

Implications of alternative spawning for bluefin tuna remain unclear

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The discovery of 67 bluefin tuna larvae in waters off the northeast US continental shelf is certainly of considerable scientific interest, but the paper in PNAS by Richardson et al. (1) makes several broad assertions that go beyond what the data support. The authors extrapolate differences in larval catch rates to conclude that the majority of spawning occurs outside of the Gulf of Mexico. This contention equates 1 y of opportunistic samples with 32 y of a design-based survey, fails to apply standard larval data corrections (2, 3), and ignores the high variance that makes comparison of these catch rates unreliable. The situation resembles the 1985 discovery of larvae offshore of the Carolinas (4), a similar northward range extension presented with the caveat that “low catches limit the precision of results” and a need to “rein in unwarranted speculation.” Similar imprecision in Slope Sea catch rates warrants similar caution until the current and historical importance of spawning in this area to the population can be confirmed with additional research.

More concerning is the claim that western Atlantic bluefin tuna mature earlier, and are therefore less vulnerable to exploitation. Stock assessments routinely consider younger (4 y of age) maturity as a sensitivity evaluation (5). Under that assumption, spawning stock biomass estimates are higher, but the number of recruits produced per spawner is lower. Stock recruitment relationships derived externally from these estimates indicate proportionally higher spawning biomass and lower fishing mortality rates are needed to achieve the maximum

sustainable yield, resulting in less optimistic appraisals of stock status (Fig. 1). In other words, maintaining the same catch, size composition, and index trends with a greater spawning biomass implies that the stock is less productive, and therefore more vulnerable to exploitation, exactly the opposite conclusion of Richardson et al. (1).

Although early-maturing species often exhibit greater resilience to fishing, vulnerability assessments of bluefin tuna do not apply this generalization in isolation of other information. The Convention on International Trade in Endangered Species (CITES) (6) and US Endangered Species Act (7) listings recently considered for Atlantic bluefin tuna placed primary consideration of vulnerability upon products of population dynamic models: specifically and respectively, the rate of historical decline (6) and probability of extinction (7).

In summary, the paper by Richardson et al. (1) could have important implications for resilience of the species to fishing and climate change, but it makes several premature claims that carry considerable risk of being misused. Any conclusions regarding vulnerability should only be made in a population dynamics context with full consideration of the wealth of information now available through enhanced research programs. Furthermore, comprehensive larval and reproductive sampling, tagging, oceanographic modeling, and genetic analyses should be initiated not only for the Slope Sea but also for other areas of known or potential spawning.

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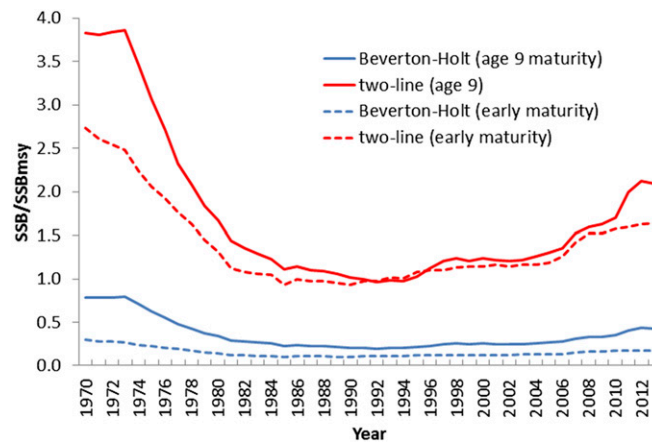


Fig. 1. Estimates of Western Atlantic bluefin tuna spawning stock biomass relative to spawning stock biomass at maximum sustainable yield (SSB/SSBmsy) under two age at maturity assumptions and two alternative stock-recruitment hypotheses. SSB/SSBmsy values less than 1 indicate that the stock is overfished.

- 1 Richardson DE, et al. (2016) Discovery of a spawning ground reveals diverse migration strategies in Atlantic bluefin tuna (*Thunnus thynnus*). *Proc Natl Acad Sci USA* 113(12):3299–3304.
- 2 Richardson DE, Hare JA, Overholtz WJ, Johnson DL (2010) Development of long-term larval indices for Atlantic herring (*Clupea harengus*) on the northeast US continental shelf. *ICES J Mar Sci* 67(4):617–627.
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- 4 McGowan MF, Richards WJ (1989) Bluefin tuna, *Thunnus thynnus*, larvae in the Gulf Stream off the Southeastern United States: Satellite and shipboard observations of their environment. *Fishery Bulletin* 87(3):615–631.
- 5 ICCAT (2014) *Report of the 2014 Atlantic Bluefin Tuna Stock Assessment Session* (ICCAT, Madrid).
- 6 CITES (1994) *Convention on International Trade in Endangered Species of Wild Fauna and Flora*. 85 Resolution Conf. 9.24 (Rev. CoP16) (Fort Lauderdale, FL).
- 7 Federal Register 76(105) (2011) pp 31556–31570.