Final Report on EMODnet Biology data grant – Planktonic Copepods

1. Purpose of grant

The grant provided was to enable data capture for the following traits with respect to marine zooplanktonic copepods of the orders Calanoida and Cyclopoida (only the families Corycaeidae, Lubbockiidae, Oithonidae, Oncaeidae, Paralubbockiidae and Sapphirinidae). At the time of the interim progress report, the total number of taxa, after elimination of freshwater taxa, invalid taxa, and all subspecies, was 2626.

However, the process of capturing length and depth data revealed numerous taxonomic problems in WoRMS (particularly the inclusion of non-documented synonyms). It has prompted GAB to "clean" some of these families and so the number of species included in the EMODnet datasets is now about **2430** (and this total still includes some synonyms).

The traits and trait values to be targeted are listed in the following table:

Trait name	**Trait score or value**
Organism type	Zooplankton
Time in plankton	Holoplankton
	Meroplankton
Larval feeding strategy	Planktotrophic
	Lecithotrophic
Feeding type (this trait can depend on gender and/or life stage)	Small particle feeder
	Predator
	Detritivore
	Non-feeding
Spawning method	Sac spawner
	Broadcast spawner
Number of life stages	6 naupliar stages
	6 copepodite stages
	reduced number of life stages
Body size (this trait can depend on gender and/or life stage)	Numerical value with unit
	Minimum, maximum, average or median
	Micro/Meso/Macro
Habitat	Neritic
	Oceanic
	Cosmopolitan
Depth range	Epipelagic
	Mesopelagic
	Bathypelagic

2. Results

We have completed the process of capturing available data for the following traits:

Organism type: all copepods covered in this pilot study are zooplanktonic. Block coding is all that is required.

Time in plankton: all copepods covered in this pilot study are holoplanktonic by all standard definitions. Block coding is all that is required. Meroplanktonic copepods, such as members of the parasitic/planktonic order Monstrilloida, were not included in this study – but will provide comparisons in future.

Larval feeding strategy: all copepods covered in this pilot study have been classified as planktotrophic or lecithotrophic where data exist. If data are available for at least one species in the genus/family, then I have applied this value to all other members of the genus/family using "expert opinion" as the justification. If information is lacking across the entire family, then "no data" has been recorded because there is no evidence base for coming to a judgement based on expert opinion.

Feeding type: all copepods covered in this pilot study have been classified as predator, detritivore or omnivorous – (small) particle feeder. It is now widely known that planktonic copepods previously considered as "herbivores" (by virtue of feeding on unicellular phytoplankton) will also take ciliates and heterotrophic flagellates - in fact any food particle within a given size range. So the category of "herbivore" is meaningless for planktonic copepods. The classification of "omnivorous – small particle feeder" includes those taxa once regarded as herbivores. If data are available for at least one species in the genus/family, then I have applied this value to all other members of the genus/family using "expert opinion" as the justification. Where no data are available for a particular family, I have used "expert opinion" to indicate a feeding type based on consideration of the mouthpart morphology. All taxa are classified.

Spawning method: all copepods covered in this pilot study have been classified as sac-spawners or broadcast spawners. If data are available for at least one species in the genus/family, then I have applied this value to all other members of the genus/family using "expert opinion" as the justification. In the exceptional case of the family Clausocalanidae, where both values can occur within a single genus – then the expert opinion is "uncertain".

Number of life stages: there is virtually no variation in this across all planktonic copepods. [The interesting comparisons will come when you include data on parasites, as life cycles get shortened dramatically.] All planktonic copepods have 6 copepodite stages, and virtually all retain the ancestral number of 6 naupliar stages…exceptions where only 5 naupliar stages are found are noted.

Body size: the maximum and minimum reported body lengths of adults of both sexes are provided (in mm). We needed to provide the data in this form because the majority of original data reports give size ranges. The variation in body length in copepods can be surprisingly large – this is because,

when fixed, the body segments often telescope and almost no observers make allowances for this. The location data given on the body length spreadsheet refer specifically to where the body length measurements were taken – they DO NOT indicate zoogeographic ranges. Geographical ranges were not included in the pilot study.

Body size categories: all copepods included in this list are mesoplanktonic – i.e. with a body length in the range 0.2 mm to 20 mm. Block coding can be used.

The only apparent exception is *Acartia bacorehuisensis* with a body length less than 0.2 mm – but I don't believe that the measurements given in the paper are correct. I think there is a foul up with the published information. I am trying to track down and verify information on this.

Habitat and Depth range: The habitat classification and the depth classification were inextricably linked. Given that the working definition of epipelagic was: "surface to 200m depth" and the definition of neritic was: "inhabiting waters over the continental shelf" – any copepod captured over the continental shelf was automatically both "neritic" and "epipelagic".

We used the classification epipelagic – mesopelagic – bathypelagic for oceanic species inhabiting a sufficiently deep water column (i.e. off the continental shelf). Copepods classified as "neritic" inhabited the water column above the continental shelf.

The problem arose of the copepods classified as hyperbenthic (= benthopelagic). These copepods live at the base of the water column and are rarely found up in the pelagic. There is a special "guild" of copepods that we have recognised increasingly over the past decade or so, which live in association with the bottom. Data are incomplete – but meaningful! The classification we have used here is "shallow hyperbenthic" and "deep hyperbenthic". The former live in association with the sea bed in continental shelf waters (to 200m), the latter in continental slope and deeper waters (>200m).

3. Literature use

The provision of Chad Walter's sources as a sheet in the Excel spreadsheet has worked brilliantly. This volume of work would have been impossible (for the size of grant) if it had been necessary to type out the citation every time. We found only a few papers that were not included – so this has been a great asset. You can see that we have heavily used his sources.

4. Problems

We tried to fix most of the emerging problems with trait scores. We included a category based on "anchialine caves" for the specialised inhabitants of marine and anchialine caves. [These are of major significance in copepod studies given that the most primitive taxa are found in these caves.]

5. Future work

Having scanned a lot of biological literature I can see that egg diameter is an interesting trait – and could be captured, although only for a minority (<10 %) of species. Another direction would be to expand the body length data to include, for example, all other families of Cyclopoida (including the Poecilostomatoida) – probably another 2000 species of benthic and parasitic forms. These data would take time to aggregate but providing such data across the entire order would allow researchers to address issues such as body size in planktonic, versus benthic versus parasitic taxa – within a single order.

Report submitted by:

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