United States
Environmental Protection
Agency

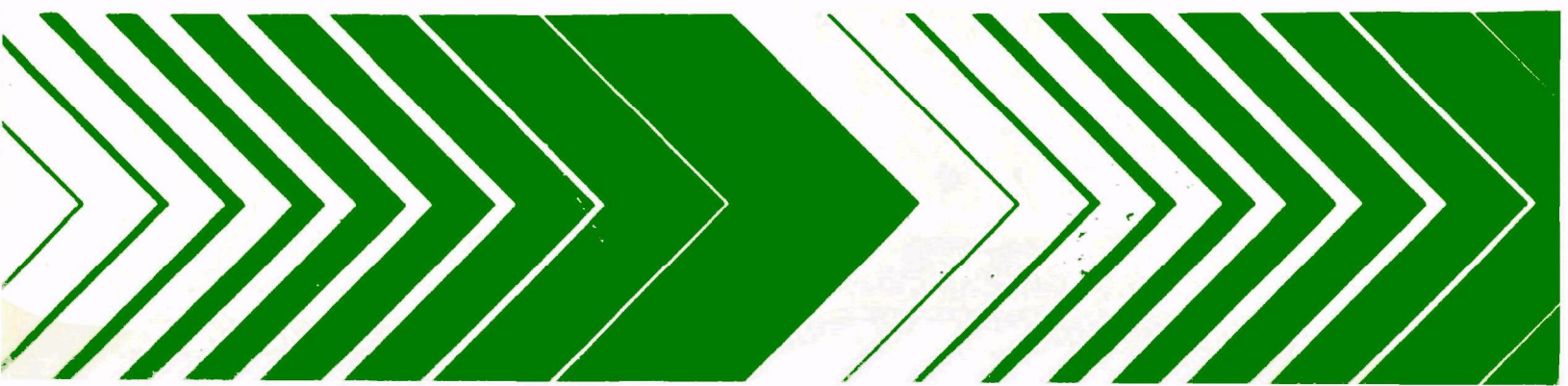
Environmental Monitoring and Support
Laboratory
Cincinnati OH 45268

EPA-600/4-80-031
June 1980

Research and Development

EPA

A Guide to the Naididae (Annelida: Clitellata: Oligochaeta) of North America



RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7 Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the ENVIRONMENTAL MONITORING series. This series describes research conducted to develop new or improved methods and instrumentation for the identification and quantification of environmental pollutants at the lowest conceivably significant concentrations. It also includes studies to determine the ambient concentrations of pollutants in the environment and/or the variance of pollutants as a function of time or meteorological factors.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

EPA-600/4-80-031
June 1980

A GUIDE TO THE NAIDIDAE (ANNELIDA: CLITELLATA: OLIGOCHAETA) OF NORTH AMERICA

by

Jarl K. Hiltunen*
Great Lakes Fishery Laboratory
U.S. Fish and Wildlife Service
Ann Arbor, Michigan 48105

and

Donald J. Klemm*
Aquatic Biology Section
Environmental Monitoring and Support Laboratory
Cininnati, Ohio 45268

*co-authors

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

DISCLAIMER

This report has been reviewed by the Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

Environmental measurements are required to determine the quality of ambient water, the character of effluents, and the effects of pollutants on aquatic life. The Environmental Monitoring and Support Laboratory - Cincinnati conducts research to develop, evaluate, and promulgate methods to:

* Measure the presence and concentration of physical, chemical, and radiological pollutants in water, wastewater, bottom sediments, and solid waste.
* Concentrate, recover, and identify enteric viruses, bacteria, and other microorganisms in water.
* Measure the effects of pollution on freshwater, estuarine, and marine organisms, including the phytoplankton, zooplankton, periphyton, macrophyton, macroinvertebrates, and fish.
* Automate the measurement of physical, chemical, and biological quality of water.
* Conduct an Agency-wide quality assurance program to assure standardization and quality control of systems for monitoring water and wastewater.

The effectiveness of measures taken to maintain and restore the biological integrity of the Nation's surface waters is dependent upon our knowledge of the changes in the taxonomic composition of aquatic life caused by discharges of toxic substances and other pollutants, and upon the level of our understanding of the complex relationships that prevail in aquatic ecosystems. Naidid worms are important components of the benthic fauna and are frequently abundant in a variety of freshwater habitats. The varied response of naidid species to different kinds of pollution and toxic substances makes them very useful as water quality indicator organisms. While several regional keys to North American Naididae have been published, this report is the first to contain an illustrated key and the distribution for all taxa. The publication was developed to assist aquatic biologists in evaluating data collected in studies of the effects of toxic substances and other pollutants on the communities of naidid oligochaetes.

Dwight G. Ballinger
Director
Environmental Monitoring and Support
Laboratory - Cincinnati

ABSTRACT

In North America the aquatic annelid worms (Clitellata: Oligochaeta), belonging in the family Naididae, are composed of 21 genera and 62 species. All taxa can be identified by external morphological features. This guide presents the following: an introduction to the general biology of the Naididae, collecting and processing methods, a species list, an illustrated key, a glossary, an annotated systematic list, and a selected bibliography which includes the references cited in the text and other publications which provide additional information on naidid taxonomy and ecology.

CONTENTS

LIST OF FIGURES

LIST OF FIGURES - continued

LIST OF FIGURES - continued

ACKNOWLEDGMENTS

The authors thank Walter J. Harman and Kurt S. Stimpson for their reviews of the technical contents of the manuscript. We also thank Cornelius I. Weber for reading the manuscript and making valuable suggestions. We are grateful to the Smithsonian Institution, U.S. National Museum of Natural History, Department of Invertebrate Zoology, Division of Worms, Washington, D.C.; The Academy of Natural Sciences of Philadelphia, Department of Invertebrate Zoology, Philadelphia, Pennsylvania; and the Naturhistoriska Riksmuseet, Sektionen for Evertebratzoologi, Stockholm, Sweden, for permitting us to examine their collections of Naididae. We are also indebted to the following individuals for supplying distribution records: Michael T. Barbour, James R. Brice, Michael S. Loden, Anthony F. Maciorowski, Bruce E. Markert, Robert Schmal, Douglas R. Spencer, Kurt S. Stimpson, and David R. Wefring.

SECTION 1

INTRODUCTION

The composition and abundance of benthic animals are commonly used to demonstrate the effects of pollution on the biological integrity of surface waters and changes in the biotic community resulting from the destructive activities of man. The segmented worms, or Oligochaeta, are one of the important components of the fauna collected during biological investigations of surface waters. This group of invertebrates is composed of fourteen families (Brinkhurst and Jamieson, 1971), including the Naididae. The naidids are, in general, relatively small, commonly 1 mm to 10 mm long, and can easily be overlooked or ignored in sample analysis, lost during sample reduction (even under standard sieving procedures), or misidentified by investigators not familiar with their morphology. Frequently the authors of environmental studies have recorded the group only by subclass (Oligochaeta), family, genus, or merely as "worms". The improper or inadequate treatment of the Naididae is attributable, at least in part, to the lack of a practical key to species. To perceive water quality requirements and pollution tolerances of aquatic organisms, the animals must be identified to the species level (Resh and Unzicker, 1975 and Carricker, 1977). In the few studies where naidids have been identified to species, a relationship between species assemblages and water quality is apparent (Hiltunen, 1967; Learner et al., 1978; Learner, 1979). For example, Wapsa mobilis is abundant in the polluted Saginaw Bay (Lake Huron), Michigan, but uncommon elsewhere in the Great Lakes. Published data, albeit meager, indicate that some species have a discontinuous or restricted distribution; e.g. a number of species have been reported only from the Gulf States. In some instances the apparent discontinuities may, however, be a function of insufficient sampling.

Thus, the present guide to the ordinarily free-living naidid species found in the United States and Canada was composed to assist aquatic biologists in Federal, state, and private water monitoring agencies in identifying specimens to the species level and to increase our knowledge of the relationship between species composition and water quality. The guide includes a species list, an illustrated key, a glossary, and an annotation for each species. The drawings of the generalized naidid (Fig. 1) and of the chaetae or bristles (Fig. 2) are especially important in the family and species identification. The morphological terms employed in the differentiation of species are defined in the Glossary. A brief discussion of methods for processing specimens is also presented. Dimensions and illustrations are based on preserved material. A Selected Bibliography section was assembled from

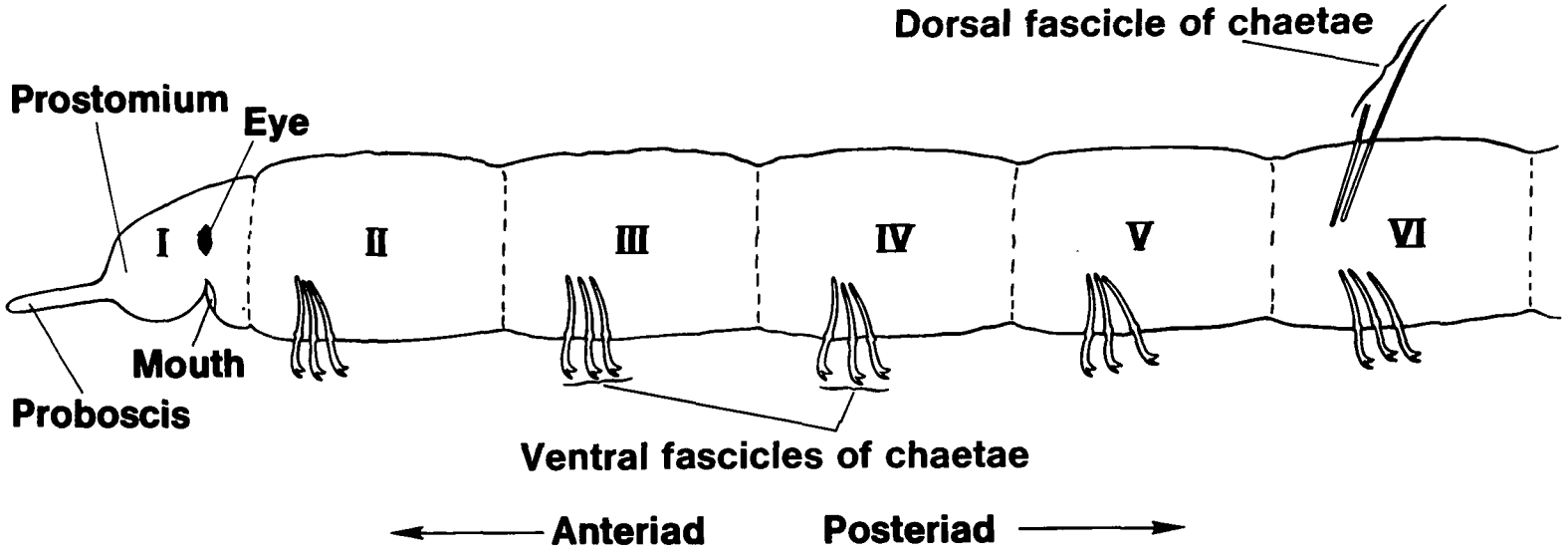


FIG. 1. Generalized naidid, lateral view, anterior segments.

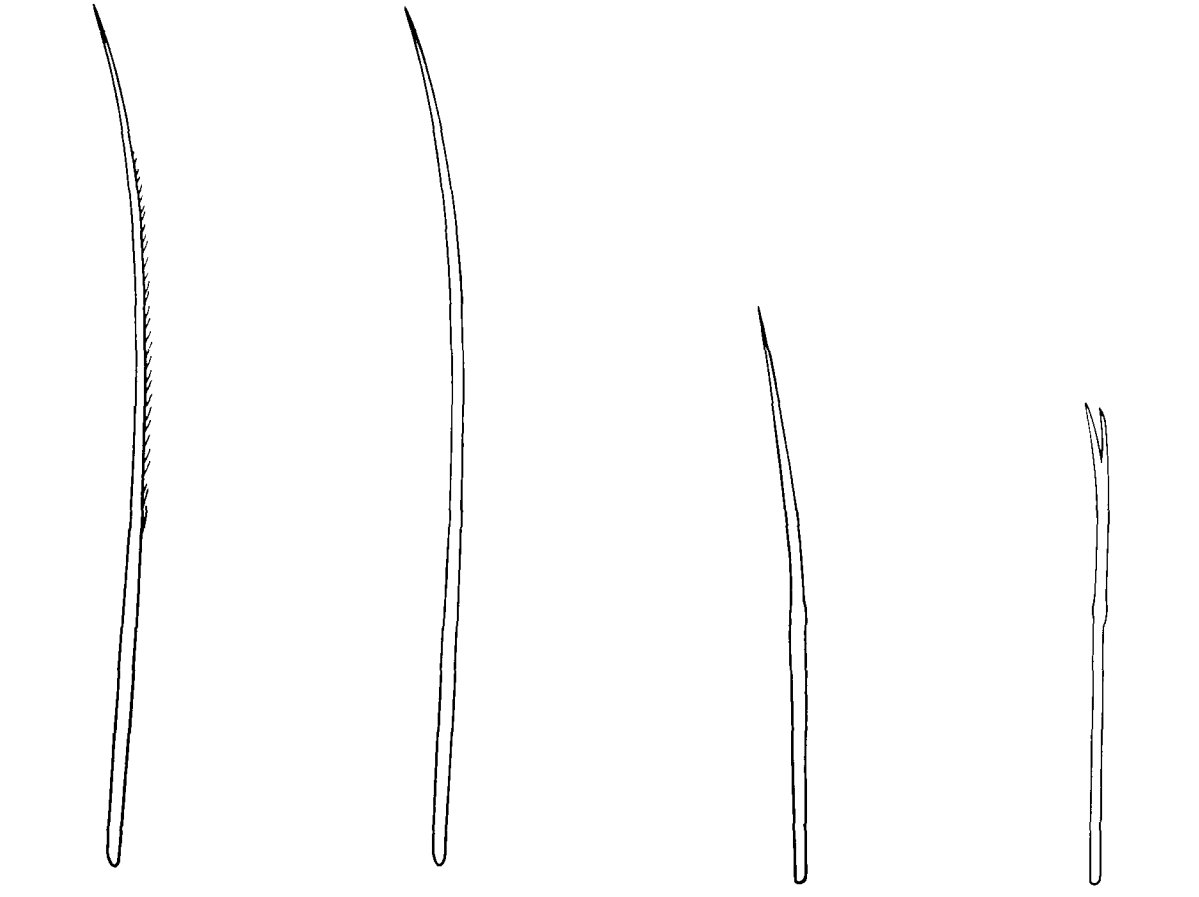


FIG. 2. Generalized forms of chaetae or bristles (cf. Glossary).

literature pertaining directly to the systematics and ecology of the Naididae of North America. Distribution data are those of the authors as well as others who have graciously made their records available to the authors.

Inasmuch as new zoogeographical records of species are published frequently, the present key may not include the latest discoveries. In instances where a species is not keyed in the present work, the reader is directed to consult Brinkhurst and Jamieson (1971), Aquatic Oligochaeta of the World.

SECTION 2

METHODS

Naididae may be collected by any sampling method suitable to the need of the collector, but inasmuch as many species are small and delicate, care should be exercised in collecting and handling samples containing naidids. Ideally the sample material should not be sieved. However, abstention from washing the samples is often impractical. In most instances it is desirable to wash mud from the sample, and this is best done by putting small amounts of a sample in the sieve and agitating it gently with the mesh submerged in water. The resultant residue containing the oligochaete specimens is transferred into a widemouthed container and fixed with 10% formalin. For studies where quantitative retention of naidid specimens is desirable, a U.S. Standard No. 60 sieve (60 meshes per inch, 0.250 mm openings) is recommended.

In the laboratory a dissecting microscope is required to discern individuals in the sample. Forceps or medicine droppers can be employed to remove specimens from the sieved residue. The oligochaetes can be stored in a vial containing 10% formalin or, if desired, the material can be mounted directly on microscope slides using a non-resinous mounting medium containing a clearing agent (e.g. Hydramount[1]). In lieu of non-resinous media the worms may be placed temporarily in Amman's lactophenol (100 g phenol, 100 ml lactic acid, 200 ml glycerine, 100 ml water), a medium which also clears tissues and eliminates the risk of specimen dessication if a permanent mount cannot be prepared immediately following extraction from the sample. The clearing process usually takes a few hours to a few days depending on the size of the specimen. Gentle application of heat will speed the clearing process. If the specimens were preserved in 70% alcohol, they should be placed in water for a short time to leach out the alcohol. The alcohol retards the clearing process of Amman's lactophenol. However, do not leave specimens in the water too long (not more than 2 hours) because the worms will begin to deteriorate. They can be held indefinitely in Amman's lactophenol or 10% formalin for later processing and mounting.

---

[1]Bio/Medical Specialities (Box 1687, Santa Monica, CA 90406)

Optimal resolution and longevity of mounted materials are achieved only in resinous media (e.g. Canada Balsam, Harleco's Xylene Coverbond[2], etc.). These mounting media require dehydration of the specimens through the alcohol series and clearing before using the mountant, but they produce the best permanent mounts. The method can be found in any standard biological techniques book (e.g. Knudsen, 1966; Meyer and Olsen, 1971). Non-resinous media are recommended for rapid processing of large numbers of specimens. For extremely important reference specimens, a permanent resinous mounting medium is best.

A 12 or 18 mm diameter, No. 0 or 1, round cover glass is appropriate because it will adequately accommodate the entire size range of naidids, and the shape allows for maneuvering the specimen to rest in the most desirable position by gentle rotation of the cover glass. When preparing a temporary or permanent mount, an attempt should be made to place the specimen on its side, thereby, revealing both dorsal and ventral fascicles of chaetae. A variation from this is allowed with specimens of Dero which must be viewed from the dorsal aspect, revealing the arrangement of the branchial apparatus. The identification of species requires a compound light microscope with oil immersion (1000X).

Caution must be taken in identifying naidids to species. Because they undergo asexual reproduction by architomy (budding), daughter zooids may not have the proper order of, or bear a normal complement of, full sized chaetae. Observing unseparated zooids will provide the investigator a clearer contrast between the features of a fully developed parent and its daughter zooids.

Naidid material no longer needed in a study should be deposited in an appropriate museum. In North America, the specimens with proper collection data can be sent to the Worm Division, Department of Invertebrate Zoology, U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.

---

[2]Scientific Products (1430 Waukegan Road, McGaw Park, IL 60085)

SECTION 3

SPECIES LIST *

Phylum Annelida
Class Clitellata
Subclass Oligochaeta
Order Haplotaxida
Family Naididae

Genus *Allonais* Sperber, 1948
Allonais paraguayensis (Michaelsen, 1905)
Allonais pectinata (Stephenson, 1910)

Genus *Amphichaeta* Tauber, 1879
Amphichaeta americana Chen, 1944
Amphichaeta leydigi Tauber, 1879

Genus *Arcteonais* Piguet, 1928
Arcteonais lomondi (Martin, 1907)

Genus *Bratislavia* Kosel, 1976
Bratislavia bilongata (Chen, 1944)
Bratislavia unidentata (Harman, 1973)

Genus *Chaetogaster* von Baer, 1827
Chaetogaster cristallinus Vejdovsky, 1883
Chaetogaster diaphanus (Gruithuisen, 1828)
Chaetogaster diastrophus (Gruithuisen, 1828)
Chaetogaster limnaei von Baer, 1827
Chaetogaster setosus Svetlov, 1925

Genus *Dero* Oken, 1815[1]
Dero abranchiata Harman, 1977
Dero digitata (Müller, 1773)
Dero flabelliger (Stephenson, 1931)
Dero furcata (Müller, 1773)
Dero nivea Aiyer, 1930
Dero obtusa d'Udekem, 1855
Dero pectinata Aiyer, 1930
Dero trifida Loden, 1979
Dero vaga (Leidy, 1880)

---

*The year of publication for some old species descriptions varies in the literature, and we have chosen the dates given in Sperber (1948).
[1]We maintain Aulophorus as a subgenus under Dero. Consequently, all the species names conform to the feminine gender of Dero.

Genus *Haemonais* Bretscher, 1900
Haemonais waldvogeli Bretscher, 1900

Genus *Homochaeta* Bretscher, 1896
Homochaeta naidina Bretscher, 1896

Genus *Nais* Müller, 1773
Nais alpina Sperber, 1948
Nais barbata Müller, 1773
Nais behningi (Michaelsen, 1923)
Nais bretscheri (Michaelsen, 1899)
Nais communis Piguet, 1906
Nais elinguis Müller, 1773
Nais magnaseta Harman, 1973
Nais pardalis Piguet, 1906
Nais pseudobtusa Piguet, 1906
Nais simplex Piguet, 1906
Nais variabilis Piguet, 1906

Genus *Ophidonais* Gervais, 1838
Ophidonais serpentina (Müller, 1773)

Genus *Paranais* Czerniavsky, 1880
Paranais litoralis (Müller, 1784)

Genus *Piguetiella* Sperber, 1939
Piguetiella michiganensis Hiltunen, 1967

Genus *Pristina* Ehrenberg, 1828
Pristina acuminata Liang, 1958
Pristina aequiseta Bourne, 1891
Pristina breviseta Bourne, 1891
Pristina foreli (Piguet, 1906)
Pristina idrensis Sperber, 1948
Pristina longidentata Harman, 1965
Pristina longiseta leidyi Smith, 1896
Pristina longiseta longiseta Ehrenberg, 1828
Pristina longisoma Harman, 1977
Pristina osborni Walton, 1906
Pristina plumaseta Turner, 1935
Pristina sima Marcus, 1944
Pristina synclites Stephenson, 1925

Genus *Ripistes* Duj, 1842
Ripistes parasita (Schmidt, 1847)

Genus *Slavina* Vejdovsky, 1883
Slavina appendiculata (d'Udekem, 1855)

Genus *Specaria* Sperber, 1939
Specaria fraseri Brinkhurst, 1978
Specaria josinae (Vejdovsky, 1883)

Genus *Stephensoniana* Černosvitov, 1938
Stephensoniana tandyi Harman, 1975
Stephensoniana trivandrana (Aiyer, 1926)

Genus *Stylaria* Lamarck, 1816
Stylaria fossularis Leidy, 1852
Stylaria lacustris (Linnaeus, 1767)

Genus *Uncinais* Levinsen, 1884
Uncinais uncinata (Ørsted, 1842)

Genus *Vejdovskyella* Michaelsen, 1903
Vejdovskyella comata (Vejdovsky, 1883)
Vejdovskyella intermedia (Bretscher, 1896)

Genus *Wapsa* Marcus, 1965
Wapsa grandis Harman, 1977
Wapsa mobilis Liang, 1958

SECTION 4

KEY TO THE NAIDIDAE OF NORTH AMERICA (NORTH OF MEXICO, EXCLUDING ALASKA)

1 With dorsal chaetae (in few or all segments) 7

Without dorsal chaetae 2

2(1) Ventral chaetae present in all segments; mouth ventral, clearly surpassed by the conspicuous prostomium (Fig. 1) . . . . . Ophidonais serpentina

Ventral chaetae present in all segments except segment III; mouth terminal, or subterminal; without prostomium (Fig. 3) or, at most, prostomium slightly developed . . . . . Chaetogaster 3

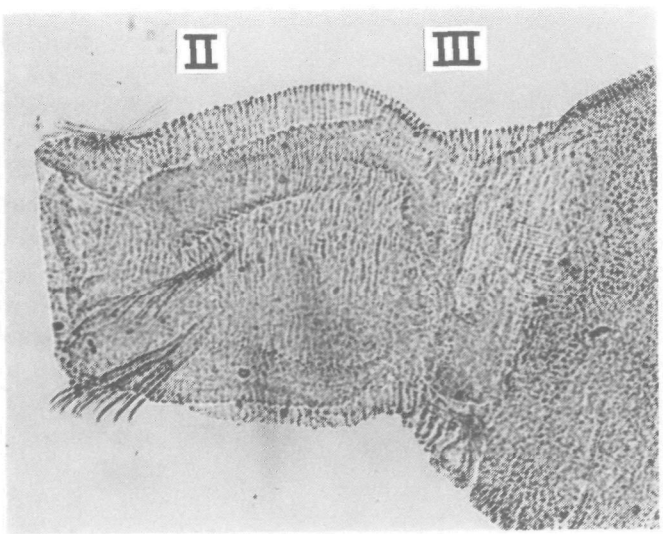


FIG. 3. Chaetogaster diaphanus, lateral view; anterior end "II" and "III" indicate approximate position of segments II and III.

3(2) Apex of chaetae simple or, if bifurcate (teeth visible under ca. 1000X), then the proximal tooth is extremely slender, appearing rudimentary and adherent to the slender distal tooth (Fig. 4). . . . . Chaetogaster setosus

Apex of chaetae with a pair of distinct teeth (evident under 400X or less magnification) 4

4(3) Teeth of chaetae distinctly reflexed (uncinate) (Fig. 5) . . . . . Chaetogaster limnaei

Teeth of chaetae not especially reflexed, similar to the teeth on ventral chaetae in Fig. 1) 5

5(4) Length of chaetae in segment II 120 µm or greater; mouth terminal, prostomium not developed 6

Length of chaetae in segment II less than 120 µm; mouth subterminal, prostomium conspicuous . . . . . Chaetogaster diastrophus

6(5) Length of chaetae in segment II less than 200 µm . . . . . Chaetogaster cristallinus

Length of chaetae in segment II greater than 200 µm . . . . . Chaetogaster diaphanus

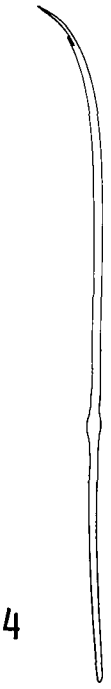


FIG. 4. Chaetogaster setosus, chaeta.

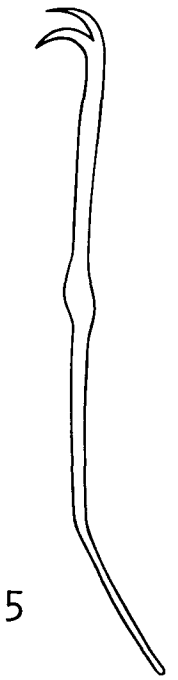


FIG. 5. Chaetogaster limnaei, chaeta.

7(1) Some or all dorsal fascicles with capilliform chaetae 8

All dorsal fascicles devoid of capilliform chaetae 16

8(7) Segment II with dorsal chaetae 9

Segment II without dorsal chaetae 24

9(8) Prostomium produced into a proboscis (Fig. 6) 10

Prostomium not produced into a proboscis (Fig. 7) 57

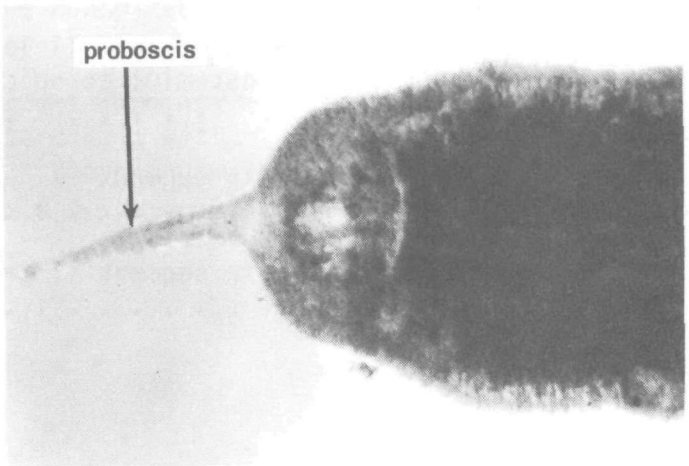


FIG. 6. Prostomium with a proboscis.

FIG. 7. Prostomium without a proboscis.

10(9) Apex of acicular chaetae appear simple under 1000X . . . . . Pristina longiseta longiseta

Apex of acicular chaetae appear bifurcate under 1000X 11

11(10) Ventral chaetae of segments IV and/or V conspicuously larger, (Fig. 8) than those in other segments (Fig. 9) . . . . . Pristina aequiseta

Ventral chaetae of segments IV or V not conspicuously larger than those in other segments 12

8

9

FIG. 8. Pristina aequiseta, enlarged ventral chaeta of segments IV and/or V.

FIG. 9. Pristina aequiseta, unenlarged ventral chaeta of segments other than segments IV and/or V.

12(11) Capilliform chaetae in segment III conspicuously longer (at least 1.3X) than those in other segments . . . . . Pristina longiseta leidyi

Capilliform chaetae in segment III not longer (may even be shorter) than those in other segments 13

13(12) Teeth of acicular chaetae unequal in length 14

Teeth of acicular chaetae equal in length 15

14(13) Capilliform chaetae serrulated (approximately as in Fig. 2). . . . . Pristina plumaseta

Capilliform chaetae not serrulated . . . . . Pristina synclites

15(13) Teeth of acicular chaetae tiny, their length not more than the thickness of the chaeta (Fig. 10). . . . Pristina foreli

Teeth of acicular chaetae long, their length about twice the thickness of the chaeta (Fig. 11). . . . . Pristina breviseta

16(7) Segment II with dorsal chaetae . . . . . Homochaeta naidina

Segment II without dorsal chaetae 17

17(16) Dorsal chaetae straight, spiciform, apex simple or minutely cleft (Fig. 12) . . . . . Ophidonais serpentina

Dorsal chaetae at least slightly sigmoid, the apex distinctly bifurcate (e.g. Fig. 13) 18

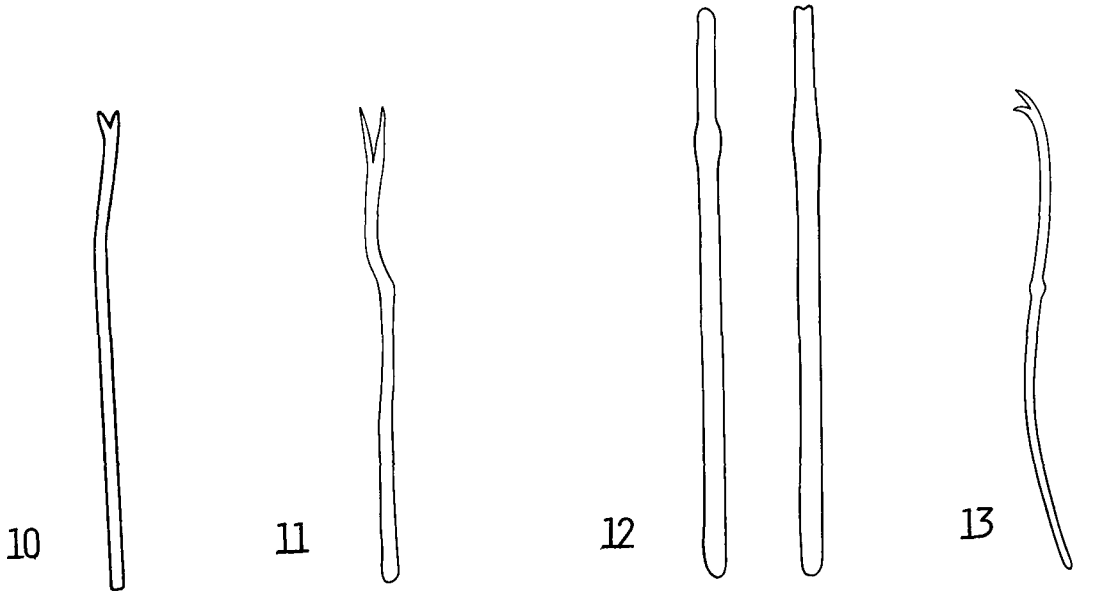


FIG. 10. Pristina foreli, acicular chaeta.
FIG. 11. P. breviseta, acicular chaeta. (Modified from Bourne, 1891).
FIG. 12. Ophidonais serpentina, dorsal chaetae.
FIG. 13. A sigmoid-shaped chaeta, apex bifurcate.

18(17) With dorsal chaetae in segments III-IV; ventral chaetae in these segments directed distinctly posteriad (Fig. 14) . . . . . Amphichaeta 19

Without dorsal chaetae in segments III-IV; ventral chaetae in these segments nearly perpendicular to the body (Fig. 1) 20

19(18) Six chaetae per fascicle in III, three per fascicle in IV, distal tooth about twice as long as the proximal tooth (Fig. 15). . . . . Amphichaeta americana

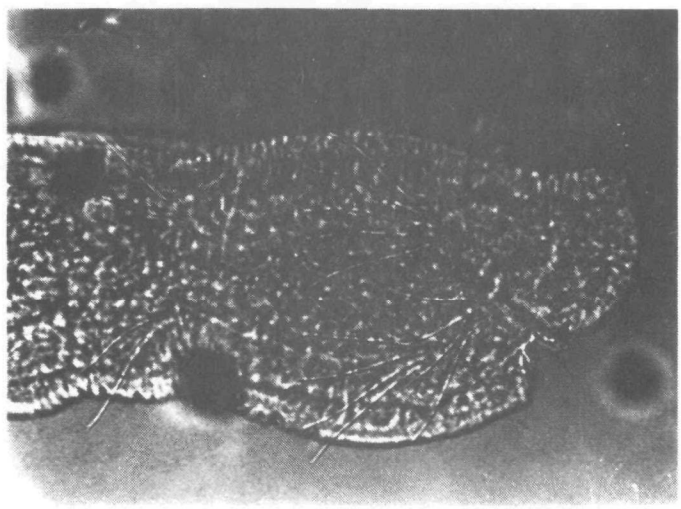
Five chaetae per fascicle in III, two per fascicle in IV, distal tooth only slightly longer than proximal tooth (Fig. 16) . . . . . Amphichaeta leydigi

20(18) Segment V with dorsal chaetae 21

Segment V without dorsal chaetae 56

21(20) Length of distal tooth of anterior (ventral) chaetae about twice that of the proximal tooth (similar to Fig. 15) . . . . . Wapsa 22

Length of the distal tooth of (ventral) chaetae anteriad to segment V, at most only slightly longer than the proximal tooth (similar to Fig. 13) 23



14

15

16

FIG. 14. Amphichaeta sp., lateral view, anterior segments with chaetae.
FIG. 15. A. americana, chaeta.
FIG. 16. A. leydigi, chaeta.

22(21) Length of chaetae in segment II 128–148 μm, about 7 chaetae per fascicle . . . . . Wapsa grandis

Length of chaetae in segment II 94–106 μm, 4 chaetae per fascicle . . . . . Wapsa mobilis

23(21) Length of ventral chaetae in segments II–IV about 60 μm; no eyes . . . . . Paranais litoralis

Length of ventral chaetae in segments II–V 100 μm or more; older individuals with eyes . . . . . Uncinais uncinata

24(8) Dorsal chaetae not present anteriad segment X . . . . . Haemonais waldvogeli

Dorsal chaetae present anteriad segment X 25

25(24) Digitiform lobes (Fig. 17) or both lobes and elongate palps (Fig. 18) present on anal segment; without eyes . . . . . Dero 26

No digitiform lobes or palps on anal segment; with or without eyes 33

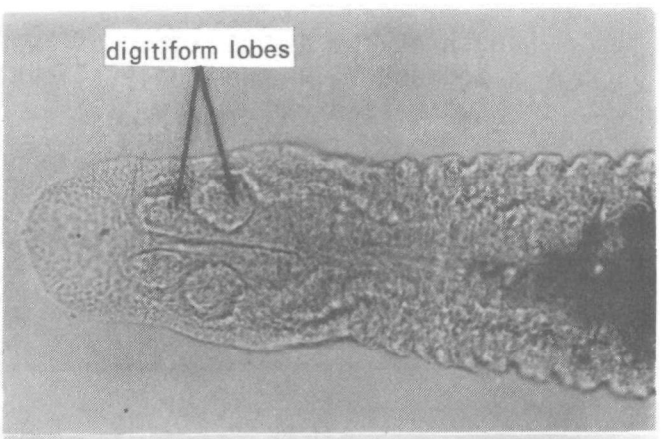


FIG. 17. Dero sp., branchial apparatus with digitiform lobes.

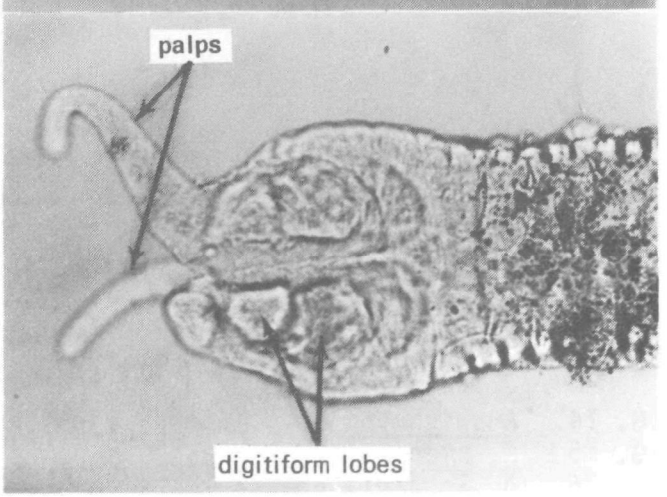


FIG. 18. Dero sp., branchial apparatus with digitiform lobes and palps.

26(25) Only digitiform lobes present on anal segment 27

Both digitiform lobes and elongate palps present on anal segment 30

27(26) Four or more pairs of gills; acicular teeth cleft, forming two or more teeth of unequal length 28

Three pairs of gills; teeth of acicular chaetae essentially equal in length 29

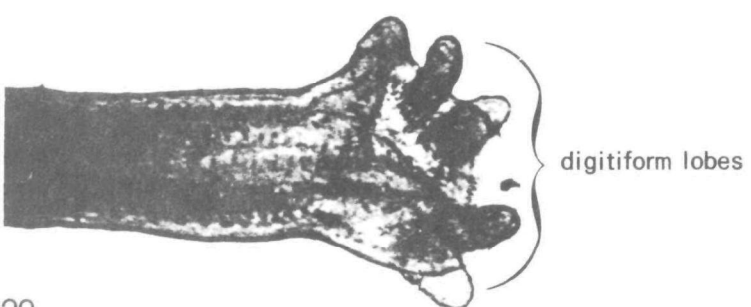
28(27) Apex of acicular chaetae cleft, forming two teeth, distal tooth being longer than proximal tooth . . . . . Dero digitata

Apex of acicular chaetae cleft, forming two teeth with a slender intermediate tooth (Fig. 19). . . . . Dero trifida

29(27) In preserved material, end of anal segment exceeded by the digitiform lobes (Fig. 20) . . . . . Dero obtusa

In preserved material, end of anal segment clearly surpasses the tips of the digitiform lobes (Fig. 17) . . . . . Dero nivea

19



20

FIG. 19. Dero trifida, acicular chaeta cleft, apex with an intermediate tooth.

FIG. 20. D. obtusa, slightly expanded digitiform lobes (gills) of the branchial apparatus. (Modified from Sperber, 1948).

30(26) Apex of acicular chaetae with one or more intermediate teeth between the lateral pair, or the entire tip expanded into a blade 31

Apex of acicular chaetae merely bifurcate . . . . Dero furcata

31(30) Intermediate teeth at the apex of acicular chaetae distinct (Fig. 21) . . . . . Dero pectinata

Intermediate teeth at the apex of acicular chaetae appearing fused to form a blade (Figs. 22, 23) 32

32(31) Blade-like apex of the acicular chaetae asymmetrical, impression of fused teeth not clearly evident (Fig. 22) . . . . . Dero flabelliger

Blade-like apex of the acicular chaetae essentially symmetrical, impression of the fused teeth evident (Fig. 23) . . . . . Dero vaga

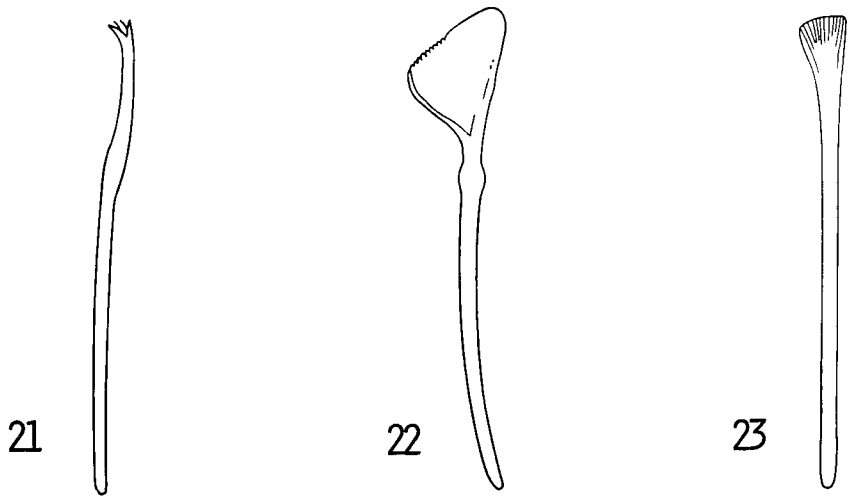


FIG. 21. Dero pectinata, acicular chaeta with few intermediate teeth.
FIG. 22. D. flabelliger, acicular chaeta.
FIG. 23. D. vaga, acicular chaeta with impression of fused intermediate teeth.

33(25) Prostomium produced into a proboscis (Fig. 6 or 24) 34

Prostomium not produced into a proboscis (Fig. 7) 37

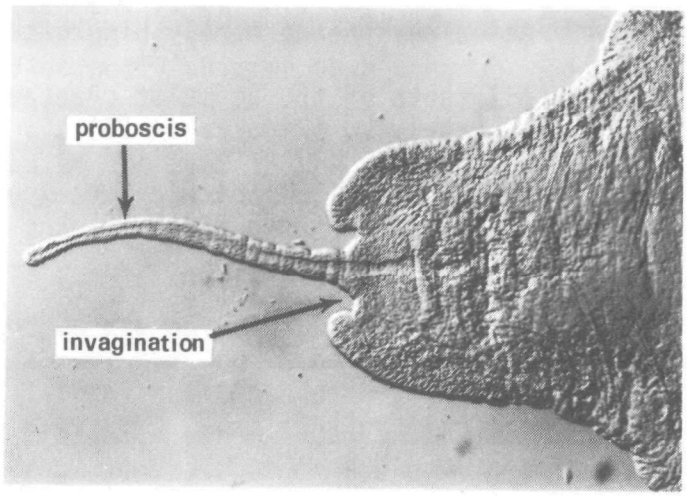


FIG. 24. Stylaria lacustris, showing proboscis and invagination of the prostomium.

34(33) More than three capilliform chaetae per fascicle 35

Not more than three capilliforms per fascicle 36

35(34) Length of capilliform chaetae in segments VI–VIII more than three times the length of those in segment IX . . . . . Ripistes parasita

Length of capilliform chaetae in segments VI–VII less than three times the length of those in segment IX. . . . . Arcteonais lomondi

36(34) Proboscis originates in an invagination of the prostomium (Fig. 24). . . . . Stylaria lacustris

Prostomium not invaginated, proboscis appears as a narrow elongation of the prostomium (Fig. 6) . . . . . Stylaria fossularis

37(33) Segment III with dorsal chaetae . . . . . Bratislavia bilongata

Segment III without dorsal chaetae 38

38(37) Capilliform chaetae in segment VI conspicuously (2 times), longer than those in other segments . . . . . Slavina appendiculata

Capilliform chaetae in segment VI not conspicuously longer than those in other segments 39

39(38) Apex of acicular chaetae bifurcate or pectinate 40

Apex of acicular chaetae simple 50

40(39) Acicular chaetae pectinate 41

Acicular chaetae merely bifurcate 44

41(40) All teeth of the acicular chaetae equally long or nearly so (Fig. 25 or 26) 42

One tooth of the acicular chaetae distinctly longer than the other teeth (Fig. 27) . . . . . Allonais paraguayensis

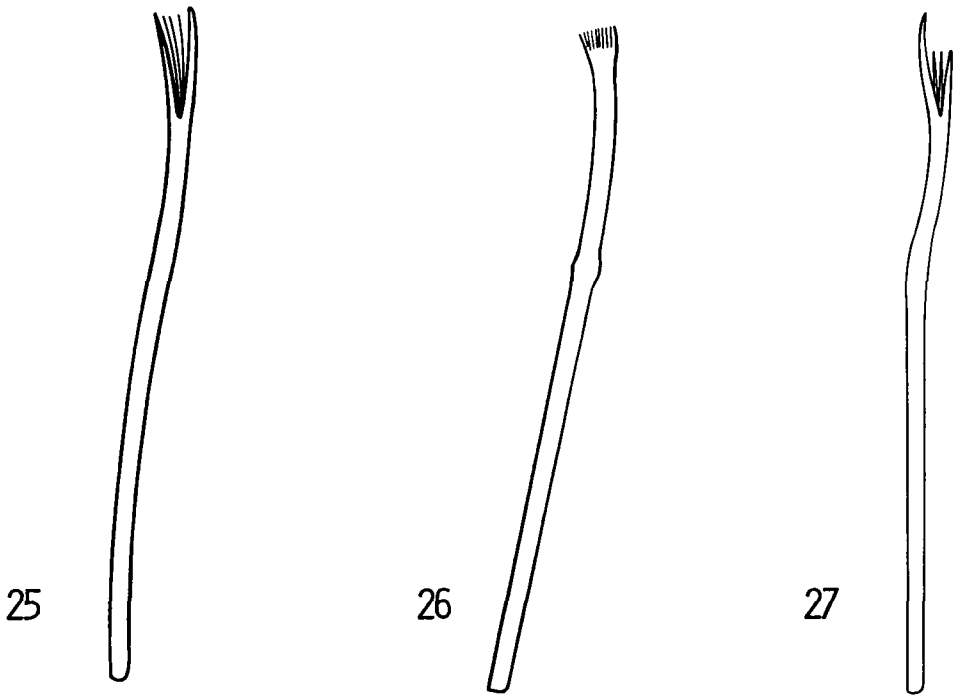


FIG. 25. Acicular chaeta with teeth equally long (Nais magnaseta).
FIG. 26. Acicular chaeta with equal teeth (Dero abranchiata).
FIG. 27. Allonais paraguayensis, acicular chaeta with unequal primary teeth.

42(41) Shape of ventral chaetae in Segment II distinctly dissimilar to those in Segment VI and posteriad (Fig. 28); lateral teeth on the acicular chaetae not different from the intermediate teeth (Fig. 26) . . . . . Dero abranchiata

Shape of ventral chaetae in segment II essentially like those in segment VI and posteriad; lateral teeth on the acicular chaetae distinctly thicker than the intemediate teeth (Fig. 25) 43

43(42) The distance from the nodulus to the apex in the acicular chaetae is approximately 20 μm; the length of the acicular teeth is about 4 μm, the lateral two teeth slightly divergent (Fig. 25) . . . . . Nais magnaseta

The distance from the nodulus to the apex in the acicular chaetae is approximately 13 μm; the length of the acicular teeth is about 3 μm, the lateral two teeth diverge slightly more than those shown in Fig. 25 . . . . . Allonais pectinata

44(40) Acicular chaetae gently sigmoid (Fig. 29); without eyes . . . . . Specaria josinae

Acicular chaetae straight or slightly bent (Fig. 30); commonly with eyes 45

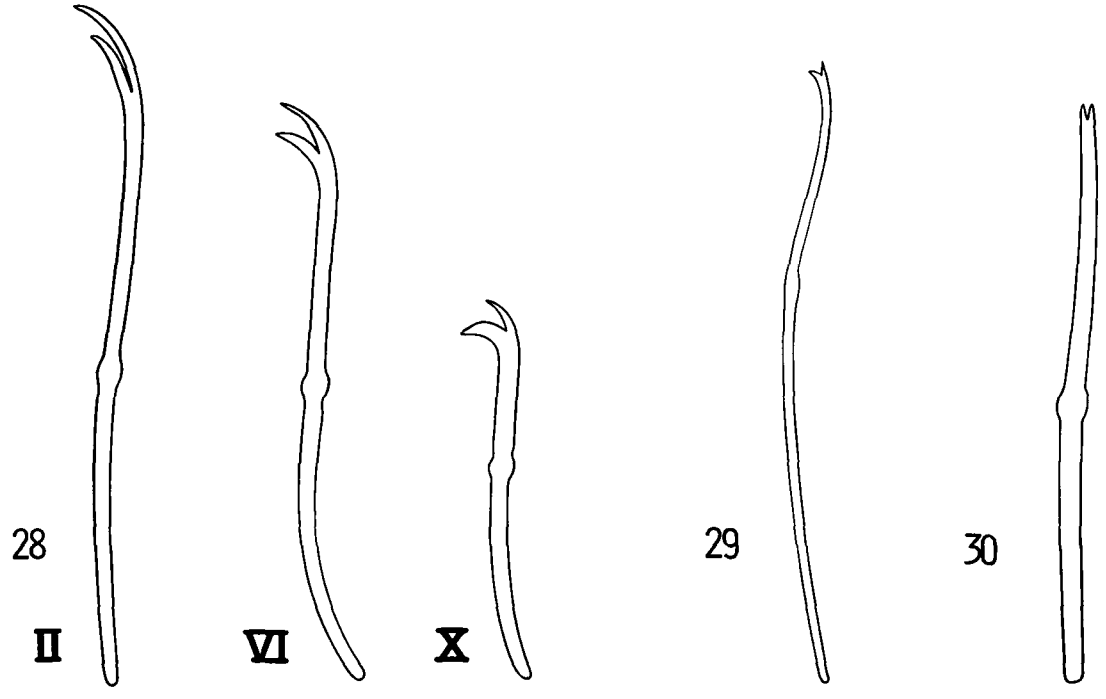


FIG. 28. Dero abranchiata, ventral chaetae in segments II, VI, and X, respectively.
FIG. 29. Specaria josinae, acicular chaeta.
FIG. 30. Slightly bent acicular chaeta (S. fraseri).

45(44) Ventral chaetae in segment II thicker and longer than those in segments III and IV . . . . . Specaria fraseri

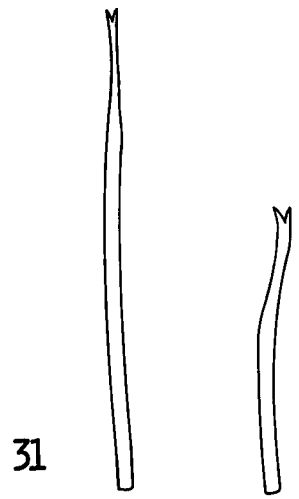
Ventral chaetae in segment II identical to those in segments III and IV 46

46(45) Size and shape of ventral chaetae in segment VI are essentially like those in segments II-V 47

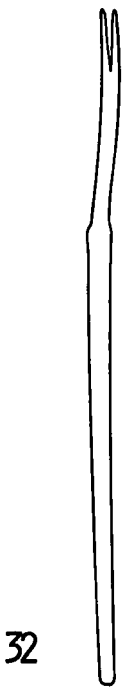
Size and shape of ventral chaetae in segment VI abruptly dissimilar to, and shorter than those in segments II-V . . 48

47(46) Teeth of acicular chaetae, short, appearing divergent (Fig. 31); distal tooth of ventral chaetae in segment VI and posteriad equal to or slightly larger than proximal tooth . . . . . Nais communis

Teeth of acicular chaetae not divergent, appearing parallel (Fig. 32); distal tooth of ventral chaetae 1.5-2 times longer than proximal tooth in segment VI and posteriad . . . . . Nais elinguis



31



32

FIG. 31. Nais communis, acicular chaetae with divergent teeth.
FIG. 32. N. elinguis, acicular chaeta with teeth not divergent.

48(46) Length of distal tooth of all ventral chaetae in segment VI and posteriad equal to, or slightly shorter than, that of the proximal (Fig. 33); acicular teeth short, often obscure, appearing essentially parallel (Fig. 34) . . . . . Nais variabilis

Length of distal tooth of (at least some) ventral chaetae in segment VI, and posteriad, 1.5 to several times longer than that of the proximal tooth; acicular teeth appearing either parallel or slightly divergent 49

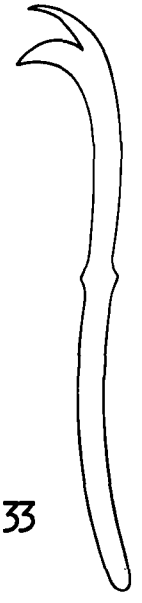


FIG. 33. Nais variabilis, ventral chaeta of segment VI.
FIG. 34. N. variabilis, acicular chaeta with short, often obscure, essentially parallel teeth.

49(48) Teeth of acicular chaetae distinct, appearing to diverge slightly (Fig. 35); in segment VI and posteriad, one or more ventral chaetae per fascicle have relatively thick distal tooth which is commonly directed strongly posteriad, the proximal tooth is relatively small to rudimentary (Figs. 36, 37) . . . . . Nais bretscheri

Teeth of acicular chaetae obscure and appearing parallel (Fig. 38); in segment VI and posteriad, one or more ventral chaetae per fascicle, with distal tooth longer than proximal, but not strongly bent posteriad (Fig. 39) . . . . . Nais pardalis

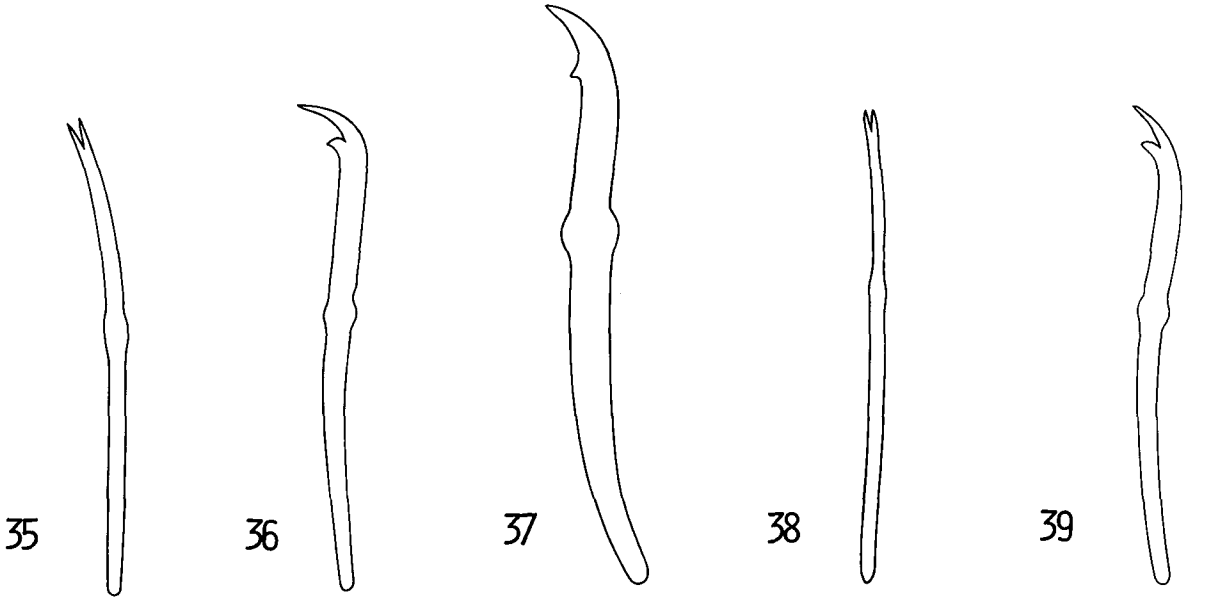


FIG. 35. Nais bretscheri, acicular chaeta.
FIG. 36. N. bretscheri, ventral chaeta of segment VI, posteriad.
FIG. 37. N. bretscheri, giant ventral chaeta of segment VI, posteriad.
FIG. 38. N. pardalis, acicular chaeta.
FIG. 39. N. pardalis, ventral chaeta of segment VI, posteriad.

50(39) More than three capilliform chaetae per anterior (i.e. segments II-VI) fascicle 51

Not more than three capilliform chaetae per anterior (i.e. segments II-VI) fascicle 52

51(50) In segment VI and posteriad, ventral fascicles composed of three or more chaetae; eyes present; all ventral chaetae alike . . . . . Vejdovskyella comata

In segment VI and posteriad, ventral fascicles reduced to a single chaeta; without eyes; often with enlarged ventral chaetae in anterior segments (i.e. VI-VII) . . . . . Vejdovskyella intermedia

52(50) Distal and proximal teeth of ventral chaetae in segments II-V slender, extremely reduced in thickness (Fig. 40) . . . . . Nais behningi

Distal and proximal teeth of ventral chaetae in segments II-V not disproportionately reduced (Fig. 41) 53

53(52) Apical part of acicular chaetae acutely attenuated (Fig. 42), mean length of acicular chaetae, ca. 90 µm 54

Apical part of acicular chaetae somewhat short ("obtuse") (Fig. 43), mean length of acicular chaetae, ca. 60 µm . . 55

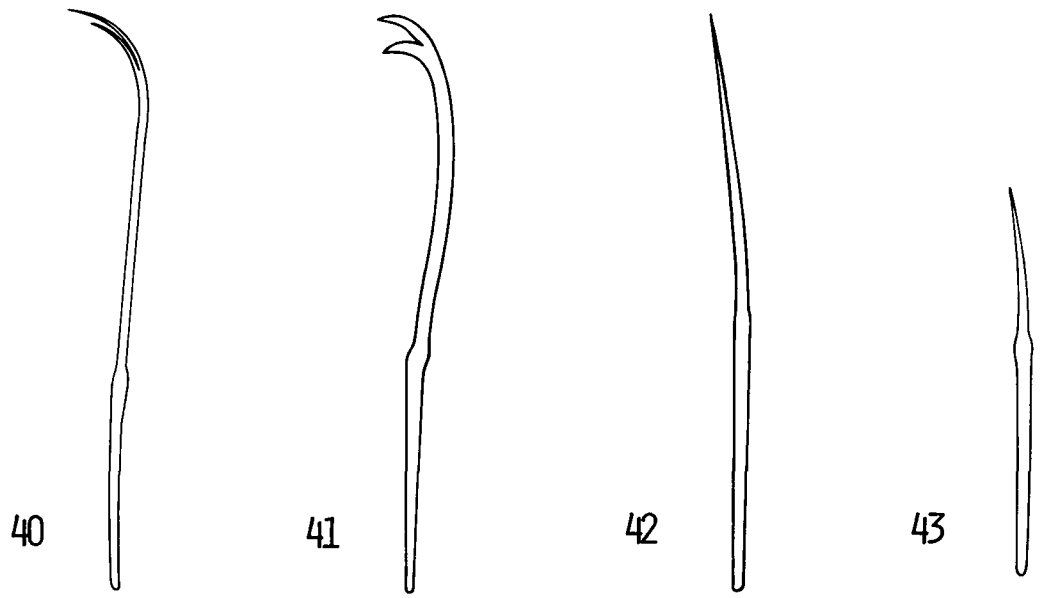


FIG. 40. Nais behningi, ventral chaeta of segments II-V.
FIG. 41. Unmodified ventral chaeta of segments II-V.
FIG. 42. Acicular chaeta with acutely attenuated apex.
FIG. 43. Acicular chaeta with somewhat short ("obtuse") apex.

54(53) Ventral chaetae in segment VI short and stout, their teeth equally long . . . . . Nais barbata

Ventral chaetae in segment VI thin, distal tooth 1.5 times as long as proximal tooth . . . . Nais pseudobtusa

55(53) Distal tooth of ventral chaetae about equal to the proximal tooth . . . . . Nais simplex

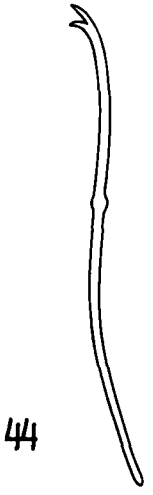
Length of distal tooth of ventral chaetae, ca. 1.5 times the length of the proximal tooth . . . . . Nais alpina

56(20) Distal tooth of chaetae in segment II distinctly longer than proximal tooth (Fig. 44); older individuals with eyes . . . . . Uncinais uncinata

Distal tooth of chaetae in segment II equal to or shorter than the proximal tooth; never with eyes (Fig. 45) . . . . . Piguetiella michiganensis

57(9) Apex of acicular chaetae simple 58

Apex of acicular chaetae bifurcate 60



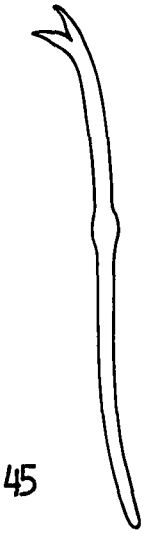


FIG. 44. Uncinais uncinata, chaeta of segment II.
FIG. 45. Piguetiella michiganensis, chaeta.

58(57) Anterior ventral chaetae dissimilar to those in segment VI, (Fig. 46); acicular chaetae nearly sigmoid-spiciform (Fig. 47) . . . . . Bratislavia unidentata

All ventral chaetae essentially alike among the segments; acicular chaetae slender 59

59(58) Distal tooth of ventral chaetae twice as long as the proximal tooth (Fig. 48) . . . Stephensoniana trivandrana

Distal tooth of ventral chaetae less than twice as long as the proximal tooth (Fig. 49) . . . Pristina longisoma

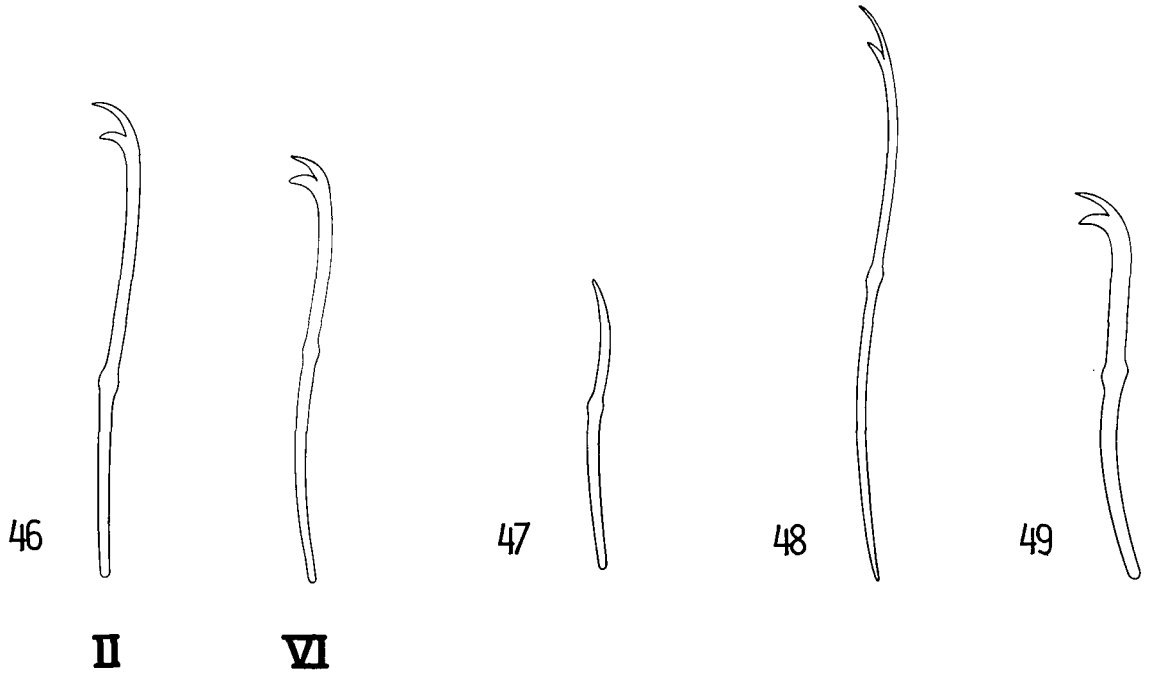


FIG. 46. Bratislavia unidentata, ventral chaetae of segments II and VI.
FIG. 47. B. unidentata, acicular chaeta.
FIG. 48. Stephensoniana trivandrana, chaeta.
FIG. 49. Pristina longisoma, ventral chaeta.

60(57) Teeth of acicular chaetae appearing divergent (Figs. 50, 51) 61

Teeth of acicular chaetae appearing parallel (Fig. 52) . . . 62

61(60) Teeth of acicular chaetae distinctly unequal in size (Fig. 51) . . . . . Stephensoniana tandyi

Teeth of acicular chaetae essentially equal in size (exclusive of intermediate teeth, when present) (Figs. 50, 53) 64

62(60) Capilliform chaetae serrulated 63

Capilliform chaetae not serrulated; penial chaetae present in sexually mature individuals (Fig. 54); (cf. Annotations). . . . . Pristina idrensis

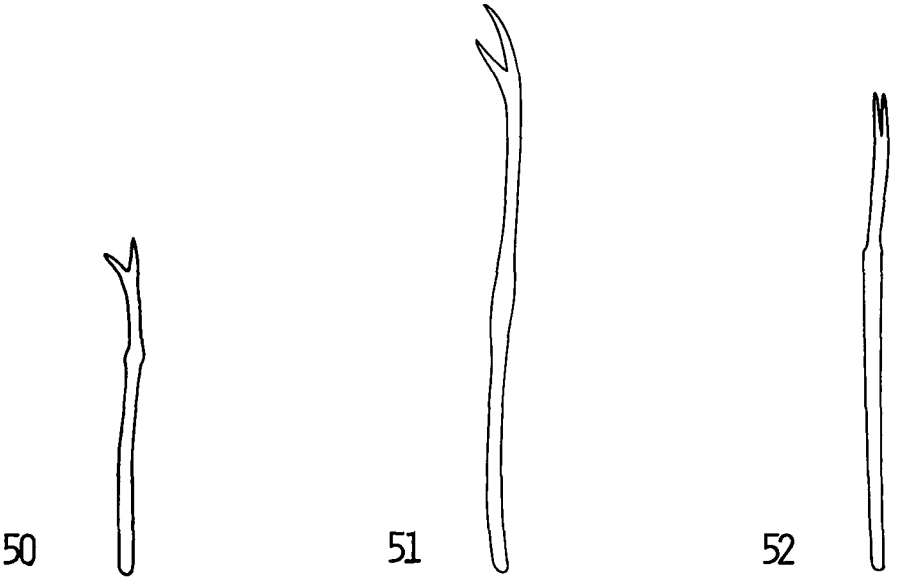


FIG. 50. Acicular chaeta with divergent teeth.
FIG. 51. Acicular chaeta with divergent teeth.
FIG. 52. Acicular chaeta with parallel teeth (Pristina idrensis).

63(62) Dorsal fascicles are composed of one capilliform chaeta and one acicular chaeta (Fig. 55) . . . Pristina longidentata

Dorsal fascicles are composed of more than one capilliform chaetae and one acicular chaeta . . . . . Pristina acuminata

64(61) Apex of the acicular chaetae with one or more small intermediate teeth (Fig. 53) . . . . . Pristina sima

Apex of the acicular chaetae without intermediate teeth (Fig. 50) . . . . . Pristina osborni

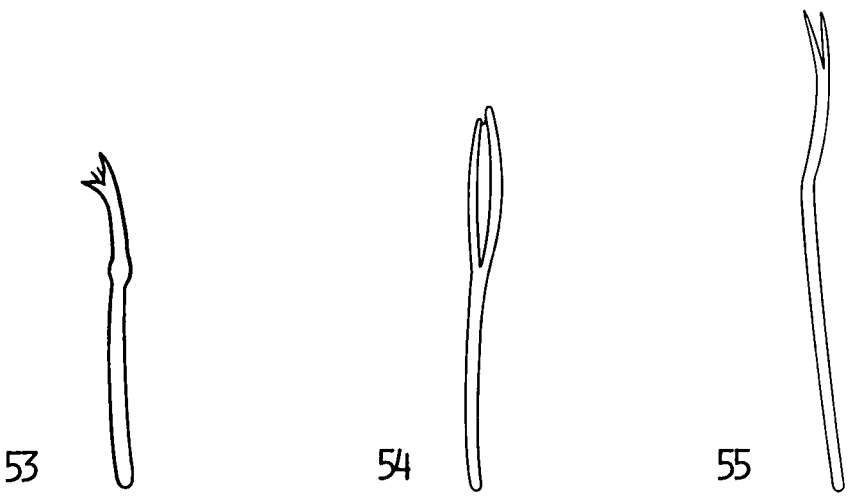


FIG. 53. Pristina sima, acicular chaeta.
FIG. 54. P. idrensis, penial chaeta.
FIG. 55. P. longidentata, acicular chaeta.

SECTION 5

GLOSSARY*

Acicular chaeta: A dorsal needle-like chaeta usually with the apex simple or cleft, forming two or more teeth, but sometimes greatly modified into various other forms. Its length approximates the thickness of the animal and ordinarily does not exceed half the length of a capilliform chaeta.

Anal segment (Periproct): The posterior terminal segment in whole (unbroken) individuals.

Anteriad: Direction toward the anterior of an organism.

Architomy: Reproduction by fission (budding) with subsequent regeneration of tissues and organs.

Bifid: A condition where the apex of a chaeta is cleft, forming two equal teeth.

Bifurcate: A condition where the apex of a chaeta is cleft, forming two unequal teeth.

Branchial fossa: A pit or hollow of the anal segment in which the palps and digitiform lobes or gills of Dero originate.

Capilliform chaeta: A dorsal hair-like chaeta; longer and usually more flexuous than an acicular chaeta (cf. acicular chaeta).

Chaeta (pl. chaetae): A bristle, which in various forms, aids primarily in locomotion or functions in connection with the reproductive organs. (In literature, "seta" is frequently used instead of "chaeta," but here the former term is reserved for its application in arthropod morphology).

Clitellum: A differentiation of the epidermis in the genital region into a somewhat verrucose "sleeve" which will transform into a cocoon that serves as a repository for the eggs following their fertilization.

Crotchet: A somatic chaeta, commonly bifurcate, with conspicuous teeth.

---

*Additional morphological terms applied in oligochaetology can be found in Reynolds (1977).

Digitiform lobes: See Gills.

Eyes: Paired masses of pigmented photoreceptor cells in Segment I.

Fascicle: A cluster or "bundle" of chaetae.

Genital chaetae: Spermathecal and penial chaetae.

Genital segments: Body segments (ordinarily, V-VII) which bear the reproductive organs.

Gills: The collection of protuberances or lobes that lie in the branchial fossa of Dero. When distended in live material the lobes may be digitiform.

Nodulus: A knob or enlarged region on crotchets and acicular chaetae.

Palps: A pair of elongate projections in the anal segment of some species of Dero. Their length clearly exceeds that of the gills, even in preserved specimens.

Pectinate chaeta: A dorsal chaeta with apex cleft into few to several spine-like teeth, thereby forming a comb.

Penial chaetae: Chaetae associated with the penes, ordinarily their shape is unlike that of the somatic chaetae.

Posteriad: Direction toward the posterior of an organism.

Proboscis: A nonretractile, narrow elongation of the prostomium.

Prostomium: The antero-dorsal part of the cephalic segment (Segment I).

Segments: A series of anatomical divisions of the body (somites or compartments), each usually separated from its neighbor by a septum (partition).

Simple chaeta: A chaeta with an uncleft apex.

Somatic chaeta: A chaeta which functions in connection with the somatic segments only.

Spermathecal chaetae: Chaetae associated with the spermathecae, their shape is unlike that of the somatic chaetae.

Spiciform: Spike-shaped as exemplified by acicular chaetae of Bratislavia unidentata and Ophidonais serpentina.

Trifid: A condition where the apex of a chaeta is cleft, forming three teeth.

SECTION 6

ANNOTATIONS

1. Allonais paraguayensis

   Distribution: Lincoln Parish, Louisiana, and southward; adventive in aquaria.

2. Allonais pectinata

   Distribution: St. Clair River, Ontario, Canada; Illinois River near Marseilles, Illinois; Mississippi River near Cordova, Illinois; Mahoning and Ohio Rivers, Ohio; Monongahela River, Pennsylvania; Hudson River near Albany, New York, and coastal Georgia.

3. Amphichaeta americana

   Distribution: Union Lake, near Millville, New Jersey (type locality); Siskiwit Lake, Isle Royale, Lake Superior; St. Marys River, Chippewa County, Michigan; South Carolina.

4. Amphichaeta leydigi

   Distribution: Widespread.

5. Arcteonais lomondi

   Distribution: Widespread. Swims with tortuous or wriggling movements.

6. Bratislava bilongata

   Distribution: Hardingville, New Jersey and Indian River County Florida.

7. Bratislavia unidentata

   Distribution: Lake Erie; Illinois River to Oklahoma, Alabama, Florida, Louisiana, Mississippi, North Carolina, and Texas. This species was first included under Pristina because acicular chaetae were present in segment II (in fact, acicular chaetae are found also in segment I in most individuals). Following the discovery of sexually mature specimens, Harman and Loden (1978) transferred the species to the present genus.

8. Chaetogaster cristallinus

Distribution: Yukon and Northwest Territories, the Great Lakes and eastward. The validity of distributional records for the species is uncertain because of its occasional confusion with C. diaphanus.

9. Chaetogaster diaphanus

Distribution: Widespread. The species' predatory and even cannibalistic behavior is unusual among oligochaetes.

10. Chaetogaster diastrophus

Distribution: Widespread. This species is difficult, if not impossible, to distinguish from C. langi; consequently, the latter is maintained in synonomy under C. diastrophus following the rules of nomenclatorial priority. The first author has examined some of Christina Sperber's specimens to which she applied either name. The distinction between the two taxa in her material was not clear. Recent collections of Great Lakes oligochaetes made by the first author have yielded few specimens that resemble C. diastrophus except that they bear not only the normal compliment of ventral chaetae, but also opposing dorsal chaetae; the later features being incongruous with the definition of the genus.

11. Chaetogaster limnaei

Distribution: Widespread, usually associated with mollusks. Specimens of C. limnaei, taken off Lymnaea stagnalis (Gastropoda) at Charlevoix, Michigan, August 6, 1894, may be the earliest collection of Naididae from the St. Lawrence Great Lakes. The specimens are housed at the Academy of Natural Sciences of Philadelphia, Pennsylvania. In literature (e.g. Gruffydd 1965a, b) some subspecies have been recognized but these are not treated here.

12. Chaetogaster setosus

Distribution: St. Marys River, Chippewa County, Michigan; Saginaw Bay, Lake Huron; Lake Erie; Lake Ontario; Hudson River near Albany, New York.

13. Dero abranchiata

Distribution: Louisiana and Texas.

14. Dero digitata

Distribution: Widespread.

15. Dero flabelliger

Distribution: Orange County, Florida; Hudson River, New York; Lake Wylie, North Carolina.

16. Dero furcata

Distribution: Ontario and Wisconsin to Texas, Alabama, Maryland, Virginia and New York.

17. Dero nivea

Distribution: Widespread.

18. Dero obtusa

Distribution: Massachusetts to Washington, including James River Virginia; Orange County Texas; Oconto River, Wisconsin. Distinction of this species from D. nivea is often difficult.

19. Dero pectinata

Distribution: Orange County, Texas and other southern states. This species should not be confused with D. pectinata which enters the genus through the subordination of Aulophorus. D. (A.) pectinata has not been reported from North America.

20. Dero trifida

Distribution: Louisiana; Cape Fear River, Chatham County, North Carolina.

21. Dero vaga

Distribution: Washtenaw and Livingston Counties, Michigan; Hancock County, Mississippi; Young County, Texas; Massachusetts.

22. Haemonais waldvogeli

Distribution: Michigan and Wisconsin to Louisiana, Texas, Mississippi, Maryland, Virginia, and New York.

23. Homochaeta naidina

Distribution: The Richmond, Virginia record is apparently the only report of the species in North America. Voucher specimens of Falls (1974) are reported lost.

24. Nais alpina

Distribution: Lake Ontario (Judd and Bocsor, 1975); Chippewa County and Presque Isle County, Michigan.

25. Nais barbata

Distribution: The Great Lakes and Fox River, Wisconsin, to the Mississippi River, Illinois River, and Jackson Parish, Louisiana; Penobscot River, Maine.

26. Nais behningi

Distribution: Widespread, frequently in lotic habitats. The morphological features of this species and N. pseudobtusa appear to overlap.

27. Nais bretscheri

Distribution: Widespread.

28. Nais communis

Distribution: Widespread.

29. Nais elinguis

Distribution: Widespread.

30. Nais magnaseta

Distribution: Bee County, Texas. The species resembles Allonais pectinata and may better be placed in Allonais.

31. Nais pardalis

Distribution: Widespread. The species closely resembles N. variabilis and is often difficult to distinguish from that species. Morphology of its chaetae can vary with respect to season and with habitat.

32. Nais pseudobtusa

Distribution: Richmond, Virginia; Lincoln Parish, Louisiana; St. Marys River, Chippewa County, Michigan; British Columbia and northwest Canada.

33. Nais simplex

Distribution: Widespread east of the Mississippi River.

34. Nais variabilis

Distribution: Widespread. One of the most commonly occurring naidids in North American freshwater environments.

35. Ophidonais serpentina

Distribution: Widespread. The compliment of dorsal chaetae on an individual, as well as between individuals, may vary from none to several chaetae.

36. Paranais litoralis

Distribution: Lake Michigan (?); Elizabeth River, Virginia; Slack Reach (Cooper River), Berkeley County, South Carolina, and Flag Creek, South Carolina; Piscataway Creek (Potomac River tributary), Maryland; Nova Scotia, New Brunswick, Ontario, British Columbia, Yukon and Northwest Territories. Re-examination of the voucher specimen on which P. litoralis was reported from Saginaw Bay, Lake Huron (Brinkhurst, 1967) revealed that the individual is Piguetiella michiganensis.

37. Piguetiella michiganensis[1]

Distribution: Great Lakes and Mississippi River to Susquehanna and Chemung Rivers, New York.

38. Pristina acuminata

Distribution: Lake Erie and Ohio River. The record of this species in North America is attributable to Spencer (1978b). When Spencer's voucher specimens were examined, few of their features (e.g. lack of serrulations on the capilliforms) did not fully agree with the description of P. acuminata. A comparison of specimens collected from the type locality (China) and North America may be necessary to resolve the morphological differences.

39. Pristina aequiseta

Distribution: Michigan to Texas and California, east to Alabama and New York.

40. Pristina breviseta

Distribution: Widespread.

41. Pristina foreli

Distribution: Yukon and Northwest Territories; Great Lakes and Mississippi River to Nebraska; Ohio River; Chemung, Susquehanna, and Hudson Rivers in New York; Penobscot River, Maine.

---

[1]After the manuscript went to press, we discovered that benthic samples, collected from Lake Michigan by the Great Lakes Research Division of the University of Michigan, contained some individuals that had chaetae in segment V and posteriad.

42. Pristina idrensis

Distribution: Yukon and Northwest Territories; St. Marys River and Lake Huron, Michigan; Buckhorn Creek, Chatham County, North Carolina; Cedar River, King County, Washington; Mississippi, Ohio, Muskingum, Monogahela, Susquehanna Rivers, east to the Hudson River and Lake Umbagog, New Hampshire. On 29 September 1968, the first author collected, from Lake Huron, two sexually mature or clitellate specimens, one of which bears a pair of penial chaetae (Fig. 52). Sperber (1948) contended, however, that P. idrensis lacks genital chaetae.

43. Pristina longidentata

Distribution: Garfield County, Oklahoma; Louisiana.

44. Pristina longiseta leidyi

Distribution: Widespread.

45. Pristina longiseta longiseta

Distribution: Several streams and lakes in Michigan, and likely elsewhere in the Great Lakes drainage. Historically, the binominal, P. longiseta, has been cleaved into subspecies or even new species based upon the presence of bifid or simple acicular chaetae. Inasmuch as that acicular feature is the only significant character employed to subdivide P. longiseta, we are maintaining the form with bifid acicular chaetae as the subspecies P. l. leidyi.

46. Pristina longisoma

Distribution: Arkansas and Louisiana to Florida.

47. Pristina osborni

Distribution: Great Lakes and Wisconsin to Louisiana, east to Virginia, Pennsylvania and Maine. P. minuta has been reported from Bee County, Texas (Harman, 1973), but we excluded it from the key because of its uncertain validity. Sperber (1948) considers P. minuta and P. osborni as probable synonyms.

48. Pristina plumaseta

Distribution: Ontario, Georgia, Virginia, Mississippi and the Potomac River, Virginia.

49. Pristina sima

Distribution: Mississippi, Susquehanna, Chemung, and Hudson Rivers. If the intermediate teeth on the aciculars are not visible, the individual is indistinguishable from P. osborni.

50. Pristina synclites

Distribution: Mississippi and Illinois Rivers; Bayou Deview, Arkansas; Chemung River at Corning New York; Susquehanna River at Binghamton, New York; Kanawha River, West Virginia.

51. Ripistes parasita

Distribution: Known in Europe but reports of the species in North America are unconfirmed.

52. Slavina appendiculata

Distribution: Widespread.

53. Specaria fraseri

Distribution: Fraser River, British Columbia.

54. Specaria josinae

Distribution: Widespread.

55. Stephensoniana tandyi

Distribution: Louisiana.

56. Stephensoniana trivandrana

Distribution: Kanawha River, West Virginia; Illinois River at Marseilles, Illinois; Ohio River; Pennsylvania; Piscataway Creek (Potomac river tributary), Maryland; Colorado River, Texas.

57. Stylaria fossularis

Distribution: Great Lakes and Wisconsin to Louisiana, Alabama, South Carolina, West Virginia, and Maine. Specimens of S. fossularis, collected at Erie, Pennsylvania in 1896 (under the supervision of Jacob Reighard) are held in The Academy of Natural Sciences of Philadelphia, Philadelphia, PA.

58. Stylaria lacustris

Distribution: Widespread. Specimens of S. lacustris, collected from Lake St. Clair and western Lake Erie in 1899, are deposited in The Academy of Natural Sciences of Philadelphia, Philadelphia, PA.

59. Uncinais uncinata

Distribution: Widespread. Superficially similar to Piguetiella michiganensis with which it is often sympatric in the Great Lakes. The relatively long distal teeth in anterior chaetae help distinguish it from P. michiganensis. Vernal populations in the Great Lakes (and Manitoba) compose individuals with chaetae in segment V and posteriad.

60. Vejdovskyella comata

Distribution: Wisconsin and Menominee Rivers, Wisconsin; Bush River, Hartford County, Maryland; Penobscot River, Maine; Nova Scotia, Canada. Eyes present.

61. Vejdovskyella intermedia

Distribution: Widespread in Great Lakes drainage; Hudson River, New York; Piscataway Creek (Potomac River tributary), Maryland; Muskingum River; Illinois River. Never with eyes.

62. Wapsa grandis

Distribution: Terrebone Parish, Louisiana.

63. Wapsa mobilis

Distribution: Widespread, often in estuaries and rivers, component species of brackish or freshwater. Species of Wapsa are morphologically similar to those in Paranais; consequently, W. mobilis is sometimes included under Paranais as P. frici.

SELECTED BIBLIOGRAPHY

Adams, D.E., and R.D. Kregear. 1969. Sedimentary and faunal environments of eastern Lake Superior. Int. Assoc. Great Lakes Res., Proc. 12th Conf. Great Lakes Res. 20 pp.

Barbour, Michael T. 1977. Chaetogaster limnaei limnaei (Oligochaeta: Naididae) inhabiting the mantle cavity of the pill clam Sphaerium. Trans. Am. Microsc. Soc. 96(1): 141-142.

Barton, D.R., and H.B.N. Hynes. 1978. Wave-zone macrobenthos of the exposed Canadian shores of the St. Lawrence Great Lakes. J. Great Lakes Res. 4(1): 27-45.

Brinkhurst, Ralph O. 1964. Studies on the North American aquatic Oligochaeta I: Naididae and Opistocystidae. Proc. Acad. Nat. Sci. Phila. 116(5): 195-230.

_____. 1967. The distribution of aquatic oligochaetes in Saginaw Bay, Lake Huron. Limnol. Oceanogr. 12(1):137-143.

_____. 1975. Oligochaeta. In: F.K. Parrish, ed. Keys to the Water Quality Indicative Organisms of the Southeastern United States, U.S. Environ. Prot. Agency, Environ. Monit. & Support Lab., Cincinnati, OH. pp. 69-85

_____. 1976. Aquatic Oligochaeta recorded from Canada and the St. Lawrence Great Lakes. Pacific Marine Science Report 76-4, Institute of Ocean Sciences, Patricia Bay, Victoria, B.C., 49 pp.

_____. 1978. Freshwater Oligochaeta in Canada. Can. J. Zool. 56(10): 2166-2175.

_____., and D.G. Cook. 1974. Aquatic earthworms (Annelida: Oligochaeta). In: C.W. Hart, Jr. and Samuel L.H. Fuller, eds. Pollution Ecology of Freshwater Invertebrates. Academic Press, N.Y. pp. 143-155

_____., and D.G. Cook, eds. 1980. Aquatic Oligochaete Biology. (Proceedings of the first International Symposium on Aquatic Oligochaete Biology, held in Sidney, British Columbia, Canada, May 1-4, 1979). Plenum Publ. Corp., New York.

_____., and B.G.M. Jamieson. 1971. Naididae. In: R.O. Brinkhurst and B.G.M. Jamieson, Aquatic Oligochaeta of the World. University of Toronto Press, Toronto. pp. 314-443.

Carriker, M.R. 1977. The crucial role of systematics in assessing pollution effects on the biological utilization of estuaries. In: Estuarine Pollution Control and Assessment, Proc. of a Conference U.S. EPA, Office of Water Planning and Standards, Washingtin, DC., Vol. 1,2. pp. 487-506.

Chen, Y. 1944. Notes on naidomorph Oligochaeta of Philadelphia and vicinity. Not. Nat. Acad. Nat. Sci. Philadelphia No. 136: 1-8.

Collins, D.S. 1973. The aquatic earthworms (Microdrili) of Reelfoot Lake. J. Tenn. Acad. Sci. 12: 188-205.

Cook, David G., and Ralph O. Brinkhurst. 1973. Marine flora and fauna of the Northeastern United States. Annelida: Oligochaeta. U.S. Dep. of Commer., NOAA Tech. Rep. NMFS Circ-374, 23 pp.

_____., and Murray G. Johnson. 1974. Benthic macro-invertebrates of the St. Lawrence Great Lakes. J. Fish. Res. Board Can. 31: 763-782.

Cover, Ellen C., and Richard C. Harrell. 1978. Sequences of colonization, diversity, biomass, and productivity of macroinvertebrates on artificial substrates in a freshwater canal. Hybrobiologia 59(1):81-95.

Craven, Richard E. 1968. Stylaria lacustris (Oligochaeta-Naididae) in Oklahoma. Southwest. Nat. 13(2): 243-251.

Elrick, Donald Lee. 1976. The morphology, reproduction, and ecology of Colorado species of Chaetogaster (Oligochaeta, Annelida). Ph.D. Thesis, Univ. Colorado, Boulder, University Microfilms International, Ann Arbor, Mich., Order No. 77-3179, 311 pp.

Falls, Elsa Q. 1974. A taxonomic survey of freshwater oligochaetes from the Richmond Virginia area with reference to commensal ciliates. Va. J. Sci. 25(1): 25-29

Galloway, T.W. 1911. The common freshwater Oligochaeta of the United States. Trans. Am. Microsc. Soc. 20: 285-317.

Green, J. 1954. A note on the food of Chaetogaster diaphanus. Ann. Mag. Nat. Hist. 7(83): 842-844.

Gruffydd, L.D. 1965a. Evidence for the existance of a new subspecies of Chaetogaster limnaei (Oligochaeta) in Britain. J. Zool. (Lond.) 146: 175-196.

_____. 1965b. The population biology of Chaetogaster limnaei limnaei and Chaetogaster limnaei vaghini (Oligochaeta). J. Anim. Ecol. 34: 667-690.

Hare, Landis, and John C. H. Carter. 1977. The Oligochaeta, Polychaeta, and Nemertea of Parry Sound, Georgian Bay. J. Great Lakes Res. 3(3-4): 184-190.

Harman, Walter J. 1965. A new species of the genus Pristina (Oligochaeta:Naididae) from Louisiana. Proc. La. Acad. Sci. 28: 28-31.

_____. 1966. Some aquatic oligochaetes from Mississippi. Am. Midl. Nat. 76: 239-242.

_____. 1973. New species of Oligochaeta (Naididae) with additional distributional records from Oklahoma and Texas. Southwest. Nat. 18(2): 151-164.

_____. 1975. A new species of Stephensoniana (Oligochaeta: Naididae) from North America. Proc. Biol. Soc. Wash. 88(1): 1-3.

_____. 1977. Three new species of Oligochaeta (Naididae) from the Southeastern U.S. Proc. Biol. Soc. Wash. 90(3): 483-490.

_____., and Richard C. Harrel. 1975. Haemonais waldvogeli (Naididae: Oligochaeta) now established in North America. Tex. J. Sci. 26(3&4): 621-623.

_____., and Michael S. Loden. 1978. Bratislavia unidentata (Oligochaeta: Naididae), a re-discription. Southwest Nat. 23(4):541-544.

_____., and Michael S. Loden. 1979. A rediscovery of Bratislavia bilongata (Chen, 1944) (Oligochaeta: Naididae) in Florida. Trans. Am. Microsc. Soc. 98(4):581-583.

_____., and Michael L. McMahan. 1975. A reevaluation of Pristina longiseta (Oligochaeta: Naididae) in North America. Proc. Biol. Soc. Wash. 88: 167-178.

_____., and Joseph H. Platt. 1961. Notes on some aquatic oligochaetes from Louisiana. Proc. La. Acad. Sci. 24: 90-95.

Harrel, Richard C., and Troy C. Dorris. 1968. Stream order, morphometry, physico-chemical conditions, and community structure of benthic macroinvertebrates in an intermittent stream system. Am. Midl. Nat. 80(1):220-251.

Hayden, H.E., Jr. 1922. Studies on American naid oligochaetes. Trans. Am. Miscrosc. Soc. 41:167-171.

Hiltunen, Jarl K. 1967. Some oligochaetes from Lake Michigan. Trans. Am. Microsc. Soc. 86(4):433-454.

_____. 1969a. Distribution of Oligochaetes in Western Lake Erie, 1961. Limnol. Oceanogr. 14(2):260-264.

_____. 1969b. The benthic macrofauna of Lake Ontario. In: Limnological Survey of Lake Ontario, 1964. Great Lakes Fish. Comm. Tech. Rep., No. 14. pp. 39-50

_____. 1973. A laboratory guide, keys to the tubificid and naidid Oligochaeta of the Great Lakes region. 2nd edition., 24 pp. Unpublished.

Howmiller, Richard P. 1974. Studies on aquatic Oligochaeta in inland waters of Wisconsin. Trans. Wis. Acad. Sci. Arts Lett. 62:337-356.

_____., and A.M. Beeton. 1970. The oligochaete fauna of Green Bay, Lake Michigan. Int. Assoc. Great Lakes Res. Proc. 13th. Conf. Great Lakes Res. pp. 15-46.

_____., and Michael S. Loden. 1977. Identification of Wisconsin Tubificidae and Naididae. Trans. Wis. Acad. Sci. Arts Lett. 64:185-197.

Johnson, M.G., and D.S. Osmond. 1969. Benthic macroinvertebrates of the Great Lakes--a list of recorded species and their distribution. Appendix VI, Biology, part 3. In: The Great Lakes as an Environment, D.V. Anderson, ed. Univ. Toronto, Great Lakes Inst. Rep. PR 39. pp. 67-86.

Judd, John H., and J.G. Bocsor. 1975. Environmental changes in a portion of Lake Ontario following pollution abatement. Verh. Internat. Verein. Limnol. 19:1984-1989.

_____., and David T. Gemmel. 1971. Distribution of benthic macro-fauna in the littoral zone of southeastern Lake Ontario. State Univ. Col., Lake Ontario Environmental Laboratory, Oswego N.Y. 12 pp. Unpublished.

Knudsen, Jens W. 1966. Slide-making. In: J. W. Knudsen, Biological Techniques. Harper and Row, NY. pp. 498-503.

Learner, M.A. 1979. The distribution and ecology of the Naididae (Oligochaeta) which inhabit the filter-beds of sewage-works in Britain. Water Res. 13:1291-1299.

_____, G. Lochhead, and B.D. Hughes. 1978. A review of the biology of British Naididae (Oligochaeta) with emphasis on the lotic environment. Freshwater Biol. 8: 357-375.

Loden, Michael S. 1974. Notes on some aquatic oligochaetes from Alabama. J. Ala. Acad. Sci. 45(4): 327-333.

_____. 1979. A new species of Dero (Oligochaeta: Naididae) from the southeastern United States. Trans. Am. Microsc. Soc. 98(4):583-587.

Maciorowski, Anthony F., Ernest F. Benfield, and Albert C. Hendricks. 1977. Species composition, distribution, and abundance of oligochaetes in Kanawha River, West Virginia. Hydrobiologia 54(1): 81-91.

Meyer, Marvin C., and O. Wilford Olsen. 1971. Preparation of specimens for study. In: M. C. Meyer and O. W. Olsen, Essentials of Parasitology. Wm. C. Brown Co. Publ., Dubuque, IA. pp. 263-271.

McElhone, M.J. 1978. A population study of the littoral dwelling Naididae (Oligochaeta) in a shallow mesotrophic lake in North Wales. J. Anim. Ecol. 47: 615-626.

Moore, J. Percy. 1906. Hirudinea and Oligochaeta collected in the Great Lakes region. U.S. Bur. Fish. Bull. 25(598):153-171.

Mozley, S.C. 1975. Preoperational investigations of zoobenthos in south eastern Lake Michigan near the Cook Nuclear Plant. Univ. Mich., Great Lakes Res. Div., Spec. Rep. 56, 132 pp.

_____., and Richard P. Howmiller, 1977. Zoobenthos of Lake Michigan. Environmental status of the Lake Michigan region. Vol. 6. Argonne National Laboratory, Argonne, Ill. ANL/ES-40, 148 pp.

Orciari, Robert D., and William D. Hummon. 1975. A comparison of benthic Oligochaete populations in acid and neutral lentic environments in southeastern Ohio. Ohio J. Sci. 75(1): 44-49.

Rains, Joseph H., and Thomas V. Clevenger. 1973. Benthos. In: Preoperational Thermal Monitoring Program of Lake Michigan Near Kewaunee Nuclear Power Plant. Industrial BIO-TEST Laboratories, Inc., Northbrook, Ill. 3rd. Ann. Rep. pp. 1-41.

Resh, V.H., and J.D. Unzicker. 1975. Water quality monitoring and aquatic organisms: the importance of species identification. J. Water Pollut. Control Fed. 47(1):9-19.

Reynolds, John W. 1977. The earthworms (Lumbricidae and Sparganophilidae) of Ontario. R. Ont. Mus. Life Sci. Misc. Publ., 141 pp.

_____., and David G. Cook. 1976. Nomenclatura Oligochaetologica: A catalogue of names, descriptions and type specimens of Oligochaeta. Univ. New Brunswick, Federicton, N.B., Canada, 217 pp.

Schmal, Robert N. 1977. Dero (Aulophorus) flabelliger Stephenson (Naididae: Oligochaeta) new to central Florida. Florida Sci. 40(3): 270-272.

Smith, Frank, and Bessie R. Green. 1916. The Porifera, Oligochaeta, and certain other groups of invertebrates in the vicinity of Douglas Lake, Michigan. Rep. Mich. Acad. Sci. 17: 81-84.

Spencer, Douglas R. 1977. A species of Pristina (Oligochaeta: Naididae) new to Lake Erie. Ohio J. Sci. 77(1): 24-25.

_____. 1978a. The Oligochaeta of Cayuga Lake, New York with a redescription of Potamothrix bavaricus and P. bedoti. Trans. Am. Microsc. Soc. 97(2): 139-147.

_____. 1978b. Pristina acuminata Liang, a naidid oligochaete new to North America. Trans. Am. Microsc. Soc. 97(2): 236-239.

Sperber, Christina. 1948. A taxonomical study of the Naididae. Zool. Bidr. Uppsala 28. 296 pp.

_____. 1950. A guide for the determination of European Naididae. Zool. Bidr. Uppsala 29. 78 pp.

Stimpson, Kurt S., James R. Brice, Michael T. Barbour, and Peter Howe. 1975. Distribution and abundance of inshore oligochaetes in Lake Michigan. Trans. Am. Microsc. Soc. 94(3): 384-394.

Walton, L.B. 1906. Naididae of Cedar Point, Ohio. Am. Nat. 40(478): 683-705.

Wiens, A.P., D.M. Rosenberg, and N.B. Snow. 1975. Species list of aquatic plants and animals collected from the Mackenzie and porcupine river watershed from 1971-1973. Fish. Mar. Serv. Res. Dev. Tech. Rep. 557. 39 pp.

INDEX TO SCIENTIFIC NAMES

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-600/4-80-031		

4. TITLE AND SUBTITLE	5. REPORT DATE
A GUIDE TO THE NAIDIDAE (ANNELIDA:CLITELLATA: OLIGOCHAETA) OF NORTH AMERICA	June 1980 issuing date
	6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
Jarl K. Hiltunen and Donald J. Klemm, Co-authors	

9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
Great Lakes Fishery Laboratory, U.S. Fish Wildlife Service, Ann Arbor, Michigan 48105 and Aquatic Biology Section, Environmental Monitoring & Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio	PE 1BD612
	11. CONTRACT/GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
Environmental Monitoring and Support Laboratory Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268	Final
	14. SPONSORING AGENCY CODE EPA/600/06

15. SUPPLEMENTARY NOTES

Supplement to "Biological field and labortory methods for measuring the quality of surface waters and effluents," EPA-670/4-73-001.

16. ABSTRACT

In North America the aquatic annelid worms (Clitellata:Oligochaeta), belonging in the family Naididae, are composed of 21 genera and 62 species. All taxa can be identified by external morphological features. This guide presents the following: an introduction to the general biology of the Naididae, collecting and processing methods, a species list, an illustrated key, a glossary, an annotated systematic list, and a selected bibliography which includes the references cited in the text and other publications which provide additional information on naidid taxonomy and ecology.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Aquatic Biology	Collection	*Naididae	6C
*Freshwater Biology	Preservation	*Clitellata	6F
Indicator Species	Aquatic Fauna	*Oligochaeta	
*Benthos	*Annelida	North America	
Taxonomy	Water Pollution	Species List	
Segmented worms	Macroinvertebrates	*Illustrated Key	
Distribution		*Identification Manual	

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
RELEASE TO PUBLIC	UNCLASSIFIED	58
	20. SECURITY CLASS *(This page)* UNCLASSIFIED	22. PRICE

EPA Form 2220-1 (9-73)

☆ U.S. GOVERNMENT PRINTING OFFICE 1980-657-146/5693