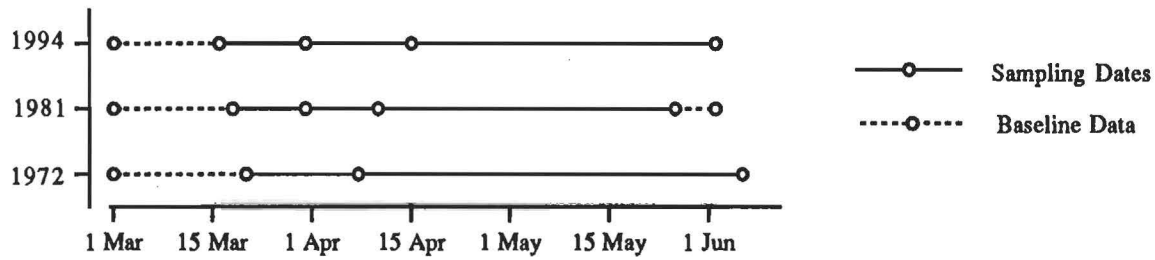


Fig. 30. Dates of aerial surveys in the Hamilton Harbour AOC.

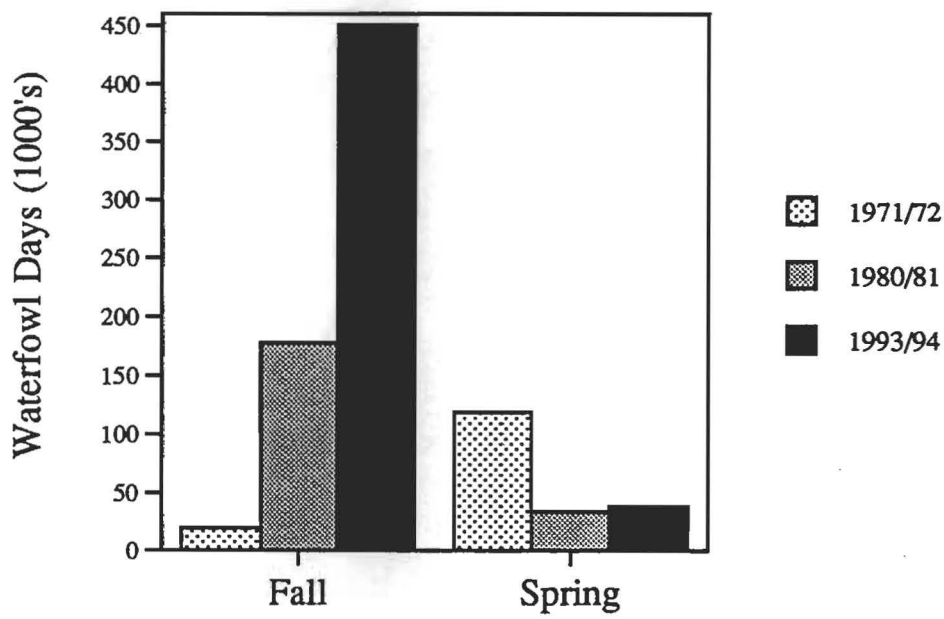


Fig 31. Total waterfowl use of the Hamilton Harbour AOC during fall and spring migrations.

The species composition of waterfowl fluctuated with season and year (Fig. 32). Over the three years, there was an increase in the proportion of geese, and a decline in the proportion of dabblers. There were no clear trends in the proportions of bay ducks, *Bucephala* spp. and mergansers. Sea ducks and swans always comprised only a small part of the total.

3.1.4.3 Hamilton Harbour - Results by Taxonomic Group

3.1.4.3.1 Bay Ducks

During fall, bay duck use of the area rose steadily from 1971 to 1993 while spring use decreased during the same period (Fig. 33). Scaup always represented more than 95% of the bay duck group, Canvasbacks and Ring-necked Ducks comprising the rest. Increases in aquatic vegetation in the north half of the harbour have improved the value of portions of the area to waterfowl and scaup have responded accordingly. It is possible that the increased use in autumn has resulted in diminished food available during spring.

3.1.4.3.2 Dabblers

Dabblers used the area more during fall than spring, except in 1971/72 (Fig. 33). During fall, dabbler use of the area was greatest in 1980 and lowest in 1971. Spring dabbler use dropped each survey year from 1972 to 1994.

The most common species were Mallards and Black Ducks, always comprising more than 90% of dabbler waterfowl days (Fig. 34). The proportion of Black Ducks in the dabbler group declined while the proportion of Mallards increased. Only small numbers of Green-winged Teal, Blue-winged Teal, and Wood Ducks were seen during either spring or fall surveys.

3.1.4.3.3 *Bucephala* spp.

During fall, *Bucephala* spp. use increased each survey year from 1971 to 1993. During spring, use was greatest in 1972 and lowest in 1981 (Fig. 33). While both Common Goldeneye and Bufflehead were present, the former were usually more abundant. Common Goldeneye represented over 80% of the *Bucephala* spp. except in spring 1981 when they dropped to 23%.

3.1.4.3.4 Mergansers

Merganser numbers were greater in fall than spring (Fig. 33). In spring, the number of waterfowl days increased each survey year from 1972 to 1994. In fall, numbers were greatest in 1980 and lowest in 1971.

3.1.4.3.5 Geese

Geese were represented entirely by Canada Geese whose numbers increased each survey year (Fig. 33).

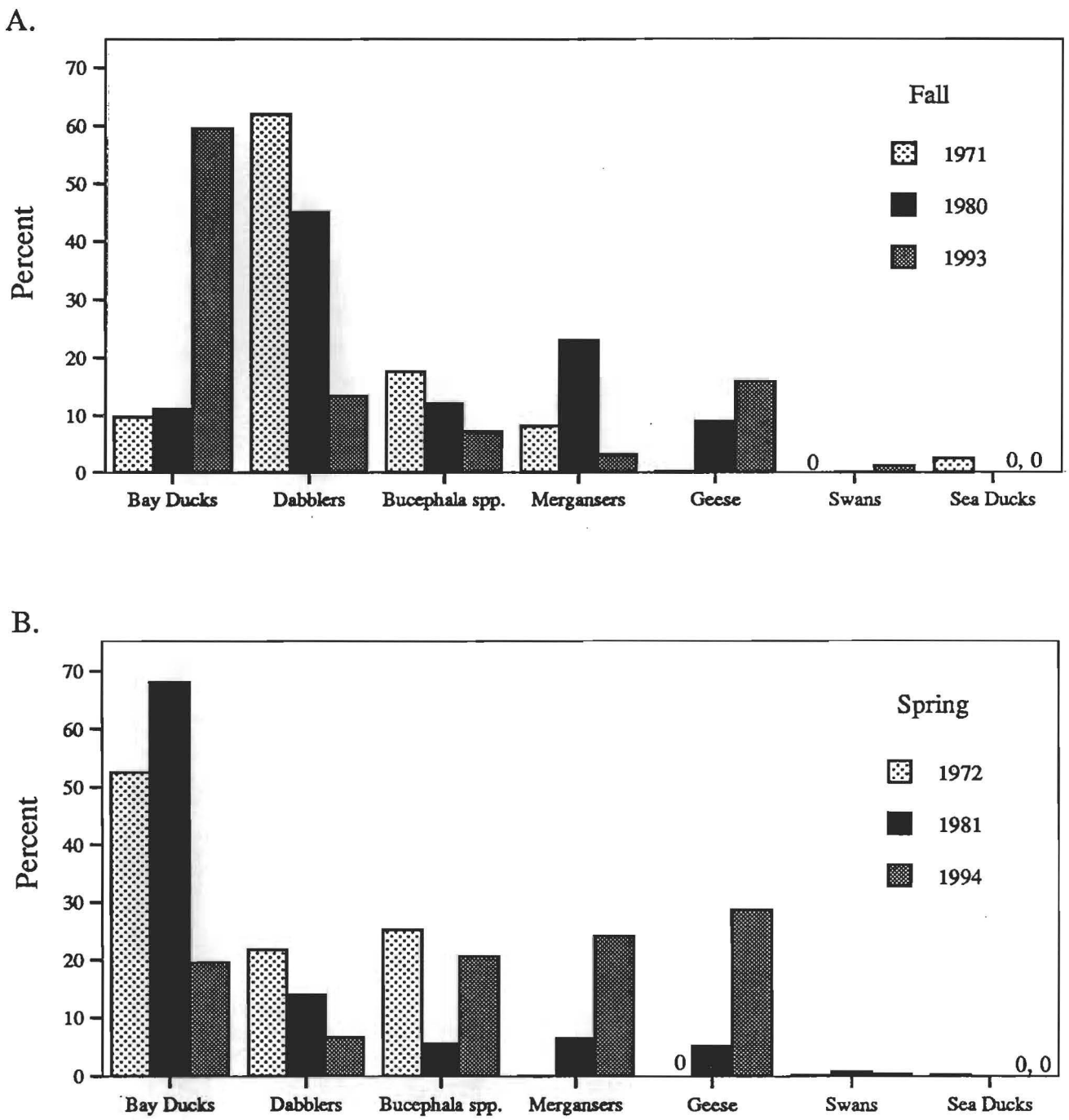


Fig. 32. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in the Hamilton Harbour AOC.

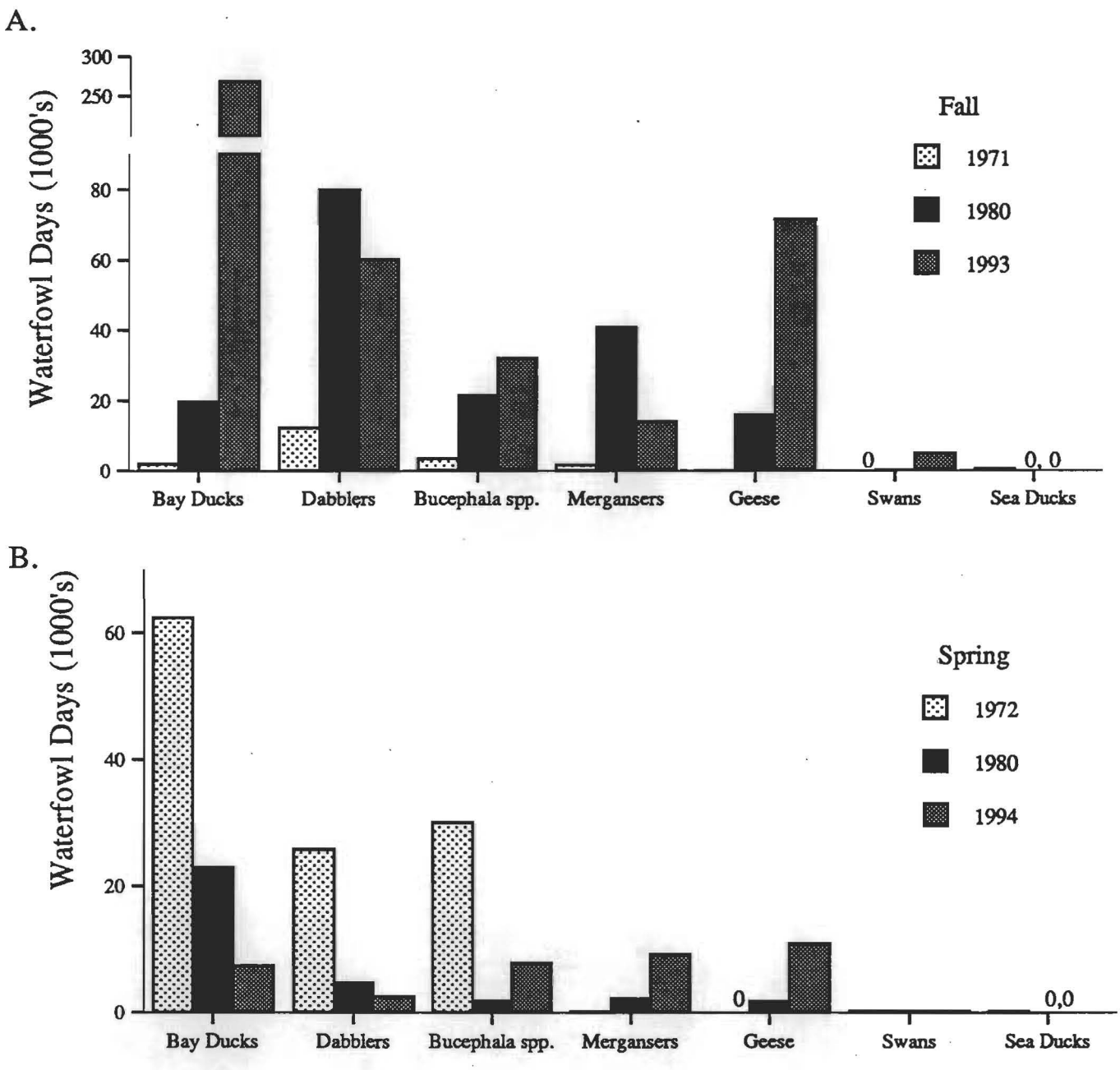


Fig. 33. Waterfowl use, by taxonomic group, of the Hamilton Harbour AOC during (A) fall and (B) spring migrations.

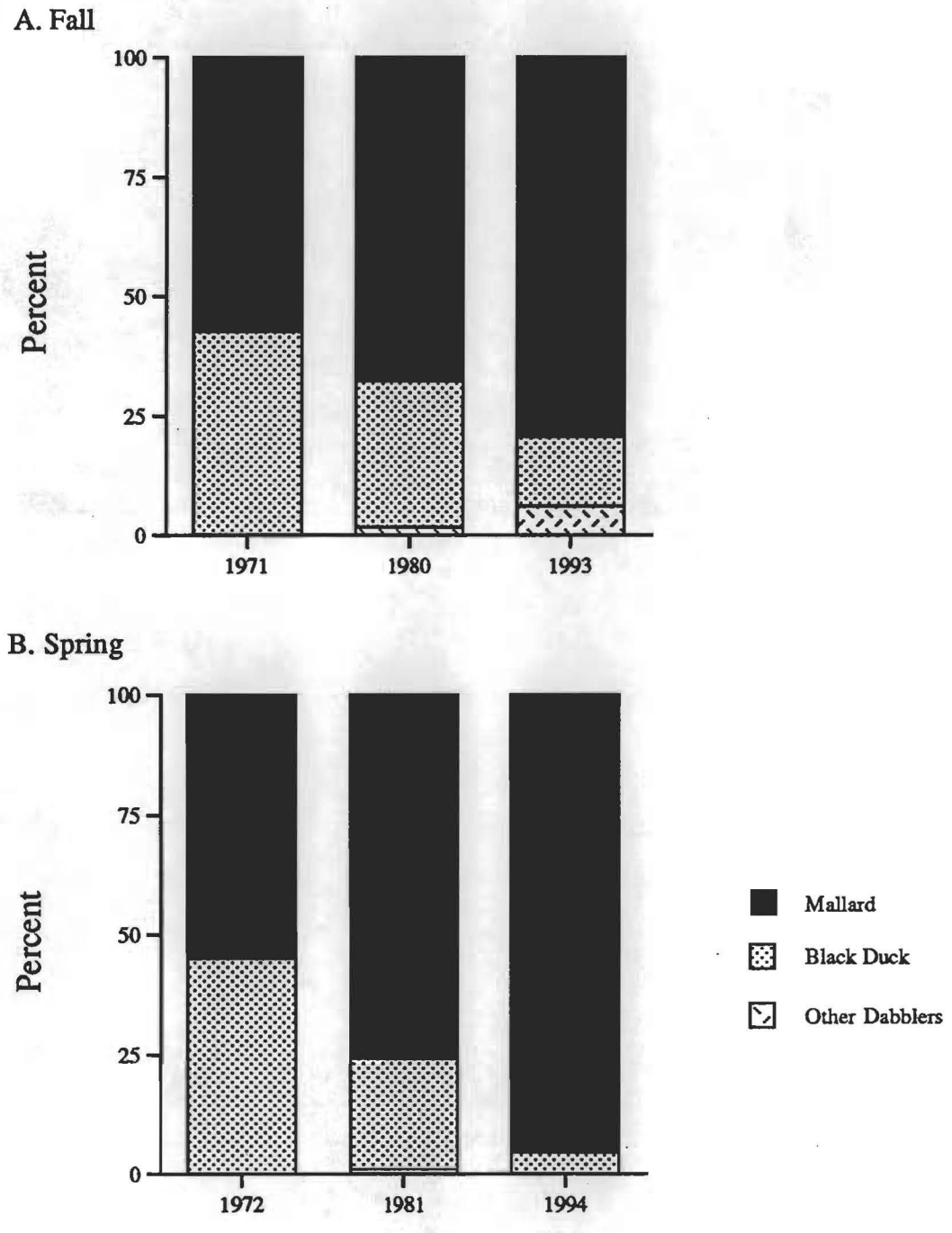


Fig. 34. Percent species composition of dabblers during (A) fall and (B) spring migrations in the Hamilton Harbour AOC.

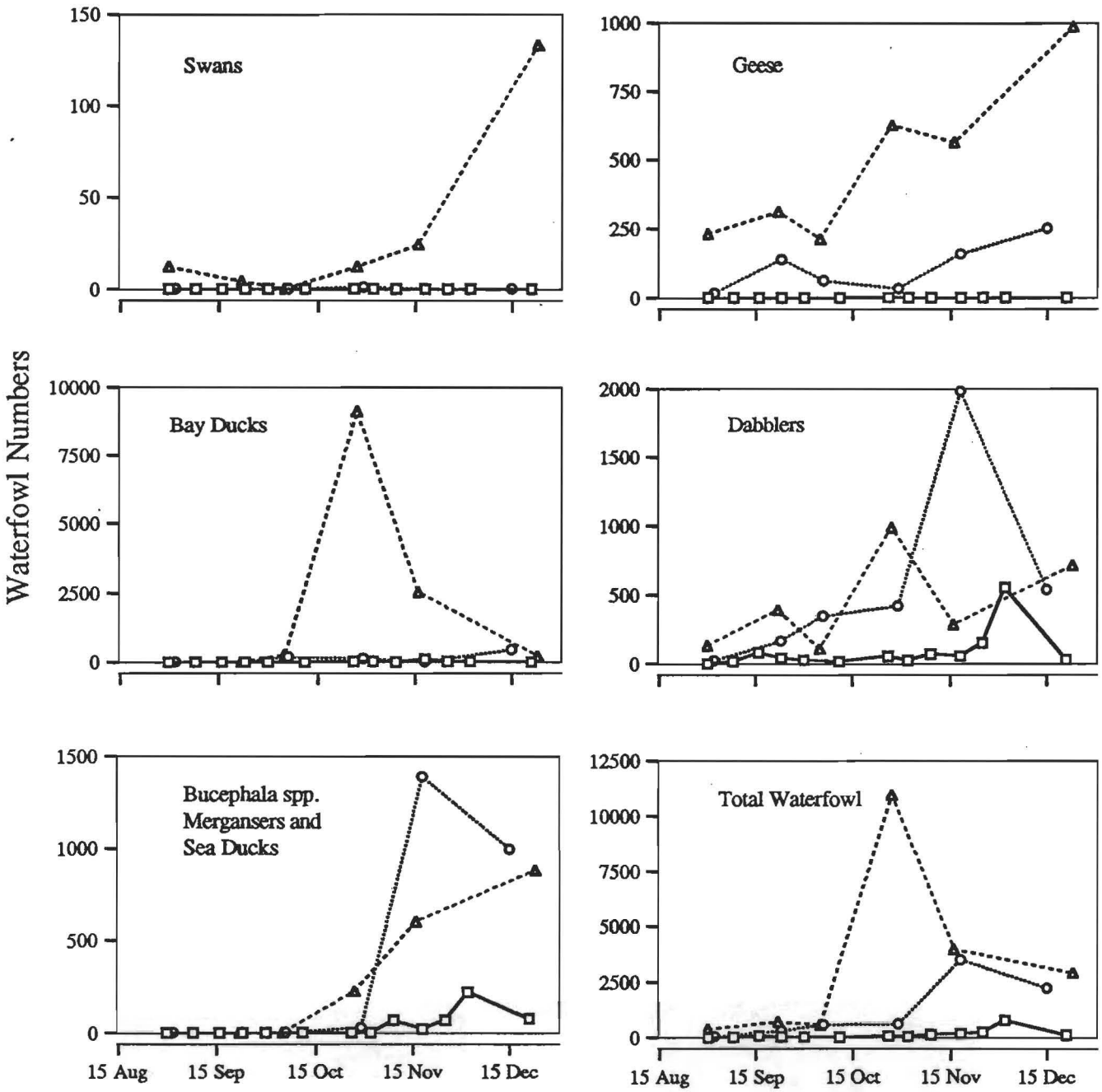


Fig. 35. Waterfowl counts in the Hamilton Harbour AOC during fall surveys.

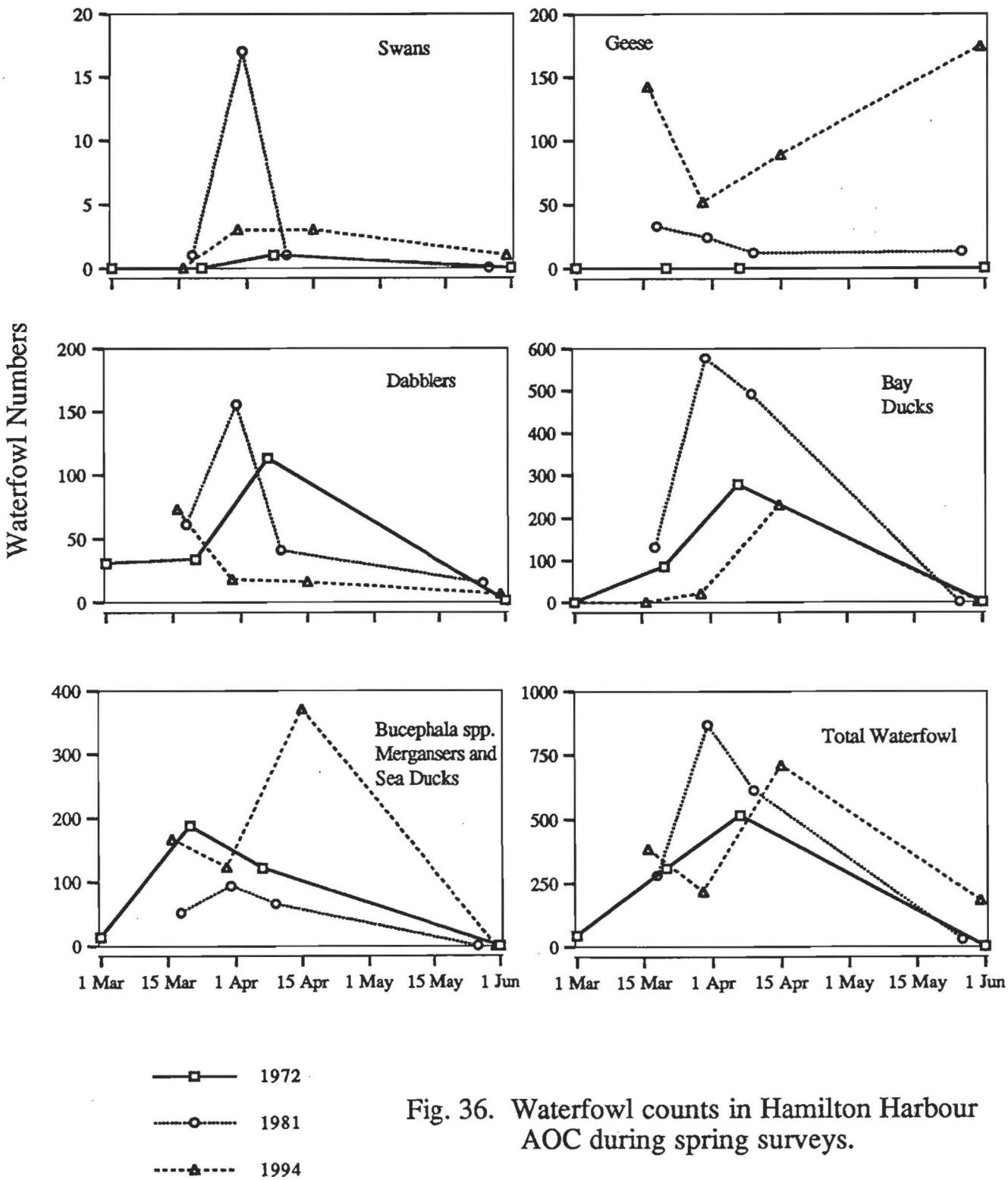


Fig. 36. Waterfowl counts in Hamilton Harbour AOC during spring surveys.

3.1.4.3.6 Swans

Swan numbers were highest in fall 1993 (Fig. 33). However, in general, use of the area by swans was relatively low, averaging 900 waterfowl days each season, representing only 0.4% of the total waterfowl. No swans were seen in fall 1971. Mute Swans were the only species seen during surveys in fall 1980 and 1993 and spring 1972. In fall 1981 and 1994, Mute Swans represented 30% and 40% respectively with Tundra Swans comprising the rest although there may have been some confusion in species identification. Increases in swan use during autumn may be a result of the overall expansion of the Mute Swan population.

3.1.4.3.7 Sea Ducks

There were 63 Oldsquaw seen during the fall 1971 survey and one seen in spring 1972.

3.1.4.3.8 Timing

During fall 1993, the bulk of the waterfowl, mostly dabblers and bay ducks, moved through the area in late October (Fig. 35). However, swan, geese, and sea duck numbers continued to rise until the end of December when survey flights were stopped. In fall 1971 and 1980, numbers peaked in mid to late November.

During spring, numbers peaked from the end of March through to mid-April (Fig. 36). The exception was geese in 1994; numbers rose from the beginning of April to the end of May when survey flights were stopped. The continual expansion of resident Canada Geese in southern Ontario has resulted in an increase in the number of moult migrants arriving in the general area in May.

3.1.4.3.9 Distribution of Waterfowl Use

The north side of Hamilton Harbour, from Carrolls Point to Burlington Beach is the main area for waterfowl activity; however since the 1970's, Windermere Basin has been used increasingly. Recently, Cootes Paradise has also shown increased use, perhaps because of management activities by Ducks Unlimited in the area.

3.1.5 Niagara River AOC

This forms a connecting channel between Lakes Erie and Ontario (58 km long) and is important for hydro generation, industry, tourism, and drinking water. Major problems relate to sedimentation, and long-term industrial pollution, particularly from American sources. Rural runoff and sewer overflow have also contributed to impairment of the area.

3.1.5.1 Survey Area and Sampling Dates

The survey area included all the Niagara River and is divided into 2 sectors, (1) above and (2) below Niagara Falls (Fig. 37).

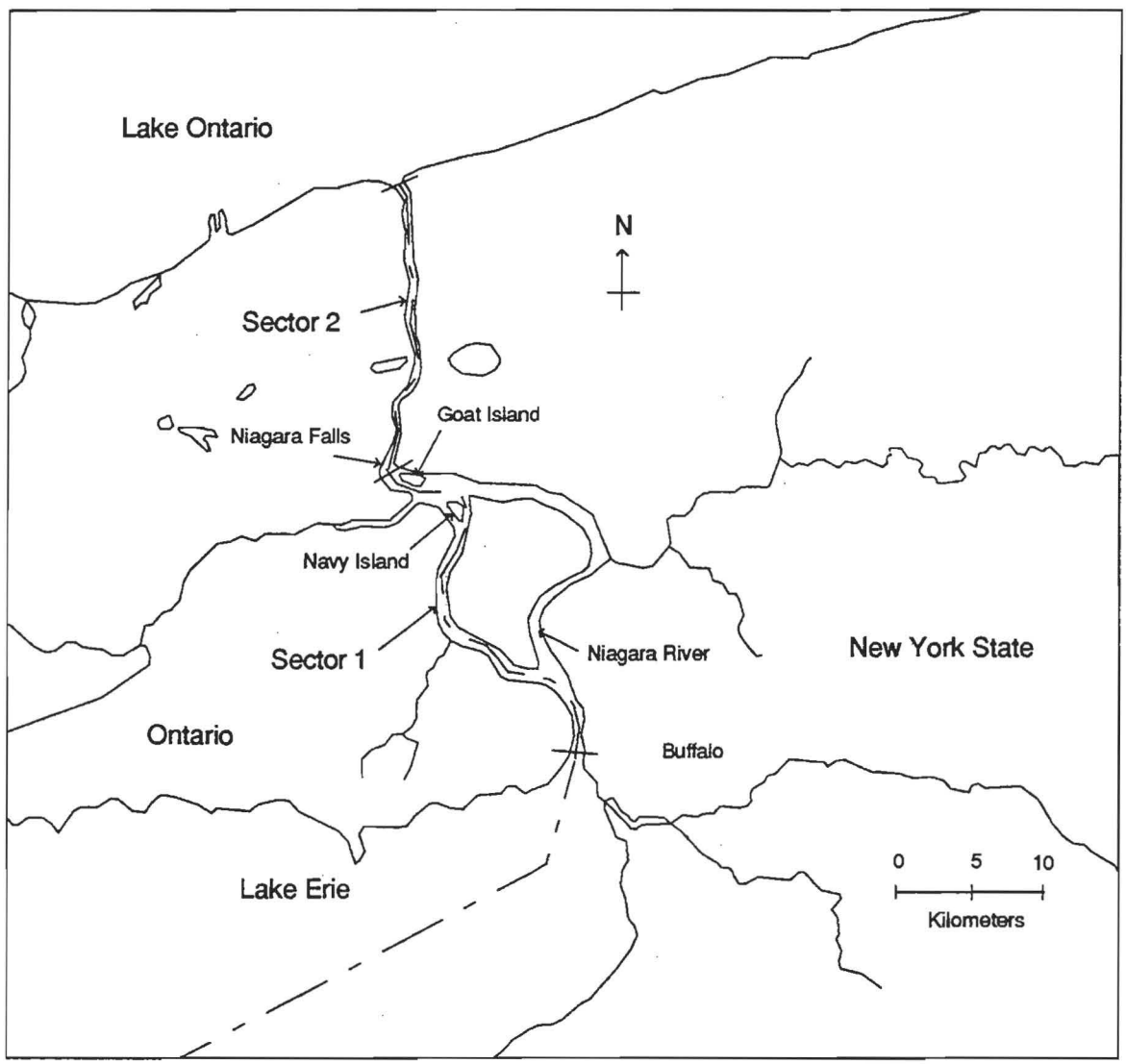


Fig. 37. Map of Niagara River AOC showing survey sectors.

Surveys took place in fall and spring of 1971/72, 1980/81 and 1993/94 (Fig. 38). Baseline dates for waterfowl use calculations are listed in Table 6.

Table 6. Baseline dates used in waterfowl day calculations for the Niagara River AOC.

	Entering Fall	End of Season	Entering Spring	End of Season
1971/72	1 Sept. 1971	21 Dec. 1971	10 Feb. 1972	5 June 1972
1980/81	3 Sept. 1980	15 Dec. 1980	19 March 1981	25 May 1981
1993/94	1 Sept. 1993	23 Dec. 1993	17 March 1994	31 May 1994

3.1.5.2 Niagara River - Overall Trends

Waterfowl use of the area was greatest during both the fall and spring migrations of 1980/81 (Fig. 39). That fall, the total number of waterfowl days exceeded 1,000,000 which can be attributed primarily to high use by large mergansers (just under 60% of the total waterfowl days that year, Fig. 40). Dabbler, *Bucephala* spp. and bay duck use also peaked during that fall migration (Fig. 41). In contrast, the high spring use (286,000 waterfowl days) was due entirely to mergansers and sea ducks as the number of waterfowl days for all other groups was lower than 1972. In the spring of 1994, geese, dabbler and bay duck numbers had risen from their 1981 lows, but the *Bucephala* group had declined further. Mergansers and sea ducks had returned to roughly the same levels as in 1972.

3.1.5.3 Niagara River - Results by Taxonomic Group

3.1.5.3.1 Mergansers

Merganser numbers were highest in 1980/81 (Fig. 41), accounting for 60% of the fall waterfowl and 70% in the spring. Otherwise mergansers represented less than 35% of total waterfowl.

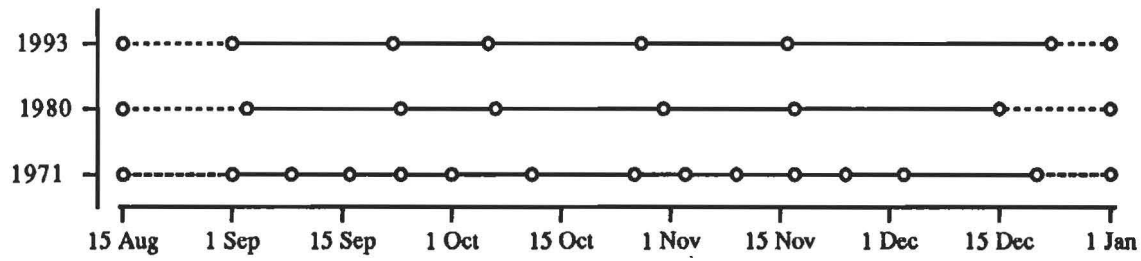
3.1.5.3.2 *Bucephala* spp.

Bucephala spp. numbers dropped during spring migrations each survey year from 1972 to 1994 (Fig. 41). During the fall migration the numbers rose from 1971 to 1980 but declined to their lowest point in 1993. The Common Goldeneye was the more abundant of the two species, always representing greater than 60% of the group.

3.1.5.3.3 Geese

Only Canada Geese were seen except for a single Snow Goose noted in the fall 1993. Use of the area by Canada Geese rose each survey year (Fig. 41). In both spring and fall of the earliest two surveys,

A. Fall



B. Spring

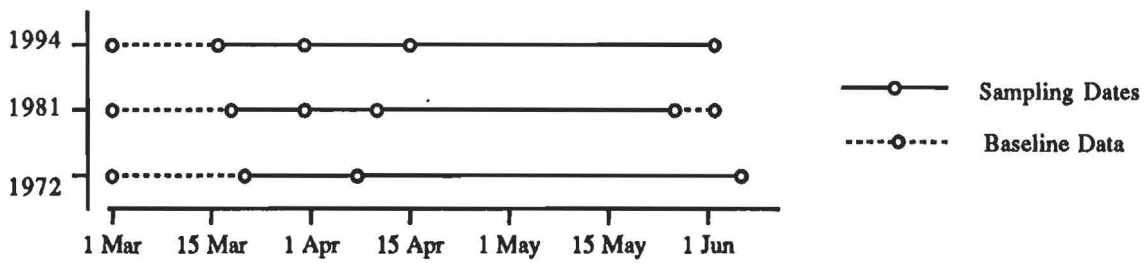


Fig. 38. Dates of aerial surveys in the Niagara River AOC.

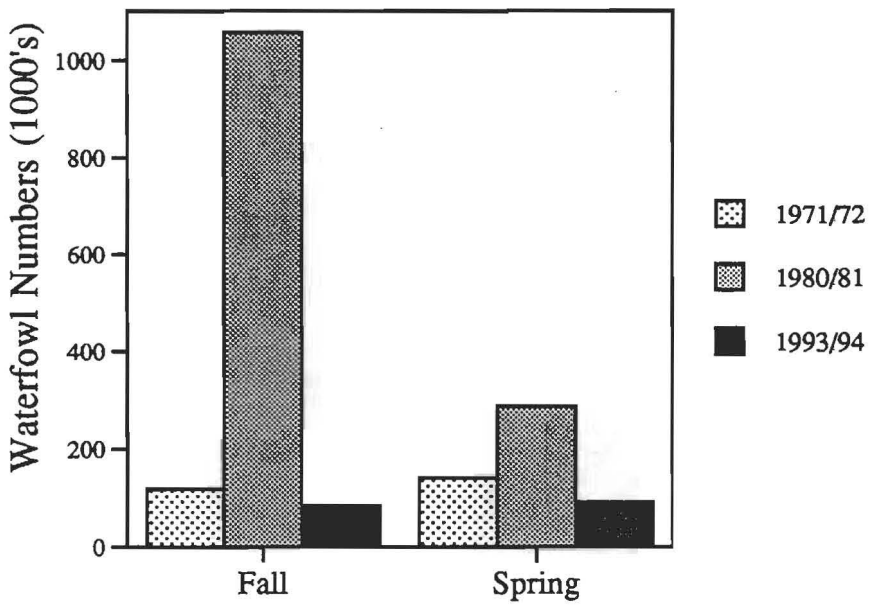


Fig. 39. Total waterfowl use of the Niagara River AOC during fall and spring migrations.

geese numbers were relatively low, always representing less than 0.5% of the total number of waterfowl days (Fig. 40). During both seasons of 1993/4, however, numbers were higher as a result of increased numbers of resident geese and represented roughly 25% of the total number of waterfowl days.

3.1.5.3.4 Dabblers

Overall dabbler use of the area has remained relatively constant (Fig. 41) with an average of roughly 10,000 waterfowl days in the spring and 30,000 in the fall. There were relatively small numbers of Northern Pintail, American Wigeon, Gadwall, and Green-winged Teal but the most common species were Mallards and Black Ducks (together always greater than 95% of dabbler waterfowl days). The proportion of Black Ducks using the area declined while the proportion of Mallards increased. During fall migration, Black Ducks represented 59%, and 58% of the dabbler use in 1971 and 1980, respectively, but contributed only 20% of the use in 1993 (Fig. 42). There were similar trends during the spring migration when Black Ducks made up 62% and 71% of the dabbler use in the first two survey years, but only 2% in 1994. In contrast, the proportion of Mallards using the area increased from 39% during the fall migration of 1980 to 80% in 1993, and from 29% during the spring migration in 1981 to 97% in 1993.

3.1.5.3.5 Bay Ducks and Stiff-tails

Numbers peaked during fall of 1980 but reached their lowest point during fall of 1993 (Fig. 41). Within the group, scaup and Canvasback were the two most abundant species (Fig. 43). Redheads and Ruddy Ducks occurred in variable numbers during the spring and were virtually absent in the fall when they comprised less than 0.04% of the group use of the area.

3.1.5.3.6 Sea Ducks

Sea ducks were more common during spring migration than during fall (Fig. 41), although they comprised only a small fraction of the waterfowl found in Niagara River AOC (less than 9.3% of the waterfowl use in the area, Fig. 40). The sea duck group was made up almost entirely of Oldsquaw with scoters reported only in spring 1972 when of the 3,419 waterfowl days, only 245 were attributed to scoters.

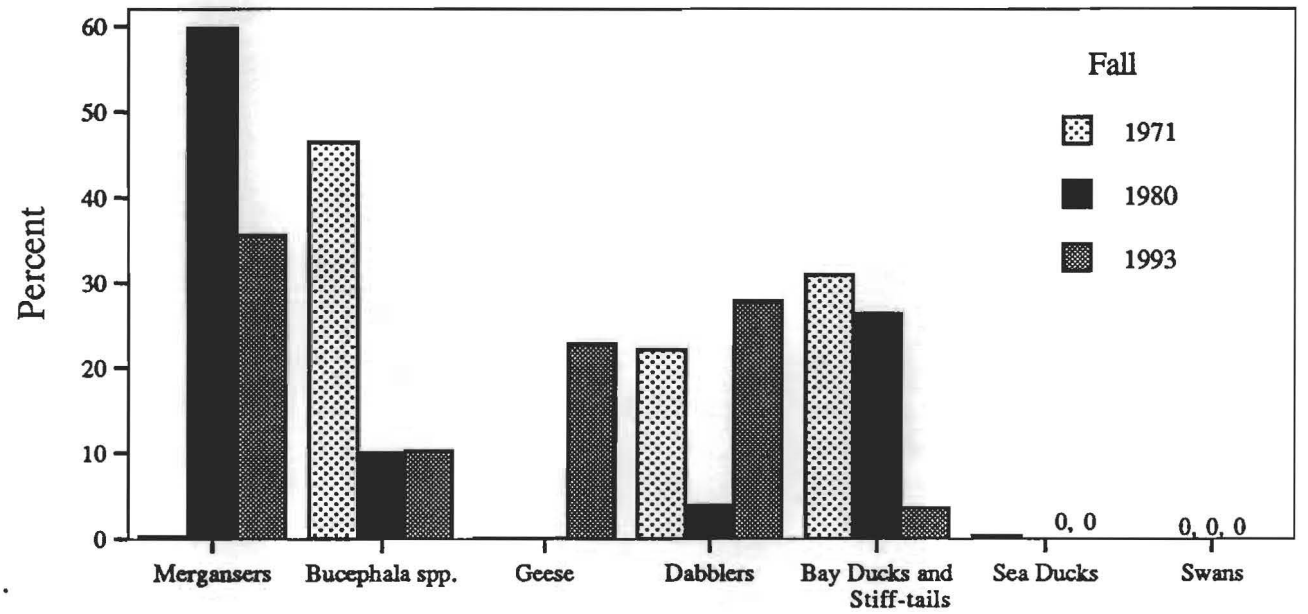
3.1.5.3.7 Swans

In spring 1994, there were two Mute Swans seen on the survey flights. No swans were seen during any other surveys.

3.1.5.3.8 Timing

In fall, total waterfowl numbers were greatest in late December due to relatively large numbers of mergansers (Fig. 44). Dabblers, bay ducks, and *Bucephala* spp. all peaked in mid-November. During spring, waterfowl numbers decreased from the beginning of March, until end of May (Fig. 45)

A.



B.

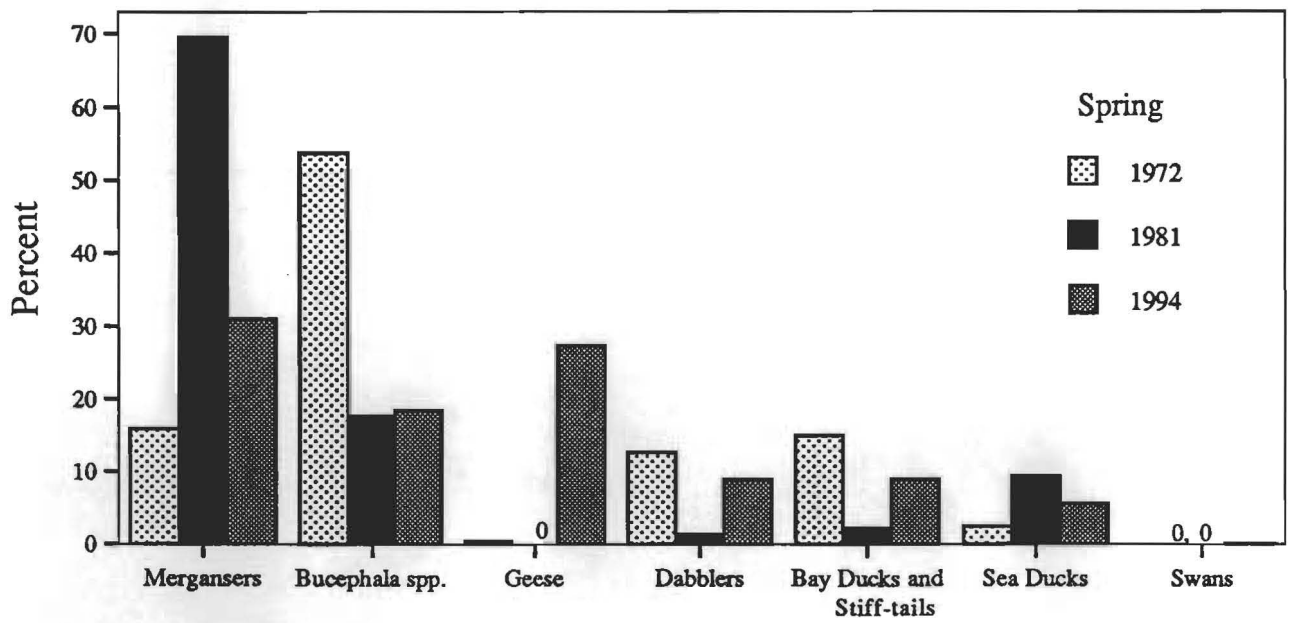


Fig. 40. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in the Niagara River AOC.

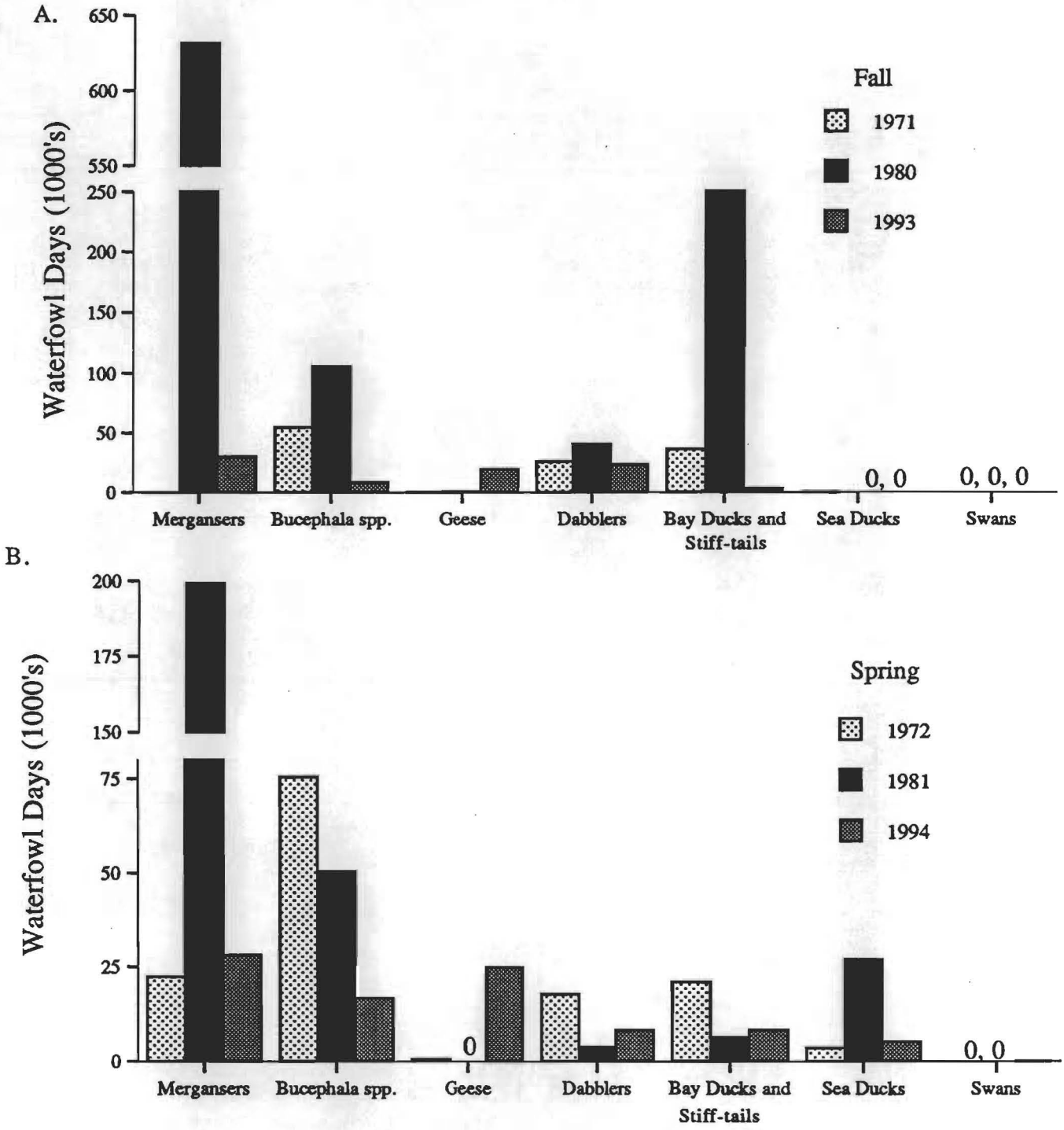


Fig. 41. Waterfowl use, by taxonomic group, of the Niagara River AOC during (A) fall and (B) spring migrations.

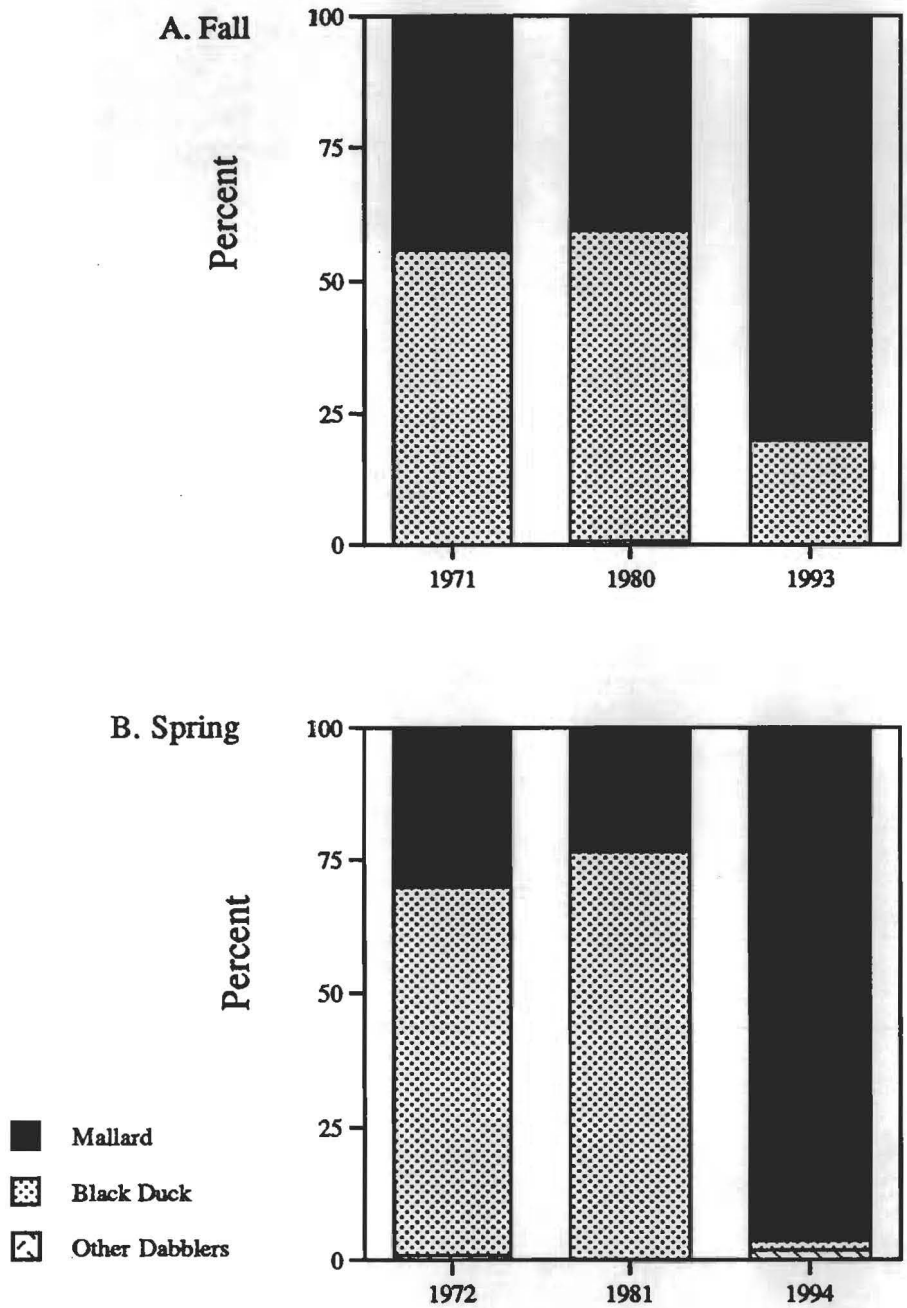


Fig. 42. Percent species composition of dabblers during (A) fall and and (B) spring migrations in the Niagara River AOC.

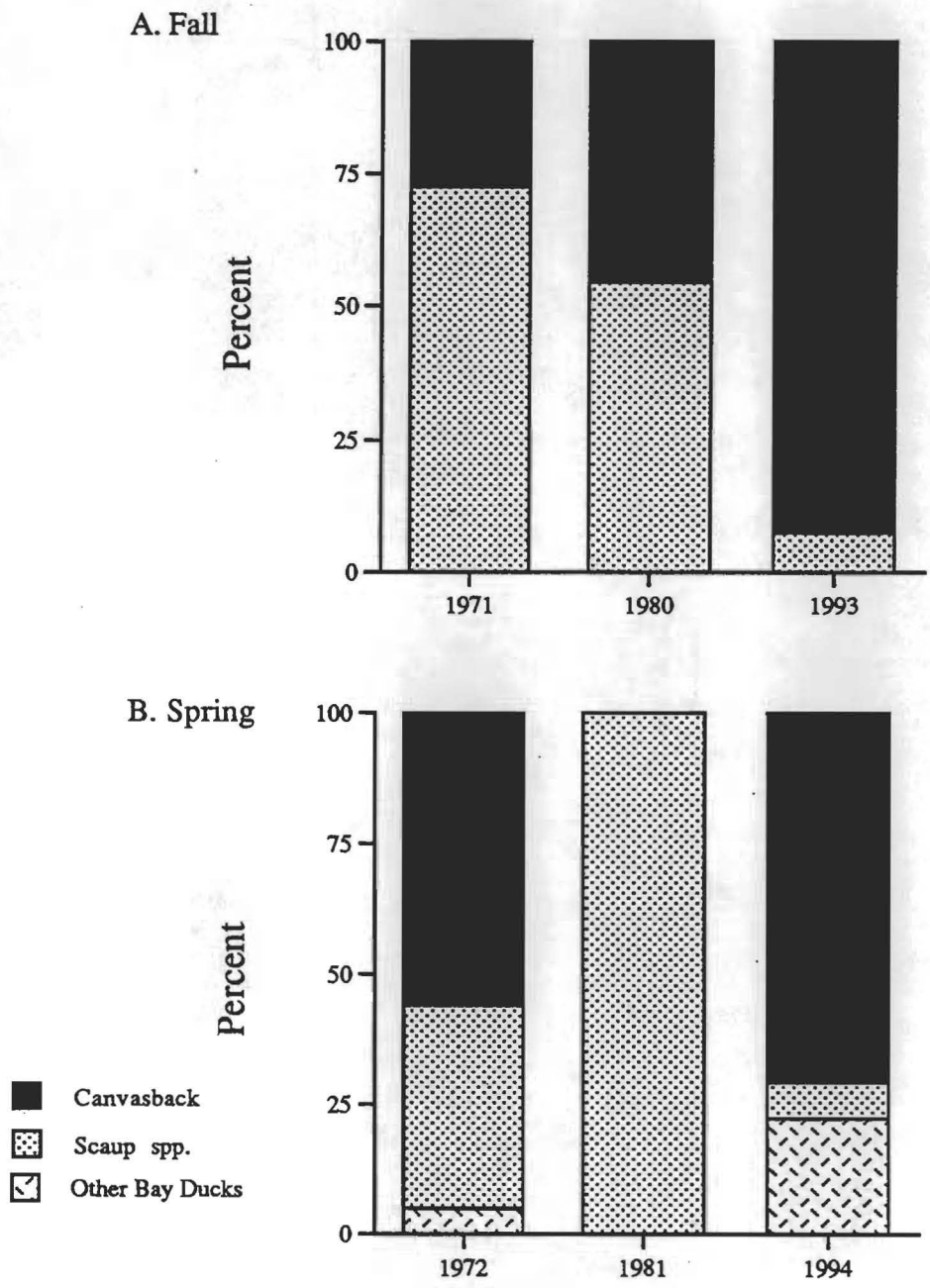


Fig. 43. Percent species composition of bay ducks during (A) fall and (B) spring migrations in the Niagara River AOC.

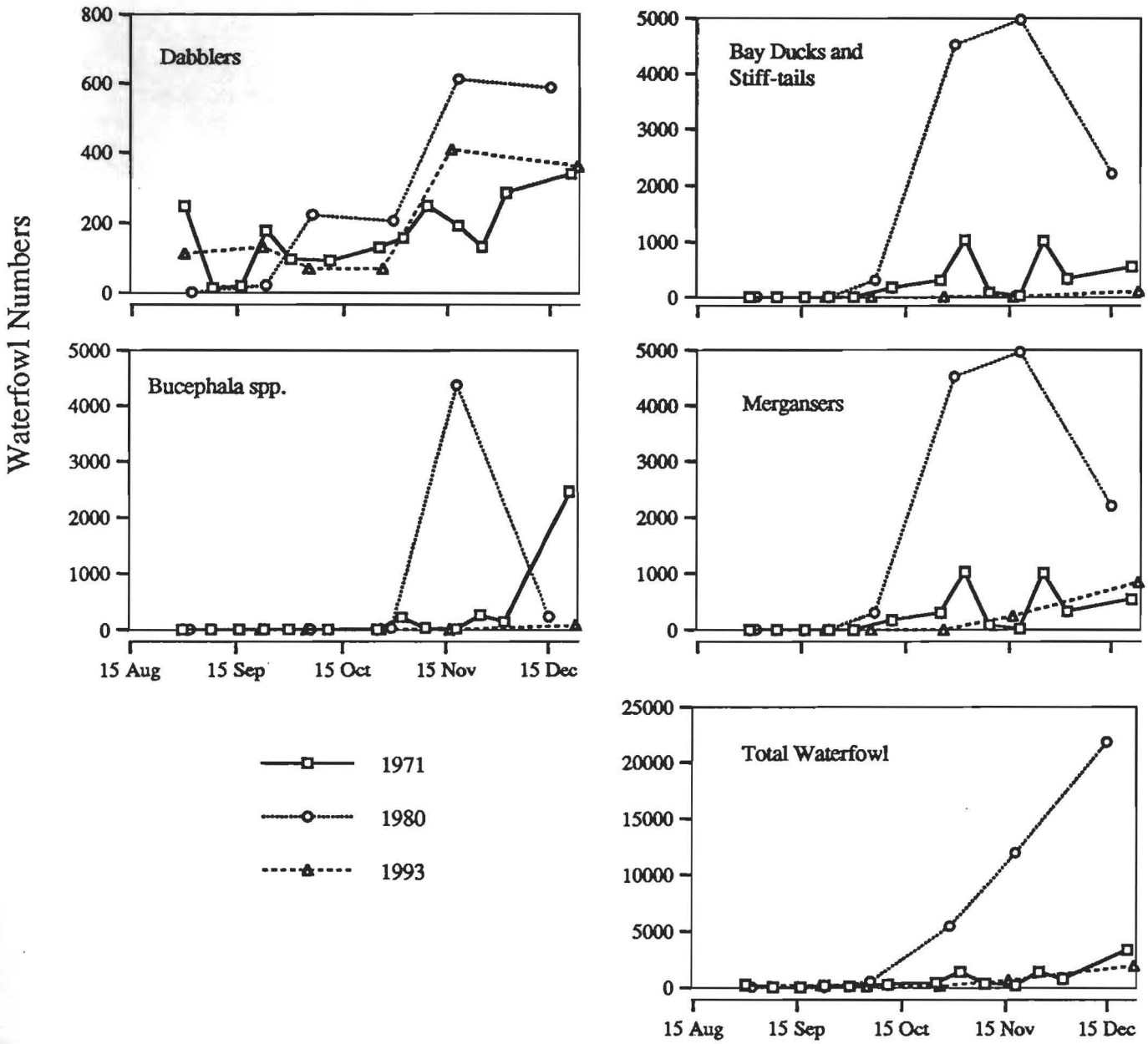


Fig. 44. Waterfowl counts in the Niagara River AOC during fall surveys.

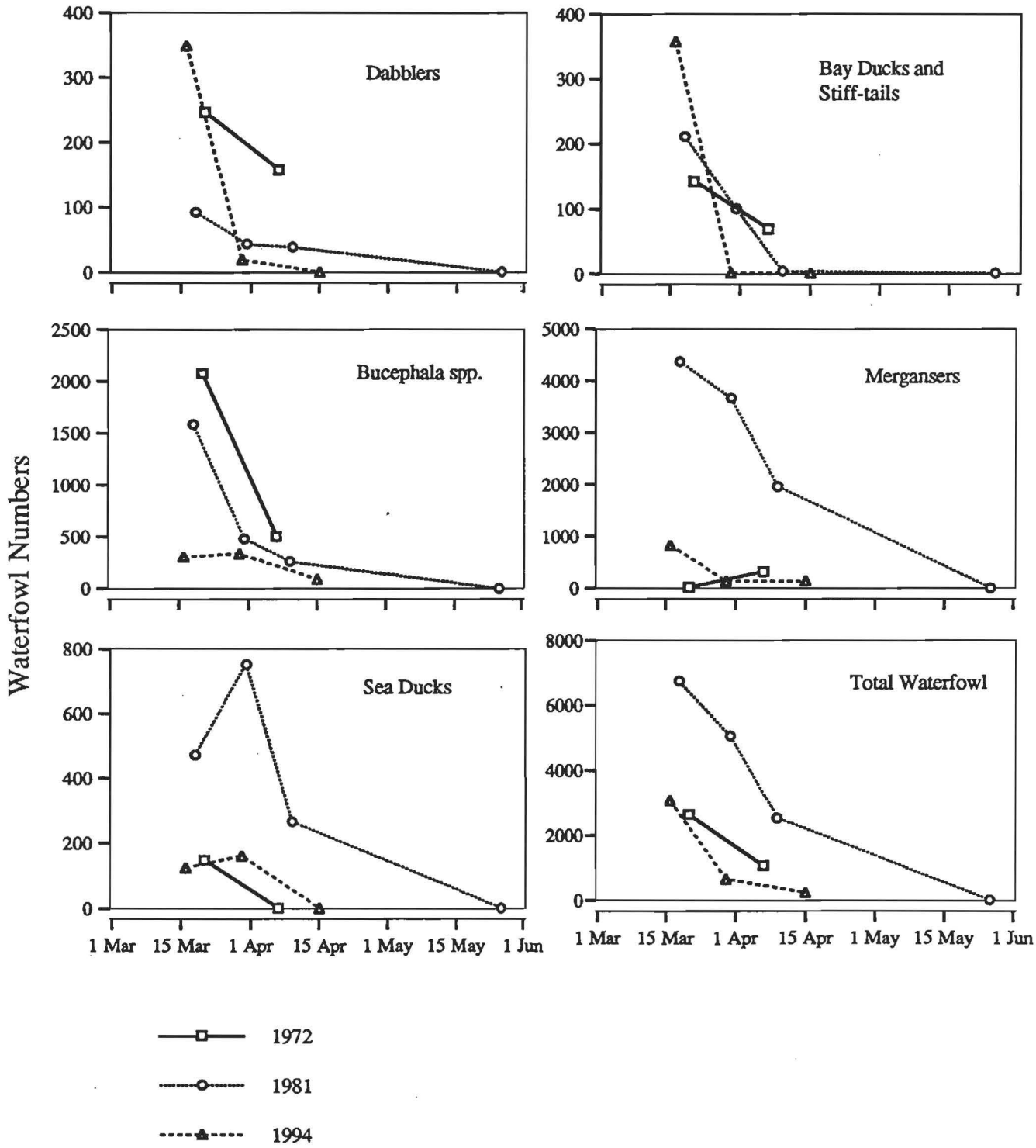


Fig. 45. Waterfowl counts in the Niagara River AOC during spring surveys.

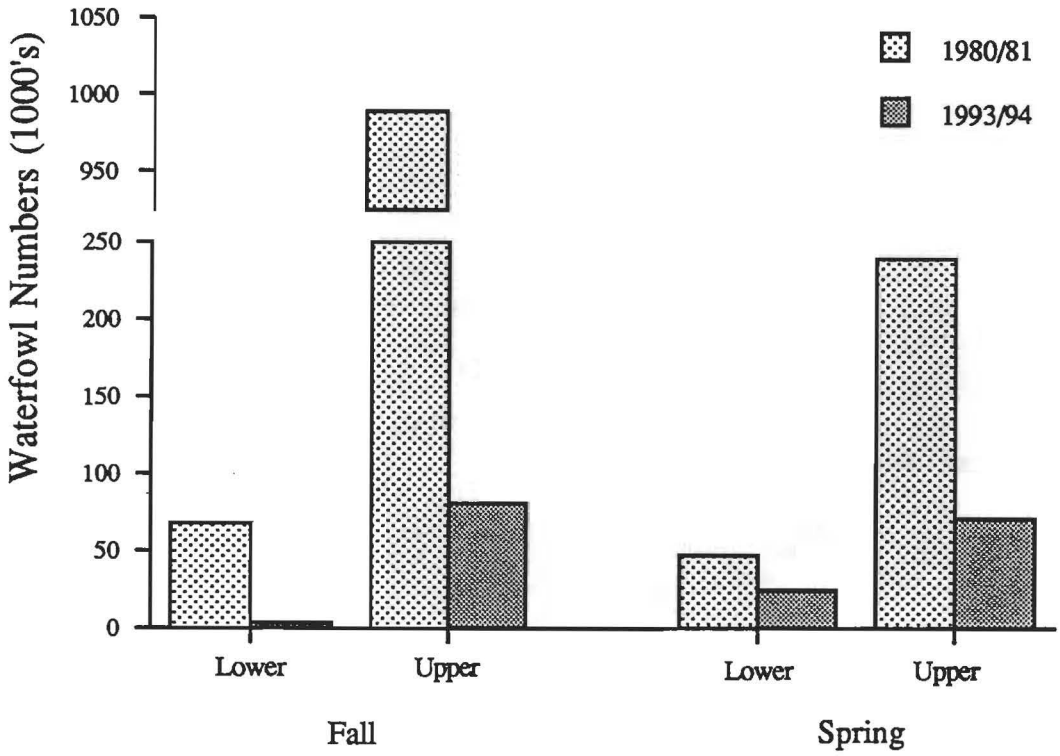


Fig 46. Waterfowl use of each survey section of the Niagara River AOC during fall and spring migrations.

indicating that the area is used more as a winter site than as a migration staging area.

3.1.5.3.9 Distribution of Waterfowl Use

The upper part of the river (Sector 1) was used more than the lower (Sector 2) (Fig. 46). Waterfowl were distributed relatively uniformly along the upper section; however, dabbler and goose concentrations occurred around parks, and mergansers, *Bucephala* spp., and some bay ducks concentrated in the area from Navy Island to Goat Island.

3.1.6 Detroit River AOC

The Detroit River provides a major international shipping route (51 km long) between Lake St. Clair and Lake Erie. Major sources of pollution include sewer overflow, and industrial discharge (metals, petroleum products, and other organic compounds) from both sides of the river.

3.1.6.1 Survey Area and Sampling Dates

The survey area included the Detroit River from Bar Point north to Belle Isle and was divided into 3 sections (Fig. 47): Section 10 comprised the shoreline from Bar Point to Edgewater Beach; Section 11 included the area from Edgewater Beach to the northern side of Turkey Island and approximately one km. up the Canard River; Section 12 stretched from Turkey Island to Belle Isle although it was poorly surveyed north of Brighton Beach due to flight restrictions.

Surveys took place in fall and spring of 1972/73, 1979/80 and 1991/92 (Fig. 48). Baseline dates used in waterfowl use calculations are listed in Table 7.

Table 7. Baseline dates used in waterfowl day calculations for the Detroit River AOC.

	Entering Fall	End of Season	Entering Spring	End of Season
1972/73	28 Aug. 1972	7 Dec. 1972	1 Jan. 1973	9 April 1973
1979/80	31 Aug. 1979	11 Dec. 1979	18 March 1980	23 May 1980
1991/92	4 Sept. 1991	16 Dec. 1991	18 March 1992	26 May 1992

3.1.6.2 Detroit River - Overall Trends

The Detroit River AOC was used by waterfowl more during fall than spring migrations (Fig. 49). However, total number of waterfowl days during fall migrations declined each survey year from 1972

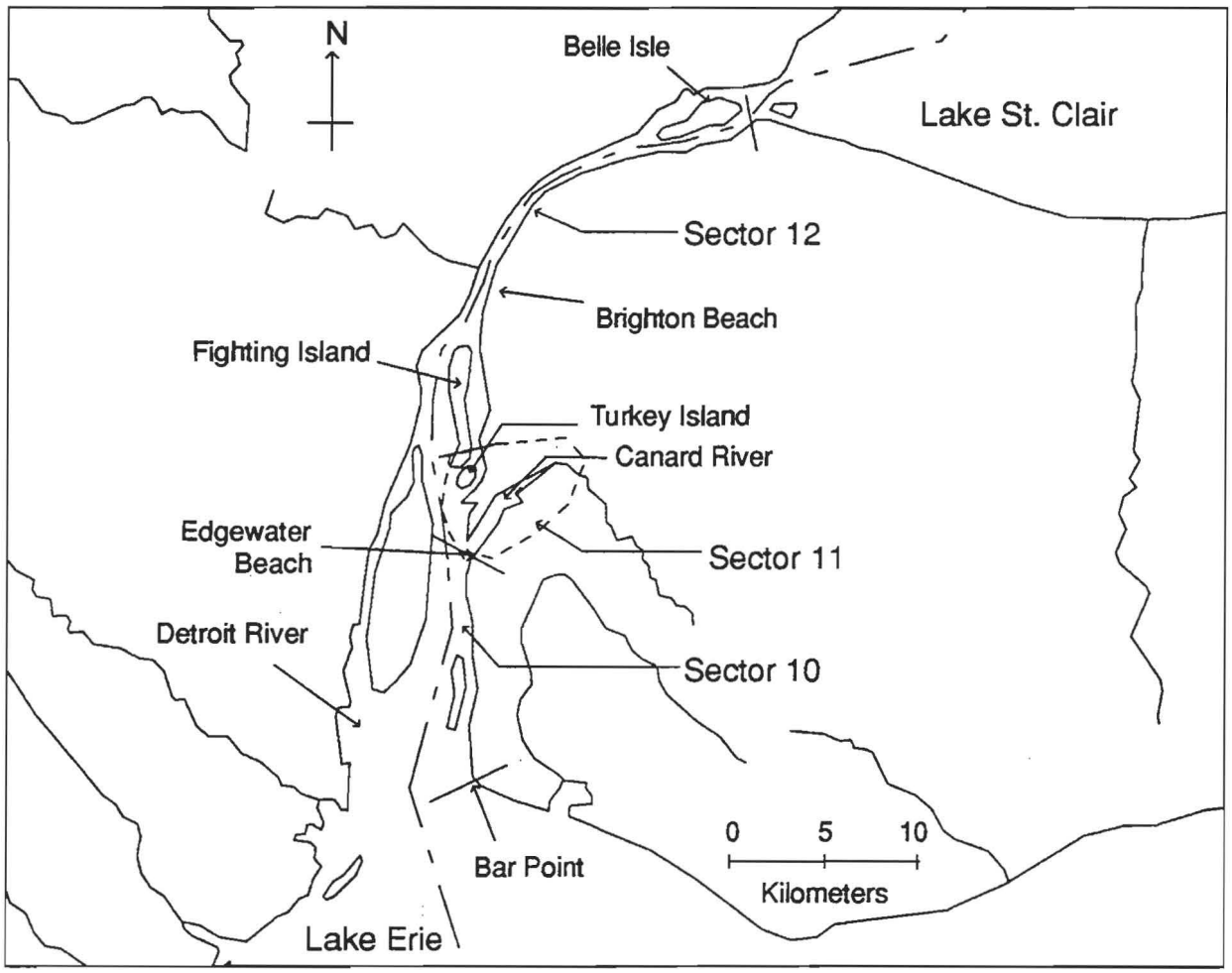
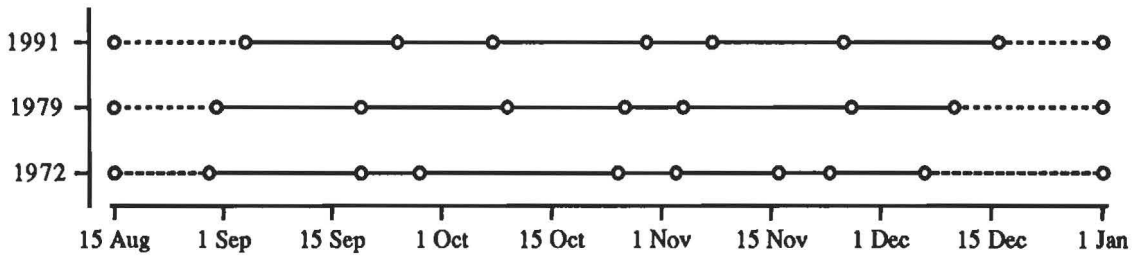


Fig. 47. Map of Detroit River AOC showing survey sectors.

A. Fall



B. Spring

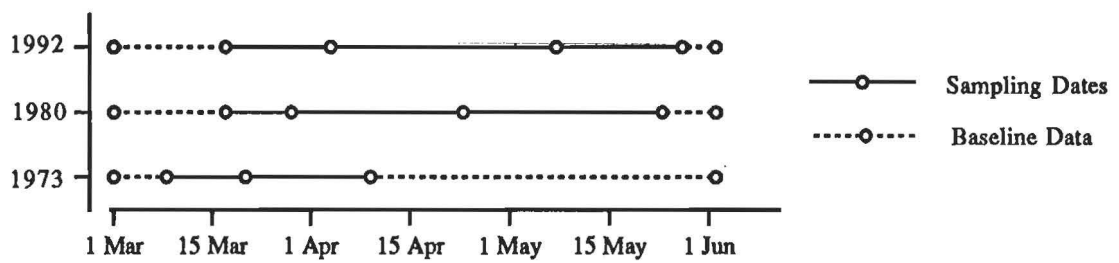


Fig. 48. Dates of aerial surveys in the Detroit River AOC.

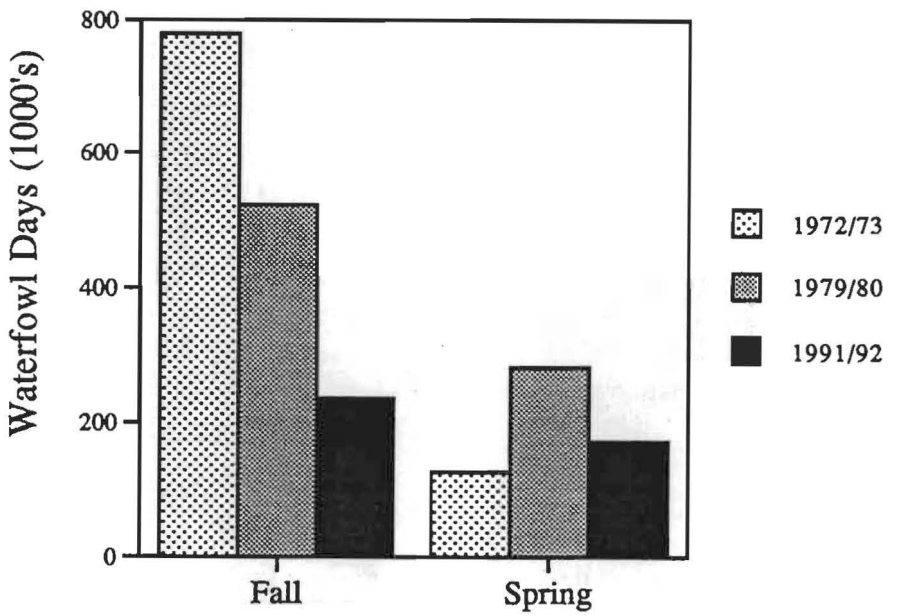


Fig 49. Total waterfowl use of the Detroit River AOC during fall and spring migrations.

to 1991. Spring migration use showed no clear trends and has averaged 193,000 waterfowl days each year.

During both seasons in all years, more than 50% of the waterfowl were bay ducks, and during fall migration in all years, dabblers comprised more than 25% (Fig. 50). Other species were present only in low numbers, together always comprising less than 20% of the total.

3.1.6.3 Detroit River - Results by Taxonomic Group

3.1.6.3.1 Bay Ducks and Stiff-tails

Bay ducks used the area roughly equally in both spring and fall (Fig. 51). During spring migration, the total number of waterfowl days fluctuated slightly, peaking in 1980 but falling to roughly 1973 levels in 1992. During fall migration, the number of waterfowl days dropped each survey year.

Canvasback always represented more than 50% of the bay ducks, and this proportion remained relatively constant (Fig. 53). However, the proportion of scaup and Redheads fluctuated with season and year. The proportion of scaup was lowest during spring of 1980 and greatest during fall of 1979 but in other survey periods, averaged about 20% of the bay ducks. The proportion of Redheads using the area was lowest during fall 1980 and highest during fall 1972 but, otherwise, averaged 13% of the group. Ring-necked Ducks were usually present in relatively small numbers (approx. 1% of the group) but reached a high of 22,000 waterfowl days (18% of total) in fall 1991. Ruddy ducks reached a high of 10,500 waterfowl days during the fall of 1972 (2.3% of the group), but accounted for only 0.03% in other periods.

3.1.6.3.2 Dabblers

Dabblers used the area more during fall than spring migrations (Fig. 51). During spring, dabbler use of the area increased each survey year. The opposite occurred during fall.

There have been small numbers of Wood Ducks, Northern Pintail, American Wigeon, Gadwall, Green-winged Teal, Blue-winged Teal and Northern Shovelers recorded during both spring and fall surveys. However, the most common species were Mallards and Black Ducks, together always comprising more than 75% of dabbler waterfowl days (Fig. 52). Black Ducks constantly comprised at least 20% and Mallards at least 50% of the dabblers in fall. The proportion of Mallards was at its lowest during the 1980 migration (51%) and was highest in 1992 (87%). The reverse was true for Black Ducks (28%) and (8%), respectively.

3.1.6.3.3 Mergansers, *Bucephala* spp. and Sea Ducks

Together, mergansers, *Bucephala* spp., and Oldsquaw comprised a relatively small proportion of the total waterfowl (Fig. 50).

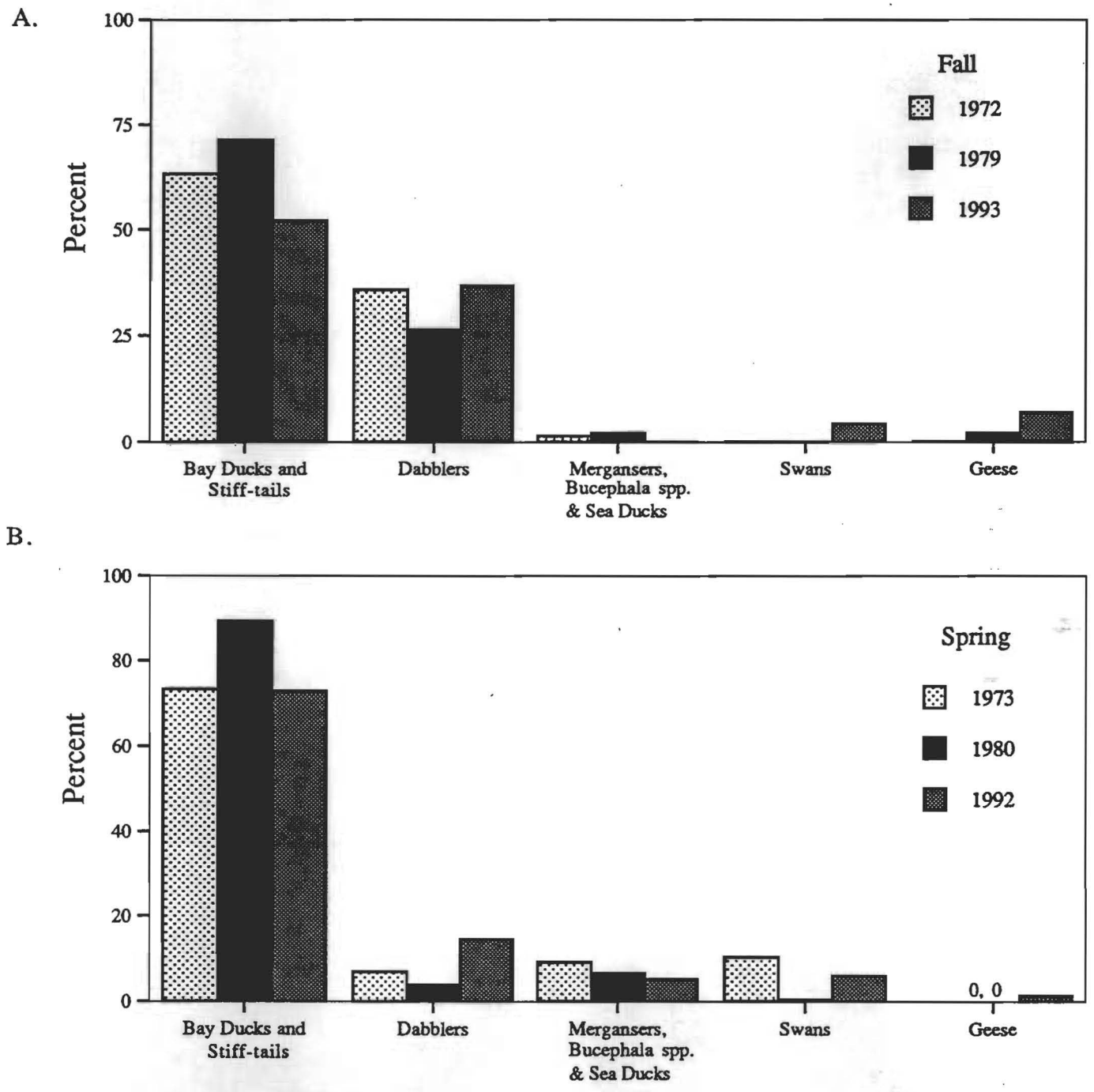


Fig. 50. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in the Detroit River AOC.

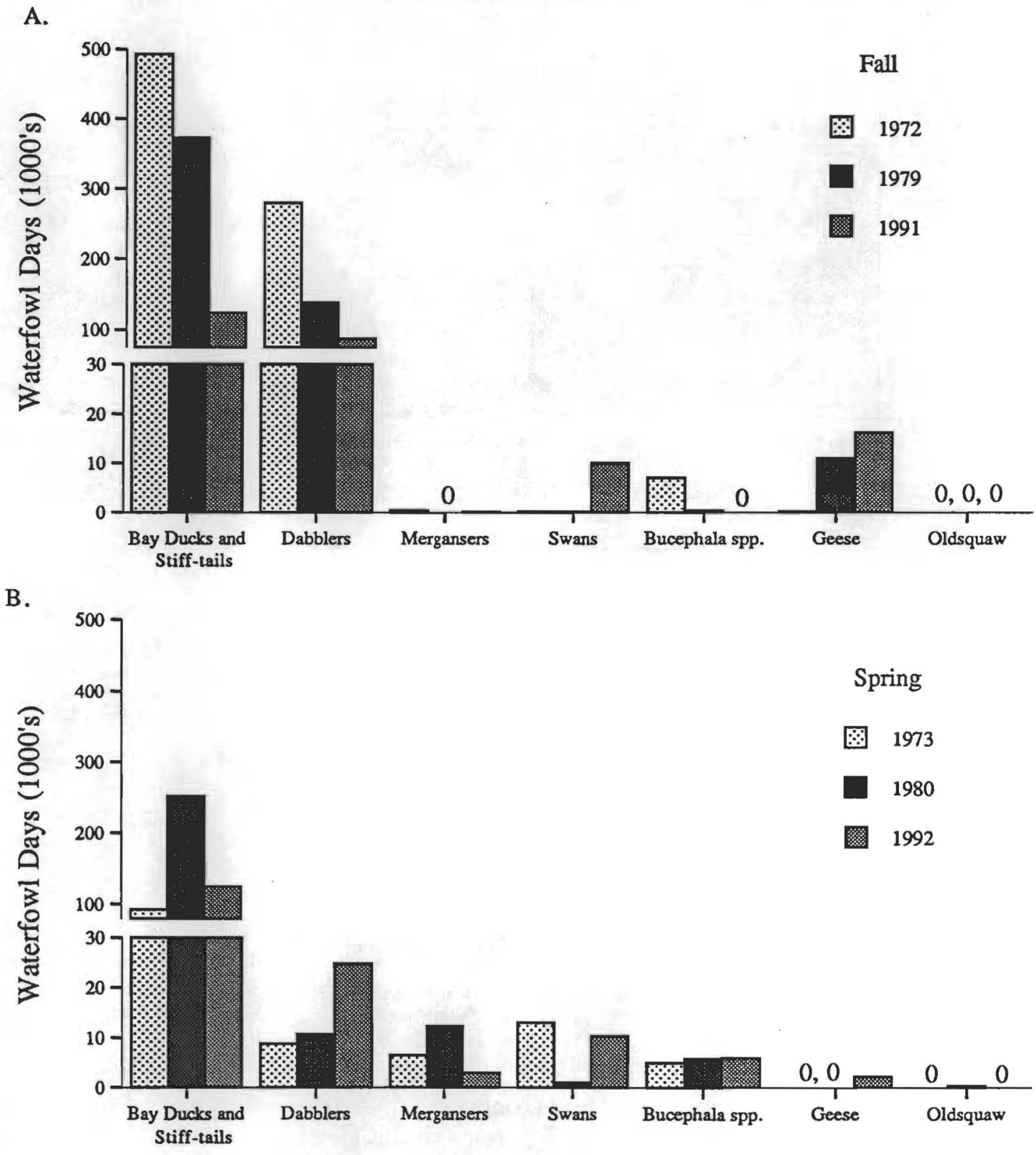


Fig. 51. Waterfowl use, by taxonomic group, of the Detroit River AOC during (A) fall and (B) spring migrations.

Merganser numbers were greater in spring than fall (Fig. 51) In fall the number of merganser days was greatest in 1972 and lowest in 1979 when none were recorded. In spring, numbers were greatest in 1980 and lowest in 1992. On average, mergansers made up 3.75% of the total waterfowl during spring migration and even less (0.02%) during fall. All species were present.

During fall migrations *Bucephala* numbers dropped from 1972 through 1979 and none were reported in 1991. Spring numbers seemed more consistent, averaging 5,600 waterfowl days. *Bucephala* made up 3.2% of the total waterfowl during spring migration and even less (0.3%) during fall. Common Goldeneye used the area more than Bufflehead during spring migrations and the fall 1972 migration. In fall 1979, only Bufflehead were reported.

There were 300 waterfowl days attributed to Oldsquaw during the fall survey of 1980.

3.1.6.3.4 Swans

Swans used the area more in spring than in fall (Fig. 51). During the spring, the number of swans using the area was lowest in 1980. In 1972 and 1992, numbers were roughly the same, averaging about 10,500 waterfowl days each season. During fall migration of 1972 and 1979, swan use of the area was low but by 1992 had risen to roughly 10,000 waterfowl days.

Both Tundra and Mute Swans were sighted during surveys. During spring 1973, the majority (79%) were Mute Swans. However, during spring 1980 and 1992, Tundra Swans accounted for 95% and 69% of all swans respectively. During fall migration, the reverse was true. In 1972, only Tundra Swans were sighted but, in 1979 and 1991, the majority were Mute Swans (100% and 60% respectively).

3.1.6.3.5 Geese

Only Canada Geese were recorded and numbers increased each survey year in both seasons (Fig. 51). No geese were sighted during spring of the first two surveys years, and only 92 Canada geese were seen during spring 1992. During fall migrations, the number of waterfowl days attributed to geese rose steadily each survey year, probably as a result of increasing numbers of resident geese.

3.1.6.3.6 Timing

In fall, most of the waterfowl peaked in abundance around mid-November (Fig. 54). One exception was geese which peaked in mid to late September, and in 1991, peaked a second time in mid-December. A second exception was dabblers which, in 1979, produced maximum numbers in mid-September.

In spring, waterfowl numbers declined from highs in March until May when numbers leveled off (Fig. 55). The exception was in 1973 when the numbers of swans increased until mid-April at which point survey flights were stopped.

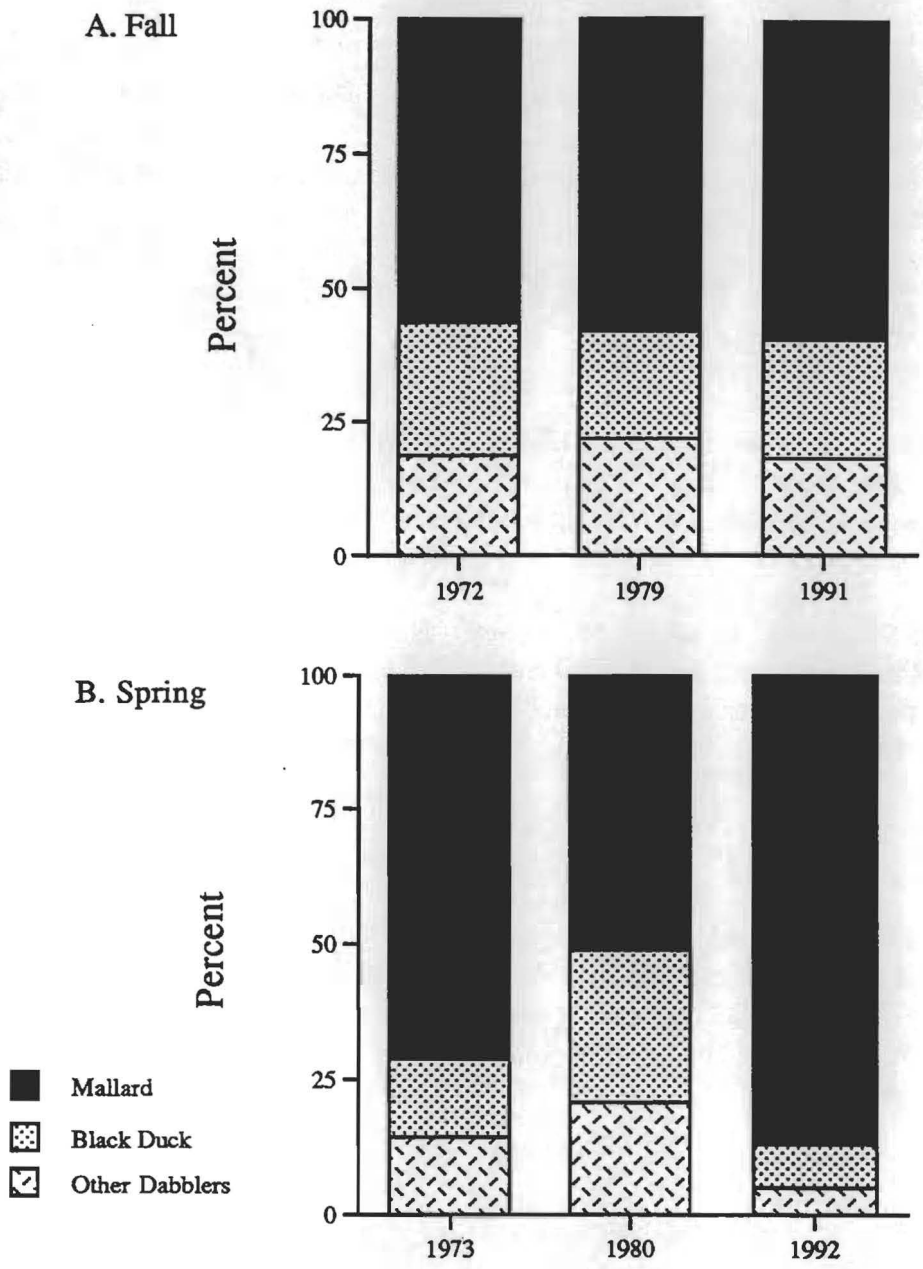


Fig. 52. Percent species compositionof dabblers during(A) fall and (B) spring migrations in the Detroit River AOC.

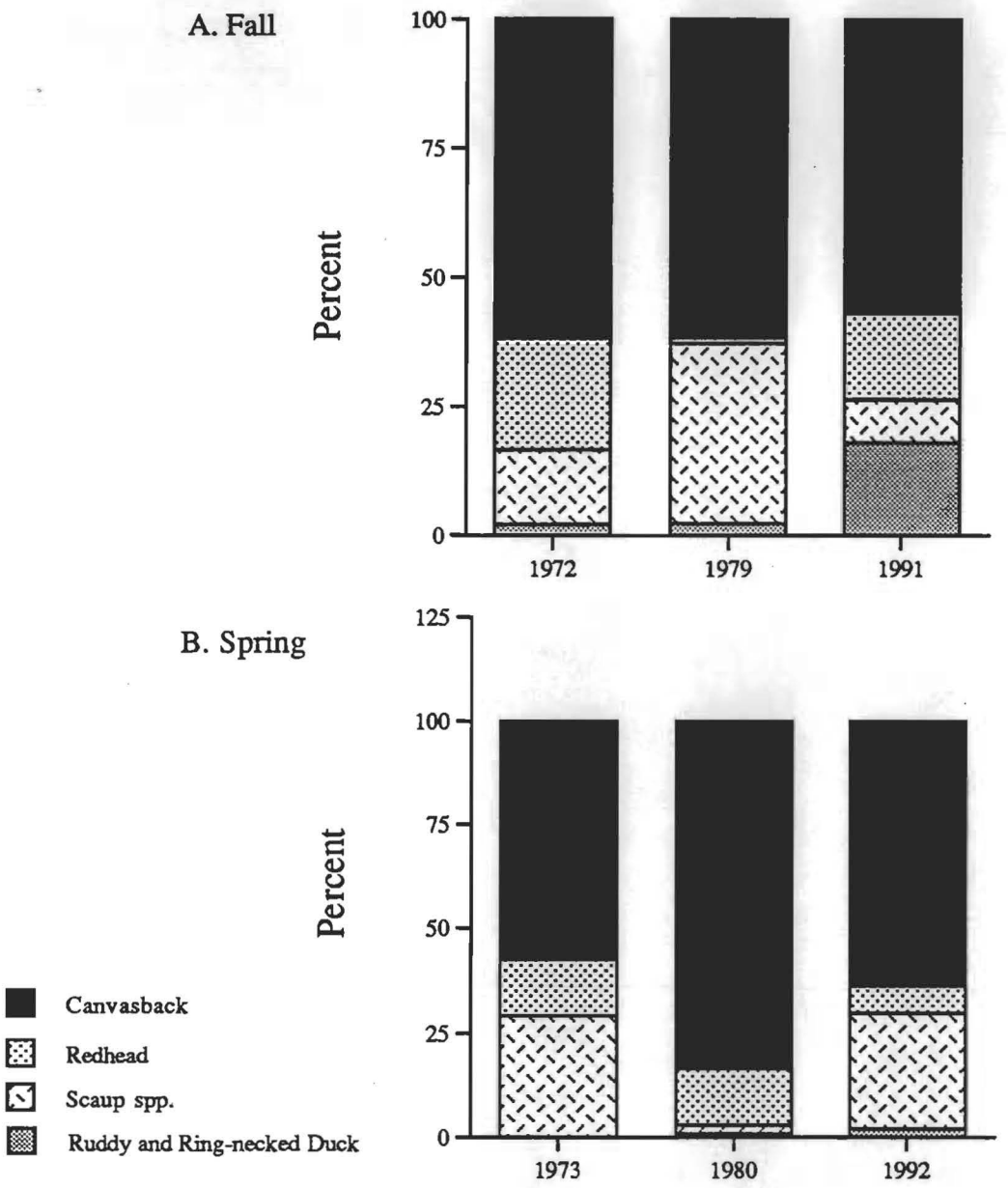


Fig. 53. Percent species composition of bay ducks during (A) fall and (B) spring migrations in the Detroit River AOC.

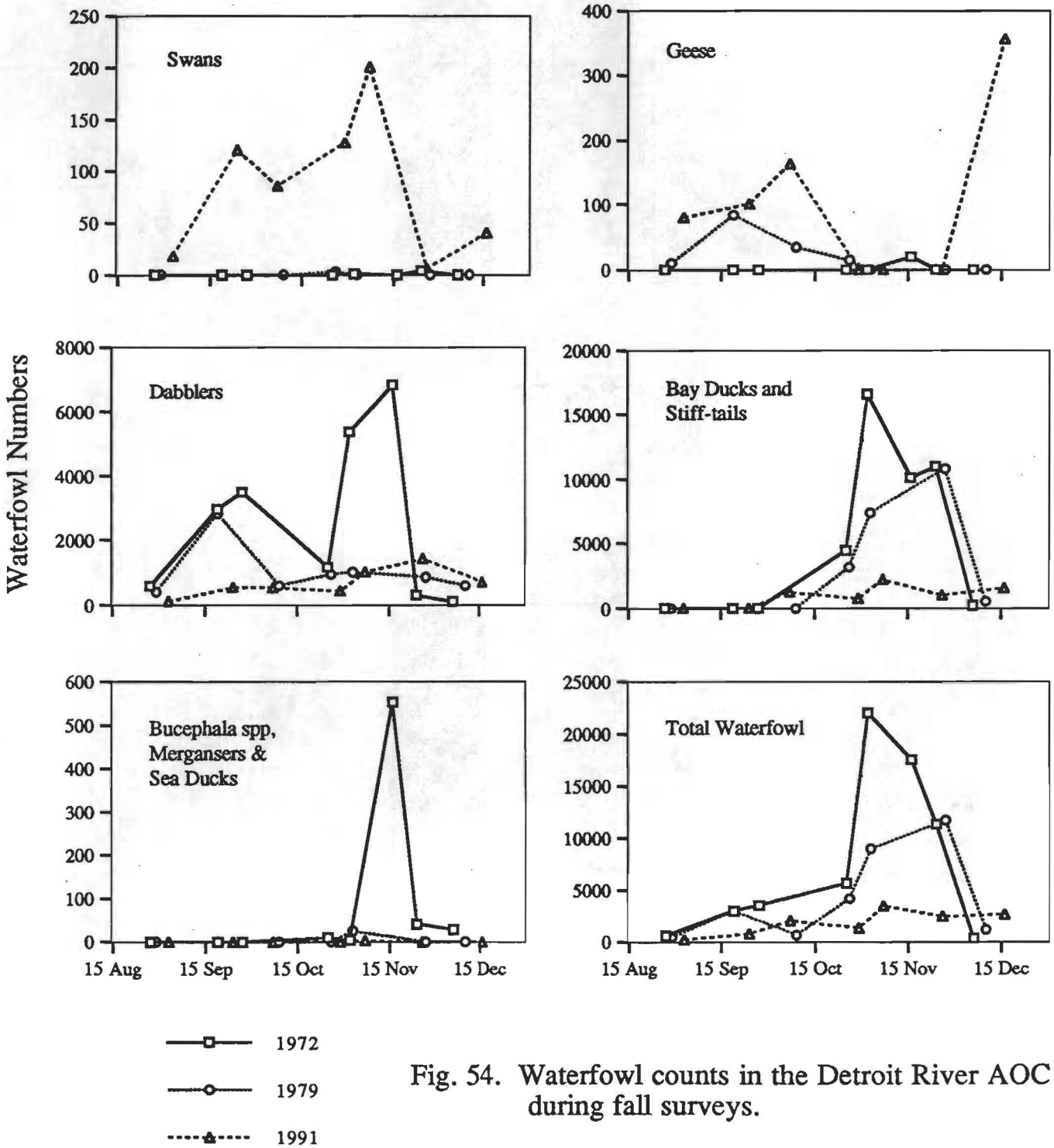


Fig. 54. Waterfowl counts in the Detroit River AOC during fall surveys.

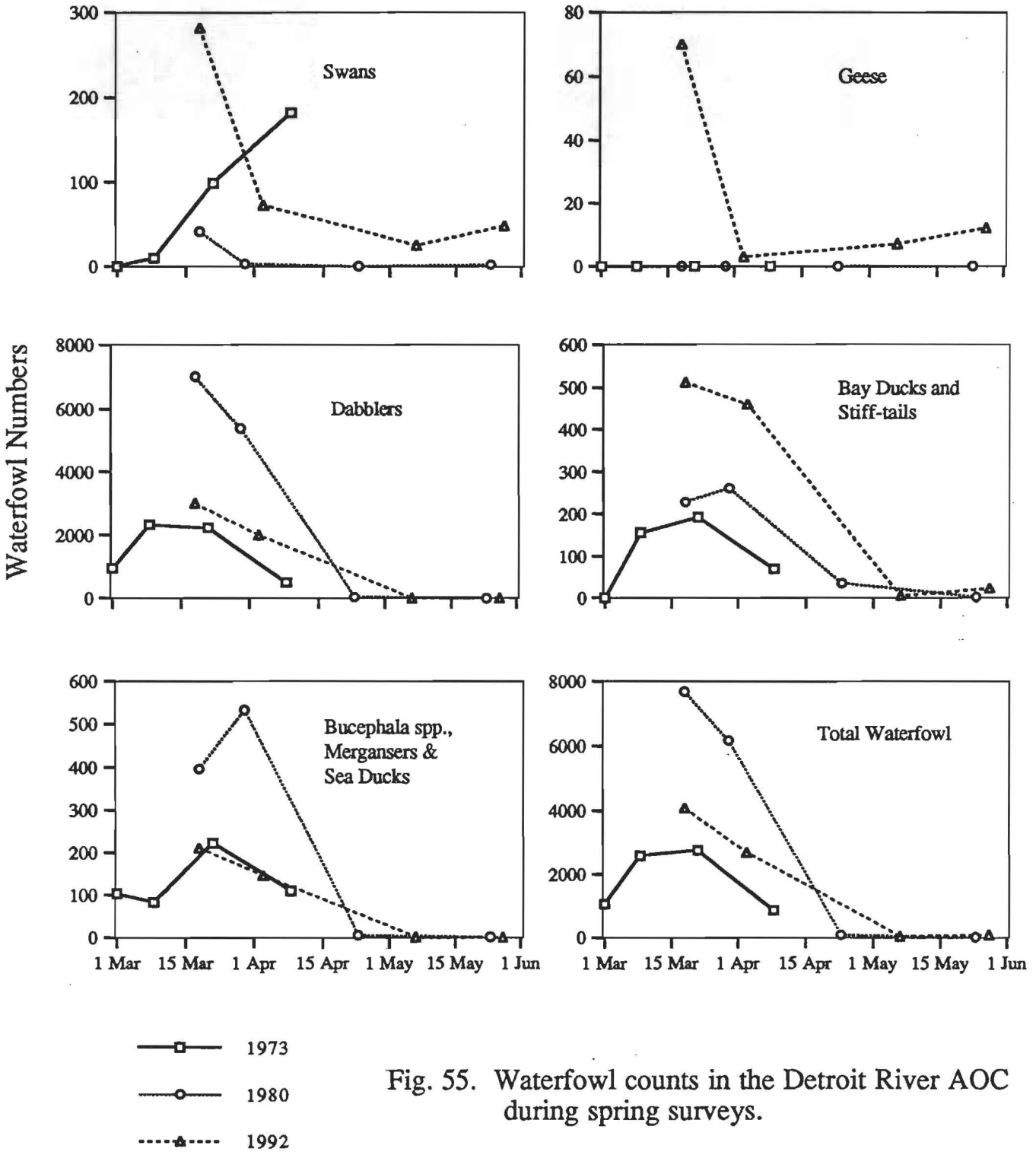


Fig. 55. Waterfowl counts in the Detroit River AOC during spring surveys.

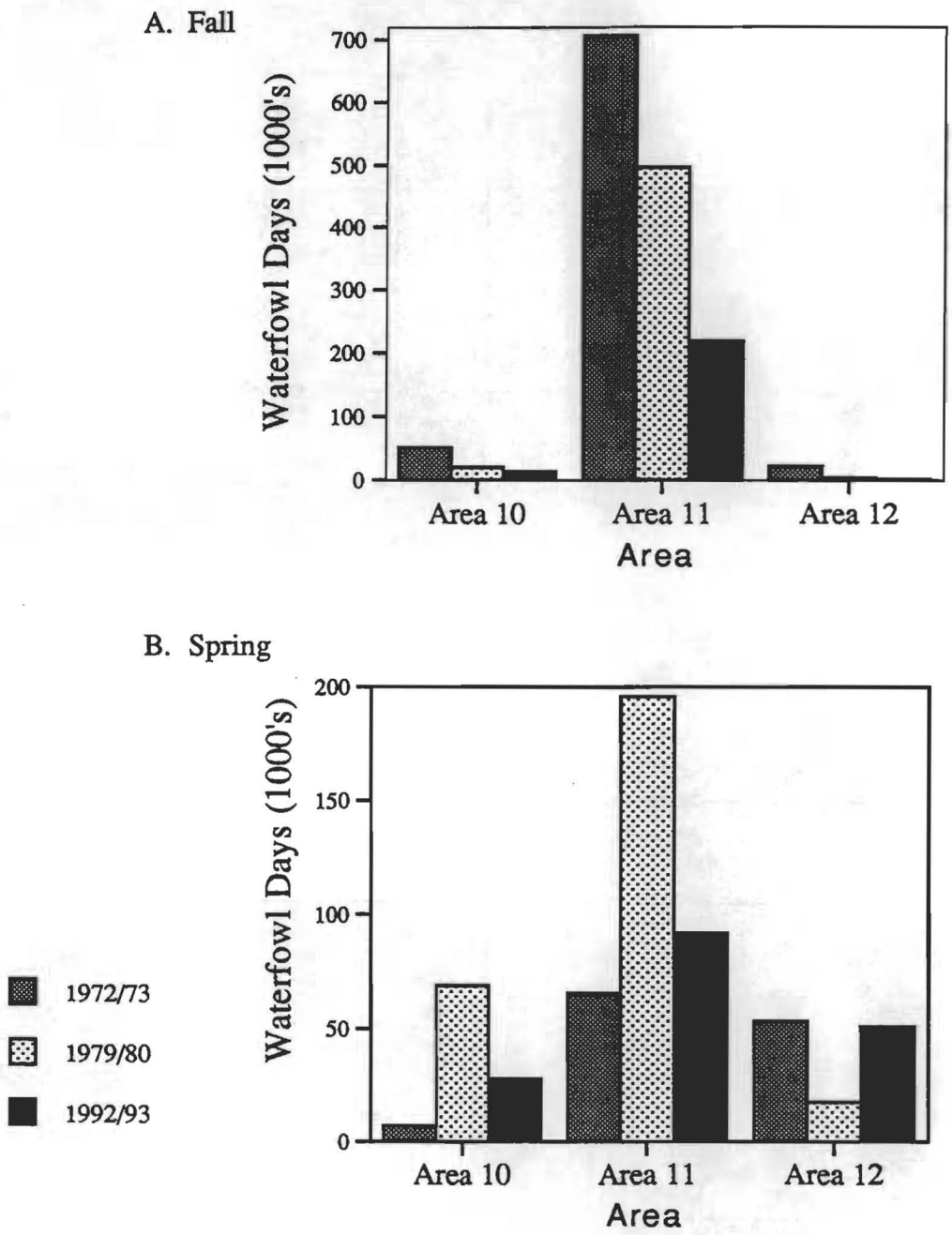


Fig. 56. Waterfowl use of each survey section of the Detroit River AOC during (A) fall and (B) spring migrations.

3.1.6.3.7 Distribution of Waterfowl Use

In Section 10, the distribution of waterfowl was uniform but numbers were low (Fig. 56). During all years, Section 11 received the most waterfowl use with large concentrations around Turkey Island; few waterfowl used the lower section of the Canard River. In Section 12, dabbling ducks concentrated around Fighting Island, particularly on the north side. Finally, there were small concentrations of geese and dabbling ducks found around Belle Isle.

3.1.7 St. Clair River AOC

The St. Clair River connects Lake Huron and Lake St. Clair and forms a major international shipping channel. The Sarnia Industrial Complex has produced a zone of contaminated sediments downstream although this has been shrinking in recent years. Industrial pollution (organic compounds, heavy metals, petroleum waste), and sewer overflow continue as environmental problems.

3.1.7.1 Survey Area and Sampling Dates

The survey area includes the St. Clair River from Lake Huron down through the South Channel to the north end of Squirrel Island (Fig. 57). Survey flights were flown in fall of 1973 and spring of 1974 (Table 8).

Table 8. Dates of aerial surveys along the St. Clair River. The first and last surveys in each period were used as baselines.

	Fall 1973	Spring 1974
Survey Dates	17 August	20 March
	4 September	1 April
	16 October	9 April
	5 November	16 April
	22 November	
	17 December	
	18 December	

3.1.7.2 St. Clair River - Overall Trends

The St. Clair River gets heavier use in winter than during migrations and numbers tend to peak in mid-December. Even so, in fall there were a total of 38,500 waterfowl days and in spring there were 53,500. The higher values in spring can be ascribed primarily to large numbers of mergansers (Fig.

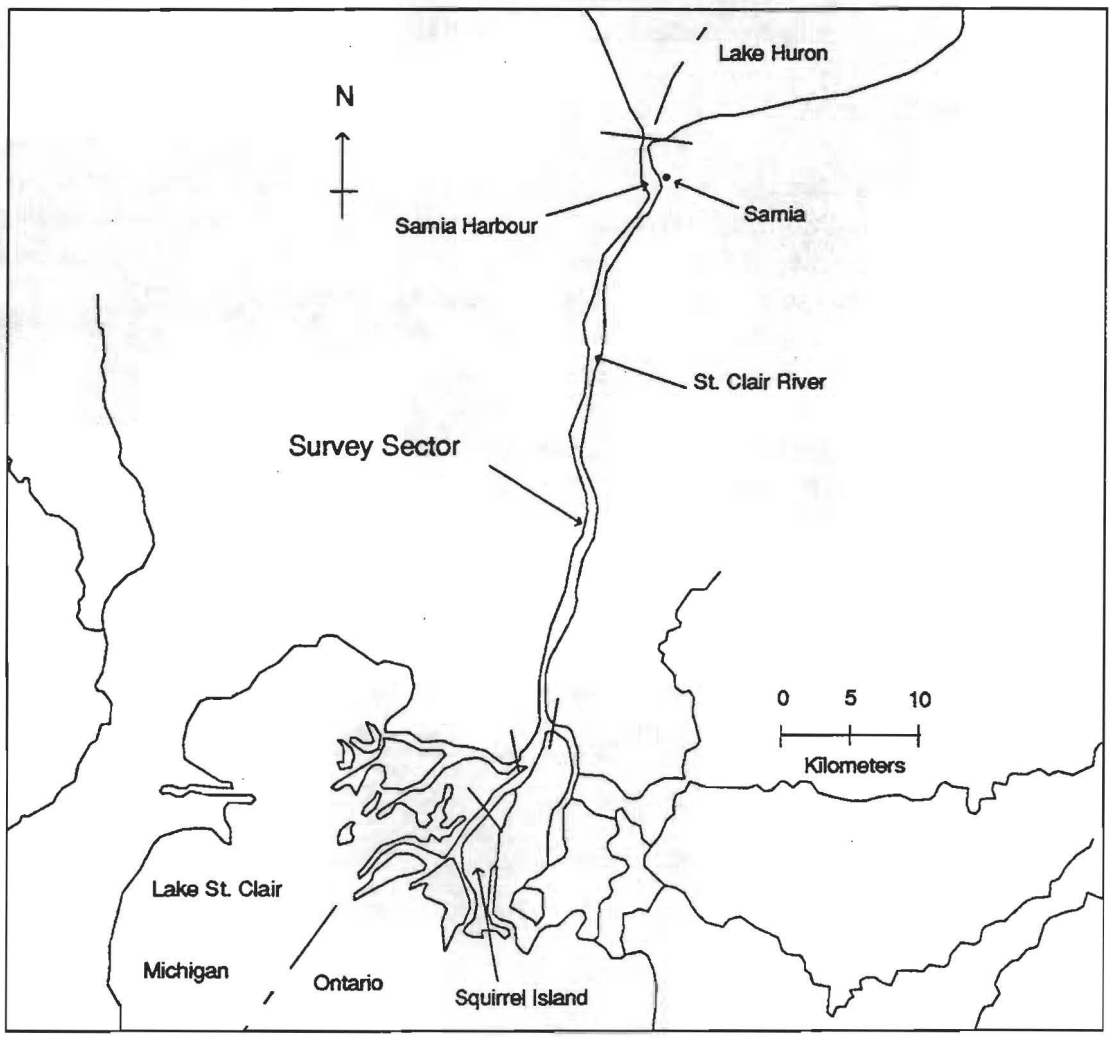


Fig. 57. Map of St. Clair River AOC showing survey sector.

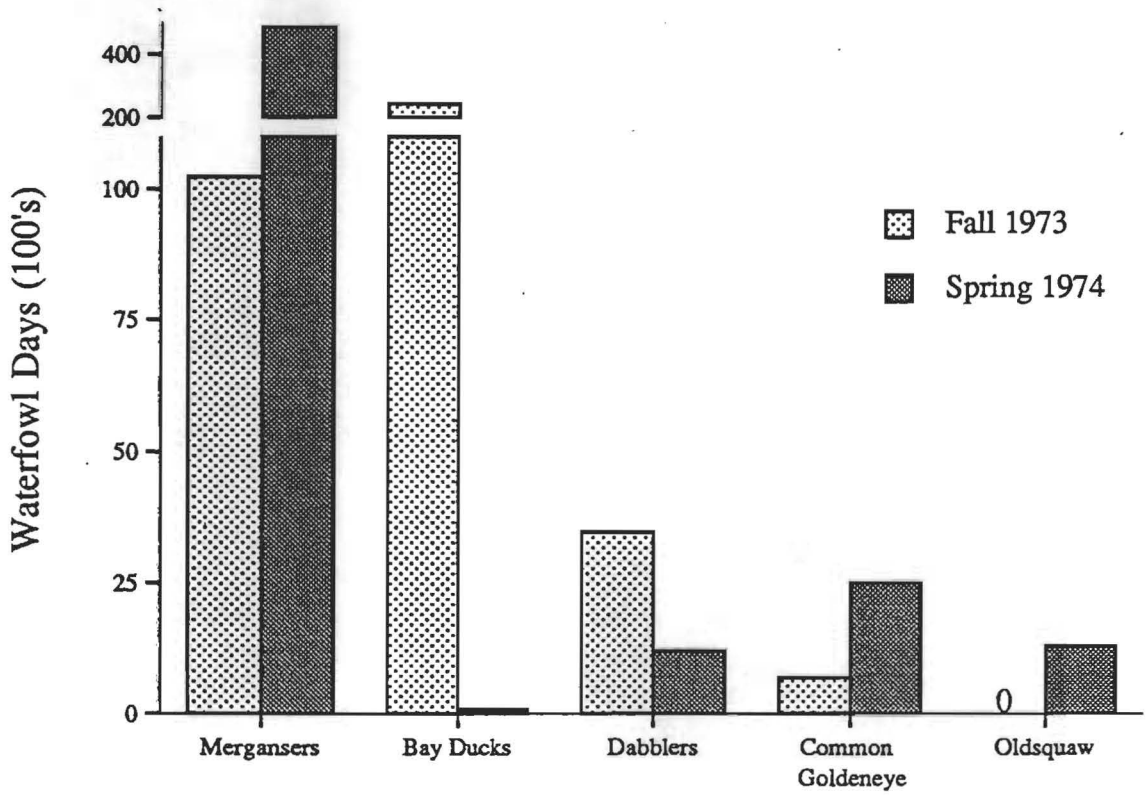


Fig. 58. Waterfowl use, by taxonomic group, of the St. Clair River AOC during fall and spring migrations.

58). Waterfowl used the entire river but there was a tendency for both bay ducks and dabblers to associate with islands, and for both dabblers and geese to concentrate north of Sarnia Harbour.

3.1.7.3 St. Clair River - Results by Taxonomic Group

3.1.7.3.1 Mergansers

Mergansers used the area most during fall (Fig. 58). Breakdown by species is not available.

3.1.7.3.2 Bay Ducks

Bay ducks used the area more in fall than in spring (Fig. 58). Redhead, scaup , and Canvasback were most commonly encountered during flights. During both seasons, Redheads accounted for more than 55% of the waterfowl days, and scaup for roughly 35%. In fall, Canvasbacks accounted for 10%. There were no Canvasbacks sighted on aerial surveys during spring migration even though this species has been seen during ground observations undertaken in early spring.

3.1.7.3.3 Dabblers

Dabblers used the area more in fall than in spring (Fig. 58). Mallards and Black Ducks were the only dabblers sighted during survey flights. During both seasons, Mallards were more numerous than Black Ducks comprising 78% of the dabblers in spring and 98% in fall.

3.1.7.3.4 Other Ducks

Only Common Goldeneye were regularly recorded, more often in spring than in fall (Fig. 58). As well, there were 52 Oldsquaw sighted in early spring.

3.1.7.3.5 Timing

During fall migration, ducks moved through in two waves (Fig. 59). The first wave consisted mostly of dabblers, and Redheads. Peaking in early September, this wave is likely comprised of birds that summered in and around the area. The larger second wave included relatively large numbers of mergansers and took place in mid-December.

During spring migration, numbers of bay ducks and other species (mostly dabblers, Common Goldeneye, and Oldsquaw) were relatively small and dropped as the season progressed. Mergansers, on the other hand, moved through the area in early April (Fig. 59).

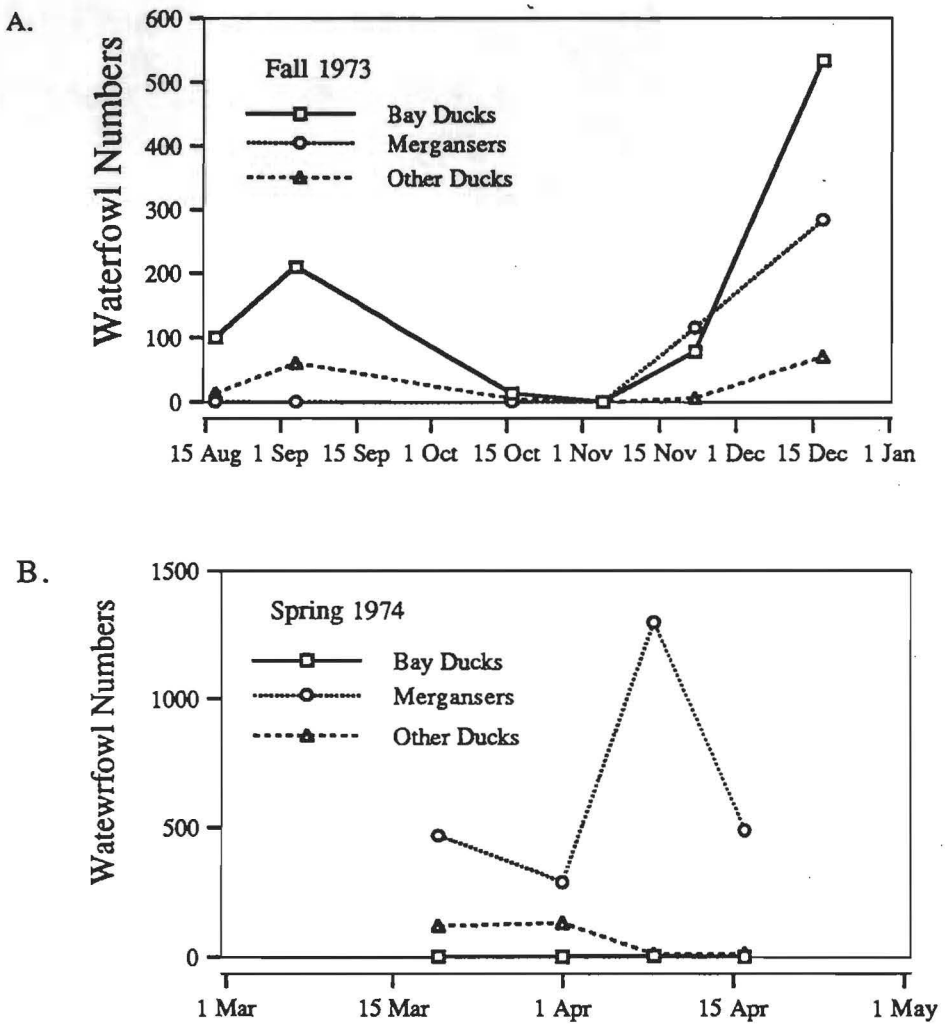


Fig. 59. Waterfowl counts in the St. Clair River AOC during the (A) fall and (B) spring surveys.

3.2 Other Areas Important to Waterfowl in the Southern Great Lakes

3.2.1 Oshawa Second Marsh

This marsh which is one of the few true coastal marshes on the Ontario shore of Lake Ontario, has considerable habitat diversity for its size.

3.2.1.1 Survey Area and Sampling Dates

The survey area included all of Oshawa Second Marsh (Fig. 60) and was surveyed in spring and fall of 1971/72 and 1980/81 (Fig. 61). Baseline dates for waterfowl use calculations are listed in Table 9.

Table 9. Baseline dates used in waterfowl day calculations for Oshawa Second Marsh.

	Entering Fall	End of Season	Entering Spring	End of Season
1971/72	1 Sept. 1971	21 Dec. 1971	10 Feb. 1972	5 June 1972
1980/81	3 Sept. 1980	15 Dec. 1980	19 March 1981	25 May 1981

3.2.1.2 Oshawa Second Marsh - Overall Trends

Waterfowl use was relatively high in the fall of 1971, amounting to over 100,000 waterfowl days. Otherwise, the average was around 5,000 waterfowl days each season (Fig. 62). Over 50% of the waterfowl were dabblers except in spring 1972 (Fig. 63) when dabbler numbers were low and Common Goldeneye numbers high (Fig. 64).

3.2.1.3 Oshawa Second Marsh - Results by Taxonomic Group

3.2.1.3.1 Dabblers

Dabblers made up most of the waterfowl (Fig. 64). The most common species were Green-winged Teal, Mallards and Black Ducks, always comprising more than 80% of dabbler waterfowl days (Fig. 65). The proportion of Black Ducks was greater in 1980/81 than in 1971/72. Small numbers of Gadwall, Blue-winged Teal, American Wigeon, and Wood Ducks were seen during both spring and fall surveys.

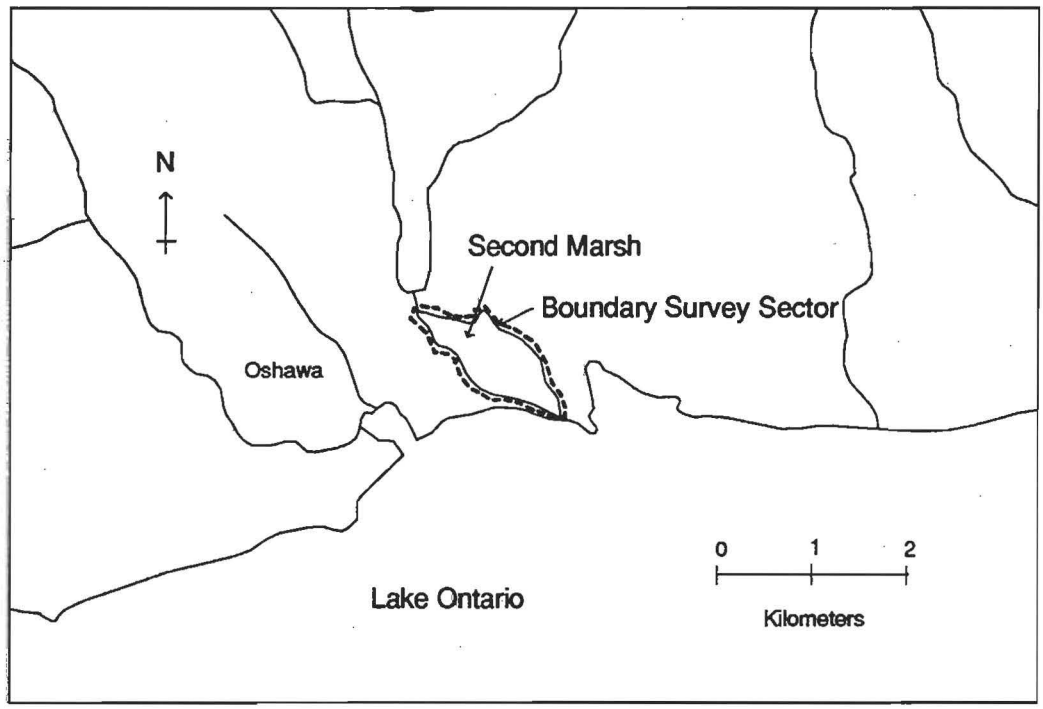
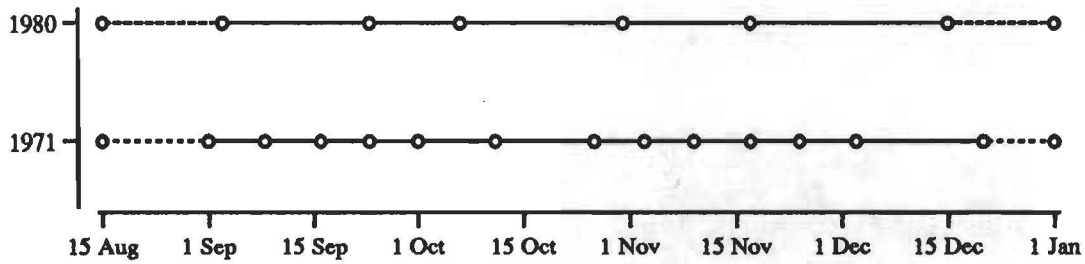


Fig. 60. Map of Oshawa Second Marsh showing survey sector.

A. Fall



B. Spring

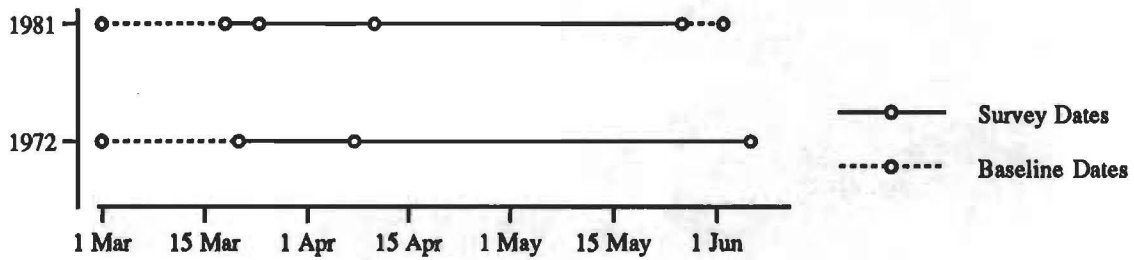


Fig. 61. Dates of aerial surveys in Oshawa Second Marsh.

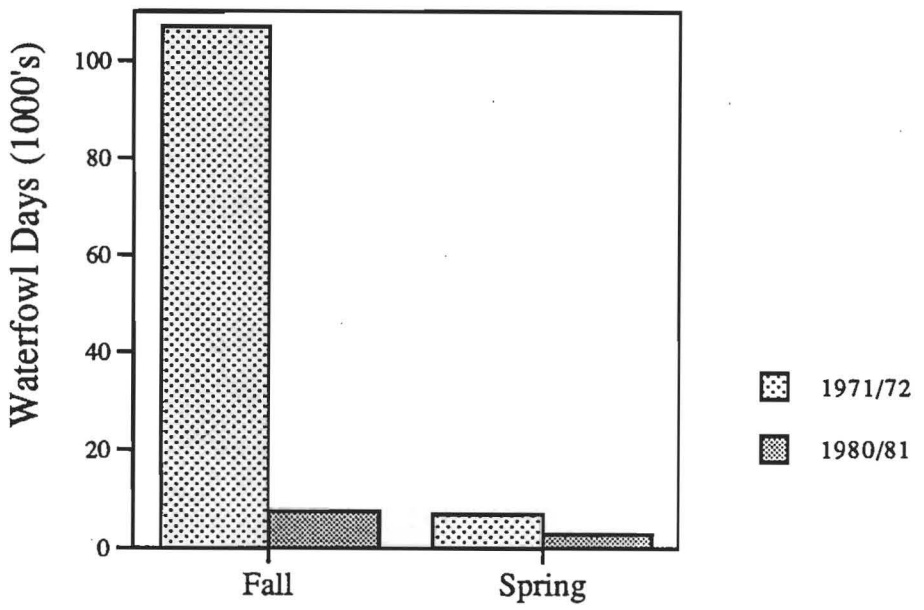


Fig. 62. Total waterfowl use of Oshawa Second Marsh during fall and spring migrations.

3.2.1.3.2 Other Ducks

This includes all the bay ducks, *Bucephala* spp., mergansers, and Ruddy Ducks and together comprised less than 15% of waterfowl numbers, except in spring 1972 when Common Goldeneye alone made up 65% of waterfowl present (Fig. 63).

The bay ducks were represented by Redheads, Canvasbacks, and scaup, although none were seen in 1980/81. There were 7,500 waterfowl days attributed to bay ducks in fall 1971 and 972 in spring 1972.

In 1980/81, neither Bufflehead nor Common Goldeneye were reported. In fall 1971, there were 400 waterfowl days attributed to Bufflehead and none to Common Goldeneye. In spring 1972, Bufflehead and Common Goldeneye accounted for 700 and 4,500 waterfowl days respectively.

Mergansers only occurred in small numbers: 30 waterfowl days in fall 1971, none in spring 1972, 1000 in fall 1980 and 115 in spring 1981.

3.2.1.3.3 Swans and Geese

Mute Swans were seen during the 1980/81 surveys (Fig. 64). The only geese reported were two Canada Geese during the spring of 1981.

3.2.1.3.4 Timing

During fall 1971 and 1980, the highest numbers of waterfowl occurred in mid-September and late October respectively. In spring of 1972 and 1981, numbers peaked in early April (Fig. 66).

3.2.2 Dunnville

This area has a moderate-sized emergent marsh complex associated with the lower reaches of the Grand River whose drainage area is very intensively developed. Hunting pressure is very heavy on these marshes which limits their fall use by waterfowl.

3.2.2.1 Survey Area and Sampling Dates

The survey area included the Grand River from Port Maitland to a point 2 km south of Cayuga (Fig. 67). Surveys were undertaken in spring and fall of 1971/72, 1980/81 and 1993/94 (Fig. 68). Baseline dates for waterfowl use calculations are listed in Table 10.

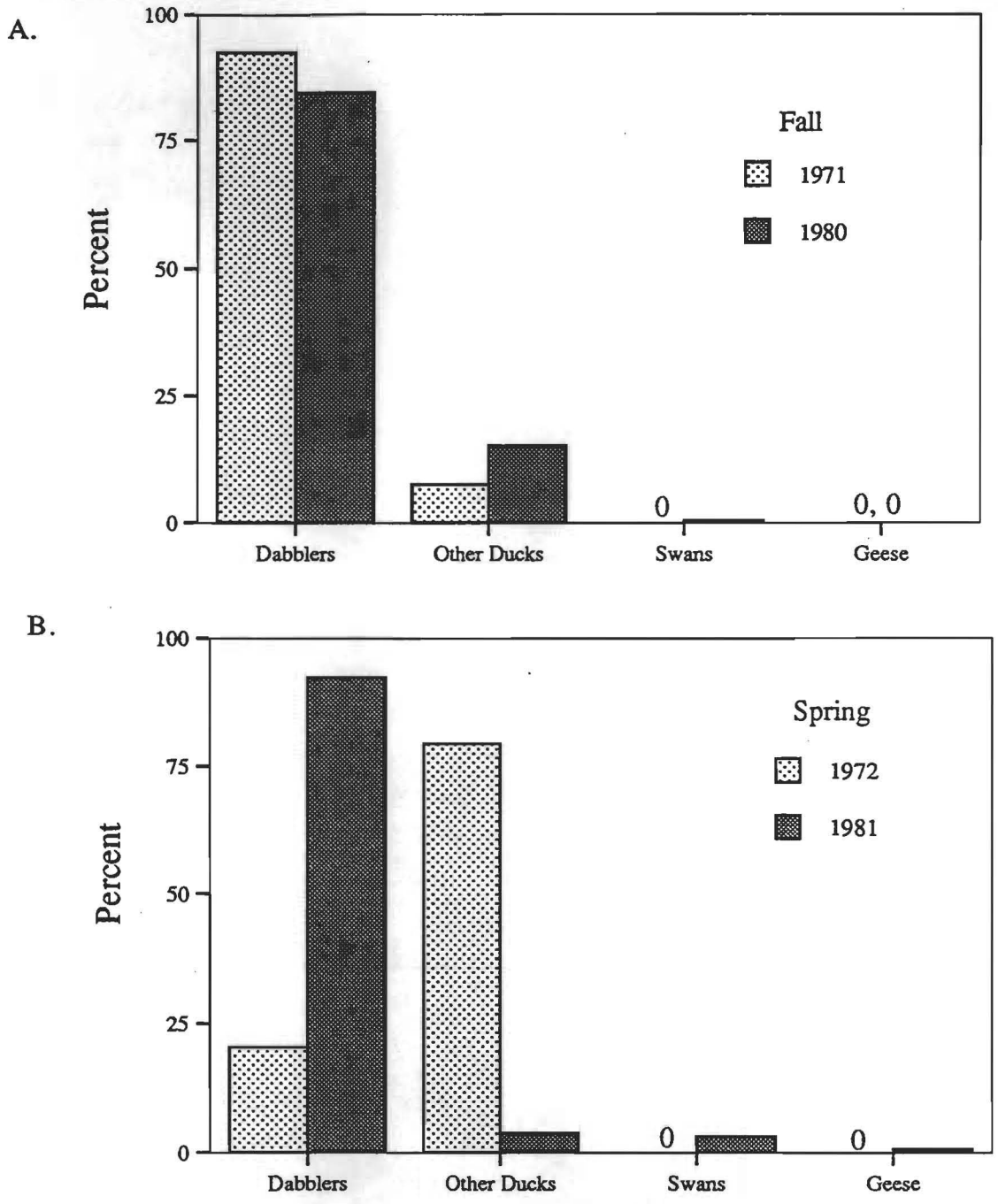


Fig. 63. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in Oshawa Second Marsh.

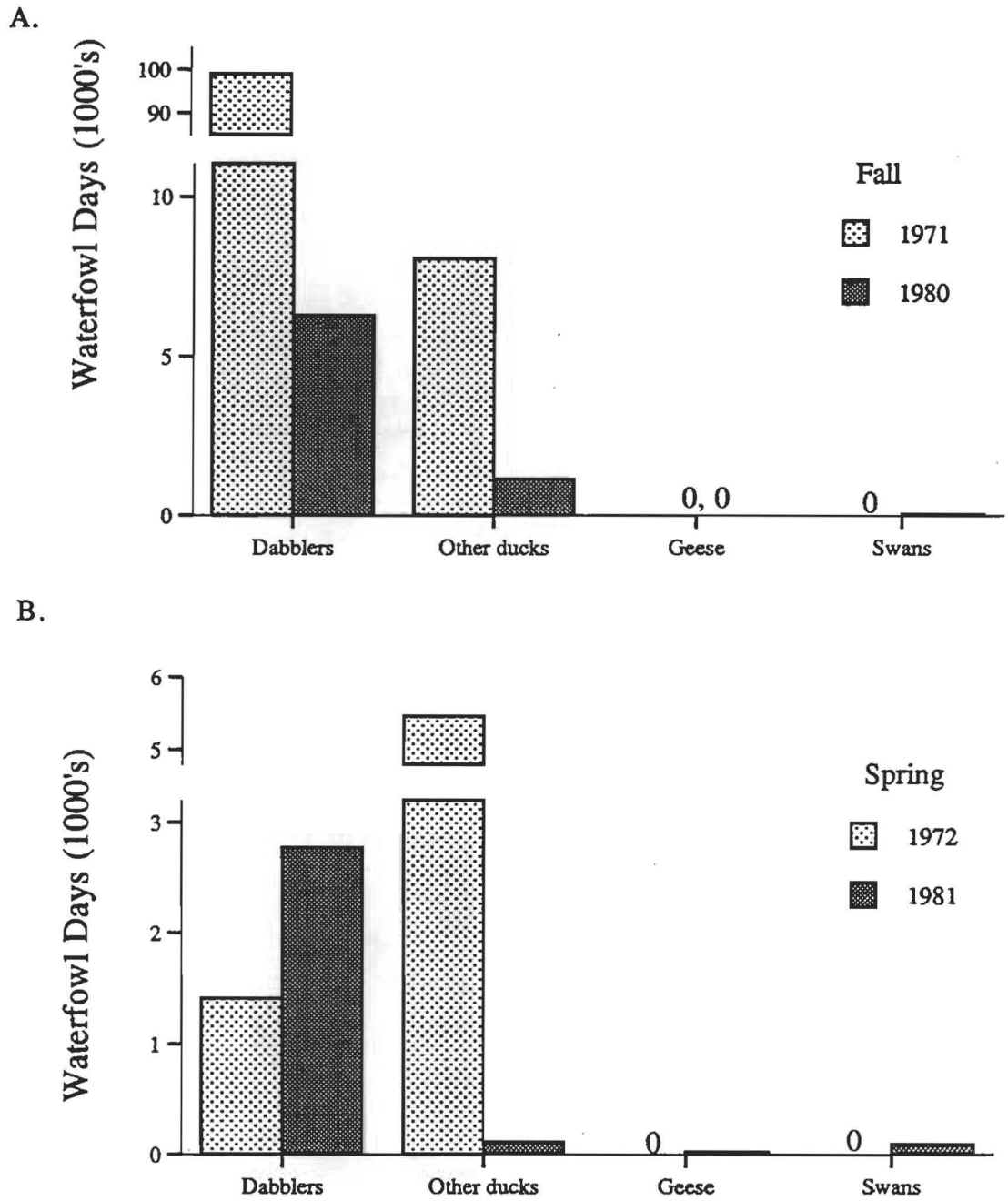


Fig. 64. Waterfowl use, by taxonomic group, of Oshawa Second Marsh during (A) fall and (B) spring migrations.

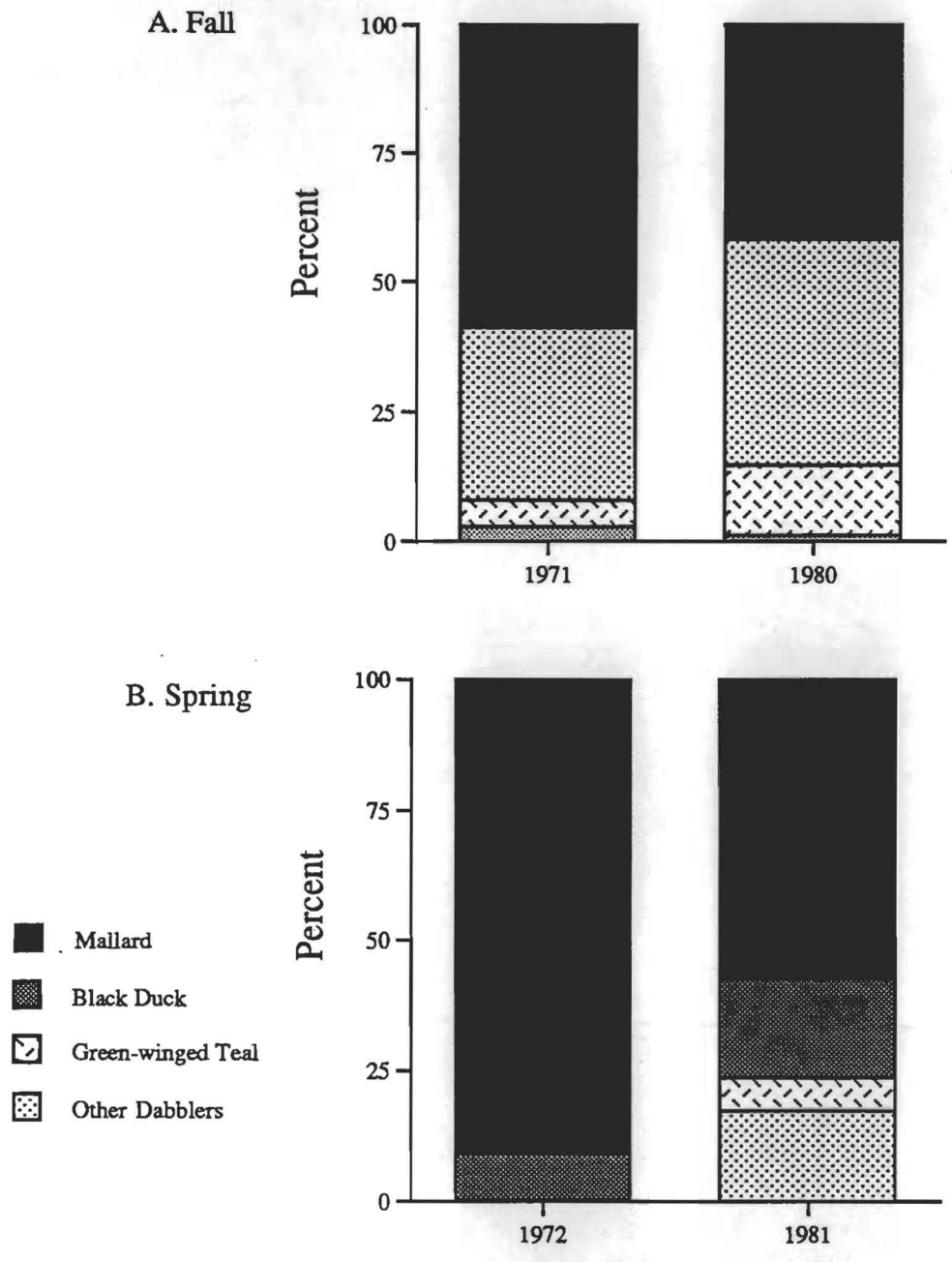
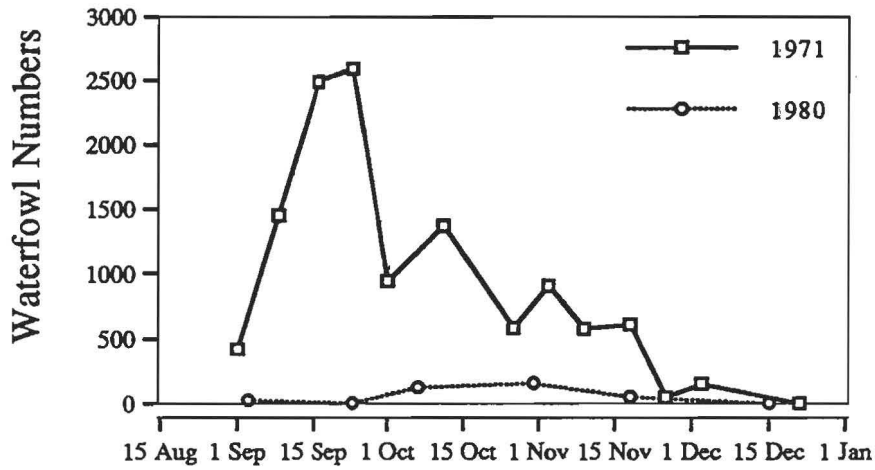


Fig. 65. Percent species composition of dabblers during (A) fall and (B) spring migrations in Oshawa Second Marsh.

A. Fall



B. Spring

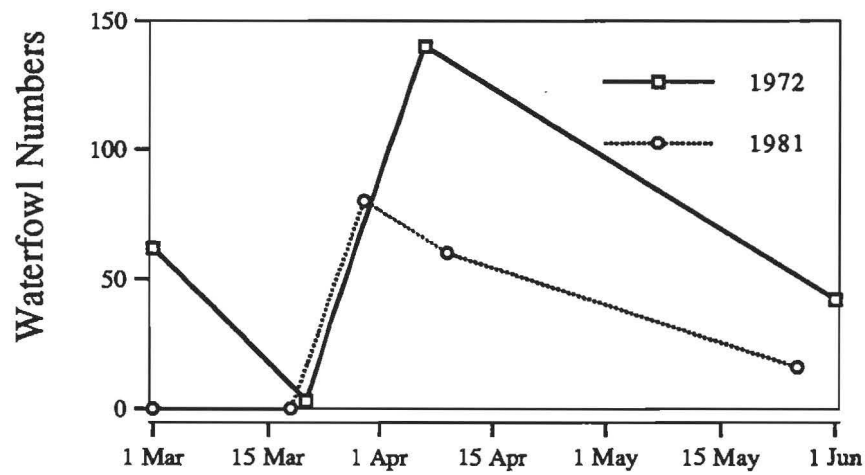


Fig. 66. Waterfowl counts in Oshawa Second Marsh during (A) fall and (B) spring surveys.

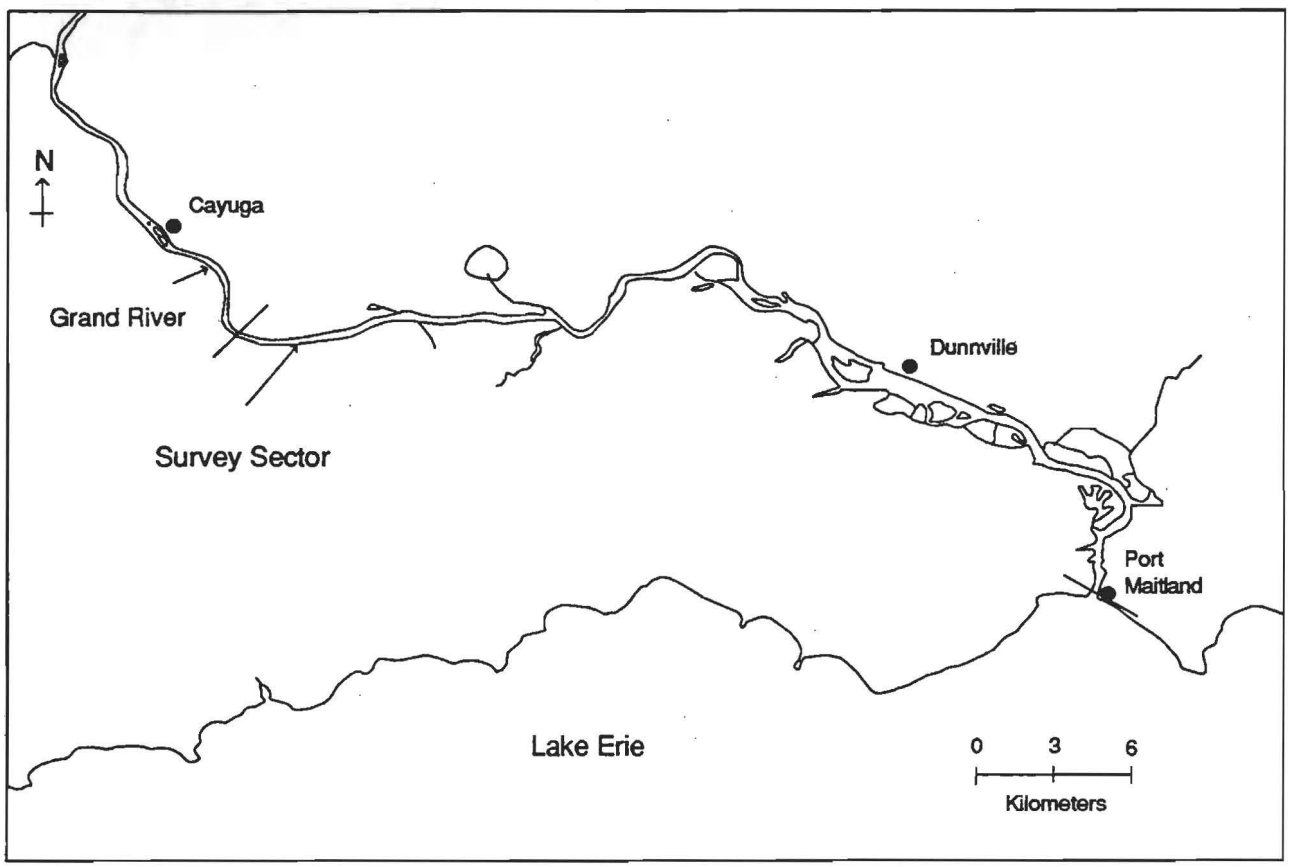
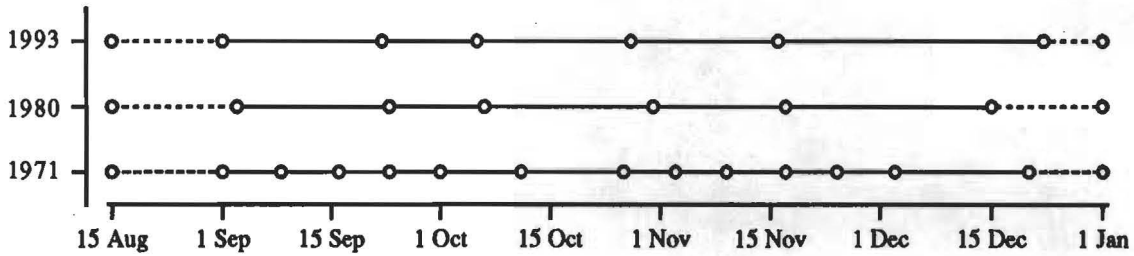


Fig. 67. Map of Dunnville showing survey sector.

A. Fall



B. Spring

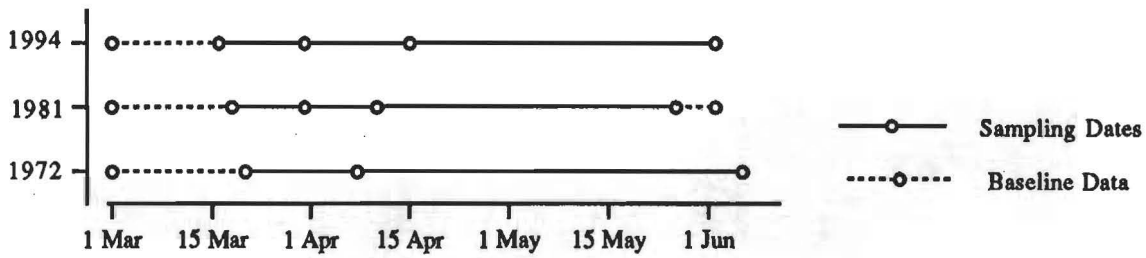


Fig. 68. Dates of aerial surveys in the Dunnville area.

Table 10. Baseline dates used in waterfowl day calculations for Dunnville.

	Entering Fall	End of Season	Entering Spring	End of Season
1971/72	1 Sept. 1971	21 Dec. 1971	10 Feb. 1972	5 June 1972
1980/81	3 Sept. 1980	15 Dec. 1980	19 March 1981	25 May 1981
1993/94	1 Sept. 1993	23 Dec. 1993	17 March 1994	31 May 1994

3.2.2.2 Dunnville - Overall Trends

The Dunnville area was used by waterfowl slightly more during spring than during fall migrations (Fig. 69). Total number of waterfowl days during fall migrations averaged 41,000, and was greatest in 1993 and lowest in 1980. Spring migration use averaged 45,500 waterfowl days, and was highest in 1972 and lowest in 1981.

Over 50% of the waterfowl were dabblers in both seasons (Fig. 70). During 1980/81, geese also made up a large proportion of the total. All other waterfowl comprised only a small fraction of the total.

3.2.2.3 Dunnville - Results by Taxonomic Groups

3.2.2.3.1 Dabblers

Dabblers were the most abundant group of waterfowl in both seasons (Fig. 70). During fall, dabbler use of the area was greatest in 1993 and lowest in 1980. During spring, the highest use was in 1972 and the lowest in 1981.

Although there were small numbers of Gadwall, Northern Pintail, both teals, American Wigeon, and Wood Ducks seen on the surveys, the most common species were Mallards and Black Ducks, always comprising more than 64% of dabbler waterfowl days (Fig. 72). The proportion of Black Ducks declined while that of Mallards increased.

3.2.2.3.2 Geese

Only Canada Geese were reported. Highest numbers were reported in 1980/81 (Fig. 71) when there was a deliberate practice, since stopped, of feeding the geese near the river. Breeding populations in the Grand River and vicinity, however, were considerably higher in 1993/94 than in earlier years.

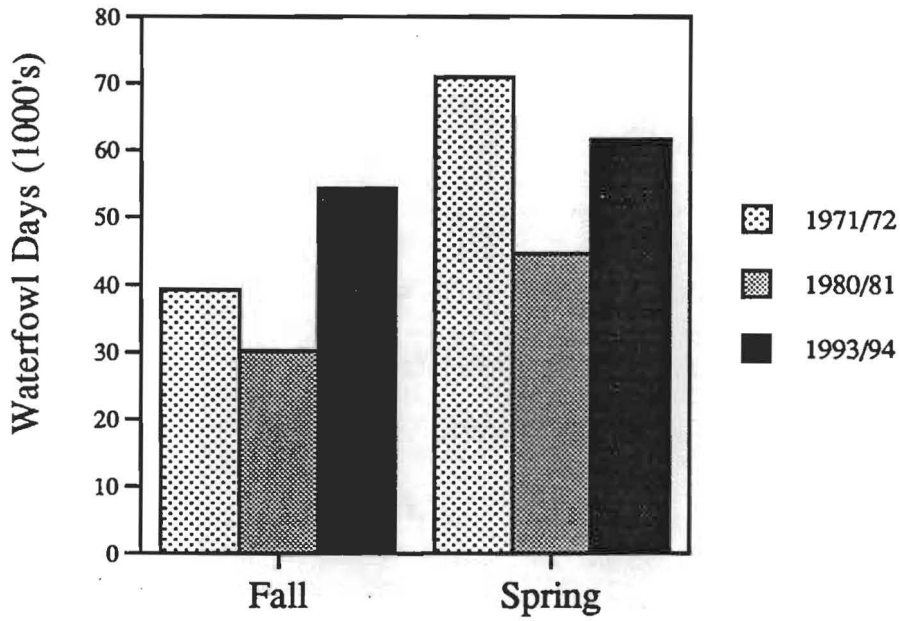


Fig. 69. Total waterfowl use of the Dunnville area during fall and spring migrations.

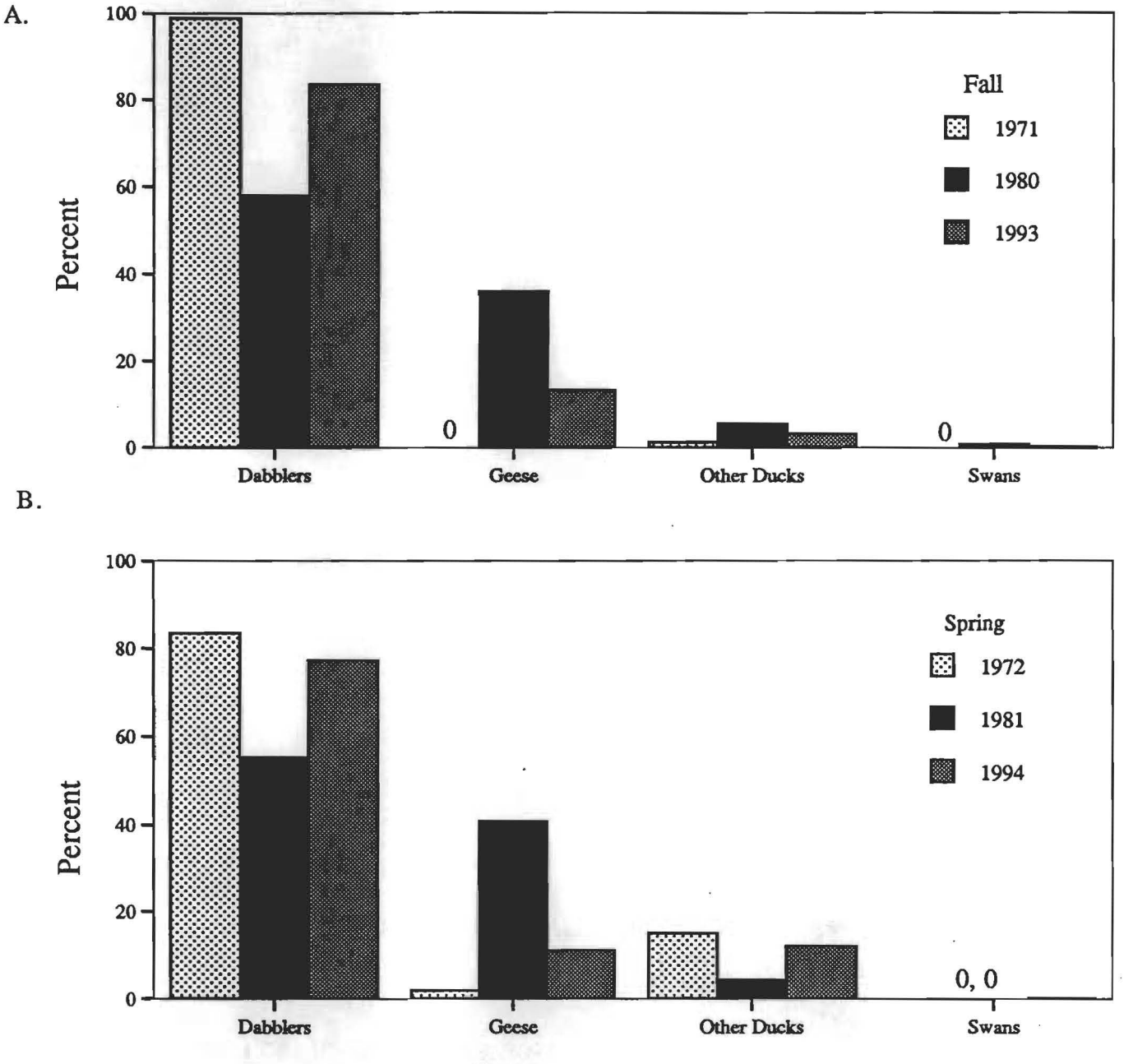


Fig. 70. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in the Dunnville area.

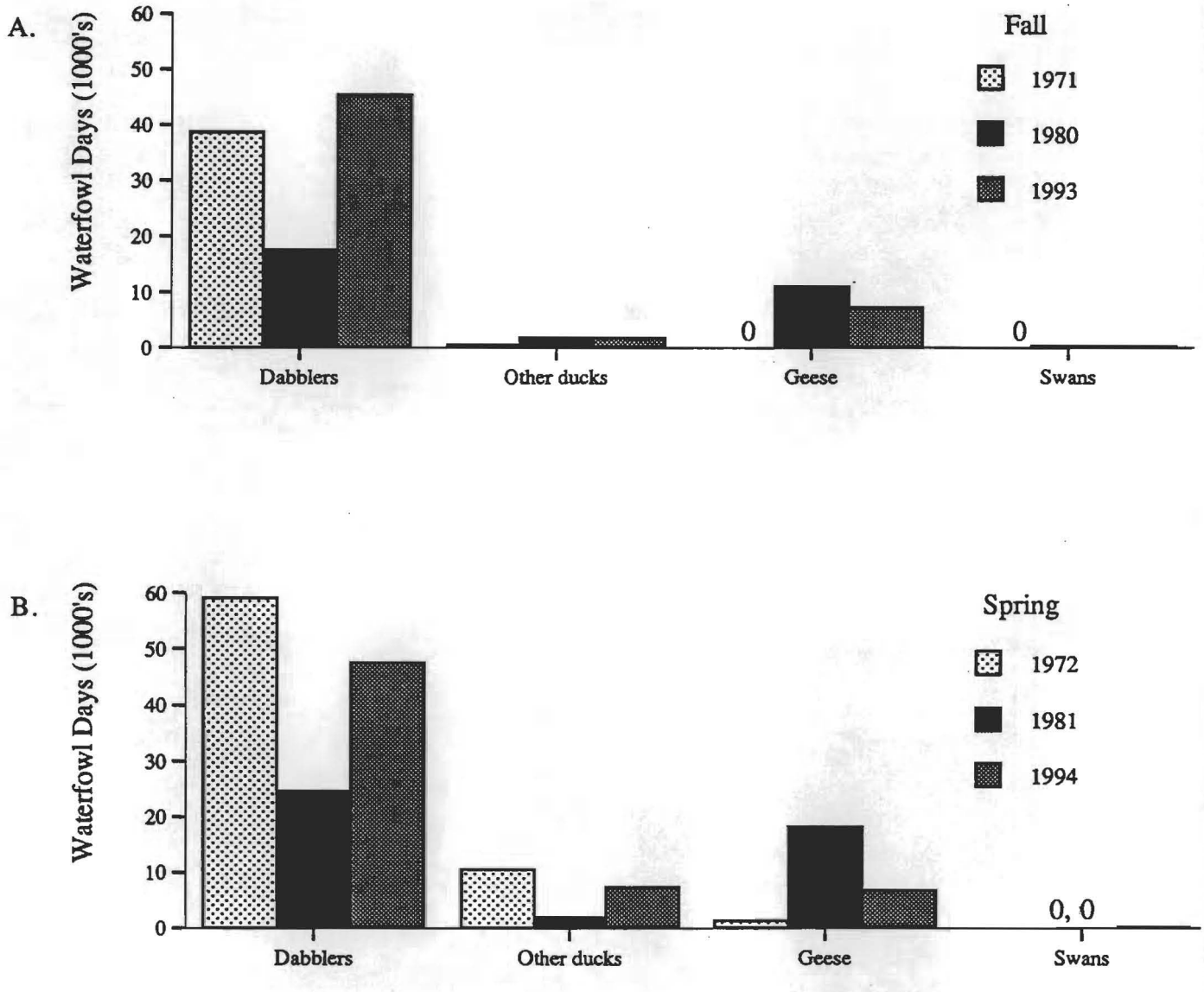


Fig. 71. Waterfowl use, by taxonomic group, of the Dunnville area during (A) fall and (B) spring migrations.

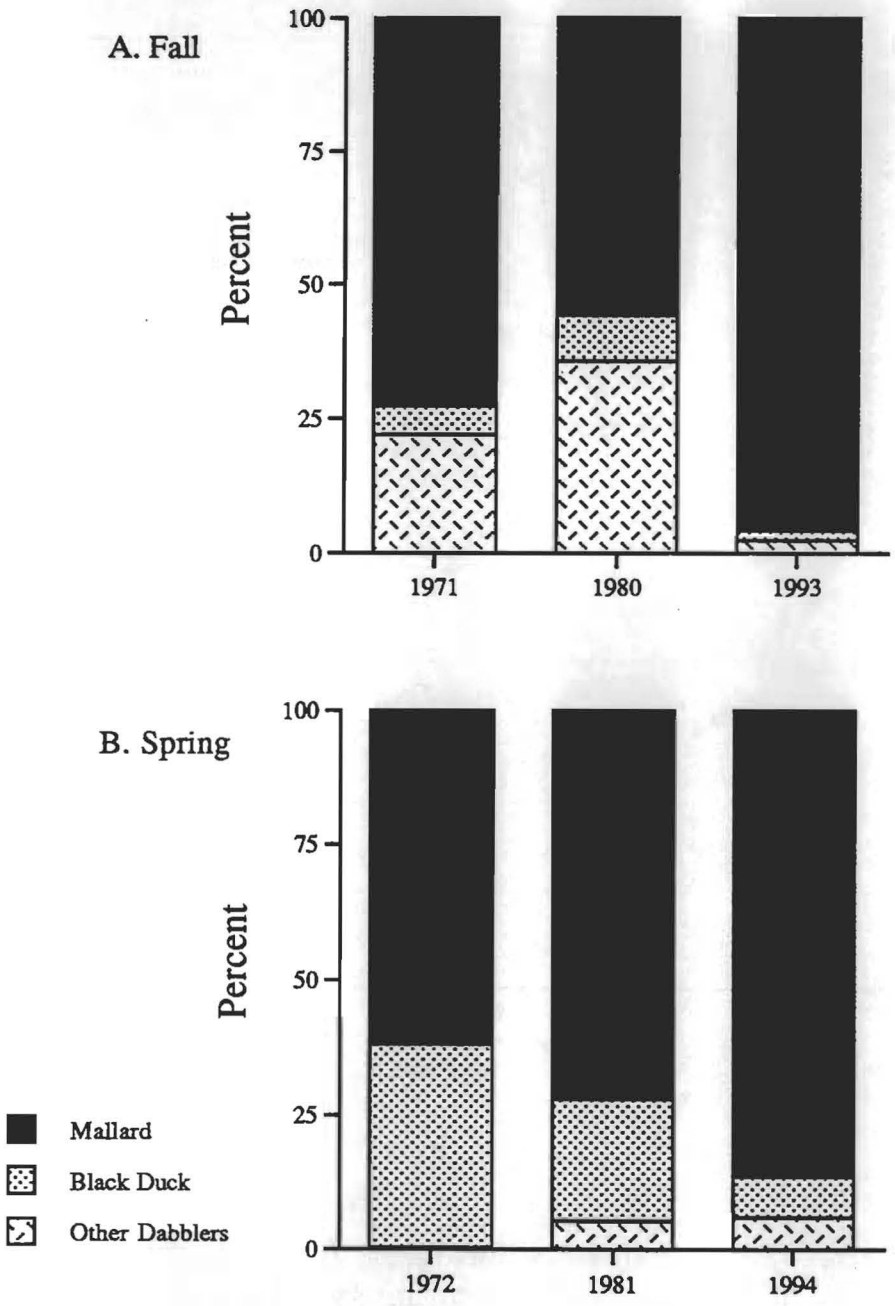
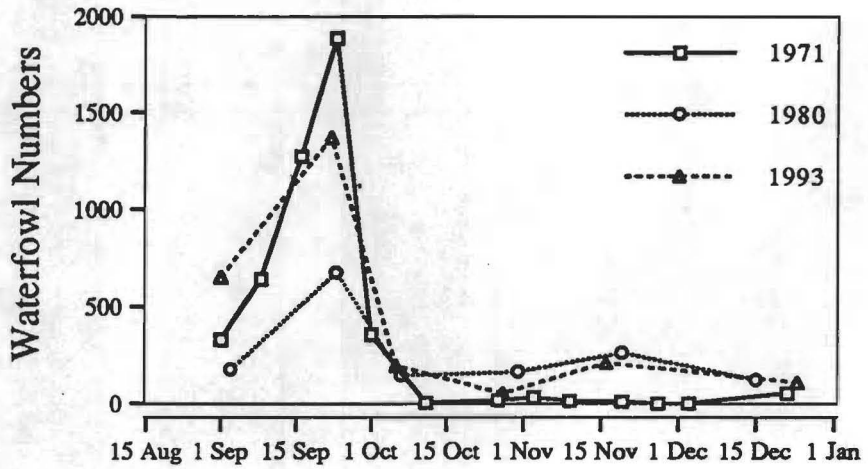


Fig. 72. Percent species composition of dabblers during (A) fall and (B) spring migrations in the Dunnville area.

A. Fall



B. Spring

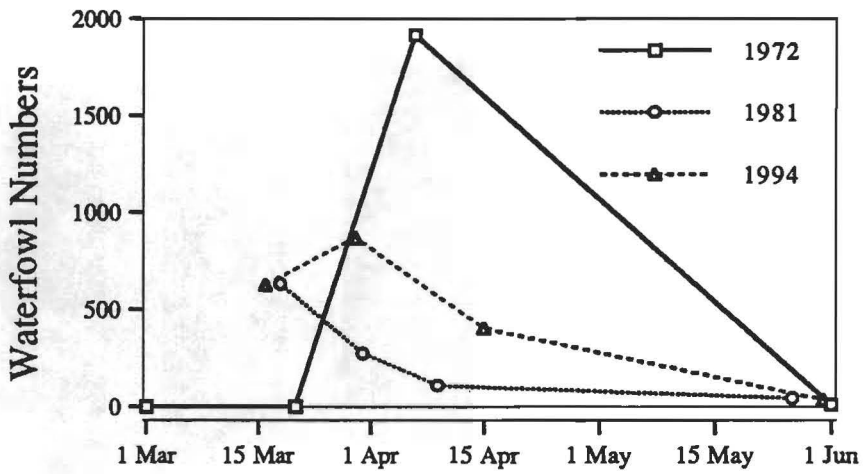


Fig. 73. Waterfowl counts in the Dunnville area during (A) fall and (B) spring surveys.

3.2.2.3.3 Other Ducks

This group includes all the bay ducks, *Bucephala* spp., mergansers, and Ruddy Ducks, together always comprising less than 15% of the waterfowl.

During fall, bay duck use of the area was very low. Spring use was higher averaging 2,500 waterfowl days each year. All bay duck species were noted in spring 1972, only Ring-necked Ducks in spring 1981, and both scaups and Ring-necked Ducks in spring 1994.

During fall, *Bucephala* spp. use averaged 500 waterfowl days each year. Only Common Goldeneye were sighted in 1971 and 1980, and only Bufflehead in 1993. During spring, this group contributed 3,500 waterfowl days in 1972 and 1994 and none in 1980; Common Goldeneye made up over 80%.

Merganser numbers averaged 1,200 each season, although no mergansers were observed in fall 1971.

3.2.2.3.4 Swans

Two species of swans were sighted in three of the six surveys and numbers were low (Fig. 71). There were two Mute Swans sighted in fall 1993 and five in spring 1994. In fall 1980, there were 10 Tundra Swans recorded.

3.2.2.3.5 Timing

During fall, the waterfowl numbers peaked in mid-September (Fig. 73) after which came a rapid decline reflecting high hunting pressure. During spring 1981 and 1994, waterfowl numbers decreased as the season progressed. In 1972, numbers were greatest in early April.

3.2.3 Long Point

This section of the Lake Erie shore is renowned throughout the continent as a major waterfowl staging site. It is composed of a large spit which extends southeastward into the lake and which shelters a large shallow bay with vast beds of submergent vegetation. Extensive marshes line the shore and are backed by rich agricultural lands.

3.2.3.1 Survey Area and Sampling Dates

The survey area included the shoreline from Turkey Point around the Long Point peninsula (Fig. 74). There were 6 fall and 5 spring surveys over 17 years (Fig. 75). Baseline dates for waterfowl use calculations are listed in Table 11.

Table 11. Baseline dates used in waterfowl day calculations for Long Point.

	Entering Fall	End of Season	Entering Spring	End of Season
1971	30 Sept. 1971	2 Jan. 1972	-	-
1974/75	19 Aug. 1974	2 Jan. 1975	20 Feb.1975	9 May 1975
1978/79	1 Sept. 1978	5 Dec. 1978	23 March 1979	31 May 1979
1984	31 Aug. 1984	9 Jan. 1985	22 Feb. 1984	31 May 1984
1986/87	28 Aug. 1986	11 Dec. 1986	16 March 1987	25 May 1987
1987/88	1 Sept. 1987	6 Jan. 1987	22 March 1988	27 May 1988

3.2.3.2 Long Point - Overall Trends

The total number of waterfowl days averaged 5,245,000 during fall and 1,444,000 during spring. During fall, use was highest in 1978, whereas highest spring use occurred in 1975 (Fig. 76). Total use was relatively low during the last three survey years, in both spring and fall.

The species composition of the total waterfowl fluctuated with season and year (Fig. 77). However, bay ducks always made up the greatest proportion of total waterfowl. Bay ducks and dabblers together comprised over 75% of the total except in spring 1984 when use by both groups was low (Fig. 78).

3.2.3.3 Long Point - Results by Taxonomic Group

3.2.3.3.1 Bay Ducks

Bay duck numbers fluctuated over seasons and years, and gave no clear trends (Fig. 80). During fall, average use was 2,723,000 waterfowl days with the highest use in 1971 and the lowest use in 1976. Spring use averaged 860,000 waterfowl days with the high in 1975 and the low in 1984.

The proportion of Ring-necked Ducks increased each survey year while the proportion of scaup appears to have declined (Fig. 80). Together, Redheads and Canvasbacks always comprise over 50% of the bay ducks, but proportions fluctuated.

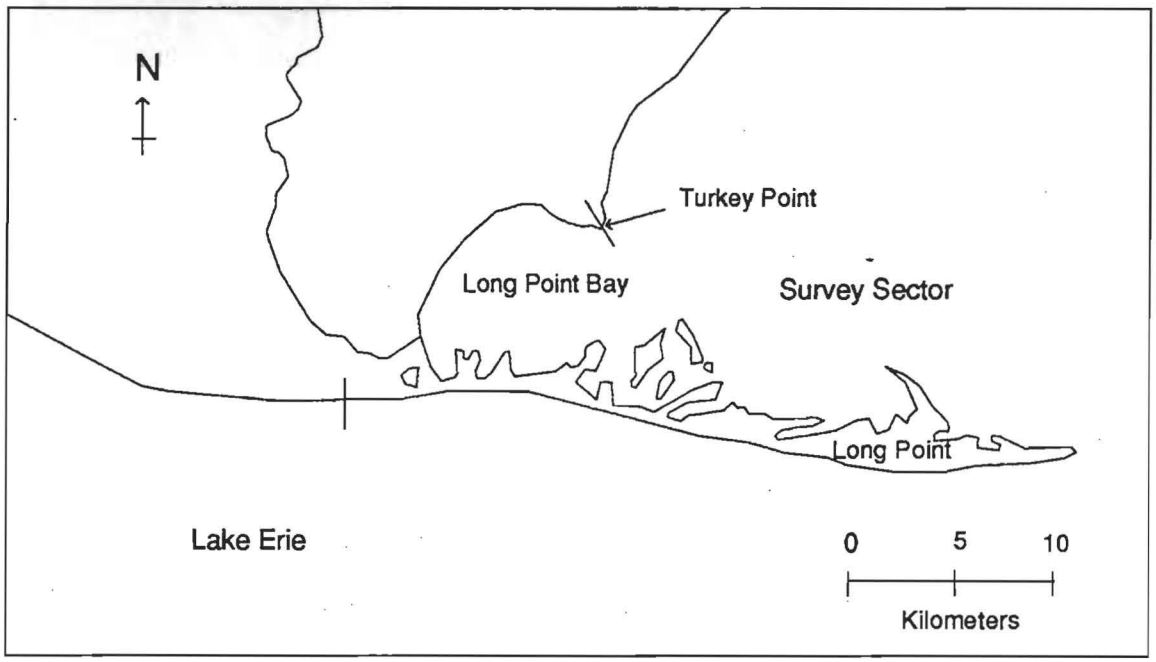
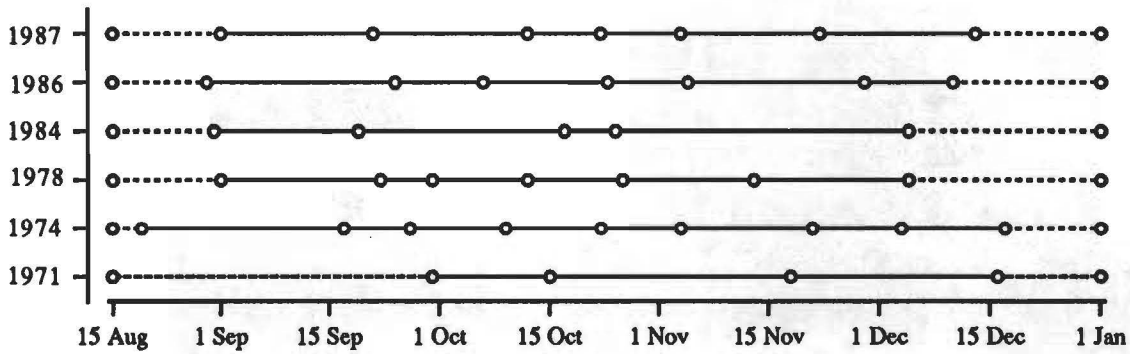


Fig. 74. Map of Long Point showing survey sector.

A. Fall



B. Spring

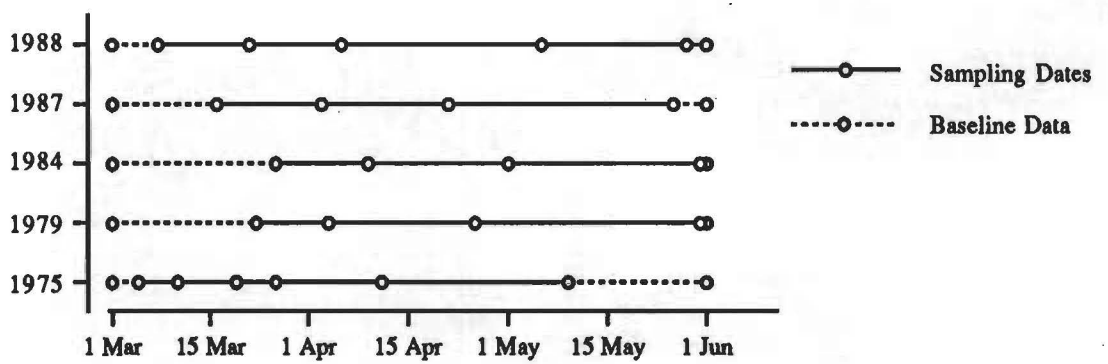


Fig. 75. Dates of aerial surveys in Long Point.

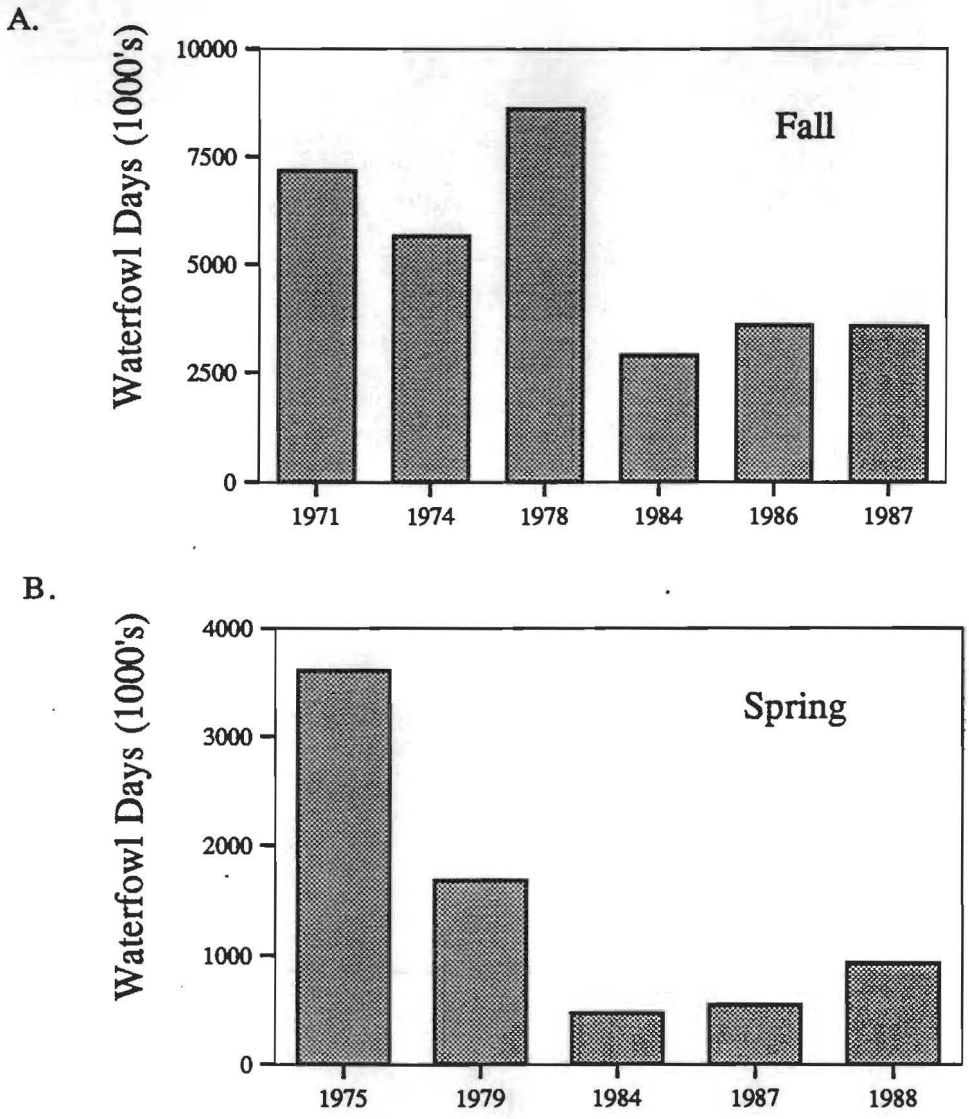


Fig. 76. Total waterfowl use of Long Point during (A) fall and (B) spring migrations.

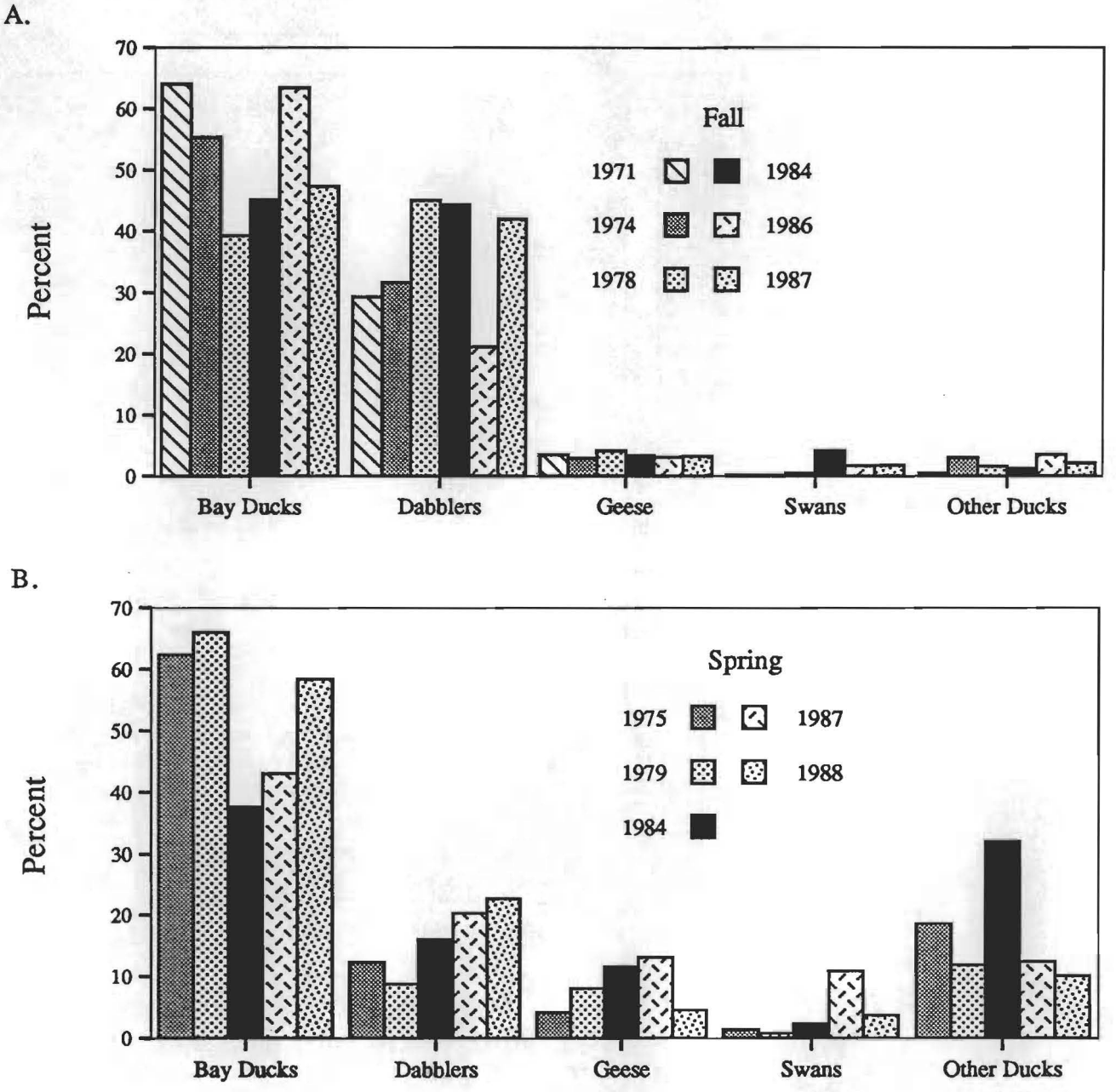


Fig. 77. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations at Long Point.

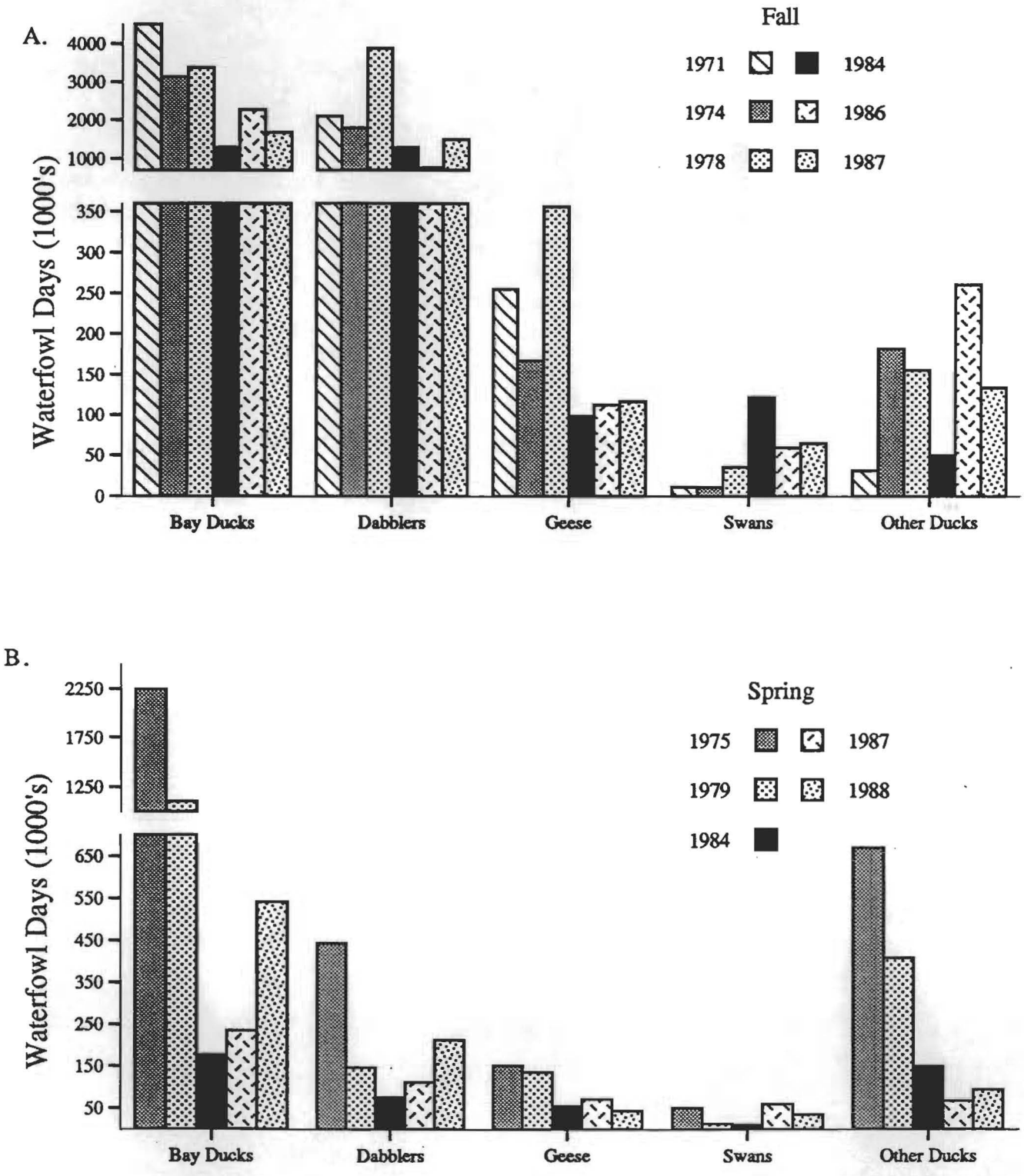


Fig. 78. Waterfowl use, by taxonomic group, of Long Point during (A) fall and (B) spring migrations.

3.2.3.3.2 Dabblers

Dabbler numbers fluctuated over seasons and years, and presented no clear trends (Fig. 79). During fall, average use was 1,882,000 waterfowl days with the highest use in 1978 and the lowest in 1986. Spring use averaged 197,000 with the high in 1972 and the low in 1984.

Green-winged Teal, Blue-winged Teal, Northern Shoveler, Northern Pintail, Gadwall, and Wood Duck were among the dabblers which use Long Point in substantial numbers during migrations. However, the most common species were Mallards, Black Ducks, and American Wigeon; together they comprised over 85% of the dabblers except during spring 1979 when the proportion dropped to 75% (Fig. 79). During that season, there were high numbers of Gadwall in the area; otherwise, the species composition of the dabbler group appears relatively constant.

3.2.3.3.3 Geese

Average use amounted to 183,000 waterfowl days in fall and 91,000 in spring, but use of the area declined slightly over time (Fig. 78) in contrast to most other sites in southern Ontario. Canada Geese always made up at least 99% of all geese, although small numbers of Snow Geese were reported in fall 1974, 1978, and 1987 and in spring 1984.

3.2.3.3.4 Swans

Swan numbers were highest in fall 1984 and lowest in fall 1974 (Fig. 78). Average fall and spring use amounted to 50,000 and 33,000 waterfowl days respectively.

Tundra Swans always comprised over 94% of all the swans. However, the proportion of Mute Swans increased each year from complete absence in 1974/75, to 5% in spring 1988.

3.2.3.3.5 Other Ducks

This grouping, which includes *Bucephala* spp., mergansers, scoters, Oldsquaw, and Ruddy Ducks, comprised less than 5% of the fall waterfowl total and less than 20% of the spring waterfowl total. The exception was spring 1984 when they contributed over 30% to the total due to low numbers of both bay ducks and dabblers.

Bucephala spp. averaged 14,000 waterfowl days in fall and 68,000 in spring. Common Goldeneyes were somewhat more abundant than Buffleheads.

Together all three species of merganser averaged 32,000 waterfowl days in fall, and 165,000 in spring.

Oldsquaw use of the immediate area was low, averaging 1,000 waterfowl days in fall and 72 waterfowl days in spring, even though much larger numbers are known to use the open lake further offshore.

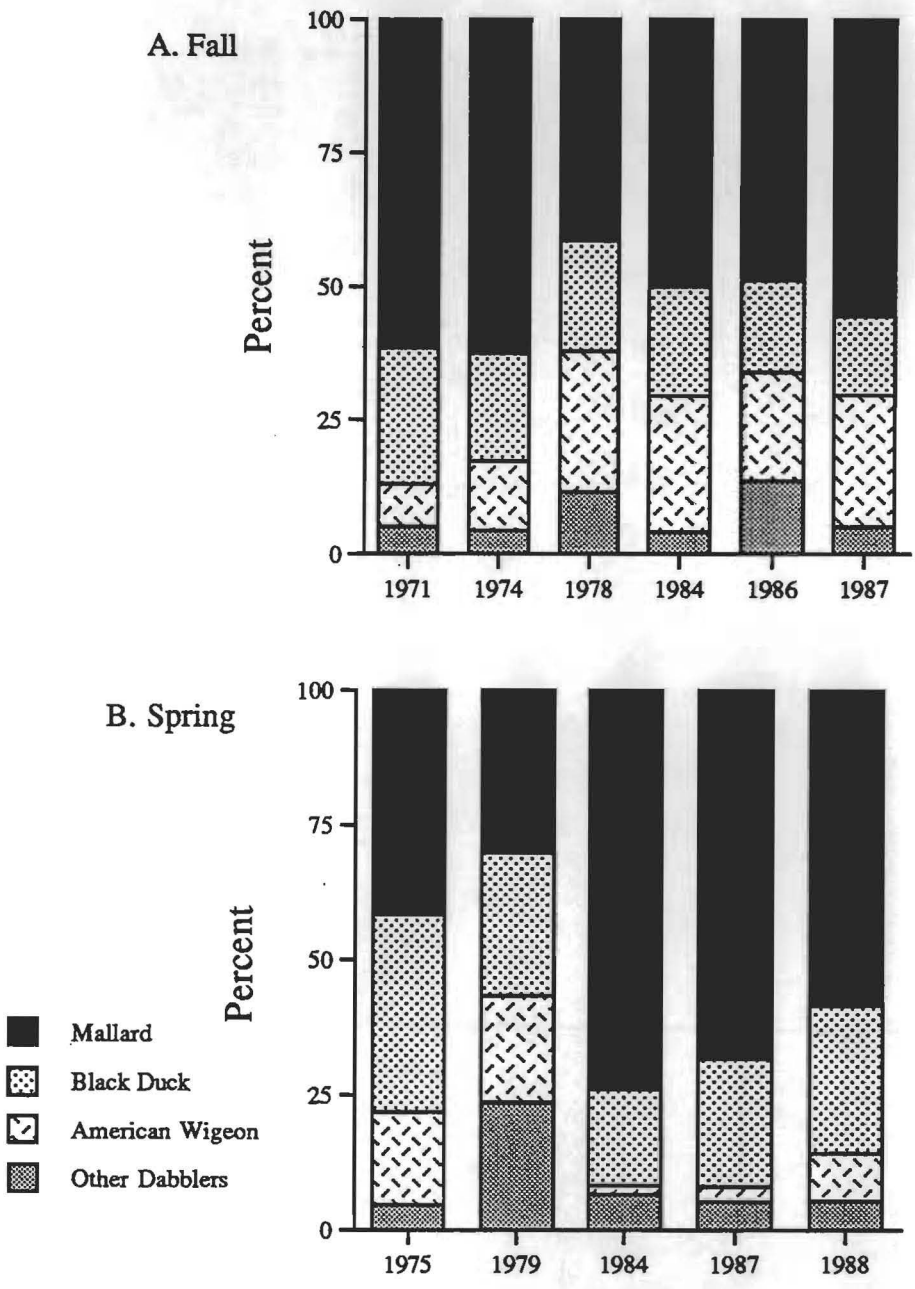


Fig. 79. Percent species composition of dabblers during (A) fall and (B) spring migrations at Long Point.

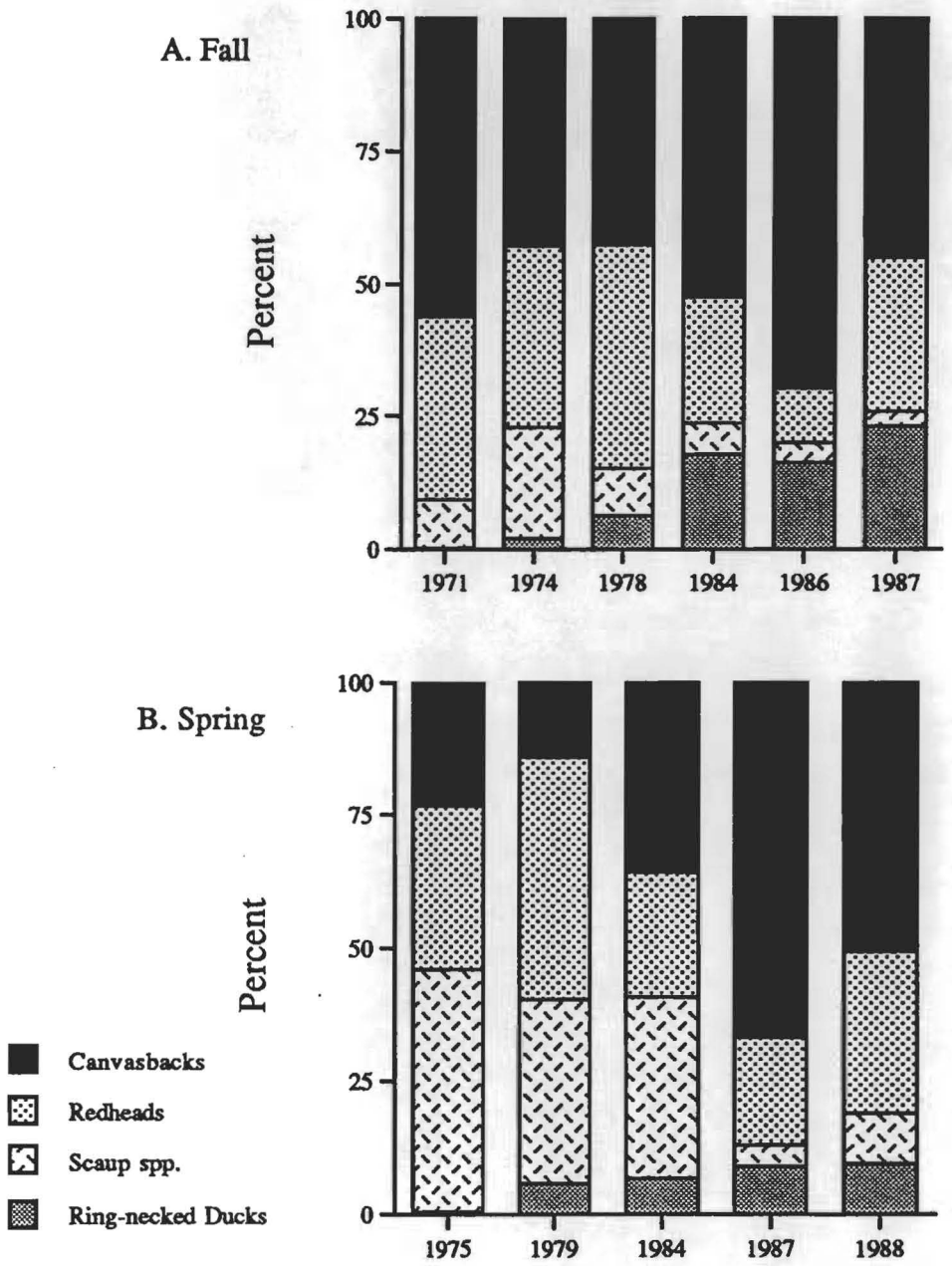


Fig. 80. Percent species composition of bay ducks during (A) fall and (B) spring migrations at Long Point.

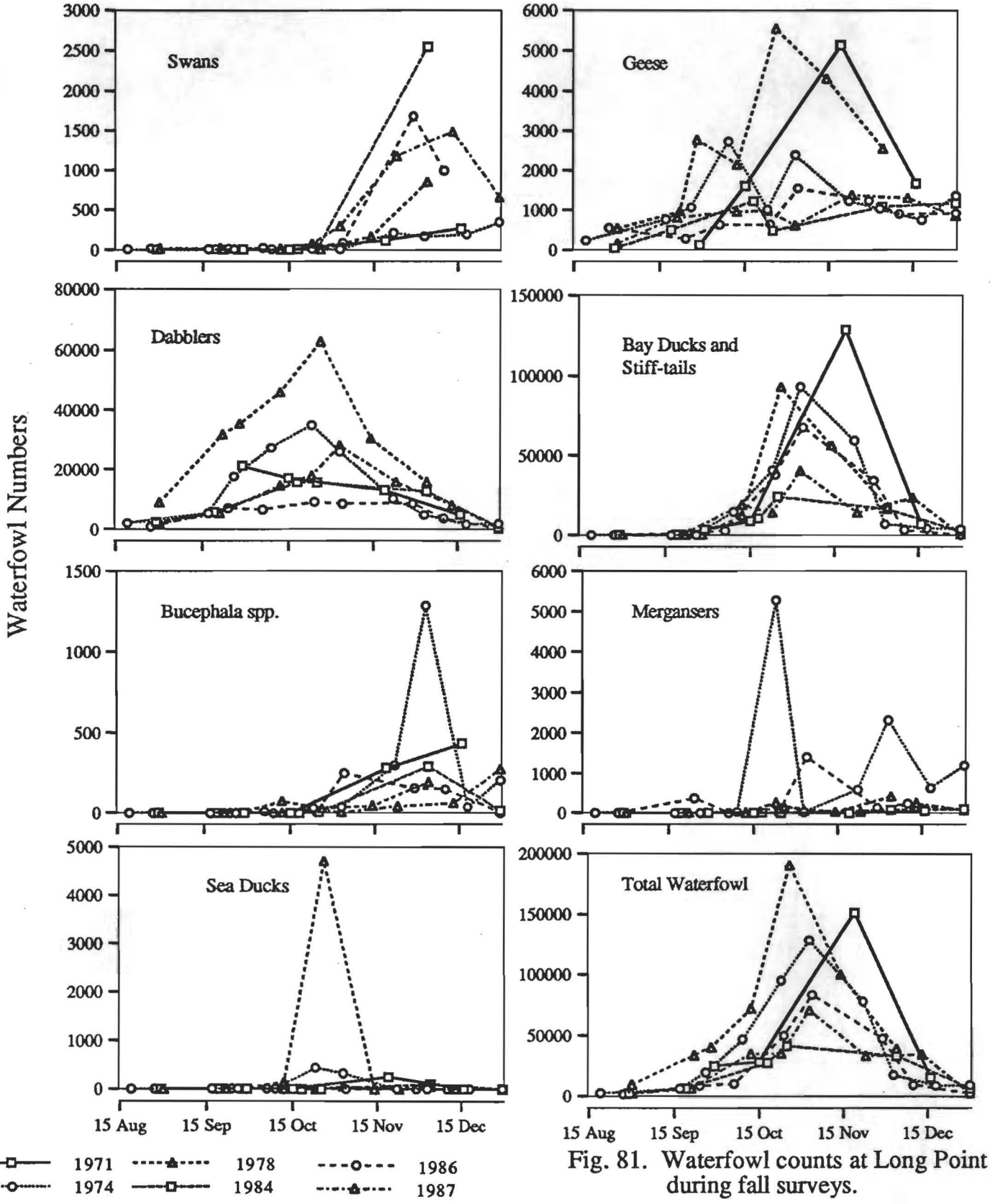


Fig. 81. Waterfowl counts at Long Point during fall surveys.

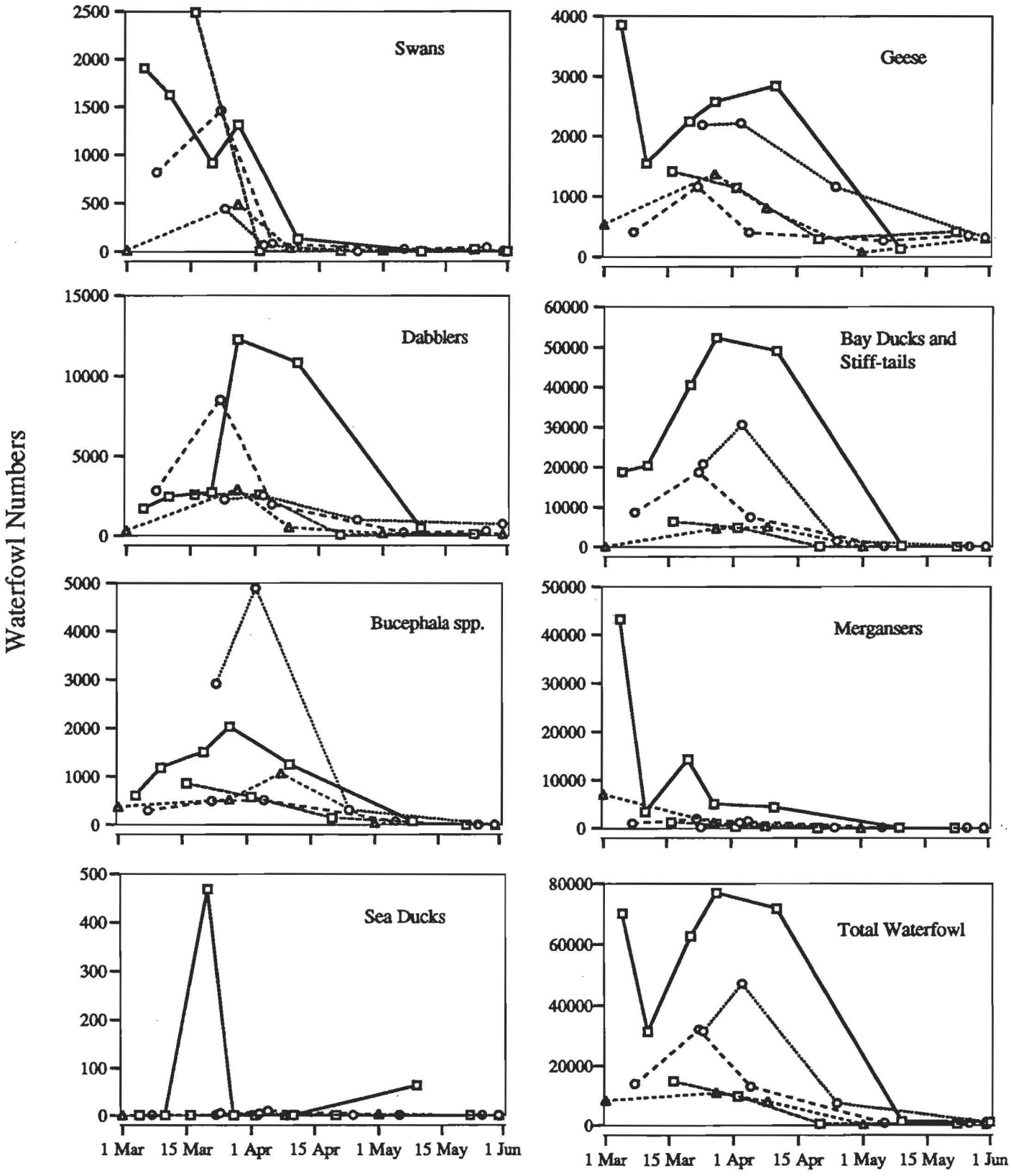


Fig. 82. Waterfowl counts at Long Point during spring surveys.

Scoter use averaged 15,000 waterfowl days in fall and 1,000 in spring. Ruddy Duck use averaged 71,000 waterfowl days in fall and 1,500 in spring.

3.2.3.3.6 Timing

During fall, overall waterfowl numbers was highest from mid-October to mid-November (Fig 81). Swans and *Bucephala* spp., however, were most abundant from late November to early December.

During spring, waterfowl numbers were greatest from late March till early April after which they decreased quite rapidly (Fig. 82).

3.2.4 Rondeau Harbour

This bay is bounded to the south and east by a large spit which comprises a provincial park. The bay is rimmed by extensive marshes and contains large beds of submergent vegetation. There can be much boating activity in the bay.

3.2.4.1 Survey Area and Sampling Dates

The survey area included the shoreline of Rondeau Provincial Park (Fig. 83) and was sampled in fall and spring of 1972/73, 1979/80, and 1991/92 (Fig. 84). Baseline dates for waterfowl use calculations are listed in Table 12.

Table 12. Baseline dates used in waterfowl day calculations for Rondeau Harbour.

	Entering Fall	End of Season	Entering Spring	End of Season
1972/73	28 Aug. 1972	7 Dec. 1972	9 Sept. 1973	9 April 1973
1979/80	31 Aug. 1979	11 Dec. 1979	18 March 1980	23 May 1980
1991/92	9 Sept. 1991	16 Dec. 1991	18 March 1992	26 May 1992

3.2.4.2 Rondeau Harbour - Overall Trends

Rondeau Harbour was used by waterfowl more during spring than fall migrations except for spring 1980 when the number of waterfowl days was low (Fig. 85), probably as a result of a die-back of aquatic vegetation. The total numbers of waterfowl days during fall migrations have declined steadily from 1972 to 1991.

During fall migrations in 1972 and 1979, dabblers and bay ducks made up the majority of waterfowl (Fig. 86). However, in 1993, increases in use by mergansers, swans, and geese, combined with

decreases in bay duck and dabbler use, resulted in a more even distribution among waterfowl groups.

During spring, dabblers and bay ducks predominated and other groups contributed roughly equally to the remainder.

3.2.4.3 Rondeau Harbour - Results by Taxonomic Group

3.2.4.3.1 Bay Ducks and Stiff-tails

During fall migration, the number of waterfowl days of this group dropped each survey year from 1972 to 1993 (Fig. 87), primarily because scaup and Canvasback counts declined. During spring migration, the total number of waterfowl days dropped slightly from 1973 to 1980, then rose to a high in 1992. Again, these changes were caused primarily by shifts in scaup and Canvasback numbers.

During fall migrations, scaup and Canvasback together made up over 80% of the bay ducks (Fig. 89). During spring migrations, this proportion dropped to a low of 45% in 1980 and rose to 73% in 1992. There was also a large proportion of Redheads. Ring-necked Ducks and Ruddy Ducks comprised the remainder of the group, the fraction ranging from 0.3% in spring 1972 to 20% in spring 1992.

3.2.4.3.2 Dabblers

Dabbler use fluctuated among seasons and years (Fig. 87). During fall, numbers were greatest in 1979 but were roughly the same in 1972 and 1991. A legal baited area was operated in 1972 and 1979 but was discontinued by 1991 resulting in decreased use of the area by Mallards and Black Ducks. Numbers during spring migrations were more erratic being greatest in 1973 and lowest in 1980.

Small numbers of Northern Pintails, Gadwalls, teals, Northern Shovelers, and Wood Ducks were reported during both spring and fall surveys. However, the most common species were Mallards, Black Ducks and American Wigeon, together always comprising more than 90% of dabbler waterfowl days (Fig. 88). The proportion of Black Ducks has declined while that of Mallards has increased.

3.2.4.3.3 Mergansers

Mergansers used the area more in spring than fall (highest counts in spring 1992). During fall of 1972 and 1991, waterfowl days averaged 29,500 but, in 1979, the total was only 5,000 (Fig. 87).

Common and Red-breasted Mergansers were the most abundant but Hooded Mergansers were occasionally observed.

3.2.4.3.4 Swans

Swans used the area more in spring than in fall (Fig. 87). During fall, swan numbers were relatively low during 1972 and 1979, averaging 2,200 waterfowl days. In 1991, however, numbers rose to 40,500 waterfowl days. Spring numbers followed the same trend, averaging 10,500 in 1973 and 1980,

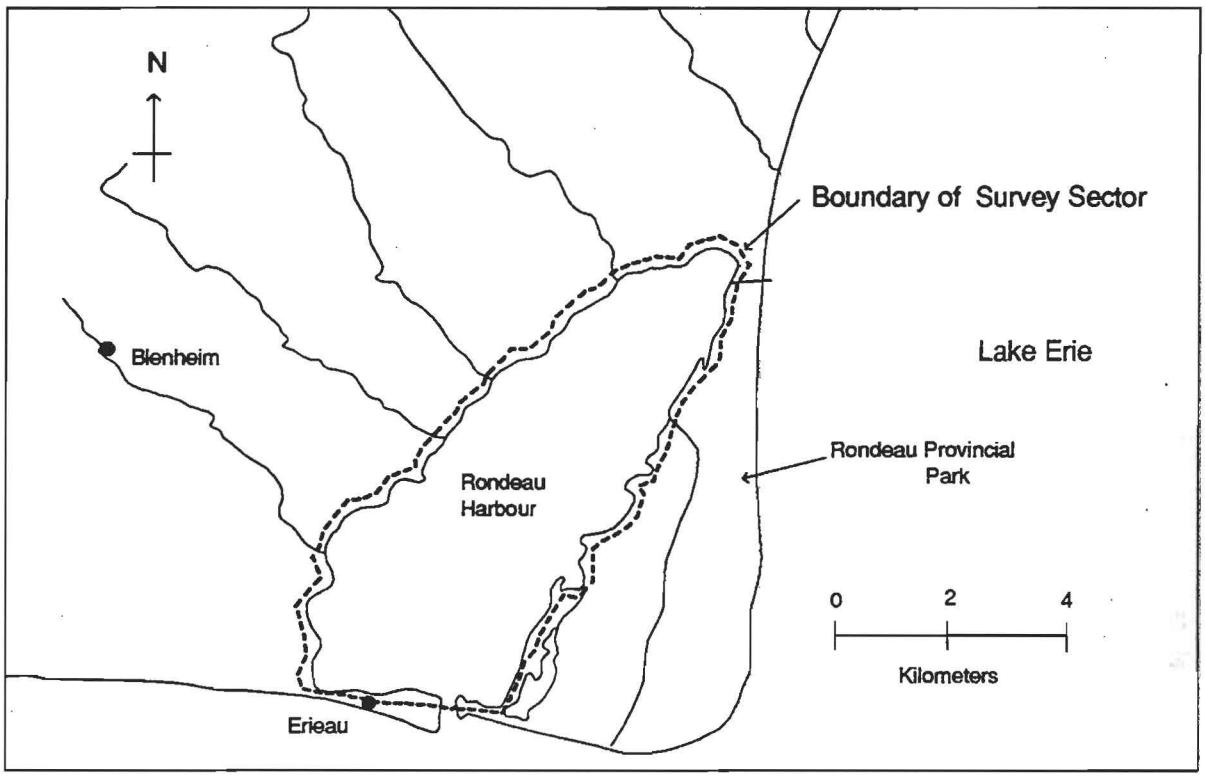


Fig. 83. Map of Rondeau Harbour showing survey sector.

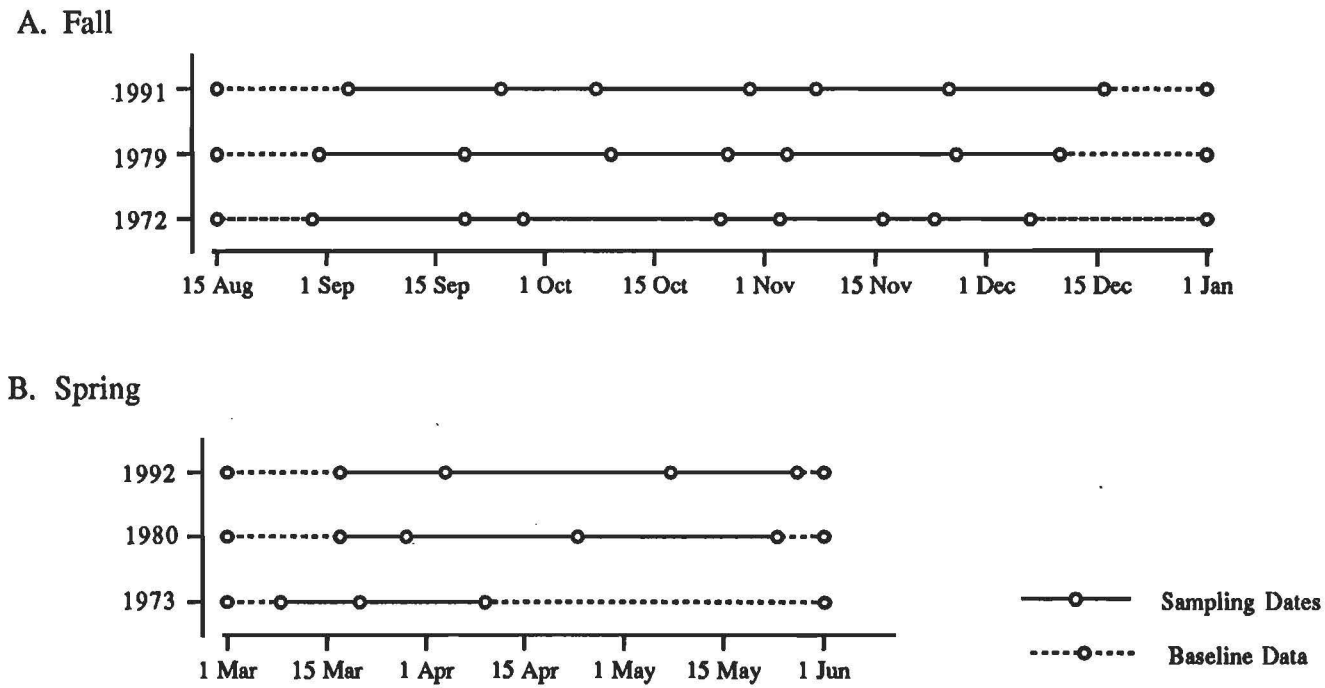


Fig. 84. Dates of aerial surveys in Rondeau Harbour.

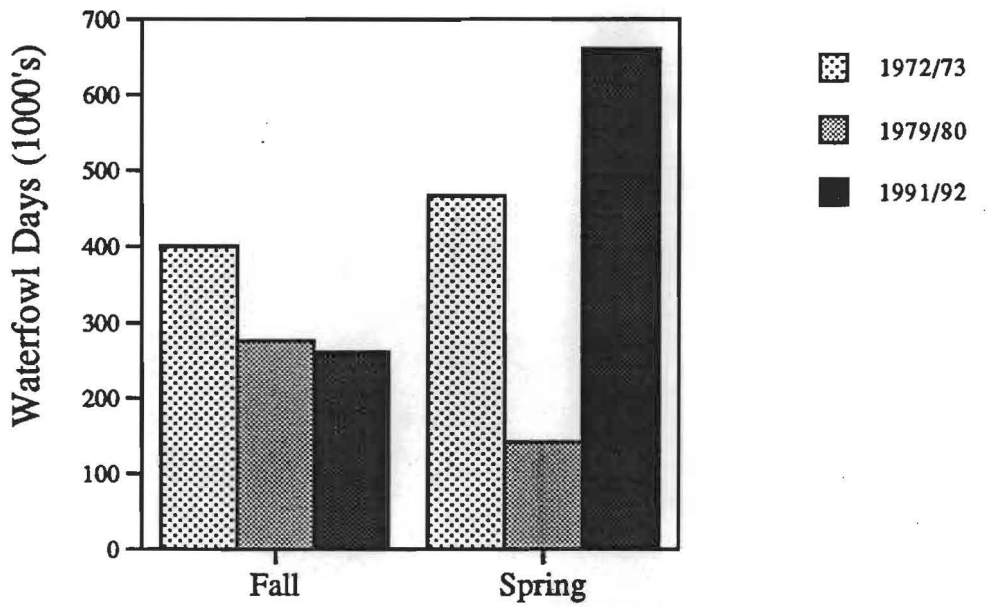


Fig 85. Total waterfowl use of Rondeau Harbour during fall and spring migrations.

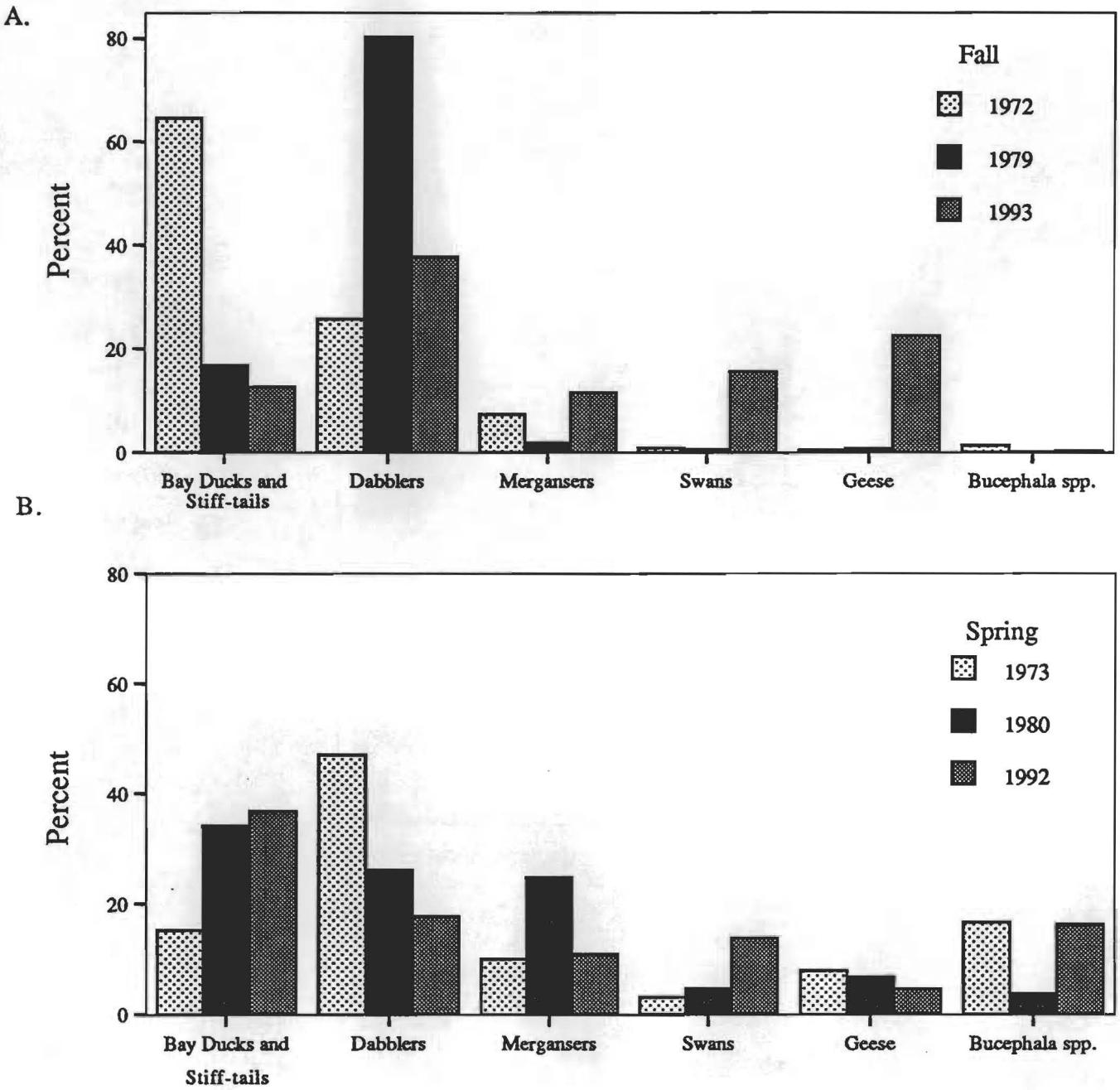


Fig. 86. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in Rondeau Harbour.

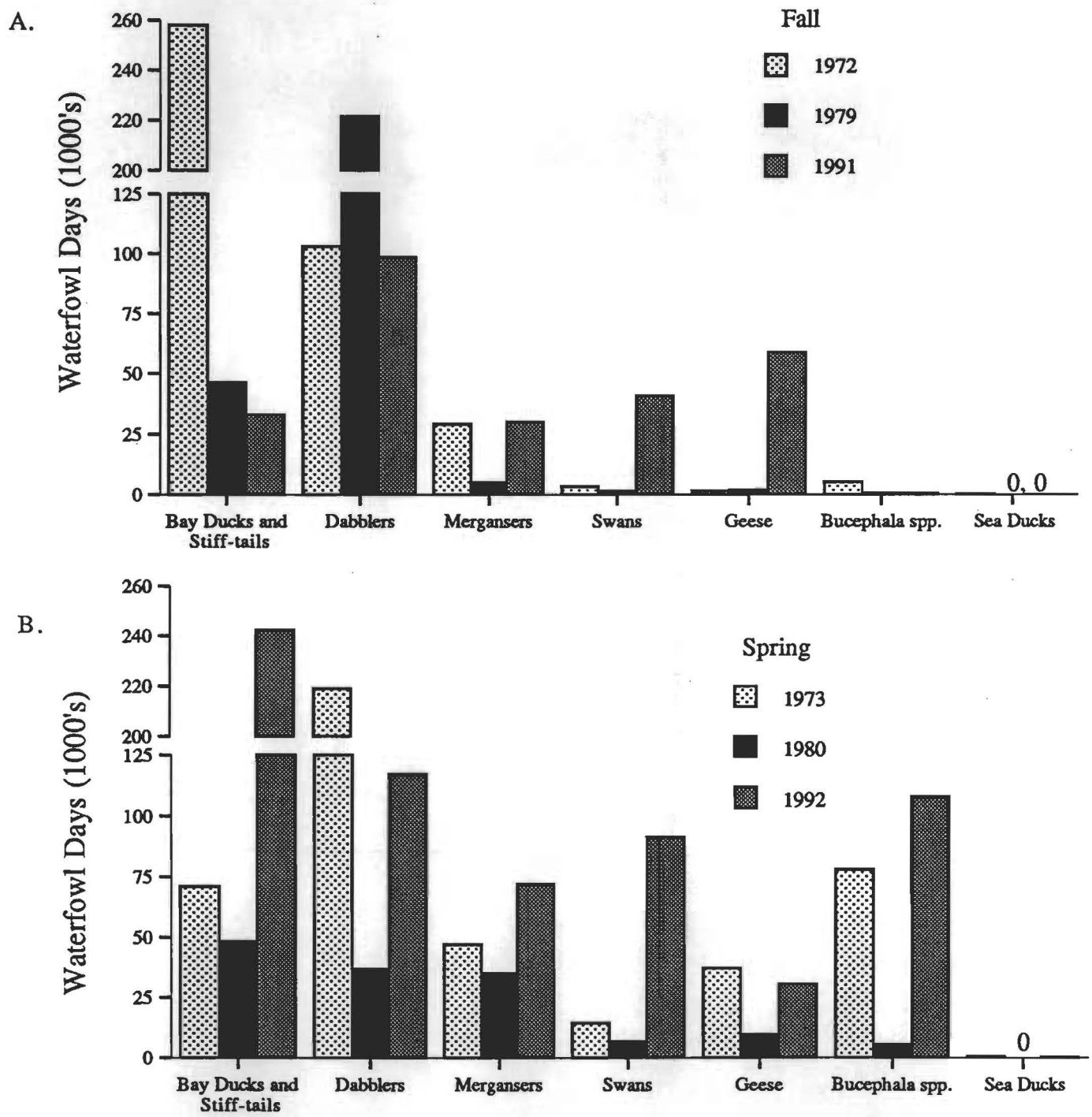


Fig. 87. Waterfowl use, by taxonomic group, of Rondeau Harbour during (A) fall and (B) spring migrations.

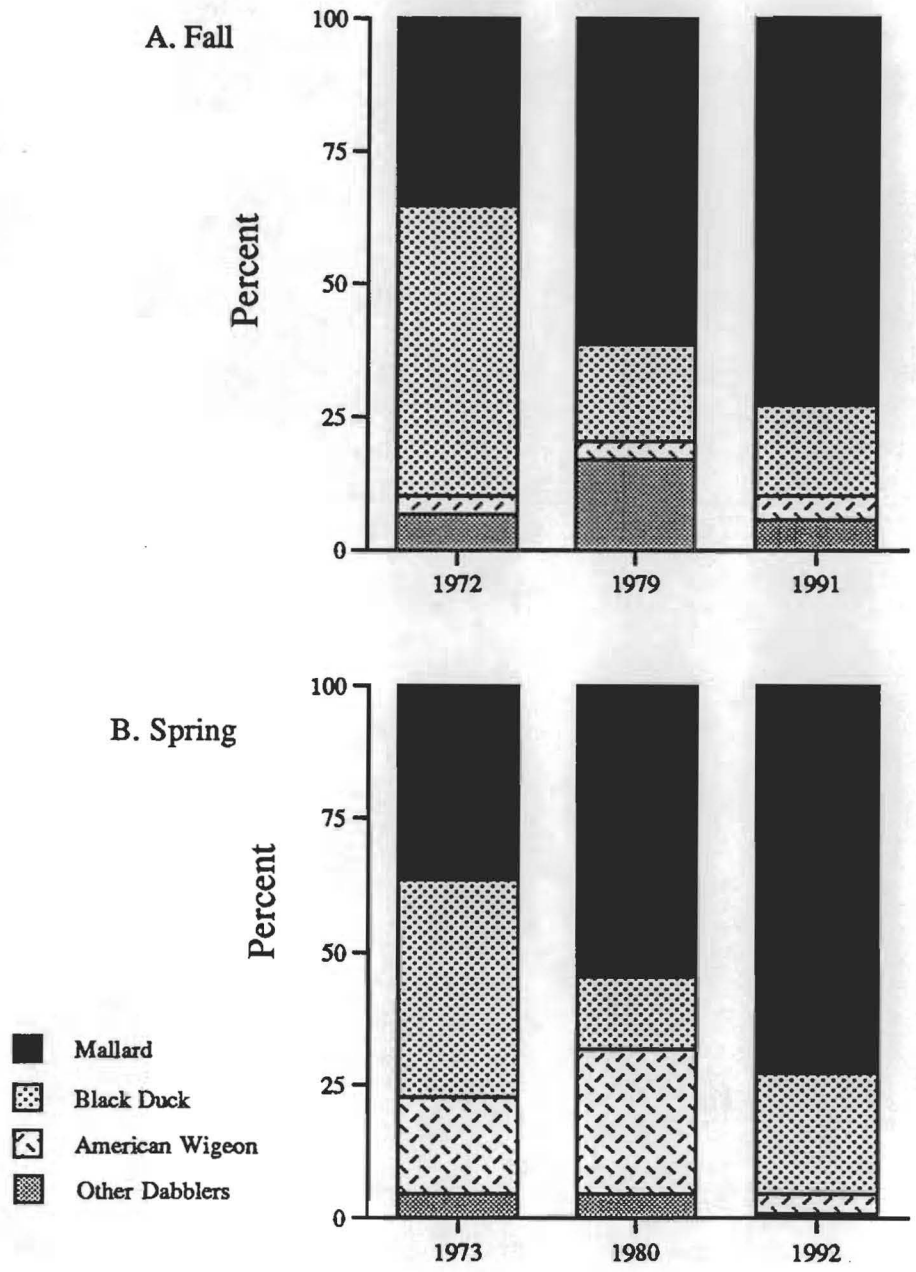


Fig. 88. Percent species composition of dabblers during (A) fall and (B) spring migrations in Rondeau Harbour.

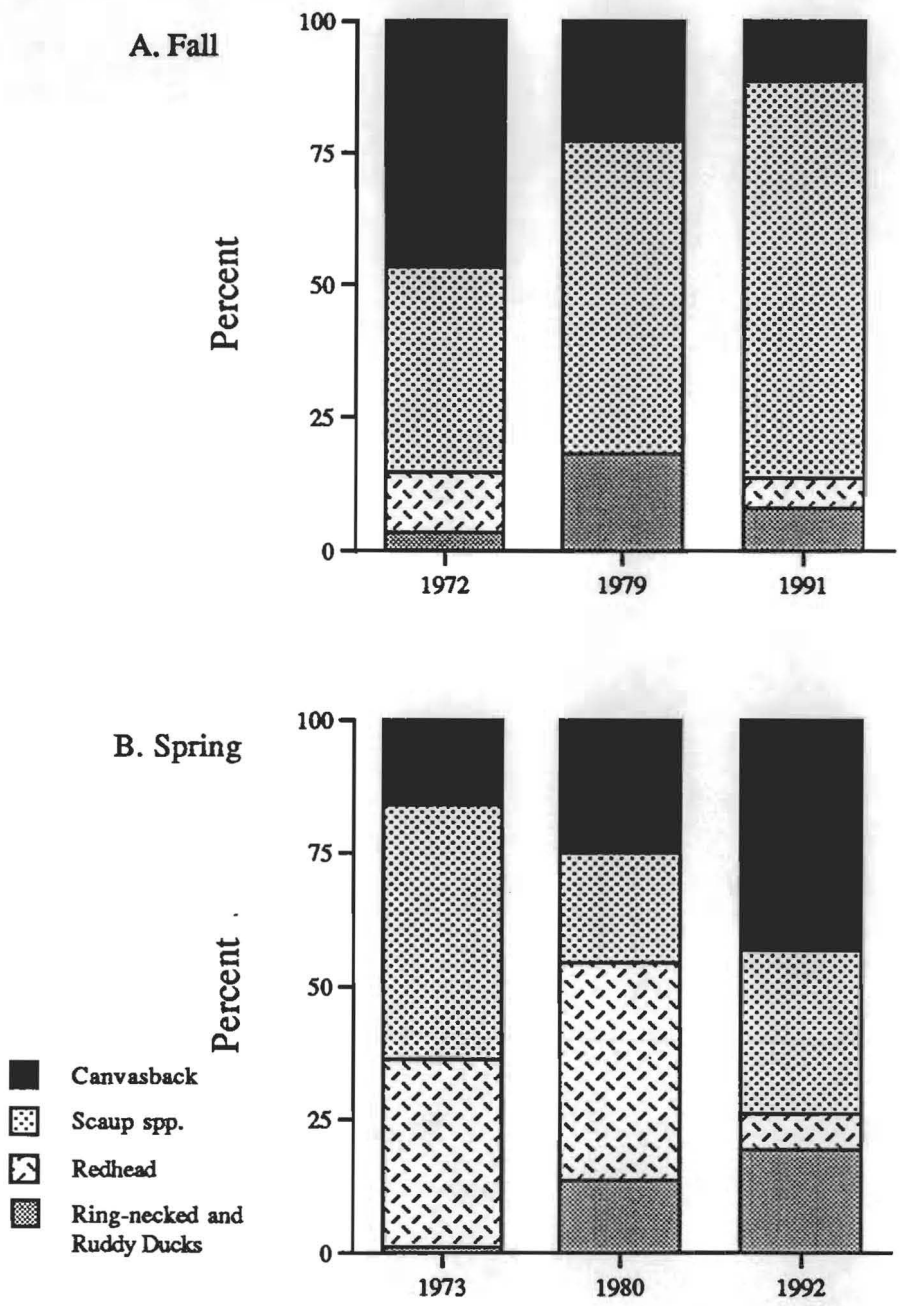


Fig. 89. Percent species composition of bay ducks during (A) fall and (B) spring migrations in Rondeau Harbour.

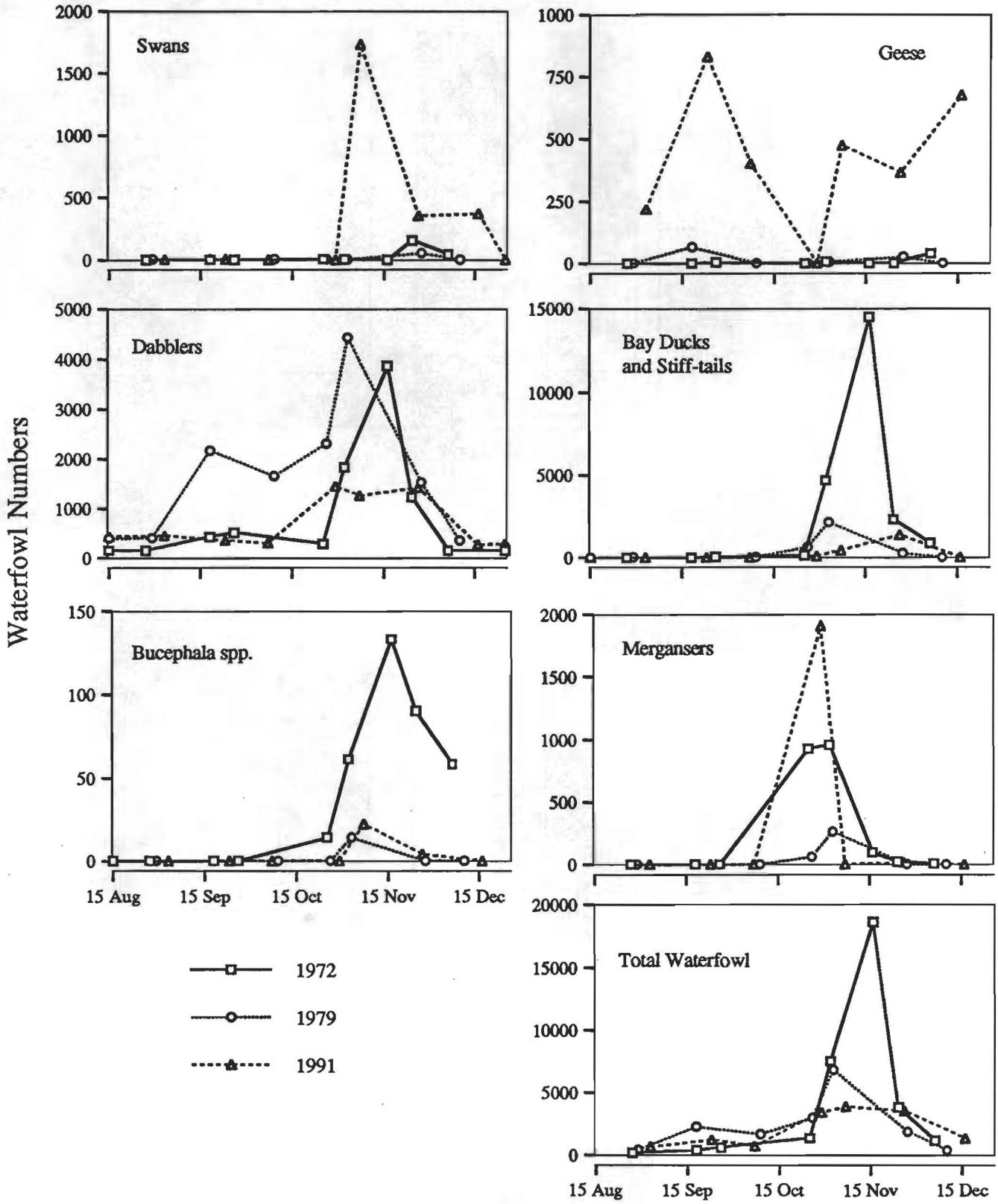


Fig. 90. Waterfowl counts at Rondeau Harbour during fall surveys.

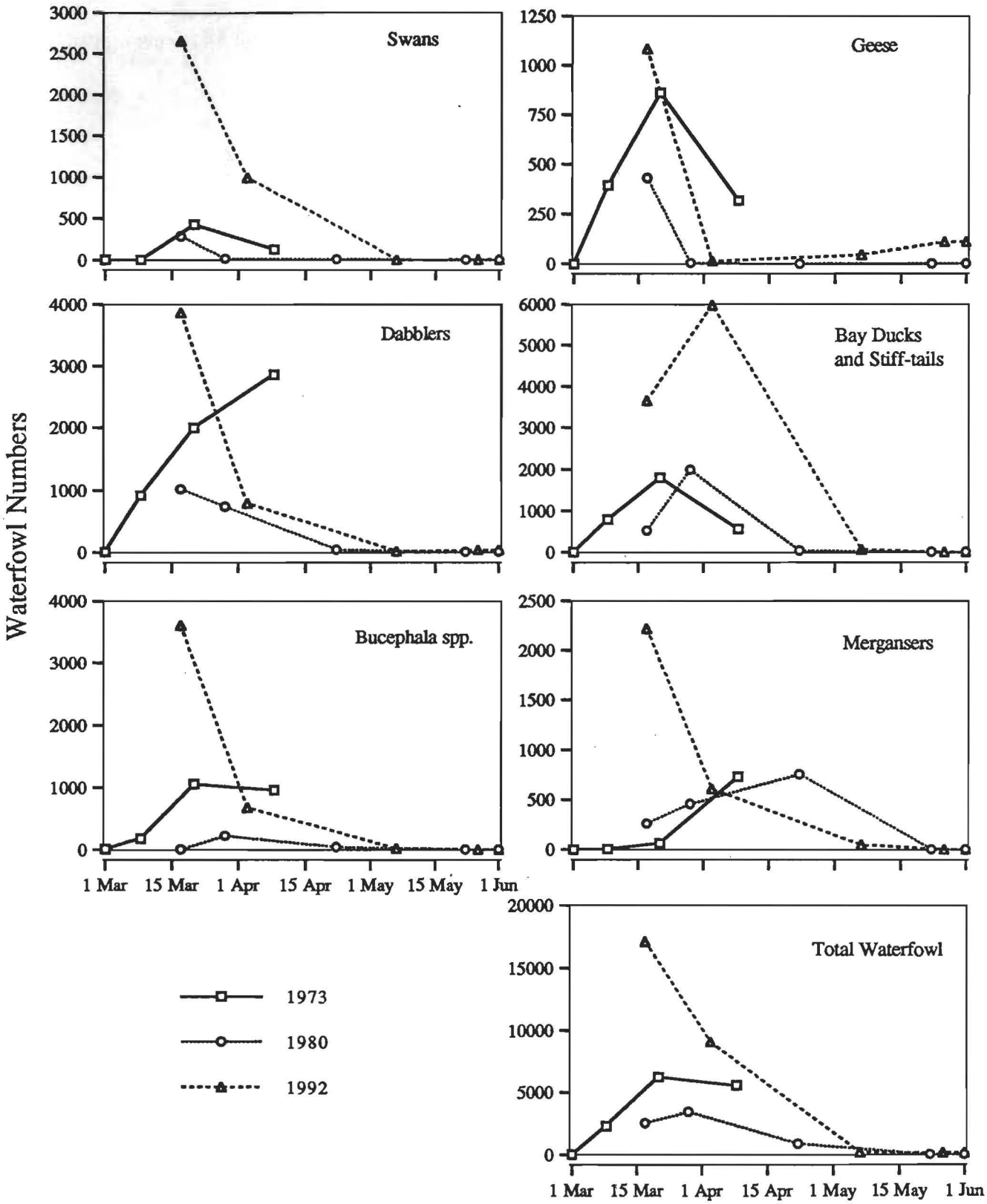


Fig. 91. Waterfowl counts at Rondeau Harbour during spring surveys.

but jumping to 100,000 waterfowl days in 1992.

Although both Tundra and Mute Swans were present, the former made up 99% of all swans reported in all surveys except fall 1980 when they comprised only 64%.

3.2.4.3.5 Geese

During fall migrations, number of waterfowl days attributed to geese rose each survey year (Fig. 87). This increase is partially a result of a private sanctuary established in the Rondeau area that attracted increasing numbers of Canada Geese during the hunting seasons. During spring migrations, geese numbers were highest in 1973, and lowest in 1980. Only Canada Geese were reported except during fall of 1979 when five Snow Geese were observed.

3.2.4.3.6 *Bucephala* spp.

During fall migrations, *Bucephala* numbers dropped from 5,000 waterfowl days in 1972 to an average of 300 waterfowl days in 1979 and 1991. During spring of 1973 and 1992, use averaged 90,000 waterfowl days but was only 35,000 in 1980. Common Goldeneye were more abundant than Bufflehead, always comprising over 70% of the *Bucephala*.

3.2.4.3.7 Sea Ducks

Oldsquaw and scoters made up this group. Neither were abundant; scoters were recorded during two surveys and Oldsquaw were noted only once.

3.2.4.3.8 Timing

In fall, peak numbers of waterfowl occurred from early to mid-November (Fig. 90). The exception was geese which moved through in two waves in 1991 (mid-September and late November).

In spring, overall waterfowl numbers were highest in mid to late March (Fig. 91). However, numbers of dabblers and mergansers during spring 1973 were greatest on April 9 which was the last survey flight that season, and merganser numbers peaked in late April in 1980.

3.2.5 Lake St. Clair

This is one of the most important staging area for waterfowl in the Great Lakes system. The shoreline is low-lying and is characterized by an extensive band of emergent marsh on the eastern side of the lake (12000 ha - Dennis and North 1984) along with much shallow-water habitat with rich beds of

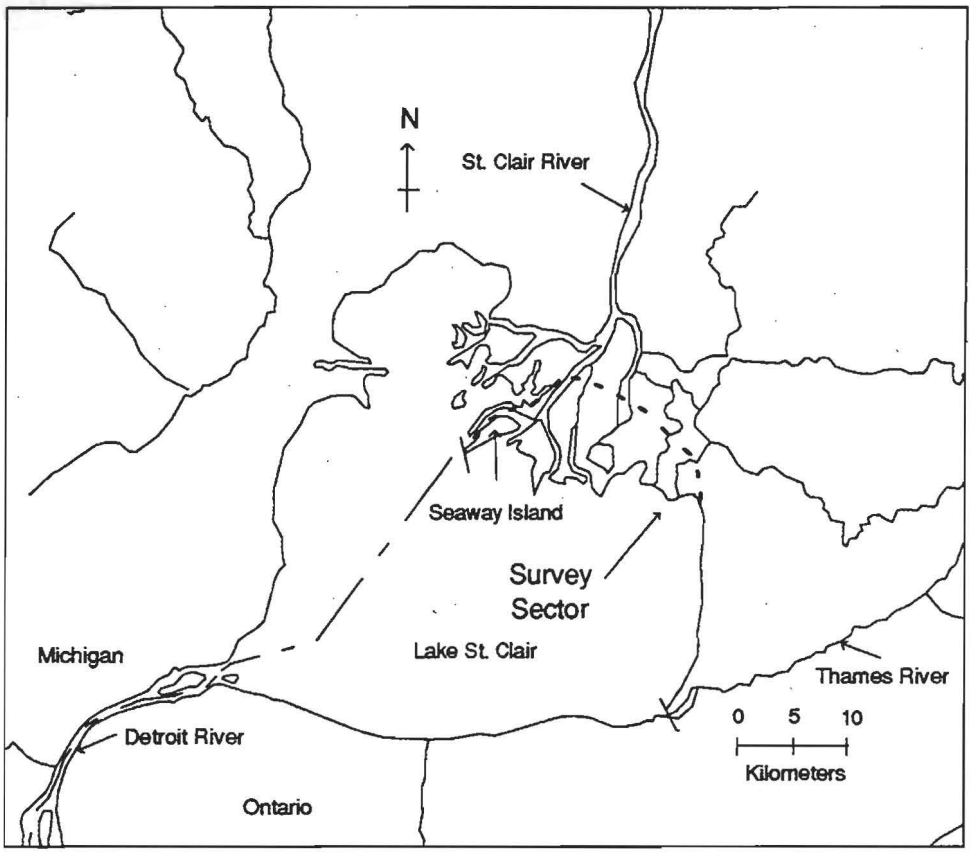


Fig. 92. Map of Lake St. Clair showing survey sector.

emergent vegetation. In Ontario, the lake is backed by particularly fertile and intensely cultivated agricultural land.

3.2.5.1 Survey Area and Sampling Dates

The survey area included the Lake St. Clair shoreline from the Thames River to Seaway Island (Fig. 92). The surveys were carried out in fall of 1968, 1976 and 1983 and in spring of 1969, 1977, 1982 and 1991 (Fig. 93). Baseline dates for waterfowl use calculations are listed in Table 13.

Table 13. Baseline dates used in waterfowl day calculations for Lake St. Clair.

	Entering Fall	End of Season	Entering Spring	End of Season
1968/69	10 July 1968	16 Dec. 1968	18 March 1969	4 June 1969
1976/77	3 Sept. 1976	22 Dec. 1976	17 March 1977	7 June 1977
1982/83	30 Aug 1982	21 Dec. 1982	19 March 1983	11 June 1983
1991	-	-	19 March 1991	17 May 1991

3.2.5.2 Lake St. Clair - Overall Trends

The total number of waterfowl days averaged 6,500,000 during fall and 1,600,000 during spring. During fall, use was highest in 1982, whereas highest spring use occurred in 1991 (Fig. 94).

The species composition fluctuated with season and year (Fig. 95). On average, dabblers made up 50% of the total, bay ducks 25%, geese 10%, swans 4% and other ducks comprised the rest.

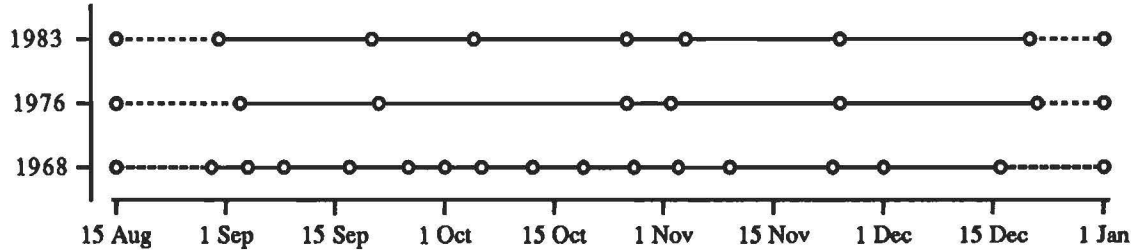
3.2.5.3 Lake St. Clair - Results by Taxonomic Group

3.2.5.3.1 Dabblers

Dabbler numbers fluctuated over seasons and years, and no clear trends are apparent (Fig. 96). During fall, average use was 4,500,000 waterfowl days with the highest use in 1982 and the lowest in 1968. Spring use averaged 600,000 with the high in 1969 and the low in 1982.

Green-winged Teal, Blue-winged Teal, Northern Shovelers, Northern Pintails, Gadwalls, and Wood Ducks were among the dabblers regularly using Lake St. Clair during migrations. However, the most common species were Mallards, Black Ducks, and American Wigeon; together they comprised over 80% of the dabblers except during spring 1969 when their proportion dropped to 65% (Fig. 97). During that season there were high numbers of Northern Pintail in the area. Since 1969 the proportion of Mallards has increased.

A. Fall



B. Spring

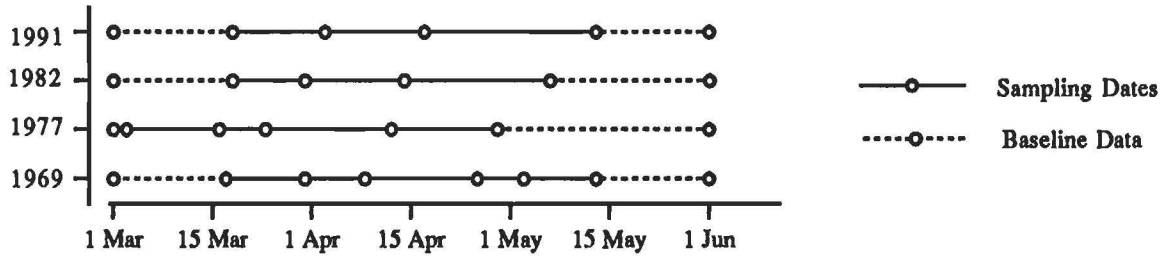


Fig. 93. Dates of aerial surveys in the Lake St. Clair area.

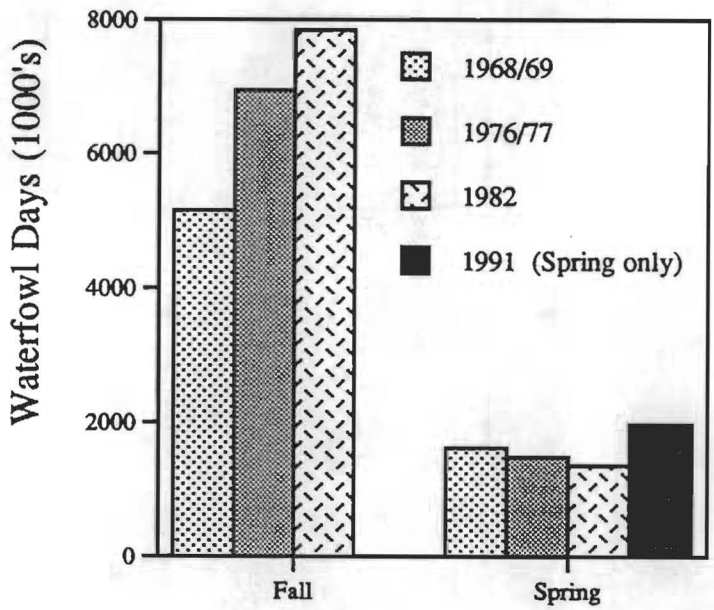


Fig. 94. Total waterfowl use of the Lake St. Clair area during fall and spring migrations.

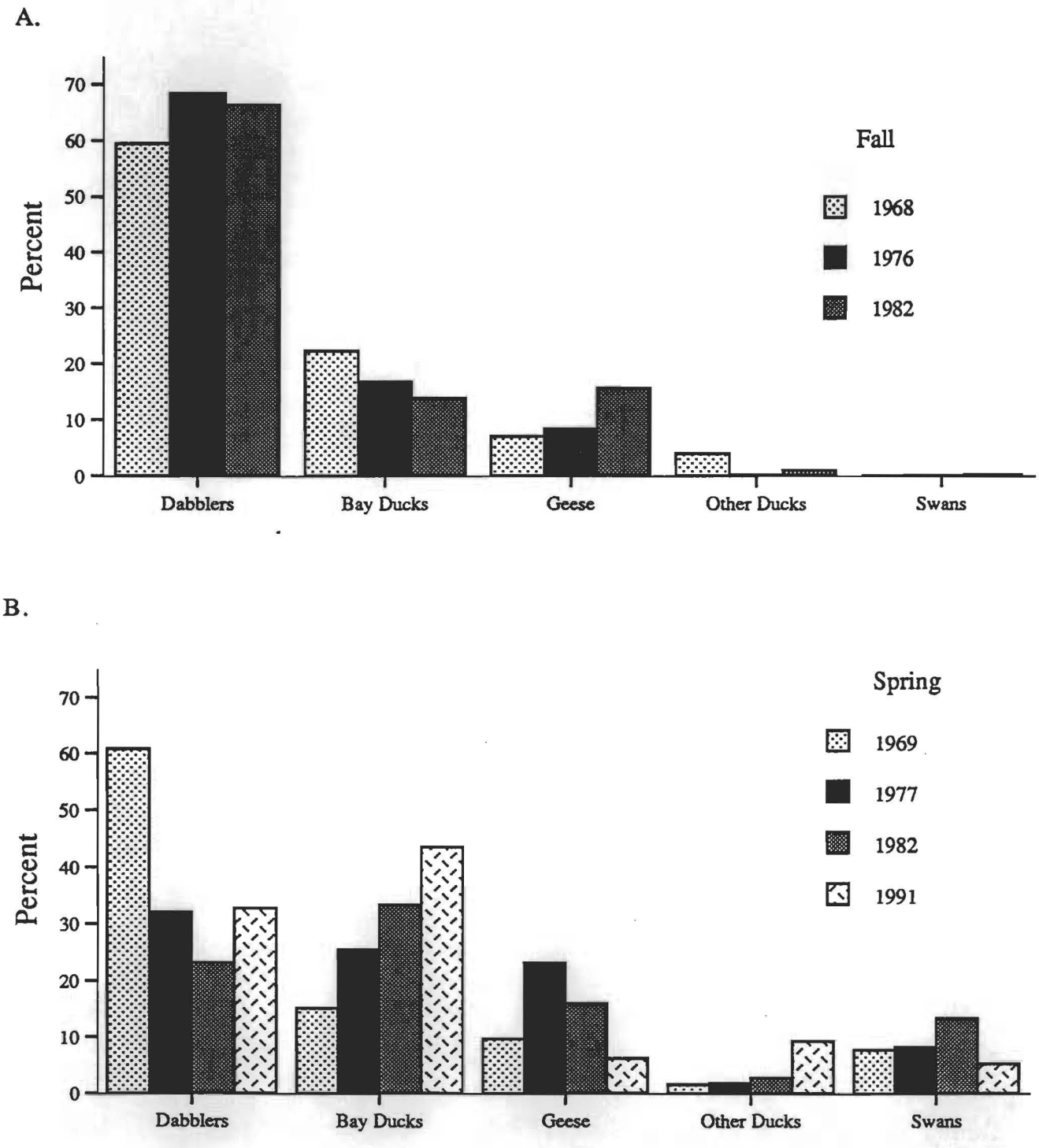


Fig. 95. Percent composition, by taxonomic group, of waterfowl day totals during (A) fall and (B) spring migrations in the Lake St. Clair area.

3.2.5.3.2 Bay Ducks

During fall, bay ducks numbers decreased steadily from 1968 to 1982 but in spring the reverse was true (Fig. 96). Average fall use was 1,000,000 waterfowl days and spring use 500,000 waterfowl days.

There are no clear trends in the composition of the bay duck group. In fall, Canvasbacks and Redheads were the most numerous (Fig. 98) while, during spring, the scaup tended to be most common. During both seasons, Ring-necked Ducks made up the smallest proportion although this fraction in the spring increased each year.

3.2.5.3.3 Geese

Average use amounted to 700,000 waterfowl days in fall and 200,000 in spring (Fig. 96). Canada Geese comprised over 99% of the geese, the remainder being Snow Geese.

3.2.5.3.4 Other Ducks

This grouping includes *Bucephala* spp., mergansers, scoters, Oldsquaw, and Ruddy Ducks. Together these ducks comprised less than 6% of the total waterfowl.

Both Common Goldeneye and Bufflehead were present, together averaging 5,000 waterfowl days in fall and 18,000 in spring. Common Goldeneye represented, on average, 60% of *Bucephala* spp.

All three species of mergansers were present, together averaging 9,000 waterfowl days in fall, and 40,000 in spring (Fig. 96). Oldsquaw were sighted in 1968/69 but were not seen again until spring 1991. Scoter were only recorded in very small numbers. Ruddy Duck use averaged 92,000 waterfowl days in fall and 10,000 in spring.

3.2.5.3.5 Swans

Swan numbers were highest in spring 1982 and lowest in fall 1968 (Fig. 96). Average fall use amounted to 9,000 waterfowl days and average spring use 140,000 waterfowl days. Tundra Swans comprised over 94% of all swans, the rest being Mute Swans.

3.2.5.3.6 Timing

During fall, total waterfowl numbers peaked in late October due to relatively large numbers of dabblers, geese, and bay ducks (Fig. 99). The other ducks and swans were most abundant in late November.

During spring, total waterfowl numbers were highest from late March to early April, and decreased as the season progressed (Fig. 100). However, in 1969, dabbler numbers remained high until early May.

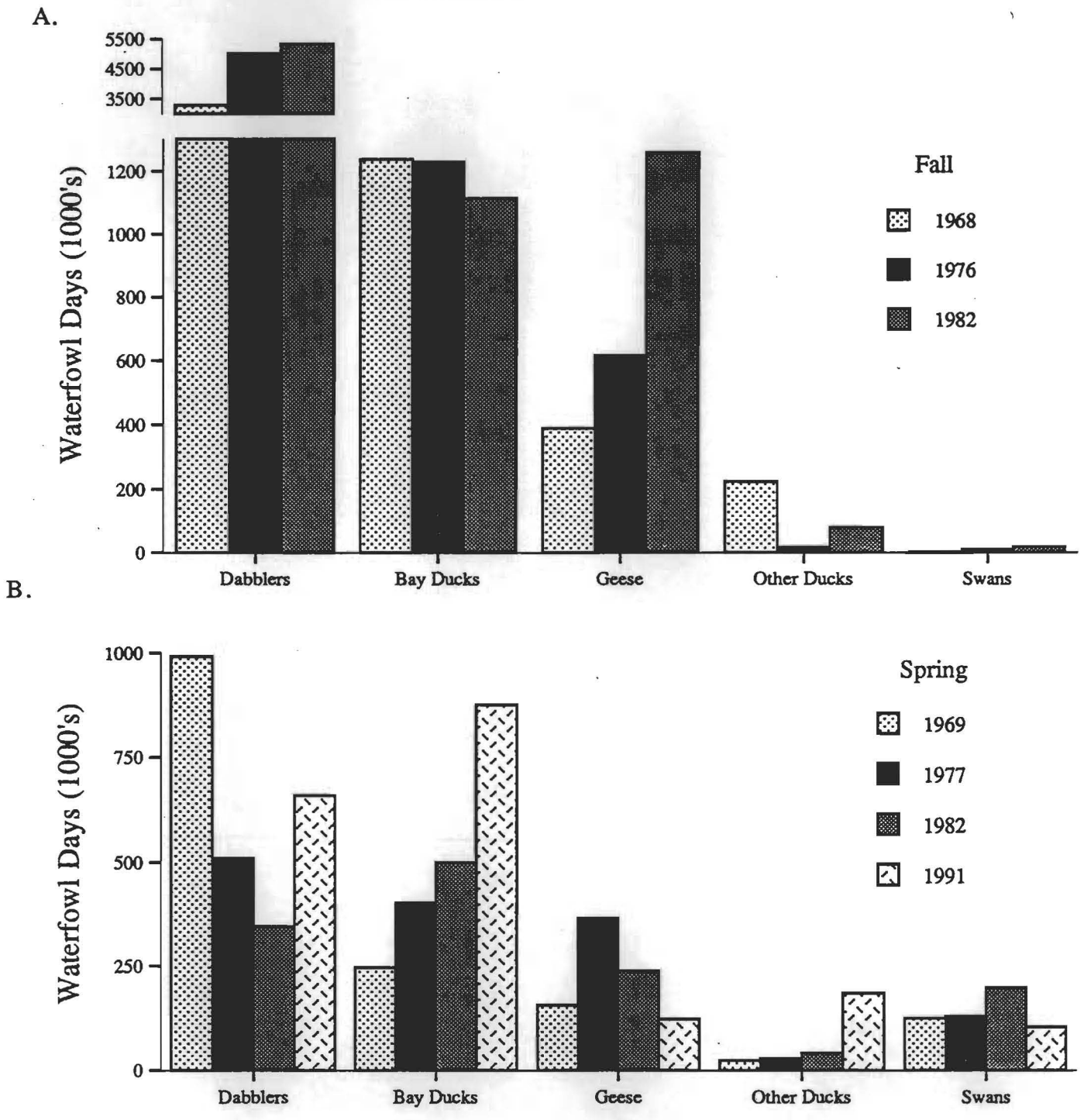


Fig. 96. Waterfowl use, by taxonomic group, of the Lake St. Clair area during (A) fall and (B) spring migrations.

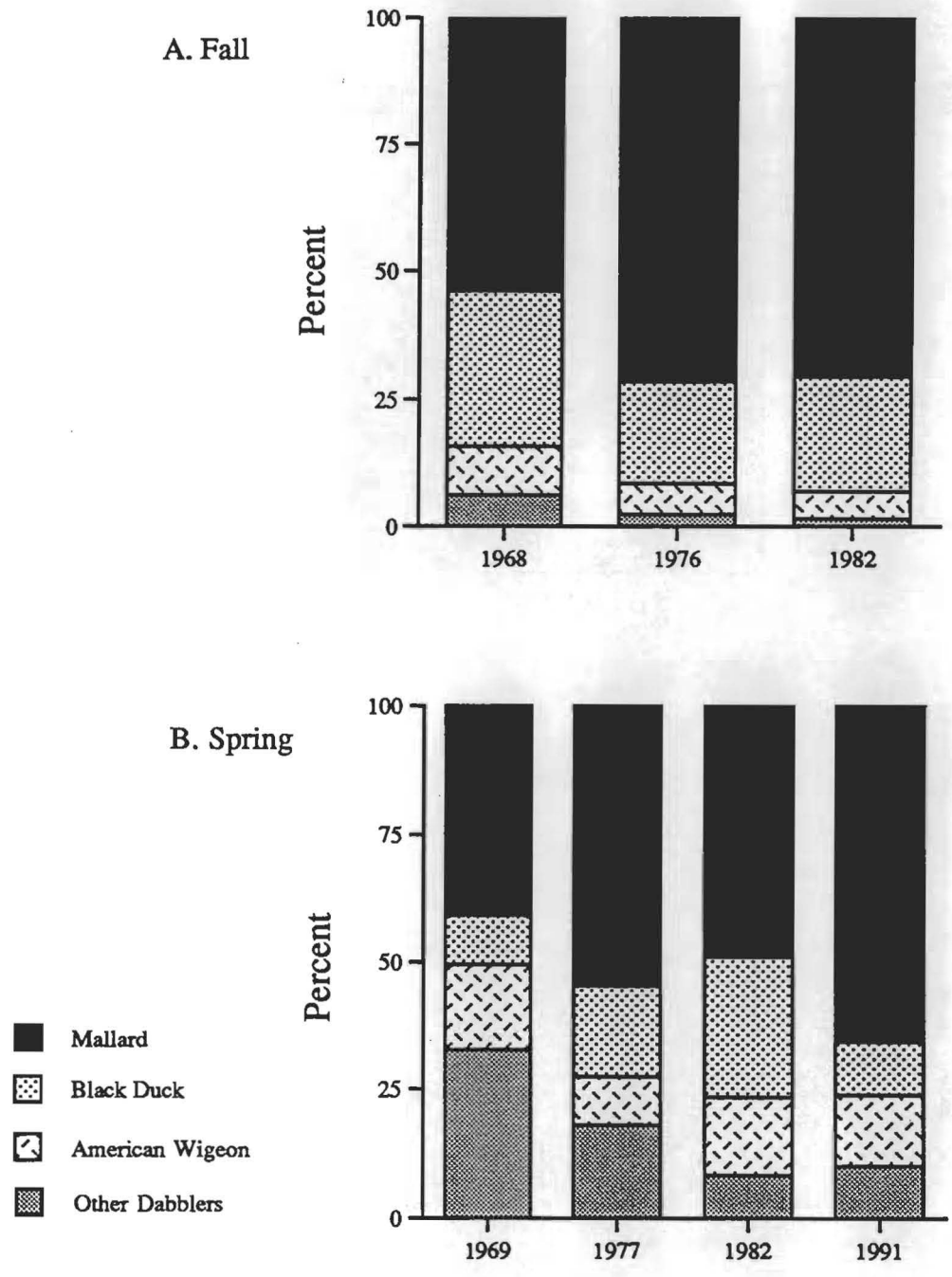


Fig. 97. Percent species composition of dabblers during (A) fall and (B) spring migrations in the Lake St. Clair area.

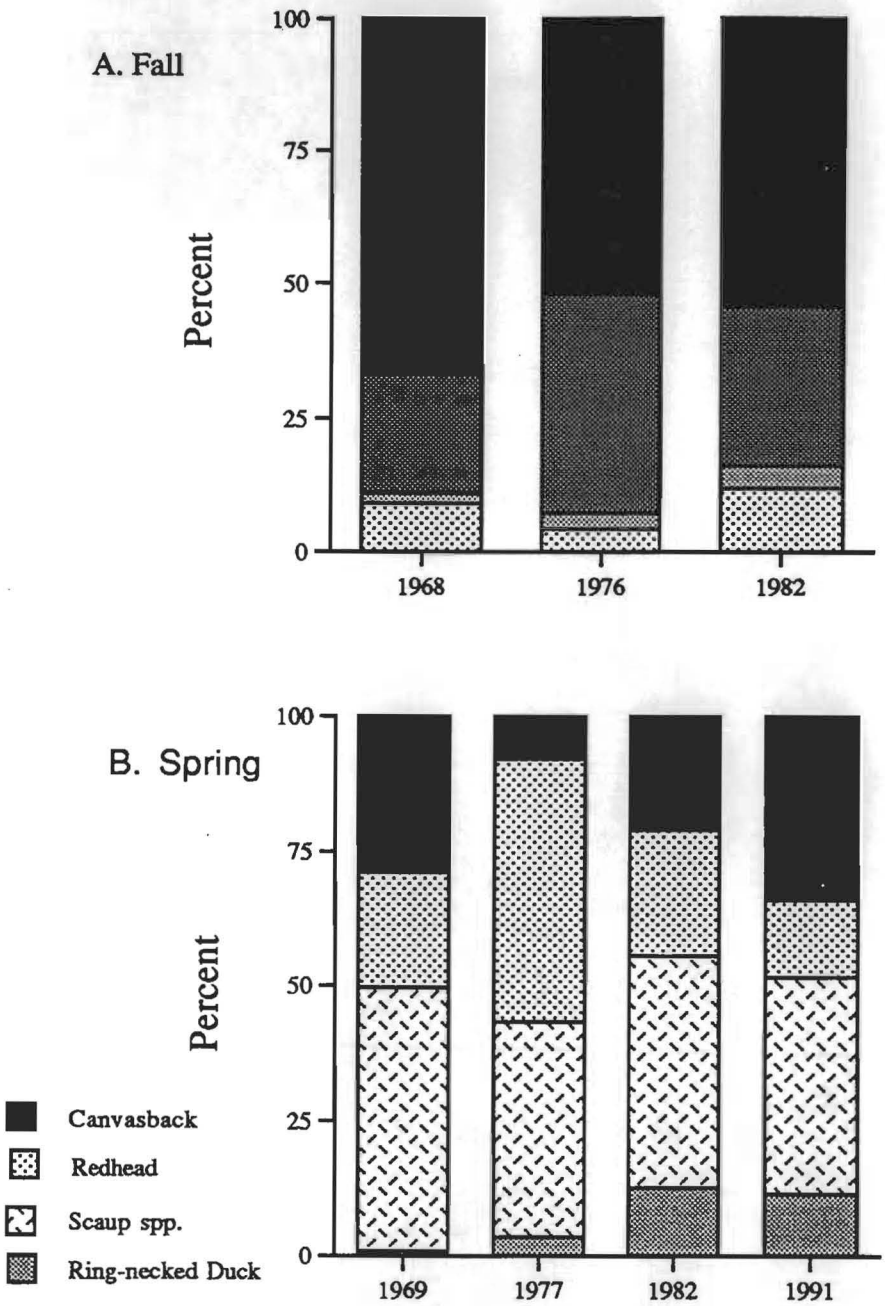


Fig. 98. Percent species composition of bay duck during (A) fall and (B) spring migrations in the Lake St. Clair area.

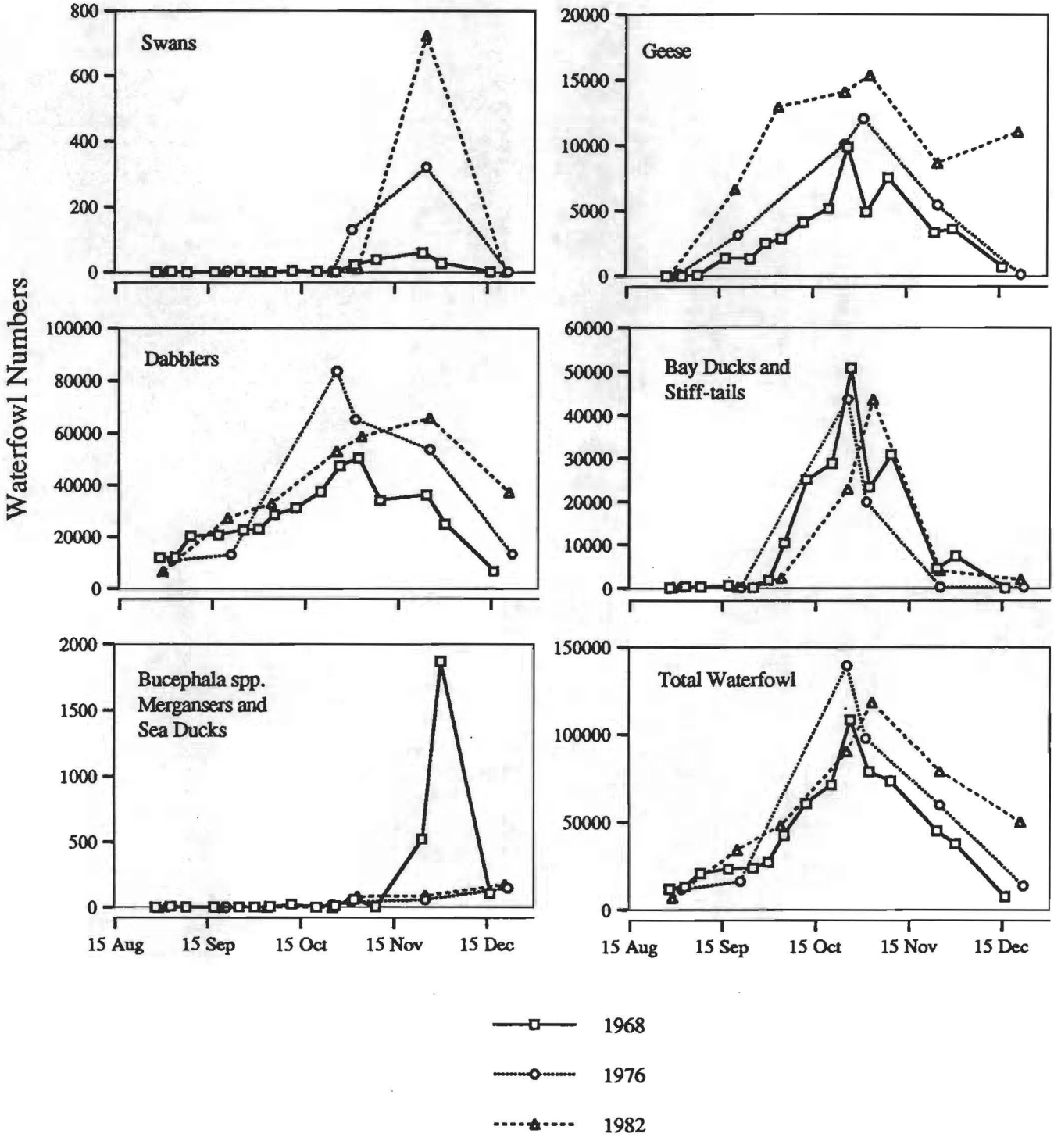


Fig. 99. Waterfowl counts in the Lake St. Clair area during fall surveys.

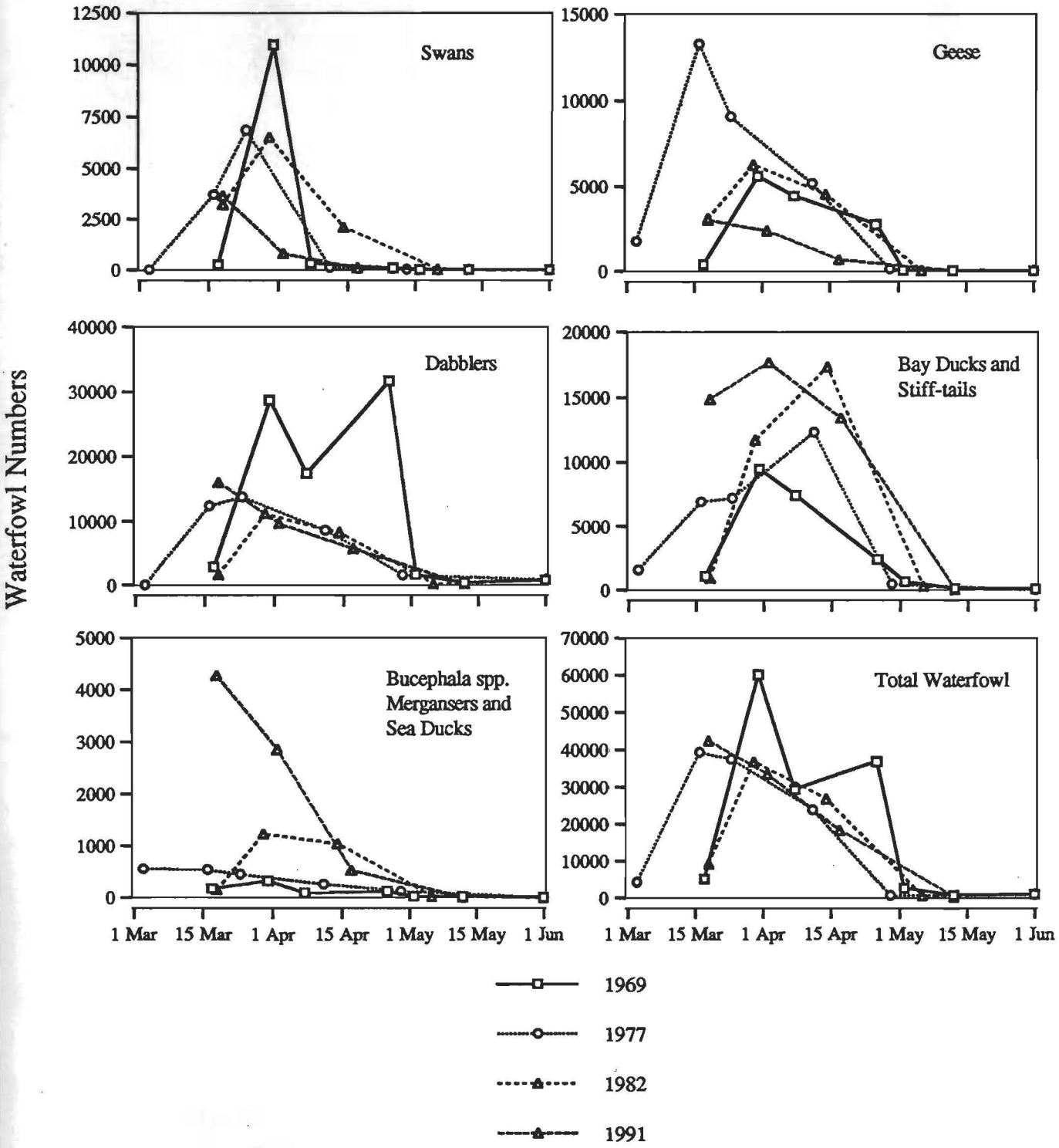


Fig. 100. Waterfowl counts in the Lake St. Clair area during spring surveys.

4.0 SYNTHESIS OF RESULTS AND GENERAL DISCUSSION

Waterfowl numbers on staging grounds can fluctuate with seasons and years for various reasons. Population size can actually change as a result of shifts in recruitment and/or mortality, these factors being affected by habitat and weather conditions on breeding and wintering grounds as well as hunting pressure. Numbers can also reflect shifts in migratory paths, often due to changing habitat quality of staging areas. There can also be considerable variability in survey results due to the design of the survey in which there is a relatively small number of counts over an extended migration period with unpredictable peaks and troughs of waterfowl abundance. Therefore, caution should be exercised in interpretation of seasonal and yearly fluctuations in waterfowl use and should be based on a knowledge of waterfowl biology and population dynamics. In this section, we examine broad patterns in the site-specific results, and, where possible, relate these to either range-wide or regional population trends as well as to distributional responses due to nutritional and other habitat requirements of staging waterfowl.

4.1 Population Trends

This section examines the role of population trends on staging abundance at a continental scale, and, where appropriate, at a provincial or local scale.

4.1.1 Swans

Populations of both Tundra and Mute Swans are growing. Tundra Swan numbers have increased slowly since the mid - 1960's (Bellrose 1980). Similarly, feral populations of Mute Swans have grown continuously since their introduction to North America in early 1900 (Bellrose 1980). These increases were reflected in the nine locales in this report that harbour swans. Eight sites in the fall, and five in the spring showed trends of increasing swan use. In the remaining cases, swan use appears to be constant.

4.1.2 Geese

Although small numbers of Snow Geese were occasionally noted in some of our study areas, Canada Geese were always more abundant and occurred in every site. Populations of Canada Geese have generally been increasing, at least until the early 1980's (Bellrose 1980) at which point some northern breeding populations have been declining; this includes all two migrant populations which pass through southern Ontario in numbers (Southern James Bay and Mid-Atlantic). However, numbers of resident Canada Geese breeding in southern Ontario have more than doubled between 1971 and 1987 (Dennis et al. 1989) and this increase is continuing at an even faster rate. Goose use in the sites surveyed reflected this population increase. In six of 11 sites containing relatively large numbers of geese, use increased between survey years during both spring and fall. In two of the remaining five sites, goose use increased between successive fall surveys but appeared relatively stable between spring surveys. However, in the remaining three sites (St. Lawrence AOC, Dunnville, and Long Point) total number of goose days actually declined from late 1970's to the last available survey date. Reasons for declines are several. Possibly, reduced foraging opportunities resulted in a shift away from the St.

Lawrence AOC to the Bourget-Riceville area (Ross 1989), particularly in the spring. At Long Point, the closing of a baited sanctuary reduced use by resident Canada Geese, and hunting pressure directed at the more vulnerable geese actually reduced the local population. The reduction at Dunnville was due to a decline in local feeding actvities concentrating geese even though the immediate breeding population has increased substantially.

4.1.3 Dabblers

In all study areas, Mallards and American Black Ducks were the most abundant dabblers. In much of eastern North America, Mallard numbers have been increasing while American Black Duck numbers have generally been dropping (Ankney et al. 1987) . Two commonly proposed explanations for these changes are hybridization and/or competitive exclusion between the two species (Ankney et al. 1987) although hunting (Grandy 1983) and habitat changes (Heusmann 1974) have also been suggested. Regardless of cause, our data showed similar trends in almost all the survey sites. The exceptions were in the Detroit River AOC where the proportion of Mallards to Black Ducks was constant, Long Point where waterfowl day estimates fluctuated considerably, and Oshawa Second Marsh where the relative proportion of Mallards to Black Ducks decreased, probably due to the reduction in abundance of aquatic vegetation favoured by Mallards.

Changes in the size of breeding populations of other dabbling duck species have been documented by Dubovsky et al. (1994). Since early 1970, Gadwall breeding populations have been increasing, and American Wigeon, Blue-winged Teal and Northern Pintail populations have been declining. Since mid-1980, Northern Shoveler numbers have also been increasing. In southern Ontario numbers of breeding Blue-winged and Green-winged Teals have declined while numbers of Wood Duck rose between 1971 and 1987 (Dennis et al. 1989). Our counts of these species are too few and erratic to be able to identify specific trends among the survey sites.

4.1.4 Bay Ducks

The estimated size of breeding populations of Redhead and Canvasback have shown little change since 1980, and estimates of Ring-necked Duck populations oscillated substantially without any clear trends. Numbers of scaup, however, have declined significantly (compiled from Dubovsky 1994). There were relatively large numbers of bay ducks in nine of our survey sites, and in seven of these, scaup were most common. During spring migrations, in five of ten survey sites, bay duck numbers declined between each survey year. However, bay duck numbers rose each survey season at Lake St. Clair and Rondeau Harbour, and oscillated with no clear trends at Long Point and Detroit River AOC. During fall migrations, numbers dropped in five of the nine survey sites, increased in the Bay of Quinte and Hamilton Harbour AOC's, and oscillated in St. Lawrence and the Niagara River AOC's. Some of these changes in distribution may be due to the explosive increase in zebra mussels which can form a significant part of scaup diet in particular (Mitchell and Carlson, 1993).

4.1.5 Other ducks

Changes in population status of *Bucephala* spp., mergansers, and sea ducks are hard to estimate due

to vast breeding ranges, much of which does not receive regular surveys (Bellrose 1980). The waterfowl use estimates for each of these groups show relatively erratic shifts without any clear pattern across study sites.

4.2 Ecological Requirements of Staging Waterfowl

4.2.1 Diet

Before and during migration, birds store massive amounts of fat, mostly synthesized from carbohydrates (Griminger 1986). Although carbohydrate contains less chemical energy than protein, it is a better fuel because birds cannot oxidize protein molecules completely (Griminger 1986, Delnicki and Reinecke 1986). In general, swans, geese, dabblers, and some bay ducks acquire most of their energy reserves for migration by eating readily-metabolized, high-carbohydrate foods such as plant seeds, buds, and tubers (Korschgen et al. 1988). Therefore, concentrations of waterfowl can be expected in areas with concentration of aquatic vegetation which offers quality, high-carbohydrate foods. For example in the Detroit River, bay ducks (especially Redheads and Canvasbacks) concentrate around beds of submerged vegetation at the mouth of the Canard River (Dennis and Chandler 1974). On the other hand, in the St. Clair River, fast current and deep water limit growth of aquatic vegetation, but inhibit ice formation. Waterfowl tend to concentrate there only when other marshes are frozen, and better sources of food are unavailable (Dennis et al. 1984).

Some aquatic plants commonly eaten by waterfowl (Table 14) are more valuable because they provide more metabolizable energy than others. For example, Bookhout et al. (1989) calculate that Mallards could store fat eating seeds of rice, cutgrass (*Leersia oryzoides*) and millet (*Echinochloa walterii*), but not on a diet of seeds from large-seeded smartweed (*Polygonum pensylvanicum*) or softstem bulrush (*Scirpus validus*). Furthermore, food preferences and diet are not the same for all waterfowl species. For example, Canvasbacks are specialized, and their diets when wintering on the upper Mississippi River consisted of 99% wild celery winter buds and arrowhead tubers (Korschgen et al 1988). In contrast, Mallard and American Black Ducks, eat a great diversity of food items (Bellrose 1980). Diets of female Mallards migrating through Missouri included over twelve genera of plants and six genera of invertebrates (Gruenhagen and Fredrickson 1990). Therefore, Dennis et al. (1984) suggested that managers should centre habitat improvements around dietary specialists because generalists like Mallards and geese adapt more effectively to other available foods.

Agricultural grains are inceasingly important in diets of some species (Delnicki and Reinecke 1986), although the extent of such importance may be overemphasized (Sheeley and Smith 1989). Regardless, these grains supply a large amount of energy but may lack some essential nutrients provided by natural foods (Fredrickson and Taylor 1982). Waterfowl, particularly dabbling ducks and geese, are attracted to marshy areas with nearby agricultural fields or baited areas where grain is provided. Loss of native habitat might mean some migrant waterfowl now need both agricultural and natural habitat types to meet nutritional requirements for migration (Gruenhagen and Fredrickson 1990). The availability of agricultural grains may be supporting concentrations of waterfowl near Lake St. Clair, Long Point, Rondeau Harbour, and the lower Detroit River AOC (Dennis and Chandler 1974). At Long Point, heavy hunting pressure and removal of a baited sanctuary served to reduce populations of resident Canada Geese. Crop depradations decreased as a result of these changes.

Table 14. Family and genera of some commonly used food plants in the diets of geese, swans, dabblers and bay ducks (compiled from Bellrose 1980).

Scientific Names	(Some) Common Name(s)
Characeae	
Chara spp.	Muskgrass
Sparganiaceae	
Sparganium spp.	Bur reed
Najadaceae	
Potamogeton spp.	Pondweeds
Zannichellia spp.	Horned pondweeds
Najas spp.	Naiads, bushy pondweed
Alismataceae	
Sagittaria spp.	Arrowhead, duck potato
Hydrocharitaceae	
Vallisneria spp.	Wild celery, tape grass
Gramineae	
Zizania spp.	Wild rice
Echinochloa spp.	Wild millet
Leersia spp.	Cut-grass
Phalaris spp.	Reed canary grass
Cyperaceae	
Cyperus spp.	Nut grass, nut sedge, chufa
Eleocharis spp.	Spike rush
Scirpus spp.	Bulrush
Lemnaceae	
	Duckweed

Table 14. (cont'd)

Polygonaceae	
Polygonum spp.	Smartweed
Ceratophyllaceae	
Ceratophyllum sp.	Coontail
Nymphaeaceae	
Nuphar spp.	Yellow water lily
Brasenia spp.	Water shield
Haloragidaceae	
Myriophyllum spp.	Water milfoil
Rubiaceae	
Cephalanthus spp.	Buttonbush

On the other hand, not all migrants center their diets around plants. In general, scaup, sea ducks, mergansers and *Bucephala*, spp. eat primarily animal matter, although the amount of vegetation consumed varies considerably within species and changes with season and locale (Bellrose 1980). The most commonly eaten foods, which include crustaceans, molluscs, insects, and fish, differ between waterfowl species (Table 15).

Depletion of food resources through destruction of habitat, pollution, or human disturbance may influence success of staging birds in meeting their energy requirements. Overgrazing can result when waterfowl must crowd into limited leftover habitat. Such overuse lowers plant and animal production and depletes the food base, further reducing quality of habitat and forcing waterfowl into energetically costly travel to less exploited, but less desirable areas (Mitchell et al 1994, Bélanger and Bédard 1989). Schloesser and Manny (1990) documented pollution-induced decline in wild celery beds in the lower Detroit River, and suggested that a decrease in waterfowl use resulted. Similarly, loss of aquatic vegetation along the lower Niagara River may be responsible for a shift in waterfowl use away from that area. In contrast, Ross (1989) speculated that increases in abundance of large fish in the Bay of Quinte region may have been responsible for an increase in merganser use between 1976 and 1986. Similarly, increased productivity due to sewage discharge may be responsible for concentrations of scaup in the Metro Toronto AOC.

Table 15. Diets of sea ducks, Bucephala spp. and mergansers (compiled from Bellrose 1980).

Species	% Plant	Primary food
Scaup	0 - 90%	Molluscs
Oldsquaw	0 - 12%	Crustaceans and molluscs
Scoters	0 - 10%	Molluscs
Bufflehead	0 - 33%	Invertebrates
Common Goldeneye	0 - 26%	Crustaceans and insects
Hooded Merganser	-	Fish and invertebrates
Red-breasted Merganser	-	Fish
Common Merganser	-	Fish

The amount of food required to support a migrant population can be estimated by calculating metabolizable energy of available food, number of waterfowl, how long they remain on the staging grounds, and energetic needs (Prince 1982). For example, Korschgen et al. (1988) estimate Canvasbacks staging on the Upper Mississippi River require 400 kcal/day. On a diet of wild celery winter buds and arrowhead tubers they would need to consume 125 g (dry wt) daily. Korschgen et al. estimate the population at 5 million use-days, and calculate that 3,470 ha of wild celery are necessary to support the population.

4.2.2 Other Habitat Requirements

Habitat requirements of migrating waterfowl go beyond adequate foraging locales (LaGrange and Dinsmore 1989). For example, Tundra Swans migrating through North Dakota prefer wetlands thick with *Potamogeton pectinatus* when foraging, but otherwise prefer wetlands with a large proportion of open water (Earnest 1994). In Lake St. Clair, waterfowl use increased when unusually high water levels opened new resting areas that were previously choked with *Typha sp.* (Dennis et al 1984). Waterfowl need rest areas with appropriate microclimate(s) (Bergan and Smith 1989) that are free from human disturbance (Bélanger and Bédard 1990) and predation risk (LaGrange and Dinsmore 1989, Michot and Nault 1993). Specific requirements differ with species (White and James 1978), change through the season (Giroux and Bédard 1988, Bergan and Smith 1989), and can depend on both sex and age (Bergan and Smith 1989). Table 16 lists some generalizations.

Table 16. Habitat preferences of staging and wintering waterfowl.

Species	Habitat Preference	Reference
Tundra Swan	Wetlands with open water	Earnest 1994
Mute Swan	Parks, wetlands with open water	Bellrose 1986
Canada Goose	Lakes, rivers, marshes, grasslands, cultivated fields, parks	Godfrey 1986
Snow Goose	Bullrush marshes, salt marsh, mudflats, sandbars, agricultural fields	Giroux and Bédard 1988
Mallard and American Black Duck	Margins of lakes and quiet streams, marshes, sheetwater and emergent wetlands, agricultural fields	LaGrange and Dinsmore 1988 Godfrey 1986
Gadwall, Northern Pintail, and American Wigeon	water 88-114 incm depth, abundant submergent, and sparse emergent vegetation	White and James 1978
Green-winged Teal, Blue-winged Teal and Northern Shoveler	water 30-88 cm in depth, some submergent and emergent vegetation	White and James 1978
Redhead	Protected bays, abundant submergent aquatic vegetation open water habitats	Ross 1984 Michot and Nault 1993
Ring-necked Duck	Shallow water, emergent and floating vegetation water 88-114 cm in depth, abundant submergent and sparse emergent vegetation	Bergan and Smith 1989 White and James 1978
Canvasback	Protected bays, abundant submergent vegetation water 114-213 cm in depth, little emergent vegetation	Ross 1984 White and James 1978
Scaup spp.	Open water, submergent vegetation water 114-213 cm in depth, little emergent vegetation	Bergan and Smith 1989 White and James 1978
Common Goldeneye and Bufflehead	Large bays, open shallow water with floating-leaved and submergent vegetation	Ross 1984 Bergan and Smith 1989

Table 16. (cont'd)

Oldsquaw and Scoters spp.	Large lakes and rivers	Godfrey 1986
Hooded Merganser	Smaller lakes and streams in or near woodlands, reeds in marshes	Ross 1984 Godfrey 1986
Common, and Red-breasted Mergansers	Large, open, shallow bays with clear water	Ross 1984 Godfrey 1986

Ice conditions affect waterfowl numbers because they limit both foraging and resting areas. Currents in the Detroit, Niagara, and St. Clair Rivers help keep water open, which attracts waterfowl when other areas are frozen. Therefore, in these areas, waterfowl concentrations will be greater later in fall and earlier in spring than in other, more frozen areas (Dennis and Chandler 1971). Furthermore, differences in ice conditions between two survey seasons might be responsible for significant changes in waterfowl-day estimates. For example, Ross (1989) suggests that dissimilar ice conditions between survey years in the Bay of Quinte explain a drop in bay duck numbers between 1977 and 1986.

Human disturbance of migrants reduces time spent foraging and changes waterfowl distribution within habitats (Bélanger and Bédard 1989). This may result in a disruption of goose family members and an increase in hunting mortality (Bartlet 1987) or, perhaps more importantly, a harmful energy deficit on staging grounds (Bélanger and Bédard 1990). Korschgen (1989) suggested that bay ducks may be the species most sensitive to disturbances. Causes and frequency of disturbance can vary but hunting and boating activities are most apparent.

Hunting affects density and dispersal of waterfowl. For example, as soon as hunting season closed, dabbling duck numbers rose 86% on the Colorado River (Anderson and Ohmart 1988). Ross (1989) speculated that more restrictive hunting regulations imposed around Cornwall were responsible for increases in diving duck numbers and that hunting pressure limits goose use in some areas concentrating geese on sanctuaries near the St. Lawrence River AOC.

Small aircraft and boat-related disturbances were the most common sources of disruption to Snow Geese staging in Quebec (Bélanger and Bédard 1989). Similarly, Dennis et al. (1984) proposed that increases in boat traffic probably contributed to decreases in waterfowl use in areas around Lake St. Clair, and that power-boat traffic in the area from Niagara River to Hamilton Harbour may be limiting scaup use. At Rondeau Harbour and Long Point, bay ducks feed in early morning and late evening, but spend days rafting in open water to avoid power boats (Dennis et al 1984). In contrast, limited boat traffic near the mouth of the Canard River in the Detroit River AOC may be partially responsible for large numbers of bay ducks in the area (Dennis and Chandler 1979). Because frequently-disturbed waterfowl avoid using a site (Bélanger and Bédard 1989), managers should reduce human disturbance and provide sanctuaries large enough that waterfowl can escape disturbance, but still promptly return to foraging (Bélanger and Bédard 1990).

4.3 Conclusions

A variety of factors affect waterfowl use of an area. Although waterfowl day estimates can be influenced by the relative timing of surveys and migrational waves, these estimates usually reflect population sizes and/or the quality and amount of local staging habitat. Waterfowl staging can be encouraged by providing undisturbed access to quality foods and resting sites. The amount and type of food available in each survey site depends on physical characteristics, demand on the resources, and extent of man-made developments in the area. Waterfowl use is also affected by human disturbance, particularly unrestricted hunting and boating activities. To identify significant changes in waterfowl abundance, frequent and long-term monitoring of migrants is required. This will provide an accurate and cost-effective tool for the assessment of the health of the shoreline ecosystem of the southern Great Lakes. As well, when combined with results of similar surveys from elsewhere in the flyways, it makes a valuable contribution to tracking the status of various waterfowl populations.

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