Some cautionary notes on fisheries evolutionary impact assessments

We commend Andersen and Brander (1) for seeking to link fisheries-induced trait change to its broader ecological and commercial consequences. However, we offer some cautionary notes, particularly where such professed evolutionary impact assessments are used to ascribe the relative urgency of managing fisheries-induced trait change versus other aspects of harvest.

Impact analyses that focus on fisheries-induced evolution alone overlook a much broader concern: the overall effects of harvest on phenotypes (i.e., observable traits). Ultimately, phenotypes, not genotypes in isolation, influence ecological dynamics and fisheries yields. Those phenotypes necessarily incorporate the full suite of genetic, environmental (i.e., phenotypic plasticity), and demographic effects shaping trait distributions. A recent meta-analysis showed that phenotypic changes in harvested populations are occurring at much faster rates than in natural or human-disturbed systems (2). The degree to which those rapid phenotypic changes are due to genetic evolution might often be a secondary concern when it comes to their ecological consequences and the sustainability of ongoing harvest. Critically, the various phenotypic effects of harvest (evolutionary, plastic, etc.) may often compound or interfere with one another, and thus should be treated in an integrated fashion by fisheries managers. Simply stated, managers should not overlook basic "phenotypic impact assessments" in their pursuit of strict "evolutionary impact assessments."

Moreover, caution is merited even when considering potentially modest fisheries-induced evolution. One generality that has emerged from the nascent study of eco-evolutionary dynamics is that modest amounts of evolution can readily give rise to unexpectedly large and diverse influences on population, community, and ecosystem processes (3). This can occur via complex indirect and interacting ecological effects of trait variation. For example, 26 generations of contemporary evolution in Chinook salmon (*Oncorhynchus tshawytscha*) resulted in a 120% difference in relative survival rates, even though the range of trait divergence for those populations was only 2%–7% [(4); amounts achievable in as little as 5–13 years based on the 0.6% per year of Andersen and Brander (1)]. At the ecosystem level, predator-induced evolution in Trinidadian guppies (*Poecilia reticulata*) not only shapes their life histories but also indirectly influences major stream ecosystem processes more than the effects caused by manipulation of the fish species assemblage (5).

Our understanding of the interactions between phenotypic change in organisms and associated eco-evolutionary linkages is in its infancy. Accordingly, a prudent conservation approach would not rush to discount the ecological or commercial relevance of even modest fisheries-induced evolution based on very generalized impact models. We do not dispute that overharvest represents an acute risk to many wild populations but instead suggest that fisheries management is unlikely to be much improved by deferring consideration of something so intimately intertwined in the fate of populations and ecosystems as phenotypic change.

Michael T. Kinnison[a,1], Eric P. Palkovacs[a], Chris T. Darimont[b], Stephanie M. Carlson[c], Paul C. Paquet[d], and Christopher C. Wilmers[b]

[a]*School of Biology and Ecology, University of Maine, 313 Murray Hall, Orono, ME 04469;* [b]*Environmental Studies Department, University of California, 405 Interdisciplinary Sciences Building, 1156 High Street, Santa Cruz, CA 95064;* [c]*Department of Environmental Science, Policy and Management, University of California, 137 Mulford Hall #3114, Berkeley, CA 94720; and* [d]*Environmental Design, University of Calgary, 2500 University Drive Northwest, Calgary, AB, Canada T2N 1N4*

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Author contributions: M.T.K., E.P.P., C.T.D., S.M.C., P.C.P., and C.C.W. wrote the paper.

The authors declare no conflict of interest.

[1]To whom correspondence should be addressed. E-mail: mkinnison@maine.edu.