Developing Maturity Schedules for Data-Poor Commercially Important Flatfishes in the Eastern Bering Sea and Aleutian Islands

NOAA FISHERIES

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INTRODUCTION

The proportion of a population mature by age is an important metric of fish populations, and plays a critical role in the formulation of fishing reference points and harvest specifications. In an effort to substantially update maturity inputs to age-structured stock assessment models for commercially important flatfishes (Pleuronectidae) within the Bering Sea-Aleutian Islands (BSAI) management area, several species were targeted to obtain and/or update maturity information. Maturity information is unique in that it directly affects estimation of fishing rate reference points such as F_{ABC} and F_{OFL} and can thus have a large influence on the recommended harvest level of stocks. New data on maturity-at-age can result in changes in the values of the fishing mortality reference points and the estimate of female spawning biomass. In order to meet this objective, ovary and otolith (age structure) samples were collected from pre-spawning and spawning females for subsequent histological analysis and ageing. The maturity estimates generated from this study will be incorporated into current age-structured stock assessment models to provide updated spawning stock biomass (SSB) estimates.

METHODS

Flatfishes in this maturity study were collected from both fishery-independent and –dependent sources in the eastern Bering Sea. Yellowfin sole (*Limanda aspera*) samples were collected during the summer of 2012 aboard the Alaska Fisheries Science Center (AFSC) annual groundfish survey of the eastern Bering Sea continental shelf. Alaska plaice *Pleuronectes quadrituberculatus* and flathead sole *Hippoglossoides elassodon* were collected during commercial fishing operations during late winter and early spring of 2012 and 2013. For Alaska plaice, specimens collected during 2013 were used to estimate age and length at maturity. For each specimen, the fork length (FL, cm) and total weight (g) was recorded for each female specimen sampled. The blind-side ovary from each specimen was excised and placed inside a cloth specimen bag with a label and preserved in 10% buffered formalin until laboratory processing. Otoliths were collected and either stored dry in plastic vials or in a glycerol-thymol solution. The presence of yolk was a defining feature for mature specimens under histological analysis. Data was fitted to a logistic equation to estimate length and age at 50% maturity using generalized linear modeling under the statistical package R. Age-structured stock assessment models were run using ADMB based on the new maturity information.

Figure 1. Ovaries from an Alaska plaice (a) and flathead sole (b) in near-spawning to spawning condition. These fish exhibited advanced oocyte vitellogenesis and hydration under histological analysis.

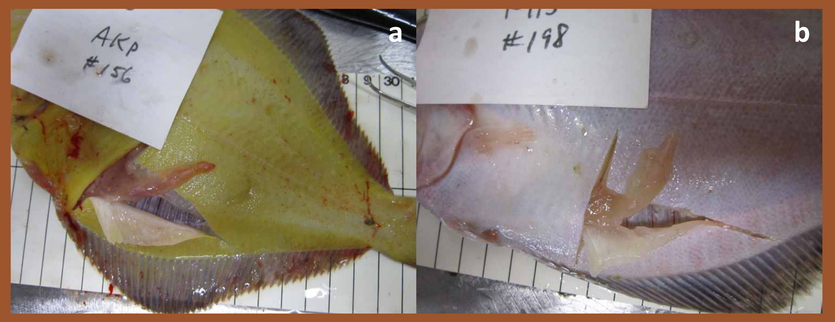

Figure 2. Immature ovaries from an Alaska plaice (a) and flathead sole (b). This fish exhibited non-vitellogenic oocytes under histological analysis.

Table. Differences in estimated female spawning stock biomass (t) between old data used in the current stock assessment and the data based on new maturity information from this study.

Species	Stock assessment	This study	Percent difference
Yellowfin sole	576,652	630,713	9.3
Alaska plaice	257,418	245,928	4.7
Flathead sole	243,334	265,345	9.0

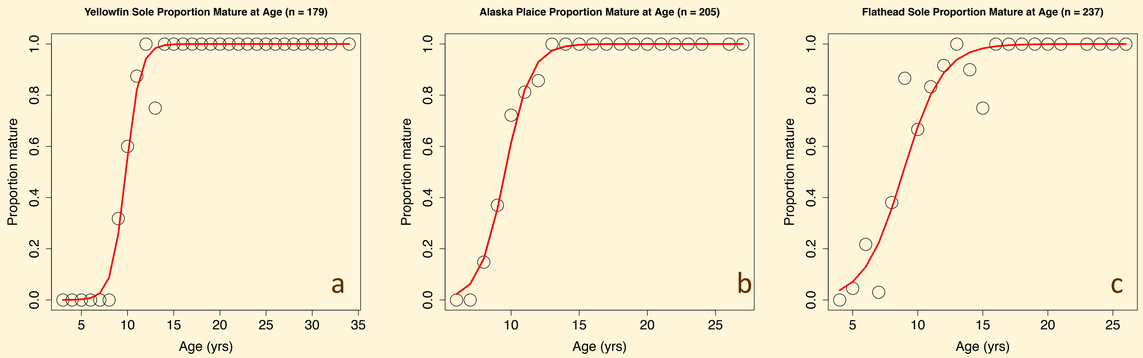

Figure 3. Maturity-at-age ogives for yellowfin sole (a), Alaska plaice (b), and flathead sole (c).

RESULTS

Age and length at 50% maturity for yellowfin sole were estimated at 9.8 years at 29.1 cm. This age at maturity estimate represents a slight decrease from the 1992-1993 estimate that is currently used in the stock assessment model (10.5 years). For Alaska plaice, age and length at 50% maturity was estimated at 9.6 years and 31.9 cm. These updated maturity estimates for Alaska plaice will replace prior estimates derived from a less reliable method of visual observations in the field from the 1980s. The age at 50% maturity estimate for flathead sole was 8.9 years, corresponding to a length at 50% maturity estimate of 34.2 cm. These current estimates for flathead sole represent an update to estimates derived from samples collected in 1999-2000.

DISCUSSION/CONCLUSIONS

Our objective to collect samples necessary for developing maturity schedules for the proposed deep-water flatfish species (arrowtooth flounder, Kamchatka flounder, and Greenland turbot) were not successful, but general notes on their reproductive biology have been documented similar to the other species. Maturity estimates for yellowfin sole indicate that this species matures at slightly younger ages than the 1992-1993 samples indicated with the effect that the stock assessment model estimates of 2013 female spawning biomass are 9% higher using the updated maturity schedule. The reference fishing mortality rates changed only slightly. The histologically-determined maturity analysis of Alaska plaice yielded results that were close to the anatomically-derived estimates with only a 5% decrease in estimated 2013 female spawning biomass with respect to the prior estimates. For flathead sole, a preliminary run of the stock assessment model resulted in a 9% increase in estimated female spawning biomass. The maturity ogives calculated for yellowfin sole, Alaska plaice, and flathead sole are now available to update the 2014 BSAI stock assessments for these species.

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