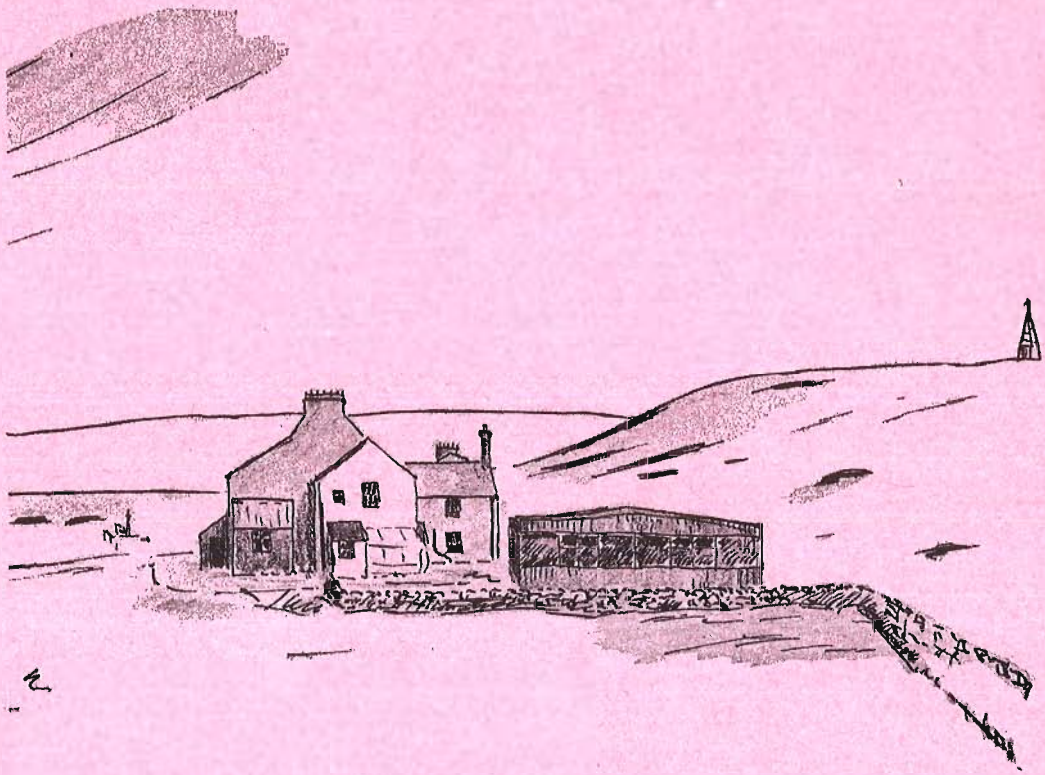
Aspects of the Ecology of The Northern Pennines

Occasional Papers

No. 5



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Aspects of the Ecology of the northern Pennines

5. Freshwater Biology

by

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November, 1973

Introduction

Butcher et al (1937) in their pioneer survey of the River Tees made some observations in headwater streams within the boundaries of what is now the Moor House National Nature Reserve, but their most intensive work was done in the lower reaches of the Tees. Since the declaration of the Reserve, an appreciable amount of further work on freshwater biology and related subjects has been done within and around the area, but the coverage has been piecemeal, consisting of independent projects by various workers, many of them visitors, without any unifying theme. The present review is therefore rather patchy in its coverage.

It would be of very limited value to summarise present knowledge of the freshwater plants and animals of the Reserve without including some information on their habitats and on the physical and chemical characteristics of their environments. The present account therefore gives a general account of the freshwater habitats on the Reserve, summarises published information on the physical and chemical environment and, finally, reviews the biological literature. In the survey of physical and chemical information, those papers which contain information on water temperature, water chemistry, discharge patterns and other factors likely to be of direct biological importance are discussed. Papers with a more strictly hydrological or meteorological content have not been included.

Description of freshwater habitats:

1. Pools, tarns and reservoirs

The standing water within and around the Reserve can be arbitrarily separated (Crisp 1962, Heal 1963) into "pools" with surface areas generally less than 100 m^2 and depths of up to 2 m, and "tarns and reservoirs", which range in size from 500 to 20,000 m^2 and may show considerable variation in depth and bottom material.

Two authors (Gorham 1956, Heal 1963) have distinguished between "bog pools" and "mine pools". The bog pools are water-filled depressions in the bog surface with substrata either of bare peat or growing Sphagnum. The mine pools are man-made and associated with past mining activity. Their substrata often consist wholly or partially of inorganic material. A single tarn with a surface area of about 5,000 m^2 is situated on the southern boundary of the Reserve at NY 736304 and three rather similar bodies of water lie beyond the southern boundary. The tarns are comparatively shallow (c. 1 m) with bottoms of sand, overlain in many places by finely-divided peat, and occasional stones.

There are numerous reservoirs in the area around the Nature Reserve. These are generally associated with past mining activity and have been constructed by building a wall across a valley or on a hillside so as to retain drainage water from the surrounding moorland. Thus, all or part of the margin of each reservoir consists of a sandstone wall, sloping steeply into 0.5 to 4.0 m depth of water. The bottoms of the reservoirs are generally fairly level and composed of sand or clay, often overlain by a depth of peat of a few cms. The areas of the reservoirs are generally within the range of 0.06 to 3.9 ha (Crisp 1962).

2. Flowing waters

The streams on the southwest edge of the Reserve are tributaries of the River Eden, and all have steep gradients in their upper reaches, eg. Crowdundle and Swindale Becks have mean gradients of 1 in 10 to 1 in 5 throughout the first 3 or 4 km downstream from their sources (Davies & Smith 1958). They are torrential throughout most of their passage through the Reserve and have channel widths of 0.5 to 2.0 m or more.

The River Tees rises on the slopes of Cross Fell and forms the northern and eastern boundary of the Reserve. The drainage water from most of the Reserve flows into the Tees, partly through fifteen small tributaries which flow directly into the main river and partly from Trout Beck, which is a major tributary entering the Tees about 1.5 km from Moor House. Trout Beck rises on the slopes of Great Dun Fell and Knock Fell where it receives water from about 9 small headwater streams. Throughout its course, its flow is augmented by water from numerous small streams and drainage channels, and, finally, about 1 km above its confluence with the Tees, it receives the combined discharges of Moss Burn, Nether Hearth Sike and Rough Sike. The headstreams of the Tees catchment within the Reserve generally rise from springs and/or lateral drainage and, during the first km of their courses, their mean gradient rarely exceeds 1 in 15. Their substrata vary from place to place but consist chiefly of bedrock, large boulders, alluvial shingle and coarse gravel. Detailed information on the proportions of different types of substratum and stream margin and on the variations of mean depth, surface width and water velocity is given by (Crisp 1966) for a fairly typical small tributary of the Tees system.

Physical and Chemical information

1. Chemical composition of water

Gorham (1956) analysed water samples from several pools and the results are summarised in Table 1. The data indicate the way in which the ionic concentrations vary in response to rainfall, while the dry weather figures also show that the water of mine pools is chemically richer than that of the bog pools.

Table 2 summarises present knowledge of the chemical composition of the Reserves flowing waters. Analyses from a chemically rich chalk river in southern England (Crisp & Gledhill 1970) are given for comparison. Gorham's (1956) comparison of samples taken from Trout Beck during dry and wet weather suggest that the ionic concentrations may vary in response to changes in stream discharge and Crisp (1966) contains figures which illustrate the way in which the concentrations of five elements varied with discharge in Rough Sike. The calcium concentration was 4.0 to 8.5 mg/l at discharges of less than 3 l/sec, but fell to 1.0 mg/l or less as the discharge approached 1,000 l/sec. In contrast, the concentrations of K and P rose with increasing stream discharge.

2. Stream water temperatures

Davies & Smith (1958) studied winter water temperatures in Swindale and Crowdundle Becks (tributaries of the Eden) by means of spot readings on mercury-in-glass thermometers and the records from two thermographs. In Swindale Beck, they found that, between January and May, the thermal sum (degree-days above 0°C) was substantially greater at 150 m O.D. than at 400 m O.D., though the situation could be reversed in summer. The authors recorded some temperatures during the summer months in Moss Burn and Trout Beck at about 600 m O.D. Between mid May and the end of September 1953, the daily maximum exceeded 14.9°C on 30 out of 155 days.

Crisp & Le Cren (1970) give detailed analyses of water temperature records from Rough Sike (Moor House National Nature Reserve) at 565 m O.D. and two Lake District becks at altitudes of 70 m and 245 m. The annual mean in Rough Sike was about 6°C whilst in the two Lakeland becks it was about 9°C. There were corresponding differences in annual degree-day totals. Although the highest and lowest temperatures recorded in the course of a year did not differ greatly between the three streams, the proportion of the total time in the year for which the temperature fell within each of a set of arbitrary temperature ranges differed markedly from stream to stream (Table 3).

3. Water velocity and discharge

Butcher et al (1937) mention the great rapidity and amplitude of water level fluctuations which can occur in the River Tees, whilst Crisp (1963), Brown et al (1964) and Crisp (1966) refer to the "flashy" nature of the Tees tributaries on the Moor House National Nature Reserve.

Phillipson (1967) recorded midstream water surface velocities of up to 1.25 m/s in Trout Beck and Brown et al (1964) measured velocities of up to 1.5 m/s during spates.

Records of discharge in Trout Beck have been kept by the Wear and Tees River Board (latterly the Northumbrian River Authority) for many years and copies are kept at Moor House. Crisp (1966) gives details of one year's observations of the discharge in Rough Sike. In Table 4, these data are compared with data for a southern chalk river (Crisp & Gledhill, 1970). The southern river shows a reasonably smooth seasonal fluctuation, with high winter and low summer values, whilst the monthly discharges have an irregular pattern of fluctuation which reflects the month-by-month pattern of rainfall. The lowest monthly discharges in a Pennine stream may occur during one or more of the winter months when the catchment is frozen. This point is illustrated in Table 4. The greatest and smallest monthly totals in the chalk river were in the ratio 14:1, whilst the corresponding ratio for Rough Sike was 77:1. This difference would be greater if daily or instantaneous discharge values had been used.

4. Suspended solids:

During spates, the streams of the Moor House National Nature Reserve become discoloured by suspended matter, chiefly peat. There is no evidence that this suspended peat has any effect upon the stream animals, but its possible harmful effects upon fish and its possible value as a source of food material for detritus consumers should be borne in mind.

During the normal spates in Rough Sike, Crisp (unpublished) recorded peat concentrations of 0.1 to 0.3 g/l and Crisp, Rawes and Welch (1965) observed concentrations of up to 2.0 g/l in the same stream during an exceptionally severe spate.

Aquatic vegetation

1. In standing water:

Most of the reservoirs and tarns contain very little macroflora, apart from occasional restricted patches of Glyceria fluitans (L.), Potamogeton natans (L.) and Juncus bulbosus agg. (Crisp 1962), Equisetum fluviatile L. and Eriophorum angustifolium Honck. (Heal 1963). Some of the smaller reservoirs,do, however, contain quite dense stands of vegetation and examples close to the Reserve are a reservoir at NY 780330 which contains dense beds of Carex sp., Equisetum sp., and Potamogeton natans, (Crisp 1962), and a reservoir at NY 735347 which has well-defined zones of Chara sp., Equisetum fluviatile, Potamogeton natans, Carex rostrata Stokes and Juncus effusus L. (Heal 1963).

The following species are listed from peat and mine pools by Gorham (1956) and Heal (1963) - Sphagnum cuspidatum Ehrh. ex Hoffm., S. subsecundum Nees., S. recurvum P. Beauv., Eriophorum angustifolium, Juncus effusus, Equisetum fluviatile, Callitriche sp. and Potamogeton natans. Heal (1963) states that the three last named occur mainly in mine pools. Gorham (1956) also mentions three bryophytes and one alga found in the pools.

2. In flowing water:

Mats of filamentous algae develop in slow-flowing reaches during summer droughts, but are rapidly scoured away by spates, a phenomenon observed by Butcher et al (1937) in the Tees and by Crisp (1963) and Brown et al (1964) in the tributary streams.

The bryophytes Fontinalis antipyretica Hedw. and Eurhynchium riparioides (Hedw.) form extensive cover of the streambeds in the limited areas where the substratum is stable (Brown et al 1964, Eddy, Welch & Rawes 1969) and, in occasional backwaters, some of the higher plants typical of the peat and mine pools occur. In general, however, the streams of the Reserve contain hardly any rooted vegetation and have very little moss cover. This reflects the "flashy" nature of the streams and the instability of their beds.

Butcher et al (1937) studied the growth of algae on glass slides suspended in the water and also the quantities and composition of free-floating algae at a number of stations in the River Tees. Their stations included one at Trout Beck Foot, just within the boundary of the present National Nature Reserve. They gave species lists and information on seasonal fluctuations of algal quantities.

A description of the flora of calcareous springs and flushes is given by Eddy, et al (1969), together with a brief description of the streamside and aquatic vegetation of eight selected streams. In addition, Proctor (1971) described the aquatic macrophytes of the Weel, a slow-flowing reach of the Tees about 1 km downstream of the S.E. corner of the Nature Reserve.

Aquatic fauna

1. General:

There are a number of unpublished species lists scattered amongst the Moor House Reserve Record Books and in other places. These lists are very patchy and, in some instances, the accuracy of the determinations has not been adequately established. For the purposes of the present review, they have, therefore, been ignored; attention will be given only to those species and groups whose distribution or biology has been described in publications.

It should be noted that, as part of a Freshwater Biological Association project at Cow Green, large numbers of aquatic invertebrates are being collected and identified both from the Cow Green area and from the Moor House National Nature Reserve. As it is hoped that the results of this survey will be published in due course, they will not be considered in detail in the present review.

2. The fauna of standing water:

(i) Order Cladocera (Subphylum Crustacea)

Heal (1963) lists ten species or varieties found in 17 pools and 5 reservoirs and tarns on or near the Reserve, and mentions a further three species known to occur on the Reserve. He found that Chydorus sphaericus and C. sphaericus v coelatus were widely distributed, whilst Acantholeberis curvirostris and Scapholeberis mucronata occurred mainly in the larger pools. Bosmina coregoni v lilljeborgi was the main species in the open water of reservoirs, tarns and the larger pools.

Chydorus spaericus was more abundant in the summer and autumn than in spring, whereas Smyly (1952, 1957) observed that, in the Lake District, it was abundant in spring and sometimes in winter, but scarce or absent in the other seasons.

The species found on or around the Reserve are listed in Table 5.

(ii) Order Hemiptera

An analysis of collections of Corixidae from the Pennines was published by Crisp (1962). This survey covered both the northern and southern Pennine areas. The list in Table 5 contains only those species found in the northern Pennines.

Corixa wollastoni was found in both pools and reservoirs and attained its greatest abundance in shallow water amongst vegetation. C. nigrolineata was found mainly in pools, generally in mine pools which had some inorganic matter in their substrata. C. carinata and Glaenocorisa propinqua were found only in reservoirs and tarns and these species (and C. germari) prefer large, deep bodies of water with steeply sloping margins and open water. Such water is often subject to severe wave action. C. germari, a common and often abundant species in south Pennine reservoirs was found in only two of the 14 samples from north Pennine tarns and reservoirs.

Two other species of Hemiptera are listed by Nelson (1971).

(ii) Order Odonata:

Nelson (1971) lists three species found on the Reserve as imagines and notes that nymphs of one of them Aeshna juncea, have been found on the Reserve.

(iv) Order Megaloptera:

Nelson found adults of both British species of Sialis but noted that S. fuliginosa was scarce.

(v) Order Coleoptera:

Five species are listed by Nelson.

(vi) Class Mollusca:

Lymnaea (Galba) truncatula was found by Nelson in alluvial pools.

3. The fauna of flowing water:

(i) (Order Diptera) Simuliidae

Field and laboratory studies of the effect of speed of current upon Simulium monticola Fried. and S. variegatum Mg. were made by Phillipson (1967) in Trout Beck and Cross Gill. He showed that both species occurred in velocities of 0.5 - 2.5 m/s but aggregate in the velocity range 1.0 - 2.0 m/s.

On the basis of material collected from Crowdundle Beck, Davies (1957) described Prosimulium inflatum, a new British species. He also recorded this species from Knock Ore Gill and Swindale Beck on the Moor House National Nature Reserve and from two Lake District becks and nine Scottish localities. These records were followed (Davies & Smith 1958) by a study of the ecological relationship between P. inflatum and the taxonomically close P. hirtipes in Crowdundle and Swindale Becks. P. hirtipes larvae were normally found below 450 m O.D., and those of P. inflatum above 660 m O.D. P. hirtipes larvae grew more slowly at 400 m O.D. than at 180 m O.D., and under laboratory conditions, they were harmed by even brief daily exposure to temperatures of 18 - 20°C. Restriction of the P. hirtipes larvae to lower altitudes may be because, above a certain point, the winter thermal sum is insufficient for completion of larval development before mid-May, after which date water temperatures up to at least 400 m O.D. may rise to harmful levels. In contrast, the larvae of P. inflatum live under constantly cool conditions and complete development in 8 months (c.f. 4 - 5 months in P. hirtipes), though some individuals may take two years. The eggs of P. hirtipes appear to have some form of resting-stage or diapause whilst those of P. inflatum do not.

The species of Simuliidae recorded from the Reserve are listed in Table 6.

(ii) Order Plecoptera:

Brown et al (1964) made a survey of Plecoptera within the Moor House National Nature Reserve. They recorded 25 of the 35 British species of Plecoptera and gave information on the nymphal habitats, altitudinal distribution and imaginal flight periods. The species list is included in Table 6.

(iii) Order Ephemeroptera:

Crisp and Nelson (1965) listed the species found during a survey of Ephemeroptera nymphs in twelve streams on the Reserve. Twelve species were found and information on the distribution and altitudinal ranges of the nymphs was obtained. When analysis of the material collected during the Freshwater Biological Association's Cow Green Project has been completed it will be possible to add to the list.

(iv) Order Trichoptera:

The presence of Rhyacophila obliterata larvae in Moss Burn is mentioned by Mackereth (1954). Nelson (1971) lists the species of adult Trichoptera taken in light traps on the Reserve (Table 6). This list cannot necessarily be regarded as comprehensive, as some species may fly only by day and may not be sampled by a light trap. The list refers only to adults and, therefore, does not necessarily imply that all the species occur on the Reserve as larvae. The list is incorporated in Table 6, though it may include some species whose larvae live in still water and which should, therefore, have been put in Table 5.

(v) Order Coleoptera:

Only one species was recorded in flowing water by Nelson (1971).

(vi) Class Mollusca:

Two species of gastropod mollusc were found in the flowing waters of the Reserve (Nelson 1971).

(vii) Order Pisces:

A brief preliminary survey of the age, growth and stomach contents of Salmo trutta and Cottus gobio in streams on the Reserve was made by Crisp(1963). This survey will be superseded by the results from a more detailed examination of fish material from Moor House during the Freshwater Biological Association's Cow Green Project.

The trout were mostly of small size and grew slowly, but some survived for at least 8 years. Few of them reached weights of more than 100 grams, though a very few individuals grew much more rapidly than their contemporaries and achieved weights of 300 grams or more. Terrestrial insects, chiefly Diptera, formed an important component of the stomach contents and were present in about 75% of the stomachs examined. Vertebrate foods, chiefly Cottus gobio, were rarely found in the stomachs of trout weighing less than 75 grams.

The growth rate of the bullheads (Cottus gobio) was comparable to that observed in the Lake District by Smyly (1957) and specimens at least years old were found on the Reserve. Most of the stomach contents were aquatic invertebrates.

4. Invertebrates on the surface of streams:

The importance of terrestrial invertebrates in the diet of trout has already been noted. Nelson (1965) and Crisp (1966) examined the catches of insects on two independent sets of sticky traps within Rough Sike. The trapping surfaces were placed in a horizontal plane about 2.5 cm above the water surface in midstream and the catches were equivalent to 70 - 80 g dry weight of insects per year. Diptera formed the bulk of the catches and Nelson (1965) gives details of the catch composition and of seasonal variation in air temperature and in quantity of insects caught.

Assuming that the catches on these traps are quantitatively and qualitatively representative of the insects at, or close to, the water surface, then the catches will give an indication of the quantities and kinds of potential surface food available to trout. Further, the summer peak of insect activity at the stream surface, observed by Nelson, corresponds closely to the time of maximum food requirement by the trout, as assessed from knowledge of the water temperatures (Crisp & Le Cren, 1970) and published information on the metabolism of salmonid fishes (Winberg, 1960).

Discussion

With few exceptions, the study of the freshwater biology of the Moor House National Nature Reserve is still at the "descriptive stage". In particular, the lists of aquatic invertebrates given in the present paper are far from comprehensive, though publication of the results of surveys made as part of the Freshwater Biological Association study at Cow Green will help to fill this gap. The evidence so far available suggests that the aquatic invertebrate fauna of the area will be rich in species. A notable example is the list of Plecoptera (Brown et al, 1964) which includes 25 of the 34 known British species.

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	Bog Pools		Mine Pools
	Dry Weather	Wet Weather	Dry Weather
pH (glass electrode)	3.62 - 4.20	4.16 - 4.24	7.20 - 8.10
Na	3.3 - 5.3	1.6 - 1.9	3.1 - 3.3
K	0.1 - 1.0	0.1 - 0.2	0.6 - 0.7
Mg	0.4 - 1.1	0.2	0.4 - 1.5
Ca	0.7 - 3.8	0.3	15.4 - 30.5
HCO_3	nil	nil	24.4 - 87.8
Cl	5.4 - 5.5	3.0 - 3.4	4.1 - 4.4
SO_4	8.0 - 19.9	3.6 - 4.3	10.5 - 19.4
NO_3-N	<0.05		-
PO_4-P	<0.004	c. 0.4	<0.004
SiO_2	0.5 - 0.6		<0.5

Table 1 Chemical composition of the water in some pools on the Moor House National Nature Reserve, from Gorham (1956). The dry weather data for bog pools are the range of values from seven pools, the wet weather values are for three pools and the ranges for mine pools refer to two pools in dry weather only. Concentrations are in mg/l.

Publication	Gorham (1956)		Crisp (1963)		Crisp (1966)	Crisp & Gledhill (1970)
Material	Single samples from Trout Beck in (a) dry weather (b) wet weather		Single samples from: Nether Hearth Sike	Trout Beck	Weekly samples from Rough Sike from May 1962 to October 1963	Means of 50 to 80 analyses of water from a mill stream in Dorset.
	(a)	(b)				
pH Glass electrode	7.8	6.2	-	-	-	8.06
Na	3.3	1.6	2.5	2.5	2.0 - 3.2	13.2
K	0.7	0.3	0.2	0.3	0.2 - 1.0	1.9
Mg	0.6	0.5	1.2	1.5	-	2.5
Ca	19.2	3.4	10.3	12.3	0.9 - 8.5	84.0
HCO_3	49.0	6.6	-	-	-	-
Cl	4.8	2.2	3.6	3.3	-	13.8
SO_4	12.0	5.6	10.5	9.3	-	30.5
NO_3-N	0.05	-	0.09	0.09	0.08 - 0.25	-
P	-	-	-	-	0.01 - 0.04	-

Table 2 Chemical composition of flowing water from the Moor House National Nature Reserve. All concentrations are in mg/l. The data in the last column of the table refer to a south-country chalk stream and are given for comparison.

Range (°C)	Black Brows Beck (Lake District, 70 m O.D.)	King's Well Beck (Lake District, 245 m C.D.)	Rough Sike (Moor House, 565 m O.D.)
0 - 4.9	16.6	9.0	45.3
5.0 - 9.9	37.7	56.8	37.4
10.0 - 14.9	37.7	29.0	14.2
15.0 - 19.9	7.7	4.7	2.9
20.0 - 24.9	0.3	0.5	0.2
>24.9	0	0	0

Table 3 Percentage of the total time in a year when the water temperature was within each of a series of 5°C temperature ranges, from Crisp & Le Cren (1970).

	Rough Sike (Moor House National Nature Reserve)		East Stoke Mill Stream (Dorset)		
	1962	1963	1964	1965	1966
January	-	13	-	2852	4415
February	-	4	-	1761	5817
March	-	307	-	1927	4028
April	-	128	-	1373	3061
May	-	106	-	1267	2260
June	-	78	-	440	631
July	-	78	-	448	326
August	-	156	-	592	364
September	-	104	-	683	-
October	-	116	387	455	-
November	87	-	396	1408	-
December	142	-	1206	4343	-
Annual totals	1368		-	17549	-

Table 4 Monthly discharges (thousands of m3) in Rough Sike, a small tributary of the Tees and in East Stoke Mill Stream, Dorset. From Crisp & Gledhill (1970).

Table 5 Lists of species of Cladocera (Subphylum Crustacea)(Heal 1963) Corixidae (order Hemiptera)(Crisp 1962) and other groups (Nelson 1971) and Coulson 1959) recorded from standing water on and around the Moor House National Nature Reserve.

Cladocera

Scapholeberis mucronata (O.F. Müller)
Bosmina coregoni v lilljeborgi (Sars)
Acantholeberis curvirostris (O.F. Müller)
Acroperus harpae Baird
Alona quadrangularis (O.F. Müller)
Alona affinis (Leydig)
Alona rustica Scott
Alonella excisa (Fischer)
Alonella nana (Baird)
Alonopsis elongata (Sars)
Chydorus spaericus (O.F. Müller)
Chydorus spaericus v coelatus Schoedler
Ceriodaphnia quadrangula (O.F. Müller)

Corixidae

Corixa wollastoni (D & S)
C. nigrolineata (Fieb.)
C. germari (Fieb.)
C. carinata (C. Sahlb.)
C. sahlbergi (Fieb.)
C. lateralis (Leach)
C. punctata (Illig.)
C. venusta (D & S)
C. praeusta (Fieb.)
C. dorsalis Leach
C. scotti (D & S)
C. distincta (Fieb)
C. semistriata (Fieb.)
C. fossarum (Leach)
Glaenocorisa propinqua (Fieb.)

Odonata

Pyrrhosoma nymphula (Sulzer)
Aeshna juncea (Linnaeus)
A. cyanea (Müller)

Hemiptera

Velia caprai Tamanini
Gerris costai (H.-S.)

Megaloptera

Sialis fuliginosa (Pictet)
S. lutaria (Linnaeus)

Diptera

Tipula melanoceros Schummel
Phalacrocera replicata L.
Erioptera fuscipennis Meigen

Coleoptera

Agabus congener (Thunberg)
A. bipustulatus (Linnaeus)
Dytiscus marginalis (Linnaeus)
Acilius sulcatus (Linnaeus)
Gyrinus natator (Linnaeus)

Mollusca

Lymnaea (Galba) truncatula (Müller)

Table 6 List of species recorded from within and around Moor House National Nature Reserve in flowing water, taken from publications by Coulson (1959), Phillipson (1967), Davies (1957, 1958, 1966), Brown et al (1964), Crisp and Nelson (1965), Nelson (1971) and Crisp (1963).

There is no known morphological distinction between the nymphs of B. tenax and B. vernus or between the nymphs of B. scambus and B. binoculatus. From what is known of the ecology of these species the Moor House specimens are most likely to be B. tenax and B. scambus.

Order Plecoptera:

Perlodes microcephala (Pictet)
Diura bicaudata (Linne)
Dinocras cephalotes (Curtis)
Perla bipunctata (Pictet)
Isoperla grammatica (Poda)
Chloroperla torrentium (Pictet)
C. tripunctata (Scopoli)
Taeniopteryx nebulosa (Linne)
Brachyptera risi (Morton)
Capnia vidua Klapalek
Leuctra nigra (Olivier)
L. inermis Kempny
L. fusca (Linne)
L. hippopus (Kempny)
L. moselyi Morton
Protonemura meyeri (Pictet)
P. praecox (Morton)
P. montana Kimmins
Amphinemura sulcicollis (Stephens)
A. standifussi Ris.
Nemoura erratica Claassen
N. cambrica (Stephens)
N. cinerea (Retzius)
N. avicularis Morton
Nemurella picteti Klapalek

Order Ephemeroptera:

Ameletus inopinatus Etn.
Rhithrogena semicolorata (Curt.)
Heptagenia lateralis (Curt.)
Ecdyonurus venosus (Fabr.)
E. torrentis Kimmins
Baëtis rhodani (Pict.)
B. pumilus (Burn.)
B. tenax Etn. /B. vernus Curt.
B. scambus Etn./B. bioculatus (L.)
Siphlonurus lacustris Etn.
Caenis rivulorum Etn.
Ephemerella ignita Poda.

Table 6 (continued)

Order Trichoptera:

Rhyacophila dorsalis (Curtis)
R. obliterata McLachlan
Glossosoma boltoni (Curtis)
Agapetus delicatulus McLachlan
Hydroptila tineoides Dalman
H. forcipata Eaton
Oxythira falcata Morton
Plectrocnemia conspersa (Curtis)
Polycentropus flavoniulatus (Pict)
Tinoides waeneri (Linne)
Oligotricha ruficrus (Scopoli)
Phryganea obsoleta McLachlan
Drusus annulatus Stephens
Ecclisopteryx guttulata (Pictet)
Limnephilus centralis Curtis
L. coenosus Curtis
L. incisus Curtis
L. luridus Curtis
L. rhombicus (Linne)
L. sparsus Curtis
Anabolia nervosa (Curtis)
Potamophylax cingulatus (Stephens)
P. latipennis (Curtis)
Halesus radiatus (Curtis)
Stenophylax permistus McLachlan
S. lateralis (Stephens)
Allogamus auricollis (Pictet)
Chaetopteryx villosa (Fabricius)
Mystacides azurea (Linne)
Sericostoma personatum Curtis
Brachycentrus subnubilus Curtis

Order Diptera

Tipula montium Egger
T. coerulescens Lackschewitz
Dicranota robusta Lundstroem
D. subtilis Loew
D. brevitarsis Bergroth
D. bimaculata Schummel
D. guerini Zetterstedt
D. exclusa Walker
Hexatoma bicolor Meigen
Limnophila mundata Loew
Erioptera lutea Meigen
E. fuscipennis Meigen
E. trivialis Meigen
Prosimulium hirtipes Fries
P. inflatum Davies
Simulium monticola Friedrichs
S. variegatum Meigen
S. dunfellense Davies
S. naturale Davies

Table 6 (continued)

Order Coleoptera:

Hydroporus melanarius (Sturm)

Class Mollusca:

Ancylastrum fluviatile (Müller)
Lymnaea peregra (Müller)

Order Pisces:

Salmo trutta L.
Cottus gobio L.
* Phoxinus phoxinus (L.)

* Recorded by the Freshwater Biological Association Cow Green Project in the Tees at NY/790308. This Station is within the original boundary of the Moor House National Nature Reserve, but is now owned by the Tees Valley & Cleveland Water Board.