# **Evolving Paradigms: The History of Meiofaunal Research**

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Carlo Heip 1945-2013

Pat Boaden 1936-2013



# Meiobenthology

**Olav Giere** 

The Microscopic Motile Fauna of Aquatic Sediments

Springer

Second Edition

Historical motivation for meiofauna research, slightly modified and substantially abridged from Olav's retrospective Chapter 10.



17<sup>th</sup> century to end of 1950s. **Discovery.** *Microscope studies, faunistics, taxonomy, meiofaunal characteristics.* 

1960 to 1970s. **Enquiry.** *Descriptive ecology, influence of abiotic factors, first experiments.* 

1970s to 1990s. **Function and role.** *Experiments and manipulations: tolerance and preference, impacts of pollution, trophic interactions, production and energy flow, life history, role in benthic ecosystems.* 

Late 1990s onwards. **Environmental concern.** *Biodiversity assessment, environmental impacts and conservation, computerised databases and analysis, molecular genetics.* 

# Molly Mare (1942)







Photographs of Molly Spooner (neé Mare) courtesy of MBA Archive

"A new terminology is needed, and these groups are here designated the *macrobenthos, meiobenthos* and *microbenthos*".

"The meiobenthos here comprises the fauna of intermediate size, such as small crustacean (copepods, cumaceans, etc.) small polychaetes and lamellibranchs, nematodes and foraminifera".

She used a 100  $\mu$ m sieve for extraction (2.5 times the aperture area of a 63  $\mu$ m sieve)

"The world is full of magic things, patiently waiting for our senses to grow sharper." - W.B. Yeats





1674



# Antonie van Leeuwenhoek 1632-1723





# Benthic rotifers: "wheel animalcules"

Euchlanis





Philodina

Testudinella



# Philip Henry Gosse (1810 –1888)

"I must now introduce to you a class of animals peculiarly microscopic: since, without our marvelshowing instrument, they are wholly beyond the sphere of human cognizance"

Evenings at the Microscope 1884

Rotifers were his "own special delight" and often "favourite objects with microsopists"

#### THE ROTIFERA;

#### WHEEL-ANIMALCULES.

10.00

C. T. HUDSON, LLD Corran.

T R GOME, FRS

WITE ILLCATEATIONS.

IN TWO VOLENDS. PLATES.

LONDON AND CO.

all sights something



# Discovery of exclusively meiofaunal taxa accorded Phylum status



Gnathostomulida (1956)\*

Loricifera (1983)

\* = "Gnathifera"

Micrognathozoa (2000)\*



# Different phyla?

# Or are loriciferans progenetic priapulids?

Terminology for homologous structures first for priapulid, second for loriciferan (in brackets)

Larva of the priapulid *Tubiluchus corallicola* 

Loricferan *Pliciloricus gracilis* 



#### Conservative reproductive adaptations of meiofaunal taxa

# Specialist feeding behaviour ("gardening") in the freeliving marine nematode *Praeacanthonchus caecus*





Nematode head and *Tetraselmis* cells drawn to scale

#### **Resting cells of Tetraselmis on nematode trails**



The diet of two turbellarian species

After Watzin (1985)

#### SIZE-RELATED ATTRIBUTES THAT SWITCH ABRUPTLY FROM MEIOFAUNA TO MACROFAUNA IN TEMPERATE SHALLOW WATER

	Smaller than 45µg	Larger than 45µg
Development	Direct benthic	Planktonic
Dispersal	As adults	Planktonic larvae
Generation time	Less than 1 year	More than 1 year
Reproduction	Semelparous	Iteroparous (usually)
Feeding	Discriminate use of particles	Indiscriminate use of particles
Resource partitioning	Particle selection (size, shape, quality)	Spatial segregation and particle size selection
Growth	Reach asymptotic body size	Continue growth throughout life
Mobility	Motile	Sedentary or motile

## TERMINOLOGY USED IN EARLY FRESHWATER MEIOFAUNA LITERATURE

Interstitial – within the interstices of sediments Psammic – in sand or gravel Psammobiotic – only in sand Psammophilic – sand loving but also in vegetation Psammoxene – planktonic stragglers found in sand Psammolittoral – in sandy shores Phraetic - in ground water Stygobiotic – in subterranean groundwater aquifers Troglobitic – in caves Hyporheic – beneath the bed of rivers or streams

- Refer to habitat, not size

Micrometazoa

### Species body size distributions in marine and fresh water





### Bett (2013; Mar Ecol Prog Ser 487:1–6).

>Using computer simulations, demonstrated that when size continua of perfect spheres are sampled using sieves with 2 mesh sizes (i.e. 45 or 63  $\mu$ m and 500  $\mu$ m), biomass size spectra are produced comprising 2 maxima with a trough between them.

Suggested that the previously proposed bimodal biomass spectrum across the meiobenthosmacrobenthos size range may be a sampling artefact.

Extrapolated this finding to account for species richness size spectra on the basis that the number of species is likely to increase with the number of specimens examined, suggesting that bimodal species size distributions are another potential artefact.

Called into question accepted ideas that meiobenthos and macrobenthos have coherent identities with distinct ecological attributes.



# Meiofaunal community ecology : the problems

- Many new and undescribed species
- Taxonomic literature poor, especially outside Europe & USA
- Soft-bodied taxa need to be examined alive

The consequence: emphasis on hard bodied taxa (especially nematodes and copepods)

or identify to higher taxa (nematodes, copepods etc.) only - is this (or was it ever) acceptable?

# Unequivocal evidence for climate change

#### Temperature



## CO<sub>2</sub> and pH













# Effects of ocean acidification on meiobenthos: mesocosm experiments



## 5 pH treatments (6.0 – 8.0): 2 and 10 weeks exposure

# Effects of ocean acidification on meiobenthos: field experiments



# Effects of ocean acidification on meiobenthos: field experiments



View of the Scottish Association for Marine Science buildings with Ardmucknish Bay (left) and Loch Etive (right) in the background



Drill, generator, office, workshop, mud recycling system and water tanker on site



Drilling of the borehole to contain the  $\rm CO_2$  release pipe in progress at Ardmucknish Bay



CO<sub>2</sub> gas cylinders and the CO<sub>2</sub> release system in the mobile laboratory

# Problem:

- Timescale of change (ecological and/or evolutionary)?
- > Meiofaunal animals have generation times in the order of months.
- Natural selection may compensate for any possible deleterious effects.
- Together with the possibility of species replacements, may render the results of short term manipulative experiments meaningless in this context.

#### Psammonalia: the rise and fall of meiofauna research? Is our Association in terminal decline?

#### PSAMMONALIA

#### Bulletin No. 1

#### 10 November 1966

At the informal meeting of psammonologists following the very successful symposium on the biology of marine interstitial fauna at the AIBS Meetings in College Park, Md., last August, it was suggested that an informal means of communication be established among kindred interests of the interstitial fauna. This issue of 'Psammonalia' is the first item of dialogue!

The object of this bulletin, which will be issued on an irregular schedule, hopefully at least twice a year, is to maintain communication among American permomonologists and to note research items and papers, of permute interest, personal and personnel news and meetings and conferences harboring papers on the interstitial fauna and its milieu. Comments, suggestions and brief notes for inclusion will be welcomed by the editors, Dr. Robert P. Biggins, Dept. of Biology, Wake Forest College, Winston-Salem, N.C. 27106 and Dr. Donald J. Zinn, Dept. of Zoology, University of Mode Island, Kingston, R. I. 02881. It is <u>perticularly important</u> for each scientist to communicate such information to the editors. We can be of much service if research papers, etc. are noted in subsequent issues of one bulletin and, indeed, the continuance will depend upon the response of those who receive it.

It is hoped that we will be able to schedule a meeting much like the post-symposium session August, at the AAAS meetings in Washington. The tentative time for this gathering is the afternoon of Wednesday, 28 December. The AAAS program will include a note

's meeting and provide time and place information. At that





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#### The first newsletter from Asia



This Neurierter is not part of the scientific literature for resonance purposes

### Meiofauna publications from Web of Science (total = 3,762) and Psammonalia (total = 14,033) - 1970-2015



Has the IAM outlived its usefulness? Are we too isolationist? Should we integrate with more general ecological research?