EIGHT SPECIES OF AQUATIC OLIGOCHAETA NEW FOR THE NETHERLANDS (ANNELIDA)

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Aquatic oligochaetes are a poorly studied group of invertebrates in the Netherlands, worms are not very popular. Even the well known earthworms are relatively poorly known, but for the aquatic oligochaetes no review exists for the species in the Netherlands. In total approximately 158 species are known in this country, but many more are expected to be found. Here we report on eight species, which had not been recorded before. One species, the North American *Limnodrilus maumeensis* had even not been recorded from Europe before. The ecology and distribution of these species is described in detail.

INTRODUCTION

The Oligochaeta belong to the Annelid worms, a large phylum with about 9000 species globally. The phylogenetic relations within the phylum remain almost completely unresolved. Several attempts have been made to solve the problem but without any success. Recently the subphylum Clitellata was split into four classes: Oligochaeta, Branchiobdellidae, Acanthobdellea and Hirudinea (Gelder & Brinkhurst 1990, Madill et al. 1990 in Neubert & Nesemann 1999). Timm (1999) adjusted the classification and recognized the Oligochaeta and Hirudinea as subclasses of the Class Clitellata (table 1). The position of the family Aelosomatidae is still under discussion, some even consider it as a family of Polychaeta.

Oligochaetes dwell in all kinds of habitats, marine, fresh water as well as terrestrial. They usually inhabit the top layer of soil and feed primarily on detritus and algae, but some species inhabit the stem of vascular plants, others are parasitic on aquatic snails or crayfish. The most familiar Oligochaeta are the earthworms or Lumbricidae. In the Netherlands, the Oligochaeta are represented by eight families. Some are typically terrestrial, such as the Lumbricidae and most species of Enchytraeidae (potworms). The other families are predominantly aquatic or semi-aquatic. The Branchiobdellidae are found mainly on freshwater astacid crayfish.

It is not exactly known how many species actually occur in the Netherlands, possibly because identifying oligochaetes never has been popular. Mol (1984) estimated the number of fresh water species to be 82 (including the Aelosomatidae and Branchiobdellidae), adding that the number may still rise. In some classifications the latter two families no longer are arranged under the Oligochaeta. The number of Enchytraeidae is probably much higher than the 45 species listed by Gunst (1965), who only collected material in a few localities. Since his publication hardly any records have been added. Also no Lumbricidae species have been added to the ca. 24 listed by Van Rhee (1970) in the first identification key and checklist for the Dutch earthworms.
In this paper we record eight aquatic species for the first time from the Netherlands. The distribution and ecology of these is described in detail. Of these, *Rhynchelmis limosella* has been included in Mol (1984) and *Psammoryctides moravicus* and *Rhyacodrilus falciformis* in Verdonschot et al. (1992) but no details have ever been published. So, together with the other

Phylum Annelida
- Class Polychaeta
- Class Aphanoneura
  - Family Aeolosomatidae
- Class Clitellata
  - Subclass Oligochaeta
    - Family Naididae
    - Family Tubificidae
    - Family Propappidae
    - Family Enchytraeidae
    - Family Lumbriculidae
    - Family Lumbricidae
    - Family Haplotaxidae
    - Family Branchiobdellidae
  - Subclass Hirudinea
    - Family Glossiphoniidae
    - Family Piscicolidae
    - Family Hirudinidae
    - Family Erpobdellidae

Table 1
Classification of the Annelida; only taxa present in the Netherlands are listed (according to Timm 1999).
Tabel 1
Systematische lijst van de Annelida met Nederlandse vertegenwoordigers (volgens Timm 1999).

metal	maximum concentration (mg/kg dry)
Cd	9.8
Hg	12.0
Cu	310.0
Ni	40.0
Pb	350.0
Zn	3100.0
Cr	160.0
As	80.0

Table 2
Maximum concentration of heavy metals in the sediment of the River Hollandse IJssel in which *L. maumeensis* has been collected (source: Doze et al. 1999, 2001).
Tabel 2
Maximale concentratie van zware metalen in het sediment van de Hollandse IJssel waarin *L. maumeensis* is gevonden (bron: Doze et al. 1999, 2001).

new species presented here, a total of 158 species is now known for the Netherlands.
There is a large number of unpublished documents with lists of species from various localities in the Netherlands, which also list several other previously unrecorded species, especially within the family Tubificidae. Based on these documents the number of Tubificidae species in the Netherlands is estimated to be 34, which could raise the total number of Oligochaeta to 168.
Identifying oligochaetes, and particularly Enchytraeidae, is difficult and normally requires study of the anatomy. This probably caused the absence of Dutch literature on oligochaetes. In the early 20th century hardly any source existed for identification of oligochaetes, except Ude (1929) and Michaelsen (1909). Since then, many species have been described by specialists as Bretscher, Michaelsen, Hrabě and Brinkhurst. In 1963 and 1971, Brinkhurst published two guides for the identification of British Oligochaeta, followed in 1971 by a handbook on the taxonomy of Oligochaeta of the world (Brinkhurst & Jamieson 1971). In addition, there are many papers on Oligochaeta from Eastern Europe, Britain, Germany and North America. The recent outstanding identification key for the Estonian Oligochaeta (Timm 1999) can also be used in Western Europe, since only a few species are missing.

CHECKLIST

The newly recorded species are classified as follows:

Family Naididae
- Subfamily Naidinae
  - Genus *Nais* O.F. Müller, 1773
    - *Nais behningi* Michaelsen, 1923

Family Tubificidae
- Subfamily Tubificinae
  - Genus *Limnodrilus* Claparède, 1862
    - *Limnodrilus maumeensis* Brinkhurst & Cook, 1966
  - Genus *Potamothrix* Vejdovský & Mrazek, 1902
    - *Potamothrix vejdovskyi* (Hrabě, 1941)
  - Genus *Psammoryctides* Hrabě, 1964
    - *Psammoryctides moravicus* (Hrabě, 1934)

Subfamily Rhyacodrilinae
Genus *Monopylephorus* Levinsen, 1884
Monopylephorus irroratus (Verrill, 1873)
Genus *Rhyacodrilus* Bretscher, 1901
Rhyacodrilus falciformis Bretscher, 1901

Family Propappidae
Genus *Propappus* Michaelsen, 1905
Propappus volki Michaelsen, 1916

Family Lumbriculidae
Genus *Rhynchelmis* Hoffmeister, 1843
Rhynchelmis limosella Hoffmeister, 1843

DESCRIPTION OF THE SPECIES

Nais behningi

Confirmed Dutch records: river Maas, Meers, 3.v.1993 (64 ex); river Maas, Maaseik, 4.v.1993 (1 ex); river Maas, Berg, 22.vi.1994 (5 ex); river Maas, Grevenbicht, 24.vi.1994 (43 ex); river Maas, Meers, 22.vi.1994 (13 ex); river Maas, Maasband, 29.v.1997 (2 ex) (coll. AquaSense, coll. Klink).

Identification

Brinkhurst & Jamieson (1971), Sperber (1950), Timm (1999).

Distribution (fig. 1)

This species has been found in the Netherlands only in the river Maas along the Dutch-Belgian border. Its main distribution area lies in eastern and central Europe.
There are records from Czechoslovakia (Sperber 1950, Russev 1998,Wolgemuth & Schenkova 1999), Russia (Sperber 1950), Austria (Uzunov & Russev 1985, Moog et al. 1994, Russev 1998), France: river Rhone (Lafont 1983, Juget 1984), Germany: river Rijn between Basel and Breisach and between Düsseldorf and Emmerich, river Isar near Munich and river Elbe (Wachs 1967, Schmelz & Schöll 1992, Petermeier et al. 1996, Schöll & Balzer 1998), the river Danube in Hungaria, former Yugoslavia, Bulgaria and Rumania (Russev 1998), northern Italy (Di Chiara Paoletti et al. 1996), Estonia: Lake Peipsi (Timm 1999), western Russia: Rivers Volga, Hoper (noted as 'Khopra') and Pripyat and Lake Ladoga (Mordukhai-Boltovskoi 1979, Fomenko 1980, Ekaterininskaya 1980, Slepukhina 1984, AquaSense 1998, 1999), eastern Russia: Amur river basin and Primorsk Region (Sokol'skaya 1980), U.S.A (Brinkhurst & Jamieson 1971, Wetzel 2000b) and Canada (Williams & Hynes 1974, Wiens et al. 1975). In Bulgaria, it has been recorded from nearly every river and various stagnant waters in the western part of the country, from the Danube area and its branches to the south in the Aegean area. There are no records from the Black Sea area in eastern Bulgaria (Uzunov & Kapustina 1993). Recent data show that the distribution area of *Nais behningi* may be regarded as an ice age relic distribution (Europe, Far East) (Sokol'skaya 1980).

Figure 1
Distribution of *Nais behningi*.
Figuur 1
Verspreiding van *Nais behningi*.

Ecology

Nais behningi occurs in fresh water, usually in large rivers. According to Ekaterininskaya (1980) it belongs to the typical fluvial fauna, but it is also found in lakes like Lake Peipsi and Lake

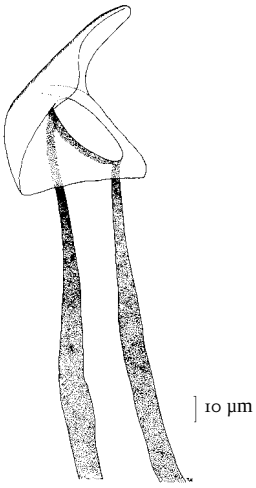

Figure 2
Limnodrilus maumeensis: Distal end of penis-sheath (sample 307139, river Hollandse IJssel, Moordrecht, 27.IV.1999; Coll. AquaSense, Amsterdam).
Figuur 2
Limnodrilus maumeensis: Distale einde van de penis-schede (monsternummer 307139, Hollandse IJssel bij Moordrecht, 27.IV.1999; Coll. AquaSense, Amsterdam.

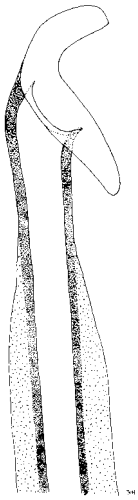

Figure 3
Limnodrilus cervix: Distal end of penis-sheath (sample 307133, river Hollandse IJssel, Moordrecht, 28.IV.1999. Coll. AquaSense, Amsterdam).
Figuur 3
Limnodrilus cervix: Distale einde van de penis-schede (monsternummer 307133, Hollandse IJssel bij Moordrecht, 28.IV.1999. Coll. AquaSense, Amsterdam).

Ladoga. In the Austrian part of the Danube it is only found in backwaters of impoundments (Moog et al. 1994) and in the Elbe only in the middle reaches (Petermeier et al. 1996, Schöll & Balzer 1998). In the river Isar the species was found on gravely bottom (Wachs 1967) and in Lake Ladoga it occurs under oligotrophic conditions (Slepukhina 1984). The species prefers mineral substrates like coarse sand and pebbles.

Status in the Netherlands
Rare, river Maas only.

Limnodrilus maumeensis

Confirmed Dutch records: river Maas, Rijkelse Bemden, 11.IX.1996 (4 ex); 28.VIII.1997 (12 ex); Hollandse IJssel, Balkengat, 29.IV.1999 (2 ex); 18.V.1999 (14 ex); 31.V.2001 (5 ex); Hollandse IJssel, Moordrecht, 27.IV.1999 (32 ex); 28.IV.1999 (25 ex); 25.V.2000 (2 ex); 30.V.2001 (3 ex); 05.VI.2001 (2 ex); Hollandse IJssel, Nieuwerkerk a/d IJssel, 22.IV.1999 (14 ex); 27.IV.1999 (8 ex); 19.V.1999 (1 ex); 18.V.2000 (3 ex); 24.V.2000 (3 ex); 5.VI.2000 (11 ex); 7.XI.2001 (36 ex); Hollandse IJssel, Capelle, 27.VI.2001 (1 ex); Oude Maas outside Spijkenisse harbour between KM 1002 and 1003, 15.III.2001 (11 ex) (coll. AquaSense).
Unconfirmed Dutch records of *L. cervix* Brinkhurst, 1963 (material lost): outlet of the 'Flevocentrale' (Hadderingh 1973); Oudezijdsvoorburgwal, Amsterdam, 09.IX.1996 (8 ex); 07.IX.1999 (7 ex); Zorgvliet, Amsterdam, 09.IX.1996 (2 ex); Florapark, Amsterdam, 11.IX.1996 (4 ex); Hartelkanaal, 5.XI.1997 (28 ex); Korendijkse slikken, 27.XI.1997 (3 ex).
Records of *L. cervix* collected by A. Klink from the river Maas near Borgharen, 24.VI.1992 (1 ex); 29.VI.1992 (1 ex) reported as '*L.* cf. *cervix*') belong to *L. claparedeianus* Ratzel, 1868.

Identification

Brinkhurst & Cook (1966), Brinkhurst & Jamieson (1971), Stimpson et al. (1982).
Limnodrilus maumeensis was first described from material collected in the North American Great Lakes: Lake St. Clair, Lake Erie and Lake Huron (Brinkhurst & Cook 1966). The shape of the penis-sheaths is the only reliable characteristic to separate *L. maumeensis* from other *Limnodrilus* species. The sheath has a very thick wall over almost its entire length, but is narrowed abruptly just before the hood. At that point, one side of the sheath becomes thinner than the other side, forming a remarkable bend in the sheath.
In some individuals, the penis-sheaths are even almost curved backward. The hood is large and triangular and has a distinctive distal lobe (fig. 2). In the Hollandse IJssel the penis-sheath length varies between 290-1750 µm. The penis-sheath of the similar *L. cervix*, which also occurs in the Netherlands, has two major differences: the sheath has two distinct layers and the hood has two projections, one pointing beyond the shaft and one pointing back along the shaft (fig. 3). The largest penis-sheath of *L. cervix* from the Hollandse IJssel measured about 1875 µm.

Distribution

The records of *L. maumeensis* from the Netherlands are the first for the Palaearctic region. Most records of the species originate from harbours. Therefore, the presence in the river Maas (Rijkelse Bemden, province Limburg) in the southeastern part of the Netherlands is remarkable for it is not in the close vicinity of any harbour. It is unclear how the occurrence in the river Maas can be explained. *Limnodrilus* species do not actively disperse by swimming upstream. To reach the Limburg location in the southeastern part of the Netherlands, from its supposed population in the Rotterdam area, it would have to swim upstream. This would be an incredible journey. The species may also originate from the port of Antwerp (Belgium) through the Albertkanaal.
Further research, for instance in Antwerp, may solve this problem.
In other European countries, the species is not known. It is possible that *L. maumeensis* has not always been recognized and has been confused with the similar *L. claparedeianus* or even *L. cervix*. *Limnodrilus maumeensis* so far is only known from the United States: Great Smoky Mountains (Wetzel 2000b), Great Lakes: Lake St. Clair, Lake Erie, Lake Huron (Brinkhurst & Cook 1966, Hiltunen 1969, Brinkhurst & Jamieson 1971, Stimpson et al. 1982, Herdendorf 1986), Illinois (Stimpson et al. 1982, Wetzel 2000a), Mississippi River and Louisiana (Stimpson et al. 1982). *Limnodrilus cervix* has been recorded from the United States (Brinkhurst & Jamieson 1971, Hiltunen 1969, Stimpson et al. 1982, Wetzel 2000), Canada (Stimpson et al. 1982), Rumania (unconfirmed record, pers. comm. T. Timm), England (Brinkhurst 1963, Kennedy 1965) and Scandinavia (Milbrink 1983). *Limnodrilus claparedeianus* is a Holarctic species.

Ecology

In the United States *Limnodrilus maumeensis* has only been reported from habitats subject to high degrees of organic pollution. It is frequently reported as an abundant species in polluted harbours and river mouths (Stimpson et al. 1982). This is in line with the Dutch records. Both rivers Hollandse IJssel and Oude Maas are very close to the port of Rotterdam. The Maas at Rijkelse Bemden, Hollandse IJssel and Oude Maas are all more or less polluted. In the Hollandse IJssel the species has shown to be very tolerant to heavy metals. They even tolerate high concentrations of zinc of up to 3,100 mg/kg dry. The sediment in which the species has been found contains also high concentrations of other metals (table 2).

Status in the Netherlands

Rare, locally common.

Potamothrix vejdovskyi

Confirmed Dutch records: Reservoir 'De Gijster', Brabantse Biesbosch, 7.VII.1997 (2 ex); 19.VII.1999 (3 ex); 18.I.2000 (9 ex); 8.V.2000 (14 ex); Reservoir 'Honderd en Dertig', Brabantse Biesbosch, 7.VII.1997 (8 ex); 1.IX.1997 (10 ex); 11.V.1998 (2 ex); 7.IX.1998 (1 ex); 18.I.1999 (2 ex); 20.IX.1999 (6 ex); Reservoir 'Petrusplaat', Brabantse Biesbosch, 18.I.1999 (1 ex); 15.I.2001 (2 ex) (coll. NV Waterwinningbedrijf Brabantse Biesbosch); river Oude Maas, Kuipersveer KM 986, 20.III.2001 (3 ex); river Oude Maas west of Dordrecht KM 978, 22.III.2001 (17 ex); Hollandse IJssel, Nieuwerkerk aan de IJssel, 7.XI.2001 (2 ex) (coll. AquaSense)

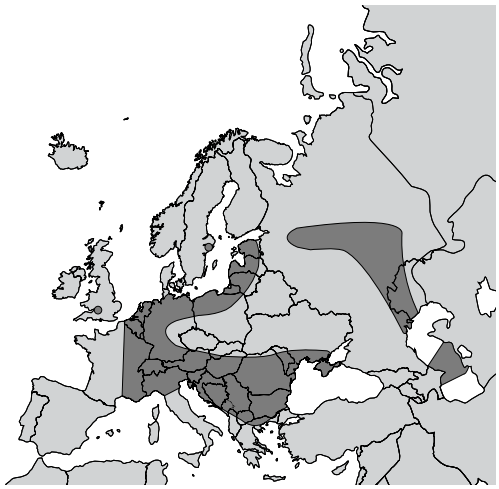

Figure 4
Distribution of *Potamothrix vejdovskyi*.
Figuur 4
Verspreiding van *Potamothrix vejdovskyi*.

Identification

Brinkhurst & Jamieson (1971), Timm (1999).

Distribution (fig. 4)

In Europe, this species seems almost to be confined to a few river basins, the Danube and Volga. Scattered throughout Europe it is further known from a few rivers in France (Rhone), northern Italy, Germany (Rijn), Poland, Latvia and Estonia (Pärnu River) and lakes in Sweden and Switzerland. There are also few records from the Caspian Sea. In the Netherlands it is restricted to a few places in the lower Rijn and Maas.

There are records from Estonia: mouth of the Pärnu River (Timm 1999), Russia: upper Volga, Volga Delta and Dnieper-Bug estuary (Mordukhai-Boltovskoi 1979, Finegenova & Poddubnaja 1990), Scandinavia (Milbrink 1978, Milbrink 1983), Sweden (Timm & Erseus 1997, Milbrink 1978, 1994; the latter cites the species as a recent immigrant, now inhabiting the eastern part of Lake Mälaren), Germany: in the upper region of the river Rijn between Breisach and Karlsruhe (Schmelz & Schöll 1992), Austria: Danube (Uzunov & Russev 1985, Brinkhurst & Jamieson 1971, Russev 1998), Switzerland: Lake Geneva and Lake Neuchâtel up to a depth of 150 m (Lang 1984, Lang et al. 1996, Brinkhurst & Jamieson 1971), France: in the underflow of the Upper Rhone (Juget 1984), northern Italy (Di Chiara Paoletti et al. 1996) and the river Danube in Slovakia, former Yugoslavia, Bulgaria and Rumania (Russev 1998). Brinkhurst & Jamieson (1971) also mention the species from Moldova, close to the Black Sea. Outside Europe it is known from the United States: Great Smoky Mountains (Wetzel 2000b), Illinois (Wetzel 2000a), Ohio, Virginia, Ontario (Kathman & Brinkhurst 1998) and the Great Lakes (Brinkhurst & Jamieson 1971, Stimpson et al. 1982).

Ecology

Potamothrix vejdovskyi occurs in fresh as well as in slightly brackish waters (Timm 1999). In Scandinavian lakes it usually occurs under mesotrophic and eutrophic conditions (Milbrink 1978) but the species tolerates considerable organic pollution (Milbrink 1983). In Switzerland it was found in the meso-eutrophic Lake Geneva between depths of 0-100 m but still it is considered a species of mesotrophic conditions (Lang 1984, Lang et al. 1996, Brinkhurst 1964). In North America it is commonly found and often abundant in mesotrophic waters of the St. Lawrence

Great Lakes and its drainage (Stimpson et al. 1982). In the Netherlands the species has only been found in eutrophic waters.

Status in the Netherlands
Rare.

Psammoryctides moravicus

Confirmed Dutch records: river Waal, Leeuwen, 31.v.1994, (1 ex); river Amstel near bridge at Vrouwenakker, 04.iv.2000 (1 ex); river Nieuwe Merwede, 23.iii.2000 (2 ex) (coll. AquaSense).

Identification
Brinkhurst & Jamieson (1971), Timm (1999).

Distribution (fig. 5)
Its main distribution area lies in central- and eastern Europe. The species is quite common in the Danube river basin.
There are records from the Netherlands (Verdonschot et al. 1992), Estonia: river Narva (Timm 1999), Russia: Rivers Volga and Oka, Czechoslovakia: river Vltava (Moldau) and Dyje, Macedonia: 'near Lake Ochrid' (Brinkhurst & Jamieson 1971, Wolgemuth & Schenkova 1999), Lake Dojran (Brinkhurst 1964), Austria: Danube (Uzunov & Russev 1985, Moog et al. 1994, Russev 1998), France: river Maas near Tilly, Lorrain (coll. AquaSense), Germany: river Elbe (Petermeier et al. 1996, Schöll & Balzer 1998), Bulgaria: river Jantra (Janeva & Russev 1997), Danube and its tributaries and rivers Tundzha and Maritsa in the Aegean area (Uzunov & Kapustina 1993, Brinkhurst & Jamieson 1971), the river Danube in Slovakia, Hungaria and former Yugoslavia (Russev 1998).

Ecology
This fluvial species is known from various rivers, especially in the Danube river basin. In the Elbe *Psammoryctides moravicus* especially occurs in the middle reaches (Petermeier et al. 1996, Schöll & Balzer 1998, Janeva & Russev 1997, Fomenko 1980). In the Danube it was recorded with a density of up to 3050 ind./m^2 (Uzunov & Russev 1985) and occurred only in backwaters of impoundments (Moog et al. 1994).

Figure 5
Distribution of *Psammoryctides moravicus.*
Figuur 5
Verspreiding van *Psammoryctides moravicus.*

Status in the Netherlands
Very rare.

Monopylephorus irroratus

Synonyms:
Postiodrilus sonderi Boldt, 1926
Monopylephorus trichochaetus Ditlevsen, 1904

Confirmed Dutch records: Hollandse IJssel, Moordrecht, 31.v.2000 (2 ex) (coll. AquaSense).

Identification
Brinkhurst & Jamieson (1971), Brinkhurst (1963, 1971, 1982) and Baker & Brinkhurst (1981). Figure 8.34B in Brinkhurst & Jamieson (1971) and the description of *M. irroratus* in Brinkhurst (1971: 33) cannot be used for a positive identification of specimens to be *M. irroratus*. A large range of variation has been found in several populations of

Monopylephorus species with thin twisted hair setae that were previously identified as *M. irroratus*. There are at least two, and perhaps four other species with thin twisted hair setae, all with limited distribution: *M. aucklandicus* (Benham, 1909) from the south Pacific coast and *M. cuticulatus* Baker & Brinkhurst, 1981 from the northeast Pacific coast (Baker & Brinkhurst 1981). A revision of the genus *Monopylephorus* is given by Baker & Brinkhurst (1981).

Distribution (fig. 6)

In the Netherlands there is one confirmed record from the Hollandse IJssel, a canalized tributary of the Nieuwe Maas, and one unconfirmed record from the Markiezaat, a part of the estuary of the Schelde in the southwest of the Netherlands (pers. comm. D. Tempelman). Outside the Netherlands, there are records from France: Wimereux (Pas de Calais), Germany: the river Werra near Albungen, Schlei (a bay in the Baltic Sea between Kiel and Flensburg) and from the Oldesloer Salzgebiet near Lübeck, Belgium: river Schelde near Ouden Doel, the United States: Massachusetts (Cape Cod) and Great Britain: river Irwell and two unconfirmed records from the river Cart, Renfrewshire and river Weaver, Cheshire (Konietzko 1953, von Bülow 1955, 1957, Wachs 1963, Brinkhurst & Jamieson 1971, Brinkhurst 1982, Baker & Brinkhurst 1981, Baker 1984, pers. comm. T. Timm). There is also an unconfirmed record from Denmark (type material of *Monopylephorus trichochaetus*). Records from the Pacific coast of U.S.A, Canada and Alaska appear to be another species: *M. cuticulatus* (Baker & Brinkhurst 1981).

Figure 6
Distribution of *Monopylephorus irroratus.*
Figuur 6
Verspreiding van *Monopylephorus irroratus.*

Ecology

Monopylephorus irroratus occurs in marine and brackish waters (pers. comm. T. Timm). According to Brinkhurst (1963, 1982) and Baker & Brinkhurst (1981) it is a coastal-estuarine species and is usually found in the marine littoral, which makes the record from the fresh water river Hollandse IJssel all the more remarkable. Von Bülow (1955, 1957) collected the species in Schlei in water with salt concentrations of 2.0-5.3‰, but noted that the type material of *Postiodrilus sonderi* was collected by Boldt in 20‰, so that this species must be tolerant for high salt concentrations. When Konietzko (1953) collected his specimen of *P. sonderi* in the silt from the bottom of the river Schelde, the salt concentration of this part of the Schelde varied between 1.75-5.32‰. The river Werra (Germany) is artificially salted in the middle reaches by drainage from the potassium mines. Consequently, at the sampling location near Albungen the salt concentration reaches up to 10‰ (Wachs 1963). *M. irroratus* was found by Von Bülow (1955, 1957) between *Vaucheria*, *Enteromorpha*, *Typha* and *Phragmites* vegetation, under stones and in silt. The similar marine species *M. cuticulatus* has shown, in experimental studies, to be tolerant (96h LC_{50}) for a black liquor concentration of the sediment of nearly 15%, cadmium up to 135 mg/l and sewage sludge up to 35%. This species is also very tolerant to anoxia and even survived an average of 42 days in anoxia (Chapman & Brinkhurst 1984). At the sampling location in the Hollandse IJssel the sediment contained high concentrations of heavy

metals, especially zinc (200 mg/kg dry) and cadmium (1.1 mg/kg dry). An increased amount of PCB (29 µm/kg dry), PAHs (1.19 mg/kg dry) and mineral oils (95 mg/kg dry) was also measured (source: Doze et al. 2001).

Status in the Netherlands
Very rare.

Rhyacodrilus falciformis

Confirmed Dutch records: river flood plain of the river Rijn 'Blauwe Kamer', Rhenen, 12.IV.1994 (2 ex) (coll. AquaSense); spring brook Tankenberg-west, Alleeweg De Lutte, 20.X.1994 (1 ex); spring brook Hoge Venterink, Oldenzaal, autumn 2000 (coll. waterschap Regge & Dinkel).

Identification
Brinkhurst & Jamieson (1971), Timm (1999), Stimpson et al. (1982).
Rhyacodrilus falciformis, the type species of this genus, was first described from material collected in 1900 from the Swiss Alps (Bretscher 1901). It was subsequently redescribed by Juget (1967), from specimens collected from the profundal area of Lake Geneva, France and by Kasprzak (1979), from specimens collected from four sites in the Pieniny Mountains of southern Poland.

Distribution (fig. 7)
In the Netherlands there are a two records from spring brooks and one from a river flood plain. Verdonschot et al. (1992) list it as Dutch, but without precise location. As they mention it as highly characteristic for eutrophic, large, deep waters, which is in contradiction with its typical habitat, the record must have been based on an incorrect identification.
The species has its main distribution area in central Europe.
Outside the Netherlands, there are records from Scandinavia (Milbrink 1978), Norway (Bremnes & Sloreid 1994), Sweden: Lake Vättern (Brinkhurst & Jamieson 1971), Denmark: river Susaa (Berg 1948), Switzerland: Lake Geneva

Figure 7
Distribution of *Rhyacodrilus falciformis.*
Figuur 7
Verspreiding van *Rhyacodrilus falciformis.*

(Brinkhurst 1964, Brinkhurst & Jamieson 1971), England: South Dorset (Ladle & Bird 1980), France: Lake Annecy, Lake Geneva, river Argens (l'Eau Salée) and the (subterranean) underflow of the upper Rhône, the southern and western foothills of the Carpathian mountains (in caves along the Hungarian/Slovakian border) (Brinkhurst & Jamieson 1971, Dumnicka (2001), WCMC 1998, Kladiva (2001), Juget 1984, Giani & Martinez-Ansemil 1981), Germany: source of the river Fulda (Wachs 1967) and Schlei (von Bülow 1957), Czechoslovakia: river Dyje (Wolgemuth & Schenkova 1999), Poland (Dumnicka 2001), Bulgaria: rivers Jantra and Struma (Uzunov & Kapustina 1993), northern Italy: source of the Adige basin (Di Chiara Paoletti et al. 1996), northwestern part of the Iberian peninsula: river Tambre and Porto do Cabo (Martinez-Ansemil & Giani 1980, Martinez-Ansemil 1984, Martinez-Ansemil & Collado 1996), Estonia (Timm 1999). In North America this species is extremely rare. It was first reported from Airport Creek, a small tributary of the Saanich Inlet on Vancouver Island, British Columbia (Brinkhurst 1978). This species has since been documented

from Cascade Cave (Vancouver Island) (R.O. Brinkhurst, cited in Wetzel 1992), the Hudson River in New York (Brinkhurst 1986) and from Fraction Run, a small groundwater-influenced stream near Lamont in Will County, Illinois (Wetzel 1992).

Ecology

R. falciformis is a typical species of oligotrophic to mesotrophic waters and is primarily a subterranean species. It can be found in ground waters, springs, small streams, in the deep profundal zone of lakes, river sources and caves or sometimes in wet soil (Bremnes & Sloreid 1994, Ladle & Bird 1980, Milbrink 1978, Timm 1999). Wachs (1967) states that it is probably a relic from the ice age and Brinkhurst (1964) suggests that it may be cold stenothermic species. The habitat of the species suggest that it can be found in sandy sediments only but Berg (1948) has found the species on gravelly bottom (in the upper course of the river Susaa at Pindsobro).

Status in the Netherlands

Very rare. In the Netherlands probably more common than presumed, due to its way of life (river sources, groundwater, springs).

Propappus volki

Confirmed Dutch records: river Maas, Ammerszoden, 1986-87 (5443 ex); river Maas, Batenburg, 1986-87 (235 ex); river Maas, Gewande, 1986-87 (2071 ex); river Maas, Keizersveer, 1986-87 (3053 ex); river Maas, Middelaar, 1986-87 (86 ex); river Maas, Ravenstein, 1986-87 (8255 ex) (Peeters 1988); river Maas between km 153-161, x.1995; river Maas between km 153-155.4, vi and xi.1996 (coll. Waardenburg); river Waal bij Opijnen km 931, 10.v.1996 (1 ex); river Maas, Bergen km 140.4, 2.vi.1997 (120 ex); river Maas, Gewande km 214, 26.v.1997 (2 ex); river Maas, Keizersveer, 22.v.1997 (1 ex) (coll. Klink); river Maas between km 153-154.6, xi.1997 (coll. Waardenburg); river Beneden Merwede, 23.iii.1998 (4 ex); 24.iii.1998 (9 ex); 25.iii.1998 (7 ex) (coll. AquaSense); river Rijn and Waal between km 859.1-951.82, v-vi.1998 (coll. Waardenburg); Sliedrechtse Biesbosch, 24.iii.1999 (75 ex) 30.iii.1999 (3 ex); river Nieuwe Merwede, 22.iii.2000 (1 ex); river Oude Maas, Heinenoord km 989.5, 20.iii.2001 (1 ex); river Oude Maas, Kuipersveer km 986, 20.iii.2001 (75 ex): river Oude Maas, Kuipersveer km 985.5, 20.iii.2001 (1 ex); river Oude Maas, Dordrecht km 978, 22.iii.2001 (8 ex); river Oude Maas, Zwijndrecht km 981.3, 20.iii.2001 (1 ex); river Oude Maas, Zwijndrecht km 981, 22.iii.2001 (14 ex) (coll. AquaSense).

Figure 8
Distribution of *Propappus volki*.
Figuur 8
Verspreiding van *Propappus volki*.

Identification

Timm (1999), Lafont (1983), Nielsen & Christensen (1959), Coates (1986). In the Palaearctic there are three species of *Propappus* (*P. volki*, *P. glandulosus* Michaelsen, 1905 and *P. arhyncotus* Sokol'skaya, 1972). *Propappus volki* is widely distributed in Europe and the former Soviet Union, *P. glandulosus* is restricted to Lake Baikal with adjacent waters, and *P. arhyncotus* to the Far East (Coates 1986).

Distribution (fig. 8)

In the Netherlands this species can be commonly found in the lower reaches of the river Rijn and

Maas. In the Maas there are no known records upstream from Bergen, in the north of Limburg. The species occurs throughout Europe, eastwards to the Ob, but is rare in Spain, Scandinavia and Great-Britain.
There are records from Estonia (Timm 1999), Baltic Sea basin, Latvia (Coates 1986), former U.S.S.R: rivers Dnieper, Volga, Oka, Prut and Lake Baikal, Kamchatka, Ukraine, Moldova, Belarus (Riemann 1966, Mordukhai-Boltovskoi 1979, Fomenko 1980, Ekaterininskaya 1980, Sokol'skaya 1980, Bird 1982, Coates 1986, AquaSense 1998, 2000a), southern Sweden (Timm & Erseus 1997), France: Upper Rhone, river Tarn and Moselle, England (Lafont 1983, Lafont et al. 1996, Coates 1986), Slovakia, Austria (Šporka & Moog 1995, Moog et al. 1994, Russev 1998), Germany: rivers Rijn, Elbe, Fulda, Isar (Riemann 1966, Wachs 1967, Bird 1982, Schmelz & Schöll 1992, Petermeier et al. 1996, Schöll & Balzer 1998), northwest Spain: river Tambre (Coates 1986, Martinez-Ansemil 1982), Italy (Di Chiara Paoletti et al. 1996), Poland: in streams and caves of the Tatra and west Carpathian Mountains (Dumnicka & Wojtan 1989, Bird 1982, Dumnicka 1994), river Welna and other Polish rivers (Coates 1986), Hungaria, former Yugoslavia (Russev 1998) and from phreatic water in Romania (Bird 1982). In Bulgaria it is only scarcely distributed, occuring only in the river Danube and in rivers in the southwestern part of the country (rivers Mesta and Struma) (Uzunov & Kapustina 1993).

Ecology
Propappus volki is usually found on gravelly or sandy substrates of deep river bottoms where the current is strong, usually more than 0.3 m/sec (Coates 1984, Fomenko 1980, Petermeier et al. 1996, Schmelz 1994, Schöll & Balzer 1998). In the Dutch part of the river Maas, 99.9% of the records originate from deep river-bottoms (Peeters 1988). It can reach densities of up to 16,000 ind./m^2 in the German part of the river Rijn, 19,500 ind./m^2 in the Volgograd reservoir (Ekaterininskaya 1980), 67,500 ind./m^2 in the Dnieper basin (Fomenko 1980) and 152,000 ind./m^2 in the Kuibyshev reservoir on the Volga (Bird 1982). In the Netherlands it reaches densities of up to 1,252 ind./m^2 in the 'Sliedrechtse Biesbosch' (AquaSense 2000b). The species declines drastically in number with increasing amounts of silt (Schmelz & Schöll 1992) or a reduction in current (Moroz 1994). *Propappus volki* is also recorded from springs and phreatic waters (moving ground waters), small stony streams, the sandy substrates of lakes and reservoirs (Coates 1984) and caves (Dumnicka & Wojtan 1989). In the sandy stretches of clear brooks it is only found under oligo- to ß-mesosaprobic conditions (Schmelz & Schöll 1992).

Status in the Netherlands
Locally abundant.

Rhynchelmis limosella

Confirmed Dutch records (immatures only): ditch in river floodplain 'Bovenpolder' south of Amerongen, 31.VIII.1982 (1 ex); ditch in polder Wiel, south of Lopik, 7.IX.1982 (9 ex); pool in river floodplain along the northside of the river Lek near Lexmond, 20.IX.1982 (1 ex); pool north of Grebbesluis, Rhenen (north of river floodplain 'Buitenwaarden' of the river Rijn), 14.V.1984 (7 ex); ditch east of Achterberg, 14.V.1984 (21 ex); 22.VIII.1984 (12 ex); ditch along freeway A12 west of De Meern, 23.V.1984 (1 ex); 12.IX.1984 (2 ex); ditch in polder Zegvelderbroek north of Zegveld, 20.V.1996 (1 ex); ditch in Riethoornse polder east of Hazerswoude, 3.VII.1996 (2 ex); western bank of the river Maas, Leeuwerik KM58, 29.V.1997 (2 ex); northeastern corner of Oolerplas along the river Maas, Limburg, 29.V.1997 (1 ex); 29.V.1997 (1 ex); pool near Westerbroek, 15.V.1998 (2 ex); Zanderijvaart, a canal in the dunes near Overveen, 2.VI.1998 (1 ex); 7.X.1998 (1 ex); canal Praamgracht, Soestdijk, 21.X.1998 (1 ex); pool in Millingerwaard, east of the river Waal, KM 872, 17.XI.1998 (1 ex); pool along the south side of the river Waal near Ewijk, 30.III.1999 (2 ex); Nieuwe Merwede, 23.III.2000 (1 ex); Langbroekerwetering east of Odijk, near the junction with Kromme Rijn, 30.V.2001 (4 ex) (coll. AquaSense); Luttenbergerven, 9.V.2000 (1 ex); Stouwe Hamingen,

IV.1994 (1 ex) (coll. Waterschap Groot Salland); Nature reserve 'de Hel' near Veenendaal, 26.V.1999 (4 ex); Duno fonteinallee near Renkum, 26.IV.2000 (3 ex); moat around castle Groeneveld, Baarn, 10.V.2000 (7 ex) (coll. Waterschap Vallei & Eem); ditch along the south side of the Railway, Leerdam, 9.VIII.1993 (1 ex) (coll. Zuiveringschap Hollandse Eilanden en Waarden).

Identification

Brinkhurst & Jamieson (1971), Timm (1999), Michaelsen & Johansson (1909) and Brinkhurst (1963).

Thick Lumbriculidae with a proboscis and single-pointed chaetae are considered here as *R. limosella*. Several authors mention this species from Europe, apart from *R. tetratheca* Michaelsen, 1920, *R. vagensis* Hrabě, 1954 and *R. granuensis* Hrabě, 1954. Although immature Lumbriculidae cannot be identified with certainty, *R. limosella* is considered as the most common *Rhynchelmis* species in Europe. *R. limosella* is listed in Mol (1984) as a Dutch species but records have never been published.

Distribution (fig. 9)

The exact distribution of *Rhynchelmis limosella* is not known, because several authors did not discriminate it from *R. tetratheca*. Therefore, records of *R. limosella* from the sources mentioned below may concern *R. tetratheca*. The species occurs throughout Europe, east up to the Ob river-basin. '*R. limosella*' is recorded from Estonia (Timm 1999), Czechoslovakia: river Dyje (Wolgemuth & Schenkova 1999), former U.S.S.R., Belgium, Italy, Poland, British Isles (unconfirmed) (Brinkhurst & Jamieson 1971), former U.S.S.R.: rivers Dnieper, Volga, Pripyat and Lake Ladoga (Mordukhai-Boltovskoi 1979, Fomenko 1980, Ekaterininskaya 1980, AquaSense 1998, 1999, Slepukhina 1984), Norway: Sørumsbekken (Bremnes & Sloreid 1994, Milbrink 1994), Sweden (Timm & Erseus 1997), Denmark: river Susaa (Berg 1948), Austria: Attersee (Löffler, undated), Germany (Brinkhurst & Jamieson 1971): river Rijn (Schmelz & Schöll 1992), river Elbe (Petermeier et al. 1996),

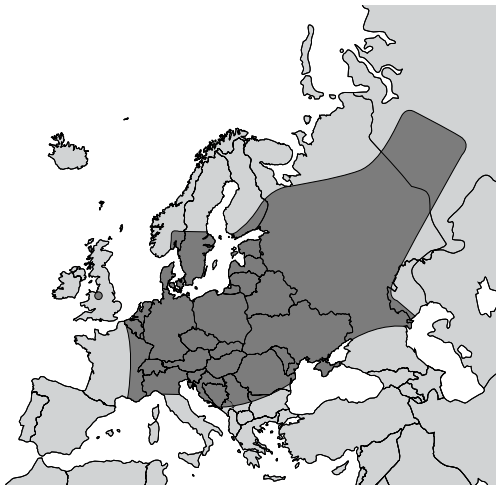

Figure 9
Distribution of *Rhynchelmis limosella.*
Figuur 9
Verspreiding van *Rhynchelmis limosella.*

Bulgaria: river Danube (Uzunov & Kapustina 1993), Slovakia: Danube (Russev 1998) and northern Italy (Di Chiara Paoletti et al. 1996).

Ecology

Although several authors mention two types of habitats for this species (for instance Brinkhurst 1963, Milbrink 1994), *R. limosella* should be considered to be only a species of organically rich muddy substrates in ditches, pools and rivers. Older references of cold-stenothermy, oligotrophic or mesotrophic lakes, sandy rivers etc. probably refer to *R. tetratheca*. That species is really stenotherm, and much more common in North Europe, than *R. limosella* (pers. comm. T. Timm). This contradiction was also noticed by Berg (1948), who found the species in fairly large numbers on the roots of *Sparganium erectum* by the Susaa riverbank, particularly when mud adhered to the roots. The Norwegian records from deep oligotrophic lakes by Bremnes & Sloreid (1994) probably do not belong to *R. limosella*.

R. limosella can reach densities of up to 50 ind./m^2 in the Dnieper basin (Fomenko 1980)

and in a pool along the river Pripyat (Belarus) near Turov its density was estimated at 2,222 ind./m^2 (AquaSense 1999). In the Netherlands the species is sometimes associated with leaf mould.

Status in the Netherlands
Common.

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SAMENVATTING

Acht soorten Oligochaeta nieuw voor de Nederlandse fauna (Annelida)
Oligochaeten behoren tot een nog nauwelijks onderzochte groep dieren in Nederland; gegevens over de verspreiding en ecologie van deze wormen zijn hier nauwelijks bekend, net zo min als het aantal soorten. Alleen door Gunst (1965) en van Rhee (1970) wordt ingegaan op de potwormen (Enchytraeidae) en de regenwormen (Lumbricidae). In Mol (1984) wordt een lijst gepresenteerd van 82 aquatische soorten oligochaeten. Voor de Nederlandse fauna zijn 158 soorten oligochaeten bekend, maar dit aantal kan alleen nog maar toenemen met name binnen de Enchytraeidae. De lijst van Mol (1984) is gebaseerd op literatuurreferenties waardoor de onderliggende data en het betreffende materiaal niet altijd gecontroleerd konden worden. Sinds deze publicatie zijn er diverse nieuwe soorten voor Nederlandse waargenomen, maar hierover is nooit in courante literatuur gepubliceerd. In dit artikel wordt ingegaan op acht aquatische soorten die nieuw zijn voor de Nederlandse fauna: *Nais behningi* Michaelsen, 1923, *Limnodrilus maumeensis* Brinkhurst & Cook, 1966, *Potamothrix vejdovskyi* (Hrabě, 1941), *Psammoryctides moravicus* (Hrabě, 1934), *Monopylephorus irroratus* (Verrill, 1873), *Rhyacodrilus falciformis* Bretscher, 1901, *Propappus volki* Michaelsen, 1916 en *Rhynchelmis limosella* Hoffmeister, 1843. *Rhynchelmis limosella* is eerder door Mol (1984) vermeld als een Nederlandse soort, maar de achterliggende data zijn nooit gepubliceerd. *Limnodrilus maumeensis* is nieuw voor het palaearctische gebied en was voorheen alleen bekend uit het oosten van de Verenigde Staten. Zij is alleen bekend van verontreinigde waterbodems van met name havengebieden. *Nais behningi* en *P. volki* zijn vrijwel alleen aan te treffen op minerale bodems in de grote rivieren. *Rhyacodrilus falciformis* is een typische grondwatersoort en wordt dan ook wel aangetroffen in inundatiegebieden, bronnen en bovenlopen van beken e.d. *Potamothrix vejdovskyi* is alleen bekend uit het beneden-rivierengebied. De aan brak water gebonden *Monopylephorus irroratus* is waargenomen in de Hollandse IJssel en is buiten Nederland vooral bekend uit de kuststreken van West- en Centraal Europa. *Psammoryctides moravicus* is een Oost-Europese soort en is vermoedelijk afkomstig uit het Donaugebied, waar de soort algemeen voorkomt in rivieren.

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