Growth of white anglerfish (*Lophius piscatorius*) tagged in the northeast Atlantic and review of age validation studies

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Objective

The growth estimated from the first tagging experience in southern European waters is analysed. A revision of growth was performed based on all available information on growth validation of white anglerfish in Atlantic waters, such as other tagging-recapture study, modal lengths of catches and microstructure analysis of hard parts.

1. Tagging in southern European waters

50 white anglerfish were recovered of 1326 tagged with external tags (spaghetti T-bar anchor), in southern European waters (ICES Divisions VIIb-k, VIIIa,b,c,d, and IXa), from 1995 to 2004. The recovery index was 2.6%.

The growth rate was estimated for the specimens were at liberty for more than 9 months, thus allowing an extrapolation of the growth rate to an annual period. The mean growth rate determined from them was 13.6 cm yr⁻¹.

2. Lengths at first ages from studies on growth validation

The available validated growth evidences of white anglerfish in Atlantic waters were considered: micro-increments (Wright et al., 2002), tagging-recapture (Laurenson et al., 2005) and modal lengths (Fulton, 1902; Dupouy et al., 1986; Thangstad et al., 2002; Landa, 2004; Jónsson, 2004). There are enough similarities between the results of the studies in spite of the different areas covered. Mean lengths at age at the end of the hatching year may be around 20 cm, depending on the hatching season. The mean length at age 1 might be around 27 cm and the mean length at age 2, around 40 cm.

3. Annual growth rates at length

Growth rate data by length from the present and previous studies were fitted to functional relationships, and the one providing the best fit was chosen. Most of the growth validation studies (tagging-recapture and modal lengths) showed a similar and decreasing growth rate with increasing length: 12-16 cm year⁻¹ for the length range 10-30 cm; 8-12 cm year⁻¹ for the length range 30-50 cm; 7-8 cm year⁻¹ for 50-60 cm; and 6 cm year⁻¹ for 60-80 cm.
The two smallest recaptures of the present study showed a higher growth rate than the other growth validation studies; however the two biggest recaptures showed similar growth rates.

Up to 50cm, the overall results of the validation studies showed a higher growth rate than those from illicia ageing.

The illicia and otoliths ageing is based on as yet unvalidated ageing criteria. Therefore, a validated overall growth based only on tagging-recaptures and modal lengths studies was estimated.

4. Growth at age: VBGF parameters and annual mean lengths at age

- The evidence suggests that the validated overall growth is faster than that estimated by illicia ageing in recent studies, especially in smaller lengths. Counting the first ring in illicia readings, which may not be a true annual ring (Wright et al., 2002), could, in part, be contributing to the underestimation of growth in smaller specimens. Taking the first assumed annual ring to be a false ring, the growth rates in Dupouy et al., (1986) are similar to the overall growth estimated with all the growth validation evidences. However, in the other illicia ageing studies (Duarte et al., 1997, Quincoces et al., 1998 and Landa et al., 2001) 1 or 2 false rings are counted as annual rings respectively between age classes 3 and 5. This shows that a slight drift has taken place over time from the illicia ageing criterion of Dupouy et al. (1986). Illicia can still be considered valid calcified structures for ageing, but it is necessary to establish a way of distinguishing the annual rings assumed to be false from the true annual rings that appear in the first part of the illicia for northern and southern stocks. The way ahead for could be to take up again the ageing criterion of Dupouy et al. (1986) but without counting the first increment as a true annual ring, where the mean lengths at age are very similar to those of the validated overall growth. Also, the observation magnifications and the thinness of the slice probably allow more rings to be seen, some of them false ones at small lengths. Research into these possibilities may improve it.

The growth pattern based on illicia from Quincoces et al. (1998) has been the used one until now in the annual assessment of the northern stock of white anglerfish in the ICES WGHMM (ICES, 2006). Therefore, using an inaccurate ageing criterion has important repercussions.

- In sectioned otoliths, the growth up to age 6 of Crozier (1989) is the most similar to the validated overall growth and also that of Woodroffe et al., (2003), without counting the first ring. However Crozier (1989) did not recommend that sectioned otoliths can be reliably used for the age analysis of specimens older than 6 years, due to the multi-ring appearance of the annulus is compacted as annihilus become progressively closer together. More research in the ageing methodology in ages older than 6 years is very necessary to be used in the routinely stock assessment procedure.

Growth from validation studies covered the first part of the length range of this species, and definitive conclusions on growth throughout the length range can only be drawn when more information on validation is available covering all size/age classes. And tagging is a very promising method for it.

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References