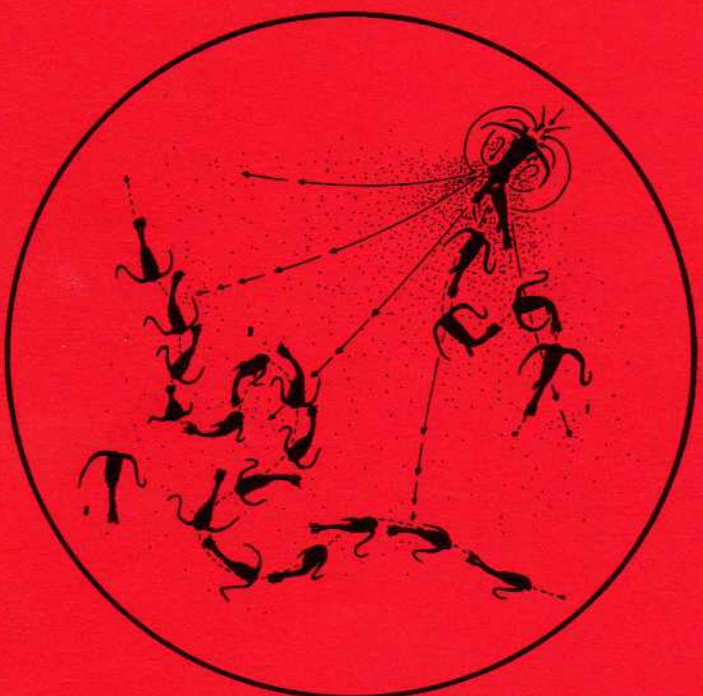
ISSN 0722-5741

MONOCULUS

Copepod Newsletter



Nr. 27

MARCH 1994

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Bibliotheks- und Informationssystem der Universität Oldenburg
North American Edition distributed by National Museums of Canada

MONOCULUS

Copepod Newsletter

Number 27 March 1994

Edited by: Hans-U. Dahms and H. Kurt Schminke, Fachbereich 7 (Biologie), Universität Oldenburg, Postfach 2503, D-26111 Oldenburg, Germany. Gerd Schriever, Forschungsinstitut Hohenwestedt, Kieler Str. 51, D-24594 Hohenwestedt, Germany.

Produced by: Bibliotheks- und Informationssystem (BIS) der Universität Oldenburg, Ammerländer Heerstr. 67/99, D-26111 Oldenburg, Germany.
Distributed in North America by: National Museum of Canada (Chang-tai Shih, National Museum of Natural Sciences, Zoology Division, P.O. Box 3434, Station D, Ottawa, Ontario, Canada U1A 6P4). Distributed in India by: M. Madhupratap, National Institute of Oceanography, Dona Paula, Goa 403004, India.

This issue has been typed by: Angelika Sievers, Fachbereich 7 (Biologie), Universität Oldenburg.

Cover (by M. Pottek, Oldenburg): Diagram of mate-seeking behaviour in *Eurytemora affinis*. 1. Short, successful search. 2. Male fails to locate distant female in long search. 3. Male is too far away from female to detect her. Scattered dots represent the concentration gradient of hypothetical chemical attractant (after KATONA 1973 - Limnology and Oceanography 18: 574-583).

Deadline for the next issue of MONOCULUS: 1st October 1994.

ERRATA

C.-t. Shih mentioned that several new members from the Republic of Korea were listed with changed family and given names. The names should be:
... Lee, Wouchoel
... Kang, Young-Shih
... Lim, Dong-Hyun

As Chang-tai explains, our Korean colleagues, like Chinese, traditionally have their surname (or family name) first, given name second. Usually their surname has only one syllable and the given name usually two syllables (sometimes united with a hyphen) but sometimes one syllable. In the latter case it may be difficult to know which one is surname, because the name may be written in traditional sequence (surname first, given name last) or in western custom (given name first, surname last). For instance should it be Choi, Kyung or Kyung Choi?

EDITORIAL

COPEPODA are a taxonomic group of relatively small Crustacean animals. This group has been established by zoosystematists, and copepod taxa are the research subject of taxonomic experts interested in phylogenetic relationships among the Copepoda. However, the WORLD ASSOCIATION OF COPEPODOLOGISTS (WAC) was founded in 1987 to promote research on any aspect of copepod biology and not only on copepod taxonomy. As five international conferences have already shown, much is going on in copepod physiology, biochemistry, ecology, genetics, behaviour, or functional morphology. Most of these disciplines overlap with each other functionally or in their methodological approach. It may, for instance, be quite important for a systematist to know, whether precopulatory mate guarding - a topic especially investigated by behavioural ecologists and geneticists - can reliably be used as an autapomorphy of a certain taxon. On the other hand, the understanding of the selective value of this behaviour may provide good arguments for the probability of its multiple and independent evolution. Copepod evolution - the elucidation of the mechanisms generating and the historical events resulting in copepod diversity - is the most integrative research subject. But all of us should acknowledge each other's indispensable role for such an endeavour. An integrative approach may offer new chances for us copepodologists. If E.O. Wilson (1989) is right, then systematics joining forces with various other biological disciplines for the investigation of one particular taxon - like the Copepoda - may have a stewardship in the coming pluralization of biology.

The MONOCULUS newsletter is not part of the scientific literature. The more it should be used as a forum for informal information exchange. We are thinking about improved tools, sampling gear, techniques ... any achievements which are either preliminary or of "minor importance", and not eligible to be published in refereed journals. We would also appreciate to receive more personal feedback from WAC members: notes on proposed or running projects, requests for help on material and literature, social news on careers, retirements, mariages, obituaries etc. We further recommend that new or reinstated members write a short biographic note mentioning their scientific interest, short- and long-term field of research, graduate or postdoctorate position etc.

The preparations for the next "Sixth International Conference on Copepoda" are on the way - more details in the next issue of MONOCULUS. Gerd Schriever (treasurer of WAC - his new address is given on the inner page of the cover) emphasizes that the annual dues for WAC members have increased to 12 US $ (20 DM), which was decided during last year's conferences in Baltimore.

The following members have changed their affiliations. Their new addresses are unknown: Dr. CHARLES L. BROWNELL, Hawaii; SIGRUN HULD JONASDOTTIR, New York; LUC A. RAINVILLE, Montreal.

This issue of MONOCULUS came about due to the efforts of several colleagues. The editorial staff thanks the following members for their contributions: A. Chandran, C.H. Fernando, G. Fryer, R. Hamond, S. Maas, T. Onbé, P. Polk, J. Reid, C.-t. Shih, J. Sieg.

OPINIONS

WHY SUPPORT RESEARCH ON COPEPODA

Although copepods are perhaps the most numerous metazoan animals globally, their very ubiquity in water leads to contempt by their familiarity. Perhaps one can coin a saying similar to that of Santayana about ignoring history and state that if we neglect commonplace and familiar animals we do so at our peril. But why Copepoda and for what end or simple or complex pleasure can we justify research on copepods when there are many pressing problems needing the attention of scientists. Perhaps we can start by asking what role these animals play in nature and whether their disappearance would cause a catastrophe in part or whole of aquatic ecosystems. The honest and object answer to this question is that if copepods disappear from the face of the earth, many if not all aquatic food webs will have an irreparable hole and be unable to function with any level of efficiency. In the sea, copepods keep young fish alive till they can graduate to other food. In freshwater, especially in the tropics, where water fleas are not so readily available (absent e.g. in L. Tanganyika), Copepoda are the manna of young fishes. In Lake Tanganyika they fuel a system leading from minute plants to sardines which is one of the most efficient known for freshwater fishes.

Because of their ubiquity in aquatic situations, they have adopted a wide variety of life styles from free living, symbiotic and commensal to parasitic. They are the insects of the oceans with a number of herbivores, omnivores and carnivores. They also live on the bottom, in the sediments or in the water column up to the surface. Why have Copepoda retained vulnerable larval stages unlike other freshwater invertebrates. Answering this question requires long-term and comparative research. Are larval stages the common reason for the success of Copepoda and insects? We can learn a great deal about basic biology from studying their life histories and population dynamics. Also parasites afflicting humans like the guinea worm or affecting fishes like the camallanid nematodes and some cestodes need copepods to complete their life histories. Knowing about copepods helps to break these links that keep life-cycles whole. Copepods can be our allies in keeping down mosquitoes by eating the early stage larvae. If we can find ways to enhance the populations of copepods, we will need less of poisonous chemicals to kill mosquitoes and in a properly balanced system, the copepods in turn can nourish fish, some of which can eat the larger mosquito larvae.

From the engineering and aesthetic point of view, Copepoda are well worth studying. These minute animals are beautifully engineered and have intricate morphologies and high efficient organs to keep them ahead in the survival game. Perhaps one could learn better about functional morphology by studying Copepoda than by studying any other group of metazoan animals. Intricate and sophisticated construction has made their study challenging to taxonomists. Their zoogeography provides interesting insights into evolution and dispersal of freshwater invertebrates. However, in the past two decades, enormous strides have been made in characterizing species.

There is a growing body of copepodologists studying various aspects of Copepoda. Copepod ubiquity makes them readily available from high-schoolers to scientists doing sophisticated work, at low costs as far as lab facilities are concerned. They are hardy and can be maintained very easily once the art of culturing is mastered.

Research on Copepoda is a worthwhile investment, because they underpin many biological systems in the aquatic medium globally. What we find out about them can be put to good use for humanity at large. Neglecting them will mean that we are passing up opportunities for education, conservation and the enhancing of natural resources. The returns from wise investment in Copepoda research can bring rich dividends.

C. Herbert Fernando, Waterloo, Canada

REPLIC ON MODEL DESCRIPTIONS

While warmly welcoming the arrival here of MONOCULUS No. 25, and agreeing with almost everything in it, I feel bound to comment (from the special viewpoint of a worker on harpacticoids) on Professor Por's remarks on p. 3. He is absolutely right about the desperate anxiety of many young people (and older people, too) concerning sheer survival; we have all experienced this in one form or another, and indeed one of the central problems of life itself is the understanding and management of the interplay between anxiety and determination.

Let us assume that the would-be copepod taxonomist has mastered this problem enough to know that he really wants to learn how to draw and describe copepods (see below, and MONOCULUS Nos. 16 to 25, for discussions of model descriptions including recommended literature). May I also say that Professor Por's next sentence ("While we need ... undescribed taxa") is to some extent self-contradictory, and would have read much better somewhat as follows: "Our real business is to ensure that every species, old or new, is the subject of a really thorough description with a complete set of first-class drawings, so that all subsequent identifications and comparisons between taxa of equal rank are based exclusively on verifiable data of the most complete kind." To revert to his original wording, what is the point of hastily assembling slipshod and unreliable descriptions, if all they do is to bequeath a residue of problems that later workers will have to clear up? It would be far better from the beginning to follow as closely as possible the standards (and, where known, the methods) of those authors mentioned by me on p. 25 of MONOCULUS No. 19, and most of all those of Rony Huys who quite simply draws better than any of them, apart from which he has been the first to use (for harpacticoids, and on a large scale) cladistic analysis, which appears to offer many highly revealing insights into relationships between copepod taxa (see the magnificent monograph "Copepod Evolution" by Huys and Boxshall, 1991, as well as nearly all Huys's papers). As to how to dissect, mount, and draw specimens, I have myself (Hamond, 1969) described certain useful techniques, and in my Australian canthocamptid monograph (published ostensibly in 1987, but in fact not until late in 1988) I have tried to provide a rational scheme for naming abdominal spinulation and other details which, while it does not

quite agree with that used by Huys and Boxshall for all kinds of copepods, covers aspects of structure, not fully dealt with by them, solely from the harpacticoid point of view; this is to show that the basic know-how is available for those who want it. Given this, the highly desirable swing back to taxonomy being accorded its rightful esteem (suggested by E.O. Wilson on p. 7 of MONOCULUS No. 25) may yet come to pass; but it will be corrupted or strangled at birth by complacency, timidity, or the pernicious philosophy of "publish or perish".

R. Hamond, Morston, Holt, United Kingdom

ANNOUNCEMENTS

Retirement

The date of my official retirement from the professorship of Hiroshima University is drawing near (31 March 1994). However, I would not like to be away from my beloved cladocerans and copepods so far as my visual acuity persists. My new address:

Dr. Takashi Onbé
2-60-406 Saijo Nishi-Honmachi
Higashi-Hiroshima 724
JAPAN

Takashi Onbé, Hiroshima University, Japan

Training course:
"Freshwater zooplankton: a tool in lake management"
1 Oct. 1994 - 31 March 1995
Laboratory of Ecology, University of Ghent, Belgium

The Institute of Ecology of the University of Ghent, Belgium (Director: Prof. Dr. H.J. Dumont), organises an International Training Course on Freshwater Zooplankton each year. The course is focussed on the taxonomy and identification of tropical and subtropical freshwater zooplankton (especially Cladocera, Copepoda and Rotifera), but devotes considerable attention to other topics such as general limnology and lake management. The next course will take place from 1 October 1994 to 31 March 1995. The working language is English. Candidates will be selected preferably, but not exclusively, from the following countries: Algeria, Angola, Bangladesh, Bolivia, Botswana, Burkina Faso, Burundi, Cambodia, Cameroun, El Salvador, Equador, Gabon, Guatemala, Indonesia, Ivory Coast, Kenya, Laos, Malawi, Mali, Morocco, Mocambique, Namibia, Nicaragua, Niger, Ruanda, Senegal, Surinam, Tanzania, Thailand, Tunesia, Vietnam, Zambia, Zimbabwe.

Application forms can be obtained at the Belgian embassies in the applicant's country of residence, but applications should be submitted through the proper administrative channels of each country. Further information on the course can be obtained from:

Prof. Dr. H.J. Dumont
c/o Mrs. S. Maas
Laboratory of Ecology
University of Gent
K. L. Ledeganckstraat 35
B - 9000 Gent, Belgium
Tel.: 32 (0) 92 64 52 53
Fax : 32 (0) 92 64 53 43

The course is sponsored by the Belgian Administration for Development and Cooperation (B.A.D.C.).

F.A.M.E.
Master's programme on Fundamental and Applied Marine Ecology
Brussels, January 1994
Director: Prof. M.H. Daro
International coordinator: Prof. P. Polk
Free University Brussels (V.U.B.)
Pleinlaan 2
B-1050 Brussels - Belgium

The scope of F.A.M.E. is to offer a diversity of theoretical lectures and practical training in marine ecology to any scientist who wants to broaden his knowledge in general marine ecology or specialize in one of the fields covered by the programme. The courses are given in English by specialists in specific fields of marine ecology (including biological, physical and chemical oceanography). The lectures belong to different Belgian and Dutch universities and institutes (see programme). As the course was originally designed for students from developing countries, specialization into tropical marine ecology (e.g. coral reef ecology) is one of the possibilities offered by the programme.

The F.A.M.E. programme is organized on a yearly basis. A good knowledge of English is required. Students having a poor knowledge of English are requested to follow the English course at the VUB institute for language teaching during the month of September. A good knowledge in mathematics is required. Upon the results obtained on a small test given in the beginning of the programme, students will have/will not have to take the course "quantitative ecology" as a compulsory subject. Regular courses start each year 1st of October. During the first year, students take a number of compulsory and optional theoretical courses on various ecological topics. Practical exercises are organized on specific subjects and during general practical exercises and excursions. Evaluation is based on exams on the different courses and reports on practical exercises. Exams are held in June and September. During the second year, students take a number of optional courses and carry out a research programme, which is reported upon in a thesis. After successfully completing the two years' programme, students obtain the degree of "Master in Fundamental and Applied Marine Ecology".

EUROPEAN SCIENCE FOUNDATION
European Research Conferences
For further information please contact:
Dr. Josip Hendekovic, Executive Director
European Science Foundation
1, Quai Lezay-Marnésia
67080 Strasbourg Cedex
France
Tel: (33) (88) 76 71 35
Fax: (33) (88) 36 69 87

Oceanography
- The Deep Sea Floor as a Changing Environment, X. Le Pichon (Paris) - San Feliu de Guixols, Spain, 8-13 February
- Oceanography: Biodiversity and Production in the Ocean, J.O. Strömberg (Fiskebäckskil) - San Feliu de Guixols, Spain, 3-8 May
- Arctic Ocean Grand Challenge: Scientific Rational-Strategy-Science Plan, O.M. Johannessen (Solheimsviken) - Helsinki, Finland, 2-7 September
- Glacial-Interglacial Sealevel Changes in Four Dimensions: Continental Shelf Evidence of Sealevels over the Last 20 ka., R.T.R. Wingfield (Nottingham) - St. Martin (near Mannheim), Germany, 5-10 November

MEMOCARD CRUSTACEA

DIMDI - Weisshausstrasse 27, Postfach 420580, D-5000 KÖLN 41

CRUSTACEA is a bibliographic database on Crustacea. At present special emphasis is given to the taxonomy of Copepoda and Tanaidacea. The database contains literature from all over the world and from more than two centuries. The documents show bibliographic data, where the titles are mostly given as original titles, but sometimes also as original title plus German, English, French or other translation. Furthermore, the documents contain subject related key words and geographical key words, both in German and/or English; there are no abstracts.

PRODUCER

Universität Osnabrück - Standort Vechta
Fachbereich Naturwissenschaften, Mathematik
Prof. Dr. J. Sieg
Driverstrasse 22
D-49364 Vechta
Telephone: 04441-15229
Telefax: 04441-15444

Universität Oldenburg
Fachbereich 7 (Biologie)
Prof. Dr. H.K. Schminke
Postfach 2503
D-26111 Oldenburg
Telephone: 0441-798-3374
Telefax: 0441-798-3000

SUBJECT COVERAGE

Biology; Ecology
The database contains mostly literature on the biological taxa Copepoda and Tanaidacea. Special emphasis is given to aspects of physiology, zoogeography and parasitism.

SOURCES

- Journals: more than 90 %
- Newspapers
- Books and Serial Books
- Conference reports and other reports
- Theses and Habilitation Papers

FILE DATA

- since 1750: 28,762 documents (Status: 30/11/90)
- update: none
- until 1970 the literature is documented as completely as possible, after 1970 the documentation is incomplete. Supplementary searches from 1970 onwards should be done in the database BIOSIS Previews

VOCABULARY

- Controlled Terms (CT) (only as alphabetical list)
  language of vocabulary: German/English mixed
- Geographical Headings (GH) (only as alphabetical list)
  language of vocabulary: German/English mixed

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INFO ID-CS (data fields)
INFO LI-Cs (licence fees)
INFO CHANGES-CS (any new features)
INFO FILES-CS (file data)

DOWNLOAD

permitted; further information: see database Copyrules (ZCOO).

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USER AIDS

- Memocard CRUSTACEA (available at DIMDI)

SPECIAL FEATURES

The data field PA (= Publication Availability) shows where an original paper is available. The complete address can be requested online with the command: DISPLAY PA=...;ALL
The original papers can then be ordered by letter from the person(s) mentioned in the retrieved addresses.
(This service must not be mixed up with DIMDI's Online Document Ordering System! It should be used only when ordering via online supplier is not possible.)

"ZOEA". Larval development newsletter for carcinologists

The 1st volume, Number 1 of ZOEA has appeared in January 1994. "ZOEA" is a newsletter intended for all workers interested in Crustacean larval development. This newsletter will serve as a forum to share results, to exchange ideas, and report on successes and failures. Interested carcinologists are encouraged to send us their address for the mailing list, short articles for publications, other items of interest, recent publications (since 1992), and suggestions for topics for us to consider. Publication has started in January 1994. Addresses of the editors are:

J.A. CUESTA, Departamento de Ecologia, Facultad de Biologia, Apdo. 1095, E-41080 Sevilla, Spain. (FAX (95) 4615780)

J.I. GONZALEZ-GORDILLO, Laboratorio de Biologia Marina, Facultad de Biologia, Apdo. 1095, E-41080 Sevilla, Spain. (FAX (95) 4233480).

Plankton Newsletter

The Plankton Newsletter is a biannually appearing journal focussing on the study of marine plankton. Each volume is dedicated to a selected group of organisms and publishes a directory of scientists working on that group and a list of recent literature references.

Journal on marine plankton, ISSN 0920-2285, published by SBNO (Organisation for the Advancement of Oceanography in the Netherlands), supported by the Institute of Taxonomic Zoology (Dept. Vermes and Marine Plankton), University of Amsterdam. Editors:

M. van Couwelaar & S. van der Spoel
Institute of Taxonomic Zoology, Amsterdam, Netherlands
All correspondence should be sent to the editors, address:
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fax: +31-20-5257238
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Subscription. The subscription rate for Plankton Newsletter Volumes 18 & 19 (1993) is only U.S. $ 10.-. Subscribe by sending an international cheque or money-order payable to: PN, the Editor, SBNO, P.O. Box 16915, 1001 RK Amsterdam, The Netherlands. Cash payment (ONLY U.S. $ banknotes) is preferred. PLEASE SPECIFY ORDER! Dutch readers can also pay Hfl 20.- on giro account 2922 (NMB Amsterdam), account no. 69.67.14.477 of SBNO, Postbus 16915, 1001 RK Amsterdam.

International Symposium: Diapause in Crustacea

12-17 September 1994
St. Petersburg
c/o Dr. Victor Alekseev
Zoological Institute
St. Petersburg
Fax No. (812) 218-29-41
Telephone: (812) 218-03-11
E-mail: AVR@ZISP.SPB.SU

7th Deep Sea Biology Symposium

September 29 - October 4, 1994
IMBC, Crete, Greece

Theme: **Biology and Ecology of the Deep Sea**

So far the announced presentations have addressed the following topics: deep-sea biota and community structure, hydrothermal vents, seamounts, microbiology, fluxes, food chains and investigations conducted by remote operated submersibles. Contributions on deep-sea biology and ecology with lectures, oral presentation of papers, posters, informal meetings and workshops, etc.

Deadline for abstracts: June 15, 1994: deadline for application and registration form, together with payment: June 15, 1994 (after this date the late registration fee will be charged).

For further information please contact the symposium office:
The Organising Secretariat
7th Deep-Sea Biology Symposium
Institute of Marine Biology of Crete
P.O. Box 2214, Iraklion 71003, Crete, Greece
Tel.: +30 81 242022/246647
Fax: +30 81 241882
E-mail: IMBC@IMBC.GR

First Announcement: XXVI SIL CONGRESS
São Paulo, Brazil
São Paulo, 23 - 29 July 1995
"Water as a Limiting Resource: Conservation and Management"
Scientific and executive committee:
President J.G. Tundisi
Vice Presidents: F.A. Barbosa, C.E. Bicudo, R. Henry, J.E. Santos
Members: Denise Bicudo, F.A. Esteves,
Maria Ermelinda Lamonica Freire, Luiz Drude Lacerda,
Odete Rocha, Albano Schwarzbold, Takako Matsumura Tundisi

OFFERS AND REQUESTS

SURVEY OF COPEPODOLOGISTS

A limited number of copies of the "SURVEY OF COPEPODOLOGISTS OF THE WORLD" (G. Schminke & H.K. Schminke, eds.) is still available. Interested colleagues who have not received a copy as yet are welcome to send their requests to:

Dr. H.K. Schminke
Fachbereich 7 (Biologie)
Universität Oldenburg
D-26111 Oldenburg, F.R.G.

REPRINTS

The Department of Invertebrate Zoology recently cleaned out its part of the museum basement. During the process a large number of old reprints on copepods was discovered. We are offering these gratis to interested colleagues. There follows a list of titles in exceedingly abundant supply. Of course we would be grateful to receive reprints in exchange for permanent deposit in the C.B. Wilson Copepod Library.

Excess reprints in Wilson Library:

MARSH, C.D. - 1895: Cyclopidae and Calanidae of Lake St. Clair, Lake Michigan ... Bull. Michigan Fish Commission 5

MARSH, C.D.: Freshwater Copepoda; Rep. Canadian Arctic Expedition 1913-18, 7, Crustacea

MARSH, C.D. - 1926: Crustacea copepodes recoltes par M. Henri Gadeau pendant son voyage zoologique en Syrie. Voyage Zoologique d'Henri Gadeau de Kerville en Syrie 1: 171-185 + plates

SHARPE, R.W. - 1910: Notes on the marine Copepoda and Cladocera of Woods Hole and adjacent regions ... Proc. US Nat. Museum 38: 405-436

WILSON, C.B. - 1907: North American parasitic copepods belonging to the Family Caligidae: Part 2. Trebinae and Euryphorinae. Proc. U.S. Nat. Mus. 31
WILSON, C.B. - 1907: North American parasitic copepods belonging to the family Caligidae. Parts III and IV. Pandarinae, Cecropinae. Proc. U.S. Nat. Mus. 33
WILSON, C.B. - 1908: New genera and species of Caliginae. Proc. US Nat. Mus. 33 (No. 1580)
WILSON, C.B. - 1908: North American parasitic copepods: list of those found upon the fishes of the Pacific Coast ... Proc. US Nat. Mus. 35 (No. 1652)
WILSON, C.B. - 1911: North American parasitic copepods. Part 9. Lernaeopodidae. Proc. US Nat. Mus. 39 (No. 1783)
WILSON, C.B. - 1911: North American parasitic copepods belonging to the Family Ergasilidae. Proc. US Nat. Mus. 39 (No. 1788)
WILSON, C.B. - 1935: New parasitic copepods from the Puerto Rican Deep ... Smithson. Misc. Coll. 91(19)
WILSON, C.B. - 1935: A new and important copepod habitat. Smithson. Misc. Colls. 94(7)
WILSON, C.B. - 1950: Copepods gathered by the United States fisheries steamer Albatross ... US Nat. Mus. Bull. 100
WILSON, M.S. - 1946: The species of Platycopia ... Smiths. Misc. Colls. 106(9)
WILSON, M.S. - 1949: A new species of ... Corycaeus ... Proc. US Nat. Mus. 99 (No. 3239)
WILSON, M.S. - 1952: Pupulina ... Proc. US Nat. Mus. 102 (No. 3301)
WILSON, M.S. - 1953: New and inadequately known species of ... Diaptomus ... Smiths. Misc. Colls. 122(2)
WILSON, M.S. - 1958: Ridgewayia ... Proc. US Nat. Mus. 108 (No. 3398)
WILSON, M.S. & J.C. TASH - 1966: Eurytemora ... Proc. US Nat. Mus. 118 (No. 3534)

Janet Reid, Washington D.C.

CURRENT RESEARCH ACTIVITIES

I am a research associate of this department and am presently working on the functional morphology and anatomy of two parasitic copepods, a lernaeopodid and a pennellid, from the Trivandrum coast of India.

A. Chandran, University of Kerala, India

BIRTHDAYS

Dr. Z. Kabata (Nanaimo, Canada) will be 70 years in March 1994.

Dr. W.J.P. Smyly (Windermere, Cumbria, United Kingdom) will celebrate his 75th birthday in July.

Dr. T. Wolff (Copenhagen, Denmark), interested mainly in deep-sea ecology, is going to be 75 in July.

Dr. P. Illg (Friday Habor, U.S.A.) will be 80 years in September.

In April Dr. E. Stella (Rome, Italy) is going to celebrate her 85th birthday. She worked on plankton of lakes and temporary waters, particularly on calanoids.

MODEL DESCRIPTION

Copepod nauplii

The developmental stages of *Longipedia americana* (COPEPODA: HARPACTICOIDA)

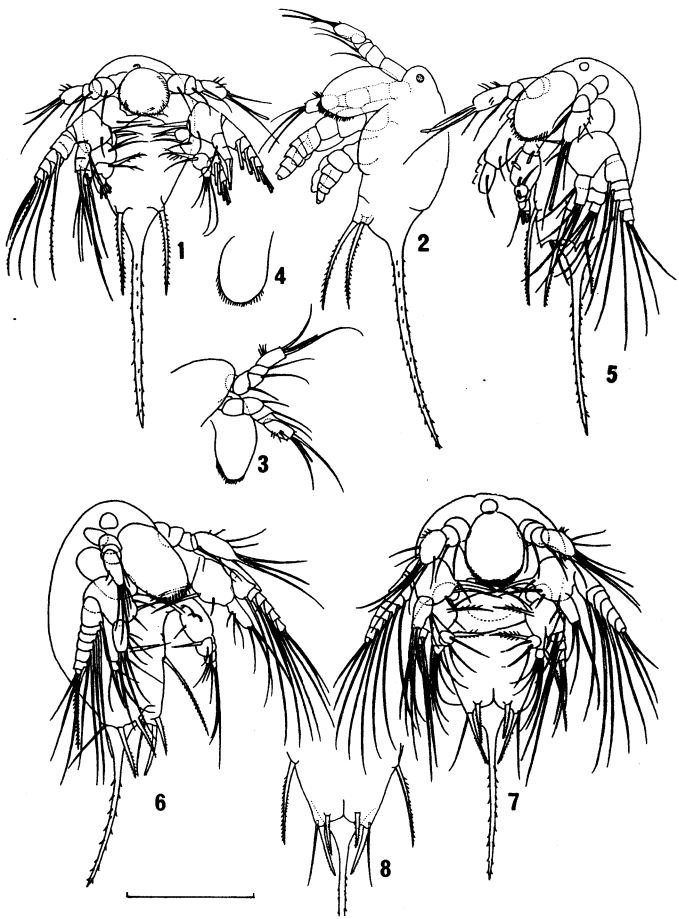
(after TAKASHI ONBÉ 1984 - J. Crust. Biol. 4: 615-631)

Nauplius Stage I (N I) (Figs. 1, 2, 3, 4, 13, 19, 25). - Body length 0.13-0.15 mm, average 0.14 mm (n = 12). Total length including median spine 0.28-0.30 mm, average 0.29 mm (n = 12). Body (Figs. 1, 2) pear-shaped, bearing long posterior spine subequal in length to body proper. Antennule (Fig. 13): indistinctly 5-segmented, having setae, aesthetasc (a), and spinules (s) with formula 0,1,1,1,2 + 1a + 4s, on the 1st through 5th segment, respectively. Antenna (Fig. 19): coxa with masticatory process on inner margin; basis with spine and 3 setae; endopod 1-segmented with 2 terminal and 2 lateral setae; exopod 5-segmented with single seta on segments 1-4 and 2 terminal setae on segment 5. Mandible (Fig. 25): coxa with spine; basis with 2 setae; endopod 2-segmented with 2 spines and 5 setae, respectively; exopod 4-segmented with 1,1,1,2 setae. Maxillule (Figs. 1, 2): represented by long stout spine with many minute spinules. Labrum (Figs. 3, 4): well developed with fine hairs on posterior and lateral margins.

Nauplius Stage II (N II) (Figs. 5, 14, 20, 26). - Body length 0.16-0.17 mm, average 0.16 mm (n = 5) (Fig. 5). Total length 0.29-0.30 mm, average 0.30 mm (n = 5). Antennule (Fig. 14): 5-segmented with setae arranged as 0,0,1,2,3 + 1a + 4s. Antenna (Fig. 20): coxa with masticatory process with 4 + 1 setae; basis with spine and 3 setae; endopod with 3 terminal and 2 lateral setae; exopod 6-segmented with single seta on segments 1-5 and 2 setae on terminal segment. Mandible (Fig. 26): coxa with spine; basis with 3 setae; endopod 2-segmented, proximal segment with spine and 3 setae and distal with 5 terminal setae; exopod 4-segmented with setae as 2,1,1,2. Maxillule (Fig. 5) as in N I. Caudal armature (Fig. 5): relative length of median spine smaller than in preceding stage; pair of small ventral processes and pair of long, dorsally directed setae.

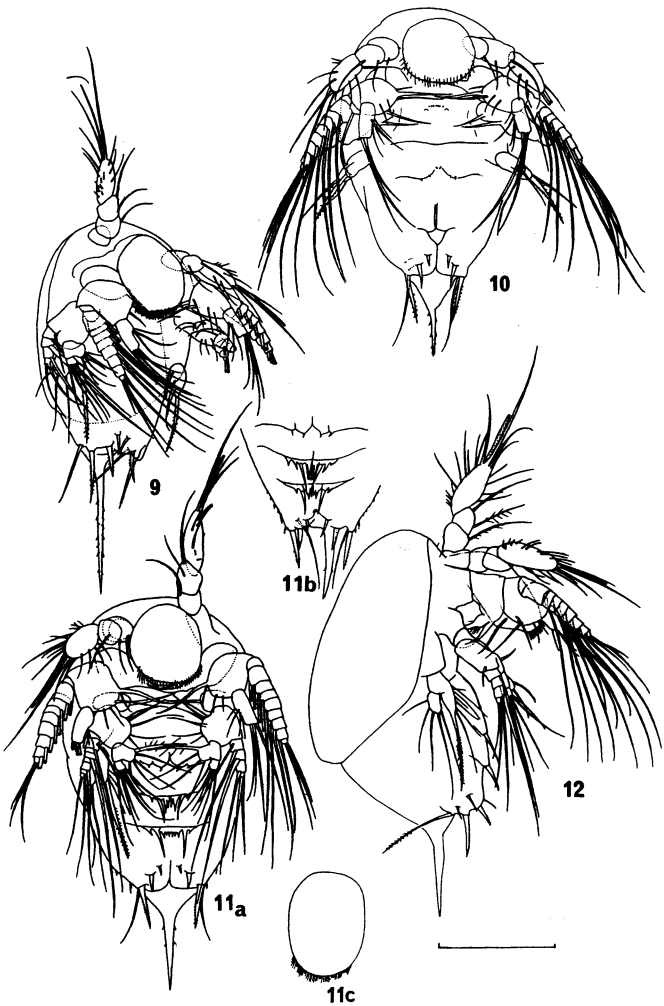
Nauplius Stage III (N III) (Figs. 6, 7, 8, 15, 21, 27). - Body length 0.17-0.19 mm, average 0.18 mm (n = 8) (Figs. 6, 7). Total length 0.28-0.31 mm, average 0.30 mm (n = 7). Antennule (Fig. 15) as in preceding stage except for terminal segment bearing 6 setae, 1 aesthetasc, and 4 spinules (6 + 1a + 4s). Antenna (Fig. 21): coxa with masticatory process and spine; basis with spine and 3 setae; endopod with 4 terminal and 3 lateral setae; exopod 7-segmented, each segment with seta except for terminal segment with 2 setae. Mandible (Fig. 27): coxa and basis as in N II; endopod 2-segmented, proximal segment with spine and 3 setae, terminal with 5 setae; exopod 4-segmented with setae as 2,1,1,2.

Maxillule (Figs. 6, 8) as in N II. Caudal armature (Fig. 8): 2 pairs of ventral spines and pair of dorsally directed setae.



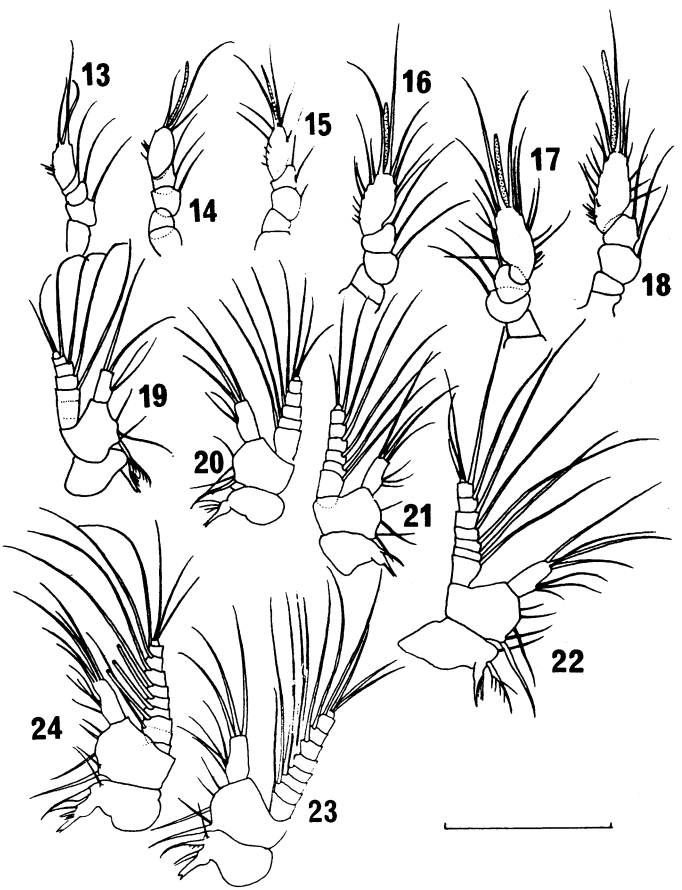
Figs. 1-8. *Longipedia americana*, naupliar stages: 1-4, Nauplius I; 5, Nauplius II; 6-8, Nauplius III. Scale bar = 100 µm.

Nauplius Stage IV (N IV) (Figs. 9, 16, 22, 28, 31). - Body length 0.20-0.24 mm, average 0.21 mm (n = 10) (Fig. 9). Total



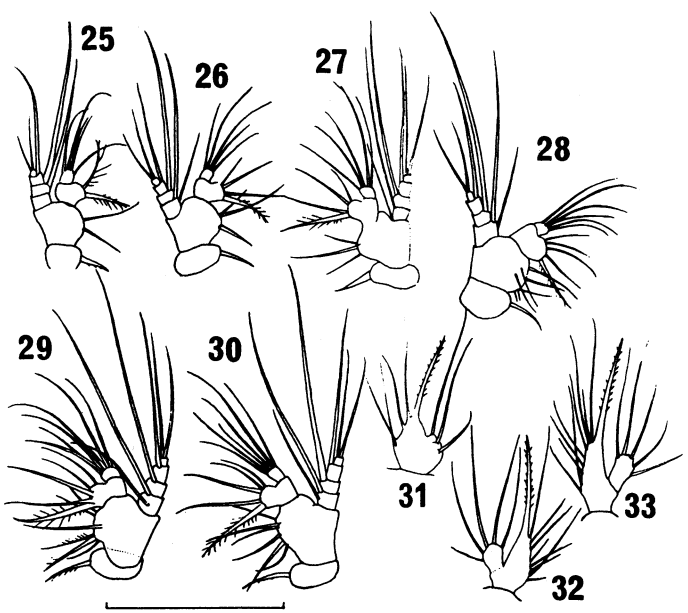
Figs. 9-12. *Longipedia americana*, naupliar stages: 9, Nauplius IV; 11a-c, 12, Nauplius VI.

length 0.28-0.35 mm, average 0.31 mm (n = 10). Antennule (Fig. 16) as in preceding stage, but terminal segment bearing 10 setae, 1 aesthetasc, and several spinules. Antenna (Fig. 22): coxa with masticatory process, spine, and seta; basis with spine and 4 setae; endopod with 4 terminal and 3 lateral setae; exopod 8-segmented, each segment with seta, but terminal with 3 setae. Mandible (Fig. 28) as in preceding stage, but basis with 7 setae, 1st endopod segment with 5 setae and 2nd with 6 setae. Maxillule (Fig. 31) represented by indistinctly bilobed appendage; endopod with 4 setae and terminal spine; exopod with 3 setae. Caudal armature (Fig. 9): pair of small spines added.



Figs. 13-24. *Longipedia americana*. 13-18, antennule, Nauplius I-VI; 19-24, antenna, Nauplius I-VI.

Nauplius Stage V (N V) (Figs. 10, 17, 23, 29, 32). - Body length 0.23-0.26 mm, average 0.25 mm (n = 21) (Fig. 10). Total length 0.29-0.34 mm, average 0.31 mm (n = 21). Antennule (Fig. 17) as in preceding stage, except terminal segment bearing 13 setae, 1 aesthetasc, and several spinules. Antenna (Fig. 23): coxa with masticatory process ornamented with 2 setae, spine, and seta; basis with spine and 4 setae; endopod with 3 terminal and 4 lateral setae; exopod 9-segmented, each segment with seta, but terminal with 3 setae. Mandible (Fig. 29) as in preceding stage except for basis with 6 setae. Maxillule (Fig. 32) with both endopod and exopod; endopod with 8 setae and long terminal spine; exopod with 5 setae. Maxilla (Fig. 10) represented by 2 pairs of very minute spines. Caudal armature (Fig. 10) as in N IV; median spine greatly reduced in length.



Figs. 25-33. *Longipedia americana*. 25-30, mandible, Nauplius I-VI; 31-33, maxillule, Nauplius IV-VI.

Nauplius Stage VI (N VI) (Figs. 11a,b,c, 12, 18, 24, 30, 33). - Body length 0.24-0.27 mm, average 0.26 mm (n = 14) (Figs. 11a, 12). Total length 0.31-0.34 mm, average 0.33 mm (n = 14). Antennule (Fig. 18) as in preceding stage, but terminal segment with 14 setae, 1 aesthetasc, and several (approximately 7) spinules at base. Antenna (Fig. 24): coxa armed with stout masticatory process ornamented with 4 setae, spine, and seta; basis with spine and 4 setae; endopod 1-segmented with 4 lateral and 5 terminal setae; exopod 9-segmented, each segment with seta except for 1st without seta, 2nd indistinctly subdivided with 2 setae, and terminal segment with 3 setae. Mandible (Fig. 30): coxa with stout spine; basis with 6 setae; endopod 2-segmented, 1st segment with spine and 4 setae, 2nd with 6 setae; exopod 4-segmented with setae as 2,1,1,2. Maxillule (Fig. 33) bilobed; inner lobe (endopod) with strong terminal spine and 9 setae; outer lobe (exopod) with 5 setae. Maxilla (Figs. 11a,b) represented by bilobed rudiment, each lobe ending in short spine. No maxillipeds. Leg 1 (P1) (Fig. 11b) rudimentary with 5 spines. P2 (Fig. 11b) rudimentary, indistinctly bilobed, each lobe bearing 2 spines. Caudal armature (Fig. 11b): median spine reduced in relative length to body; 3 pairs of spines and pair of setae; 2 pairs of minute spines on lateral margin with several pairs of spinules. Labrum (Fig. 11c): posterior margin setose with 5 minute processes.

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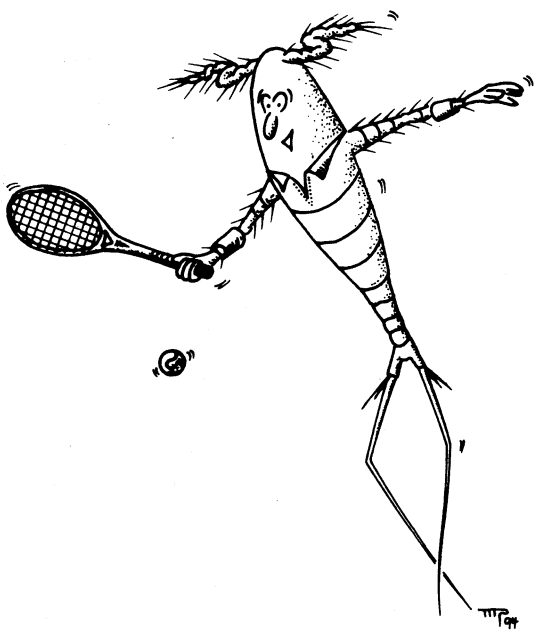

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