MONOCULUS *Copepod Newsletter*

The Newsletter of the World Association of Copepodologists

Number 45 June 2003

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Message from the President

Dear copepodologists,

My letter to Dennis came back. I remember him from earlier conferences. Once he gave a talk dressed in a white t-shirt with the outlines of Australia on his chest. When he wanted to show where his study had been done he pointed somewhere on the map on his chest and provoked the question from the audience: "Could you, please, focus it a bit?" Dennis seems to have lost contact with WAC, as have many others as well.

I have posted more than 750 letters to inform members about what is new with WAC (*MONOCULUS* on-line, Copepoda List), to remind them of what has not changed (dues, our two libraries), and to add a questionnaire in the hope of getting a chance of updating our "Survey of Copepodologists of the World" published in 1990. What came back first, of course, were all those letters which because of our partly outdated lists of addresses had not reached their addressees, like my letter to Dennis Tafe. I also received emails from people saying that the letter had been passed on to them and that they have to inform me that the addressee had passed away years ago. Other emails were more encouraging, saying that this was the first sign of WAC for a long time and that the writer wanted to know when he had last paid his dues or how he could renew his membership. Meanwhile also the first completed questionnaires trickle in and I received the first four consignments with reprints for the MONOCULUS Library.

Renewal of contact, that is what as President I regard as my first and most urgent task. *Renewal of contact* is of concern for us all, not only for those who have stayed away for some time. *Renewal of contact* means helping to find the new addresses of those who could not be approached so far (see list on page 2). *Renewal of contact* means completing the questionnaire also added to this issue (download, fill in, send to me). *Renewal of contact* means paying dues. *Renewal of contact* means putting our two central reprint libraries, the WILSON Library and the MONOCULUS Library, on your mailing list for automatic mailing.

If this is seriously taken to heart by everyone, the foundations will be laid for more ambitious goals. I count on your help.

— Kurt Schminke, President of the World Association of Copepodologists
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.*

Several colleagues have told me how heavily they rely on the list of new literature provided in each newsletter. This list does not somehow magically appear, fully developed. The basic source is commercial search services, from which Chad Walter regularly downloads lists and integrates the information. Chad then sends the list to me, and I add references from other sources including reprints sent to me, the Web, etc. Kurt Schminke's people then add more titles from works donated to the Monoculus-Library.

This process takes time. An article may not be listed in *MONOCULUS* until more than a year after its publication! Moreover, the search services miss many articles, especially in journals that are not indexed. You can help to reduce the delay and make the list as complete as possible by sending me information about your new publications as they appear. This information will then be transmitted to both copepod libraries. Also, if you find an error in publication information provided in *MONOCULUS*, let me know and I will correct it in the next number of the newsletter.

The list in this *MONOCULUS* includes many, very recently published works that were located on the Web. Therefore the list includes about double the usual number of references, and accounts for much of the unusual length of this newsletter. Lists in future newsletters will be shorter but probably more current.

MONOCULUS No. 45 included H.B.N. Hynes' excellent review of the book *Sri Lanka: Freshwater Fauna and Fisheries*, by C.H. Fernando and S.R. Weerewardhena. Prof. Hynes' review was originally intended for publication and appeared in Volume 38 (January 2003) of *SILnews*, the newsletter of the International Association of Theoretical and Applied Limnology.

For their contributions and assistance for this number, I am grateful to Deo Baribwegure, Geoff Boxshall, Jeffery Cordell, Hans-Uwe Dahms, David Damkaer, John A. Fornshell, Nico Grobler, Tatiana A. Heptner, Ju-shey Ho, Slava Ivanenko, Oleh Ivanets, Carol Eunmi Lee, Waldemar G. Piasecki, Mark Pottek, Manuela D. Samargiu, Kurt Schminke, Eduardo Suárez-Morales, Shin-ichi Uye, Chad Walter, and the late Kir N. Nesis. I thank Clara A. Fabbro and Ian A. E. Bayly for their permission to reproduce Ian's review, originally published in volume 38 of *SILnews*, of the new book on Calaniformes by Bernard Dussart and Danielle Defaye.

— Jan Reid

Martinsville, U.S.A.

Renewal of Contact

We still need to renew contact with several WAC members. Will anyone who knows the present addresses of these colleagues please contact Kurt:

Lynn. D. Barker (USA), Stephen Cohen (USA), Michael Dadswell (Canada), Sabine Diel-Christiansen (Germany), Alain Dinet (France), Mark Freeberg (USA), Miriam Frugis (USA), Moira Galbraith (Canada), Diane J. Gifford (USA), Edward Grainger (Canada), Edmund Green (USA), Kent Gustavson (Canada), Goran Gyllenberg (Finland), Hiroshi Itoh (Japan), Charles Jacobi (Australia), Andrea LeBlanc (Canada), Mai D.G. Lopez (USA), David Marcogliese (Canada), Brian Marcotte (USA), A. B. McCrary (USA), Takeshi Mizushima (Japan), Ashmead Mohammed (Canada), Byron Morris (USA), S.B. Moskowitz (USA), Shin-ichiro Oka (Japan), M. Pichon (Australia), Ernest Ruber (USA), Jeffrey Runge (Canada), Nabuchiro Saito (Japan), Kevin Sellner (USA), David M. Standiford (USA), Karl Steib (Germany), Dennis Tafe (Australia), Toshiya Takegami (Japan), David Tranter (Australia), Siebrecht Van der Spoel (The Netherlands), Guy Anthony West (Australia), Joseph Wroblewski (Canada).

Financial Statement for the World Association of Copepodologists for 2002

Beginning balance on January 1, 2002	$22,022.13
Membership dues paid	$5,632.66
Membership dues paid*	NT$42,600.00
Payment to 8th LOC for student awards*	NT$42,600.00
Payments for 7th ICOC Conference Volume	$176.28
Interest Earned	$413.02
Postage for mailing 7th ICOC Conference Volume	$2.86
Balance on December 31, 2002	$28,241.23

* Paid in New Taiwan Dollars.

All members of the WAC are encouraged to pay their dues by mailing them to the address given below. Dues for the WAC are $20.00 US Dollars/year. Dues should be paid in US Dollars (USD) if possible. In the event that this creates a hardship for any member, then dues may be mailed to the treasurer in local currency equivalent to the amount being paid in USD. Because the collection of such foreign currency checks will incur a fee of USD$5.00 against the WAC bank account, it is requested that such payments be made for a minimum of three years' dues.

— John A. Fornshell

Treasurer, WAC
PAUL VI High School
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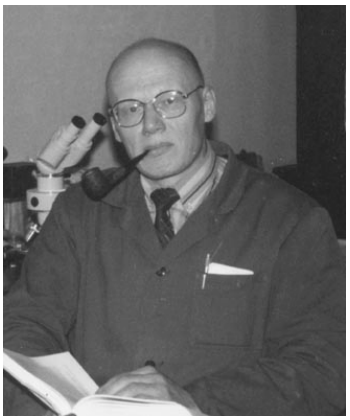

MIKHAIL V. HEPTNER

16 November 1940 – 20 July 2002

Mikhail Vladimirovich Heptner, marine biologist, zoologist and planktologist, was born in Moscow in a German-Russian family cherishing traditions of Russian culture. His father was the well-known biologist Vladimir Georgievich Heptner (1901–1975), professor at Moscow State University and founder of the monographic series "Mammals of the Soviet Union" (later "Mammals of Russia and Adjacent Regions"). His mother Nina, whose maiden name was Rudneva (1905–1992), a well-educated woman, was the secretary of her professor husband. Under the influence of his father, to whom Mikhail devoted magnificent biographical sketches (Heptner, 1994, 2001), Mikhail developed as a biologist-naturalist, a field researcher, who was deeply interested in all manifestations of living nature. More than once he brought back shellfish, spiders, giant tropical insects, etc. from expeditions and cruises. Many of these creatures then lived at his home for long periods.

In 1957, after graduating from high school in Moscow, Mikhail entered Moscow State University where he specialized in invertebrate zoology. During his student years he began research work at the White Sea Biological Station of Moscow State University and, like many biologists, was fascinated by the White Sea. There Mikhail carried out his fourth-year independent project on the biology of *Caprella septentrionalis* (Amphipoda). One year later he published his first scientific paper (Heptner, 1963a). In the same year he defended his Diploma (equivalent to the M. Sc. degree), already dealing with species composition and distribution of copepods in the Kurile-Kamchatka Trench (1963b). The student Mikhail participated in his first marine cruise (the third cruise of the research vessel "Bataisk", in August – September 1961). The Bataisk left Murmansk, sailed to Arkhangelsk and from there to Iceland, carried out studies of the seamounts, and returned to Kaliningrad. During this first marine training cruise Mikhail fell in love with the Ocean. He kept up lifelong friendships with many members of the crew of the Bataisk.

After graduating from Moscow State University in 1963, Mikhail became a postgraduate student at the P.P. Shirshov Institute of Oceanology (Academy of Sciences of the USSR). Two years later he obtained the position of scientist in the plankton laboratory, and continued preparing his dissertation (equivalent to the Ph.D.). His initial projects in the institution, where he was to work until 1981, were related to the taxonomy of oceanic copepods and bioluminescence (Heptner, 1965, 1968a, 1969).

In the summer of 1966 Mikhail took part in the cruise of the legendary research vessel "Vityaz" (in English, "Knight") to the Kurile-Kamchatka Trench (39th cruise, headed by Lev A. Zenkevich). This was one of the most outstanding and fruitful biological cruises of the Vityaz. Complex and abundant material dealing with all chains of organic transformation was collected. Mikhail collected a unique series of level-by-level samples (at depths to more than 9000 m!), which formed the basis of his dissertation (Heptner, 1973) and several publications (Heptner, 1968b, 1971, 1986a, 1987; etc.).

In April – July of 1969, Mikhail participated in the next biological cruise of the Vityaz, to the northeastern Pacific near the Aleutian Islands and Alaska (45th cruise, headed by Z.A. Filatova), where Mikhail was a group leader and where new and unique material of deep-sea plankton was collected.

Two cruises (50^{th} and 57^{th}) of the Vityaz to the tropical Pacific Ocean as well as Australian and Asian waters then followed (April – July of 1971, headed by M.E. Vinogradov; and February – May of 1975, under cruise chief N.V. Parin). During these cruises Mikhail proved to be a skilled deck worker and a magnificent expert in the sampling of deep-sea plankton (Heptner, 1986b). He actively took part in creating and testing of new equipment, and advised designers in constructing new and improving old models. His wonderfully adapted dissecting needles, chambers and other improvements reflect his unique personality (Heptner, Mikhailov, 1989; Heptner, 2000; etc.).

During the 57th cruise of the Vityaz, Mikhail and his colleagues applied "Murena", a new electronic closing apparatus fitted with a depth gauge, allowing a net to be closed at any depth and the distance traversed by the net to be precisely determined (Flint et al., 1978; 1983). Later, on the 17th cruise of the new Vityaz, Mikhail and his colleagues applied the new dredge device "Sound–Geo" equipped with two plankton nets used to measure the biomass of near-bottom seston on seamounts. It was found that a significant part of the seston is consumed by benthic and epibenthic predators (Rudyakov et al., 1990).

Once, while sampling material in the Banda Sea, Mikhail slightly "released" the rope of a planktonic net, and the net reached bottom at a depth of 7340 m. Although full of mud, the net was safely brought to the surface, and undamaged specimens of an extremely fragile sea urchin were found. This sea urchin, the deepest known, was subsequently described as a new species, *Pourtalesia heptneri* Mironov, 1978.

In 1973, between the 50th and 57th cruises, Mikhail completed his dissertation on the taxonomy and regularities of vertical distribution of calanoid copepods (Euchaetidae, Lucicutiidae, and Heterorhabdidae) from the northwest Pacific. In the dissertation, 10 genera and 73 species of copepods were investigated, and 2 genera and more than 20 species were recognized as new. It was shown that the greatest diversity of these families occurs at depths ranging from 3000 to 4000 m. The system of families was reconsidered on the basis of new features. In particular, Mikhail investigated the structure of the genital field, which is important for the taxonomy of euchaetids. The taxonomic descriptions were illustrated by detailed figures. This brilliant work was appreciated by critics and many experts.

The unique deep-sea materials collected by Mikhail allowed him to discover the specific vertical distribution of deep-sea planktonic animals known as "Heptner's Carrot". He explored and specified different habitat zones of deep-sea copepods (Heptner, 1973, 1981). Later he developed a typological theory of vertical distribution of planktonic animals, and revealed the linkage between the pattern of vertical distribution of some taxa and the general picture of distribution of zooplankton in the World Ocean (Heptner, 1996).

During tropical expeditions, Mikhail became interested in the biology of coral atolls and their lagoons. He collected a series of plankton samples in a lagoon and surrounding areas close to New Guinea, and additional material near the West Caroline Islands. The material confirmed his hypothesis interpreting atolls as very isolated ecological systems (Heptner, 1977, 1979).

In 1981 Mikhail moved from the Shirshov Institute to the Zoological Museum of Moscow State University, assuming a new position as senior scientist. He administered the Section of Invertebrates until 1996. Like his father, he worked in the Zoological Museum until his last days.

His last long cruise was during the 17th cruise on a new vessel, also named "Vityaz", to the southwestern Indian Ocean (October 1988 – February 1989, headed by N.V. Parin). In this expedition numerous dead copepods captured in the plankton attracted the attention of Mikhail and his colleagues. It was assumed that dead copepods are not a casual phenomenon, and moreover are important for the biology of the ocean, as they are eaten by specialized animals. Vertical changes in the density of dead copepods allowed estimations of the activity of their consumers at different depths (Heptner et al., 1990).

In the 1990s, Mikhail became interested in the taxonomy, functional morphology and biology of deep-sea hydrothermal-vent copepods, partly continuing his old interest in symbiotic copepods (Heptner 1968a). A review of copepods living in one of the most intriguing habitats in the Ocean has been prepared (Heptner & Ivanenko, 2002a,b). His interest in the deep-sea hydrothermal vents led him to create a new museum exposition "Life in Deep-Sea Hydrothermal Vents of the World Ocean" where biological and geological exhibits are combined with schemes, maps, and video.

Mikhail was one of the founders and a member of the Editorial Board of the journal "Arthropoda Selecta" from its first year (1992). Since 1991 he was a member of the Editorial Board of the "Bulletin of Moscow Society of Naturalists, Biological Series" [= MOIP, Biological Series]. The Editorial Board of the Zoologicheskii Zhurnal remembers with keen appreciation Michael's comments on manuscripts on the taxonomy and ecology of crustaceans. All his reviews were very diligent, critical, and benevolent at the same time.

Two dissertations, on myriapods by A.A. Shileiko and on copepods by V.N. Ivanenko, were prepared under Mikhail's supervision. Mikhail always had time to devote to his students. There was no detail in manuscripts in which he was not interested. Long conversations and discussions of any scientific and related topics were very helpful for the beginners.

In the last year of his life, Mikhail was invited by the Department of Invertebrate Zoology of Moscow State University to prepare a new course on "Museum Affairs". Not limiting himself to lecturing, he enthusiastically acquainted his students with the "kitchen" of natural history museums.

Mikhail was a thorough person with fundamental character. The most characteristic features of his publications are their validity and carefulness; the second feature is the variety of ideas and approaches. For this reason all the publications of Mikhail are memorable. Studying different aspects of copepod species, mostly from the deep sea, Mikhail described the new siphonostomatoid family Megapontiidae, the new genera *Microdisseta* and *Neorhabdus* (Heterorhabdidae), 24 new species of calanoids (Euchaetidae, Heterorhabdidae, and Lucicutiidae) and one new species of siphonostomatoid copepod.

Mikhail was a physically strong, powerful man, who appeared much younger than his actual, not yet advanced age, and gave the impression of an unbreakable man. He had many plans and projects … Serious illness stole upon him invisibly. Mikhail passed away after a few days in hospital, where he admitted himself. Mikhail was a member of the Orthodox Church, a parishioner of the University's House Temple of Holy Tatiana − the heavenly patroness of all "teaching and studying". In this Temple, located a few steps from the Zoological Museum, the burial service was held. His

wife, son, relatives, friends, and colleagues fondly remember Mikhail.

— Kir N. Nesis (deceased), Tatiana A. Heptner, and Slava Ivanenko
Moscow, Russia

Selected publications of Mikhail V. Heptner

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Heptner M.V. 1963a. Reproductive biology and life-cycle of *Caprella septentrionalis* Kroyer (Amphipoda, Caprellidea) in the White Sea. Zoologicheskii Zhurnal, 1963, 42(11): 1619-1630. [in Russian]

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Heptner M.V. 1973. Analiz taksonomii i zakonomernostei vertikal'nogo rapredeleniya veslonogih rakoobraznyh (Copepoda, Calanoida) na primere semeistv Euchaetidae, Lucicutiidae i Heterorhabdidae v severo-zapadnoi chasti Tihogo okeana. [Analysis of taxonomy and regularities of vertical distribution on example of the families Euchaetidae, Lucicutiidae, and Heterorhabdidae from the northwestern part of the Pacific Ocean.] Dissertation, Moscow, P.P. Shirshov Institute of Oceanology, Academy of Sciences of the USSR: 152 pp. (with supplementary volume) [in Russian]

Heptner M.V. 1977. Zooplankton laguny i sopredel'nyh vod atolla Ninigo (arhipelag Bismarka, o-va Zapadnye). [Zooplankton of the lagoon and adjacent waters of the Ninigo Atoll (Bismarck Archipelago, Western Islands).] Trudy Instituta Okeanologii, Akademiya Nauk SSSR 107a: 189-203. [in Russian]

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Zoologicheskogo muzeya MGU, Izdatel'stvo MGU 24: 3-58. [in Russian]

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SADAMI KADOTA

23 October 1929 – 20 January 2003

Dr. Sadami Kadota, who was Chairman of the Organizing Committee of the Fourth International Conference on Copepoda (Karuizawa, Japan, 16-20 September 1990), died of a myocardial infarction in Fujisawa on 20 January 2003, when he was visiting his former university, Nihon University Fujisawa Campus, for a lecture meeting. He was 73 years old.

Dr. Kadota was born in Ehime Prefecture on 23 October 1929. After graduating from Nihon University, the largest (in terms of student numbers) private university in Japan, in 1952, he devoted his later life to the education of students in planktology and fisheries science in the Faculty of Agriculture and Veterinary Science of Nihon University until his retirement in 2000. He was promoted to the rank of Professor in 1974 and appointed as Dean of the Faculty of Agriculture and Veterinary Science in 1988. He served as Dean for 12 consecutive years until his retirement. At the same time, he was also twice appointed as Vice-President of Nihon University, in 1989-1990 and 1997-1998, and twice as Acting President in 1991 and 1998-2000. In spite of his busy schedule in the management of the university, he loved

students and enjoyed teaching classes. After his lecture was over, students often came to the podium to talk and ask questions, and he remained in the center of a circle of students until his secretary called him for the next meeting.

Dr. Kadota's main research field was the ecology of fresh-water crustacean zooplankton, and he was awarded his Doctorate in Agriculture from Tohoku University in 1976 on this theme. He participated in the IBP (International Biological Program), examined sedimented zooplankton's hard body fragments in cores from the bottom of Lake Biwa, and studied the effects of eutrophication on plankton species composition in marine coastal waters. He was a coauthor of 13 books and published 57 scientific papers.

To WAC members, I should mention Dr. Kadota's enormous contribution to the success of the Fourth International Conference on Copepoda. The Karuizawa Seminar House of Nihon University was available as a conference venue because of his special arrangement with the university head office. He was also very helpful in applying to funding agencies to raise our conference budget. In every meeting for the organization, he was always cheerful and accepted our requests. He was like a father. The Karuizawa Conference was in fact an outcome of the combined efforts of a broad-minded, intelligent father and his sons with no authority but full of vigor and vitality. I was so happy to be one of the sons in the organizing committee.

On the morning of 20 January 2003, Dr. Kadota left his home in Yokohama in good spirits, and a few hours later his heart stopped beating. This happened when he was just stepping into the entrance of the hall where he had addressed audiences many times as Dean. Herein, I express my sadness at his loss.

— Shin-ichi Uye
Hiroshima University, Japan

Student Essays

It is important to hear from our younger colleagues. Here are essays from two of the recipients of the awards for Best Student Presentation at the Keelung Conference. Look for articles by other students in future numbers of *MONOCULUS*.

On the genus *Thermocyclops* and the venue of the 8th International Conference on Copepoda

By Deo Baribwegure
Laboratory for Animal Ecology
University of Ghent, Belgium

I was pleasantly surprised when my name was called out to receive the "Award for the Best Student Presentation" during the closing ceremony of the 8th International Conference on Copepoda in Keelung (Taiwan) in July 2002. For me this award was not only a nice surprise but it also represented a token of acknowledgement for the five years I have put in my work.

If I were to mention the two milestones in my professional life in research, I would summarise them as first, the contact I established with Prof. Dr Henri J. Dumont, Miss Sibylle Maas and Dr Janet W. Reid and secondly, the occasion of the 8th ICOC.

Apparently, on embarking on their research work most PhD students follow a common trend in the sense that during the first year they are quite unsure of where they are headed. Despite their hard work, in most cases the results often seem elusive. My interest in copepods started in 1995 with participation in a training course in freshwater biology organised at the University of Ghent, Belgium. After the course, Prof. Dumont and Miss Sibylle Maas encouraged me to apply for a PhD scholarship. Prof. Dumont became my Promotor and I benefited a lot from his experience. Parallel to the knowledge I got from him and from Miss Sibylle Maas, I was fortunate to meet Dr Marcelo Silva-Briano, who was also pursuing a PhD in 1998. He advised me to meet with Dr Reid. But due to cultural barriers on my part, I was initially apprehensive about establishing contact. Two weeks after my conversation with Dr Silva-Briano, I gathered courage to write to Dr Reid. At that time I had no idea my future work would develop from the advice I received from her. She was to continue guiding me until I eventually presented my work at the 8th ICOC. It is a pity for me that she did not conclude this honourable task by becoming the co-promotor of my PhD work.

Literature on pore mapping of cyclopoids is sparse. This makes the task of mapping the pore pattern of the genus *Thermocyclops* relatively difficult. Unlike the Order Calanoida, only a limited number of good publications in this field of study deal with the Cyclopoida. After my publication on *T. emini* in 1999, I started receiving some positive comments. Then I produced other publications in 2001. Now each time I re-read these publications, I am astounded because although I did my best, there is still a lot of work to be accomplished in this field.

By working on pore mapping I have sharpened my personal criticism. A comparison among the pore mappings of some cyclopoids revealed to me the striking differences that exist between them and calanoids. In calanoids the species-specific pore signature is mainly limited to the urosome (Koomen, 1992), whereas in cyclopoids, at least in *Thermocyclops*, it is found on the cephalosome, metasome

and urosome (Baribwegure & Dumont, 1999; Baribwegure et al., 2001). A comparison between *Thermocyclops* and *Mesocyclops* (two closely related genera) showed clear differences in the rostral pore signatures (Fig. 1). Analysis of the rostra in other genera revealed similar differences. It became obvious that the rostral pore signature is a generic discriminatory pattern.

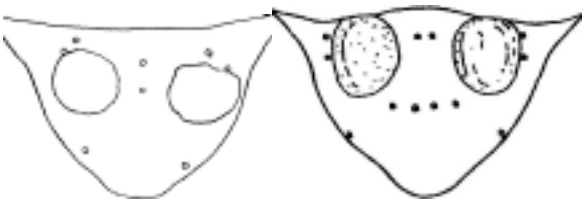

Figure 1. Rostral pore patterns in *Thermocyclops* (left) and *Mesocyclops* (right).

I was armed with this kind of information including the complete descriptions of some *Thermocyclops* species when I went to participate in the 8th ICOC. However, my inexperience in international conferences caused me some anxiety and doubts as to what would be the expectation of the top copepodologists in attendance at Keelung. After I was registered for the conference, things surprisingly turned positively for me. When I contacted both the local and international organising committees, I received a positive response that I would be offered accommodation. On the strength of this, my laboratory granted me the travel ticket. I became the first PhD student to benefit from such a grant from my laboratory.

I went to Taiwan with quite a lot of documentation (including an album of 80 scanning electron micrographs) to illustrate my results. The 8th ICOC was the first international conference in which I actively participated. Prior to this, in 1998 Prof. Victor Alekseev kindly invited me to participate in the "Special International Conference on New Methods in Copepod Taxonomy", which was organised at the University of St. Petersburg, Russia. But at that time I was only a passive student since I had not yet produced tangible results to present. My experience in Keelung was therefore a unique eye-opener for me, and I am sure for others as well, because I often overheard participants expressing their amazement at how successful the 8th ICOC had turned out to be.

The 8th ICOC was particularly special to me because I feel I received not one but three awards simultaneously. The first one was the ticket sponsorship from my laboratory which amounted to US$ 1000. The second one was the best student award. And to crown it all, the results I presented at Keelung were a major contribution to my final PhD thesis, which I successfully defended at the University of Ghent in Belgium on the 10th of January 2003 – this I consider to be the third award.

The 8th ICOC set a precedent as the first ICOC to honour students by directly rewarding them for their results. I hope that we were only the first ones and not the last to receive such awards.

Last but not least, it was also during the 8th ICOC that a consensus was reached to honour Tunisia to be the first African nation to prepare and host the forthcoming 9th ICOC in 2005. I hope many new students will use this opportunity to join the World Association of Copepodologists (WAC). This will be yet another occasion for students and other members of WAC to personally meet and talk with top copepodologists like Drs Geoff Boxshall, Jiang-Shiou Hwang, Janet Reid, Kurt Schminke, Grace Wyngaard, Victor Alekseev, Maria Holynska, Iskandar Mirabdullayev, Hiroshi Ueda, La-orsri Sanoamuang, Rubens Lopes, Carlos Rocha, Eduardo Suárez-Morales, ...whose literature in copepodology is both widely read and unique.

I challenge the young students to seize this golden opportunity in Tunisia to establish contacts with future promotors of their Msc and PhD degrees in copepodology.

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The biomimetic application of parasitic fish copepods (Siphonostomatoida) to the development of improved oceanic fish tags

By Abby Ingram

University of Oxford, UK

Copepods which parasitise fish have evolved a variety of attachment structures, commonly involving modified antennae (Kabata, 1979). These structures facilitate attachment in what can be extremely adverse conditions. Ecto-parasites are subject to regular flushing and if they live on the outer skin of the fish, the surface is well covered in

slippery mucus and tough scales or denticles. Once attached, there is the risk of predation for the copepod and host associated with the exposed conditions of the ocean, but again copepods have evolved effective solutions to protect both themselves and the host. Copepods have in fact, achieved something which man has been trying to perfect with fish tags for 50 years: to remain attached to high-speed oceanic fish without reducing host survival. Here at Oxford we have been interested in the application of nature to technology known as 'biomimetics'. We can learn a great deal from animals and here I outline how parasitic copepods of marlin and sharks may provide clues as to how we can improve tags deployed on these fish species.

Tagging potentially provides an important source of data describing the population size and migration of oceanic fish species. Such information is invaluable in the conservation of fish stocks by determining stock structure and based on this, the refinement of fishery models. This is particularly the case for species about which little is known, for example marlin and sharks, and without this data over-fishing will continue. However, for such information to be collected from tags, they must be effective and tag retention in the fish's skin is currently poor. Tags can also cause physical damage and disrupt the fish's camouflage system, both of which reduce survival and defeat the object of the tag. By studying the functional morphology of copepod attachment structures and the adaptations for camouflage, it is hoped that we may be able to suggest ways of solving the problems associated with tagging and potentially produce a tag design which is effective whilst being non-invasive.

The copepods selected for study are all common ectoparasites of marlin (*Tetrapturus* and *Makaira* spp.) and mackerel sharks (Lamnidae, e.g. *Carcharodon* spp. and *Isurus* spp.), and should therefore, theoretically demonstrate optimal attachment structures for the conditions on these fish. By examining the morphology and mechanics of the attachment appendages, in addition to the substrate and location in which they attach, potential was noted for the improvement of current tags. Here, I shall describe the results from three copepods: *Anthosoma crassum* (Abildgaard, 1794), an extremely tenacious copepod which attaches primarily by modified antennae and is parasitic in mackerel shark buccal cavities (Benz et al., 2002); *Gloiopotes longicaudatus* (Marukawa, 1925), a parasite of the outer skin of marlin species which attaches similarly by antennae and also the cephalothoracic cup (Kabata, 1979) and finally *Pennella instructa* Wilson, 1917, a mesoparasite of marlin species which attaches by antennae modified into antlers (Kabata, 1979) and closely resembles conventional tags. In each case aspects of the attachment which make them effective and which could be incorporated into a new design for fish tags, were noted.

Anthosoma crassum demonstrated the most complex attachment structure and therefore possessed the least biomimetic potential. However, this species was biologically very interesting and did suggest some tag design improvements. *Anthosoma crassum* has peculiar retractable antennae (Shiino, 1955). Observations showed that embedded adults could move towards or away from the host substratum, by means of shortening or lengthening the antennae respectively, correspondingly altering the strength of the antennal attachment. This movement was controlled primarily by elongated retractor muscles in the first segment capable of 30% contraction, and by virtue of the highly flexible wall in this region (Fig. 1).

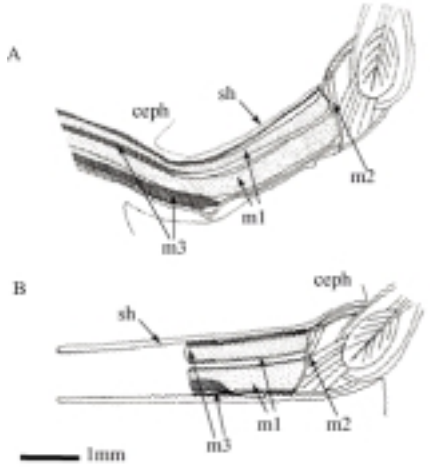


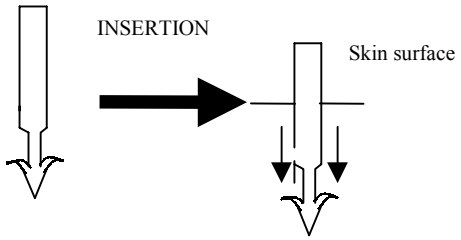
Figure 1. Schematic of the movement of the first antennal segment of *Anthosoma crassum*. A.) The first segment extended (ceph, cephalothorax; m1, retractor muscles; m2 and m3 additional muscles; sh, sheath). (B.) The first segment contracted (ceph, cephalothorax; m1, retractor muscles; m2 (one of pair shown) and m3 additional muscles; sh, sheath).

Further attachment strength could be derived from striations on the terminal claw, running parallel to the claw axis, and posteriorly-directed micro-protuberances on the penultimate segment, both of which were thought to increase friction in the adult. It was hoped that the study would provide clues to how initial attachment by copepodids occurs.

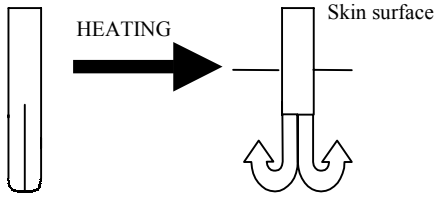
Gloiopotes longicaudatus highlighted the importance of camouflage to tag design. This species has been shown not only to have conventional methods of camouflage in the visible spectrum–the carotenoid-containing chromatophores –but also two other previously unseen methods outside the visible spectrum: Preliminary photographs taken in ultraviolet light of *G. longicaudatus* ventrally on a blue marlin (*Makaira nigricans* (Lacépède, 1802)), showed that the parasites were reflecting the UV to the same degree as the skin, making them invisible. At the other end of the spectrum, in infrared light, they were highly conspicuous. The reasons for such a system, may be related to avoidance of predation by *Remora* spp. which are known to feed on *Gloiopotes* (Cressey & Lachner, 1970) and are thought not

to possess UV receptors (Uli Siebeck, University of Queensland, pers. comm.). Such camouflage may also maintain host survival and reproductive fitness by the parasites mimicking the host's camouflage, although it is not yet known if mako sharks (*Isurus oxyrinchus* Rafinesque, 1809), common predators of marlin, possess UV receptors. Marlin cannot see in UV (Fritsches et al., 1998), so the parasite's camouflage would also mean that potential mates would be unaware of parasitism. The second potential camouflage mechanism which has been revealed involves the transparent cephalothoracic selvage composed of regularly-spaced grooves. When white light is shone directly onto *G. longicaudatus*, the outer edge of the cephalothorax becomes iridescent. The grooves have been shown to be responsible for this effect, behaving as a diffraction grating and splitting the incident white light into its component colours (Parker, 2000). The function of the iridescence could be to disrupt the outline of the copepod to potential predators, although it could also play a role in communication between conspecifics. Behavioural experiments are required to elucidate what, if any, role this plays.

Gloiopotes longicaudatus demonstrates the significance of camouflage to both the parasite and the host on which it depends, in a habitat where there are few hiding places from predators. Current fish tags are often luminous or bright white to make them obvious to anglers, but what of the impact on the fish's survival? Could they be defeating the object of tagging the fish in the first place?



A: Current plastic double-barb tag showing areas of tissue damage (arrows) behind the barbs as the tag is inserted.



B: Memory-shape polymer design showing the two shapes: permanent (left) and transformed (right). The transformed shape develops only upon heating in the fish's body, reducing tissue damage.

Figure 2. Schematic of current and new fish tags.

Finally, *Pennella instructa* was considered to possess the greatest biomimetic potential for tag anchor design despite attaching by a complex anchor. *Pennella instructa* is virtually impossible to remove intact due to the fact that it can burrow so deeply and has such an effective anchor design. One other reason why attachment may be so strong, and a potentially highly significant difference between *P. instructa* and current tag anchors, is that *P. instructa* develops the anchor fully when it has reached its final destination at a food source in the host (Wilson, 1917). Tags' anchors by contrast are preformed and therefore increase the relative area of tissue damage during penetration, weakening the attachment strength. We decided to try and mimic this post-embedded anchor development with "memory shape polymers". They have a permanent form (e.g. a rod-shape), which under certain conditions may be transformed into a different, predetermined shape (e.g. a hook). This transformation is reversible. Changes in form are effected by heating to a predetermined temperature, at which point the polymer assumes its transformed shape (Lendlein & Langer, 2002). By "training" the polymer to keep its shape in a certain temperature range and then transform at the higher ambient temperature encountered 2 to 3 inches (5 to 8 cm) beneath the fish skin surface (the depth to which a tag would normally be inserted), the polymer will bend into an anchor-like form once in place (Fig. 2). It is hoped that a working model of two possible designs will be produced and trials will take place on aquarium fish.

In summary, we have learned that parasitic copepods may hold the answer to better tag design, allowing us to realise the full potential of tagging. There are many more attachment structures amongst the parasitic copepods, some of which may also hold solutions to other technological problems. However, one should not forget the pure biological wonder of the adaptations of these amazing creatures. I am very glad to have had the opportunity to work with the 'giants' of the copepod world!

Acknowledgments

I would like to acknowledge the help of my supervisor, Dr Andrew Parker, and funding provided for the project by EPSRC and QinetiQ.

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Request for Historical Signatures

From David Damkaer, Monroe, Washington, U.S.A.
(Cockercrek@aol.com)

For my review on the history of the study of copepods, I have made a great effort to obtain portraits of biographical subjects. To complement the portraits, I try to find signatures as well. There are many that I do not yet have. Signatures can be copied or scanned from letters as well as from these authors' own reprints and books that they have presented to others, or from reprints and books that they have owned. Obviously, such precious items could be found anywhere and not just in the country of origin. I hope that the readers of *MONOCULUS* will look again at their libraries and see if they can find some of these elusive signatures. I would be most grateful.

William Baird	Maurice Caullery
Emilio Cornalia	Antonio Della Valle
Sebastian Fischer	Fritz Früchtl
Carl Heider	Eugene Hesse
Vladimir Karavaev	Wilhelm Keferstein
August Kramer	Wilhelm Lilljeborg
Aleksander Linko	H. Marukawa
Richard Menzel	Felix Mesnil
Edward John Miers	Peter Olsson
Simon Albrecht Poppe	Heinrich Rathke
Sebastiano Richiardi	Charles Henry Turner
Františček Vejdovsky	Carl With

Demand for Mass Production of Copepods

It has been known since the 1980s that most major commercial fishes in the ocean had been overfished. Thus, instead of continuing to fish the dwindling natural food resources of the sea, fishing industries turned their attention to aquaculture (farming) of high-value marine food fish. Now, more then 50 species of fish have been succeeded for aquaculture in the world.

Although hatcherists throughout the world have been making steady progress in hatching technology and larviculture techniques of many species of marine fishes, development of marine aquaculture had run into a bottleneck for not being able to produce large quantities of live and nutritious food to meet the first feeding of the vast numbers of fish fry. Meanwhile, studies to meet this new demand for live feed have found that copepods are the best candidates to meet this demand in the marine aquaculture development. Thus, in order to find a breakthrough, the Oceanic Institute of Hawaii sponsored a workshop on **Culture of Copepods and Applications to Marine Finfish Larval Rearing** on May 5-8, 2003. The workshop was held at the East-West Center on the campus of the University of Hawaii. Eighteen speakers from six countries (Australia, Italy, Japan, Philippines, Taiwan, and U.S.A.) were invited to the workshop, where each of them delivered a 30-minute presentation. Five of the 18 invited speakers are members of WAC: Edward Buskey, Ju-shey Ho, Adriana Ianora, Nancy Marcus, and Shin-ichi Uye. Below are the speakers and the titles of their lectures (listed in order of presentation at the workshop):

Nancy H. Marcus: Calanoid copepods, resting eggs, and aquaculture.
John W. Fleeger: What is the potential to mass-culture harpacticoid copepods for use as food for larval fish?
Ju-shey Ho: Symbiotic copepods as live feed in marine finfish larval rearing.
Adrianna Ianora: Birth-control effects of diatoms on copepod reproduction: Implications for aquaculture studies.

Sarah Hazzard: Maximizing the nutritional values of copepods in aquaculture. Managed vs. balanced nutrition.

Adelaide Rhodes: Formulated feeds for marine copepods: Nutritional status and population growth.

Shin-ichi Uye: Extremely high biomass and production of planktonic copepods in a brackish-water lagoon in Japan: Potential use as food for fish larvae.

Edward J. Buskey: Behavioral characteristics of copepods that affect their suitability as food for larval fishes.

Robert J. Rippingale: Selecting the right copepod for intensive cultivation.

Ralph G. Turingan: Development of feeding mechanics in marine fish larvae: Does prey size matter in the larviculture of marine fishes?

Edward J. Chesney: Copepod-fish larvae interactions: What factors influence the feeding success of marine fish larvae?

Ronald P. Phelps: Intensive and extensive production techniques to provide copepod nauplii for feeding larvae red snapper *Lutjanus campechanus*.

Joebert D. Toledo: Studies on the use of copepods in the semi-intensive seed production of grouper *Epinephelus coioides*.

Huei-Meei Su: Culture of copepods and applications to marine finfish larval rearing in Taiwan.

David Morehead: Striped trumpeter: current progress on a difficult to rear marine finfish.

Chin-Fa Liu: Introduction of commercial copepod production in Taiwan

Robin J. Shields: Intensive culture of a calanoid copepod, *Parvocalanus* sp., as prey for small sub-tropical marine fish larvae.

Jason T. Lemus: Characterization of an extensive zooplankton outdoor production system coupled with intensive larval rearing of red snapper *Lutjanus cmapechanus*.

Dr. Cheng-Sheng Lee, Director of the Center for Tropical and Subtropical Aquaculture of the Oceanic Institute, conducted the workshop. During the progress of the workshop, the 18 presentations were interspersed with six Discussion Sessions. The discussions were based on the premise that the desired copepod for hatchery operation is a hardy animal, small in size (with naupliar larvae 20-75 μm in width), slow in escape response, with high productivity, and enrichable with fatty acid. Finally, recommendations to the industry were made in addition to listing candidate copepod species for studies of their mass culture. The Oceanic Institute is planning to publish the 18 lectures presented at this workshop in a proceedings.

— Ju-shey Ho
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Long Beach, U.S.A.

New Books and Webkey: Reviews

World Directory of Crustacea Copepoda of Inland Waters. I. Calaniformes.

By Bernard Dussart and Danielle Defaye. 2002. Backhuys Publishers, Leiden. 276 pp., paperbound. ISBN 90-5782-108-7. EURO 62.00.

French workers Bernard Dussart and Danielle Defaye have done a great service to limnological copepodologists by compiling this very useful directory. The task they set themselves was not for the faint-hearted. They have succeeded in bringing together a huge amount of widely scattered literature and have produced order out of chaos. This new work is a highly amended and enlarged version of their 1983 "Répertoire Mondial des Crustacés Copépodes des eaux intérieures 1.- Calanoïdes". Apart from the fact that translation into English will bring this work before a wider audience, accuracy has been greatly improved. In the Centropagidae, for example, I found a significant number of errors in the original French version, but these have all been rectified in this new work.

This monograph is not just for the taxonomist, for it includes references to general biology, ecology and physiology. Also, coverage is not restricted to fresh waters since euryhaline species, characteristic of estuaries and lagoons, in such families as the Pseudodiaptomidae and Acartiidae, are included. The index is comprehensive and highly convenient in that it includes synonyms in differentiated type, thus enabling the reader to establish quickly the current valid name.

There are some 1,800 references (the original version had only 950), and having checked a fair subsample of these, I am happy to say that they have been compiled with much care and are, in general, highly accurate. In a work of this magnitude and complexity perfection is probably unobtainable, and a few small glitches have been detected. For example, the original (1967) description of *Boeckella bispinosa* is cited on page 21 but omitted in the list of references on page 192. Conversely, Ough and Bayly (1989)

appears in the references (p. 236) but is not cited for *Sulcanus* on page 54.

I strongly recommend the purchase of this volume to all serious students of copepods occurring in inland waters and estuaries. Libraries serving limnological interests should also have a copy for reference.

— Ian A. E. Bayly
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School of Biological Sciences
Monash University, Australia

Progress in Zooplankton Biology: Ecology, Systematics, and Behavior

Edited by Carol Eunmi Lee, Suzanne Strom and Jeanette Yen. 2002. Hydrobiologia Volume 480, Special Issue. Kluwer Academic Publishers, Dordrecht. 207 pp., paperbound. US$120.00. Obtainable by order from Cynthia De Jonge, Special Issues Coordinator, Hydrobiologia, Cynthia.deJonge@wkap.nl.

Progress in Zooplankton Biology: Ecology, Systematics, and Behavior, the July 15, 2002 special issue of the journal Hydrobiologia, is a commemorative volume dedicated to Professor Bruce W. Frost for his service as a mentor and colleague to the authors of this volume and for his contributions to the marine science community at large. This volume contains papers presented at a symposium organized by Professor Frost's former graduate students, in honor of his sixtieth birthday at the School of Oceanography, University of Washington on March 17, 2001. The broad scope of this volume reflects the enormous breadth of Professor Frost's career, which includes population, community, and ecosystem ecology (Part II), systematics and evolution (Part III), and sensory biology and behavior (Part IV). This compilation contains historical essays, synthetic reviews, and research articles, some which aim to challenge current paradigms and identify areas for future research.

This volume begins in Part I with a biographical sketch of Professor Frost, where Karl Banse describes his multifaceted contributions to biological oceanography and zooplankton biology. Part II of this volume focuses largely on marine ecosystems, to which Professor Frost has devoted much of his career, particularly on the role of zooplankton grazing on phytoplankton abundance. The following three studies in Part III highlight difficulties of copepod systematics caused by the problem of stasis in morphology, and emphasize the importance of combining multiple approaches, such as morphometrics, genetics, and mating experiments to identify species boundaries and evolutionary relationships among populations. Patchiness in distribution often results from complex individual behaviors, in response to food resources or predators. Such behaviors are often difficult to observe or characterize, requiring measurements of sensory perception, detailed field observations, and mathematical models, as illustrated by the papers in Part IV. Together, these papers represent efforts of those that have collaborated with or have been influenced by Professor Frost. These papers reflect his approach of examining multiple hierarchical levels and employing numerous techniques and conceptual frameworks for solving problems. Thus, Professor Frost has passed on a legacy of conducting integrative and individual-based research, with the aim of making larger-scale inferences.

— Carol Eunmi Lee
Department of Zoology
University of Wisconsin, Madison, U.S.A.

Copepoda: Cyclopoida. Genera *Mesocyclops* and *Thermocyclops*

Edited by Hiroshi Ueda and Janet W. Reid. Authors: Mária Hołyńska, Iskandar M. Mirabdullayev, Janet W. Reid and Hiroshi Ueda. 2003. Guides to the Identification of the Microinvertebrates of the Continental Waters of the World, Coordinating Editor Henri J. F. Dumont, Volume 20. Backhuys Publishers, Leiden. 317 pp., paperbound. ISBN 90-5782-126-5. EURO 80.00.

It is emphasized by the editors of this monograph that representatives of the cyclopoid taxa *Mesocyclops* and *Thermocyclops* are common and even numerically dominant planktonic and benthic members of lacustrine small-sized fauna, particularly in tropical and temperate latitudes worldwide. Some of their species also occur in tiny water bodies (as tree holes and crab burrows), others are subterranean, or inhabit caves and wells. Because of their voracious predatory habit and ability to survive harsh environmental conditions, several species of *Mesocyclops* have shown promise as biological control agents for disease-bearing species of anopheline mosquitoes. On the other hand, representatives of *Thermocyclops* and *Mesocyclops* have been found to serve as intermediate hosts for human parasitic nematodes or trematodes. Some of the larger species may reach high abundances in fish hatcheries, where they result in commercial losses by predating on fish larvae. Still others have been introduced by humans extensively across the globe – and, as neofaunal invaders, they have significantly altered ecosystems that they had not belonged to historically.

For students of cyclopoid biodiversity, it has been difficult so far to establish a firm base for reliable identifications. The primary literature sources are scattered too widely, and the journals in which they appear are too difficult to obtain. This holds true especially for the taxa described from the tropics. The monograph introduced here now rectifies this deficiency and it is the first exhaustive book published on *Mesocyclops* and *Thermocyclops*.

This monographic review is written by the world's experts on these taxa: Drs. Maria Holynska (Warsaw),

Iskandar M. Mirabdullayev (Tashkent), Janet W. Reid (Martinsville), and Hiroshi Ueda (Ehime). All four have not only described many of the cyclopoids in question for more than a decade of being professionally proliferative – they also collected many of their research items themselves in their subtropical and tropical habitats. Therefore, they are not only scholarly systematists but are also faunistic, ecological and geographical experts based on their own practical experience.

The monograph is conveniently split into an introductory part (with remarks on biology, ecology, evolution, determination techniques, and terminology), keys for identification, a survey of species descriptions, references, and an index of species and subspecies. The chapters are authoritative, comprehensive, up-to-date and well written. I found the text well organized and informative. No slip of the pen could be detected – all cross-references are painstakingly correct. The extensive index of species and subspecies at the end provides an excellent survey and allows the possibility to track back all the information provided for a particular taxon.

An exhaustive review is provided on all published works of systematic relevance. Included are: descriptions, redescriptions, synonyms, and distributional as well as faunistic records. The reference list offered for these topics is exhaustive. One wished to have more biological and ecological information included though – for example, mention of postembryonic development is only marginal. The figures reproduced from the originals given in the primary literature are of equal quality – or even better. It is a great achievement by the editors and publishers that the work of the original contributors is reproduced in this quality. Often, the figures are combined from several authors and sources in such a way that the reader is provided with the most detailed information with as many characters as possible. The authors of this review are not to blame for the fact that males have been notoriously neglected in previous cyclopoid descriptions (not so much because they are rare, but more for the "tradition" to be content with the description of the more abundant and larger females). This is the reason why the authors could only provide "keys to females" for both *Mesocyclops* and *Thermocyclops*. The same holds for oral appendages, which have been left undescribed throughout history. Only recently, have referees and editors insisted on adequate considerations of these important cephalic limbs – and those descriptions are also provided in the monograph.

The target group of users for this book is certainly an academic audience. Anyone with more than a passing interest in the biodiversity of freshwater invertebrates will find this monograph invaluable. This may hold for scientists with an interest in the available morphological and distributional data or the exact identification of the known species belonging to *Mesocyclops* and *Thermocyclops* – whether this is for archive purposes, faunistic or biogeographical surveys, or for ecological studies. Some of the papers will serve as significant reference works for researchers in individual disciplines or regions. Certainly a most striking merit of the book is that the keys to taxa are organized in a way that this monograph is suitable also for beginners such as students, technicians, or scientists from non-organismic fields. Particularly helpful is the description of a technique of ventral-side-up-inspection (without needle-preparation of the appendages – which often makes many students hesitate to study copepods). Also helpful are the copious pages on morphological terminology alongside schematic illustrations – terms which are used in the keys as well as in the description of particular species further on. The keys are straightforward – and are comparatively easy to follow – at least for the species I have at hand for examination. However, they could have benefited from the inclusion of small pictorial key-characters (instead of referring to the pages where those are illustrated).

It would have been reasonably easy for the authors, and so much more helpful for the reader, to have global distribution maps included. Also, I was curious throughout my reading – whether there will be some generalizations made about biodiversity patterns of representatives belonging to *Mesocyclops* and *Thermocyclops*. Are their members equally distributed on all continents? If not, are there any hot spots or diversification centers discernible for certain groups? Is there any adaptive radiation to make out? How many more species are to be expected, from which habitats, and where geographically? Is there any threat of extinctions due to human impact before they are collected and described? What about the phylogenetic relationships of *Mesocyclops* and *Thermocyclops* – to other Cyclopinae, as well as within the limits of their own presumably monophyletic borders? These are some questions one would appreciate getting answers to. If anyone, the authors of this review would have the expertise to provide such explanations. Yet, in all fairness, I do not think anyone could have done any better given the problems involved. There is hardly any phylogenetic reconstruction to be found so far for the Cyclopinae in the primary literature – and more should not be expected from a review. For me, one major obstacle for the evolutionary interpretation of freshwater cyclopinid relationships is their remarkable degree of both – character similarity and variability – intraspecific and also beyond species- and categorial borders. Even only diagnostically (and that became very clear throughout this scholarly contribution) – it is difficult to characterize cyclopinid species by certain unique characters. Instead, several species can only be differentiated by a combination of characters.

In conclusion – this monograph does provide an invaluable and ready source of information from which everyone interested in the organismic diversity of representatives of freshwater cyclopoids will benefit. It should also be a useful source of knowledge for limnologists from other disciplines, or for copepodologists usually working on other topics. I would have preferred an expansion on some sections, but perhaps this reflects my

personal interests rather than necessity. Will this book get dusty on the bookshelf? I doubt it.

— Hans- U. Dahms
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Free-living and Parasitic Copepods of the Laurentian Great Lakes: Keys and Details on Individual Species

By Patrick L. Hudson and Lynn T. Lesko. 2003.
Great Lakes Science Center, Ann Arbor, Michigan.
http://www.glsc.usgs.gov/greatlakescopepods/

Patrick Hudson (Great Lakes Science Center) and his collaborators have done a service to ecological researchers in the North American Great Lakes and surrounding region in compiling the web resource *Free-living and Parasitic Copepods of the Laurentian Great Lakes: Keys and Details on Individual Species*. The Great Lakes are ecologically complex, and reliable species identifications are essential in understanding processes such as planktonic and benthic community dynamics, food webs, and fish diseases. This website makes a large step toward providing a single resource that will allow researchers to identify copepods from the Great Lakes.

After the opening screen, the first working page of the website offers the following choices: a brief introduction, a higher classification of copepods, keys to the major groups, a species list for each major group with their distribution within the Great Lakes, literature cited, and a glossary. One useful tool is evident on first opening the introduction. Throughout the various layers of the keys and text, all literature citations can be opened from the text for more information, as can individual species names, and definitions of various taxonomic keys and life history stages. This is a good example of how a web-based key can be superior to a traditional one, i.e., in almost instantaneous access to ancillary information about an animal. The concept is particularly helpful in the taxonomic keys themselves, where for every species identified, one can access links to characters used for identification, distribution, life history, ecology, and synonymies for that species.

The heart of this website is the set of species keys for four main groups of copepods: calanoids, cyclopoids, harpacticoids, and parasitic forms. One feature that I wish the authors had included in conjunction with the species keys is a set of serial images and a detailed description of how to distinguish copepodids from adult individuals. In my experience, this has been among the most difficult problems for beginners, especially telling apart copepodid V and adult stages. The keys to the adults of each major group are dichotomous, and based on characters familiar to anyone having conducted copepod identifications, e.g., for cyclopoids, the configuration of the fifth leg, first antennae, and caudal rami. These characters are illustrated using a combination of digital photomicrographs and line drawings, and both types of images are excellent. Important identification characteristics have been clearly indicated in the images with text, numbers, and arrows. In cases where line drawings are used there is a small camera icon on the screen, and using it brings up a photograph of that character. In the high-speed version of the website (not in the dialup version) each key couplet and each species page have an enlarged photograph of a copepod part as a background. I found this distracting, and couldn't tell if the background photo had any relevance to what was on the screen – in my opinion the background should be neutral so that one focuses entirely on the content being displayed. When a species identification is reached, a whole-animal photograph is displayed, with a sidebar on the right discussing problems or idiosyncrasies in identification for that species, with linked literature citations. There is a left-hand sidebar giving links to the other information categories that I mentioned above. Another feature of the keys that was added while I was in the process of reviewing them (another benefit of web-based resources – the ability to constantly update) ws a "quick views" button in the species keys. When used, this feature displays a menu that allows the user to bring up thumbnail photographs of key characters for all of the species in that group. For example, one can see images of all of the fifth leg photographs on one screen. This will be a great feature for the more experienced user who wants to make a quick identification based on a character that they are familiar with.

I have accessed perhaps several dozen other taxonomic invertebrate keys on the web, and none of them remotely approach the sophistication of *Free-living and Parasitic Copepods of the Laurentian Great Lakes: Keys and Details on Individual Species*. In perusing the website for several weeks, I constantly found new layers of interesting information and features. I ran several local species through the keys and had little trouble navigating them as far as they would go (these are regional keys and should not be used for definitive species identifications outside the Great Lakes region). Anyone wishing to construct a web-based key or wanting to identify Great Lakes copepods would be well served by this work.

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Preliminary Notice

The Ray Society, a registered charity, announces that it will shortly publish a new book on copepods. This monographic work is entitled "*An Introduction to Copepod Diversity*" and is by Geoff Boxshall with Sheila Halsey.

It is intended as a companion volume to *Copepod Evolution* by Huys & Boxshall, also published by The Ray Society, and is essentially a family-level work. For each family-level taxon across the Copepoda the book contains:

1) Diagnosis – a modern diagnosis of the family, accompanied by 1 or more pages of line drawings.
2) List of Included Genera – with approximate number of species.
3) Taxonomic Notes – a section detailing existing problems and, in some cases, relevant history.
4) Key to Genera – presented for each family where possible (with only three exceptions); in some cases the keys are expanded to include species.
5) Biology – a section to briefly introduce the biology of the family, serving as an entry point to the literature by giving key references or reviews, details of host taxa in the case of parasites, etc.

The work is large: it will total approx. 950 printed pages and will be case-bound in two volumes. The work comprises a 2-volume set: separate volumes will not be available. The contents for these volumes are as follows:

Volume 1.
Colour Frontispiece
Introduction
Taxonomic part
- Platycopioida
- Calanoida
- Misophrioida
- Harpacticoida
- Gelyelloida
- Mormonilloida

Volume 2.
Taxonomic part
- Cyclopoida
- Siphonostomatoida
- Monstrilloida

Bibliography
List of invalid genera and families
Indexes

It is expected that the work will be published during 2003 and The Ray Society will offer a pre-publication concessionary price to members of the World Association of Copepodologists. This price has yet to be fixed, but the next issue of *MONOCULUS* will contain details of the price and how to order this work. This information will also be provided through the Copepod List discussion group.

Information on The Ray Society can be found at: http://www.books.free-online.co.uk/

— Geoff Boxshall
The Natural History Museum
London, U.K.

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Recent Publications on Copepoda

Compiled by Chad Walter
(National Museum of Natural History, Washington, D.C., U.S.A.) and Jan Reid

A few older publications that were recently listed in the "World of Copepoda" bibliographic database (C. B. Wilson Library) are also included. Please advise us if you know of publications (including theses and "gray literature"), on any aspect of the Copepoda, that are not in the Monoculus Library or in the "World of Copepoda" database.

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***** Titles received by the Monoculus-Library are indicated by an asterisk. *****

Recently Associated Members

Forty Candidate-Members became Full Members last July at the WAC business meeting in Keelung. Two of them introduce themselves here:

A salute from the Romanian Black Sea Coast!

Some months ago, at the end of the previous year, an e-mail letter from Ms. Dr. Janet Reid was a great surprise for me! She announced me that I was accepted into the great "family" of the world copepodologists. So, as it is an honor for me to know that I can call myself *a member* of the WAC, please permit me to briefly introduce my activity and research interests.

I am MANUELA DIANA SAMARGIU, 36 years old, and I live in Constanta, Romania, near the Black Sea Coast. I am married and I have a three-year-old son.

In the summer of 1993 I graduated from The Biology Faculty of the University of Bucharest. After that, beginning in October, I became, after a competitive examination, a junior assistant of the Natural Sciences Faculty of "Ovidius" University of Constanta (Department of Animal Biology and Ecology). I taught labs in *Hydrobiology* and *Invertebrate Zoology* and organized environmental field work camps. In 1996, I became a professor's assistant and then a senior lecturer in *Aquatic Ecology* at the same faculty.

Beginning in 1994 I started to research harpacticoids from our littoral region, as a PhD student at the Biology Institute of the Romanian Academy – Bucharest, under the scientific coordination of academician Petru Bănărescu. The thesis title was ***"The Biology of Harpacticoids of the Romanian Black Sea Coast"***.

Between 1994 and 2002, my work in our university covered different areas: teaching activity, environmental education, research on marine and limnetic invertebrates, and most of all harpacticoid studies. Through the years I have participated with different papers in national and international conferences and workshops.

For objective reasons, until now I have limited my research on these copepods to only the midlittoral and infralittoral zone (to about 10 m depth, maximum).

After long and hard work, the data obtained were the basis for a synthesis of their ecology in the study sector, which materialized in my doctoral thesis (which is 442 pages, including annex and references – more than 335 titles). The thesis includes, in the first part, aspects of the place of the harpacticoids in systematic zoology and their role in aquatic ecosystems, a perspective history of research on harpacticoids, and a short ecological presentation on the Pontic basin. In the second part I presented in detail the material and methods used in my research, and in a special chapter I made a compilation of the most important biological elements for characterization of the harpacticoid species collected. The last chapter refers to the identified species and their responses to environmental conditions, with synecological data on their spatial distribution on different substrata (sedimentary, rocky, and macrophytes, and in some sulphurous infralittoral marine springs). At the end I presented about 15 general highlights about harpacticoid research and 20 personal conclusions regarding my results. As a principal feature it could be said that of all the 43 identified harpacticoid species, most of them have an eurytopic and euryhaline character, and are distinguished by their wide general distribution. Comparing with literature quantitative data regarding their distributions of about 30 - 40 years ago, our studies revealed for the period 1995 –1999 much decreased values of their density, abundance, frequency, and other parameters.

Since September 2002 I became a Doctor in Biology, after a public presentation of my results at the Biology Institute of the Romanian Academy, in Bucharest.

Before I finish this summary of my last 9 years of activity, I want to express my gratitude and respect to all scientists who studied harpacticoid copepods from Romanian waters and other territories, since the middle of the XIXth Century until now. Their papers are the basis of any study on these little crustaceans.

I am grateful to Doctor PETRU BĂNĂRESCU and to Doctor MARIAN TRAIAN GOMOIU who guided me during the entire period of my thesis preparation, and a special thanks to Doctor CORNELIU PLEŞA of Cluj for his important help with references. To Monsieur PHILIPPE BODIN and to Mister FRANK FIERS I have to thank for sending me *The Catalogue of the New Marine Harpacticoid Copepoda* (1997) which was very helpful for systematic

studies. To all my colleagues who understood my work and sustained me from time to time, and to my family I would like to express my love and acknowledgements.

At present I continue my work on systematics, biogeography, and ecology of marine harpacticoid copepods, and I intend to extend my studies to deeper waters of the Black Sea Coast.

This was and is a difficult project. I know that it will never be finished, because with every day that passes a little bit or a major aspect of our environment is changing, so I think that it is our responsibility to grasp moments of these challenges.

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Fish parasites of southern Africa

Our study group (Aquatic Parasitology Research Group) at the University of the Free State, Bloemfontein, deals with all kinds of aquatic parasites, mainly of fish species, but marine invertebrates as well. The Aquatic Parasitology Research Group forms part of a team of researchers, under the leadership of Prof Jo van As, undertaking an in-depth study on the effect and biodiversity of fish parasites possibly contributing to the decline of the fish populations of the Okavango Delta in Botswana. Another project takes place at the De Hoop Nature Reserve, situated along the southern Cape Coast, SA, where the biodiversity of symbionts and parasites of all the intertidal organisms is being investigated. I have also started collaboration with the Zoology Department, University of Zululand, investigating the copepod parasites found on estuarine and marine fish species in certain estuaries along the east coast of South Africa. These projects are funded by the National Research Foundation of South Africa.

I was doing my Honors in zoology (1997) and had to include a year project along with my theoretical classes. My study leader, Prof Jo van As, told me that they had collected caligid parasites (didn't have a clue what he was talking about!) from estuarine fish species during their latest fieldtrip to Lake St Lucia (1996/1997) on the east coast of South Africa, and that these parasites would form the basis for my year project. Yeh right, what's the possibility of identifying one *Caligus* species (let alone three or four species!) when you have only literature on about 15 species, and there are more than 300 known species! Not a nice prospect when you have less than six months to do it in! I completed my Honors year project, and this project was then extended and I did more work on four species of *Caligus* in my Masters, concentrating on the morphology of these species, including some scanning electron microscopy studies. I also included developmental stages of one species, and found udonellid monogeneans on another species, which were also included in my Masters study.

After the completion of my Masters in June 2000, I continued with my Ph.D., which is a continuation of my research on the caligids of South Africa. A lot of my fieldwork was conducted in estuaries on the east coast of SA, as I held a temporary lecturer position in the Zoology Department (University of Zululand) in 2001. I returned to Kovsies (University of the Free State) in 2002. In 2002 I worked through all the parasitic copepods collected from Zululand, and initially thought this to be the basis for my Ph.D. project. Wrong again! Prof Ju-Shey Ho was not convinced that this would turn out to be a good thesis, and suggested that I do a revision of the South African caligids. Wow! Huge task! But I accepted the challenge with a smile, and aim to complete the revision of the SA caligids by November 2003. The revision of all the SA caligids collected by earlier copepodologists such as Barnard (1948, 1955 and 1957), Kensley & Grindley (1973) and Oldewage & Van As (1989) seems to be a necessity. The work done by these authors includes many discrepancies, which will be sorted out. All museum material will be reidentified and redescribed, and will include material collected by myself. My supervisor is Prof Jo Van As, and co-supervisors are Prof Piet Olivier of the University of the North, and Prof Ju-Shey Ho of California State University, Long Beach.

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Currently I am occupying the position of docent in the Department of Zoology, Biology Faculty, Ivan Franko National University of Lviv.

I am studying the biodiversity of freshwater Copepoda inhabiting different types of aquatic habitats in the west part of Ukraine. The main attention is devoted currently to the systematics and ecology of Copepoda from mountainous lakes (Ukrainian and Carpathians), which were poorly studied in this respect.

I am planning to make a comparison of the characteristics of the Copepoda from different lakes of the Ukrainian Carpathians and other mountainous regions.

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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)			_____	_____	_____
	( )	( )	_____	_____	_____
	( )	( )	_____	_____	_____