The phylum Platyhelminthes encompasses three distinct groups of flatworms: the entirely parasitic tapeworms (Cestoidea) and flukes (Trematoda) and the free-living and commensal turbellarians (Turbellaria). Aquatic turbellarians occur commonly in freshwater habitats, often in exceedingly large numbers and rather high densities. Their ecology and systematics, however, have been less studied than those of many other common aquatic invertebrates (Kolasa 2001). Terrestrial turbellarians inhabit soil and leaf litter and can be found resting under stones, logs, and refuse. Like their freshwater relatives, terrestrial species suffer from a lack of scientific attention.

Most texts divide turbellarians into microturbellarians (those generally < 1 mm in length) and macroturbellarians (those 5-20 mm in length, with most being 10 mm or greater), a division that reflects superficial morphological similarities rather than phylogenetic relationships (Kolasa 2001). Biologists have recorded approximately 150 species of freshwater microturbellarians in North America (Kolasa 2001), but we know almost nothing about the smaller soil-dwelling turbellarians (Ball and Sluys 1990). Many additional genera and species of microturbellarians await discovery and description.

All macroturbellarians belong to the order Tricladida, also known as planarians. These have been studied more thoroughly than the microturbellarians. Biologists have used two species, *Girardia dorotocephala* and *G. tigrina*, extensively for decades as laboratory and classroom animals. Approximately 40 freshwater and at least 12 nonnative terrestrial macroturbellarian species have been recorded in North America (Kolasa 2001). However, the actual number of taxa that occur here is likely substantially higher. Nemerteans resemble turbellarians and possess many flatworm features. About 900 (mostly marine) species comprise this phylum, which is represented in North American freshwaters by three species of benthic, predatory worms measuring 10-40 mm in length (Kolasa 2001). These ribbon worms occur in both lakes and streams. Although flatworms show up commonly in invertebrate samples, few biologists have studied the Wisconsin fauna. Published records for turbellarians and ribbon worms in the state remain limited, with most being recorded under generic rubric such as “flatworms,” “planarians,” or “other worms.” Surprisingly few Wisconsin specimens can be found in museum collections and a specialist has yet to examine those that are available. No state checklist has been available. To help remedy this situation, I here review the literature, summarize records, and provide a provisional list of species.

**INTRODUCTION**

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zoology database (NMNH 2005) and the Turbellarian Taxonomic Database (Tyler, et al. 2005). From these sources, I compiled the provisional list of Wisconsin species presented below.

Ordinal and familial level taxonomy in the flatworm checklist generally follows Kolasa (2001), with species listed alphabetically within each family. I use Tyler, et al. (2005) for up-to-date species nomenclature. I omit general "Wisconsin" records from the checklist except when site-specific information remains unavailable. Accounts are annotated with comments on habitat and associated species when this information is available readily in the literature. I discuss misidentifications, poorly described species, otherwise problematic records, and a few species that have not yet been reported from Wisconsin, but which likely occur here, under “Uncertain Turbellarian Species.”

PROVISIONAL CHECKLIST OF WISCONSIN TURBELLARIANS

MICROTURBELLARIANS

Order Catenulida

Family Catenulidae

*Catenula virginiana* Kepner and Carter 1930

Hayes (1942) collected *C. virginiana* from various waterways in Dane and Vilas counties. He considered it "outstanding for tolerating bog conditions."

Family Stenostomidae

*Myostenostomum tauricum* Nasonov 1924

Hayes (1942) reported collecting *M. tauricum* specimens from Wisconsin localities. Tyler, et al. (2005), however, considered *M. tauricum*, a species previously reported from several eastern United States, South American, African, and European localities, to be a *nomen dubium*.

*Rhynchoscolex simplex* Leidy 1851

Hayes (1942) collected *R. simplex* from two localities in Dane County and seven in Vilas County. He found it in a variety of habitats, but believed "it seems to be best able to compete under strictly bog conditions especially in the well leached detritus." Kolasa, et al. (1987) found 42 of their 51 New York specimens in interstitial waters. They collected their other specimens in stream surface sediments (1) and springs (8).

*Stenostomum anops* Nuttycombe and Waters 1938

Hayes (1942) collected *S. anops* twice in July 1941, once from a Vilas County bog and once from a nearby lake drain.

*Stenostomum arevaloi* Gieysztor 1931

Hayes (1942) collected *S. arevaloi* at several Vilas County localities and thought it “difficult to believe that it does not occur around Madison, unless, perhaps, the water is too hard.”

*Stenostomum grande* Child 1902

Hayes (1942) collected *S. grande* from the Bad River in Ashland County, Lake Mendota in Dane County, and several lakes and lake drains in Vilas County. At most sites, he reported *S. grande* as being “abundant” in July and “common” or “fairly common” in August. Kolasa, et al. (1987) collected all of their New York specimens from stream surface sediments.

*Stenostomum leucops* (Duges 1828)

*S. leucops* occurs in interstitial waters throughout much of the eastern United States. Hayes (1942) reported collecting *S. leucops* in Wisconsin. Some of Higley’s (1918) specimens may also have been collected in Wisconsin.

*Stenostomum predatorium* Kepner and Carter 1931

Hayes (1942) collected *S. predatorium* from three Vilas County lakes, but considered it “fairly common” at only one. In New York, this species has been found primarily in stream surface sediments and interstitial waters (Kolasa, et al. 1987).

*Stenostomum ventronephrium* Nuttycombe 1932

Hayes (1942) collected a few specimens from the Bad River in Ashland County in August 1941 that he thought “probably belong to this species.”

*Stenostomum virginianum* Nuttycombe 1931

Hayes (1942) considered *S. virginianum* to be “one of the most widely distributed rhabdoceles in Wisconsin.” He collected it at “every littoral collecting station in Dane County” and “from bogs, fresh ponds, rivers, and lakes of Vilas County.”
Order Macrostomida

Family Macrostomidae

Macrostomum ruebushi Ferguson 1940
Hayes (1942) found M. ruebushi, usually in small numbers, at all “thoroughly worked littoral collecting stations in Dane County at various seasons.” He also collected it from several Vilas County sites. Hayes noted that “Macrostomum has not been found living in Wisconsin under strictly bog conditions, but has been found at all other types of station.”

Family Microstomidae

Microstomum lineare (O.F. Müller 1774)
Hayes (1942) found M. lineare at all of his Dane County littoral collection stations and several Vilas County sites. He described the seasonal sexual development of this species in southern Wisconsin. He also noted that this “American form” actually may not be the common European species. In New York, M. lineare has been found primarily in stream surface sediments (Kolasa, et al. 1987).

Order Dalyellioida

Family Provorticidae

Pilgramilla virginiensis (Ruebush and Hayes 1939)
Hayes (1942) reported collecting this species at several Dane County localities and Mann Lake in Vilas County. The only other North American records of this species appear to be the type specimens and Kolasa, et al.’s (1987) report from interstitial waters in New York.

Family Dalyelliidae

Castrella pinguis (Silliman 1884)
Hayes (1942) collected C. pinguis at several Ashland, Dane, and Vilas county localities and later (1945) provided a complete description of and taxonomic commentary on this species, based entirely on his Wisconsin collections.

Microdalyellia rossi (Graff 1911)
Hayes (1942) described a new variety, aklados, of this species based on specimens collected from a drainage ditch in Dane County. He also described a second new variety, multispina, based on specimens collected in a Vilas County bog. He reported additional Vilas County collection localities for this variety as well. Finally, Hayes (1942) reported collecting a previously described variety, tennesseensis, in Dane and Vilas counties.

Order Typhloplanoida (Neorhabdocoela)

Family Typhloplanidae

Castrada hofmanni Braun 1885
Hayes (1942) described a new variety, minuta, from specimens collected in the Manitowish River (Vilas County). He also reported collecting C. hofmanni in nearby Black Oak and White Sand lakes and characterized it as “common” in July and “abundant” in August.

Mesostoma ehrenbergii (Focke 1836)
Muttkowski (1918) collected M. ehrenbergii in late July and August in Lake Mendota (Dane County) and reported that it was “very common” in May and June in nearby Picnic Pond. Hayes (1942) described a new variety, indverticulata, based on specimens taken in the Manitowish River (Vilas County).

Phaenocora kepneri Gilbert 1938
Hayes (1942) found P. kepneri “abundant” in Lake Mendota (Dane County), where he collected it in April, May, and June.

Protoascus wisconsinensis Hayes 1941
Hayes (1941) described this species based on material collected in a “permanent ditch located southeast of Lake Wingra” (Dane County) in autumn and spring collections. The NMNH’s invertebrate zoology database includes records (catalog nos. 20571 and 20572) of four syntype specimens.

Rhynchomesostoma rostratum (O.F. Müller 1774)
Hayes (1942) collected “a few specimens” of R. rostratum at three sites in Vilas County.

Strongylostoma elongatum Hofsten 1907
Hayes (1942) collected S. elongatum at several Ashland, Dane, and Vilas county localities. He believed his records to be the first valid report of this genus from the Western Hemisphere. Kolasa, et al. (1987) later collected a single specimen in interstitial waters in southeastern New York.

(continued on next page)
Order Kalyptorhynchia
Family Polycystitidae

Gyratrix hermaphroditus Ehrenberg 1831

Hayes (1942) collected G. hermaphroditus from several Ashland, Dane, and Vilas county localities. He found G. hermaphroditus generally to be “abundant” in April and November and “fairly common” in August and October, but did not indicate specific microhabitats. Kolasa, et al. (1987) collected all of their New York specimens from interstitial waters.

MACROTURBELLARIANS
Order Tricladida

Family Dugesiidae

Cura foremanii (Girard 1852)
C. foremanii inhabits cool streams (Kenk 1944, 1974b, 1976). The NMNH’s invertebrate zoology database includes a record (catalog no. 50662) of five specimens of this species from Wisconsin. C.A. Long and J. Krause collected these from the Little Plover River (Portage County) in October 1973 and the specimens are apparently the vouchers for their distribution note (Long and Krause 1974) and physiological study (Krause 1974).

Girardia dorotocephala (Woodworth 1897)
G. dorotocephala occurs in both running and standing waters (Kenk 1944, 1976). Stringer (1918) made early reference to this species occurring in Wisconsin. Muttkowski (1918) reported G. dorotocephala as “abundant” in Merrill Springs and “occasional” in Lake Mendota (Dane County). Krause (1974) collected it from small ponds and streams near Amherst (Portage County) in September and October 1973. A G. dorotocephala specimen was taken in an unnamed tributary to Raccoon Creek (Rock County) in 1995 (M.J. Wetzel, Illinois Natural History Survey, pers. comm.).

Baumann, et al. (1977) tested the effects of Antimycin A, a fish toxicant, on G. dorotocephala. They suggested G. dorotocephala was “abundant in portions of the Rock River system.” Their experimental animals, however, came from a biological supply house and the collection locality remains unknown. Wisenden and Millard (2001) also used experimental animals collected from unnamed natural Wisconsin populations in their assessment of chemical alarm cues used as part of the antipredator behaviors of this species.

Girardia tigrina (Girard 1850)
G. tigrina is widely distributed, “generally in warm ponds, lakes, and rivers” (Kenk 1976) and “one finds it commonly along the shores of lakes on the undersides of stones” (Kenk 1944). Muttkowski (1918) found G. tigrina at various depths in Lake Mendota (Dane County). He noted that the specimens he collected were highly variable and commented that he may have lumped several species together under this name. Baker (1924) reported G. tigrina from the Lake Winnebago region and Hyman (1939) reported it occurring in southern Lake Michigan. Barton and Hynes (1978) found G. tigrina common in the wave-zone along Lake Superior’s north shore. It certainly occurs along this lake’s south shore as well.

Family Planariidae

Phagocata gracilis (Haldeman 1840)
According to Kenk (1970, 1974b), P. gracilis occupies streams, springs, and subterranean waters in caves. Stringer (1918) recorded P. gracilis from Wisconsin, but Kenk (1970) considered this a doubtful record. Further work will be necessary to confirm Stringer’s record.

Phagocata morgani (Stevens and Boring 1906)
The subspecies P. morgani morgani (Stevens and Boring 1906) inhabits springs and cold creeks (Kenk 1974b, 1976). Kenk (1944) and Hyman (1951) included Wisconsin, without further details, in their tallies of states where P. morgani had been reported. Kenk (1944) also noted that P. morgani “appears to be common” across the border in Michigan’s Upper Peninsula.

Phagocata velata (Stringer 1909)
Kenk (1974b, 1976) reports P velata from springs, streams, and spring-fed ponds and Ball, et al. (1981) and Smith (1991a) record it from vernal ponds and intermittent streams. Kenk (1944) believed Castle and Hyman’s (1934) record from near Madison needed “further verification,” which he apparently found. The NMNH’s invertebrate zoology database includes two records of four specimens (catalog nos. 52565 and 52566) collected by Kenk at the Nevin Fish Hatchery south of Madison (Dane County) in August 1967. Ball, et al. (1981) reported this record. Elsewhere, P velata has been collected in temporary ponds with Hymanella retenuova (Ball, et al. 1981) and from a spring with Cura foremanii (Kenk 1943).
Family Dendrocoelidae
Procytola fluviatilis  Leidy 1857
Stringer (1918), Kenk (1943, 1944, 1976), and Hyman (1951) reported this species from unspecified Wisconsin localities. According to Kenk (1974b, 1976), *P. fluviatilis* inhabits ponds, lakes, rivers, streams, and springs. Muttkowski (1918) found *P. fluviatilis* occurred "frequently" in 0-1 m depths in Lake Mendota (Dane County). Smith and Verrill (1871) and Smith (1874) reported *P. fluviatilis* in Canadian waters of Lake Superior at depths of 4-13 fathoms. It likely occurs in the southern parts of this lake as well.

Family Rhynchodemidae
Microplana terrestris  (O.F. Müller 1774)
The NMNH's invertebrate zoology database includes a record (catalog no. 40935) of three *M. terrestris* specimens from Wisconsin. A.R. Cahn collected these near Oconomowoc (Waukesha County) in July 1927, and these are the basis for Hyman's (1939, 1943) reports from the state, one of only three North American records (Bail and Sluys 1990). Hyman (1939, 1943) noted that the uniformly black specimen was found inhabiting rotten wood.

Rhynchodemus sylvaticus  (Leidy 1851)
Ogren (1955, 1986) recorded three immature specimens of the nonnative *R. sylvaticus* collected along a roadside at New Glarus Woods State Park in August 1952.

UNCERTAIN TURBEILLARIAN SPECIES
The identity of several "species" reported from Wisconsin remains in question. Hoy (1872) reported "a small white Planaria" as part of the deep-water benthos collected in Lake Michigan offshore from Racine. It is impossible to know what species he actually had and causing *P. simplex* to be considered a species *inquirienda* (Kenk 1976). Muttkowski (1918) reported "Polygella nigra" from Lake Mendota. *Polygella nigra* (Müller 1774), however, is a European and north African species not otherwise reported from North America. The only two North American species of *Polygella, P. coronata* (Girard 1891) and *P. sierrensis* Kenk 1973, inhabit the western half of the continent leading me to believe that Muttkowski's identification almost certainly was made in error. Peck and Christiansen (1990) collected a "new and very primitive flatworm" from Popp's Cave in Richland County. They listed this as "family, genus, and species indeterminate" in the "Alloeocoela." Alloeocoela, however, has remained ill defined and of uncertain taxonomic position (Tyler, et al. 2005) and this new species has yet to be described.

Higley (1918) collected turbellarians throughout the Upper Midwest, including from ponds near Milwaukee (Milwaukee County). Unfortunately, her species accounts included only general references to the habitats in which the worms were collected, making it virtually impossible to know the specific localities her specimens came from. Some species that Higley (1918) may have collected in the Wisconsin area include: *Stenostomum leucops* (Leidy, 1851), *Giesztoria dodggi* (Graff 1911), *Phaenocora megalcephala* (Higley 1918), and *Rhynchomesostoma rostratum* (O.F. Müller 1774). Higley (1918) also described *Stenostomum glandiferum* and *Mesostoma simplex* from localities in the area, but these are now considered *nomen dubium* (Tyler, et al. 2005).

Hayes (1942) reported collecting a number of species from Wisconsin lakes that currently are considered valid (Table 1), but which are not included in Kolasa's (2001) list of species recorded from North America. He also reported collecting the European *Macrostomum tuba* Graff 1882 from a tank in a greenhouse on the University of Wisconsin campus, but noted that there was no way of knowing from where it had been introduced (Hayes 1942). Kolasa (2001) did not include *M. tuba* in his list of North American microturbellarians. In his thesis, Hayes (1942) provided descriptions of eight species new to science based on specimens collected in Wisconsin. He never published formal descriptions of seven of these (Table 2), however, leaving their validity in question. Hayes (1942) also reported records of specimens of nine species that he could identify only to the genus level (Table 3). Representatives of all of these genera, except *Koinocystis*, have been reported from North America (Kolasa 2001, Tyler, et al. 2005), but Hayes believed several of his unidentified material to represent undescribed species.

<table>
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<tr>
<th>Table 1. Valid species reported by Hayes (1942) from Wisconsin, but not included in Kolasa’s (2001) list of North American species.</th>
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<tbody>
<tr>
<td>Giesztoria dodggi (Graff 1911)</td>
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<td>Giesztoria triquetra (Fuhrmann 1894)</td>
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<tr>
<td>Klattia virginiana (Kepner, Stirewalt and Ferguson 1939)</td>
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<tr>
<td>Stenostomum salliens (Kepner and Carter 1931)</td>
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<tr>
<td>Typhloplana viridata (Abildgaard 1789)</td>
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<th>Table 2. Species newly described by Hayes (1942) in his thesis, but not elsewhere in the literature.</th>
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<tr>
<td>Castrella trifurca Hayes 1942</td>
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<tr>
<td>Microdalyellia oligostyrakia Hayes 1942</td>
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<tr>
<td>Microdalyellia pteridioides Hayes 1942</td>
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<td>Microdalyellia stephanoma Hayes 1942</td>
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<td>Mesostoma magnoreceptaculum Hayes 1942</td>
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<td>Mesostoma ochnobolbos Hayes 1942</td>
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<td>Opistomum micropharynx Hayes 1942</td>
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<th>Table 3. Specimens uncertainty identified by Hayes (1942).</th>
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<tr>
<td>Castrada (?) sp. 1 and sp. 2</td>
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<tr>
<td>Koinocystis sp.</td>
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<td>Krumbachia sp.</td>
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<td>Microdalyellia sp. 1 and sp. 2</td>
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<tr>
<td>Olisthanella sp.</td>
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<td>Phaenocora sp.</td>
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<td>Prorhynchella sp.</td>
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Several additional species likely occur in Wisconsin. Ball (1969b) confirmed the presence of the nonindigenous Dugesia polymorpha (Schmidt 1861) in the St. Lawrence River system. Although it has not yet been reported from Wisconsin, it is possible that D polymorpha has spread elsewhere from its point of introduction and may now occur in Lake Michigan as well. Hymanella retenuova Castle 1941 occurs in vernal pools, floodplain pools, and seepage springs throughout the eastern United States (Kenk 1976, Ball et al. 1981, Smith 1991a). Although not yet reported from Wisconsin, further survey work will likely show that H. retenuova occurs here.

Finally, an unidentified Bipalium sp. was collected in a Milwaukee-area greenhouse in the mid-1990s. This could have been the widely distributed Bipalium kewense Mosely 1878, which has been found in about 19 eastern states including neighboring Illinois (Ogren 1984, Ball and Sluys 1990) or B. adenititium Hyman 1943, which Zaborski (2000) recently reported from Illinois.

RIBBON WORMS (NEMERTEA) IN WISCONSIN

There is only one published ribbon worm record from Wisconsin. Browning (1972) reported Prostoma rubrum from Silver Creek in the City of Ripon (Fond du Lac County). According to the NMNH’s online invertebrate zoology database (NMNH 2005), voucher specimens (catalog no. 45773) from this report are available in the NMNH collection. P. rubrum is no longer a valid species (Gibson and Moore 1976, Gibson 1995), however, so this observation has to be treated as Prostoma sp. until the voucher can be examined to determine the species involved.

CONCLUDING REMARKS

The conservation status of flatworms and ribbon worms in Wisconsin remains unknown. Neither state nor federal agencies consider any platyhelminths or nemerteans to be endangered, threatened, or of “special concern,” but biologists have not conducted a statewide, systematic survey for these groups. I have been able to document only 31 turbellarian and one nemertean species based on the literature, considerably more than the two triclads included in Ball’s (1969a) tally, but probably far short of the total number of species that occurs here. Most of the limited museum specimens have yet to be examined by a specialist. Cave habitats, vernal pools, and interstitial and subterranean waters have not been investigated significantly.

The basic biology, taxonomy, distribution, phenology, population dynamics, status, habitat selectivity, and trophic relationships of these animals remain areas that could benefit from additional research. The potential impacts of nonnative species also merit investigation. The literature cited in this report and in Kenk (1974a, 1974b, 1989), Gibson and Moore (1976), Moore and Gibson (1985), Ball and Sluys (1990), Gibson (1995), and Kolassa (2001) can serve as starting points for interested investigators. Kolassa (2001) summarizes techniques for obtaining both quantitative and qualitative samples of freshwater turbellarians. Winsor (1998) provides directions for collection and preservation of terrestrial species, which are more cryptic and difficult to find. Routine preservation of field samples in alcohol or formalin, unfortunately, makes most turbellarians unrecognizable. Ribbon worms, however, can be preserved in 80% ethanol, but should be narcotized first (Kolassa 2001).

Many turbellarians can be identified by squash mounts of live animals. Identification, however, remains a challenge for inexperienced researchers as histological preparations also often are required. Similarly, the principal taxonomic characters used to distinguish species of Prostoma are restricted to internal anatomical features of the anterior end. Thus, identification necessarily involves preparing histological sections of the head of the animal (Smith 1991b).


ACKNOWLEDGEMENTS

Work on this report began as a result of the “Wisconsin’s Species Diversity: The State of Scientific Knowledge” symposium sponsored by the Aldo Leopold Chapter of the Society for Conservation Biology in April 1997. I am indebted to the chapter for providing the push to initiate this synthesis and publish it now to support work on Wisconsin’s Comprehensive Wildlife Conservation Plan.

LITERATURE CITED


**AUTHOR CONTACT INFORMATION**

**Address:**
Wisconsin DNR
Bureau of Integrated Science Services
PO Box 7921, Madison, WI 53707-7921

**Telephone:** (608) 266-8931
**E-mail:** dreux.watermolen@dnr.state.wi.us

**Graphic Design:** Michelle E. Voss

**Illustrations:** Dreux J. Watermolen