



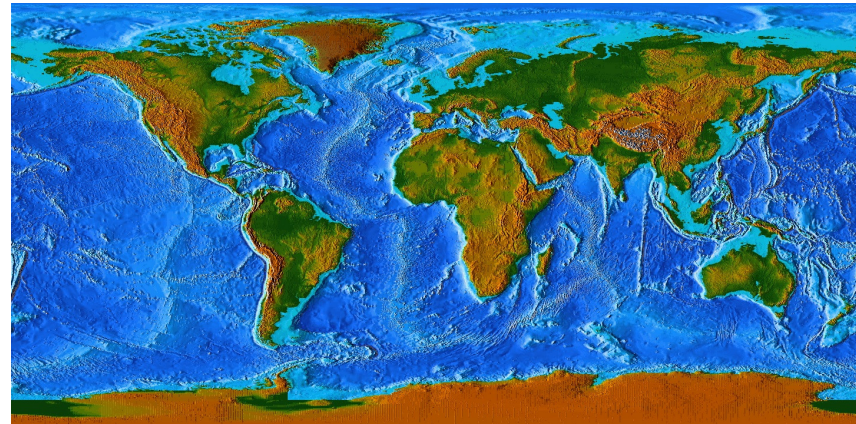
Meiofauna matters: The roles of meiofauna in benthic ecosystems

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Looking closer at the seafloor

- Marine sediments are, by surface, the largest habitat on Earth
- Actions of benthic organisms mediate ecosystem processes that are important on a global scale
- Processes are shaped by interactions amongst organisms and between organisms and their environment



Looking closer at a human world

- Society obtains benefits from benthic ecosystems in the form of ecosystem services
- Ecosystem services are
 - provided on multiple scales and at no charge to society
 - ecological in nature
 - delivered by the living components of the ecosystem



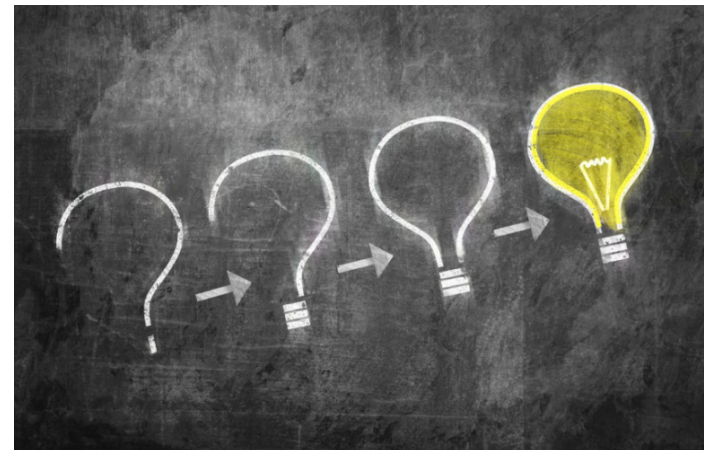
Looking closer at a miniature world

- Ecosystem processes often depend on particular populations, species or species guilds
- Few studies have reconciled the role of meiofauna in ecosystem processes
- Does high meiofauna abundance and diversity translate into significant effects on ecosystem processes?

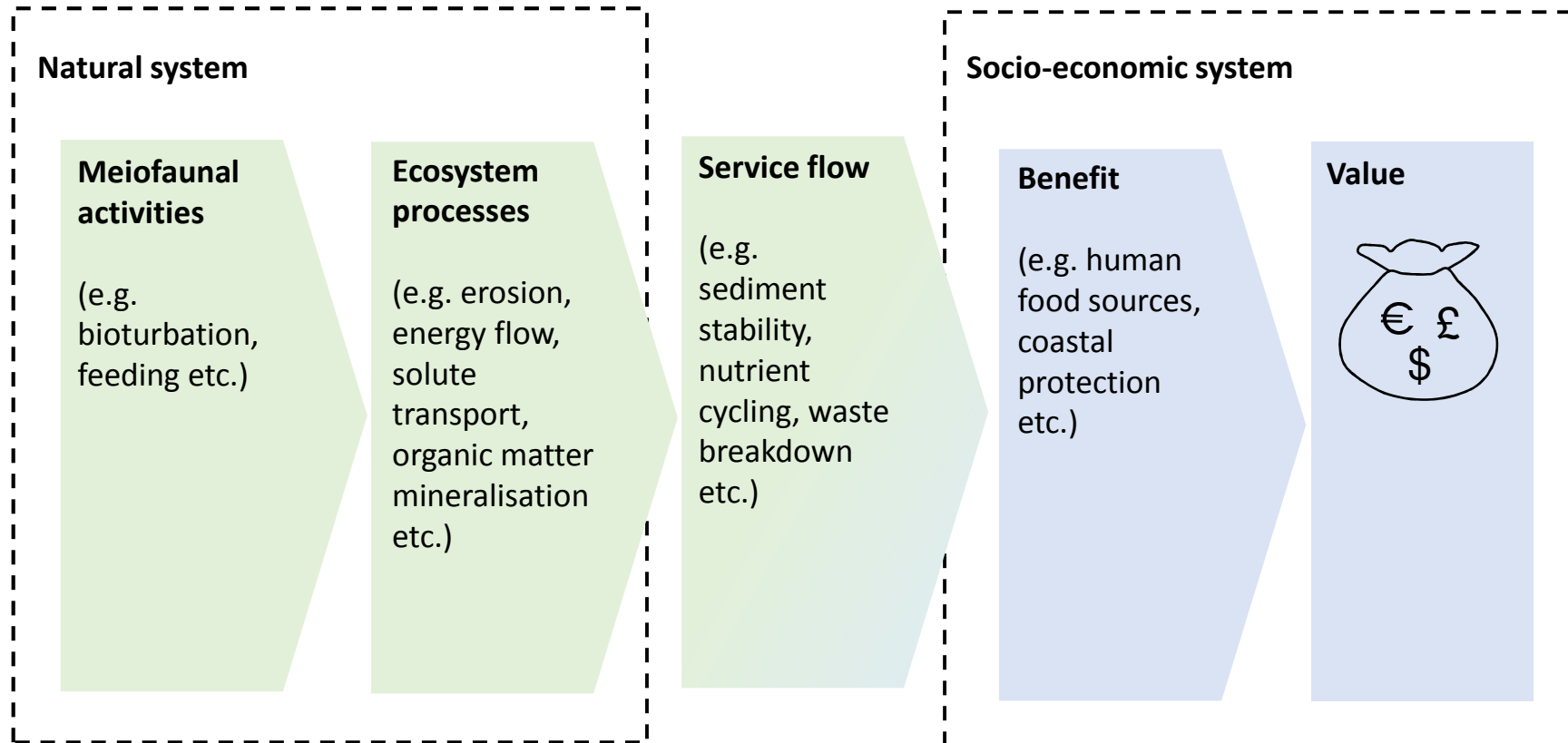


Does meiofauna matter?

- What is the contribution of meiofauna to benthic ecosystem processes?
- How do meiofauna-mediated effects modulate the delivery of ecosystem services?
- How can we best provide useful information for scientists and decision-makers?



Linking ecology and socio-economy

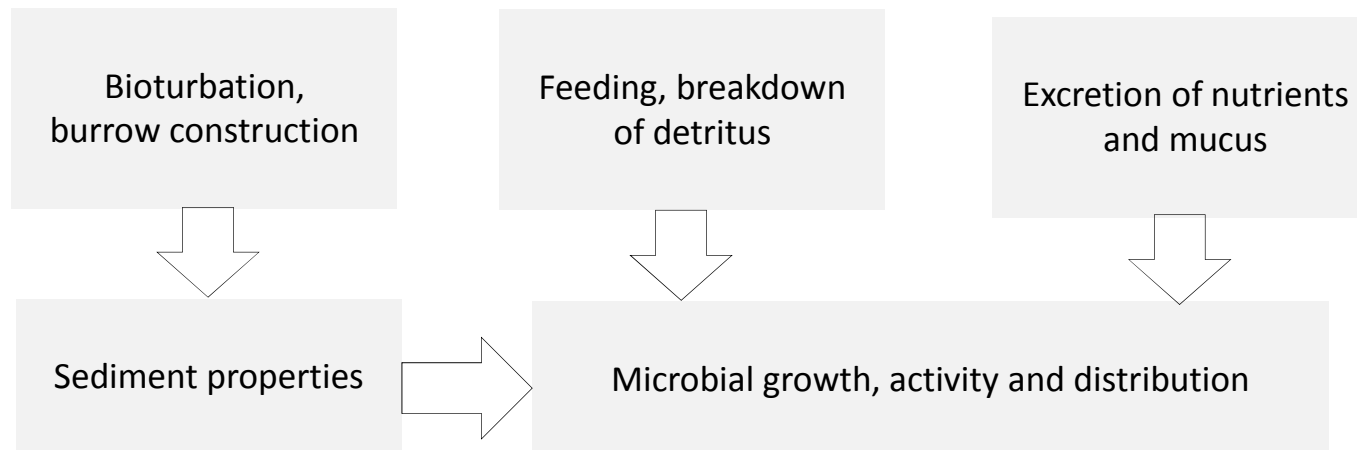


de Groot et al (2010)
Haines-Young & Potschin (2010)

Liquete et al (2013)
Maes et al (2016)

Pre-21st Century perspective: Activities

- Meiofauna activities are pivotal in shaping benthic ecosystems:



? Precise effects of meiofauna-microbe interactions

Coull (1973)
Gerlach (1978)
Kuipers et al (1981)

Chandler & Fleeger (1984)
Montagna (1984)
Heip et al (1985)

Nehring et al (1990)
Reichelt (1991)
Aller & Aller (1992)

Nehring (1993)
Coull (1999)

Pre-21st Century perspective: Energy

- Meiofauna form some part of the diet of predators

? Energetic benefits of eating meiofauna

- Meiofaunal throughput of carbon can be orders of magnitude higher than its standing stock
- Production rates for meiofauna often exceed those of macrofauna

? Precise role of meiofauna in the production and flow of energy

Warwick & Price (1979)
Warwick et al. (1979)
Warwick (1982)

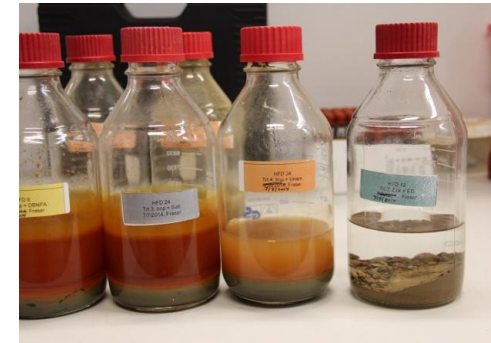
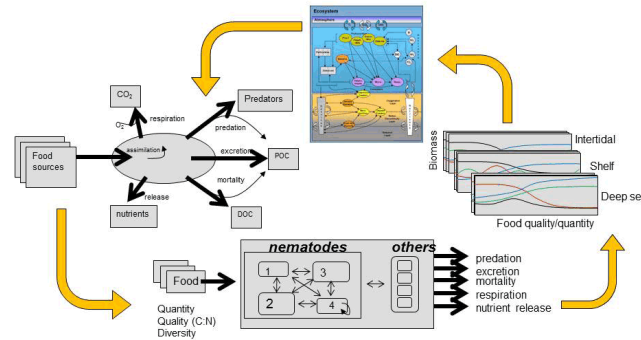
Schwinghamer et al (1986)
Vranken & Heip (1986)
Gee (1989)

Coull (1990)
Gaston (1992)
Kennedy et al (1994)

Coull 1999
Sutherland et al (2000)



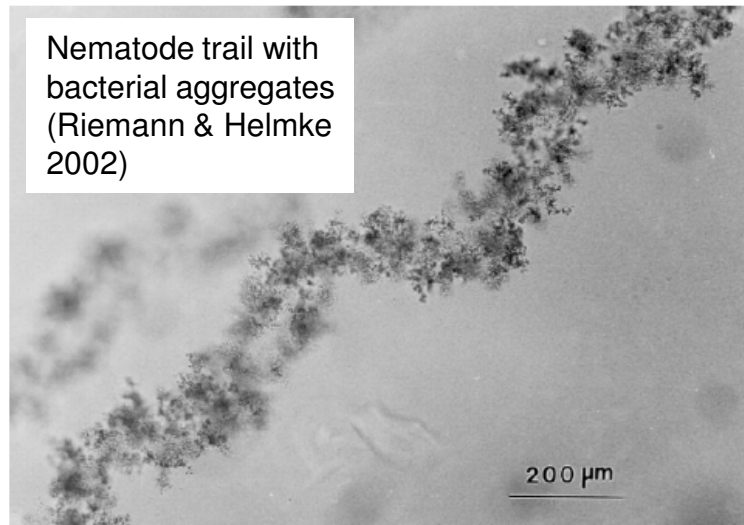
Leaps forward in understanding



- Development of molecular tools to establish the position and roles of meiofauna in benthic ecosystems
- Application of innovative experimental and modelling approaches to identify the factors affecting these roles

Microbe-meiofauna interactions

- Meiofauna exerts direct and indirect effects on microbial activity, growth and community structure



- Grazing
- Mucus secretion
- Exo-enzyme production
- Excretion
- Symbiosis

De Mesel et al (2004)
Ott et al (2004)
De Troch (2005)

Frangoulis et al (2005)
Moens et al (2005)
Musat (2006)

Dubilier et al (2008)
Bayer et al (2009)
Hunter et al (2012)

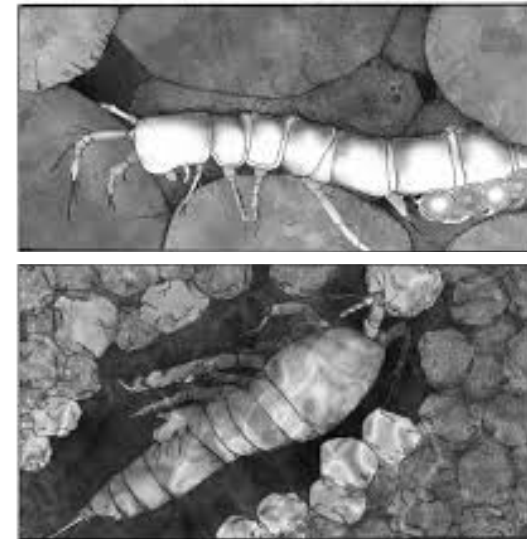
Cnudde et al (2013)

Meiofauna-mediated effects

This slide originally showed a conceptual diagram linking meiofauna activities to sedimentary, trophic and ecological processes. The diagram will be published in the IsIMCo special issue of the Journal of Experimental Marine Biology and Ecology

Physical sedimentary processes

- Microscale effects of meiofauna can potentially lead to larger scale effects worldwide:
 - sediment texture and cohesion
 - shear strength
 - permeability and pore space
 - distribution of sediment sizes, etc.
- Comprehensive meiofaunal reworking of ancient and modern sediments



Sediment stability

This slide originally showed a conceptual diagram summarising meiofauna-mediated effects on sediment stability. The diagram will be published in the IsIMCo special issue of the Journal of Experimental Marine Biology and Ecology

Biochemical sedimentary processes

- Meiofauna-induced modifications of physical sediment properties have implications for their biogeochemistry:
 - porosity and permeability of the sediments
 - efficiency with which organic matter is mineralised and nutrients are recycled



Nutrient cycling

This slide originally showed a conceptual diagram summarising meiofauna-mediated effects on nutrient cycling and organic matter mineralisation. The diagram will be published in the ISIMCo special issue of the *Journal of Experimental Marine Biology and Ecology*

Rysgaard et al (2000)
Bonaglia et al (2014)
Stock et al (2014)

Removal of contaminants

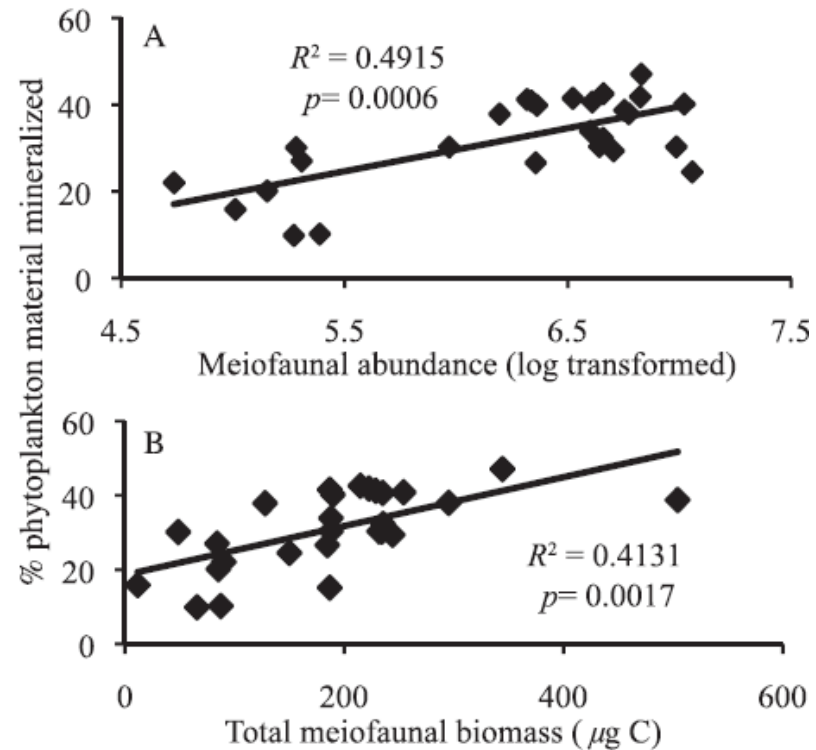
This slide originally showed a conceptual diagram summarising meiofauna-mediated effects on waste removal. The diagram will be published in the IsIMCo special issue of the Journal of Experimental Marine Biology and Ecology

Bradshaw et al (2005)
McGenity et al (2012)

Näslund et al (2012)
Louati et al (2013)

Trophic processes: OM mineralisation

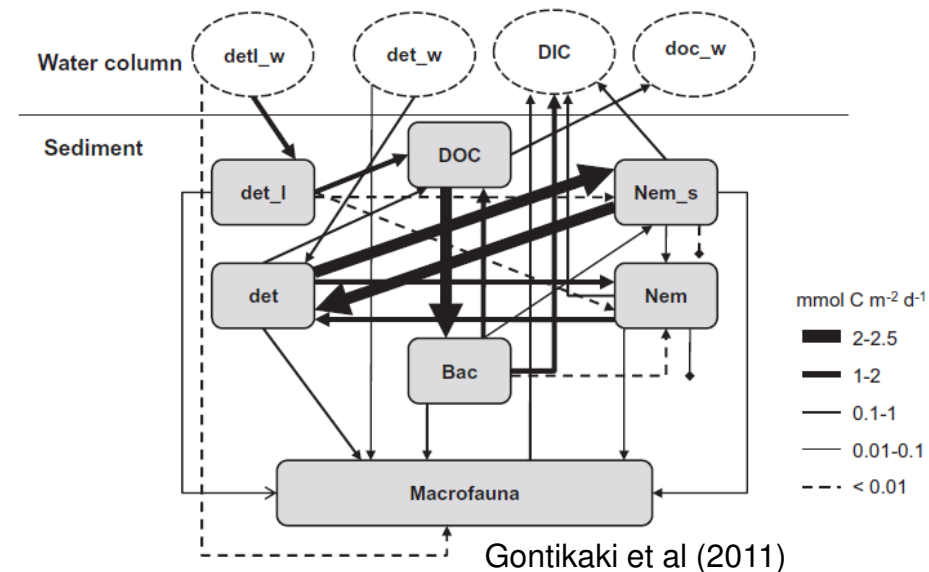
- Meiofauna affects how labile organic matter is mineralised
- Direct mineralisation by meiofauna is small compared to microbiota
- Meiofauna stimulates bacterial degradation of organic matter



Nascimento et al (2012)

Trophic processes: Energy flow

- Meiofauna consume a wide spectrum of food sources
- Meiofauna ingestion rates are generally low
- Variable meiofauna contribution to C-processing may be habitat-specific



Middleburg et al (2000)
 Carman & Fry (2002)
 Moens et al (2002)

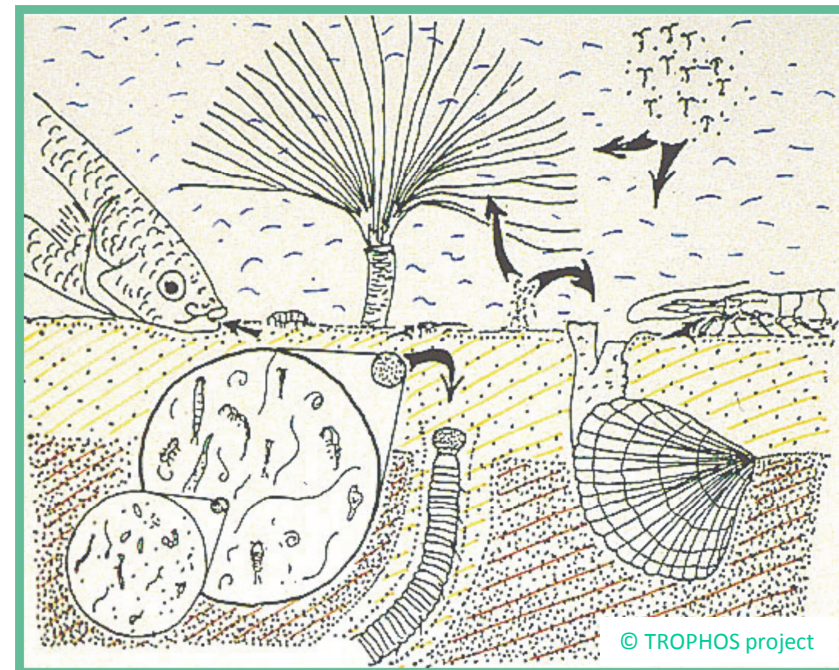
Rzeznik-Orignac et al (2008)
 Maghsoud et al (2014)
 van Oevelen et al (2006, 2011, 2012)

Food web dynamics

This slide originally showed a conceptual diagram summarising meiofauna-mediated effects on food web dynamics. The diagram will be published in the IsIMCo special issue of the Journal of Experimental Marine Biology and Ecology

Ecological processes

- Striking influence of interactions amongst microbiota, meiofauna and macrofauna on benthic ecosystems
- Benthic species often simultaneously compete with and facilitate each other



Austen et al (2003)
Ólafsson (2003)
Braekman et al (2011)

Nascimento et al (2011)
Arroyo et al (2012)
Piot et al (2013)

Ingels et al (2014)

Ecological interactions

This slide originally showed a conceptual diagram summarising interactions between and amongst benthic organisms. The diagram will be published in the IsIMCo special issue of the Journal of Experimental Marine Biology and Ecology

Meiobenthologists in action

- Consider future states of marine ecosystems in the context of a coupled social-ecological system
- Effective application of research findings to societal needs

