Working title:

*Increasing seafood production to meet global protein demands: can we avoid ecological tradeoffs?*

Wild harvested seafood is an important component of the global food supply, satisfying 8% of animal-based protein demands 1. While challenges with overfishing remain, many of the world’s fisheries have reached sustainable levels of harvest. Current global assessments 2,3 suggest that many fish stocks are underfished, providing capacity to increase harvest to meet an ever growing global seafood demand. Yet the benefits of fishery food production come at a cost of impacts to marine ecosystems. Trawls and other bottom-tendered gears, in particular, can cause reductions in the abundance of epifauna and other benthic structural habitat features that support marine ecosystem integrity. Consequently, mitigating benthic impacts is a key ecosystem consideration for maintaining sustainable fisheries. Here we make the first estimate of global benthic habitat impacts from fishing and quantify tradeoffs between maximizing food production from the sea and the associated habitat impacts from increased fisheries effort. Globally, we estimate 9% of the world’s continental shelves (2.9 million sq. km of seafloor) is currently impacted by trawls and other bottom-tendered fishing gear. If bottom-tendered fisheries were managed to achieve maximum sustainable yield, we estimate sustainable harvests could increase by 26% (10 million mt), but at a cost of an 11% (340,00 sq. km) increase in the area of seafloor impacted. These competing objectives necessitate an informed discussion about tradeoffs between seafood production and habitat impacts from fishing. Existing strategies to reduce habitat disturbance from fishing are dominated by approaches that either displace the problem elsewhere, as may be the case with marine reserves, or require directly reducing fishing effort, and thus seafood production. However, technological solutions that modify fishing gear or maintain high catch rates to reduce gear-seafloor interactions may provide an alternative means to overcome this impasse. Globally we estimate reducing gear-seafloor interactions by 30%—an amount within the range of existing examples of bottom contact adjustments achieved through gear modifications—could mitigate the increase in habitat impacts associated with fishing that maximizes sustainable harvests from bottom tendered fisheries.

Paper outline

Introduction

1. Fishing provides food but comes with ecosystem impacts
2. Habitats are able to recover, requiring dynamic models to assess impacts
3. Fishery production and ecosystem impacts are competing societal objectives
4. Some argue to harvest more from the sea, others want better ecosystem protections

Results/Discussion

1. Assessment of current state of habitat impacts
   1. Describe trends by region/LME
2. Tradeoff analysis
   1. Additional impacts required to meet maximum harvest
   2. Harvest reductions required to meet ecosystem objective (reduced impacts)
   3. Explain why these tradeoffs vary by regions w/examples (i.e. LME stock status, aggregation of fishing effort).
3. Gear modifications/increased catch efficiency
   1. Discuss what gear modifications/increased catch efficiency mean for habitat impacts (i.e. less overall interaction with seafloor while maintaining harvest rate)
   2. Evaluate necessary changes to contact adjustment to increase harvest with no effect on ecosystem
   3. Compare to contact adjustment achieved in North Pacific and elsewhere

Conclusions

1. Ecosystem tradeoffs will be an inevitable point of contention as we try to feed a growing population.
2. Innovative solutions may be our only way out of these tradeoffs
3. Technological solutions will have benefits beyond habitat impacts

References

1. FAO. *The state of world fisheries and agriculture 2018 - meeting the sustainable development goals*. (2018).

2. Hilborn, R. & Costello, C. The potential for blue growth in marine fish yield , profit and abundance of fish in the ocean. *Mar. Policy* **87**, 350–355 (2018).

3. Worm, B. *et al.* Rebuilding Global Fisheries. *Science (80-. ).* **325**, 578–585 (2009).