

Reply to Koons: Harvest-related trait changes in an increasingly variable world

Koons (1) offers welcome insight into an additional threat to sustainability that could arise from harvest-driven trait changes. His contribution stems from our finding that shifts to life-history traits (e.g., reproduction at earlier ages and/or smaller sizes) in harvested populations averaged $\approx 25\%$ and were among the most rapid changes we observed in our dataset of 40 human-harvest systems (2).

Koons (1) frames his concern as evolutionary. We had not distinguished evolutionary from phenotypically plastic effects on trait expression but reasoned that the implications we identified hold irrespective of this distinction (2). How the implication Koons highlights might vary under differing degrees of genetic or plastic control is less clear, given that plasticity is itself an adaptation for variable environments.

Although not central to his contribution, Koons (1) suggests that shifts to faster reproductive tempos can increase maximum yield in terms of numbers of individuals. This is possible, but we suspect that, for aquatic communities in particular, such shifts might lead to declines in harvestable biomass (2), in part because younger, smaller breeders are often less fecund (3), with offspring less likely to survive (e.g., ref. 4).

Koons offers an important bridge between previously isolated literatures relating to contemporary life-history evolu-

tion and joins others in suggesting that harvest-related trait change might compound stochastic threats to populations (5). Such scenarios in which human-induced organismal changes interact with environmental perturbations could become increasingly common, cumulatively exposing populations to greater peril than predicted by the sum of independent threats.

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