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Working group report

WG7: The mesopelagic layer

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Introduction:

Working definition: mesopelagic layer is the region between euphotic zone and benthos (this is a functional definition, rather than traditional definition).

Processes occurring in the mesopelagic zone control the remineralization of organic matter and biominerals produced in the overlying euphotic zone, and delivery to the benthos (and possible sequestration) of materials that escape remineralization. These processes are carried out by mesopelagic ecosystems. These ecosystems are structured vertically and horizontally by the changing biochemistry of particles and DOM, and by the movements and migrations of organisms themselves. Knowledge of the structure and functioning of mesopelagic ecosystems is therefore needed to provide mechanistic understanding of flux exchanges among the photic zone, the benthos, and the ocean margins. It is also needed to enable prediction of responses of these flux exchanges to such diverse perturbations as climate change, iron fertilization, CO_2 injection, or increased harvesting of mesopelagic fish stocks.

Theme 1. Characterization and development of predictive capability for the fluxes and material transformations in the mesopelagic.

- Q 1. What are the fluxes of material passing through the mesopelagic in space and time? Examples: Redfield ratios, ballast, nitrification
- Q 2. What are the main processes involved in the transformations? Examples: particle transformation, remineralization
- Q 3. How are and will these processes and rates respond to global change, including anthropogenic activity? Examples: changes in stratification, circulation, nutrient inputs
- Q 4. How will changes affect sequestration in the interior?

Theme 2. Characterization and development of predictive capability of mesopelagic ecosystem structure, dynamics, and function.

- Question 1. What are the structures and spatial/temporal variability of mesopelagic ecosystems? Example: key species?
- Question 2. What are the main processes controlling structure and function of mesopelagic ecosystems?
- Question 3. How do mesopelagic ecosystems control the material flux and material properties?
- Question 4. How are and will mesopelagic ecosystems be influenced by global change, including anthropogenic activity?

Theme 3.Characterization and development of predictive capability interactions and feedbacks between mesopelagic and boundary systems.

- Q 1. How does the mesopelagic respond to the characteristics and amounts of material entering to the system above?
- Q 2. How does the mesopelagic respond to the characteristics and amounts of material entering to the system from benthos, including continental margins?
- Q 3. How does the mesopelagic processes determine the fluxes to the benthos?
- Q 4. How does the mesopelagic system affect the surface ecosystem? (CO_2, nutrients, trace metals, greenhouse gases)

Potential problems

- The eternal sediment trap sampling problem
- Difficulty of working at depth. Environmental properties that complicate this are sampling for low concentration material, patchiness problem, measuring slow rate of changes,
- Lack of taxonomists.
- Difficulty of disentangling vertical migrators from feeders.

Innovative approaches

- Observatories/permanent moorings/autonomous vehicles. Availability of instruments for remote detection, including acoustic instruments, video instruments. These also extend the capabilities of ship-connected instruments.
- Rapid development of new molecular techniques provides means to give taxonomy, to tell about metabolic rates.
- Foster the development of advanced *in situ* experimental facilities.
- Use multiple approaches to make budgets, verify approaches.
- New institutional arrangements for doing taxonomy.
- New institutional arrangements to facilitate technology transfer.
- Use of alternative sampling systems, such as OTEC. Use subsurface eddies (e.g. Meddies) as natural laboratories to isolate and observe populations.