ICES CM 2016/C:259

The relative impacts of early life conditions and maternal size effects in determining average fitness and population growth of pike

Yngvild Vindenes[§*], Øystein Langangen[§], Ian J. Winfield[$], Asbjørn Vøllestad[§]

[§]Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences, University of Oslo, Norway

[$]Lake Ecosystems Group, Centre for Ecology & Hydrology, Lancaster, U.K.

[*]yngvild.vindenes@ibv.uio.no

Abstract

Vital rates of fish largely depend on body size, including reproduction parameters like fecundity and egg size. Recent studies have re-emphasized the potential importance of maternal size effects on early survival and growth of offspring. For instance, large females often produce larger eggs, which may increase the survival and/or growth of the offspring. If such maternal effects are important drivers of population growth, fishery management should potentially implement upper size limits to protect the large/old females.

We tested the impact of such maternal size effects to mean fitness and population growth in pike (*Esox lucius*) from Windermere, U. K. Based on unique long-term data, we developed a female-based integral projection model (IPM) including length, length at age 1, and temperature as state variables. Average egg weight increased with maternal length, leveling off for the largest females. However, elasticity analysis of the IPM suggested that this maternal effect had only minor impacts on the growth rate lambda (average fitness), even if we assumed a very strong positive (and linear) effect of egg weight on offspring survival. In contrast, lambda was sensitive to temperature conditions during the first year of life, having long-lasting fitness consequences through somatic growth.

These results highlight the importance of environmental conditions experienced in early life for population growth. Using principles from life history theory we discuss how the results may be generalized to species of similar life history (highly fecund and relatively long-lived species). The model and results can provide useful knowledge to conservation and management.