**ICES CM 2016/P:644**

# Climate change impacts on the ecosystem services of Arctic cod (*Boreogadus saida*)

Benjamin J. Laurel[1], Louise A. Copeman[2,3]
[1]Fisheries Behavioral Ecology Program, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, Hatfield Marine Science Center, Newport, OR, 97365, U.S.A.
[2]College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, Corvallis, OR, 97331, U.S.A.
[3]Cooperative Institute for Marine Resources Studies, Oregon State University, Hatfield Marine Science Center, Newport, Oregon, USA

## Abstract

Forecasting the ecosystem impacts of climate change in the Arctic is limited by a fragmented biological understanding of the marine species that live there. Of particular concern are Arctic cod (*Boreogadus saida*), a key forage species that carries out much of its life history under the ice but is suspected to be vulnerable to both the direct effects of warming as well as competition from other gadids shifting their distribution poleward. To address these data gaps, the NOAA Alaska Fisheries Science Center and external partners initiated a unique broodstock program for Arctic cod alongside related species (saffron cod, *Eleginus gracilis*; walleye pollock, *Gadus chalcogrammus*; Pacific cod, *Gadus macrocephalus*). The goal of the program has been to provide eggs, larvae and juvenile fish for a series of common garden behavioral and physiological experiments examining how climate change will impact the relative growth, survival and energetic value of these species in the Arctic. Results from these experiments indicate Arctic cod have a distinct growth advantage and are more lipid rich than other gadids at low temperatures (< 3 °C). Boreal type gadids outperform Arctic cod under mesothermal conditions (5 – 12 °C) but require much higher food consumption. Eurythermal species like saffron cod are resilient to warming but are energetically inferior to Arctic cod across all thermal habitats. Thus far, the research strongly suggests that Arctic cod provide a unique and important ecosystem service to the Arctic, but only at low temperatures where food consumption can be efficiently transferred into somatic growth and rich lipid energy.