Energy-budget modelling for early-life stages of Atlantic cod and haddock

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Fish Model Species in Human and Environmental Toxicology
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The early life stages of organisms are of considerable interest in ecotoxicology as they constitute a vital aspect of population dynamics and often display considerable sensitivity towards toxicants. Furthermore, embryo and early-life stage toxicity tests for vertebrates (i.e., fish and amphibians) are increasingly being suggested as alternatives for testing with the later (and legally-protected) life stages. To interpret the patterns of effects observed in toxicity tests, and to extrapolate such results to field conditions, requires mechanistic models. Such models should consider both the toxicokinetic (TK) and toxicodynamic aspects (TD) of toxicity. Substantial research efforts are currently concentrating on the molecular level. However, molecular-level approaches need to be combined with energy-budget models to allow for a causal link between exposure and the whole-organism life-history traits (as represented by AoPs). This combination is necessary as life-history traits are not independent, but connected through the energy budget (e.g., structural growth and development are causally linked to the available yolk and to respiration rates), and feedbacks at this level cannot be explained from the molecular level up. In this contribution, we report on our progress in applying the simple DEBkiss model to yolk-feeding stages of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). The model was previously calibrated on literature data for cod, and we now compare the calibrated model to extensive data on growth, development and respiration gathered in the DiTail project (https://ditail.no/en/). Experiments were performed in presence of stressors (mine tailings and copper). However, the stress levels were apparently too low to produce sufficient effects on the biometry to allow modelling, and therefore this presentation will focus on the control responses. In a later stage of the project, we will use our model to interpret toxicity data and to investigate the links between molecular-level data and the energy budget.