A STUDY OF THE INVERTEBRATE FAUNA AND CRUSTACEAN ZOOPLANKTON OF THE SHROPSHIRE UNION CANAL AND THE LLANGOLLEN CANAL

BY

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CONTENTS

AIM OF THE STUDY

The primary aim of this study was to make a general ecological survey of the invertebrate fauna (Bottom-fauna, Shore-fauna and Crustacean zooplankton) of the Shropshire Union and Llangollen Canals.

The secondary aim was to investigate:-

(1) The differences in the invertebrates distribution along the length of each canal.

(2) The effect of the chemical and physical properties of the water on the distribution of the invertebrates along each canal.

(3) The seasonal qualitative and quantitative changes in the invertebrates of each canal, so that the changes in the population caused by the changing of the environmental conditions could be understood.

(4) To compare the invertebrates of the Shropshire Union Canal with those of the Llangollen Canal.

ABSTRACT.

Five sites were chosen on the main Shropshire Union Canal and three on the Llangollen Canal. Monthly quantitative samples of the bottom fauna, shore fauna, and crustacean zooplankton were taken from all sites over a period of 24 months from the Shropshire Union Canal, and over 18 months from the Llangollen Canal.

An account for the topography and the geographical location of the sampling sites on the Shropshire Union and Llangollen Canals are given, for it is believed that these are important and affect the physical conditions of the canal waters.

Sampling apparatus and procedures are described suitable for quantitative collection of the bottom-fauna, shore-fauna and crustacean zooplankton of the two canals, including the sites with rough and uneven bottoms.

Experiments were done, as a further contribution on the assessment of the accuracy of the dredge, which was designed for sampling the bottom fauna of canals.

The qualitative and quantitative composition of the invertebrate varied with season and prevailing physical and chemical conditions.

The seasonal qualitative and quantitative changes of the more common invertebrates are described. Monthly size frequency distributions of the more common species are illustrated graphically and in tables.

The water chemistry of the two canals was investigated by collecting samples from all sites. The results obtained by standard analytical techniques showed that the following constituents all exhibited definite gradients along the canal:- PH, Total hardness, Calcium and Magnesium concentrations (as mg per litre). These constituents showed a difference in concentration from one site to another.

The Llangollen Canal water chemistry was significantly different from the Shropshire Union Canal.

Undoubtedly, many reasons for the restriction of any particular species to a particular environment lies in the basic chemical and physical features pertaining to that environment. These have been described and discussed in results and discussion.

Some groups, (notably Tubificidae, Chironomidae larvae and pupae,Limnephilidae larvae) could not be fully identified within the scope of this study. The general composition of the invertebrate fauna at all sites can be seen in the tables.

The work provides guide lines which might be profitably used in investigating the life cycle of some Ephemeroptera, Trichoptera and Hemiptera. It should also be useful for work concerned with maintenance of fish and fish food organisms and the assessment of pollution in canals.

1. INTRODUCTION

Until recently, very little research has been carried out on canals compared with other freshwaters, such as rivers, streams and lakes.

Like most inland waters, canals present a wide range of plant and animals species, they also have a balanced natural economy but with well-marked seasonal fluctuations. In addition to these common characteristics, canals have certain advantages over the other bodies of water as subjects for biological study. A canal may traverse widely differing tracts of country, and yet as an engineered waterway many of its reaches are physically compared. It is usually both narrow and shallow enough to be sampled easily from the towpath without elaborate equipment. Its regime is carefully controlled so that neither flooding nor drying out occur except under exceptional and infrequent occasions.

Very little ecological work has been done previously on the canals. A paper by Boycott and Oldham, (1938) dealt with the Mullosca, Wilson (1952) contributed popular and useful articles, chiefly on historical aspects of the canals to the Shropshire Magazine. The ecological field work carried out by Preston Montford Field Centre, Twigg (1958), was concentrated on the North-Western branches of Shropshire Union Canal system, and used only for teaching purposes. Twigg, H.M. (1959) wrote a paper on both used and disused parts of the Shropshire Union Canal.

An attempt has also been made to give a balanced account of the Llangollen Canal as a whole environment by the M.Sc. Environmental Resource Course at Salford University (1969).

The present work on the Shropshire Union Canal and the Llangollen Canal is the outcome of a general study on the two canals. The desirability of recording the present stage in the ecological changes, and the possibility of setting standard methods of sampling, sorting and recording might be of use in the study of canals elsewhere in the country.

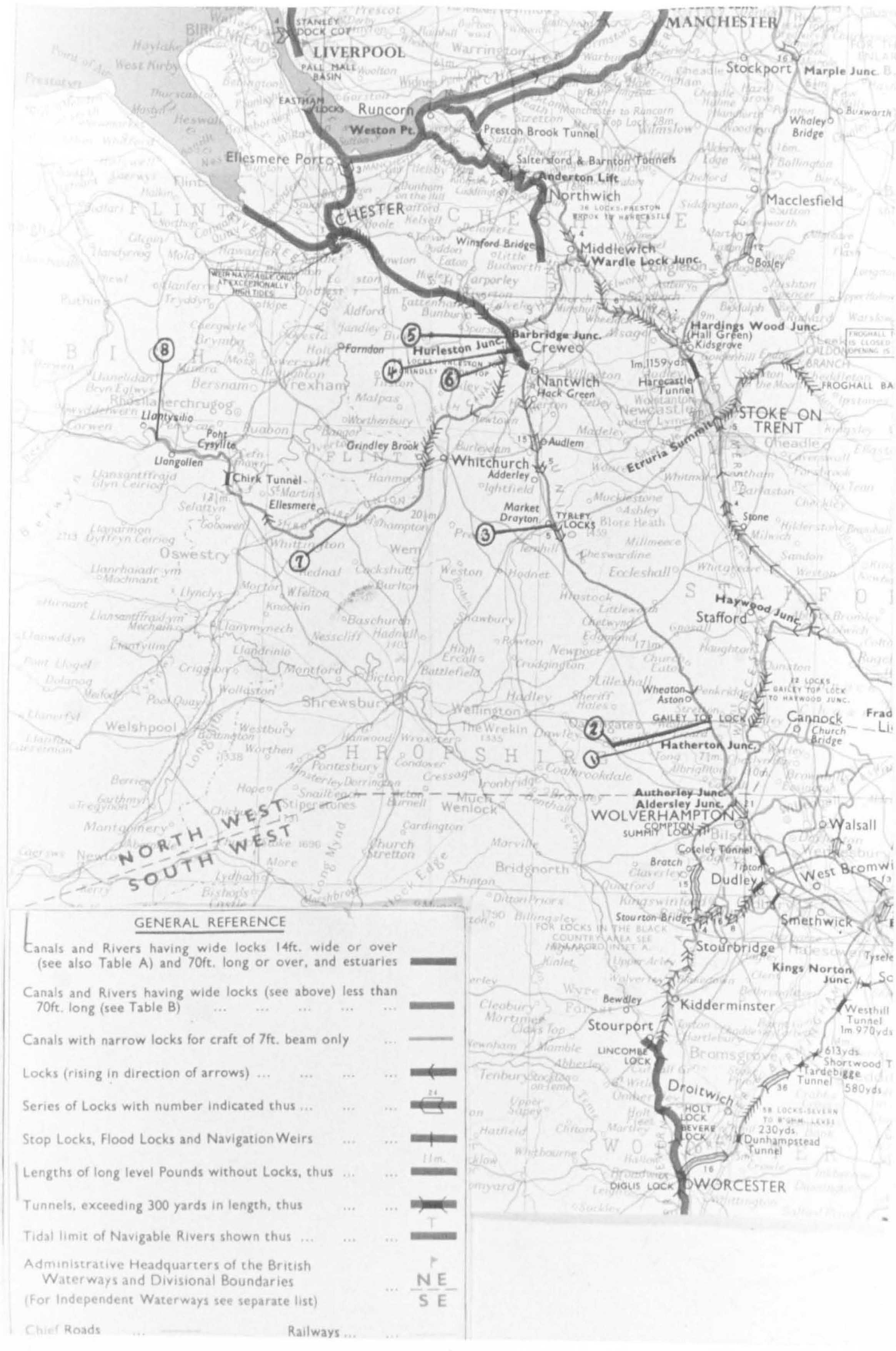
The establishment of reliable check-lists of the species of the invertebrates found in the Shropshire Union and Llangollen Canals were felt to be an essential part of any basic ecological study and one which would obviously prove most useful in connection with other work on the fauna of the canals. In conjunction with an inquiry of this type, it was also considered desirable to find not only what species are present in the two canals, but also how they are distributed. Ideally, such distribution should be studied both in time and space. Other aspects such as the physical and the chemical changes were considered.

Quantitative samples of the bottom-fauna were taken. It was decided to follow the method developed and tested by the help of Dr. Pugh Thomas and other members of the Biology Department, using a specially designed dredge. This apparatus worked satisfactorily on all sites except the Horse-shoe falls site on the Llangollen Canal, where bottom-fauna samples were taken with an Ekman grab, as the water was too deep to use the dredge.

A kicking technique, and hand-net with 24 meshes/cm was used to collect the shore-fauna samples.

It was convenient to have such a conical net of coarse mesh silk (48 meshes/cm) for collecting crustacean zooplankton samples.

Certain chemical and physical factors (Temperature, pH, O_2 concentration (p.p.m.), Total hardness, and Calcium and Magnesium concentrations (mg per litre)) were obtained either by recording in the field or by taking samples for laboratory analysis. The only chemical surveys carried out only on the Llangollen Canal were by Boycott and Oldham (1936), by Mid-Cheshire Water Board (1957), H.M. Twigg (1959) and T. Christian (1969).



Diagram, (1A) A map of the Shropshire Union Canal and Llangollen Canal showing the position of the sampling sites.

There are 46 locks on the main line, and at Nantwich and Stretton, there are two cast-iron aqueducts with the original cast-iron balustrades carrying the canal over trunk roads.

Llangollen Canal:-

The Llangollen Canal had its origins in the eighteenth century, when the iron foundries of Coalbrookdale were a focus of the Industrial Revolution (Raistrick 1953). It was one of the first steps to meet the need for improved communications in the region, and to carry goods in and out of North Wales.

The Llangollen Canal runs from the Horse-shoe falls Weir, on the River Dee, near Llantysilio in North Wales, to Hurleston Lock. From the Horse-shoe falls, the canal passes through five neighbouring counties, linking up with the Shropshire Union Canal at Hurlston Junction in Cheshire. Its greater part runs through the Shropshire-Cheshire Plain, as shown in Diagrams 1A and 1B.

The plain is a basin-like syncline of New-Red Sandstone, (Trias), with a rim of Carboniferous rocks - Coal measures and limestone - to the West and South, (Pocock and Whitehead, 1948). Beyond this rim, more ancient rocks rise into sharp relief. The surface of the plain is thickly mantled with glacial deposits, ranging from heavy boulder clay, to loose sands and gravels, which give variety and fertility to the soil.

Industries are concentrated on the Carboniferous outcrop, with its resources of coal, iron and lime. Elsewhere, the economy is largely rural, with dairy farms on the plain giving place to sheep farms. The pattern of the canal network, can be understood in terms of these physical and economic factors. Its original traffic depended on the exchange of minerals and agricultural produce; a barge carrying coal or iron in one direction, might return, laden with cheese or wood.

Improvement in roads and rail transport brought about the decline of the Shropshire Union and Llangollen canals. At the present day they are still open, but only for pleasure traffic. The two canals run mostly through gently undulating land, no higher than 300 feet O.D. Three large rivers flowing Eastwards out of Wales - the Severn, the Tanat (for Shropshire Canal) and the Dee (for the Llangollen Canal) have been used as feeders. These give the average rate of flow in both canals. 0.5 - 0.7 feet per second, or about 18 million gallons, per day.

To maintain its level with minimum of locks, even in the lowland, the course of the two canals pass through a sequence of cuttings and embankments. Numerous hump-back bridges cross the canals, (though several have been levelled in the interests of road-traffic) at these points, the canal narrows to barge-width.

The average width of both canals is 35 feet, and the maximum depth about 6½ feet at the centre. Full maintenance operations are still carried out on both canals. The towpath is kept in repair and mown annually; patches of the bottom and sides are relined with clay where this is essential; water weeds are cut occasionally; dredging is carried out as required.

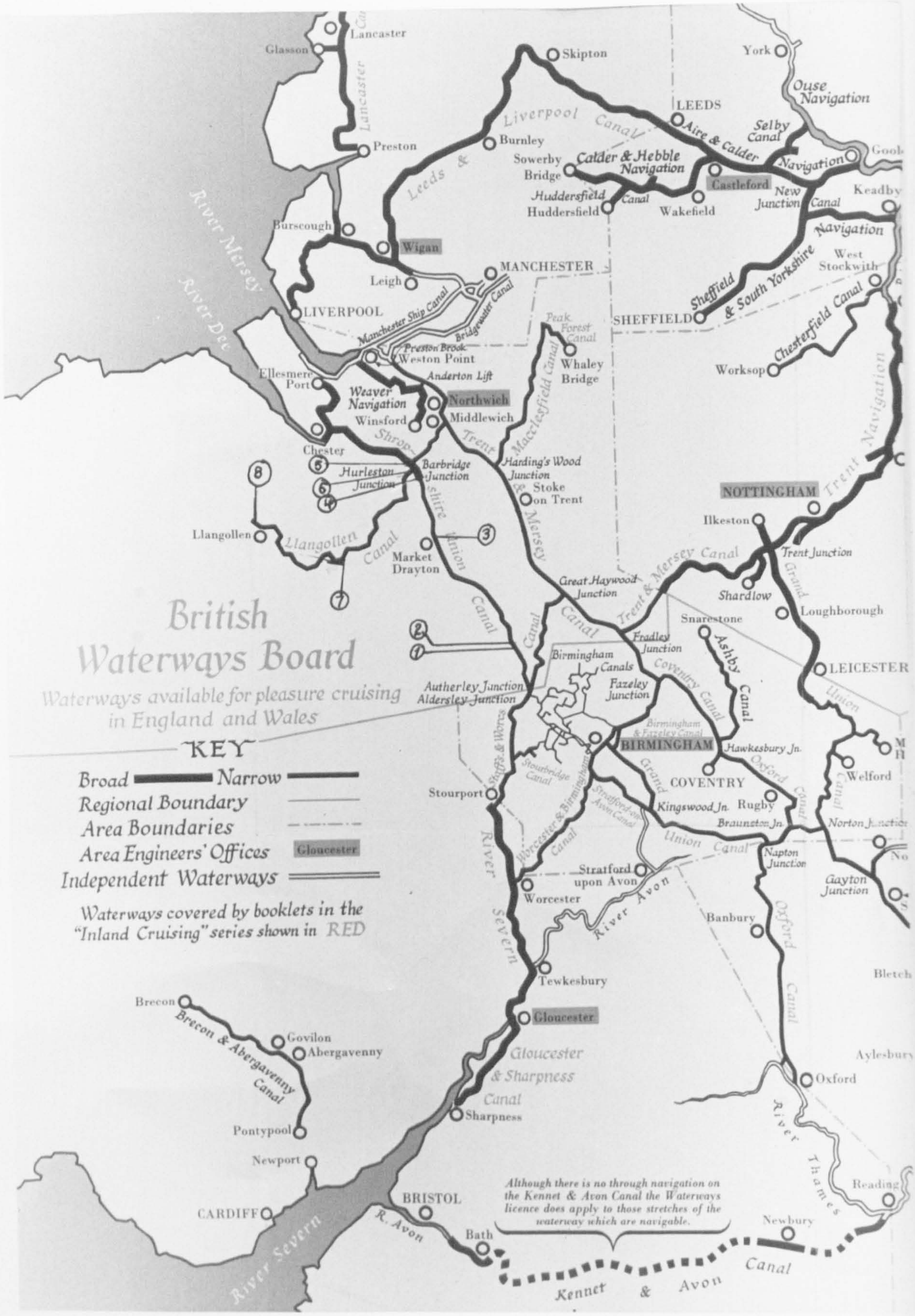
The use and maintenance of the canals has important leaving on their biology for instance.

(1) The state of repair exerts a direct or indirect control on almost every influential factor. Use and maintenance ensure constant flow and level, and keep the canals clear of weeds. There is room for a good plant succession on either side which is further favoured by the gentle shore gradient if the banks of the deep water have slumped. The two canals are shallow enough through to be inhabited to its full depth by a wide range of organisms, and for photosynthesis to occur even in the deepest waters.

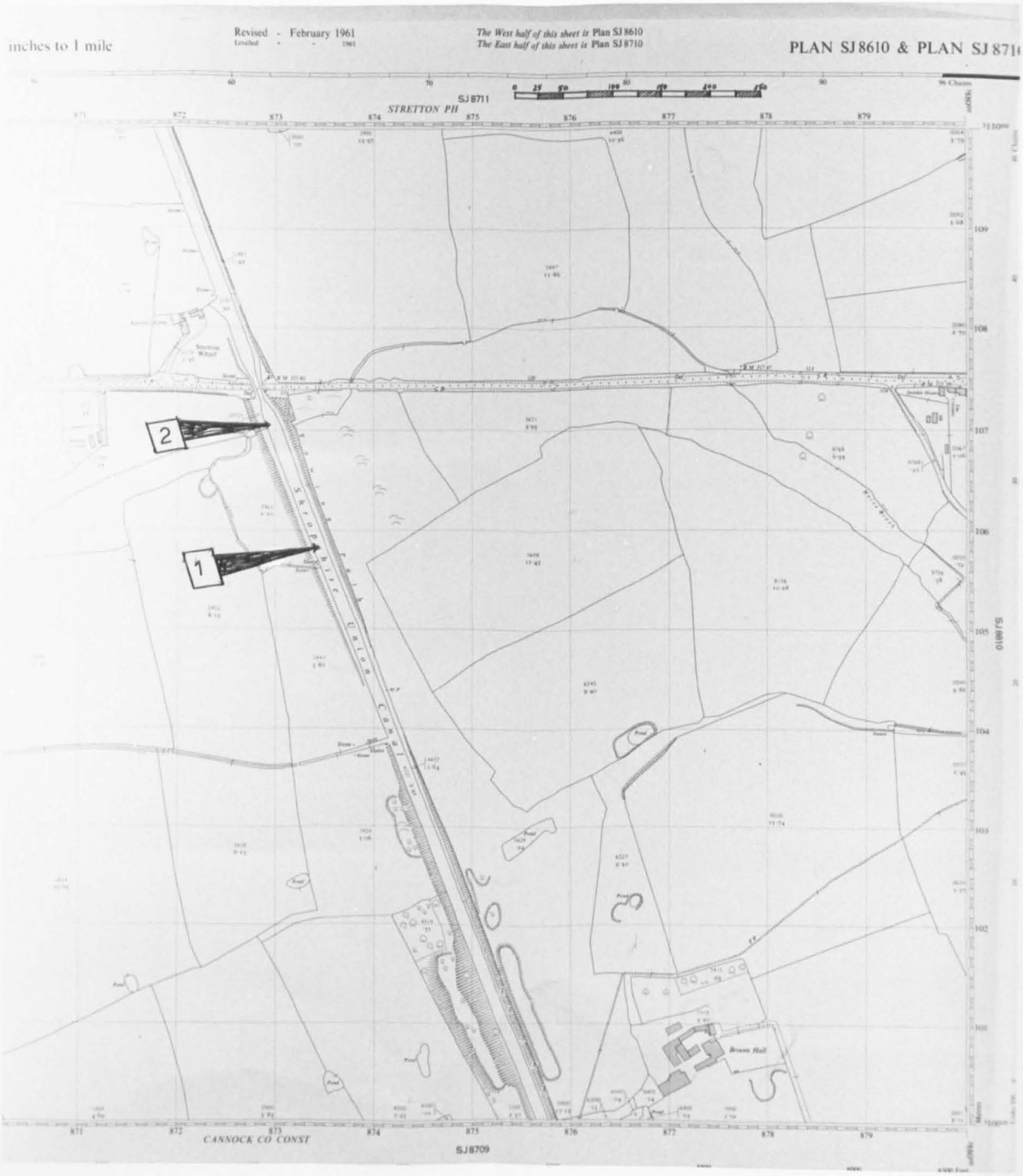
(II) Flow is about 0.5-0.7 feet/second on both canals (H.M. Twigg, 1959). This constant flow is sufficient to maintain good supplies of both mineral (Calcium, Magnesium and Sulphates) and Oxygen. This current can transport nothing coarser than clay, (Minnikin, 1920), so the local redistribution of coarse material is brought about mainly by slumping from the banks.

(III) Nature of the bottom:- The bed was originally made of stones with a uniform cover of clay, but this no longer continues. Stones, sand, silt and organic materials have fallen in from the bank and spread over parts of the bottom, especially in cuttings. This variety of superficial deposits is important in the consideration of the bottom-fauna.

The water is generally shallow, slow-moving, and well lit, so it tends to warm and cool rapidly, depending on local conditions for instance the degree of shade provided by the trees growing along the towpath.



<u>Diagram,(1B).</u> A map of the Shropshire Union and Llangollen Canals showing the position of the sampling sites.



Diagram, (2). Ordinance survey map showing the position of sites No(1&2) on the Shropshire Union Canal.

3. DESCRIPTION OF THE SAMPLING SITES

3.1 On the Shropshire Union Canal

The Shropshire Union Canal extends for about 120 miles, mostly in Staffordshire and Cheshire, so it was not thought possible to investigate the whole length of the canal intensively.

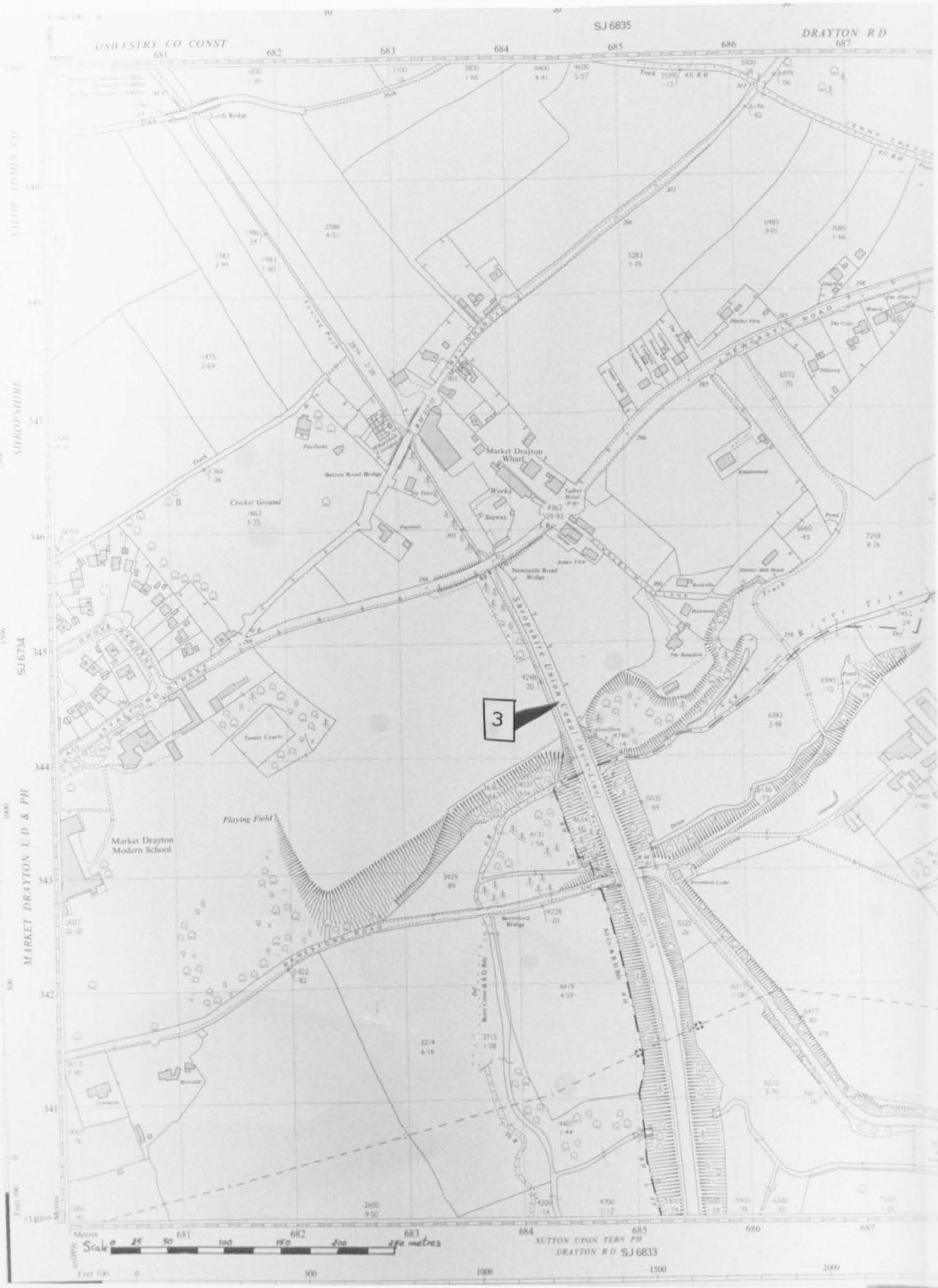
The part which the author was concerned with was from the Stretton Aqueduct in the South to the Hurleston junction in the North as shown in Diagrams 1A and 1B.

After extensive reconnaissance, 5 sites were chosen for detailed study, each representing a different habitat type. All sites were readily accessible from main roads. The location of each site is shown in Diagrams 1A and 1B.

a. Site No.1 (Off A5)

This site lies a short distance 250 yards to the South of the Stretton Aqueduct (Diagram 2) and 20 yards from the fence. The course of the canal at this site shows a sequence of embankments, so the towpath bank is steep, being banked up with stones. The stone used is almost entirely limestone (Heather, M. Twigg, 1959). The water is about 33 feet wide and 5 feet deep. The towpath bank falls one foot vertically to the water surface and nearly as much again to the bottom.

The bottom has been neither dredged nor repuddled recently. Silt, stones and mainly black organic mud cover the bed at this site, because of the growing of reedswamp during the summer and the falling



Diagram, (3). Ordinance survey map showing the position of site №(3) on the Shropshire Union Canal.

of large amounts of leaves in October and November from higher plants growing beside the bank of the canal.

b. Site No.2 (Off A5)

This site is adjacent to site No.1, 5 yards from the Stretton Aqueduct and 20 yards from the fence (Diagram 2). It is generally similar to the preceding site, and because of its uniformity, was chosen for study to try to identify the errors of the technique.

c. Site No.3 (Market-Drayton) Newcastle Road Bridge.

This site is located 220 yards south of the Newcastle Road Bridge which carries the A53, and just opposite to the electric post No.3 as shown in the Diagram 3. The course of the canal does not need any embankments, because it is cut in hard flat land. The water is about 31 feet wide and the towpath bank falls less than one foot to the water surface, and about 1½ foot to the bottom.

The bottom has been dredged recently, as this part of the canal is an important stopping place for the boats. Sand, silt, clay stones and a little black organic mud cover the bed at this site. Reedswamp and higher plants have rooted and fallen along the shore of the canal at this site.

d. Site No.4 (Hurleston Junction - South of Corne's Bridge).

This site located 220 yards south of Corne's bridge, and just under the electric cables crossing over the canal (Diagram 4). At this site the canal runs in a low land, so embankments were necessary,

Diagram, (4). Ordinance survey map showing the position of sites №(4&5) on the Shropshire Union Canal and site (6) on Llangollen Cana and the towpath bank is steep being banked up with stones. The width of the canal is 32 feet and 6 feet deep in the middle. The towpath bank falls 1½ feet vertically to the water surface and nearly 2 feet to the bottom, while the opposite side shelves gently down from a high rough grazing land.

Mainly hard heavy clay, stones and little silt are distributed over most of the bottom but there are patches of small amounts of black organic mud with clay, stones and silt right in the middle only. This variety of superficial deposits are important in the consideration of bottom-fauna.

e. Site No.5 (Hurleston Junction - North of Corne's Bridge)

This lies only a short distance (70 yards) to the north of Corne's bridge, and just opposite the mark of the danger area on the opposite side (Diagram 4). The canal has a shelving shore line at this site. There has been no scything recently, and the breach caused a fall in water level, whose middle depth is now only 4 feet, and it lies less than 1 foot at the shore. The width is 30½ feet.

Slumped soil forms most of the shore line. The bottom has not been dredged recently. Black organic mud and soft clay were noticed and were quite thick stretching straight from the shore, to the middle with increasing thickness. Reedswamp and higher plants are rooted and have been falling along the shore.

Diagram,(5). Ordinance survey map showing the position of site № (7) on the Llangollen Canal.

3.2 On the Llangollen Canal

The Llangollen Canal arises at Llantysilio, 2 miles west of Llangollen and passes down for about 50 miles to Hurleston junction in Cheshire where it links with Shropshire Union Canal, Diagrams 1A and 1B. Three sites were chosen, each representing a different habitat type and all the three received detailed study. The location of the sites are shown on the Diagrams 1A and 1B.

f. Site No.6 (Llangollen Canal - Hurleston Junction)

This site is adjacent and only 10 yards west of the bridge which carries the A51 (Diagram 4). It is generally similar to site No.3 apart from the bottom deposits or nature. The maximum depth is 5 feet in the middle and the width of water is 28 feet with a gentle shore-line.

The entire bottom has been dredged recently, and is mostly covered by sand and stones. There are patches on the towpath bank where mud occurs under rooted reedswamp. Certain places of the towpath bank are fringed under water with the roots of plants growing on the land.

g. Site No.7 (Ellesmere)

This site lies parallel to the southern shore of Blackmere close to the junction of the main Shrewsbury-Ellesmere road (A528) with the Whitchurch-Ellesmere road (A495); the reach examined was 25 yards east of the bridge (Diagram 5). The water is about 31 feet wide and 4½ feet deep in the middle.

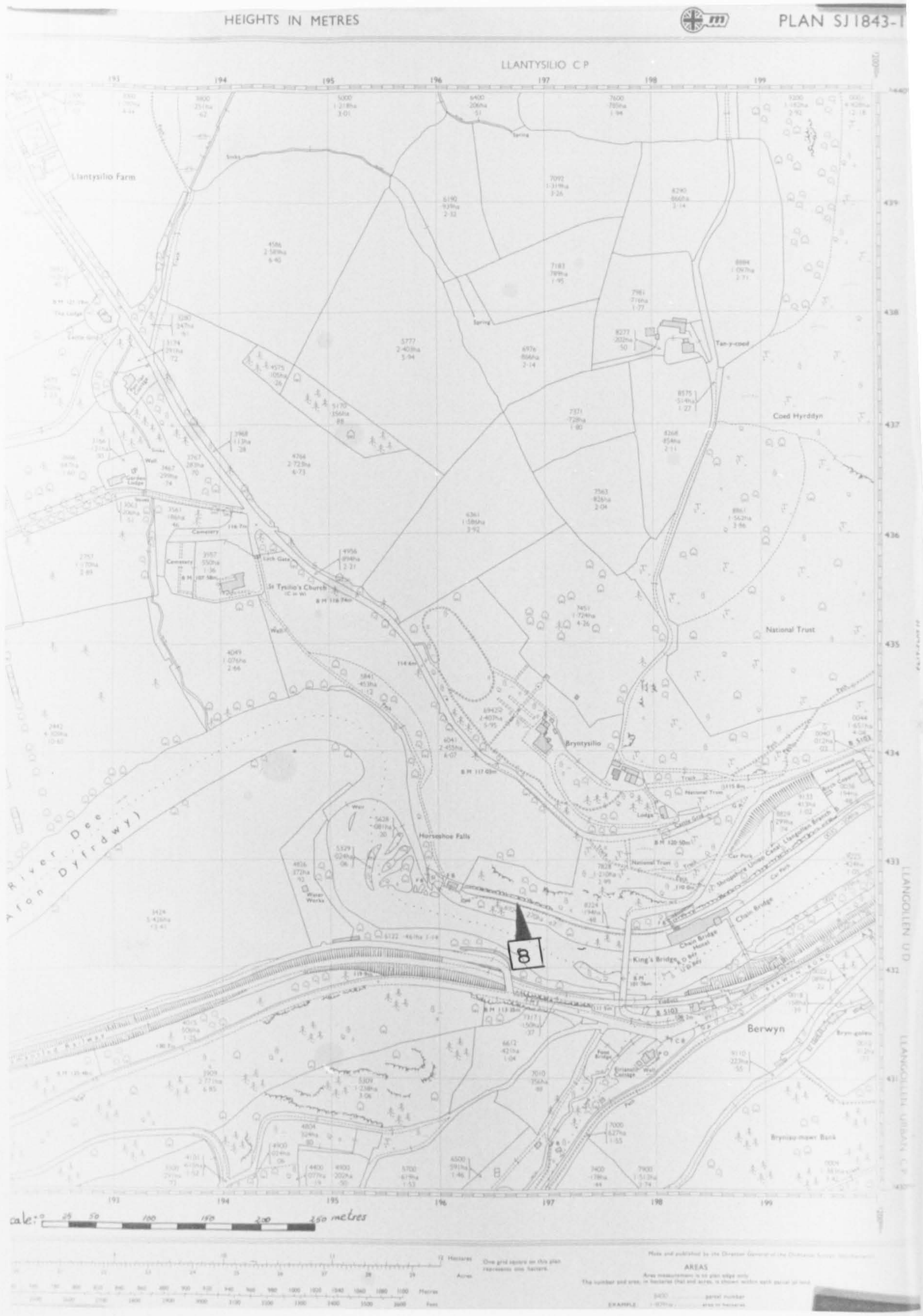


Diagram. (6). Ordinance survey map showing the position of site No (8) on the Llangollen Canal.

The bottom has been neither dredged nor repudded recently, but the towpath is mown annually. The towpath bank falls one foot to the water surface and nearly as much again to the bottom. Redistributed silt and fine sand cover most of the bottom, but there are patches of fallen stones on the towpath side and black organic mud under rooted reedswamp. Trees and rising grounds give a little shade and some shelter from the wind. Also, certain lengths of the towpath bank are fringed under water with trees and grass roots.

h. Site No.8 (Horse-Shoe Falls)

The Chain-bridge Hotel is situated 220 yards east of the start of the canal at Llantysilio. This site lies about 110 yards west of the Hotel, and the same east of the start (mouth) of the canal (Diagram 6). The canal at this part was cut into the rock, so neither embankments nor puddling was necessary. The width is reduced to 15-17 feet only and the maximum depth is 6½ feet. The towpath bank falls about 3-3½ feet to the water surface and almost 5½ feet to the bottom.

The bottom has not been dredged recently, and it looks as if cleaning is not needed for a while. The canal bottom at this site consists of small stones intercepted with coarse gravel, fine sand and occassionally with silt. Black organic mud is found under rooted reedswamp in the canal as well as tree-roots, and remains of fallen branches and fruit of surrounding trees on the towpath.

This site has a completely different characteristic from the other sites, i.e., nature of the bottom, depth and the speed of the current. To sample the bottom of the canal an Ekman Grab was used. There was no shore at this site as the banks were vertical, so no shore samples were taken.

4. FIELD WORK

4.1 Selection of Sampling Device

Methods suitable for the comparative study of invertebrate fauna must differ in order to meet the requirements of various kinds of bottoms as they exist in the canals. The requirements for bottom sampling, for example, are so diverse that no one sampler has been devised which will serve all the purposes.

Water bottom samplers are of various kinds. Some workers have used grabs which are pushed by hand into the substratum and so bite out a definite area, (Berg, 1938; Ford and Hall, 1958; Minckley, 1963). A whole family of devices has been designed which are pushed down into the substratum and then pulled forward a fixed distance, like a shovel, to take up a definite area of substratum (Macan, 1958; Dittmar, 1955b; Allen, 1940, 1951; Kamler and Riedel, 1966b; and Hynes, 1961). Such dredge-like devices, if they are heavy enough, can also be used on lines in fairly deep water (Usinger and Needham, 1956).

Another family of devices is perhaps best described as box or drum samplers. They consist of square or cylindrical boxes open at top and bottom which are pushed into the substratum (Wilding, 1940; Riedel, 1960b; Whilley, 1962).

Alternative methods of quantitative sampling are to set out trays of substratum in the water bed, and then to lift them complete with the fauna that has moved in after a fairly long interval, (Moon, 1935; Vene and Wickliff, 1940; Egglishaw, 1964), or to put in entirely

PLATE, (1)   "The Dredge."

artificial stones, (Britt, 1955; Cianficconi and Riatti, 1957). Such methods, however, are likely to provide a reasonable measure of the population, and they are a good source of specimens, and under some circumstances they are the only way to obtain large numbers of certain species. Artificial substrate have also proved to be very useful in comparative census of black-fly larvae which seem to be attracted to white surfaces or strips of polyethylene sheet, (Wolfe and Peterson, 1958; Williams and Obeng, 1962 and Ferguson, 1971).

The various types of apparatus and methods which have been evolved for quantitative sampling of the bottom in running water have been discussed by (Albrecht, 1959; Macan, 1958B; Cummins, 1962; and by H.B.N. Hynes, 1970).

As might be expected, any biological survey with, as a complex structure of the bottom as the Shropshire Union and Llangollen Canals, is difficult to evaluate. On the advice of Dr. M. Pugh Thomas, and satisfactory experiment results,(page 29), a new type of aquatic bottom sampler has been designed. It was built with the help of Dr. M. Mille. It was a "Dredge" and was used to take quantitative samples of the bottom fauna from the various sites on the two canals, except site No.8 on the Llangollen Canal where an Ekman grab was used.

The dredge (Plate 1) was made of heavy galvanized iron sheeting box (2mm thick). The rear end of this dredge was a sheet of metal net, with meshes of a size 0.6 mm, enough to keep small animals from escaping through it and to let water pass when the dredge is towed. The fore-edge is sharp to cut deeper in the bottom when the dredge is towed. At the top surface two iron bars are fitted to a 150 cm stick.

The dredge weighs 6½ kilograms and it is not expensive or complicated to build.

Of all the various bottom samplers, the Birge-Ekman grab is so successfully and so widely used for soft bottoms and deep waters, that it has become a standard instrument "Limnological Methods, Paul S. Welch (1948), page 176". A site No.8 (Horse-shoe falls - on the Llangollen Canal) has such characteristics of depth and structure of the bottom material that this device for sampling bottom fauna was used.

For the shore-fauna, all the sampling devices have their advantages and disadvantages. Many methods are used for sampling from running waters. Some of these are described in the publications of Welch (1948), Usinger (1956) and Edmondson (1966). Critical appraisals and comparisons of these procedures, have been made by Macon (1958B, 1963), Morgan and Egglishaw (1956), and Hynes (1970B).

In practice, the galvanized box used by Needham (1927), the Hess sampler (Welch (1948); Mackay (1969), and shovel samplers, (Macon (1958); Elliott (1967), do not work very well, (Hynes (1970a)) as they are cumbersome in water deeper than 50 cm. The Surber sampler (Surber (1937)) does not enclose the area to be sampled (Hynes (1970a)); it is also difficult to use in canals, where the current is slow. This was tried, but was unsatisfactory.

Kicking techniques, (outlined by Hynes (1961), Hynes and Williams (1962), Morgan and Egglishaw (1965), Minshall and Minshall (1966), Minshall and Kuehne (1969), Huni (1969)), and improved techniques of this kind devised by Kershaw et al, (1968), are useful and give satisfactory results for numerical assessment of the difference between the populations of different sites. Frost (1967), Hynes (1961), Huni (1969) and S. Frost (1970), have satisfactorily used this technique to collect their samples. This technique is not accurately quantitative, because it does not sample a known (defined) area of substrata, nor the animals living deep; it is, however, sufficient to enable approximate qualitative and quantitative comparison, Spence and Hynes (1971), of different sites.

Considering the limitation of different sampling techniques, the shore-fauna of Shropshire Union Canal and Llangollen Canal under investigation were surveyed using kicking technique to collect routine samples, because this requires only simple and readily portable equipment, and the wide variety of substrates from heavy clay to sand and small stones can be sampled.

It was also important not to incur structural damage to either the towpath or the canal bottom. Both canals are used for navigation and sampling techniques likely to hinder the passage of boats could not be employed.

Studies of the plankton of running fresh-water (mainly large rivers and streams) have been geographically widespread. In Europe they include some Irish and English rivers (Southern and Gardiner (1938); Rice (1938); Swale (1964)), several German rivers including the Rhine (Lauterborn, (1902); Bennin (1926); Jiigensen (1935); Waser et al (1943); the Danube (Schallgruber (1944); Liepolt (1961); Czernin-Chudenitz (1966); the Brynica in Poland (Sieminska, (1956)) and in Russia, the Volga (Behning (1929a); Romadina (1959)). In Asia they include several Siberian rivers (Greze (1953); Pirozhnikov and Shulga (1957)). In North America studies have been made on the Californian San Joaquin (Allen (1921)) and Sacramento (Greenberg (1964)), the Ohio (Eddy (1934); Hartmann (1965)), several parts of the Mississippi (Reinhard (1931); Denham (1938); Lackey (1942); Berner (1951)); and many other rivers

(Williams (1964),(1966)). In Africà most work has been done on the Nile (Rizoska et al, (1955); Klimovicz (1961)), and in South America there has been some studies on the Amazon and the Orinoco (Gessner (1955a,b)).

For these investigations a general outline of methods used in the collection of the plankton are given below together with a more detailed description of those methods used in the two canals.

Before any particular system of sampling was chosen, all the usual methods were considered. Full details of these can be obtained from Welch (1948 and 1952). Briefly, they are:-

(1) Vertical or horizontal hauls with a bolting-silk net.

(2) The withdrawal of a known volume of water by a suction pump and hose.

(3) The use of a Clarke-Bumpus Plankton Sampler. (Clarke and Bumpus (1940)).

(4) The use of a plankton trap.

All methods have their limitations.

A silk net catches irregularly, and it is difficult to make even an estimate of the volume of water passing through the net. Also the slow towing of the net through the water allows animals to swim away from its path, but it is likely to be successful because of the large number of animals caught, and it is ideal for the study of life-cycles because of this, and that is why the author used it.

The Clarke-Bumpus sampler probably suffers from the same clogging as an ordinary net, but if it is calibrated an estimate of the amount of water passing through the meshes can be obtained. The smaller diameter of the opening is off set by increased hauling speed. A comparison between a bolting-silk net and a Clarke-Bumpus Sampler indicated that there is no significant difference in the proportions in which the two devices catch animals which are abundant in water, providing that the meshes of the nets are the same, M. Pugh Thomas (1959).

The suction pump and hose does not seem to have any advantage over the two previous methods, and although an exact measurement of the amount of water filtered can be obtained, it is still impossible to estimate the number of animals swimming away from the device. The weight made it undesirable as it was planned to sample from many sites far apart during the same day. This method was definitely rejected.

The plankton trap was rejected as being too slow to use and too bulky for easy transport.

After consideration the author decided to use a standard Freshwater Biological Association silk net (48 meshes/cm) and (40 cm deep). Rough measurements by M. Pugh Thomas had shown that this would retain the nauplii and the majority of the Rotifera while letting through most of the phytoplankton and as all of the young stages of crustacean zooplankton were always caught it was always possible to see changes in the population structures quite clearly.

PLATE, (2)   The Dredge, "Rear view."

4.2 Collecting Technique

For the investigation of the bottom-fauna of the Shropshire Union and Llangollen Canals the "Dredge" described below and shown in Plate 2 was used.

When taking a sample, the dredge is set up first by fixing the stick to its top. The operator then walks a few steps in the shallow water of the canal, and lowers it gently until it rests on the bottom. The dredge is then towed by the stick, slowly, until it is near the operators feet, then picked up gently by both hands. As the dredge is towed along, its sharp fore-edge, cuts into the bottom and causes the bottom material, to a depth of 3-4 inches to enter the box. The rear net of the dredge keeps all the material needed, and lets through the turbulent flow of the water.

During the main sampling period, bottom fauna samples were collected and transferred to rectangular plastic boxes, with water-tight lids. Any material left in the dredge, was washed into the plastic box. 10 per cent Formalin was added to kill and preserve the fauna. The place and date of sampling was then written on the box containing the sample.

The same technique was applied to collect the bottom samples from all the sites except site No.8.

In accordance with particular needs of the depth and structure of the bottom material, at site No.8 (see description of the sampling sites on the Llangollen Canal,(page, 15), an ordinary Birge-Ekman grab was used for the investigation of the bottom fauna.

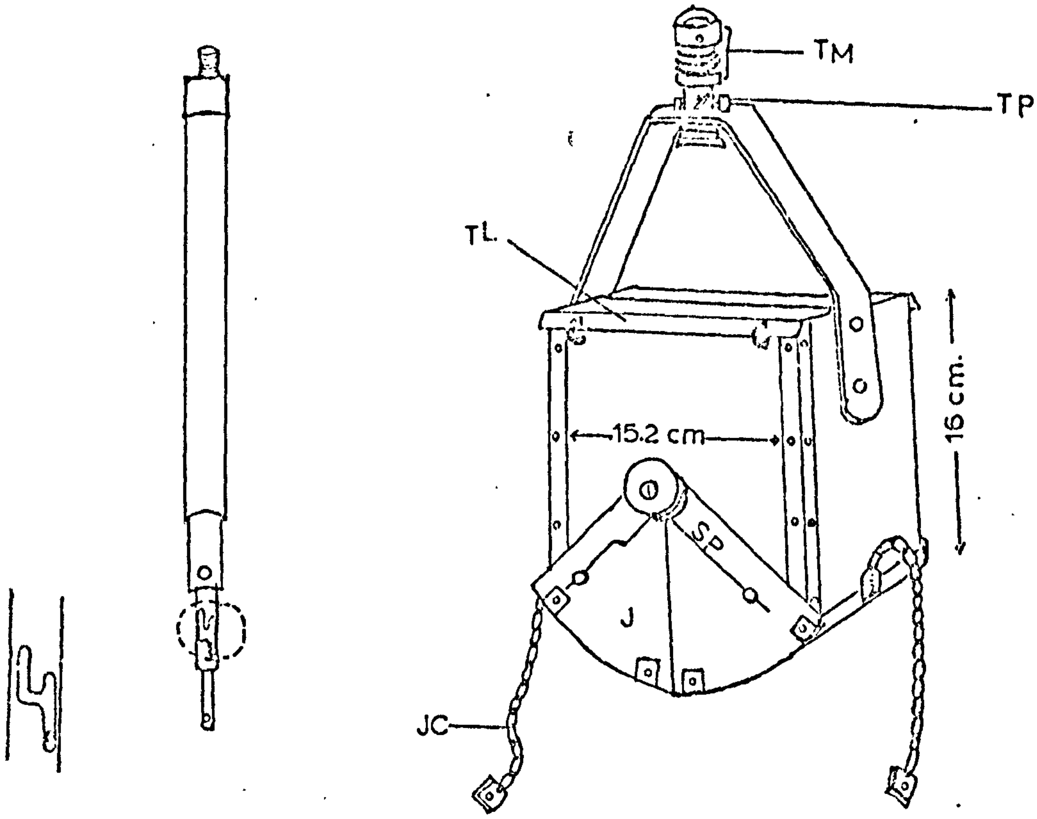
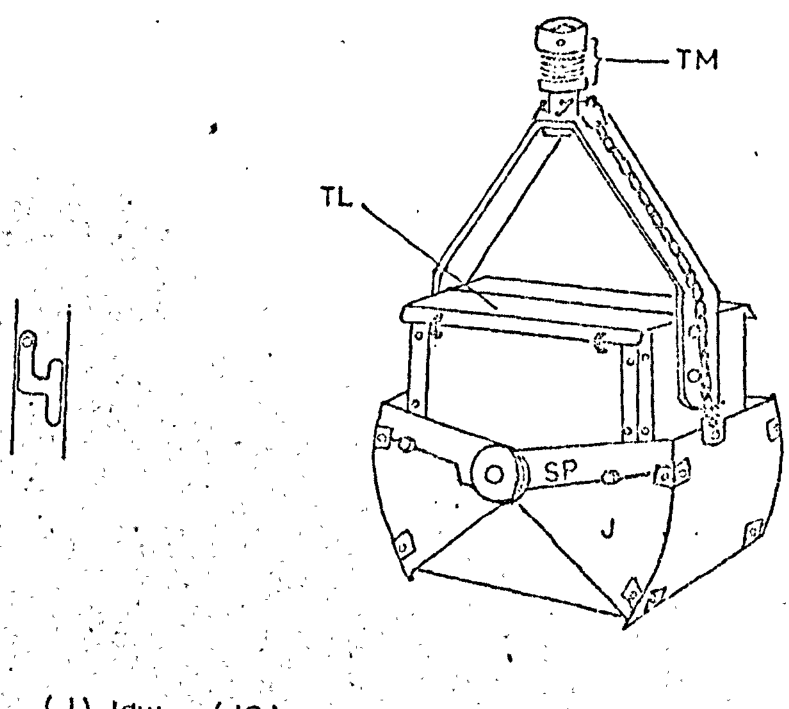


PLATE.(3) Ekman grab of usual type (above) in closed form.

(below) in open form and ready to be lowered into water.



(J) Jaw, (JC) Jaw chain; (TL) Top lid, (TP) Trip pin;

(SP) Spring which operates jaws, (TM) Trip mechanism.

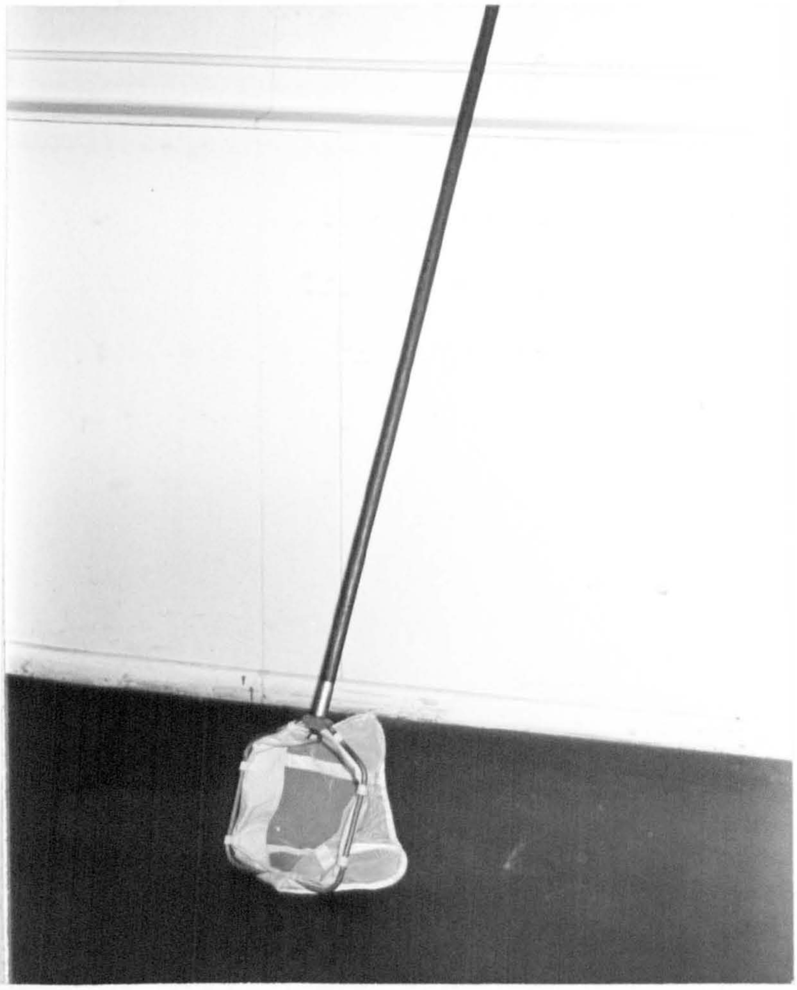
In its present form, (Plate 3), it is built in a size having a cross section of 15.2 x 15.2 cm. with height of 16 cm.

In operation, the sampler is attached to a strong rod, by passing the latter through the trip mechanism and screwing it securely below the underlying plate. The sampler is then lowered into the water until it rests on the bottom. Its weight plus a little pressure from the operator is usually sufficient to sink it into the bottom for considerable depth. After a short time, to allow for settling, the jaws were closed biting out a sample of the bottom. The sample is delivered into a rectangular plastic box by merely pulling up the jaws chains.

Triple samples were always taken because it was assumed that single samples taken with the Ekman grab may be considerably different from one another. The triple samples would give a more accurate picture of the bottom fauna, K. Berg (1938)).

When a bottom sample had been taken up, each collection was placed individually in a plastic box with a label with the date on. A dilute solution of formalin (10 per cent) was added to kill and preserve the fauna before being sorted and examined in the laboratory later on. When there was enough time, the samples were passed through a sieve, the bottom of which consisted of a copper net with meshes of a size 0.6 mm. During this process the sieve was held overside, its bottom just touching the surface of the water. By careful shaking the mud was washed out. The coarser parts were left in with the animals and they were then transferred to a labelled glass jar. It is impossible to employ a sieve with finer meshes than 0.6 mm, if the sieve is to be handy enough.

An improved kicking technique devised by Kershaw et al (1968) and described below, was used to collect the shore-fauna samples from the two canals.



PLATE, (4)　　"The Hand-net."

A standard Freshwater Biological Association net was used. The net was made of strong cloth mesh (24 meshes to the inch), bound into a four sided aluminium alloy frame. The length of the net was 25 cm, and the width of the frame was 22 cm. A wooden handle, 75 or 150 cm, long was screwed into the top of the frame (Plate 4). Thigh-high waders with metal studs in the soles were worn while sampling. The open end of the net faced the current, and the substrate in front of the net was sharply kicked. The waders with metal studs in the soles were useful for this manoeuver. The disloged animals and debris were carried into the net by the current and the swinging of the net.

A total of five kicks at five separate places were used in a line along the canal shore and at intervals of about 1½ meters apart. The material that was collected in the five kicks at five places was pooled into one sample. At each site the sample was washed with canal water, and the massed material was then transferred to a small rectangular polythene box, with a water-tight lid. Any material adhering to the net was washed into the box with water from a wash-bottle, or picked by hand and added to the box. 4 per cent formaline was added to kill and preserve the fauna. The date and place were suitably marked on the sides of the box. The samples could then be stored until they were required for examination.

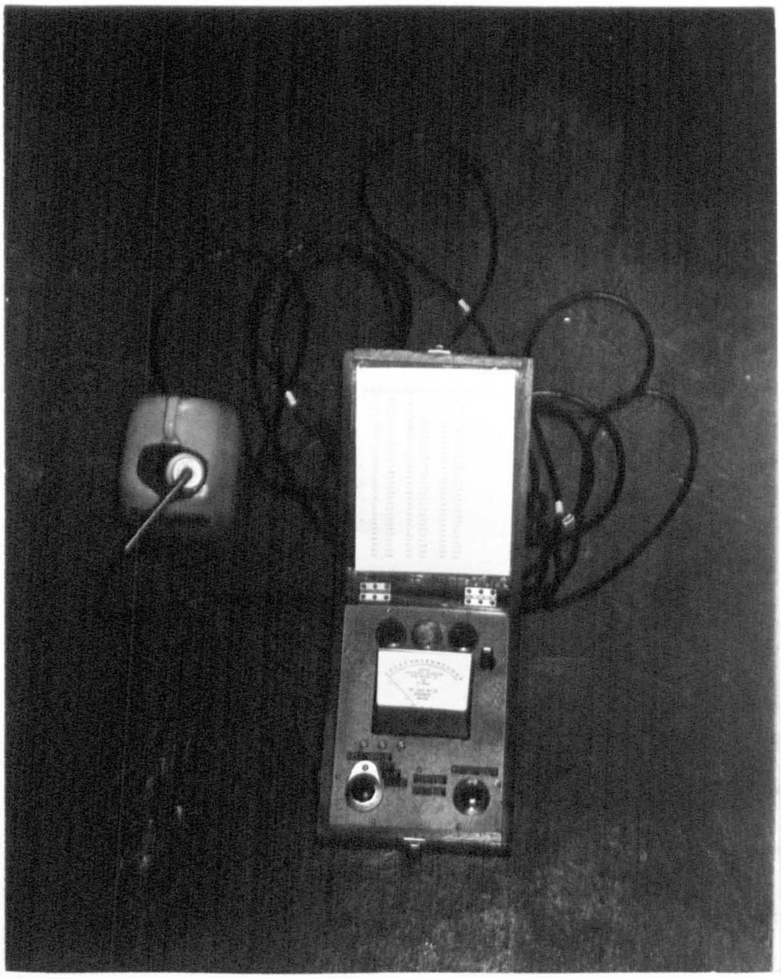
Therefore, the "number of kicks" in each sample were standards by which samples from different sites could be compared. This technique is outlined by Hynes (1961); Hynes and Williams (1962); Morgan and Egglishaw (1965); Minshall (1966); Minshall and Kuchne (1969); Huni (1969); Frost, Huni and Kershaw (1971) and Arskad (1972).

PLATE, (5) "The Plankton net."

For collecting crustacean zooplankton samples monthly, a standard Freshwater Biological Association net was used too. The net was conical (40 cm. deep) and made of silk mesh (48 meshes/cm) or (120 meshes to an inch). The apex of the conical net was open and the hole filled with a removable rubber cone. This cone measured 7 cm. high, 3 cm. diameter at the base and had a flat blocked apex of diameter 1 cm. The net was mounted on a metal ring (25 cm. diameter). A wooden handle of 150 cm. length was fitted at the side of the metal ring (see Plate 5). Samples were taken by drawing the plankton net along for 20 metres near the bank (shore) tow, twice at each site. The material collected in both samples at each site was mixed to give one single sample. At each time the net was lifted from the water in an upward sweeping movement to allow the material to fall to the apex of the net. When the sides of the net were clean and the material massed together, it was tipped into a small glass jar.

Formal-Alcohol solution (5 per cent formaline added to 70 per cent alcohol, equal parts), as recommended by most of limnologists for general plankton preservation than any other liquid, was added to kill and preserve the zooplankton. The date and place of sampling was written in pencil on a strip of white card and placed into the jar containing the sample.

The same technique was applied to collect the zooplankton samples from all the sites.



PLATE, (6) "The Oxygen / Temperature meter."

4.3 Physical and Chemical Factors Recorded in the Field

The following physical and chemical factors were recorded at each site to study their effect on the distribution of the invertebrates.

a. Chemical composition of the water "Total hardness, Calcium concentration and Magnesium concentration".

b. Dissolved oxygen concentration.

c. Water temperature.

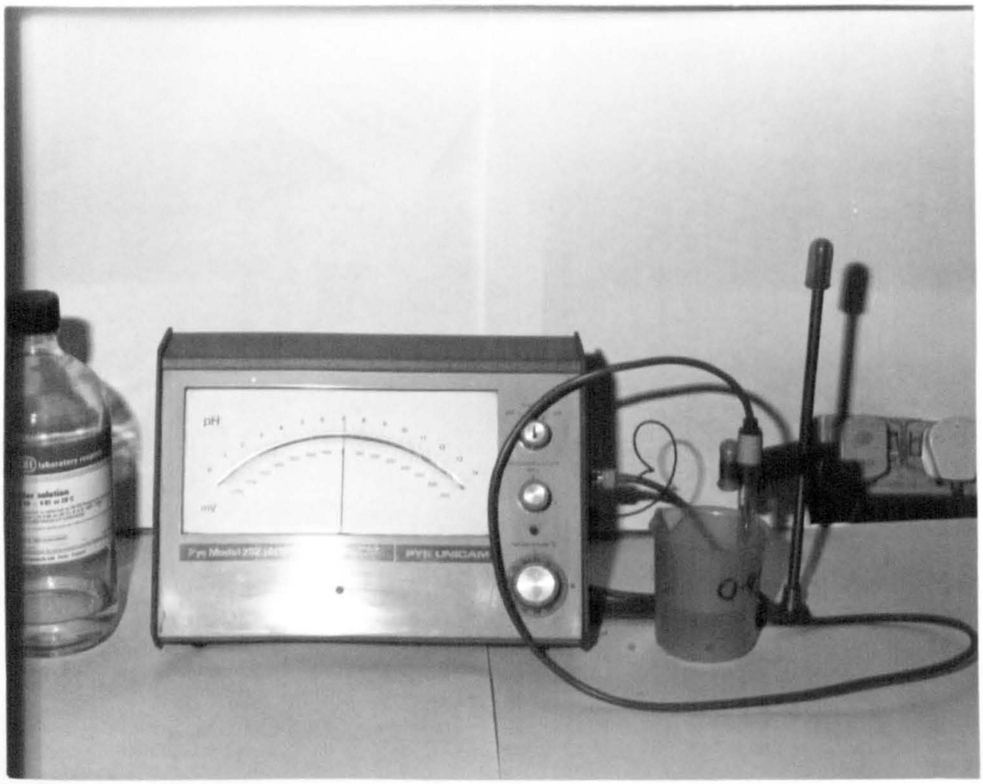
d. pH of the water.

a. Chemical Composition of the Water

Samples of the two canals were taken at each site, using screw top polypropylene bottles of 1000 ml. capacity. The bottles were transported filled with distilled water and washed out and refilled with canal water at each site. Closing the bottles should be done under the water surface so as to make sure they were completely full. These samples were returned to the laboratory and analysed within twenty-four hours (page, 40)

b. Dissolved Oxygen Concentration

The Mackereth oxygen/temperature probe was used to measure the oxygen concentration at each site on both canals throughout the sampling period. Described by Winkler (Mackereth, 1963) and Plate 6.



PLATE, (7)   "The pH meter."

c. Water Temperature

The water temperature was taken using, at each site on both canals, the "Mackereth oxygen/temperature probe" Plate 6, described by Winkler, Mackereth, (1963). Reading accuracy up to 0.10 ^{o}C.

d. pH of the Water

The water for the pH estimations was collected using 500 ml glass bottles. These bottles were held below the surface with their tops off and allowed to fill to overflowing. The bottles were then stoppered so as not to include any bubbles. These were then returned to the laboratory. A pH meter type (Plate 7) was used to measure the pH of the water of every site on the two canals throughout the sampling period regularly.

4.4 Methodology "Experiments to Test the Accuracy of the Dredge Method"

Experiments were carried out to test the validity of the sampling method. On July 20th, 1972 and on August 26th, 1972, five samples were taken separately by the dredge at site (2) on the Shropshire Union Canal and also at site (7) on the Llangollen Canal.

Procedures

Five sampling points were made in a straight line parallel with the canal shore and within the marked area at site (2). A similar five sampling points were taken at site (7). Each of the five samples were taken from the canal in a straight line of sampling points near the middle and drawn towards the shore of the canal. To avoid sampling the same area twice, sampling points were made two metres apart.

The contents of every sample were transferred into suitably marked plastic boxes and kept separately. A sufficient amount of 40% formaline was added to kill and preserve the animals.

In the laboratory each sample was separately treated and searched, and the animals found were identified, measured and recorded, Tables 1 and 2.

The relationship between the total number of animals in each sample of the series was analysed in terms of the χ^2 (or Chi-squared) test.

The statistic χ^2 may be defined as

$$\chi^2 = \sum \left(\frac{(f_o - f_e)^2}{f_e} \right)$$

where f_o = an observed class frequency

f_e = the theoretical (expected) class frequency

TABLE No.(1) To Test the Accuracy of the Dredge Sampling Method.

Experiment No.1 The identity, size and number of invertebrate fauna collected at site No.2
20 July, 1972. on the Shropshire Union Canal and site No.7 on the Llangollen Canal.

	Size	SAMPLES					SAMPLES				
	in mm	I	II	III	IV	V	I	II	III	IV	V
				Site 2					Site 7		
OLIGOCHAETA											
Homochaeta naidina	3-10	84	106	90	112	98	48	61	40	71	59
" "	> 10	59	50	70	35	43	29	32	21	24	19
Pristina longiseta	3-10	7	14	18	15	10	1	1	2	2	3
" "	> 10	7	9	12	5	8	1	3	1	-	1
Pristina menoni	3-10	25	15	23	20	17	5	3	3	2	4
" "	> 10	12	10	8	13	14	3	2	4	2	1
Pristina idrensis	3-10	17	14	18	15	10	3	5	4	4	5
" "	> 10	7	9	12	5	8	2	4	4	3	-
Stylodrilus heringianus	> 20	-	1	2	-	-	2	4	2	1	-
Lumbriculus varigatus	> 20	-	-	-	-	-	-	1	-	1	-
Tubificidae	> 15	10	8	4	9	7	6	2	5	4	3
HIRUDINEA (Leeches)											
Glossophonia complanata	5-10	-	-	1	-	-	1	-	-	2	-
Erpobdella octaculata	5-15	-	-	-	1		-	-	1	-	-
Helobdella stagnalis	5-10	-	1	-	-	-	-	2	-	-	1
DIPTERA											
Chironomidae larvae	5	15	13	21	18	9	3	2	4	6	5
" "	5-10	10	8	7	9	6	5	3	3	2	2
" "	10-22	3	6	4	5	3	4	2	1	-	-
Ceratopognoidae larvae	5-15	-	-	1	-	-	2	3	-	4	2
GASTROPODA											
Planorbis planorbis	2- 5	-	-	-	-	1	-	-	-	-	-
Valvata piscinalis	2- 5	1	-	1	-	1	-	-	-	-	-
Succina putris	3- 7	-	-	-	-	-	1	-	2	-	-
Viviparus viviparus	>10	-	-	-	-	1	1	-	-	1	-
Bithynia tentaculata	2- 5	-	-	1	-	-	-	-	1	-	-
LAMELLIBRANCHIA (Bivalves)											
Pisidium amnicium	< 5	2	4	2	3	2	10	10	8	12	14
" "	>5-15	2	-	1	2	-	5	3	1	2	4
Sphaerium corneum	< 5	-	1	2	3	-	5	6	5	3	4
" "	>5-15	-	-	-	1	1	1	-	-	1	2
Dreissina polymorpha	>20	1	-	1	2	-	-	-	1	-	-
Andonta cygenea	>20	-	-	-	-	-	-	2	-	-	-
TOTALS		262	271	301	273	240	138	151	113	147	128

TABLE No.(2) To Test the Accuracy of the Dredge Sampling Method.

Experiment No.II The identity, size and number of invertebrate fauna collected at site No.2
August, 1972 on the Shropshire Union Canal and site No.7 on the Llangollen Canal.

	Size	SAMPLES					SAMPLES				
	in mm	I	II	III	IV	V	I	II	III	IV	V
				Site 2					Site 7		
OLIGOCHAETA											
Homochaeta naidina	3-10	89	89	101	131	94	100	89	120	94	105
" "	> 10	24	32	29	27	30	51	41	38	39	43
Pristina longiseta	3-10	13	8	15	18	9	2	2	2	3	4
" "	> 10	3	5	7	6	6	1	2	1	2	2
Pristina menoni	3-10	13	19	26	15	18	3	3	4	5	4
" "	> 10	7	8	6	6	9	3	2	1	2	3
Pristina longiseta	3-10	17	17	20	14	18	3	5	6	7	5
" "	> 10	10	9	8	8	6	3	4	2	1	1
Stylodrilus heringianus	> 20	-	3	1	-	-	6	4	2	5	1
Lumbriculus varigatus	> 20	-	-	-	-	1	-	2	-	2	-
Tubificidae	> 15	15	10	6	9	11	6	3	6	4	8
HIRUDINEA (Leeches)											
Glossophonia complanata	5-10	-	-	1	-	-	-	1	-	2	-
Glossophonia hetrochita	5-10	2	-	-	-	1	-	-	1	-	-
Erpobdella octaculata	5-15	-	-	-	1	-	-	2	-	-	1
Helobdella stagnalis	5-10	-	-	-	2	-	-	-	3	1	-
DIPTERA											
Chironomidae larvae	< 5	26	22	24	28	17	8	15	10	7	10
" "	>5-10	10	9	6	7	9	5	6	4	3	5
" "	>10-22	4	3	4	2	9	2	3	3	2	4
Ceratopognoidae larvae	5-15	-	-	-	-	2	1	-	3	1	-
GASTROPODA											
Planorbis planorbis	2- 5	-	1	-	-	1	-	-	-	-	-
Valvata piscinalis	2- 5	1	-	2	-	-	-	-	1	-	-
Succina putris	3- 7	-	-	-	1	-	2	-	2	-	1
Lymnaea glabra	3- 5	-	-	1	-	-	-	-	-	-	-
Bithynia tentaculata	2- 5	-	1	-	1	-	-	2	-	-	1
Viviparus viviparus	10	-	1	-	-	-	1	1	-	2	-
LAMELLIBRANCHIA (Bivalves)											
Pisidium amnicium	5	2	3	1	4	3	9	14	7	10	11
" "	5-15	-	1	-	1	-	4	2	5	2	4
Sphaerium corneum	5	1	2	-	1	-	3	5	7	8	5
" "	5-15	-	-	-	-	1	-	-	1	1	2
Dreissina polymorpha	20	1	-	2	1	2	1	1	-	-	-
Anodonta cygenea	20	-	-	-	-	-	1	-	2	-	1
TOTALS		219	243	262	283	247	215	209	230	203	219

TABLE No.(1) To Test the Accuracy of the Dredge Sampling Method.

Experiment No.1 20 July, 1972. The identity, size and number of invertebrate fauna collected at site.No.2 on the Shropshire Union Canal and site No.7 on the Llangollen Canal.

	Size in mm	SAMPLES Site 2 I	II	III	IV	V	SAMPLES Site 7 I	II	III	IV	V
OLIGOCHAETA											
Homochaeta naidina	3-10	84	106	90	112	98	48	61	40	71	59
" "	> 10	59	50	70	35	43	29	32	21	24	19
Pristina longiseta	3-10	7	14	18	15	10	1	1	2	2	3
" "	> 10	7	9	12	5	8	1	3	1	-	1
Pristina menoni	3-10	25	15	23	20	17	5	3	3	2	4
" "	> 10	12	10	8	13	14	3	2	4	2	1
Pristina idrensis	3-10	17	14	18	15	10	3	5	4	4	5
" "	> 10	7	9	12	5	8	2	4	4	3	-
Stylodrilus heringianus	> 20	-	1	2	-	-	2	4	2	1	-
Lumbriculus varigatus	> 20	-	-	-	-	-	-	1	-	1	-
Tubificidae	> 15	10	8	4	9	7	8	2	5	4	3
HIRUDINEA (Leeches)											
Glossophonia complanata	5-10	-	-	1	-	-	1	-	-	2	-
Erpobdella octaculata	5-15	-	-	-	1		-	-	1	-	-
Helobdella stagnalis	5-10	-	1	-	-	-	-	2	-	-	1
DIPTERA											
Chironomidae larvae	5	15	13	21	18	9	3	2	4	6	5
" "	5-10	10	8	7	9	8	5	3	3	2	2
" "	10-22	3	8	4	5	3	4	2	1	-	-
Ceratopognoidae larvae	5-15	-	-	1	-	-	2	3	-	4	2
GASTROPODA											
Planorbis planorbis	2- 5	-	-	-	-	1	-	-	-	-	-
Valvata piscinalis	2- 5	1	-	1	-	1	-	-	-	-	-
Succina putris	3- 7	-	-	-	-	-	1	-	2	-	-
Viviparus viviparus	>10	-	-	-	-	1	1	-	-	1	-
Bithynia tentaculata	2- 5	-	-	1	-	-	-	-	1	-	-
LAMELLIBRANCHIA (Bivalves)											
Pisidium amnicium	< 5	2	4	2	3	2	10	10	8	12	14
" "	>5-15	2	-	1	2	-	5	3	1	2	4
Sphaerium corneum	< 5	-	1	2	3	-	5	6	5	3	4
" "	>5-15	-	-	-	1	1	1	-	-	1	2
Dreissina polymorpha	>20	1	-	1	2	-	-	-	1	-	-
Anodonta cygenea	>20	-	-	-	-	-	-	2	-	-	-
TOTALS		262	271	301	273	240	138	151	113	147	128

TABLE No.(2) To Test the Accuracy of the Dredge Sampling Method.

Experiment No.II August, 1972 The identity, size and number of invertebrate fauna collected at site No.2 on the Shropshire Union Canal and site No.7 on the Llangollen Canal.

	Size in mm	SAMPLES Site 2 I	II	III	IV	V	SAMPLES Site 7 I	II	III	IV	V
OLIGOCHAETA											
Homochaeta naidina	3-10	89	89	101	131	94	100	89	120	94	105
" "	> 10	24	32	29	27	30	51	41	38	39	43
Pristina longiseta	3-10	13	8	15	18	9	2	2	2	3	4
" "	> 10	3	5	7	6	6	1	2	1	2	2
Pristina menoni	3-10	13	19	26	15	18	3	3	4	5	4
" "	> 10	7	8	6	6	9.	3	2	1	2	3
Pristina longiseta	3-10	17	17	20	14	18	3	5	6	7	5
" "	> 10	10	9	8	8	6	3	4	2	1	1
Stylodrilus heringianus	> 20	-	3	1	-	-	6	4	2	5	1
Lumbriculus varigatus	> 20	-	-	-	-	1	-	2	-	2	-
Tubificidae	> 15	15	10	6	9	11	6	3	6	4	8
HIRUDINEA (Leeches)											
Glossophonia complanata	5-10	-	-	1	-	-	-	1	-	2	-
Glossophonia hetrochita	5-10	2	-	-	-	1	-	-	1	-	-
Erpobdella octaculata	5-15	-	-	-	1	-	-	2	-	-	1
Helobdella stagnalis	5-10	-	-	-	2	-	-	-	3	1	-
DIPTERA											
Chironomidae larvae	< 5	26	22	24	28	17	8	15	10	7	10
" "	>5-10	10	9	6	7	9	5	6	4	3	5
" "	>10-22	4	3	4	2	9	2	3	3	2	4
Ceratopognoidae larvae	5-15	-	-	-	-	2	1	-	3	1	-
GASTROPODA											
Planorbis planorbis	2- 5	-	1	-	-	1	-	-	-	-	-
Valvata piscinalis	2- 5	1	-	2	-	-	-	-	1	-	-
Succina putris	3- 7	-	-	-	1	-	2	-	2	-	1
Lymnaea glabra	3- 5	-	-	1	-	-	-	-	-	-	-
Bithynia tentaculata	2- 5	-	1	-	1	-	-	2	-	-	1
Viviparus viviparus	10	-	1	-	-	-	1	1	-	2	-
LAMELLIBRANCHIA (Bivalves)											
Pisidium amnicium	5	2	3	1	4	3	9	14	7	10	11
" "	5-15	-	1	-	1	-	4	2	5	2	4
Sphaerium corneum	5	1	2	-	1	-	3	5	7	8	5
" "	5-15	-	-	-	-	1	-	-	1	1	2
Dreissina polymorpha	20	1	-	2	1	2	1	1	-	-	-
Anodonta cygenea	20	-	-	-	-	-	1	-	2	-	1
TOTALS		219	243	262	283	247	215	209	230	203	219

TABLE 3

The Chi-Squared Test to Find the Accuracy of the Dredge Sampling Method.

(Degree of Freedom (V) = N-1)
= 5-1=4

EXPERIMENT NO.1

	I	II	III	IV	V	I	II	III	IV	V
	SITE 2 ON THE SHROPSHIRE UNION CANAL					SITE 7 ON THE LLANGOLLEN CANAL				
f_o =	262.00	271.00	301.00	273.00	240.00 = 1347	138.00	151.00	113.00	147.00	128.00 = 677
f_e =	269.40					135.40				
f_o-f_e =	- 7.40	1.60	31.60	3.60	-29.40	2.60	15.60	-22.40	11.60	- 7.40
$(f_o-f_e)^2$ =	54.76	2.56	998.56	12.96	864.36	6.76	243.36	501.76	134.56	54.76
$\frac{(f_o-f_e)^2}{f_e}$ =	0.20	0.01	3.70	0.05	3.20 = 7.16	0.05	1.79	3.70	0.99	0.4 = 6.93
χ^2 = 7.6 Probability (P) = > 0.05 = > 5%						χ^2 = 6.93 Probability (P) = > 0.05 = > 5%				

EXPERIMENT NO.2

	I	II	III	IV	V	I	II	III	IV	V
f_o =	219.00	243.00	262.00	283.00	247.00 = 1254	215.00	209.00	330.00	203.00	219.00 = 1076
f_e =	250.80					215.20				
f_o-f_e =	-31.80	- 7.80	11.20	32.20	- 3.80	-0.20	- 6.20	14.80	-12.20	3.80
$(f_o-f_e)^2$ =	1011.24	60.84	125.44	1036.84	14.44	0.04	38.44	209.04	148.84	14.44
$\frac{(f_o-f_e)^2}{f_e}$ =	4.03	0.24	0.5	4.13	0.06 = 8.95	0.00	0.18	1.02	0.69	0.07 = 1.96
χ^2 = 8.95 Probability (P) = > 0.05 = > 5%						χ^2 = 1.96 Probability (P) = > 0.05 = >5%				

The χ^2 Table is entered at the appropriate value (V), or number of "degree of freedom" = (N-1) where N = the total frequency.

Results:- A comparison of the samples is shown in Tables 1 and 3 for the experiment No.1 and Tables 2 and 3 for the experiment No.2.

Conclusions:- The results of the experiments indicate that the sampling method is reliable in that consistent figures were obtained.

5. LABORATORY METHODS

5.1 Methods of Sorting the Samples in the Laboratory

One of the most tedious and time-consuming tasks in gathering the data is separating the animals in the bottom fauna and the shore-fauna from the debris. Hand-sorting in flat pans is possible, but it is so time-consuming that it limits the number of samples that can be dealt with. It is also not particularly efficient as it is easy to overlook specimens covered by or attached to other objects.

Various attempts have been made to decrease the labour by many means. The first of these and the simplest technique is merely to place the sample in a trough, with baffles,along which a current of water flows and washes out the animals and lighter debris into a sieve and leaves behind the partitions (Moon (1935)). Lauff et al, (1961), placed the sample in a vertical tube up which a current of water or a stream of air bubbles passed. Animals and light debris were carried to the surface where they could be drawn off. The same effect can be obtained even more simply by using large amounts of water and a shallow dish, which is operated in the same manner.

The other methods of sorting depend upon density differences and are based upon differential flotation in a solution of high specific gravity. Such methods have long been used for sorting certain organisms from terrestrial soils, and Beak (1938b) first adapted the idea to stream samples. He used a strong solution of calcium chloride, and since then various other salts and sugars have been used. The merits of different materials are discussed by Macan, (1958b) and Anderson (1959), who advocate the use of a solution of sucrose of specific gravity 1:12. Almost all animals float, with the exception of some Molluscs and a few Trichoptera larvae which form cases of heavy material. Hynes (1970) suggests that floatation techniques must be carried out rapidly because animals gradually sink as they loose water by exmosis. Whitehouse and Lewis (1966) used carbon tetrachloride for sorting samples, but there are obvious safety hazards with the continued use of it. Mason and Yevich (1967), and Hamilton (1969) used dyes to make animals conspicuous. The drawback of these methods is that these dyes may interfere with the specific identification of animals where natural colour is important.

Still, the simplest technique is merely to place the sample (or part of it) in a shallow trough, with baffles along which a current of water flows and washes out the animals and the lighter debris in a sieve (Moon (1935)), and which was used in the sorting technique in the laboratory in this survey.

a. Bottom Samples

In the laboratory, at the first stage the bottom samples were passed through a sieve whose bottom consisted of a copper net with meshes of size 0.6 mm. It was impossible to employ a sieve with a finer mesh, if the sieve is to be handy enough. The sample (or part of it) was poured into the sieve and tap water was directed gently from a hose. By careful shaking the mud was washed out. The coarser parts were left with the animals and all were transferred to another labelled plastic box.

Some of the animals have a tendency to adhere to the metal net of the sieve which rendered their transfer difficult, therefore a metal plate was fastened to one corner of the bottom of the metal sieve, being soldered to the meshes. With plenty of water the animals could be washed into the corner where the metal plate prevented a little water from running through. From this place the animals could easily be transferred. The second stage is to place every partly cleaned sample (or part of it) into a shallow trough, with baffles along which a current of water flows and washes out the animals and lighter debris into the same sieve (0.6 mm), leaving behind the heavy partitions. The sieve contents were transferred to labelled glass bottles. Some animals adhered to the mesh and the same technique was used as with those mentioned before. Then the sample was transferred from the bottles into a white enamelled tray (12 x 10 x 2 inches). The bottle was checked afterwards to make sure that nothing remained inside by more washing.

The tray base was divided into a one square inch grid of black waterproof pen. Using a projected light from an intensity lamp each square was searched with the help of a pair of forceps and by the naked eye. Animals of size 3-5 millimetre or more were picked out of the tray individually and dropped into a petri dish, where they could be identified, measured, counted and recorded. In case there was not enough time for identification, the animals of each sample should be preserved and stored in a sufficient quantity of 70 per cent alcohol. Then the samples were poured into petri dishes, when required for identification, they should be transferred to 30 per cent alcohol first and then to water and examined. When there was enough time for immediate full sorting, the small animals in the remainder of the sample in the tray were examined and counted with a binocular microscope (of X25 magnification). This was done by taking a small portion of the sample from the tray with a rubber bulb pipette into a small petri dish having a grid of (5 millimetres) squares cut onto its bottom. If samples had large amounts of residue, it was easier to sub-sample it (page, 38). In case further investigation of the material proved necessary, and there was not enough time, the remainder of the samples were preserved in 4% formaline.

The washed silt, sand, small stones and inorganic material remained in the trough, were searched in a similar manner. This was found to contain heavy animals mainly Molluscs and Trichoptera larvae without cases or in cases made of sandy or stony grains. Occasionally some light animals such as Chironomidae larvae, Oligochaeta and Nematodes were also recorded.

The animals found were not recorded separately, but added to the animals in the petri dishes or bottles. This agreed with S. Frost (1971); who thought it is essential to insure that encased Trichoptera larvae are not overlooked in the washed sand and gravel. Also, Hynes (1970a), pointed out that some heavy animals remain in the debris.

b. Shore-Fauna Samples

They were completely searched and all treated in entirely the same way as the bottom samples.

5.2 Methods of Recording and Counting

a. Bottom Samples

For identification and counting the preserved animals which were in 70 per cent alcohol, were transferred from the bottle to 30 per cent alcohol first and then to the water, "because of the difference in osmotic pressure", before transferring to a 5 cm. diameter petri-dish which had a 5 mm square grid cut onto its bottom. The animals were examined under a binocular microscope (magnification X25). Using a direct light and with the help of a right angled needle fixed into wooden handle, each animal was moved to the middle, identified, measured and recorded individually. After finishing each portion of the sample, the petri-dish was gently shaken and the animals poured into a suitably marked jar. The petri-dish was also washed with water before another portion was added. This process was repeated until the whole sample was examined. Occassionally the unidentified small animals were transferred to a microscope slide in few drops of Amman's lactophenol prepared as follows:

Carbolic acid 400 gm. - Lactic acid 400 ml.

Glycerol 800 ml. - Distilled water 400 ml.

The animals should be covered with a cover-slip and left in this fluid for several hours before identification under a compound microscope.

A pipette with a rubber teat was used to transfer small amounts of the remainder of the sample to a 5 cm. diameter petri-dish. The debris and animals were thinly dispersed and the petri dish searched under a binocular microscope (magnification X25). The petri dish was moved from right to left and back at successive levels on the microscope stage, thus avoiding the risk of counting animals more than once. Animals were measured to the nearest millimetre using the needle and 5 mm. grid, identified, counted and recorded by marking them against a check list. After searching each amount, the petri dish was washed and another amount added. This process was repeated until the whole sample was completed.

Searched material and large animals were kept in labelled storage jars in dilute formaline (4%).

b. <u>The Shore-Fauna</u>

The shore-fauna samples were mainly treated in entirely the same way as the bottom samples.

c. <u>Crustacean Zooplankton</u>

The crustacean zooplankton animals were stored in Formal-alcohol solution (5 per cent formaline added to 70 per cent alcohol, equal parts), as recommended by most of the limnologists as being better than any other liquid for general plankton preservation.

The animals were counted in a half cylindrical Perspex trough (30 cm. long and about 2 cm. in diameter (Plate 8)). This was pushed along under the low power of a binocular microscope by hand. The number of animals in summer samples was too large to be counted without reduction. The use of a number of museum jars 5-6 cm. in diameter and about 15 cm. tall had their bottoms partitioned into four sections of equal areas (Plate 9). These were filled with preservative solution, the animals were then added and the liquid stirred. After allowing time for settling (12 hours), the animals were withdrawn with a pipette from opposite sectors and counted, or if they were still concentrated, the animals remaining in the jar were restirred and the procedure was repeated. In the proportions of the animals caught it was assumed that this method of reduction was reasonably accurate. This was also checked by M. Pugh Thomas (1959) from a series of samples taken from Llyn Tegrid.

In this survey count the large Microcrustacea can be identified under binocular microscope, leaving all smaller ones to be picked out, identified and counted by transferring them to slides, and for examination under a compound microscope.

The animals were identified with the aid of the keys of the following workers:-

<u>CLADOCERA</u>	<u>COPEPODA</u>
D.J. Scourfield and J.P. Harding	J.P. Harding and W.A. Smith
A Key to the British Freshwater Cladocera	A Key to the British Freshwater Cyclopoid and Calnoid (Copepods)
Freshwater Biological Association	Freshwater Biological Association
Scientific Publication No.5 (1966)	Scientific Publication No.18 (1960)

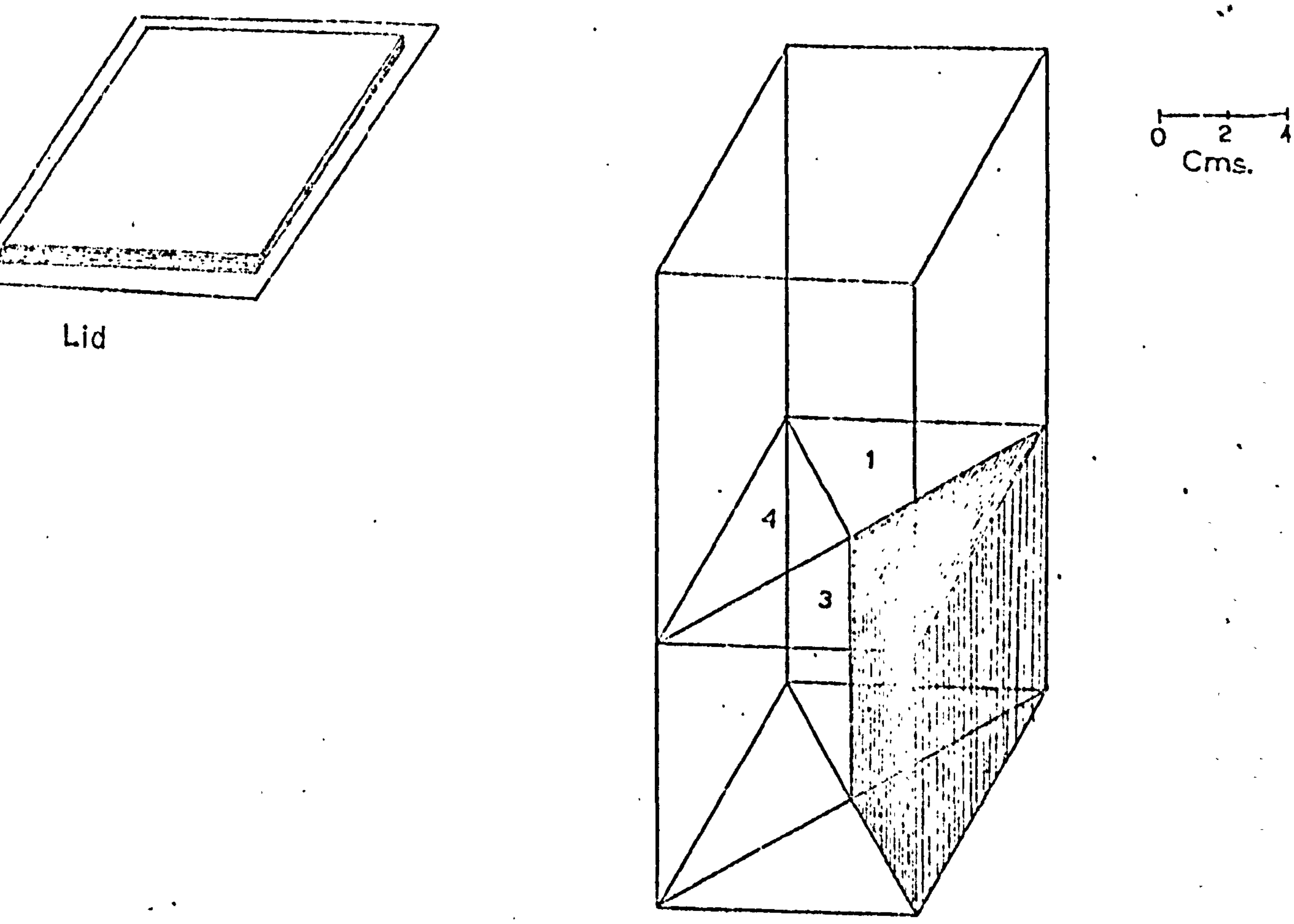
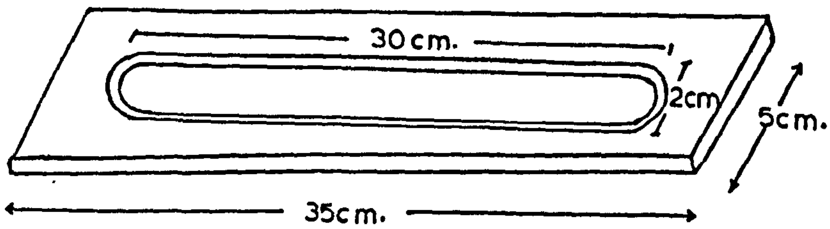


PLATE 10 Sub-sampler

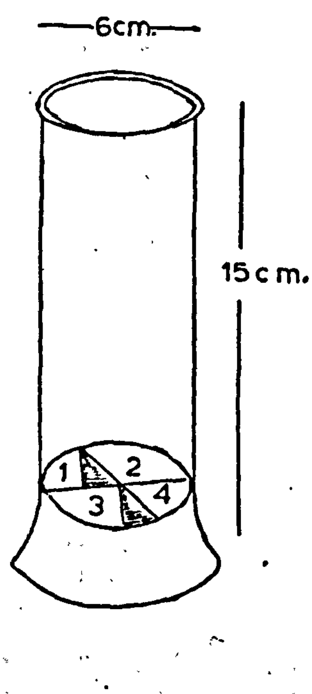


PLATE, (8) Plankton counting trough.

1, 2, 3 & 4

=

Sectors of equal areas.



PLATE, (9) Redution jar

5.3 Sub-Sampling Technique

Even after preliminary sorting, some of the bottom fauna and the shore fauna samples were found to contain large quantities of animals, debris and inorganic material, which made the sample too large to be searched. A sub-sampling technique was applied, to save time and reduce labour.

Allanson and Kerrich (1961) tried to overcome the problem of extensive sorting, by using a sieve to separate the macro and micro portions of samples. They examined the whole macro-portion and sub-sampled the micro-portion by marking it to a definite volume and taking out a known volume for examination.

The method used in this survey, however, is similar to the one used by Hynes (1961), King (1969), Huni (1969) and Ferguson (1970).

The sub-sampler (Plate 10) is a water-tight, perspex box, with a blocked bottom and an open top. Two vertical plates (8 cm. high) are fastened diagonally across the base, thus forming a cube of 8 cm. sides, divided into four equal triangular compartments, and the walls of each compartment were leak-proof.

Animals larger than 4 or 5 mm. were picked out of the sample, as mentioned before, and the remaining sample was sub-sampled.

In sub-sampling the remaining material was poured into the box and water was added carefully from a wash bottle, to fill the cube. A flanged, leak-proof lid was placed on the top and held firmly. The box was turned upside down and shaken vigorously for a few times and then quickly stood on its bottom on a level surface to settle for several hours. By this procedure the sample material was divided into four parts in the four equal triangular compartments. The contents of the two opposite compartments were then completely removed and kept aside in a suitably marked jar, this represented half the sample. Sufficient water was added to the material remaining in the sub-sampler to again fill the four compartments. The box was again shaken and the material left to settle. Parts of the sample from two opposite compartments (each was approximately one eighth of the original volume) were again removed and transferred to a separate jar. If a further dilution of the sample was required more water was added to the remains in the box and the process repeated.

In order to save time and reduce labour, one eighth or some times one sixteenth of the sample was searched under the binocular microscope and the number of animals counted was multiplied by 8 or 16 to calculate the total number of individuals in the whole sample.

The accuracy tests of these sub-sampling techniques have been carried out by Huni (1969), and Ferguson (1970), who divided one sample into 8 sub-samples and showed that the coefficient of variation of the total numbers was not statistically significant.

5.4 Chemical Analysis

The only previous chemical analysis carried out on these canals were by Boycott and Oldham (1936), by the Mid-Cheshire Water Board in (1957), H.M. Twigg (1959) and T. Christian (1959) analysed the Llangollen Canal water for many of the important constituents.

It will be obvious from the above that there was a lack of up-to-date information on the water chemistry of the two canals as a whole.

One of the aims of this project was to investigate the various chemical properties of the canal water on the distribution of the invertebrates at various sites and over a period of time.

The water analysis samples were taken in 1000 ml flasks. The flasks were transported filled with distilled water and washed out at each site just before the water sample. The samples were then analysed within twenty-four hours by the following technique.

a. Total Water Hardness

E.D.T.A. (Ethylenediamine tetraacetic acid) forms a chelated soluble complex when added to a solution of metal cations. If a small amount of a dye such as Eriachrome Black "T" or "R" is added to a solution containing calcium and magnesium ions at a pH of 10, the solution will become wine red. If the E.D.T.A. is then added as a titrant, the calcium and magnesium will be complexed and the solution will turn blue. This is the end-point of the titration.

Method

Add 1 ml of pH buffer to 50 mls of a sample, to give a pH of 10-10.1. A tablet of dry powder indicator was then added. The titrant (E.D.T.A.) is then added slowly with continuous shaking until the last reddish tinge disappeared, the remaining few drops were added, this gave a blue-end point.

Calculation

$$\text{Total Hardness as mg/l litre Ca } CO_3 = \frac{A \times B \times 1000}{\text{ml sample}}$$

or parts per million (p.p.m.)

where A = ml titrated

B = mg Ca CO_3 = 1.0 ml E.D.T.A.

OR

Total Hardness as mg per litre Ca CO_3

$$= \frac{\text{ml (E.D.T.A.) titrant} \times 1000}{\text{ml sample}}$$

$$= \frac{\text{ml (E.D.T.A.) titrant} \times 1000}{50}$$

= ml (E.D.T.A.) titrant X20.

b. Calcium Hardness

When E.D.T.A. is added to water containing both calcium and magnesium, it combines first with the calcium that is present. Calcium may be determined directly using E.D.T.A. when the pH is sufficiently high so that the magnesium is largely precipitated as the hydroxide and an indicator is used which combines with calcium only. Several indicators are available that will give a colour change at the point where all the calcium has been complexed by E.D.T.A. at pH of 12-13.

Method

Use 50 ml. of sample. Add 2.0 ml. of N NaOH solution to produce a pH of 12-13. Add the indicator "Calcon" until pink colour resulted. Titrate with E.D.T.A. solution slowly until the pink almost disappears.

Calculation

Calcium hardness as mg/l Ca CO_3

$$= \frac{A \times B \times 1000}{\text{mls sample}}$$

where A = ml titration

B = mg Ca CO_3 ≡ 1.0 ml of E.D.T.A.

c. Magnesium Hardness

To estimate magnesium present, subtract calcium values from total hardness result.

From the methods employed, as described in the above section, the detailed results obtained have been given in Tables 63-70 and Figure 1.

TABLE No.4 Total Numbers and % of Each Group or Order Taken From All Sites on Each Canal by the Dredge in 1970-71 and 1971-72 to the Total of the Invertebrates.

	S.U.C. 1970-71	S.U.C. 1971-72	Ll.C 1971-72
OLIGOCHAETA	11,819	14,784	7,105
%	22.9	27.3	70.2
HIRUDINEA	32	30	96
%	0.08	0.08	0.97
CRUSTACEA	69	51	64
%	0.11	0.09	0.65
INSECTA	36,419	36,401	2,068
%	70.13	67.05	20.64
Diptera	34,950	35,499	1,915
%	69.55	65.50	18.11
Ephemeroptera	468	390	27
%	0.90	0.75	0.27
Trichoptera	763	500	124
%	1.50	0.90	1.26
Coleoptera	34	12	2
%	0.08	(+)	(+)
Hemiptera	2	0	0
%	(+)	-	-
Odonata	2	0	0
%	(+)	-	-
GASTROPODA	2,481	2,188	107
%	4.6	4.00	1.09
LAMELLIBRANCHIA	1,087	768	578
%	2.10	1.40	5.9
NEMATODA	32	140	0
%	0.08	0.18	-

(+) = sign indicates that an item contributes less than (0.05%)
S.U.C. = Shropshire Union Canal
Ll.C. = Llangollen Canal

TABLE No.5 Total Numbers and % of Each Group or Order Taken From All Sites on Each Canal by the Hand-Net in 18 Months to the Total of the Invertebrates.

Group or Order	S.U.C.	Ll.C
OLIGOCHAETA	12,451	3,020
%	21.6	85.3
HIRUDINEA	110	101
%	0.2	0.8
CRUSTACEA	3,596	3,989
%	6.26	34.48
INSECTA	28,464	3,617
%	49.50	31.50
Diptera	25,317	2,070
%	44.0	18.20
Ephemeroptera	651	56
%	1.13	0.48
Trichoptera	824	1,303
%	1.42	11.25
Coleoptera	910	168
%	1.60	1.45
Hemiptera	600	15
%	1.05	(+)
Odonata	161	5
%	0.49	(+)
GASTROPODA	8,641	515
%	15.01	4.45
LAMELLIBRANCHIA (Bivalves)	4,282	296
%	7.43	2.56
NEMATODA	61	3
	0.11	(+)

(+) = Sign indicates that an item contributes less than 0.05%
S.U.C. = Shropshire Union Canal
Ll.C. = Llangollen Canal

6. RESULTS

6.1 The Qualitative and Quantitative Composition of the Fauna

The invertebrate results are interpreted in the light of previous authors such as Macan, Hynes and Elliott. Each group of animals will be considered separately. The number of invertebrates (bottom fauna, shore fauna and crustacean zooplankton) taken from each site in all months have been given in Tables 41-62 in the appendix. The physical and chemical factors recorded have also been given in Tables 63-70 in the appendix.

All those species which had been recorded from both canals at all sites are discussed further in the systematic sections below.

Monthly quantitative changes and seasonal variations in the non-insect and the insect species or groups will be discussed (page95-123). Life cycles of the common species have been described where possible, also the newly recorded Trichoptera species (Economus tentellus) in England, has been described (page,102).

The following abbreviations have been used in Tables and Histograms.

Ny = Nymph or Nymphs

Lv = Larva or Larvae

Pup = Pupa or Pupae

S.U.C. = Shropshire Union Canal

Site 1 = Site off A5

Site 2 = Site off A5

Site 3 = Site at Market Drayton, New Castle Road Bridge

Site 4 = Site at Hurleston Junction (South of Corne's Bridge)

Site 5 = Site at Hurleston Junction (North of Corne's Bridge)

Ll.C. = <u>Llangollen Canal</u>

Site 6 = Site at Hurleston Junction (Llangollen Canal)

Site 7 = Site at Ellesmere

Site 8 = Site at Horse-Shoe Falls

Most of the animal species or groups were found in the dredge and the hand-net samples, in the two canals. Oligochaeta, Diptera and Gastropoda orders were the major components of the invertebrate community.

A complete list of all the bottom fauna taken by the dredge, the shore fauna taken by the hand-net, and Crustacean zooplankton taken by the plankton net, with relative frequencies, is given below. Each order will be considered separately in each canal.

Table № 6

Monthly occurrence of each Oligochaeta species taken by the dredge at each site on the Shropshire Union Canal and the Llangollen Canal.

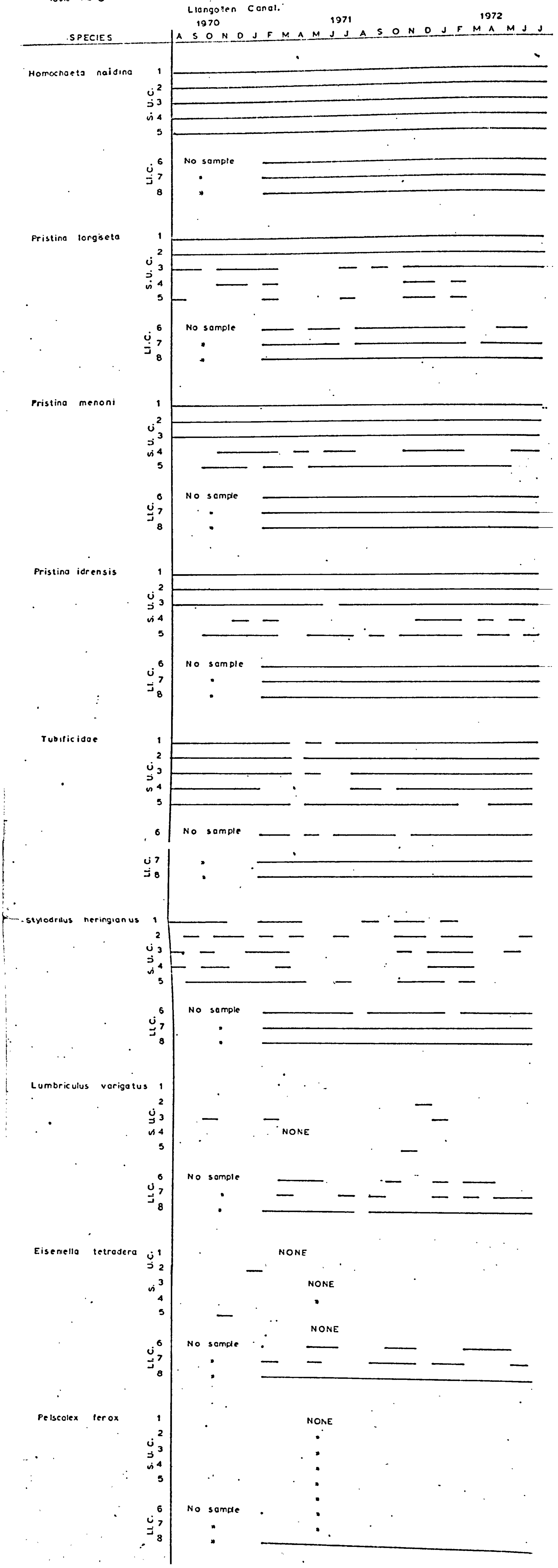
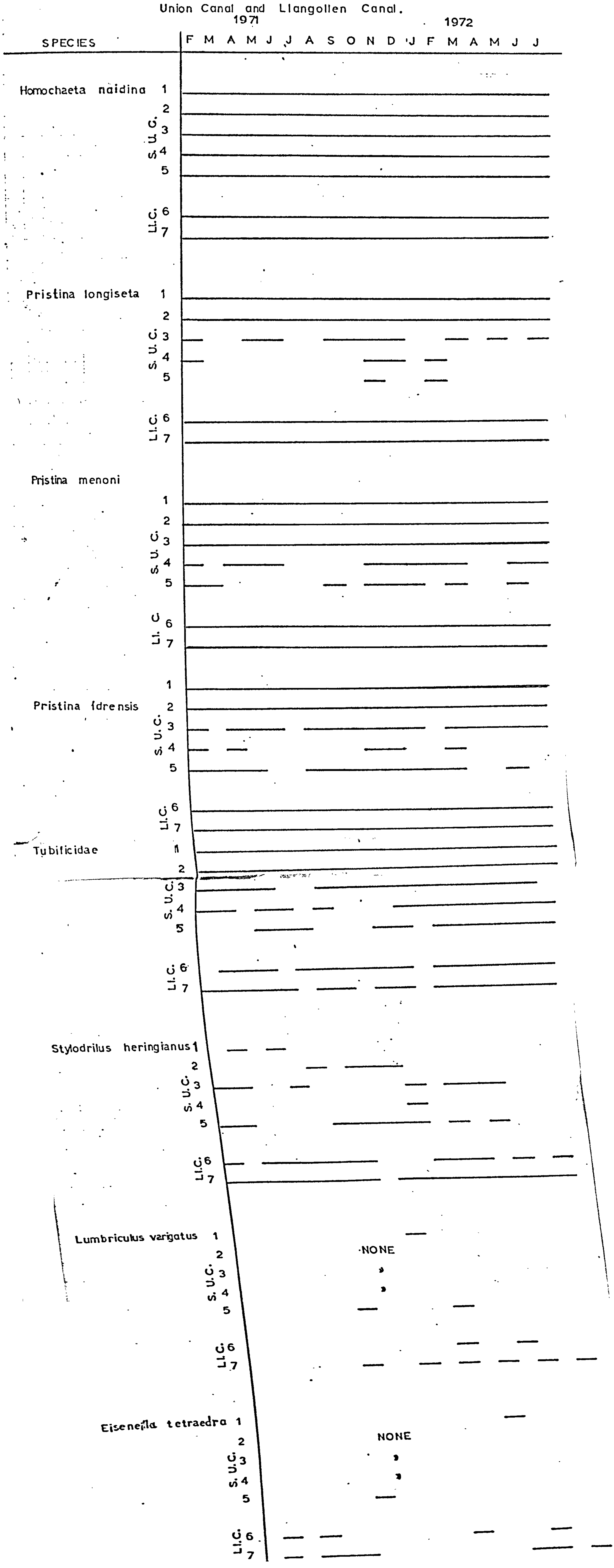


Table No. 7 Monthly occurrence of each Oligochaeta species taken by the hand-net at each site on the Shropshire Union Canal and Llangollen Canal.



6.2 OLIGOCHAETA

Oligochaetes were the most abundant group of invertebrates in all months, and at all sites, but they are clearly much more abundant both in density and numbers in the Shropshire Union Canal, than in the Llangollen Canal. This abundance is possibly attributable to the larger amounts of black organic matter, on which many of these animals depend for their food (Egglishaw (1964)) and (P.S. Maitland (1966)).

In the Shropshire Union Canal, they represented 22.9% of the total invertebrates in 1970-71, and 21.8% in 1971-72 of the dredge samples. Also they represented 21.64% of the total invertebrates of the hand-net samples.

In the Llangollen Canal theyrepresented (70.2%) of the total invertebrates in 1971-72 in dredge samples, and (25.3%) in hand-net samples.

The following species have been recorded from the Shropshire Union and Llangollen Canals so far. Species recorded during the study period included

Homochaeta naidina	(Brecher)
Pristina longiseta	(Ehrenberg)
Pristina menoni	(Aiyer)
Pristina idrensis	(Sperber)
Stylodrilus horingianus	(Claparède)
Lumbriculus variegatus	(Müller)
Eiseniella tetraedera	(Savingny)
Peloscolex ferax	(Eisen)

TABLE No. 8 Total Number and % of the Oligochaeta (*Homochaeta naidina*) Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total of the Oligochaeta.

	S.U.C.						Ll.C			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Homochaeta naidina	2,414	2,478	1,292	1,199	1,960	8,543				
%	20.42	20.96	10.10	10.14	16.58	77.7				
1971-72										
Homochaeta naidina	2,582	2,547	1,933	1,903	1,630	10,595	1,600	1,852	1,857	5,309
%	17.50	17.50	13.02	12.90	11.03	72.10	22.80	26.40	26.72	76.00

Total Number and % of the Oligochaeta (Homochaeta naidina) Taken from Each Site by the Hand-Net in 18 Months to the Total of Oligochaeta.

	S.U.C.						Ll.C			
	1	2	3	4	5	TOTAL	6	7	8.	TOTAL
Homochaeta naidina	2,034	2,216	652	1,102	1,054	7,058	193	1,764	NO SAMPLE	1,957
%	16.34	17.80	5.24	8.93	8.47	57.47	6.39	58.41		62.58

S.U.C. = Shropshire Union Canal
Ll.C. = Llangollen Canal

The following descriptions of the development pattern of the species found in the two canals are based on the percentage frequency distributions along each canal. For these descriptions both dredge and hand-net samples results have been used separately. Monthly quantitative changes, seasonal variations and notes on the more common species have been given. Total numbers and sizes of each sample have been shown in Tables (4 to 62).

Homochaeta naidina

In the Shropshire Union Canal large numbers of Homochaeta naidina were taken in all months from every site with monthly maxima in the two years obtained in November, December, January and February. It forms 77.7% in 1970-71 and 72.1% in 1971-72, of the total Oligochaetas in Dredge samples.

In the two years they declined in numbers from March to October and the monthly distribution pattern was slightly different, numbers were more or less constant, until November, they then increased to a maximum in December (Tables 41-55). Their percentage and distribution for every site in the two years, can be noticed in Tables 6, 7 and 8.

In the Llangollen Canal, this species was also the most common one throughout the year, and at all sites. It formed 76% in 1971-72, of the total Oligochaeta in Dredge samples, and 62.58% in the Hand-net samples.

The numbers of this species found in December, January and February 1971 and 1972, were considerably greater than the numbers taken during the rest of the two years. As shown in Tables 41-55

TABLE No.9 Total Number and % of the Oligochaeta (*Pristina longiseta*) Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Pristina longiseta	243	210	31	7	4	495				
%	2.05	1.80	0.26	0.06	(+)	4.20				
1971-72										
Pristina longiseta	330	228	31	9	9	607	22	42	67	131
%	2.24	2.20	0.21	0.06	0.06	6.00	0.31	0.60	0.95	2.20

Total Number and % of Oligochaeta (*Pristina longiseta*) Taken from Each Site by the Hand-Net in 18 Months to the Total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
Pristina longiseta	482	483	15	4	7	991	53	131	NO SAMPLE	
%	3.87	3.87	0.12	(+)	(+)	7.95	1.75	4.33		6.08

(+) = Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

TABLE No. 10 Total Number and % of the Oligochaeta (*Pristina menoni*) Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Pristina menoni	351	360	94	17	38	860				
%	2.96	3.03	0.79	0.14	0.32	6.40				
1971-72										
Pristina menoni	670	592	129	23	52	1,466	66	111	221	398
%	4.53	4.00	0.87	0.16	0.34	12.00	0.94	1.58	3.15	4.15

Total Number and % of the Oligochaeta (*Pristina menoni*) Taken from Each Site by the Hand-Net in 18 Months to the Total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
Pristina menoni	865	926	50	21	21	1,883	98	299	NO SAMPLE	397
%	6.94	7.43	0.40	0.17	0.17	15.26	3.24	9.90		14.13

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

large numbers were present at every site in the 18 months samples.

Pristina longiseta

In the Shropshire Union Canal this specieswas less common than H. niadina and even rarely occurred in certain months. It only formed 4.2% in 1970-71 and 6% in 1971-72 of the total Oligochaeta in Dredge samples and 7.95% in Hand-net samples, most of it was taken from sites 1 and 2 with maximum numbers in November and December of both years. Very few of this specieswere taken from sites 3, 4 and 5, less than 0.3% in site 3 and less than 0.07% in sites 4 and 5 of the total Oligochaeta.

In the Llangollen Canal, this specieswas also rare, Tables 6, 7, 9 and 41-55, comprising only 2.2% of the total Oligochaeta in the Dredge samples, and 6.06% in the Hand-net samples. Mostly they were collected from site 7, but peak numbers were taken in May, 1971, and January, 1972.

Pristina menoni

In the Shropshire Union Canal this species was present all year round, Tables 6, 7, 10 and 41-55, in sites 1, 2 and 3. It formed 6.4% in 1970-71 and 12% in 1971-72 of the total Oligochaeta in the Dredge samples and 15.26% in the Hand-net samples. It was most numerous in September and October 1971 in Dredge samples and December 1971 and January 1972 in Hand-net samples, Table 10.

On the whole, the maximum numbers were taken from sites 1 and 2 and the minimum from sites 4 and 5, and less than 0.4% of the total Oligochaeta Table 10.

TABLE No. 11 Total Number and % of the Oligochaeta (*Pristina idrensis*) Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Pristina idrensis	409	392	76	4	44	925				
%	3.46	3.31	0.64	(+)	0.37	7.90				
1971-72										
Pristina idrensis	410	706	147	11	39		74	130	299	
%	2.95	4.77	0.99	0.06	0.26	10.7	1.05	1.80	4.26	4.2

Total Number and % of the Oligochaeta (*Pristina idrensis*) Taken from Each Site by the Hand-Net in 18 Months to the Total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
Pristina idrensis	1,064	1,077	43	5	28	2,217	76	271	NO SAMPLE	347
%	8.58	8.65	0.35	(+)	0.22	17.83	2.51	9.00		11.50

(+) = Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

In the Llangollen Canal, this species was one of the most common species, especiay in site 7, where it formed 9.9% of the total Oligochaetas in Hand-net samples.

Maximum numbers were collected in December 1971, January and February, 1972 in Dredge samples and June 1971 and 1972 in the Hand-net samples, Tables 6, 7 and 10.

Pristina idrensis

In the Shropshire Union Canal, this species was more common and present in sites 1, 2 and 3, through the year, but was very rare or absent from sites 4 and 5, (Tables,6,7,11&41-55).Maximum numbers were taken in September, October and November, 1972, in Dredge samples, and December, 1971 and January, 1972 from the Hand-net samples.

It formed 7.9% in 1970-71 and 13.7% in 1971-72 from the total Oligochaeta in Dredge samples and 17.8% in Hand-net samples. The lowest numbers were collected from sites 4 and 5 less than 0.07% from site 4 and less than 0.4% in site 5 from the total Oligochaeta for both years.

In the Llangollen Canal, this species was also more common and found in all the sites, throughout the year, with maximum numbers in November 1971, December 1971 and January 1972 in the Dredge samples and December 1971 and January 1972 in the Hand-net samples. It formed 4.2% in the Dredge samples and 11.49% in Hand-net samples from the total Oligochaeta , Tables 6, 7, 11 and 41-55.

TABLE No. 12 Total Number and % of Oligochaeta (Tubificidae) Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Tubificidae	51	68	19	15	32	185				
%	0.43	0.57	0.16	0.12	0.27	1.60				
1971-72										
Tubificidae	94	91	51	31	51	318	33	47	91	171
%	0.63	0.61	0.33	0.21	0.33	2.70	0.47	0.67	1.30	2.30

Total Number and % of the Oligochaeta (Tubificidae) Taken from Each Site by the Hand-Net in 18 Months to to the Total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
Tubificidae	92	94	31	26	18		27	42	NO SAMPLE	
%	0.72	0.71	0.23	0.20	0.13	2.01	0.84	1.28		2.12

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

Tubificidae

Members of this family were found in nearly all the months and at almost all sites. Like many of the previous species discussed, only a very much smaller number was found, as compared with, for example, Homochaeta naidina species. The largest number was found in July 1972, (77 specimens) in the Dredge sample. Before this the largest number was found in September, October, November and December of 1971 and June 1972 in the Dredge samples, also December 1971, January and February 1972 in the Hand-net samples. The apparent increase in numbers during the winter is shown by both methods, but the sizes are small.

In the Shropshire Union Canal they formed (1.6%) in Dredge samples in 1971-72 and 2.7% in 1971-72 and 2.01% in Hand-net samples of the total Oligochaetes.

In the Llangollen Canal, they formed 1.4% in Dredge Samples 1971-72 and 2.12% in Hand-net samples of the total Oligochaetes.

The total of the percentage at each site is shown in Tables 6, 7, 12 and 41-55, for both canals.

Other Oligochaetes

They include the following species.

a. Stylodrilus heringianus - (Claparède)

b. Lumbriculus variegatus - (Müller)

c. Eiseniella tetradera - (Savingny)

d. Peloscolex ferox - (Eisen)

TABLE No.13 Total Number and % of the Other Oligochaeta Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Other Oligochaeta	15	11	16	7	14	63				
%	0.12	0.08	0.12	0.06	0.12	0.50				
1971-72										
Other Oligochaeta	7	15	10	2	11	45	47	71	360	478
%	0.05	0.10	0.07	(+)	0.07	0.31	0.67	1.01	5.13	6.80

Total Number and % of the Other Oligochaeta Taken from Each Site by the Hand-Net in 18 Months to the Total of the Oligochaeta.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
Other Oligochaeta	3	8	11	0	15	37	32	60	NO SAMPLE	92
%	(+)	0.08	0.09	-	0.12	0.30	1.06	1.99		3.04

(+) = Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

Very few members of these species were found especially in the Shropshire Union Canal at all sites (66 specimens in 1970-71) and 42 specimens in 1971-72)in Dredge samples and they formed 0.6% and 0.4% of the total Oligochaetes. Also, only 38 specimens in the Hand-net samples where it formed 0.29% of the total Oligochaetes.

Larger numbers of these species were found in the Llangollen Canal where they formed 4.2% in 1971-72 in the Dredge samples and 3% in the Hand-net samples of the total Oligochaetes.

In all sites of the two Canals the number of each specieswas small and the detailed percentage and numbers of each one at all sites is shown in Tables 6, 7 and 41-55.

Table No 14

Monthly occurrence of the more common Hirudinea taken by the dredge at each site on the Shropshire Union Canal and the Llangollen Canal.

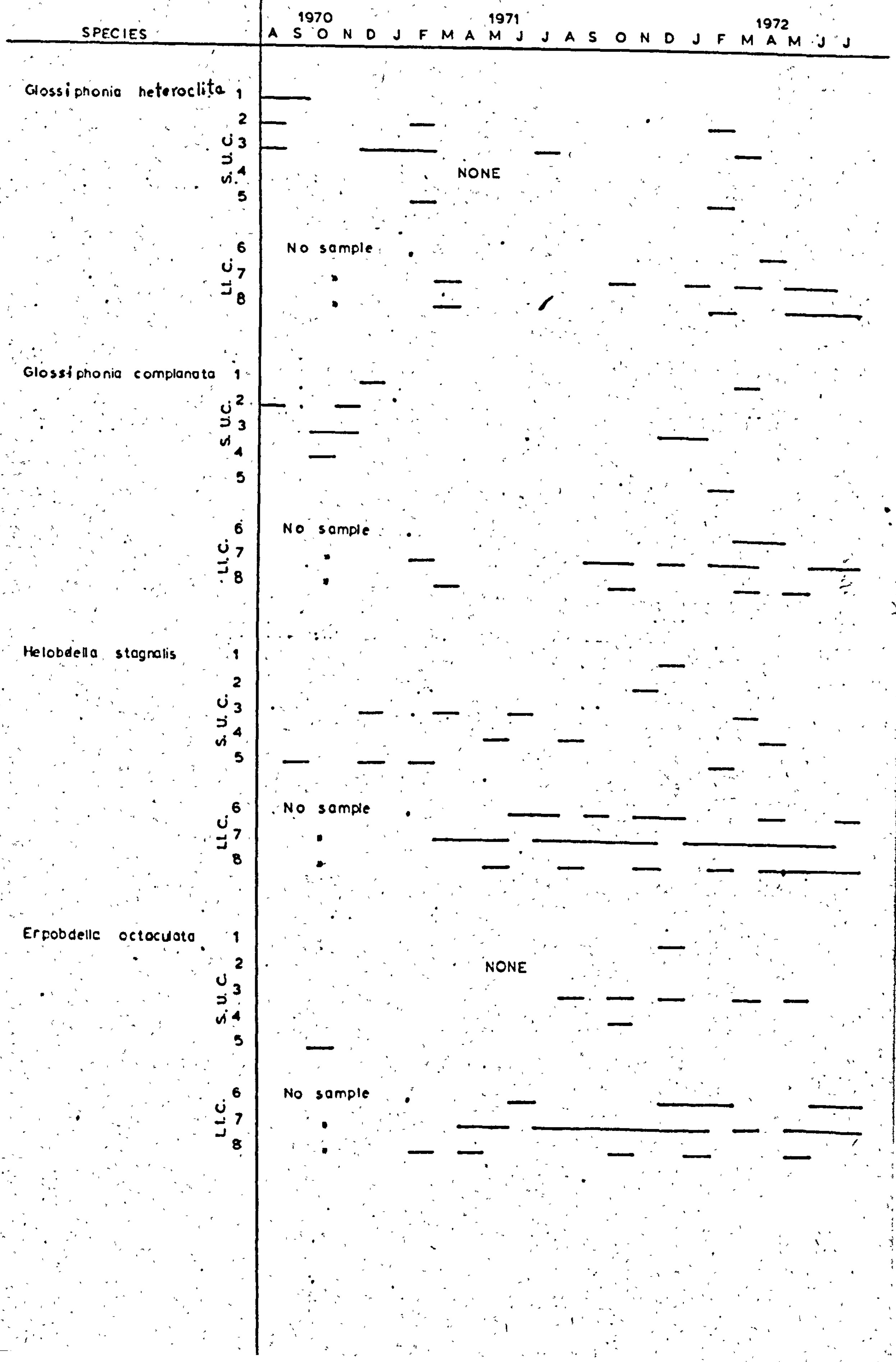


Table No 15

Monthly occurrence of the more common Hirudinea taken by the hand-net at each site on the Shropshire Union Canal and Llangollen Canal.

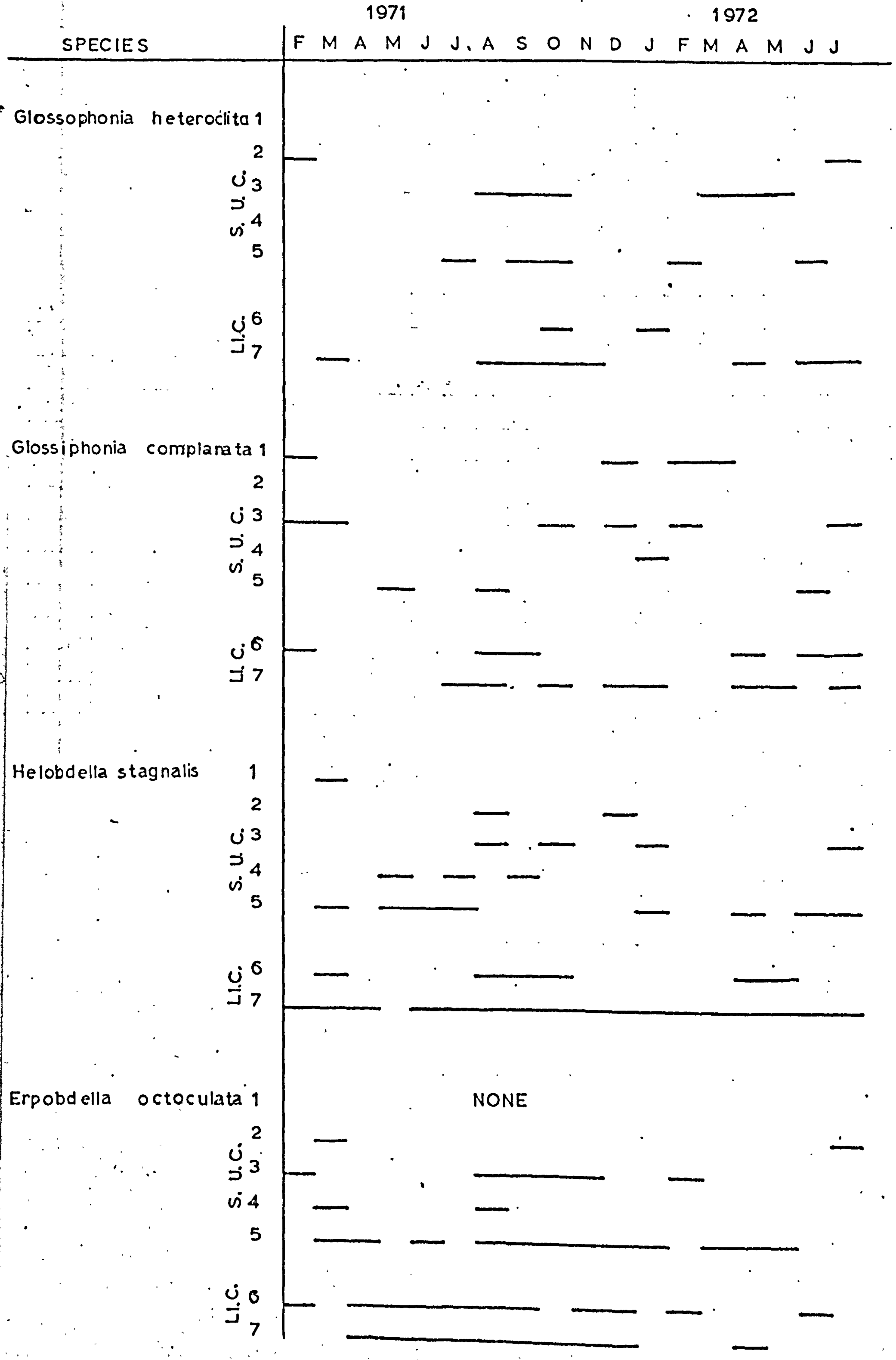


TABLE No. 16 Total Number and % of the Hirudinea (Leeches) Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total of the Invertebrates.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Hirudinea (Leeches)	4	5	12	3	8	32				
%	(+)	(+)	(+)	(+)	(+)	0.09				
1971-72										
Hirudinea (Leeches)	3	1	18	4	4	30	14	60	22	96
%	(+)	(+)	(+)	(+)	(+)	0.08	0.14	0.61	0.22	0.97

Total Number and % of the Hirudinea (Leeches) Taken from Each Site by the Hand-Net in 18 Months to the Total of the Invertebrates.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
Hirudinea (Leeches)	6	10	39	9	43	107	49	92		141
%	(+)	(+)	0.06	(+)	0.07	0.20	0.42	0.80		1.10

(+) = Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

6.3 HIRUDINEA (Leeches)

Very small numbers of leeches were taken in all months from both canals. They were represented by 6 species.

(1) *Glossiphonia heteroclita* (2) *Pisicola geometra*

(3) *Glossiphonia complanata* (4) *Hemiclepsis marginata*

(5) *Helobdella stagnalis* (6) *Erpobdella octoculata*

In the Shropshire Union Canal, all together they formed in 1970-71 0.09% and in 1971-72 0.09% in the dredge samples, and 0.2% in Hand-net samples of the total invertebrates.

Among the common species were *Glossiphonia* (*hetrochita* and *complanata*) and *H. stagnalis*. They were present throughout the sampling period, especially in site 3, Tables 14 and 15. Most other species were occasionally collected from all sites in different months. The average size and number of these species at each site being given in Tables 41-55.

This group of animals showed the biggest difference between maximum and minimum numbers present in different months.

In the Llangollen Canal, all species were found in the dredge and hand-net samples taken from all sites throughout the sampling period, where they formed 0.97% in 1971-72 in the dredge samples and 0.8% in Hand-net samples of the total invertebrates.

The total number of these species found in monthly samples taken from the canal was much more in site 7. Among the common species were *H. stagnalis* and *E. octoculata* - Tables 14 and 15. Very small numbers of other species as compared with these last two taken from other sites throughout the sampling period, Tables 41-55.

Also this group of animals showed the biggest difference between maximum and minimum numbers present in different months. The average size and number of each species at each site being given in Tables 41-55.

Table Nº 17 Monthly occurance of the more common Trichoptera larvae taken the dredge at each site on the Shropshire Union Canal and the Llangollen Canal.

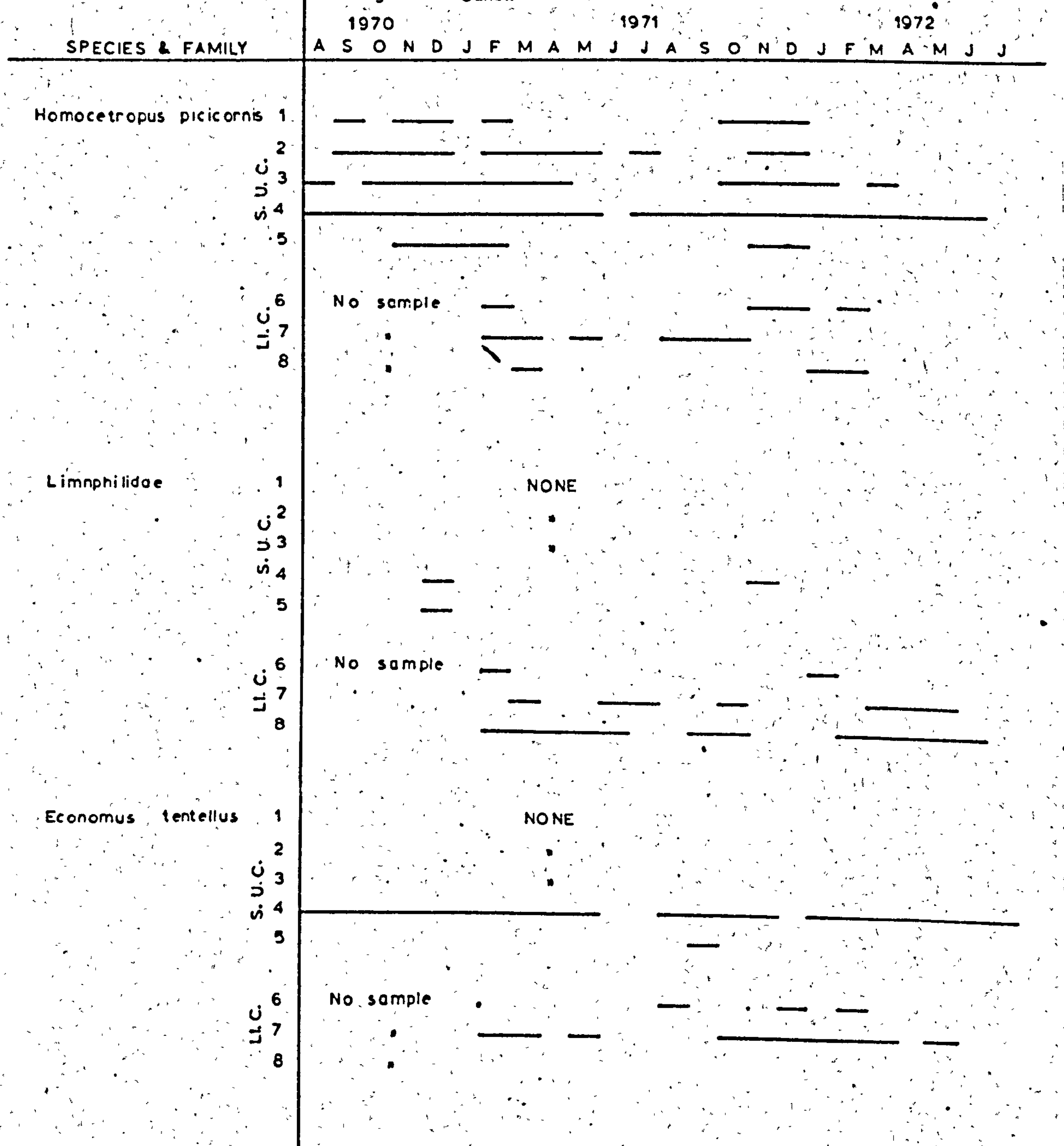


Table Nº 18 Monthly occurance of the more common Trichoptera taken by the hand-net at each site on the Shropshire Union Canal and the Llangollen Canal.

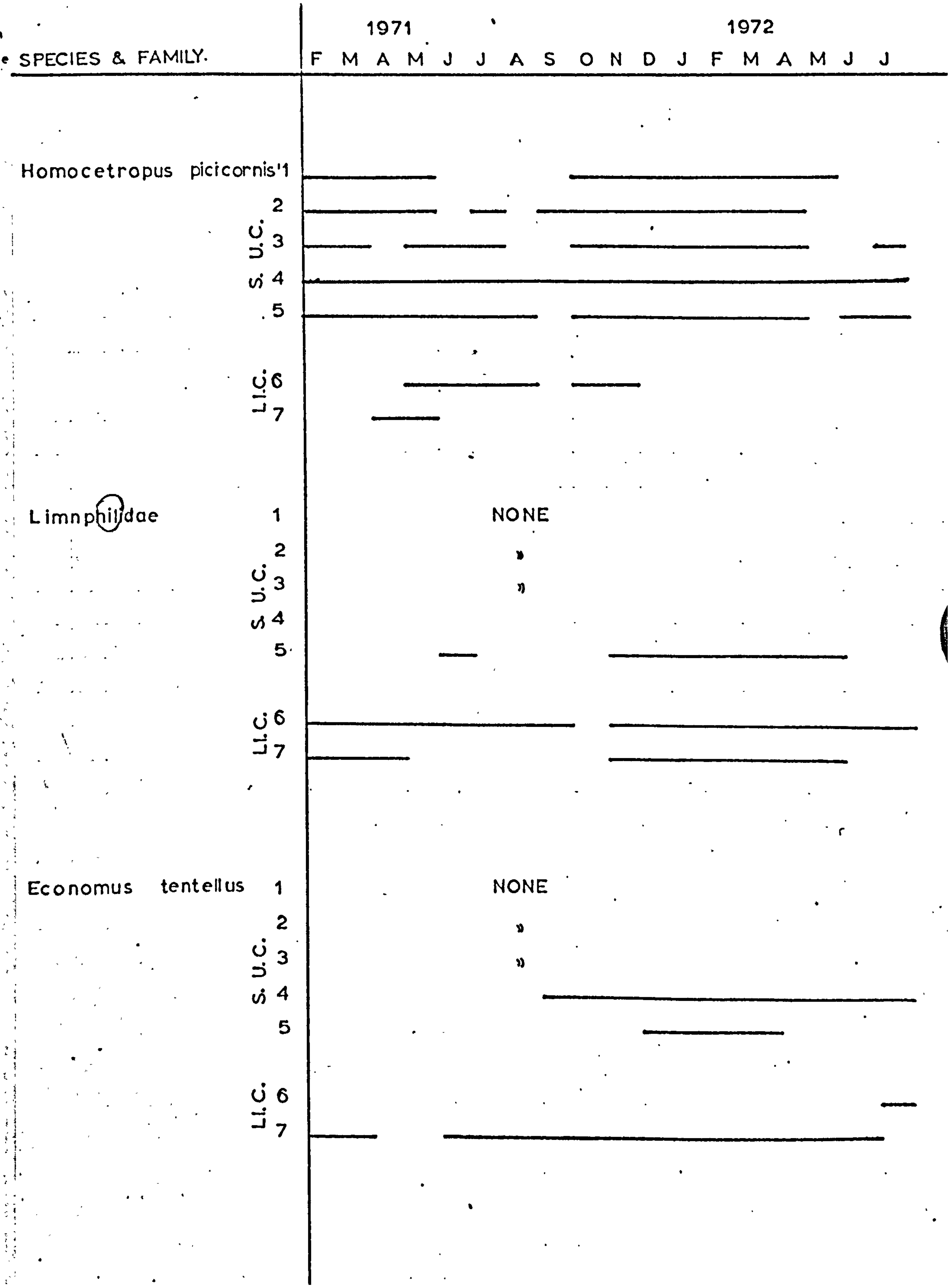


TABLE No. 19 (i) Total Numbers and % of Trichoptera (Larvae) Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total Number of the Insects.

(ii) Total Numbers and % to the Total of the Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
1970-71												
Trichoptera Larvae	8	26	46	670	17	763						
%	(+)	0.07	0.12	1.88	(+)	2.11	1.5					
1971-72												
Trichoptera Larvae	3	4	15	472	6	500		12	75	37	124	
%	(+)	(+)	(+)	1.29	(+)	1.4	0.9	0.6	3.92	1.93	6.5	1.26

(i) Total Numbers and % of Trichoptera Larvae Taken from Each Site by the Hand-Net in 18 Months to the Total Number of the Insects.

(ii) Total Numbers and % to the Total of the Invertebrates

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
Trichoptera Larvae	91	109	92	433	101	824		1,165	138	'NO SAMPLE'	1,303	
%	0.32	0.38	0.32	1.52	0.39	2.90	1.42	32.2	3.54		35.9	11.25

(+) Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

6.4 TRICHOPTERA

Trichoptera larvae were found in Hand-net and Dredge samples in both canals throughout the year. Although the numbers were sometimes high, they rarely formed an important proportion of the whole insect population, especially in the Shropshire Union Canal.

In the Dredge samples from the Shropshire Union Canal, they found 1.5% in 1970-71 and 0.9% in 1971-72 from the total invertebrates; and 2.11% in 1970-71 and 1.4% in 1971-72 of the total insects, while in the net samples they formed 1.42% of the total invertebrates and 2.9% of the total insects.

In the Dredge samples from the Llangollen Canal they formed 1.26% of the total invertebrates and 6.5% of the insects in 1971-72 and in Hand-net samples they formed 11.35% of the total invertebrates, and 35.9% of the total insects throughout the sampling period.

Larvae belonging to the following species and families, were recorded in both canals throughout the sampling period.

Family Polycentropidae

(1) Homocentropus picicornis (Stephens)

(2) Polycentropus flavomaculatus (Pictet)

Family Psychomyiidae

(1) Economus tentellus (Rambur)

Family Limnephilidae

Family Glossosomatidae

(1) Glossosoma boltoni (Curtis)

Monthly quantitative changes, seasonal variation, and notes on the life cycles of each species have been given. Total numbers and sizes of each species have been shown in Tables 41-55 in the Appendix.

Family Polycentropidae

Larvae belonging to this family were taken throughout the sampling period from both canals. Two species were found.

(1) Homocentropus picicornis

This was the most common species in Shropshire Union Canal, and formed 84% in 1970-71 and 73% in 1971-72 of the total Trichoptera in the Dredge samples, while it formed 76% of the total Trichoptera in the hand-net samples. Larvae were taken in all months, Tables 17, 18, 19 and 41-55. Most of the Homocentropus picicornis was found in site 4, where the bottom is heavy clay, little stones and silt. This seems to be compatible with the observations of Badcock (1949) in which she noted that the greater densities of Polycentropus larvae may be partly attributed to the clay and silt.

Very small numbers of Homocentropus picicornis were found in the Llangollen Canal throughout the year. It formed in the Dredge samples, 12% in 1971-72 and 3.2% in the Hand-net samples of the total Trichoptera, Tables 16, 17, 19 and 41-55.

Numbers of larvae collected each month were too small to determine the life history of this species. However, Hickin (1967) has shown that it is univoltine with a short flight period from the end of June until the middle of July.

Polycentropus flavomaculatus

Only 3 larvae were taken from the Shropshire Union Canal, 2 in February and one in March, 1971, and 10 larvae in the Llangollen Canal, 5 in March 1972 and the rest throughout different months of the year, Tables 41-55.

It is difficult to separate larvae of P.flavomaculatus from those P.kingi. Edington (1964) has separated the two species on the basis of the anal claws. The anal claws are supposed to be obtuse angled in kingi and right angled in p.flavomaculatus. Numbers of larvae collected in both canals were too small to determine the life history of this species. Tables 41-55. Adult flight period of P. flavomaculatus occurs from May to September or October (Maccan and Maudsley, (1968)); Elliott (1968) and Crisp and Gledhill (1970) reported.

Family Limnephilidae

Limnephilidae larvae were taken in Hand-net samples almost every month. The largest numbers were found in the Llangollen Canal in February and March, 1971 and January, February and March, 1972. 1196 larvae = 91.5% of the total Trichoptera in the Llangollen Canal, most of it found at site No.6, Tables 41-55. The vegetation may be responsible. A microhabitat of particular interest here are the soil free roots of alder and grasses under the towpath bank, where most larvae use the roots and fallen branches for case-making as well as for the attachment. Twigg (1957). Very few were found in Dredge samples.

In the Shropshire Union Canal Limnephilidae larvae were less common, only small numbers were taken in the hand-net samples, where it formed 11.1% of the total Trichoptera, all of it was found in sites 3 and 5, with maximum numbers in February and March, 1971 and 1972, Tables 17, 18 and 41-55.

Limnephilidae larvae are univoltine with overwintering larvae. Small larvae in the Llangollen Canal, site 6, first appeared in September each year, grew steadily through the autumn and winter and full grown larvae were found in March, (Hynes (1961)). The monthly larvae sizes and numbers in both canals are shown in Tables 41-55.

Family Glossosomatidae

Glossosoma boltoni

Only two caseless G. boltoni were found in the Shropshire Union Canal in August and September in 1971 in the hand-net samples. G. boltoni has a univoltine life cycle. In the River Rheidol (Wales) they hatch in spring and grow rapidly after hatching particularly in summer, (Jones (1949)), the pupae occur from June to August (Arshed, (1972)) and the adult fly from April to September,(Hicken (1967)).

Family Psychomyiidae

Economus tentellus (Rambur)

E. tentellus larvae were less common in the Shropshire Union Canal, they formed in 1970-71 (14.2%) and in 1971-72 (29%) of the total Trichoptera in the Dredge samples, where they were only 12.6% of the total Trichoptera in the Hand-net samples, most of it collected from site 4 with the maximum number in winter time.

Smaller numbers were also collected from the Llangollen Canal almost all from site 7 where it is probably associated with the presence of Spongilla (Hickin (1967)). In the hand-net samples they formed 4.4% of the total Trichoptera, but only a few were found in the dredge samples.

Although this species was less abundant than others, its monthly distribution pattern indicates that it has a univoltine life cycle, flying in summer, suggesting that the eggs hatch during summer months, grown rapidly during summer, and autumn and over winter as full grown larvae.

Table № 20 Monthly occurrence of the Coleoptera taken by the hand-net at each site on the Shropshire Union Canal and Llangollen Canal.

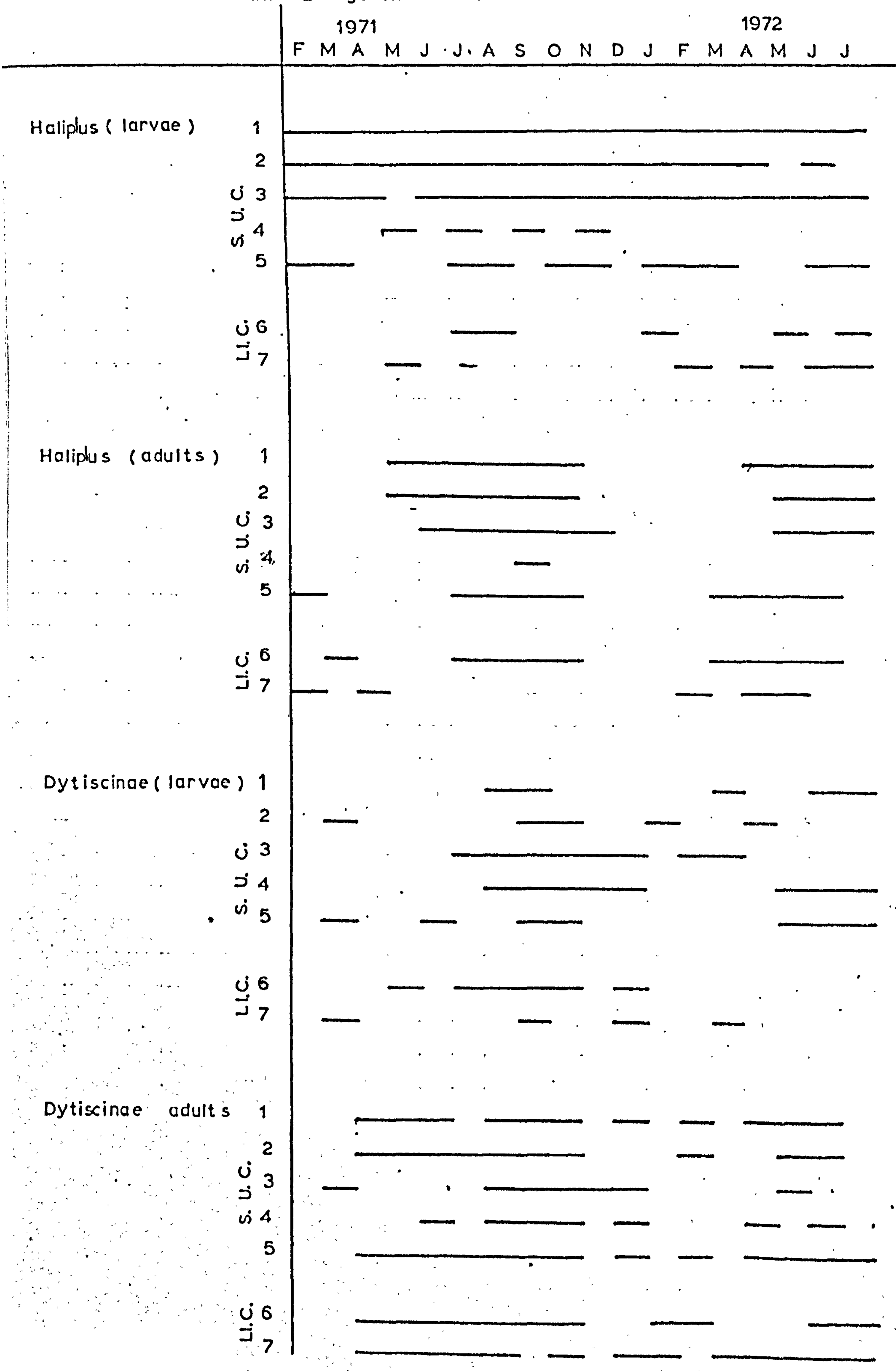


TABLE No. 21 (i) Total Number and % of the Coleoptera Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total Number of the Insects.

(ii) Total Number and % to the Total of the Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
1970-71												
Coleoptera	13	6	10	3	2	34						
%	(+)	(+)	(+)	(+)	(+)	(+)	0.08					
1971-72												
Coleoptera	8	1	1	2	0	12						
%	(+)	(+)	(+)	(+)	(+)	(+)	(+)	1	1	0	2	
								(+)	(+)	-	(+)	(+)

(i) Total Number and % of the Coleoptera Taken from Each Site by the Hand-Net in 18 Months to the Total Number of the Insects.

(ii) Total Number and % to the Total of the Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
Coleoptera	327	299	130	31	115	902	11	112	47	NO SAMPLE	159	
%	1.14	1.05	0.45	(+)	0.40	3.20	1.60	3.09	1.30		4.64	1.45

(+) Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

6.5 COLEOPTERA

Larvae and adults belonging to this order were taken from the Shropshire Union and the Llangollen Canals in both dredge and Hand-net samples throughout the year in all months. In the Shropshire Union Canal they formed 1.6% and in the Llangollen Canal 4.64% of the total insects in the Hand-net samples. The highest numbers were recorded in July, August and September 1971, and the least numbers were recorded in January 1970 and January and February 1972.

Two different families were recorded.

(1) Family Dytiscidae

Dytiscinae - (Sub-family) Larvae and adults

(2) Family Halipidae

Haliplus (species) Larvae and adults

Monthly occurrence, numbers and sines of each taxon at each site from both canals are summarised in Tables 20, 21 and 41-55.

Family Halipidae

Haliplus (species)

Haliplus larvae and adults were the most abundant Coleoptera in both the Shropshire Unicn and the Llangollen Canals and were collected throughout the sampling period.

In the Shropshire Union Canal, they were present in all hand-net samples, Table 20, though they were found in larger numbers in sites 1 and 2, than in sites 3, 4 and 5. Maximum numbers of larvae and adults were collected in summer and the least through winter with irregular numbers in between. In the hand-net samples, they formed 78.4% of the total Coleoptera.

Small numbers of Haliplus larvae and adults were taken frequently from the Llangollen Canal, in most of the months. They made 43.3% of the total Coleoptera, in the hand-net samples, Table 20. Their numbers were at maximum in summer and least in winter.

In Dredge samples, only a very few larvae and adults were found throughout the sampling period, in both the Shropshire Union and Llangollen Canals, as seen in Table 21 .

Family Dytiscidae

Both larvae and adults belonging to the sub-family Dytiscinae occurred spasmodically in both the Shropshire Union and the Llangollen Canals, and were found mainly in the hand-net samples.

In the Shropshire Union Canal they formed 21.6% of the total Coleoptera taken in the hand-net samples, where only one larva was found in the Dredge samples taken throughout the sampling period.

In the Llangollen Canal they formed 56.7% of the total Coleoptera found in the Hand-net samples, where only four larvae recovered from the dredge samples. Their numbers were very small and were mostly taken in the summer time and in all other months less irregular numbers were collected.

Larvae and adults of the Dytiscinae collected from both Canals were sparse and their life cycles were not clearly defined. Pupae were absent from all samples, and no separate samples were taken to trace its pupae and this makes elucidation of their life cycles (histories) more difficult. The life history of the Dytiscinae has recently been investigated by Holland (1972) in the River Alun and the River Dee in Denbighshire. Adults and larvae can be found throughout the year. From June to September, however, larvae climb out of the water to pupate. The pupal stage is spent in crevices in the river banks. Adults are sexually mature during Spring and early Summer. Some late larvae may, over winter a second time to pupate the following year, thus taking two years to reach adulthood. Also, some adults may survive a second summer and breed again, (Holland (1972)).

Table No 22

Monthly occurrence of the more common Ephemeroptera taken by the dredge at each site on the Shropshire Union Canal and the Llangollen Canal.

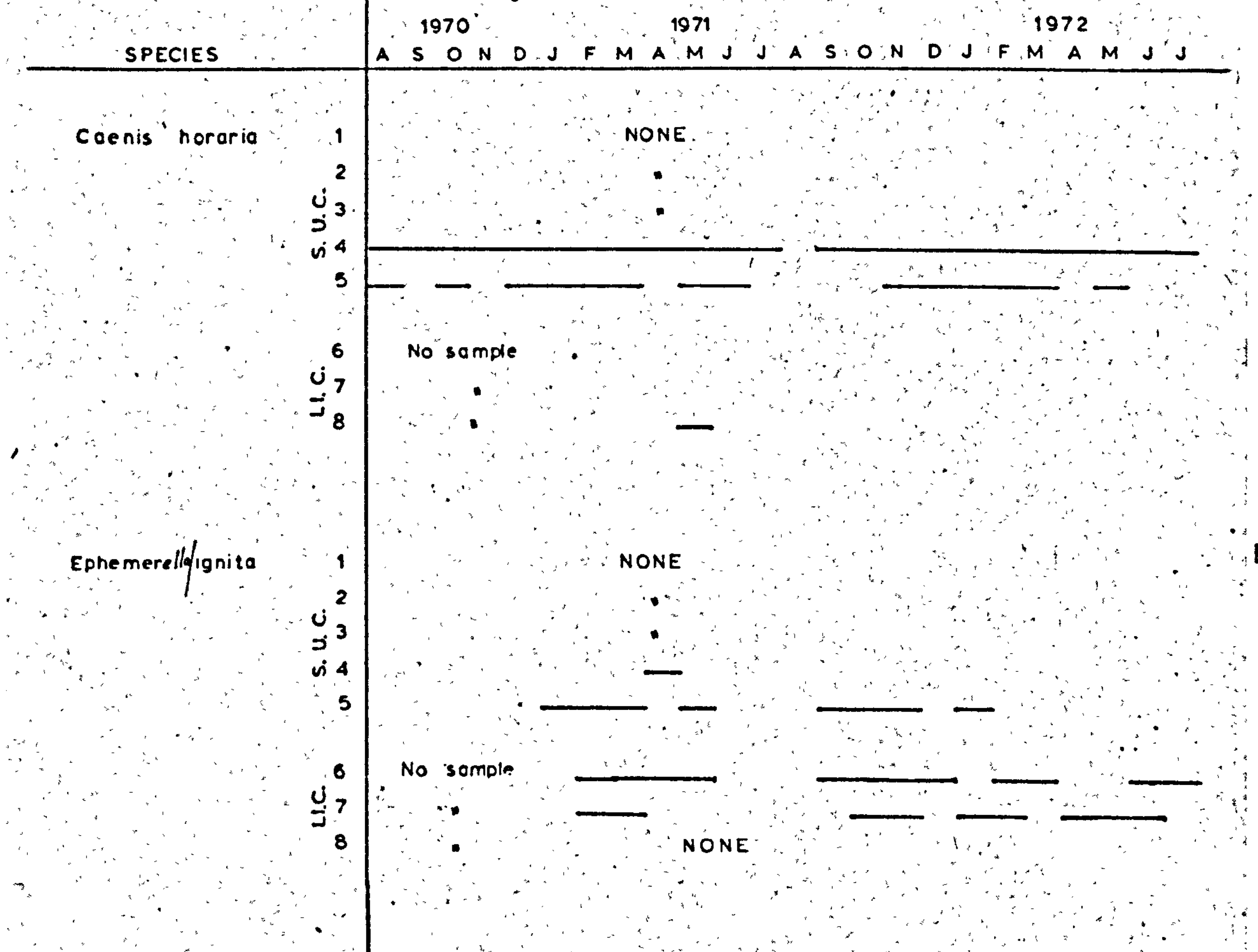


Table No 23

Monthly occurrence of the more common Ephemeroptera taken by the hand-net at each site on the Shropshire Union Canal and the Llangollen Canal.

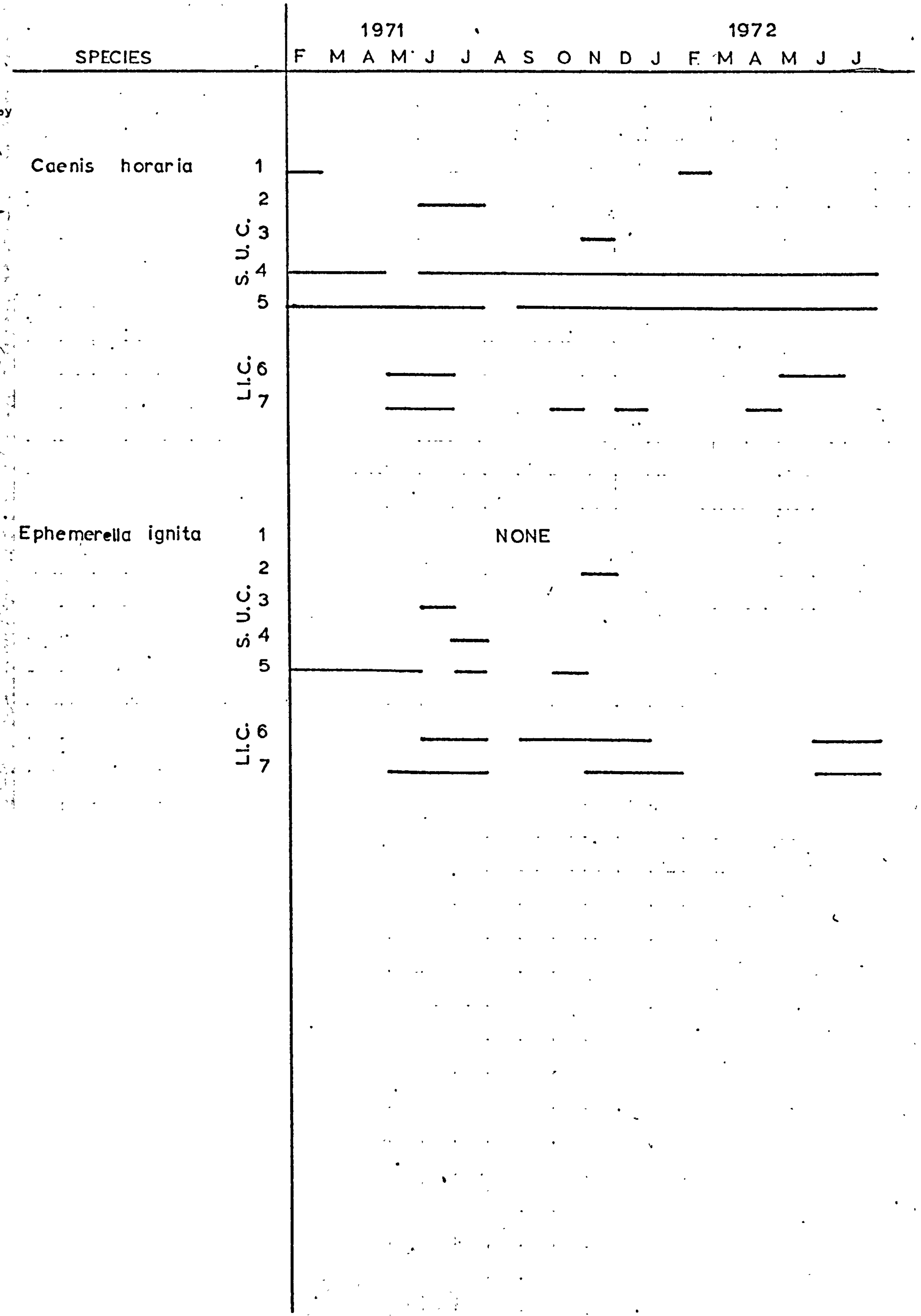


TABLE No. 24 (i) Total Numbers and % of Ephemeroptera Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total Number of Insects.

(ii) Total Numbers and % to the Total of the Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
1970-71												
Ephemeroptera	0	0	0	417	51	468						
%	0	-	-	1.15	0.14	1.28	0.9					
1971-72												
Ephemeroptera	0	0	0	360	31	391		16	11	0	27	
%				0.99	(+)	1.06	0.75	0.16	0.11	-	1.4	0.27

(i) Total Numbers and % of Ephemeroptera Taken from Each Site by the Hand-Net in 18 Months to the Total Number of the Insects.

(ii) Total Numbers and % to the Total of the Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
Ephemeroptera	5	9	12	483	142	651		26	31	NO SAMPLE	57	
%	(+)	(+)	(+)	1.69	0.5	2.3	1.42	0.71	0.85		1.54	0.48

(+) Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

6.6 EPHEMEROPTERA

Nymphs belonging to three May fly species were taken from both canals throughout the sampling period, and they were:-

(1) Caenis horaria (Linn.)

(2) Baetis mutinus (Pumilus)

(3) Ephemerella ignita (Poda)

In the Shropshire Union Canal in the dredge samples they formed 1.26% of the total insect and 0.9% of the total invertebrates in 1970-71, and 1.06% of the total insects and 0.75% of the total invertebrates in 1971-72. They were found more in the Hand-net samples where they formed 2.3% of the total insects and 1.13% of the total invertebrates in the 18 months samples.

In the Llangollen Canal Ephemeroptera nymphs were found in very small numbers throughout the sampling period, and they comprised 1.4% of the total insects and 0.29% of the total invertebrates in 1971-72 in the dredge samples. In the Hand-net samples they formed 1.54% of the total insects and 0.46% of the total invertebrates in the 18 months sampling period.

Monthly quantitative changes, seasonal variations, and notes on the life-cycle of each species are described. Monthly numbers taken from each site of the two canals are given in Tables 41-55 and the total numbers found at all sites during the sampling period are summarized in Tables 23 and 24.

Caenis horaria

Caenis horaria was the most common species present in the Shropshire Union Canal. Large numbers of nymphs were taken in most months of the sampling period. Most of them from sites 4 and 5, Tables 23 and 24.

At site 4 in the Dredge samples they formed in 1970-71 86.4% and in 1971-72 91.5% and in Hand-net samples 74.3% of the total Ephemeroptera. At sites 1, 2 and 3 in the Dredge samples there were none and in Hand-net samples only six nymphs were found in the 18 months sampling period.

Monthly maxima each year were collected in May and June 1971 and 1972, from the Hand-net samples and November, December and January 1970 and 1971 in the Dredge samples.

In the Llangollen Canal very small numbers of nymphs were taken in the Hand-net samples only in different months throughout the sampling period (28 specimens only).

Ephemerella ignita (Poda).

Very small numbers of E. ignita nymphs were collected during the sampling period.

In the Shropshire Union Canal in the Dredge samples they formed 1.16% of the total Ephemeroptera in 1970-71 and 1% in 1971-72, while in the Hand-net samples they formed 2.8% of the total Ephemeroptera in the sampling period. Most of the nymphs were found in site 5, Tables 22 and 23.

In the Llangollen Canal also small numbers were found in sites 6 and 7 only. In the Dredge samples (13 nymphs) were found in 1970-71 and (25 nymphs) in 1971-72, and in Hand-net samples (29 nymphs) were found throughout the sampling period.

E. ignita is well known to be univoltine, spending winter in the egg stage (Macan, 1957), but the hatching varies from one area to another. Frost (1942) at Ballysmutton (Eire), reported a few newly hatched nymphs in February. Small nymphs occur in Denmark (Jensen (1956)), in March in the Afon Hirnant in Wales (Hynes (1961)), and in late May or early June in the English Lake District (Maccan (1957)).

Egglishaw and Mackay (1967) in the Scottish Highland streams found small nymphs in June and Langford (1969) in Lincolnshire, England, has found nymphs of E.ignita in most months of the year.

Sawyer (1953) and Crisp and Gledhill (1967) in Southern England, found the adults of this species over a long period, suggesting that this species may have more than one generation per year in the South of England.

At the Shropshire Union and Llangollen Canals maximum numbers of nymphs were small and occurred at different months of the sampling period. These observations correspond that this species may have more than one generation in both canals.

Baetis mutinus (Pumilus)

This species was far less common and rarely occurred in both canals in the Dredge and Hand-net samples, Tables 41-55. In the Shropshire Union Canal (15 nymphs) and in the Llangollen Canal (5 nymphs) were found in both the Dredge and Hand-net samples throughout the sampling period.

TABLE No.27 (i) Total Numbers and % of the Diptera Taken from Each Site by the Hand-Net in 18 Months to the Total Number of Insects.

(ii) Total Numbers and % to the Total of the Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
Chironomidae larvae	3,926	3,346	3,923	8,191	3,527	22,913		637	1,115		1,752	
%	13,75	11,73	13,54	28,75	12,38	80.50		17.51	30.80		47.5	
Chironomidae pupae	467	488	299	360	603	2,217		76	194		270	
%	1.61	1.71	1.04	1.26	2.11	7.78		2.09	5.35		7.45	
Other Diptera	1	4	3	61	19	88		18	32		50	
%	(+)	(+)	(+)	0.21	0.06	0.30		0.3	0.95		1.38	
							25,218					2,072
							44.01					18.25

(+) Sign indicates that at item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

TABLE No.28 (i) Total Numbers and % of the Diptera Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total of the Insects.

(ii) Total Numbers and % to the Total of the Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
1970-71												
Chironomidae larvae	469	491	1,099	33,839	1,623	37,521						
%	1.29	1.36	3.04	91.52	4.48	95.5						
Chironomidae pupae	17	21	20	97	28	183						
%	(+)	0.05	0.05	0.26	0.07	0.53						
Other Diptera	0	0	38	119	45	192						
%	-	-	0.10	0.33	0.12	0.6						
							37,896					
							69.55					
1971-72												
Chironomidae larvae	431	316	989	32,327	1,272	35,335		494	781	414	1,686	
%	1.18	0.85	2.71	88.83	3.49	96.88		25.79	40.77	21.62	88.3	
Chironomidae pupae	6	3	6	53	5	73		2	4	0	6	
%	(+)	(+)	(+)	0.14	(+)	0.20		(+)	(+)	(+)	(+)	
Other Diptera	0	1	46	98	28	173		12	34	13	59	
%	-	(+)	0.12	0.27	0.08	0.5		0.62	1.93	0.62	3.3	
							35,581					1,751
							65.50					18.11

(+) Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

6.7 DIPTERA

This order is undoubtedly one of the most important in both canals, forming a large part of the fauna at all sites. Larvae and pupae of this order were found in dredge as well as in Hand-net samples at all sites throughout the sampling period.

In the Shropshire Union Canal they formed in 1970-71 69.55% and in 1971-72 65.5% of the total invertebrates, while in hand-net samples they formed 44% of the total invertebrates throughout the sampling period.

In the Llangollen Canal they formed 18.1% in 1971-72 in the Dredge samples and 18.2% in the Hand-net samples to the total invertebrates throughout the sampling period.

The following families were found:

(1) Family Chironomidae (Larvae and pupae)

Sub-families Chironominae

" Orthocladinae

" Tanypodinae

(2) Family Ceratopognoidae (Larvae only)

(3) Family Tipulidae Tipula (sp) Larvae and pupae

(4) Family Culicidae Chaoborus sp. larvae only

Monthly quantitative changes and seasonal variations in each Dipteran group are described. Also, monthly numbers and sizes of each group taken from both canals at each site have been shown in Tables 41-55, in the Appendix.

Family <u>Chironomidae</u>

Larvae of three sub-families were represented in both canals, but unfortunately it is impossible at the present time to identify the great majority of the larvae to species, or to separate sub-families, so no proportions to each other have been done.

Chironomid larvae were the most abundant single group among all the insects and the total invertebrates found in the Dredge and Hand-net samples from both canals. This was due to the large numbers of larvae recorded in each monthly sample in all seasons. Similarly, Horton (1966) in a Devonshire river, Ali (1969 and 1972) in the River Lune and Huni (1969 and 1972) in a Tributory of the River Lune, all found Chironomid larvae in the drift as the most abundant insect group at all times of the year.

In the Shropshire Union Canal in the Dredge samples, they comprised 95.5% in 1970-71 and 96.88% in 1971-72 of the total insects, and in Hand-net samples 80.5% of the total insects throughout the sampling period.

Maxima of larvae were taken in November, December, January and February in Dredge samples in both years, and June, July and August in the Hand-net samples. These were largely small larvae (< 5 mm) possibly newly hatched). Other size groups were also most abundant at these months of the year, also numbers were lower in the rest of the months of every year.

The largest numbers were found in site 4 especially in the dredge samples where they were very small in size as well (< 5 mm), forming 93.5% in 1970-71 and 88.8% in 1971-72 of the total insects. The reasons for this are by no means certain. This group apparently prefer the particular substrate of this site which is different from any other site (see description of the site No.4).

In the Llangollen Canal Chiromid larvae were the most abundant as well in the Dredge and the Hand-net samples. They formed in Dredge samples in 1971-72, 88.3% and in Hand-net samples 48.3% of the total insects throughout the sampling period. They were fairly well distributed along the canal sites with maximum numbers in January and February of both years in Dredge samples and June, July and August in Hand-net samples. Numbers were less in the other months of the year.

Chiromid pupae were the second most abundant group of Dipteran in the two canals, and they were present in most of the months of the year, Tables (28, 29 & 41 55).

In the Shropshire Union Canal they were more abundant in Hand-net samples, where they formed 9.12% of the total Diptera, while in the Dredge samples in 1970-71, 0.53%, and 1971-72, 0.2%, of the total Diptera. They were fairly distributed along the canal sites, most pupae taken in summer with maximum numbers in June, July and August of both years, in particular no pupae were found in November, December and January of both years, Tables 25 and 26.

In the Llangollen Canal they were also more abundant in Hand-net samples than in Dredge samples. In Hand-net samples they formed 13.04% of the total Diptera, while in the Dredge samples in 1971-72 they formed 0.9% of the total Diptera. They were fairly well distributed along the canal with maximum numbers in summer (June, July and August), also no pupae were taken in winter, Tables 25 and 26.

The number of Chironomid species present in the two canals was not known (page, 65), therefore life history can not be deduced. However, small larvae (possibly newly hatched) were present in all months with maximum numbers being captured in summer and winter. Pupae were present throughout the year except winter, but most numerous in summer. Adults were noticed during Spring and Summer (Ali (1972)).

Family Ceratopognoidae

Larvae of this family were taken in all months in the Shropshire Union Canal and in most months in the Llangollen Canal, Tables 25 and 26. In the Shropshire Union Canal in the Dredge Samples, they formed 0.6% in 1970-71 and 0.5% in 1971-72, while in the Hand-net samples, 3% of the total Diptera. Most larvae were taken in different months, in particular large numbers were taken during April and May of both years.

In the Llangollen Canal they were taken in almost every month of the year but they were found in smaller numbers than in the Shropshire Union Canal. They formed in the Dredge samples 2.9% in 1971-72 and in Hand-net samples 1.4% of the total Diptera with maximum numbers in April, May and June, 1972 in the Dredge samples. Their occurrence is shown in Tables 25 and 26.

In the absence of knowledge of the number and variety of species present, life-histories can not be determined. The only observation made by Ali (1972), that larvae (> 7 mm) were taken from June to August. Small larvae were collected from March to September, and adults were noticed in May and June.

Family Tipulidae

Tipula species (larvae and pupae) were rarely found, especially in the Shropshire Union Canal where only two larvae were found.

Larvae were more abundant in the Llangollen Canal, where they formed in the Hand-net samples, 0.8% of the total Diptera throughout the sampling period, but they were absent in the Dredge samples in both canals.

Tipulid larvae were also noted as very rare drifters in the Wella Brook (Elliott (1967a)) and in the River Duddon (Lake District), they contributed less than 0.05% of the total insects, (Elliott and Minshall (1968)).

Work on the life history of the members of this family is scarce. The only data available by Hynes (1961) from the Afon Hirnant (North Wales), but unfortunately the monthly numbers taken by him are too small to deduce the life history.

Family Calicidae

Chaoborus species (only larvae) are rarely found in the Shropshire Union Canal, three larvae were found in the Dredge samples in 1971-72 and one larva in the Hand-net samples at site No.4 throughout the sampling period. No larvae were found in the Llangollen Canal.

Table № 29 Monthly occurrence of the more common *Hemiptera* taken by the hand-net at each site on the Shropshire Union Canal and the Llangollen Canal.

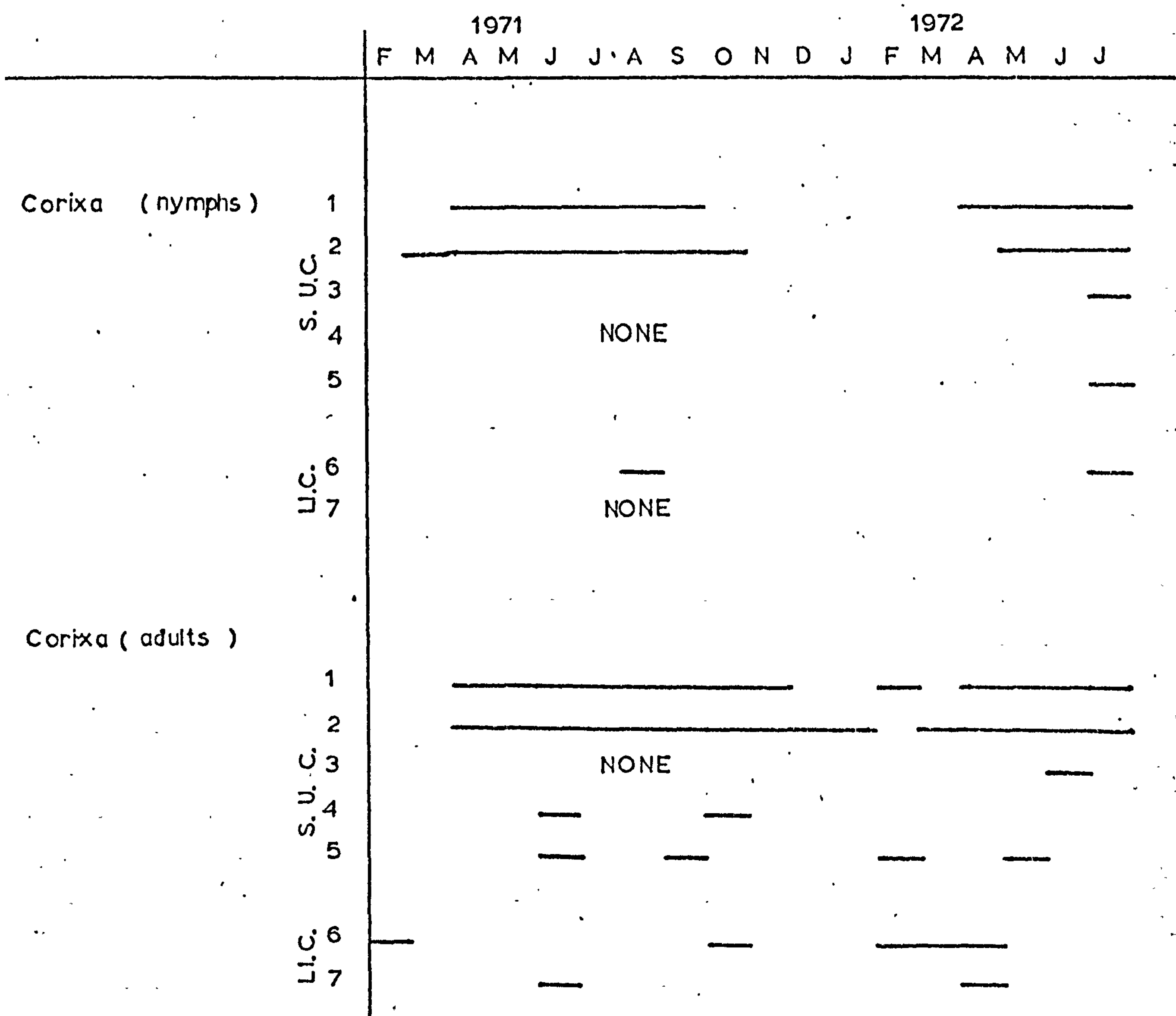


TABLE No. 30 (i) Total Number and % of the Hemiptera Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total Number of the Insects.

(ii) Total Number and % to the Total of the Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
1970-71												
Hemiptera	0	1	1	0	0	2						
%	(+)	(+)	(+)	-	-	(+)	(+)					
1971-72												
Hemiptera	0	0	0	0	0	0		0	0	0	0	
%	-	-	-	-	-	-	-	-	-	-	-	

(i) Total Number and % of the Hemiptera Taken from Each Site by the Hand Net in 18 Months to the Total Number of the Insects.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
Hemiptera	265	308	2	2	13	590		9	5	NO SAMPLE	14	
%	0.95	1.06	(+)	(+)	(+)	2.11	1.05	0.24	0.13		0.50	(+)

(+) Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

6.8 HEMIPTERA

Hemiptera (nymphs and adults) were taken in the Hand-net samples mostly from the Shropshire Union canal in all months except January, and February of 1971 and 1972. They formed 1.05% of the total invertebrates and 2.11% of the total insects. While in the Llangollen Canal in the Hand-net samples they made a negligible percentage ($<$ 0.05%) of the total invertebrates and 0.5% of the total insects.

The largest numbers were found in July, August and September 1971, and July 1972. In the Dredge samples, they were rarely found in both Canals.

Nymphs and adults belonging to the following species and families were recorded in the Hand-net samples throughout the sampling period.

(1) Family Corixidae *Corixa* (sp) (Nymphs and adults)

(2) Family Notonectidae *Notonecta (sp)* (Adults only)

(3) Family Nepidae *Nepa cinerea* (Adults only)

Monthly quantitative changes and notes on the common species have been given. Total numbers and sizes of each at every site at both canals are shown in Tables 41-55, in the Appendix.

Family Corixidae

Members of *Corixa* (sp) nymphs and adults were present in the Shropshire Union Canal and were very rare in the Llangollen Canal.

In the Shropshire Union Canal in the Hand-net samples they were the most abundant Hemiptera and they formed 96.7% of the total Hemiptera, mostly from sites 1 and 2, with maximum numbers in July, August and September of 1971, and June and July, 1972. This might be a result of its life-cycle (history) features as it has a quick summer generation and an overwintering one and the hatching period is mainly from April to September. This also showed that this species is directly affected by temperature.

Numbers taken each month from individual sites have been summarized in Table 29.

In the Llangollen Canal Corixa nymphs and adults were represented by a very small number in the samples taken during the summer months and 9 individuals only were found, Table 29.

Family Notonectidae

Notonecta (adults only) were found in infrequent numbers in samples taken from both the Shropshire Union and the Llangollen Canals. In the Hand-net samples, in the Shropshire Union Canal, they formed 2.9% of the total Hemiptera. They were mainly present at sites 1, 2 and 5, Tables 41-55.

In the Llangollen Canal, they were rarely found in Hand-net samples, only 4 adults taken throughout the sampling period.

Family Nepidae

Nepa cinerea, only 2 adults specimens of this species were taken from the Shropshire Union Canal in the Hand-net samples, one in September, 1971 and the other in April, 1972. Members of this species have not been found in the Llangollen Canal.

TABLE No. 31 (i) Total Number and % of the Odonata (Damsel Fly Naiad) Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total Number of the Insects.

(ii) Total Number and % to the Total of the Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
1970-71												
Odonata (naiad)	0	2	0	0	0	2						
%	-	(+)	-	-	-	(+)	(+)					
1971-72												
Odonata (naiad)	0	0	0	0	0	0						
%	-	-	-	-	-	-	-					

(i) Total Number and % of Odonata (Damsel Fly Naiad) Taken from Each Side by the Hand-Net in 18 Months to the Total Number of the Insects.

(ii) Total Number and % to the Total Number of Invertebrates.

	S.U.C.							Ll.C.				
	1	2	3	4	5	TOTAL	ii	6	7	8	TOTAL	ii
Odonata (naiad)	0	1	1	145	4	151		0	3	NO SAMPLE	3	
%	-	(+)	(+)	0.51	(+)	0.60	0.28	(+)	(+)		(+)	(+)

(+) Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

6.9 ODONATA

The total number of Odonata nymphs found in monthly samples from the Shropshire Union and the Llangollen Canals was very small in both Dredge and Hand-net samples.

In the Shropshire Union Canal in the Dredge samples only two nymphs were found, but in the Hand-net samples they were more abundant, forming 0.6% of the total insects throughout the sampling period. Most of the nymphs were found in sites 1 and 2, with maximum numbers in September, October and November of 1971 in hand-net samples,(Table 31.).

In the Llangollen Canal very few nymphs were found, only one nymph in the dredge samples in two years, and 5 nymphs in hand-net samples throughout the sampling period. Their occurrence is shown in Tables 41-55.

In the absence of knowledge of the number of species present, and the small numbers which can be found, the life-histories can not be determined.

6.10 NEMATODA

A very small variable number of Nematodes were found in samples in the Dredge and Hand-net samples taken from both canals throughout the sampling period. These could not be identified any further because of the lack of a suitable quick identification technique. Schuurman Steckhoven (referred to by Crofton (1966)), however, has estimated that about a thousand Nematode species inhabit freshwater.

Nematodes formed (< 0.05%) of the total invertebrates in both Dredge and the Hand-net samples of the two canals and the numbers found have been given in Tables 41-55.

Table No 32 Monthly occurrence of the more common Gastropoda taken by the dredge at each site on the Shropshire Union Canal and the Llangollen Canal.

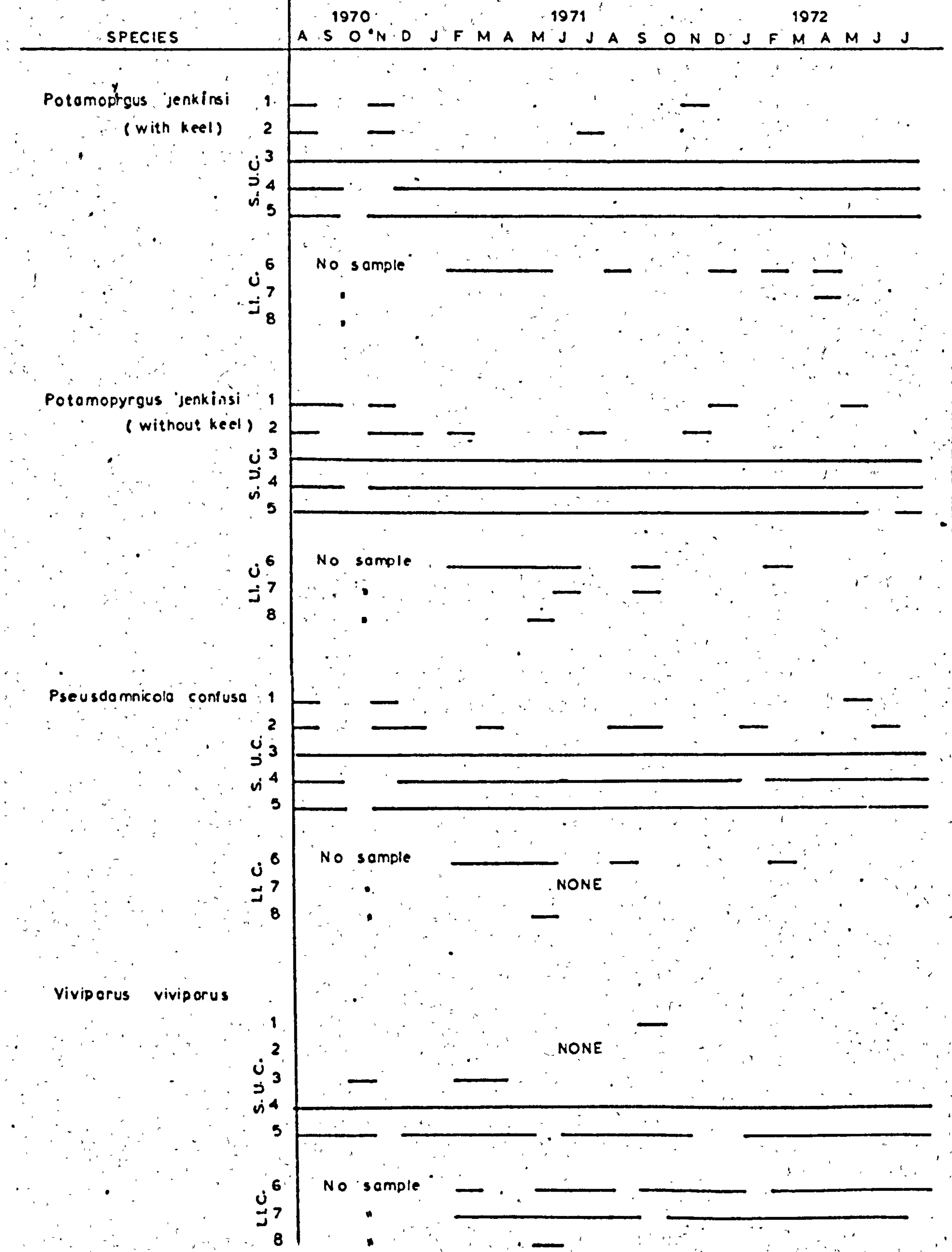


Table No 33 Monthly occurrence of the more common Gastropoda taken by the hand-net at each site on the Shropshire Union Canal and Llangollen Canal.

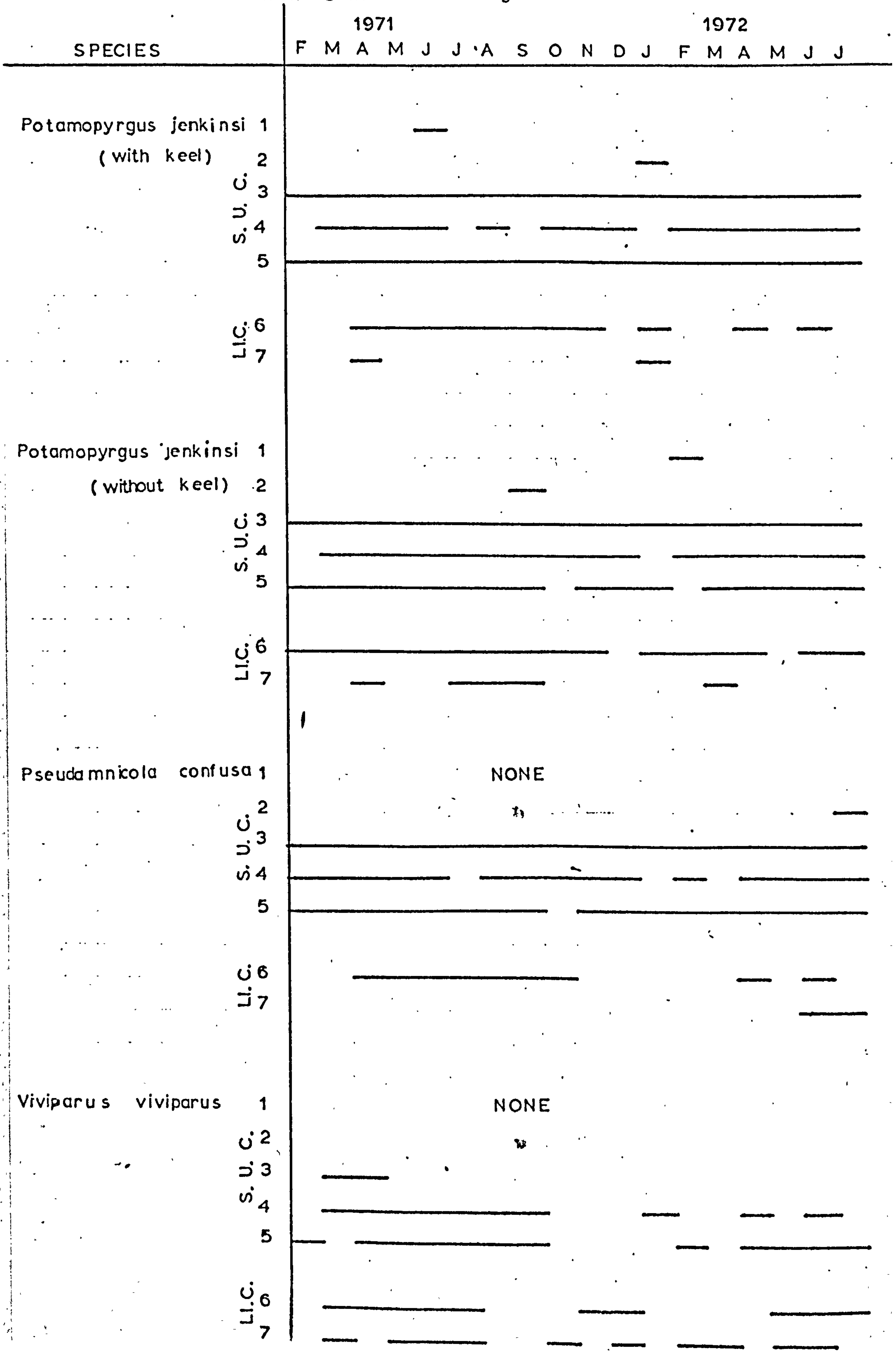


TABLE No. 34 (i) Total Number and % of the Gastropoda Taken from Each Site by the Dredge in 1970-71 and 1971-72 to the Total Number of the Invertebrates.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Gastropoda	67	83	1,771	254	305	2,481				
%	0.13	0.16	3.42	0.49	0.59	4.6				
1971-72										
Gastropoda	58	43	1,703	227	158	2,188	32	56	19	107
%	0.1	0.08	3.14	0.42	0.29	4.0	0.3	0.58	(+)	1.09

(i) Total Number and % of the Gastropoda Taken from Each Site by the Hand-Net in 18 Months to the Total of the Invertebrates.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
Gastropoda	83	63	7,947	148	401	8,641	385	130	NO SAMPLE	515
%	0.14	0.1	13.8	0.26	0.7	15.01	3.29	1.12		4.45

(+) Sign indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

6.11 MOLLUSCA

Numbers of this group occur at most sites along the Shropshire Union Canal and the Llangollen Canal in the Dredge and the Hand-net samples throughout the sampling period.

Gastropoda

Gastropods were found in all Dredge and Hand-net monthly samples taken from the Shropshire Union Canal throughout the sampling period. In the Dredge samples they formed 4.6% in 1970-71 and 4% in 1971-72 of the total invertebrates, while in the Hand-net samples they formed 15.01% of the total invertebrates throughout the sampling period. The largest numbers of Gastropods were found in April, May and June of every year in both Hand-net samples and Dredge samples.

In the Llangollen Canal they were also found in the Dredge and Hand-net samples every month throughout the sampling period. They formed in the Dredge samples 1.1% in 1971-72 and in Hand-net samples 4.45% of the total invertebrates with maximum numbers in June and July, 1971 and 1972 in Hand-net samples.

The following species were recorded in both canals during the investigation period:

(1) Potamopyrgus jenkinsi (with keel) (Smith)

(2) Potamopyrgus jenkinsi (without keel) (Smith)

(3) Pseudamnicola confusa (Frau)

(4) Valvata macrostoma (Steenbuch)

(5) Valvata piscinalis (Mûll)

(6) Zonitoides nitidus (Mûll)

(7) Viviparus viviparus (Linn)

(8) Theodoxus fluviatilis (Linn)

(9) Lymnaea glabra (Müll)

(10) Lymnaea peregra (Müll)

(11) Acroloxus lacustris (Linn)

(12) Succinea putris (Müll)

(13) Planorbis corneus (Linn)

(14) Planorbis planorbis (Linn)

(15) Bithynia tentaculata (Linn)

(16) Bithynia leachi (Sheppard)

(17) Hydrobia ulvae (Pennant)

Monthly quantitative changes, seasonal variations and notes on the common species have been given. Total monthly numbers and sizes of each species at each site on both canals are shown in Tables 41-55, Appendix.

Potamopyrgus jenkinsi (with and without keel)

Among the very common Gastropods was (P. jenkinsi) mostly with keel (some specimens with a keel in the middle of the whorls). It was present throughout the sampling period, especially in the Shropshire Union Canal where they were abundant in site No.3, with maximum numbers in May, June and July 1971 and 1972; in the Hand-net samples.

In the Shropshire Union Canal they formed in the Dredge samples 52% in 1970-71 and 51.8% in 1971-72 of the total Gastropods, and 59.8% of the total Gastropods in the Hand-net samples throughout the sampling period (Tables 32 and 33).

In the Llangollen Canal the number of *P.jenkinsi* recorded in monthly samples taken with the Dredge and the Hand-net from all sites was very much less than that of the Shropshire Union Canal (Tables 41-55). Both species found mostly in site No.6 and only very few in site No.7, but they were completely absent in samples taken from site No.8. (Table 32).

Pseudamnicola confusa

This species was also one of the most common Gastropods found in the Shropshire Union Canal, they were taken in Dredge and Hand-net samples every month, mostly from site No.3, with maximum numbers in May, June and July of both years in Hand-net samples (Table 32&33). They formed in the Dredge samples 30.8% in 1970-71 and 36.6% in 1971-72 of the total Gastropods, also 38.2% of the total Gastropods in Hand-net samples throughout the sampling period.

In the Llangollen Canal very few members of this species were found in the Hand-net and the Dredge samples, throughout the sampling period. Most of this species were collected in the Hand-net samples with maximum numbers in July and August 1971 and June 1972. They were absent from samples taken from site No.8. Their occurrence is shown in Tables 32 and 33.

Viviparus viviparus

Members of this species were present all year round in the Shropshire Union Canal and throughout most of the year in the Llangollen Canal.

In the Shropshire Union Canal in the Dredge samples, they formed

2.4% in 1970-71 and 2.8% in 1971-72 of the total Gastropods, while in Hand-net samples they formed only 0.8% of the total Gastropods throughout the sampling period. Most of the members of this species were collected in May, June and July 1971 in the Hand-net samples, (Tables 32 and 33).

In the Llangollen Canal this species was present in all months in the Dredge samples and most of the months in Hand-net samples. V. viviparus represented in the dredge samples in 1971-72, 43.9% and in the Hand-net samples 9.2% of the total Gastropods throughout the sampling period. Their occurrence is shown in Tables 32 and 33.

The Other Gastropods

These include the following species V. piscinalis, V. macrostoma, Z. nitidus, T. fluviatilis, L. glabra, L. peregra, A. lacustris, S. putris, P. corneus, P. planorbis, B. tentaculata, B. leachi and H. ulvae.

Very small numbers of these species have been taken in different months throughout the sampling period from both canals. Total numbers taken each year and the time of their occurrence have been summarized in Tables 41-55. Monthly numbers and sizes of each species at each site on both canals are shown in Tables 41-55 in the Appendix.

Table Nº 35 Monthy occurrence of the more common *Lamellibranchia* (Bivalves) taken the dredge at each site on the Shropshire Union Canal and the Llangollen Canal.

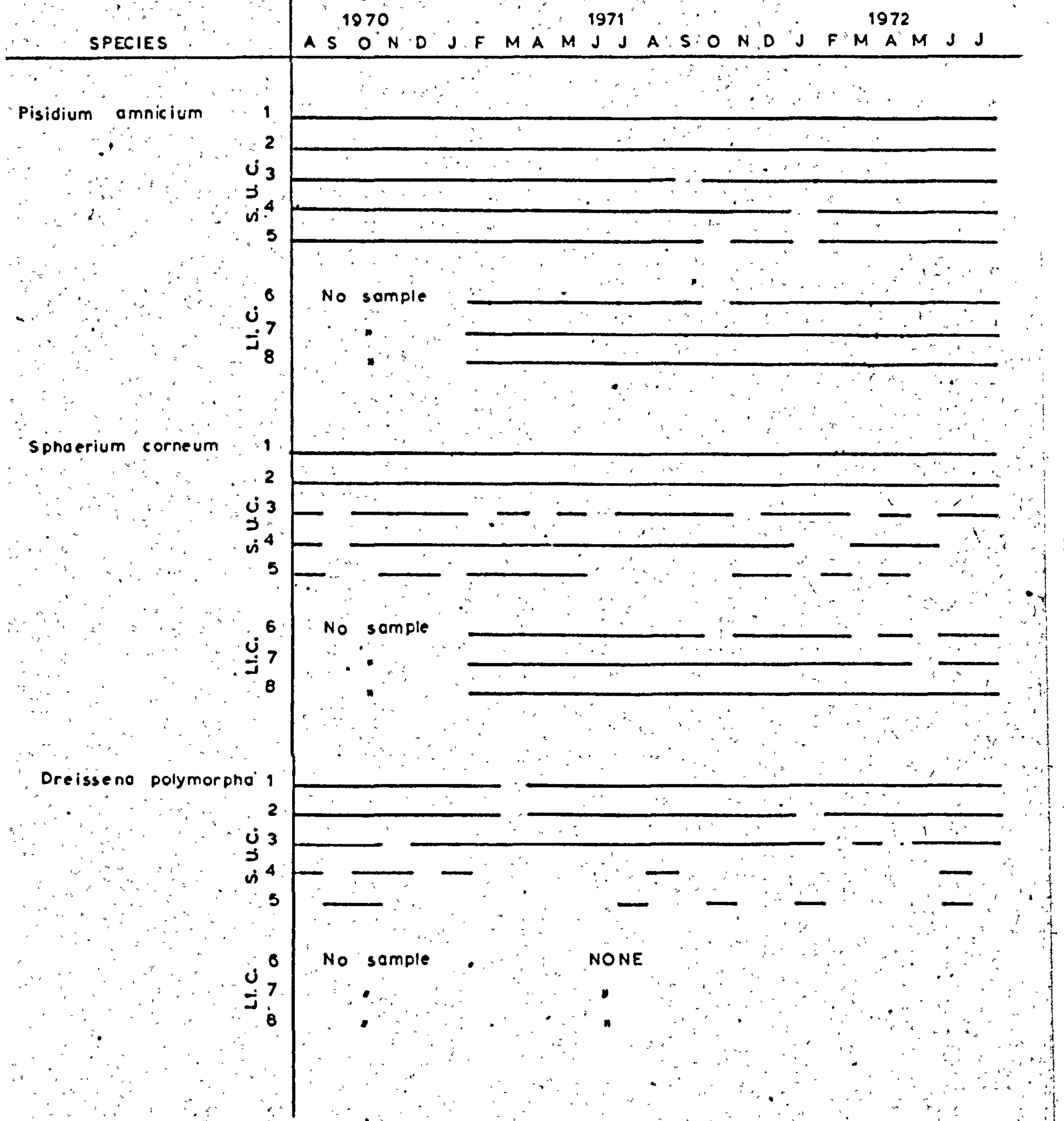


Table Nº 36 Monthly occurrence of the more common *Lamellibranchia* (Bivalves) taken by the hand-net at each site on the Shropshire Union Canal and Llangollen Canal.

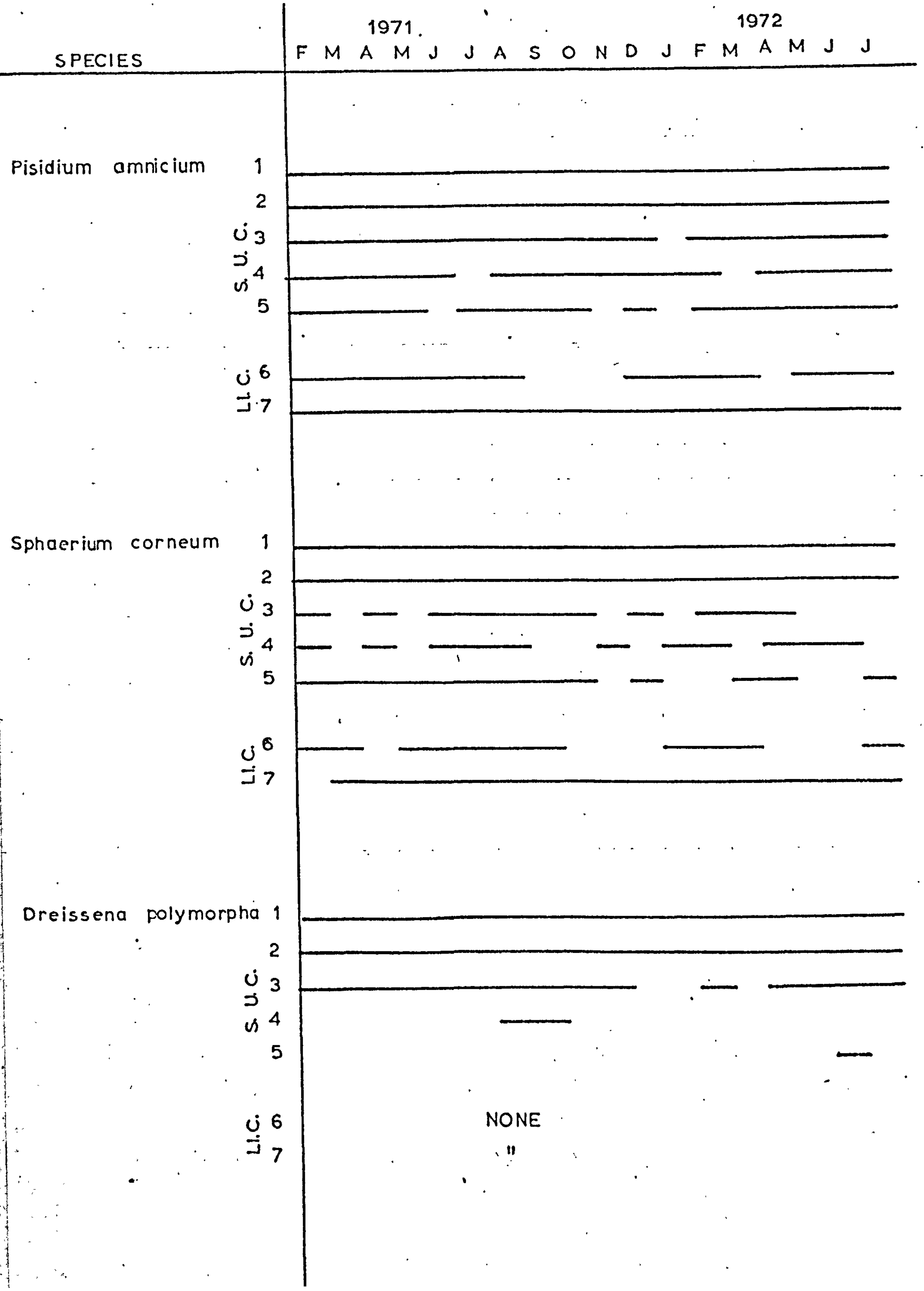


TABLE No. 37 (i) Total Number and % of the Lamellibranchia (Bivalves) Taken from Each Site with the Dredge in 1970-71 and 1971-72 to the Total Number of the Invertebrates.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Lamellibranchia (Bivalves)	346	339	127	158	117	1,087				
%	0.67	0.65	0.24	0.30	0.22	2.1				
1971-72										
Lamellibranchia (Bivalves)	301	224	72	114	55	766	97	174	307	578
%	0.60	0.41	0.13	0.21	0.10	1.4	1.00	1.76	3.11	5.9

(i) Total Number and % of the Lamellibranchia (Bivalves) Taken from Each Site by the Hand-Net in 16 Months to the Total Number of the Invertebrates.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
Lamellibranchia (Bivalves)	2,030	1,956	118	74	109	4,287	71	225	NO SAMPLE	
%	3.52	3.40	0.20	0.12	0.19	7.43	6.15	19.5		

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

Lamellibranchia (Bivalves)

Lamellibranchia (or Bivalves) were found in all Dredge and Hand-net samples collected from both canals throughout the sampling period.

In the Shropshire Union Canal they comprised in the Dredge samples in 1970-71, 2.1% and 1971-72, 1.4%, and in the Hand-net samples, 7.4% of the total invertebrates throughout the sampling period. In the Llangollen Canal they comprised in the Dredge samples 5.9% in 1971-72 and in the Hand-net samples 2.6% of the total invertebrates throughout the sampling period. Large numbers of Bivalves were collected in the Hand-net samples from Shropshire Union Canal in May, June and July, 1971 and 1972.

The following species were recorded during the sampling period:

(1) *Pisidium amnicium*

(2) *Sphaerium corneum*

(3) *Dreissenia polymorpha*

(4) *Anodonta cygnaea*

(5) *Unio pictorum*

Monthly occurrence and numbers of most common species have been summarised in Tables 35 and 36. Monthly numbers and sizes of each species at each site on both canals are shown in Tables 41-55 in the Appendix.

Pisidium amnicium

P. amnicium was the most abundant species of Lamellibranchia in both the Shropshire Union and the Llangollen Canals. They were present in all months in the Dredge and Hand-net samples (Tables 35 and 36). Numbers were low in Winter (December, January and February 1971 and 1972) in both Dredge and Hand-net samples, but in Summer the numbers increased (June, July 1971 and 1972). These were largely small ones. Other sizes were also most abundant in the samples at this time of the year.

In the Shropshire Union Canal they made 57.1% in 1970-71 and 54.4% in 1971-72, while in the Hand-net samples they comprised 64% of the total Bivalves throughout the sampling period. Monthly numbers of occurrence of P. amnicium were high in sites Nos. 1 and 2, especially in Summer.

In the Llangollen Canal, P. amnicium were taken in all months throughout the sampling period, comprising 63% in 1971-72 in the Dredge samples, and 55.1% in the Hand-net samples of the total Bivalves, (Tables 35 and 36).

Sphaerium corneum

S. corneum was the second most abundant species of Bivalves in both the Shropshire Union and Llangollen Canals. They were taken in all months in the Dredge and Hand-net samples, (Tables 35 and 36).

In the Shropshire Union Canal they were more abundant in Summer and monthly peaks were obtained in July 1971 and 1972 in the Hand-net samples (Tables 35 and 36). These were mostly small ones. S. corneum made in the Dredge samples 22.5% in 1970-71 and 22.5% in 1971-72 of the total Bivalves, while in the Hand-net samples they formed 26.6% of the total Bivalves throughout the sampling period.

S. corneum were taken in smaller numbers from the Llangollen Canal with maximum numbers in Summer too. They formed in the Dredge samples 23.9% in 1971-72 and in the Hand-net samples 27.2% throughout the sampling period.

Dreissenia polymorpha

D. polymorpha was less common than *P. amnicium* and *S. corneum*. Small numbers were taken throughout the sampling period from both canals.

In the Shropshire Union Canal they were present in all months in the Dredge and Hand-net samples, throughout the sampling period. In the Dredge samples they formed 17.6% in 1970-71 and 14.06% in 1971-72 and in the Hand-net samples 5.8%, of the total Bivalves. Their occurrence is shown in Tables 35 and 36.

In the Llangollen Canal *D. polymorpha* was very rare, only one specimen present in the Dredge and one in the Hand-net samples, throughout all the sampling period and both were found in site No.7.

Anodonta cygnaea

Very small numbers of this species were taken in the Dredge and the Hand-net samples from both canals throughout the sampling period. Their occurrence is shown in Tables 41-55.

In the Shropshire Union Canal they were comprising only 0.3% in the Hand-net samples and in the Dredge samples (3.4%) in 1970-71 and 2.6% in 1971-72 of the total Bivalves, all found in sites 4 and 5. While in the Llangollen Canal small numbers of *A.cygnaea* were frequently taken in the Dredge and in the Hand-net samples forming in 1971-72, 3.4% in the Dredge samples and 4.08% in the Hand-net samples of the total Bivalves.

Unio pectorum

Odd numbers of this species were taken from the Shropshire Union and the Llangollen Canals in the Dredge and the Hand-net samples, throughout the sampling period. Their occurrence is shown in Tables 41-55.

Table № 38

Monthly occurrence of each Crustacea taken by the dredge at each site on the Shropshire Union Canal and the Llangollen Canal.

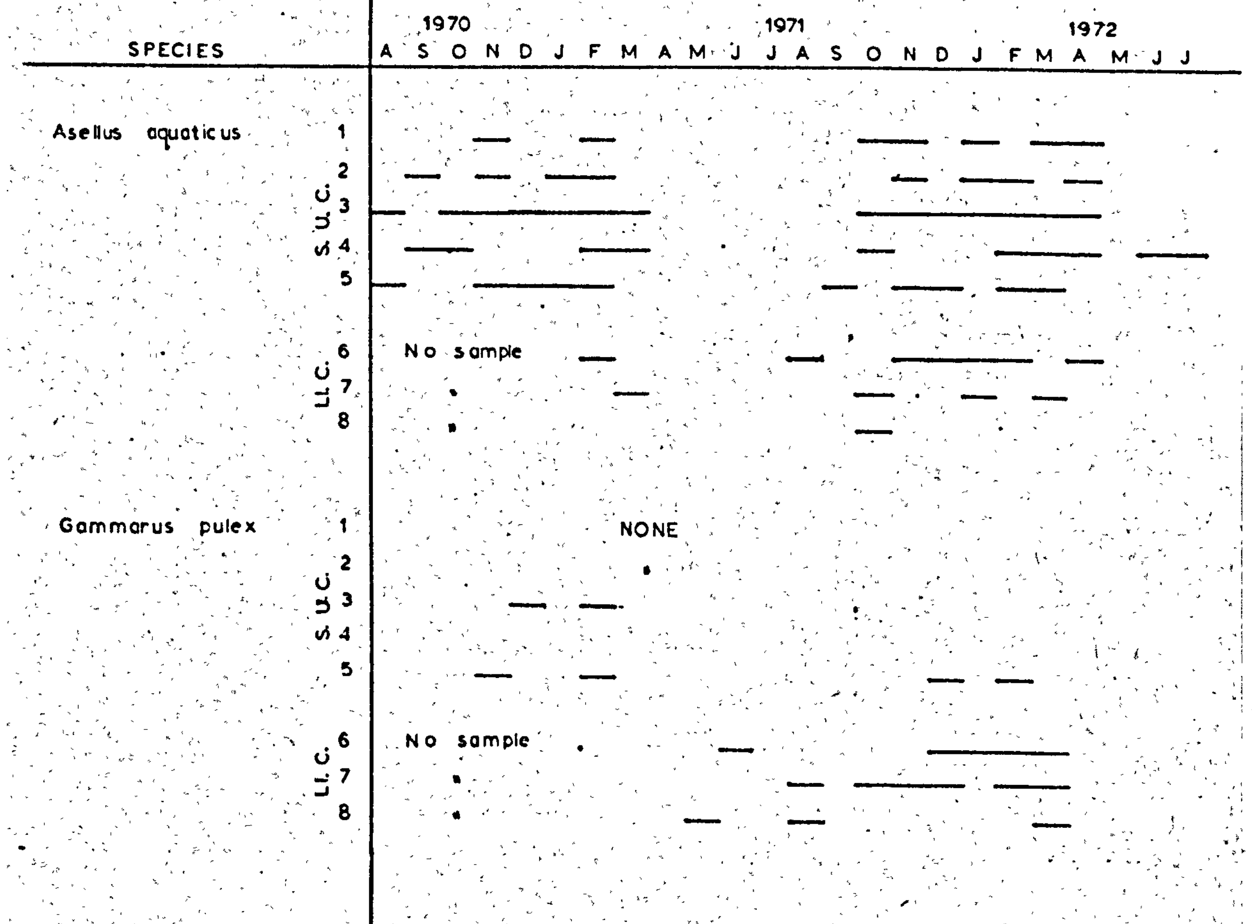


Table № 39

Monthly occurrence of the Crustacea taken by the hand-net at each site on the Shropshire Union Canal and the Llangollen Canal.

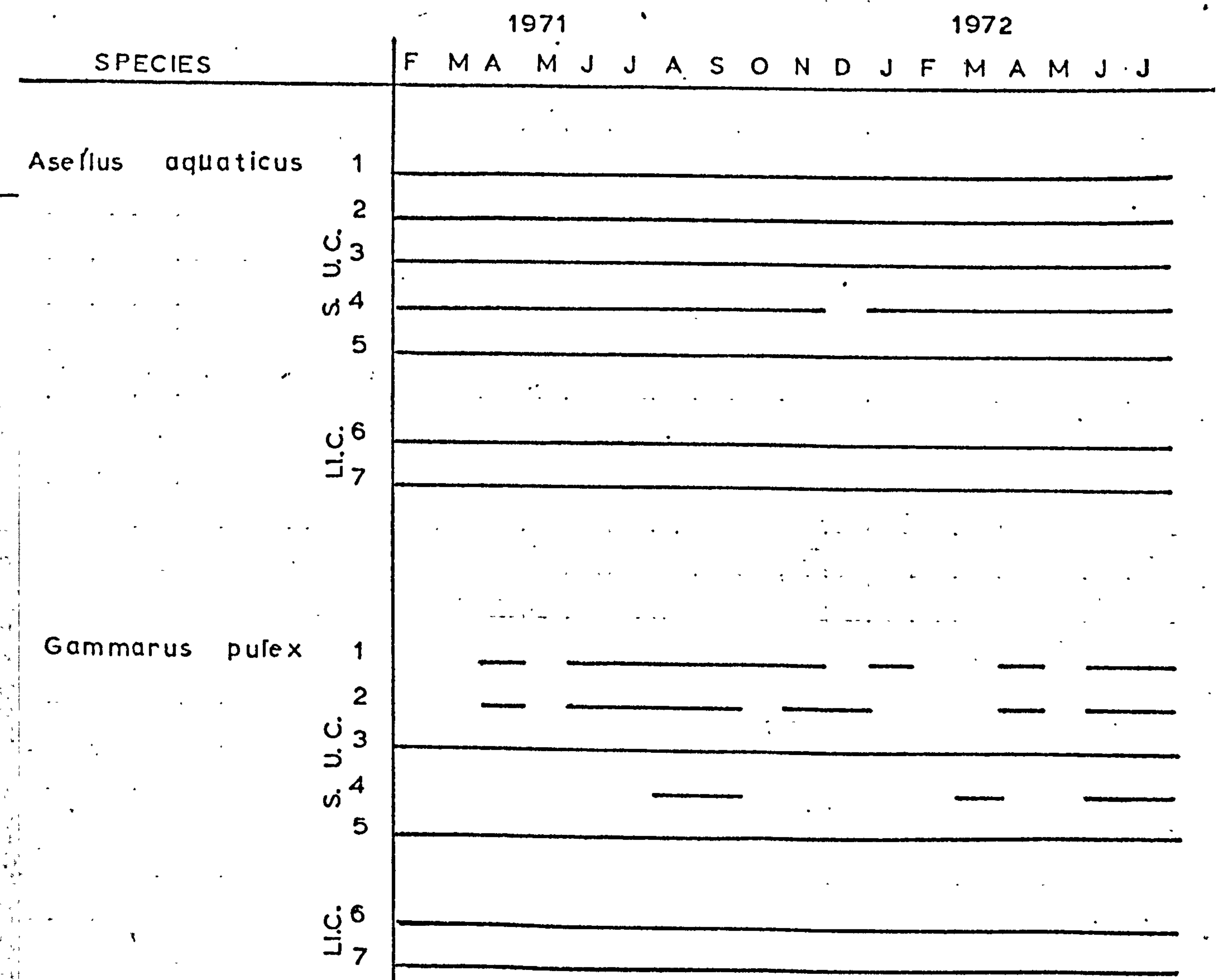


TABLE No. 40 Total Number and % of the Crustacea Taken from Each Site with the Dredge in 1970-71 and 1971-72 to the Total of the Invertebrates.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
1970-71										
Crustacea	2	7	35	6	18	68				
%	(+)	(+)	0.07	(+)	(+)	0.11				
1971-72										
Crustacea	7	8	16	9	11	51	21	34	9	64
%	(+)	(+)	(+)	(+)	(+)	0.09	0.21	0.34	(+)	0.63

Total Number and % of the Crustacea Taken from Each Site with the Hand-Net in 18 Months to the Total of the Invertebrates.

	S.U.C.						Ll.C.			
	1	2	3	4	5	TOTAL	6	7	8	TOTAL
Crustacea	737	650	746	146	1328	3,625	2,802	1,157		3,959
%	1.28	1.11	1.29	0.25	2.30	6.25	25.51	10.03		34.48

(+) = Sign Indicates that an item contributes less than 0.05%

S.U.C. = Shropshire Union Canal

Ll.C. = Llangollen Canal

6.12 CRUSTACEA

Amphipoda (Gammarus pulex), and Isopoda (Asellus aquaticus) were found in the Dredge and Hand-net samples in all months of the year. Numerically, they formed a variable and sometimes important proportions of the Dredge and Hand-net samples particularly in Summer.

The majority of Crustacea were Copepoda (Cyclopoid and Calanoid) and Cladocera, found in all Crustacean zooplankton samples taken from both canals throughout the sampling period and it is going to be considered separately under section Crustacean Zooplankton, (page 83).

Amphipoda

Gammarus pulex (Linn) was the only species recorded. It was a common species in samples taken from the Shropshire Union and the Llangollen Canals in all months, especially in Hand-net samples where it was more abundant. It was taken infrequently and in smaller numbers in the Shropshire Union Canal than the Llangollen Canal.

In the Shropshire Union Canal, G. pulex was found in all samples, it formed 33.6% in the Hand-net samples, of the total Crustacea taken throughout the sampling period. Most were taken in July and August 1971 and June and July 1972 and least occurred in January and February of 1971 and 1972, (Tables 38 and 39).

In the Llangollen Canal, G. pulex was the most common Crustacean group (Tables 38 and 39). It formed 85.6% of the total Crustacea in Hand-net samples throughout the sampling period, and there were far less in the Dredge samples. Their monthly numbers were also high in July and August 1971 and in June and July 1972 and the lowest in

February of both years.

Isopoda (Asellus aquaticus) (Linn)

A. aquaticus was abundant as well and found in each month in the Hand-net samples. Like G. pulex more A. aquaticus were taken in summer.

In the Shropshire Union Canal they were more common where they formed 66.4% in the Hand-net samples of the total Crustacea taken throughout the sampling period. Maximum numbers were captured in August and September 1971 and June and July 1972 (Tables 38 and 39).

In the Llangollen Canal, A. aquaticus were less common than G. pulex. They formed only 14.4% of the total Crustacea taken in Hand-net samples throughout the sampling period. They were rare in the Dredge samples (Table 38). Monthly maxima were taken in June and July 1971 and 1972. They were more numerous in site No.6 in every month (Tables 38 and 39).

6.13 CRUSTACEAN ZOOPLANKTON

Copepoda (Calonoid and Cyclopoid), Cladocera groups and indefinite numbers of Nauplii were the most common Crustacean zooplankton found in both canals.

Cyclopoids were the most common in both canals, they were not present in all the samples, but they were found each month in some samples.

17 different species of Cyclopoid were recorded in both canals and they were mainly found in the samples taken during the Summer. They were as follows:-

(1)	Cyclopina norvegica	(Boeck)
(2)	Halicyclops christianensis	(Boeck)
(3)	Halicyclops neglectus	(Kiefer)
(4)	Cyclops fuscus	(Jurine)
(5)	Cyclops albidus	(Jurine)
(6)	Cyclops agilis (S.Str)	(Koch, Sars)
(7)	Cyclops agilis speratus	(Lillijeborg)
(8)	Cyclops fimbriatus (S.Str)	(Fischer)
(9)	Cyclops fimbriatus poppei	(Rehberg)
(10)	Cyclops affinis	(Sars)
(11)	Cyclops streanuus abyssorum	(Sars)
(12)	Cyclops scutifer	(Sars)
(13)	Cyclops vicinus	(Uljanin)
(14)	Cyclops gigas (S.Str)	(Claus)
(15)	Cyclops varicans (S.Str)	(Sars)
(16)	Cyclops varicans rubellus	(Lilljeborg)
(17)	Cyclops bicolor	(Sars)

Cladocera were the second most common Crustacea zooplankton group in both canals, also they were not present in all samples. They were taken infrequently in small numbers throughout the sampling period from both canals, except in summer when they were abundant. Four species belonging to three families, Daphniidae, Bosminidae and Chydroidae were taken from both canals. They were

(1) Daphnia pulex (De-Geer)

(2) Bosmina longirostris (O.F. Müller)

(3) Alona affinis (Leydig)

(4) Chydorus piger (Sars)

Monthly quantitative changes, seasonal variations and notes on the common species have been given. Total monthly numbers at each site on both canals have been shown in Tables 56-62 in the Appendix. Other, but unidentified Nauplii were found in large numbers especially in Summer.

Calanoid, Sub-genus Diaptomus

Two species of this sub-genus (D. gracilis and D. castor) were present throughout the sampling period of 1972 and they were fewer in the year before in both canals.

In the Shropshire Union Canal, there was a large population of adults (both males and females) in May, June and July 1972. During the whole sampling period the adult population continued to decrease slowly from August each year, apparently due to the death of males (Thomas (1959)). The records available on these two species, shows that the autumn breeding only takes place in favourable years

(Thomas (1959)). Their occurrence has been shown summarised in Tables 52-60.

Adults (males and females) of D. gracilis and D. castor were taken in smaller numbers from the Llangollen Canal and in different months too. Most were taken in July 1972. Their occurrence is shown in Tables 61 and 62.

Group Cyclopoida Genus Cyclopina

Only one species of this genus has been found in the Shropshire Union Canal (Cyclopina norvegica) and only a few adults were taken in May, June and July 1971 and 1972. No C. norvegica were found in the Llangollen Canal.

Genus Halicyclops

This is a common genus. Adults were taken from both canals in all months throughout the sampling period except November, December 1971 and January and February 1972. Two species were found in both canals, H. Christianensis and H. neglectus.

In the Shropshire Union Canal both species were almost equally distributed along the canal sites. Summer samples (June, July and August) of each year contained the maximum numbers of both species, also the number decreased steadily from September until December, where only very small numbers were found in 1972.

The total numbers of adults of H. christianensis and H. neglectus collected from the Llangollen Canal were less than found in the

Shropshire Union Canal. They were found in sites 6 and 7 only with maximum numbers collected during the summer. Their occurrence is shown in Tables 56-62.

Genus Cyclops

This genus was the most common one found in the Shropshire Union Canal and the Llangollen Canal. Adults were taken in samples every month from both canals. The largest number of adults was found in Summer (June and July 1971 and 1972), and the lowest number was taken in Winter (January and February 1971 and 1972).

14 species of this genus have been found (recorded in both canals (page, 83).

(1) C. fuscus

Adults of this species were rare and found only in the Shropshire Union Canal. Few adults were taken from sites 1 and 2 in February and April, 1972 only (Tables 56-62).

(2) C. albidus

In the Shropshire Union Canal adults of this species were taken in all monthly samples 1971-72 and most of 1970-71. Maximum numbers were found in June, July and August 1971 and 1972, and the minimum during the winter. They were found in all sites and their numbers varied slightly from one site to another (Tables 56-60).

In the Llangollen Canal, very small numbers of adults were frequently taken in samples from sites 6 and 7 only, and were mostly taken in Summer (July 1971 and 1972).

(3) C. agilis

This species was one of the common Cyclops species found in the Shropshire Union Canal. Adults were taken in every monthly sample throughout the sampling period. Their numbers varied considerably in different sites (Tables 56-60). Summer samples (June and July) contained the maximum numbers in the two years. Their monthly occurrence is shown in Tables 56-60.

In the Llangollen Canal very few adults were found in sites 6 and 7 during summer only, Tables 61 and 62.

(4) C. agilis speratus

This species was rare (Tables 56 - 62) and recorded only in the Shropshire Union Canal, with maximum numbers in July 1971 and 1972.

(5) C. fimbriatus

This species was also one of the common cyclops species found in the Shropshire Union and the Llangollen Canals.

In the Shropshire Union Canal, adults were found in every monthly sample except February 1971. Maximum numbers in the two years were captured in the summer (June to August) of each year.

In the Llangollen Canal this species was common too, but in smaller numbers as compared with the Shropshire Union Canal. Maximum numbers were captured in June and July 1971 and 1972, (Tables 61 and 62).

(6) C. fimbriatus poppei

This species was less common than C. fimbriatus, (Tables 56-62).

In the Shropshire Union Canal, small numbers were found throughout the sampling period with maximum numbers found in June and July, 1971 and 1972.

In the Llangollen Canal very small numbers were found in sites 6 and 7 only, most were captured in the summer (June and July, 1971 and 1972) (Tables 61 and 62).

(7) C. affinis

This species was very rare and found only in the Shropshire Union Canal. Very small numbers of adults were found at different months of the year, mostly in June 1972 (Tables 56-60).

(8) C. strenuus abyssorus

Only very few adults were found in the Shropshire Union Canal at site 3 in July 1972.

(9) C. scutifer

Also rare and found in the Shropshire Union Canal only. Small numbers were found at certain sites in different months, Tables 56-60.

(10) C. vicinus

This species is less common too, and found in the Shropshire Union Canal only. Small numbers were taken throughout the sampling period with maximum numbers in July 1971 and 1972.

(11) C. gigas

Also rare and found in the Shropshire Union Canal only. Most numbers were collected in June and July 1971 and 1972, Tables 56-60.

(12) C. varicanus

This species was also a common Cyclop species found in the Shropshire Union and the Llangollen Canals. In the Shropshire Union Canal adults were taken almost every month throughout the sampling period, with maximum numbers taken in Summer (June to August each year). Their numbers varied considerably in different sites, Tables 56-60.

In the Llangollen Canal smaller numbers of adults were taken from sites 6 and 7 only. Most in June and July 1972, Tables 61 and 62.

(13) C. varicanus rubellus

This species was less common in both canals. Adults were found in most of the monthly samples taken from the Shropshire Union Canal with maximum numbers captured in June and July 1971 and 1972, Tables 56-60.

In the Llangollen Canal very small numbers were found throughout the sampling period mostly in June and July 1972, Tables 61 and 62.

(14) C. bicolor

Adults of this species were very rare too and found in the Shropshire Union Canal only in different months of the year and in very small numbers. Their occurrence is shown in Tables 56-60.

Cladocera

(1) Alona affinis

This species was the most abundant species of Cladocera found in both the Shropshire Union and the Llangollen Canals.

In the Shropshire Union Canal large numbers of adults were taken in the summer time (June to August) each year, (Tables 56-60), but they were absent in December, January and February of 1971, and 1972 from all sites, and in between these months only small numbers were found. Their monthly distribution was slightly different from one site to another along the canal.

In the Llangollen Canal adults of A. affinis were taken in different months of the two years. They were more plentiful in summer (June and July 1971 and 1972) and found in sites 6 and 7 only, (Tables 61 and 62).

Daphnia pulex

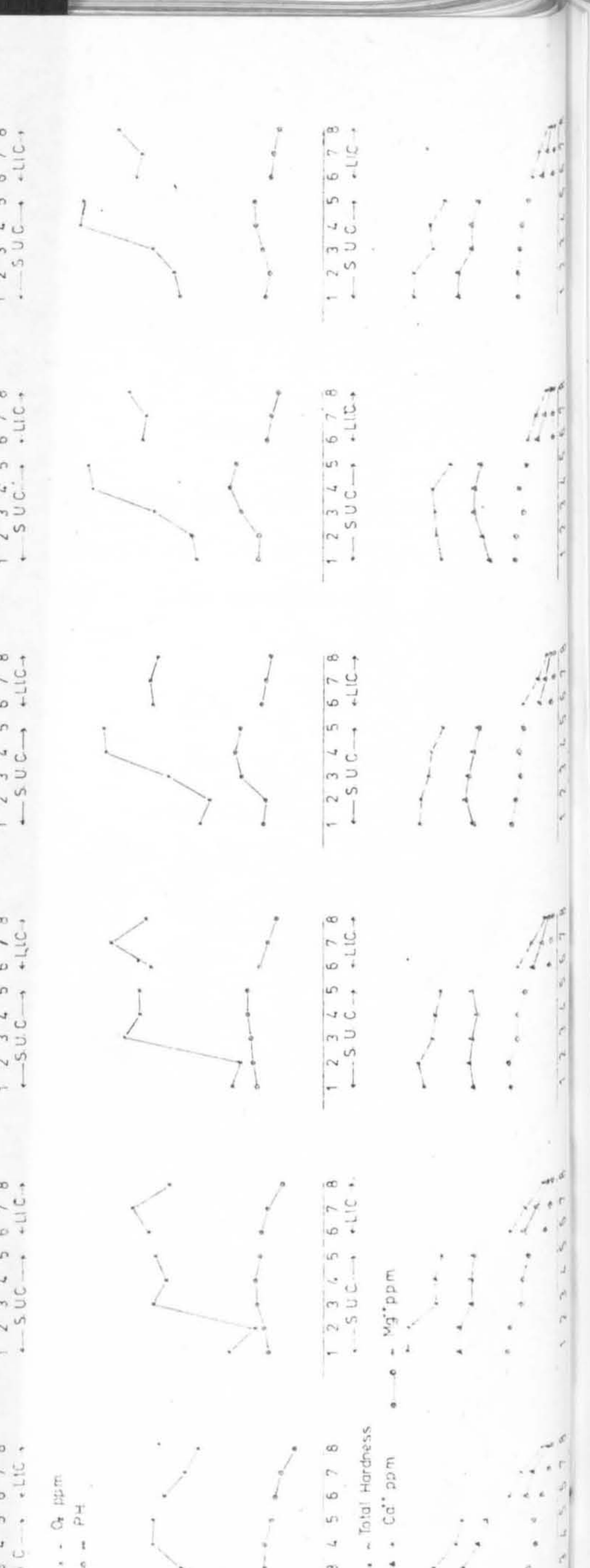
This species was the second most common one of Cladocera, and found in the Shropshire Union Canal only. Adults were taken in most months of the two years and they were more abundant in Summer (June and July 1971 and 1972). They were almost equally distributed along the canal sites (Tables 56-60).

Bosmina longirostris

This species was taken infrequently in very small numbers throughout the sampling period from both canals, (Tables 56-62).

Chydorus piger

This species was the least common Cladoceran species and found in the Shropshire Union Canal only. It occurred irregularly in different months at different sites along the canal, (Tables 56-62).



6.14 Physical and Chemical Factors

Temperature

A summary of the water temperature reco sampling sites in both canals is given in Ta The tables also show mean values for each mo seasonal variation in water temperature, wi recorded in August of both years and the lo significance can be attached to the progres temperature with distances between sites, s invariably taken at different times of day. Shropshire Union Canal were always sampled site 8 on the Llangollen Canal was sampled

The record of temperatures showed the both canals, Tables 63-70 and Figure 1.

pH

The pH of the two canals was recorded the sampling period. It was found that th increase in the Llangollen Canal from the i water down to Hurleston, Tables 63-70. Th substantial contents which may be derived f in the Llangollen Canal's construction, Bo and Twigg (1959). On all occasions, it wa the Shropshire Union Canal was alkaline (pH small differences in the pH of the water f Tables 63-70 and Figure 1.

6.14 Physical and Chemical Factors

Temperature

A summary of the water temperature recorded monthly at the sampling sites in both canals is given in Tables 63-70 and Figure 1. The tables also show mean values for each month. There is a clear seasonal variation in water temperature, with the highest temperatures recorded in August of both years and the lowest in December. Little significance can be attached to the progressive trend of increasing temperature with distances between sites, since recordings were invariably taken at different times of day. Sites 1 and 2 on the Shropshire Union Canal were always sampled in the morning, while site 8 on the Llangollen Canal was sampled in late afternoon.

The record of temperatures showed the range of temperatures in both canals, Tables 63-70 and Figure 1.

pH

The pH of the two canals was recorded at each site throughout the sampling period. It was found that there was a marked pH increase in the Llangollen Canal from the intake of the River Dee water down to Hurleston, Tables 63-70. This is in spite of the substantial contents which may be derived from the limestone used in the Llangollen Canal's construction, Boycott and Oldham (1936) and Twigg (1959). On all occasions, it was found that the water of the Shropshire Union Canal was alkaline (pH > 7), and there were only small differences in the pH of the water from one site to another, Tables 63-70 and Figure 1.

Oxygen

The oxygen concentration recorded at all sites along the two canals is summarized in Tables 63-70 and Figure 1. As these measurements were taken to give a rough indication of the differences between the sites throughout the sampling period, the difference between the highest and the lowest being too slight and it may be of seasonal nature, Tables 63-70, and Figure 1.

The analyses do not give any picture of the effecting influence on the distribution of the invertebrate fauna, (page123).

Chemical Analysis of Water Samples

The results of chemical analysis of water samples taken from each site on both canals are presented in respective tables, Tables 63-70. A summary of these results is given in Figure 1, which shows the average values throughout the sampling period for each site. Here the results are expressed as maximum and minimum and a mean value for each different analysis at each site on both canals. This allows the two canals to be compared and any gradients to be easily seen.

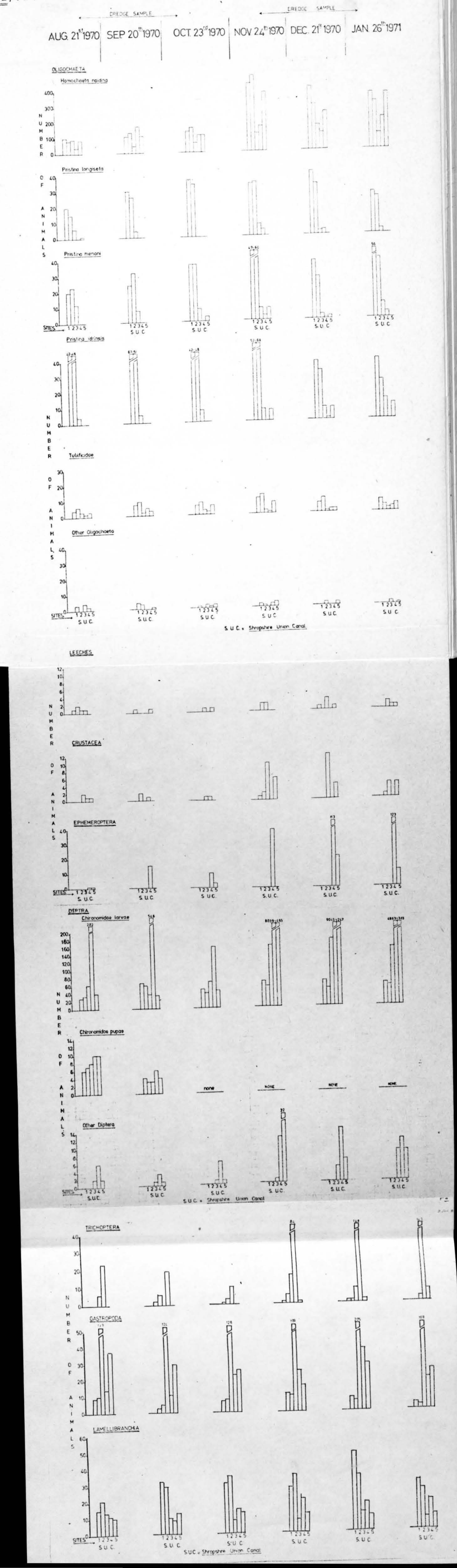
The total hardness, Calcium and magnesium of the two canals varies, Tables 63-70 and Figure 1.

In the Shropshire Union Canal the total hardness varies only slightly from one site to another as shown in Tables 63-70.

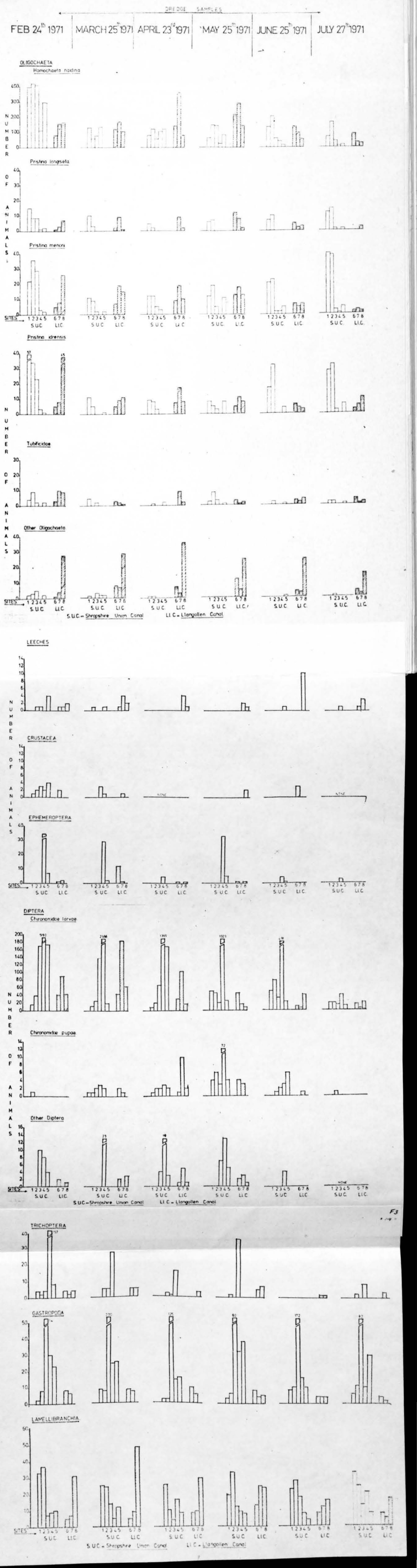
In the Llangollen Canal it was found that there was a marked total hardness, calcium and magnesium upwards gradient from the intake of the River Dee water at the start of the canal at Llansillo down to Hurleston, Tables 61 and 62 and Figure 1. This gradient was also found by Boycott and Oldham, (1936.). This hardness was predominantly calcium which may be derived from the limestone used in the construction of the canal, Boycott and Oldham (1936), Twigg (1959) and Christian T., (1969).

The analyses give a clear picture of these findings.

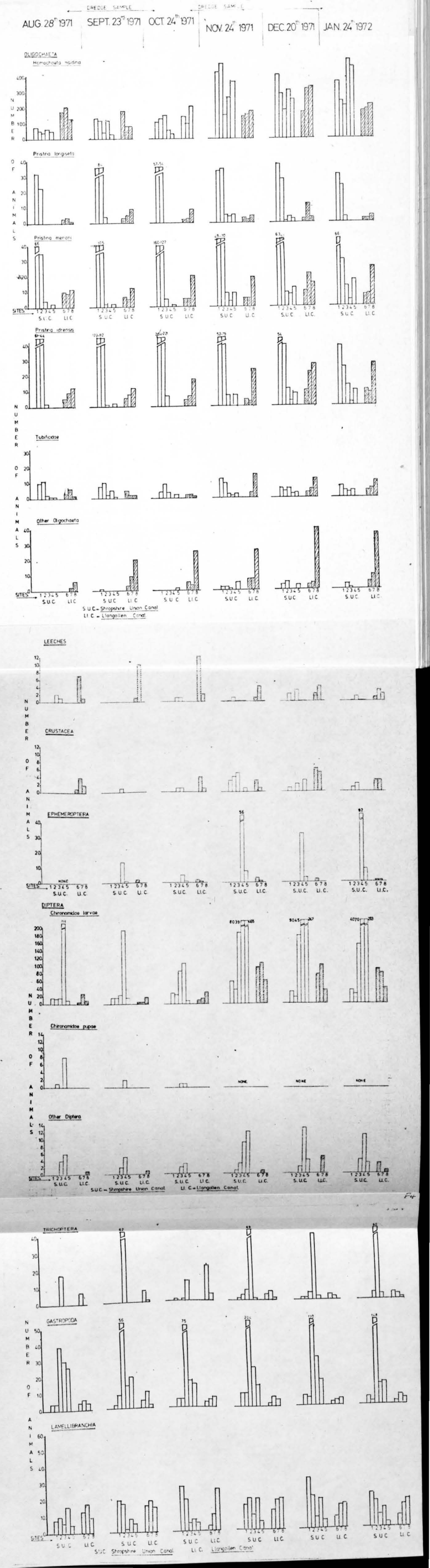
FIGURE. (2)


DREDGE SAMPLE
DREDGE SAMPLE
AUG. 21st 1970
SEP 20th 1970
OCT. 23rd 1970
NOV 24th 1970
DEC. 21st 1970
JAN. 26th 1971
OLIGOCHAETA
Homochaeta naidina
NUMBER OF ANIMALS
Pristina longiseta
Pristina menoni
SITES
S.U.C.
Pristina idrinsis
Tubificidae
Other Oligochaeta
S.U.C. = Shropshire Union Canal
LEECHES
CRUSTACEA
EPHEMEROPTERA
DIPTERA
Chironomidae larvae
Chironomidae pupae
none
NONE
Other Diptera
TRICHOPTERA
GASTROPODA
LAMELLIBRANCHIA

FIGURE,(3)


DREDGE SAMPLES
FEB 24th 1971
MARCH 25th 1971
APRIL 23rd 1971
MAY 25th 1971
JUNE 25th 1971
JULY 27th 1971
OLIGOCHAETA
Homochaeta naidina
Pristina longiseta
Pristina menoni
Pristina idrensis
Tubificidae
Other Oligochaeta
NUMBER OF ANIMALS
SITES
1 2 3 4 5 6 7 8
S.U.C. LI.C.
S.U.C.= Shropshire Union Canal
LI.C.= Llangollen Canal
LEECHES
CRUSTACEA
NONE
EPHEMEROPTERA
DIPTERA
Chironomidae larvae
Chironomidae pupae
Other Diptera
TRICHOPTERA
GASTROPODA
LAMELLIBRANCHIA

FIGURE, (4)


DREDGE SAMPLE
DREDGE SAMPLE
AUG. 28th 1971
SEPT. 23rd 1971
OCT. 24th 1971
NOV. 24th 1971
DEC. 20th 1971
JAN. 24th 1972
OLIGOCHAETA
Homochaeta naidina
Pristina longiseta
Pristina menoni
Pristina idrensis
Tubificidae
Other Oligochaeta
NUMBER OF ANIMALS
SITES
1 2 3 4 5
6 7 8
S.U.C.
Ll.C.
S.U.C = Shropshire Union Canal
Ll.C = Llangollen Canal
LEECHES
CRUSTACEA
EPHEMEROPTERA
NONE
DIPTERA
Chironomidae larvae
Chironomidae pupae
Other Diptera
TRICHOPTERA
GASTROPODA
LAMELLIBRANCHIA

FIGURE, (5)

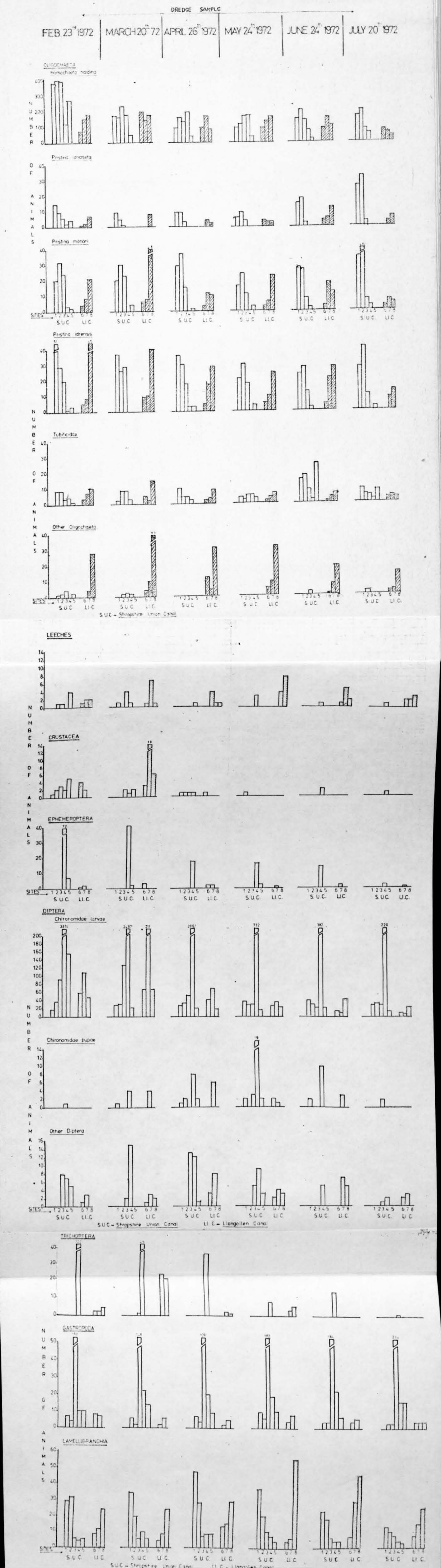

DREDGE SAMPLE
FEB 23rd 1972
MARCH 20th 72
APRIL 26th 1972
MAY 24th 1972
JUNE 24th 1972
JULY 20th 1972
OLIGOCHAETA
Homochaeta naidina
NUMBER OF ANIMALS
Pristina longiseta
Pristina menoni
Pristina idrensis
Tubificidae
Other Oligochaeta
SITES
S.U.C.
LI.C.
S.U.C = Shropshire Union Canal
LEECHES
CRUSTACEA
EPHEMEROPTERA
DIPTERA
Chironomidae larvae
Chironomidae pupae
Other Diptera
S.U.C = Shropshire Union Canal
LI.C = Llangollen Canal
TRICHOPTERA
GASTROPODA
LAMELLIBRANCHIA
S.U.C = Shropshire Union Canal
LI.C = Llangollen Canal

FIGURE. (6)

HAND-NET SAMPLE
FEB. 24th 1971
MARCH 25th 1971
APRIL 23rd 1971
MAY 24th 1971
JUNE 25th 1971
JULY 27th 1971
OLIGOCHAETA
Homochaeta naidina
Pristina longiseta
Pristina menoni
Pristina idrensis
Other Oligochaeta
LEECHES
NUMBER OF ANIMALS
SITES
1 2 3 4 5 6 7
S.U.C. L.C.
S.U.C. = Shropshire Union Canal
L.C. = Llangollen Canal
CRUSTACEA
Asellus aquaticus
Gammarus pulex
EPHEMEROPTERA
DIPTERA
Chironomidae larvae
Chironomidae pupae
NONE
Other Diptera
HEMIPTERA
TRICHOPTERA
COLEOPTERA
GASTROPODA
LAMELLIBRANCHIA

FIGURE, (7)


HANDNET SAMPLE
AUG. 28th 1971
SEPT. 23rd 1971
OCT 24th 1971
NOV 24th 1971
DEC. 21st 1971
JAN 26th 1972
OLIGOCHAETA
Homochaeta naidina
Pristina longiseta
Pristina menoni
Pristina idrensis
Other Oligochaeta
LEECES
CRUSTACEA
Asellus aquaticus
Gammarus pulex
EPHEMEROPTERA
DIPTERA
Chironomidae larvae
Chironomidae pupae
NONE
Other Diptera
HEMIPTERA
TRICHOPTERA
COLEOPTERA
GASTROPODA
LAMELLIBRANCHIA
NUMBER OF ANIMALS
SITES
1 2 3 4 5 6 7
S.U.C. LI.C.
S.U.C. = Shropshire Union Canal
LI.C. = Llangollen Canal

FIGURE, (8)


HAND-NET SAMPLE
HAND-NET SAMPLE
FEB. 23rd 1972
MARCH 20th 1972
APRIL 26th 1972
MAY 24th 1972
JUNE 24th 1972
JULY 20th 1972
OLIGOCHAETA
Homochaeta naidina
Pristina longiseta
Pristina menoni
Pristina idrensis
Other Oligochaeta
LEECHES
NUMBER OF ANIMALS
SITES
S.U.C.
LL.C.
S.U.C. = Shropshire Union Canal
LL.C. = Llangollen Canal
CRUSTACEA
Asellus aquaticus
Gammarus pulex
EPHEMEROPTERA
DIPTERA
Chironomidae larvae
Chironomidae pupae
Other Diptera
HEMIPTERA
TRICHOPTERA
COLEOPTERA
GASTROPODA
LAMELLIBRANCHIA

7. DISCUSSION

7.1 Seasonal Occurrence of the Invertebrate Fauna

The composition of the constituents of the invertebrate fauna revealed by the bottom fauna, shore fauna and Crustacean zooplankton samples taken from the sites on the Shropshire Union Canal and the Llangollen Canal are shown in Tables 6-62 and Figures 2-8.

The results reflect the known seasonal fluctuations of species population both qualitatively and quantitatively. The seasonal variations are related not only to change in age, life history and diversity of aquatic invertebrates, but also to physical and chemical conditions of the water of the two canals. While several species were found throughout the year, others occurred for only a few months.. The species which seem to be found throughout the year are burrowing forms, notably, all Oligochaeta, Diptera (Chironomid larvae), Gastropoda (P. jenkensi) and Bivalves (P. amnicium and S. corneum), Tables 3-55 and Figures 2-8. The presence or absence of any other group or species at a particular time might be the result of several features of its life history, Ephemeroptera (E. ignita nymphs), Coleoptera (Dytiscinae larvae), Hemiptera (Corixa nymphs and adults) and all Crustacean zooplankton species,(page, 117).

The nature of the canal bottom also plays a primary role in determining the distribution of the invertebrate fauna qualitatively more than quantitatively (page, 115), while certain chemical and physical factors play a secondary role in determining the presence of certain species,(page, 114) .

The discussion of the invertebrate results interpreted in the light of the work of previous authors such as Macan, Hynes, Elliott and Brinkhurst. Each group of animals will be considered and discussed separately.

OLIGOCHAETA

The Oligochaetes were the most abundant group of invertebrates in all months and at all sites on both canals, with maximum numbers in November, December and January of both years. This great increase in all sites during the winter months was an effect of detritus and natural pollution, caused by the accumulation of fallen leaves in the canal, which act as an attractant by decomposing into black organic mud on which these animals depend for their food (Egglishaw (1964) and Maitland, P.S. (1966)). They were clearly much more abundant in the Shropshire Union Canal than the Llangollen Canal, because of the more black organic mud on the Shropshire Union Canal sites.

Homochaeta naidina

The major part of the Oligochaetes at all sites on both canals throughout the sampling period was H. naidina. It occurs at all sites and its abundance varies from one site to another, Tables 6, 7 and 8 and Figures 2-8.

In the Shropshire Union Canal a large number of H. naidina were taken from all sites in every month, with maximum numbers in November, December and January. This abundance during winter months is possibly attributable to the larger amounts of black organic mud, caused by fallen leaves in the canal. Sites 1, 2 and 5 were found to have more

[illegible]

black organic mud, so they had a higher H. naidina population, Tables 6, 7 and 8 and Figures 2-8.

In the Llangollen Canal H. naidina was the most common species too. The cause of its maximum numbers in winter months was the same as in the Shropshire Union Canal and similar observations that sites 7 and 8 have a larger population than site 6, because of the more black organic mud at those two sites, Tables 6, 7 and 8 and Figures 2-8.

Pristina (longiseta, menoni and idrensis)

The Pristina of both the Shropshire Union Canal and the Llangollen Canal was restricted to these three species. Over the sampling period, they have been collected every month, but the proportions varied greatly from one site to another and from one canal to another, Tables 6, 7 and 9-11 and Figures 2-8.

In the Shropshire Union Canal they occurred at all the sites throughout the sampling period, although their abundance varied enormously from one site to another. Tables 6, 7 and 9-11 and Figures 2-8 show that they were particularly abundant at sites 1, 2 and 5 and becoming far less abundant at sites 3 and 4, indicating that these species can not thrive in the dense clay bottoms in those last two sites (see description of sites,(pages, 14-17). Pristina species are well recognised as a species attracted to organic mud, stones and gravel (Brinkhurst and Jamieson (1971)) and Brinkhurst, (1965b). Similar observations found that sites 1, 2 and 5 have more black organic mud.

In the Llangollen Canal these Pristina species were found at all the sites throughout the sampling period and their abundance differs slightly from one site to another, Tables 41-55 and Figures 2-8. A relatively smaller number of these species was collected at site 6, where there was organic mud and more sand (page. 14).

Tubificidae

Tubificidae was collected in considerable numbers. Over the sampling period it was collected from every site, but the percentage was far less than H. naidina and Pristina species, Tables 6, 7 and 12 and Figures 2-8.

In the Shropshire Union Canal, Tubificidae occurred at all sites sampled, although its abundance varied. Figures 2-8 show that it was particularly more abundant at sites 1 and 2, thus indicating that Tubificidae show a relationship to the organic substrate. Brinkhurst (1966a), Ladle (1971) and J.P. Eyres (1973) reported that Tubificidae species are more common in organic mud bottoms than any other bottom condition.

In the Llangollen Canal Tubificidae were found at all sites sampled. Figures 2-8 and Tables 6, 7 and 12 show that it was more abundant at sites 7 and 8, where the bottom contains more organic mud.

Other Oligochaetes

It has been reported, however, that although substrate composition plays an important role or part in determining the kind of Oligochaetes species, (Wachs (1967) and Della Croce (1955)), many species can inhabit a variety of substrates. These species including S. heringianus, L. variegatus and E. tetraedera were found in very small numbers at all sites on both canals throughout the sampling period and their relative scarcity at all sites and absence from many others make it difficult to explain, Tables 6, 7 and 12 and Figures 2-8.

The Pleoscolex ferox species has been recorded only at site 8 on the Llangollen Canal in very small numbers. This result is largely due to the low pH, total hardness and calcium concentration, Hynes (1970).

In general, all the Oligochaetes species are regularly reported to thrive in organic substrates (Brinkhurst (1965b) and (1966a), Brinkhurst and Kennedy (1965), Ladle (1971) and Aston (1973)) but it has been pointed out also that many of the species are found in all types of habitat(Brinkhurst and Jamieson (1971)).

In both canals these species show similar patterns of distribution.

HIRUDINEA Species

Figures 2-8 are included to refer to the distribution of the total Hirudina and Tables 14, 15 and 41-55 present the mean numbers and numbers of species at every site on both canals.

In general, results from both canals show certain similarities, in spite of differences in the number of these species, that site 3 on the Shropshire Union Canal and site 7 on the Llangollen Canal are notably in greater numbers than at other sites, Tables 14 and 15. It is possible that the Hirudinea are rather more characteristic of stones (Maitland (1966)), such habitat (patches of fallen stones and higher plant roots) are characters of sites 3 and 7.

Very small numbers of all species were taken from both canals at every site, so it was difficult to explain and compare every species on its own.

TRICHOPTERA

This order was found to be one of the least abundant order of invertebrates found over the sampling period at both canals, its occurrence reaching the maximum at site 4 on the Shropshire Union Canal and site 6 on the Llangollen Canal. This high occurrence agrees with the general findings on Trichoptera in that they usually predominate on coarse substrates (Hynes (1961), Sprules (1947) and Percival and Whitehead (1929)).

Four different species and one family were collected from both canals.

Homocentropus picicornis

In the Shropshire Union Canal this species was found to be the most common one with maximum occurrence in January, February and March of both years, Tables 17 and 18. Most of the H. picicornis was found at site 4 where the bottom is heavy clay, silt, little stones and slow current. This seems to be compatible with observations of Badcock (1949) in which she noted that greater densities of Polycentropus larvae may be partly attributed to clay, silt and to slack water.

In the Llangollen Canal only very small numbers of H. picicornis were found at different sites throughout the sampling period.

Polycentropus flavomaculatus

The number of P. flavomaculatus collected was very small. (3 specimens from the Shropshire Union Canal and 10 specimens from the Llangollen Canal throughout the sampling period), therefore it was difficult to explain anything. The life-history and flight period of this species have been described by Macan and Mudsley (1968), Elliott (1968) and Crisp and Gledhill (1970).

Limnephilidae

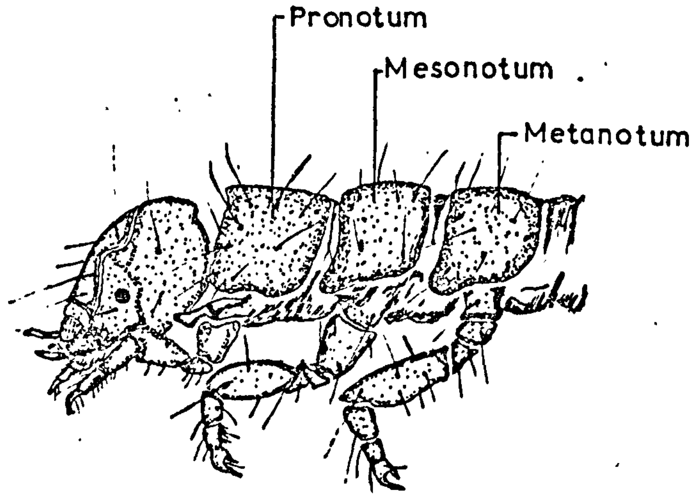
A variety of unknown species of this family were recorded in both canals in most of the months of the sampling period, Tables 17 and 18.

Only small numbers were taken from the Shropshire Union Canal and mostly at sites 3 and 5 with maximum numbers in February and March of both years.

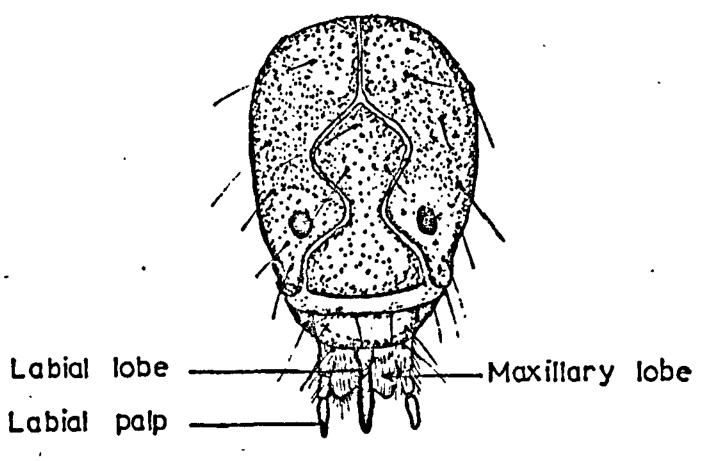
In the Llangollen Canal Limnephilidae larvae were more common. The largest numbers were found in February and March of both years. Most were found at site 6 and very few at sites 7 and 8, Tables 17 and 18. The vegetation may be responsible for this abundance at those sites. A microhabitat of particular interest at these sites, 3 on the Shropshire Union Canal and 6 on the Llangollen Canal (see description of sites,(page,11-17) are the soil free roots of older grasses under the towpath bank, where most larvae use the roots and fallen branches for case-making as well as for attachment, Twigg (1957).

Glossosoma boltoni

Two larvae of G. boltoni species were found in the Shropshire Union Canal and none in the Llangollen Canal throughout the sampling period.



(Head and thorax, lateral view).



(Head, from below)

PLATE. (11) Economus tentellus (Ramber).

Economus tentellus

No description based on a British material is available. The newly recorded larvae in England were found in both the Shropshire Union Canal and the Llangollen Canal and were between 5-8 mm in length. The labial lobe is conical and very slender with the labial palps long and made of two segments. The pro-, meso-, and meta-notum entirely sclerotized, the nota slightly larger in the front than behind, Plate 11.

Mr. P.E.S. Walley from the British Museum, kindly re-identified the larvae and he asked for specimens for the museum which the author handed over with pleasure.

The larvae were found in tubes made of secretion and were attached to stones in the Shropshire Union Canal at site 4 only and sometimes associated with freshwater sponges in the Llangollen Canal at site 7. Hickin (1967) referred to the association between E. tentellus and sponges.

COLEOPTERA

Coleoptera (adults and larvae) were also less common invertebrates in both canals. Only adults and larvae of two families were recorded in both canals throughout the sampling period with small numbers.

Müller (1954) reported that the scarcity of Coleoptera is mainly due to their mode of life as they are usually found only among thick plant growths in water.

Dytiscinae

Adults and larvae of this sub-family were rare in both the Shropshire Union Canal and the Llangollen Canal. However, monthly total numbers were too small to discuss. The life-history of the Dytiscinae has recently been investigated by Holland (1972)(page, 60).

Haliplus

Larvae and adults of this species were the most abundant Coleoptera in both the Shropshire Union Canal and the Llangollen Canal.

In the Shropshire Union Canal they were found throughout the year. They were found in larger numbers at sites 1 and 2 with maxima in the Summer months. Usually there are thick plant growths along the towpath at these sites 1 and 2, Table 20, Müller (1954).

Smaller numbers were found in the Llangollen Canal, mainly at site 6, where there are plant growths at this site and they were very scarce at sites 7 and 8.

Ephemeroptera

This order was represented by three different species one of which (C. horaria) occurred all year round in the Shropshire Union Canal at site 4, while E. ignita and B. mutinus were only recorded in a very small number at both canals, Tables 41-55.

On an annual basis the highest numbers of Ephemeroptera occurred in January, and February of both years, Tables 41-55 and Figures 2-8.

Caenis horaria

In the Shropshire Union Canal C. horaria was the most abundant species of Ephemeroptera and its occurrence was greatly increased in January and February of both years. Most of the C. horaria was found at site 4 and only a very few were found at the other sites. However, site 4 differs from all the other sites in that its substrate is dominated by heavy clay and small stones.

Percival and Whitehead (1929), Eastham (1932) and Moon (1939), reported that Caenis occurs most commonly on the bottoms where the range particles are very small and this is possibly one of the main factors which causes the abundance of C. horaria at site 4, page

In the Llangollen Canal only very few nymphs of this species were recorded and most were found at site 6, Tables 22 and 23.

Ephemerella ignita

The occurrence of E. ignita along the Shropshire Union Canal and the Llangollen Canal is difficult to explain as very small numbers were collected during the sampling period, Tables 22 and 23. Its life-history has been described by many people such as Macan, T.T., Jensen, C.F. and Hynes H.B.N. (page, 63).

Baetis mutinus

This species rarely occurs, Tables 41-55, and very small numbers were collected in different months at different sites on both canals.

DIPTERA

The Diptera contributed a great deal towardsthe composition of the fauna at all sites on both canals, Tables 25-27 and Figures 2-8. The maximum occurrence was at site 4 on the Shropshire Union Canal with maximum numbers in November and December of both years. The Diptera have been treated here as being composed of groups, and each has its own environmental requirements.

Chironomidae

As a result of the difficulty in the identification of species within this family, nothing is known about the distribution of individual species although as a family a great deal is known. The main findings have been the association of Chironomid larvae with fine sediments in spaces between large stones in riffles (Percival and Whitehead (1929)) and with sediments with large amounts of organic detritus present (Egglishaw (1964)).

In the Shropshire Union Canal the results shown in Figures 2-8 and Tables 25-27 show the distribution of Chironomidae to be inversely proportional to the median particle size of the substrate. The large occurrence at site 4 in relation to particle size is true in most of the months. If the relationship of detritus to the deposition of fine particles were strictly applicable, then the highest occurrence would be in November and December. This was found to be true as the highest occurrence found at site 4, suggesting that the distribution of organic matter and particle size of the substrate are the factors controlling Chironomid distribution at all sites.

In the Llangollen Canal (Figure 1 and Tables 25-27) show the distribution of Chironomid larvae to be inversely proportional to the median particles and organic matter. The large numbers found at site 7 in relation to particle size and organic matter proved this to be true.

The seasonal occurrence of the Chironomid pupae show a clear pattern, as high occurrences were recorded in summer months in both canals, Tables 25-27, Figures 2-8.

Ceratopognoidae

Larvae of this family were taken in all months from the Shropshire Union Canal and most of the months from the Llangollen Canal, but in very small numbers, Tables 41-55.

In the absence of knowledge of the number and variety of species present, neither distribution nor life-history could be determined.

Tipulidae

Tipulid larvae and pupae were noted to be very rarely found in both canals throughout the sampling period. Their occurrence is shown in Tables 41-55.

Culicidae

Larvae of this family belonging to Chaoborus species was rarely found in the Shropshire Union Canal. Only four larvae throughout the sampling period and none in the Llangollen Canal.

HEMPITERA

Hemiptera (adults and nymphs) were also less common invertebrates in both canals, especially in the Llangollen Canal, Figures 2-8. Three different families with three species were recorded during the sampling period from both canals. Minckley's (1963) records showed that the presence of vegetation and current speed affected the presence of all Hemiptera "they were abundant among thick plants and slow waters".

Corixa

Adults and nymphs of this Corixa were the most abundant Hemiptera in the Shropshire Union Canal, and they were scarce in the Llangollen Canal.

In the Shropshire Union Canal, they were found in all months except January of both years, with maximum numbers in the Summer months. This might be a result of their life-cycle features as it has a quick summer generation and an overwintering one. They were more abundant at sites 1 and 2 in Summer more than any other site. This was due to the growth of vegetation at these two sites, Table 29. Minckley (1963).

In the Llangollen Canal Corixa were represented by a very small number throughout the sampling period (9 specimens only were found in the Summer) - Table 29.

Notonecta

Adults only of this species were not found in sufficient numbers throughout the sampling period from both canals, to allow comment on their seasonal abundance or life-cycle, Tables 41-55.

ODONATA

The nymphs of this order were not recorded in sufficient numbers throughout the sampling period in both canals, to allow comment on their seasonal abundance and to trace their life-cycles because of the absence of knowledge of the number of species present.

MOLLUSCA

Members of this group occurred at most sites along the Shropshire Union Canal and the Llangollen Canal, throughout the sampling period. In many sites they formed an important part of the invertebrate fauna, but only very few species were wide-spread. The majority being found in lower parts of the Llangollen Canal, sites 6 and 7, and all the Shropshire Union Canal. This is presumably related to the fact that most freshwater Mollusca require a certain amount of calcium in the water, Boycott (1936) and solid surfaces for it to hold on to, Geldiay (1956).

Gastropoda

Inthe Shropshire Union Canal Gastropods were recorded in all monthly samples at every site throughout the sampling period. The largest numbers of Gastropods were found in May and June of every year. 17 species were recorded but only a very few were common, Tables 32 and 33.

Potamopyrgus jenkinsi (with and without keel) and Pseudamnicola confusa were the most common species found. Themaximum numbers were recorded in May and June of both years, mostly taken at site 3, Tables 32 and 33. Geldiay (1956) noted the relationship of the solid surfaces of stones and the presence of Gastropods holding onto them. Site 3 has such characteristics, (page; 12). Viviparus viviparus species was present all year, but in very small numbers and at different sites Tables 32 and 33. The other species of Gastropoda were found in very small numbers in different months and at different sites throughout the sampling period, Tables 41-55.

In the Llangollen Canal, P. jenkinsi, P. confusa and V. viviparus were the most common species found, but in smaller numbers as compared with the Shropshire Union Canal, Tables 32 and 33. Most were found at sites 6 and 7, and very few at site 8. The other species of Gastropoda were found in very small numbers at different sites in different months throughout the sampling period, Tables 41-55.

The common species were found more in the Shropshire Union Canal than the Llangollen Canal, because of the greater amount of calcium in the Shropshire Union Canal water. This observation was reported by Boycott (1936), Macan (1955) and Shoup (1943).

LAMELLIBRANCHIA (Bivalves)

This order was found in all samples collected from all sites every month throughout the sampling period at both canals with maximum numbers in the Summer months, Figures 2-8. Four species were found in both canals.

Pisidium anicium and Sphaerium corneum were the most abundant species in the Shropshire Union Canal. They were found in all months with maximum numbers during the Summer months. This might be a result of their life-cycle features, as it has a quick summer generation and very slow one during the Winter. They were more abundant at sites 1 and 2 than any other site during the Summer, this was due to the growing plants in these two sites. This also shows that P. amnicium and S. corneum are directly affected by temperature for their seasonal distribution.

In the Llangollen Canal P. amnicium and S. corneum were taken in all months throughout the sampling period, but in smaller numbers than in the Shropshire Union Canal and with little difference in distribution along the sites, with maximum numbers during the summer months, Tables 41-55.

Dreissina polymorpha, Anodonta cygnaea and Unio pectorum were far less common than the P. amnicium and S. corneum in the Shropshire Union Canal and the Llangollen Canal. Their small number taken every month at each site (Tables 41-55) was very small to indicate any seasonal distribution.

CRUSTACEA

The major part of the Crustacea collected by the Dredge and the Hand-net is made of only two species Gammarus pulex and Asellus aquaticus. These two species were generally taken in higher frequency at summer months from both canals, Figures 2-8 and Tables 38, 39 and 41-55.

Gammarus pulex

In the Llangollen Canal G. pulex was the most abundant Crustacea, with maximum number during the Summer. The highest numbers were collected from site 6.

In the Shropshire Union Canal smaller numbers of G. pulex were found with maximum numbers during the summer, and most were collected from sites 3 and 5, Tables 38 and 39 and Figures 6-8.

Asellus aquaticus

In the Shropshire Union Canal this species was found in every month at every site, with maximum numbers in the Summer months and mostly they were collected from sites 1, 2 and 5, Tables 38 and 39 and Figures 6-8.

Smaller numbers were found in the Llangollen Canal with maximum numbers during the summer, and mostly they were collected at site 6, Tables 38 and 39, Figures 6-8.

The vegetation (the growing plants in the water and the roots, branches of the grasses under the towpath bank) may be responsible for this abundance at these sites,(pages, 11–16) A habitat of this particular interest was found at sites 1, 2 and 5, on the Shropshire Union Canal and at site 6 on the Llangollen Canal. The maximum numbers during the Summer at these sites is due to their life-cycle features, affected directly by temperature, Macan (1957) and Elliott (1967b)(1972).

CRUSTACEAN ZOOPLANKTON

As will be discussed below, many small factors affect the life of the Crustacean zooplankton, but the main control is undoubtedly temperature. Temperature influences the formation of the resting eggs in the autumn and their hatching in the spring. It controls the rate of reproduction both directly by increasing or decreasing the metabolic rate, and indirectly by affecting the production of phytoplankton, M. Pugh Thomas (1959).

From Tables 56-62, it can be seen that the temperature is critical for all the species of Crustacean zooplankton, therefore, the species have a breeding period stretching from early spring to early summer. All the species have their maximum in summer, but there is a gradual increase of population over the early spring and the animals making up the spring peak die and their young make up the summer maximum, M. Pugh Thomas (1959). From the samples taken from the Shropshire Union Canal and the Llangollen Canal, this seems to be agreeable.

Therefore, not only is the effect of temperature directly on the animals important, but its effect on the phytoplankton is also of importance (abundance of phytoplankton means an abundance of the food that the Crustacean zooplankton live on).

The distribution of the Crustacean zooplankton along the Shropshire Union Canal and the Llangollen Canal (Tables 56-60) show the average number of species caught at each site.

On the Shropshire Union Canal the Crustacean zooplankton were abundant at all sites with maximum numbers at the summer months.

Group Cyclopoida (Copepoda) were the most common Crustacean zooplankton, were found at all sites and among the most common species were H. christianensis, H. neglectus, C. agilis, C. fimbriatus, C.f. poppei, C. varicans and C. v. rubbelus and their abundance varied slightly at different sites. Summer samples of each year contained the maximum numbers of these species. Tables 56-62 show that all these species are directly affected by temperature for their seasonal distribution.

On the Llangollen Canal the Crustacean zooplankton were found at sites 6 and 7 only and the group Cyclopoida (Copepoda) were the most abundant at these two sites and the most common species recorded were H. christianensis, H. neglectus, C. fimb riatus, C.f. poppei, C. varicans and C.v. rubellus with maximum numbers during the summer months, this also shows that these species are affected directly by the temperature, for their seasonal abundance, Tables 61 and 62. At site 8 no Crustacean zooplankton were recorded throughout the sampling period, as the canal draws water from the River Dee and the Crustacean zooplankton can not become established at this site because of the rapid flow of the canal water at this point.

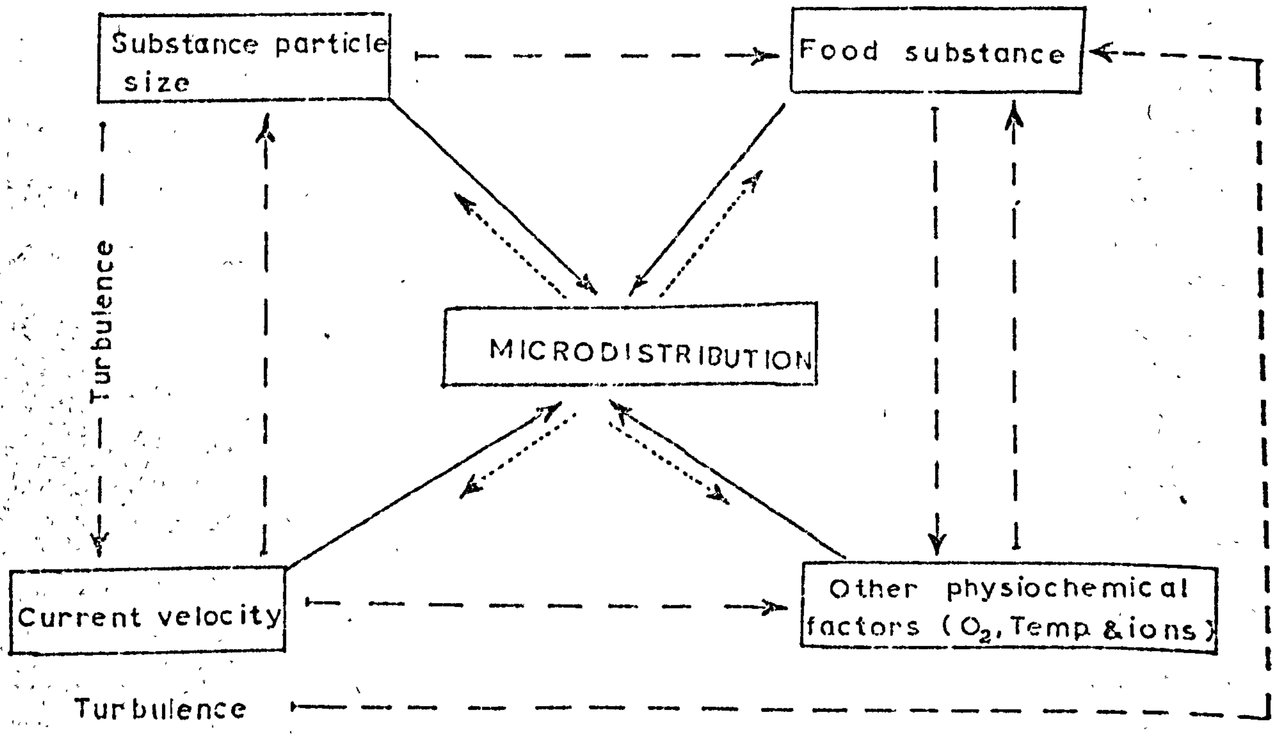
In the Shropshire Union Canal Cladocera were found in some samples, at different sites throughout the sampling period. They were represented by these species, D. pulex, B. longirostris, A. affinis and C. piger. They were all found in small numbers so their seasonal distribution cannot be followed, Tables 56-62.

In the Llangollen Canal Cladocera were very rare and found only at sites 6 and 7. Their disappearance from site 8 may be due to the rapid flow at that site.

The Crustacean zooplankton are more abundant in hard waters (contain more calcium), Slack (1955), Shoup (1943) and Reynoldson (1961). It is indeed true that Crustacean zooplankton were more abundant in numbers and more numbers of species were found in the Shropshire Union Canal than the Llangollen Canal, Tables 56-62.

FIGURE, (9)

General relationship between environmental parameters and the microdistribution of a species of benthic macroinvertebrate. (Cummins and Lauff, 1969)



———→ Influence of the environment on a benthic species which results in recognition of its microhabitat.

– – – –→ Interaction between components of the environment to which given species interact.

··········→ Influence of a given benthic species on the microhabitat.

7.2 Factors Controlling Distribution

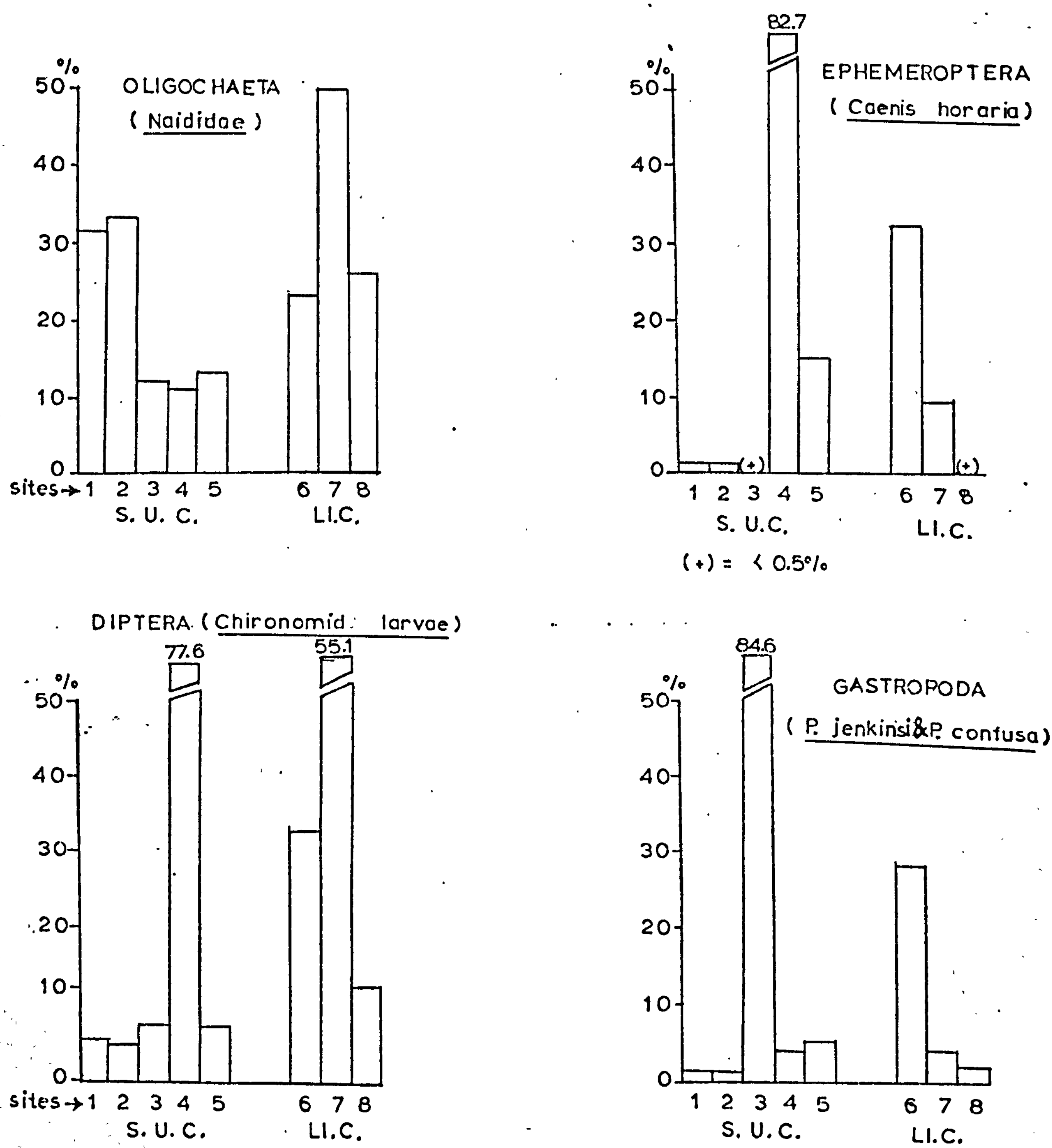
It is clear from even the earliest limnological research, (Shellford (1911), Carpentar (1927), Percival and Whitehead (1929), Sprules (1947)) that certain benthic invertebrates are characteristic of certain environmental conditions.

Cummins and Lauff (1969) propose that there are four main environmental factors controlling the distribution of benthic invertebrates, as summarised in Figure 9. With increased research into the relationship of organisms to substrate, (Cummins and Lauff (1969), Moon (1939) and others, (page, 115), Current speed (Philpson (1956), Zahar (1951) and Zimmermann (1961)), dissolved substances, (Hynes (1970),(page,120) and food (Chapman and Demory (1963), it is clear that the relative importance of each factor varies greatly depending on the organism concerned. Whereas temperature range and dissolved substances control the organisms range of tolerance, it seems that substrate particle size is the primary factor controlling habitat selection.

Cummins and Lauff (1969) found that substrate composition was a primary factor in the habitat selection of *Esolus parallelopipedus* *Naididae* (Oligochaeta) and *Chironomidae* (Diptera), while other species showed a wide range of tolerance to particle size. The same can be said of those species found in this work to be distributed as a function of substrate particle size composition, e.g., *Caenis horaria* (Ephemeroptera), *Naididae species* (Oligochaeta) and *Chironomid larvae* (Diptera), see(page, 116–117)

Fig.(10)

Mean percentage distribution of the invertebrate groups over the sampling sites on both canals.



S. U. C. = Shropshire Union Canal.

Sites (1&2)	Silt, stones and mainly black organic mud.
" (3)	Silt, stones and little of black orgnic mud.
" (4)	Stones, little of silt and black orgnic mud and mainly hard clay.
" (5)	Mixture of soft clay and black organic mud.

Ll. C. = LIANGOIIEN CANAL.

Site (6)	Mostly sand and stones.
" (7)	Silt, stones and mainly black orgnic mud.
" (8)	Gravel, sand and little of black organic mud.

It is difficult to isolate the effects of different factors. Egglishaw (1964) found that the microdistribution of most species of invertebrates had a positive correlation with organic detritus in the substrate, (page, 116–117)The amount of detritus settling out of the water being dependent on the current speed, making it difficult to isolate the influence of each single factor. This research, however, confirms the finding of Cummins and Lauff (1969) and Lillehammer (1966) that substrate composition is possibly the most important single factor affecting the microdistribution of invertebrates in the running waters, (see pages, 116&117) .

Seasonal variations in the number of the invertebrates found in both canals was related to their life-cycle features. Physical and chemical factors (temperature, pH and total hardness "calcium and magnesium concentrations") influence the seasonal occurrence, (page,117)

The discussion of these factors is interpreted in the light of the work of previous authors. Each factor will be considered and discussed.

7.2.1 Nature of the Bottom

The nature of the bottom plays a primary role in determining the distribution of the invertebrate (mainly bottom fauna and shore fauna) species, Percival and Whitehead (1929, 1930), Linduska (1942), Spurles (1947), Berg (1948), Jones (1950), Armitage (1958, 1961), Throup (1966) and Cummins and Lauff (1969).

Cummins and Lauff (1969) found in "the influence of substrate particle size on the distribution of river benthos" that substrate composition was the primary factor in the habitat selection of

Oligochaetes (Naididae), Diptera (Chironomidae larvae). The same thing can be said of those species found in this work.

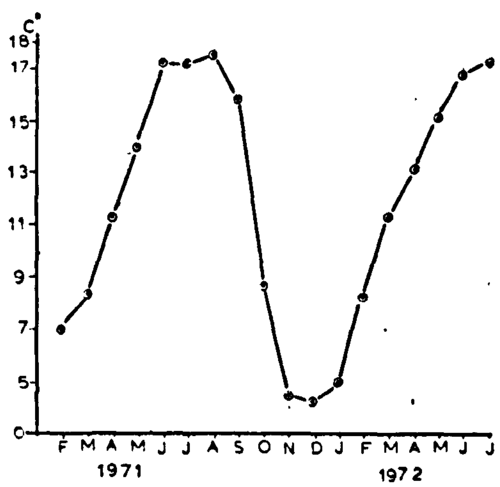
The Oligochaeta (Naididae H. naidina, P. longiseta, P. menoni, and P. idrensis) show an increased occurrence at those sites 1 and 2 on the Shropshire Union Canal, and site 7 on the Llangollen Canal where there is more organic mud than at any other sites,(pages, 11& 12). The great increase at those sites during the winter months, Tables 41-55 and Figures 2-8,10,was an effect of detritus and natural pollution caused by the accumulation of fallen leaves in the canal which act as an attraction by decomposing to black organic mud on which these animals depend for their food (Egglishaw (1964) and Maitland (1966)) see(page, 45), and Figures 2-8.

One expects a high percentage of Chironomid larvae at sites dominated by fine particles (mainly clay and organic mud), Cummins and Lauff (1969) and Edward (1973). In this work the Diptera (Chironomid larvae) show a preference type of distribution, with high percentage at site 4 on the Shropshire Union Canal and site 7 on the Llangollen Canal where the bottom is covered mainly by clay and organic mud,(pages 12,14)and(Figures 2-8 &10).

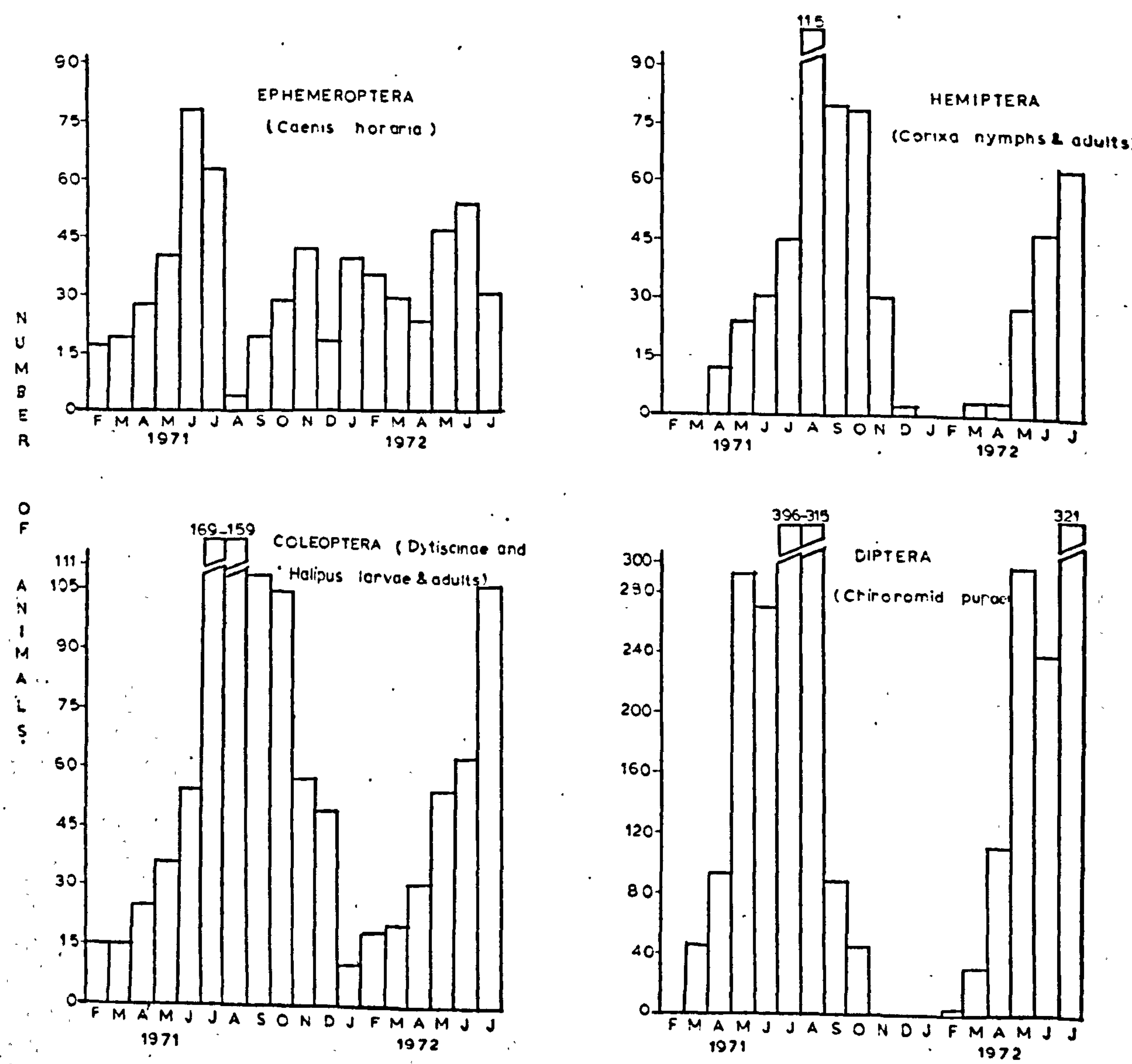
The Ephemeroptera (Caenis horaria) also shows an increased occurrence at site 4 on the Shropshire Union Canal,(Figure, 10). This seems to be related to the fine substrate of this site (mainly clay and organic mud),(see page, 12). Percival and Whitehead (1929) and Moon (1939) reported that Caenis occurs most commonly on the bottoms with very small particles.

Geldiay (1956) noted the relationship of the solid surfaces and stones and presence of Gastropoda living on it. In this work the

FIG.(11) Water Temperature (C°) - (all sites average)



Total numbers of the invertebrate groups or species taken every month from all sites of both canals.



Gastropods (P. jenkinsi and P. confusa show an obvious abundance at site 3 on the Shropshire Union Canal (Figure, 10). This is a response to the substrate at this site (mainly silt and stones, page, 12). A substrate type particularly followed by the species.

7.2.2 Seasonal Changes

Seasonal quantitative changes in all species are mainly due to their life cycles. It was observed that the major increase or decrease in the numbers of most species were related to their life cycles. Different species complete their development one after another and appear or disappear from the samples at intervals throughout the year.

It is well known that the most obvious factor controlling the life cycles is temperature and it is well-established that low temperatures decrease the growth rates of many animals. Life-histories of Ephemeroptera, Crustacea, Coleoptera, Trichoptera and Hemiptera change from place to place and throughout the year and many of these changes are related to temperature (Pleskot (1958 and 1961) Elliott (1967b) and Macan (1970)). Also temperature acts indirectly through its effects on times of egg-hatching and times of emergence (Macan (1957) (1960) and Elliott (1972)) making different species or groups more available in the samples at different times of the year.

Similarly, observations in the Shropshire Union Canal and the Llangollen Canal indicate that the life-histories of many species or groups differed in each year, Figures 2-8&11). This was due to different prevailing temperature regimes, and the recorded monthly temperatures show the normal seasonal variations, Tables 63-70 and(Figure, 1&11)

Ephemeroptera (Caenis horaria), (Figure, 11) , this common species of Ephemeroptera occurred all year round at site 4 on the Shropshire Union Canal with maximum numbers during summer. Elliott (1967) also found an increasing abundance of this species with increasing temperature from spring until summer followed by very low occurrence in winter.

Hemiptera (Corixa nymphs and adults) (Figure, 11), were collected in most monthly samples from sites 1 and 2 on the Shropshire Union Canal. They show an increased abundance at these two sites in summer time, though this does seem to be related to change in temperature. Minckley (1963) reported the abundance of Hemiptera during the summer in slow waters.

Coleoptera (Dytiscinae and Haliplus larvae and adults) varied greatly with the site involved as shown in Table 20 and (pages 58-102) The orders distribution from May until August (Figure, 11), show that the numbers of Coleoptera increased with temperature increase. Percival and Whitehead (1929) and Egglishaw (1964) state that it is interesting to note that as summer water temperature increased so did the occurrence of the Coleoptera, similarly as temperature fell in autumn, so the occurrence decreased.

Diptera (Chironomid pupae) (Figure, 11) seasonal occurrence showed a clear high abundance during the summer and almost complete absence during the winter. These high abundances were found to be at all sites on both canals, inferring that the seasonal temperature changes are the only factors controlling Chironomid pupae distribution.

From the study of the geographical distribution of the Crustacean zooplankton in both canals, it may be seen that any species of Crustacean zooplankton may behave differently in different sites, and that various sites may have different Crustacean zooplankton. As discussed on(page,112),many factors affect the life of any Crustacean zooplankton organisms, but still the main control is undoubtedly temperature. Temperature influences the formation of the resting eggs in the autumn and their hatching in the spring. It controls the rate of reproduction both directly by increasing or decreasing the metabolic rate and indirectly by affecting the production of phytoplankton on which Crustacean zooplankton live on,(pages,111&112)Thomas (1959) found that the resting eggs are produced in the autumn by several species such as Bosmina longirostris, Daphnia hyalina and many Cyclops species, these eggs sink to the bottom of the water and come to rest on mud. Under natural conditions resting eggs remain quiescent until the spring, and then when the water reaches a certain temperature (usually 8-9^{o}C) they begin to hatch, this is shown in the Ph.D. thesis of M.P. Thomas, University of Liverpool.

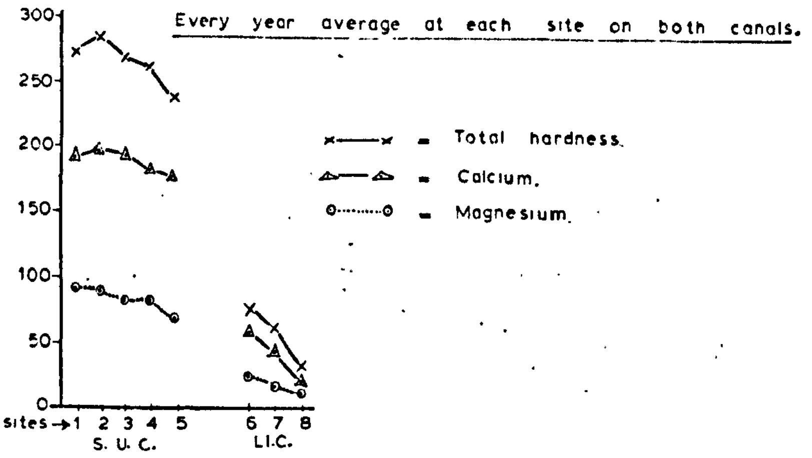
Thomas (1959) noted also that high temperature may be directly favourable to Crustacean zooplankton life in other ways. The higher the temperature, the higher the metabolic rate and the extra activity of the animal. The decrease in viscosity with the increase in temperature would allow the animal greater ease of movement through the water. It would be difficult to determine the relative importance of these two phenomena in this work.

In this work the distribution of Crustacean zooplankton species along the Shropshire Union Canal and the Llangollen Canal shown in Tables 56-62 and described on(pages,83-94) Summer samples of each year at each site on both canals contained the maximum number of species.

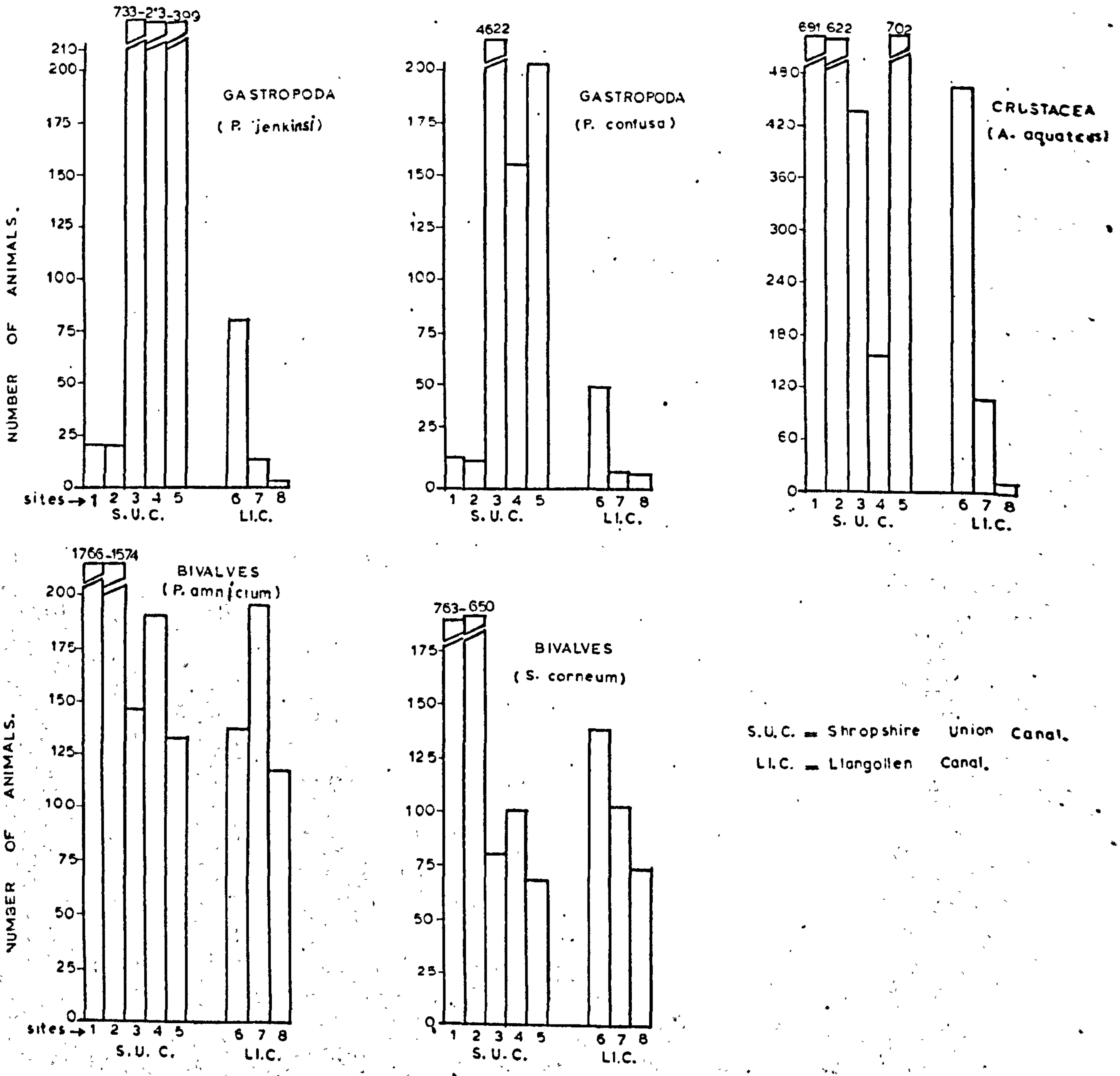
FIG. (12)

Total hardness, Calcium and Magnesium concentrations (p.p.m.).

Every year average at each site on both canals.



Total numbers of the invertebrate species taken from each site on both canals.



Tables 56-62 show a very clear seasonal distribution linked to temperature change.

The flow is another local condition which played an important part in the absence of the Crustacean zooplankton at site 8 on the Llangollen Canal. At this site no Crustacean zooplankton were recorded throughout the sampling period, as the Llangollen Canal draws from the River Dee and the Crustacean zooplankton can not become established at this site because of the rapid flow of the canal water at this point and the inability of Crustacean zooplankton to swim against it. The flow in all other sites of both canals is almost constant (0.5-0.7 feet/sec).

7.2.3 Total Hardness

Water hardness appears definitely to be of some importance in affecting distribution although it should be stated at the outset that even this often remains to be proved (Hynes (1954), Illies (1952b) Maitland (1956b) and Dittmar (1953)).

It is perhaps appropriate, therefore, first to consider how water hardness might affect animals. Very few freshwater animals are completely watertight, so most of them have problems with osmotic pressure, which they overcome by various combinations of three physiological devices (Beadle (1957)). These are absorption of salts from the water, the production of urine and lowering of the osmotic pressure of their body fluids and hence a lessening of the tendency of the water to enter. To live in very soft water, therefore, demands very efficient osmo-regulation and animals which do not produce hypotonic urine (e.g., river-crab - "Potamon" would not be expected in soft waters and do not, in fact, occur there (Beadle (1957)). Although this species was not found here, however, it is an example.

On all occasions it was found that the Shropshire Union Canal sites had a higher total hardness value (Calcium and Magnesium) than the Llangollen Canal sites, this was consistent with higher pH recorded too (Tables 63-69 and Figure 1).

In the Shropshire Union Canal the hardness was consistent with the pH, and it was noted that it differed slightly from site 1 to site 5, Tables 63-69. While in the Llangollen Canal it was found that there was an increase in the hardness gradients as the water passed down from Llantysilio site 8 to Hurleston junction, site 6, it became harder, Tables 63-69. This hardness increase was predominantly calcium, which may be derived from the lime stone used in the construction of the canal, (Boycott and Oldham (1939) and Twigg (1959)).

Many Crustacea and Mollusca secrete shells of calcium carbonate so one expects them to be confined to waters where these are readily obtained (Clarke and Berg (1959), Reynoldson (1961), Slack (1955) and Edwards (1973)).

In(Figures,2-8&12)it can be seen that Asellus aquaticus (Crustacea), P. jenkinsiand P. confusa (Gastropoda) and P. amnicium and S. corneum (Bivalves), show an increased abundance at the Shropshire Union Canal with higher total hardness over the Llangollen Canal with lower hardness.

Calcium not only affects the efficiency of osmo-regulation, but it has also been shown for groups as the Oligochaeta and fishes, that both it and magnesium affect the rate of respiration. Both ions raise respiratory rates at low temperatures, (Schlieper et al, (1952)). It can be expected, therefore, that the Shropshire Union Canal has more Oligochaetes than the Llangollen Canal and it was true, Tables, 41-55, and (Figures, 2-8 & 12).

Many groups (insecta - Diptera larvae, (Grenier (1949) and Hall (1960)) Ephemeroptera (Illies (1952)), Trichoptera (Macan (1957, 1961a)) Coleoptera (Berthelemy (1966)) Amphipoda "Gammarus" (Hynes (1954)) and Leeches (Macan (1955)), seen to be quite indifferent to water hardness. The same applies to the findings in this work, by recording these groups in sufficient numbers at all sites on the Shropshire Union Canal and the Llangollen Canal, Tables, 41-55, and (Figures, 2-8)

It is generally a valid assumption that the higher the concentration of salt ions (nutrients) dissolved in water, the larger will be the standing crop of phytoplankton, and as a result of this the larger the number of the Crustacean zooplankton. (A low concentration of dissolved salts will only allow a small growth of phytoplankton and the amount of available food will be too small to support large numbers of Crustacean zooplankton (Thomas (1959)).

Tables 56-62 show that the Crustacean zooplankton are more abundant in all the Shropshire Union Canal sites, where it contains more calcium and magnesium and it is far less in the Llangollen Canal sites where it has less concentration of these ions.

We can conclude, therefore, that water hardness is a controlling factor in the ecology of at least some canal invertebrates, but that very often we have little idea as to how it operates and that we need much more detailed studies in the future.

7.2.4 Oxygen

Oxygen is rarely a factor in the ecology of invertebrates in shallow waters, such as canals because it hardly ever drops to a low level. It falls to very low levels only under one condition "continuous ice-cover for long periods". In the two canals this condition did not happen during the period of the investigation. This condition appears to be almost unstudied from the viewpoint of invertebrate ecology, although it is known to have some influence on fishes in Northern Siberia (Mosevich (1947) and Mossewitch (1961)).

In polluted waters, on the other hand, lack of oxygen can be of great importance, but this is outside the scope of this work and the reader is referred to Hynes (1960) for further information.

The results obtained from this section of the project were somewhat disappointing, for although the results showed a maximum and minimum dissolved oxygen concentration, the difference between these two was slight, Tables 63-70 and Figure 1.

In both the Shropshire Union Canal and the Llangollen Canal, on the other hand, lack of oxygen can not be of any importance, because as can be seen from Tables 63-69, it does not drop to a low level at any site.

8. CONCLUSION AND RECOMMENDATION

Applying a rather simple technique for collecting and sorting the bottom fauna, shore fauna and Crustacean zooplankton samples, the invertebrate fauna results of the Shropshire Union Canal and the Llangollen Canal provided a clear picture of the animal community structures in given sites, (page,43).

The quantitative distribution in the invertebrate fauna and the life cycles of particular species were examined monthly at given sites, and attempts were made to correlate this distribution with chemical and physical composition of the two canals waters (nature of bottom, temperature, total hardness and oxygen).

The Oligochaeta (Naididae), Diptera (Chironomid larvae), Ephemeroptera (*Caenis horaria*) and Gastropoda (*P. jenkinsi* and *P. confusa*) showed an increased abundance at certain sites on both canals. This abundance being correlated to the kind of bottom, (page,115).

Seasonal fluctuations in the invertebrate fauna are associated with changes of physical conditions in the water of the two canals. Variation in the water temperature throughout the year, however, may act directly or indirectly, making different organisms available at certain times of the year. Crustacean zooplankton, Hemiptera, Coleoptera, Ephemeroptera and Crustacea show a direct linear relationship with the changing of temperature,(page, 117).

Water chemistry was found to have some effect on the distribution of the invertebrates such as Bivalves, Gastropoda and Crustacean zooplankton,(page, 120).

Lack of oxygen can not be of any importance, because it does not drop to a very low level at any site on both canals,(page, 123).

Only Crustacean zooplankton showed a direct relationship with changing current velocity, where it was absent at site 8 on the Llangollen Canal and were found in large numbers at other sites on both canals,(page 120).

The number of species and individuals in the Shropshire Union Canal were greater than in the Llangollen Canal. This was due partly to the substrate composition. Other causes were active too, among these "total hardness calcium and magnesium contents in the water".

Since the limiting of physical and chemical factors have so radical an effect on the canal invertebrate fauna, they seem to deserve a much greater interest. It is desirable that detailed investigations of these factors be made and also a clearer picture of the structure of the animal community be obtained.

Since quantitative investigations in themselves, owing to collection, sorting, counting and identification, require much time-consuming work, and since intensive investigations of the environment also demand considerable chemical and physiological knowledge, future research if it is to hold out any prospect of finding new information of caşual nature, must evidently be carried out with the co-operation of several people with different qualifications, i.e., confining themselves to a single or to a few problems. There is some danger in concentrating attention on single species before a general ecological picture of the habitat has been obtained, but such study involving careful observation and attention to detail, can bring to light points which would be missed in a broader survey.

There are few areas left which have not been affectedto some degree by the activities of man. The Shropshire Union and the Llangollen Canals are no exception and man has influenced the ecology of most habitats in some way. His influence on them, especially in connection with the use of the water, construction of tunnels and locks, affect the canal and its biology.

As far as pollution is concerned, the worst dangers in the canal were the effect of running boats, especially when the depth is low, which may have an effect on the animals. Also clearing and repairing the canal by removal of sediments from the bottom must have an effect on animals as it takes time to build a new suitable substrate in which the fauna can recover. So the increase of use of the two canals in the future with increase of clearing and repairing may have an effect on the bottom fauna.

It would be possible to detect the effect of these points on the composition and the density of invertebrate fauna at both canals.

9. SUMMARY

I. The introduction deals first with the purpose for undertaking this study, and previous work on the subject is mentioned. The physical and historical background of the Shropshire Union Canal and the Llangollen Canal are briefly described, with short comments on the state of repair, flow and nature of the bottom.

II. Five sites on the Shropshire Union Canal and three sites on the Llangollen Canal were selected as shown in the map,(pages, 11-17) Bottom fauna, shore fauna and Crustacean zooplankton samples were taken monthly at each site over two years for bottom fauna and Crustacean zooplankton and 18 months for shore fauna.

III. The methods used during the investigation period from the two canals are discussed in detail in the method section.

IV. Species of animals were identified as far as possible, and counted from these sites, classified lists and graphs were completed. Studies of fauna populations were mainly descriptive in results in detail.

V. The selected sites are compared and contrasted in terms of their physical and chemical characters and their animal population.

VI. Monthly water samples were collected at the sampling sites, and analysed for total hardness, calcium and magnesium.

VII. Temperature, pH and oxygen concentration at each sampling site were recorded in the field.

VIII. The results reveal the structure of the whole invertebrate fauna at each site on the two canals. It is desirable that in order to confirm the consistency of this structure sampling, so an investigation to the physical and chemical factors be made and probably made a clearer picture to the structure of the animal community.

IX. Great quantitative changes were observed in the distribution of Ephemeroptera, Diptera, Trichoptera, Coleoptera, Hemiptera and Gastropoda along the two canals. The Oligochaeta and Diptera (Chironomid larvae) were most abundant at the two canals, this correlated to the kind of substrate.

X. The present work or account, therefore, is intended to be no more than an introduction - and it is hoped a stimulus to future work in an area where natural studies are important and valuable.

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12. APPENDIX

TABLES	41-48	Lists of Bottom Fauna Invertebrates Collected by the Dredge.
TABLES	49-55	Lists of Shore Fauna Invertebrates Collected by the Hand-Net.
TABLES	56-62	Lists of Crustacean Zooplankton.
TABLES	63-70	Analysis of Chemical and Physical Factors.

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No 41 The identity, size and number of invertebrate fauna (collected by the dredge) from site No.1, on the Shropshire Union Canal.

Species or groups	Size in mm	21 Aug	20 Sep	23 Oct	24 Nov	21 Dec	26 Jan	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																									
Homochaeta naidina	3-10	85	105	93	389	366	309	312	93	56	42	95	42	43	79	55	311	281	274	255	137	70	70	100	143
"	> 10	15	28	12	48	51	57	85	25	21	19	40	27	27	56	48	126	136	82	125	34	20	28	47	25
Pristina longiseta	3-10	16	22	30	20	27	19	11	6	2	3	4	5	22	33	37	20	26	14	8	4	4	3	7	12
"	> 10	4	8	7	14	14	8	4	5	2	3	3	7	13	24	25	14	11	17	6	4	5	3	8	14
Pristina menoni	3-10	15	20	26	34	25	49	15	8	7	8	14	22	43	69	100	35	42	44	13	8	14	9	15	23
"	> 10	5	4	11	15	13	17	7	3	5	5	7	18	33	49	60	14	21	22	7	12	15	7	13	12
Pristina idrensis	3-10	34	55	29	34	27	26	35	7	5	5	11	15	41	70	124	30	31	26	29	21	18	12	17	14
"	> 10	8	12	13	18	11	13	22	4	4	2	6	13	20	52	80	22	13	13	22	16	18	9	10	14
Stylodrilus heringianus	> 20	3	4	1	2	-	-	2	1	1	-	-	-	-	1	-	2	3	-	1	-	-	-	-	-
Tubificidae	> 15	4	7	6	10	6	7	3	4	-	2	-	2	10	7	4	12	5	7	8	2	10	3	16	9
CRUSTACEA																									
Asellus aquaticus	< 5	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	2	1	-	1	-	1	1	-	-
"	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
HIRUDINEA																									
Glossiphonia hetrochita	5-10	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glossiphonia complanata	5-10	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Hemiclepsis marginata	5-10	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Erpobdella octoculata	5-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
DIPTERA																									
Chironomidae larvae	5	4	27	34	50	48	32	4	6	5	30	34	8	13	8	14	30	14	10	8	6	4	16	16	15
"	5-10	16	20	10	10	15	17	3	3	3	14	14	7	3	5	10	16	7	17	6	9	12	14	16	13
"	10-22	6	17	3	5	3	10	7	1	-	5	4	3	1	3	4	10	7	15	2	13	9	4	5	1
Chironomidae pupae	3-10	6	4	-	-	-	-	1	1	1	4	-	-	-	-	-	-	-	-	-	1	1	2	2	-
TRICHOPTERA																									
Homocentropus picicornis	3- 5	-	2	-	1	1	-	4	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
COLEOPTERA																									
Halipus larvae	5-12	3	6	-	2	1	-	-	-	-	-	-	-	-	2	5	-	-	-	-	-	-	-	-	-
Dytiscinae larvae	5-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
GASTROPODA																									
Potamopyrgus jenkinsi (with keel)	2- 3	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Potamopyrgus jenkinsi (without keel)	2- 3	2	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-	-
Pseudamnicola confusa	2- 3	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Valvata macrostoma	2- 5	-	-	1	1	3	2	-	1	-	-	2	-	-	-	-	-	1	1	1	2	-	-	1	-
Valvata piscinalis	2- 5	-	-	3	-	1	-	-	3	-	2	-	-	-	1	-	1	-	-	2	-	-	1	1	-
Zonitoides nitidus	3- 8	2	-	2	3	2	2	1	-	1	-	2	2	2	-	2	2	2	-	3	1	2	-	-	-
Viviparus viviparus	< 10	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Theodoxus fluviatilis	3- 5	1	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lymnaea glabra	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-
Acroloxus lacustris	3- 5	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	1	-	-	-	-	-
Succinea putris	3- 7	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Planorbis corneus	5-10	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	1	3	3	-	-
Bithynia tentaculata	2- 5	-	-	-	-	2	-	1	-	-	1	1	1	-	-	1	-	-	-	1	-	-	-	1	1
Bithynia leachi	3- 5	-	-	-	-	-	-	-	-	-	-	3	2	-	1	1	1	1	1	-	-	1	-	-	-
LAMELLIBRANCHIA																									
Pisidium amnicum	< 5	6	18	10	12	20	18	19	18	15	9	12	18	4	10	15	9	17	13	18	17	30	18	14	8
"	>5-15	-	2	2	1	3	2	2	1	-	3	-	-	-	-	-	-	1	-	-	3	1	-	-	-
Sphaerium corneum	< 5	5	7	7	5	13	6	11	8	8	4	6	12	2	5	7	5	9	8	6	10	12	12	8	3
"	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dreissena polymorpha	< 5	-	3	7	3	10	2	1	-	1	1	3	4	1	2	2	1	4	-	3	3	2	1	1	1
"	5-17	2	2	5	7	3	3	-	-	2	2	1	2	1	2	3	-	1	1	2	1	2	1	-	1
NEMATODA	5-20	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No 42 The identity, size and number of invertetrate fauna (collected by the dredge) from site No.2, on the Shropshire Union Canal.

Species or groups	Size in mm	21 Aug	20 Sep	23 Oct	24 Nov	21 Dec	26 Jan	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																									
Homochaeta naidina	3-10	70	115	108	411	204	271	351	34	85	98	133	106	29	63	87	323	198	172	275	135	79	87	147	105
"	> 10	8	42	21	77	83	36	66	19	45	47	69	57	20	53	38	150	82	70	126	31	76	31	57	58
Pristina longiseta	3-10	10	16	22	23	20	18	5	1	2	4	7	9	15	52	34	21	17	12	5	1	3	5	11	18
"	> 10	5	10	12	12	13	6	3	2	-	3	3	5	7	32	20	14	11	12	4	3	6	4	7	14
Pristina menoni	3-10	19	25	23	38	20	20	26	5	8	7	18	23	20	66	91	47	36	23	23	16	20	12	13	26
"	> 10	4	7	14	22	7	9	10	4	4	12	7	16	16	39	36	23	14	7	9	14	17	12	14	22
Pristina idrensis	3-10	39	39	36	54	20	18	27	3	8	3	17	20	21	64	117	48	23	14	17	17	12	17	13	20
"	> 10	10	12	12	25	12	7	7	2	2	2	16	12	13	58	104	31	17	11	12	9	18	13	15	21
Stylodrilus heringianus	> 20	-	3	-	1	2	-	2	-	1	-	-	2	-	-	-	2	4	-	2	1	-	-	-	2
Lumbriculus varigatus	> 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Tubificidae	> 15	6	9	8	12	9	4	8	-	1	7	2	2	11	10	9	8	4	4	8	7	4	2	19	15
Eiseniella tetraedra	> 25	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRUSTACEA																									
Asellus aquaticus	< 5	-	2	-	1	-	-	1	-	-	-	-	-	-	-	-	2	-	1	1	-	1	-	-	-
"	> 5	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-
HIRUDINEA																									
Glossophonia hetrochita	5-10	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Glossophonia complanata	5-10	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
DIPTERA																									
Chironomides larvae	< 5	7	24	20	28	35	22	13	13	10	25	43	8	12	6	11	24	10	18	20	12	12	15	14	15
"	5-10	20	29	6	17	8	20	14	10	8	15	25	5	4	5	10	10	4	5	13	8	8	12	12	13
"	10-22	6	6	2	8	2	10	10	-	2	5	10	4	1	5	2	2	2	1	4	10	12	1	4	4
Chironomidae pupae	3-10	8	3	-	-	-	-	-	1	2	6	1	1	1	-	-	-	-	-	-	-	2	-	-	-
Chaoborus larvae		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
TRICHOPTERA																									
Homocentropus picicornis	3- 5	-	6	1	5	1	-	4	5	3	2	-	2	-	-	-	3	1	-	-	-	-	-	-	-
COLEOPTERA																									
Halipus larvae	5-12	-	-	-	3	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
HEMIPTERA																									
Corixa adults	8-12	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ODONATA																									
Damsel fly (naiad)	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA																									
Potamopyrgus jenkensi (with keel)	2- 3	3	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Potamopyrgus jenkensi (without keel)	2- 3	4	-	-	1	1	-	2	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Pseudamnicola confusa	2- 3	1	-	-	2	1	-	3	-	-	-	-	1	1	-	-	-	1	-	-	-	-	1	-	-
Valvata macrostoma	2- 5	-	-	-	-	1	1	1	-	1	-	2	-	-	2	-	-	1	-	1	1	-	-	1	1
Valvata piscinalis	2- 5	-	-	1	-	2	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	1	-	-
Zonitoides nitidus	3- 8	1	3	4	4	1	2	-	2	1	2	3	4	-	2	3	3	2	-	2	-	2	-	-	-
Theodoxus fluviatilis	3- 5	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Lymnaea glabra	3- 5	-	-	1	-	-	-	-	-	-	-	1	-	2	-	1	-	-	-	-	-	-	-	-	-
Acroloxus lacustris	3- 5	-	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Succinea putris	3- 7	-	2	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	-	1	1	-	-
Planorbis corneus	5-10	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
Bithynia tentaculata	2- 5	-	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1	1	-	-	-	-	1	2	-
Lymnea peregra	3- 5	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Bithynia leachi	3- 5	-	-	-	-	-	-	-	-	-	-	2	1	-	2	1	1	-	-	-	-	-	-	-	-
LAMELLIBRANCHIA																									
Pisidium amnicum	<5	10	12	13	20	14	13	21	15	4	18	10	13	4	8	10	10	12	4	21	14	15	9	10	5
"	>5-15	-	3	2	4	3	2	-	3	2	1	-	-	1	-	1	2	-	-	-	-	-	-	-	-
Sphaerium corneum	<5	6	4	10	7	10	7	10	6	1	10	8	8	2	5	6	4	4	2	7	2	9	6	4	2
"	>5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dreissena polymorpha	<5	1	5	8	2	5	1	5	-	-	3	2	2	2	2	2	3	1	-	1	2	3	3	2	1
"	5-17	4	5	2	3	3	3	1	-	3	1	1	1	1	1	1	1	3	-	2	1	1	1	1	[illegible]
NEMATODA	5-20	-	-	1	1	-	-	-	-	2	-	-	-	-	-	-	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No.43 The identity, size and number of invertebrate fauna (collected by the dredge) from site No.3, on the Shropshire Union Canal.

Species or groups	Size in mm	21 Aug	20 Sep	23 Oct	24 Nov	21 Dec	26 Jan	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	26 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																									
Homochaeta naidina	3-10	77	48	33	74	79	87	322	60	35	62	46	20	25	20	89	102	106	136	250	160	78	106	97	58
"	> 10	8	12	7	41	36	13	84	16	18	62	11	18	16	16	66	52	80	81	142	70	52	63	56	26
Pristina longiseta	3-10	3	3	-	4	1	3	6	-	-	-	-	-	-	2	-	5	2	2	4	-	2	2	1	2
"	> 10	2	1	-	3	1	-	2	-	-	-	-	1	-	1	-	4	-	1	2	1	1	2	1	1
Pristina menoni	3-10	8	4	5	6	2	7	21	2	4	3	1	2	2	1	3	5	6	8	14	16	13	7	6	4
"	> 10	4	3	3	2	1	3	8	-	1	2	1	1	2	1	2	3	3	5	10	7	2	4	2	3
Pristina idrensis	3-10	2	4	4	4	3	8	18	-	2	2	-	1	1	1	4	4	7	7	13	19	10	10	8	6
"	> 10	2	1	3	3	5	5	5	-	1	1	-	1	1	-	3	3	4	6	7	10	7	8	4	4
Stylodrilus heringianus	> 20	4	-	1	-	-	2	4	3	-	-	-	-	-	-	-	1	-	3	3	2	-	-	2	-
Lumbriculus varigatus	> 20	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Tubificidae	> 15	3	2	3	2	1	2	2	2	-	3	-	-	2	10	3	2	6	3	3	7	4	5	10	4
CRUSTACEA																									
Asellus aquaticus	< 5	2	-	1	6	8	2	2	2	-	-	-	-	-	-	1	4	1	-	2	1	1	-	-	-
"	> 5	-	-	-	4	2	2	-	1	-	-	-	-	-	-	-	1	1	2	1	1	-	-	-	-
Gammarus pulex	3-10	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HIRUDINEA																									
Glossophonia hetrochita	5-10	1	-	-	-	2	1	1	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	1
Glossophonia complanata	5-10	-	-	1	2	-	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-
Piscicola geometra	5-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Helobdella stagnalis	5-10	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	2	-	2	1	-
Erpobdella octaculata	5-15	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	1	-	-	1	-	1	-	-
DIPTERA																									
Chironomidae larvae	< 5	42	22	45	71	106	60	68	67	30	11	15	3	13	10	32	110	103	108	33	50	24	13	8	12
"	5-10	22	8	11	54	33	43	62	45	17	5	12	2	2	5	25	45	33	35	26	42	12	10	9	10
"	10-22	8	5	1	36	40	52	43	26	20	4	6	7	1	8	28	30	40	15	32	32	13	7	5	8
Chironomidae pupae	3-10	8	3	-	-	-	-	-	2	2	3	2	-	-	-	1	-	-	-	-	-	-	3	-	2
Ceratopognoidae larvae	5-15	2	1	1	1	4	8	10	-	4	7	-	-	2	2	2	3	2	4	8	2	13	5	-	1
Chaoborus larvae		-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
TRICHOPTERA																									
Homocentropus picicornis	3- 5	6	-	3	16	8	3	3	4	2	-	-	-	-	-	1	5	4	4	-	1	-	-	-	-
Polycentropus flavomaculatus	> 5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glossosma boltoni	5-10	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COLEOPTERA																									
Halipus larvae	5-12	4	1	-	-	2	1	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
HEMIPTERA																									
Nepa cinerca	10-15	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA																									
Potamopyrgus jenkensi (with keel)	2- 3	62	62	60	86	65	74	48	84	50	40	51	35	12	26	32	80	60	72	72	69	60	66	68	89
Potamopyrgus jenkensi (without keel)	2- 3	26	19	18	26	36	21	13	35	20	14	33	10	12	7	10	33	15	15	27	22	21	23	19	29
Pseudamnicola confusa	2- 3	51	38	54	82	74	70	47	112	50	37	82	32	16	20	30	90	52	55	90	52	44	60	62	102
Valvata macrostoma	2- 5	-	-	-	-	-	-	1	-	-	-	2-	-	-	-	-	-	-	-	-	-	-	-	-	1
Valvata piscinalis	2- 5	2	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Zonitoides nitidus	3- 8	-	2	2	5	-	4	-	1	-	-	-	2	-	-	-	2	-	2	1	-	-	-	-	-
Viviparus viviparus	< 10	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
"	> 10	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Theodoxus fluviatilis	3- 5	1	2	-	-	5	-	4	4	3	1	4	3	2	3	2	3	2	2	8	3	4	6	8	5
Lymnae glabra	3- 5	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Acroloxus lacustris	3- 5	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Succinea putris	3- 7	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	4
Planorbis corneus	5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
Bithynia tentaculate	2- 5	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	1	1	-
Lymnea peregra	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4	-
Bithynia leachi	3- 5	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrobia ulvae	3- 5	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	2	-	-	-	2	-
LAMELLIBRANCHIA																									
Pisidium amnicum	< 5	8	5	3	4	4	3	2	6	2	3	6	5	2	-	3	3	2	4	3	2	5	4	2	3
"	>5-15	2	1	-	2	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Sphaerium corneum	< 5	2	-	2	2	2	1	-	2	-	3	5	1	1	-	1	1	1	-	2	-	2	1	-	1
"	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dreissena polymorpha	< 5	-	1	2	-	2	3	4	2	1	4	1	5	2	1	-	1	3	2	-	1	-	3	2	-
"	5-17	1	3	1	-	3	1	1	3	1	2	3	2	1	1	1	4	1	1	-	2	-	2	2	1
NEMATODA	5-20	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1

"CORRECTIONS"

OLIGOCHAETA
Stylodrilus variegatus

HIRUDINEA
Glossiphonia heteroclita
Glossiphonia complanata
Erpobdella octoculata

TRICHOPTERA
Limnephilidae

EPHEMEROPTERA
Ephemerella ignita
Baetis mutinus

COLEOPTERA
Haliplus larvae
Haliplus adults

GASTROPODA
Potamopyrgus jenkinsi (with keel)
Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA
Pisidium amnicium
Anodonta cygnaea
Unio pictorum

TABLE No 44 The identity, size and number of invertebrate fauna (collected by the dredge) from site No.4 on the Shropshire Union Canal.

Species or groups	Size in mm	21 Aug	20 Sep	23 Oct	24 Nov	21 Dec	26 Jan	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																									
Homochaeta naidina	3-10	29	87	152	112	72	125	85	105	75	17	28	4	40	65	31	237	214	360	68	136	140	130	45	34
"	> 10	7	22	17	37	37	79	21	40	45	8	9	2	23	53	17	30	107	130	50	40	54	43	27	22
Pristina longiseta	3-10	-	-	-	2	1	-	1	-	-	-	-	-	-	-	-	2	2	-	2	-	-	-	-	-
"	> 10	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-
Pristina menoni	3-10	-	-	-	2	-	2	1	-	-	-	1	-	-	-	-	2	4	3	1	2	-	-	2	2
"	> 10	-	-	-	1	1	2	2	-	-	-	1	1	-	-	-	1	4	1	2	2	-	-	-	1
Pristina idrensis	3-10	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	2	2	-	-	3	-	2	-
"	> 10	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-
Stylodrilus heringianus	> 20	2	-	1	2	-	-	-	1	-	-	-	-	-	-	-	-	-	1	1	2	-	-	-	-
Tubificidae	> 15	2	5	2	1	2	3	-	-	2	-	-	-	1	5	-	3	2	4	4	3	2	5	2	2
CRUSTACEA																									
Asellus aquaticus	< 5	1	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-	2	1
"	> 5	-	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-
HIRUDINEA																									
Glossophonia complanata	5-10	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Piscicola geometra	5-12	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hemiclepsis marginata	5-10	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-
Erpobdella octaculata	5-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
DIPTERA																									
Chironomides larvae	< 5	42	102	89	7700	8264	4586	4935	2344	1185	945	366	10	230	105	45	7854	8750	3910	3583	2201	2702	660	280	180
"	5-10	22	68	50	118	280	176	161	184	142	45	62	14	85	32	30	180	249	75	223	167	115	49	72	20
"	10-22	8	12	20	221	501	201	94	138	72	33	41	12	60	56	27	25	46	15	48	76	50	24	30	20
Chironomidae pupae	3-10	8	6	-	-	-	-	-	3	3	72	3	-	8	2	1	-	-	-	1	4	8	19	10	-
Ceratopogncidae larvae	5-15	2	3	6	12	14	11	8	23	19	13	4	-	4	5	3	9	13	11	7	15	12	9	5	2
Chaoborus larvae		-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
TRICHOPTERA																									
Homocentropus picicornis	3- 5	6	16	8	69	124	111	133	21	11	29	-	8	14	65	9	48	19	44	92	24	16	2	3	-
Economus tantellus		4	3	2	14	22	22	24	6	4	7	-	-	4	15	3	21	-	16	26	21	20	5	10	1
Polycentropus flavomaculatus	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Limnphilicae	5-15	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
EPHEMEROPTERA																									
Caeris horaria	3- 5	1	15	10	40	110	119	43	26	3	32	3	3	-	13	5	56	32	92	70	41	17	15	14	2
Ephemera ignita	10-25	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baetis muticus	5-10	-	-	-	-	3	4	2	3	-	1	1	-	-	-	-	-	-	-	2	-	-	1	-	-
COLEOPTERA																									
Halipus larvae	5-12	-	-	-	-	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Dytiscinae larvae	5-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
GASTROPODA																									
Potamopyrgus jenkensi (with keel)	2- 3	6	3	-	-	13	6	7	6	4	8	4	1	6	2	4	6	10	4	3	9	5	5	6	4
Potamopyrgus jenkensi (without keel)	2- 3	4	2	-	3	7	3	11	3	2	4	4	2	2	3	3	4	3	3	4	5	2	3	4	3
Pseudamnicola confusa	2- 3	4	3	-	-	10	5	10	12	4	13	6	1	10	3	3	6	15	-	2	4	3	5	5	3
Valvata macrostoma	2- 5	-	-	2	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valvata piscinalis	2- 5	-	-	9	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zonitoides nitidus	3- 8	-	-	4	3	4	2	-	-	1	2	-	2	-	-	-	1	-	-	-	-	-	-	-	-
Viviparus viviparus	< 10	1	2	1	-	1	-	1	2	1	3	1	3	5	1	2	3	1	2	-	2	4	3	2	2
"	> 10	-	1	1	2	3	2	2	-	2	2	-	1	3	1	2	3	-	2	1	1	6	1	3	2
Theodoxus fluviatilis	3- 5	-	-	2	3	-	-	-	-	-	-	-	1	-	-	1	4	-	-	-	-	-	-	-	-
Lymnae glabra	3- 5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acroloxus lacustris	3- 5	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Succinea putris	3- 7	-	-	4	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-
Planorbis corneus	5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Bithynia tentaculata	2- 5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-
Lymnea peregra	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bithynia leachi	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
Hydrobia ulvae	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
LAMELLIBRANCHIA																									
Pisidium amnicum	< 5	8	2	5	7	9	6	5	1	7	3	3	9	8	2	5	10	10	-	3	5	6	4	3	2
"	>5-15	-	3	2	1	1	1	1	2	4	-	2	3	-	2	-	3	2	-	1	1	-	-	-	2
Sphaerium corneum	< 5	5	-	3	3	4	3	3	1	4	1	2	6	4	1	2	6	6	-	-	3	2	2	-	-
"	> 5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dreissena polymorpha	< 5	-	-	3	4	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-
"	5-17	2	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anodonata cygneea	>25	-	1	1	2	2	3	-	1	1	1	-	1	1	1	-	-	-	2	-	-	-	-	-	-
Unio pectroum	>20	-	2	1	1	2	2	-	-	1	2	1	2	2	1	-	-	-	-	-	-	-	-	-	-
NEMATODA	5-20	-	-	1	5	-	1	1	-	-	5	2	2	1	2	2	23	14	16	18	25	26	5	-	2

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No. 45 The identity, size and number of invertebrate fauna (collected by the dredge) from site No.5, on the Shropshire Union Canal.

Species or groups	Size in mm	21 Aug	20 Sep	23 Oct	24 Nov	21 Dec	26 Jan	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																									
Homochaeta naidina	3-10	73	81	79	272	191	275	249	30	75	55	12	9	31	19	21	216	162	310	192	22	19	23	14	18
"	> 10	10	28	27	107	56	92	49	15	45	26	5	5	19	9	6	139	86	119	83	13	14	12	6	16
Pristina longiseta	3-10	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	1	-	-	-	-	-
"	> 10	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-	2	1	-	3	-	-	-	-	-
Pristina menoni	3-10	-	-	2	6	2	-	2	2	-	8	2	4	1	2	1	6	8	10	1	-	1	3	-	-
"	> 10	-	-	1	2	-	-	-	-	-	3	3	1	1	-	-	3	4	6	1	-	-	-	-	-
Pristina idrensis	3-10	-	-	2	4	4	7	-	1	-	5	1	3	-	1	-	4	4	6	1	-	-	2	-	2
"	> 10	-	-	-	3	4	3	1	-	-	2	2	3	-	1	-	2	3	4	2	-	3	2	-	-
Stylodrilus heringianus	> 20	-	1	2	3	1	1	2	1	-	-	1	-	-	-	1	4	3	-	2	-	-	-	-	-
Lumbriculus varigatus	> 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Tubificidae	> 15	3	3	6	7	2	5	2	-	2	1	1	1	1	1	2	-	3	-	1	-	-	3	13	7
Eiseniella tetraedra	> 25	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRUSTACEA																									
Asellus aquaticus	< 5	1	-	-	2	3	1	-	-	-	-	-	-	-	-	-	1	2	-	2	2	-	-	-	-
"	> 5	-	-	-	2	1	3	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Gammarus pulex	3-10	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	1	-	3	-	-	-	-	-
HIRUDINEA																									
Glossophonia hetrochita	5-10	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Glossophonia complanata	5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Piscicola geometra	5-12	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	1	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Erpobdella octaculata	5-15	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIPTERA																									
Ch ironomidae larvae	< 5	18	9	30	420	128	175	90	9	64	13	10	4	7	7	5	301	140	201	130	5	8	10	12	7
"	5-10	12	20	8	35	34	112	48	5	32	4	8	2	2	3	3	133	65	62	23	10	6	3	7	3
"	10-22	9	3	5	10	85	96	36	4	75	7	4	3	1	5	-	32	42	20	3	2	5	2	2	2
Chironomidae pupae	3-10	10	4	-	-	-	-	-	2	2	4	6	-	-	-	-	-	-	-	-	-	2	2	-	-
Ceratopognoidae larvae	5-15	2	1	4	22	6	8	4	-	3	5	-	-	-	-	-	12	4	3	5	-	1	3	-	-
TRICHOPTERA																									
Homocentropus picicornis	3- 5	-	-	-	1	1	7	7	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
Econumus tantellus	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Polycentropus flavomaculatus	> 5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Limnphilidae	5-15	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMEROPTERA																									
Caenis horaria	3- 5	1	-	3	-	21	8	5	-	-	4	1	-	-	-	-	6	3	5	7	2	-	2	-	-
Ephemera ignita	10-25	-	-	-	-	-	2	2	2	-	1	-	-	-	1	1	1	-	1	-	-	-	-	-	-
Baetis muticus	5-10	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
COLEOPTERA																									
Halipus larvae	5-12	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA																									
Potamopyrgus jenkensi (with keel)	2- 3	13	10	-	2	10	10	8	8	4	16	3	12	8	7	5	5	4	5	4	5	2	3	2	5
Potamopyrgus jenkensi (without keel)	2- 3	5	3	2	1	5	6	7	6	6	7	1	8	4	3	3	4	5	2	2	3	1	2	-	2
Pseudamnicola confusa	2- 3	15	7	-	1	9	8	6	8	4	9	4	9	12	6	1	3	6	3	1	5	2	2	1	4
Valvata Macrostoma	2- 5	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valvata piscinalis	2- 5	-	-	10	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zonitoides nitidus	3- 8	-	2	6	3	2	-	-	-	-	1	1	-	-	-	2	1	-	-	-	-	-	-	-	-
Viviparus viviparus	< 10	1	2	1	-	2	1	-	1	1	-	1	-	1	1	2	-	-	1	2	1	1	1	1	-
"	> 10	2	3	1	-	1	2	1	2	1	-	-	1	1	1	1	-	-	-	1	-	2	-	-	2
Theoduxus fluviatilis	3- 5	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lymnee glabra	3- 5	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acroloxus lacustris	3- 5	-	2	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Succinea putris	3- 7	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Planorbis corneus	5-10	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bithynia tentaculata	2- 5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1
Lymnea Peregra	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Bithynia leachi	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
LAMELLIBRANCHIA																									
Pisidium amnicum	< 5	4	2	6	4	3	5	4	5	3	3	-	2	2	1	-	3	2	-	3	2	4	2	1	1
"	5-15	-	1	1	1	1	1	-	1	-	2	1	-	-	-	-	-	-	-	-	2	-	-	-	-
Sphaerium corneum	< 5	1	-	-	3	-	-	3	3	1	1	-	-	-	-	-	1	1	-	1	-	2	-	-	-
"	> 5	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dreissena polymorpha	< 5	-	2	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
"	5-17	-	4	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	1	-
Anodonata cygnaea	> 25	3	2	2	2	2	2	2	2	2	1	2	1	2	2	2	1	1	1	1	1	1	1	1	1
Unio pectroun	> 20	2	2	2	2	3	2	1	1	2	1	1	1	1	2	2	1	1	-	-	-	1	-	1	1
NEMATODA	5-20	-	-	-	1	-	2	1	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No.46 The identity, size and number of invertebrate fauna (collected by the dredge) from site No.6 on the Llangollen Canal.

Species or group	Size in mm	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	61	98	65	126	89	50	109	101	77	58	107	114	56	102	70	61	59	51
" "	> 10	20	39	42	88	72	35	65	78	65	57	60	58	24	96	25	30	27	27
Pristina longiseta	3-10	-	-	-	8	2	-	2	2	1	2	1	-	1	-	-	3	2	-
" "	> 10	1	2	-	4	3	-	-	1	-	1	1	2	-	-	-	1	2	-
Pristina menoni	3-10	3	4	5	9	4	1	7	4	3	5	5	5	2	4	3	1	1	2
" "	> 10	2	3	4	4	3	1	4	2	2	1	5	2	2	2	-	2	2	1
Pristina idrensis	3-10	2	3	4	2	2	1	4	3	1	2	7	8	3	6	4	4	2	-
" "	> 10	3	2	3	3	4	1	1	2	2	2	3	2	2	3	-	1	2	-
Stylodrilus heringianus	> 20	1	4	5	4	2	4	-	3	3	5	3	4	-	2	7	2	1	2
Lumbriculus variegatus	> 20	-	2	2	2	-	-	-	-	1	-	-	1	-	1	2	-	-	-
Tubificidae	> 15	2	3	-	3	3	4	3	5	2	-	3	4	3	5	2	2	1	3,
Eiseniella tetraedra	> 25	-	-	-	6	2	-	-	-	1	2	-	-	-	1	3	3	-	-
CRUSTACEA																			
Asellus aquaticus	< 5	2	-	-	-	-	-	1	-	-	2	1	1	1	-	-	-	-	-
" "	> 5	-	-	-	-	-	-	-	-	-	1	1	-	1	-	1	-	-	-
Gammarus pulex	↳ 3-10	-	-	-	-	3	-	-	-	-	-	4	2	2	1	-	-	-	-
HIRUDINEA																			
Glossophonia heteroclita	5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Glossophonia complanata	5-10	-	1	-	-	1	-	-	-	-	-	-	-	-	1	1	-	-	-
Piscicola geometra	5-12	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	-	-	-	7	1	-	1	-	1	1	-	-	-	2	-	-	1
Erpobdella octaculata	5-15	-	-	-	-	2	-	-	-	-	-	1	1	1	-	-	-	1	1
DIPTERA																			
Chironomidae larvae	< 5	25	31	14	26	6	5	1	3	5	81	70	70	31	40	25	13	6	3
" "	5-10	13	7	12	17	4	3	4	2	3	10	6	20	17	17	14	12	3	4
" "	10-22	2	4	3	3	-	4	-	-	2	4	-	1	10	8	2	1	1	3
Chironomidae pupae	3-10	-	2	1	4	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Ceratopogonidae larvae	5-15	2	2	1	2	-	-	-	-	-	-	-	3	1	1	3	2	-	2
TRICHOPTERA																			
Homocentropus picicornis	3- 5	1	-	-	-	-	-	-	-	-	3	2	-	1	-	-	-	-	-
Economus tenellus	> 5	-	-	-	-	-	-	6	-	-	-	1	-	1	-	-	-	-	-
Limnephilidae	5-15	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
EPHEMEROPTERA																			
Ephemera ignita	10-25	1	8	1	1	-	-	-	2	2	3	1	1	-	3	2	-	-	1
Baetis muticus	5-10	-	4	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-
COLEOPTERA																			
Dytiscinae adults	5-10	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
GASTROPODA																			
Potamopyrgus jenkinsi (with keel)	2- 3	2	3	2	3	-	-	2	-	-	-	1	-	2	-	1	-	-	-
Potamopyrgus jenkinsi (without keel)	2- 3	1	1	4	1	2	-	-	1	-	-	-	-	1	-	-	-	-	-
Pseudamnicola confusa	2- 3	1	4	3	2	-	-	1	-	-	-	-	-	3	-	-	-	-	-
Valvata piscinalis	2- 5	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Viviparus viviparus	< 10	1	-	-	2	1	1	-	1	1	-	1	-	1	1	1	1	2	1
" "	> 10	-	-	-	-	-	1	-	-	1	1	-	-	1	1	-	1	1	1
Lymnaea glabra	3- 5	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Acroloxus lacustris	3- 5	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Succinea putris	3- 7	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Planorbis corneus	5-10	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Bithynia tentaculata	2- 5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Bithynia leachi	3- 5	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
LAMELLIBRANCHIA																			
Pisidium amnicum	5	3	3	4	7	4	4	6	10	-	7	2	4	4	3	8	2	5	4
" "	5-15	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sphaerium corneum	5	2	1	2	4	2	2	4	6	-	3	1	2	2	-	4	-	2	2
Andonata cygnaea	25	1	1	-	2	1	1	1	-	1	1	2	-	1	-	1	1	-	-
Unio pectroum	20	1	-	1	-	1	1	2	-	1	1	2	-	-	1	-	1	-	1

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

Table No. 47 The identity, size and number of invertebrate fauna (collected by the dredge) from site No.7 on the Llangollen Canal.

Species or groups	Size in mm	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	119	102	276	199	62	19	120	48	66	97	222	122	96	92	107	75	120	39
" "	> 10	34	68	189	92	34	10	88	29	30	59	105	60	55	50	60	62	32	18
Pristina lohgiseta	3-10	1	2	5	5	1	-	2	2	-	2	7	1	-	-	3	2	3	2
" "	> 10	2	7	4	3	1	-	1	2	2	-	5	1	2	-	1	1	2	1
Pristina menoni	3-10	4	12	11	12	2	-	5	3	4	3	17	2	5	5	5	4	12	3
" "	> 10	4	7	8	7	3	1	4	2	1	3	6	6	3	2	6	2	6	4
Pristina idrensis	3-10	2	6	12	7	1	2	6	4	4	1	17	4	4	6	10	6	13	4
" "	> 10	6	3	5	4	3	3	3	3	2	2	6	4	4	4	7	4	8	4
Stylodrilus heringianus	> 20	3	5	3	4	3	2	2	4	2	5	4	4	2	8	4	6	4	2
Lumbriculus varigatus	> 20	-	2	-	-	-	1	-	2	-	-	-	2	-	2	-	3	2	1
Tubificidae	> 15	10	2	9	1	2	1	6	2	2	3	5	6	7	2	3	4	3	4
Eisenielle tetradra	> 25	1	-	-	1	-	-	-	3	1	2	-	3	2	-	-	-	1	-
CRUSTACEA																			
Asellus aquaticus	< 5	-	-	-	-	-	-	-	-	1	-	-	2	-	6	-	-	-	-
" "	> 5	-	1	-	-	-	-	-	-	-	-	-	1	-	3	-	-	-	-
Gammarus pulex	3-10	-	-	-	-	-	-	4	-	3	1	5	-	2	9	-	-	-	-
HIRUDINEA																			
Glossophonia hetrochita	5-10	-	1	-	-	-	-	-	-	3	-	-	1	-	1	-	1	1	-
Glossophonia complanata	5-10	1	-	-	-	-	-	-	2	4	-	3	-	1	2	-	-	1	1
Piscicola geometra	5-12	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	3	3	1	-	2	5	3	1	3	-	1	1	2	1	2	2	-
Erpobdella octaculata	5-15	-	-	1	1	-	1	2	5	2	1	1	1	-	2	-	1	1	1
DIPTERA																			
Chironomidae larvae	< 5	65	118	51	7	4	2	15	2	10	84	62	60	57	105	32	20	6	4
" "	5-10	16	90	21	4	2	1	12	3	4	22	36	20	59	70	23	12	3	2
" "	10-22	7	5	30	5	-	1	1	-	-	-	3	-	2	36	12	3	-	1
Chironomidae pupae	3-10	-	1	10	3	1	-	-	-	-	-	-	-	-	4	6	1	3	-
Ceratopognoidae larvae	5-15	-	-	5	3	-	-	-	-	-	1	5	-	3	3	8	4	7	3
TRICHOPTERA																			
Homocentropus picicornis	3- 5	1	1	-	3	-	-	1	1	2	-	-	-	-	-	-	-	-	-
Economus tentellus	> 5	2	1	-	1	-	-	-	-	18	5	2	3	2	18	-	1	-	-
Limnophilidae	5-15	-	3	-	-	1	3	-	-	1	-	-	-	-	5	2	2	-	-
EPHEMEROPTERA																			
Ephemera ignita	10-25	2	1	-	-	-	-	-	-	1	1	-	1	2	-	2	1	2	-
COLEOPTERA																			
Halipus larvae	5-12	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Dytiscinae larvae	5-15	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ODONATA																			
Damsel fly (naiad)	> 10	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
GASTROPODA																			
Potamopyrgus jenkensi (with keel)	2- 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Potamopyrgus jenkensi (without keel)	2- 3	-	-	-	-	1	-	-	4	-	-	-	-	-	-	-	-	-	-
Valvata macrostoma	2- 5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Valvata piscinalis	2- 5	-	-	-	-	-	-	1	-	-	-	1	-	1	-	-	-	-	-
Zonitoides niticus	3- 8	2	3	-	1	-	1	-	2	2	-	-	-	-	-	-	-	-	-
Viviparus viviparus	< 10	1	1	-	1	1	1	3	-	1	1	1	1	3	2	1	1	1	-
" "	> 10	2	-	2	-	1	-	1	-	-	2	2	3	1	3	-	1	2	-
Theodoxus fluviatilis	3- 5	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-
Lymnea glabra	3- 5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-
Acroloxus lacustris	3- 5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Succinea putris	3- 7	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2
Planorbis corneus	5-10	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
Bithynia tentaculata	2- 5	-	-	2	2	1	-	-	-	-	2	-	-	2	-	-	-	2	-
Lymnea peregra	3- 5	-	-	1	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Bithynia leachi	3- 5	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAMELLIBRANCHIA																			
Pisidium amnicum	< 5	4	6	4	13	3	3	7	7	6	10	8	7	7	5	8	10	14	8
" "	5-15	-	-	1	3	4	-	5	5	-	2	-	2	-	-	2	6	7	2
Sphaerium corneum	< 5	2	2	2	7	3	1	3	4	2	6	5	4	4	1	5	-	18	5
" "	> 5	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Dreissena polymorpha	5-17	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-
Anodonata cygnaea	> 25	1	1	2	2	1	1	2	2	2	3	1	-	-	1	-	-	1	-
Unio pectroum	> 20	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No. 48 The identity, size and number of invertebrate fauna (collected by Ekman grab) from site No.8 on the Llangollen Canal.

Species or group	Size in mm	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	123	75	41	31	30	15	64	43	140	107	190	188	110	90	48	92	63	29
" "	> 10	41	24	35	10	22	10	64	35	76	68	138	25	66	85	30	73	41	12
Pristina longiseta	3-10	5	1	2	1	2	2	1	4	6	3	2	3	4	4	-	2	8	4
" "	> 10	2	-	-	1	1	-	-	5	2	1	1	1	3	4	2	1	4	2
Pristina menoni	3-10	19	10	6	5	3	1	7	7	13	10	6	20	15	26	5	18	8	3
" "	> 10	7	5	4	8	4	1	4	5	7	9	9	5	6	18	5	5	4	2
Pristina idrensis	3-10	27	7	4	4	2	5	7	6	13	12	14	23	28	27	13	18	20	8
" "	> 10	18	4	4	3	1	5	5	6	4	12	13	4	17	13	15	7	8	5
Stylodrilus heringianus	> 20	17	18	28	9	9	6	3	12	12	16	23	20	14	65	14	17	8	7
Lumbriculus varigatus	> 20	5	7	5	3	4	2	-	4	6	7	10	7	9	12	6	7	5	3
Tubificidae	> 15	9	1	2	2	4	2	2	2	1	15	13	10	10	15	8	6	6	6
Eiseniella tetrodra	> 25	3	1	1	8	2	3	2	1	3	1	2	5	1	5	3	3	2	1
Peloscolex ferox	> 10	3	1	4	6	10	4	1	3	4	2	5	6	4	3	8	5	4	3
CRUSTACEA																			
Asellus aquaticus	< 5	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Gammarus Pulex	3-10	-	-	-	2	-	-	2	-	-	-	-	-	-	8	-	-	-	-
HIRUDINEA																			
Glossophonia hetrochita	5-10	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1
Glossophonia complanata	5-10	-	1	-	-	-	-	-	-	1	-	-	-	-	1	-	1	-	-
Hemiclepsis marginata	5-10	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Helobdella stagnalis	5-10	-	-	-	1	-	-	1	-	-	-	-	1	1	-	1	3	1	2
Erpobdella octaculata	5-15	1	-	1	-	-	-	-	-	1	-	-	1	-	-	-	1	-	-
DIPTERA																			
Chironomidae larvae	< 5	20	41	10	4	23	10	-	10	20	35	15	24	27	20	7	8	23	12
" "	5-10	17	19	8	4	14	7	7	5	13	25	15	11	17	33	10	12	18	8
" "	10-22	4	2	1	-	3	1	1	4	2	-	2	15	3	12	-	2	-	3
Chironomidae pupae	3-10	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae larvae	5-15	1	3	1	1	-	-	1	-	-	-	-	1	-	2	-	3	5	-
TRICHOPTERA																			
Holocentropus picicornis	3-5	-	1	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-
Polycentropus flavomaculatus	> 5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Limnephilidae	5-15	3	3	3	6	1	-	-	1	3	-	-	-	2	15	1	5	-	-
Glossoma boltoni	5-10	-	-	-	-	-	-	-	-	1	-	-	-	-	5	-	-	-	-
EPHEMEROPTERA																			
Caenis lar	3-5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baetis muticus	5-10	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA																			
Potamopyrgus jenkensi (without keel)	2-3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudamnicola confusa	2-3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valvata macrostoma	2-5	-	-	-	2	-	-	2	-	-	-	2	-	-	-	-	-	-	-
Valvata piscinalis	2-5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Zonitoides nitidus	3-8	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-
Viviparus viviparus	< 10	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Theodoxus fluviatilis	3-5	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Succinea putris	3-7	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Planorbis corneus	5-10	-	-	-	-	1	-	-	-	-	1	2	-	-	-	-	-	-	-
Planorbis planorbis	3-5	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-	1
Bithynia tentaculata	2-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Lymnea peregra	3-5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Bithynia leachi	3-5	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Hydrobia ulvae	3-5	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
LAMELLIBRANCHIA																			
Pisidium amnicum	< 5	18	23	14	14	8	9	4	7	15	7	6	7	14	12	14	31	24	13
" "	5-15	4	12	2	3	4	3	2	4	3	7	7	3	3	4	6	15	7	4
Sphaerium corneum	< 5	9	13	13	8	4	4	3	3	7	5	2	4	7	8	9	14	15	7
" "	> 5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No. 49 The identity, size and number of invertebrate fauna (collected by hand-net), from site No.1 on the Shropshire Union Canal

Species or group	Size in mm	1971 24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	1972 24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	[illegible] Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	120	82	94	64	31	29	24	23	110	65	139	125	106	88	83	45	32	41
" "	> 10	65	43	31	30	18	16	26	60	47	25	74	42	60	64	23	21	13	24
Pristina longiseta	3-10	9	4	4	6	13	11	16	8	15	17	65	20	20	20	14	14	10	15
" "	> 10	7	7	3	3	7	3	8	13	15	15	31	32	11	8	10	6	9	12
Pristina menoni	3-10	25	16	12	14	23	23	28	15	22	58	70	68	24	21	24	20	21	38
" "	> 10	12	9	7	10	12	24	18	20	16	31	38	47	23	18	12	14	22	22
Pristina idrensis	3-10	34	21	11	5	23	20	23	24	22	52	107	130	36	30	16	16	27	20
" "	> 10	15	10	4	6	18	13	25	31	23	32	60	87	31	20	11	5	22	14
Stylodrilus heringianus	> 20	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lumbriculus varigatus	> 20	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Tubificidae	> 15	4	3	1	1	4	4	8	6	4	6	12	10	7	5	4	3	4	6
Eiseniella tetradra	> 25	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CRUSTACEA																			
Asellus aquaticus	< 5	10	8	10	7	11	12	30	88	94	43	27	20	20	20	16	10	18	44
" "	> 5	7	4	5	3	6	6	14	20	26	12	12	7	14	8	10	5	13	21
Gammarus pulex	3-10	-	-	4	-	3	14	11	6	2	3	-	1	-	-	3	-	4	10
HIRUDINEA																			
Glossophonia complanata	5-10	2	-	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-	-
Helobdella stagnalis	5-10	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIPTERA																			
Chironomidae larvae	< 5	14	25	59	105	415	359	338	185	63	35	20	10	13	25	55	60	410	426
" "	5-10	6	10	20	43	78	170	58	55	62	36	22	24	12	18	23	45	240	150
" "	10-22	3	-	-	4	10	4	20	53	18	16	27	8	10	14	5	5	14	25
Chironomidae pupae	3-10	-	8	12	26	41	89	84	10	6	1	-	-	-	4	15	24	52	95
Ceratopognoidae larvae	5-15	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRICHOPTERA																			
Homocentropus picicornis	3- 5	24	15	12	2	-	-	-	-	1	2	3	4	12	10	3	2	-	-
EPHEMEROPTERA																			
Caenis horaria	3- 5	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Baetis muticus	5-10	-	-	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
COLEOPTERA																			
Halipus larvae	5-12	3	5	5	3	7	3	13	52	30	17	6	2	3	4	4	2	4	-
Halipus adults	4- 5	-	-	-	3	7	32	36	4	2	-	-	-	-	-	2	8	7	40
Dytiscinae larvae	5-15	-	-	-	-	-	-	3	1	-	-	-	-	-	1	-	-	2	5
Dytiscinae adults	5-10	-	-	2	3	2	-	2	2	1	-	1	-	1	-	2	2	4	-
HEMIPTERA																			
Corixa adults	8-12	-	-	4	10	10	18	20	39	36	13	1	-	-	1	-	5	8	6
Corixa nymphs	5- 7	-	-	2	3	6	5	12	16	9	-	-	-	-	-	-	5	10	27
Notonecta adults	10-13	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
ODONATA																			
Damsel fly (naiad)	> 10	-	-	-	-	3	-	18	24	14	1	1	-	2	-	-	1	4	1
GASTROPODA																			
Potamopyrgus jenkensi (with keel)	2- 3	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Potamopyrgus jenkensi (without keel)	2- 3	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Valvata macrostoma	2- 5	-	-	-	-	-	1	-	-	-	-	-	2	2	-	1	-	-	3
Valvata piscinalis	2- 5	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Zonitoides nitidus	3- 8	1	1	-	-	1	3	1	-	1	1	-	-	2	2	-	-	-	-
Theodoxus fluviatilis	3- 5	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Lymnaea glabra	3- 5	1	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-
Acroloxus lacustris	3- 5	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Succinea putris	3- 7	-	-	-	-	2	-	-	1	-	-	1	-	-	1	-	-	3	-
Planorbis corneus	5-10	-	-	-	-	-	1	3	1	-	-	-	-	-	-	-	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	3	5	4	1	-	2	-	-	-	-	-	-	2
Bithynia tentaculata	2- 5	-	-	-	-	-	2	-	-	1	1	1	-	-	-	-	-	1	1
Lymnea peregra	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Hydrobia ulvae	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
LAMELLIBRANCHIA																		1	1
Pisidium amnicum	5	24	32	33	57	60	178	60	74	78	107	60	44	40	42	35	61	100	289
" "	5-15	-	-	2	6	5	4	-	-	3	2	-	-	-	-	-	1	-	-
Sphaerium corneum	5	11	17	12	23	36	85	24	29	35	40	23	17	24	10	15	23	40	60
Dreissena polymorpha	5	4	3	4	3	3	2	3	2	1	6	3	3	1	3	3	2	2	4
" "	5-17	6	6	6	2	2	4	3	2	3	3	2	2	-	2	2	1	3	3

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No. 50 The identity, size and number of invertebrate fauna collected by the hand-net from site No.2 on the Shropshire Union Canal

Species or group	Size in mm	1971 24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	1972 24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	110	65	78	73	35	22	20	34	142	76	181	115	112	106	105	45	29	28
" "	> 10	54	29	41	33	20	34	40	34	37	52	88	39	81	86	40	29	27	26
Pristina longiseta	3-10	8	6	4	5	8	12	13	13	12	30	45	26	22	20	19	14	10	10
" "	> 10	4	4	2	3	7	6	8	17	8	14	27	45	10	15	10	5	13	14
Pristina menoni	3-10	17	10	12	12	27	29	28	25	24	72	74	67	20	21	21	24	20	41
" "	> 10	11	13	8	10	13	18	17	20	20	32	65	51	17	12	14	10	24	28
Pristina idrensis	3-10	26	9	11	7	29	20	19	24	22	96	120	128	39	30	22	10	24	24
" "	> 10	12	12	6	7	20	14	26	23	15	35	87	75	15	12	10	8	23	14
Stylodrilus heringianus	> 20	-	-	-	-	-	1	-	2	2	3	-	-	-	-	-	-	-	-
Tubificidae	> 15	3	3	2	3	3	3	8	6	2	4	15	9	6	4	6	4	6	7
CRUSTACEA																			
Asellus aquaticus	> 5	12	7	12	6	13	13	32	70	101	37	26	19	18	15	12	13	15	40
" "	> 5	4	3	4	4	6	5	12	17	15	8	6	13	8	5	7	7	10	14
Gammarus pulex	3-10	-	-	2	-	2	9	8	7	-	3	2	-	-	-	1	-	2	6
HIRUDINEA																			
Glossophonia hetrochita	5-10	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Piscicola geometra	5-12	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-
Erpobdella octaculata	5-15	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
DIPTERA																			
Chironomidae larvae	5	13	28	48	[illegible]	5	350	259	100	75	45	30	15	6	20	31	80	340	245
" "	5-10	7	8	41	57	67	61	112	35	23	12	23	21	11	13	25	62	156	178
" "	10-22	-	-	-	5	12	6	13	22	14	5	15	18	18	10	6	12	39	81
Chironomidae pupae	3-10	-	6	19	30	56	108	95	12	8	2	-	-	1	5	10	25	31	80
Ceratopogonidae larvae	5-15	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Tipulidae larvae	5- 7	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
TRICHOPTERA																			
Holocentropus picicornis	3- 5	5	17	8	1	-	2	-	1	2	6	6	8	18	13	4	-	-	-
EPHEMEROPTERA																			
Caenis horaria	3- 5	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-
Ephemera danica	10-25	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Baetis muticus	5-10	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	1	-
COLEOPTERA																			
Haliplus larvae	5-12	2	2	5	2	4	1	16	26	22	20	16	3	2	3	3	-	6	-
Haliplus adults	4- 5	-	-	-	2	7	25	24	10	4	-	-	-	-	-	-	6	4	25
Dytiscinae larvae	5-15	-	1	-	-	-	-	-	2	4	-	-	1	-	-	2	-	-	-
Dytiscinae adults	5-10	-	-	1	4	1	3	4	12	3	-	-	-	1	-	-	2	3	-
HEMIPTERA																			
Corixa adults	8-12	-	-	5	6	6	10	36	50	43	17	1	1	-	2	1	3	16	6
Corixa nymphs	5- 7	-	-	2	3	4	7	12	17	9	-	-	-	-	-	-	10	10	16
Notonecta adults	10-13	-	-	-	-	1	-	-	4	1	-	-	-	-	-	-	3	-	-
ODONATA																			
Damsel fly (naiad)	> 10	-	-	-	-	-	-	3	14	8	3	1	1	-	-	-	1	4	1
GASTROPODA																			
Potamopyrgus jenkensi (with keel)	2- 3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Potamopyrgus jenkensi (without keel)	2- 3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Pseudamnicola confusa	2- 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Valvata macrostoma	2- 5	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	1
Valvata piscinalis	2- 5	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-
Zonitoides nitidus	3- 8	1	1	-	-	1	1	1	-	2	1	2	-	2	-	2	-	-	2
Theodoxus fluviatilis	3- 5	-	-	-	2	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Lymnea glabra	3- 5	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Succinea putris	3- 7	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-	-	-	-
Planorbis corneus	5-10	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	5	3	1	-	-	-	-	-	-	-	2	-	-
Bithynia tentaculata	2- 5	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	2	-
Lymnea peregra	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	4
Bithynia leachi	3- 5	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-
LAMELLIBRANCHIA																			
Pisidium amnicum	< 5	22	35	34	87	69	164	55	90	75	90	53	28	25	34	43	82	79	150
" "	5-15	2	-	5	10	4	5	-	1	-	3	-	-	-	3	-	-	-	1
Sphaerium corneum	< 5	8	23	10	30	35	22	28	35	33	44	18	18	14	18	20	41	20	71
" "	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dreissena polymorpha	< 5	5	3	7	3	6	3	1	2	2	4	3	1	2	5	1	5	3	-
" "	5-17	5	1	8	2	4	3	2	7	2	2	1	1	1	3	-	5	2	1
NEMATODA	5-20	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No. 51 The identity, size and number of invertebrate fauna (collected by the hand-net) from site No.3 on the Shropshire Union Canal

Species or group	Size in mm	1971 24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	1972 24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	20	23	21	26	9	13	10	12	14	19	36	20	25	31	24	17	7	20
" "	> 10	21	17	23	22	14	20	11	17	13	18	23	15	20	23	10	12	8	18
Pristina longiseta	3-10	1	-	-	-	-	-	-	-	1	-	2	-	-	1	-	-	-	-
" "	> 10	-	-	-	1	2	-	-	2	-	2	1	-	-	1	-	1	-	2
Pristina menoni	3-10	4	-	1	1	1	1	1	-	2	1	3	4	1	1	1	1	1	3
" "	> 10	2	2	1	1	2	1	-	3	-	1	1	1	3	1	-	1	1	1
Pristina idrensis	3-10	1	-	-	-	-	-	1	3	2	1	2	2	-	2	-	1	-	-
" "	> 10	3	-	1	2	1	-	2	1	1	4	2	4	-	-	2	2	1	2
Stylodrilus heringianus	> 20	2	3	-	-	1	-	-	-	-	-	2	-	1	1	1	-	-	-
Tubificidae	> 15	3	2	1	2	-	-	1	2	2	2	1	3	5	3	1	1	1	-
CRUSTACEA																			
Asellus aquaticus	< 5	10	4	1	5	10	10	16	12	17	29	21	15	12	6	5	5	8	12
" "	> 5	5	3	-	3	4	5	8	6	6	14	5	8	5	4	2	3	4	8
Gammarus pulex	3-10	16	12	15	19	28	32	54	45	30	25	12	17	16	14	17	24	36	43
HIRUDINEA																			
Glossophonia hetrochita	5-10	-	-	-	-	-	-	1	1	1	-	-	-	-	1	1	1	-	-
Glossophonia complanata	5-10	1	1	-	-	-	-	-	-	3	-	2	-	1	-	-	-	-	1
Piscicola geometra	5-12	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Hemiclepsis marginata	5-10	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	-	-	-	-	-	3	-	1	-	-	1	-	-	-	-	-	1
Erpobdella octaculata	5-15	2	-	-	-	-	-	3	5	2	3	-	-	1	-	-	-	-	-
DIPTERA																			
Chironomidae larvae	< 5	63	113	112	110	284	231	361	148	78	47	30	40	82	120	110	140	119	146
" "	5-10	40	37	29	67	201	100	207	92	54	31	25	35	15	67	75	60	85	123
" "	10-22	-	28	14	4	18	23	10	24	15	15	14	13	8	18	13	5	5	12
" pupae	3-10	-	3	6	18	31	45	34	25	10	-	-	-	-	2	21	35	32	37
Ceratopognoidae larvae	5-15	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Chaoborus larvae		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
TRICHOPTERA																			
Homocentropus picicornis	3-5	13	3	-	1	1	2	-	-	3	2	4	4	2	1	2	-	-	1
Polycentropus flavomaculatus	> 5	6	-	-	-	-	-	1	-	-	C	0	0	-	-	-	-	-	-
Limnphilidae	5-15	10	10	9	1	-	-	-	-	-	1	3	6	7	7	5	2	1	-
EPHEMEROPTERA																			
Caenis horaria	3- 5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Ephemera ignita	10-25	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Baetis muticus	5-10	-	-	-	-	1	1	1	1	1	1	2	-	-	-	-	-	1	2
COLEOPTERA																			
Haliplus larvae	5-12	2	1	2	-	6	2	8	10	8	6	7	1	2	3	1	1	3	2
Haliplus adults	4- 5	-	-	-	-	3	6	4	3	2	2	-	-	-	-	-	1	1	5
Dytiscinae larvae	5-15	-	-	-	-	-	1	3	6	8	6	5	-	2	1	-	-	-	-
Dytiscinae adults	5-10	-	1	-	-	-	-	1	1	1	1	1	-	-	-	-	-	1	-
HEMIPTERA																			
Corixa adults	8-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Corixa nymphs	5- 7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
GASTROPODA																			
Potamopyrgus jenkensi (with keel)	2- 3	216	188	222	213	326	209	217	129	158	76	55	39	171	265	253	255	380	182
Potamopyrgus jenkensi (without keel)	2- 3	112	98	109	45	129	63	46	41	55	28	14	12	56	102	88	125	170	70
Pseudamnicola confusa	2- 3	163	153	128	257	336	164	223	131	162	95	45	40	114	197	280	280	270	162
Valvata macrostoma	2- 5	-	-	1	4	-	-	-	-	1	-	2	2	-	-	-	-	-	-
Valvata piscinalis	2- 5	-	2	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-
Zonitoides nitidus	3- 8	10	20	12	2	7	2	4	4	4	2	2	-	-	-	-	-	-	-
Viviparus viviparus	< 10	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
" "	> 10	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Theodoxus fluviatilis	3- 5	8	25	12	10	6	7	13	12	15	4	1	8	10	12	21	19	10	5
Lymnae glabra	3- 5	7	-	-	2	-	-	3	10	4	8	-	-	-	2	-	2	-	-
Acroloxus lacustris	3- 5	-	-	1	-	-	-	-	-	-	1	-	-	5	-	-	-	-	-
Succinea putris	3- 7	-	-	-	-	2	1	-	6	2	-	1	-	4	2	-	2	-	-
Planorbis corneus	5-10	-	-	-	3	-	-	-	-	-	-	-	4	10	1	4	1	-	2
Planorbis planorbis	3- 5	-	-	-	1	-	-	-	-	-	1	-	8	6	3	15	3	-	2
Bithynia tentaculata	2- 5	1	-	-	-	-	-	-	-	1	-	-	1	6	4	3	2	3	2
Lymnea peregra	3- 5	-	5	-	-	-	-	-	2	-	-	2	2	15	5	-	4	-	2
Bithynia leachi	3- 5	-	-	-	-	-	-	-	-	-	-	-	1	3	1	1	-	1	-
Hydrobia ulvae	3- 5	-	2	-	-	-	-	-	-	-	-	-	-	2	1	8	2	1	-
LAMELLIBRANCHIA																			
Pisidium amnicum	< 5	1	4	3	4	2	1	6	8	10	3	1	-	4	4	2	3	2	2
" "	>5-15	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Sphaerium corneum	< 5	1	-	1	-	1	1	4	1	2	-	2	-	2	1	3	-	-	-
" "	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dreissena polymorpha	< 5	1	1	1	-	1	-	-	5	2	1	-	-	-	-	-	-	-	-
" "	5-17	1	1	3	2	1	1	2	3	1	-	-	-	1	-	-	3	1	1
Anodonata cygneea	> 25	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	2	1	-
NEMATODA	5-20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No. 52 The identity, size and number of invertebrate fauna (collected by the hand-net) from site No.4 on the Shropshire Union Canal

Species or groups	Size in mm	1971 24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	1972 24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	40	18	8	5	6	12	17	52	38	65	80	115	52	50	62	50	21	14
" "	> 10	20	12	6	4	5	4	10	37	39	27	60	35	20	33	30	25	17	14
Pristina longiseta	3-10	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
" "	> 10	2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-
Pristina menoni	3-10	1	-	1	1	3	-	-	-	-	1	-	1	-	1	-	-	1	-
" "	> 10	1	-	-	-	2	-	-	-	-	2	1	1	1	-	-	-	2	1
Pristina idrensis	3-10	1	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
" "	> 10	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Stylodrilus heringianus	> 20	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Tubificidae	> 15	1	1	-	1	1	-	2	-	-	-	3	4	1	2	2	2	2	4
CRUSTACEA																			
Asellus aquaticus	< 5	4	6	3	3	8	12	12	7	4	2	-	2	3	8	4	4	7	6
" "	> 5	2	2	1	4	4	3	6	3	2	-	-	-	1	4	2	3	6	4
Gammarus pulex	3-10	-	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	2
HIRUDINEA																			
Glossophonia complanata	5-10	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Piscicola geometra	5-12	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-
Hemiclepsis marginata	5-10	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-
Erpobdella octaculata	5-15	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
DIPTERA																			
Chironomidae larvae	< 5	101	885	196	540	434	507	206	397	120	120	164	259	105	240	536	435	330	270
" "	5-10	64	60	110	42	170	239	135	162	91	60	98	30	35	135	45	72	160	120
" "	10-22	24	43	58	17	33	67	21	20	37	16	32	17	12	30	15	10	85	60
Chironomidae pupae	3-10	-	4	8	20	58	64	46	12	8	-	-	-	-	-	17	28	40	57
Ceratopogonidae larvae	5-15	3	9	8	5	2	-	2	3	1	2	4	4	2	6	4	3	2	1
TRICHOPTERA																			
Homocentropus picicornis	3- 5	27	33	19	12	27	19	14	29	40	25	29	29	10	13	4	9	3	3
Economus tentellus	> 5	-	-	-	-	-	-	-	10	13	10	18	10	5	9	3	4	3	5
EPHEMEROPTERA																			
Coenis horaria	3- 5	22	18	12	-	62	8	4	18	24	30	52	32	23	24	19	30	45	16
Ephemera ignita	10-25	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Baetis muticus	5-10	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
COLEOPTERA																			
Halipus larvae	5-12	-	-	-	2	-	1	-	3	-	1	-	-	-	-	-	-	-	-
Halipus adults	4- 5	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
Dytiscinae larvae	5-15	-	-	-	-	-	-	1	3	2	1	1	-	-	-	-	2	1	2
Dytiscinae adults	5-10	-	-	-	-	2	-	3	1	1	-	6	-	-	-	1	-	1	-
HEMIPTERA																			
Nepa cinerca	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Corixa adults	8-12	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-
ODONATA																			
Damsel fly (naiad)	> 10	-	-	-	-	-	-	12	10	-	-	-	-	-	6	-	4	-	1
GASTROPODA																			
Potamopyrgus jenkensi (with keel)	2- 3	-	2	3	2	2	-	2	-	1	2	2	-	4	4	4	2	2	5
Potamopyrgus jenkensi (without keel)	2- 3	-	1	1	1	2	1	2	2	1	1	3	-	3	5	1	1	2	3
Pseudamnicola confusa	2- 3	1	1	2	1	5	-	1	1	1	2	2	-	1	-	2	4	1	6
Zonitoides nitidus	3- 8	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Viviparus viviparus	< 10	-	-	1	3	3	2	2	-	-	-	-	1	-	-	1	-	3	-
" "	> 10	-	1	2	1	1	2	1	1	-	-	-	2	-	-	-	-	2	-
Lymnea glabra	3- 5	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Succinea putris	3- 7	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	2	-
Planorbis corneus	5-10	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Planorbis planorbis	3- 5	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-
Bithynia tentaculata	2- 5	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-
Lymnea peregra	3- 5	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
LAMELLIBRANCHIA																			
Pisidium amnicum	< 5	1	1	3	1	2	-	6	-	2	2	2	4	3	-	4	2	5	1
" "	>5-15	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	2	1	1
Sphaerium corneum	< 5	1	-	1	-	1	1	3	-	-	1	-	2	1	-	2	1	3	-
Dreissena polymorpha	< 5	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
" "	5-17	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Anodonata cygraea	> 25	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Unio pectroum	> 20	-	-	-	1	1	-	1	1	-	-	-	-	-	-	1	-	-	-
NEMATODA	5-20	-	-	1	1	-	4	-	-	1	9	12	5	5	10	-	4	4	3

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No. 53 The identity, size and number of the invertebrate fauna (collected by the hand-net) from site No.5 on the Shropshire Union Canal

Species or group	Size in mm	24 Feb 1971	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan 1972	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	106	63	47	20	3	2	12	21	16	41	48	27	82	37	40	3	13	13
" "	> 10	25	33	13	37	6	4	8	18	15	26	28	19	58	30	47	20	18	6
Pristina longiseta	3-10	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
" "	> 10	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-
Pristina menoni	3-10	-	4	-	-	-	-	-	2	-	1	2	2	-	-	-	-	-	-
" "	> 10	1	1	-	-	-	-	-	-	-	2	1	2	-	2	-	-	1	-
Pristina idrensis	3-10	1	3	2	1	-	-	2	2	-	2	2	2	-	-	-	-	1	-
" "	> 10	1	-	1	-	-	-	1	2	2	1	-	-	1	1	-	-	1	-
Stylodrilus heringianus	> 20	1	1	-	-	-	-	1	1	1	1	2	-	1	-	1	-	-	-
Lumbriculus varigatus	> 20	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-
Tubificidae	> 15	-	-	-	1	1	1	-	-	-	2	3	-	1	2	1	1	2	2
Eiseniella tetrodra	> 25	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CRUSTACEA																			
Asellus aquaticus	< 5	8	10	10	20	39	29	69	61	41	34	31	15	17	17	14	10	32	23
" "	> 5	7	6	3	15	21	17	15	12	24	11	9	10	7	8	8	3	12	11
Gammarus pulex	3-10	9	12	14	19	35	95	84	49	55	32	29	4	27	18	45	26	42	72
HIRUDINEA																			
Glossophonia hetrochita	5-10	-	-	-	-	-	1	-	2	1	-	-	-	1	-	-	-	2	-
Glossophonia complanata	5-10	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	1	-
Piscicola geometra	5-12	2	-	-	-	-	-	1	1	-	-	1	-	-	1	-	-	-	-
Hemiclepsis marginata	5-10	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	1	-	1	2	1	-	-	-	-	-	1	-	-	1	-	1	1
Erpobdella octaculata	5-15	-	3	2	-	1	-	2	1	1	1	1	1	-	1	1	1	-	-
DIPTERA																			
Chironomidae larvae	< 5	41	34	42	140	335	205	225	47	67	35	43	28	12	15	129	152	193	157
" "	5-10	30	56	75	90	145	155	119	39	26	15	15	12	19	25	86	70	114	45
" "	10-22	10	125	83	33	9	18	27	45	30	6	5	10	15	12	6	5	54	19
Chironomidae pupae	3-10	-	10	18	75	50	47	24	10	4	-	-	-	-	-	125	120	65	45
Ceratopogonidae larvae	5-15	1	3	1	2	-	-	-	-	-	1	-	2	1	2	-	4	1	-
TRICHOPTERA																			
Homocentropus picicornis	3- 5	6	3	8	3	1	3	1	-	3	4	3	4	4	1	1	-	1	2
Econonus tentellus	> 5	-	-	-	-	-	-	-	-	-	-	3	2	5	3	-	-	-	-
Polycentropus flavomaculatus	> 5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Limnphilidae	5-15	-	-	-	-	1	-	-	-	-	2	1	6	2	9	6	1	-	-
EPHEMEROPTERA																			
Caenis horaria	3- 5	6	1	5	40	16	3	-	3	4	10	12	6	9	4	4	16	5	4
Ephemera ignita	10-25	3	7	1	1	-	1	-	-	2	-	-	-	-	-	-	-	-	-
Baetis muticus	5-10	-	-	-	-	-	-	-	-	3	-	2	-	-	-	-	1	-	-
COLEOPTERA																			
Halipus larvae	5-12	2	1	-	-	-	10	3	-	1	1	-	1	1	2	-	-	3	2
Halipus adults	4- 5	1	-	-	-	-	3	5	8	2	-	-	-	-	1	4	8	2	-
Dytiscinae larvae	5-15	-	2	-	-	4	-	-	1	2	-	-	-	-	-	-	1	1	2
Dytiscinae adults	5-10	-	-	3	5	1	3	3	4	1	-	2	-	2	-	3	9	4	1
HEMIPTERA																			
Nepa cinerca	10-15	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-
Corixa adults	8-12	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	1	-	-
Corixa nymphs	5- 7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Notonecta adults	10-13	-	-	-	-	-	-	1	-	1	-	-	-	-	1	-	3	-	-
ODONATA																			
Damsel fly (naiad)	> 10	-	-	-	12	1	1	1	1	10	-	-	1	3	-	3	-	2	1
GASTROPODA																			
Potamopyrgus jenkensi (with keel)	2-3	4	6	6	21	12	3	3	6	3	3	8	6	4	5	5	10	7	8
Potamopyrgus jenkensi (without keel)	2-3	2	2	3	5	9	2	2	4	-	1	3	2	-	1	2	3	5	7
Pseudamnicola confusa	2-3	4	1	4	12	4	5	4	3	-	2	5	4	1	3	4	6	9	6
Valvata piscinalis	2-5	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zonitoides nitidus	3-8	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Viviparus viviparus	10	-	-	2	-	7	4	2	2	-	-	-	-	-	-	-	-	2	-
" "	10	1	-	3	2	2	2	-	1	-	-	-	-	1	-	2	2	1	2
Theodoxus fluviatilis	3-5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	3	-	1
Lymnae glabra	3-5	2	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-
Succinea putris	3-7	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Planorbis corneus	5-10	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-
Planorbis planorbis	3-5	-	1	-	-	-	-	-	1	-	-	-	-	1	-	-	2	-	-
Bithynia tentaculata	2-5	2	3	-	-	-	-	10	-	-	-	-	-	-	-	-	1	-	-
Lymnea peregra	3-5	-	-	-	4	-	1	-	2	-	2	1	1	2	6	2	3	-	-
Bithynia leachi	3-5	-	-	-	-	-	-	2	-	-	-	1	2	1	-	-	-	-	-
Hydrobia ulvae	3-5	-	-	-	2	1	2	-	4	-	-	2	-	-	3	1	-	-	-
LAMELLIBRANCHIA																			
Pisidium amnicum	< 5	3	3	3	3	-	4	6	8	5	-	4	-	1	5	4	3	2	4
" "	>5-15	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Sphaerium corneum	< 5	1	1	2	2	2	3	4	3	3	-	2	-	-	3	1	-	-	-
" "	5-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anodonata cygnaea	> 25	-	1	1	1	2	-	-	2	-	1	-	-	-	-	-	-	1	-
Unio pectroum	> 20	-	2	-	2	2	-	-	1	-	2	-	-	-	-	-	-	1	-
NEMATODA	5-20	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	1

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complanata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No. 54 The identity, size and number of invertebrate fauna (collected by the hand-net) from site No.6 on the Llangollen Canal

Species or groups	Size in mm	1971 24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	1972 24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	2[illegible] Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	8	10	6	6	3	1	2	2	10	10	14	12	12	7	8	3	2	4
" "	> 10	7	4	4	4	4	2	2	2	5	6	4	8	50	5	7	2	1	2
Pristina longiseta	3-10	2	-	-	-	2	-	3	2	1	1	2	2	2	2	-	2	-	1
" "	> 10	1	2	1	4	2	1	2	1	1	1	2	2	2	1	2	2	3	1
Pristina menoni	3-10	2	1	4	5	1	2	6	4	3	5	4	2	1	2	1	2	2	2
" "	> 10	2	2	2	5	3	1	6	3	2	3	6	5	1	2	2	4	1	2
Pristina idrensis	3-10	3	-	3	-	2	3	2	3	2	2	4	3	3	4	5	1	2	2
" "	> 10	3	4	1	2	2	-	2	2	1	2	2	2	2	2	2	1	2	1
Stylodrilus heringianus	> 20	3	-	2	1	2	1	2	3	-	-	-	2	2	1	-	3	-	2
Lumbriculus varigatus	> 20	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
Tubificidae	> 15	-	1	1	1	-	2	2	2	2	1	2	-	2	2	3	2	2	2
Eiseniella tetradra	> 25	-	2	-	1	-	-	-	-	-	-	-	2	-	-	-	1	-	-
CRUSTACEA																			
Asellus aquaticus	< 5	10	14	10	19	25	27	49	24	27	20	10	10	10	12	7	12	19	20
" "	> 5	6	3	8	7	10	13	19	14	4	7	8	3	5	4	6	5	9	13
Gammarus pulex	3-10	46	64	74	74	110	389	313	195	172	64	41	35	54	79	87	64	150	249
HIRUDINEA																			
Glossophonia hetrochita	5-10	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-
Glossophonia complaneta	5-10	1	-	-	-	-	-	1	1	-	-	-	-	-	-	1	-	2	1
Piscicola geometra	5-12	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Hemiclepsis marginata	5-10	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Helobdella stagnalis	5-10	-	1	-	-	-	-	1	1	1	-	-	-	-	-	1	1	-	-
Erpobdella octaculata	5-15	1	-	2	2	1	2	3	1	-	1	1	-	1	-	-	-	1	-
DIPTERA																			
Chironomidae larvae	< 5	6	7	10	8	30	54	20	20	13	10	50	10	4	7	12	16	33	40
" "	5-10	2	3	7	10	17	35	38	18	14	13	25	5	4	4	3	8	24	20
" "	10-22	-	-	-	-	-	-	4	11	-	-	-	-	-	-	-	-	-	11
Chironomidae pupae	3-10	-	1	4	8	6	10	5	4	2	-	-	-	-	9	3	15	6	12
Ceratopognoidae larvae	5-15	-	-	1	1	-	-	-	-	-	-	-	-	-	-	1	-	2	-
Tipulidae larvae	5- 7	-	2	-	-	-	-	-	-	2	-	4	3	-	2	-	-	-	-
TRICHOPTERA																			
Homocentropus picicornis	3- 5	-	-	-	8	15	1	1	-	4	2	-	-	-	-	-	-	-	-
Economus tentellus	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Polycentropus flavomaculatus	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Limnphilidae	5-15	163	126	36	15	3	14	7	3	-	51	145	150	192	132	44	37	9	5
EPHEMEROPTERA																			
Caenis horaria	3- 5	-	-	-	14	1	-	-	-	-	-	-	-	-	-	-	2	3	-
Ephemera ignita	10-25	-	-	-	-	3	1	-	2	1	1	1	-	-	-	-	-	1	1
Baetis muticus	5-10	-	-	-	-	-	2	1	-	-	2	1	1	-	-	1	-	-	-
COLEOPTERA																			
Halipus larvae	5-12	-	-	-	-	-	3	4	-	-	-	-	1	-	-	-	1	-	4
Halipus adults	4- 5	-	1	-	-	-	8	8	3	5	-	-	-	-	1	4	4	3	-
Dytiscinae larvae	5-15	-	-	-	1	-	2	2	2	3	-	1	-	-	-	-	-	-	-
Dytiscinae adults	5-10	-	-	4	5	8	3	4	8	2	-	-	1	1	-	-	-	7	5
HEMIPTERA																			
Corixa adults	8-12	1	-	-	-	-	-	-	-	1	-	-	-	1	1	1	-	-	-
Corixa nymphs	5- 7	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Notonecta adults	10-13	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
ODONATA																			
Damsel fly (naiad)	> 10	-	-	-	-	-	2	2	1	-	-	-	-	-	-	-	-	-	-
GASTROPODA																			
Potamopyrgus jenkensi (with keel)	2- 3	-	-	1	2	3	8	8	6	4	5	-	2	-	-	6	-	6	-
Potamopyrgus jenkensi (without keel)	2- 3	3	3	4	4	3	4	7	4	4	3	-	5	2	2	2	-	4	1
Pseudamnicola confusa	2- 3	-	-	3	2	2	6	8	2	3	-	-	-	-	-	1	-	7	-
Valvata Macrostoma	2- 5	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Valvata piscinalis	2- 5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zonitoides nitidus	3- 8	-	-	-	1	2	1	3	-	3	-	-	-	-	-	-	-	2	-
Viviparus viviparus	< 10	-	1	-	1	2	5	-	-	-	1	1	-	-	-	-	1	1	1
" "	> 10	-	-	1	4	-	2	-	-	-	-	1	-	-	-	-	1	-	1
Theodoxus fluviatilis	3- 5	-	-	-	-	-	-	-	-	-	7	-	-	-	2	1	-	-	2
Lymnae glabra	3- 5	3	-	-	-	-	1	-	-	10	-	-	-	-	-	1	-	-	-
Acroloxus lacustris	3- 5	-	-	-	6	10	-	-	-	-	-	1	-	-	-	1	-	-	-
Succinea putris	3- 7	1	1	-	-	-	-	10	9	3	-	-	-	2	-	-	-	1	2
Planorbis corneus	5-10	3	3	-	-	-	12	-	-	-	1	-	1	1	2	3	2	-	-
Planorbis planorbis	3- 5	5	-	1	1	2	-	-	-	-	2	2	5	5	-	-	-	1	-
Bithynia tentaculata	2- 5	1	-	-	-	-	-	4	1	2	2	1	-	-	4	-	2	1	2
Lymnea peregra	3- 5	-	4	-	-	-	-	2	-	-	-	2	4	6	-	-	1	-	-
Bithynia leachi	3- 5	-	-	-	-	-	2	1	-	-	-	1	-	-	-	-	-	-	-
Hydrobia ulvae	3- 5	1	-	-	-	-	-	1	-	-	-	-	-	2	-	1	-	-	-
LAMELLIBRANCHIA																			
Pisidium amnicum	< 5	2	1	2	1	2	3	2	-	-	-	2	2	3	3	-	2	2	9
" "	>5-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Sphaerium corneum	< 5	1	1	-	1	1	2	1	1	-	-	-	1	1	2	-	-	-	5
Anodonata cygnaea	>25	-	-	1	-	-	-	-	-	1	1	-	-	-	1	-	-	-	-
Unio pectroum	>20	-	2	1	-	-	-	-	3	1	-	-	-	-	1	1	2	1	-
NEMATODA	5-20	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

"CORRECTIONS"

OLIGOCHAETA

Stylodrilus variegatus

HIRUDINEA

Glossiphonia heteroclita

Glossiphonia complenata

Erpobdella octoculata

TRICHOPTERA

Limnephilidae

EPHEMEROPTERA

Ephemerella ignita

Baetis mutinus

COLEOPTERA

Haliplus larvae

Haliplus adults

GASTROPODA

Potamopyrgus jenkinsi (with keel)

Potamopyrgus jenkinsi (without keel)

LAMILLIBRANCHIA

Pisidium amnicium

Anodonta cygnaea

Unio pictorum

TABLE No. 55 The identity, size and number of invertebrate fauna (collected by the hand-net) from site No.7 on the Llangollen Canal

		1971											1972						
Species or group	Size in mm	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
OLIGOCHAETA																			
Homochaeta naidina	3-10	90	85	48	26	45	16	54	44	50	80	82	91	6	73	53	50	50	27
" "	> 10	43	46	15	20	20	33	34	46	34	52	38	65	7	47	34	27	32	20
Pristina longiseta	3-10	2	3	5	11	5	2	6	2	2	3	4	4	3	2	5	7	7	5
" "	> 10	2	2	4	7	3	-	2	4	2	1	6	2	3	3	2	5	3	2
Pristina menoni	3-10	4	4	14	15	11	7	10	1	4	6	12	3	8	4	11	17	28	14
" "	> 10	4	6	5	11	11	7	12	4	3	3	10	5	6	6	5	12	10	7
Pristina idrensis	3-10	6	5	4	10	8	6	3	7	7	8	17	14	4	5	13	18	11	9
" "	> 10	2	2	2	8	5	2	7	5	2	9	10	11	5	3	7	11	12	5
Stylodrilus heringianus	> 20	2	2	2	4	4	3	3	2	-	2	2	2	2	3	2	5	3	1
Lumbriculus variegatus	> 20	-	-	-	-	-	-	1	-	-	1	-	4	-	2	-	1	-	1
Tubificidae	> 15	3	2	2	2	2	-	4	2	-	2	6	-	1	1	5	3	4	3
Eiseniella tetraedra	> 25	-	1	-	1	1	3	-	-	-	-	-	-	-	-	1	1	-	1
CRUSTACEA																			
Asellus aquaticus	< 5	3	1	1	3	2	3	6	8	3	3	3	2	2	3	6	3	6	6
" "	> 5	-	2	1	-	-	1	2	1	-	1	-	-	2	1	3	2	4	8
Gammarus pulex	3-10	34	34	34	38	70	110	128	92	80	40	23	32	56	47	39	61	75	62
HIRUDINEA																			
Glossiphonia heteroclita	5-10	-	1	-	-	-	-	1	1	1	1	-	-	-	-	1	-	1	1
Glossiphonia complanata	5-10	-	-	-	-	-	1	1	-	2	-	1	1	-	-	1	1	-	2
Piscicola geometra	5-12	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Helobdella stagnalis	5-10	1	2	1	-	3	3	2	2	3	2	1	2	1	2	2	1	1	1
Erpobdella octoculata	5-15	-	-	1	2	1	1	4	2	2	1	1	-	-	-	1	-	-	-
DIPTERA																			
Chironomidae larvae	< 5	28	35	37	50	15	23	24	10	14	24	20	49	26	45	45	58	45	35
" "	5-10	14	31	30	32	14	12	13	18	10	25	10	25	23	42	47	30	26	47
" "	10-22	4	5	20	8	13	-	2	1	-	-	1	-	-	4	10	9	-	10
Chironomidae pupae	3-10	-	2	8	14	21	32	18	9	3	-	-	-	-	2	19	15	20	31
Ceratopogonidae larvae	5-15	-	2	2	3	-	-	2	-	-	-	4	4	-	-	2	-	3	2
Tipulidae larvae	5- 7	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Tipulidae pupae	5-12	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
TRICHOPTERA																			
Holocentropus picicornis	3- 5	-	-	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ecnomus tenellus	> 5	7	4	-	-	2	1	1	3	2	7	5	3	8	5	3	1	3	-
Polycentropus flavomaculatus	> 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Limnephilidae	5-15	8	10	2	-	-	-	-	-	-	2	5	8	10	12	10	1	-	-
Glossosoma boltoni	5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
EPHEMEROPTERA																			
Caenis horaria	3- 5	-	-	-	1	3	-	-	-	1	-	1	-	-	-	2	-	-	-
Ephemera igrita	10-25	-	-	-	2	2	2	-	-	-	2	2	2	-	-	-	-	3	1
Baetis muticus	5-10	-	-	-	-	-	-	-	-	1	-	1	-	-	-	1	1	-	2
COLEOPTERA																			
Haliplus larvae	5-12	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1	-	1	1
Haliplus adults	4- 5	1	-	2	-	-	-	-	-	-	-	-	-	1	-	3	2	-	-
Dytiscinae larvae	5-15	-	1	-	-	-	-	-	5	-	-	1	-	-	1	-	-	-	-
Dytiscinae adults	5-10	-	-	1	2	2	2	3	-	1	-	1	1	-	1	1	4	5	2
HEMIPTERA																			
Corixa adults	8-12	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-
Notonecta adults	10-13	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-
ODONATA																			
Damsel fly (naiad)	> 10	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
GASTROPODA																			
Potamopyrgus jenkensi (with keel)	2- 3	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Potamopyrgus jenkensi (without keel)	2- 3	-	-	1	-	-	1	2	4	-	-	-	-	-	2	-	-	-	-
Pseudamnicola confusa	2- 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Valvata macrostoma	2- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2
Valvata piscinalis	2- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Zonitoides nitidus	3- 8	-	-	4	4	1	4	1	2	2	2	-	-	-	1	-	-	2	-
Viviparus viviparus	< 10	-	2	-	1	1	-	-	-	1	-	1	-	1	2	-	-	1	-
Viviparus viviparus	> 10	-	2	-	3	2	2	-	-	2	-	1	-	1	1	-	1	-	-
Theodoxus fluviatilis	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Lymnea glabra	3- 5	-	-	-	-	-	-	-	-	3	-	-	-	-	-	3	-	-	-
Acroloxus lacustris	3- 5	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-	-
Succinea putris	3- 7	2	1	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Planorbis corneus	5-10	-	-	-	-	-	-	-	1	-	-	-	-	2	2	4	1	-	4
Planorbis planorbis	3- 5	3	1	-	-	-	-	-	2	-	-	-	1	2	1	5	3	1	3
Bithynia tentaculata	2- 5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-
Lymnea peregra	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Bithynia leachi	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrobia ulvae	3- 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
LAMELLIBRANCHIA																			
Pisidium amnicum	< 5	-	2	8	18	8	3	8	7	8	7	4	4	3	3	9	13	7	10
" "	>5-15	1	-	-	-	2	-	-	3	-	2	-	1	-	-	2	-	4	2
Sphaerium corneum	< 5	-	1	4	8	4	2	4	2	2	5	2	1	1	1	8	7	4	6
Anodonata cygnaea	>25	2	1	1	-	-	2	1	2	2	2	1	-	1	-	1	-	-	1
Unio pectroum	>20	1	-	-	2	-	1	-	2	-	3	1	-	-	-	-	-	-	1
NEMATODA	5-20	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1

TABLE No. 56 Relative Abundance of the Crustacean Zooplankton Taken from Site No.1 on the Shropshire Union Canal.

	1970 21 Aug	20 Sep	23 Oct	24 Nov	21 Dec	1971 26 Jan	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	26 Aug	23 Sep	24 Oct	24 Nov	20 Dec	1972 24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
Group CALANOIDA																								
Sub-genus Diaptomus	-	-	-	-	-	-	-	-	-	-														
Diaptomus castor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	•	-	•	-	∴	-
" gracilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	•	-	•	-
Group CYCLOPOIDA																								
Genus Helicyclops						-																		
H. Christianensis	••	-	-	-	-	-	-	-	•	∴	••	∴	••	••	•	•	•	•	•	•	•	•	••	∴
H. Neglectus	••	-	-	-	-	-	-	-	∴	•	::	::	::	::	•	•	•	••	•	•	•	•	∴	∴
Genus Cyclops																								
Sub-genus Macrocyclops										-														
C. fucus	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-
C. albidus	•	-	-	-	-	-	-	-	-	••	•	••	••	•	-	-	-	-	-	-	••	-	••	•
Sub-genus Eucyclops																								
C. agilis	∴	-	•	•	•	•	-	-	•	::	⁙	⁙	⁙	-	•	-	-	-	-	-	•	-	⁙	::
C.e. speratus	-	-	-	•	•	-	-	-	-	•	•	••	•	-	-	-	-	-	-	-	-	-	•	•
Sub-genus Paracyclops																								
C. fimburiatus	••	-	•	-	-	-	-	-	•	∴	::	∴	∴	••	•	•	-	-	-	•	•	-	∴	∴
C.f. poppei	•	-	-	-	-	-	-	-	•	•	•	•	••	•	-	-	-	-	-	•	•	-	••	-
C. affinis	-	-	-	-	-	-	-	-	•	-	•	•	•	-	-	-	-	-	-	-	-	-	-	-
Sub-genus Cyclops																								
C. scutifer	•	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	•	-	-	-	-
C. vicinus	•	-	-	-	•	-	-	-	-	-	•	•	-	-	-	-	-	-	-	-	-	-	-	-
Sub-genus Microcyclops																								
C. varicans	••	•	-	-	-	-	-	-	•	••	••	::	∴	•	•	-	-	-	-	-	-	•	∴	••
C. v. rubellus	•	-	-	-	-	-	-	-	-	•	•	••	••	•	-	-	-	-	-	-	-	•	••	•
Group CLADOCERA																								
Family DAPHNIIDAE																								
Daphnia pulex	-	-	-	-	-	-	-	-	-	-	-	-	-	••	-	••	-	-	•	-	•	-	••	-
Family BOSMINIDAE																								
Bosmina longirostris	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-
Family CHYDORIDAE																								
Alona affinis	••	-	-	-	-	-	-	-	-	-	-	•	••	-	•	-	-	-	-	-	-	-	-	•
Chydorus piger	•	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-	-	-	-

Key to order of abundance:

• = 1-5   •• = 6-10   ∴ = 11-20   :: = 21-100   ⁙ = 101 or more

TABLE No. 58 Relative Abundance of the Crustacean Zooplankton Taken from Site No.3 on the Shropshire Union Canal

	1970					1971												1972						
	21 Aug	20 Sep	23 Oct	24 Nov	21 Dec	26 Jan	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
Group CALANOIDA																								
Sub-genus Diaptomus																								
Diaptomus castor	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	•	•	-
" gracilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-
Group CYCLOPOIDA																								
Genus Cyclopina																								
C. norvegica	•	-	-	-	-	-	-	-	-	•	•	•	•	-	-	-	-	-	-	-	-	•	•	•
Genus Halicyclops																								
H. Christianensis	•••	-	-	-	-	-	-	-	•	•	•••	••	••	•	-	•	•	••	••	•	•	•••	•••	••
H. neglectus	••••	-	-	-	-	-	-	-	•	•	•••••	•••	•••	•••	-	•	••	•••	•	•	•	••••	••••	••
Genus Cyclops																								
Sub-genus Macrocyclops																								
C. albidus	•	-	-	-	-	-	-	-	-	•	•	•	•	•	•	-	••	•	-	-	•	•	•	••
Sub-genus Eucyclops																								
C. agilis	•••	-	•	-	•	-	-	-	-	••	•••	•••••	••••	-	••	-	•	••	•	•	••	••	••	••••
C. a.speratus	•	-	-	-	-	-	-	-	-	•	•	•	•	-	-	-	-	•	-	-	•	-	-	•
Sub-genus Paracyclops																								
C. fimbriatus	••	-	-	-	•	•	-	•	•	••	•	••	•••	•••	••	•	•	•••	•	•	•	•••	•••••	••••
C.f. poppei	•	-	-	-	-	-	-	-	•	•	••	••	•	••	•	•	•	•	•	•	•	••	••	••
C. affinis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	••	-	-	-	-	••	-
Sub-genus Cyclops																								
C.s. abyssorum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. scutifer	•	-	-	-	-	-	-	-	-	-	•	••	-	-	-	-	-	•	-	•	-	-	-	-
C. vicinus	-	-	-	•	-	-	-	-	-	-	•	•	-	-	-	-	-	-	-	-	-	-	-	-
Sub-genus Acanthocyclops																								
C. gigas	•	-	-	-	-	-	-	-	-	-	•	••	•	-	-	-	-	•	••	-	-	-	•	•
Sub-genus Microcyclops																								
C. varicans	•••	••	•	•	•	-	-	-	-	-	••	••	••••	••	••	-	-	•••	••	-	-	-	•••	••
C.v. rubellus	••	•	-	•	•	-	-	-	-	-	•	•	••	•	•	-	-	••	•	-	-	-	•	••
C. bicolor	•	-	-	-	-	-	•	-	-	-	-	-	••	-	•	-	-	-	-	-	-	-	•	••
Group CLADOCERA																								
Family DAPHNIIDAE																								
Daphnia pulex	•	-	-	-	-	-	-	-	-	-	•	••	-	-	-	-	•	-	-	-	-	-	••	-
Family BOSMINIDAE																								
Bosmina longirostris	-	•	•	•	-	-	-	-	••	-	-	•	-	•	•	•	-	-	-	-	-	-	-	-
Family CHYDORIDAE																								
Alona affinis	•••	•	-	-	-	-	-	-	••	-	-	•	••	-	••	-	-	-	-	•	-	-	••	-
Chydorus piger	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Key to order of abundance:

• = 1-5   •• = 6-10   ••• = 11-20   •••• = 21-100   ••••• = 101 or more

TABLE No. 59 Relative Abundance of the Crustacean Zooplankton Taken from Site No.4 on the Shropshire Union Canal

	1970										1971										1972			
	21 Aug	20 Sep	23 Oct	24 Nov	21 Dec	26 Jan	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
Group CALANOIDA																								
Sub-genus Diaptomus																								
Diaptomus castor	-	-	-	-	-	-	-	-	-	-	-	•	•	-	-	-	•	•	•	-	-	•••	••	••
" gracilis	•	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	••	•	•
Group CYCLOPOIDA																								
Genus Cyclopina																								
C. norvegica	•	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Genus Halicyclops																								
H. Christianensis	•••	-	-	-	-	-	-	•	•	•	••	••	••	••	•	•	•	•	•	••	•	•••	••	••
H. neglectus	•••	•	-	-	-	-	-	-	•	•	••••	••••	•••••	••••	•	•	•	•	•	••	•	••	•••	•••
Genus Cyclops																								
Sub-genus Macrocyclops																								
C. albidus	••	-	-	-	-	-	•	-	-	•	•	•	•	•	•	-	•	-	•	•	•	-	••	•
Sub-genus Eucyclops																								
C. agilis	••	•	•	-	•••	•	•	-	-	-	-	-	•	•••	-	-	-	-	•	-	-	-	-	-
C.e. speratus	•	-	-	-	•	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-
Sub-genus Paracyclops																								
C. fimbriatus	••	••	•	•	••	•	-	-	••	-	•••	••••	•••	•••	•	•	•	-	•	-	•	•	••••	••••
C.f. poppei	•	-	-	-	-	-	-	-	-	•	•	•	•	•	•	•	•	-	-	-	•	•	••	••
C. affinis	-	-	-	-	-	-	-	•	-	-	-	-	-	-	•	-	-	-	-	-	-	•	•	••
Sub-genus Cyclops																								
C. acutifer	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
C. vicinus	••	-	•	•	•	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	••	-	-	••
Sub-genus Acanthocyclops																								
C. gigas	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	•
Sub-genus Microcyclops																								
C. varicans	••	•	•	•	-	-	-	•	-	-	•	•	••	•••	•	-	-	-	•	-	-	•	••	••
C. v. rubellus	•	-	-	•	-	-	-	-	-	-	•	•	•	••	•	-	-	-	-	-	-	•	•	•
C. bicolor	•	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-
Group CLADOCERA																								
Family DAPHNIIDAE																								
Daphnia pulex	-	-	-	-	-	-	-	-	-	-	-	••	-	-	-	-	-	-	-	-	-	-	••	-
Family BOSMINIDAE																								
Bosmina longirostris	••	•	•	••	-	•	-	-	•	-	-	-	-	-	•	-	-	-	-	-	-	-	-	•
Family CHYDORIDAE																								
Alona affinis	•	-	-	-	-	-	-	•	•	-	-	•	-	-	•	-	-	-	-	•	-	-	-	-
Chydorus piger	•	-	-	-	-	-	-	-	-	-	•	-	-	-	-	•	-	-	-	-	-	-	-	-

Key to order of abundance:
• – 1-5   •• – 6-10   ••• – 11-20   •••• – 21-100   ••••• – 101 or more

TABLE No. 60 Relative Abundance of the Crustacean Zooplankton Taken from Site No.5 on the Shropshire Union Canal

	1970											1971										1972		
	21 Aug	20 Sep	23 Oct	24 Nov	21 Dec	26 Jan	24 Feb	25 Mar	23 Apr	24 May	25 Jun	27 Jul	28 Aug	23 Sep	24 Oct	24 Nov	20 Dec	24 Jan	23 Feb	20 Mar	26 Apr	24 May	24 Jun	20 Jul
Group CALANOICA																								
Sub-genus Diaptomus																								
Diaptomus castor	•	-	-	-	-	-	-	-	-	-	-	•	-	-	-	•	-	-	-	-	-	•	-	∵
" gracilis	-	-	-	-	-	-	-	-	-	-	-	•	•	-	-	-	-	-	-	-	-	•	-	••
Group CYCLOPOIDA																								
Genus Cyclopina																								
C. norvegica	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	•
Genus Halicyclops																								
H. Christianensis	∵	-	-	-	-	-	-	-	•	•	∵	∵	••	••	-	•	•	•	•	∵	•	••	••	∵
H. neglectus	••	-	-	-	-	-	-	-	•	•	::	::	∵	∵	-	•	•	•	•	••	••	∵	::	∵
Genus Cyclops																								
Sub-genus Macrocyclops																								
C. fucus	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	•
C. albidus	••	-	-	-	-	-	-	-	-	-	•	•	•	•	•	-	•	-	-	•	-	••	••	••
Sub-genus Eucyclops																								
C. agilis	•	-	-	-	••	•	•	-	-	-	-	-	•	••	-	-	-	-	•	••	••	••	•	•
C.a. speratus	•	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Sub-genus Paracyclops																								
C. fimbriatus	∵	••	•	-	••	-	-	-	•	••	•	∵	••	∵	•	-	-	•	•	••	••	∵	••	::
C.f. poppei	•	-	-	-	•	-	-	-	-	•	-	•	•	•	•	-	-	•	-	•	•	•	•	••
C. affinis	•	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-
Sub-genus Cyclops																								
C. scutifer	•	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	•	•	-	-	•	-	-	•
C. vicinus	••	-	•	-	•	-	-	-	-	•	-	-	-	-	-	-	-	••	•	•	•	•	•	∵
Sub-genus Acanthocyclops																								
C. gigas	•	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-
Sub-genus Microcyclops																								
C. varicans	••	•	•	•	-	-	-	-	-	-	•	•	•	•	•	-	-	-	-	-	-	-	•	∵
C.v. rubellus	•	•	•	•	-	-	•	-	-	-	-	•	•	-	•	-	-	-	-	-	-	-	-	••
C. bicolor	•	-	-	-	-	-	-	-	-	•	-	-	-	•	-	-	-	-	-	-	-	-	-	-
Group CLADOCERA																								
Family DAPHNIIDAE																								
Daphnia pulex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	•
Family BOSMINIDAE																								
Bosmina longirostris	-	•	-	•	-	-	-	-	•	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-
Family CHYDORIDAE																								
Alona affinis	-	•	-	•	-	-	-	-	•	-	-	•	-	-	•	-	-	-	-	•	-	-	-	••
Chydorus piger	•	-	-	•	-	-	-	-	•	-	-	-	•	-	-	-	-	-	-	-	-	-	-	•

Key to order of abundance:

• = 1-5   •• = 6-10   ∵ = 11-20   :: = 21-100   ⁙ = 101 or more

TABLE No. 61 Relative Abundance of the Crustacean Zooplankton Taken from Site No.6 on the Llangollen Canal

	1971											1972						
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Group CALANOIDA																		
Sub-genus Diaptomus																		
Diaptomus castor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	• •
" gracilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Group CYCLOPOIDA																		
Genus Halicyclops																		
H. Christianensis	•	-	•	-	•	•	-	-	•	-	•	•	•	• •	-	•	•	-
H. neglectus	-	-	-	-	• •	• •	-	-	-	-	•	•	•	•	-	•	•	-
Genus Cyclops																		
Sub-genus Macrocyclops																		
C. fucus	-	-	-	-	-	-	-	-	-	-	-	-	• -	-	-	-	-	•
C. albidus	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Sub-genus Eucyclops																		
C. agilis	-	•	-	-	-	-	• •	-	-	-	-	-	-	-	-	-	• •	• •
C.a. speratus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-genus Paracyclops																		
C. fimbriatus	-	•	•	• •	•	• •	• •	-	•	-	•	-	-	-	-	•	• •	• •
C.f. poppei	-	•	•	•	-	-	-	-	•	-	-	-	-	-	-	-	•	•
C. affinis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-
Sub-genus Cyclops																		
C. vicinus	-	-	-	•	-	-	-	-	•	-	-	-	-	-	-	-	•	•
Sub-genus Microcyclops																		
C. varicans	-	•	•	-	-	-	-	-	-	-	-	-	-	-	-	-	•	• •
C.v. rubellus	•	-	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Group CLADOCERA																		
Family BOSMINIDAE																		
Bosmina longirostris	-	-	•	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-
Family CHYDORIDAE																		
Alona affinis	-	-	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Chydorus piger	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Key to order of abundance:

• = 1-5 • • = 6-10 ∴ = 11-20 ⁚⁚ = 21-100 ⁙ = 101 or more

TABLE No. 62 Relative Abundance of the Crustacean Zooplankton Taken from Site No.7 on the Llangollen Canal

	1971												1972					
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Group CALANOIDA																		
Sub-genus Diaptomus																		
Diaptomus castor	-	-	-	-	-	-	•	-	-	•	-	-	•	-	-	-	-	•
" gracilis	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Group CYCLOPOIDA																		
Genus Halicyclops																		
H. Christianensis	-	•	•	•	••	-	••	•	-	-	•	•	•	•	•	-	•	•
H. neglectus	•	-	•	•	••	•	•	••	-	-	•	•	•	•	•	-	•	••
Genus Cyclops																		
Sub-genus Macrocyclops																		
C. fucus	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. albidus	-	•	-	-	-	-	-	-	•	-	-	-	•	-	-	-	-	•
Sub-genus Eucyclops																		
C. agilis	-	•	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	•
C.a. speratus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Sub-genus Paracyclops																		
C. fimbriatus	-	••	••	-	••	••	•	•	-	•	•	-	-	•	•	-	•	•.•
C.f. poppei	-	-	•	-	•	•	-	•	-	•	•	-	-	•	-	-	-	•
Sub-genus Cyclops																		
C.s. abyssorum	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-genus Microcyclops																		
C. varicans	-	••	•	•	-	-	-	-	•	-	-	-	-	-	-	-	••	••
C.v. rubellus	•	•	-	-	-	-	-	-	•	-	-	-	-	-	-	-	•	••
Group CLADOCERA																		
Family DAPHNIIDAE																		
Daphnia pulex	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	•
Family CHYDORIDAE																		
Alona affinis	-	-	-	-	-	-	-	-	•	-	-	-	-	•	-	-	-	•
Chydorus piger	•	-	-	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Key to order of abundance:

• = 1-5 •• = 6-10 •.• = 11-20 :: = 21-100 .:. = 101 or more

TABLE No.63 Summary of Chemical and Physical Analysis of Water Samples Taken at Site No.1 on the Shropshire Union Canal.

Months	T.H.	Ca^{++}	Mg^{++}	O_2ppm	Temp. °C	P.H.
1971						
February	262	180	82	8.81	6.65	7.35
March	232	180	52	8.92	8.33	7.50
April	240	160	80	8.81	11.05	7.80
May	313	220	93	10.31	13.10	7.40
June	243	150	93	10.45	15.1	7.15
July	287	190	97	11.10	15.0	7.80
August	282	187	95	8.12	16.1	7.5
September	280	186	94	7.40	15.5	7.60
October	273	190	83	6.20	8.95	7.30
November	279	182	97	7.52	4.20	7.51
December	287	197	90	8.95	3.70	7.50
1972						
January	281	199	82	8.90	4.80	7.30
February	310	229	81	8.74	7.85	7.25
March	320	210	110	8.97	10.45	7.30
April	288	182	106	8.85	11.85	7.80
May	286	183	103	10.30	13.45	7.50
June	247	149	98	10.35	15.30	7.70
July	307	216	91	11.00	15.95	7.40

T.H. = Total Hardness as mg per Litre $CaCO_3$

Ca^{++} = Calcium Hardness as mg per Litre Ca

Mg^{++} = Magnesium Hardness as mg per Litre Mg

O_2ppm = Oxygen Concentration Parts Per Million

Temp. °C = Temperature in °C

TABLE No.64 Summary of Chemical and Physical Analysis of Water Samples Taken at Site No.2 on the Shropshire Union Canal.

Months	T.H.	Ca^{++}	Mg^{++}	O_2ppm	Temp.°C	P.H.
1971						
February	270	196	74	8.65	6.70	7.35
March	230	164	66	7.71	8.31	7.70
April	250	175	75	8.58	11.57	7.15
May	316	244	72	9.58	14.34	7.4
June	261	168	93	10.54	15.2	7.15
July	284	183	95	11.15	15.9	7.75
August	280	188	92	7.60	16.10	7.40
September	278	190	88	7.27	15.6	7.55
October	268	187	81	6.14	8.75	7.35
November	274	176	98	7.70	4.20	7.58
December	284	194	90	7.90	3.75	7.40
1972						
January	282	203	79	8.80	4.75	7.30
February	313	229	84	8.65	7.80	7.25
March	318	213	105	7.80	10.42	7.50
April	302	190	112	8.50	11.99	7.85
May	295	201	94	8.89	13.46	7.45
June	262	167	95	10.50	15.28	7.70
July	308	216	92	11.32	16.00	7.25

T.H. = Total Hardness as mg per Litre $CaCO_3$

Ca^{++} = Calcium Hardness as mg per Litre Ca

Mg^{++} = Magnesium Hardness as mg per Litre Mg

O_2ppm = Oxygen Concentration Parts Per Million

Temp.°C = Temperature in °C

TABLE No. 65 Summary of Chemical and Physical Analysis of Water Samples Taken at Site No.3 on the Shropshire Union Canal.

Months	T.H.	Ca^{++}	Mg^{++}	O_2ppm	Temp. ^oC	P.H.
1971						
February	260	187	73	10.42	6.80	7.45
March	284	212	72	12.50	7.67	8.1
April	270	199	71	13.52	10.59	7.85
May	293	224	69	11.65	13.21	8.80
June	286	196	90	12.16	15.5	8.00
July	301	209	92	12.50	16.01	7.90
August	260	173	87	11.45	17.4	7.50
September	300	211	89	11.52	15.95	8.50
October	252	187	65	10.20	8.80	7.50
November	230	170	60	11.70	4.30	7.55
December	250	185	65	12.65	4.00	7.70
1972						
January	261	189	72	12.20	4.90	7.55
February	264	201	63	10.95	7.40	7.40
March	260	181	79	12.20	9.89	7.70
April	271	182	89	13.41	11.76	8.05
May	281	198	83	11.54	13.68	8.50
June	265	190	75	12.06	15.57	8.45
July	268	180	88	12.19	16.10	7.55

T.H. = Total Hardness as mg per Litre $CaCO_3$

Ca^{++} = Calcium Hardness as mg per Litre Ca

Mg^{++} = Magnesium Hardness as mg per Litre Mg

O_2ppm = Oxygen Concentration Parts Per Million

Temp. ^oC = Temperature in ^oC

TABLE No.66 Summary of Chemical and Physical Analysis of Water Samples Tàken at Site No.4 on the Shropshire Union Canal.

Months	T.H.	Ca^{++}	Mg^{++}	O_2ppm	Temp.°C	P.H.
1971						
February	245	180	65	11.51	7.10	7.40
March	266	200	66	11.58	7.98	8.60
April	278	210	68	12.83	11.58	7.95
May	265	181	84	14.21	15.19	9.00
June	272	189	83	14.95	18.30	8.90
July	269	193	76	15.23	17.2	8.45
August	245	176	69	12.95	17.6	8.65
September	290	213	77	13.00	16.10	9.10
October	285	201	84	11.56	8.85	8.40
November	244	177	67	13.23	4.30	8.70
December	249	179	70	13.37	4.10	8.20
1972						
January	251	171	80	12.45	5.10	7.65
February	218	161	57	12.15	8.00	7.35
March	266	187	79	11.55	12.00	7.80
April	268	176	92	12.75	13.50	8.20
May	274	184	90	14.20	15.05	8.75
June	269	180	89	14.71	16.75	8.90
July	275	190	85	15.23	17.04	7.85

T.H. = Total Hardness as mg per Litre $CaCO_3$

Ca^{++} = Calcium Hardness as mg per Litre Ca

Mg^{++} = Magnesium Hardness as mg per Litre Mg

O_2ppm = Oxygen Concentration Parts Per Million

Temp.°C = Temperature in °C

TABLE No.67 Summary of Chemical and Physical Analysis of Water Samples Taken at Site No.5 on the Shropshire Union Canal.

Months	T.H.	Ca^{++}	Mg^{++}	O_2ppm	Temp. °C	P.H.
1971						
February	237	181	56	11.63	7.15	7.35
March	240	184	56	12.21	8.45	8.10
April	282	202	80	13.65	11.73	7.95
May	231	163	68	14.37	15.25	9.10
June	260	182	78	15.03	18.25	8.70
July	236	160	76	15.02	18.30	8.25
August	202	146	56	11.62	18.65	8.30
September	240	175	65	12.03	16.00	9.10
October	232	161	71	11.04	8.69	8.30
November	231	162	69	12.16	4.50	8.70
December	238	175	63	12.50	4.30	7.90
1972						
January	236	150	56	12.30	5.15	7.50
February	210	153	57	12.10	8.00	7.10
March	250	183	67	12.01	12.00	7.65
April	262	193	69	12.81	13.45	8.20
May	252	174	78	12.30	15.06	8.50
June	234	168	66	14.85	16.80	8.65
July	245	176	69	15.08	17.09	7.90

T.H. = Total Hardness as mg per Litre $CaCO_3$

Ca^{++} = Calcium Hardness as mg per Litre Ca

Mg^{++} = Magnesium Hardness as mg per Litre Mg

O_2ppm = Oxygen Concentration Parts Per Million

Temp. °C = Temperature in °C

TABLE No. 68 Summary of Chemical and Physical Analysis of Water Samples Taken at Site No.6 on the Llangollen Canal.

Months	T.H.	Ca^{++}	Mg^{++}	O_2ppm	Temp. °C	P.H.
1971						
February	87	59	28	11.29	7.18	7.20
March	87	58	29	11.69	8.45	8.10
April	73	51	22	12.38	12.30	7.80
May	71	53	18	12.15	14.83	7.90
June	90	65	25	12.70	18.21	7.30
July	55	40	15	13.15	18.2	7.20
August	67	50	17	10.30	18.40	7.25
September	56	40	16	9.78	16.25	7.70
October	56	39	17	8.78	8.50	7.10
November	73	53	20	10.27	4.50	7.30
December	64	45	19	11.08	4.60	7.20
1972						
January	120	82	38	11.00	5.00	7.50
February	107	73	34	11.68	8.50	7.00
March	108	77	31	12.31	12.22	7.60
April	87	64	23	12.30	13.90	7.60
May	68	47	21	12.19	15.60	7.50
June	73	53	20	12.56	17.30	7.30
July	55	38	17	12.84	17.95	7.20

T.H. = Total Hardness as mg per Litre $CaCO_3$

Ca^{++} = Calcium Hardness as mg per Litre Ca

Mg^{++} = Magnesium Hardness as mg per Litre Mg

O_2ppm = Oxygen Concentration Parts Per Million

Temp. °C = Temperature in °C

TABLE No. 69 Summary of Chemical and Physical Analysis of Water Samples Taken at Site No.7 on the Llangollen Canal.

Months	T.H.	Ca^{++}	Mg^{++}	O_2ppm	Temp. °C	P.H.
1971						
February	71	52	19	11.25	7.25	6.90
March	70	52	18	13.20	8.70	7.00
April	60	36	24	14.03	10.62	7.90
May	58	42	16	12.35	12.63	7.40
June	61	41	20	12.59	18.30	6.95
July	41	31	10	12.64	18.30	6.90
August	50	35	15	11.78	18.10	6.95
September	44	28	16	10.68	16.20	7.20
October	43	31	12	9.43	6.2	6.95
November	70	51	19	10.94	5.05	7.25
December	49	34	15	11.24	4.50	7.10
1972						
January	84	60	24	11.20	5.20	6.80
February	80	60	20	10.74	8.60	6.75
March	70	52	18	13.02	12.20	7.40
April	57	40	17	14.01	14.75	7.45
May	48	35	13	12.30	17.35	7.40
June	50	36	14	12.45	18.05	7.15
July	46	32	14	12.60	18.20	7.10

T.H. = Total Hardness as mg per Litre $CaCO_3$

Ca^{++} = Calcium Hardness as mg per Litre Ca

Mg^{++} = Magnesium Hardness as mg per Litre Mg

O_2ppm = Oxygen Concentration Parts Per Million

Temp. °C = Temperature in °C

TABLE No. 70 Summary of Chemical and Physical Analysis of Water Samples Taken at Site No.8 on the Llangollen Canal.

Months	T.H.	Ca^{++}	Mg^{++}	O_2ppm	Temp. °C	P.H.
1971						
February	28	17	11	10.76	7.61	6.65
March	24	16	8	11.58	7.98	7.00
April	25	17	8	12.52	11.66	7.10
May	32	23	9	12.17	13.44	7.20
June	26	15	11	13.45	19.00	6.90
July	27	15	12	13.76	18.10	6.80
August	20	12	8	10.31	17.80	6.75
September	26	15	11	10.02	15.65	7.20
October	27	16	11	9.61	8.25	6.65
November	33	19	14	10.61	5.08	6.85
December	27	16	11	10.79	4.00	6.80
1972						
January	30	17	13	10.50	5.10	6.65
February	35	19	16	10.28	8.64	6.20
March	30	18	12	11.44	10.90	6.75
April	31	19	12	12.50	14.20	7.00
May	29	18	11	12.05	17.30	7.20
June	28	17	11	13.15	18.60	6.80
July	27	15	12	13.65	18.15	6.90

T.H. = Total Hardness as mg per Litre $CaCO_3$

Ca^{++} = Calcium Hardness as mg per Litre Ca

Mg^{++} = Magnesium Hardness as mg per Litre Mg

O_2ppm = Oxygen Concentration Parts Per Million

Temp. °C = Temperature in °C