



Fisheries Classics: The Model That Turned Out to Be, Sadly, but Absolutely Right; and, Everything You Thought about Stone Crab Fisheries Is Wrong

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Fisheries Classics: The Model That Turned Out to Be, Sadly, but Absolutely Right

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The upper Laurentian Great Lakes were separated physically from the Atlantic coast by Niagara Falls, but constructed ship canals allowed marine invaders to penetrate the system. Invading Sea Lampreys *Petromyzon marinus* decimated native piscivores during the 1940s, which allowed Alewife *Alosa pseudoharengus* to proliferate to nuisance levels of abundance by the 1960s. Fisheries managers attacked the Alewife problem by introducing Pacific salmon *Oncorhynchus* spp. This worked, and created a wildly popular sport fishery that had not existed previously.

This was a classic “be careful what you wish for, because you may get it” conundrum. There was some evidence that Alewives were being controlled, and there was tremendous stakeholder pressure to maximize salmon populations because the novel sport fishery was actually revitalizing coastal communities. Indeed, Lakes Michigan and Huron resembled a cornucopia in that there was no apparent upper limit in terms of how many predators could be sustained.

However, in 1981, Don Stewart, Jim Kitchell, and Larry Crowder published a *Transactions* paper that suggested there was an upper limit to how many predators could be sustained. Using bioenergetics modeling (a rather novel concept at that time), they suggested that stocking programs had decoupled predatory demand from prey production, with possible destabilization of the predator-prey system and ultimately strong potential effects on Alewife biomass, with most consumption by Chinook Salmon *O. tshawytscha*.

Their work created a firestorm in that it was the basis for a wide range of subsequent applications of their method to evaluate other predator-prey systems (many of those manuscripts appeared in TAFS), but in the Great Lakes it began a controversy that raged for the next 25 years. There were some managers and researchers who began calling for more judicious stocking rates, while others expressed utter disbelief that a stocking program could actually impact prey dynamics within one of the largest freshwater ecosystems on the planet. No real consensus emerged, but a regional approach developed in which both predators and prey were assessed annually, stocking rates were reduced somewhat from initial levels, and predator-prey dynamics were studied intensively. This approach sustained the salmon fishery until 2004 when Alewife collapsed in Lake Huron, with concurrent decline in Lake Michigan. While there is still some debate regarding the role of climate and invasive effects as contributing factors, salmonid predation was implicated strongly as being severe enough to serve as an absolute slate-wiper for Alewife, with both stocked and feral fish contributing to a high predatory demand. And while salmon controlled a malignant invader, there was an economic burden placed on coastal communities, especially in Lake Huron where fishing effort declined sharply in many areas. On the other hand, Alewife absence was followed by strong recruitment of several native fishes that had experienced chronic low abundance for decades in the presence of Alewife.

We love this paper because it was so prescient, and it stimulated a broad range of new research efforts that led to great insight into how models can be useful in understanding predator-prey dynamics. And it began a compelling story about a bold management strategy that led to initial great success, but eventually experienced the most feared and unlikely outcome.

REFERENCE

Stewart, D. J., J. F. Kitchell, and L. B. Crowder. 1981. Forage fishes and their salmonid predators in Lake Michigan. *Transactions of the American Fisheries Society* 110(6):751-763. [dx.doi.org/10.1577/1548-8659\(1981\)110<751:FFATSP>2.0.CO;2](https://doi.org/10.1577/1548-8659(1981)110<751:FFATSP>2.0.CO;2)

Everything You Thought about Stone Crab Fisheries Is Wrong

The Stone Crab *Menippe* spp. fishery is one of the most unusual fisheries in the world, because only claws are harvested, and animals are released to remain in the fishery via survival and claw regeneration. Florida accounts for the majority of landings, and there only one claw can be removed, but the fishery extends into South Carolina where both claws can be taken. One of the major drivers of this fishery is the assumption that stone crabs survive claw harvest and regenerate, but Elizabeth Duermit (South Carolina Department of Natural Resources, Marine Resources Research Institute and Grice Marine Laboratory, College of Charleston) and her colleagues found that this may not be the case due to both direct and indirect effects. They used a series of elegant experiments to determine that wound widths greater than 7 mm caused high post-removal mortality, and that wound size was more important than if one or both claws were taken. This suggests that fisher skill with claw removal was an important component underlying short-term survival, but there were also long-term effects in that stone crabs with one claw consumed fewer bivalves, and stone crabs with no claws could consume only fish flesh. Restricted feeding could exacerbate an already-long intermolt claw regeneration interval such that few stone crabs return to the fishery. And by examining stone crab claws for sale in retail environments, they found that 20% of the claws exhibited breakage consistent with high short-term mortality.

We featured this paper because it was elegant and creative, but also because it is a great example of how some long-held beliefs do not hold up when actually tested. And their work suggests that at least a proportion of mortality depends on fisher skill. The Florida Fish and Wildlife Commission (FFWC) has already established video outreach efforts to teach claw removal ([youtube.com/watch?v=YTgXTS8gLjU](https://www.youtube.com/watch?v=YTgXTS8gLjU)), but new knowledge of long-term effects may need to be considered to maintain this fishery, as well as outreach directed at providing science education to Youtube commenters.

REFERENCE

Duermit, E., P. R. Kingsley-Smith, and D. H. Wilber. 2015. The consequences of claw removal on stone crabs *Menippe* spp. and the ecological and fishery implications. *North American Journal of Fisheries Management* 35(5):895-905. [dx.doi.org/10.1080/02755947.2015.1064836](https://doi.org/10.1080/02755947.2015.1064836)

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