

Review information on anchovy age estimations, otolith exchanges, workshops and validation work done so far

*ToR a*

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## Background of the age determination of anchovy in European waters

- ✓ The anchovy is a species that is assessed in most of the stocks that are distributed in European waters. The assessments are conducted within the framework of ICES for the area Atlantic stocks and in the GFCM for stocks in the Mediterranean Sea.
- ✓ There is an international age reading protocol and a consensual age reading criteria for Atlantic and Mediterranean areas from the last Workshop on Anchovy age reading in 2009 (ICES WKARA 2009).
- ✓ In the past, from the decades of the 90s, exchanges, workshops and checks on determination of age of anchovies have been made in the Atlantic areas (Bay of Biscay and Gulf of Cadiz). However, no proper exchanges or workshops on reading procedures of European anchovy otoliths have been held in Mediterranean areas until 2009.
- ✓ Since 2009, there have been two exchanges and one workshop on Anchovy otoliths taking into account both areas, the Atlantic and the Mediterranean together.
- ✓ 2008 PGCCDBS recommends the realization of first otolith exchange and workshop of anchovy between the Atlantic and Mediterranean areas together
- ✓ 2014 PGCCDBS identified the need of a full-scale European Anchovy otolith exchange to take place in 2014.
- ✓ 2015 WGBIOP recommends the realization of Workshop on Age Reading of Anchovy for all European countries in 2016

## Summary of the last annual growth workshops and exchanges

WK/Exchange	Area	Mode of preparation	% Agreement (All readers/area readers)	CV
Exchange 2014	English Channel-VII	Whole otolith, in resin (only images)	66.7/-	127.6
	Bay of Biscay-VIII		74.3/90.9	45.1/11.4
	Division IXa		68.5/75.7	49.1/33.0
	Albora Sea- GSA01		58.9/-	58.7/-
	Western Mediterranean-GSA06		60.9/-	49.9/-
	Gulf of Lion - GSA07		73.4/-	31.3/-
	Southern Tyrrhenian-GSA10		62.9/67.3	67.2/58.1
	Strait of Sicily-GSA16		58.5/85.6	78.7/11.2
	Western Ionian –GSA19		61.9/73.5	60.9/55.3
	Aegean Sea-GSA22		70.0/97.1	55.7/6.7
WKARA 2009	Bay of Biscay	Whole otolith, in resin (otoliths and images)	86.2/92.5	41.4/8.1
	Alboran Sea		75	66.40
	Strait of Sicily		61.9	67.30
Exchange 2009	Bay of Biscay	Whole otolith, in resin (otoliths and images)	72.2/ 88.8	84.5/12.9
	Gulf of Cadiz IXa		58.30	68.1
	North of Morocco		60.7	99.8
	Alboran Sea		64.1	61.6
	North Adriatic Sea		55.60	72.2
	Gulf of Lion		71.50	37.40
	North Adriatic Sea	Whole otolith, in alcohol (otoliths and images)	60.30	63.3

**Summary of age validation methodologies used for small and medium pelagic species in European waters (ICES CRR, submitted)**

Method	Annual/Daily Validation	Pelagic species in which this validation techniques has been employed
Marginal increment analysis/Edge zone analysis	A	<u>Anchovy</u> , Sardine, Sprat, Chub Mackerel, horse mackerel, Mediterranean horse mackerel
Progression of strong year-classes	A	<u>Anchovy</u> , Horse mackerel
Length Frequency analysis	A	<u>Anchovy</u> , Sardine, Chub Mackerel, Horse Mackerel, Mediterranean horse mackerel
Weight Frequency analysis	A	Sprat
Daily increments between annuli	A	<u>Anchovy</u> , Sardine
Daily increments widths	A	Herring, Sprat
Captive rearing	D	<u>Anchovy</u> , Sardine, Herring, Spratt, Mackerel

**Anchovy Age Validation: Marginal increment analysis/Edge zone analysis**

✓ Validation of anchovy annual ageing method is achieved following the marginal otolith structure development throughout the year for validating the periodicity of annual growth increment formation in some areas: Bay of Biscay, Gulf of Cadiz, Alboran Sea and North Adriatic Sea. In all cases the qualitative method was used, except in the Bay of Biscay that also a quantitative otolith growth analysis was made.

Validation Method	Area	Method	Time series	Age/Size Range	References
Marginal Increment Analysis/Edge Analysis	Bay of Biscay	Quantitative	2004-2009	Ages 1-4	Uriarte et al, 2016 (Supplementary material)
		Qualitative	1984-1992	Ages 0-3+	
	Gulf of Cadiz		2005-2008	Ages 1-4	Millan and Tornero, 2009
	Alboran Sea		Oct. 1989-Dec. 1992	All ages together	Giraldez and Torres, 2009
	North Adriatic Sea	Jan. to Dec. 2007	All ages together/ 10.5-16.5 cm	Donato and La Mesa, 2009	

## Anchovy Age Validation: Progression of strong year-classes

✓ The age estimation criteria of Bay of Biscay anchovy were also corroborated (or indirectly validated) by tracking year-classes abundance indices 1982-2013 in research surveys in the Bay of Biscay.

Validation Method	Area	Method	Time series	Age/Size Range	References
Progression of strong year-classes	Bay of Biscay	Successive modal lengths in the catches	1983-1986	Age 1-4	Uriarte and Astudillo, 1987
			1982-1992	8-20 cm	Uriarte, 2002
		Tracking abundance indices by age in surveys	1987-2013	Age 1-3	Uriarte et al. 2016

## Anchovy Age Validation: Length frequency analysis

✓ In the NW Mediterranean Sea, length frequency analysis methods were applied to corroborate the otolith interpretation and growth model parameters of anchovy.

Validation Method	Area	Time series	Age/Size Range	References
Length frequency analysis	NW Mediterranean Sea	April 1984-Oct. 1985	Age 0-4/5-18.5 cm	Pertierra, 1987
		Jan. 1987-Jun. 1989	Age 0-4 /6.5-20 cm	Morales-Nin and Pertierra, 1990

## Anchovy Age Validation: Daily increments between annuli

✓ Based on different daily growth studies, the position of the first annulus was validated (Aldanondo et al., 2016) and the position of the first false ring or check was corroborated in anchovy in the Bay of Biscay .

Validation Method	Area	Method	Time series	Age/Size Range	References
Daily increments between annuli	Bay of Biscay	Validation of first annulus	October 2012-April 2013	Age 1/8.5-13.6 cm	Aldanondo et al., 2016
		Corroboration of first check	2010-2011	Age 1/11.7-20.5 cm	Hernandez et al., 2013

## Other methods (no validation): Back-calculation of length

✓ In The Strait of Sicily, the back-calculation method was applied of anchovy to compare results from the growth model estimation. Back calculation of length should not be considered as neither validation nor corroboration (Campana, 2001), merely shows consistency in the interpretation .

Method	Area	Time series	Age/Size Range	References
Back calculation of length (no validation method)	Strait of Sicily	May 2000-Oct. 2001	Ages 0-3/7-16 cm	Basilone et al., 2004

## Conclusions

- ✓ Currently, monitoring of the age determination of Anchovy is well taken in European waters, especially concerning inter-laboratory calibrations and protocols, but not so well in what refers to age validations in different areas / stocks
- ✓ Indirect validations (marginal increment analysis, length frequency analysis, progression of year classes, Daily increments between annuli) for the annual age determination of European anchovy have been applied in some areas/stocks , but direct validations (Tagging and captive rearing) have not been used in any area/stock for annual growth.
- ✓ The majority of works attempting to validate annuli of anchovy apply the qualitative method of marginal increment analysis, one of the least rigorous methods.
- ✓ So far, there are only two areas/stocks (Bay of Biscay and Northern Western Mediterranean) where more accurate validation methods have been used and it has been published (Morales-Nin and Pertierra, 1990; Aldanondo et al., 2016; Uriarte et al., 2016). There are several areas/stocks in which validations for the anchovy annual age determination have been not done yet.
- ✓ The provision of age validation studies should be carried out for all anchovy stocks, and especially those that are assessed analytically
- ✓ Precision in age readings may be improved by workshops and otolith exchange, but the validation of the annual deposition of seasonal zones and the checks in the otolith represent the focal point to the improve the precision in the Anchovy age determination.



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