MONOCULUS *Copepod Newsletter*

The Newsletter of the World Association of Copepodologists

Number 46 November 2003

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WAC Homepage
http://www.copepoda.uconn.edu
MONOCULUS Homepage
http://www.copepoda.uconn.edu/newsletter
MONOCULUS Homepage – University of Oldenburg
http://www.uni-oldenburg.de/monoculus

— Message from the President —

Dear copepodologists,

This is not the first time that I have written messages to members of a Society to urge them to join forces in order to achieve what can be attained only collectively. Whenever afterwards I returned to the ranks I discovered that some effort is necessary not to fall back into a normal member's attitudes. Normal members are seldom reached the first time. They have to be reminded. The difference with the WAC is that the proportion of members who react straight away fortunately is higher than I anticipated.

Renewal of contact is my first goal, as pointed out last time. I sent letters with a questionnaire and asked for it to be completed and sent back to me. The questionnaire will be used for an update of the "Survey of Copepodologists" published in 1990. This survey is meant to facilitate internal (among copepodologists) and external contacts (to and from the outside). Guess how many questionnaires have been returned? The number is 120. This is a very good start, indeed, but it is not enough yet to begin the preparation of the survey. I had sent a letter to 750 copepodologists. If the survey is to demonstrate the full breath of our competence the action has to be repeated. You find the questionnaire at the end of this newsletter. The "Survey" will be free of charge for those who return the questionnaire.

Renewal of contact also means putting our two reprint libraries, the WILSON Library and the MONOCULUS Library, on your mailing list. We have again been able to help at short notice many users of our libraries who would have had difficulties in obtaining the literature as quickly elsewhere. I thank those who have sent their reprints and urge the others (the majority) to follow their good example.

Copepods are, as we know, of enormous ecological importance. Whole ecosystems would crumble without them. Copepodologists are, as we know, a huge fraction among aquatic biologists. Their results are of vital importance for applied aquatic science. Yet, as a group they are hardly perceived outside. It is time we entered the international scene to profit like others from funding opportunities and other possibilities. It is my second goal to prepare this step. For this we need a logo and a flyer to explain why copepodology is so important. To illustrate this flyer I would like to ask for your help. We need good photographs of copepods, planktonic ones, parasitic ones, benthic ones. If you have such photos, please, make them available to me either as slides or via the internet. Your name will be mentioned in case of publication. The text, I hope, will be ready when the next issue of our newsletter appears next spring.

I leave it to our editor, Janet Reid, to comment on the present issue, but I would like to thank her very much for putting together the very extensive list of recent literature which is a prominent part of this issue.

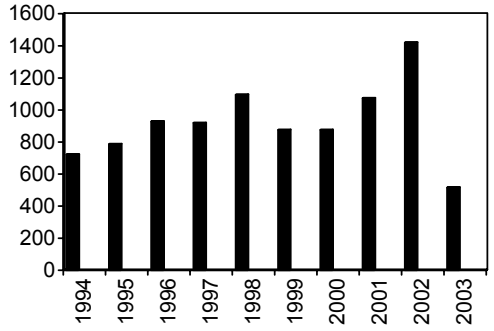
— H. Kurt Schminke
President
Oldenburg University, Germany

— Editor's Notes —

We are trying to be as proactive as possible in gathering and communicating news of the copepod world. *Please help by letting me know about future conferences, books about to be published, recent theses, and any other events of interest.*

Many of the dissertations listed in the literature section were located through the database of recent Ph.D. dissertations provided by the American Society of Limnology and Oceanography. Susan Weiler cordially gave permission to reproduce these citations, and describes the ASLO-sponsored DIALOG program on page 9.

In this number of MONOCULUS, the literature references have been posted and printed as a separate supplement. If the list were included in the newsletter, the large number of reported references would result in an exceptionally unwieldy file. The chart below shows a very rough estimate, compiled from totals in the Wilson Copepod Library database and *MONOCULUS*, of the growth in the scientific literature on copepods and branchiurans from 1994 up to now. Over 1,400 references appeared in the year 2002, and even this total is doubtless incomplete. (The total for 2003 is of course partial.)



***Please help us to make these lists as complete as possible*,** by sending reprints or even just references of new papers to the Monoculus-Library or the Wilson Copepod Library. I thank the two colleagues who responded to my request for references made in September through several discussion groups. Several of the people listed below also helped with literature.

For their contributions and assistance for this number, I thank Annemarié Avenant-Oldewage, George Benz, Zdenek Brandl, Ann Bucklin, Bruce Coull, Mohammed Néjib Daly Yahia, Susan Dippenaar, Frank Ferrari, Lesya Garlitska, Rodrigo Gonçalves, Sanda Iepure, Ryuji J. Machida, Elena Markhaseva, Silvina Menu-Marque, Marion Nipper, Sami Souissi, Wim Vader, Chad Walter, Susan Weiler, Judy Williams, Rina Winter, and the Ray Society.

— Jan Reid
Editor
Martinsville, Virginia, U.S.A.

— WAC Website —
Call for Contributions

The website of the World Association of Copepodologists (WAC), located at: http://www.copepoda.uconn.edu, has been established to promote communication among copepodologists, members and non-members of WAC. The website contains several sections dedicated to this objective. To mention a few examples, it is open to advertise scientific meetings, jobs and research opportunities, to discuss new methods and technologies, as well as to publish biographies of copepod researchers who made a major contribution in their particular field while professionally active. Of course the website is the new home of our biennial newsletter, *MONOCULUS*, which has been published electronically since last year.

I would like to invite *MONOCULUS* readers to visit other sections of the website and to submit contributions on any aspect of interest to other copepodologists. Some suggestions for topics are:

1) a short note with a list of key references to your research subject – this would go in the "Reference Series" section of the website; or

2) a short tutorial on your research topic with a few figures and/or tables – this would go as a separate link on the "resources" webpage (for an example, see http://www.copepoda.uconn.edu/sampling.htm).

Material already used on PowerPoint® presentations may be adapted as an Internet page (e.g., as a pdf file).

Please contact me if you need more information or any assistance on how to prepare your contribution. The community thanks you for your collaboration!

— Rubens M. Lopes
Website Manager
Instituto Oceanográfico, Universidade de São Paulo,
São Paulo, Brazil
rmlopes@usp.br

— Copepoda List –

The Copepoda List, an e-mail list developed by the World Association of Copepodologists, is a major discussion

forum on copepod research. It provides an opportunity to list subscribers (about 400 copepodologists at present) to exchange information and ideas on a more constant basis. In this respect, the Copepoda List is a sister tool of our long-lived newsletter, Monoculus, which is published twice a year.

The mailing list address has moved to a new location.

To send messages to the list please write to:

list@copepoda.oceanografia.org.

If you are not subscribed to the list, write a message to:

list-subscribe@copepoda.oceanografia.org

We welcome your active participation!

— Rubens M. Lopes
Copepoda List moderator
IOUSP, São Paulo
rmlopes@usp.br

The 9th International Conference on Copepoda (ICOC): Hammamet, Tunisia, July 11-15, 2005

A Message to Members and Friends of WAC

The World Association of Copepodologists (WAC) officially decided to hold its 9th Conference in Tunisia in 2005, during the business meeting at the 8th International Conference on Copepoda in Keelung, Taiwan. It is the pleasure of the International Organizing Committee for the 9th International Conference on Copepoda to extend its invitation to you all, members and non-members, to attend the Conference. Members of the Committee (in alphabetical order) are Drs Geoff Boxshall (United Kingdom), Mohammed Néjib Daly Yahia (Tunisia, co-chairman), Ons Daly Yahia-Kéfi (Tunisia), Jiang-Shiou Hwang (Taiwan), Rubens Lopes (Brazil), Laurent Seuront (France) and Sami Souissi (France, co-chairman).

This conference will be organised for the first time in Africa and for the first time in the Mediterranean. It is also the first time that there are two co-organisers. Both Tunisian and French authorities and scientific institutions will officially host and support the 9th ICOC.

The 9th ICOC will be held in Hammamet, a very beautiful city of Tunisia from the 11th to the 15th July 2005. The professional company 'Tunisie Voyages', specialised in organising national and international conferences, will take charge of the organisation of the 9th ICOC. This will be a good guarantee for efficient organisation and give us more time to focus on the organisation of the scientific programme. The conference will take place in the five-star Golden Yasmin, Mehari Hotel, which will offer all facilities for participants. You can find more information about the company 'Tunisie Voyages' and the hotel at the following websites:

www.tunisie-voyages.tourism.tn

http://www.goldenyasmin.com/hammametmehari/en/index.htm

Since the end of the 8th ICOC, more than five meetings were organised in Tunisia between both co-organisers of the 9th ICOC. The **pre-conference workshop** (training course) will be held at the University of Bizerta (one of the hosting institutions, with 7000 students and 300 faculty members) in another pleasant Mediterranean city located in the north of Tunisia (very close to Tunis city and to its airport). You can find more information about northrn Tunisia and Bizerta at the following websites:

www.tourismtunisia.com

www.bizertaeconomicpark.com.tn/english/bizerta

This course will focus on the importance of processes (and characteristics) at the individual scale of copepods: morphology, physiology, behaviour (feeding, mating, host-parasite encounter) etc. Prominent scientists will give courses, providing an overview of their specialties with a focus on up-to-date techniques and technologies used for practical classes. The members of the International Organizing Committee are working hard on several aspects of the organisation of this conference. Prof. Jiang-Shiou Hwang is planning to stay several months in France (Marine Station of Wimereux) during his sabbatical year. This scientific visit will also be a good occasion to stimulate further efforts towards better organisation of the 9th ICOC.

The scientific programme of the conference is not yet completely established. We will appreciate your suggestions and comments. On behalf of the International Organizing Committee Dr Sami Souissi will answer you (use this email address: Sami.Souissi@univ-lille1.fr with a copy (cc) to Copepoda2005@free.fr).

The University of Sciences and Technologies of Lille (France) will host the official website of the 9th ICOC. This website is under construction and will be ready very soon. A link to this website will be made on the WAC official website. You can also obtain the address of the website (or any other information) by sending an email to Dr Sami Souissi. All future announcements will be available from the website as well as from *MONOCULUS*. We look forward to meeting you all at the 9th ICOC in 2005 in Tunisia.

— Sami Souissi
Mohammed Néjib Daly Yahia
Co-Chairs and Local Secretaries of the International Committee of the 9th ICOC

Zbigniew Kabata Receives ASP Award

Dear Members of the World Association of Copepodologists,

Although many copepods are parasites, few parasitologists study them. Hence, it is especially notable when a parasitological society bestows one of its highest honors on a copepodologist … allowing us to raise our antennae, clap our maxillipeds, and toast one of our own as an accomplished parasitologist.

I am delighted to report that in Halifax, Canada on 2 August 2003 the American Society of Parasitologists (ASP) honored Dr. Zbigniew Kabata by bestowing upon him the Eminent Parasitologist Award at the Society's 78th Annual Meeting. Not limited to ASP members, the Eminent Parasitologist Award is bestowed on a bi-annual basis to honor someone of eminence and international visibility for a substantial contribution to parasitology over a long period of time. Dr. Kabata could not attend the meeting, but the ASP membership in attendance viewed a prerecorded acceptance speech that demonstrated his obsession with parasitic copepods.

The societal lineage of all members of the World Association of Copepodologists (WAC) is tied to Dr. Kabata, for Dr. Kabata was the Association's founding president. But WAC has molted from copepodid to adult, and unfortunately younger members may be familiar with Dr. Kabata only through his contributions to our field. This is unfortunate, because Dr. Kabata's story of excellence far transcends copepodology, and it is a fascinating and inspirational one. Thus I will digress a bit to provide a wider view of his history.

Zbigniew "Bob" Kabata was born in 1924 in Poland. Kabata attended the Polish Military Academy as a young man, only to have his studies cut short by the invasion of Poland and World War II. From 16-21 years old, he fought alongside other partisans in a clandestine war against the Nazis. His actions during this period resulted in several citations for bravery, and the army unit he served in became legendary. During the resistance, Kabata wrote several poems honoring his compatriots. The most famous of these poems, written years later, became an unofficial anthem of Poland's combatant community. Today, this poem graces memorials throughout Poland. In 1945 Kabata pulled off a hair-raising escape and ended up in Italy. After peace came to Italy, his army unit was transferred to England. From there he traveled to Scotland, where he became a North Sea fisherman. It was during this period that Kabata's passion for science became nurtured, and this, as well as a fishing accident that traumatized his leg, prompted him to undertake academic studies where he become a brilliant student, graduating at the top of his class and earning his doctorate from the University of Aberdeen. After graduation, Dr. Kabata continued on at Aberdeen until 1966, when he exported himself to the Pacific Biological Station on the West Coast of Canada to work with his esteemed friend Dr. Leo Margolis… a dynamic pair bringing international attention to the Station. Dr. Kabata retired in 1989, but not surprisingly he still arrives early at the Station each day to continue his work. Besides correspondence, journal reviews, and other mundane but important tasks of an essential elder statesman, he is currently working on a book detailing the biology of parasitic copepods.

The patriotic and civic character that Dr. Kabata possesses has not gone without recent notice. In 1996 he was awarded one of Poland's highest decorations, the Grand Commander Cross of Polonia Restituta, for his scientific accomplishments as well as for his outstanding war record. In 2002 he became the first-ever recipient of the Immigrant Achievement Award from the Canadian Bar Association, Immigration Branch, and he was also honored that same year with an Honorary Doctor of Letters degree from Malaspina University-College.

In choosing Dr. Kabata for The Eminent Parasitologist Award, members of the ASP awards committee no doubt considered three of Dr. Kabata's major contributions to parasitology. First, is his exemplary contribution to our understanding of parasitic copepods. In endorsing his

nomination, one supporter wrote, *"It would be difficult to overstate Dr. Kabata's contributions to parasitology and copepodolgy. An intellectual leader for contemporary copepodologists, Dr. Kabata is the most influential and significant copepodologist of the 20th century. His publications have liberated the study of copepods from the dark ages through the genesis of a modern systematic foundation based on a deeply insightful understanding of biology and homology ... insight gained through painstaking microscopic examination of thousands of copepods. The "Yoda" of copepodology, Kabata's science is brilliant, and it will forever serve as bedrock for the foundation of copepod research."* Beyond his countless journal publications dealing with parasitic copepods, his book *Parasitic Copepoda of British Fishes* (Kabata, 1979) must be considered the benchmark of accomplishment within our field.

The second major area of influence considered by the ASP awards committee no doubt concerned Dr. Kabata's instrumental role in pioneering the use of parasites as biological tags and his ecosystem approach to fisheries management. He was among the first to demonstrate that parasites could be used to delineate fish stocks for management purposes (e.g., Kabata, 1959, 1963).

The third major area of influence regarding Dr. Kabata's impact on parasitology relates to his translation of Russian parasitology literature. Dr. Kabata made the literature of Dogiel and other Russian authors (e.g., Dogiel et al., 1961) available to a new generation of parasitologists. One of his ASP nominee supporters wrote, *"I was brought up on these Russian works and depended heavily on the fruits of Kabata's work in my early years."*

In addition to the Eminent Parasitologist Award, Dr. Kabata has been the recipient of other parasitology awards, such as the Wardle Medal from the Canadian Society of Zoologists and the Janicki Medal from the Polish Parasitological Society. In 2002 he was designated the honorary president of the Tenth International Congress of Parasitology. Further testament to the impact that Dr. Kabata has had on the field of parasitology stems from the fact that at least 20 parasitic taxa (copepods, helminths, and Myxozoa) have been named in honor of him. In his letter supporting Dr. Kabata's nomination for the ASP award, Dr. Damkaer noted that Kabata's own work has added 23 new genera and hundreds of new species to the ranks of Copepoda. Furthermore, and as many are aware based on firsthand experience, Dr. Kabata's service as a journal referee is legendary. I am one of many no doubt who owe him thanks for "saving my bacon" on several occasions when his keen eye as a reviewer prevented me from making an embarrassing lapsus. In addition, Dr. Kabata has served on the editorial boards of several journals, including *Journal of Parasitology*, *Acta Parasitologica*, and *Systematic Parasitology*, and respect for his meticulous systematic work, as well as his command of Greek and Latin, earned him a 15-year stint as a Commissioner on the International Commission on Zoological Nomenclature.

In his introduction to the 2003 Eminent Parasitologist Award, Dr. Timothy Goater opened, *"Heroic freedom fighter, deep-sea fisherman, award-winning scholar, famous author and poet, inspirational leader, influential and outstandingly productive scientist, generous mentor, highest honors citizen, humble gentleman, and steadfast friend — these are a few of the achievements and superlatives that apply to the person we honor today."* When I casually mentioned to Dr. Kabata that I would be writing this announcement for *Monoculus*, he asked me to *"not put too much into the blurb for Monoculus. The readers of that bulletin know too much about copepods to be snowed. You tend to be too generous in your assessment of my contribution to copepodology."* I have quoted Dr. Kabata here without his permission or knowledge, and for this I apologize; however, to the foregoing request I must publicly reply, Dr. Kabata, despite you easily trumping me in virtually all suits, I must vehemently disagree with your assessment of my judgement. Congratulations on your recent and well-deserved award and sincerest thanks for your service and contributions to society and copepodology, as well as for your friendship and inspirational leadership to so many. We are truly blessed to have you amongst our ranks.

Respectfully submitted,

— George W. Benz
Tennessee Aquarium Research Institute
Chattanooga, Tennessee, U.S.A.

References

Dogiel, V.A., G.K. Petrushevski & Yu.I. Polyanski. 1961. Parasitology of Fishes. Oliver and Boyd, Edinburgh. [English translation of Russian text by Z. Kabata]

Kabata, Z. 1959. Investigations of the subdivisions of North Sea whiting population. II. Some observations on gall-bladder Protozoa in North Sea whiting. Paper 36, Near Northern Seas Committee, I.C.E.S., 1959.

Kabata, Z. 1963. Parasites as biological tags. International Commission on Northwest Atlantic Fisheries, Special Publication 4: 31-37.

Kabata, Z. 1979. Parasitic Copepoda of British Fishes. The Ray Society, London.

Vladislav Monchenko Elected to Ukrainian Academy of Sciences

Professor Vladislav I. Monchenko was elected recently to the Ukrainian Academy of Sciences. Among his many accomplishments, Professor Monchenko has: used interbreeding experiments among species of Cyclopidae to study the formation of sibling species; studied endemism and evolutionary relationships of brackish water Ponto-Caspian cyclopoids; discussed the origin of ecological relationships between symbiotic copepods and their animal hosts; written about the induction and termination of diapause in copepods; and correctly illustrated the 3-segmented protopod of the cyclopinid maxilliped. Professor Monchenko also has described 34 copepods new to science.

— Frank Ferrari
National Museum of Natural History
(Smithsonian), Washington, D.C., U.S.A.

Collection from Mongolia Available for Study

In an expedition to south-central Mongolia in 2002, we collected branchiopod crustaceans. Invertebrates as well as other crustaceans incidentally collected with the branchiopods are available for study. This unsorted material is curated to highest museum standards, is in 95% ethanol, and is useful for both molecular and morphological studies. A website describing this collection allows researchers to search the database for locality data, field photos, and common taxonomic names (e.g., copepod, cladocera, ostracod, insect, etc.): http://collections.nhm.org/mongolia. Researchers interested in accessing this material should contact: Drs. Joel Martin or Regina Wetzer, Crustacea, Natural History Museum of Los Angeles County (jmartin@nhm.org or rwetzer@nhm.org).

— Regina Wetzer
Natural History Museum of Los Angeles County,
California, U.S.A.

— Obituary Notice —

Mónica Montú

We sadly report that our colleague, the planktologist and carcinologist Mónica Adelina Montú passed away on the 12th of October, 2003. A full obituary article will appear in the next number of the newsletter.

Specimens Wanted

I am interested in obtaining whole specimens of the following harpacticoid copepods – *Canthocamptus staphylinus* or *staphylinoides*. I would accept any other canthocamptids that are known to undergo some form of dormancy (encystment or otherwise) that you may have. I would prefer to have some in the encysted stage if at all possible, and others in the free-living stage. I think it is best for them to be preserved in either 95% ethanol or a 10% buffered formalin solution. Please put them in small glass vials, with cotton and pack well for shipment to the following address: Dr. Judith Williams, Biological Sciences, Div. of Sci/Tech. USM Gulf Coast, 730 Beach Blvd., Long Beach, MS 39560, USA. For inquiries please email me at: judith.williams@usm.edu

— Judith Williams
University of Southern Mississippi Gulf Coast
Long Beach, Mississippi, U.S.A.

Special Pre-publication Offer for WAC Members

"***An Introduction to Copepod Diversity***" by Geoff Boxshall with Sheila Halsey will be published by the Ray Society in January 2004. This work is intended as a companion volume to *Copepod Evolution* by Huys & Boxshall, and is essentially a family-level work. For each family-level taxon across the Copepoda the book contains: 1. An illustrated diagnosis of the family, 2. A list of included genera – with approximate number of species, 3. A taxonomic notes section, 4. A key to genera for every family (with three exceptions), and 5. An introduction to the biology of the family – serving as an entry point to the literature (key references or reviews, details of hosts, etc.)
The work comprises 966 pages and is supported by 289 plates of line drawings. It is bound as **two hardback volumes** and is fully indexed.

The Ray Society has agreed to make this new work available to members of the WAC at a special prepublication price of **£80 UK pounds** (the full retail price is 150 pounds). The two-volume set can be ordered directly from the Ray Society using the form below.

— Dr Nick Evans
Honorary Secretary, The Ray Society
c/o The Natural History Museum
Cromwell Road
London SW7 5BD, U.K.

ORDER FORM (copy or print and send with your payment)

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Send orders to: Dr Nick Evans, Honorary Secretary, The Ray Society, c/o The Natural History Museum, Cromwell Road, London SW7 5BD, UK.

OFFER Ends: 31st December 2003

ZooGene, a DNA Sequence Database for Calanoid Copepods and Euphausiids

Ann Bucklin (University of New Hampshire), Bruce W. Frost (University of Washington), and Peter H. Wiebe (Woods Hole Oceanographic Institution). For a complete list of participants, please see http://www.ZooGene.org

ZooGene, an international partnership established in 2000, has created a DNA database for calanoid copepods and euphausiids. ZooGene's goal is to add DNA sequences to the taxonomic characters used for species identification of these groups. ZooGene is one of eight pilot projects of the Ocean Biogeographical Information System (OBIS, see http://www.iobis.org), a component of the Census of Marine Life (see http://www.coml.org), a global initiative sponsored by the Alfred P. Sloan Foundation.

Recent ZooGene efforts have focused on the calanoid copepod genera *Calanus, Clausocalanus, Neocalanus*, and *Pseudocalanus* (see Hill et al., 2001; Bucklin et al., 2003). Current efforts are focused on *Metridia* and *Pleuromamma* (and others of this family), *Acartia*, and *Paracalanus* (and allied genera). Species with widespread or cosmopolitan geographic distributions are of particular interest for ZooGene. Molecular phylogeographic studies using mtCOI sequence variation are currently underway for *Acartia tonsa, Calanoides carinatus, Clausocalanus* spp., *Paracalanus parvus* s.l., and others.

Molecular phylogenetic studies are underway to examine phylogenetic relationships among genera and families of the Calanoidea (Fig. 1).

ZooGene builds upon the taxonomic expertise of the partners; only specimens identified by an expert morphological taxonomist are used for molecular analysis. ZooGene uses existing collections – samples must be preserved and stored in undenatured ethanol – and samples collected from ships of opportunity. Following identification by an expert, specimens are sent to the University of New Hampshire (UNH) for DNA sequencing. Samples of 10 – 20 identified specimens are needed, in order to ensure that reference specimens can be archived at UNH. For each species, a DNA type sequence is determined for a 660 base-pair portion of the mitochondrial cytochrome oxidase I (mtCOI) gene; multiple mtCOI sequences are included as necessary to reflect variation within species. DNA sequences are submitted to the GenBank molecular database (http://www.ncbi.nlm.nih.gov).

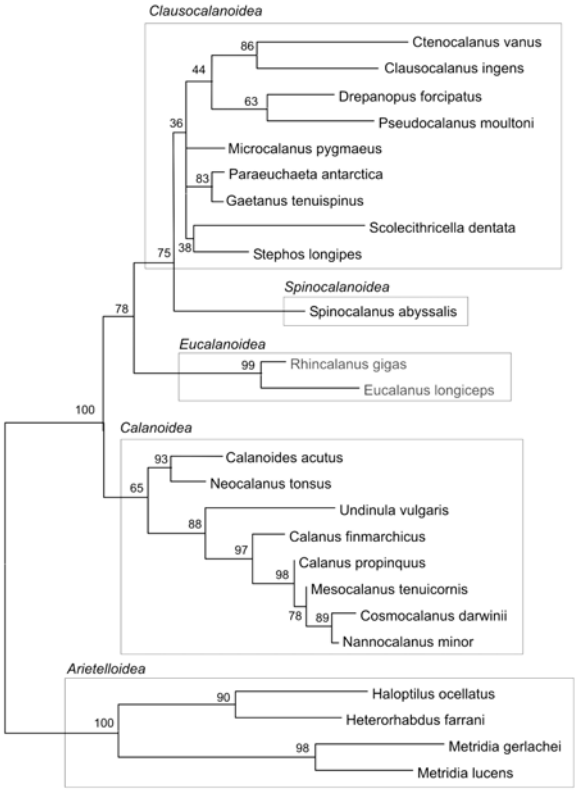

Figure 1. Phylogeny of the Calanoida based on 18S rRNA. With the exception of the Clausocalanoidea, relationships among genera and families are well resolved. Numbers at branch-points are bootstrap values. (A. Bucklin, S. Grabbert, J. Bradford-Grieve, S. Ohtsuka, H.-Y. Soh et al., in preparation.)

MtCOI DNA sequences are used to identify species and reveal incipient or cryptic species. Significant genetic divergence within a putative species requires further analysis by the alpha-taxonomist, who then looks for morphological characters to match the genetic divergence. We anticipate that DNA may reveal genuinely cryptic variation within species, and we are already discussing how ZooGene will interpret such results.

ZooGene welcomes new partners and suggestions for new topics. We seek alcohol-preserved zooplankton samples from nearly every ocean region (please see the sample collection and preservation protocol at http://www.ZooGene.org). We are especially interested in receiving alcohol-preserved specimens that have been identified by an expert taxonomist. These can be sent to UNH for mtCOI sequencing at any time.

References

Bucklin, A., B.W. Frost, J. Bradford Grieve, L.D. Allen & N.J. Copley. 2003. Molecular systematic assessment of thirty-four calanoid copepod species of the Calanidae and Clausocalanidae using DNA sequences of mtCOI and nuclear 18S rRNA. Marine Biology 142:333-343.

Hill, R.S., L.D. Allen & A. Bucklin. 2001. Multiplexed species-specific PCR protocol to discriminate four N. Atlantic *Calanus* species, with a mtCOI gene tree for ten *Calanus* species. Marine Biology 139: 279-287.

— Ann Bucklin
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DIALOG Program for Recent Ph.D.s Fosters Interdisciplinary and International Connections

DIALOG, the Dissertations Initiative for the Advancement of Limnology and Oceanography, is an interdisciplinary, international program to reduce the barriers that reduce the exchange of information across the aquatic sciences (http://aslo.org/phd.html). The program targets recent Ph.D.s, but many resources are on line. The program includes:

Ph.D. DISSERTATION REGISTRY. Abstracts are posted online in a fully searchable format to provide a concise overview of the field and highlight individual accomplishments. All recent graduates are encouraged to register with the program.

Visit http://aslo.org/dialog/dcite.html to view the Dissertation Abstracts.

A convenient on-line registration form is posted at http://aslo.org/forms/phdform.html.

ELECTRONIC COMMUNICATION. The weekly DIALOG News provides a clearinghouse for job announcements and other information of interest to recent Ph.D.s. Graduates are added to the news list as soon as they submit their Ph.D. abstract to the registry.

Send announcements to **dialog@whitman.edu**.

Program reports and other resources are archived on-line for easy access.

SYMPOSIA. DIALOG symposia enable graduates to present their research in an interdisciplinary forum, learn about agency programs, discuss emerging research, education and societal issues, and forge lasting collegial bonds with their peers. Past symposia have been held on a biennial cycle. Participation is limited to 40 recent graduates, with a 6-member review panel selecting from among the applicants.

Application instructions are posted at http://aslo.org/phd.html.

The next symposium, DIALOG VI, will be held October 30 – November 6, 2004, at the Dauphin Island Sea Lab (Dauphin Island, Alabama, U.S.A.; http://www.disl,org). Co-organizers are Susan Weiler, Monty Graham (Dauphin Island Sea Lab), and Maarten Boersma (Alfred-Wegener-Institute for Polar and Sea Research, Helgoland, Germany).

Symposium eligibility: Graduates who completed their Ph.D. between April 1, 2002 and March 31, 2004 and whose work in biological, chemical, geological, or physical science is relevant to freshwater or marine biology/ecology are eligible. Partial travel subsidies are available from the sponsoring agencies (DOE, NASA, NOAA, NSF, and ONR).

Deadline for applications is **May 1, 2004**.

DIALOG is sponsored by the the American Society of Limnology and Oceanography (ASLO) and co-sponsored by the American Fisheries Society (AFS), American Geophysical Union (AGU), Ecological Society of America (ESA), Estuarine Research Federation (ERF), International Society of Limnology (SIL), North American Benthological Society (NABS), North American Lake Management Society (NALMS), Phycological Society of America (PSA), The Oceanography Society (TOS), Society of Canadian Limnologists (SCL) and Western Society of Naturalists (WSN).

DIALOG is supported through grants from the U.S. National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), National Science Foundation (NSF), Office of Naval Research (ONR), and Department of Energy (DOE).

— C. Susan Weiler
Whitman College, Walla Walla,
Washington, U.S.A.

Recent Workshop on Taxonomy

The report on a workshop on crustacean plankton taxonomy, sponsored by the ICES and held at Plymouth, U.K. on 10-13 June 2003 is available: ICES CM 2003/C:14 and http://www.ices.dk/reports/occ/2003/wkzt03.pdf.

The report takes note of initiatives to update and to extend electronic publication of the ICES Identification Leaflets.

— Student Essay —

Our younger colleagues continue to contribute to *MONOCULUS*. We are pleased to present this essay by one of the recipients of the awards for Best Student Presentation at the Keelung Conference.

Impressions of the 8th International Conference on Copepoda, with notes on the mitochondrial genome of copepods as a genetic marker

By Ryuji J. Machida
Ocean Research Institute
University of Tokyo, Japan

First, I would like to express my sincere thanks to the committee of the 8th ICOC members.

The most enjoyable and important outcome from the 8th ICOC was meeting with colleagues from all over the world. Most of them I knew only through the journal articles, but this occasion brought me the great opportunity to meet with them directly. I also enjoyed talking with students from other countries. I was pleased and inspired to know that many students, from all over the world, are enthusiastically studying copepods. Within this family-like atmosphere, I enjoyed discussion with them. I definitely believe that these personal connections will benefit my future professional development.

My Ph.D. course on the theme "Molecular phylogenetic study of copepods" started with extreme difficulty. I could not amplify even a single portion of the targeted gene by PCR during my first year. It was then that I was able to receive excellent advice from Dr. Masaki Miya and Dr. Mutsumi Nishida, who both work on the complete mitochondrial genome of fishes. I started the complete mitochondrial genome analyses from that time and we discovered the eccentricity of the copepod mitochondrial genome, such as unconservative modes of gene order, extremely fast evolutionary rates, and small genome size. These are some of the results, which I have presented at the 8th ICOC (Figure 1).

So far, we have analyzed one complete (*Tigriopus japonicus*; Machida et al., 2002) and two semi-complete (*Eucalanus bungii* and *Neocalanus cristatus*; Machida et al., submitted) mitochondrial genomes for copepods. After the conference, we designed new copepod-specific versatile primers for the COI gene based on the sequences obtained above. These primer pairs, as well as the previously designed primer pairs for the srRNA gene, were applied to 20 species representing 4 orders of copepods and could amplify at least one species from each order (Machida et al., submitted). However, this is still not a perfect solution for copepod mitochondrial genomic analyses. Difficulties remain with the PCR amplification of certain groups of copepods and often many haplotypes (there usually should be one) have been obtained from a single individual. Therefore, more work needs to be done with the mitochondrial genome of copepods to make it more useful as a genetic marker.

We are currently working on the phylogenetic relationships of the genus *Neocalanus*. *Neocalanus* are pelagic calanoid copepods comprising six species plus one form (Tsuda et al., 1999; Kobari et al., 2001), distributed from tropical to subarctic and subantarctic waters. Some species of the genus (*N. tonsus, N. cristatus, N. flemingeri,* and *N. plumchrus*) perform extensive ontogenetic vertical migration. We have determined about 4,000 base pairs of the mitochondrial DNA sequences encoding three protein-coding and two ribosomal RNA genes (COI, ND4L, ND6, srRNA, and lrRNA) and the rearrangement of a protein-coding gene (ND6) was observed within the genus. The complete COI gene (1,462 base pairs) sequences were subjected to phylogenetic analyses, and the resultant tree had a well-resolved topology. We plan to reconstruct their evolutionary history by comparing their phylogenetic relationships and biogeography, and will discuss how they may have reached their present distributions (Machida et al., in preparation).

Finally, I feel highly honored to receive the Award for Excellence in Student Presentation. I definitely believe this award will help my future career and would like to encourage younger students to participate in the 9th ICOC in Tunisia, 2005.

Acknowledgments

I sincerely appreciate Dr. Shuhei Nishida for supervising during the course of my Ph.D. Special thanks are due to Dr. Masaki U. Miya, and Mutsumi Nishida for their guidance on molecular genetic theories and techniques. I would also like to thank Ms. Erica Goetze, Dr. Kazuyoshi Hashizume, and Dr. Jun Nishikawa who kindly provided specimens. I also wish to thank Mr. Sean Toczko for reading this manuscript. These studies were supported by a Grant-in-Aid for Creative Basic Research No.12NP0201 from the Ministry of Education, Sports, Culture, Science, and Technology of Japan.

References

Kobari, T. & T. Ikeda. 2001. Life cycle of *Neocalanus flemingeri* (Crustacea: Copepoda) in the Oyashio region, western subarctic Pacific, with notes on its regional variations. Marine Ecology Progress Series 209:243-255.

Machida, R.J., U.M. Miya, M. Nishida & S. Nishida, S. 2002. Complete mitochondrial DNA sequence of *Tigriopus japonicus* (Crustacea: Copepoda). Marine Biotechnology 4:406-417.

Machida, R.J., U.M. Miya, M. Nishida & S. Nishida (submitted). Large-scale gene rearrangements in the mitochondrial genomes of two calanoid copepods *Eucalanus bungii* and *Neocalanus cristatus* (Crustacea),

with notes on new versatile primers for the *srRNA* and *COI* genes.

Tsuda, A., H. Saito & H. Kasai. 1999. Life histories of *Neocalanus flemingeri* and *Neocalanus plumchrus* (Calanoida: Copepoda) in the western subarctic Pacific. Marine Biology 135:533-544.

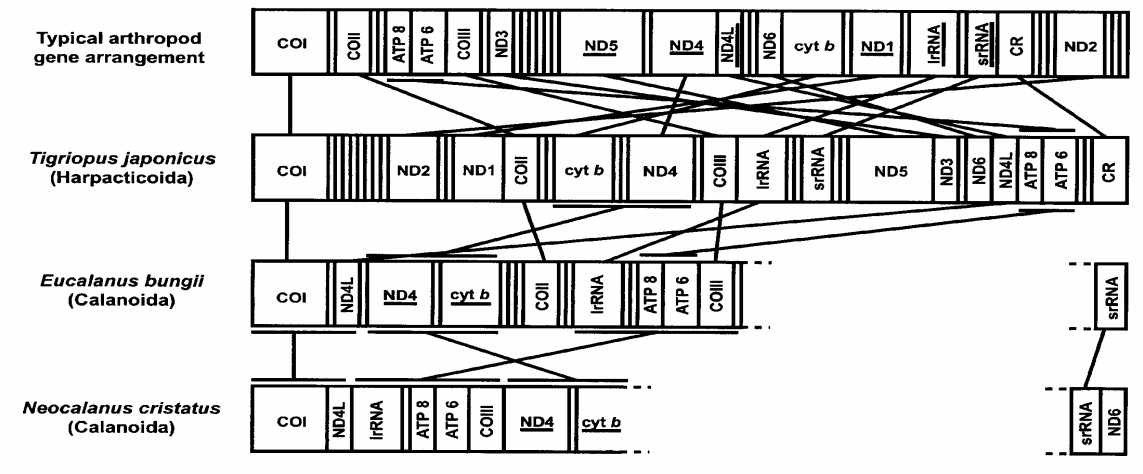

Figure 1. Gene organization of a typical arthropod, *Tigriopus japonicus, Eucalanus bungii,* and *Neocalanus cristatus* mitochondrial genomes. All protein and rRNA genes are transcribed from left to right except those that are underlined. tRNA genes were not indicated to avoid confusion. ND1–6/4L indicates NADH dehydrogenase subunits 1–6/4L; COI–III, cytochrome *c* oxidase subunit I–III; cyt *b*, cytochrome *b*; ATPase 6 and 8, ATPase subunits 6 and 8. Homologous protein-coding and rRNA genes are connected by lines.

— New Books and Websites —

Tabular Harpacticoid Keys Online

Professor J. B. J. Wells' Tabular Keys to the marine harpacticoid copepods (1976 and updates) are now online. The keys were prepared by Ms. Lesya Garlitska of the Odessa Branch of the Institute for Biology of the Southern Seas. Odessa, Ukraine when she was a visiting scientist at the University of South Carolina, U.S.A. 2001-2002. The online keys are NOT modified beyond the latest Wells published update (1985) and therefore do not include species described or taxonomic changes made since that date.

The keys are hosted on the University of South Carolina Meiofauna Laboratory website and can be accessed two ways:

1) go to http://www.biol.sc.edu/~coull_lab and follow the link via Related WWW Sites and click on "Tabular Keys to marine harpacticoid copepods" or
2) go directly to http://www.biol.sc.edu/~coull_lab/Wells/. The "W" in Wells must be typed in upper case.

Comments on the keys should be directed to Professor Wells (wellsjm@xtra.co.nz) or Ms. Garlitska(garlitska@farlep.net)

— Bruce C. Coull
University of South Carolina, Columbia, South Carolina, U.S.A.

Key to calanoid copepod families By Janet Bradford-Grieve

Crustacea.net: An Information Retrieval System for Crustaceans of the World
http://crustacea.net/crustace/calanoida/index.htm
Cite this publication as: Bradford-Grieve, J. M. (2002 onwards). Calanoida: families. Version 1: 2 October 2002.

Researchers in all fields of biological sciences: zoology, ecology, as well as in genetics and molecular biology need correct taxonomic expertise. Often taxonomic identification is a very time-consuming job. However, usually the task becomes much easier if you are lucky to attribute the studied organism to the family level. Then you feel as a traveller with a compass and understand what direction to choose to find the right way. Certainly it is necessary to know how to use this compass, but if you follow Janet Bradford-Grieve and enter the Internet address:

http://crustacea.net/crustace/calanoida/index.htm you can more successfully navigate in the world of Calanoida.

The first Interactive Key (Intkey) for the identification of the families of marine Calanoida, by Janet Bradford-Grieve, is a timely response to the gaps in the identification requests. It provides an illustrated interactive key to families of world calanoids, with a comprehensive characterization of their morphology, a glossary of morphological terminology supplied with illustrations of taxonomic characters used in identification, and, finally, general data on calanoid ecology, biology and distribution (Introduction, Identification). With a click on a family name in the section "Monographs and Interactive Keys" the user will be provided with a detailed family description, and information about the family's mode of life, bathymetry and generic composition. In remarks to the latter paragraph the author relocates some earlier tentatively placed genera to the family where they key, or underlines their ambiguous taxonomic position.

The key covers all 43 described calanoid families (Checklist) world-wide, which is extremely valuable as the few existing keys to calanoid families are usually restricted to some area or region. With this key one can identify marine calanoids from all their possible habitats: from different depths of the water column, seafloor, anchialine caves, and estuarine, coastal or oceanic waters.

There are still many unsolved questions in calanoid taxonomy, and some families need re-diagnosis. A number of genera have unclear taxonomic status, and as the author mentions "key out to families other than those some workers consider they belong to". These cases are mentioned in the section "Limitations of this key" (Introduction) and in the section "Generic composition" in the family description (Monographs and Interactive Keys).

The key contains invaluable comprehensive taxonomic materials and at the same time is easy and even exciting to use (click "Identification"). It will be widely used, not only by copepodologists and zooplanktonologists, but by the wide range of marine biologists including beginners.

—Elena L. Markhaseva
Zoological Institute
Russian Academy of Sciences
St. Petersburg, Russia

Guides to the Freshwater Invertebrates of Southern Africa

A series of guides to several groups of Southern African freshwater invertebrates is available from the South African Water Research Commission. Nancy Rayner is the author of the chapter on Copepoda in Volume 3. For additional information, contact:

Rina Winter
Water Research Commission
Private Bag X03
Gezina
0031 South Africa
E-mail: orders@wrc.org.za

Day, J.A., B.A.Stewart, I.J. de Moor & A.E. Louw (eds.). 1999. Guides to the Freshwater Invertebrates of Southern Africa. Volume 2: Crustacea 1: Notostraca, Anostraca, Conchostraca and Cladocera. Water Research Commission, Pretoria, Report No. TT 121/00. 126 pp. ISBN 1 86845 581 5.

Day, J.A., I.J. de Moor, B.A. Stewart & A.E. Louw (eds.). 2001. Guides to the Freshwater Invertebrates of Southern Africa. Volume 3: Crustacea 2. Ostracoda, Copepoda and Branchiura. Water Research Commission, Pretoria, Report No. TT 148/01. 177 pp. ISBN 1 86845 703 6.

Day, J.A., B.A. Stewart, I.J. de Moor & A.E. Louw (eds.). 2001. Guides to the Freshwater Invertebrates of Southern Africa. Volume 4: Crustacea 3: Bathynellacea, Amphipoda, Isopoda, Spelaeogriphacea, Tanaidacea and Decapoda. Water Research Commission, Pretoria, Report No. TT 141/01. 141 pp. ISBN 1 86845 676 5.

Day, J.A. & I.J. de Moor (eds.). 2002. Guides to the Freshwater Invertebrates of Southern Africa. Volume 5: Non-Arthropods. Water Research Commission, Pretoria, Report No. TT 167/02. 293 pp. ISBN 1 86845 827 X.

Day, J.A. & I.J. de Moor (eds.). 2002. Guides to the Freshwater Invertebrates of Southern Africa. Volume 6: Arachnida and Mollusca: Araneae, Water Mites & Mollusca. Water Research Commission, Pretoria, Report No. TT 182/02. 141 pp. ISBN 1 86845 875 X.

de Moor, I.J., J.A. Day & F.C. de Moor (eds.). 2003. Guides to the Freshwater Invertebrates of Southern Africa. Volume 7: Insecta I: Ephemeroptera, Odonata & Plecoptera. Water Research Commission Report No. TT 207/03. 288 pp.

Day, J.A., A.D. Harrison & I.J. De Moor (eds.). 2002. Guides to the Freshwater Invertebrates of Southern Africa. Volume 9: Diptera. Water Research Commission Report No. TT 201/02. ISBN: 1 86845 900 4.

— Free Online Search Services —

The struggle to keep up with the ever-expanding scientific literature never ends. Happily, several online search services now exist and are rapidly extending and deepening their reference bases. All those listed below are

"free" in the sense that a non-subscriber can search their databases and in most cases read abstracts of articles. Many of the listed journals now make available the entire text of articles.

General orientation:
BioMedNet (Elsevier; includes Medline) http://journals.bmn.com/
BioOne http://www.bioone.org
HighWire (includes Medline) http://highwire.stanford.edu
Ingenta http://www.ingenta.com
Scirus (includes Elsevier) http://www.scirus.com

Regional or special-interest:
CASPINFO (Caspian Sea; several searchable databases including a bibliography) http://www.caspinfo.net
Ejournal (Mexican journals) http://www.ejournal.unam.mx
INASP (African journals) http://www.inasp.org.uk/ajol/index.html
Integrated Marine Information System, Flanders Marine Institute, Belgium (marine topics) http://www.vliz.be/vmdcdata/Imis/bibsrch.htm
MBWEB (marine biology resources for students; includes several reference databases) http://life.bio.sunysb.edu/marinebio/mbweb.html
NRC Research Press (Canadian journals) http://pubs.nrc-cnrc.gc.ca/cgi-bin/rp/rp2_jour_e
NatureBase (Western Australia) http://science.calm.wa.gov.au/papers/search.php
PubMed (Medical topics) http://www.pubmedcentral.nih.gov
Sea Grant Nonindigenous Species Site (SGNIS; aquatic species introduced into the U.S.A.) http://www.sgnis.org
SciELO (Collections of journals from Brazil, Chile, Cuba, Spain, and on Public Health) http://www.scielo.org
U.S. Department of Energy "Information Bridge" (mostly North America) http://www.osti.gov/bridge/index.jsp
U.S. Geological Survey (mostly North America) http://search.usgs.gov/
U.S. National Technical Information Service (mostly North America) http://www.ntis.gov/search/index.asp?loc=3-0-0

Commercial publishers:
Allen Press http://apt.allenpress.com
Blackwell Synergy http://www.blackwell-synergy.com
Cambridge University Press http://titles.cambridge.org
Inter-Research http://www.int-res.com/index.html
Kluwer Online http://www.kluweronline.com/
Nature Publishing Group http://www.nature.com/dynasearch/app/dynasearch.taf?site_source=nature
Pfeil-Verlag http://www.pfeil-verlag.de/01such/esuch.php
Springer Link http://www.springerlink.com/app/home
Urban & Fischer http://www.urbanfischer.de/journals
Wiley Interscience http://www3.interscience.wiley.com/search/allsearch

Societies providing search engines:
American Society of Limnology and Oceanography http://aslo.org/index.html
Ecological Society of America http://www.pfeil-verlag.de/01such/esuch.php

These links have been posted on the WAC website. If you know of other useful – and free – search services, please inform me so that we can add this information.

— Jan Reid

— News from WAC Member —

Dr. Judith Williams
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Long Beach, MS 39560 U.S.A.
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My main interest involves all aspects of diapause (programmed dormancy) in free-living copepods; in the ecology and distribution of dormant copepods and in particular, physiological mechanisms controlling induction, termination and survival during diapause. Copepods are known as the "insects of the sea" and are the most numerically dominant organism on earth. I am also interested in meiofauna ecology; as well as the distribution of and study of dormancy in the meiobenthic harpacticoid copepod, *Heteropsyllus nunni*, which undergoes dormancy in a self-made cyst in coastal marine waters.

Current research:
1. Investigation of Pheromone Biosynthesis Activating Hormone (PBAN) from *Helicoverpa zea* (Insecta) and its potential cross-reactivity with the brain ganglia of *Diaptomus stagnalis* (Copepoda) and *Heteropsyllus nunni* (Copepoda); an immunohistochemical study.
2. Fatty acid profiles and lipid classes of the freshwater copepods *Aglaodiaptomus stagnalis* and *Aglaodiaptomus clavipoides*. In collaboration with Dr. Patricia Biesiot, University of Southern Mississippi Hattiesburg.
3. Lipid class and fatty acid profiles of the copepod *Eurytemora affinis* – comparing wild populations to lab reared populations. In collaboration with Dr. Carol Lee, Univ. Wisconsin- Madison and Dr. Biesiot, USM Hattiesburg.
4. The physiology of the cyst and cyst production in the harpacticoid copepod, *Heteropsyllus nunni* during diapause. In collaboration with Dr. Patricia Biesiot, USM Hattiesburg

Recent Publication:
Williams, J. L. & P. M. Biesiot. 2003. Lipids and fatty acids of the benthic marine harpacticoid copepod, *Heteropsyllus nunni* Coull during diapause: a contrast to pelagic copepods. Accepted, Marine Biology, July 2003.
Graduate Student Research:
Jim Hessel – M.S. student; invertebrates of the *Sargassum* mats in the Gulf of Mexico
Undergraduate Research:
Scott Melton – immunohistochemical analysis of brain/ neural network in copepods during diapause
Matthew Dykes – population distribution of *Heteropsyllus nunni* along the Mississippi Gulf coast

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Membership in the WAC: Any person interested in any aspect of the study of Copepoda is eligible for membership in the WAC. Applicants for membership must be nominated by two active members of the Association. Those interested in becoming a member of the WAC may write to the General Secretary for an application form and other information.
Dues: Dues of US $20.00 per annum are payable by Founder, Active, and Candidate members. Members who have difficulty paying dues may apply to the President and the Executive Council for a waiver or reduction. Dues may be paid in advance. WAC accepts personal checks issued in local currencies, made payable to WAC. Checks should be sent by mail to the Treasurer of WAC. Dues may also be paid in person at WAC conferences. Members who are more than two years in arrears will automatically have their membership terminated.
Newsletter: All members receive the newsletter *MONOCULUS*, which appears at least once a year, in electronic or printed versions.
Copepod Libraries: Monoculus-Library: C/o Prof. Kurt Schminke, Fachbereich 7, Universität Oldenburg, D-26111 Oldenburg, Germany.
C. B. Wilson Library: C/o T. Chad Walter, Smithsonian Institution, PO Box 37012, NMNH, MRC-163, Washington DC 20013-7012, U.S.A.

New Census and Questionnaire

Dear members of WAC,

The list of addresses of our members is partly outdated and full of mistakes. So it is time for a new census. This census we want to combine with an update of our "Survey of Copepodologists of the World". The last one was published in 1990. Here is a questionnaire and I would be very grateful if you took a quarter of an hour of your time to fill it in. If you want the WAC to represent you effectively it has to be clear how many members stand behind it and what they do. A free copy of the "Survey" is guaranteed to everyone who returns the completed questionnaire to me.

When filling in the questionnaire please make sure:

– that you begin with that part of your surname which in lists of cited literature appears first. We tend to have difficulties with names from China, Spain, South America and partly also from India.

– that the information on the taxonomic group you are working with is as specific as possible. If you study the biology of one species, just give the name of that species and not that of a higher category. Your work is not less important when you study just one or a few copepods instead of all. Please use an extra sheet if there is not enough space to account for your particular situation.

– that the information pertaining to geographic and ecological area is also as specific as possible.

As a general rule try to avoid vague statements and unless strictly appropriate refrain from using broad generalizations like "worldwide", "marine", "Harpacticoida" (when only two families are studied), etc. Be as precise as possible.

Thank you for your help.

— Kurt Schminke, President

SURVEY OF COPEPODOLOGISTS 2003

Please complete **(type or print)** and return to:
Dr. H. K. Schminke, Fachbereich 7, Universität Oldenburg, Postfach 2503, D-26111 Oldenburg, Germany.

_____

1. Name and title: surname first (i.e. the one to appear first in reference lists of literature)

_____

2. Position (e.g. senior research officer, student, curator etc.) **3.** Date of birth (day/month/year

_____

4. Institution and address (with postal code and in the sequence customary in your country)

_____

_____

_____

_____

(_____) - _____
5. Telephone

(_____) - _____
6. Fax

_____
7. email

Do you publish on copepods? No ( ), yes: regularly ( )
irregularly ( )

If no: I am retired ( ); I have other main fields of interest ( ).
If the last, specify your field of research _____

_____

Brief titles of your current projects in copepod research:

1. _____

2. _____

3. _____

4. _____

Fields of interest (please check ( ) your major and minor fields and indicate, if applicable, the taxonomic group (at any level) dealt with (e.g. Copepoda, Calanoida, Cyclopidae, *Tigriopus*, *Tisbe furcata* etc.), the geographic area (e.g. Pacific, North Sea, Brazil, Antarctic etc.), and the ecological areas (e.g. lakes, interstitial, phytal, deep-sea benthos etc.).

Discipline	Major	Minor	Taxonomic groups	Geogr. area	Ecological area
Systematics	( )	( )	_____	_____	_____
(order, family, genus or	( )	( )	_____	_____	_____
species, as specific as	( )	( )	_____	_____	_____
possible)	( )	( )	_____	_____	_____
Zoogeography	( )	( )	_____	_____	_____
	( )	( )	_____	_____	_____
Morphology	( )	( )	_____	_____	_____
_____			_____	_____	_____
organ system (specify)					
			_____	_____	_____
Ecology	( )	( )	_____	_____	_____
_____			_____	_____	_____
subdiscipline (e.g. aut-					
_____			_____	_____	_____
ecology, life history					
Physiology	( )	( )	_____	_____	_____
_____			_____	_____	_____
subdiscipline (hormone,					
_____			_____	_____	_____
receptor physiology etc.)					
			_____	_____	_____
Behaviour	( )	( )	_____	_____	_____
Biochemistry	( )	( )	_____	_____	_____
Genetics	( )	( )	_____	_____	_____
			_____	_____	_____
Embryology	( )	( )	_____	_____	_____
Larval	( )	( )	_____	_____	_____
development			_____	_____	_____
Evolution	( )	( )	_____	_____	_____
Parasitology	( )	( )	_____	_____	_____
Planktology	( )	( )	_____	_____	_____
Aquaculture	( )	( )	_____	_____	_____
Others (specify)			_____	_____	_____
	( )	( )	_____	_____	_____
	( )	( )	_____	_____	_____