BCLME/BENEFIT/CMarZ
REGIONAL ZOOPLANKTON TAXONOMY AND IDENTIFICATION TRAINING WORKSHOP

Swakopmund, Namibia, 8-19 January 2007

Workshop Report

Compiled by

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Participants from Angola, Namibia and South Africa at the *Regional Zooplankton Taxonomy and Identification Training Workshop*, held at the Alte Brücke Rest Camp and Conference Centre in Swakopmund, Namibia, 8-19 January 2007. The workshop, which was funded by the two regional capacity building programmes BCLME and BENEFIT as well as by the Alfred P. Sloan Foundation (through the Census of Marine Zooplankton), was convened by Drs Hans Verheye (South Africa) and Anja Kreiner (Namibia), and facilitated by Dr Janet Bradford-Grieve (New Zealand).

Introduction

Zooplankton are the diverse assemblage of animals that drift the waters of the world's oceans. These usually microscopic organisms occupy a key position in the pelagic food web, as they transfer organic energy produced by phytoplankton to higher trophic levels, including fish stocks exploitable by man. Thus, zooplankton plays a pivotal role in the pelagic foodweb by controlling primary production and shaping pelagic ecosystems.

During the last fifteen years, zooplankton research has globally gained a fresh impetus and its great significance in food web studies is reflected in a number of large international research programmes. For instance, within JGOFS (Joint Global Ocean Flux Study), zooplankton plays an important role in regulating particle flux to the deep sea, whereas the impact of climate change on zooplankton population dynamics, which influences the recruitment success of pelagic fish stocks, forms the main focus of GLOBEC (Global Ocean Ecosystem Dynamics).

In the coastal upwelling region of the Benguela Current Large Marine Ecosystem (BCLME) off southern Africa, data on zooplankton have been collected routinely, primarily in support of fisheries research, since the development of the pelagic fishing industry in southern Africa in the early 1950s. Zooplankton monitoring is ongoing in the region, and even if only the biomass distribution is usually investigated by applying bulk methods like volume or weight measurements, inspection of the species composition adds valuable information on the relative abundance, distribution and diversity of taxa. However, the BCLME region in general, and South Africa in particular, have over the past two decades suffered an enormous loss of expertise in zooplankton taxonomy at an exponential rate, to the extent that the very few experts remaining are on the list of 'Endangered Species'. Furthermore, such expertise has still to be developed to a large extent in Namibia and particularly in Angola.

The rapid dwindling of zooplankton taxonomic expertise in the BCLME region over the years has restricted local scientists in their ability to study changes in zooplankton community structure in detail. Such knowledge is essential to understand and be able to predict the impact of environmental changes on fish stock fluctuations. In addition to the harvesting of marine living resources, the region is a hub of maritime activities, including oil and gas exploration and production, diamond mining, shipping, ports, and sovereignty and resource protection. The impacts of these activities on ecosystem health require judicious management at the ecosystem level, and the Benguela Current Commission (BCC) was recently established for that purpose. Detailed zooplankton taxonomic analyses will provide the BCC with practical applications to a range of policy issues such as climate change, biodiversity, the introduction of alien species, pollution and eutrophication in addition to fisheries.

The Workshop

To address this situation of a declining critical mass of zooplankton taxonomists (or rather, parataxonomists), a regional training course in zooplankton taxonomy and species identification was developed by Dr Hans Verheye, as part of a BCLME project on '*Retrospective Analysis of Plankton Community Structure in the Benguela Current Large Marine Ecosystem (BCLME), to Provide an Index of Long-Term Changes in the Ecosystem*' (Ref. No. EV/PROVARE/02/05). The primary aim of the course was to upgrade the institutional capacity in the BCLME region.

Five scientists and technicians from each of the three BCLME countries, viz. Angola, Namibia and South Africa, took part in this training workshop (for a list of participants and their contact details: see below). They hailed from a broad spectrum of ethnic, educational and linguistic backgrounds, which at times

caused communication to be rather challenging. Their participation was supported by their respective national government institutions, viz. INIP (National Institute of Fisheries Research, Luanda, Angola), NatMIRC (National Marine Information and Research Centre, Swakopmund, Namibia) and MCM (Marine and Coastal Management, Cape Town, South Africa). Funds covering all costs for the workshop were sourced from the two regional capacity building programmes, BENEFIT (Benguela Environment Fisheries Interaction and Training) and BCLME, as well as from the Alfred P. Sloan Foundation (USA) through the Census of Marine Zooplankton, a project of the global Census of Marine Life, of which Dr Verheye is a Member of the Steering Group. The course was convened by Dr Verheye (MCM) and Dr Anja Kreiner (NatMIRC), while Ms Pavs Pillay, the BENEFIT/BCLME Training Officer, took care of all logistical support.

The course was held at the Alte Brücke Rest Camp and Conference Centre in Swakopmund, Namibia, during the period 8-19 January 2007. It was facilitated by Dr Janet Bradford-Grieve, FRSNZ and world authority on copepod taxonomy from New Zealand's National Institute of Water and Atmospheric Research (NIWA) in Wellington, and also a Member of the CMarZ Steering Group. Practical sessions on taxonomy and microscope identification of different zooplankton groups were interspersed with lectures on: (i) the Benguela Current ecosystem by Dr Anja Kreiner (NatMIRC); (ii) zooplankton ecology by Dr Jenny Huggett (MCM); (iii) sampling devices used in the region for the collection of zooplankton, (iv) traditional and novel techniques used for sample analysis, and (v) prospects for the establishment of a regular CPR survey in the BCLME by Dr Hans Verheye (MCM); and (vi) copepod morphology, (vii) using keys, and (viii) copepod dissection and observation by Dr Janet Bradford-Grieve (NIWA). Material used for microscope analysis during the workshop included samples collected by scientists from the three BCLME countries.

The focus of the workshop was – unavoidably – on the identification of copepods, simply because of their sheer numerical abundance and species diversity in all plankton samples available at the workshop. After a few days, each participant was to select a family, genus or species of copepod, note its main distinguishing morphological characteristics and prepare an oral presentation to the rest of the group.

During the course of the workshop, a guide to common copepods was compiled by Drs Huggett and Bradford-Grieve as an informal but useful take-home tool for the participants (see Appendix 2). It highlights some of the key features used to distinguish some of the more abundant genera and species in the region, drawing on a number of more comprehensive references, which are listed at the end of the guide. It is by no means comprehensive and is intended to serve as a basis for further laboratory-based learning in each BCLME country.

This copepod guide is also envisioned as the first in a series of identification guides to other taxa. These taxa include euphausiids, decapod larvae, amphipods and chaetognaths, which – although often abundant in zooplankton collections in the region – were examined only to a lesser extent during the workshop. Other, equally important taxa such as the gelatinous zooplankton taxa (incl. jellyfish, ctenophores, appendicularians, salps, and doliolids) and the lesser abundant cladocera, were unfortunately not covered during the workshop owing to a lack of expertise.

List of Participants

Name	Affiliation	E-mail address
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NIWA - National Institute of Water and Atmospheric Research (incorporating Zew Zealand Oceanographic Institute),Wellington, New Zealand;
MCM – Marine and Coastal Management, Dept of Environmental Affairs and Tourism, Cape Town, South Africa;
INIP – National Institute for Fisheries Research, Luanda, Angola;
NatMIRC - National Marine Information and Research Centre, Ministry of Fisheries and Marine Resources, Swakopmund, Namibia

Impressions by workshop participants

At the end of the workshop, participants were given five questions to answer, and present – per country – their impressions of the workshop to the other participants in a concluding plenary session. It should be noted that the answers given below are the original ones given *verbatim* by the workshop participants; they have only been edited for spelling mistakes.

1. What did you learn about the process of identification?

a) Main characteristic features used to differentiate between groups of zooplankton and/or taxa.
b) The optimal use and the importance of microscopes, esp. the compound microscope.
c) How to use a key and the importance of using it.
d) Characteristics of species
e) Measuring of specimens
f) Use of a compound microscope
g) Specimen identification using different magnifications. Myself I learned a lot because I'm still new in the plankton programme, thus I'm not that familiar with the identification process. The use of identification keys, preparation of slides, and the use of a microscope – to mention but a few – were some of the new identification processes that I learned
h) The presentation also helped me to learn in more detail about the different types of zooplankton especially the *Metridia* female that I presented.
i) I did learn how to look at different body structures of the species as well as the use of the microscope
j) To learn how one can use the keys for the identification of zooplankton species.
k) We learned to use the computer programmes for the identification of species

l) We learned to use lactic acid and some techniques for using a microscope.

m) About the process of identification I learned some procedure to identify the zooplankton species, how to better use the microscope and also how to prepare the animal with lactic acid before analysing it under the microscope. I learned to use the keys for the identification of zooplankton species using Boltovskoy and the computer programmes.

n) The procedure to identify the zooplankton species using the keys in the taxonomic books and in the computer programmes

o) To work with the compound microscope

p) New technical words used for identification.

q) To better use the microscope, like the different light intensities to see better the animal or parts of it

r) To use the lactic acid

s) To use the keys for the identification of zooplankton species

t) That it is critical to have a compound microscope to assist in identification, especially for the small species and small details of larger species

u) How to use keys, and how useful they can be

v) That one needs to use more detailed references for the copepod families in addition to the general guides, such as Janet Bradford-Grieve's guides

w) How to do a temporary mount of copepod specimens in lactic acid, for viewing under a compound microscope.

x) This process involved a lot of new methods, mainly the use of keys in the front of the reference book. Close observation to detail is essential with zooplankton identification as the diagnostic features of each species can vary by way of a spine or rami in certain areas. Terminology is important, to understand the various parts of the copepod and to relate to the correct part.

y) The use of a compound microscope is essential to be able to see each feature as clearly as possible. It is impossible to use any other.

z) The mounting of animals on slides was new to all of us. We learnt how to select the best specimen and carefully place it in the slide well. A few drops of lactic acid are used to hold the copepod in its correct position, before placing the cover slip on top. Care must be taken to avoid trapping any air bubbles. This process enables the specimen to be seated correctly for detailed scanning.

aa) The measurement of each species is most important, as the (adult) sizes can vary so much. This is a big help in the initial identification process.

bb) Accuracy, observation of detail and perseverance: time and patience are also essential when identifying a species. Collect more than one specimen (male and female) and photograph if possible. Identify the group and check against the keys. The Delta program is most useful and works by eliminating various family characteristics, leaving a choice of diagnostic features to check on.

2. What will you need in order to progress your learning when you go home?

a) Practice makes perfect
b) By preserving samples for a thorough analysis later will buy us more time to look at more details
c) Keep/isolate unknown specimens for later identification. This will allow more time to search in books and use the keys
d) Keep/isolate specimen of known species for reference. Particularly important when you have damaged specimen and also for demonstrations
e) Test each other during the routine counting and identification so as to be sure what a colleague says is exactly what is in the samples
f) During sample analysis in the lab, subsamples must be done by two/more individuals, just for accuracy

g) What will be needed is much more practice; I mean it will be of no use not to practice after coming from such an educative course, because a person might forget what was taught.
h) The approach that I will take to further improve my zooplankton identification knowledge is to try and do identification using the keys and the microscope. I will also try and improve more on the usage of the identification keys and preparation of the slides as I'm a bit new with that.
i) Practicing is the most important tool, the more you practice the more you will know
j) First of all, we have to acquire a compound microscope. We have to learn the technical words, in order to facilitate the use of the keys. We would like to analyse the samples that we have in our Institute, in order to practice what we learned during the course (learning by doing).
k) After my return to Angola I am going to carry on what I learned during the course.
l) In order to progress, it is essential to practice in the laboratory with the samples that already exist. If one species is well identified it can be isolated, in order to compare with other samples in the future and not to have to identify it once again.
m) In order to progress my learning when I go home, it is necessary that I spend more time in the laboratory analysing the samples already existing, in order that I not forget what I learned during the course.
n) A dedicated compound microscope in the laboratory
o) More detailed taxonomic references, such as Janet Bradford-Grieve's guides
p) Taxonomic keys available on computer media.
q) Firstly, a compound microscope is essential for identifying the really fine and detailed parts of the animal. At the moment we are using stereo microscopes, which, without better objectives cannot give us this detail.
r) We should recap – with the knowledge gained from this course – on previous samples and correct any errors found.

s) Learn the terminology found in the keys and apply it to the copepod features.
t) Discuss all these points with colleagues and pass on this knowledge and experience to other students

3. Did this course meet your expectations?

a) Technically, yes. It has improved my knowledge of species identification
b) Expectations were: to be able to identify copepods up to family and genus level; to know what structures to look at and/or what the main features are; to know the ecology or trophic role of common copepod species in Namibian waters
c) Yes, learn key features that we don't know
d) Use of microscopes
e) Very much, I was expecting to further improve my knowledge of using the microscope; that was well covered during the course.
f) I was expecting the course to be complicated with the identification as I'm new but everything was of a normal standard.
g) The instructor (Janet) made this course interesting especially for me and was always available for assisting.
h) To a certain extent, yes. I happened to learn most things I didn't know such as how to measure the specimen, how to use the key.
i) Yes, we learned a lot of things during these two weeks
j) The course was so interesting that it went over my expectations
k) Yes, because I learned things that I did not know, like using the keys for the identification of zooplankton species and to fix the sample with lactic acid, etc.
l) Yes, this course went over my expectations, because I expected that we analyse the samples like we did in our laboratory. The change of experience was very good, but the highlight for me during this course, was

how to use: (1) the lactic acid, (2) the different light intensities of the microscope, (3) the keys for the identification of zooplankton species and how to dissect some leg from the animal and count the segments.

m) Yes, in that we were given the tools to identify small copepods, our main difficulty. However, we did not spend as much time with actual specimens as we had hoped, so did not leave the course proficient in their identification (perhaps an unrealistic expectation)

n) An unqualified YES!!! It was a quantum leap forward for us all. As a group, we all benefited in different areas: Diane studied *Pareucalanus sewellii* and *Subeucalanus pileatus* from our Indian Ocean samples. Susan felt more confident regarding *Parvocalanus crassirostris* and presented *Undinula vulgaris* (male & female) during the course. Marco learnt a lot about microscopes and quickly found an aptitude for identification. He was able to present *Rhincalanus nasutus* at the workshop. Hans was able to concentrate on the larger species, particularly euphausiids and amphipods. To end the course, a guide to some common copepods was compiled by Jenny Huggett and Janet Bradford-Grieve as an informal and most useful take-home reference guide. It was really well co-ordinated and will be referred to a lot.

4. What could have been done better by the course leaders?

a) Inadequate books. I think borrowing more books from elsewhere can solve this
b) Already have sorted the specimen to be identified either by species and size beforehand
c) More time should have been spent on copepods (major species of zooplankton)

d) The South Atlantic Zooplankton book that was used for identification was not enough; the same applies to the Laptops, this causes a delay in the process. I think for the future if we can improve on that it will be better.
e) In general, the course leader tried her utmost best to do what she could, even though I tend to agree with the colleagues who mention that too little time was spent on small species of copepods which are difficult to identify.
f) All leaders were excellent, especially Janet. She was tireless and very patient
g) The course leaders were excellent. They showed us competence. It is to underline the knowledge from Janet. She was very kind.
h) The leaders should orientate the course in order to identify more copepods species. For example, we spend a lot of time to identify amphipods and it was for me very difficult.
i) The leader of the course was an exemplary person. She was patient and tireless. The time was not sufficient to learn more, because I think she is very experienced and has much more to teach.
j) More compound microscopes would have been useful
k) The handouts (Janet's notes) were really useful but were reproduced at too small a resolution to be legible by the BENEFIT Secretariat (6 Powerpoint slides per A4 page, instead of perhaps 2 per page)
l) Would have been useful to have the copepod guide (Huggett & Bradford-Grieve) available for reference during the course [Huggett: I spent so much time preparing this guide that I missed out on sessions dedicated to identifying other taxa]
m) Should have had more copepod specimens sorted prior to the course
n) More tasks or projects during the course would have been beneficial, as some people lost focus during the day
o) More time spent on identifying small copepods
p) More experts on other taxa (although time – and funds!– were limited for this)

q) Maybe more copies of literature and reference books could have been made available. With 15 participants, some time was wasted in waiting for them to become available.
r) A few more compound microscopes would have speeded things up and kept interest peaked.
s) A few more projects to work on and to present as we tended to drift at times.
t) Although sample material was supplied, other areas would have been beneficial to vary the species.
u) We found that some of the diagrams included in the manual initially supplied, proved to be rather on the small side and could perhaps have been enlarged for clarity.
v) Some participants thought that 2 weeks for the workshop, was rather a long period of time for long hours of daily concentration.

5. Any other comments?

a) Such workshop should take place every year in order for the three countries to exchange new ideas on zooplankton
b) Still need to be convinced that there are no *Calanus* males in our waters
c) What I need is for the course to be continuous, not to have another in five years time, but if funds can be readily available we can even have the course twice a year.
d) It's my hope that a follow-up to this workshop could be held on a regional level.
e) The time was not sufficient to identify more species. We recommend organizing another workshop with the three countries, if possible this year.
f) It should be good, if we could have the possibility to participate in another course this year. I suggest for the next course more taxonomic books, like Boltovskoy and more computers with keys programmes for the

identification of species. We spent 3 days to identify the amphipod. I think we could take 1 day of the 3, in order to identify another zooplankton species.

g) The course was interesting. Janet was marvellous, tireless and very patient. Sometimes, more people were needed to help at the same time and she could manage it very well. It should be good, if we could have the possibility to participate in another course this year, in order to continue the learning process, because the two weeks were not sufficient. We spent a lot of time to identify amphipod instead of more copepods. I am grateful to participate in this course, because I had the opportunity to improve my knowledge concerning zooplankton identification.
h) Would be extremely useful to have regional workshops, or bilateral visits, in order to confirm species identifications. During the course it emerged that the Namibians have been mis-identifying *Nannocalanus* as *Calanus*.

Closing remarks and recommendations for future training courses

In summing up the workshop, Dr Bradford-Grieve highlighted the importance for local parataxonomists to have access to a good-quality compound microscope with *camera lucida*, as this will enable them to produce detailed drawings of specimens, which could *inter alia* be very useful in correspondence with experts abroad to assist with or confirm species identification. She echoed several of the points noted by the participants, as listed above, including the availability of course material prior to the course in the future, the importance of establishing an archive of voucher specimens for future reference, and the need for quality control of identifications.

There was a general consensus by all present that this regional zooplankton workshop should not be seen as a once-off event, but rather as the first in a series of several follow-up workshops, where both progress made since

this workshop should be assessed and zooplankton groups other than copepods should be tackled in detail. The role of the respective national governments of Angola, Namibia and South Africa – and possibly also the Benguela Current Commission – in supporting and funding such workshops in the future will be instrumental for building on the achievements made during this first workshop with respect to the identification of Benguela Current zooplankton.

Acknowledgements

We wish to thank the following people, organisations, institutions and programmes for their respective contributions, which made this first regional zooplankton taxonomy and identification workshop a success: Dr Janet Bradford-Grieve for facilitating this workshop in a most energetic and committed manner, which undoubtedly has instilled a great deal of enthusiasm and perseverance in the participants; the regional BENEFIT and BCLME programmes and the Alfred P. Sloan Foundation (through Prof. Ann Bucklin, Chair of CMarZ) for providing generous funding; the governmental fisheries research and management agencies of Angola, Namibia and South Africa for supporting their staff to attend this important training and capacity building event; the University of Namibia, and both NatMIRC and MCM for making their microscopes available; Ms Pavs Pillay and the BENEFIT Secretariat for making all necessary arrangements in respect of international travel, accommodation and sustenance; Dr Antonio da Silva and Mr Victor Hashoongo for their sustained efforts in translating from English into Portuguese for the Angolan participants; the management and staff of the Alte Brücke Rest Camp and Conference Centre for putting up with us converting their conference facility into a temporary formalin-smelling plankton laboratory…

Appendix 1

Useful plankton identification references (by J Bradford-Grieve)

General

Boltovskoy D. 1999. South Atlantic Zooplankton. Backhuys Publishers, Leiden, 1705 pp.

The *Synopsis of British Fauna* series may be useful although they deal with a limited set of species.

Ctenophora

MILLS, C.E. 2000: Phylum Ctenophora: List of all valid species names. Electronic internet document available at http://faculty.washington.edu/cemills/Ctenophore.html. Web page established March 1998, last updated 8 February 2000.

HARBISON, G.R.; MADIN, L.P. 1982: Ctenophora. Pp. 707–715, pls 68–69 *in* Parker, S.P. (ed.) *Synopsis and Classification of Living Organisms*, 1. McGraw-Hill, New York.

HARBISON, G.R. 1985: On the classification and evolution of the Ctenophora. Pp 78–100 *in* Conway-Morris, S.C.; George, J.D.; Gibson, R.; Platt, H.M. (eds) *The Origin and Relationships of Lower Invertebrates*. Clarendon Press, Oxford. 394 p.

Cnidaria

Boltovskoy D. 1999. South Atlantic Zooplankton. Backhuys Publishers, Leiden, 1705 pp.

Chaetognatha

http://nlbif.eti.uva.nl/bis/chaetognatha.php

Ostracods

http://www.eti.uva.nl/products/catalogue/cd_detail.php?id=41&referrer=search
Windows 95/98, will work with Windows XP

Cladocera

https://www.ices.dk/products/fiche/Plankton/SHEET143.PDF - to obtain paper key to genera

Copepoda

Published literature

Definition of all Copepod families
Boxshall, G.A.; Halsey, S.H. 2004. An Introduction to Copepod Diversity. The Ray Society, London. 2 vols.

Keys

http://www.crustacea.net/intro.htm
Dr Jim Lowry's Crustacea website, uses DELTA software for the production of keys to crustacean. DELTA and IntKey can be accessed through this web site.

Bradford-Grieve, J.M.; Markhaseva, E.L.; Rocha C.E.F.; Abiahy, B. 1999. Copepoda. In: Boltovskoy D. (ed.) South Atlantic Zooplankton. Backhuys Publishers, Leiden, The Netherlands, pp. 869-1098.

Mauchline, J. 1998. **The biology of calanoid copepods**. *Advances in Marine Biology 33, 710 pp.*

Databases

http://copepodes.obs-banyuls.fr/
Razouls C., de Bovée F., Desreumaux N., 2005-2006. **Diversity and Geographical Distribution of Pelagic Copepoda**. Site in French and English

http://www.nmnh.si.edu/iz/copepod/
Bibliography, Wilson Copepod Library, USNM types, Genera, Species, Techniques, Researchers

Amphipoda

Crustacea.net – updated electronic key on a CD

VINOGRADOV, M.E.; VOLKOV, A.F.; SEMENOVA, T.N. [1996] 1982: *Hyperiid Amphipods (Amphipoda, Hyperiidea) of the World Oceans*. Science Publishers, Lebanon, New Hampshire. 632 p. [I have only the Russian version]

Mysidacea

Crustacea.net – Key to families - I will bring on a CD
MAUCHLINE, J.; MURANO, M. 1977: World list of the Mysidacea, Crustacea. *Journal of the Tokyo University of Fisheries 64*: 39–88.

Euphausiids

http://www.eti.uva.nl/products/catalogue/cd_detail.php?id=23&referrer=search
Windows 95/98, will work with Windows XP

BRINTON, E. 1962a: The distribution of Pacific euphausiids. *Bulletin of the Scripps Institution of Oceanography, University of California 8*: 51–270.

MAUCHLINE, J.; FISHER, L.R. 1969: The biology of euphausiids. *Advances in Marine Biology 7*: 1–454.
SHEARD, K. 1953: Taxonomy, distribution and development of the Euphausiacea (Crustacea). *Report of the British and New Zealand Antarctic Research Expedition, ser. B (Zoology and Botany) 8*: 1–72.

Appendicularia

FENAUX, R. 1993: The classification of Appendicularia (Tunicata): History and current state. *Mémoires de l'Institute Océanographique, Fondation Albert 1er, Prince de Monaco 17*: 1–123. [has keys]

THOMPSON, H. 1948: *Pelagic Tunicates of Australia*. Commonwealth Council for Scientific and Industrial Research, Australia, Melbourne. 196 p, 75 pls. [has keys]

FRASER, J.H. 1981: *British Pelagic Tunicates*. Cambridge University Press, Cambridge. 57 p. *Synopsis of the British Fauna N.S. 20.* [limited number of species but has keys]

Thaliacea

THOMPSON, H. 1948: *Pelagic Tunicates of Australia*. Commonwealth Council for Scientific and Industrial Research, Australia, Melbourne. 196 p, 75 pls. [has keys]

FRASER, J.H. 1981: *British Pelagic Tunicates*. Cambridge University Press, Cambridge. 57 p. *Synopsis of the British Fauna N.S. 20.* [has keys – limited number of species]

SOEST, R.W.M. VAN 1974: Taxonomy of the subfamily Cyclosalpinae Yount, 1954 (Tunicata, Thaliacea), with the description to two new species. *Beaufortia 288*: 17–55. [key]

SOEST, R.W.M. VAN 1981. A monograph of the order Pyrosomatida (Tunicata, Thaliacea). *Journal of Plankton Research 3*: 603–631. [key]

Appendix 2

‘Guide to some common copepods in the Benguela Current LME’
compiled by Jenny Huggett & Janet Bradford-Grieve (**pdf**)