

**Discrimination Among U.S. South Atlantic and Gulf of Mexico King Mackerel
Stocks with Otolith Analysis and Otolith Microchemistry
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Study Objective: To develop natural tags based on otolith microchemistry and shape analyses to: (1) be employed to estimate the relative contribution of each stock to the winter fishery off southeastern Florida, as well as region-specific mixing proportions around peninsular Florida in winter; and (2) establish methods enabling annual estimation of stock mixing to facilitate more effective management of U.S. king mackerel stocks.

Methods and Materials: King mackerel were sampled from recreational landings from northeastern Florida to North Carolina in the Atlantic and from northwestern Florida to Mississippi in the Gulf of Mexico (Gulf) in summer 2001 and 2002 when Atlantic and Gulf stocks were separate. Fish also were sampled from commercial and recreational landings taken from three zones around the southern tip of Florida in winter 2001/02 and 2002/03 when stocks were mixed. Individuals were measured to fork length (FL) and sagittal otoliths were extracted. Opaque zones in one otolith were counted to estimate age and the second otolith was used for otolith shape and otolith chemistry analyses.

Otolith shapes first were digitized with an Image Pro image analysis system. The software then was used to compute otolith roundness, circularity, rectangularity, area, perimeter, and the first 20 Fourier amplitudes. The relationship between all shape variables and fish size was removed by subtracting the common slope. Variables were tested for normality and homogeneity of variances and transformed accordingly. Stepwise discriminant function models were built with shape data to distinguish between stocks. Finally, maximum likelihood models were parameterized with summer shape data and applied to winter landings to estimate the stock composition of winter landings from each south Florida zone.

Once shape analysis was complete, otoliths were processed for chemical analysis. Otoliths were rinsed with ultrapure water and scrubbed with a synthetic bristle brush to remove any surface tissue. Otoliths then were flooded with 1% ultrapure nitric acid to oxidize remaining tissue and clean their surfaces. Cleaned otoliths were rinsed repeatedly with ultrapure water and allowed to air dry under a class-10 clean hood. Dry otoliths were weighed on a microbalance and dissolved in ultrapure nitric acid. Otolith solutions were spiked with Indium as an internal standard and their chemical composition analyzed with magnetic sector-inductively coupled plasma-mass

spectrometry (MS-ICP-MS). Statistical analysis of stock-specific otolith elemental signatures of summer-collected fish and estimation of stock composition of winter landings followed the same methodologies as were used with otolith shape data.

Conclusions and Recommendations: Results from otolith shape analyses indicate shape data should be handled separately for males and females and between years. Jackknifed classification accuracies computed from discriminant functions ranged from 68.7 to 76.4 among all models, indicating shape analysis was an effective tool to distinguish between king mackerel stocks. Maximum likelihood estimation of winter stock composition of the three zones in south Florida indicated extensive mixing between stocks that is contrary to the current management strategy of assigning all south Florida winter landings to the Gulf stock. Otolith chemistry analyses and statistical tests are ongoing, but preliminary results indicate higher stock classification accuracies for summer-sampled fish than those achieved with shape data. Analysis of winter-sampled fish is ongoing but those results will be presented at the MARFIN conference.

Our results indicate assigning all winter landings taken from the mixing zone in south Florida to the Gulf stock does not reflect true mixing conditions. Methods developed during this study provide tools to estimate the composition of winter landings and assign winter landings to either the Atlantic or Gulf stock. We recommend ongoing studies to estimate the stock composition of south Florida winter landings and that our estimates be used in future stock assessments and management plans.