

## Energy-based ecosystem modelling illuminates the ecological role of northeast Pacific herring

Szymon Surma, Evgeny A. Pakhomov, Tony J. Pitcher

The ecological importance of Pacific herring (*Clupea pallasii*) as a forage fish in the northeast Pacific was re-evaluated by accounting for its high average energy content relative to most other prey fish. An existing mass-balanced Ecopath food web model focusing on northern British Columbia (Canada) was converted into a set of energy-balanced models using published energy content values for all model functional groups. Proportions of herring in predator diets were compared across all models. The trophic effects of future recovery of depleted whale populations, as well as a herring depletion scenario, were then assessed using Ecosim runs in all mass- and energy-balanced models. The simulated trophic effects of both whale population recovery and herring depletion were noticeably stronger for numerous herring predators, including endothermic groups (several marine mammals and piscivorous seabirds) as well as fish, than suggested by published mass-balanced model results. However, most simulation outputs of the energy-balanced models agreed qualitatively with those of the mass-balanced parent model. These findings demonstrate the potential for improved analysis of ecosystem structure and function in general, and forage fish trophodynamics in particular, when prey group energy content is accounted for in ecosystem models.

Keywords: trophodynamics, ecosystem modelling, Ecopath with Ecosim, energy content, forage fish, Pacific herring, *Clupea pallasii*, northeast Pacific, Canada

Contact author: Szymon Surma. Institute for the Oceans and Fisheries, University of British Columbia. Email: [s.surma@oceans.ubc.ca](mailto:s.surma@oceans.ubc.ca)