

AN ECOLOGICAL STUDY OF HUMMOCK-HOLLOW FORMATIONS
ON CERTAIN PEATLANDS OF THE AVALON PENINSULA,
NEWFOUNDLAND WITH SPECIAL EMPHASIS ON THE ROTIFERA

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LOIS E. BATEMAN

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AN ECOLOGICAL STUDY OF HUMMOCK-HOLLOW FORMATIONS
ON CERTAIN PEATLANDS OF THE AVALON PENINSULA, NEWFOUNDLAND,
WITH SPECIAL EMPHASIS ON THE ROTIFERA

by



Lois E. Bateman, B.Sc.

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ABSTRACT

Rotifers encountered in samples obtained from six peatland sites on the Avalon Peninsula of Newfoundland are listed. Seventy species and varieties including 25 bdelloids and 45 Monogononta were recorded. Sixty-three species and three varieties represent new records for Newfoundland, while there are 23 new records for Canada, and 16 for North America.

A seasonal quantitative study of rotifer communities in the hummock-hollow formations on one of the sites, a nutrient poor fen, was carried out from August, 1973 to October, 1974. An average of 354 rotifers per sq. cm. and 17 species were found in each hummock-hollow complex. Monogononta almost totally disappeared during winter while the bdelloids became somewhat diminished in number. Hummock tops supported mainly bdelloid rotifers. The number of Monogononta increased in both species and number of individuals in the slopes of the hummocks and was greatest in the hollows and pool edges, although total number of rotifers was less in these areas than in the hummock tops. Results indicate that the components of each hummock-hollow formation may be different in both quality and number from neighbouring formations.

Some physical and biological factors affecting the rotifer communities were examined, which showed that rotifers in these sites do not suffer dessication. Predation of or by rotifers was not important in these communities.

A quantitative sampling method was devised for procuring relatively accurate samples from living *Sphagnum* moss, and extracting rotifers from these samples. A guide to preserved illoricate rotifers was constructed to enable contracted species to be recognized and accurately counted in the preserved samples.

Several *Sphagnum* samples were maintained in the laboratory under varying conditions with a view to determining the effect of storage on the numbers and species of rotifers contained in the samples.

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INTRODUCTION

Favourable conditions for extensive development of *bogs, fens and other peatlands in Newfoundland are the cool, moist, boreal, maritime climatic conditions and the subsequent slow rate of development of the thin acidic soils over the recently glaciated land. Although the Avalon Peninsula is the area with the greatest precipitation in Newfoundland, the frequent presence of fog prevents the production of many large thick peat deposits by slowing the rate of photosynthesis, and thus retarding the rate of peat accumulation (Pollett, 1968a). There are, however, many easily accessible examples of bog and fen on the Avalon Peninsula.

There have been numerous investigations carried out on peatlands, mainly concentrated on physical or vegetational aspects or on commercial uses. Newfoundland peatlands have not been neglected. Løddesøl (1955), Heikurainen (1968) and Pollett (1968b) have evaluated their potential for agriculture, forestry and peat moss. The properties of various peatland types and their classification have been described by Pollett (1968a, 1972b). Allington (1955) has described Labrador bogs, and a vegetational study of a Newfoundland bog pond was conducted by H.E. Smith (1970).

There has been very little previous attention given to the peatland fauna of Newfoundland and Labrador. Most studies are of the planktonic and littoral pond fauna. Cushman (1908), Smirnov and Davis (1973) and Daggett and Davis (1975) included some samples from water-covered *Sphagnum* in wider studies of freshwater crustacea of the province. Part of the study by Duthie and Ostrofsky (1974) of Labrador lake plankton included lakes situated in extensive boggy areas.

*All terms referring to and including 'peatlands' as used in this thesis are defined in Pollett's "Glossary of Peatland Terminology" (1968a).

The study by Daggett and Davis(1974) of the littoral crustacea of a bog pond in Newfoundland is the only previous faunal investigation in Newfoundland concentrated specifically on a peatland area.

Elsewhere in Canada, Judd's many papers on the Byron Bog in Ontario, most of which deal with the insects, seem to be the only studies of the animal inhabitants of peatlands, except for those of Swale(1969,1972) on pitcher plant fauna in Quebec. (See Judd, 1957a, for a description of Byron Bog, and Judd, 1969, for references to previous papers.) Other North American studies consist of work on rotifers by Harring(1914) and Harring and Myers(1921,1924,1926,1927), and Welch's(1945) limnological study of the water in a bog mat in Michigan, which includes an account of the fauna.

In Britain and Europe, the fauna of peatlands has not been so neglected. Several early studies of rotifers included random qualitative samples from *Sphagnum* and other peatland mosses. Many of the early complete descriptions of moss rotifer species resulted from the work of Milne(1889), Murray(1909), Heinis(1910) and Bryce(1929). More recently, studies devoted to peatland or moss rotifers, rather than merely including such specimens in a study of wider scope, have been conducted by Wulfert, (1940,1951), Burger(1948), Bartoš(1950), Donner(1950) and Nagy(1962). Testaceous rhizopod amoebae are the only other group of animals to have received much attention with regard to their presence in peatlands. Harnisch(1927) and Grospietsch(1953), in Europe, and Heal(1962,1964), in Britain, examined these Protozoa. Reichle(1967) has looked at the relations of bog pselaphid beetles to temperature and humidity in *Sphagnum* moss, and Blackith(1974) concentrated on Collembola in Irish blanket bogs. Occurrences of other peatland animals such as tardigrades and nematodes have, like the rotifers, often been mentioned as part of wide-ranging moss

studies such as those by Heinis(1910) and Bartoš(1950,1960).

In the past decade or so, more extensive research on the fauna of peatlands has been carried out by a few workers. In one of the few studies of a specific peatland site, P.E. Smith(1962) completed an ecological analysis of a *Sphagnum* bog in Iowa. In Europe, Batut(1965) and Popp(1965) have examined the sub-microscopic fauna of *Sphagnum* bogs in France, and the fauna of hillocks (including some *Sphagnum* hillocks) on moors in Germany, respectively, while the fauna of a bog region influenced by man has been studied by Schroevers(1966) in the Netherlands.

Generally, however, the fauna of peatlands is a neglected group, and very few of the above studies are year-round or quantitative in nature. For this reason, and since peatlands form such a prominent part of Newfoundland landscape (Pollett,1972a, estimates two million hectares of peatland in insular Newfoundland), it was decided to conduct a quantitative faunistic survey of a peatland area. An easily accessible nutrient poor fen site on the Avalon Peninsula was chosen. After preliminary qualitative examinations were carried out, the survey was limited to one phylum. Rotifera were chosen as a group which is well represented both numerically and specifically, but is generally neglected in this country.

In the majority of early descriptive work carried out on rotifers of *Sphagnum* and other mosses, physical and chemical factors such as amount of moisture, pH, and temperature were neglected.

The first records of rotifers in Canada are those of Murray(1911), consisting of bdelloid rotifers from British Columbia and Ontario. Haring(1921) identified 64 species collected by the Canadian Arctic Expedition of 1913-1918. Koch(1929) and Odell and Harris(1933) listed rotifer species from New Brunswick and Ontario, and Ahlstrom(1940,1943) reported various *Brachionus* and *Keratella* species, from British Columbia and Ontario, in his

monographs on the respective genera. All later records deal with planktonic species. Edmondson (1936) listed species from New Brunswick, and Myers (1936) from Quebec. From 1936 until 1971, rotifers were reported in Canada only as they occurred in plankton studies, often as part of a zooplankton list, and infrequently identified to species. Works by Chengalath (1971), Chengalath, Fernando and George (1972) and Chengalath and Fernando (1972) have provided a fairly exhaustive coverage of planktonic rotifer species occurring in Ontario waters. A study of the genus *Lecane* in littoral regions of the same area was carried out by Chengalath and Mulamoottil (1974).

Rotifers reported from Newfoundland and Labrador are limited to those encountered during studies of fish and plankton. Frost (1940) found several unidentified rotifers including *Conochilus* species in a survey of possible planktonic food organisms of fish in Murray's Pond on the Avalon Peninsula. More recently, studies of plankton of Newfoundland by Megyeri (1969), Dadswell (1970), Davis (1972a, 1972b, 1973) and O'Connell (1974), and of lake plankton in Labrador by Duthie and Ostrofsky (1974) have produced records of several rotifer species.

No record could be found of previous quantitative studies of rotifers in *Sphagnum* moss. Reasons for this undoubtedly include the difficulties involved in securing quantitative samples, as well as in the identification of preserved bdelloids and other illoricate forms which together comprise the greater part of such samples. Sampling problems are caused by the fact that the habitat of the animals is the water surrounding the *Sphagnum* plants. This ranges from a very thin film and/or isolated droplets in leaves to a situation in which the plants are totally immersed in water. Therefore a quantitative sample of *Sphagnum* plus rotifers must be obtained, and the rotifers must then be separated from the plants for

enumeration. The structure of the *Sphagnum* plant itself compounds the problem of obtaining a quantitative sample, as it has a very soft, non-rigid stem, and the leaves of individual plants are often intertwined, so that slight pressure at any point on the upper surface of the group of plants causes several plants to be compressed downward simultaneously. Any common sampling tool used in similar areas, such as a peat corer, is useless in living *Sphagnum* as it pushes the mass of plants beneath it, and does not cut through them until they are solidly compacted, substantially altering the original appearance and form of the moss.

Sampling methods employed by others in previous studies of *Sphagnum* or similar habitats have been deemed not useful in this study. Methods used by Pennak(1962), Gillespie and Brown(1966) and Daggett(1973) are designed for littoral vegetation, which contains much greater quantities of free water than *Sphagnum* hummocks and hollows. Methods of earlier qualitative studies on rotifers from mosses usually involved squeezing the water and animals from the plants (Bryce, 1917, Harnisch, 1927), or examining the moss and water together in a suitable container (Bryce, 1917). In such cases, exact quantities of moss were not required. Overgaard(1948) published a method of extracting rotifers and nematodes quantitatively from moss and soil, but gave no method for obtaining the original sample. Investigations on testate amoebae were either carried out on individual plants(Heal, 1962) or on core samples(Grospietsch, 1953). An original method of obtaining relatively accurate quantitative samples from this habitat had therefore to be devised for the present study.

Once a quantitative sample is obtained, the rotifers must be preserved and separated from the moss in order to be counted. Since, when preserved, non-loricate rotifers contract into shapes differing greatly from the

appearance of living specimens, a means whereby these species could be recognized was necessary. This problem was recognized by de Beauchamp (1912), who used an intricate narcotizing method to solve the problem. Various other methods of producing preserved, but uncontracted, specimens of illoricate rotifers through narcotization have been promoted. Rousselet (1898) and de Beauchamp (1912) used cocaine, and Hanley (1949) used benzamine hydrochloride. Edmondson's (1950) method of pouring boiling water over the specimens is much simpler. However, all such procedures are intended for use in obtaining a few good specimens for identification purposes only. They cannot be relied upon to produce effective enough results on large numbers of rotifers to recommend their use with quantitative samples. A guide to preserved illoricate rotifers was devised during this study and no attempt was made to narcotize the samples.

Using the methods devised for the study, the rotifer community in the hummock and hollow formation of the poor fen was studied for fourteen months. Quantitative and qualitative samples were taken at intervals of two weeks, for the purpose of obtaining a seasonal record of the distribution and occurrence of rotifer species in the hummocks and hollows of the fen. Qualitative samples were obtained for comparative purposes from five other peatland sites, including a fen, an ombrotrophic bog, and from the edge of a bog pond. The rotifer populations of pools in the poor fen were also examined, as were those of pitcher plant (*Sarracenia purpurea*) leaves. Some of the rotifer samples thus obtained were maintained for varying lengths of time under different temperature and moisture conditions in order to determine the reliability of stored samples. Some attempts were made to culture a few rotifer species.

DESCRIPTION OF SAMPLING SITES

All sites are situated on the eastern Avalon Peninsula of Newfoundland. The approximate locations are shown on Figure 1.

1. SITE I - NUTRIENT POOR FEN.

This fen was chosen on the basis of easy accessibility as the site for the year-long study of rotifer communities in a *Sphagnum* hummock and hollow formation. It is situated approximately sixteen kilometers west of the city of St. John's, Newfoundland, Canada, on the southeast side of Tucker's Hill Road between the villages of St. Phillips and Portugal Cove. On Canadian Topographical Map no. 1N/10W, it is located at co-ordinates easting 59.2, northing 70.5, and lies at an altitude of approximately 83 meters. The fen occupies approximately 3.3 hectares, and is drained by Goat Cove Brook, which skirts the southwest corner of the fen before flowing one kilometer northwest into Goat Cove, Conception Bay (Avalon Peninsula) (See Fig.2). The fen is supplied with water by several small runoffs from the forest on the north side as well as by a road-ditch runoff from beneath the adjacent roadway. These runoffs are to a large degree seasonal, being reduced to trickles during July and August. The site is surrounded by forest on all sides except that facing the highway. The predominant tree species is black spruce (*Picea mariana*(Mill)B.S.P.), mixed with balsam fir (*Abies balsamea*(L.)Mill) a short distance away from the fen, and with larch (*Larix laricina*(Du Roi)K.Koch) at the edges of the fen. Situated in the centre of the fen is an 'island' of several small *Picea mariana* and *Larix laricina* trees (See Figs. 3 & 4). The trees on the outer edges of this group appeared dead, and there was a noticeable increase in dead or dying specimens during the period of study.

Figure 1

Map of northern Avalon Peninsula of Newfoundland
showing approximate locations
of sites I, II, III, IV, V, and VI

⑤ Route number

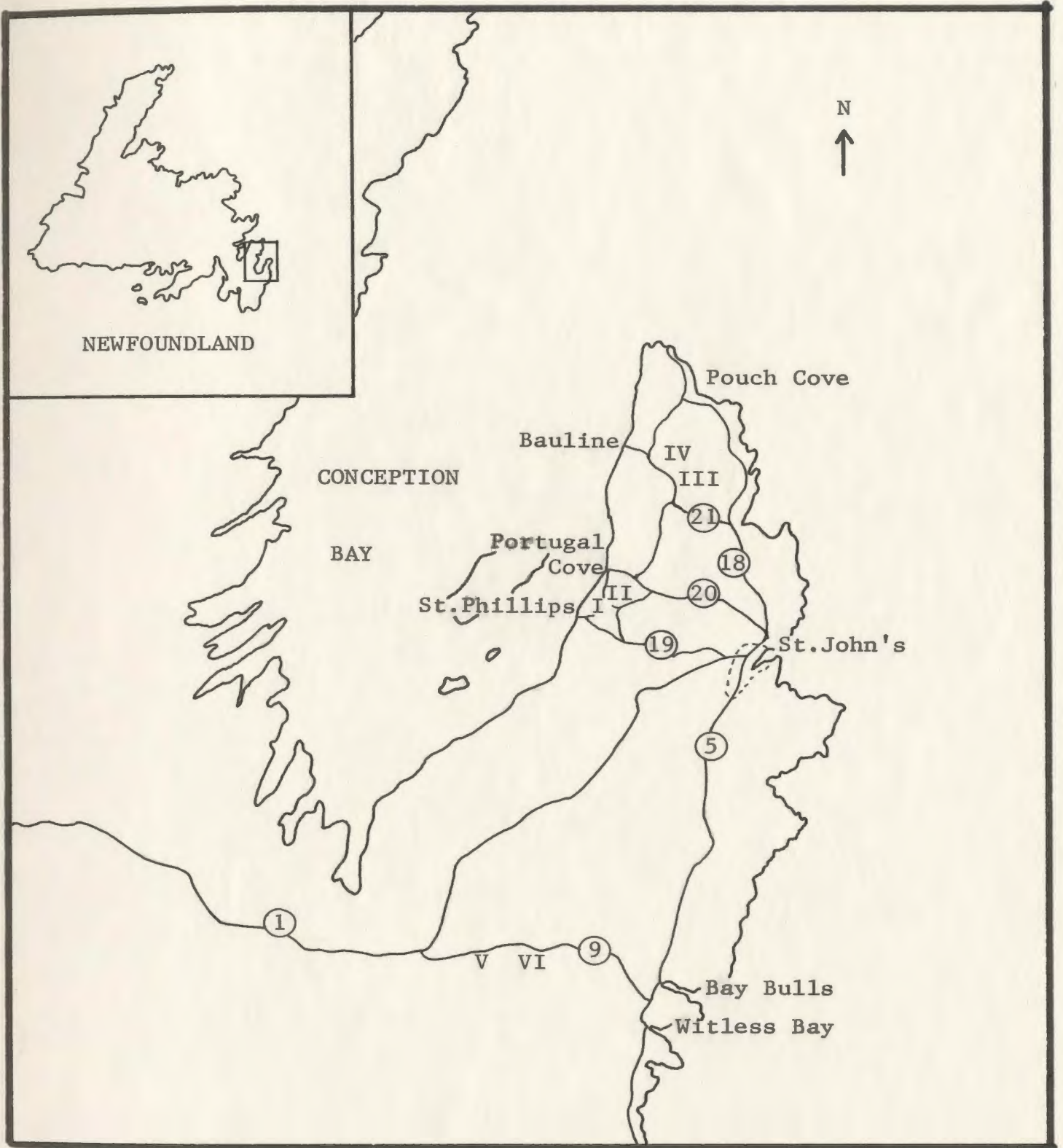


Figure 2

Aerial photograph showing site I (A) in
relation to Tucker's Hill Road (B), and
Goat Cove Brook (C).

Figure 3

Map of site I showing area from which
samples were taken.

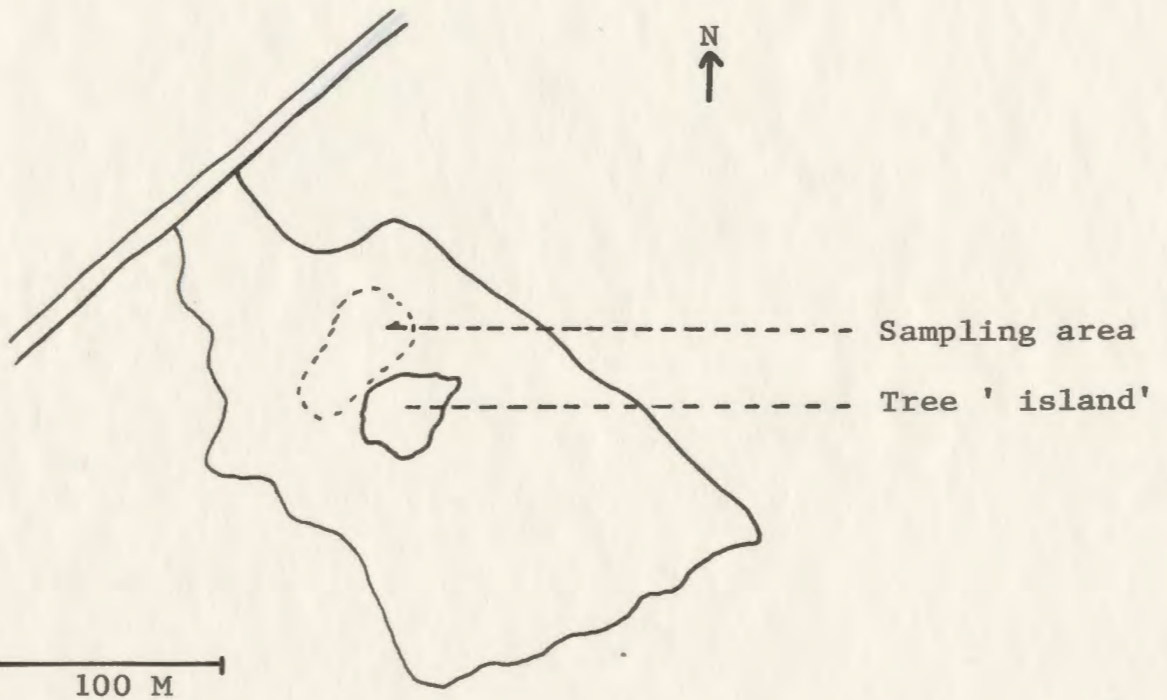
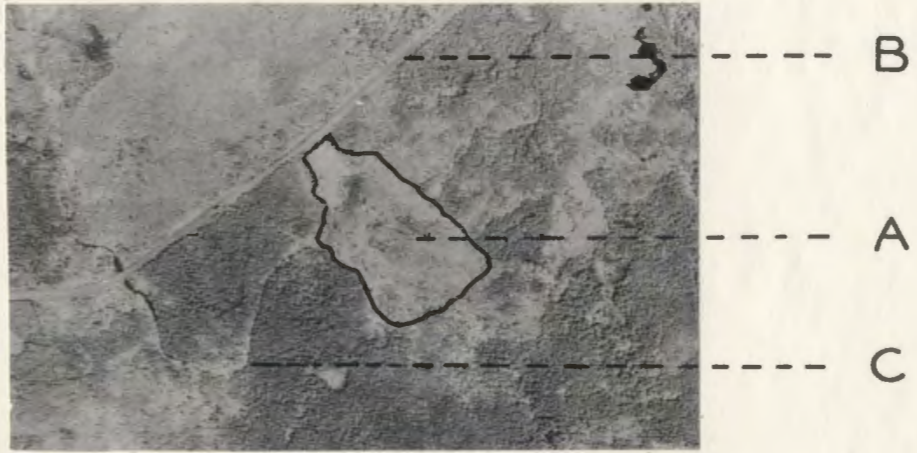
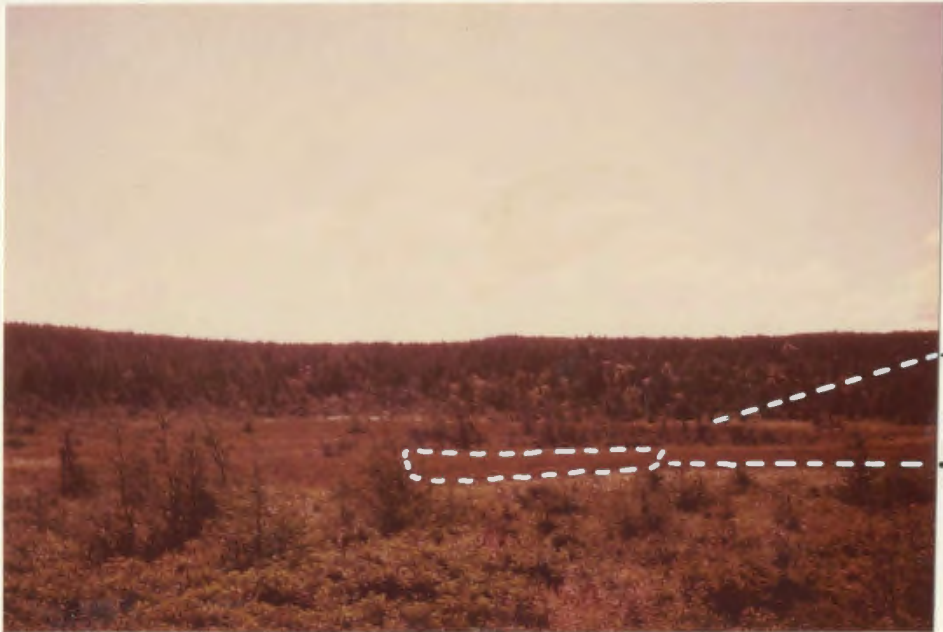


Figure 4

View of site I from Tucker's Hill Road showing
tree 'island' (A) and sampling area (B).



A

B

The reason for the death of the trees was not evident, although Pollett(1967) states that in the growth of fens on the Avalon Peninsula, *Sphagnum* often grows over and kills trees.

The body of the fen is characterized by shallow hummocks and hollows formed by *Sphagnum* species. The average height from the bottom of the hollows to the top of the hummocks is 20 to 30 cm., with the width of the hummocks averaging 50 to 60 cm. According to Pollett (personal communication) the site can be classified as a poor (mesotrophic) fen, whose characteristics approach those of a mesotrophic bog. The site has features of the former as described by Pollett(1968b,1972a), but contains several plant species characteristic of the latter. Pollett(1968b) has suggested that most Newfoundland peatlands pass through the stages of mesotrophic fen and mesotrophic bog respectively as they mature to the ombrotrophic bog stage.

Sphagnum species are the dominant vegetation on the fen.**Sphagnum fuscum*(Schimp)Klinggr. and **S.rubellum* Wils. form most of the hummocks, with *S.pulchrum*(Braithw.)Waenst., *S.papillosum* Lindb. and *S.plumulosum* Roll. common in the hollows. **S.magellanicum* Brid. and *S.cuspidatum* Ehrk. occur in wetter hollows and near pools. Some *S.papillosum* and *S.magellanicum* appeared in the tops and slopes of hummocks, while *S.rubellum* is at times found in the more shallow hollows.

Other vegetation associated with the fen is categorized below:

1. Species scattered over the total area of the fen:

+ <i>Carex excilis</i> Dewey	-	abundant	
+ <i>C.nigra</i> L.	-	abundant	
<i>Sarracenia purpurea</i> L.	-	abundant	(pitcher plant)
+ <i>Calamagrostis pickeringii</i> Gray	-	scarce	

* Identified by Allan Fife, Research Assistant, Biology Dept., M.U.N.

+ Identified by Dr. Peter Scott, Biology Dept., M.U.N.

2. Species found on most hummocks:

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- +*Pyrus floribunda* Lindl. - Small specimens
Ledum groenlandicum L. - Small specimens (Labrador tea)
Chamaedaphne calyculata (L.) Moench - Small specimens
(leatherleaf)
+*Aster nemoralis* Ait. - (bog aster)
+*Solidago uliginosa* Nutt. (bog goldenrod)
Vaccinium oxycoccus L. (small cranberry)
+*Juncus articulatus* L. - rare

3. Species occurring only on the large hummocks:

- Rosa nitida* Willd. - Small specimens (northeastern
rose)
Larix laricina (Du Roi) K. Koch - Small specimens (larch)
Empetrum nigrum L. (crowberry)

4. Species occurring only in hollows:

- Drosera intermedia* Hayne (spatulate-leaved sundew)

5. Species occurring only on edges of larger pools:

- +*Eriophorum tenellum* Nutt.
Menyanthes trifoliata L. (buckbean)

6. Species occurring on fen edges:

- +*Juncus articulatus* L.

7. Species occurring at point of drainage into Goat Cove Brook:

- Pyrus floribunda* - large specimens
Ledum groenlandicum - large specimens
Chamaedaphne calyculata - large specimens
Rosa nitida - large specimens
Kalmia angustifolia L. (sheep laurel)
Rhododendrum canadense (L.) Torr. (rhodora)
Iris versicolor L. (larger blue flag)
Habenaria blephariglottis (Willd.) (white fringed orchis)

Several small pools are present in the fen. The larger ones, about one meter long and one half meter wide, tend to be narrowly rectangular with the long axis pointing towards Goat Cove Brook.

The smaller pools are generally round and of two types. Some persist all the year, like the larger pools, though they may decrease in size during the summer, exposing the edges of their detritus-covered substrata. The other small pools are temporary, formed in *Sphagnum* hollows during periods of heavy inundation of the fen, and persist for less than two weeks. The depth of all pools is less than 15 cm.

Quantitative samples were taken mainly from an area northwest of the tree 'island' (Fig.3). The fen was entered from the edge of Goat Cove Brook, and the same path was used, as much as possible, for each sampling trip, in order to minimize disturbance and confine it to one area. Since the depression caused by a footstep remained evident in the moss for several months, the constantly trodden path eventually became water-filled and, in effect, created another series of pools oriented towards the stream.

2. SITE II - 'DISTURBED' AREA.

This site is situated .75 kilometers due east of Site I, on the south branch of Beachy Cove Brook. (Fig. 5 & 6). It is located at co-ordinates easting 60.1, northing 73.5, on Canadian topographical Map No. 1N/10W, adjacent to the roadway on the southwest side of Witch Hazel Road, .8 kilometers southeast of its junction with Route 17. The altitude of the site is approximately 128 meters. The area was flooded periodically until 1972 by overflow from the collecting pond of a nearby pig farm. In the spring of 1973, the area was partially covered by a fine black mud as a result of the floodings. The vegetation is characteristic of that of a wet area which has been disturbed by man's intervention (probably, in this case during road-building as well as by the flooding), and cannot be classified as a fen or a bog, although there are *Sphagnum* hummocks scattered throughout the site (Pollett, personal communication). It is partially surrounded by *Picea mariana* and *Abies balsamea* forest.

Figure 5

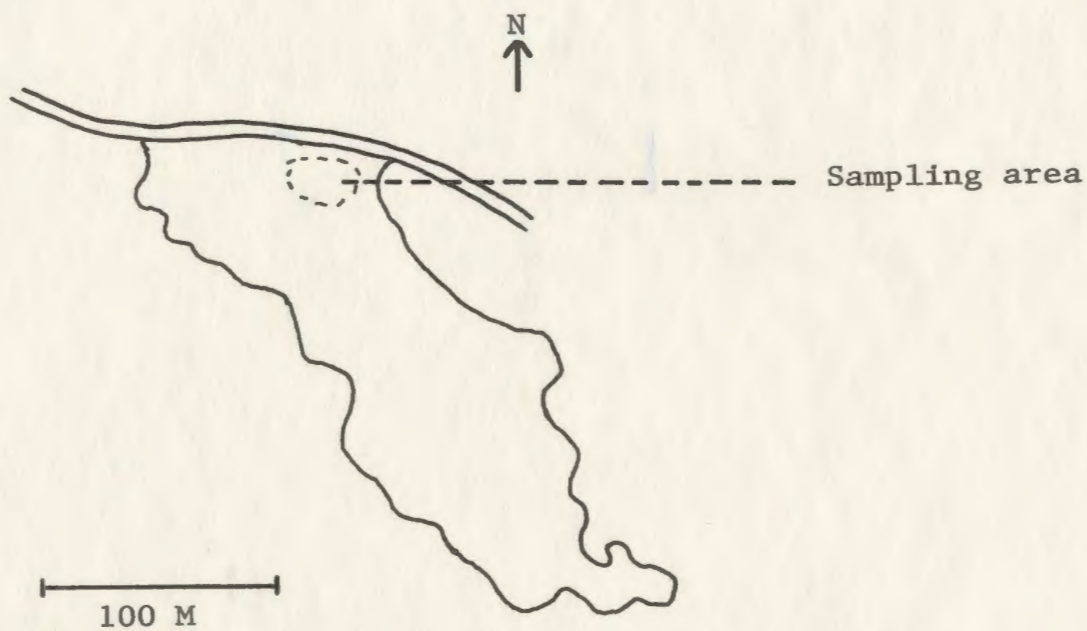
Aerial photograph showing site II (A) in
relation to Witch Hazel Road (B).

Figure 6

Map of site II showing area from which
samples were taken.



----- A
----- B



3. SITE III - EDGE OF BOG POND.

This pond is located about 15 kilometers northwest of the city of St. John's, (altitude approximately 180 meters), on the northeast side of Route 21, at co-ordinates easting 65.0, northing 84.0 on Canadian Topographical Map No. 1N/10W (Fig. 7&8). It is a shallow pond with emergent and floating vegetation evident over most of the surface. Water is received from streams flowing through extensive peatlands to the northeast. A partially submerged patch of *Sphagnum cuspidatum* Ehrk., occupying about one square meter on the southwest side of the pond, near the roadway, was the sampling site (Fig. 8).

4. SITE IV - OMBROTROPHIC BOG.

This bog is situated 0.5 kilometer northwest of Site III, and at the same altitude, on Route 21, 2.8 kilometers southeast of the town of Bauline, at co-ordinates easting 64.5, northing 84.4 on Canadian Topographical Map No. 1N/10W (Fig. 9 & 10). It is a fairly dry ombrotrophic bog, with lichens (*Cladonia* sp.) and *Sphagnum fuscum* predominant. *Empetrum nigrum* and liverwort *Mylia anomala* (Hook.) Gray are also abundant. The hummocks on the bog are much wider and slightly higher than those on the nutrient poor fen, being up to a meter in diameter and 0.5 meter in height. Two sampling areas were used on this site. Area (i) is a dry area at the greatest altitude of the bog on the northeast side. Area (ii) is lower, and comparable in moisture content to the poor fen. The positions of the sampling areas are illustrated in Fig. 10.

5. SITE V - FEN (i).

This fen, of slightly lower pH than the nutrient poor fen at Site I, is part of a large expanse of peatland on both sides of Witless Bay Line (Route 9), about 4 kilometers south of it's junction with the Trans-Canada Highway (Route 1). At an altitude of approximately 240 meters, the approximate co-ordinates of this and the following site are easting 47.5, northing 44.5

Figure 7

Aerial photograph showing site III (A) in
relation to Route 21 (B).

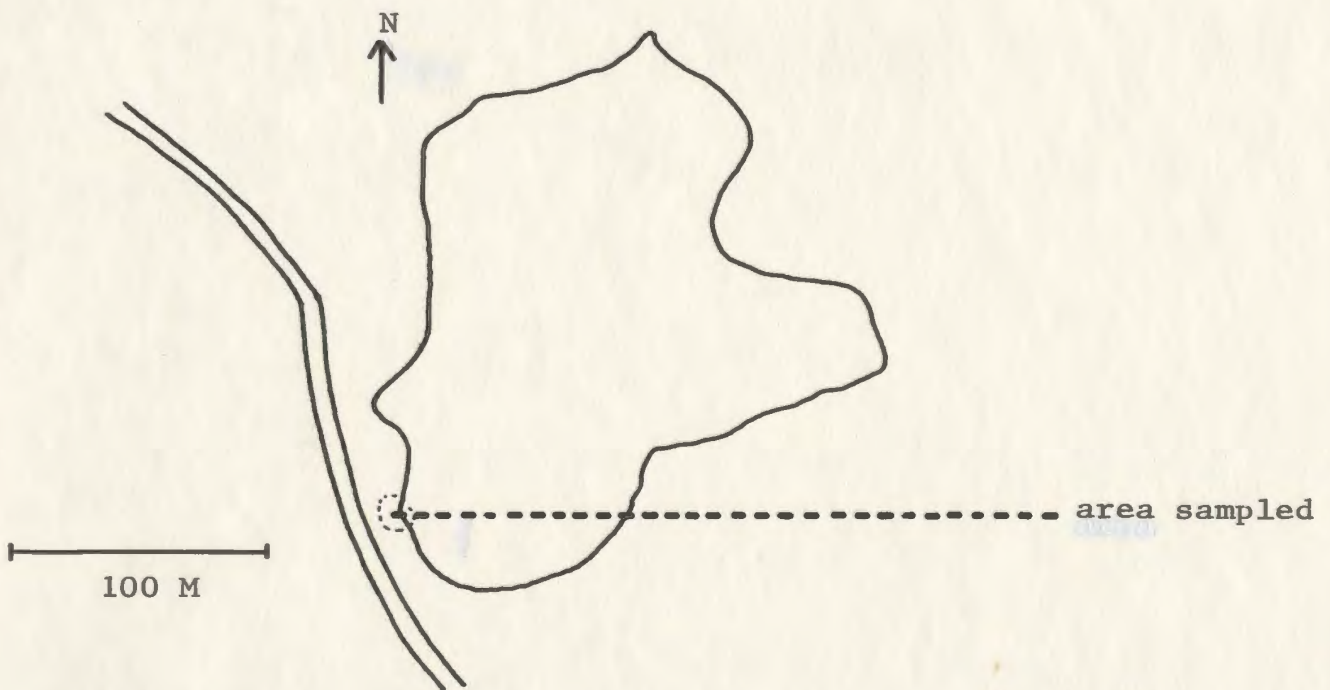
Figure 8

Map of site III showing area from which
samples were taken.



B

A



N

area sampled

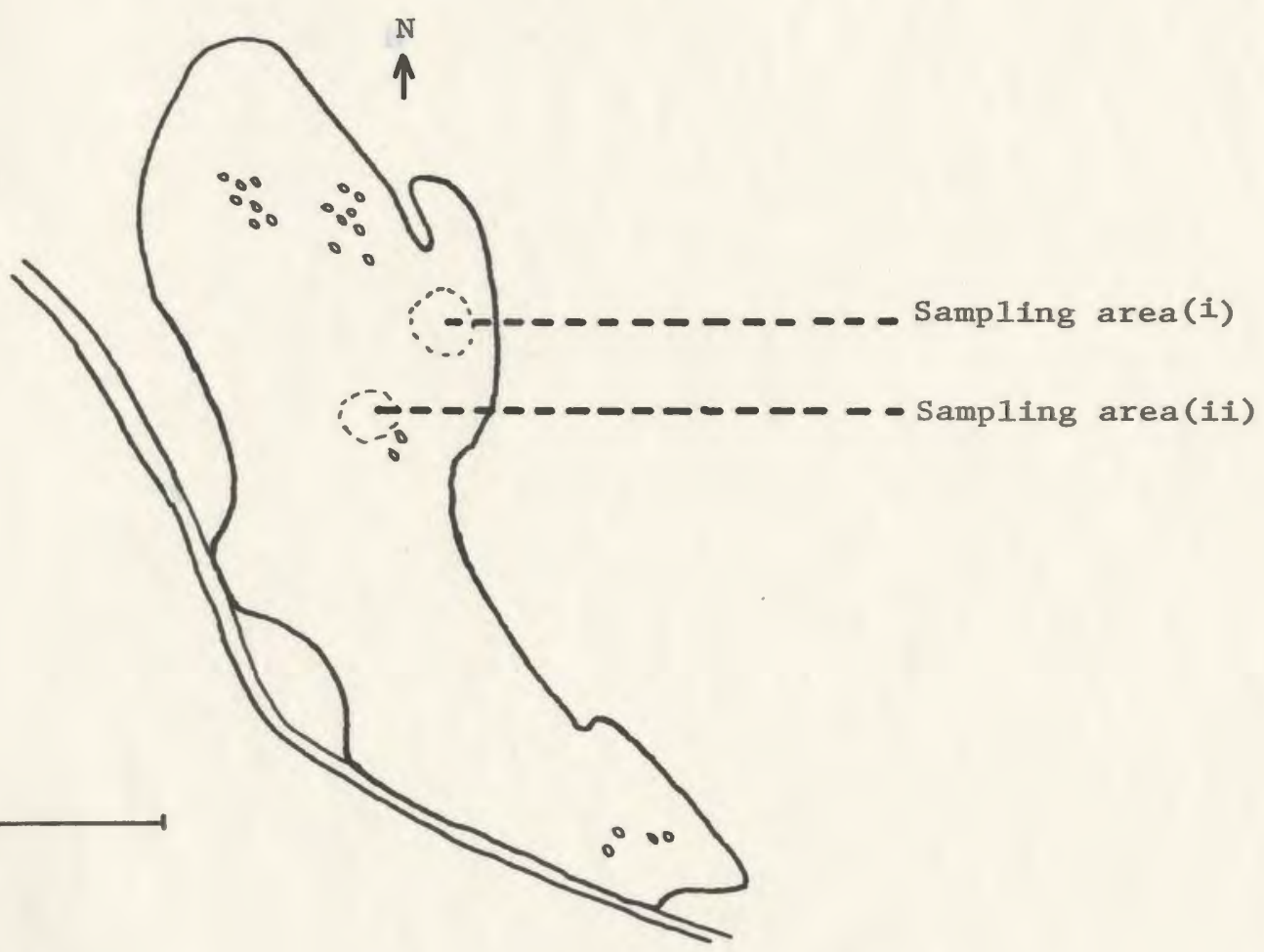
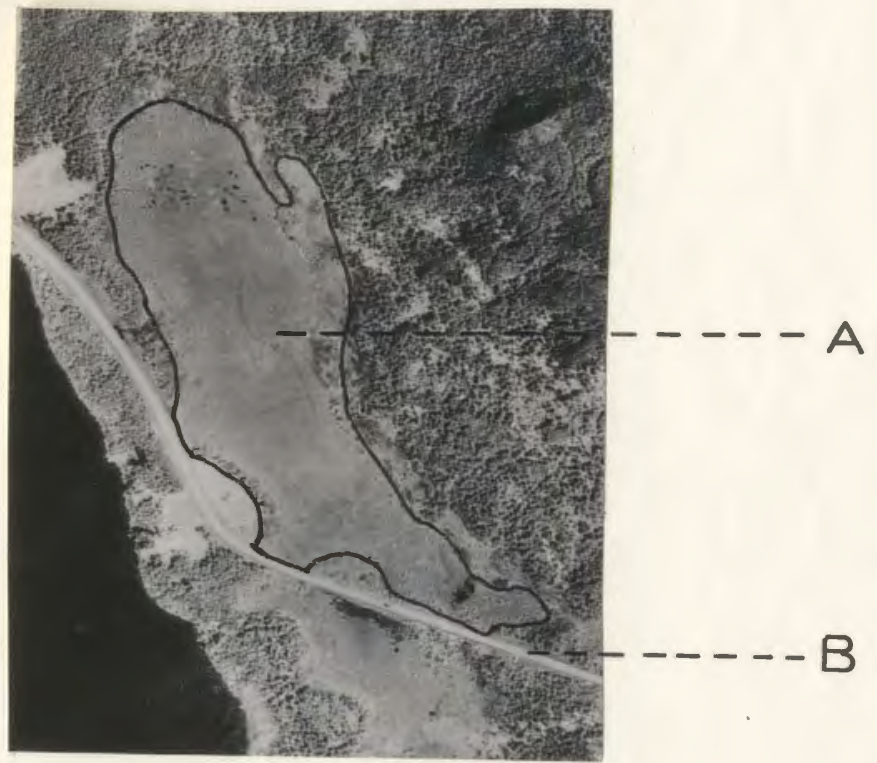
100 M

Figure 9

Aerial photograph showing site IV (A) in
relation to Route 21(B).

Figure 10

Map of site IV showing area from which
sample was taken.



on Canadian Topographical Map No. 1N/6E (Fig. 11 & 12). Definite hummock and hollow formation is evident, with *Sphagnum rubellum* dominant in the hummocks and *S. papillosum* in the hollows.

6. SITE VI - FEN (ii).

This fen is part of the same peatland complex as Site V (Fig. 11 & 12), but is much drier and the hummock and hollow formation is much less prominent. Lichens (*Cladonia* sp.) are present, but comparatively little *Sphagnum* on the hummock tops. There is a greater degree of decomposition evident than in any of the other sites, as peat exposed at the edge of the roadway is black and heavily compacted, made up of finely broken plant fragments. Peat seen in other sites is loose, brown in colour, and contains still distinguishable *Sphagnum* plants.

Figure 11

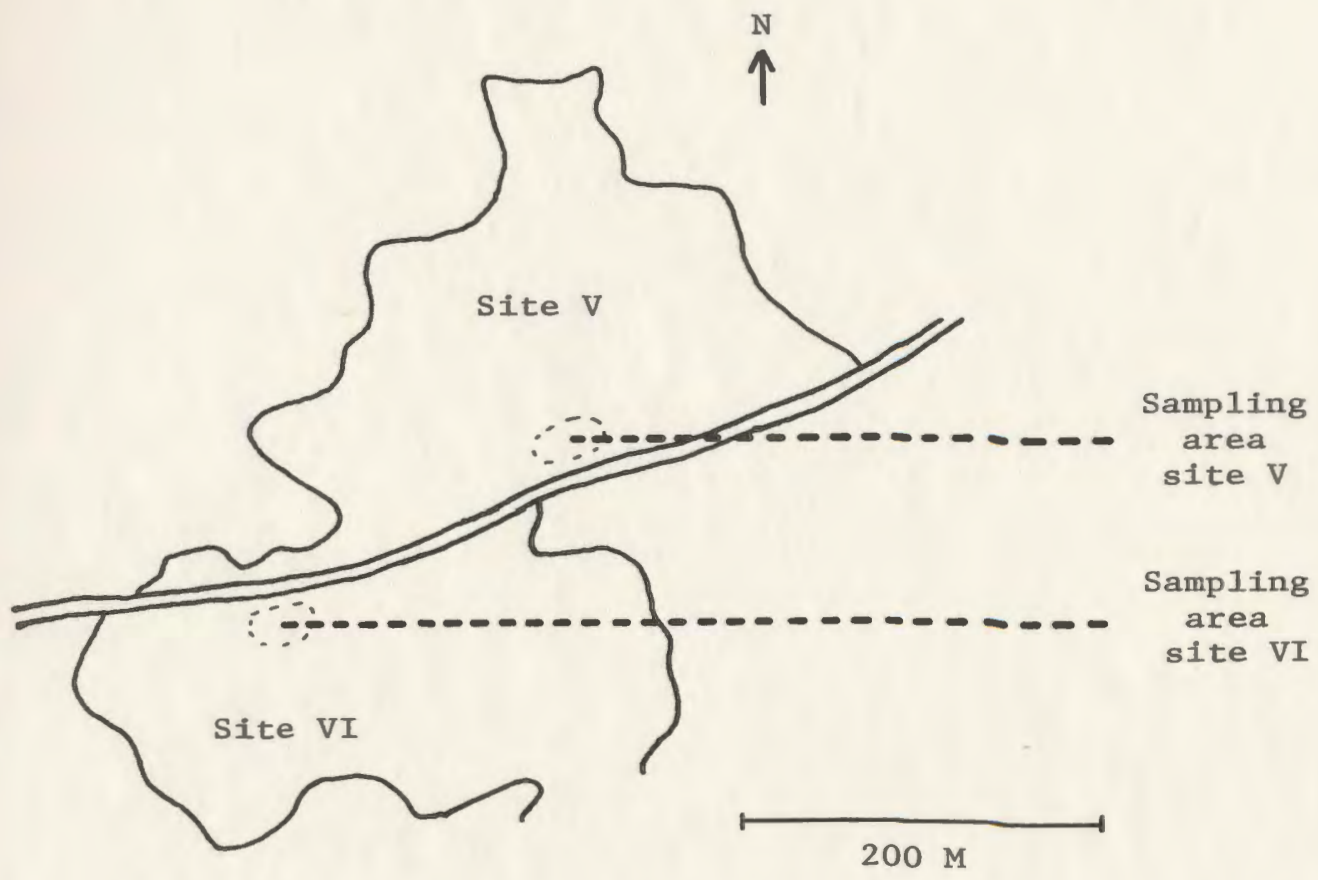
Aerial photograph showing sites V (A) and VI (B)
in relation to Route 9 (C).

Figure 12

Map of sites V and VI showing areas from which
samples were taken.



A
C
B



Site V

Site VI

Sampling area site V

Sampling area site VI

N
↑

200 M

MATERIALS AND METHODS

1. Physical Conditions

The temperature and pH of living moss in the immediate vicinity of each quantitative sample were measured. The pH was determined using an Instrumentation Laboratory portable pH meter, Model # 175. In cases where water could not be squeezed from the moss, the electrode was placed directly in the moss. (In all cases, pH refers to the pH measurement of living *Sphagnum* samples, not to the pH of the peat, as is customary in most peatland investigations.)

Air temperature was measured approximately one meter above the fen surface. The thermometer was inserted in the moss to a depth of four to five centimeters to obtain temperatures of the areas sampled.

Other physical conditions were examined. The relative wetness of a sample was determined by observing the ease with which water dripped or could be squeezed from the moss. The frozen or unfrozen state of the moss during winter months was also noted, as was the presence of ice in pools, and in *Sarracenia purpurea* leaves.

2. Sampling Methods, Preservation and Examination of Samples.

(a). Quantitative Samples.

Rectangular columnar samples measuring 3.5 cm. by 3.5 cm. on the top surface by 5.0 cm. in depth were cut from the chosen areas with an extremely sharp fishing knife. (Any instrument with cutting surfaces in more than one plane would depress the *Sphagnum* beneath it rather than slice through it.)

A preliminary incision at least 7 cm. deep was made in the area to be sampled. The moss was then gently pulled away from that side of the cut which was not to be included in the sample. This provided a reasonably flat surface from which to begin measurements of the sample. Once the measured cuts had been made, severing the sample from the surrounding moss, a scoop

was used to lift the sample into a plastic sample bag. The scoop was fashioned from a child's plastic sand shovel, by cutting the back corners and glueing the edges so as to made the two sides parallel. (see Fig. 13). The shovel provided a thin, flat lower surface, to slide under the sample without disturbing it, as well as relatively high sides which prevented loss of any water which might drain from the sample.

The width of the sample was chosen to conform to the width of the scoop. The depth of 5 cm. was chosen as it contained 97% of all rotifers found in a column of moss 10 cm. in depth. This was determined by taking a series of 10 cm. deep columns, cutting them in two pieces at various depths, and examining both pieces for rotifers after preservation. It was found that below 8 cm. no rotifers other than an occasional lorica were encountered. When samples 10 cm. in depth were taken from three other areas and bisected, more than 95% of the rotifers in the samples occurred in the top 5 cm. in each case.

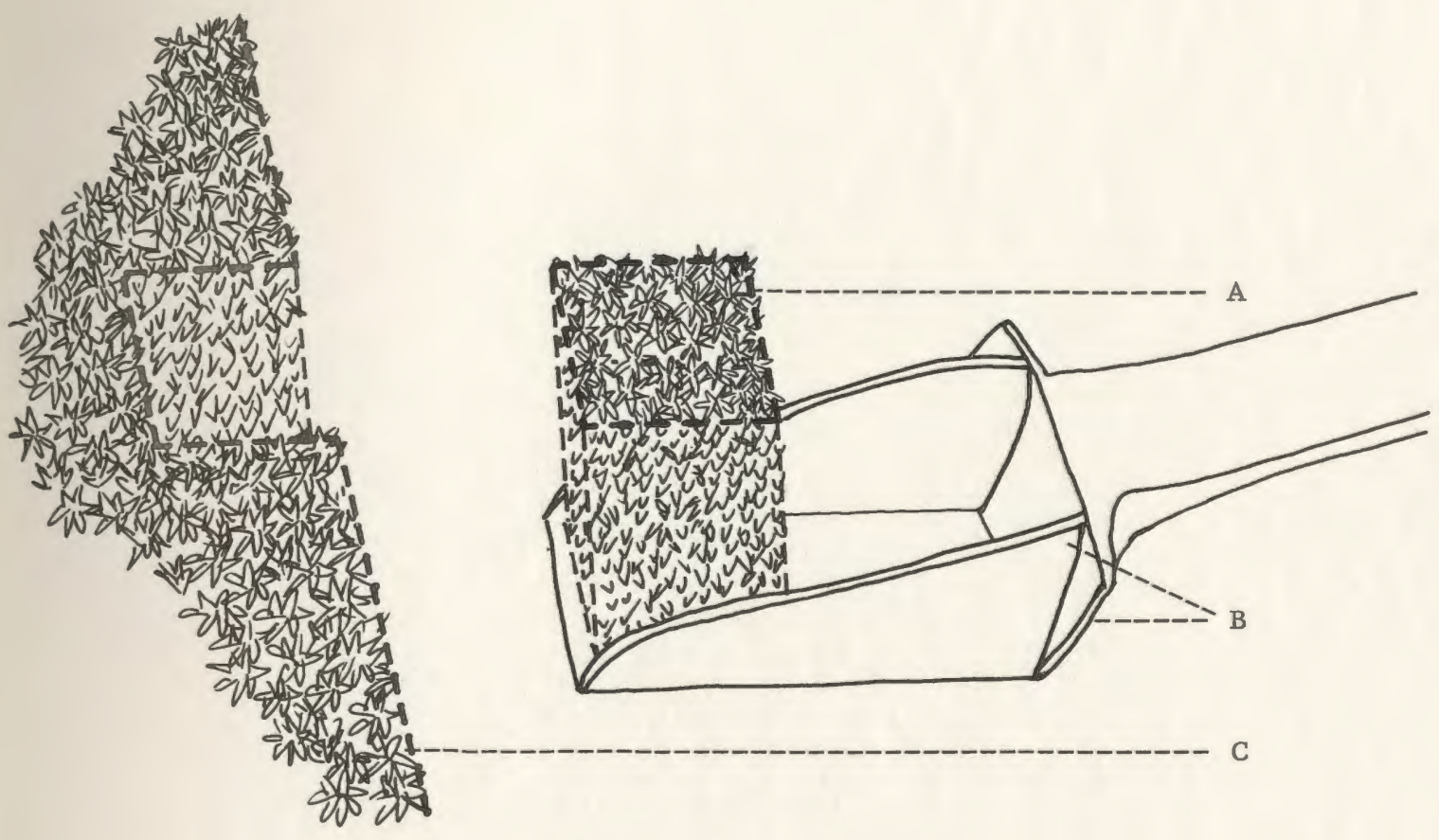
The quantitative samples were taken every two weeks, conditions permitting, beginning in August 1973 and ending in October 1974. On each sampling expedition three samples were taken from a single hollow-hummock formation as follows:

Sample 'A'	-	From the top of the hummock.
Sample 'B'	-	From the mid-slope of the hummock.
Sample 'C'	-	From the center of the hollow.

The samples were not taken from the same hummock-hollow structure on successive sampling dates, as it was felt that once such a structure was sampled it had been disturbed enough to affect future samples. On two occasions, September 25th, 1973, and May 2nd, 1974, duplicate samples were taken from separate hummock-hollow formations in order to obtain some indication of similarities between the rotifer populations of different hummock-hollow formations. Due to the time required for the identification and counting of specimens in a set of samples, it was not feasible to take

Figure 13

A sketch of the scoop used to lift a quantitative sample (A), showing the edges cut (B) in order to make the sides of the scoop parallel. (C is the preliminary incision made in the moss before cutting the sample).



replicate samples throughout the entire sampling period.

The samples were transported to the laboratory in plastic bags and preserved within twenty-four hours, by pouring 200 ml. of approximately 5% formalin over it in a finger bowl (capacity approx. 300 ml.). After standing at least overnight, the plants were picked up with forceps, shaken in the formalin, and placed in a second bowl (the stems of *Sphagnum* in the sample were counted as this procedure was carried out). A third bowl was filled with 200 ml. of approximately 5% formalin and the plants were shaken a second time into this bowl. The plants were then squeezed by hand to remove as much liquid as possible, and then discarded.

By carrying out several consecutive rinses of *Sphagnum* samples, it was ascertained that two rinses removed nearly all rotifers from the samples. Several times throughout the sampling period, random samples were rinsed a third time, and the third rinse examined for rotifers. These extra rinses produced an average of 7 rotifers while the average number of rotifers obtained from a sample was 4337.

The various containers were rinsed with formalin solution and the washings added to the other liquids. All liquids obtained from the sample were poured through two stacked sieves, No. 18 (openings of 1.00 mm.), and No. 40 (openings of .425 mm.), in the Canadian Standard Sieve Series. The coarser upper sieve retained large *Sphagnum* pieces and other debris, while most *Sphagnum* leaves which are usually over .500 mm. in size, were retained by the lower, finer sieve. All rotifers in the preserved (contracted) state are less than .400 mm.

The filtered sample was poured into a 500 ml. graduated cylinder, covered, and allowed to settle undisturbed at least 72 hours. Most of the liquid was then siphoned off, allowing approximately the bottom 20 mls., containing the sediments, to remain in the cylinder (the sediments never occupied more than 5 ml. on the bottom of the column). The remaining

volume was poured into a labelled 65 ml. sample bottle, and made up to 30 ml. with washings from the graduated cylinder. The sample was stored in the stoppered bottle until counted.

For quantitative examination, 1.0 ml. aliquots were removed from the 30 ml. sample, using a calibrated medicine dropper. Before removal of the aliquot, the sample was shaken thoroughly, attempts being made to keep the shaking irregular so as to ensure an unbiased aliquot. In some cases, samples taken from the hollows contained enough detritus to render counting difficult by obscuring the rotifers. The aliquot was then diluted with an equal amount of approximately 5% formalin, and one half the resulting volume was examined.

The 1.0 ml. aliquot was placed on a Sedgewick-Rafter cell, and the entire cell was examined at a magnification of 100X on a Wild M20 Binocular Compound microscope. The number of individuals of each rotifer species was counted, the results thus representing 1/30 of the total number to be found in the original sample. Two counts were made for each sample on separate days and the results averaged. The results were expressed as the number of individual rotifers under 1 sq. cm. in a 5 cm. column of moss. This was determined using the following equation:

$$A = \frac{B \times \text{Dilution factor} \times 30 \text{ ml.}}{12.25 \text{ sq. cm.}}$$

where A = number of rotifers / sq. cm.

B = number of rotifers counted / ml.

12.25 sq. cm. = area of top surface of sample (3.5cm. x 3.5cm.)

In addition to the number of individuals for each species, determination was made of the total number of all rotifers, the total number of Monogononta species and individuals, the total number of Digononta species and individuals, and the total number of all species. The presence of eggs

and other organisms was also noted.

b. Qualitative Samples.

(i). Hummock and Hollow Formations.

Qualitative samples were obtained in these areas by a method similar to that used in quantitative sampling, omitting measurements, or by pulling a handful of moss. Qualitative samples taken with corresponding quantitative samples in the poor fen were removed from moss immediately adjacent to the position occupied by the quantitative sample. In the laboratory, qualitative samples were placed in labelled finger bowls with tap or distilled water, or stored in a refrigerator (at approx. 11° C) until examination, usually within one week. The samples were examined in the finger bowl under a Zeiss Binocular Stereoscope at 20X magnification, and rotifer species present were noted. Any species not immediately identifiable were transferred to cavity slides and examined live on the compound microscope at magnifications of 100X and 200X. Other organisms were noted also. The qualitative samples from the poor fen were always examined before the corresponding quantitative samples were enumerated, in order to record the species to be expected in the quantitative sample, and to add any species not yet included to the guide to preserved illoricate rotifers (described below).

The dates and sites of all qualitative samples, except those taken in conjunction with the quantitative samples from Site I, are shown in Table I.

(ii). *Sarracenia purpurea* samples.

Whole leaves of *Sarracenia purpurea* were picked as close to the base as possible, and placed carefully in sample bags, ensuring that none of the contained liquid was lost. After being transported to the laboratory they were, if not examined immediately, placed in a refrigerator at 11°C. The leaves and contents were examined in a finger bowl, under the Zeiss dissecting microscope each day for approximately one week. Rotifers and other organisms present were recorded. The leaf was split longitudinally to aid

TABLE 1

QUALITATIVE SAMPLES TAKEN FROM HUMMOCK-HOLLOW FORMATIONS ON
SITES II, IV, V & VI

+ areas in which samples were taken

DATE	SITE	HUMMOCK TOP	HUMMOCK SLOPE	HOLLOW
May 3, 1973	II	+		+
Sept. 19, 1974	II	+		+
Oct. 8, 1974	IV(i)	+		+
Oct. 8, 1974	IV(ii)	+		+
Oct. 8, 1974	V	+	+	+
Oct. 8, 1974	VI	+		+

the examination. Before plucking the pH and temperature of the leaf contents were measured. Temperature and pH were also recorded every two weeks for *Sarracenia purpurea* leaves at Site I, from Sept. 25th, 1973 to Oct. 18th, 1974. Dates and locations of *Sarracenia purpurea* leaf samples are given in Table 2.

(iii) Pool and Pool Edge Samples.

On several occasions, qualitative samples were removed from the bodies of pools on various sites by scooping out water with a 750 ml. wide-mouthed glass beaker. The pools were generally so shallow (15 cm. or less in depth) that the soft sediment on the bottom became roiled after one passage of an object through the water, precluding the use of even a small net.

Samples were also taken from totally or partially submerged *Sphagnum* in the same pools by lowering the inverted beaker over the *Sphagnum* and water, breaking the plants off at the mouth of the beaker, fitting a petri dish lid over the mouth of the beaker, and quickly righting the beaker. These samples and the pool samples were poured into plastic bags and examined in the same manner as other qualitative samples. Dates and locations of the pool and pool edge samples are shown in Table 2.

The temperature and pH of a pool near the area of the quantitative sample were measured on each fortnightly visit to Site I, from Sept. 25th 1973 to Oct. 18th 1974.

3. Construction of Guide to Preserved Illoricate Rotifers.

In May and June, 1973, several qualitative samples were taken, mainly from Site I, and examined unpreserved for organisms. Each species of rotifer found, both in these preliminary samples and in all later samples, were examined in detail, alive and/or preserved, and identified if possible. Drawings were made and measurements recorded to aid in the future recognition of the species in other samples. Since many rotifers, especially non-loricate species, contract as they are preserved and cannot

TABLE 2

DATES OF SAMPLES FROM
LEAVES OF *SARRACENIA PURPUREA*, POOLS AND POOL EDGES.

+ source of sample

DATE	SITE	LEAVES OF <i>SARRACENIA PURPUREA</i>	POOL	POOL EDGE
April 14, 1973	II	+		
May 3, 1973	II		+	+
June 6, 1973	I		+	+
October 8, 1973	I		+	+
October 23, 1973	I	+		
March 7, 1974	I	+		
April 18, 1974	I	+		
May 2, 1974	I		+	+
May 16, 1974	I	+		
June 13, 1974	I	+		
June 27, 1974	I	+		
July 25, 1974	I		+	+
September 19, 1974	I	+		
September 30, 1974	III		+	
October 8, 1974	IV		+	

be keyed in this state, and since quantitative counts cannot be carried out on live rotifer specimens, it was necessary that some method be devised of recognizing individual species for counting purposes. With few exceptions all individuals of any one species assume a nearly identical shape on contraction due to preservation. Attempts were made to record this shape for all species found. Identification of loricate ploimates, especially the Brachionidae and Lecanidae, is often based solely on contracted specimens, so a guide was necessary primarily for the Bdelloidea and non-loricata Monogononta (this guide is presented in the Results of this thesis).

Individuals of each species were examined alive, assigned a number and identified if possible. They were then killed and fixed by adding a drop of 5% formalin to the cavity slide on which they rested. Specimens were measured, a drawing was made and the features recorded of the contracted form. During counting, the diagrams of the contracted rotifers were used as a reference to determine under which species, or species number, a specimen should be recorded.

The classification system used is that of Edmondson(1959). The bdelloids were identified with the aid of monographs by Donner(1965) and Bartos(1951). Monogononta were keyed to genus level by using Edmondson(1959) and to species level using papers by the following authors for the genera indicated:

<i>Keratella</i>	Ahlstrom(1943)
<i>Lecane, Cephalodella, Dicranophorus, Proales</i>	Harring and Myers (1921, 1924, 1926, 1927)
<i>Cephalodella</i>	Wulfert(1938)
<i>Lepadella</i>	Harring(1917)
<i>Ptygura</i>	Edmondson(1949)
<i>Colurella</i>	Hauer(1924)

The works by Hudson and Gosse(1889), Harring(1913) and Voigt(1957), were also helpful.

Herr. Walter Koste, German Federal Republic, kindly identified the following species:

Macrotrachela plicata plicata, *M.plicata hirundinella*, *M.habita*, *M.musculosa*, *Philodina proterva*, *Habrotrocha constricta*, *H.tridens*, *H.collaris*, *Keratella cochlearis*, *Trichotria tetractis*, *Squatinella minor*, *S.mutica aurita*, *Colurella hindenburgi*, *Lecane flexilis*, *L.(Monostyla) lunaris*, *L.(M.)closterocerca*, *L.(M.)acus*, *L.(M.)pygmaea*, *Cephalodella hyalina*, *C.gibba*, and *Dicranophorus lütkeni*.

He also confirmed identifications of the following:

Habrotrocha lata lata, *H.roeperi*, *Macrotrachela quadricornifera quadricornifera*, *M.q.quadricorniferoides*, *M.multispinosa multispinosa*, *M.gunningi*, *Mniobia bredensis*, *Adineta gracilis*, *Adineta vaga minor*, *Squatinella microdactyla*, *Lepadella acuminata*, *Colurella obtusa*, *Lecane stitchaea*, *L.elasma*, *L.tenuiseta*, *L.(Monostyla) hamata*, *L.(M.) pyriformis*, *Cephalodella apocolea*, *Elosa woralli*, *Ptygura pilula*.

Specimens of most of the above species were sent to Herr. Koste, alive in small glass vials containing water and a piece of *Sphagnum*. Some loricate species were sent as preserved specimens.

4. Experiments on Maintenance of Rotifer Samples.

(a). Refrigerated Samples.

In order to determine how long *Sphagnum* samples could be left in a refrigerator before being examined, several samples, in plastic sample bags were placed in the refrigerator at approximately 11° C, and allowed to remain there for lengths of time, varying from one day to six months. After removal from the refrigerator, they were treated as were other qualitative samples, by being placed in a finger bowl with water, and maintained at room temperature (approx. 23° C). As some of the refrigerated samples

appeared to contain no rotifers when first removed from the refrigerator, all samples were examined every one or two days until they contained rotifer populations similar in number of species and individuals to a fresh sample.

(b). Dried samples.

Sphagnum samples were placed in a finger bowl with water and allowed to dry out at room temperature. (This took from one week to ten days.) Water was then added to the sample, which was examined every one or two days. If rotifers appeared, the culture was maintained at room temperature, with water added to prevent drying, and it was examined approximately once a week.

(c). Room Temperature Samples.

Several qualitative samples were retained after examination and maintained at room temperature with additions of water to maintain the water level. These were examined every few days or every week. A *Sarracenia purpurea* leaf containing *Philodina proterva* specimens was also maintained in the same manner.

5. Rotifer Culturing Experiments.

When specimens of rotifers of a species that was not yet identified, or of which few individuals had been seen, appeared in a sample, attempts were made to raise populations of these species for closer examination. Two methods were employed. In the first, individuals were introduced into finger bowls containing several rinsed *Sphagnum* stems in water from the poor fen. Rotifers of other species were removed from the water before adding the *Sphagnum* and individuals of the species to be cultured. The bowls were maintained at room temperature, and water was added periodically.

The following species were used in attempts involving this method:

Habrotrocha constricta, unidentified *Mniobia* species, unidentified bdelloid species, *Lecane (Monostyla) crenata*, *Proales brevipes*, *P. decipiens*, *Cephalodella apocolea*, *C. gibba*, *C. hyalina*, *C. strepta* and *Dicranophorus lütkeni*.

The second method attempted was that of Linder, Goldman, and Ruzicka (1961) using skim milk powder solution as a nutrient source. *Philodina proterva*, *Habrotrocha lata lata* and *Colurella obtusa* were introduced into the culture medium. No other species were used with this method after attempts with the first three species failed.

RESULTS

1. Physical Conditions.

(a). Temperature.

The air temperature measured fortnightly approximately one meter above the surface of the poor fen ranged from a low of -10°C . in March, 1974, to a high of 23°C . in July, 1974. Except during the winter months, sample temperatures were within a few degrees of the air temperature. Temperatures from the hollow samples showed less tendency to correspond to air temperature fluctuations than the other sample areas (see Fig.14,15, & 16). From early November, 1973, until mid-April, 1974, all sample temperatures were approximately 0°C . An exception was a cold sampling day in early January, 1974 (air temperature = -10°C), when hummock top and slope sample temperatures were -11°C and -7°C . respectively.

Temperatures measured in pools and *Sarracenia purpurea* leaves throughout the study period also closely followed the air temperatures, except from early December, 1973, to mid-April, 1974, when ice was present in both. These values are shown in Fig. 17.

Temperatures were not recorded for all samples from the other sites, however, those measured corresponded closely to values measured on Site I, at approximately the same time.

(b). pH.

No pH values are available for samples from early December through late March, as the samples were frozen when obtained. During the remainder of the sampling period, pH values measured in hummock tops ranged from 3.8 to 4.5, with an average pH of 4.3. (see Fig. 14). Slope pH values from 3.8 to 4.8 showed a similar average of 4.25, but they fluctuated more erratically than those of the hummock top (see fig.15). Slightly higher pH

Figure 14

Temperature, pH, number of species and number of rotifers
for hummock top samples from site I.

- (o) values for replicate samples, all rotifers
- (⊙) values for replicate samples, Monogononta
- * quantitative sample accidentally destroyed
before enumeration

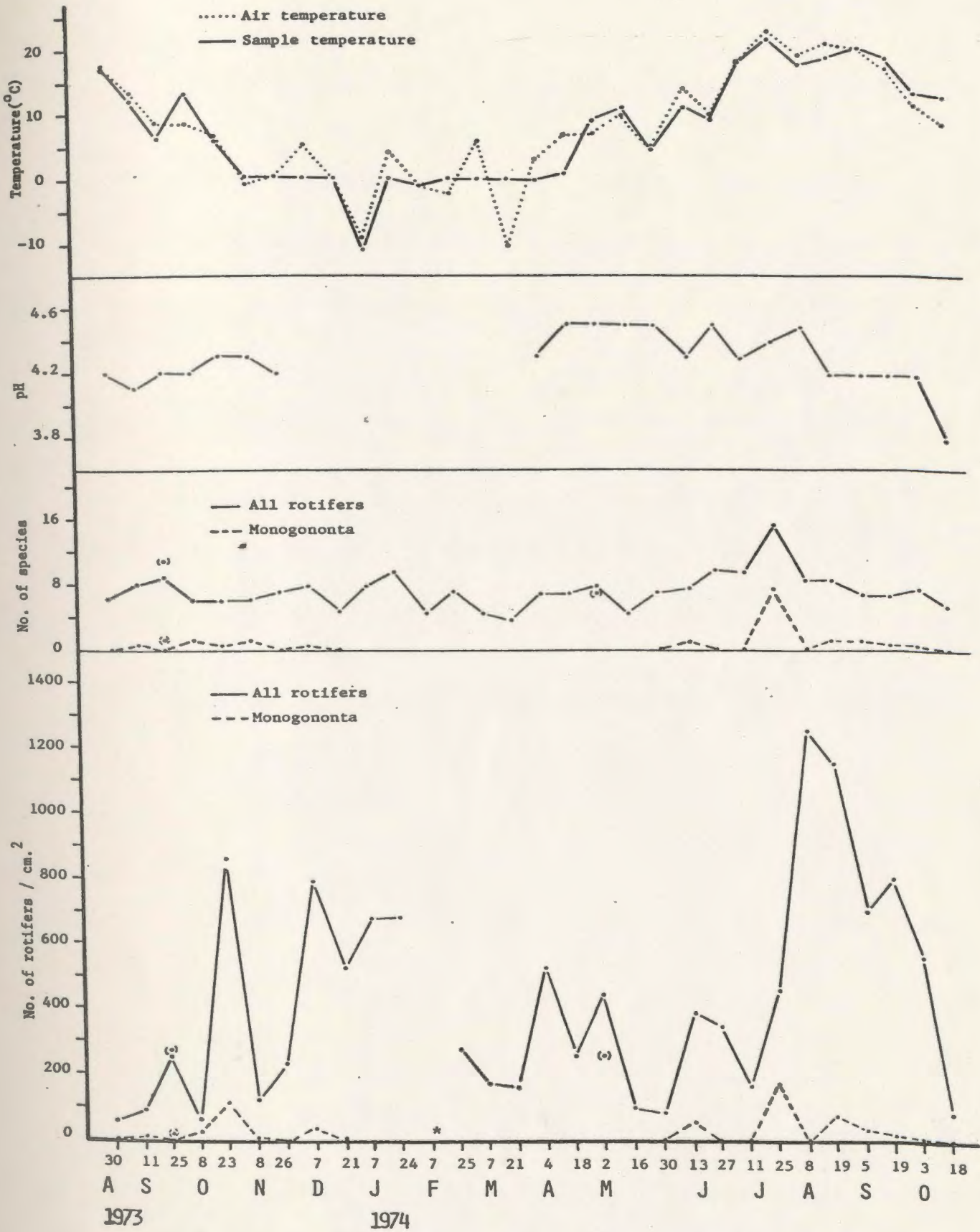


Figure 15

Temperature, pH, number of species and number of rotifers
for hummock slope samples from site I.

- ⊙ values for replicate samples, all rotifers
- ⊕ values for replicate samples, Monogononta

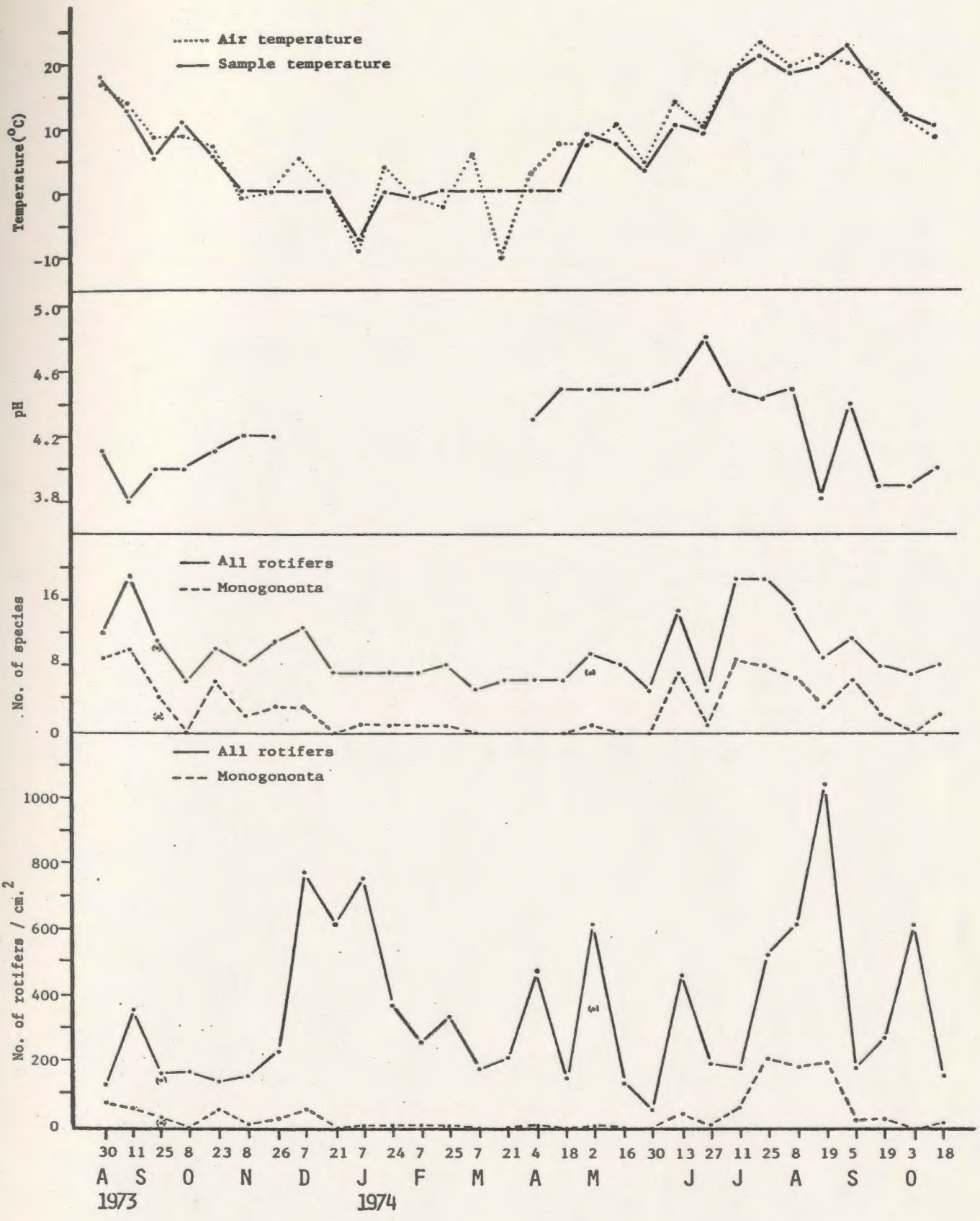


Figure 16

Temperature, pH, number of species and number of rotifers
for hollow samples from site I.

- ⊙ values for replicate samples, all rotifers
- ⊕ values for replicate samples, Monogononta
- * no quantitative sample obtained due to ice conditions

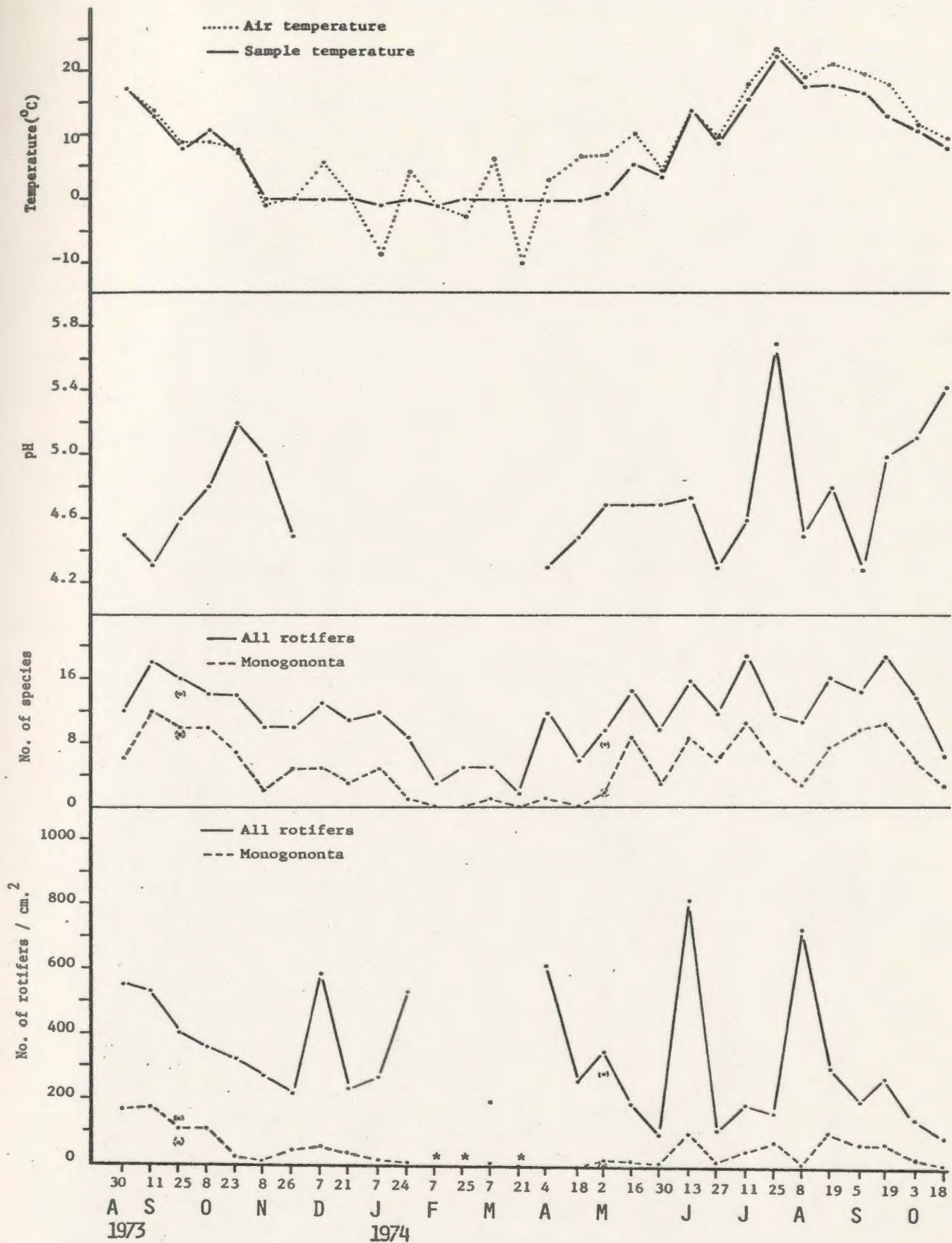
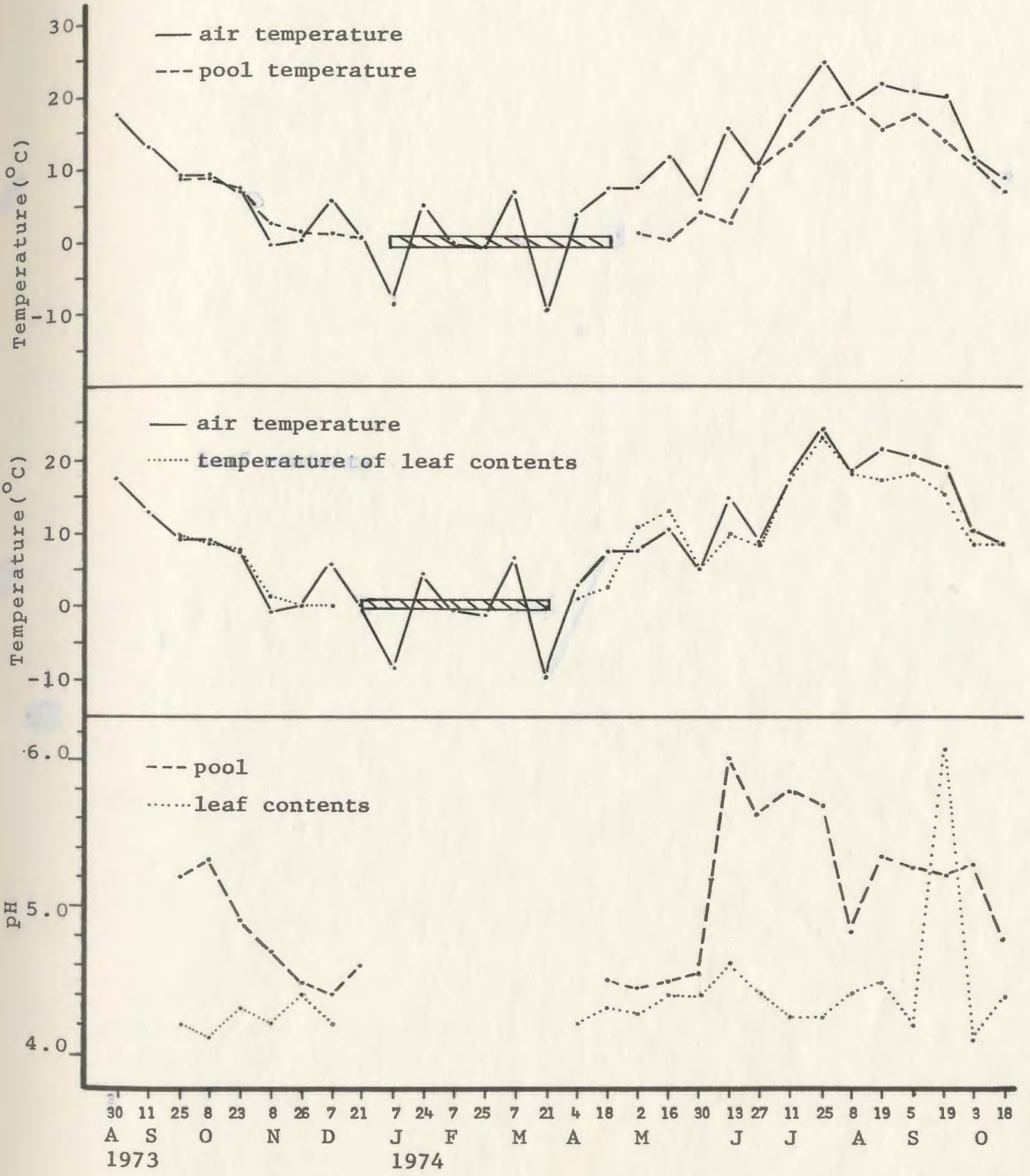


Figure 17

Temperature and pH for pools at site I and for
contents of leaves of *Sarracenia purpurea*.



values were obtained from the hollows. The average here was 4.7, with a range of 4.3 to 5.7 (see Fig.16).

The pH values measured in pools on Site I, were comparable to those of the hollow samples, exhibiting a minimum of 4.4, and maximum of 6.0. The average pool pH was 5.0 (see Fig. 17).

Except for a value of 6.1, in September, 1974, the pH readings for the water in *Sarracenia purpurea* leaves were similar to those of hummock top samples, a range of 4.1 to 4.65, producing an average pH of 4.3, (the average pH would be 4.4, if the value of 6.1, were included). These values are given in Fig. 17.

From June 1974 through September 1974 pH values in the hummocks and hollows, pools and *Sarracenia purpurea* leaves fluctuated irregularly. The highest and lowest pH values in the five areas measured were recorded during this period.

Excluding the pH recorded in the bog hollow at Site II, which was slightly less than the minimum recorded from similar areas in Site I, pH values were similar in both sites. Although, the pH values in hummocks at Site IV, were similar to those of the nutrient poor fen, readings from the hollow and the pool were lower than even the minimum of the range from these areas on the nutrient poor fen. Values measured on Sites V and VI, were comparable to those of Site I, tending towards the lower end of the range in wetter areas. Table 3 gives the pH measured at Sites II,III,IV,V, and VI.

(c). Moisture and Ice Conditions.

Samples from hummock tops contained relatively little moisture and could often be classified as merely damp, even in the spring immediately after thawing. On two sampling dates, in August 1974 after a heavy rainfall, and in September 1974 when water level in the fen had increased considerably after several days of rain, samples were much wetter. No water

TABLE 3

VALUES OF pH MEASURED AT SAMPLING AREAS ON SITES II, IV, V & VI

SITE	pH VALUES			
	Hummock top	Hummock slope	Hollow	Pool
II	4.0	4.2	4.2	
IV(i)	3.8		4.0	
IV(ii)	4.2		3.9	4.2
V	3.7	3.95	4.6	
VI	4.2		4.4	

could be wrung from most hummock top samples by squeezing them in the hand, even on sampling days during or immediately following a rainfall.

Slope samples were damp, as well, although they more often were wet after rain. Samples from hollows were always wet enough to allow water to drip from them when they were squeezed, and at times contained enough water to drip from the sample without any pressure. This water was always clear and colorless, except in a hollow sample from Site V, in which the water was the clear brown normally considered typical of peatlands, and in a hollow sample from Site VI, which contained a large amount of fine brown detrital particles.

The first frost occurred in mid-September, 1973, and by late November Site I was being periodically covered by snow. The maritime climate of the Avalon Peninsula does not normally allow a great accumulation of snow. This, combined with the wind on the exposed fen area, served to keep the hummocks exposed most of the winter in question. By mid-November, 1973, the hummocks and hollows were beginning to freeze from the top, and could support the weight of a person by early December, although they were at this time not frozen below 8 cm. By early January, 1974, the sampling knife could not reach unfrozen *Sphagnum*, and pools and *Sarracenia purpurea* leaves were also frozen solid. All samples from early December, 1973, until early April, 1974, were solidly frozen, and on three occasions, in February and March, 1974, the moss in the hollows was so hard that quantitative samples could not be obtained.

Hummock tops showed one to two centimeters of thawing on warm days in March, 1974. The layer of thawed *Sphagnum* increased through April, and by mid-May only a few of the large hummocks still contained a deep core of ice. All were completely thawed by the end of May. Pools and *Sarracenia purpurea* leaves contained no ice after mid-April, 1974.

2. Organisms Found During the Study.

(a). Rotifers.

During the present investigation, 74 separate rotifer species or varieties were encountered. Identification was completed on 22 genera, 67 species and 3 varieties. One bdelloid could not be identified to genus, and one species of the genus *Mniobia* could not be determined. Seven of the species were not seen by the author, but were identified by Herr. Walter Koste, German Federal Republic, in samples sent to him. Bdelloids were present from 7 genera containing 23 species and 2 varieties. There were 15 genera of Monogononta represented by 44 species and 1 variety.

Twenty-three species or varieties are new records for Canada, and 16 are apparently new records for North America. All species and varieties except *Kellicottia longispina*, *Keratella cochlearis*, *K. quadrata*, and *K. taurocephala* are new records for Newfoundland and Labrador.

Listed below are the rotifers found in the peatlands of the eastern Avalon Peninsula which were examined, with new records indicated and comments included for any species which differed from accounts given in the literature.

Phylum : Rotifera
 Class : Digononta
 Order : Bdelloidea
 Family : Habrotrochidae

Habrotrocha angusticollis angusticollis, (Murray 1905).

- This species was not seen by the author, although a few houses were noticed. W. Koste recognized it in samples sent to him.

H. collaris, (Ehrenberg 1832).

- Not previously recorded in Canada.
 - Specimens seen were larger than those found by Bartos(1951), but within the larger of the two size ranges given by Voigt(1957).

H. constricta (Dujardin 1841).

- The body of all specimens was a deep orange color. Donner(1965) describes it as brownish or decidedly yellowish, while Bartos(1951) states it is usually colorless.

H. constricta, colorless form (Fig. 18).

- These specimens were smaller than the normal species range, their length ranged from 180-240 μ . The body was colorless or pale yellow, never deep orange like the preceding *H. constricta* specimens. The upper lip extended only one-half the height of the pedicels, unlike that of the preceding specimens which reached the top of the pedicels. Donner(1965) shows several variations of upper lip structure in this species, some of which have short upper lips. The rump folds of these specimens were not prominent, and did not form a point during contraction. Murray(1910) shows a specimen similar to this, and Burger's(1948) described specimen is also probably a similar form.

H. lata lata (Bryce 1892).

Not previously recorded from Canada.

H. pusilla textrix brevilabris Donner 1950.

This subspecies has not previously been recorded from North America, although the species was found by Murray(1911) in British Columbia.

H. roeperi (Milne 1889).

- Not previously recorded from Canada.
- The corona of this species was not seen. It is rarely seen, and as far as is known, has not yet been illustrated.

H. tridens (Milne 1886).

- Not previously recorded from North America.

Family : Philodinidae

Philodina proterva Milne 1916.

- Not previously recorded in North America.
- Specimens seen had no notch in the upper lip, resembling one of the forms illustrated by Donner(1965).

Macrotrachela ehrenbergii (Janson 1893).

- This species was seen by W. Koste, but not by the author.

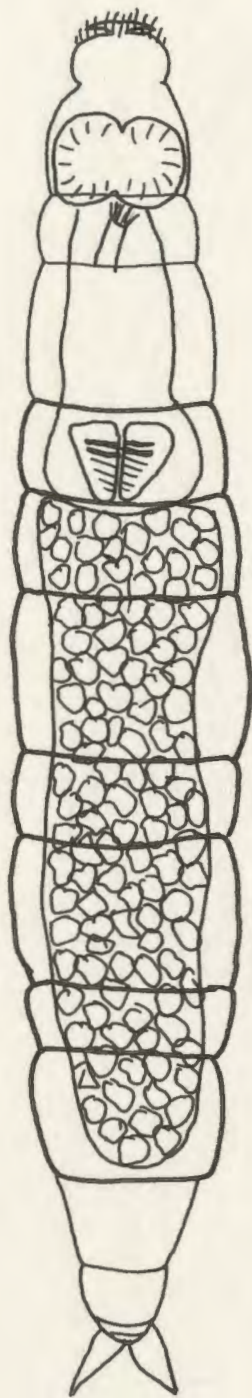
M. gunningi (Murray 1911).

- Not previously recorded in North America.

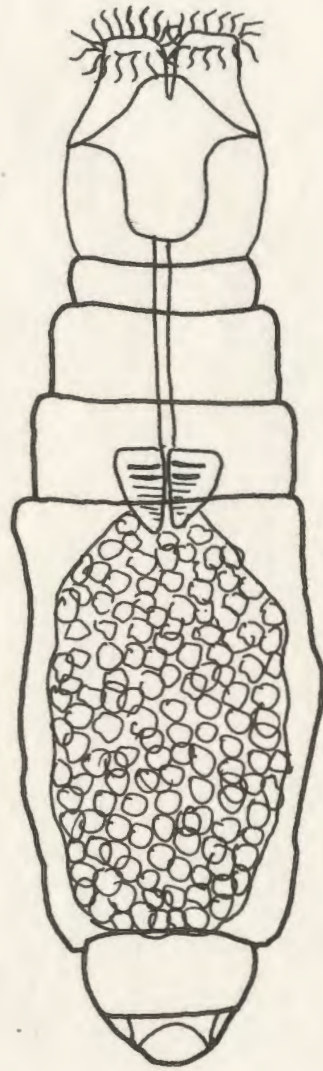
Figure 18

Habrotrocha constricta, colourless form.

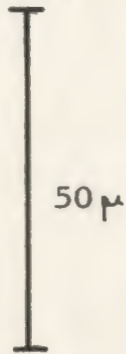
A creeping B swimming



A



B



M. habita (Bryce 1894.)

- These specimens were smaller than those recorded by Bartos(1951), Voigt(1957), and Donner(1965). The length ranged from 280-310 .

M. multispinosa multispinosa Thompson 1892.M. multispinosa, short spined form.

- Several of these specimens were seen with short spines, which were not flattened or widened as in var. *brevispinosa* or *crassispinosa*, but similar to specimens illustrated by Murray(1906,1907) and Bartos(1951).

M. musculosa Milne 1886.M. natans (Murray 1908.)

- Not previously recorded from North America.
- Specimens seen were smaller than those described by Donner(1965). The length while creeping was 200 .

M. papillosa (Thompson 1892.)

- The dental formula in this species can range from 2/2 to 5/5 (Donner, 1965).
- All specimens seen had a dental formula of 2/2.

M. plicata hirundinella (Murray 1909.) Fig.19.

- Not previously recorded in North America.
- The rump processes of this variety are described by Voigt(1957) and Donner(1965) as more than 50 long. Those of the specimens seen in the present study were always slightly shorter than 50 , although their appearance resembled those illustrated by Donner(1965).

M. plicata plicata (Bryce 1892).M. quadricornifera quadricornifera Milne 1886.

- Specimens were smaller than the range given by Voigt(1957), although within that of Bartos (1951). The length ranged from 250-300 .

M. quadricornifera quadricorniferoides Bryce M.S. de Koning 1929.Rotatoria rotatoria (Pallas 1766)

- This is an extremely variable species (Donner 1965). Specimens found were approximately 300 in length, with spurs of 12 . The eyes were colorless.

Mniobia bredensis deKoning 1947.

- Not previously recorded in North America.

Figure 19

Various forms of rump processes of

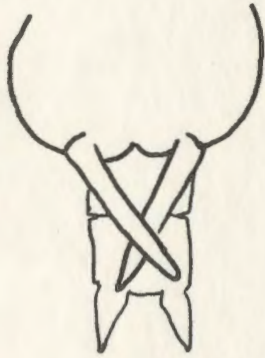
Macrotrachela plicata hirundinella.

A after Voigt(1957)

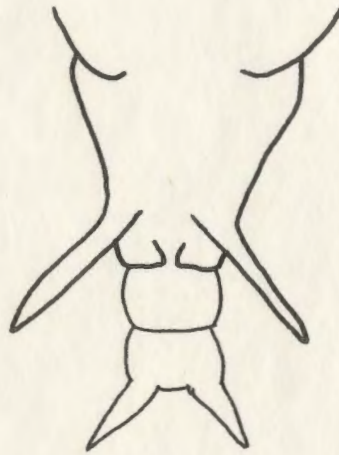
B after Bartos(1951)

C after Donner(1965)

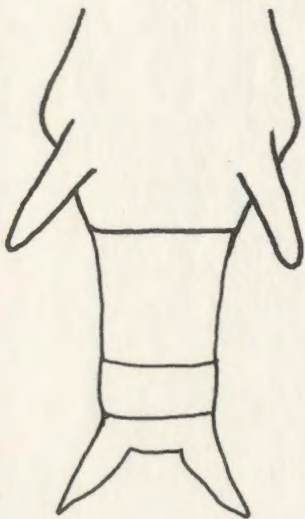
D as seen in present study



A



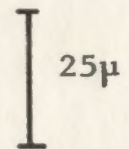
B



C



D



Mniobia sp. Fig. 20.

- No description could be found of a *Mniobia* species resembling this. Attempts to culture the species from the few individuals found failed. It is a small species with an orange body (length 60-70 μ). The rostrum is wide with two lamellae. The dorsal antenna is short. There is a dental formula of 4/4. The cuticle is smooth, with longitudinal folds extending to the rump. A constriction occurs in the cuticle at approximately three quarters of the length of the trunk near the rump. The trunk posterior to the constriction is wider than the anterior portion. A dorsal thickening is evident in a lateral view of the foot. The spurs are separated by an interspace the width of their individual bases. The outside edges of the spurs are straight and smooth, and the inside edges are slightly curved.

Pleuretra sulcata Bartos 1950.

- This species was seen by W. Koste, but not by the author.
- Not previously recorded in North America.

Family: Adinetidae.

Adineta gracilis Janson 1893.*A. vaga minor* Bryce 1893.*A. steineri* Bartos 1951.

- Not previously recorded from North America.

Unidentified Bdelloid Species. Fig. 21.

- This species was seen only in a contracted position, either in preserved samples or contracted normally in qualitative samples. The unusually long spurs were 40 μ in length. Dental formula was 2/2. The foot was seen extended once, with the toes remaining contracted.

Class : Monogononta.

Order : Ploima.

Family : Brachionidae.

Sub-Family : Brachioninae.

Kellicottia longispina (Kellicott 1879)*Keratella cochlearis* (Gosse 1851)

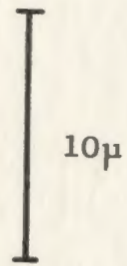
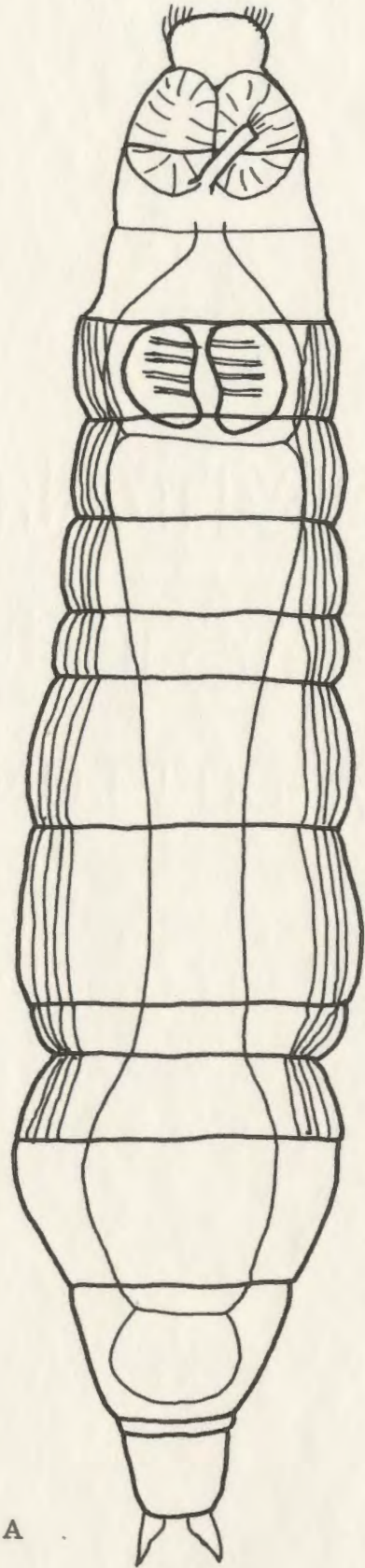
- Most specimens seen were within the size range of those seen in Ontario Lakes by Chengalath(1971). One specimen was larger (total length 230 μ).

Figure 20

Unidentified *Mniobia* species.

A creeping animal

B lateral view of foot showing dorsal hump



A

B

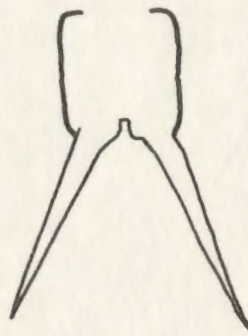
Figure 21

Unidentified bdelloid species.

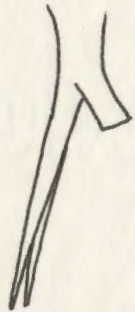
- A contracted specimen
- B partially extended foot and spurs
- C lateral view of spurs



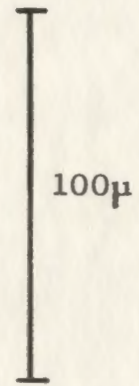
A



B



C



K. taurocephala Myers 1938.

- Specimens were larger than those found by Chengalath(1971) in Ontario, although his were larger than specimens of Ahlstrom(1943) and Myers(1938). The posterior spine of the Newfoundland specimens is longer in relation to the body length than that of other specimens.

Newfoundland specimens: total length-330 μ ; body length-120 μ ;
post. spine length-160 μ .

Ahlstrom's(1943) specimens: total length-182-270 μ ; body length-105-114 μ ;
post. spine length-60-118 μ .

Chengalath's(1971) specimens: total length-225-291 μ ; body length 105-114 μ ;
post. spine length 78-135 μ .

Trichotria tetractis paupera (Ehrenberg 1830).

- The specimens were within the size range of those found by Chengalath(1971), which is larger than the range given by Voigt(1957).

Trichotira truncata (Whitelegge 1889).

Sub-Family : Colurinae.

Colurella hindenburgi Steinecke 1917.

- Not previously recorded in Canada.

C. obtusa (Gosse 1886).

C. sinistra Carlin 1939.

- This species was seen by W. Koste, but not by the author.
- Not previously recorded from North America.

C. tessalata (Glasscott 1893).

- This species was seen by W. Koste, but not by the author.

Lepadella acuminata (Ehrenberg 1834).

L. amphitropis Harring 1917.

- This species was seen by W. Koste, but not by the author.
- Not previously recorded from Canada.

L. apsidea Harring 1917.

- Not previously recorded from Canada.
- Specimens were slightly longer and narrower than the measurements of the type species given by Harring(1917).

Newfoundland specimens: body length-90 μ ; body width-55 μ .
 Harring's (1917) specimens: body length-70 μ ; body width-60 μ .

L. triptera Ehrenberg 1830.

Squatinella microdactyla (Murray 1906)

- Not previously recorded from North America.

S. minor Wulfert 1967.

- Not previously recorded from North America.

S. mutica (Ehrenberg 1832)

S. mutica aurita (Wulfert 1950)

- Not previously recorded from North America.
- Specimens were slightly smaller than measurements given by Voigt (1957).

Family: Lecanidae.

Lecane agilis (Bryce 1892)

- Not previously recorded from Canada.

L. elasma Harring & Myers 1926.

- Not previously recorded from Canada.

L. flexilis (Gosse 1886)

L. lauterborni Hauer 1924.

- This species was seen by W. Koste, but not by the author.
- Not previously recorded from Canada.

L. stitchaea Harring 1913.

L. tenuiseta Harring 1914.

- Not previously recorded from Canada.

L. (Monostyla) acus (Harring 1913)

L. (M.) clostercerca (Schmarda 1859)

L. (M.) crenata (Harring 1913.)

- The specimens of Chengalath and Mulamoottil(1974) from Ontario are slightly larger than the Newfoundland specimens which, in turn, are slightly larger than specimens from Wisconsin(Harring & Myers,1926). The claws are the same length as the Ontario specimens.

L. (M.) hamata (Stokes 1896.)

- Specimens were larger than those of Chengalath and Mulamoottil(1974), but the same size as those of Harring and Myers(1926). The median depression is present in the anterior ventral sinus.

L. (M.) lunaris (Ehrenberg 1832.)L. (M.) galeata (Bryce 1892.)L. (M.) pyriformis (Daday 1905.)

- The toe length of these specimens is much shorter than described by Hauer(1929), Voigt(1957) or Chengalath and Mulamoottil(1974). The length of the lorica is similar.

Newfoundland specimens:toe length-12 μ .

Chengalath and Mulamoottil(1974) specimens:toe length-25 μ .

Voigt(1957) specimens: toe length-24-36 μ .

Hauer(1929) specimens:toe length-26 μ .

Harring and Myers(1926) specimens: toe length-24 μ .

Family:Proalidae.

Proales brevipes Harring & Myers 1924.

- Not previously recorded from Canada.

P. decipiens (Ehrenberg 1831.)

- Harring and Myers(1921) report rare specimens with a dark retrocerebral organ. One such individual was seen, all others appeared normal.

Family:Notommatidae.

Cephalodella apocolea Myers 1924.Cephalodella hyalina Myers 1924.

- Not previously recorded from Canada.

C. gibba (Ehrenberg 1832.)

- Some specimens were considerably smaller than most of the specimens seen, and smaller than size ranges given by Wulfert(1938) and Berzins(1950).

Newfoundland specimens: body length-120-300 μ ; body width-20-70 μ .
 body depth-40-90 μ ; length of toes-50-90 μ .
 Wulfert's (1938) specimens: length-250-300 μ ; length of toes-60-80 μ .
 Berzin's (1950) specimens: length-280-250 μ .

C. strepta Myers 1924.

- Not previously recorded from Canada.

Monommata aequalis (Ehrenberg 1832)

- Not previously recorded from Canada.

M. longiseta (Muller 1786)

Notommata cyrtopus (Gosse 1886)

N. falcinella Harring & Myers 1921.

- Not previously recorded from Canada.

Family: Trichocercidae.

Elosa woralli Lord 1891.

- Not previously recorded from Canada.
 - Specimens were slightly larger than measurements for the species given by Voigt (1957).
 Newfoundland specimens: length-100 μ ; width-30 μ .
 Voigt (1957): length-82-89 μ .

Family: Dicranophoridae.

Dicranophorus lütkeni (Bergendal 1892)

- Not previously recorded from Canada.

Family: Synchaetidae.

Polyarthra remata Skorikov 1896.

- Not previously reported from North America.

Order: Flosculariaceae.

Family: Floscularidae.

Ptygura pilula (Cubitt 1872)

(b). Organisms other than Rotifers.

Following is a list of organisms other than rotifers which were observed in the samples from the peatlands. Included in the list are remarks indicating from what type of area samples containing these organisms were taken.

Chlorophyta	
Desmidiaceae	
<i>Micrasterias</i> sp.	Wet samples from hollows & slopes
Chrysophyta	
Bacillariophyceae	
<i>Asterionella</i> sp.	Wet samples from hollows & slopes
<i>Tabellaria fenestrata</i> (Lyngbye) Kützing.	" " " " " "
<i>T. flocculosa</i> (Roth) Kützing.	" " " " " "
Unident. pennate sp.	" " " " " "
Protozoa	
Mastigophora	Wet samples from hollows & slopes
Sarcodina	
Rhizopoda	
<i>Nebela caudata</i> Leidy	Found in most samples.
several other unident. species.	" " " "
Ciliophora	
<i>Vorticella</i> sp.	Found in samples from pool edges.
motile ciliate species.	Found in samples from wet hollows & pools.
Platyhelminthes	
Turbellaria	
Tricladida	Found in samples from hollows.
Catenuclida	" " " " "
Nematoda	Found in all samples.
Gastrotricha	Found in samples from hollows & wet slopes.
Tardigrada	
Eutardigrada	
Macrobotidae	
<i>Macrobotus</i> spp.	One or two animals and several
<i>Hypsibus</i> spp.	eggs found in several samples
Eggs of several species.	from all sites.
Annelida	
Oligochaeta	
<i>Aelosoma niveum</i> Leydig.	Found in samples from hollows.
Unident. spp.	" " " " "

Arthropoda	
Crustacea	
Ostracoda	Found in samples from wet hollows.
Copepoda	
Cyclopoida	" " " " " "
Harpacticoida	" " " " " "
Insecta	
Collembola	
Arthropleona	Found in most samples.
Symphypleona	" " " "
Coleoptera	
Eggs and larvae of unident.sp.	Found in samples from hollows.
Diptera	
Chironomidae larvae	Found in samples from hollows & wet slopes.
Stratiomyidae larvae	Found in sample from hummock top.
Hymenoptera	
Formicoidea	" " " " " "
Arachnida	
Acari	
Oribatidae	Found in samples from hummock tops & slopes.
Mollusca	
Gastropoda	
Planorbidae	
<i>Planorbula</i> sp.	A few specimens found in various samples from hummock tops & slopes.

3. Results from Study of Hummocks and Hollows at Site I.

Relatively few of the preserved rotifers in the quantitative samples contracted in such a manner as to be unrecognizable. Unidentified rotifers never amounted to more than 5% of the total number of rotifers in any one sample.

The number of rotifers in a 5 cm. column of *Sphagnum*, under one square centimeter of fen surface area, varied from 44 in a slope sample in late May, 1974 to 1260 in a sample from the top of a hummock, taken in early August, 1974. The average of all samples taken was 354 rotifers per square centimeter.

The total number of rotifers in individual samples varied irregularly throughout the sampling period in all three sampling areas, although there

was a tendency for numbers to decrease during the winter months in hummock tops and slopes (see Fig.14 & 15). The totals of all rotifers and of Monogononta rotifers per square centimeter are shown for hummock tops, slopes, and hollows in Figures 14, 15 and 16 respectively.

On the two occasions on which replicate samples from separate hummock-hollow formations were obtained, the species present and the numbers of individuals, in total and of each species, were dissimilar (See Table 4). In the duplicate samples from September, 1973, only 17 of the total of 32 species found were common to both samples, and only 7 of the 20 species from the May, 1974 duplicate samples were the same in both hummock-hollow formations.

On the basis of the results obtained from the quantitative samples and the temperature and ice conditions, the sampling period was divided into two periods, termed the cold and warm seasons. The former extends from December, 21st 1973 to May, 30th 1974, while the latter is composed of the two portions of the sampling period before and after these dates. During the cold season, all samples were frozen, recorded a temperature of approximately 0° C, and very few, if any, Monogononta were present in the *Sphagnum*. Samples taken during the warm season were not frozen and temperatures varied considerably, always above 0° C. Monogononta were present in all three areas during the warm season. The average numbers of rotifer individuals and species are illustrated in Table 5. for the total sampling period and for the warm and cold seasons. Similar values are given for the two classes, Digononta and Monogononta.

During most of the year, the total number of individual rotifers decreased slightly from hummock top through slope to hollow as the number of species increased. This increase in species number is the result of an increase in the number of Monogononta species as the moss becomes wetter

TABLE #

OCCURRENCE OF ROTIFERS IN REPLICATE SAMPLES FROM HUMMOCK-HOLLOW FORMATIONS
ON SITE I (EXPRESSED IN NO. / cm.²)

* species seen in qualitative sample but not in quantitative sample

ROTIFER SPECIES	SAMPLES COLLECTED ON SEPT. 25, 1973						SAMPLES COLLECTED ON MAY 2, 1974					
	TOP		SLOPE		HOLLOW		TOP		SLOPE		HOLLOW	
	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd
<i>Habrotrocha collaris</i>									*			
<i>H. constricta</i>			10	2	15							
<i>H. constricta</i> (colourless form)	22		48	61	27		22	17	15	17		27
<i>H. lata lata</i>	6	22	9	37	159	26	5		12	22	54	88
<i>H. pusilla tatrix brevilabris</i>						1						
<i>H. roeperi</i>	96	118			34		7					
<i>H. tridens</i>	53											
<i>Macrotrachela gunningi</i>	13	6	7	1	34						10	
<i>M. habita</i>	43		38				34	17	140	25		
<i>M. multispinosa multispinosa</i>	1	31					22		1		5	9
<i>M. multispinosa</i> (short-spined form)		4							1			
<i>M. musculosa</i>							34					
<i>M. natans</i>							7				20	
<i>M. papillosa</i>											20	
<i>M. plicata hirundinella</i>		2		10			34		104		36	
<i>M. plicata plicata</i>	18	17		7			45	25		13		26
<i>M. quadricornifera quadricornifera</i>				15		10						
<i>M. quadricornifera quadricorniferoides</i>		11	4	9	27			2	7	64	99	78
<i>Adineta gracilis + A. vaga minor</i>	5	47	45				289	152	336	218	83	59
<i>A. steineri</i>						5				6		
Unidentified bdelloid					1							
<i>Colurella obtusa</i>		1	1		15	7						
<i>Lepadella acuminata</i>						1						
<i>L. triptera</i>												2
<i>Squatina mutica aurita</i>				*		1						
<i>Lecane elasma</i>		13	4		15						15	
<i>L. (Monostyla) acus</i>					15	20						
<i>L. (M.) crenata</i>					10	11						
<i>L. (M.) galeata</i>					11	12						
<i>L. (M.) lunaris</i>					2	1						
<i>Proales brevipes</i>			26	16					2		*	
<i>P. decipiens</i>					21	1						
<i>Cephalodella apocolea</i>					5							
<i>C. hyalina</i>			*									
<i>Monommatia aequalis</i>					1							1
<i>Dicranophorus lütkeni</i>					2							
<i>Polyarthra remata</i>						9						
Total bdelloid species	9	9	7	8	6	5	8	7	9	7	8	6
Total Monogononta species	0	2	4	2	10	9	0	0	1	0	2	2
Total rotifer species	9	11	11	10	16	14	8	7	10	7	10	8
No. of species common to both samples		6		5		8		4		5		4
Total no. of rotifers / cm. ²	257	272	155	145	400	132	443	269	618	365	342	290

TABLE 5

MEAN NUMBERS OF SPECIMENS AND SPECIES OF ROTIFERS FOUND AT SITE I

N mean number of specimens

S mean number of species

ORIGIN OF SAMPLE	CLASS OF ROTIFERA	"COLD SEASON" DEC. 21, 1973 TO MAY 30, 1974		"WARM SEASON" BEFORE DEC. 21, 1973 AND AFTER MAY 30, 1974		TOTAL SAMPLING PERIOD AUG. 30, 1973 TO OCT. 18, 1974	
		N	S	N	S	N	S
HUMMOCK TOP	BDELLOIDEA	352	7	430	7	400	7
	MONOGONONTA	0	0	30	1	18	1
	ALL ROTIFERA	352	7	460	8	418	8
HUMMOCK SLOPE	BDELLOIDEA	344	6	284	7	308	7
	MONOGONONTA	1	1	54	5	32	3
	ALL ROTIFERA	345	7	238	12	341	10
HOLLOW	BDELLOIDEA	291	6	269	8	276	6
	MONOGONONTA	8	2	64	6	45	5
	ALL ROTIFERA	299	8	333	14	321	11

towards the hollow. In all samples, bdelloids formed the majority of the individuals. There was an average of nine species of rotifers in each sample taken, three of these being Monogononta and six Bdelloidea. However, during the cold season, both numbers and species of Monogononta were reduced to zero or nearly zero in all three areas. The average number of bdelloid species remained nearly constant at six or seven throughout the year, with the presence or absence of the Monogononta species determining the total number of species in a sample.

Analysis of variance shows significant differences between rotifer populations of the three areas of the hummock-hollow formation only in the Monogononta. There were significantly more rotifers of this class during the warm season in the slopes and hollows than in the hummock tops (p 0.05, f value 4.8066, M.S. within 0.5379, df 51, M.S. between 2.5855, df 2). During the cold season, there were no Monogononta in the hummock tops, but numbers were significantly greater in the hollows than in the slopes (p. 0.01, t value 3.8353). Differences in populations of the three areas between warm and cold seasons were significant only in the Monogononta (hummock tops: p 0.01, t value 4.1608; slopes: p 0.01, t value 4.1608; hollow p 0.01, t. value 4.0013).

The total number of rotifer species encountered on each sampling day is given in Table 6. The greatest number of species, 30, was recorded in September, 1973, and a low of 7, species was recorded twice in March, 1974. The total number of bdelloid species in all three samples from a hummock-hollow complex on any one sampling day ranged from six to 15, and there were anywhere from zero to 18 Monogononta species.

Of the total of 29 bdelloid species and varieties encountered in this study, only *Rotatoria rotatoria* and the unidentified *Mniobia* species did not appear in Site I. Most of the other bdelloid species were present at

TABLE 6

TOTAL NUMBERS OF SPECIES OF BDELLOIDEA AND MONOGONONTA FOUND IN
HUMMOCK-HOLLOW FORMATIONS ON INDIVIDUAL SAMPLING DATES

() numbers in brackets are results of replicate samples

SAMPLING DATE	NUMBER OF SPECIES IN HUMMOCK-HOLLOW FORMATION		
	BDELLOIDEA	MONOGONONTA	TOTAL
AUG. 30, 1973	8	11	19
SEPT. 11, 1973	12	18	30
SEPT. 25, 1973	14(15)	11(11)	25(26)
OCT. 8, 1973	9	11	20
OCT. 23, 1973	10	10	20
NOV. 8, 1973	12	3	15
NOV. 26, 1973	12	6	18
DEC. 7, 1973	13	5	18
DEC. 21, 1973	12	3	15
JAN. 7, 1974	11	6	17
JAN. 24, 1974	13	2	15
FEB. 7, 1974	7	1	8
FEB. 25, 1974	9	1	10
MAR. 7, 1974	6	1	7
MAR. 21, 1974	7	0	7
APR. 4, 1974	15	1	16
APR. 18, 1974	9	0	9
MAY 2, 1974	14(9)	2(2)	16(11)
MAY 16, 1974	11	9	20
MAY 30, 1974	15	3	18
JUNE 13, 1974	10	13	23
JUNE 27, 1974	11	7	18
JULY 11, 1974	13	13	26
JULY 25, 1974	13	12	25
AUG. 8, 1974	10	7	17
AUG. 19, 1974	8	11	19
SEPT. 5, 1974	6	14	20
SEPT. 19, 1974	8	13	21
OCT. 3, 1974	11	7	18
OCT. 18, 1974	10	5	15

some time in all three sampling areas of the site. Four species, *Habrotrocha collaris*, *Macrotrachela quadricornifera quadricornifera* (Fig.34) *Adineta steineri* (Fig.35) and the unidentified bdelloid species were never found in hummock tops, while *Macrotrachela natans* was the only bdelloid species not occurring in the hummock slopes. (See Table 7.) Four bdelloid species did not occur in the hollows: *Habrotrocha collaris*, *Philodina proterva*, the short-spined form of *Macrotrachela multispinosa*, (Fig.25) and *Mniobia bredensis*. The colorless form of *Habrotrocha constricta* (Fig.22), *H. lata lata* (Fig.23), *Adineta gracilis* and *A. vaga minor* (Fig.29) were present in over 70% of the samples from all three areas, and at various times formed collectively or individually a significantly large portion of the number of rotifers in a sample. Other bdelloids which were present in more than 50% of the samples from one or more sample areas and sometimes contributed large numbers of individuals to the total population were: *Macrotrachela plicata plicata* (Fig.27), *M. habita* (Fig.24) and *M. quadricornifera quadricorniferoides* (Fig.28), *M. plicata hirundinella* (Fig.27), *M. musculosa*, (Fig.25), *Habrotrocha constricta* (Fig.22), *H. roeperi* (Fig.23), and *H. tridens* (Fig.24), were present in large numbers in a few samples.

Of all the Monogononta species found in the peatland sites, the following were absent from the poor fen: *Trichotria tetractis paupera*, *Lepadella apsidea*, *Cephalodella strepta*, *Notommata cyrtopus*, *N. falcinella* and *Ptygura pilula*. Samples from hummock tops contained, with one exception, at the most one or two species of Monogononta represented by very few individuals (the hummock top sample of July 25th, 1974, contained seven species of Monogononta). Only two Monogononta species occurred in hummock tops more than twice; *Elosa woralli* (Fig.35) and *Proales brevipes* (Fig.34) were common to all three areas.

The following species were found only once in hummock top samples: *Squatinella mutica aurita* (Fig. 30), *Lecane agilis*, L. (*Monostyla*) *lunaris* (Fig. 33), L. (*M.*) *galeata* (Fig. 32), L. (*M.*) *pyriformis* (Fig. 33), and *Cephalodella apocolea*. The last three species occurred in the July 25th, 1974 sample. *Kellicottia longispina*, *Lecane elasma* (Fig. 31), *L. tenuiseta* and *Colurella obtusa* each occurred in hummock tops twice.

Of the 38 species of Monogononta found in the hummocks and hollows of the poor fen, approximately 25% were confined to the hollows. These species were: *Keratella quadrata testudo*, *Lepadella acuminata*, *L. triptera*, *Squatinella microdactyla*, *S. minor*, *S. mutica*, *Lecane stitchaea*, *Monommata longiseta* and *Dicranophorus lütkeni* (Table 7). All other species also occurred in the hummock slopes. The following species at times contributed relatively large numbers to the total populations: *Lecane elasma*, *L. (Monostyla) acus* (Fig. 31), *L. (M.) galeata*, and *Elosa woralli*. No Monogononta species was ever present in numbers comparable to those of the most common bdelloid species.

The occurrence of all species which several times occurred in numbers larger than 20 individuals per sq. cm., or which occurred in more than three or four samples, is illustrated graphically in Figures 22 to 35. Where feasible, varieties of a species have been included in the graph of the parent species. *Adineta steineri* is included in the graph of the other *Adineta* species, and *Colurella hindenburgi* and *C. obtusa* are placed on the same figure. All other species are represented on Table 7.

4. Other Qualitative Results.

(a). Hummocks and Hollows from Site, II, IV, V and VI.

The rotifers found in the hummocks and hollows of these sites are listed in Table 8, with some indication of their relative abundance.

Figures 22 - 35

Seasonal occurrence of individual rotifer species at site I

- (---) results of replicate samples
- * species seen in qualitative sample
but not in quantitative sample

- 'A' Results from hummock top samples
- 'B' Results from hummock slope samples
- 'C' Results from hollow samples

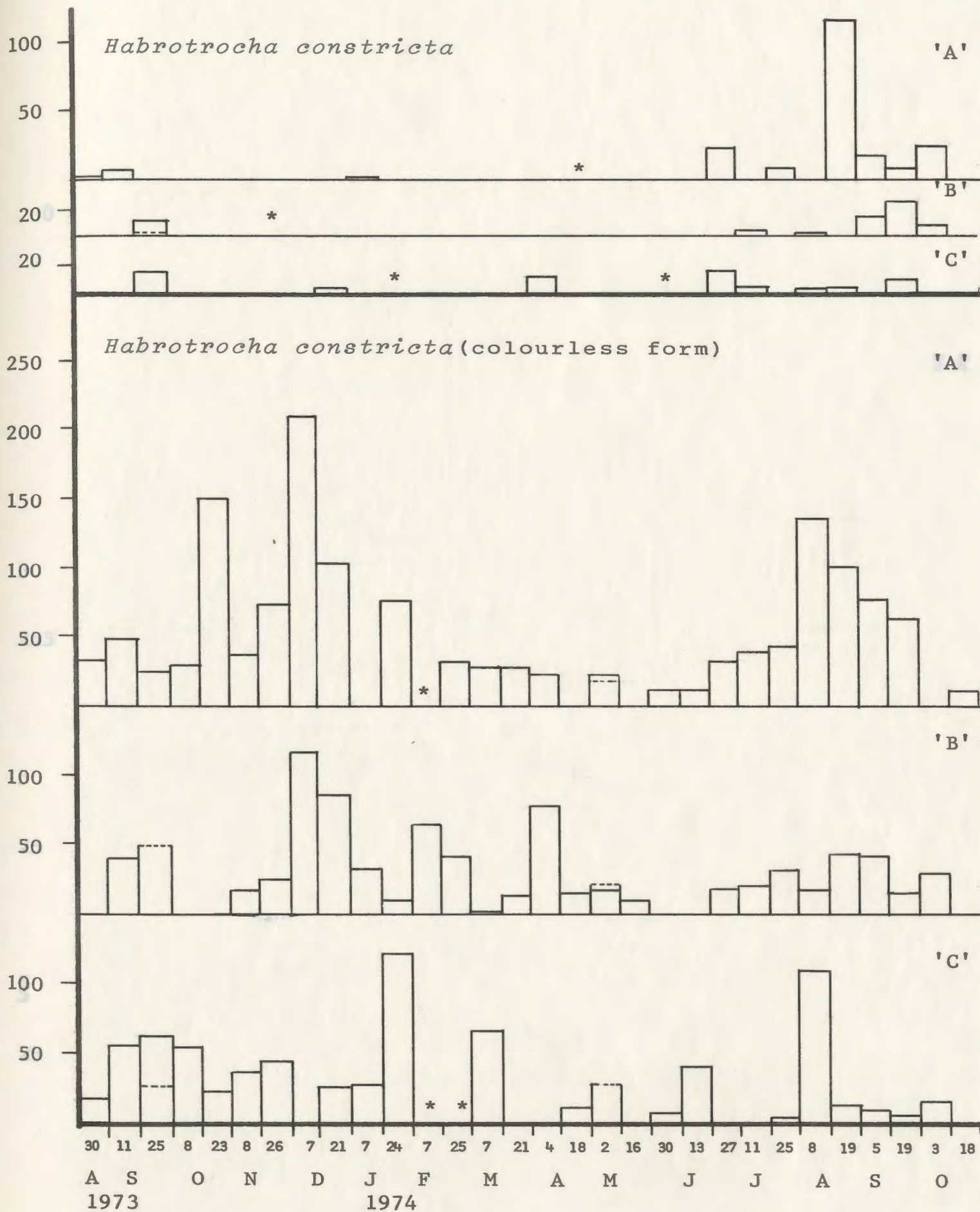


FIGURE 22

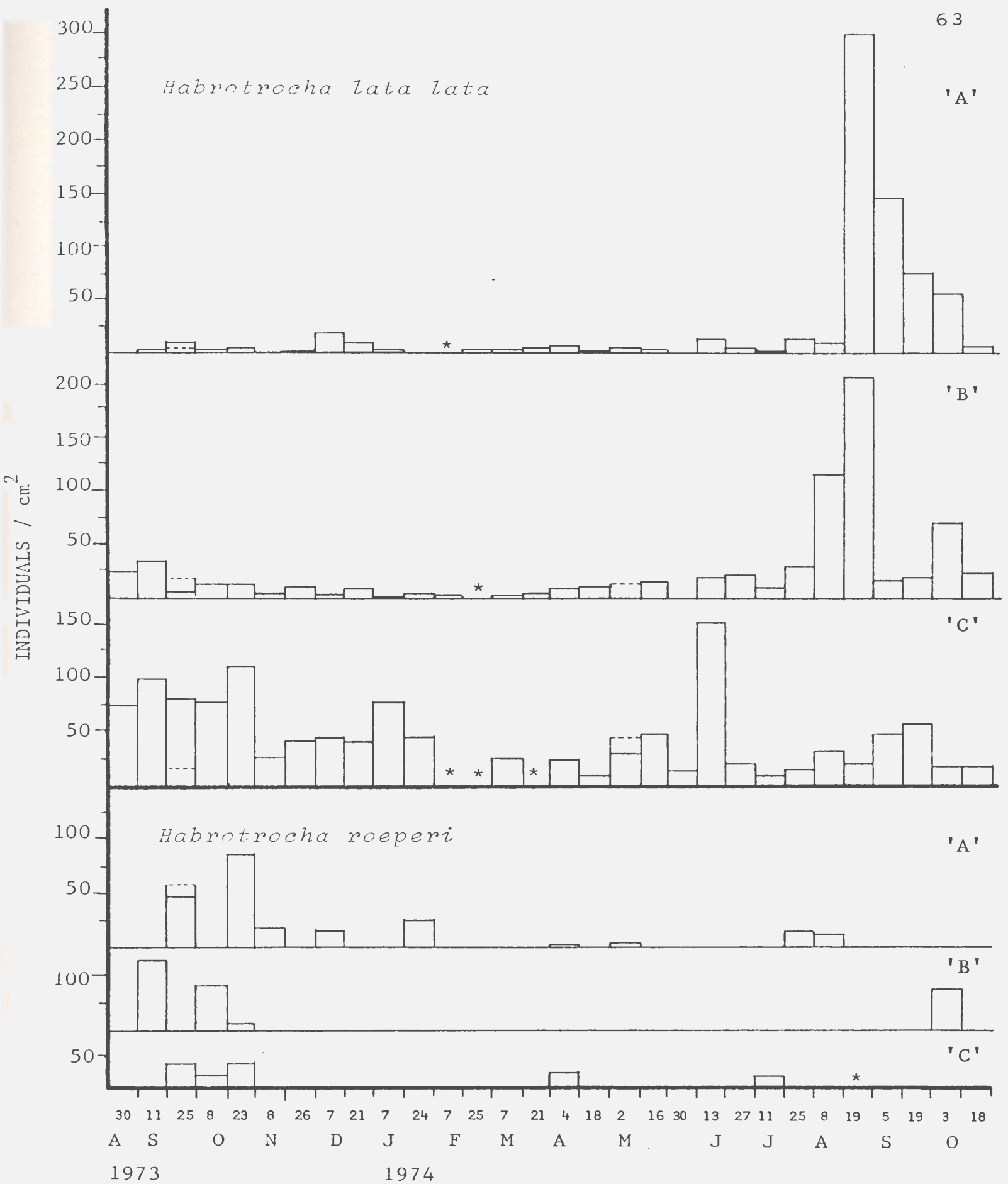


FIGURE 23

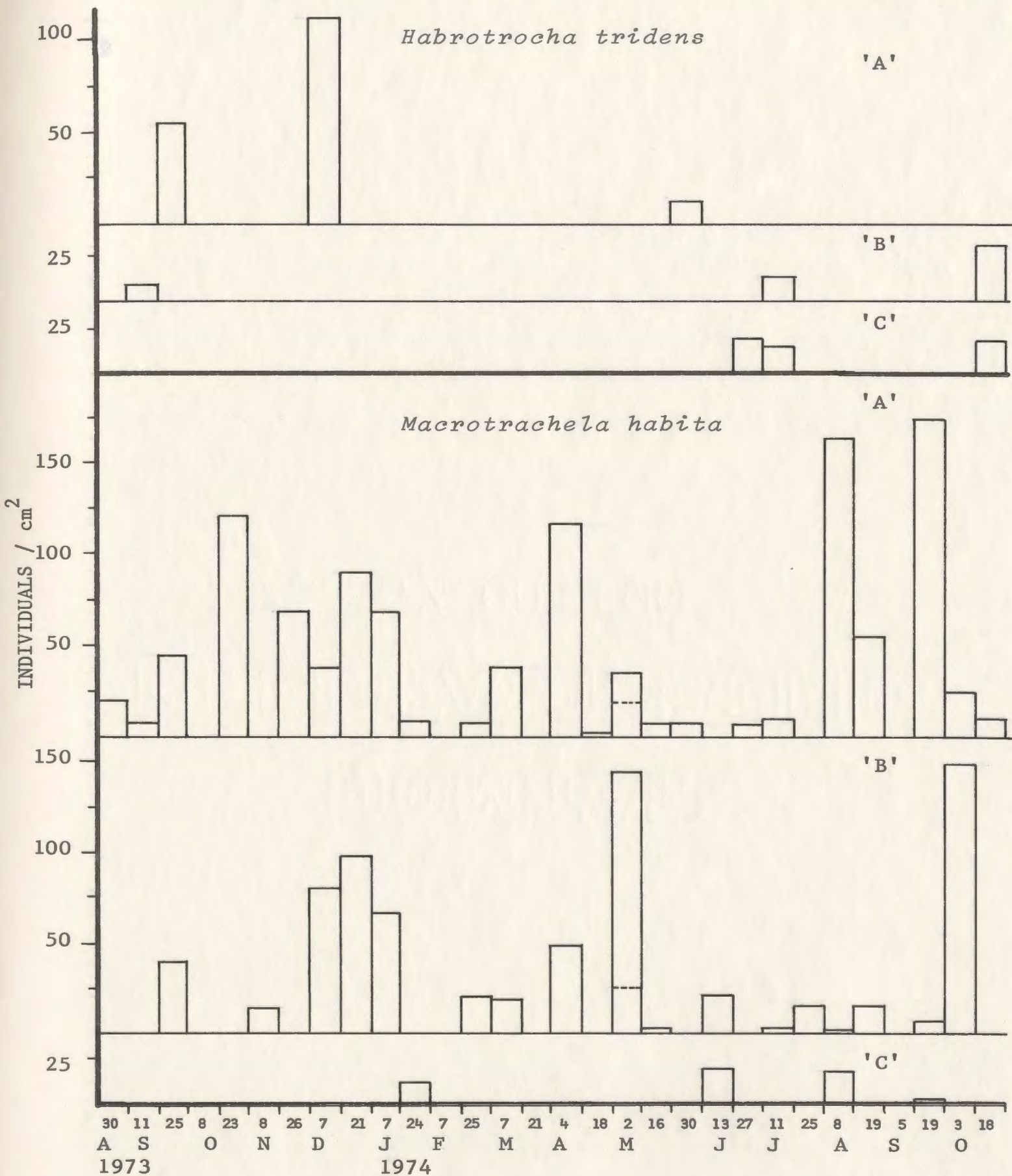


FIGURE 24

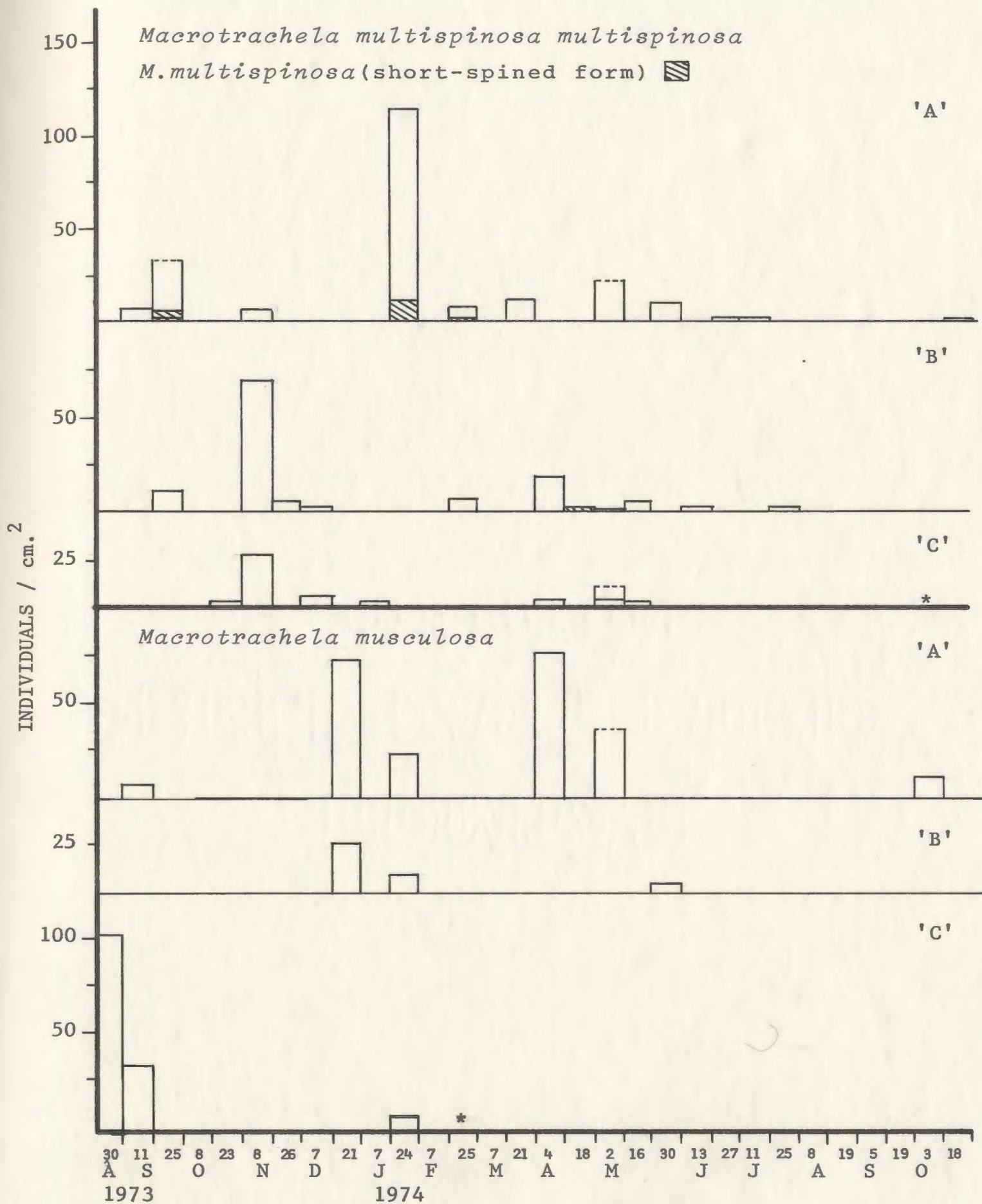


FIGURE 25

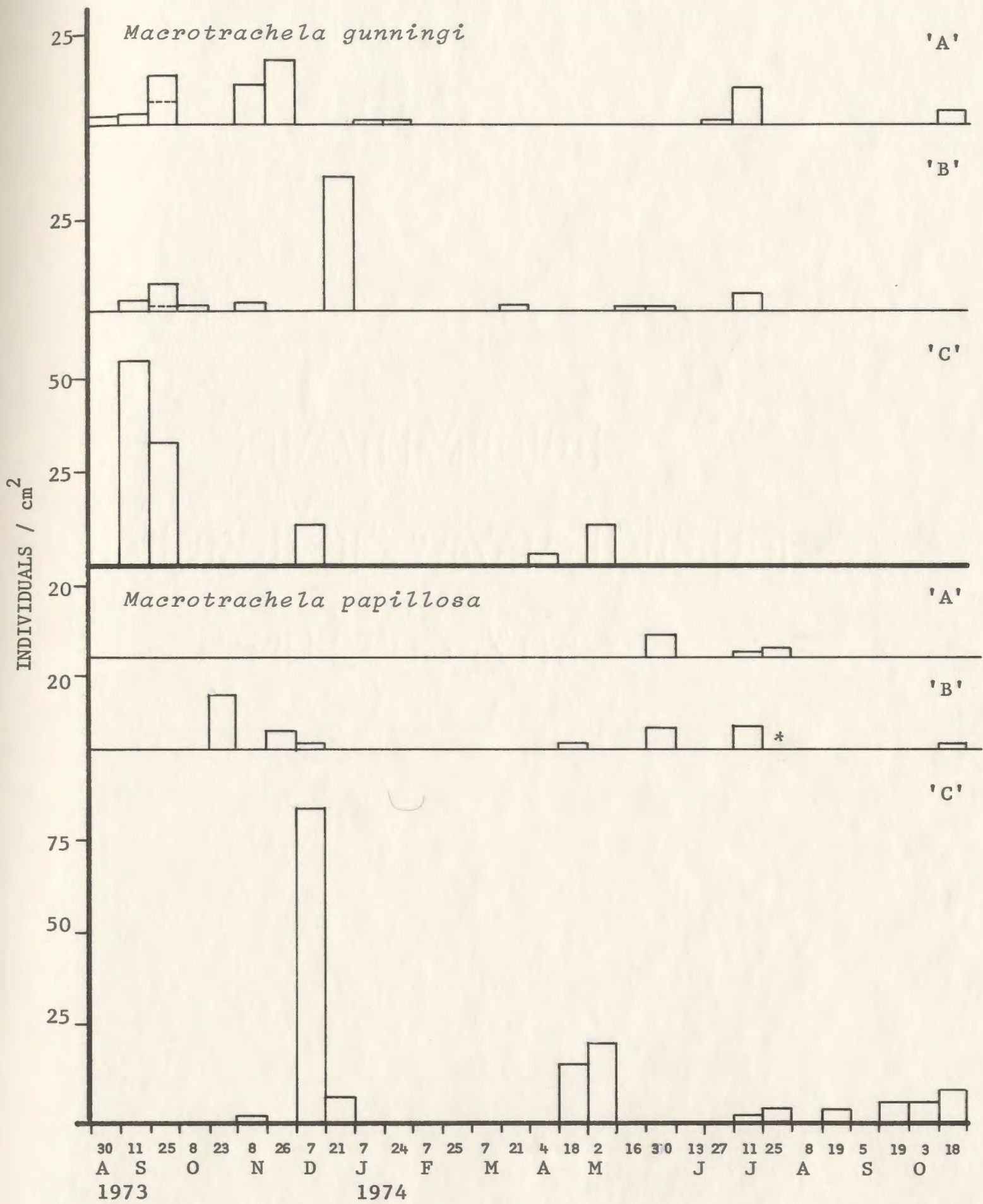
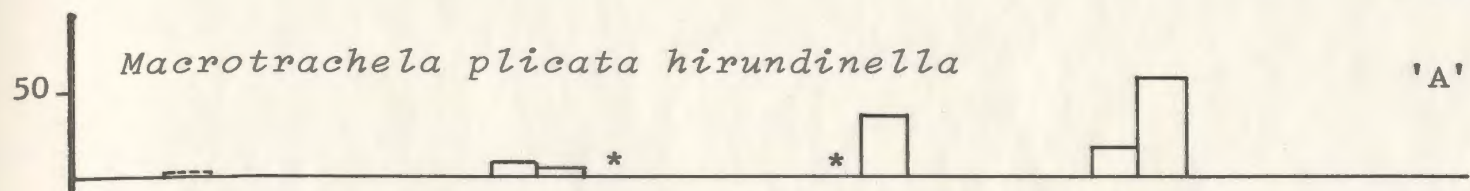


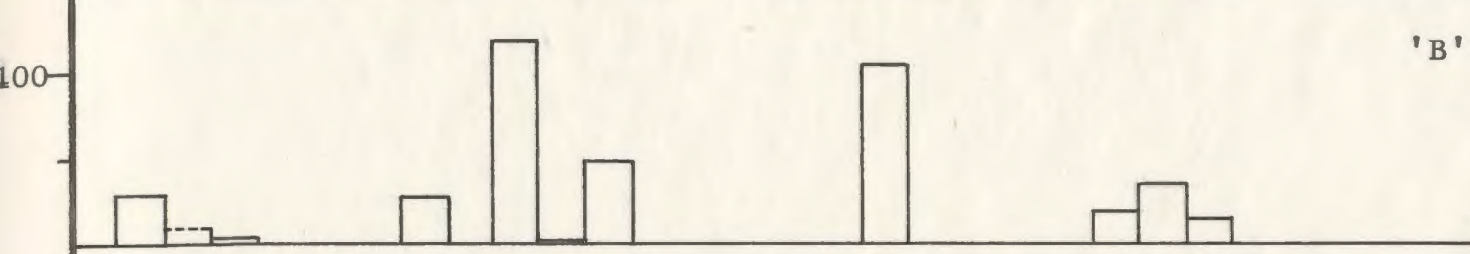
FIGURE 26

Macrotrachela plicata hirundinella

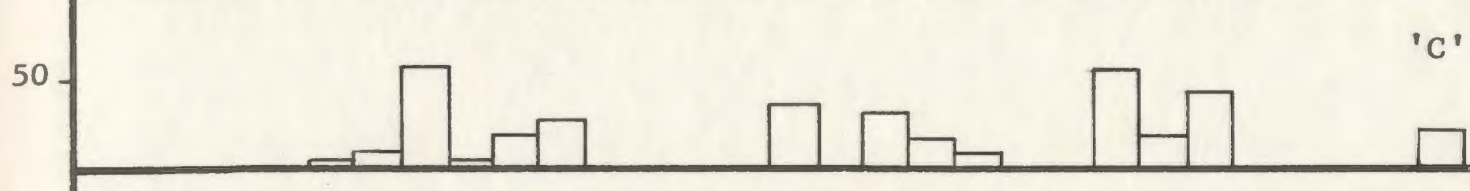
'A'



'B'



'C'

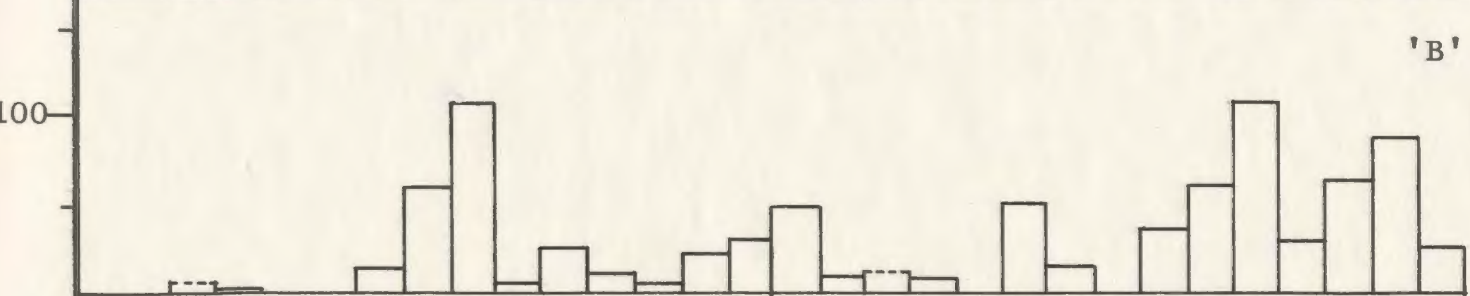


Macrotrachela plicata plicata

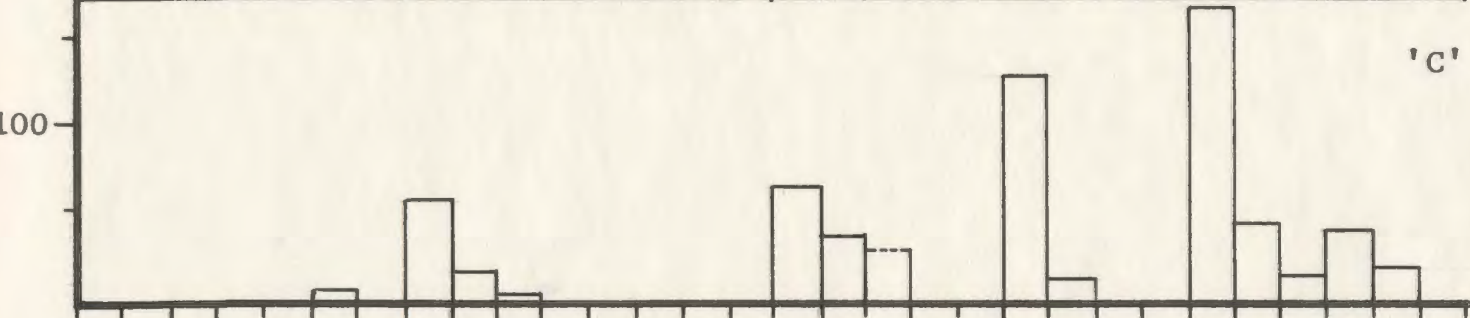
'A'



'B'



'C'



30 11 25 8 23 8 26 7 21 7 24 7 25 7 21 4 18 2 16 30 13 27 11 25 8 19 5 19 3 18
 A S O N D J F M A M J J A S O
 1973 1974

FIGURE 27

Macrotrachela quadricornifera quadricorniferoides

M. quadricornifera quadricornifera

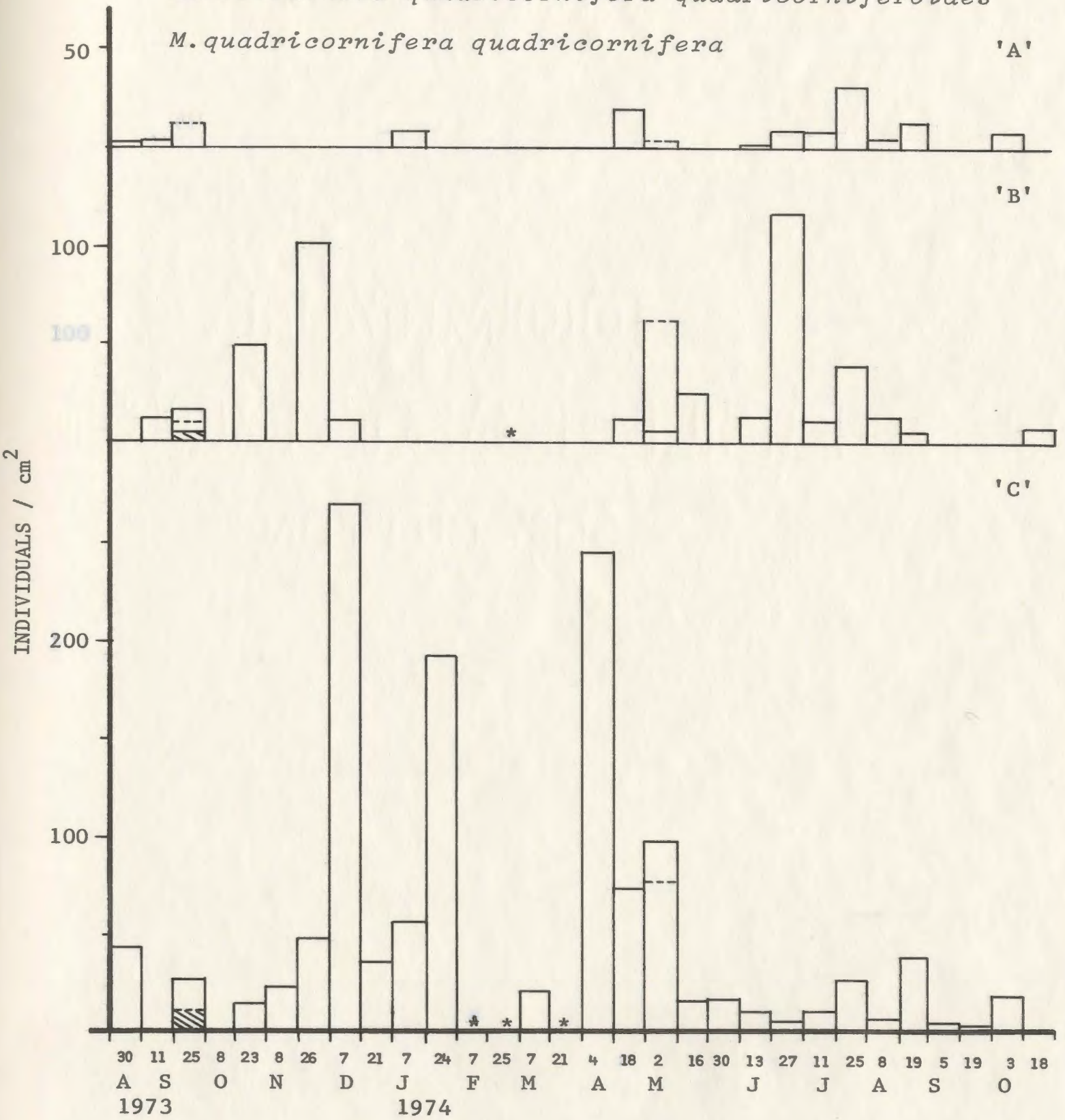



FIGURE 28

Adineta gracilis + *A. vaga minor*

A. steineri 

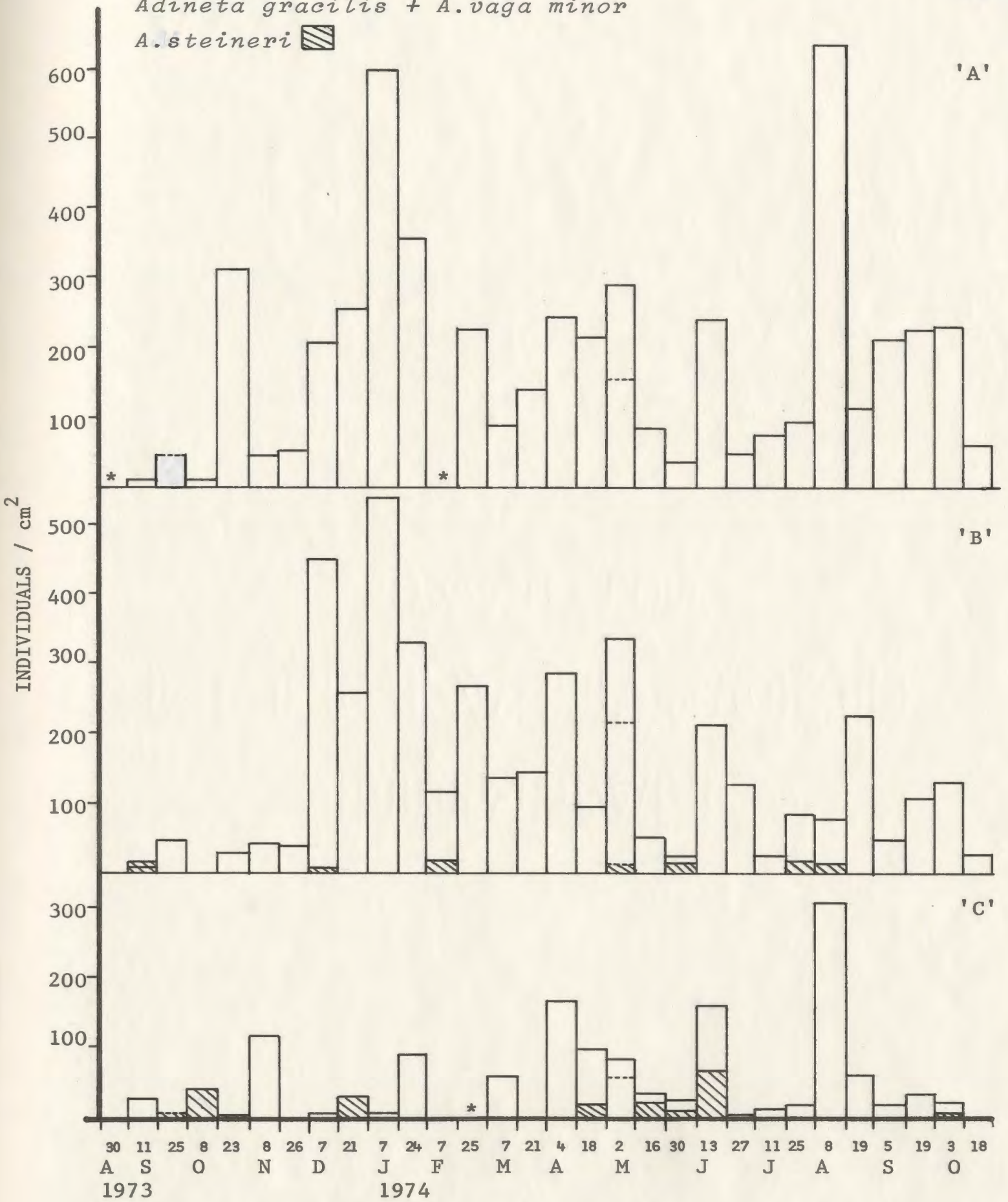


FIGURE 29

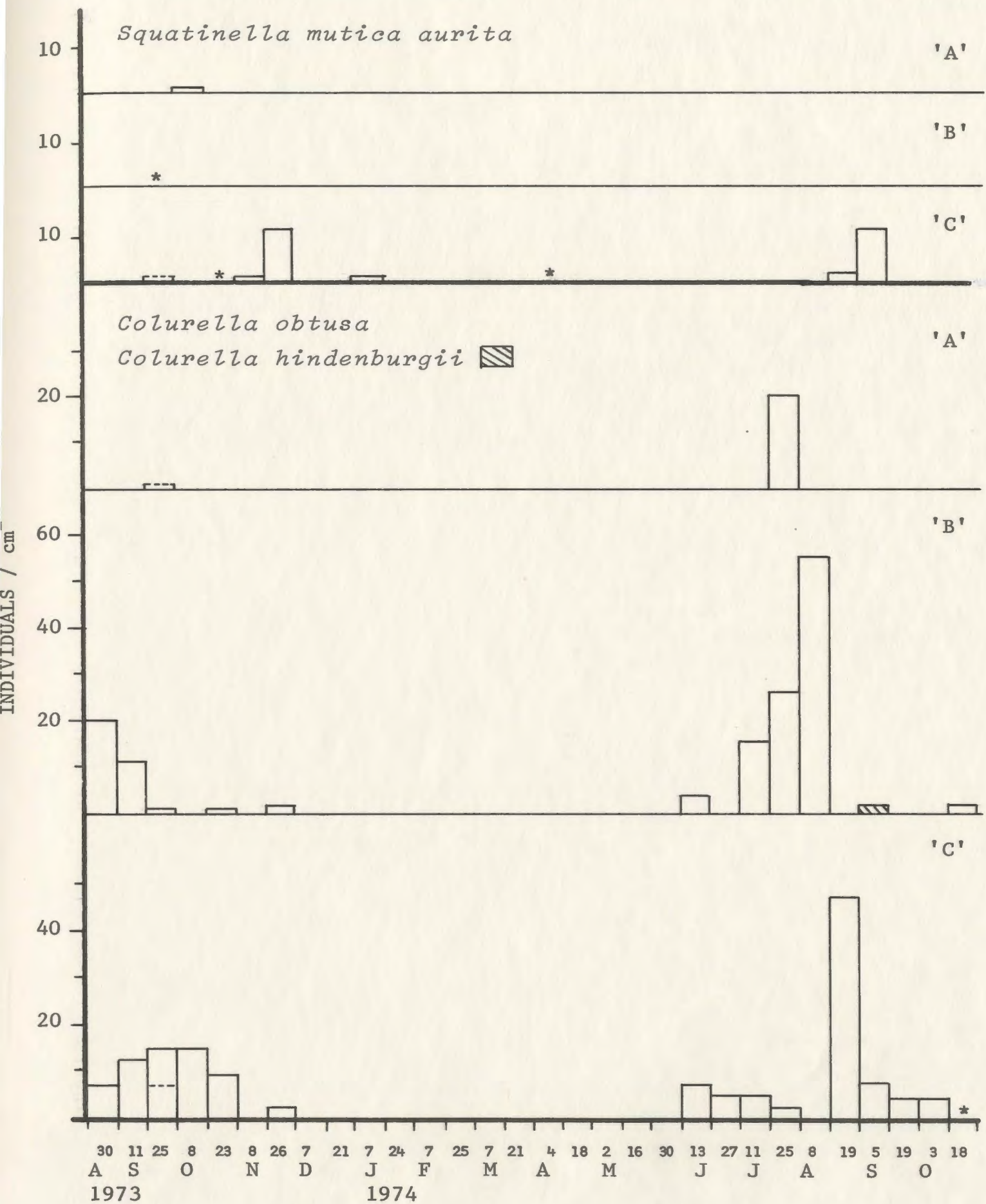


FIGURE 30

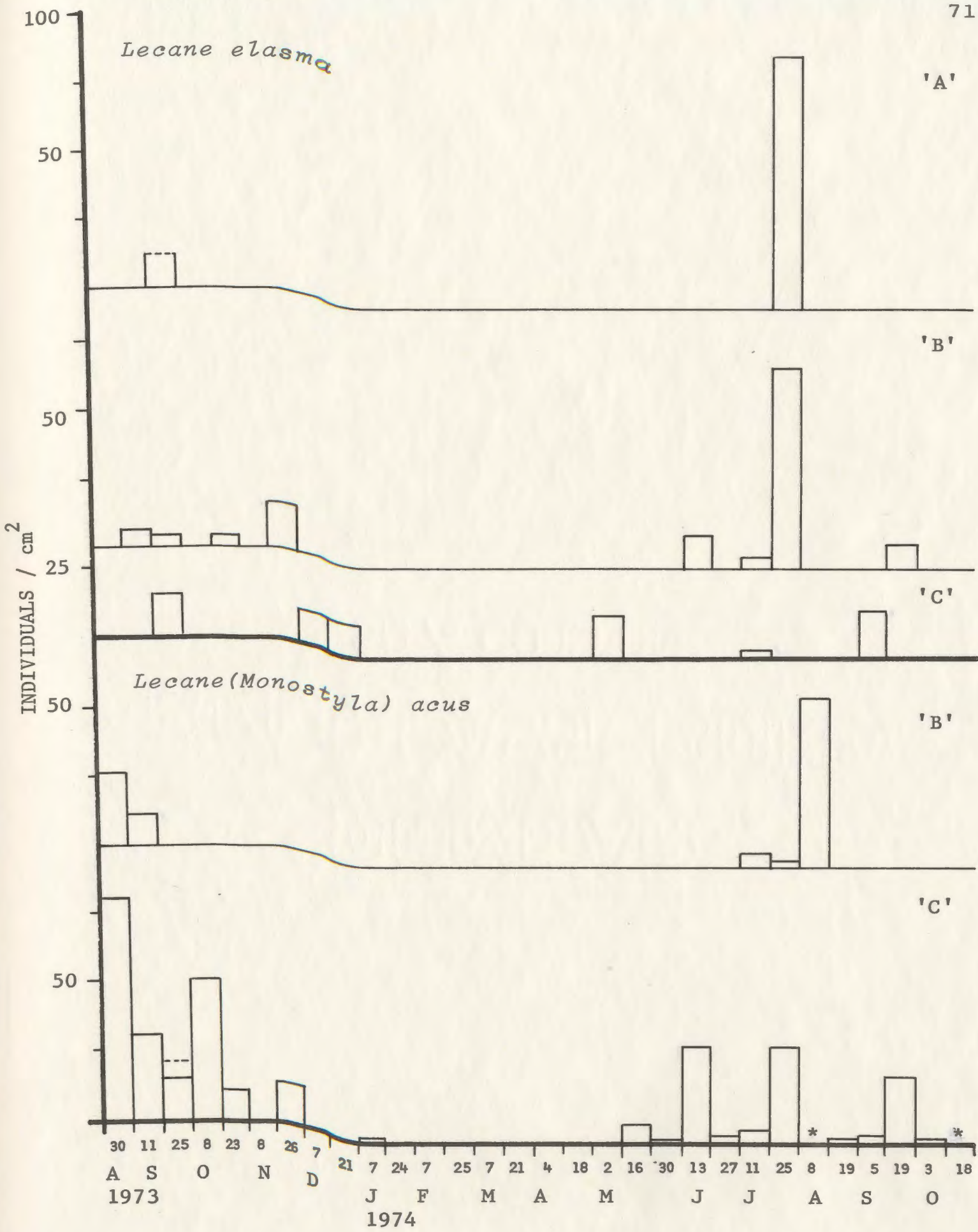
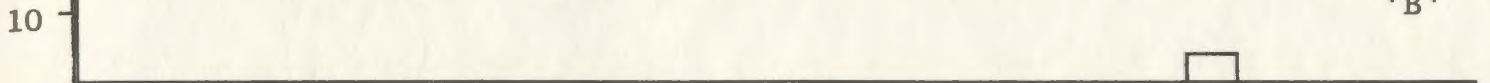


FIGURE 31

Lecane (Monostyla) crenata

'B'



'C'



Lecane (Monostyla) galeata

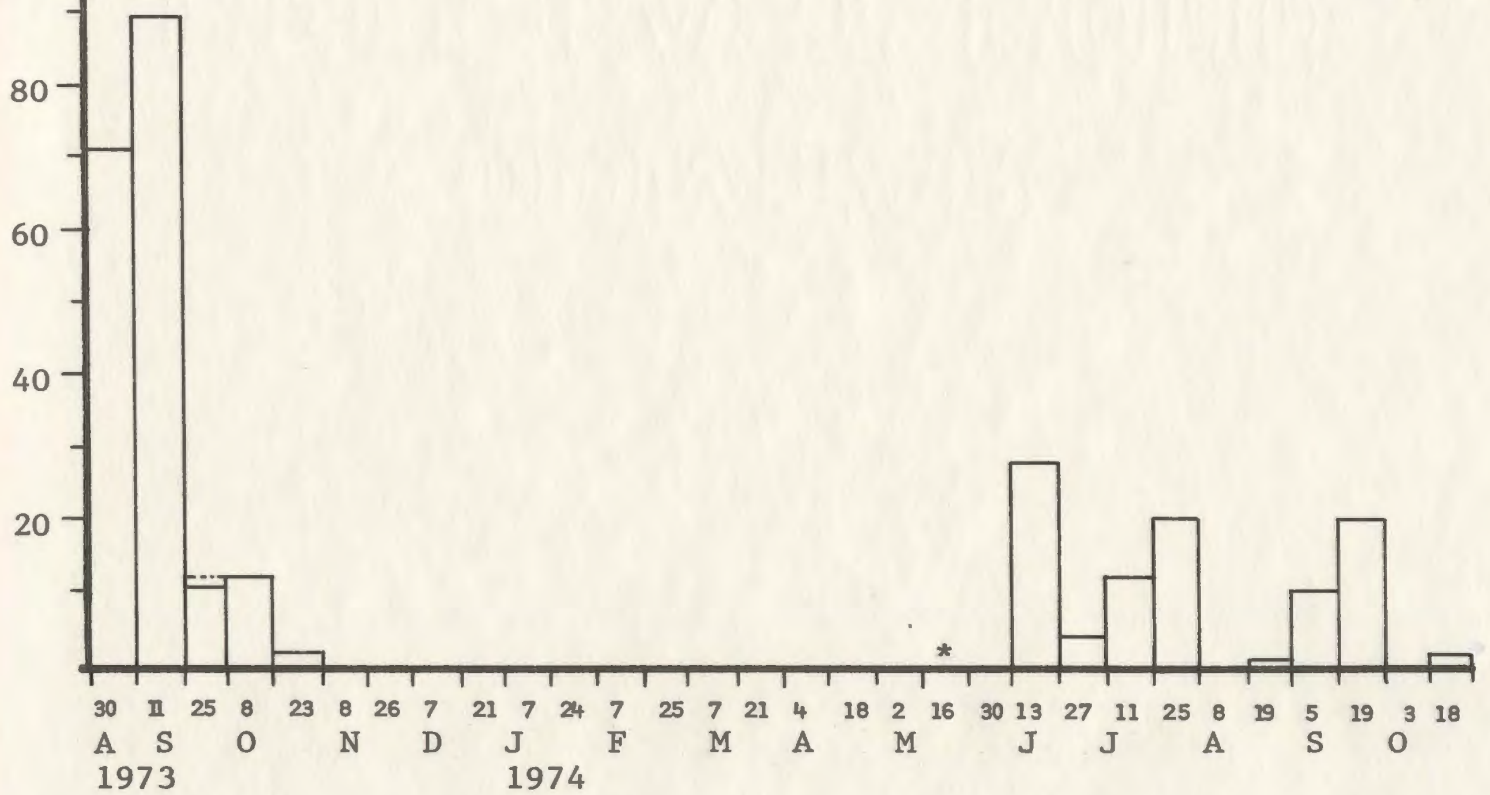
'A'



'B'



'C'



INDIVIDUALS / cm²

30 11 25 8 23 8 26 7 21 7 24 7 25 7 21 4 18 2 16 * 30 13 27 11 25 8 19 5 19 3 18
 A S O N D J F M A M J J A S O
 1973 1974

FIGURE 32

Lecane (Monostyla) hamata

'B'

10

10

'C'

Lecane (Monostyla) lunaris

'A'

5

*

'B'

10

INDIVIDUALS / cm²

5

'C'

Lecane (Monostyla) pyriformis

'A'

10

'B'

10

'C'

5

30 11 25 8 23 8 26 7 21 7 24 7 25 7 21 4 18 2 16 30 13 27 11 25 8 19 5 19 3 18
A S O N D J F M A M J J A S O
1973 1974

FIGURE 33

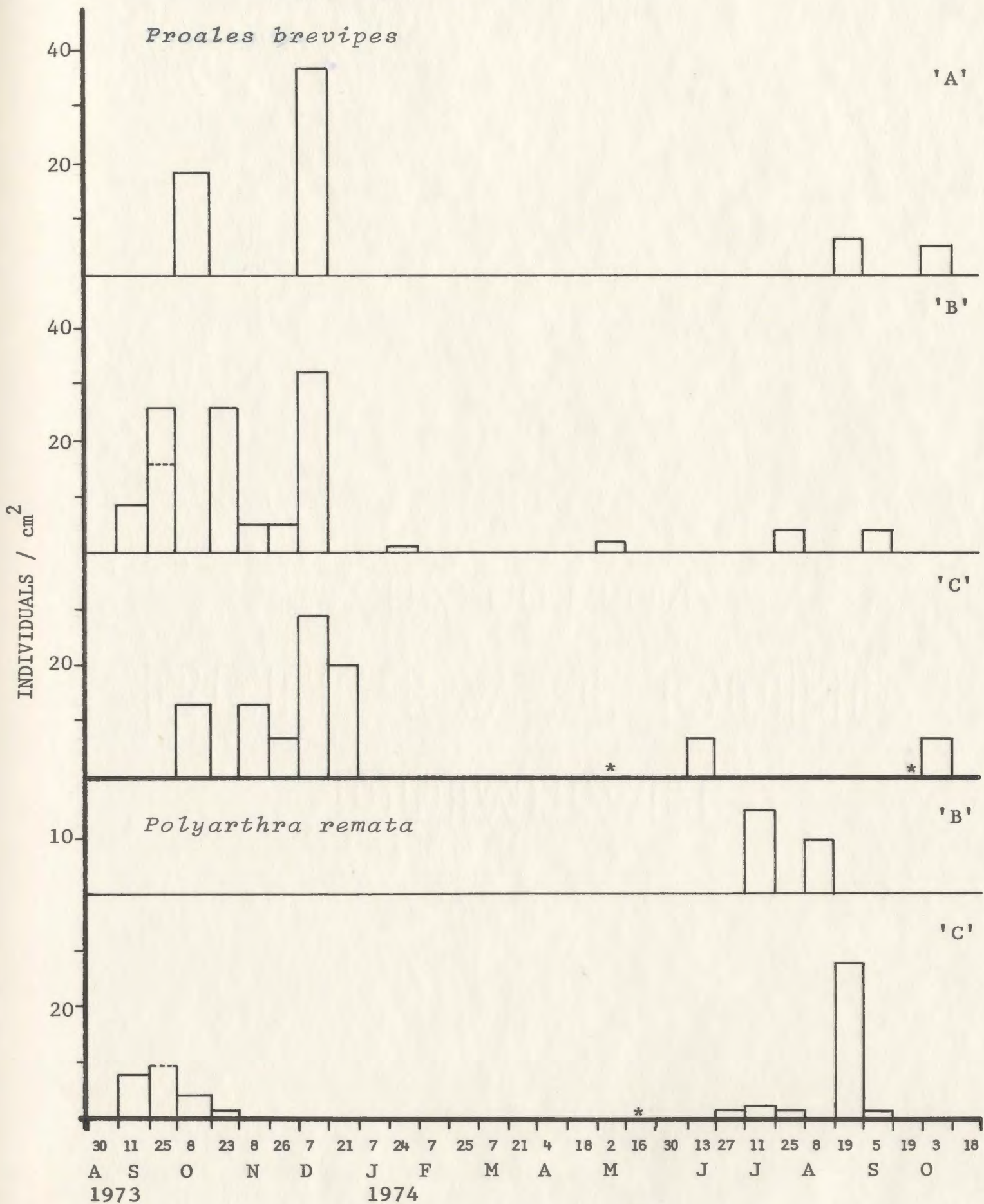


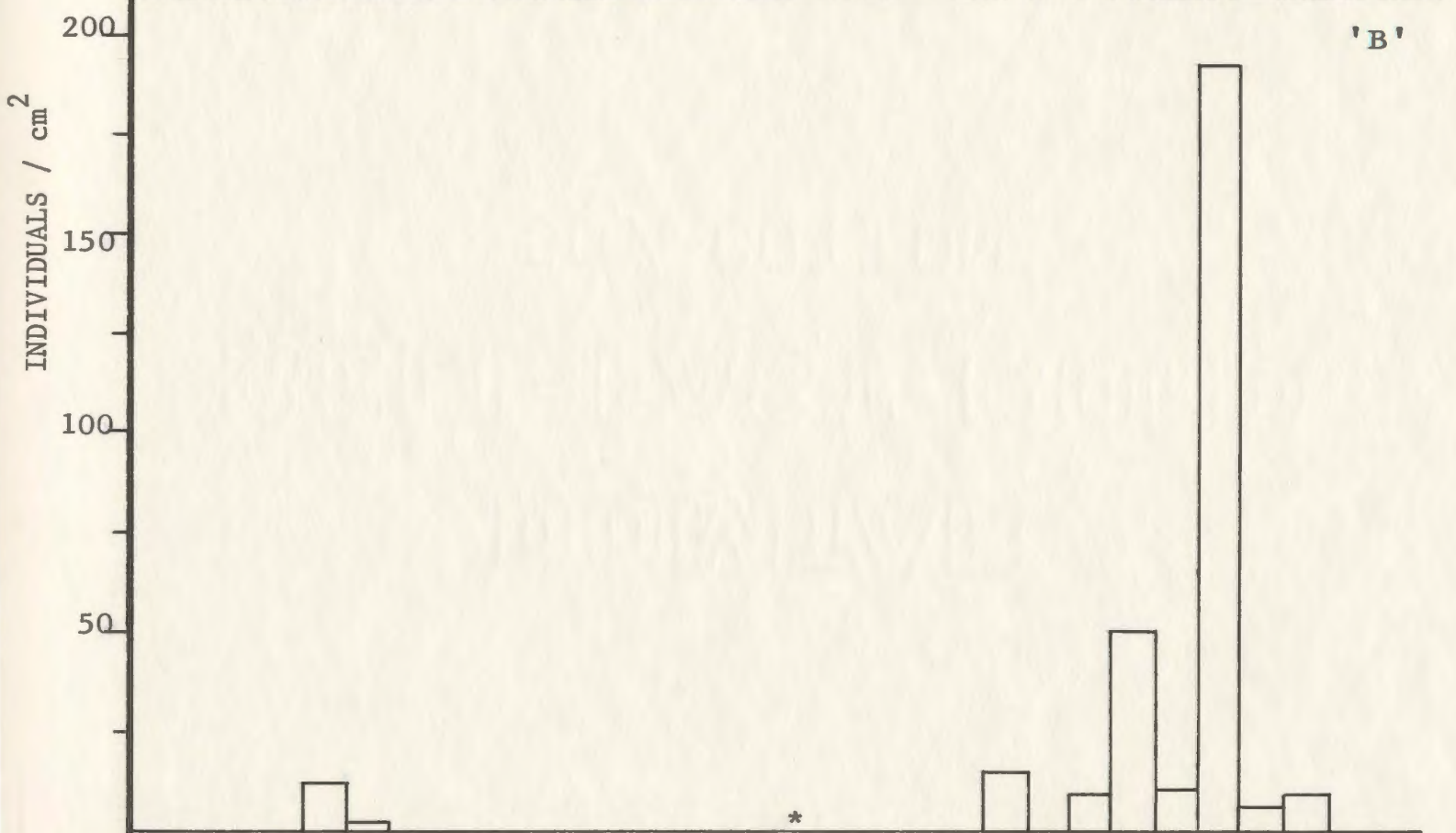
FIGURE 34

Elosa woralli

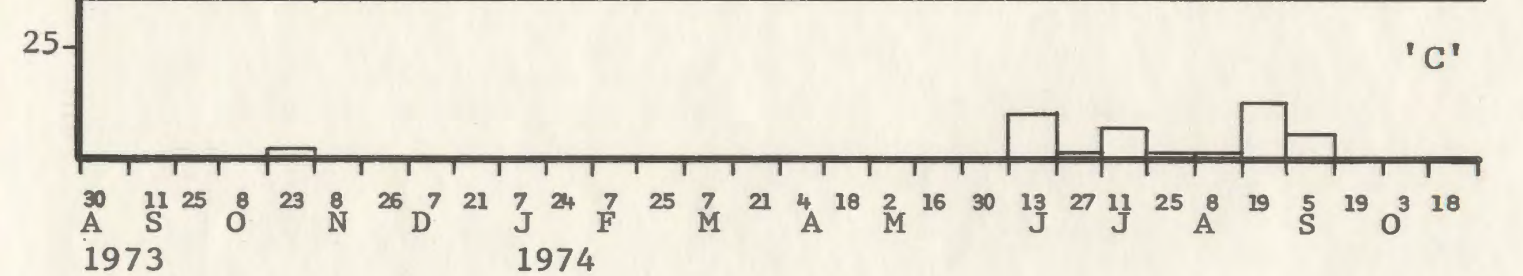
'A'



'B'



'C'



*

FIGURE 35

RELATIVE ABUNDANCE OF ROTIFERS IN HUMMOCK-HOLLOW FORMATIONS AT

SITES II, IV, V AND VI

- one or two individuals seen in sample
 + from 2 to 20 individuals seen in sample
 ++ more than 20 individuals seen in sample

A, B, C see Table VII

ROTIFER SPECIES	SITE II			SITE IV				SITE V			SITE VI	
	A	B	C	(i)		(ii)		A	B	C	A	C
				A	C	A	C					
<i>Habrotrocha collaris</i>							+					-
<i>H. constricta</i>			+				-	+	+			+
<i>H. constricta</i> (colourless form)	+		+					++	+	+		
<i>H. lata lata</i>	+	+	+	+	+	++		+	++			++
<i>H. roeperi</i>				+								
<i>Macrotrachela gunningi</i>						-						
<i>M. habita</i>			+			+		+		-		+
<i>M. multispinosa multispinosa</i>						-						
<i>M. plicata hirundinella</i>			+			-						
<i>M. plicata plicata</i>	+		+									- +
<i>M. quadricornifera quadricornifera</i>							+					
<i>Rotatoria rotatoria</i>												-
<i>Mniobia</i> (unidentified species)						+						
<i>Adinata steineri</i>						++						
<i>A. vaga minor</i>				++	++	+		+				
<i>Trichotria tetractis paupera</i>												++
<i>Colurella hindenburgi</i>								+				
<i>C. obtusa</i>								++	+			+
<i>Lepadella acuminata</i>								+				
<i>L. apsida</i>												+
<i>L. triptera</i>												+
<i>Squatinella microdactyla</i>								++				
<i>Lecane agilis</i>				+				+				
<i>L. stitchaea</i>												-
<i>L. (Monostyla) acus</i>									++			
<i>L. (M.) lunaris</i>												+
<i>Cephalodella gibba</i>												+
<i>C. hyalina</i>			-									
<i>C. strepta</i>												-
<i>Notommata falcinella</i>												-
<i>N. cyrtopus</i>												-
<i>Elosa woralli</i>			++									
<i>Proales brevipes</i>			+					+	+			
<i>Ptygura pilula</i>								++				
No. of bdelloid species	3	1	6	4	6	5	1	5	3	3	5	1
No. of Monogononta species	0	0	3	1	0	0	4	4	4	3	0	8
Total no. of species	3	1	9	5	6	5	5	9	7	6	5	9

The numbers of species found in the various areas are indicated. The two bdelloid species *Rotatoria rotatoria* and the unidentified *Mniobia* species, which had not been recorded as present in the poor fen, each appeared in a single hollow sample, the former from Site V, and the latter from Site VI. Six species of Monogononta which had not been present in Site I, were recorded at the following sites:

<i>Ptygura pilula</i>	-	In a wet hollow at Site IV.
<i>Cephalodella strepta</i>	-	In hollows at Sites V and VI.
<i>Lepadella apsida</i> , <i>L. triptera</i> , <i>Notommata cyrtopus</i> , <i>N. falcinella</i>	-	In hollow at Site VI.

(b). Contents of *Sarracenia purpurea* leaves.

The contents of various leaves of *Sarracenia purpurea* which were examined are listed in Table 9. As well as living organisms, all leaves contained detritus, which normally included insect cuticle remains. Three leaves contained no rotifers, and one leaf contained only a lorica of *Keratella cochlearis*. The remaining leaves contained living rotifers. No more than one species of living rotifer was found in any leaf. The bdelloids *Macrotrachela habita*, *Philodina proterva*, and the unidentified *Mniobia* species were the only species numbering more than two individuals in a leaf. No species was found to have living individuals in leaves more than once, although loricas of *Keratella cochlearis* were found in two leaves besides the leaf in which were recorded two living specimens of the same species.

(c). Results from Examination of Pools and Pool Edges.

Very few rotifers were found in the main water bodies of the small pools sampled. Three was the greatest number of species found in one sample, and this sample contained the only bdelloid species, *Rotatoria rotatoria*, found in any of the pools. Monogononta species found in the pools included *Trichotria truncata*, *Lepadella acuminata*, *Lecane (Monostyla) acus* and *Monommata aequalis* (Table 10).

TABLE 9

CONTENTS OF *SARRACENIA PURPUREA* LEAVES

DATE SAMPLED	ROTIFER SPECIES PRESENT	OTHER ORGANISMS PRESENT
APR. 14, 1973 (i)	NONE	chironomid larvae lepidopteran larvae
APR. 14, 1973 (ii)	NONE	culicid larvae
OCT. 23, 1973	<i>Mniobia</i> (unidentified species) -10 specimens	pennate diatoms
MAR. 7, 1974	<i>Keratella cochlearis</i> -2 specimens	
APR. 18, 1974	<i>Cephalodella</i> sp. -1 specimen	chironomid larvae appeared 5 days after sampling
MAY 16, 1974	<i>Keratella cochlearis</i> (lorica only)	chironomid larvae
JUNE 13, 1974	<i>Macrotrachela habita</i> -6 specimens <i>Kellicottia longispina</i> (lorica only) <i>Keratella cochlearis</i> (lorica only)	
JUNE 27, 1974	NONE	<i>Tabellaria</i> sp.
SEPT. 19, 1974	<i>Philodina proterva</i> -over 20 specimens, all containing eggs	

TABLE 10

OCCURRENCE OF ROTIFERS IN POOLS AND MARGINS OF POOLS

P sample taken from body of pool
 M sample taken from *Sphagnum* in margin of pool
 + species was represented in sample

ROTIFER SPECIES	SITE I				SITE II	SITE III								
	MAY 3, 1973		JUNE 6, 1973		OCT. 8, 1973		MAY 2, 1974		JULY 25, 1974		SEPT. 30, 1974		OCT. 8, 1974	
	M	P	M	P	M	P	M	P	M	P	M	P	M	P
<i>Habrotrocha collaris</i>	+													
<i>H. lata lata</i>			+						+					
<i>Macrotrachela plicata hirundinella</i>													+	
<i>M. plicata plicata</i>													+	
<i>M. quadricornifera quadricorniferoides</i>													+	
<i>Rotatoria rotatoria</i>	+	+						+						
<i>Trichotria tetractis paupera</i>														+
<i>T. truncata</i>	+	+	+					+		+	+			
<i>Colurella hindenburgi</i>					+			+				+		
<i>Lepadella acuminata</i>	+	+	+	+	+	+	+							
<i>L. apsidea</i>														+
<i>L. triptera</i>														+
<i>Squatinella minor</i>														+
<i>S. mutica</i>					+									
<i>Lecane (Monostyla) acus</i>	+		+		+		+		+	+				+
<i>Cephalodella apocolea</i>							+							
<i>Monommata aequalis</i>					+	+			+					
<i>M. longiseta</i>														+
<i>Dicranophorus lutkeni</i>													+	
No. of bdelloid species	2	1	1	0	1	0	1	0	1	0	1	0	3	0
No. of Monogononta species	3	2	3	1	5	2	5	0	3	2	2	2	2	6
Total no. of species	5	3	4	1	6	2	6	0	4	2	5	2	5	6

Sphagnum submerged at the edges of the pools supported a richer rotifer fauna, from four to six species being found in the samples. Bdelloids were fewer in number of species than Monogononta in most pool edges. The rotifer species found in the pools and the pool edges at the various sites are recorded in Table 10.

5. Guide to Preserved Illoricate Rotifers.

It was noticed that the majority of rotifers of any one species, upon contraction due to preservation in approximately 5% formalin, consistently assumed a particular form. It was possible, therefore, to produce a guide to preserved rotifers, consisting of diagrams of their contracted forms with appropriate size ranges and remarks. (Fig. 36 - 71). Included in the guide are 24 bdelloid species and 12 illoricate or semi-loriccate species of Monogononta. Most other Monogononta species found during the present study were loriccate. Since members of the loriccate genera *Keratella*, *Kellicottia*, *Trichotria*, *Lepadella*, *Colurella*, and *Lecane* (including *Monostyla*) are normally identified on the basis of the appearance of the lorica of contracted animals, diagrams of the contracted animals already exist in several keys and monographs (Harring (1917); Harring and Myers (1921, 1924, 1926, 1927); Hauer (1924); Wulfert (1938); Ahlstrom (1943); Edmondson (1949)).

The unidentified *Mniobia* species was not included in the guide as all specimens died shortly after an attempt was begun to culture the species. The appearance of the contracted forms of *Adineta gracilis* and *A. vaga minor* were virtually indistinguishable, therefore one drawing is given for both species, and the results of the quantitative portion of the study are expressed as a combined total of both species.

Diagrams for the following non-loriccate or semi-loriccate species were not constructed, principally due to lack of suitable specimens: *Squatinella*

Figures 36-71

Guide To Preserved Illoricate Rotifers

Diagrams of contracted forms of illoricate rotifers.

All diagrams drawn to same scale.

GUIDE TO PRESERVED ILLORICATE ROTIFERS

1. SMALL SPECIMENS $\leq 80\mu$ IN LENGTH

a. BDELLOIDEA

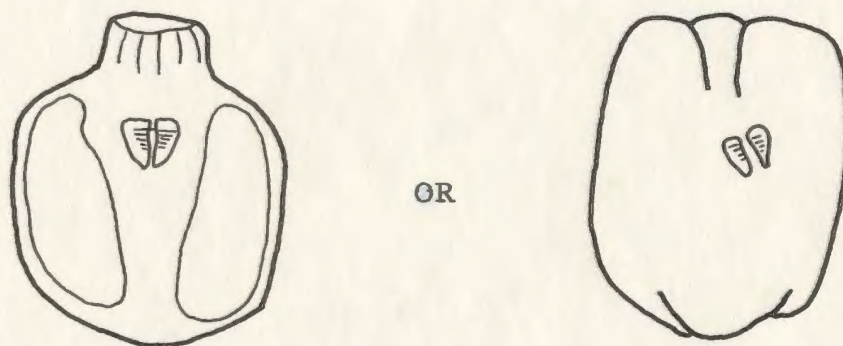


FIGURE 36

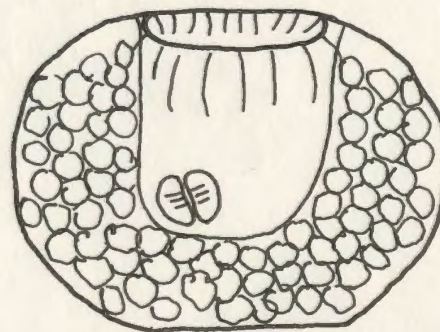
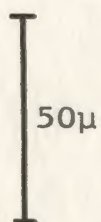
Length 70-80 μ Width 50-60 μ *Habrotrocha constricta* (colourless form)

FIGURE 37

Length 50-80 μ Width 65-90 μ

Colour: yellow-gray to orange

Width always greater than length

Habrotrocha lata lata

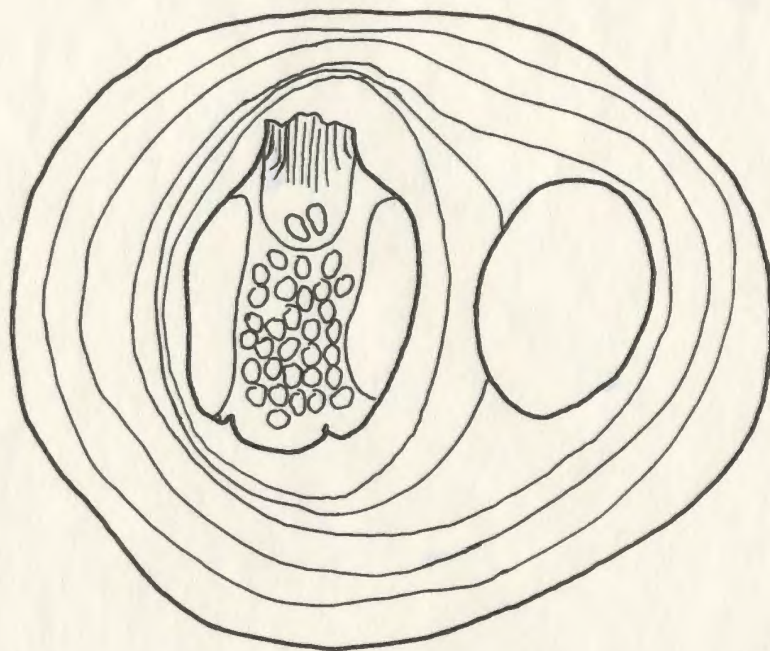
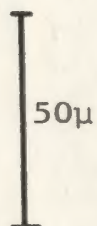


FIGURE 38

Length 80 μ Width 50 μ Secreted 'nest' approximately
160 μ x 150 μ Shown with egg (60 μ x 35 μ)*Habrotrocha pusilla tatrix brevilabris*

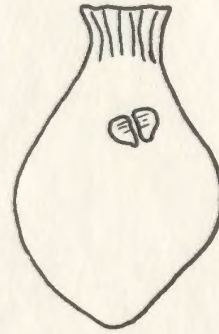
OR



FIGURE 39

Length 50-60 μ Width 35-40 μ *Habrotrocha roeperi*

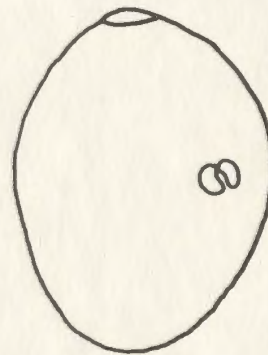
FIGURE 40



Length 80 μ
Width 40 μ
Colourless

Habrotrocha tridens

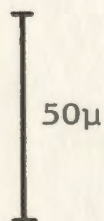
FIGURE 41



Length 80 μ
Width 55 μ

Macrotrachela natans

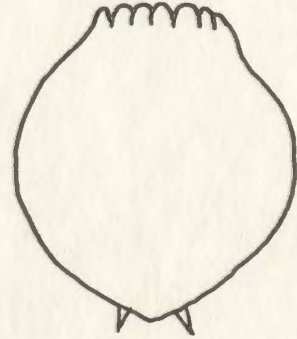
FIGURE 42



Length 70 μ
Width 60 μ

Macrotrachela papillosa

FIGURE 43

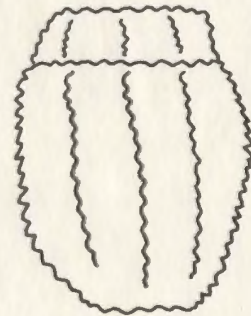
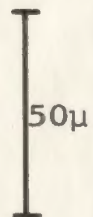
Length 80 μ Width 60 μ

Colourless

Spurs always protrude
beyond posterior end
of contracted specimen

Rotatoria rotatoria

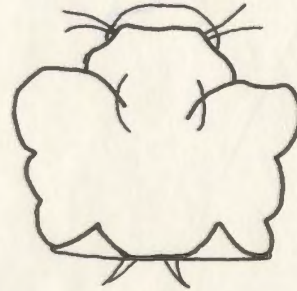
FIGURE 44

Length 75 μ Width 50 μ *Mniobia bredensis*

1. SMALL SPECIMENS $\leq 80\mu$ IN LENGTH

b. MONOGONONTA

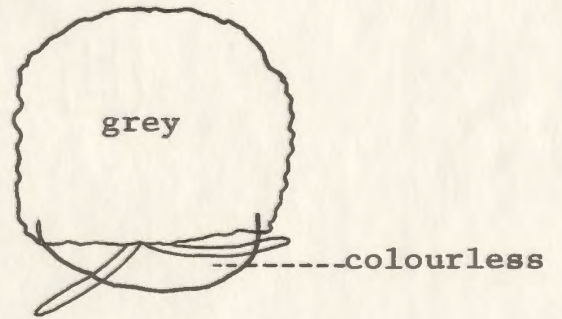
FIGURE 45



Length 60 μ
Width 60 μ
Cirri and/or toes not
always visible

Squatinella mutica

FIGURE 46



Length 70 μ
Width 60 μ

Squatinella mutica aurita

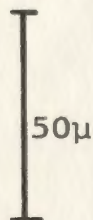


FIGURE 47

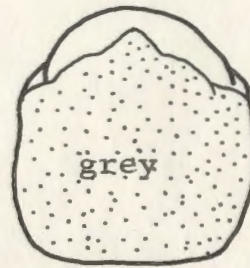
Length 62 μ Width 50 μ *Squatinella minor*

FIGURE 48

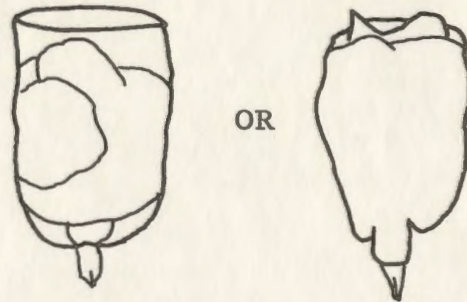
Length 70 μ Width 30-35 μ *Lecane agilis*

FIGURE 49

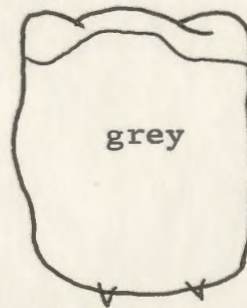
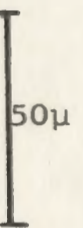
Length 60-70 μ Width 40-50 μ *Proales brevipes*

FIGURE 50



Length 60μ
Width 50μ

Proales decipiens

FIGURE 51



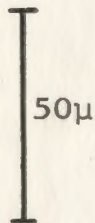
Length(excluding toes)
80μ
Width 50μ

Cephalodella apocolea

FIGURE 52

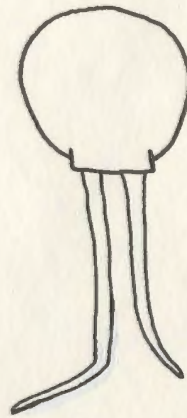


Length(excluding toes)
54μ
Width 40μ



Cephalodella gibba

FIGURE 53



Length(excluding toes) 40 μ
Width 35 μ

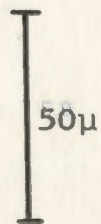
Monommata longiseta

FIGURE 54



Length 70 μ
Width 20 μ

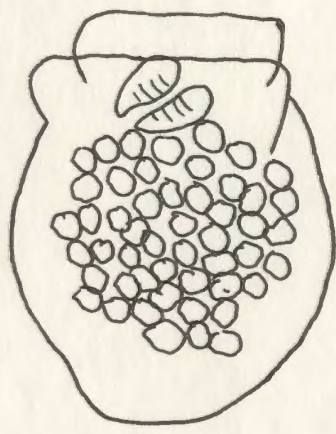
Elosa woralli



2. MID-SIZED SPECIMENS >80μ AND ≤100μ IN LENGTH

a. BDELLOIDEA

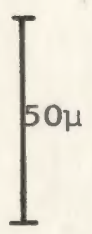
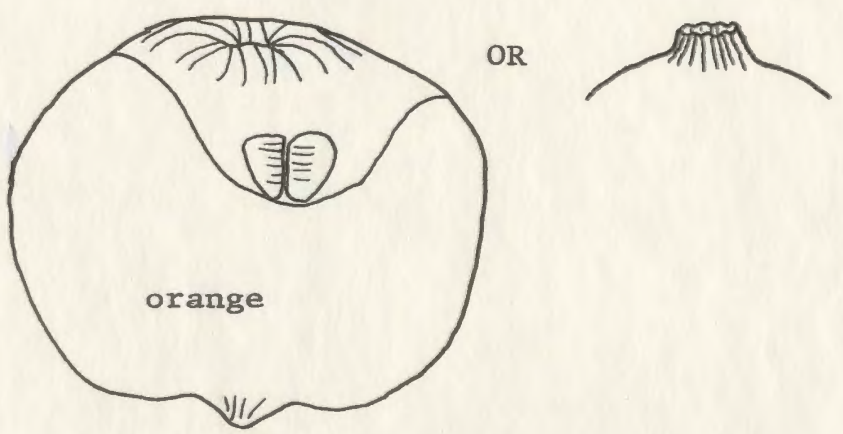
FIGURE 55



Length 80-100μ
 Width 55-68μ

Habrotrocha collaris

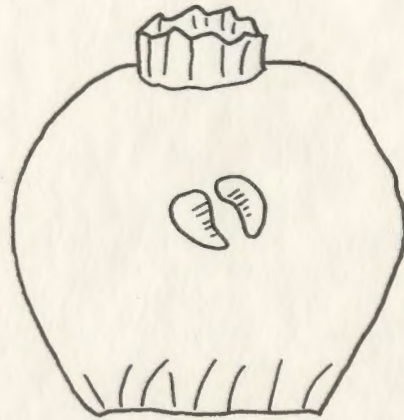
FIGURE 56



Length 100μ
 Width 95-100μ
 Point of rump always visible

Habrotrocha constricta

FIGURE 57

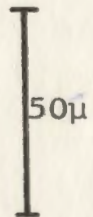


Length 90-100 μ

Width 75-82 μ

Macrotrachela musculosa

FIGURE 58



Length 100 μ

Width 60 μ

Macrotrachela multispinosa
(short-spined form)

FIGURE 59

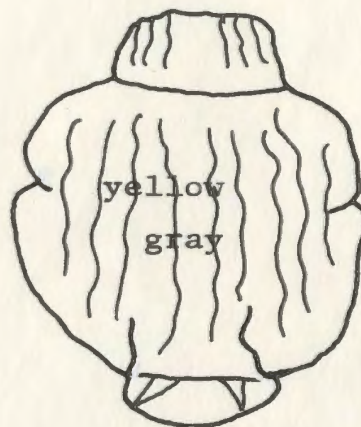
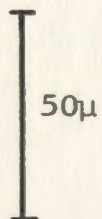
Length 100 μ Width 75 μ *Adineta steineri*

FIGURE 60



Length(exclusive of spurs)

100 μ Width 70 μ

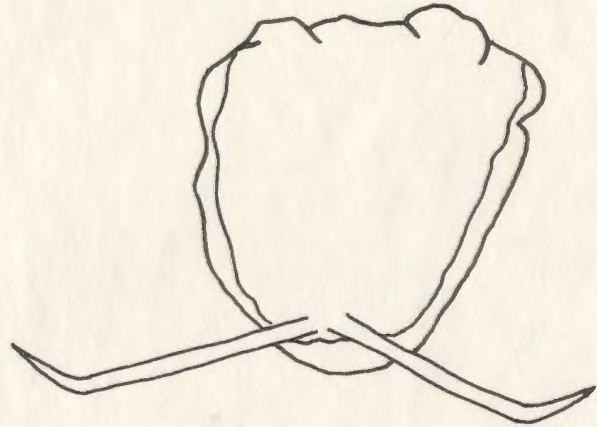
Unidentified bdelloid

NOTE: *Adineta gracilis* and *A. vaga minor* infrequently produced contracted specimens of this size range. See FIG. 68 in 3.a.

2. MID-SIZED SPECIMENS $>80\mu$ AND $\leq 100\mu$ IN LENGTH

b. MONOGONONTA

FIGURE 61



Length 90μ
Width 70μ

Dicanophorus lütkeni

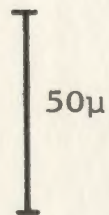
3. LARGE SPECIMENS $>100\mu$ AND $\leq 120\mu$ IN LENGTH

a. BDELLOIDEA

FIGURE 62



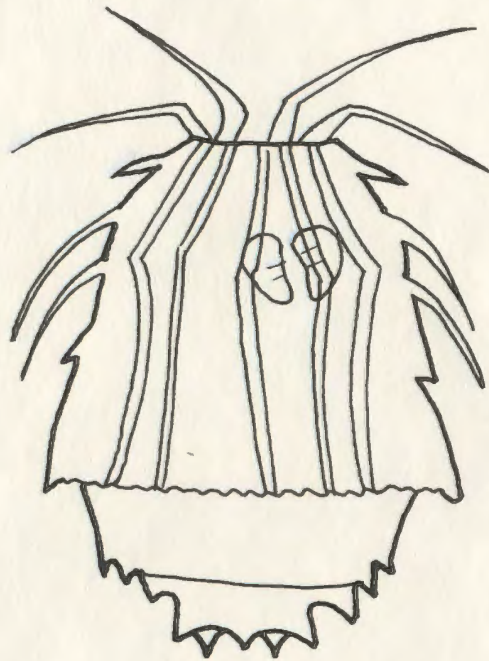
Length $100-120\mu$
Width $70-80\mu$



Length

Macrotrachela habita

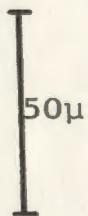
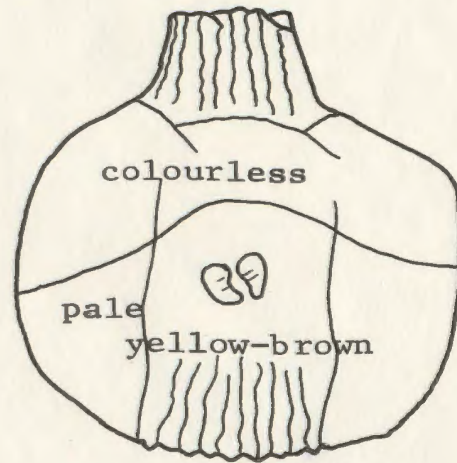
FIGURE 63



Length 120μ
 Width 80μ

Macrotrachela multispinosa multispinosa

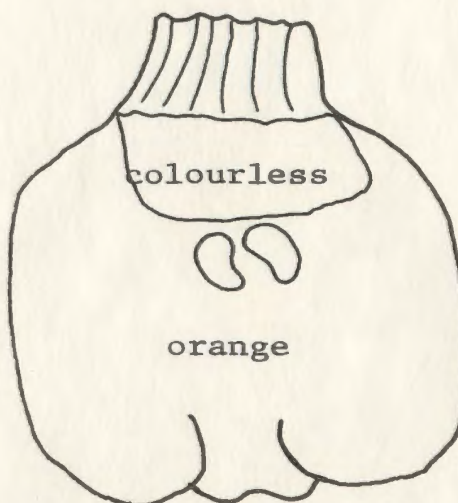
FIGURE 64



Length 100-110μ
 Width 90μ
 Mastax dark brown

Macrotrachela plicata hirundinella

FIGURE 65

Length 110-120 μ Width 80-95 μ

Mastax dark brown in colour

Macrotrachela plicata plicata

FIGURE 66

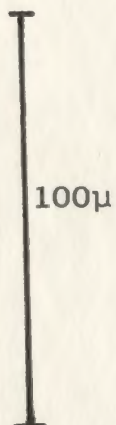
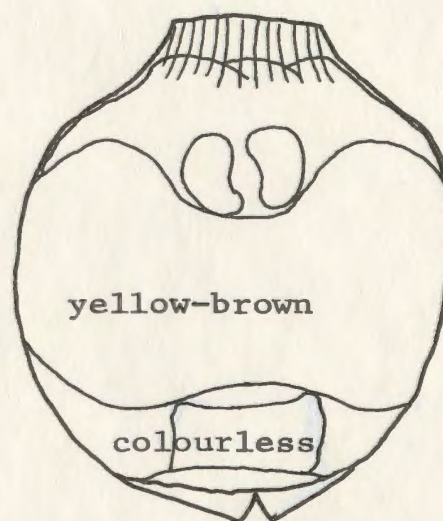
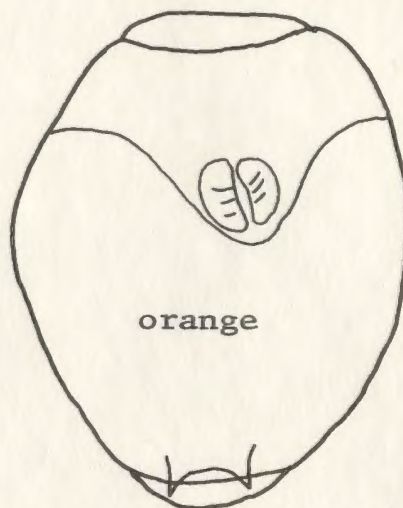
100 μ Length 110-120 μ Width 80-90 μ *Macrotrachela quadricornifera**quadricornifera*

FIGURE 67



orange

Length 110-120 μ Width 80 μ

Spurs always visible

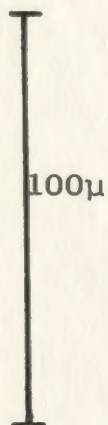
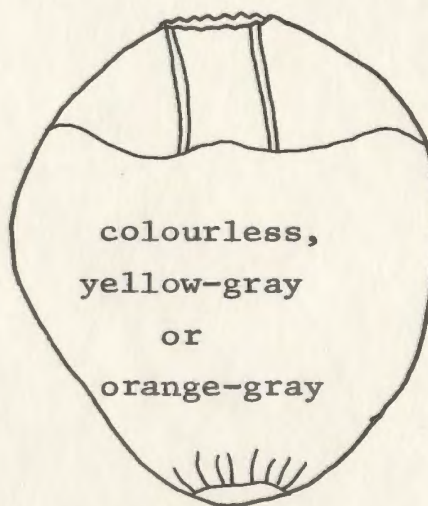
Philodina proterva

Figure 68

colourless,
yellow-gray
or
orange-grayLength 80-120 μ Width 50-60 μ

Mastax not usually visible

Adinata gracilis + A. vaga minor

NOTE: Some specimens of *Macrotrachela quadricornifera quadricorniferoides* may fall in this category. See FIG. 70 in 4.a.

3. LARGE SPECIMENS $\geq 100\mu$ AND $\leq 120\mu$ IN LENGTH

b. MONOGONONTA

None of the Monogononta found during the present study occurred in this size range.

4. VERY LARGE SPECIMENS $> 120\mu$ IN LENGTH

a. BDELLOIDEA

FIGURE 69

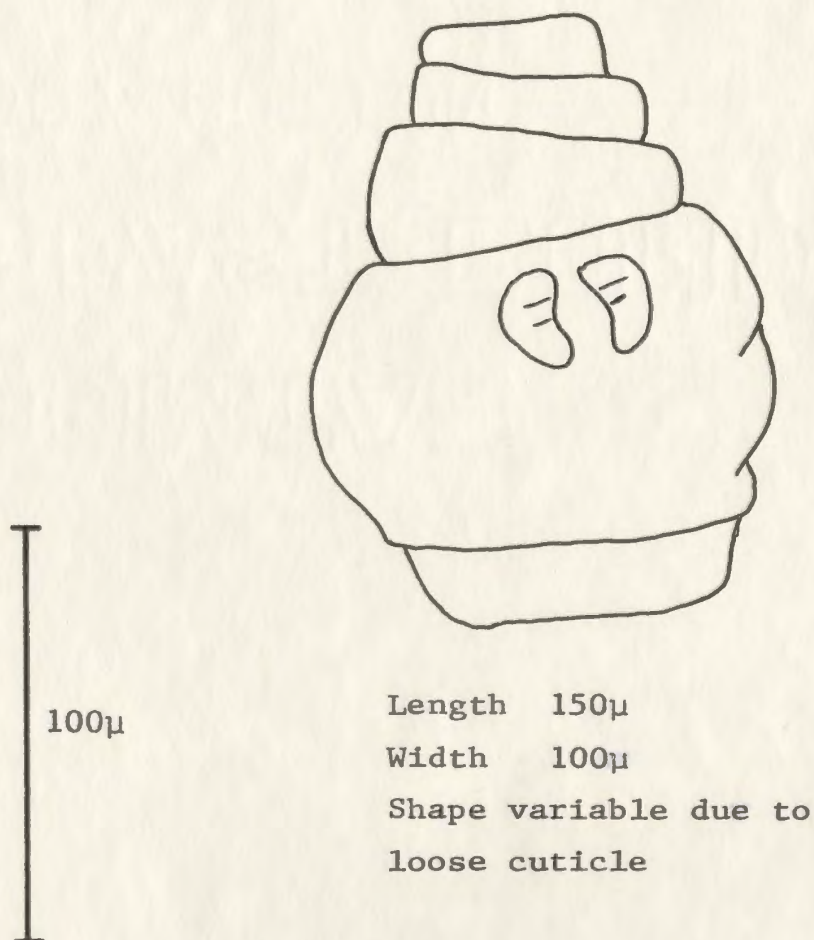
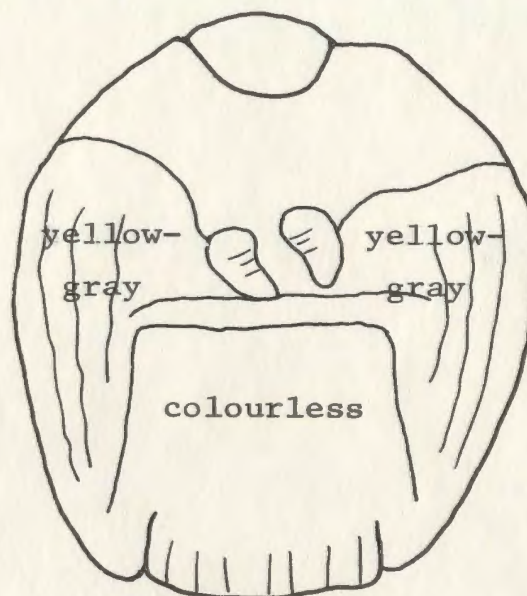
*Macrotrachela gunningi*

FIGURE 70

Length 100-160 μ Width 70-110 μ *Macrotrachela quadricornifera quadricorniferoides*4. VERY LARGE SPECIMENS >120 μ IN LENGTH

b. MONOGONONTA

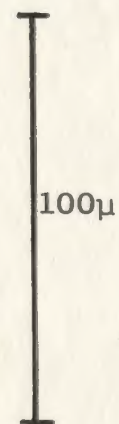


FIGURE 71

Length 190 μ Width 110 μ *Cephalodella tenuiseta*

microdactyla, *Cephalodella strepta*, *Monommata aequalis*, *Notommata cyrtopus*, *N. falcinella* and *Ptygura pilula*. Of the above, only *Monommata aequalis* and *Squatinella microdactyla* appeared in any of the quantitative samples from Site I. Both occurred rarely, and both were easily recognizable in the contracted state.

Slight variations in size and such physical characteristics as wrinkles and folds appeared in the contracted forms of most species, so the diagrams in the guide represent a 'typical' appearance, constructed from several individuals, rather than an exact reproduction of the appearance of a single specimen. In the case of four species, two distinct variations of the contracted shape appeared regularly and both are represented in the guide. These four species were; *Habrotrocha constricta*, the colorless form of *H. constricta*, *H. roeperi*, and *Lecane agilis*.

The construction of a key to accompany the diagrams which form the guide was attempted. This did not prove feasible. However, in order to facilitate the use of the guide, the diagrams are presented in various categories according to size and taxonomic class. Bdelloids are always distinguishable, as the ramate mastax is usually clearly visible. Most Monogononta fall in the 'small' category.

6. Maintenance of Rotifer Samples.

(a). Refrigerated Samples.

Samples of *Sphagnum* which had been resting in a refrigerator at 11° c., produced motile rotifers within varying lengths of time, directly dependent on the refrigeration time. In samples refrigerated less than a week, numerous rotifers were evident within an hour after the sample was wetted and brought to room temperature. In samples refrigerated from one week to a month, numerous rotifers became active within a few hours of wetting. The time elapsing between removal from the refrigerator and the appearance

of active rotifers gradually increased with an increase in the time spent in the refrigerator by the sample. In samples which were refrigerated for more than one or two months, several days elapsed before more than one or two active rotifers appeared in the wetted sample. These samples required approximately two weeks to establish a population equivalent in numbers and species to the original sample.

(b). Dried Samples.

Three species of rotifer appeared in large numbers from *Sphagnum* samples which had been air dried at room temperature and then covered with water. All of these samples contained several rotifer species before drying, but in each sample, only one or two species appeared in any numbers after the rewetting. *Habrotrocha lata lata*, *Adineta steineri* and *Macrotrachela quadricornifera quadricorniferoides* appeared in their respective samples within a few days. *H. lata lata* and *A. steineri* appeared in great numbers within two days and the majority of individuals of both species contained eggs. Both species survived over six months in the original bowl at room temperature, with additions of water to maintain the level. The numbers of *M. q. quadricorniferoides* increased more slowly, and the population did not survive more than three months. *M. gunningi* also appeared in a previously dried sample but only in small numbers. This species did not survive more than a week in the finger bowl.

(c). Samples Maintained at Room Temperature.

The leaf of *Sarracenia purpurea* which contained individuals of *Philodina proterva* was placed in a finger bowl with water and left at room temperature in September, 1974. In June, 1975, the population was still flourishing, much increased in numbers from the original sample.

Samples of *Sphagnum* placed in finger bowls of water became impoverished in the number of species of rotifer present after approximately one month at room temperature. If *Lecane (Monostyla) acus*, *L. (M.) galeata* or *Proales*

decipiens was present in the original sample, the species increased in numbers in the first week, but decreased and then disappeared after three to four weeks. The samples then usually maintained mixed populations of *Habrotrocha lata lata*, the colourless form of *H. constricta* and *Adineta vaga minor* for several months, as these species were present in nearly all the original samples.

7. Rotifer Monoculture Experiments.

Dicranophorus lutkeni was the only species of rotifer from those used that was successfully raised in monoculture in a finger bowl with *Sphagnum* and water. All other attempts using this method failed when the specimens placed in the bowls died within a period of a few days to two weeks without producing living progeny.

The second culture method using skim milk powder was totally unsuccessful under existing laboratory conditions. No living rotifers were found in the medium after two days.

DISCUSSION

The micro-environment of organisms inhabiting *Sphagnum* hummocks has long been recognized as unique, combining acidic properties and low mineral content with a high humidity. The acid-forming properties of the species of the genus, which have a higher ability than other plants for cation exchange at low pH conditions, have been discussed by Moore and Bellamy (1974). However, conditions are not uniform within areas of *Sphagnum*, as there is an increase in pH from hummock top to pool (Clymo, (1963), Mueller (1973), Moore and Bellamy, (1974)). Variations in the ion exchange ability of the *Sphagnum* are correlated with the height above the free-water table, and with the pH of the water around the plants (Clymo, 1963). The lower overall pH of hummock tops, which is in turn lowest in the summer, is attributed partially to evaporation rates in these areas, which are higher than in the hollows or lower slopes of the hummocks. The higher rate of evaporation is due to the greater exposure of the hummocks (Clymo, 1963), and is increased in summer by higher environmental temperatures (Moore and Bellamy, 1974). Moore and Bellamy also conclude there is a higher ion exchange capacity in hummock-forming species of *Sphagnum* than in the other species, which may be explained by Clymo's (1963) statement that there may be a greater chemical concentration of exchange sites in hummocks.

On all sites examined in the present study, higher pH values were recorded from pools and hollows than from hummock slopes and hummock tops. In site I, there were irregular pH fluctuations from time to time in all areas of the hummock-hollows complex, a phenomenon not discussed in any previous studies. It is probable these fluctuations were caused in part by the frequent rainstorms and subsequent irregularities in the water table

at Site I, although it has not been found possible to correlate specific changes in pH with any of the observed changes in the water table. The fact that the pH readings were not taken in the same hummock-hollow formation throughout the study, would reflect local differences, thus contributing to the irregular graphs produced (Fig.14, 15 & 16). It would be interesting to record the pH values of a single hummock-hollow formation over the period of a year.

It has been estimated that the relative humidity within a *Sphagnum* micro-habitat is always greater than 94% (Reichle, 1967). Reichle also maintains that even the surface layers of a bog rarely become dessicated. Dry *Sphagnum* was never found in hummock tops at any site studied in the present investigation, so the problem of dessication as a result of a dry environment is probably non-existent in peatlands at sites I to VI. In Site I, it is more likely that the inhabitants of the hummocks have flooding to contend with. Dai, Haavisto and Sparling(1974) have found in Northeastern Ontario, that poor fens are generally wetter throughout the year than bogs, as they are characterized by a higher water table which responds more strongly to rain than does that of bogs. In both 1973 and 1974, at Site I, Goat Cove Brook was much higher in August and September, than during the spring runoff. At such times the fen had a higher than normal water level, and contained many more temporary pools, or flooded hollows, than during the remainder of the year.

Existing data on temperature profiles of *Sphagnum* hummock-hollow formations is somewhat contradictory, probably due to differences in local environmental factors such as air temperature, intensity and duration of sunlight and surface evaporation. Wilson(1939) found temperatures from *Sphagnum* to be similar to the ambient air temperatures, within the top one

foot (30.5 cm.) with a major drop in temperature occurring below that level. In studies by Reichle(1967), the temperature drop occurred in the first five centimeters of *Sphagnum*, while Norgaard (1951) noted a steep drop within the first ten centimeters. Temperatures of the present study were recorded within the top five centimeters of moss, although no attempt was made to determine at precisely what depth they were taken. No significant drop from the air temperature was observed, and it can be concluded that in the habitats examined the temperature within the hummocks, hollows and pools does not differ greatly from the air temperature, and is therefore, subject to similar fluctuations, except when frozen during the cold season. The pools examined in Site I, were too small and shallow to exhibit strongly the reduction in temperature variation that was noted by Mueller (1973) in open water in bogs, as opposed to temperature variations shown by water trapped within the vegetation.

Very few methods, other than the use of a peat-corer, have been utilized in quantitative faunal studies of peatlands. Heal(1962) managed to estimate rhizopod numbers by counting specimens on individual plants. Blackith(1974) used a method similar to that employed in the present study, his instrument for cutting waterlogged peat being a serrated bread knife. The peat in the latter study was probably of a firmer consistency than the living *Sphagnum* encountered at Site I, on which a straight-edged knife was most successful.

By using individual plants, as mentioned above, Heal(1962) eliminated the necessity of achieving accuracy in both parts of the sampling process, that is in the procurance of the original sample and in the extraction of the organisms from the plant material. Overgaard(1948) claims over 90% accuracy using an extraction method for rotifers and nematodes, without describing his sampling technique in the field. No information was

provided concerning the type of moss sampled, nor the specific rotifers found with his method, which was based on the organisms suffering a non-fatal heat paralysis and dropping through the water-covered sample to a collecting vessel where they recover. The method could lead to gross inaccuracies in that sessile rotifers would be unlikely to be released from the sample, and in *Sphagnum*, bdelloids would sometimes contract in the spaces enclosed by the rolled leaves rather than in the free water, and be prevented from dropping through the sample.

Similarly, the method of quantitative sampling devised for the present study, although designed to accommodate the unique characteristics of the medium to be sampled, cannot be described as a highly accurate procedure. Since the sample was cut "by sight" into a box-like shape, approximately of the dimensions chosen, there is a possibility of inaccuracies in the sample sizes. Loss of specimens conceivably could occur, although care was taken to minimize this, at any point in the transfer of the sample from the site to the sample bag, to the finger bowls, and during the sieving process. Since more than one species of *Sphagnum* was involved, often in the same sample, individual samples may have contained more or less plant surface area, depending on the various structures of the species, and the amount of crowding of the plants. Counts of *Sphagnum* plants in samples during extraction of the rotifers indicated that most samples contained approximately twenty to thirty plant stems. However, in one sample of very thin *Sphagnum* stems, over fifty were included in the sample. This variance could alter the amount of water trapped in a particular sample. The *Sphagnum* species present in individual samples were not recorded. It was beyond the design of this study to determine whether any rotifer species exhibit preferences for particular *Sphagnum* species.

In spite of its disadvantages, this sampling and extraction method

is useful. It can be repeated on other *Sphagnum* areas to produce comparable results, expressed in the same units in future studies. It should be also possible to compare results of this method with results obtained by using other sampling methods, if similar units are employed. The method is preferable to the use of specific volumes or weights of the sampled plant material, the procurement of either of which would be more difficult logistically and cause more disturbance and possible loss of the specimens. The use of individual plants, or a specific number of them is impractical in sampling rotifers, all of which cannot be assumed to be attached to, or resting on, the plant at the time of sampling. This is especially true in wetter areas, inhabited by numerous species of swimming Monogononta.

Preservation before extraction of the specimens from plant material ensures that most rotifers, especially bdelloids, become detached from plant surfaces. That the subsequent washing and filtering extracts a high percentage of the rotifers contained in the original sample was confirmed by examination of extra rinsings carried out on normally treated samples.

This extraction method would not be useful in indicating the presence of sessile rotifers accurately. In the present study, this presented no problem, as no sessile rotifers were found in Site I, where quantitative sampling was carried out. A few specimens of a single sessile species occurred in one qualitative sample from Site IV.

The quantitative results in this study should be regarded more as indicative of trends in rotifer populations of the peatland studied, than as representations of actual population numbers. The only figures available from peatlands for comparison are those of Heal(1962) for testaceous amoebae, which he found occurred at the rate of 1600/sq.cm. In the present study, rotifers ranged from 44/sq. cm. to 1260/sq. cm.

The guide to preserved illoricate rotifers described above proved to be extremely useful in the present study during enumeration of the samples. It's usefulness to other investigators depends on the tendency of the various rotifer species to consistently assume the illustrated shapes under varying experimental and preservation conditions. Experiments in which several of the species included in the guide were preserved in various alcohol concentrations and in undiluted formalin indicated that such consistency can be expected.

The procedures employed in the establishment of the guide are not difficult, and additions to the present guide, or guides designed for future specific investigations involving illoricate rotifers, may be useful.

Very few diagrams of contracted rotifers excepting loricate ploimates, have been published, except to illustrate how "impossible" it is to identify the species from such a specimen (Donner, (1966), Edmondson, (1959)), so it is difficult to compare drawings in the guide with contracted specimens as seen by other investigators. Zelinka(1886) produced a drawing of a contracted *Mniobia symbiotica*, a species not encountered in the present study. Hudson and Gosse(1886) have produced a few diagrams of contracted or, more often, partially contracted bdelloids. A diagram of *Adineta vaga* by H. Davis(1873) closely resembles the contracted structures of both this species and *A. gracilis* as seen by the present author. Unfortunately, the contracted structures of these two *Adineta* species are not sufficiently different in the present study to enable them to be distinguished. Davis does not mention what preservative, if any, was used. Bdelloids exhibiting spiny or very rough cuticles which, like the cuticles of loricate Monogononta are often used for identification purposes, are more often figured in their contracted state (see Donner,1965).

The geographical distribution of rotifers is irregular, although many

species are regarded as cosmopolitan (Edmondson, (1944)). Jennings, in Ward and Whipple, (1918), stated: "Two bodies of water half a mile apart, presenting entirely different conditions, are likely to vary more in their rotifer fauna than two bodies of water 5000 miles apart that present similar conditions". Dependent partially upon wind currents and the feet and intestines of birds for their distribution as eggs or cysts, the success of a rotifer species at the site of 'landing' is determined by local environmental factors rather than by geographical location. However, recently, Green, (1972) has discovered that the farther apart in latitude two areas are, the greater is the difference in their planktonic rotifer fauna. Green recognizes four groups of planktonic Rotifera based on distribution: cosmopolitan, cosmotropical, arctic-temperate and American. No similar system of classification exists for any group of non-planktonic rotifers. Several of the species found during this study have, however, been described as cosmopolitan by various investigators, including the usually planktonic *Kellicottia longispina* and *Keratella cochlearis* (Ahlstrom (1943)). These two species, which Pejler (1957a) terms the two commonest planktonic rotifers in temperate lakes, have been found in most studies of Newfoundland plankton (Megyeri, (1969), Davis, (1972a, 1972b), Duthie and Ostrofsky, (1974), O'Connell, (1974)). In his monograph on the bdelloids, Donner, (1965) has described as cosmopolitan the following species found in this study: *Habrotrocha constricta*, *H. angusticollis angusticollis*, *Macrotrachela plicata plicata*, *M. habita*, *M. quadricornifera quadricornifera*, *M. q. quadricorniferoides*, *M. multispinosa multispinosa*, *M. papillosa*, *M. musculosa*, *M. ehrenbergi*, *Rotatoria rotatoria*, *Adineta gracilis* and *A. vaga minor*. Also included in this category are *Lepadella acuminata*, Harring, 1917) and *Ptygura pilula* (Edmondson, 1949).

Among the Monogononta, both planktonic and non-planktonic species are

often grouped according to Myer's(1931) ecological divisions which segregate acidic, alkaline and transcursional (pH tolerant) species. It is recognized that the concentration of the hydrogen ion itself is not the limiting factor in the occurrence of a particular rotifer species, but that it may be one or more of several variables, such as total dissolved salts, calcium or bicarbonate, all of which contribute to a pH readings (Pennak,1953). Bdelloids, being tolerant of a wide pH range, are all regarded as transcursional (Pennak, 1953).

Acidic habitats (pH 4.0 - 7.0) are characterized by small numbers of individuals of many species of ploimate rotifers, while in areas with higher pH, fewer species are present in large numbers, and below pH 4.0 few individuals or species are found (Harring and Myers, 1927). Following these criteria, the rotifer fauna of bogs and fens should consist of small populations of a relatively large number of acidic and transcursional species. No figures are available in the literature for comparison with the population numbers obtained in the present study because other quantitative rotifer studies, carried out on planktonic, sessile or psammon communities, express results in number of specimens per volume of water (for example, Davis (1972a), Pennak (1949 , 1940), Edmondson (1946)). In faunal investigations of various *Sphagnum* peatlands in France, Batut(1965) found a maximum of 38 species of Monogononta at one site. Thirty-nine species were encountered in the present study of Site I. Fourteen species found by Batut in France were present in the Newfoundland sites, including eight of the ten species she found most abundantly and most frequently in wet or damp *Sphagnum*.

The following species found in the peatland sites studied were described by Bryce (1929) as common to boggy habitats: *Lepadella acuminata*, *Lecane stitcheae*, *L. flexilis*, *L. agilis*, *L. (Monostyla) acus*, *L. (M.) galeata*, *L. (M.) lunaris*, *Dicranophorus lütkeni* and *Elosa woralli*. He also included

the bdelloids *Adineta gracilis*, *Macrotrachela plicata*, *M. quadricornifera*, *Habrotrocha angusticollis*, *H. constricta*, *H. lata* and *H. roeperi*.

No members of Myer's (1931) alkaline genera *Brachionus*, *Eosphora*, *Notholca*, *Sinantherina* or *Lacinularia* occurred in the sites of the present investigation. Twelve acidic species and 17 transcurSIONal species were found (exclusive of bdelloids). These species are listed in Table 11.

Characteristic of all rotifer populations are their unpredictable fluctuations in both numbers of individuals and relative importance of species from year to year Edmondson (1946). In planktonic rotifers, Green(1972) recorded great fluctuations occurring over short periods of time, and Batut (1965) found a similar phenomenon in rotifers of *Sphagnum* habitats. As a result of similar findings, Wesenburg-Lund in 1923 concluded that although it is feasible to predict with some accuracy a season of maximum numbers for planktonic species, it is totally impossible for rotifer species found in vegetation. Erratic fluctuations in total and individual species population numbers and to a lesser extent in numbers of species occurred in the present investigation in the three areas studied quantitatively at Site I. It must be remembered that because consecutive samples were not obtained from the same hummock-hollow formations these fluctuations are not those in a single community. The rotifer communities of separate hummock-hollow formations, though exposed to similar physical and environmental conditions, and lying perhaps within a meter of each other, will on the same data contain different combinations of species, each species represented by a different population size in the two areas.

The quantitative results from the present study do, however, indicate certain properties of rotifer communities in the fen. The rotifer populations of this and the other peatland sites studied on the Avalon Peninsula are similar to those described in *Sphagnum* areas elsewhere(Batut (1965),

TABLE 11

ACIDIC AND TRANSCURSION ROTIFER SPECIES FOUND DURING STUDY

- * unless otherwise indicated, acidic species as listed by Wulfert(1951), transcurSION species by Myers(1931)
 # occurs only in *Sphagnum*(Edmondson,1940)
 + described as pH tolerant by Wulfert(1951)
 = described as possibly acidophilic by Wulfert(1951)

ACIDIC SPECIES *	TRANSCURSION SPECIES *
<i>Colurella hindenburgi</i>	<i>Colurella obtusa</i>
<i>C. tessellata</i>	<i>Keratella quadrata</i>
<i>Keratella taurocephala</i> (Ahlstrom,1943)	<i>Lepadella acuminata</i>
<i>Lecane elasma</i>	<i>L. triptera</i>
<i>L. lauterborni</i>	<i>Squatinella mutica</i>
<i>L. stitchaea</i>	<i>Trichotria tetractis</i>
<i>L. (Monostyla) acus</i>	= <i>Lecane agilis</i>
<i>L. (M.) galeata</i> (Wulfert,1956)	<i>L. flexilis</i>
+ <i>Cephalodella apocolea</i> (Myers,1931)	<i>L. tenuiseta</i>
<i>C. strepta</i> (Myers,1931)	<i>L. (Monostyla) closterocerca</i>
# <i>Notommata falcinella</i> (Edmondson,1940)	<i>L. (M.) hamata</i>
<i>Elosa woralli</i>	<i>L. (M.) lunaris</i>
	<i>Proales decipiens</i>
	<i>Monommata longiseta</i>
	<i>Notommata cyrtopus</i>
	<i>Cephalodella gibba</i>

Bryce, (1929)). They are typified by relatively large numbers of bdelloid rotifers, many of them cosmopolitan species, and lesser numbers of Monogononta, although the number of bdelloid species found is approximately one half the number Monogononta species. The Monogononta are confined to wetter *Sphagnum*, while bdelloids are present in all areas.

Rotifer populations in the *Sphagnum* mosses studied decreased in size during the cold season, when the moss was frozen. Bdelloids were least affected by these conditions, as they decreased on the average by only one species and maintained sizeable numbers of individuals in the three areas of the hummock-hollow formation. Murray (1906) found autumn, winter and spring, in Britain, to be better than summer for collecting bdelloids from moss, although he does not specify months. In Newfoundland, the results of the present study indicate bdelloids are most numerous in *Sphagnum* moss from late summer (August) to mid-winter (January), especially the colorless form of *Habrotrocha constricta*, *H. lata lata*, *Macrotrachela habita*, *M. plicata plicata* and the combined *Adineta gracilis* and *A. vaga minor*. It appears there may be a relatively slow increase of population numbers of these species after the winter low. The cold weather and frozen state of the habitat in winter undoubtedly slows or brings to a halt the process of egg production, resulting in lowered populations from January to July.

Individuals of Monogononta species virtually disappear during the cold season. Their inability to undergo any form of cryptobiosis as adults (Gilbert, 1974), would prevent their surviving the freezing of the moss. Resting eggs of Monogononta would be present during the cold season, but were not recognized in the samples. In an area with a richer summer Monogononta fauna and a milder winter climate than in Newfoundland, Batut (1965) did find some Monogononta present in *Sphagnum* during the winter months.

Since Monogononta use swimming as the primary means of locomotion,

species of this class are more numerous in wet hollows and pools than in the damp slopes and hummock tops, where the creeping locomotion of the bdelloids is more efficient in the relatively confined water spaces. The number of species of Monogononta increase from hummock top through slope to the hollows. Pool edges, where *Sphagnum* is much wetter than in the hollows, support a rotifer fauna similar to that in the hollows. The bodies of the pools, however, produced very few species of rotifer of either class when sampled. Further studies, using more exact sampling methods are required to determine whether this is a characteristic of the pools, or is a result of the crude sampling method employed.

Within the hummock-hollow formations, there appears to be no correlation between total populations of either bdelloid or Monogononta rotifers and local fluctuations of the pH or temperature. Pejler, (1957b) has found no relationship between pH (or the humus content) and the number of species or individuals of planktonic rotifers. Testaceous amoebae, however, are distributed according to pH and water content in bogs, and fens (Heal 1962, 1964).

Among the most commonly occurring bdelloid species in Site I, the majority are more numerous in hummock tops and slopes than in the hollows—enough to give the former areas a higher total rotifer population than the latter. The periods of greatest abundance of these species are staggered throughout the year. The colorless form of *Habrotrocha constricta* and *Macrotrachela plicata plicata* were most abundant in December, 1973 and August - September, 1974, while the combined *Adineta* species (*A. gracilis* and *A. vaga minor*), *M. habita* and *M. multispinosa multispinosa* were abundant throughout the year. There was a lessening of numbers in the autumn of the *Adineta* species and in the summer of the two last-mentioned *Macrotrachela* species. *H. constricta* was not present continuously throughout the year, but

appeared in greatest numbers in the summer and autumn.

Three bdelloid species, *H. lata lata*, *M. plicata hirundinella* and *M. quadricornifera quadricorniferoides*, occurred in greater numbers in hollows than in the hummocks. These three species were present throughout the year, *H. lata lata* producing its smallest population in winter, when *M. q. quadricorniferoides* was at its maximum. *Macrotrachela plicata hirundinella* was reduced in numbers in autumn and early spring. Although bdelloids as a whole are regarded as transcurational, (Pennak, 1953), it may be that a pH range from 4.4 - 5.0 is more optimal for *H. lata lata*, *M. p. hirundinella* and *M. q. quadricorniferoides*.

Other factors than pH could be involved in the distribution of rotifer species in various parts of the hummock-hollow formation. Separate rotifer species often occupy what appears to be the same niche, (Pejler, 1957b), and occur in the same geographical area. However, too little is known of the micro-habitats offered by the *Sphagnum* plants of various species to make the assumption that species in this medium are occupying identical niches. Physical characteristics of the *Sphagnum*, such as leaf size and shape, crowding of plant material, and humidity and wetness, as well as chemical characteristics on a very minute scale associated with the ion-exchange sites on the *Sphagnum* leaves, undoubtedly produce a complex variety of micro-habitat conditions.

Food availability in various parts of the hummock-hollow formation could be a factor in bdelloid distribution. All bdelloids feed on organic particles filtered from the surrounding water. Particulate - feeding rotifers are capable of selection, and the greater part of the particles filtered by planktonic species are not ingested, (Pejler, 1957b). From personal observations of feeding bdelloids, it was determined that very few particles of a size visible under 200X magnification entered the mouth and mastax. More investigations are required concerning exact type and size of

food particles ingested by bdelloids in conjunction with studies of the dimensions of their mouths and mastax. Such a study of *Polyarthra*, *Kellicottia*, and *Keratella* was carried out by Edmondson, (1965) as part of an investigation of the reproduction rates of planktonic Rotifera.

One species of Monogononta, *Elosa woralli*, was encountered more frequently in hummock tops and slopes than in hollows. All other species of the class were concentrated in the hollows. Bryce, (1929) lists *E.woralli* as one of those species more commonly found in bogs than pools. Other investigators report it as occurring in *Sphagnum* with no further details (Wulfert, 1940), (Myers, 1942) and (Voigt, 1957).

The samples from fens at Site V and VI indicate the presence of rotifer communities similar in number and species to those at Site I. The community in the bog (Site IV) consists of fewer species than that of the poor fen, as does the community in the disturbed area at Site II. The rotifer community of the bog consisted almost solely of bdelloids in the dry area. On the other hand, the hollow in the wetter area at the same Site showed evidence of only one bdelloid species, *Macrotrachela quadricornifera quadricornifera*. This hollow also contained the only sessile rotifers found during the entire study, individuals of the species *Ptygura pilula*. Many sessile rotifer species are reported from *Sphagnum*, (Edmondson, 1940), (Koste, 1970), and it was anticipated that several species would be present in the bogs and fens investigated. However, few sessile rotifers are found in water with temperatures lower than 15° C, and they never occur in large numbers in cold waters, (Edmondson, 1945). At Site I, the *Sphagnum* temperature is above 15° C, for only two months of the year.

Most investigations of the fauna of *Sarracenia purpurea* leaves have concentrated on insects. Larvae of the lepidopteran *Exyra rolandiana* Grt. were raised from such leaves by Judd (1957b). Leaves inhabited by these

larvae usually had a silk web spun across the leaf chamber at the opening or below, and the inner tissues were eaten away, leaving the outer layers nearly transparent. A lepidopteran larvae found in a pitcher plant leaf in April, 1973 had produced similar characteristics in the leaf in which it was found. Unfortunately, it died before pupation. Judd does not mention whether the leaves he studied were examined for the presence of microscopic organisms. In the leaf from the present study, no rotifers were found.

In a further study of inquilines and victims of pitcher plants, Judd (1959) again lists no microscopic organisms. Swales (1972) has found bdelloids present as inquilines in young *S.purpurea* leaves in Quebec, but does not specify whether there were one or several species. The contents of the young leaves had a pH ranging from 7.0 - 7.8, and Swales suggests the rotifers were feeding on bacteria and other microscopic organisms which would not thrive in the more acidic liquid of older leaves, the pH of which (4.1 - 4.6) was more nearly that of the surrounding bog water (pH 4.4 - 4.6) (Swales, 1969). She apparently found no rotifers in the older leaves. In the present study, only the older leaves were examined. They also contained liquid at a pH similar to that of the surrounding *Sphagnum*, and bdelloids were present in one third of the leaves examined. *Philodina proterva* was very numerous in one leaf examined.

Undoubtedly eggs and resting stages of various rotifer species fall into opened leaves of *S.purpurea*. It can be assumed that not all species are capable of both hatching and producing future generations under the specialized conditions of the leaf contents. Unlike the leaves found by Swales (1972), which remained several years without decomposing, the new leaves at Site I, of one year had decomposed completely by July of the following year. Any organisms which overwinter in the leaves on the

Newfoundland peatlands investigated will therefore be released into the surrounding moss in early summer, as the leaves disintegrate. Dipteran larvae probably pupate and become adults before decomposition takes place.

The rotifer species found inhabiting the peatland sites studied are mainly detrital or particle feeders, or grazers. *Dicranophorus lütkeni* is the only member of the genera Pennak(1953) lists as predatory rotifers. Also, very few of the other organisms inhabiting these *Sphagnum* areas are potential predators of rotifers. Turbellaria, individuals of which occurred irregularly in some hollows, are known to feed on small living invertebrates and some Nematoda are carnivorous, feeding on rotifers as well as other small metazoans. Tardigrades, which exist mainly on plant fluids occasionally make use of the body fluids of rotifers and nematodes. Other *Sphagnum* dwellers, including Collembola, dipteran larvae, gastrotrichs, microscopic Crustacea, oligochaetes and most nematodes are herbivorous, saprophobic or like the rotifers ingest particulate organic matter(Pennak, 1953). Predators therefore, probably exert little influence on the rotifer populations in *Sphagnum*. According to Pejler (1957b), if a population is not numerous enough to withstand predation, and still maintain the predator population, very few predators will be there. This is a probable cause of the lack of predators in the Sites studied.

Since most moss habitats are subject to rapid and drastic changes in physical conditions such as temperature, drying, wetting and freezing, it is not astonishing that three of the most common and numerous groups of animals found in such areas, nematodes, rotifers, and tardigrades, exhibit characteristics enabling them to survive such normally detrimental conditions (Crowe, 1971). Cryptobiosis is common to some members of each of these phyla. Anhydrobiosis is not the type of cryptobiosis most useful to inhabitants of the *Sphagnum* hummocks of Site I, as the hummocks do not dry out enough to

cause dessication of their inhabitants. Rather it is cryobiosis which undoubtedly enables the bdelloid species to survive the cold temperatures and lack of free water in the frozen moss during the cold season. Full-grown bdelloids of many species were observed moving actively in partially thawed samples of *Sphagnum*, in numbers which precluded their having hatched from eggs as the moss thawed. All bdelloids are capable, by means of their abilities of contraction, to withstand extreme conditions for at least a short period of time. The mechanics of anhydrobiosis have been more thoroughly investigated in bdelloid rotifers than those of cryobiosis (see Gilbert, (1974)), but it is probably safe to assume that the bdelloids remain in a contracted state, similar to the tun (tun is the term applied to contracted, dehydrated forms of anhydrobiotic bdelloids (Gilbert, 1974)), described in anhydrobiotic bdelloids, when they are frozen. It is unlikely that cysts are produced by bdelloids in the peatlands under investigation, as most evidence indicates encystment occurs rarely, and under dry conditions (Gilbert, 1974). Pennak (1953) states that species known to produce cysts are more common to areas which become completely dessicated.

Results of the experiments involving dried *Sphagnum* samples indicate that *Habrotrocha lata lata*, *Macrotrachela quadricornifera quadricorniferoides*, *Adineta steineri* and perhaps *M. gunningi* are species from this always moist habitat which could survive in a periodically dessicated habitat. It was not determined whether these species survived the drying of their moss samples in the form of tuns or resting eggs. According to Bryce (1917), *H. lata lata* is seldom found outside *Sphagnum*, so may never face dessication under normal environmental conditions. Too little information is available on the specific habitats of the other three species to determine whether they ever encounter such dry conditions.

Results obtained from the *Sphagnum* samples maintained for varying lengths of time in the refrigerator and at room temperature indicate that a

short period spent under either condition does not alter the qualitative aspects of the rotifer population of the samples to any great extent. This period should not exceed one month in either case, if such moss samples are expected to give fairly reliable indications of the qualitative rotifer community of the area from which they were obtained. If samples are kept for longer periods of time than that indicated, it can be expected that the rotifers appearing in the sample will under-represent the original community. Several species will have died out, although the reappearance of the species in refrigerated samples kept at room temperature indicates that eggs are probably produced by most species. It is recommended that qualitative samples of moss rotifer communities be examined within one month of gathering. If only bdelloid rotifers are of interest, the samples can be frozen and maintained indefinitely.

Because of possible changes in the population numbers due to deaths, births, hatchings, predation, etc., preservation of quantitative samples of rotifers in mosses should be carried out as soon as possible after sampling. The life span of many rotifers is only several days, and of males only a few hours (Donner, 1966) so any delay undoubtedly decreases the accuracy of the results.

Throughout the years, many investigators have successfully cultured various rotifer species. Bryce (1929), Lindau (1958), Linder et al (1961), and Aloia and Moretti (1973) are only a few. Over 40 species of rotifer were reported in culture in January, 1975, by various rotifer workers (Anonymous, 1975). The primary purpose of culturing attempts in the present study was not to add new species or methods to this field of knowledge, but to increase the number of specimens available to the author of species found during the study which were rare, or difficult to identify. As a result, no stringent precautions were taken to ensure uncontaminated cultures. Except for *Dicranophorus lütkeni*, none of the species used in

the attempts were successfully cultured, although as Bryce (1929) found, it was relatively easy to maintain populations of some bdelloids in *Sphagnum* and water. *Philodina proterva*, *Habrotrocha lata lata*, the colorless form of *H. constricta* and *Adineta vaga minor* all proved capable of sustaining populations for several months under such conditions.

SUMMARY

Sixty-seven rotifer species and three varieties were reported for selected peatlands on the Avalon Peninsula of Newfoundland. These included 23 species of bdelloids and 44 species of Monogononta, of which only four species have already been recorded in Newfoundland. Twenty-three species or varieties are new Canadian records, and 16 species and varieties have not previously been recorded in North America.

In a fourteen month quantitative study of the rotifer community of a poor fen, the average rotifer community of a hummock top consisted of eight species (seven bdelloids and one Monogononta) and 418 individuals/sq. cm. Similar values for hummock slopes are ten species (seven bdelloids and three Monogononta) and 341 individuals/sq.cm., while rotifer communities in hollows contained an average of 11 species (six bdelloids and five Monogononta) and 321 individuals/sq.cm. Hummock tops contained slightly more rotifer individuals per sq.cm., than the wetter slopes and hollows, but fewer species. Bdelloid communities persist throughout the year in all parts of the hummock-hollow formation, with some reduction in numbers during winter. Monogononta are found chiefly in hollows and all adults of this class die during early winter.

Monogononta are distributed in the hummock-hollow formation according to moisture conditions, but bdelloids probably owe their distribution to a complex combination of environmental conditions such as availability of food and microhabitat conditions provided by *Sphagnum*. These have not been fully investigated.

There are very few predator-prey relationships in the community of organisms in the hummock-hollow complex, as most inhabitants are consumers

of particulate vegetable matter. Dessication is non-existent in these peatlands. Bdelloids survive the winter by cryobiosis.

The quantitative sampling method devised for this study proved useful enough to be recommended for use in studies of similar areas, but will not indicate correctly the numbers of sessile rotifers. The guide to preserved illoricate rotifers, and the method of its production, is potentially useful to other investigators. To ensure accuracy, quantitative samples should be preserved immediately after collection, while qualitative samples of moss rotifers should be examined within one month if stored at room or refrigerator conditions.

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