Validation of annual formation of growth zones in otoliths of red porgy, *Pagrus pagrus*

Validación de la formación anual de zonas de crecimiento en otolitos de pargo rojo, *Pagrus pagrus*

Validation de la formation annuelle des zones de croissance dans les otolithes de Pagre rouge, *Pagrus pagrus*

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EXTENDED ABSTRACT

Accurate age information is foundational for calculations of growth and mortality rates in fish (Campana 2001). Age estimates are critical inputs for contemporary stock assessments, which rely heavily on age composition, growth estimates, age-based reproductive parameters and estimates of natural mortality for the fishery stocks. The U. S. South Atlantic red porgy (*Pagrus pagrus*) stock is presently overfished and undergoing overfishing, and stock recovery has not been achieved through recent management efforts (SEDAR 2020). After two southeastern U. S. laboratories submitted data for the first Southeast Data, Assessment and Review process (SEDAR; SEDAR, 2002), it was discovered that the age readings were not consistent between the labs. One laboratory read the otoliths whole, and the other read sections from the otoliths. Ages from reading the sectioned otoliths were biased high by approximately 0.5 years compared to the readings from whole otoliths. In addition, the oldest fish, >12 years, were underaged when reading whole otoliths compared to the sections. Thus, an age validation study of red porgy was undertaken to determine if the opaque zones, presumed annuli, were formed once per year and to identify the first annulus.

During this study, adult Red Porgy were caught with vertical hook and line gear from offshore waters of North Carolina during December of year-1 and then held in an aquaculture facility. Seasonal demersal water temperatures and natural day/night cycle were maintained throughout the study. The adult fish were injected with calcein in March following their capture. They volitionally spawned in the winter of year-1 and year-2 of the study. Progeny from year-1 were injected with calcein in March, on the first anniversary of their hatching. The wild caught fish and the spawned fish were held from 1 month to two years. The otoliths were extracted from 54 wild caught fish and 161 of the spawned and reared fish. Otoliths were viewed whole and after sectioning to record paired age estimates. The position of the calcein mark on the otoliths in relation to expected growth zone formation was noted. In addition, radial measurements from the core area to opaque zones and the otolith margin in the transverse plane were recorded on the otoliths from the spawned and reared fish.

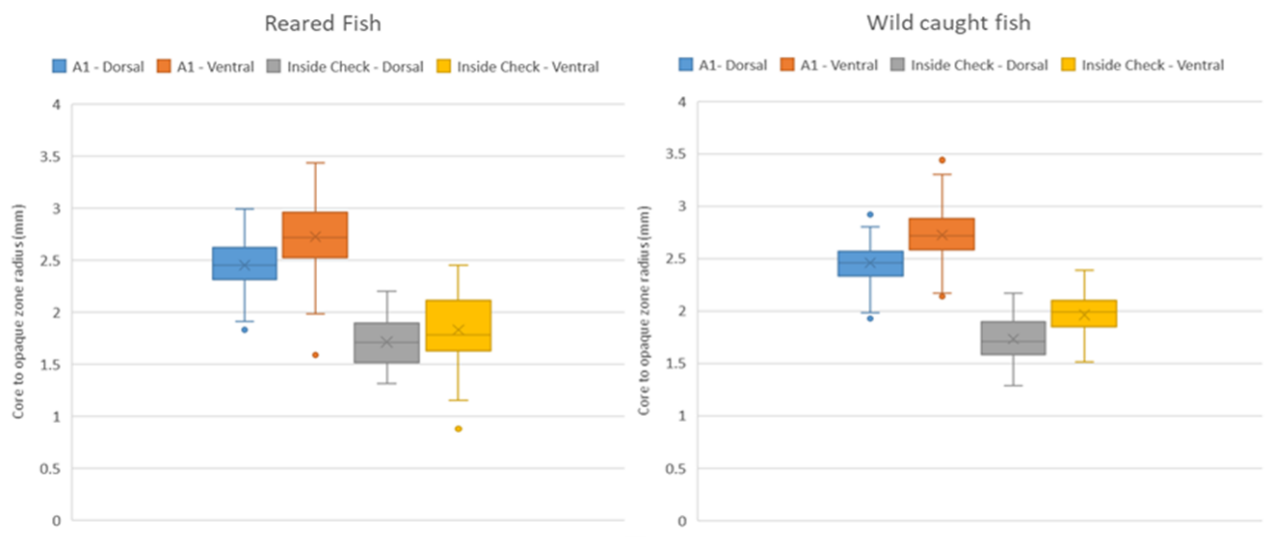

Figure 1. Radial measurements from core to true, first annulus (A1) and inside check mark in the transverse plane to the dorsal and to the ventral side. These measurements were taken on the sectioned otoliths of young-of-year and 1-year old red porgy, which were spawned and reared in this study and wild caught fish.

Results of the study showed the expected amount of otolith growth zone deposition on all otoliths after the first year, but a different formation pattern was noted for the first annulus. The known age spawned and reared fish revealed the first true annulus and identified a strong opaque zone inside of the true annulus, considered to be a check mark. This check mark was noted on 16% of the whole otoliths, but was seen on 45% of the sectioned otoliths. To corroborate these findings, otoliths from small wild caught fish, presumed young-of-year and one-year olds, were obtained. They exhibited a distinct opaque zone inside of the true first annulus on 14% of the whole otoliths and on 44 % of the sectioned otoliths. From the sectioned otoliths, the radial measurements to the first annulus and the inside opaque zone were similar on both the reared fish and the wild fish (Figure 1), and averaged 2.45 mm in the dorsal plane and 2.72 mm in the ventral plane. The radial measurements from the whole otoliths were similar.

This study was successful in validating the annual deposition of growth zones on the otoliths of red porgy and identifying the first annulus. The radial measurements to the first, true annulus can be used as a guide when estimating the age of red porgy. All subsequent opaque zones should be counted as annuli. We recommend that all otoliths be sectioned prior to age reading, especially for the oldest fish. As the fish gets older, the opaque zones become tightly spaced making the individual annuli difficult to enumerate.

KEYWORDS: red porgy, *Pagrus pagrus*, age validation, otoliths

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