Dynamics of lipid storage in marine copepods and its consequences for effects of oil pollution

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Mechanistic models are essential tools for interpreting and predicting the consequences of a changing environment on the life histories of marine organisms. The ENERGYBAR project (funded by the Research Council of Norway) has focussed on the effects of pollution related to offshore petroleum activities on the calanoid copepod *Calanus finmarchicus*. Within this project, we applied toxicokinetic models to analyse body-residue data, GUTS models to analyse effects on survival, and DEB-based (DEBkiss) models to understand the life history of the copepods, including the determinate growth and the dynamics of lipid storage.

Nauplius larvae do not have a lipid storage; this feature starts to build up in the early copepodite stages and finally fills up a large fraction of the body just before the moult to adulthood. As the relative size of the lipid sac increases over the copepodite life stages, this body-mass component should not be seen as a DEB-style reserve but as a reproduction buffer in the 1-kappa branch. The lipid sac is used to pay maintenance costs during diapause, but most of it is used in gonad maturation and in support of egg production. However, the exact implementation into the DEBkiss allocation scheme requires further study. For example, it remains unclear whether the switch from maturation to storage at puberty is complete, and it is unclear how adult females use food and the remaining storage to fuel egg production and maintenance needs.

The lipids in the storage (mainly wax esters) have a very high affinity for hydrophobic chemicals, thereby influencing toxicokinetics and toxicity. With regards to the toxicokinetics, we have to consider the lipid sac and the structural part of the biomass as separate compartment. The influence of lipid content on toxicokinetics thus depends on the partition coefficients and rate constants associated with these two biomass compartments. Toxicokinetic knowledge is essential to predict exposure of predators feeding on copepods, and to assess maternal transfer of toxicants with the eggs. Furthermore, we can assume that only the concentration in the structural part is directly related to toxicity in the copepods themselves. Although our model predicts that a high lipid content provides limited protection for the copepods from toxicity of hydrophobic compounds, the results from acute toxicity studies show contrasting results.

In this contribution, we provide some of the highlights of the ENERGYBAR project, focussing on the dynamics of lipid storage and its consequences for body residues and toxicity.