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Diversity of Enchytraeidae (Annelida: Clitellata) in habitats within the Magnesian Limestone Plateau of County Durham, U.K.

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Abstract

Sampling of various terrestrial habitats (woodland, grassland, sea edge) of Hawthorn Dene and surroundings within the Magnesian Limestone plateau of County Durham yielded 17 species of Enchytraeidae and the naidid/tubificid *Rhyacodrilus falciformis*. Five enchytraeid species were recorded for the first time in the British Isles: *Fridericia auritoides*, *F. maculatiformis*, *F. semisetosa*, *F. sylvatica*, and *F. isseli*.

Keywords: soil fauna, annelids, Oligochaeta, *Rhyacodrilus*, England

1. Introduction

A brief study of the Enchytraeidae of a variety of habitats within the Magnesian Limestone plateau of County Durham, U.K. was undertaken as part of the 8th International Symposium on Enchytraeidae held in Durham. Fifteen delegates from eight European countries – Czechia, Poland, Estonia, Germany, Greece, Spain, the Netherlands and the U.K. – participated in field work and in the taxonomic workshop which followed.

The enchytraeid fauna of Britain is not well-known, despite numerous contributions of H. Friend on the topic, published between 1891 and 1928 (Černosvitov 1941). However, Friend's records and descriptions of species have been considered unreliable ever since, and not more than 3 enchytraeid species out of 70 described by Friend are currently accepted. Further studies on British enchytraeids are especially scarce at non-acidic terrestrial sites (e.g. Černosvitov 1945), which use to harbour the greatest diversity of species. Work after the revision of Nielsen & Christensen (1959) focused on species-poor assemblages in acidic soils (e.g. O'Connor 1963, Springett 1970). In northern England enchytraeids were intensively

studied in many upland habitats of the Pennines and North Yorkshire Moors. Most sites were bogs with peat and of those with mineral soil very few had a soil pH above 6 (Standen 1980). Grassland sites studied in northern England had typically a pH below or around 5 (Standen, 1982). Enchytraeid assemblages of woodlands in northern England have not been studied at all.

The objective of the work was to add to the knowledge of the more diverse species assemblages present in limestone soils and so give a better idea of the total species richness of this group in Britain. The enchytraeid fauna was sampled from as large a range of habitats as possible.

2. Methods

Study site

The Magnesian Limestone plateau occupies the eastern part of County Durham in north-east England and is bordered to the east by the North Sea. The majority of the plateau has been cultivated for arable crops for over 100 years. However the plateau is dissected west to east by a number of steep sided valleys known locally as 'denes' and these have escaped intensive cultivation and remain covered with semi-natural woodland. From the beginning of the twentieth century deep mines were developed along the coastal edge to extract coal. Colliery waste was removed by overhead 'flights' and dumped at sea. Some of the waste material accumulated on the beaches forming a series of artificial dunes and slacks which supported a wealth of vegetation and invertebrates. When the mines were closed in the 1990's the sea began to encroach on the artificial dunes and most of this habitat had disappeared by the time of the study. In the year 2000 European Union funding was obtained by Durham County Council for the 'Turning the Tide' project to remove the mine buildings and colliery waste. Some of the strip of land between the north-south railway line and the cliff had been arable, but patches of herb-rich undisturbed semi-natural grassland remained. Seeds from this grassland were used to restore the arable land.

The site chosen for study was Hawthorn Dene (Grid reference: NZ427458) and surrounding area as it contains a variety of habitats ranging from woodland, old and restored grassland, marine cliff-top vegetation and beach (Fig. 1).

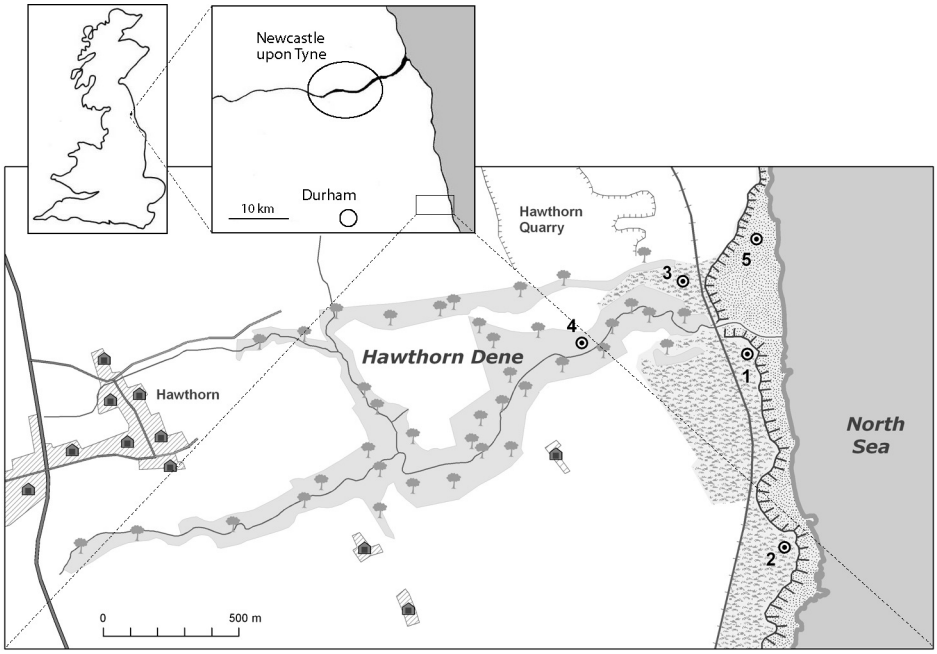

Fig. 1 Sampling sites in Hawthorn Dene and surrounding area (County Durham, Northern England, U.K.): 1: Shippersea; old grassland; 2: restored grassland; 3: meadow; 4: woodland incl. *Equisetum* marsh; 5: sea edge (cliff base and beach).

Sampling and identification

Sampling was carried out on 4 July 2008. Soil cores were collected with a corer 0.001 m^2 from woodland (soil and litter under *Fraxinus excelsior* and *Taxus baccata,* dead wood); marsh (*Equisetum* marsh within woodland); grassland (old grassland, restored grassland, meadow) and coastal (cliff base, beach). Four cores from each habitat were extracted overnight in wet funnels. The worms extracted from the soil were used as the basis of a two-days workshop on the taxonomy of Enchytraeidae. Enchytraeids and other annelids of small body size were identified alive under the light microscope. Some material was fixed in heated Bouin´s fluid for further study and the results incorporated into Tab. 1. Reference specimens will be deposited at the British Museum of Natural History, London.

Tab. 1 Enchytraeid and naidid/tubificid species recorded in terrestrial habitats of Hawthorn Dene and its surroundings (four soil cores per habitat, each 0.001 m² in area, taken on 4 July 2008).

	Grassland			**Woodland**				**Sea edge**	
	Shipper-sea, old grassland	Restored grassland	Meadow	Under *Fraxinus excelsior*	Under *Taxus baccata*	Dead wood	*Equisetum* marsh	Beach	Cliff base
Enchytraeidae									
Achaeta bohemica (Vejd.) sensu Niels. & Christ. (1959)	x	x	x	x	x				
Achaeta eiseni Vejdovský, 1878							x		
Buchholzia appendiculata (Buchholz, 1862)							x		
Cernosvitoviella sp. 1				x			x		
Enchytraeus buchholzi s.l. Vejdovský, 1879		x	x	x			x		
Enchytronia parva Nielsen & Christensen, 1959	x								
* *Fridericia auritoides* Schmelz, 2003	x			x		x			
Fridericia bisetosa (Levinsen, 1884)				x					
Fridericia galba (Hoffmeister, 1843)		x				x			
**Fridericia maculatiformis* Dózsa-Farkas, 1972	x								
Fridericia parathalassia Schmelz, 2002									x
Fridericia paroniana Issel, 1904		x		x					
* *Fridericia semisetosa* Dózsa-Farkas, 1970		x			x				
Fridericia sp. indet.								x	
* *Fridericia sylvatica* Healy, 1979	x	x	x	x	x	x			
* *Fridericia isseli* Rota, 1994	x	x		x			x		
Henlea cf. *perpusilla* Friend, 1911							x		
Marionina argentea (Michaelsen, 1889)		x		x					
Naididae/Tubificidae *Rhyacodrilus falciformis* Bretscher, 1901	x						x		
Number of species	7	7	3	9	3	3	7	1	1

3. Results

In total 17 species of enchytraeids were identified, and one species of naidids/tubificids – *Rhyacodrilus falciformis* (Rhyacodrilinae) – was found in the samples (Tab. 1). (Nomenclatural note: The unification of Tubificidae and Naididae into one family – Naididae – is not accepted by all authors of this paper.) Of these, 12 species were collected from the three combined grassland sites, 11 species from the three combined woodland sites/microhabitats, 5 species from the *Equisetum* marsh site (within the woodland), and only 2 species from the two combined sea-edge sites.

4. Discussion

Fifty-one species of enchytraeids are listed for the British Isles in the Fauna Europaea (Rota 2007, not updated since 2003). Here we record five more enchytraeid species, all of one genus: *Fridericia auritoides*, *F. maculatiformis*, *F. semisetosa*, *F. sylvatica*, and *F. isseli*. Below we give some comments on the species found.

Achaeta bohemica (Vejdovský, 1879), sensu Nielsen & Christensen, 1959

Widespread in Europe. Grassland and forest soils with humus form Mull. In fresh mineral soil of average moisture, pH-range ($CaCl_2$) 4.2–7.4.

Achaeta eiseni Vejdovský, 1878

Widespread in Europe. Grassland and forest soils with humus form Mull. In fresh mineral soil of average moisture, pH-range 4.2–7.4.

Buchholzia appendiculata (Buchholz, 1862)

Widespread in Europe from southern Scandinavia to the Mediterranean Region. Forest, grassland, urban sites, mainly litter dweller. Dominating species in Mediterranean forests, where it replaces *Cognettia sphagnetorum*. Wet to fresh soils, pH-range 4.2–7.4. Quick recovery after drought due to reproduction by fragmentation (r-strategist).

***Cernosvitoviella* sp.**

All *Cernosvitoviella* species are more or less restricted to moist and wet soils or live in aquatic surroundings.

Enchytraeus buchholzi Vejdovský, 1879

Widespread in Europe, species complex. All kinds of land use, often dominant at disturbed and eutrophicated sites (r-strategist). Wet to fresh soils, pH-range 4.2–7.4.

Enchytronia parva Nielsen & Christensen, 1959

Widespread in Europe. Grassland and forest, preferring fresh mineral soil of average moisture. Weakly acid-tolerant species, pH-range ($CaCl_2$) 3.4–5.8.

Fridericia auritoides Schmelz, 2003

Known from Ireland, Denmark, Italy, U.S.A., no records from central Europe so far. Perhaps an atlantic element of the British fauna.

Fridericia bisetosa (Levinsen, 1884)

Widespread in Europe, known also from Brazil and the U.S.A. Wide range of land uses. Wet to fresh soils, pH-range 4.2–7.4.

Fridericia galba (Hoffmeister, 1843)

Widespread in Europe, known also from the U.S.A. Wide range of land uses. Wet to fresh soils, pH-range 4.2–7.4.

Fridericia isseli Rota, 1994

Widespread in Europe, known also from Morocco and Turkey. All kinds of land use. Wet to fresh soils, also in temporarily dry soils, pH-range 4.2–7.4.

Fridericia maculatiformis Dózsa-Farkas, 1972

Widespread in Europe. All kinds of land use. Mineral soil, wet to fresh soils, pH-range 4.2–7.4.

Fridericia parathalassia Schmelz, 2002 = *F. callosa* (Eisen) sensu Nielsen & Christensen (1959)

Widespread in European marine coastal habitats: sea cliffs, sand dunes, upper salt marsh, wrack beds, brackish water; chiefly terrestrial. The most salt-tolerant *Fridericia* species. The single site where it was recorded (cliff base) had been sampled with the purpose to find this species. Its presence supports the claim in Schmelz (2003: 275) that *F. parathalassia* is common along the European coast line.

Fridericia paroniana Issel, 1904

Widespread in Europe, known also from North Africa and the U.S.A. All kinds of land use. Wet to fresh soils, also in temporarily dry soils, pH-range 4.2–7.4.

Fridericia semisetosa Dózsa-Farkas, 1970

Widespread in Europe, known also from Japan. Forest and grassland.

Fridericia sylvatica Healy, 1979

Widespread in Europe. All kinds of land use. Loamy and sandy soils, wet to fresh soils, pH-range 4.2–7.4.

Henlea perpusilla Friend, 1911

Holarctic distribution. Wide range of habitats. Dominant species in Arctic tundra, floodplains and marsh soils. Species complex. Wet to fresh soil conditions, pH-range 4.2–7.4, slightly salt-tolerant.

Marionina argentea (Michaelsen, 1889) sensu Nielsen & Christensen (1959)

Holarctic distribution. Wide range of habitats. Wet to damp soils, often in deeper, badly aerated soil layers, pH-range 4.2–7.4, slightly salt-tolerant.

Rhyacodrilus falciformis Bretscher, 1901 (Tubificidae/Naididae)

This tubificid/naidid species (see above), originally described from freshwater habitats (lakes and springs), is often found in wet and damp soils, where it lives in deeper, badly aerated layers. Widespread in Europe. Forest, grassland, arable land, pH-range 4.2–7.4.

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