

ANALYSIS OF SEX-RATIO BY LENGTH-CLASS FOR BLUEFIN TUNA (*THUNNUS THYNNUS* L.) IN THE WESTERN MEDITERRANEAN AND EASTERN ATLANTIC

J.M. de la Serna¹, J.M^a Ortiz de Urbina², E. Alot²

SUMMARY

This article analyzes patterns of bluefin tuna sex-ratio by length-class for the Spanish trap fishery in the eastern Atlantic and the Spanish purse seine and longline fisheries in the Mediterranean Sea. Observed differences in sex-ratio patterns within and between fisheries are tackled in terms of differential maturation rates by sex and by fish origin.

RÉSUMÉ

Le présent document analyse les schémas du sex-ratio du thon rouge par classe de tailles pour la pêche espagnole de madrague dans l'Atlantique est, et les pêcheries espagnoles de senneurs et de palangriers dans la Méditerranée. Les différences observées dans les schémas du sex-ratio à l'intérieur des pêcheries et entre celles-ci sont examinées en termes de taux de maturation différentiels selon le sexe et l'origine du poisson.

RESUMEN

Este documento analiza patrones de ratio de sexos del atún rojo por clases de talla para la pesquería española de almadraza en el Atlántico oriental y en las pesquerías de cerco y palangre españolas en el mar Mediterráneo. Se examinaron las diferencias observadas en los patrones de ratio de sexos en y entre pesquerías en términos de tasas de maduración diferenciales por sexo y por origen de los peces.

KEYWORDS

Bluefin tuna, sex ratio, trap fishing, longlining, purse seining

1. INTRODUCTION

Several studies regarding bluefin tuna in the Atlantic and in the Mediterranean Sea have focussed on this biological parameter: Rodríguez- Roda (1964), Azevedo and Gomes (1985), Rey and Alot (1987), Rey *et al.* (1987), Arena (1963, 1979), de la Serna *et al.* (1992). The general conclusions for the aforementioned studies are that differences in the mortality ratios as well as differences in growth rates by sex result in different percentages of males and females by length-class. Furthermore, as regards bluefin tuna, these percentages are higher for females belonging to smaller length-classes and lower for females belonging to higher length-classes.

2. MATERIAL AND METHODS

Information on catch, effort, fishing location, size composition and sex identification from the Spanish purse seine, longline and trap fisheries for bluefin tuna in the Mediterranean and eastern Atlantic was collected by the Spanish Sampling and Information Network, which included several

¹ Tuna Department. Spanish Institute of Oceanography (IEO- CO Málaga. Spain). delaserna@ma.ieo.es

² Tuna Department. Spanish Institute of Oceanography (IEO - CO Málaga. Spain). delaserna@ma.ieo.es

landing ports as well as observers on board the vessels targeting bluefin tuna. To conduct this preliminary analysis information on 13135 fish was recorded.

3. RESULTS AND DISCUSSION

Sex ratio by length-class for each fishing gear is shown in **Table 1** and **Figure 1**. **Figure 1** includes approximate 95% confidence levels (Collet, 1991). A preliminary analysis of sex-ratio shows that patterns for purse seine and longline fisheries in the Mediterranean area are very similar in these fisheries and differ from the one observed in the trap fishery (eastern Atlantic area). In general, the proportion of females is higher than the proportion of males for several length classes (up to 210 cm for the Mediterranean fisheries and up to 230 cm for the Atlantic trap fishery), above these length-classes, the proportion of males is higher for both areas. This general pattern, common to both areas, is thought to relate to differences in growth rates and maturation rates among sexes: at present, it is accepted that bluefin tuna females become mature before males.

On the other hand, the observed specific differences between areas (a higher length class for the change in the proportion of females for the trap fishery as compared to the longline and purse seine fisheries) in addition to the fact that the proportion of males for length-classes less than 150 cm (theoretical age at first maturity) is lower for the trap fishery as compared to the fisheries in the Mediterranean area may reinforce the idea that there are differences in the sexual maturation depending on the Mediterranean or eastern Atlantic origin of the bluefin tuna (Hattour and Macías, 2001; El Tawil *et al.*, 2001). Hence, the proportion of mature bluefin tuna in pre-spawning or spawning season varies among areas.

At last, it can be also observed that the transition from higher female percentages to higher male percentages is drastic for the Atlantic trap fishery (that might be expected for an homogeneous shoal sharing identical maturation patterns) and smoother for the Mediterranean area fisheries, which might be the expectation under an heterogeneous fishery composed of fish of Atlantic origin and fish of Mediterranean origin.

4. ACKNOWLEDGEMENTS

The authors thank *Pesquerías de Almadraba* and *Ricardo Fuentes S.A* for their inestimable cooperation with the Instituto Español de Oceanografía regarding bluefin tuna research.

LITERATURE CITED

- ARENA, P. 1963. Observations dans la partie sud de la mer Tyrrhenienne sur les habitudes et le comportement du thon rouge pendant sa periode genetique. *Proc. Gen. Fish. Coun. Medit.*, 7: 395-411.
- ARENA P. 1979. Aspects Biologiques et comportement des concentrations genétiques du thon rouge en Méditerranée. Actes des colloques du CNEXO, 8:53-57.
- AZEVEDO M.M. y M.C. Gomes. 1985 Bluefin fishery in the Portuguese economic zone. ICCAT, SCRS/85/21,16pp.
- COLLET, D. 1991. Modelling Binary Data. Chapman and Hall, NY.
- DE LA SERNA, J.M y E. Alot, E, E. Rovera. 1992. Analisis preliminar del sex-ratio por clase de talla del Atún Rojo (*Thunnus thynnus*) capturado por las Almadrabas Atlánticas españolas durante el periodo 1988-1991. SCRS / 91/63.

- DE LA SERNA, J.M y E. Alot. 1992. Analisis del sex-ratio por clase de talla y otros datos sobre la madurez sexual del atún rojo (*Thunnus thynnus* L.) en el área del Mediterráneo Occidental durante el periodo 1988-1991. ICCAT.Col. Doc. Cien.Vol XXXIX(3) pag:704-709.
- TAWIL, M.Y., D. Macias, J. M. de la Serna. Preliminary study on age at fist maturity of bluefin tuna in Libyan waters. SCXRS/01/127.
- HATOUR, A., D. Macias, J.M. de la Serna. Bluefin tuna maturity in Tunisian waters: A preliminary approach. SCRS /01/128.
- REY, J. C., E. Alot, and J.L. Cort. 1987. Análises de las capturas de atun rojo por almadrabas españolas en 1984 y 1985. *ICCAT Col. Vol. Sci. Pap., XXVI (2):* 300-307.
- REY, J.C., E. Alot y J.L. Cort 1987. Análisis de las capturas de atún rojo (*Thunnus thynnus* L.) por las almadrabas españolas en 1984 y 1985. ICCAT.Col. Doc. Cien.Vol 26(2):330-307.
- RODRÍGUEZ RODA, J. 1964. Biología del atún (*Thunnus thynnus* L.) de la costa sudatlántica española. *Inv. Pesq.*, 25:33-146.

Table 1.- Sex- ratio by length-class for Spanish fisheries directed to bluefin tuna in the Mediterranean Sea and Straits of Gibraltar.

Length-class	Sex-ratio (proportion of females)		
	Longline	Purse seine	Trap
135	0.50		0.67
140	0.50	0.56	0.69
145	0.44	0.57	0.72
150	0.58	0.41	0.73
155	0.87	0.69	0.63
160	0.65	0.64	0.58
165	0.69	0.60	0.60
170	0.65	0.57	0.64
175	0.76	0.57	0.65
180	0.67	0.58	0.71
185	0.69	0.63	0.67
190	0.68	0.62	0.62
195	0.62	0.64	0.61
200	0.57	0.62	0.60
205	0.53	0.57	0.58
210	0.52	0.55	0.63
215	0.43	0.52	0.63
220	0.36	0.48	0.58
225	0.35	0.32	0.61
230	0.24	0.37	0.50
235	0.25	0.44	0.53
240	0.30	0.31	0.40
245	0.22	0.39	0.38
250		0.25	0.15
255		0.32	0.11
260		0.18	0.14
265		0.20	0.05
270			0.07
275			0.14
280			0.11

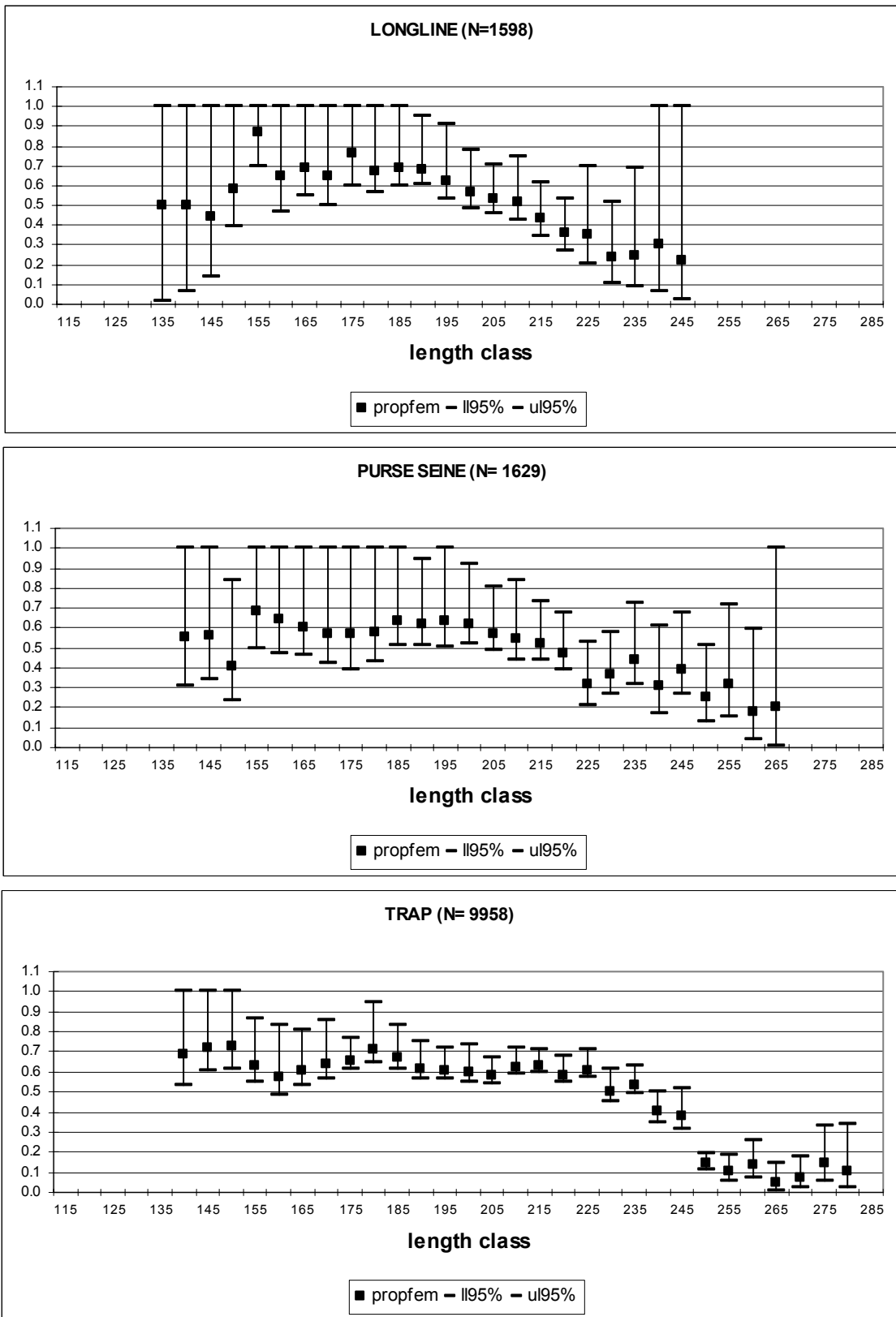


Figure 1.- Sex- ratio by length-class and approximate 95% confidence limits for several gears directed to bluefin tuna in the Mediterranean Sea and Straits of Gibraltar.