CHANGES IN WATERFOWL NUMBERS AND HABITAT WITH FLOODING ON THE OTTAWA RIVER

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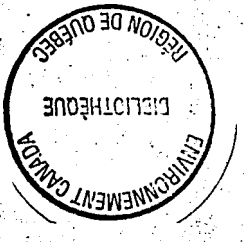

by

Wm. T. Munro

Canadian Wildlife Service

Dept. of Indian Affairs and Northern Development

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a) PUBLICATIONS AND REPORTS ARISING FROM THE PROJECT: (Bibliographic references; proposed titles)

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b) PAPERS DELIVERED: Munro, W.T. 1965. Some Effects of Flooding on Waterfowl Habitat. Northeast Wildlife Conference. 19pp.

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a) PUBLICATIONS AND REPORTS ARISING FROM THE PROJECT: (Bibliographic references; proposed titles)

Munro, Wm. T. 1962. Waterfowl investigation of the Ottawa River from Carillon to Hull, Quebec. Mémoire au Cabinet Provincial from Comité du Parc Dollard-des-Ormeaux. Sept. 1962. multi. 28-33.

_____. 1967. Changes in waterfowl habitat with flooding on the Ottawa River. J. Wildl. Mgmt 31 (1): 197-199.

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Some of the data used in this report were used also in a thesis presented to Laval University in 1965 in partial fulfilment of the requirements for the degree of Master in Science.

INTRODUCTION

Waterfowl habitat throughout most of North America is in short supply. Therefore if we are to maintain our waterfowl resources we must preserve our existing wetlands and attempt to improve their productivity. Improvement and management of habitat are important means of increasing waterfowl production. Before we can improve or successfully manage waterfowl habitat we must have a basic understanding of the interaction of marsh inhabiting plant and animal species.

In 1962 it was learned that a hydro-electric dam was to be constructed across the Ottawa River at Carillon, Quebec. Engineers predicted an average six foot rise in water level along 50 miles of river. The Ottawa River, at that time, was considered to be an important area for waterfowl breeding, harvest and migration (Lemieux 1951, 1953; Tener 1949, 1950; Tener and Lemieux 1952). It was believed that a six foot rise in the level of the river would have a large effect on the vegetation and waterfowl to be found in the area. Plans were made to study closely the changes in the vegetation and in the use of the area by waterfowl to determine the relationships between the

pre-flood and post-flood vegetation complex and waterfowl use.

Description of the area

The source of the Ottawa River is about 150 miles due north of Ottawa. It flows west to Lake Timiscaming on the Quebec-Ontario border immediately south of the 47th parallel. The river then flows southeast to Ottawa and east to its junction with the St. Lawrence River via Lake of Two Mountains and Lake St. Louis (Fig. 1). It follows, and helped create, what is known as the Ottawa Valley. For almost one-half of its length the river marks the Quebec-Ontario border.

The intensive study area was located near the town of Thurso, 30 miles east of Hull, on the north shore of the river. It covered about 4,000 acres commencing two miles west of Thurso and terminating six miles east of Thurso near Plaisance (Fig. 2).

Precambrian formations of the Canadian Shiels characterize the Ottawa Valley. Rowe (1959) mentions that the area "has a bedrock of flat-lying Ordovician limestones and shales, and local Cambrian beds, covered by glacial deposits over which in turn lie extensive marine

clays and sands dating from the period of inundation by the Champlain Sea in late Pleistocene times. Grey brown podzolic and brown forest soils generally have been developed, with locally some podzols, mucks and peats."

The climate of the lower Ottawa Valley is not severe. Data from the Bulletin Météorologique (1962-1964) for the Thurso station are summarized in Table 1. The frost-free period during 1962, 1963 and 1964 averaged about 130 days between mid-May and late September.

The bays generally freeze about mid-November and are free from ice about mid-April. The river freezes in early December and breaks in early April. The river usually floods in the spring. Water levels may be up to six feet higher in April and early May than at other times of the year.

The hardwood forest along the edge of the river fits the upper St. Lawrence Section of the Great-Lakes - St. Lawrence Forest Region as described by Rowe (1959). The marshes are predominantly bulrush. Scientific names of plants observed on the study area are given in Appendix A.

Over 20 species of waterfowl were observed on the study area. The Ottawa Valley appears to be a major

migration route for waterfowl, both going to, and coming from, James Bay and Hudson Bay. Ducks of nine species were believed to have bred on the study area. Waterfowl of other species were observed during the spring or fall migrations or both. Scientific names of all waterfowl species observed on the study area are given in Appendix B.

Hunting was general along the river. Local residents hunted the first few days of the season and thereafter hunting was conducted primarily by the clubs. No large influx of hunters was noted from the nearby urban centers before the flood. The total harvest of ducks was light.

The common bullhead (Ameiurus nebulosus (Le Sueur)) appeared to be the mainstay of the fishermen on the river.

Muskrats (Ondatra zibethica (L.)) were the only fur-bearing animals of importance. Each spring, several of the local farmers set traps. Harvests were not heavy and the full potential of the muskrat population was not exploited.

Ownership and use of the land and water in the valley varied greatly. Most was in the possession of local people but the Provincial Government and absentee landlords owned scattered portions.

All land bordering the river in the study area was privately owned. In several cases aerable land was leased to local farmers by absentee owners. Land immediately surrounding some of the better waterfowl marshes was often leased to individuals or groups by the farmer owners. The land under water in some of the larger bays was privately owned. Waterfowl hunting was the primary objective in such instances. Access was controlled in such areas and guardians were employed during the hunting season to prevent poaching. Hunting rights on some bays were leased to outside parties by local people who did not actually own the bays, only the land surrounding them.

In 1962 Quebec Hydro began to expropriate all land that was to be flooded. In some cases the owner retained the hunting rights on this land. In other cases hunting rights were leased to outsiders. Since the expropriation of lands and the subsequent leasing of some of them by Quebec Hydro the situation has become extremely complicated.

Previous related studies

Little work on aquatic succession in flooded areas has been reported. Robel (1961, 1962) studied the growth

of submersed vegetation in a marsh at the northern end of Great Salt Lake, Utah, before and after a three inch rise in water level. He found a 32 percent increase, by dry weight, in depths of less than 16 inches and a 35.1 percent decrease in depths of over 16 inches. The difference resulted from changes in the abundance of foliage rather than in the number of plants. A net increase in production occurred in the marsh, due to an increase in the extent of shallow areas.

Hartman (1949), MacNamara (1957) and Kadlec (1962) found that waterfowl use of impoundments reached a peak in the first few years after flooding, and later declined. Kadlec (1962) observed that drawdown followed by reflooding rejuvenated impoundments, making them more attractive to waterfowl. He found impoundments with variable water levels to be more productive than those with stable levels. The unstable water levels tended to favour the establishment of emergent cover necessary for nesting waterfowl. A rise in the water level after a drawdown often improved the soil and thereby increased aquatic plant production.

Bayly (1961) observed a rapid regeneration of aquatic plants along the St. Lawrence Seaway in areas which had

a gently sloping shoreline and available plant seeds. She noted that neither in areas of strong current nor in water with a depth greater than four feet was there any establishments of aquatic plants. She found underwater obstacles such as stumps, rocks, shrubs and fences promoted the establishment of vegetation, as seeds and plant gragments would lodge behind them and become permanently established.

Silker (1948) studied the growth of water-tolerant trees in areas of fluctuating water levels. After nine years of growth, intermittently flooded to a depth of one to three feet during each growing season, he found 96 percent survival in Baldcypress (Taxodium distichum), 88 percent survival in Tupelo (Nyssa aquatica) and 58 percent survival in Southern White Cedar (Chamaecyparis thyoides).

Hall and Smith (1955), in a study of the effects of flooding on woody plants, determined the percentage of the growing season that several woody plant species could be flooded with no individuals dying. They found that Black Willow (Salix nigra) could be emersed for 42.5 percent of the growing season, Ash (Fraxinus sp.) for

38.4 percent, Red Maple (Acer rubrum) for 36.4 percent, Cottonwood (Populus deltoides) for 34.5 percent and American Elm (Ulmus americana) for 24.6 percent, with no ill effects.

METHODS

All acreages used in this report were determined with the use of a planimeter from a set of large scale (1" equal to 100') aerial photographs. Distances were measured on the same set of photographs. The study included two parts, determining the effect of flooding on the vegetation, and determining the effect of flooding on the number of breeding waterfowl.

1) Vegetation

In the preliminary field work and in the designation of the intensive study area the vegetation was classified from data collected on line transects through each marsh. The observer walked a straight line through the marsh noting the percentage of each ten foot section occupied by each plant species. In the intensive study area, four permanent line transects (each about 500 feet long), staked out in 1962, extended from above the flood line to open water. Two were in Black Bay, and two in Pentecote Bay. One transect in each bay ran through cleared hardwood forest and marsh, and one through farmland and marsh. One short transect (200 feet) was established through standing hardwood forest in Lochaber Bay. The areas

covered by the transects were representative of all major habitat types present along the river. Successive three foot sections of each transect were examined in mid-August from 1962 through 1968. The percentage occupied by each plant species and the depth of water in each of the sections were recorded.

2) Waterfowl

A survey route through the study area followed the junction of dense emergent vegetation or shoreline and open water. The route was followed weekly by canoe from the second week of May to the first week of June. All waterfowl observed were recorded as breeding pairs, single males presumed on territory, and other. Single males were presumed on territory and counted as breeding pairs when they flushed at close distances, circled overhead, and landed nearby. The distance travelled in each bay at each visit was recorded. The number of breeding pairs seen in each bay was totalled for all trips and divided by the total number of miles travelled in that bay to give the number of breeding pairs per mile of edge.

CONDITIONS BEFORE FLOODING

The northern shoreline of the Ottawa River in the study area was characterized by numerous bays and marshes, many small and a few large. About 75 percent of the shoreline supported hardwood forest and about 25 percent farmland. The marshes and bays contained abundant aquatic plant growth and supported breeding populations of waterfowl. Along the shoreline of the river was a narrow strip occupied by an unvaried plant community. Migrating waterfowl were numerous in the spring and fall. Hunting was carried on at varying intensity throughout the fall.

The intensive study area (Fig. 2) included about 4,000 acres of low-lying forest, farmland and marsh on the north shore of the river about 30 miles east of Hull, extending from the edge of the river to the upper limit of the expected flood zone. Three large bays and the marshes associated with each made up a large portion of the area. The bays were Lochaber (450 acres), Black (800 acres), and Pentecote (250 acres). The remaining 2,500 acres were made up of forest and farmland that was to be flooded.

Vegetation

Mixed hardwood forests composed of sugar maple, red

maple, american beech, white ash and cottonwood made up about 70 percent of the expected flood zone. Pasture, primarily coarse grasses and shrubs, made up about 25 percent of the expected flood zone and cropland, planted in hay and oats, made up about five percent of the zone.

The terrestrial vegetation in the expected flood zone at Lochaber Bay was almost all hardwood forest. The northern edge of the bay sloped steeply, constricting the zone to a width of 25 feet. The eastern and western edges of the bay were nearly level, permitting a flood zone of several hundred feet. A ridge running the full length of the southern edge of the bay, separating the bay from the river, restricted the flood zone to about 50 feet. The total area of the expected flood zone in Lochaber Bay was over 300 acres. The hardwood forest on the north, east and south sides of the bay was cleared in 1962. Trees on about 100 acres of land were left standing in the flood zone at the west end of the bay.

Approximately 75 percent of the expected flood zone in Black Bay was hardwood forest. Farmland, pasture and cropland in equal proportions, made up the other 25 percent. The zone was about 60 feet in width on the north and east sides of the bay. On the south and west sides

it covered several hundred feet. The total area of the zone was over 700 acres. The hardwood forest in the whole of the flood zone was cleared in 1962.

About 60 percent of the expected flood zone in Pentecote Bay was hardwood forest. Pasture made up 30 percent and cropland 10 percent of that zone. The steep northern shoreline constricted the flood zone to 20 feet. To the east, south and west the zone varied from 100 to several hundred feet in width. The total area in the flood zone was about 400 acres. The hardwood forest throughout the zone was cleared in 1962.

Between Lochaber Bay and Thurso there was an expected flood zone of 600 acres. Hardwood forest made up 60 percent and pasture made up 40 percent of the zone. The hardwood forest was cut in 1962.

Between Thurso and Black Bay there was an expected flood zone of 600 acres. Hardwood forest and pasture were present in equal proportions. The hardwood forest was cleared in 1962.

Three distinct pre-flood habitat types were present in the expected flood zone on the intensive study area; standing hardwood forest, cleared hardwood forest and farmland composed of pasture and cropland.

The aquatic vegetation occurred in zones whose breadth was determined by the depth of water. The dominant plant type in the marshes of the Ottawa River was the bulrush, both river and softstem.

Lochaber Bay, with 400 acres under water, had a gently sloping shoreline with an average water depth of three to four feet. Because of heavy emergent vegetation no large body of open water was present, although several one-half acre ponds were scattered throughout the bay. Emergent vegetation near the shoreline consisted of sedges, pickerel-weed and arrow-leaf. As the water deepened these gave way to wild rice, river bulrush and bur-reed. Emergent vegetation in the deepest water was made up of softstem bulrush and lilypads, wild celery and water milfoil.

Black Bay, with 800 acres under water, had a moderately sloping shoreline and an average water depth of six to seven feet. The central 350 acres were open water with no vegetation. Towards the western edge of the bay were several one-half acre ponds. The emergent vegetation in Black Bay was similar to that in Lochaber Bay but with less arrow-leaf and bur-reed and more river bulrush. There was a greater abundance of wild celery in Black Bay than there was in Lochaber Bay.

Pentecote Bay, with 250 acres under water, had shorelines of two types. The southern arm of the bay had a gently sloping shoreline and a maximum water depth of six inches. Sedges, pickerel-weed and river bulrush were the dominant plant species. The western arm of the bay had an abrupt northern shoreline and a deep non-vegetated channel through the center. The average water depth, exclusive of the channel, was three to four feet. River and softstem bulrushes and pondweeds were the main plant species.

The area between Lochaber Bay and Thurso contained less than 60 acres of marsh. The marsh was shallow and the aquatic vegetation was made up of sedges and river bulrush. At the shoreline of the river proper was a band of aquatic vegetation varying from 30 to 50 feet in width. The vegetation included sedges, pickerel-weed and arrow-leaf near the shore, and river bulrush and pondweeds nearer the open water.

The area between Thurso and Black Bay had less than 50 acres of marsh. The aquatic vegetation in the marsh and along the shore of the river proper was the same as in the area between Lochaber Bay and Thurso.

Waterfowl

Waterfowl were studied during three periods: spring migration, breeding, and harvest (fall migration). The spring migration included the period from the first arrival dates in the spring to the beginning of the breeding season, which generally began about the first week in May and ended with hatching of the first broods about the end of May or the first week in June. The harvest period began with the opening of the hunting season on the fourth Saturday in September and extended until freeze-up, about the third week in November. Brood surveys were not conducted due to the difficulty of spotting broods amongst the heavy emergent vegetation.

The greatest scaup was the first arrival in the spring, making its appearance on the study area soon after break-up in mid-April. The Canada goose, black duck, mallard and blue-winged teal followed closely. The species achieving the highest populations in the area were the greater scaup, Canada goose, black duck and blue-winged teal.

Lochaber Bay was not used extensively by waterfowl on their spring migration. At no time were more than a hundred individuals of a single species observed on

the bay, with the exception of the Canada goose, of which, each spring, a flock of about 200 was observed on the bay.

Black ducks, mallards and Canada geese used Black Bay for feeding and resting. Each spring flocks totalling about 400 birds of each species were observed scattered through the bay.

The blue-winged teal used Pentecote Bay extensively on its spring migration. Concentrations of up to 400 birds were seen prior to the breeding season.

Waterfowl made little use of the small marshes between Lochaber Bay and Thurso and Thurso and Black Bay during their spring migration. The shore of the river proper in these areas was heavily used by migrating greater scaup. Up to 1,500 birds were counted on the river in a single visit.

Prior to flooding, most of the marsh area was attractive to breeding waterfowl of several species. Because changes in the breeding population seemed more likely to be detectable than changes in the numbers of migrating waterfowl using the study area, the surveying of breeding pairs was emphasized. Breeding pair counts were made prior to the flood only in 1963.

The wood duck was the most common waterfowl species breeding in Lochaber Bay. The blue-winged teal, black duck and mallard followed closely. Mallard, black duck and wood duck were the most abundant waterfowl breeding in Black Bay. Blue-winged teal, wood duck and mallard were the most abundant waterfowl breeding in Pentecote Bay. Pentecote Bay had the greatest density of breeding waterfowl in the study area prior to the flood. Wood duck and blue-winged teal were the most common waterfowl breeding between Lochaber Bay and Thurso. The black duck was the only waterfowl species observed breeding between Thurso and Black Bay.

Ducks used all the marsh areas extensively during the fall migration. Details of the species composition of the harvest were available only for Lochaber Bay. Estimates for the other areas were based on information from local hunters and from personal observations during the first and third weekends of the hunting season.

Hunting records were available for 15 years prior to 1964 on Lochaber Bay from Mr. J.C. Wilson. The species composition of the kill, in order of importance, was black duck, ring-necked duck, blue-winged teal, mallard and wood duck. In those same years waterfowl

of over 20 species were killed on the bay. The average yearly bag during tha time was slightly less than 200 birds. The light harvest was the result of shooting restrictions established by the owner. The bay was hunted only by the owner and a few of his friends and then only on weekends. The bay actually acted as a sanctuary by providing an area where the birds could rest undisturbed during the week. It helped to keep birds in the vicinity later in the fall.

Detailed records of the species composition of the kill in Black Bay were not available. The records kept by the local club listed only the number of ducks killed per hunt and only occasionally the number of guns per hunt. The average number of ducks killed per season was about 450. About one-half were black ducks. The bay was hunted only by the owners and guests, and hunting was normally confined to weekends. Like Lochaber Bay, Black Bay acted as a sanctuary and helped to keep birds in the area for a longer period of time in the fall.

No shooting records were available for Pentecote Bay. Prior to the flood about six blinds were set up each season. The blinds were occupied by hunters on weekdays as well as on weekends. During the first two

weeks of the open season about 30 local hunters without previously made blinds also hunted on the bay. It is unlikely that more than 500 birds were killed in a season. In comparison to its size the kill on Pentecote Bay was much higher than that on Lochaber and Black bays.

Two or three blinds were normally constructed between Lochaber Bay and Thurso each season prior to the flood. Local residents sometimes jump-shot the area during the first month of the season. Probably no more than 200 birds were taken in a season.

Two blinds were normally constructed between Thurso and Black Bay prior to the flood. No more than 100 birds were taken in a single season.

THE EFFECTS OF FLOODING

The water level rose two feet between June and late August of 1963, and an additional two feet during the last week of August and the first week of September. During the fall it rose another two feet so that in the spring of 1964 the water level was six feet higher than it was in the spring of 1963. The water level remained stable from the spring of 1964 until the fall of 1968.

Following the rise in water level Lochaber Bay gained 300 acres, Black Bay 700 acres, and Pentecote Bay 650 acres. A new marsh of 800 acres was created between Lochaber Bay and Thurso and one of 600 acres between Thurso and Black Bay. The difference in the size of the marshes before and after flooding is shown in Fig. 2.

Vegetation

The water level was two feet higher during the 1963 vegetation survey than during the 1962 survey. It was four feet higher during the 1964 and subsequent surveys than during the 1963 survey. The effects of flooding on the vegetation will be discussed in relation to the transects and water depth rather than in relation to each bay. The changes that took place were similar in each bay.

All the trees in the expected flood zone except those at the west end of Lochaber Bay were cut and removed before the rise in water level. The flooded trees survived but lost their leaves two weeks earlier than surrounding non-flooded trees. The few shrubs and grasses that grew up in the area to be flooded before the rise in water level died as a result of the flood.

Soon after the transects were examined in 1963 all the beds of wild rice died. The bulrushes and pondweeds grew as quickly as the water rose and produced an extremely heavy seed crop. On the flooded farmland and flooded, cleared hardwood forest, aquatic growth appeared in early July.

The percentage of each transect occupied by plants in relation to water depth during the years 1962 to 1968 are presented in Figs. 3, 4, 5 and 6. The species of aquatic plants on flooded farmland and marsh are indicated in Figs. 3 and 4, and on flooded, cleared hardwood forest and marsh in Figs. 5 and 6. The vegetated proportion of the transects on flooded farmland and marsh in 1964 was 45 percent and on flooded, cleared hardwood forest and marsh 38 percent. In 1965 it was 54 percent and 72 percent, in 1966, 24 and 36 percent, in 1967, 10.5 and

12.5, and in 1968, 16.5 and 29.0 percent respectively. The aquatic plant species established in 1964 on the two vegetation types were much the same. They were similar in 1965 but the flooded farmland had more smartweeds and the flooded cleared forest had more Canada water-weed. Neither water levels nor plant growth were stable in 1963, a transition year. In 1964, on flooded farmland and on flooded, cleared hardwood forest, in order of greatest density, sedges, grasses and shrubs grew in water between 0 and 12 inches deep; river bulrush, cinquefoil, pondweeds and smartweeds between 13 and 36 inches; river and softstem bulrush, pondweeds and cinquefoil between 37 and 48 inches; and river bulrush and pondweeds between 49 and 60 inches. In 1965 grasses and sedges grew in water between 0 and 12 inches deep; Canada water-weed and smartweeds between 13 and 48 inches; and smartweeds between 49 and 60 inches. In 1966 arrow-leaf and Canada water-weed grew in water 0 to 12 inches deep, Canada water-weed in water 13 to 36 inches deep, almost nothing in water 36 to 48 inches deep and some smartweeds in water 49 to 60 inches deep. In 1967 and 1968 vegetation was limited to those areas having a water depth of less than 25 inches with the exception of one transect which had a solid bed of smartweed in depths from 49-60 inches. In depths less than 25 inches

the main plants were blunt spike rush, cattail, pickerel weed and arrow-leaf.

Each water depth, above 12 inches, bore plant communities of similar species composition in 1962 and 1964. A greater influence on the development of the vegetation after flooding was apparently exerted by water depth than by the previous vegetation type. The pioneering aquatics in both flooded farmland and flooded cleared hardwood forest were river bulrush, pondweeds, cinquefoil and smartweeds. In 1965 the vegetation appeared to have become stabilized in broad zones each consisting of one or two species. Broad areas of water-weed and smartweeds covered the area. Prior to 1964, little cinquefoil had been found on the study area, and it seemed probable that seeds had floated downstream from cinquefoil beds located outside the study area. In 1966 the vegetation was still in zones but the amount had decreased. By 1967 only shallow areas were vegetated with the exception of a few floating beds of smartweeds.

In the flooded, standing hardwood forest no aquatic vegetation grew beneath the trees. Openings between the trees and along the edge of the forest produced, at all depths from one to four feet, cinquefoil and smartweeds.

In the flooded, standing hardwood forest no aquatic vegetation grew beneath the trees. Openings between the trees and along the edge of the forest produced, at all depths from one to four feet, cinquefoil and smartweeds. In 1965 and 1966 the cinquefoil and smartweeds, mixed with buttonbush grew only at the perimeter of the flooded forest. In 1967 and 1968 most of the buttonbush was gone but the cinquefoil and smartweeds were evident in a wide land around the perimeter of the flooded forest. Here a greater influence on the development of the vegetation after flooding was apparently exerted by the previous vegetation type than by water depth.

The total vegetated proportion of the four transects at different water depths, for each year from 1962 to 1968, is indicated in Fig. 7. Before flooding, the optimum water depth for plant growth extended from 0 to 36 inches. In 1963, following a two foot increase in the water level during the summer, it extended up to 48 inches. The increase in vegetation in water depths of 37 to 48 inches in 1963 was probably due to the rapid growth of river bulrush and pondweeds, which were the most common plants in the same locations in 1962. The decrease in plant cover in water depths of 13 to 36

inches might have been due to the lack of river bulrush and pondweeds in the corresponding location in 1962. The abundant seed crop produced by river bulrush and pondweeds in 1963 likely accounted for much of the plant growth in 1964.

In 1965 there was an increase in plant cover over 1964, in all water depths. The increase was most noticeable in water depths from 49 to 60 inches, and affected chiefly smartweeds and pondweeds. There was a marked decrease in plant cover in 1966 in all water depths which continued into 1968.

Waterfowl

No noticeable change occurred in the number of waterfowl using the area during spring migration, approximately the same numbers being seen after the flood as before. Both the breeding population and the autumn harvest showed considerable increases.

An increase in the number of breeding pairs per mile of edge occurred in 1964, 1965 and 1966 but in 1967 the number of pairs began to decline (Table 2 and Figure 8). In Lochaber Bay the wood duck remained the most abundant breeder after flooding until 1968 when it was

replaced by both the mallard and black duck (Table 3). In Black Bay the black duck and wood duck were the most common breeders prior to flooding; in the first year after flooding, 1964, the blue-winged teal became the most common. The following year, 1965, the black duck showed a remarkable increase and regained and continued to hold its position as the most breeding duck (Table 4). The blue-winged teal remained the most abundant duck breeding in Pentecote Bay although its relative abundance decreased (Table 5). Prior to the flood the wood duck was the most abundant breeding duck between Lochaber Bay and Thurso. In 1964 and subsequently its place was taken by the blue-winged teal although the black duck and the mallard increased considerably (Table 6). Between Thurso and Black Bay the blue-winged teal replaced the black duck as the most common breeding duck in 1964 and 1965. In 1966 the black duck was once more the most common breeding species and remained until 1968 when it was overtaken by both the mallard and blue-winged teal (Table 7). The greatest increase in the number of breeding pairs per mile occurred in this region.

Lone drakes presumed on territory were considered to be paired and were therefore counted as breeding pairs

in Tables 2 to 7 and in Fig. 8. Lone black ducks are difficult to sex, so all single individuals were considered to be paired and counted as such. Therefore there were probably fewer breeding black ducks than the figures in Tables 2 to 7 might suggest.

The increase in breeding pairs of waterfowl in Lochaber, Black and Pentecote bays after the flood was probably due to the large increase in the number of loafing spots resulting from the rise in water level. Prior to flooding, the only loafing spots were muskrat houses and the solid shore of each bay. When the forests were cut, logs and stumps were left behind and pushed into the ground by machinery. Following the rise in water level many of the logs and stumps rose from the softened ground and projected above the surface of the water. Muskrat houses increased up to 2,000 percent both in flooded farmland and in flooded, cleared hardwood forest. Breeding waterfowl made use of the logs and muskrat houses as loafing areas. A lack of loafing areas probably limited the breeding population prior to flooding. By 1967 many of the logs and stumps had rotted away and the population of muskrats had diminished markedly.

The large increase in the number of breeding waterfowl between Lochaber Bay and Black Bay must have been due to the increase in water area. Where only small marshes and the edge of the river proper provided water and cover prior to the flood, extensive areas of small, shallow ponds were present after the flood. Wherever emergent vegetation, small bodies of open water, and loafing spots occurred, breeding waterfowl were abundant. Where one of these three necessities was absent, however, breeding waterfowl also were absent. The three ingredients were present in about the same proportion on flooded farmland and on flooded, cleared hardwood forest. They were not present in flooded, standing hardwood forest, where wood ducks were the major waterfowl breeding until many of the trees were felled in 1967 and 1968.

The harvest of waterfowl increased in the study area in 1964. The data on kill and the success rate of blinds were obtained in part from interviews with local hunters, and in part from observations and bag checks conducted early in the hunting season until 1966. After 1966 no bag checks were conducted nor were blind counts made.

The kill in Lochaber Bay did not differ much in 1964 and 1965 from the preceeding 15 year average. The bay was

not hunted more heavily in 1964 than in previous years, so the increase in the number of birds present was not reflected in the kill (see Table 8). The kill in 1966 was higher per gun day due to a decrease in the number of guests. The few persons that did shoot were all good shots.

The kill in Black Bay did not increase in 1964 for the same reason that it did not at Lochaber Bay. Similarly, the 1965 and 1966 kill did not appear to differ appreciably from previous years. The kill increased in Pentecote Bay in 1964. Whereas before the flood there were about six blinds on the bay, over thirty were noted in 1964. Hunter success at the blinds dropped a little in 1964, due perhaps to greater crowding, but the overall kill probably tripled. In 1965 and 1966 there were over 40 blinds, and crowding was responsible for a decrease in total kill. The kill between Lochaber Bay and Thurso was considerably greater in 1964 than in 1963. About 20 blinds were constructed in 1964. Hunter success at the blinds also increased. About 2,000 birds were probably killed on the area in 1964. In 1965 and 1966, over 40 blinds were counted in the area. Hunter success dropped due to crowding, but the total kill was probably little changed. The kill between Thurso and Black Bay was

greater in 1964 than in 1963. The number of blinds rose from two to eight. Much of the area was leased, which accounted for the small number of blinds. The total kill was probably less than 500 birds. The number of blinds remained constant in 1965 and 1966 and the kill did not change appreciably.

A greater number of birds stayed in the study area throughout the fall in 1964, 1965 and 1966 than in 1963. The newly flooded areas provided plenty of food, and the large private marshes provided sanctuary for the birds.

FUTURE STUDIES

Breeding pair counts should be continued until such time as the population reaches a stable level. If time allows, a complete reassessment of the vegetation should be made throughout the study area, not just on the transects, to determine the overall change in the plant communities. Another look at the hunting pressure and kill should be conducted in 1969 or 1970.

Wm. T. Munro,
Wildlife Biologist.

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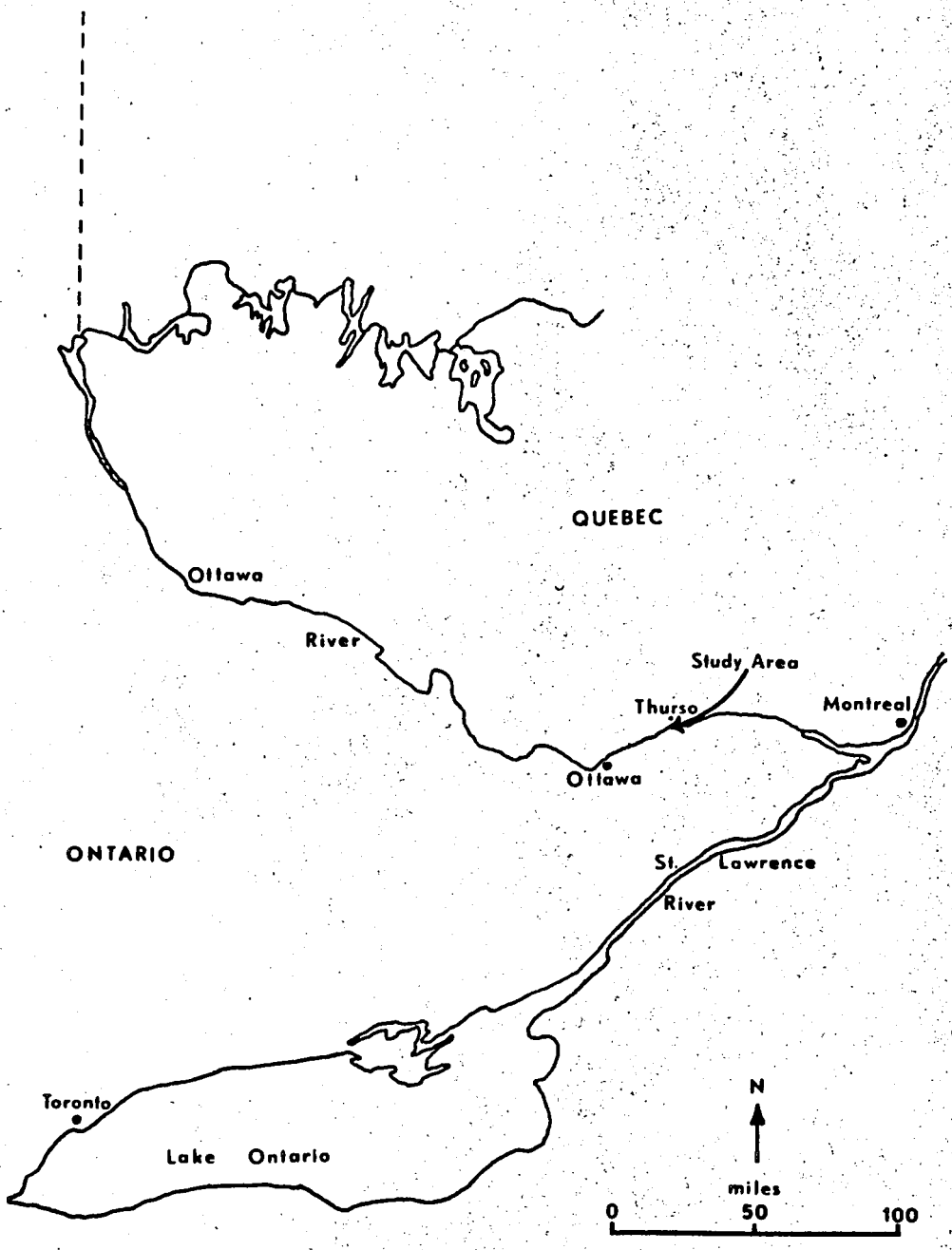
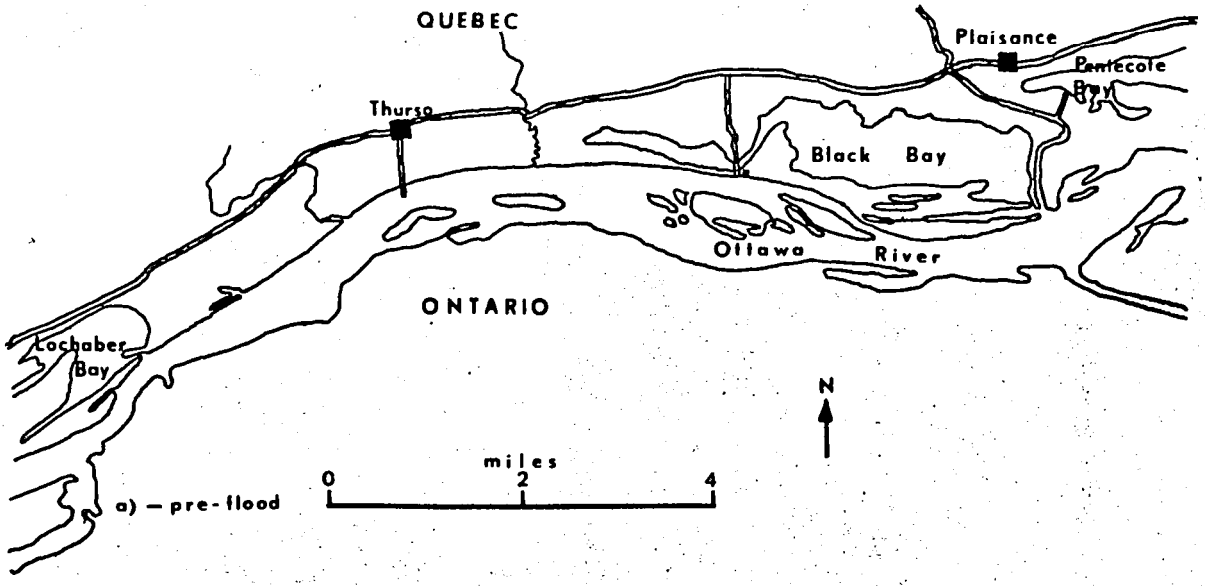


Fig. 1. Ottawa River showing the location of the study area.



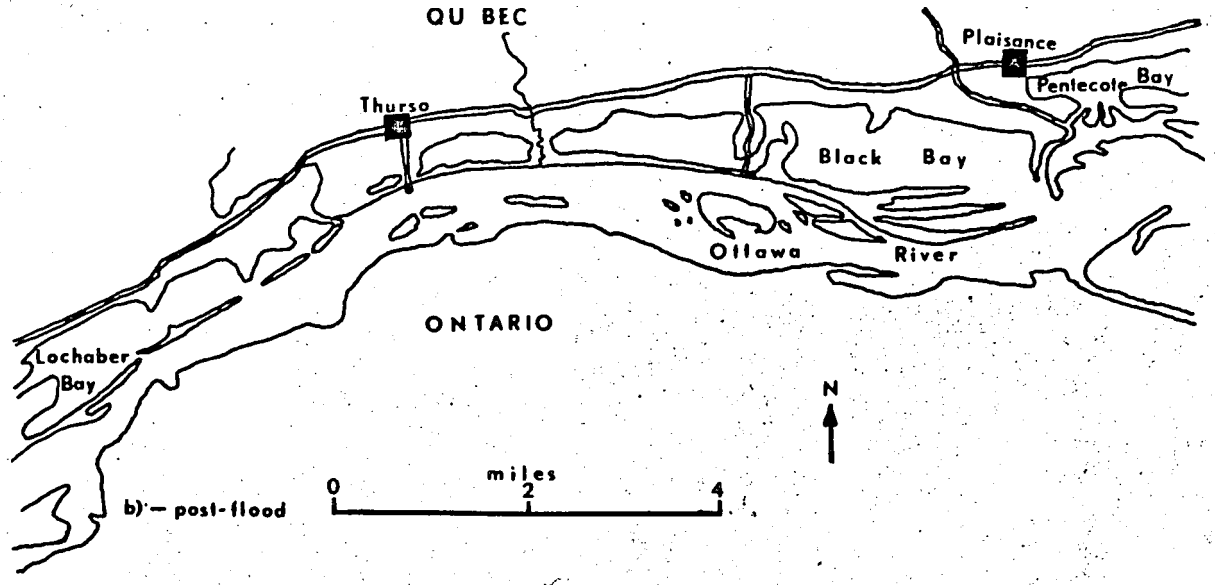


Fig. 2. The study area as it was before flooding (a) and after flooding (b).

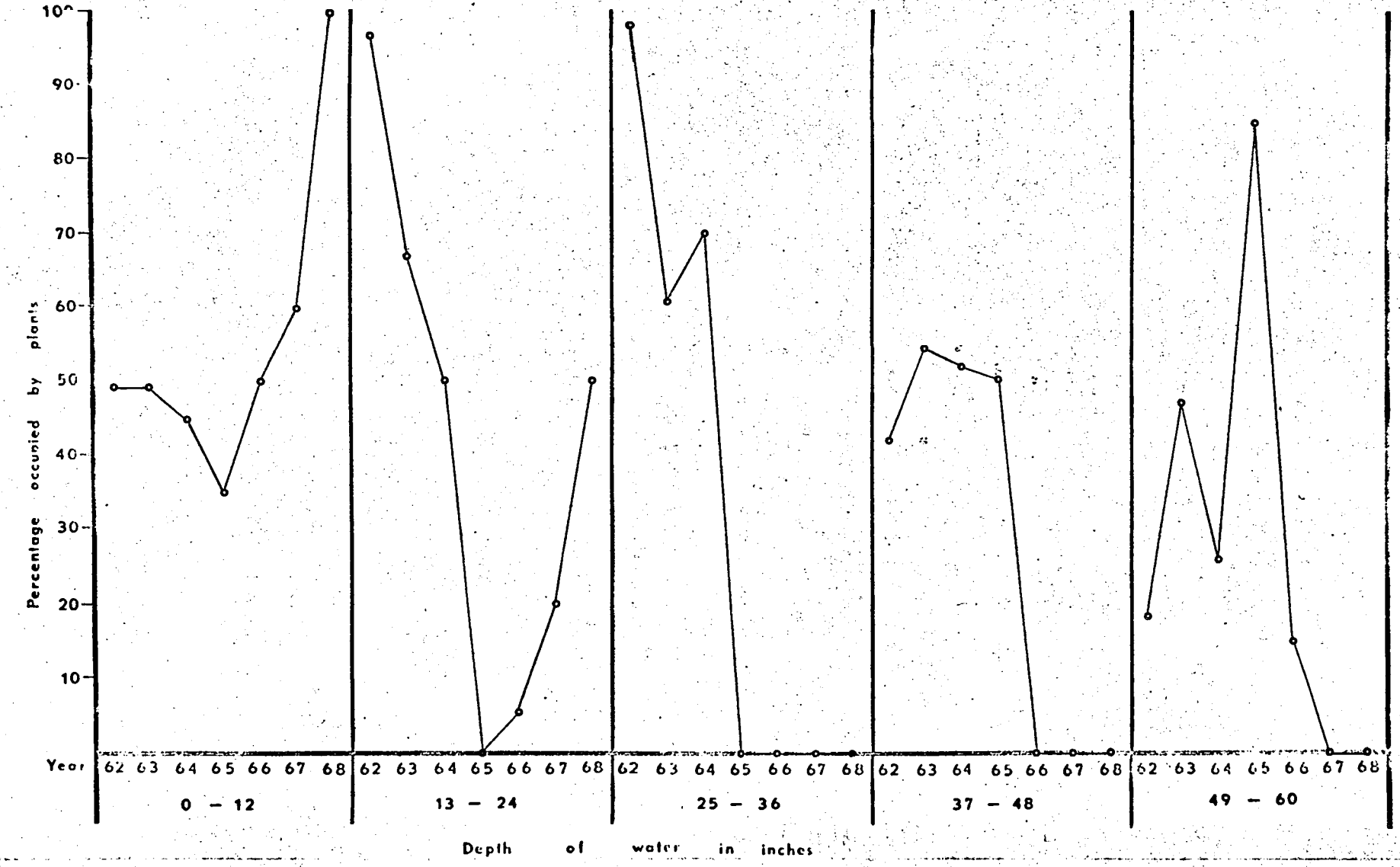


Fig. 3. Percentage of transect number 1 occupied by plants at varying water depths, 1962-1968.

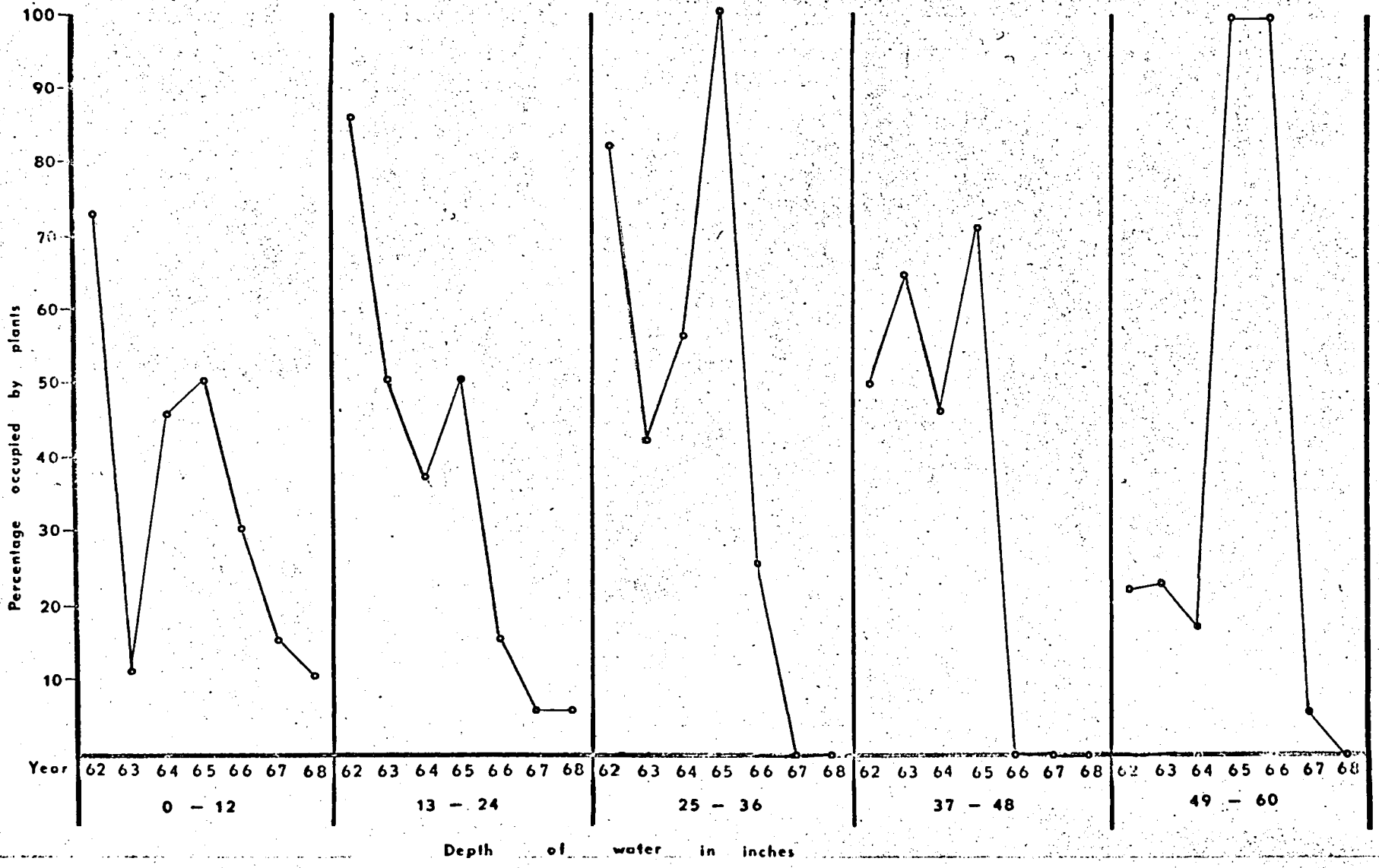


Fig. 4. Percentage of transect number 2 occupied by plants at varying water depths, 1962-1968.

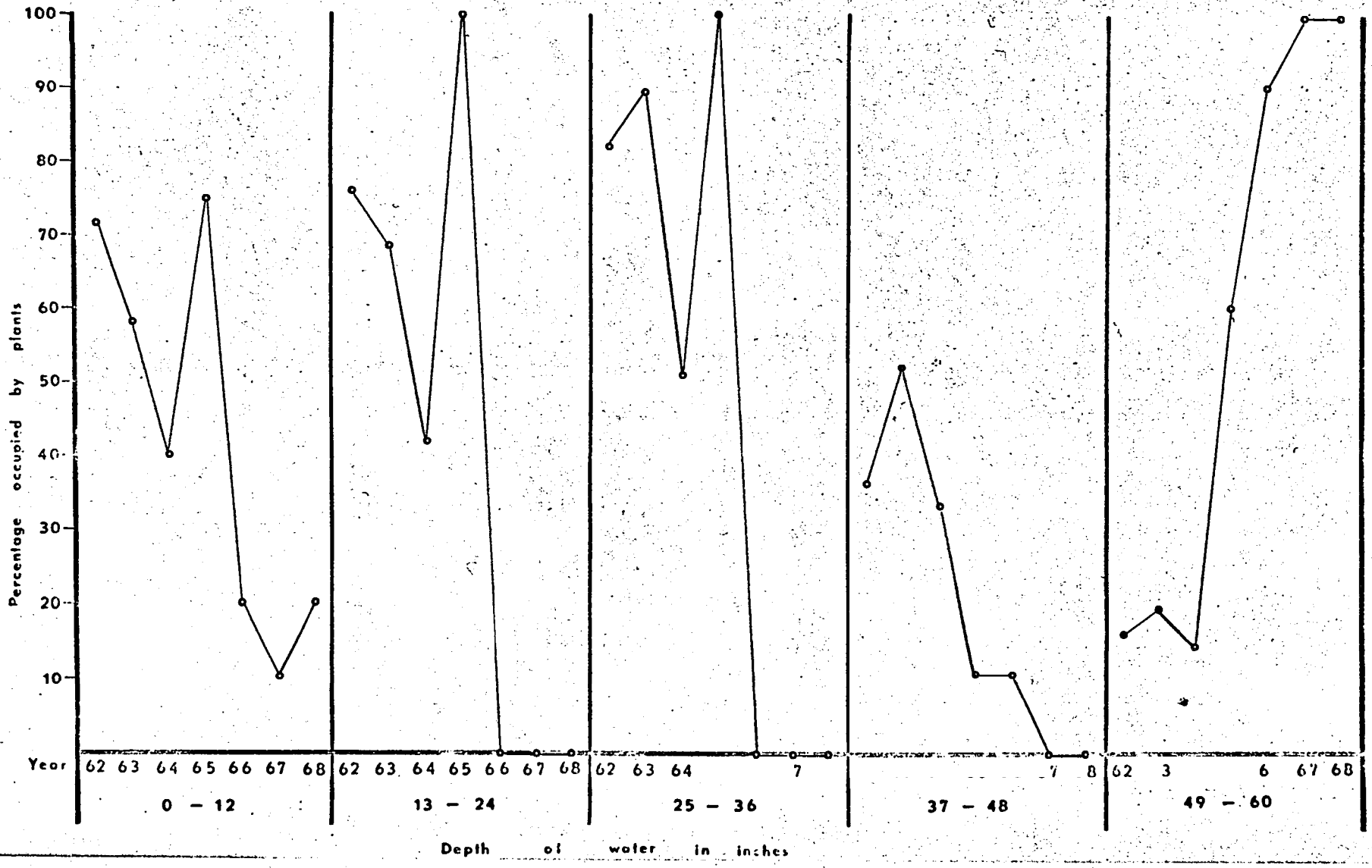


Fig. 5. Percentage of transect number 3 occupied by plants at varying water depths, 1962-1968.

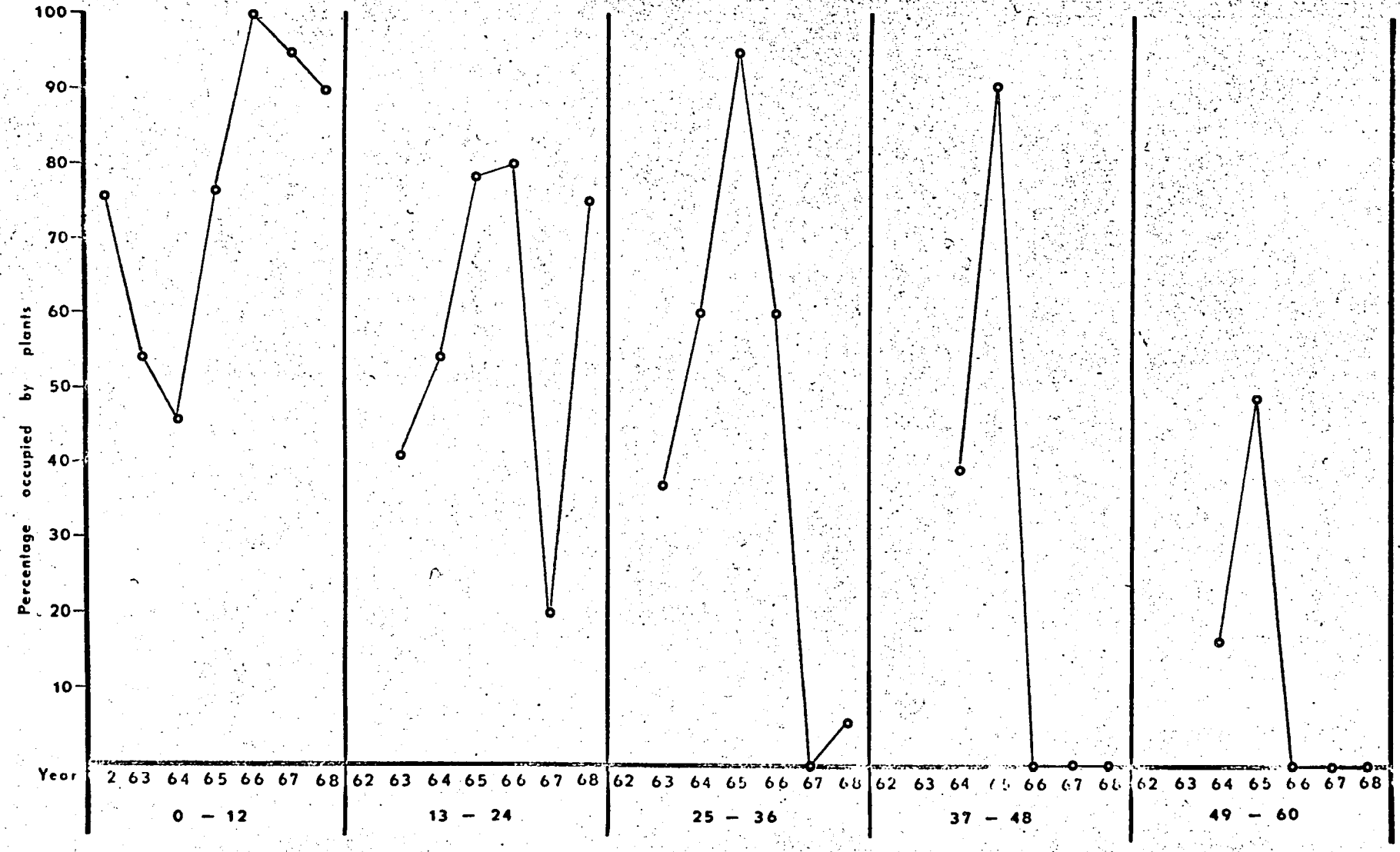


Fig. 6. Percentage of transect number 4 occupied by plants at varying water depths, 1962-1968.

Total

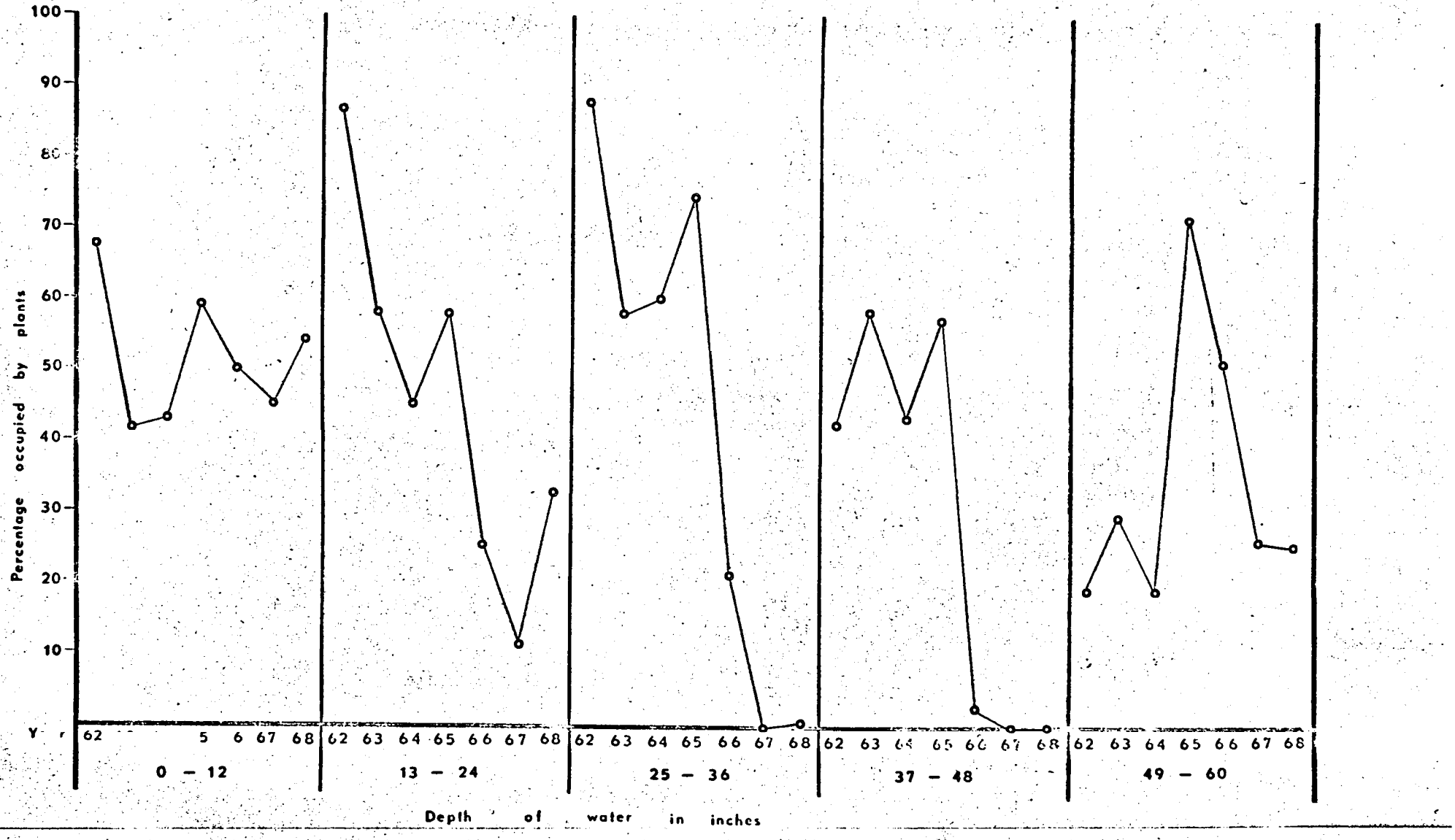


Fig. 7. Percentage of all transects occupied by plants at varying water depths, 1962-1968.

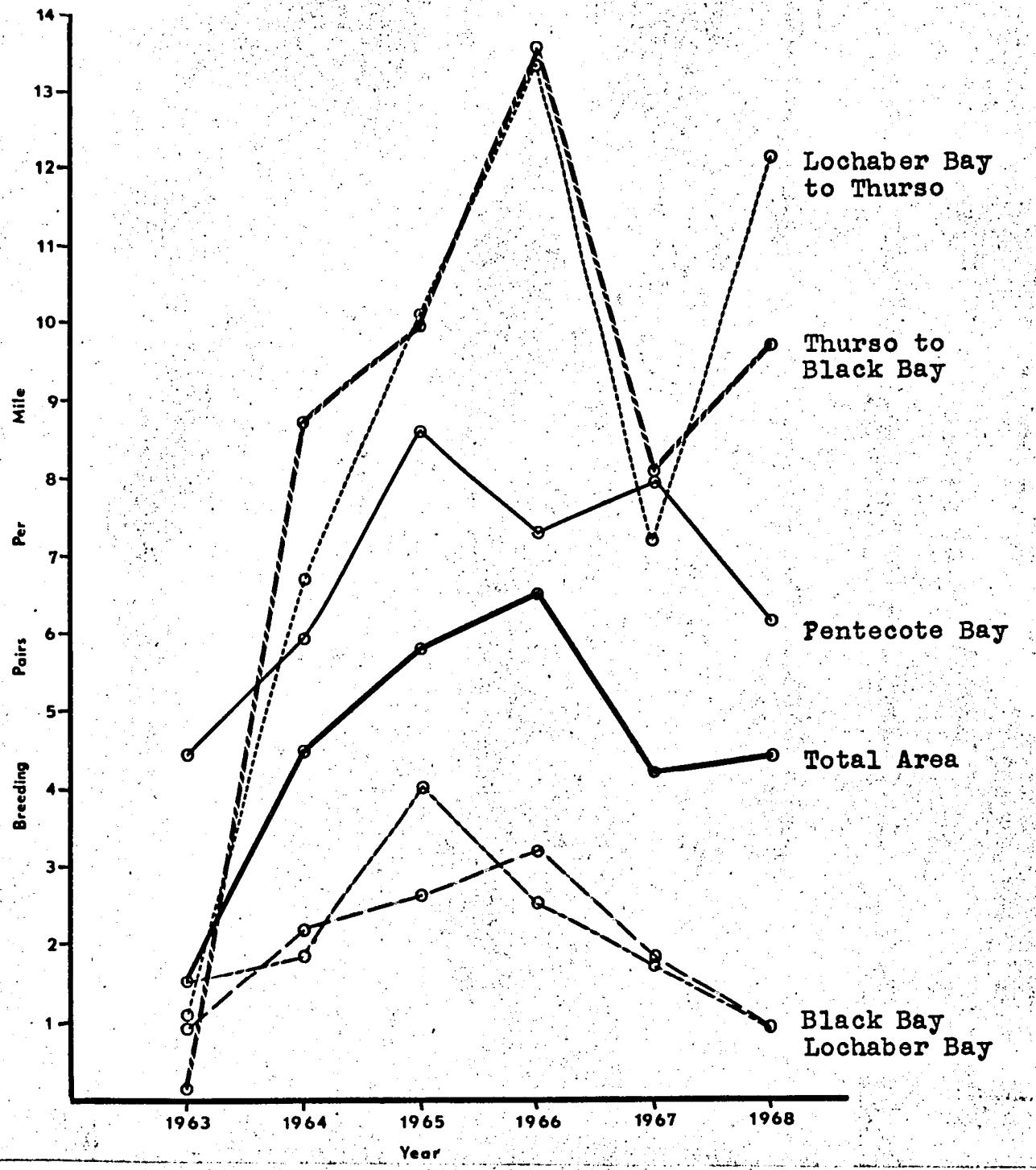


Fig. 8. The number of breeding pairs of waterfowl on each unit of the study area, 1963-1968.

Table 1. Mean Monthly Temperature and Precipitation, Thurso, Quebec, 1962-1964.

Month	Mean temperature in °F.	Mean precipitation in inches Rain	Snow
January	10	0.29	14.0
February	8	0.01	22.8
March	27	0.41	19.6
April	41	3.39	1.0
May	55	2.00	1.3
June	64	2.40	-
July	67	5.09	-
August	63	3.37	-
September	55	3.01	-
October	48	3.88	4.4
November	34	3.08	4.9
December	20	2.30	15.2
Annual	mean 41	total 29.23	83.2

Table 2. Relative abundance of breeding waterfowl, 1963-1968, Ottawa River, Quebec.

Year	Black Duck		Mallard		B.-w. Teal		Wood Duck		Other		Miles * Surveyed	Pairs per Mile
	%	#	%	#	%	#	%	#	%	#		
1963	13.9	20	16.0	23	38.2	55	31.3	45	0.7	1	93	1.5
1964	13.3	67	20.7	104	47.9	241	7.6	38	10.6	53	111	4.5
1965	23.5	118	12.7	64	45.1	227	9.5	48	9.1	46	87	5.8
1966	27.4	145	14.7	78	23.0	122	5.5	29	29.4	156	81	6.5
1967	30.9	106	25.7	88	22.7	78	7.3	25	13.4	46	81	4.2
1968	24.5	87	24.5	87	29.0	103	4.8	17	17.2	61	81	4.4

* Total of three surveys.

Table 3. Relative abundance of breeding waterfowl, Lochaber Bay, Que., 1963-1968.

Year	Blk Duck		Mallard		B.-w. T.		W. Duck		Pintail		G.-w. T.		Other		Total Pairs	Miles Surveyed	Pairs per Mile
	%	#	%	#	%	#	%	#	%	#	%	#	%	#			
1963	21.7	5	13.0	3	30.4	7	30.4	7	0.0	0	0.0	0	4.3	1	23	15	1.5
1964	13.6	6	11.4	5	25.0	11	45.4	20	2.3	1	2.3	1	0.0	0	44	24	1.8
1965	14.5	12	9.6	8	28.9	24	42.2	35	0.0	0	2.4	2	2.4	2	83	21	4.0
1966	20.0	9	11.1	5	6.7	3	42.2	19	0.0	0	15.6	7	4.4	2	45	18	2.5
1967	29.0	9	19.4	6	16.1	5	32.3	10	0.0	0	3.2	1	0.0	0	31	18	1.7
1968	35.3	6	52.9	9	7.1	2	11.8	2	0.0	0	0.0	0	0.0	0	17	18	0.9

Table 4. Relative abundance of breeding waterfowl, Black Bay, Que., 1963-1968.

Year	Blk Duck		Mallard		B.-w. T.		W. Duck		Pintail		G.-w. T.		Other		Total Pairs	Miles Surveyed	Pairs per Mile
	%	#	%	#	%	#	%	#	%	#	%	#	%	#			
1963	26.9	7	30.8	8	11.5	3	30.8	8	0.0	0	0.0	0	0.0	0	26	30	0.9
1964	28.8	21	17.8	13	47.9	35	4.1	3	1.4	1	0.0	0	0.0	0	73	33	2.2
1965	42.9	33	9.1	7	27.3	21	3.9	3	0.0	0	14.3	11	2.6	2	77	30	2.6
1966	38.9	37	15.8	15	10.5	10	3.2	3	5.3	5	20.0	19	6.3	6	95	30	3.2
1967	44.4	24	31.5	17	14.8	8	0.0	0	0.0	0	5.6	3	3.7	2	54	30	1.8
1968	50.0	14	14.3	4	7.1	2	0.0	0	10.7	3	17.9	5	0.0	0	28	30	0.9

Table 5. Relative abundance of breeding waterfowl, Pentecote Bay, Que., 1963-1968.

Year	Blk Duck		Mallard		B.-w. T.		W. Duck		Pintail		G.-w. T.		Other		Total Pairs	Miles Surveyed	Pairs per Mile
	%	#	%	#	%	#	%	#	%	#	%	#	%	#			
1963	6.5	5	13.8	11	51.3	41	28.8	23	0.0	0	0.0	0	0.0	0	80	18	4.4
1964	10.6	13	13.0	16	61.8	76	0.8	1	8.9	11	4.1	5	0.8	1	123	21	5.9
1965	15.5	16	12.6	13	66.0	68	0.0	0	1.9	2	3.9	4	0.0	0	103	12	8.6
1966	12.1	8	28.8	19	40.9	27	1.5	1	9.1	6	7.6	5	0.0	0	66	9	7.3
1967	18.3	13	12.7	9	42.3	30	11.3	8	7.0	5	8.4	6	0.0	0	71	9	7.9
1968	21.4	12	17.9	10	32.1	18	8.9	5	8.9	5	10.7	6	0.0	0	56	9	6.2

Table 6. Relative abundance of breeding waterfowl, Lochaber Bay to Thurso, Que., 1963-1968.

Year	Blk Duck		Mallard		B.-w. T.		W. Duck		Pintail		G.-w. T.		Other		Total Pairs	Miles Surveyed	Pairs per Mile
	%	#	%	#	%	#	%	#	%	#	%	#	%	#			
1963	7.7	1	7.7	1	30.8	4	53.8	7	0.0	0	0.0	0	0.0	0	13	12	1.1
1964	8.7	7	21.3	17	52.5	42	1.3	1	6.3	5	7.5	6	2.5	2	80	12	6.7
1965	24.2	22	13.2	12	45.1	41	6.6	6	6.6	6	3.3	3	1.1	1	91	9	10.1
1966	12.5	15	13.3	16	22.5	27	1.7	2	22.5	27	15.8	19	11.7	14	120	9	13.3
1967	21.5	14	30.8	20	29.2	19	4.6	3	1.5	1	9.2	6	3.1	2	65	9	7.2
1968	22.0	24	15.6	17	35.8	39	5.5	6	5.5	6	12.8	14	2.8	3	109	9	12.1

Table 7. Relative abundance of breeding waterfowl, Thurso to Black Bay, Que., 1963-1968.

Year	Blk Duck		Mallard		B.-w. T.		W. Duck		Pintail		G.-w. T.		Other		Total Pairs	Miles Surveyed	Pairs per Mile
	%	#	%	#	%	#	%	#	%	#	%	#	%	#			
1963	100.0	2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	2	18	0.1
1964	10.9	20	29.0	53	42.1	77	7.1	13	6.0	11	2.2	4	2.7	5	183	21	8.7
1965	23.5	35	16.1	24	49.0	73	2.7	4	4.7	7	1.3	2	2.7	4	149	15	9.9
1966	37.2	76	11.3	23	26.9	55	2.0	4	7.4	15	1.5	3	13.7	28	204	15	13.6
1967	37.7	46	29.5	36	13.1	16	3.3	4	4.9	6	0.0	0	11.5	14	122	15	8.1
1968	21.4	31	32.4	47	30.3	44	2.8	4	4.1	6	7.6	11	1.4	2	145	15	9.7

Table 8. Waterfowl Kill, Lochaber Bay, Que., 1949-1966.

Year	Per cent of Total Kill						Kill/Gun/Day	Gun Days
	Black Duck	Mallard	Wood Duck	R.-n. Duck	B.-w. Teal	Other Ducks		
1949 to 1963	55.0	6.7	5.8	20.2	8.3	4.0	3.27	50
1964	46.7	6.0	5.8	13.6	9.3	18.6	3.98	53
1965	40.7	22.8	13.2	5.2	4.7	13.5	3.64	42
1966	39.0	21.0	16.2	5.4	4.3	14.1	5.38	31

APPENDIX A

English and scientific names of plants identified during the course of the study.*

Scientific	English
Acer rubrum L.	Red Maple
Acer saccharum Marsh	Sugar Maple
Acorus calamus L.	Sweet Flag
Brasenia schreberi Gmel.	Water-shield
Butomus umbellatus L.	Flowering Rush
Carex spp.	Sedges
Cephalanthus occidentalis L.	Button-bush
Dulichium arundinaceum (L.) Britton	Three-way Sedge
Eleocharis spp.	Spike-rushes
Elodea canadensis Michx.	Canada Water-reed
Equisetum fluviatile L.	River Horsetail
Fagus americana L.	White Ash
Fagus grandifolia Ehrh.	American Beech
Hydrocharis morsus-ranae L.	Frogbit
Iris versicolor L.	Larger Blue-flag

*English and scientific names are from "Flore Laurentienne" by Frère Marie-Victorin. Second edition, 1964. Les Presses de l'Université de Montréal. 925 pp.

Scientific	English
Lemna minor L.	Lesser Duck-weed
Myriophyllum humile (Raf.) Morong.	Water Milfoil
Nuphar microphyllum (Pers.) Fernald	Small Pond-Lily
N. variegatum Engelm.	Variegated Pond-lily
Nymphaea tuberosa Paine	Tuberous Water-lily
Polygonum spp.	Smartweeds
Populus deltoides Marsh	Cottonwood
Potamogeton amplifolius Tuckerm.	Large-leaved Pondweed
P. natans L.	Floating Pondweed
P. richardsonii (A. Bennett) Rydb.	Richardson's Pondweed
P. robbinsii Oakes	Robbin's Pondweed
Pontederia cordata L.	Pickerel-weed
Potentilla palustris (L.)	Marsh Cinquefoil
Rumex verticillatus L.	Swamp Dock
Sagittaria latifolia Willd.	Broad-leaved Arrow-leaf
Scirpus atrovirens Willd.	Blackish Bulrush
S. expansus Fern.	Expanded Bulrush
S. fluviatilus (Torr.) Gray	River Bulrush
S. torreyi Olney	Torrey's Bulrush
S. validus Vahl	Softstem Bulrush
Sparganium androcladum (Engelm.) Morong.	Branching Bur-reed
S. eurycarpum Engelm.	Broad-fruited Bur-reed

Scientific	English
Typha latifolia L.	Broad-leaved Cat-tail
Utricularia geminiscapa Benj.	Twin-scapped Bladderwort
Valisneria americana Michx.	Wild Celery
Zizania aquatica L.	Wild Rice

APPENDIX B

English and scientific names of waterfowl observed on the study area.*

Scientific	English
** Branta canadensis (L.)	Canada Goose
Chen hyperborea (Pallas)	Snow Goose
** Anas platyrhynchos L.	Mallard
** A. rubripes Brewster	Black Duck
A. strepera L.	Gadwall
** A. acuta L.	Pintail
** A. carolinensis Gmelin	Green-winged Teal
** A. discors L.	Blue-winged Teal
** Mareca americana (Gmelin)	American Widgeon
** Spatula clypeata (L.)	Shoveler
** Aix sponsa (L.)	Wood Duck
** Aythya americana (Eyton)	Redhead
** A. collaris (Donovan)	Ring-necked Duck
A. marila (L.)	Greater Scaup
A. affinis (Eyton)	Lesser Scaup
Bucephala clangula (L.)	Common Goldeneye

* English and scientific names are from American Ornithologists' Union "Checklist of North American Birds", Fifth edition, 1957. Port City Press Inc., Baltimore, xiii + 691 pp.

** Species believed to have bred on the study area.

	Scientific	English
	B. islandica (Gmelin)	Barrow's Goldeneye
	B. albeola (L.)	Bufflehead
	Clangula hyemalis (L.)	Oldsquaw
**	Lophodytes cucullatus (L.)	Hooded Merganser
	Mergus merganser L.	Common Merganser
	M. serrator L.	Red-breasted Merganser