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Nematodes of Plummers Island, Maryland

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Abstract.—The nematode fauna of Plummers Island, on the Potomac River near Washington, D.C., is virtually unknown. Only three species have been reported from the Island: *Daptonema dubium* (Bütschli, 1873) Lorenzen, 1977, *Isolaimium papillatum* Cobb, 1920, and *Tylolaimophorus cylindricum* (Cobb, 1920) Goodey, 1963. We surveyed terrestrial and aquatic habitats on Plummers Island to begin to characterize its nematode fauna. Nematodes of 47 genera were found, representing 9 orders and 32 families, including an estimated 59 species. We provide diagnoses of the 3 species reported from the literature, a classified list of genera, their habitats and life stages found, and an estimate of the number of species found in each genus.

Key words.—Sampling, inventory, identification, *Polystichum acrostichoides*, roots, humus, Potomac River, Nemata.

Nematodes are one of the most speciose, ubiquitous, and numerically abundant groups of animals known, inhabiting marine, estuarine, freshwater and soil habitats throughout the world, and they may be found in such extreme environments as arctic ice, desert sand and highly polluted soil and water. They are also important parasites of plants and most species of animals, from sponges to man. Nematode diversity in non-agricultural soils and sediments remains poorly studied, primarily due to the daunting numbers of individuals and species involved. Terrestrial nematodes can be so abundant as to exceed 1 million individuals per square meter of soil (Floyd et al. 2002). Nematode identification is challenging due to inadequate descriptions and taxonomic keys for many common taxa. The nematode fauna of Plummers Island and the Potomac River Drainage in the Washington, D.C. area is virtually unknown. This study represents a preliminary attempt at characterizing the terrestrial and aquatic nematodes of Plummers Island.

Only three species of nematodes have been reported in the scientific literature from Plummers Island per se. They are *Daptonema dubium* (Bütschli, 1873) Lorenzen, 1977 [= *Monhystera sentiens* (Cobb, 1914)], collected from a sand bar off Plummers Island; *Isolaimium papillatum* Cobb, 1920, collected on Plummers Island with no other habitat information; and *Tylolaimophorus cylindricum* (Cobb, 1920) Goodey, 1963 (= *Triplonchium cylindricum* Cobb, 1920), collected from humus on Plummers Island. Six other species have been collected from the Potomac River in the Washington, D.C. area, and it is

likely that they also may be found on the shore of Plummers Island. These include *Crocodyrolaimus fecundus* (Cobb, 1914) Andrassy, 1988 associated with algae in the Potomac River, Washington, D.C.; *Aphanolaimus spiriferus* Cobb, 1924, from the Potomac River, Washington, D.C.; *Aphanolaimus minor* Cobb, 1914, from mud in the Potomac River; *Pelodera punctata* (Cobb, 1914) Dougherty, 1955, from around the roots of aquatic plants, Potomac River, Washington, D.C.; *Tobrilus longus* (Leidy, 1851) Bastian, 1865 (= *Trilobus longus* Cobb, 1914), from mud around the bases of aquatic plants in the Potomac River; and *Tobrilus hopei* Loof & Riemann, 1976, from mud in the intertidal zone of Roosevelt Island, Potomac River, Washington, D.C.

Materials and Methods

From May 2005 to January 2006 we collected nematodes from terrestrial and aquatic habitats on Plummers Island during 4 sampling trips. Nematodes were collected from terrestrial habitats by gathering moss, bark, leaf litter, and humus from the surface of the soil and by collecting soil approximately 6 inches below the surface in the root zone of plants or under rotting logs. Nematodes were extracted from terrestrial material by a Baerman funnel technique. Aquatic sediments were sampled using a small, hand-held core sampler or by scraping algae and leaves from the sediment surface. Nematodes were extracted from aquatic sediments by sieving. Nematodes were examined on temporary wet slide mounts after having been heat-killed, or heat-killed, fixed in 5% formalin,

and processed to glycerin via standard methods (Seinhorst 1959), and permanently mounted on glass slides. Specimens were identified to genus using published keys: Goodey (1963), Andr assy (1988), Bongers (1988), Jairaijuri & Ahmad (1992), and Loof et al. (1995). Voucher slides will be submitted to the Nematode Collection at the National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C.

We provide diagnoses from the literature of the 3 species previously reported from Plummers Island, along with a list of genera (and the sex of individuals) found in our study and the habitat in which they were found. These genera are placed in the most current classification of the phylum Nematoda (De Ley & Blaxter 2002). While species-level identifications are beyond the scope of the present study, we provide an estimate of the number of species found in each genus. These estimates are very conservative, and it is likely that future work will reveal greater species-level diversity.

Results

Diagnoses of Reported Species

Daptonema Cobb, 1920

Cylindrotheristus Wieser, 1956:92 op Lorenzen, 1977:222.

Mesotheristus Wieser, 1956:91 op Lorenzen, 1977:222. *Allomonhystera* Micoletzky, 1923:23 op Gerlach and Riemann, 1973:140, nomen oblitum.

Pseudotheristus Wieser, 1956:87 op Lorenzen, 1977:222.

Spirotheristus Timm, 1961:78 op Lorenzen, 1977:222.

Tubolaimus Allg en, 1929b:467 op Lorenzen, 1977:222.

Nec *Theristus* (*Daptonema*) auctores.

Type species.—*Daptonema fissidens* Cobb, 1920:281.

Daptonema is a very large genus of mostly meso- to euhaline species. Species known to occur in freshwater include *D. dubium* (B utschli, 1873) Lorenzen, 1977, *D. inversum* Alekseev, 1984, and *D. limnobia* Wu & Liang, 2000.

Generic diagnosis.—Cuticle circumferentially striated, striae present or absent in lateral field. Somatic sensilla present, usually less than one body width in length. Cephalic sensilla 6+6+4; inner labial sensilla papilliform, outer- and paralabial sensilla setiform. Stoma cyathiform, enclosed by esophageal tissue. Esophagus cylindrical. Males usually diorchic. Spicula usually about one cloacal-body diameter in length with right-angle bend at mid-length. Gubernaculum present, seldom with apophysis. Females didelphic

with gonoducts opposed and outstretched. Tail terminus with two or three setiform sensilla.

Habitat and distribution (for species known to inhabit freshwater).—Sediment from freshwater lakes and streams in Europe, Russia and China.

Daptonema dubium (B utschli, 1873)

Lorenzen, 1977

Monhystera sentiens Cobb, 1914:63 op Lorenzen, 1977.

Daptonema setosum (B utschli, 1874) Lorenzen, 1977 op Andr assy, 1981.

Diagnosis.—Length 1.6 mm. Amphids 0.16 as wide as corresponding body diameter; distance from oral surface to anterior rim of amphid about 1 head diameter. Length of cephalic sensilla less than one-half of corresponding head diameter.

Habitat and distribution.—Cosmopolitan, including a previous record from near Plummers Island (Cobb 1920).

Tylolaimophorus de Man, 1880

Triplonchium Cobb, 1920:300.

Type species.—*Tylolaimophorus typicus* de Man, 1880:64.

Generic diagnosis.—Body dark with internal organs often obscure. Head triangular; cephalic sensilla papilliform. Amphid cyathiform; ovoid external aperture transverse to body axis; broad corpus gelatum often extruded from fovea. Male tail bluntly conical with taper on dorsal side only; female tail bluntly conical with taper on dorsal and ventral sides. Buccal capsule narrow and indistinct, but armed with minute onchiostyle (tooth + onchiophore). Onchiostyle thickest at mid length, uniformly tapered to acute anterior tip, tapered more abruptly posteriorly and with three posterior knobs (thickened radii); length about equal to corresponding body width. Esophagus anteriorly slender, often slightly swollen near end of first third of esophagus length, and ending with posterior, pyriform bulb. Gonads paired and opposed; gonoducts reflexed in females, outstretched in males. Transverse vulva situated near mid-body length. Spicula thin and curved ventrad; capitula small if present; proximal half to two thirds of spicula enveloped by specialized sheath of muscle. Thin gubernaculum mostly parallel to spicula; apophysis absent. Ventromedian supplements papilliform.

Habitat and distribution.—Sixteen valid nominal species exist in the genus. In soil about roots of plants in Europe and North America, and in slime flux of a walnut in Germany (Goodey 1963).

Tylolaimophorus cylindricum (Cobb, 1920)
Goodey, 1963

Triplonchium cylindricum Cobb, 1920:300.

Diagnosis [from Cobb (1920) and observations of single female collected by the senior author on Plummers Island].—Males 1.0 mm long, females 1.2 mm. Cuticle thin with fine transverse striae. Somatic sensilla absent. Head obtusely triangular. Hypodermal tissue with opaque granular inclusions. Stylet slender with posterior knobs; length about equal to head diameter. Esophagus anteriorly cylindrical, posteriorly with terminal pyriform bulb. Tail obtusely conical, slightly concave ventrally and distinctly convex dorsally. Females didelphic and amphidelphic; vulva near mid-body. Males always (?) diorchic, testes opposed. Ventromedian supplements papilliform. Spicula strongly curved ventrad, narrow and enclosed in ovoid sheath of specialized, longitudinal musculature. Gubernaculum thin without apophysis.

Habitat and distribution.—Humus. On Plummers Island found about roots of Christmas fern, *Polystichum acrostichoides*, and oak tree, *Quercus* sp.; and soil under rotting log. Soil with humus between Plummers Island and the Chesapeake and Ohio Canal, Maryland.

Isolaimium Cobb, 1920

Type species.—*Isolaimium papillatum* Cobb, 1920:258.

Diagnosis.—Isolaimidae. Relatively large nematodes; length 3–7 mm. Cuticle thin with transverse rows and/or files of minute punctations. Cephalic sensilla 6+6+4. Amphid aperture minute and pore-like. Stoma elongate and tubiform with distinctly cuticularized walls. Esophagus cylindrical to clavate; cardium long, cylindrical to pyramidal and dorso-ventrally symmetrical. Female gonoducts didelphic, amphidelphic, and antidromous; vulva near mid body length. Male reproductive system dirorchic, gonoducts outstretched. Spicula thick, arcuate to falcate, with or without capitulum. Gubernaculum short with apophyses. Papilliform, ventromedian, pre-cloacal supplements present. Tail short, conoid and bluntly rounded to pointed (Swart & Heyns 1991).

Habitats and distribution.—Twelve valid nominal species are known for this genus. Whereas *I. andrassyi* Hogewind & Heyns, 1967 was collected in freshwater, most of the remaining species have been found in agricultural soil from different continents. Two species, *I. hamataspiculatum* Bernard, 1984 and

I. papillatum Cobb, 1920, were extracted from soil in mixed hardwood forests of North America. *Isolaimium collare* Andrassy, 2001 was collected in a forest preserve in Tanzania. It is likely that all species of this genus are widespread in uncultivated soils but have been reported most frequently from agricultural soils because the latter have been much more commonly sampled. Nothing is known of their biology, including their sources of food.

Isolaimium papillatum Cobb, 1920

Diagnosis.—Males 3.8 mm long, females 3.9 mm. Cuticle thin with surface innervations at edges of lateral field. Spicula simple, blunt, uniform, more or less slender and one cloacal-body diameter in length. Gubernaculum frail, slender, arcuate, parallel to spicula, and with short caudad apophysis; length of gubernaculum one-third length of spicula. Six papilliform, ventromedian supplements sub-equally dispersed over pre-cloacal distance equal to three cloacal-body diameters. Tail length slightly greater than one cloacal-body diameter and bluntly conoid; ventral and dorsal contours of tail nearly straight and slightly arcuate, respectively. One subdorsal, one lateral, one ventrolateral and one subventral papilliform sensilla present on each side of tail.

Isolaimium papillatum is the type species of *Isolaimium*, the only genus and the only family of the entire order. The original description of *I. papillatum* is inadequate by contemporary standards, but it has not been redescribed because type specimens do not exist, and specimens have not been re-collected from the type locality or elsewhere.

Habitat and distribution.—Collected from soil in mixed hardwood forest on Plummers Island.

List of Genera Found

- Class Enoplea Inglis, 1983
- Subclass Enoplia Pearse, 1942
- Order Enoplida Filipjev, 1929
- Suborder Ironina Siddiqi, 1983
 - Superfamily Ironoidea de Man, 1876
 - Family Ironidae de Man, 1876
 - Ironus* sp. Bastian, 1865
 - Habitat.*—Muddy sand at water line.
 - Sex.*—Female. Species estimate: One.
- Order Triplonchida Cobb, 1920
- Suborder Diphtherophorina Coomans & Loof, 1970
- Superfamily Diphtherophoroidea Micoletzky, 1922
- Family Diphtherophoridae Micoletzky, 1922
- Tylolaimophorus cylindricum* (Cobb, 1920)
Goodey, 1963
- Habitat.*—About roots of Christmas fern, *Polystichum acrostichoides* and oak tree, *Quercus* sp.; soil under rotting log.
- Tylolaimophorus* sp. De Man, 1880 (Fig. 1)

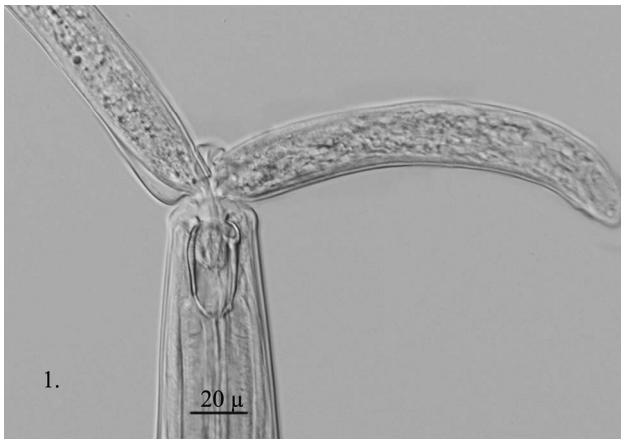


Fig. 1. Anterior region of female *Prionchulus* sp. (Mononchiidae) consuming a male *Tyololaimophorus* sp. (left lateral view; composite of multifocal images).

Habitat.—About roots of oak tree, *Quercus* sp.

Sex.—Female. Species estimate: Two (including *T. cylindricum*).

Diphtherophora sp. de Man, 1880

Habitat.—About roots of oak tree, *Quercus* sp.

Sex.—Female. Species estimate: One.

Family Trichodoridae Thorne, 1935

Trichodorus sp. Cobb, 1913

Habitat.—About roots of oak tree, *Quercus* sp.; soil under rotting log.

Sex.—Male and female. Species estimate: One.

Suborder Tobrilina Tsalolikhin, 1976

Superfamily Tobrioloidea De Coninck, 1965

Family Tobrilidae De Coninck, 1965

Tobrilus sp. Andr ssy, 1959

Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*.

Sex.—Male, female, and juvenile. Species estimate: Three.

Superfamily Prismatolaimoidea Micoletzky, 1922

Family Prismatolaimidae Micoletzky, 1922

Prismatolaimus sp. de Man, 1880

Habitat.—Soil under rotting log; muddy sand at water line.

Sex.—Female. Species estimate: One.

Suborder Tripylina Andr ssy, 1974

Superfamily Tripyloidea de Man, 1876

Family Tripylidae de Man, 1876

Tripyla sp. Bastian, 1865

Habitat.—Leaves and algae on sediment surface above water line.

Sex.—Male, female, and juvenile. Species estimate: One.

Trischistoma sp. Cobb, 1913

Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*.

Sex.—Female and juvenile. Species estimate: Two.

Subclass Dorylaimia Inglis, 1983

Order Isolaimida Cobb, 1920

Superfamily Isolaimoidea Timm, 1969

Family Isolaimidae Timm, 1969

Isolaimium papillatum Cobb, 1920: 258

Habitat.—See detailed account above; this taxon was not collected in the current survey.

Order Dorylaimida Pearse, 1942

Suborder Dorylaimina Pearse, 1942

Superfamily Dorylaimoidea de Man, 1876

Family Dorylaimidae de Man, 1876

Mesodorylaimus sp. Andr ssy, 1959 (Fig. 2)

Habitat.—Bark in humus; About roots of Christmas fern, *Polystichum acrostichoides*.

Sex.—Male, female, and juvenile. Species estimate: One.

Family Aporcelaimidae Heyns, 1965

Aporcelaimellus sp. Heyns, 1965

Habitat.—About roots of oak tree, *Quercus* sp.

Sex.—Female. Species estimate: One.

Aporcelaimium sp. Loof and Coomans, 1970

Habitat.—About roots of oak tree, *Quercus* sp.

Sex.—Female. Species estimate: One.

Family Longidoridae Thorne, 1935

Longidorus sp. Micoletzky, 1922

Habitat.—About roots of oak tree, *Quercus* sp.

Sex.—Juvenile. Species estimate: One.

Xiphinema sp. Cobb, 1913

Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*, and cherry tree, *Prunus* sp.

Sex.—Female and juvenile. Species estimate: One.

Family Qudsianematidae Jairajpuri, 1965

Eudorylaimus sp. Andr ssy, 1959

Habitat.—About roots of oak tree, *Quercus* sp.; soil under rotting log.

Sex.—Male, female, juvenile. Species estimate: Four.

Labronema sp. Thorne, 1939

Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*.

Sex.—Female and juvenile. Species estimate: One.

Family Actinolaimidae Thorne, 1939

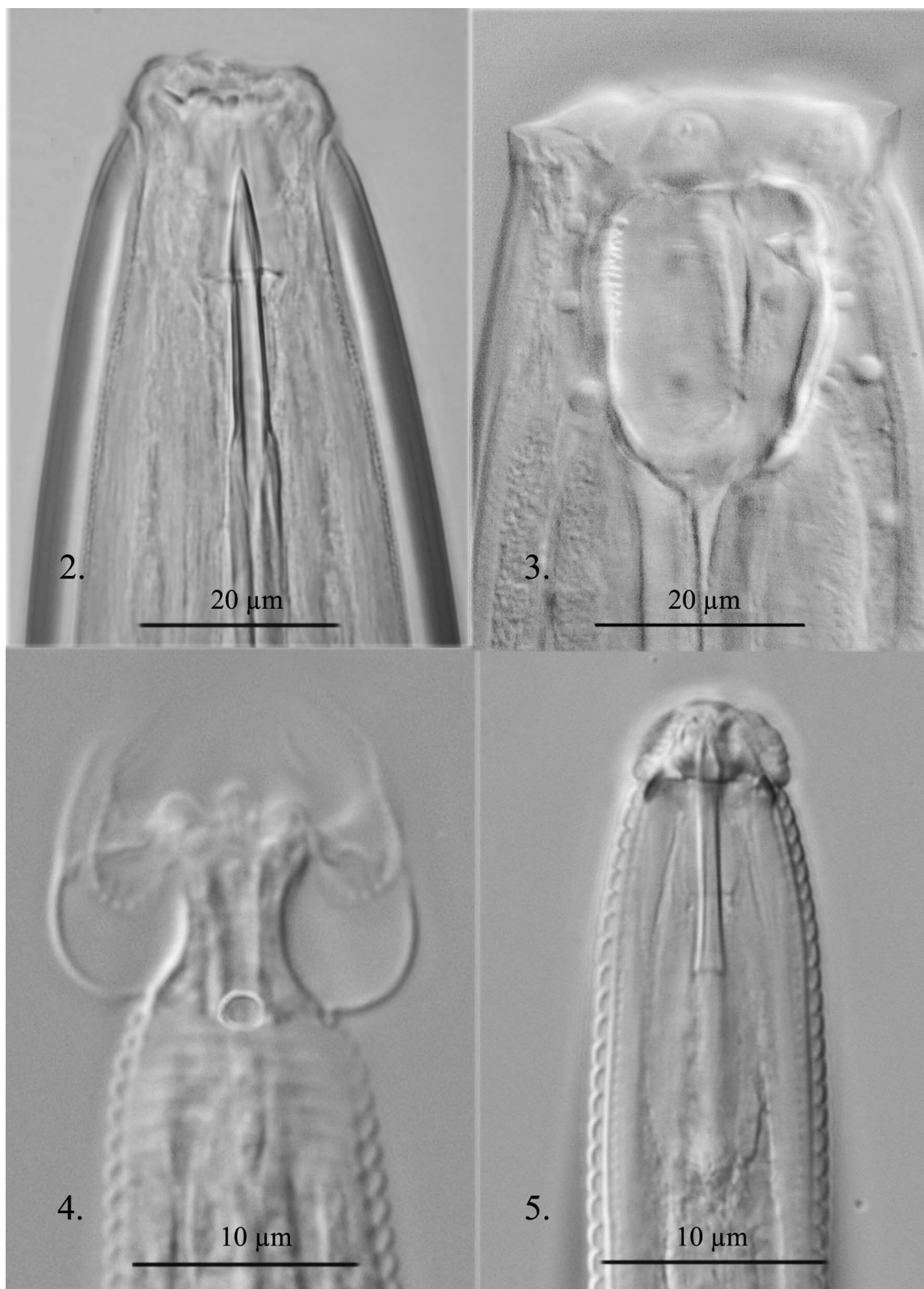
Actinolaimus sp. Cobb, 1913

Habitat.—Humus; moss.

Sex.—Female. Species estimate: One.

Superfamily Tylencholaimoidea Filipjev, 1934

Family Tylencholaimidae Filipjev, 1934



Figs. 2–5. Anterior region of nematodes (composites of multifocal images). 2, Male *Mesodorylaimus* sp. (Dorylaimidae) (dorsal view); 3, Female *Prionchulus* sp. (Mononchidae) (left lateral view); 4, Female *Neotylocephalus* sp. (Plectidae) (right lateral view); 5, Male *Hoplolaimus* sp. (Hoplolaimidae) (right lateral view).

- Tylencholaimus* sp. de Man, 1876
Habitat.—Soil under rotting log.
Sex.—Female. Species estimate: One.
- Order Mononchida Jairajpuri, 1969
 Suborder Mononchina Kirjanova & Krall, 1969
 Superfamily Mononchoidea Chitwood, 1937
 Family Mononchidae Chitwood, 1937
Mononchus sp. Bastian, 1865
Habitat.—Bark in humus; about roots of oak tree, *Quercus* sp.; soil under rotting log; muddy sand at water line.
Sex.—Female. Species estimate: One.
- Prionchulus* sp. (Cobb, 1916) Wu & Hoeppli, 1929 (Figs. 1, 3)
Habitat.—About roots of ash tree, *Fraxinus* sp.
Sex.—Male, female, and juvenile. Species estimate: Two.
- Family Mylonchulidae Jairajpuri, 1969
Mylonchulus sp. (Cobb, 1916) Pennak, 1953
Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*.
Sex.—Female. Species estimate: One.
- Class Chromadorea Inglis, 1983
 Subclass Chromadoria Pearse, 1942
 Order Chromadorida Chitwood, 1933
 Suborder Chromadorina Filipjev, 1929
 Superfamily Chromadoroidea Filipjev, 1917
 Family Achromadoridae Gerlach and Riemann, 1973
Achromadora sp. Cobb, 1913
Habitat.—Humus.
Sex.—Female. Species estimate: One.
- Order Monhysterida Filipjev, 1929
 Suborder Monhysterina De Coninck and Schuurmans Stekhoven, 1933
 Superfamily Monhysteroidea de Man, 1876
 Family Monhysteridae de Man, 1876
Monhystera sp. Bastian, 1865
Habitat.—Moss; muddy sand at water line; leaves and algae on sediment surface above water line.
Sex.—Female. Species estimate: Two.
- Monhystrella* sp. Cobb, 1918
Habitat.—Muddy sand at water line.
Sex.—Female. Species estimate: One.
- Superfamily Sphaerolaimoidea Filipjev, 1918
 Family Xyalidae Chitwood, 1951
Daptonema dubium (Bütschli, 1874) Lorenzen, 1977
Habitat.—See detailed account above; this taxon was not collected in the current survey.
- Theristus* sp. Bastian, 1865
Habitat.—About roots of ash tree, *Fraxinus* sp.; muddy sand at water line.
Sex.—Female. Species estimate: One.
- Order Plectida Malakhov, 1982
 Suborder Plectina Malakhov, 1982
 Superfamily Plectoidea Örley, 1880
 Family Plectidae Örley, 1880
Plectus sp. Bastian, 1865
Habitat.—About roots of ash tree, *Fraxinus* sp.
Sex.—Female and juvenile. Species estimate: Two.
- Tylocephalus* sp. Crossman, 1933
Habitat.—Soil under rotting log.
Sex.—Female. Species estimate: One.
- Neotylocephalus* sp. (Fig. 4)
Habitat.—Soil under rotting log.
Sex.—Female. Species estimate: One.
- Order Rhabditida
 Incertae sedis: Family Teratocephalidae Andrásy, 1958
Teratocephalus sp. de Man, 1876
Habitat.—Moss.
Sex.—Female. Species estimate: One.
- Suborder Tylenchina
 Superfamily Panagrolaimoidea Thorne, 1937
 Family Panagrolaimidae Thorne, 1937
Panagrolaimus sp. Fuchs, 1930
Habitat.—Bark in humus; about roots of oak tree, *Quercus* sp.
Sex.—Male and female. Species estimate: One.
- Panagrobelus* sp. Thorne, 1939
Habitat.—Moss.
Sex.—Female. Species estimate: One.
- Superfamily Strongyloidoidea (Chitwood & McIntosh, 1934) De Ley & Blaxter, 2002
 Family Alloionematidae Chitwood and McIntosh, 1934
Rhabditophanes sp. Fuchs, 1930
Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*.
Sex.—Female. Species estimate: One.
- Superfamily Cephaloboidea Filipjev, 1934
 Family Cephalobidae Filipjev, 1934
Acrobelloides sp. Cobb, 1924
Habitat.—Soil under rotting log.
Sex.—Female and juvenile. Species estimate: Two.
- Cephalobus* sp. Bastian, 1865
Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*; humus; soil under rotting log.
Sex.—Female and juvenile. Species estimate: Two.
- Acrobeles* sp. Linstow, 1877
Habitat.—Bark in humus.
Sex.—Female. Species estimate: Two.
- Superfamily Aphelenchoidea Fuchs, 1937
 Family Aphelenchidae Fuchs, 1937

- Aphelenchus* sp. Bastian, 1865
Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*.
Sex.—Female. Species estimate: One.
- Family Aphelenchoididae Skarbilovich, 1947
Aphelenchoides sp. Fischer, 1894
Habitat.—Soil under rotting log.
Sex.—Female. Species estimate: One.
- Laimaphelenchus* sp. Fuchs, 1937
Habitat.—Soil under rotting log.
Sex.—Female. Species estimate: One.
- Seinura* sp. Fuchs, 1931
Habitat.—Soil under rotting log.
Sex.—Female. Species estimate: One.
- Superfamily Criconematoidea Taylor, 1936
 Family Criconematidae Taylor, 1936
Hemicriconemoides sp. Chitwood and Birchfield, 1957
Habitat.—About roots of oak tree, *Quercus* sp.; soil under rotting log.
Sex.—Female. Species estimate: One.
- Family Hemicycliophoridae Skarbilovich, 1959
Hemicycliophora sp. de Man, 1921
Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*, and cherry tree, *Prunus* sp.
Sex.—Female. Species estimate: One.
- Superfamily Tylenchoidea Örley, 1880
 Family Hoplolaimidae Filipjev, 1934
Hoplolaimus sp. Daday, 1905 (Fig. 5)
Habitat.—Soil under rotting log.
Sex.—Male and female. Species estimate: One.
- Helicotylenchus* sp. Steiner, 1945
Habitat.—Soil under rotting log.
Sex.—Female. Species estimate: One.
- Family Tylenchidae Örley, 1880
Tylenchus sp. Bastian, 1865
Habitat.—Soil under rotting log.
Sex.—Female and juvenile. Species estimate: One.
- Suborder Rhabditina Chitwood, 1933
 Superfamily Diplogasteroidea Micoletzky, 1922
 Family Neodiplogasteridae Paramonov, 1952
Pristionchus sp. Kreis, 1932
Habitat.—Humus.
Sex.—Female. Species estimate: One.
- Superfamily Rhabditoidea Örley, 1880
 Family Diploscapteridea Micoletzky, 1922
Diploscapter sp. Cobb, 1913
Habitat.—About roots of Christmas fern, *Polystichum acrostichoides*.
Sex.—Female. Species estimate: One.
- Family Rhabditidae Örley, 1880
Oscheius sp. Andrassy, 1976
Habitat.—Bark in humus; soil under rotting log.
Sex.—Female and juvenile. Species estimate: One.

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