

## **“When does fishing forage species affect their predators?” Key Facts and Findings**

- 1) High-density locations of forage fish may be more important to predators than total population.**
  - Predators often depend on dense groups of forage fish near their breeding sites. This means that high-density locations may be more important to predators than total forage fish population.
  - “If there tend to be “core” areas where even at low overall abundance the forage fish can be found at high density, and these core areas are close to breeding sites of predators, predators would see far more stability in prey availability than indicated by total population size.” (pg. 9)
  
- 2) More forage fish does not always mean more predators.**
  - There is no strong link between larger forage fish populations and increases in predator populations.
  - Predator diets are flexible, and predators feed on many different types of prey.
  - “Our analysis of the relationship between predator rate of change and abundance of individual prey species suggests little evidence for strong connections.” (pg. 10)
  
- 3) Previous studies of forage fish impacts on predators ignore the unpredictable nature of forage fish.**
  - Forage fish may experience high or low population levels independent of fishing.
  - As forage fish levels vary due to factors outside of fishing, analyses of forage fish must account for these natural fluctuations.
  - Previous studies assumed the only impact on forage fish was from fishing, ignoring natural variability.
  - “The most important feature that needs to be considered is the natural variability in forage fish population size. Their abundance is highly variable even in the absence of fishing, and a creditable analysis of the fishing impacts must consider how the extent of fishing-induced depletion compares with that of natural variability.” (pg. 10)
  
- 4) Fisheries and predators target different size forage fish.**
  - Mouth sizes for predator fish and marine birds limit the size of the prey that they can consume.
  - Many marine predators consume forage fish that are too small and young for commercial fisheries to harvest.
  - A large population of forage fish does not necessarily mean predators have more to eat if the forage fish are too large for consumption.
  - “Some marine predators consume forage fish at sizes and ages before the fishery harvests them. This is most true for predatory fish and marine birds, where mouth gape sizes limit the maximum size of prey that can be eaten, and probably least true for marine mammals.” (pg. 2)

## **Key Quotes**

“Most forage fish are well documented to undergo substantial fluctuations in abundance unrelated to fishing (Schwartzlose et al., 1999), a feature that is ignored in the ecosystem models used to evaluate ecological impacts of fishing.” (pg. 2)

“Local density can either amplify natural variability in food supply, or the predators may be able to concentrate on high density locations even at low prey abundance, thus buffering them from the fluctuations in total abundance.” (pg. 2)

“In the extreme, if the recruitment of forage fish is not affected by fishing, and the predators consume sizes smaller than taken by the fishery, then the fishery would have no impact on the food available to the predator. In other words, the fishery harvests only those individuals that have survived and grown large enough to escape most of their predators.” (pg. 2)

“For the populations studied, we found little evidence that the abundance of individual species of forage fish was positively related to the per capita rate of change in their predator populations.” (pg. 6)

“If the predators can switch between alternative prey, then the fluctuations in any individual forage species may be well buffered by the predator switching to other forage species.” (pg. 6)

“We find several reasons to concur with the conclusion of Essington and Plaganyi (2013) that the models used in previous analysis were frequently inadequate for estimating impact of fishing forage species on their predators.” (pg. 10)

“There is a need for a much more thorough analysis of the nature of recruitment trends in forage fish. That there are major environmentally-driven regime changes for many species is unarguable, but what exactly changes is unclear.” (pg. 10)

