THE TURBELLARIA OF SOME FRIESLAND LAKES WITH INCIDENTAL RECORDS OF GASTEROPODA AND HIRUDINEA

by

J. O. YOUNG
Department of Zoology, University of Liverpool, Liverpool, England

Introduction

During the week 7th to 12th June, 1971 opportunity was taken of accompanying members of the I.B.P. team based at the Tjeukemeer, the Netherlands, on a boat journey through the Friesland lakes. The main aim of the author was to collect Turbellaria (Tricladida and Microturbellaria) from the vegetation and stones in the littoral zone of 16 lakes (see Table 1). However, any specimens of Gasteropoda and Hirudinea obtained in samples were also noted.

Methods

In the reed beds, mostly *Phragmites* (see Table 1), an F.B.A. net (60 meshes/inch = approx. 23.6 meshes/cm) mounted in a square frame on a 5 ft. (1.524 metres) pole was used to sweep through the vegetation and top layers of substratum for a given period of time (minimum 15 minutes). The contents of the bag net were emptied periodically into white polythene basins containing a little lake water; after sampling was completed large pieces of vegetation etc. were picked out of the basins before their contents were poured into glass jars. In the laboratory on the boat the relevant animals were removed and identified (for details see Young, 1970).

On stony littoral areas (see Table 1), when these were present in the vicinity of the landing area, stones were examined for the relevant taxa and washed in a little water contained in white polythene basins. Again collections continued for a given length of time (minimum 15 minutes). The samples were then treated in the same way as for the vegetation samples.

Irrigation/drainage ditches adjacent to the Brandemeer, Heegermeer and Tjeukemeer were also sampled for Microturbellaria using the same technique as employed for the vegetation in the littoral zone.

The shortcomings of the techniques used are well documented, for example,

Table 1.

The location and nature of the sampling areas in the various lakes visited. The abbreviation for the lakes used in Tables 2-4 are shown in brackets.

Lake	Shore	Stones	Vegetation
Bergumermeer (BE)	west	bricks	*Phragmites*, little detritus
Brandemeer (BR)	west	—	*Phragmites*, little detritus
De Leijen (D)	north	bricks, rough stones	*Phragmites*, little detritus
Fluessen (F)	west	broken bricks	*Phragmites*, *Typha*, little detritus
Heegermeer (H)	north	bricks, rough stones	*Phragmites*, little detritus
Koevorde (K)	north	bricks	*Phragmites*, little detritus
Langweerder Wielen (L)	south-east	—	*Phragmites*, a little *Typha*, little detritus
Morra (M)	east	bricks	*Phragmites*, little detritus
Oorden	south-east	broken concrete	*Phragmites*, a little *Typha*, little detritus
Pikmeer (PI)	south	round stones	*Phragmites*, little detritus
Prinsenhof (PR)	south-east	bricks	*Phragmites*, little detritus
Slotermeer (SL)	north	bricks, rough stones	*Phragmites*, little detritus
Sneekermeer (SN)	west	broken bricks	*Phragmites*, little *Scirpus*, little detritus
Tjeukemeer (T)	south	broken bricks	*Phragmites*, medium detritus
Wijde Ee (De Veenhoop) (W1)	north	—	*Typha*, little *Scirpus*, thick detritus
Wijde of Peanster Ee (W2)	north	—	*Phragmites*, little *Typha*, little detritus

TABLE 2

The abundances of Turbellaria on the stony (s) and vegetational (v) littoral of the various lakes. Abundance categories are as follows: A = 1-10 individuals per hour; B = 11-30; C = 31-100; D = 101-300 and E = 301+. dit = adjacent irrigation/drainage ditches. The abbreviations of the lakes are indicated in Table 1.

	BE		BR	D		F		H	K		L	M		O		PI		PR		SL		SN		T		W1	W2
Tricladida	s	v	v	s	v	s	v	s v	s	v	v	s	v	s	v	s	v	s	v	s	v	s	v	s	v	v	v
Dendrocoelum lacteum (Müller)	B	C	B	C	A	A			C	A	B	B	A	B	E	B	B	C	A	B		C	A	A	A	C	A
Dugesia lugubris (Schmidt)									A																		
Dugesia polychroa (Schmidt)	D	C	A	D	A	C	A		B	A	B	A	A	C	B	A	A	B		A		C	A	C	B	B	A
Dugesia tigrina (Girard)				B					B											A	C	A		D	B		
Polycelis tenuis (Ijima)	A	A	C	A	C	D	D		A	A	A	A	B	B	B	C	C		A	A		C	C		A	D	C
Microturbellaria																											
Bothromesostoma esseni Braun			A																								
Bothromesostoma personatum (Schmidt)								ditB																		A	
Castrella truncata (Abildgaard)														A													
Gyratrix hermaphroditus Ehrenberg								ditC																ditB			
Macrostomum distinguendum (Papi)															A											B	
Mesostoma lingua (Abildgaard)																								ditB			
Microstomum lineare (Müller)								ditC																			
	B	B	D	A		B	D		E	C	C	B		C		C	D	D	C	A	C	C	B	D	C		C
Olisthanella truncula (O. Schmidt)														A												A	
Plagiostomum lemani (Du Plessis)		A		A			B			C	C					A	C	A		B				B			
Prorhynchus stagnalis Schultze			A																								
Stenostomum leucops (Dugès)						C								A						C				ditC			
Stenostomum unicolor Schmidt			ditA																					ditA			
Strongylostoma radiatum (Müller)								A																B			
																								ditB			
Typhloplana viridata (Abildgaard)			ditA					ditA																			

for vegetation see Macan (1963) and for stones see Reynoldson (1958). It should be emphasised that only a small area of one shore of each lake was examined and several authors, for example, Macan & Maudsley (1968), Macan (1970) and Chambers (1971) have commented on the discontinuous distribution of the various elements in the invertebrate fauna along the littoral of large lakes.

Results

As collection periods varied from lake to lake the data are standardised and expressed as the number of organisms collected in 1 hour. Since the samples were not strictly quantitative in nature the numbers have been grouped into arbitrary categories viz. A = 1-10, B = 11-30, C = 31-100, D = 101-300, and E = 301+.

The Turbellaria found are shown in Table 2 and altogether 5 triclad species and 14 species of Microturbellaria were recorded.

Dendrocoelum lacteum, Dugesia polychroa and *Polycelis tenuis* occurred in all the lakes with the exception of the Heegermeer which also did not reveal any leeches. The absence of these two taxa from this lake is difficult to explain though on the day the lake was visited the weather was rather rough and there was much water movement in the littoral zone. *Dugesia tigrina* was found only in 5 lakes whilst *D. lugubris* was recorded only from the Koevorde. The relative proportions of the 3 common widespread species varied from lake to lake.

Of the 14 species of Microturbellaria three, *Mesostoma lingua, Stenostomum unicolor* and *Typhloplana viridata,* were found in ditches only; the other 11 species were recorded in the lakes. *Microstomum lineare* and *Plagiostomum lemani* were most widespread, and the former was often recorded in considerable numbers. The small numbers recorded and the infrequent distribution of the species do not allow comments on the distribution of the various species within or between lakes.

The Gasteropoda and Hirudinea obtained are listed in Tables 3 and 4 respectively. It was thought worthwhile to include these incidental records as limited collections of these taxa have been made in the Friesland lakes. Twenty one species of Gasteropoda were obtained. There were 7 widespread occurring species: *Ancylastrum fluviatile, Acroloxus lacustris, Bithynia tentaculata, Potamopyrgus jenkinsi, Lymnaea peregra, Physa fontinalis,* and *Theodoxus fluviatilis.* All of these, with exception of *G. jenkinsi,* occurred in some places at least in high numbers (i.e. categories C-E). The other species were recorded in one or two lakes only. In the Wijde Ee

TABLE 3

The abundance of Gasteropoda in the stony (s) and vegetational (v) littoral of the various lakes. The abundance categories are indicated in Table 2; the abbreviations of the lakes in Table 1.

	BE		BR	D		F		H		K		L	M		O		PI		PR		SL		SN		T		W1	W2
	s	v	v	s	v	s	v	s	v	s	v	v	s	v	s	v	s	v	s	v	s	v	s	v	s	v	v	v
Acroloxus lacustris (L.)			C								A	D				A		A		B		A		A		A	B	A
Ancylastrum fluviatile (Müller)	A			C		A				A			A		A		A		A		A		E		A			
Bithynia leachii (Sheppard)			A																									
Bithynia tentaculata (L.)	D	D	D	D	D	B					D	B	C	C		C		C	C	C	A	B	C	C		B	A	E
Lithoglyphus naticoides (Pfeiffer)		A	A								A																A	
Lymnaea auricularia (L.)																				A								
Lymnaea palustris (Müller)																												A
Lymnaea peregra (Müller)		B	D	B	C	E	C	D	D	A	D	E	D	D	C	C	B	D	B	D	E	C	C	C	D	B	A	B
Lymnaea stagnalis (L.)														A														
Physa fontinalis (L.)		B	B	B	C		A				A	C		D		B		A		B		A			B	B	D	E
Planorbareus corneus (L.)		A																										
Planorbis albus (Müller)		A			A		A													A								A
Planorbis carinatus (Müller)														A														
Planorbis contortus (L.)																											A	
Planorbis crista (L.)											A																	
Planorbis vortex (L.)			A											A													A	A
Potamopyrgus jenkinsi (Smith)					A		A	B	B	B		B						A		B			A		B	B	D	E
Segmentina complanata (L.)		A			A									A		A											D	A
Segmentina nitida (Müller)																											B	
Theodoxus fluviatilis (L.)	B			A		B		E	A	A			A		A						E		B		E			
Valvata piscinalis (Müller)		A								A								A										

TABLE 4

The abundance of Hirudinea in the stony (s) and vegetational (v) littoral of the various lakes. The abundance categories are indicated in Table 2; the abbreviations of the lakes in Table I.

	BE		BR	D		F		H		K		L	M		O		PI		PR		SL		SN		T		W1	W2
	s	v	v	s	v	s	v	s	v	s	v	v	s	v	s	v	s	v	s	v	s	v	s	v	s	v	v	v
Erpobdella octoculata (L.)	D	C	A	D	C	C	A			A	B	C	C	B	C	B	B	A	D	B	C	A	C	A	C		A	C
Erpobdella testacea (Savigny)																											A	
Glossiphonia complanata (L.)	D	B	A	C	B	B	A			A	A	B	A	A		B	A	B	A	A		B		B		A	A
Glossiphonia heteroclita (L.)	A			B	B		A							B						A				A		C	A
Helobdella stagnalis (L.)	D	C	A	C	D	B	A			A	A	B	C	B	C	B	B		C	B	B		B	A	B		C	B
Hemiclepsis marginata (Müller)																										A		
Pisicola geometra (L.)		A			C		A				A	A	A		B	A		C	B				A		B			
Theromyzon tessulatum (Müller)	A				A		A				A	A	B		A								A			A		

(De Veenhoop) *Segmentina nitida* and *S. complanata* were recorded in high numbers. As might be expected *A. fluviatile* was found only and *T. fluviatilis* mostly on the stony littoral. There was a tendency for the other species to be found only or to be apparently more abundant in the vegetation. However, it is difficult to compare the data obtained by the different sampling techniques and this point cannot be laboured too much particularly in the case of *B. tentaculata* and *L. peregra.*

Seven species of Hirudnea were recorded. *Erpobdella octoculata, Glossiphonia complanata* and *Helobdella stagnalis* were recorded from all of the lakes with the exception of the Heegermeer which has been commented on earlier. The other species, with the exception of *Erpobdella testacea* found only in the Wijde Ee (De Veenhoop) in thick detritus in a dense *Typha* bed, were recorded in half or more of the lakes. Again there was an impression, particularly in the case of the 3 common leeches that the stony littoral supported more leeches than did the vegetation. However, it is stressed again that this is only an impression as the different sampling techniques do not permit a direct comparison of the data.

Conclusions

The list of triclad species, viz. *Dendrocoelum lacteum, Dugesia polychroa* and *Polycelis tenuis,* is in general typical of that found in lakes rich in calcium and total dissolved matter in Britain (Reynoldson, 1958). *Polycelis nigra* was not recorded in the present survey. Reynoldson (1966) found that in Britain as the calcium content increased a level was reached (20 mg/litre) beyond which *P. nigra* showed a decline in numbers which paralleled by the occupation of a smaller proportion of lakes. Calcium figures are not available for most of the Friesian lakes: however Golterman (1969) shows chemical data for the Tjeukemeer obtained in February and September 1969, and calcium readings of 36.4 and 44.6 mg/litre respectively are quoted (see Table 5). The previous records of *Dugesia lugubris* in the Netherlands (see Den Hartog, 1962, who lists and features Dutch triclads, and Tulp, 1967, who lists triclads from the Grote Wielen) probably refer to *D. polychroa,* as recently Reynoldson & Bellamy (1970) have pointed out the confusion that has arisen in the identification of these two species. However, in the present survey *D. lugubris,* with its characteristic distinguishing criteria including the massive penial papilla with an ejaculatory duct surrounded by thick musculature and possessing a permanent nipple, was found in the Koevorde. The spread of *D. tigrina* in the Netherlands is recorded by Den Hartog (1959, 1967) who found it in the Sneekermeer in 1957, the Grote Wielen, the Oudegaasterbrekken, the Fluessen and the

Table 5.

Winter (2/2/69) and summer (24/9/69) values of the chemical composition of Tjeukemeer water. (From Golterman, 1969).

	meq/l						mg/l (mean)	
	2 Febr.	24 Sept.		2 Febr.	24 Sept.		winter	summer
$Ca^{2}+$	1.82	2.23	$HCO^{3}-$	1.44	1.67	NO_3–N	1.5	0.1
$Mg^{2}+$	0.52	0.75	C_l-	1.18	3.14	NH_3–N	1.5-2	0.05
Na+	0.97	2.22	$SO_4^{2}-$	0.49	0.64	PO_4–P	0.4	0.04
K+	0.21	0.24		——	——	P_{tot}–P	0.6	0.1
Fe	(7.5-10 mg)	(3)		3.11	5.45	SiO_2–Si	5	0.1
	3.52	5.44				pH	7.5	8.5

Gaastmeer in 1958, and in 3 small lakes by Amsterdam in 1961. Tulp (1967) also found it in the Grote Wielen. The present survey extends the range of the species in Friesland by 4 lakes.

In the 19th century, Maitland (1851), Herklots (1862), and De Man (1875; 1876) give collectively 13 records of freshwater Microturbellaria from the southern part, particularly Leiden, of the Netherlands, viz. *Bothromesostomum personatum* (Schmidt), *Castrella truncata* (Abildgaard), *Dalyellia viridis* (Shaw), *Geocentrophora sphyrocephala* De Man, *Gyratrix hermaphroditus* Ehrenberg, *Macrostomum distinguendum* Papi, *Mesostoma tetragonum* (Müller), *Microdalyellia picta* (O. Schmidt), *Microstomum lineare* (Müller), *Rhynchomesostoma rostratum* (Müller), *Stenostomum leucops* (Dugès), *Strongylostoma radiatum* (Müller) and *Typhloplana viridata* (Abildgaard). Middelhoek (1948) also records *D. viridis* in Lattrop, the Netherlands. Van der Land (1965) collected material from distribution mains for drinking water in the south and west of the Netherlands, and from a canal in the city of Leiden, and lists the following species of Microturbellaria: *Catenula confusa* Nuttycombe, *Gieysztoria macrovariata* (Weise), *Microdalyellia macrobursalis* van der Land, *Stenostomum leucops, S. unicolor* and 1 species of Typhloplanoida. Tulp (1967) records *M. lineare* from the Grote Wielen. Tulp (1971) includes the following species: *Castrella truncata, Gieysztoria cuspidata* (Schmidt), *G. infundibuliformis* Fuhrmann, *Gyratrix hermaphroditus, Macrostomum distinguendum, M. rostratum* (Papi), *Mesostoma ehrenbergi* Focke, *Microdalyellia brevimana* (Beklemischev), *M. fairchildi* (Graff), *M. fusca* (Fuhrmann), *Microstomum lineare, Stenostomum leucops, S. unicolor, Strongylostoma* sp., *Tetracelis marmorosa* (Müller) and *Typhloplana viridata.* Of these, *G. infundibuliformis* and *T. marmorosa* were found on the island of Ter-

schelling only, *M. rostratum* on the mainland only, and the other species were found on the island and probably most, if not all, on the mainland too (Den Hartog & Tulp, 1960).

Nine of these species were recorded in the present survey from Friesland. The other 5 species found in the present investigation constitute new records from the Netherlands. Luther (1963) and Young (1970) provide keys and illustrations for the identification of these species.

Janssen & De Vogel (1965) and Dresscher & Engel (1960) provide aids for the identification of the Gasteropoda and Hirudinea respectively, and Jutting (1947) lists localities in the Netherlands, including the Tjeukemeer (probably), for the occurrence of the former. Thus she lists *Acroloxus lacustris* (L.), *Myxas glutinosa* (Müller), *Planorbis crista* (L.), *Potamopyrgus jenkinsi* (Smith), *Segmentina complanata* (L.), and *Theodoxus fluviatilis* (L.) for the Tjeukemeer. Other species she indicates as common in the Netherlands without, however, specific reference to localities in Friesland. Chambers (1971) records 18 species from the Tjeukemeer, that is, 11 more than was found in the present survey. However, of these additional 11 species, seven were recorded in only a few of his fortnightly or monthly samples during the two years of his sampling programme. His eleven additional species are *Planorbareus corneus* (L.), *Planorbis albus* (Müller), *P. contortus* (L.), *P. crista* (L.), *P. planorbis* (L.), *P. vortex* (L.), *Segmentina complanata* (L.), *S. nitida,* (Müller), *Valvata cristata* Müller, *V. piscinalis* (Müller), and *Viviparus fasciatus* (Müller). Of these *P. planorbis, Valvata cristata,* and *Viviparus fasciatus* were not found in any of the Friesian lakes during the present study. It is pertinent to mention that M. Beattie (personal communication) has recorded *Valvata piscinalis* in all of the lakes studied in this investigation. Tulp (1967) records 25 species of Gasteropoda in the Grote Wielen. Dresscher & Engel (1960) include general occurrence records of leeches; they indicate that *Erpobdella testacea* (Savigny) and *Piscicola geometra* (L.) had not yet been found in Friesland. Tulp (1967), however, records 11 species of Hirudinea, including *E. testacea* and *P. geometra* from the Grote Wielen. Chambers (1971) records the same number of leech species from the Tjeukemeer as was found in the present survey. The snails and leeches comprise species which can usually be found in hard waters in Britain (see Boycott, 1936, and Macan, 1969 for former, and Mann, 1962 for latter). In his book, Redeke (1948) refers to the general occurrence of the flatworms, snails and leeches in the Netherlands.

In conclusion it can be said that a more exhaustive and regular sampling programme is necessary to provide more complete information on the

occurrence and distribution of the taxa, viz. Turbellaria, Gasteropoda and Hirudinea, studied in this brief survey. A more thorough search round the complete shore of each of the lakes and repeated sampling is certainly necessary. With especial regard to the Microturbellaria, the seasonal nature of the occurrence of many species and the inherent difficulties in sampling the group (see Young, 1970) would certainly necessitate this repeated and prolonged sampling schedule. Comparison of the species lists of snails from the Tjeukemeer obtained by Chambers (1971) and in the present investigation (see earlier in text) exemplifies how the species list of each of the taxa might be expanded.

Many of the species of the three taxa considered have a wide distribution in the Friesian lakes studied, and it is suggested that a more detailed investigation might produce a similar species list for each of the lakes. The alteration of the water chemistry, including the chloride level, during the course of a year (see Chambers, 1971 and in preparation, for details) when water from the IJsselmeer (chloride content approx. 200-300 mg/litre) is taken into the Friesian system during times of water shortage, usually in the summer, causing a raising of the ionic concentration and the dilution and expulsion of water in wet seasons, usually in the winter, causing a lowering of the chemical composition does not seem to have an effect on the occurrence and distribution of many of the species in the taxa examined. The composition of the taxa does not seem to differ in the lakes at the north-east end of the system, that is, furthest from the IJsselmeer and the south-west of the system, that is, nearest the IJsselmeer; compare for instance the Bergumermeer and the Morra.

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Samenvatting

Gedurende één week in juni werden de Turbellaria van het onbegroeide stenige en het begroeide littoraal bestudeerd in 16 Friese meren. Het voorkomen van Gasteropoda en Hirudinea werd eveneens geregistreerd. De relative algemeenheid van de soorten is weergegeven in vijf opéénvolgende graden van talrijkheid. Vijf soorten Tricladida, 14 soorten Microturbellaria, 21 soorten slakken en zeven soorten bloedzuigers werden

waargenomen. Eén soort uit de Tricladida, *Dugesia lugubris* (oude opgaven van deze soort betreffen vermoedelijk *D. polychroa*) en vijf soorten Microturbellaria (*Bothromesostoma esseni, Mesostoma lingua, Olisthanella truncula, Plagiostomum lemani* en *Prorhynchus stagnalis*, zijn nieuw voor de Nederlandse fauna. Het bekende areaal van *Dugesia tigrina* is met vier meren vergroot.

Vele soorten uit de drie taxa komen in alle onderzochte meren voor en de veronderstelling wordt geuit dat een grondiger inventarisatie gelijkvormige soortenlijsten voor de verschillende meren zou opleveren. De periodieke inlaat van water uit het IJsselmeer in de Friese meren, en omgekeerd het spuien op het IJsselmeer, hebben waarschijnlijk weinig effect op de verspreiding van de taxa.

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