Supplementary text

Comparative sampling

A consistent Atlantic mackerel (*Scomber scombrus*) egg survey has occurred in the Gulf of St. Lawrence, Canada, since 1979 (Fig. 1 in main article), with a few gaps in sampling. As with sampling on the northeastern U.S. continental shelf, a 61-cm bongo frame with 333-μm mesh is deployed in the Gulf of St. Lawrence to a maximum depth of 50 m (versus 200 m in the United States) and with a minimum tow time of 10 min (versus 5 min in the United States) are used. In developing a joint U.S.-Canada egg index, we used all annual egg production and spawning stock biomass estimates from the assessment conducted in 2017 by the government of Canada (DFO, 2017).

We reanalyzed data from sampling of Atlantic mackerel eggs on the northeastern U.S. shelf in 1932 (Sette, 1943) and by the RV *Dolphin* cruises in 1966 (Berrien, 1978). The data from these surveys provide an estimate of regional egg production prior to the substantial landings of the early 1970s. The sampling in 1932 used an oblique tow of a net with a 1-m diameter outfitted with a flowmeter. For stations with bottom depths greater than 50 m, 2 nets were towed, with 1 net targeting depths of 0–20 m and the other net targeting depths of 22–45 m. Sampling occurred at fixed stations during 7 cruises from 2 May through 20 June 1932, with a total of 163 stations sampled. The sampling domain extended from the Chesapeake Bay in the south (36.7°N) to Martha's Vineyard in the east (70.5°W), with the Gulf of Maine not sampled. Temperature measurements were made at the surface and at a few points through the water column, but there were not enough collected to resolve the average temperature of the upper 10 m of the water column (Bigelow, 1933). Eggs were assigned to 1 of 3 stages, with stage A eggs corresponding to stage 1 eggs in the recent sampling. The procedure in Sette (1943) for

calculating egg abundances (measured as number of eggs per square meter) was maintained, and sea-surface temperature was used to determine incubation times. A weighted mean daily egg production per square meter for each cruise was calculated, with weighting factors corresponding to the area of the shelf nearest to each station. The same spawning seasonality curve used in the analysis of recent data was used to calculate annual egg production from cruise-specific values of daily egg production.

We also reanalyzed data from the sampling conducted on the RV *Dolphin* from south of Cape Hatteras, North Carolina, to Cape Cod, Massachusetts, during 2 cruises during 13–22 May 1966 and during 17–29 June 1966. This survey used 2 simultaneously towed Gulf V samplers (Arnold, 1959); one sampler covered depths of 0–15 m and the second sampler covered depths of 18–33 m. Flowmeters were not used; instead an estimate of 495 m^3 of water sampled was applied to all tows. Contamination of the deep net during passage through the shallower layer was accounted for by deducting 10% of the shallower catch of mackerel eggs from the deep catch. The amount of time the deep net spent in the shallow layer was used to derive this 10% value. Each cruise sampled 122 stations on 11 cross-shelf transects, with closer station spacing at the inshore edge. A 2-stage weighting factor was used in calculating average daily egg production to account for the transect sampling. First, for each transect we estimated the relative proportion of the continental shelf from Cape Hatteras (35.5°N parallel) to south of Nantucket, Massachusetts (70°W meridian), represented by that transect. This estimation was done by generating polygons that encompassed areas of the continental shelf nearest to each transect. Second, given the uneven spacing of stations along the transect, a relative weighting factor was developed to account for the distance along the transect represented by each station. The product

of these 2 factors was used as the station weighting factor. All additional calculations matched those used for analyzing data collected since 1977.

References

Arnold, E. L., Jr.

1959. The Gulf V plankton sampler. *In* Galveston Biological Laboratory fishery research for the year ending June 30, 1959. U.S. Fish Wildl. Serv. Circ. 62, p.111–113. [Available from website.]

Berrien, P. L.

1978. Eggs and larvae of *Scomber scombrus* and *Scomber japonicus* in continental shelf waters between Massachusetts and Florida. Fish. Bull. 76:95–115.

Bigelow, H.

1933. Studies of the waters on the continental shelf, Cape Cod to Chesapeake Bay. 1. The cycle of temperature. Pap. Phys. Oceanogr. Meteorol. 11, no. 4, 135 p. Contrib. no. 34 Woods Hole Oceanogr. Inst. [Available from website.]

DFO (Fisheries and Oceans Canada).

2017. Assessment of the Atlantic mackerel stock for the Northwest Atlantic (Subareas 3 and 4) in 2016. Can. Sci. Advis. Secr. Sci. Advis. Rep. 2017/034, 15 p. [Available from website.]

Sette, O. E.

1943. Biology of Atlantic mackerel (*Scomber scombrus*) of North America. Part 1: early life history including growth, drift, and mortality of the egg and larval populations. Fish. Bull. 50:149–237.