A Novel Procedure to Process Ocean Whitefish, *Caulolatilus princeps*, Otoliths in the Galapagos Marine Reserve

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Background

Ocean Whitefish (*Caulolatilus princeps*) (Fig. 1) is an endemic species in the Galapagos Marine Reserve, Ecuador and is important economically in both the artisanal fishery and as a local food source. However, little is known about its life history in this region. To discern age structure information in the fishery for bony fish such as *C. princeps*, it is common to determine the count of annual growth rings on the species' otoliths, or ear bones (Fig.1). The goals of this study were 1) to identify the most repeatable and accurate method for aging *C. princeps* from the examination of adult otoliths, and 2) to characterize the age structure of fish caught in the fishery, in the Galapagos.

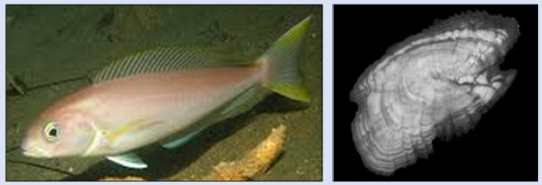

Fig 1. A photo of *Caulolatilus princeps* and its unprocessed sagittal otolith.

Methodology

Sagittal otoliths were collected from fish caught in artisanal fishing locations around Santa Cruz Island, Ecuador (Fig. 2) and processed and analyzed at the Charles Darwin Research Station Marine Sciences Department laboratory. Fish selected for processing were drawn randomly from a large population and were similar in size and range across all subsamples. Samples (n=49) of otoliths each received one of five different otolith preparation procedures in order to visually count growth bands. Otoliths contain alternating clear and opaque bands of growth. Age was estimated by two readers independently counting bands (2x) without knowledge of the sex or size of the fish.

Fig 2. Popular artisanal fishing locations around Santa Cruz Island.

Procedures

Procedure 1: Burning Whole Otoliths in an Oven (Elorduy-Garay & Díaz-Uribe, 1994)

Selected otoliths were placed in a household oven at 250°C for 7.5 minutes.

Procedure 2: Otoliths Polished in Resin (The Campana Lab Sectioning Method)

Otoliths were encapsulated with Epo-fix™ Cold-setting embedding resin following protocols from the manufacturer. Sections were polished on both sides using wet-or-dry paper and 3M diamond lapping film (30MIC grade 127.0 mm) until growth bands were visible.

Procedure 3: Otoliths Cracked and Burned (Christensen, 1964)

Otoliths were cracked in half and polished using 3M diamond lapping film (30MIC grade 127.0 mm) until smooth, then subjected to an open flame from a candle.

Procedure 4: Whole Otoliths Soaked in Hydrogen Peroxide (Green et. al., 2002)

Otoliths were soaked in 30% hydrogen peroxide for 10 minutes, concave up, and dried to remove the hydrogen peroxide.

Procedure 5: Otoliths Burned Over a Flame (unpublished) (Fig. 3, Fig. 4)

Selected otoliths were held 2-3 inches above an open flame, concave up. Otoliths were held above the flame for 10-30 second intervals, 2-5 times.

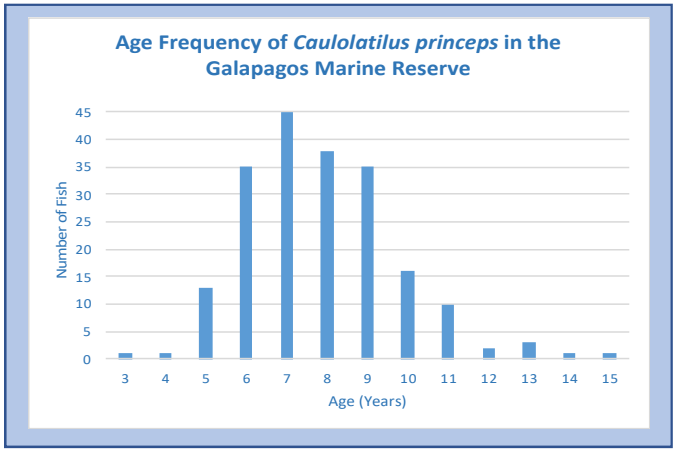

Fig. 5. Distribution and frequency of age in *C. princeps* in the Galapagos Marine Reserve.

Results

Otoliths were most accurately processed with our novel, Procedure 5 (Fig. 3, Fig. 4) (20% Agreement, 6.54 Coefficient of Variance between readers, St. Dev.± 1.20). Burning the whole otolith concave up over an open flame provided the most dramatic color change. Procedure 5 contrasted the annuli without highlighting the seasonal growth rings (Fig. 4). Both recorders struggled with other procedures, and in some, failed to detect any growth bands. Procedure 5 always had distinct annuli demarcations. Using this procedure, we estimated the age structure of *C. princeps* in the Galapagos fisheries. A vast majority of fish in the fishery ranged from 6 – 10 years, with the average approximately 8-years old (Fig. 5).

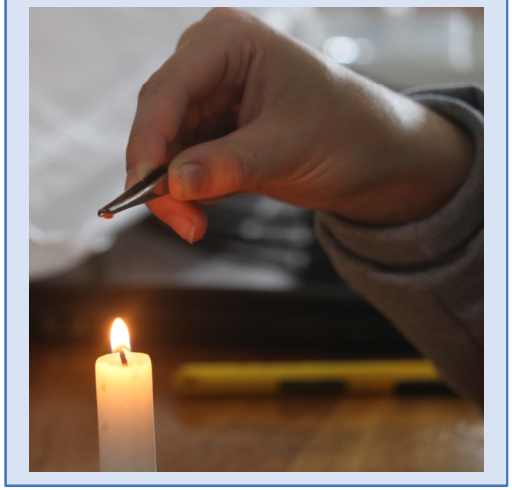

Fig. 3. Photo depicting our novel procedure, Procedure 5.

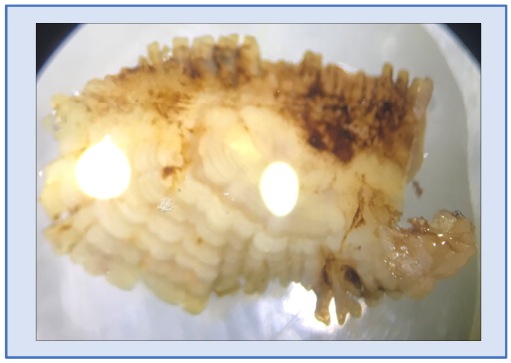

Fig. 4. *Caulolatilus princeps* otolith processed by Procedure 5.

Discussion

Our results suggest that the fish used in our study were fished from areas of maximum spawning, as old fish (>10 years old) in the fishery were not common. We found the artisanal fishery captured many young adults, which are likely not reproductively mature, suggesting that the current fishery is unsustainable. While research is still being conducted, we advise that in order to sustain the health of *C.* princeps populations in the Galapagos Marine Reserve, changes will have to be made in the artisanal fishery. This is vital to sustain *C. princeps* as a food source for both the human consumer living in Galapagos, and the health and sustainability of the fish species.

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