# OBSERVATIONS ON SMALL TUNAS CAUGHT IN THE TUNA TRAP FISHERY OFF SOUTHERN PORTUGAL (NE ATLANTIC) BETWEEN 1996 AND 2014

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*SUMMARY*

*This study reports on the trends of small tuna catches from a tuna trap operating off the southern coast of Portugal between 1996 and 2014. Landing and catch at size data from one tuna trap were available for bullet tuna (Auxis rochei), Atlantic bonito (Sarda sarda) and little tunny (Euthynnus alletteratus). Trends of intra- and inter-annual catches for the three species were analyzed. Landings occurred mostly during the 2nd and 3rd quarters, with peaks in May for A. rochei and in September for S. sarda and E. alletteratus. Catch at size data shows that similar size ranges of the three species were captured.*

*KEYWORDS: Small tuna, Algarve (Portugal) tuna trap catch, catch-at-size, landings.*

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## 1. Introduction

In the Algarve (southern Portugal), the tuna fishery dates back to the 14th century. In 1903, 19 traps were set in Portuguese waters, of which, only 6 remained in 1927 and none in 1972. Eventually the fishery collapsed mainly caused by the free increase of the fishing effort which turned the tuna trap fishery economically unsustainable for the Portuguese fishermen (Costa, 2000). Starting in 1995 a Portuguese-Japanese enterprise (Tunipex) set a modern tuna trap off the Portuguese South coast, near the fishing village of Fuzeta (Santos et al, 2002). Like traditional tuna traps, it is composed of a complex net system that leads the fish through a maze, so they may be trapped and captured (Leite *et al*., 1986).

Most fishing gears are size selective, but have low species selectivity. Thus, the catch of non-target species is unavoidable. In multi-specific fisheries, by-catch could represent a very large part of the total catch (Alverson & Hughes, 1996). This is also the case for the tuna trap operating off the South coast of the Algarve where the target species since 1995 has been the highly valuable bluefin tuna *Thunnus thynnus* (Santos *et al*, 2011, 2015). Santos et al (2002) reported a list of species that were captured as by-catch. Among these were several species of small tunas, such as the Atlantic bonito (*Sarda sarda*), the little tunny (*Euthynnus alletteratus*), the bullet tuna (*Auxis rochei*) and the skipjack tuna (*Katsuwonus pelamis*).

Small tunas are considered by the Food and Agriculture Organization of the United Nations (FAO) to be of great interest both in terms of the high total catches and because they include both native species that are not fully exploited, such as *Auxis rochei* (Risso, 1810), and recent immigrant species, which is becoming an important fishing resource for several Mediterranean countries (Relini *et al*, 2010).

The main objective of the current working document is to report catches (landings) and catch-at-size trends for the three most abundant small tuna species during the 1996 to 2014 fishing seasons of the tuna trap operating in Southern Portugal.

## 2. Materials and methods

### *2.1. Data collection*

Catch-at-size data was regularly collected by IPMA (*Instituto Português do Mar e da Atmosfera*) technicians throughout the tuna trap fishing season within the scope of the National and European fisheries data collection framework. The data presented in this study corresponds only to catches from the Fuzeta tuna trap, operated by company Tunipex, which is located at 37º 01'10"N and 007º 42'20"W, 2Nmi off the coast line, covering a bathymetric range between 20 and 60m **(Figure 1)**. All size data in this paper refers to fork length (FL) in cm. Landing data was extracted from IPMA's landings database. All landings refer to live weight (kg).

### *2.2. Data analysis*

Data was analyzed for the period between 1996 and 2014. Specific data on numbers (N) and biomass (kg) caught per month in each year were available for the entire period. Data on the individual specimen sizes was available and analyzed between January 1996 and December 2014. The catch was further analyzed in terms of catches per month along the years.

The ranges of the sizes of bullet tuna (BLT), Atlantic bonito (BON) and little tunny (LTA) caught per year and per month were explored with boxplots and plots of means with the respective standard errors.

Data analysis for this paper was carried out using the R language for statistical computing 3.2.0 (R Core Team, 2014), with the plots designed using library ggplot2 (Wickham, 2009).

## 3. Results

### *3.1. Total landings from the tuna trap by species*

Between 1996 and 2014, the total amount of landed Atlantic bonito ranged from an annual minimum of 39.1 kg in 1998, to a maximum of 601422.5 kg in 2006 (**Figure 2**). Landings were around 600MT in the period 2005-2007 followed by a sharp decrease. Currently the catches seem to be recovering with landings for 2014 at 138MT. The landings for the little tunny ranged between 9.3kg and a peak of 211514.8kg (in 1997) but except for that particular year the catches were always lower than 30MT. The third most abundant small tuna species

was the bullet tuna with landings ranging between 940.9kg (in 1999) and 18762.7kg (in 2000). The landings show another similar peak in 2006 and a raising tendency in the last years, but total landings were usually below 5MT. Finally the skipjack tuna, although it was caught every year (except for 1999) in the study period, had always a very low catch, ranging from 24.7kg (in 2014) and 3294.7kg (in 1998) but with several years below 150kg.

### *3.2. Monthly distribution of the catches*

The catches for bullet tuna show a strong peak in abundance in May (**Figure 3**) and a second smaller from August to November. The Atlantic bonito clearly has a peak in September as does the little tunny. The skipjack tuna seems to be more abundant in October.

### *3.3. Yearly size structure of the catches*

The ranges of sizes of bullet tuna caught in the tuna traps showed almost no variation between 1996 and 2014 (**Figure 4**), with a relatively stable trend (**Figure 5**).

For the Atlantic bonito the range of sizes since 1996 shows in average a decreasing trend (**Figure 6**) but this could be biased by the strong catches in the smaller batch/cohort that occurred in 2014 (**Figure 7**).

Finally for the little tunny, the size ranges show an increasing trend (**Figure 8**) with the largest specimens registered in 2009 but with the average size of the fish constantly increasing since 2003. It should be noted that the number of fish measured for this species is much lower than for the previous and the size distributions are not so clear (**Figure 9**).

### *3.4. Size structure of the catches by month*

The size distribution by month, when pooled for the period 1996-2014, shows that for bullet tuna there is an increase in size from February to April, then a decrease until July, followed by an increase until November (**Figure 10**).

For the Atlantic bonito (**Figure 11**) there is a similar pattern with an increase from January to April then a decrease until June followed by and increase until September but decreasing until November.

Finally for the little tunny (**Figure 12**) there is a gap for the June-July data so it is dificult to observe a trend but unlike the other species, the largest specimens were captured in December.

## 4. Discussion

The total landings of small tunas for the study period were quite important, in particular for the Atlantic bonito. In the period 2000-2008 the landings were higher than those of bluefin tuna reported in Santos *et al* (2014).

The total landings per month pooled for the 2006-2014 period show two peaks of catches with a first in March to June for the bullet tuna and a second one starting in July up to November especially for Atlantic bonito but also for the other species. These results are in agreement with the findings of Sabates & Recasens (2001) who suggested that these species avoid the same areas to avoid competition for food. Interestingly July is the peak season for the catches of bluefin tuna (Santos *et al*, 2014), so this could be an indication that these species avoid the same area as the larger bluefin to avoid competition for food or that they avoid the trap because of the presence of the bluefin tuna.

The trends shown by the average size and the size ranges are mostly positive, with the bullet tuna showing a stable size along the 18 year study period, while the Atlantic bonito showed a decrease which deserves future investigation and the little tunny, in spite of the very few data seems to be showing an increasing trend.

In general the three species show a range of sizes between 30 to 70cm FL (with the bullet tuna showing a narrower range between 30 to 50cm). Since the selectivity curve for a trap is a sigmoid (Restrepo *et al*, 2007) this means that above the minimum this is the full range present in the area, which coincide with the interval of sizes of fish between 2-3 years of age that are not captured in the Mediterranean (Macias et al, 2009).

The size distribution of the small tunas by month also showed smaller fish in June for Atlantic bonito, in July for bullet tuna and an absence of catches of little tunny in both June and July. These results are the pooled data for a

series of 18 years so they could be showing the exclusion of larger fish in the months were bluefin tuna is dominant in the area or simply within the trap.

The small tunas are increasingly becoming an interesting resource because even if the commercial value is lower than bluefin tuna, they could be further exploited by fishermen (Relini et al, 2010). This obviously would require that a better knowledge and a thorough assessment of the status of these stocks is carried out, as already requested for the Mediterranean and Black Sea areas (Di Natale & Mangano, 2009). Further, as bluefin tuna stocks passing through the Algarve coastal waters seem to be recovering (Santos *et al*, 2011, 2014) this could cause direct competition with the small tunas.

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**Figures**

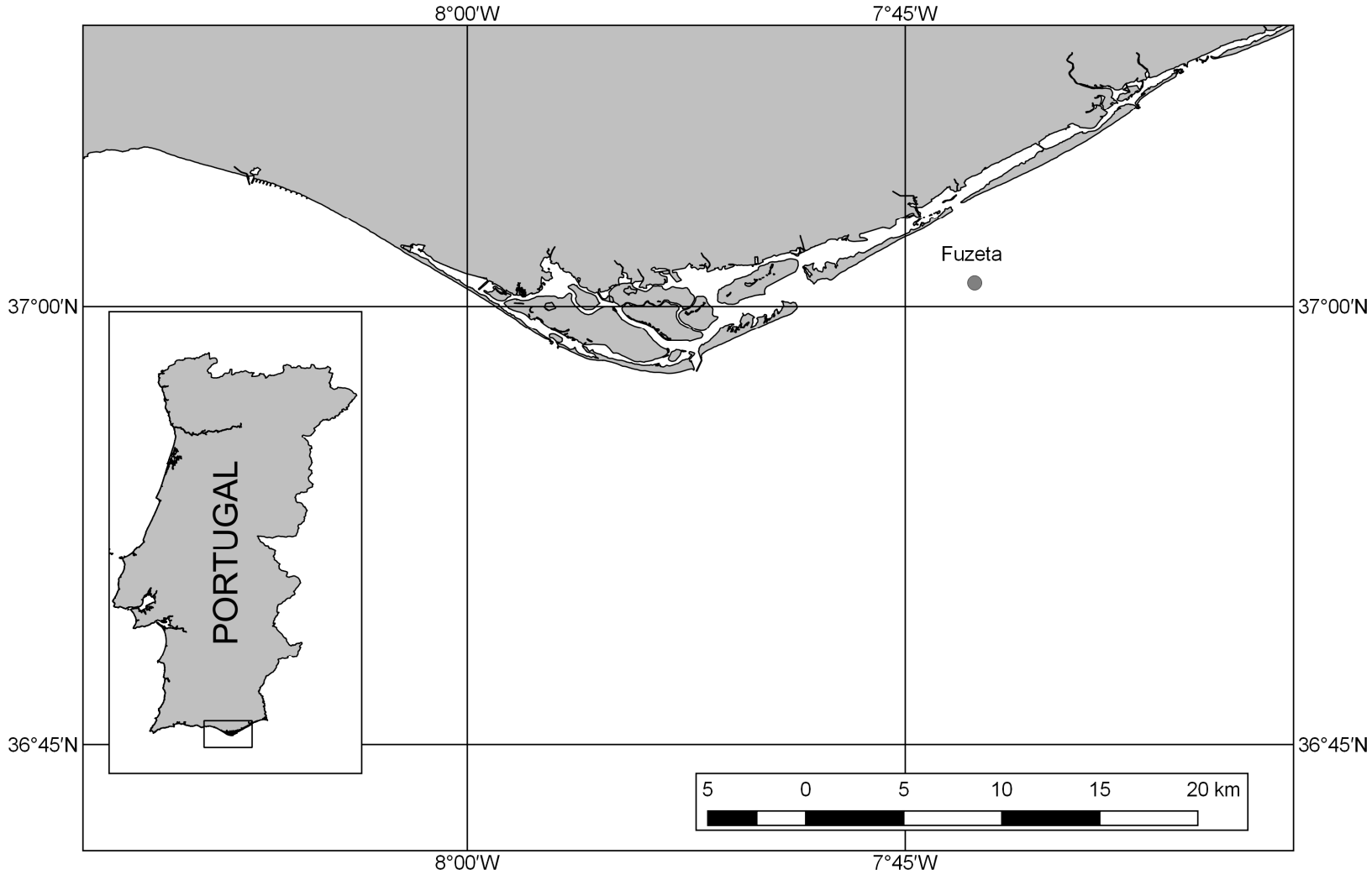


**Figure 1.** Location of the Fuzeta tuna trap, operated by company Tunipex.

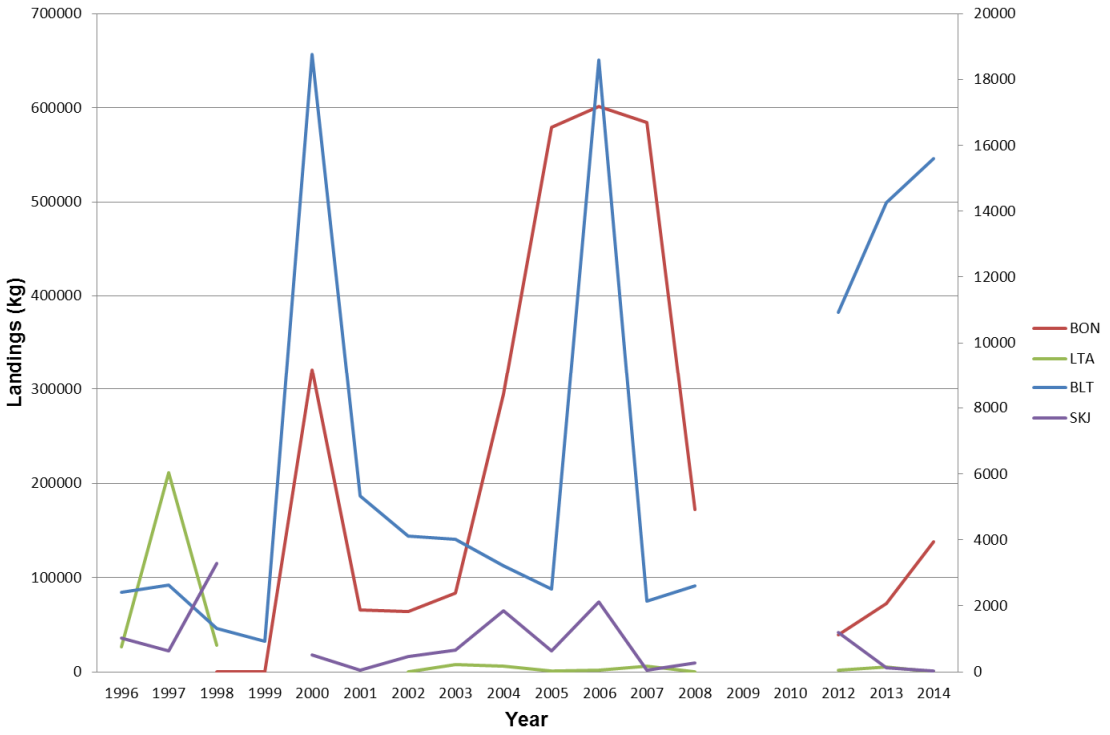


**Figure 2.** Total landings per year for the four most abundant small tunas captured in the Fuzeta tuna trap. BON is Atlantic bonito (*Sarda sarda*)**;** LTA is little tunny (*Euthynnus alletteratus*), BLT is bullet tuna (*Auxis rochei*) and SKJ is skipjack tuna (*Katsuwonus pelamis*). Values for BLT and SKJ are read on the Y-axis on the right.

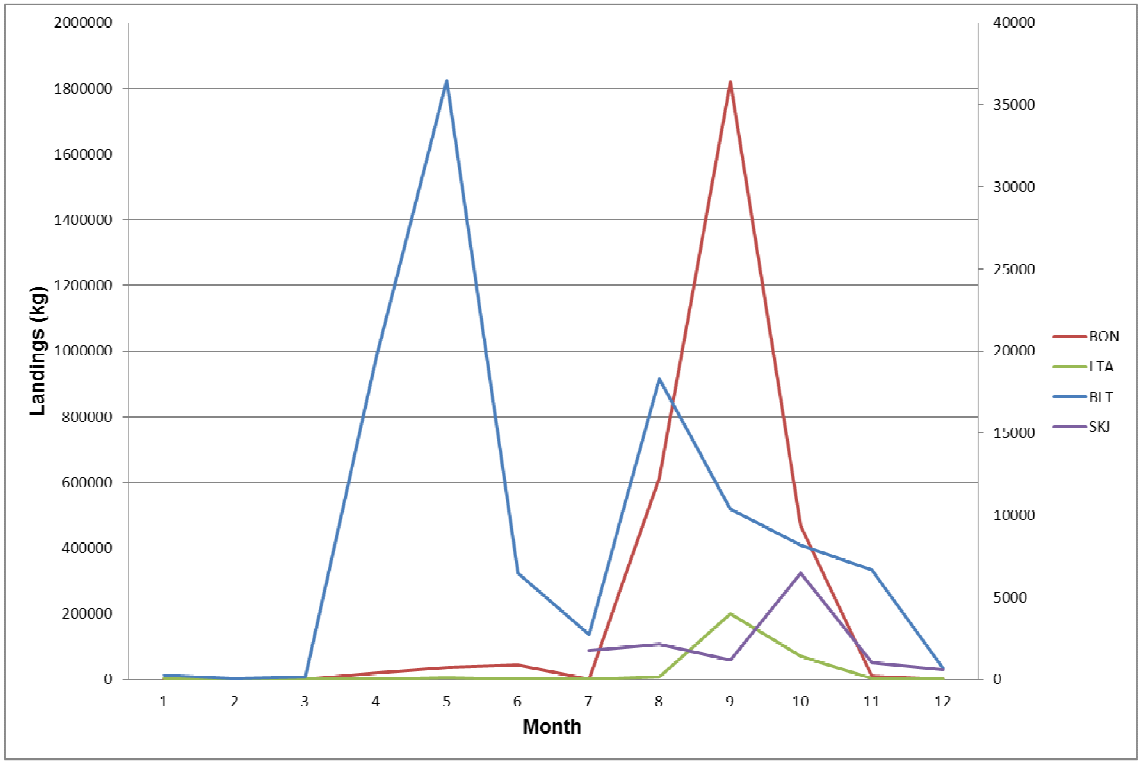


**Figure 3.** Total landings per month for the four most abundant small tunas captured in the Fuzeta tuna trap. BLT is bullet tuna (*Auxis rochei*); BON is Atlantic bonito (*Sarda sarda*); LTA is little tunny (*Euthynnus alletteratus*) and SKJ is skipjack tuna (*Katsuwonus pelamis*). Values for BLT and SKJ are read on the Y-axis on the right.

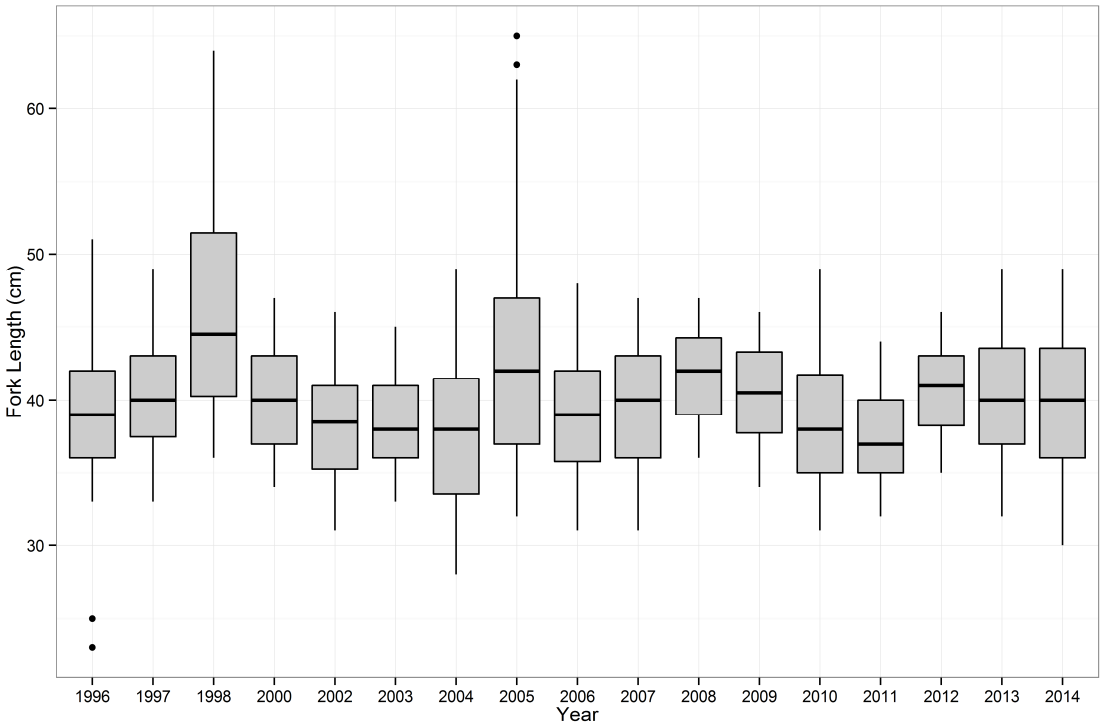


**Figure 4**. Annual sizes of *Auxis rochei* caught in the tuna trap off the Algarve, represented as boxplots with the median, inter-quartile range, and non-outlier range. Outliers are represented as points.

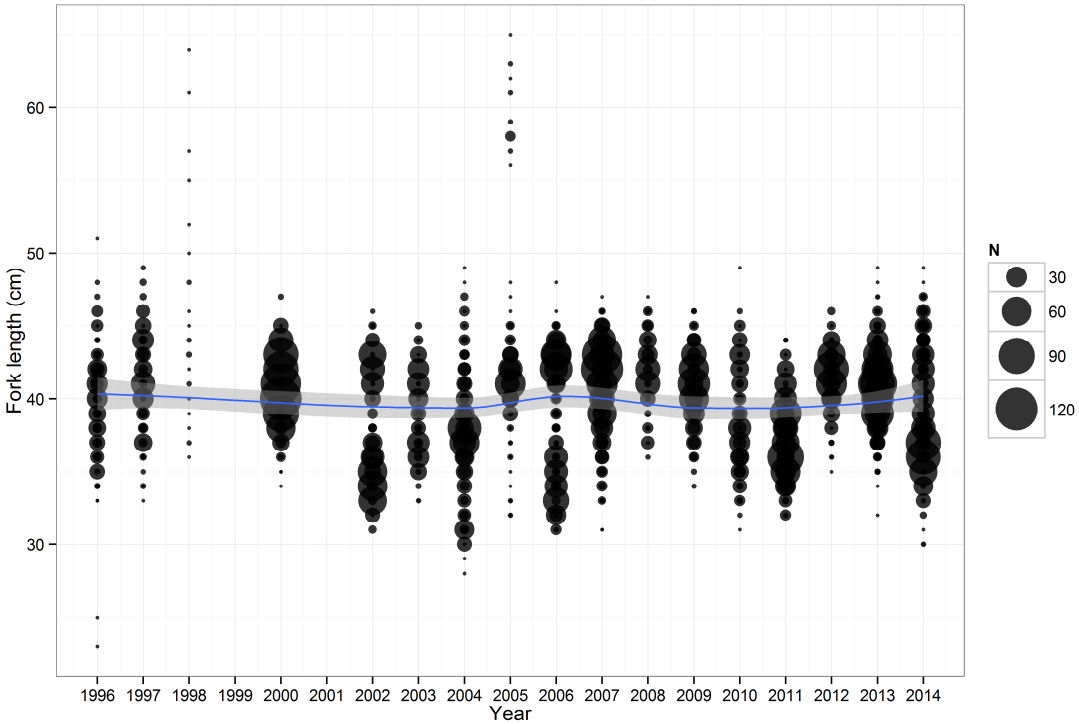


**Figure 5**. Annual size distribution of the captured *Auxis rochei* (by 1 cm FL size classes) along the study period (1996 to 2014). A Loess (locally weighted scatterplot smoothing) regression line and the respective 95% confidence intervals (grey shadow) are shown.

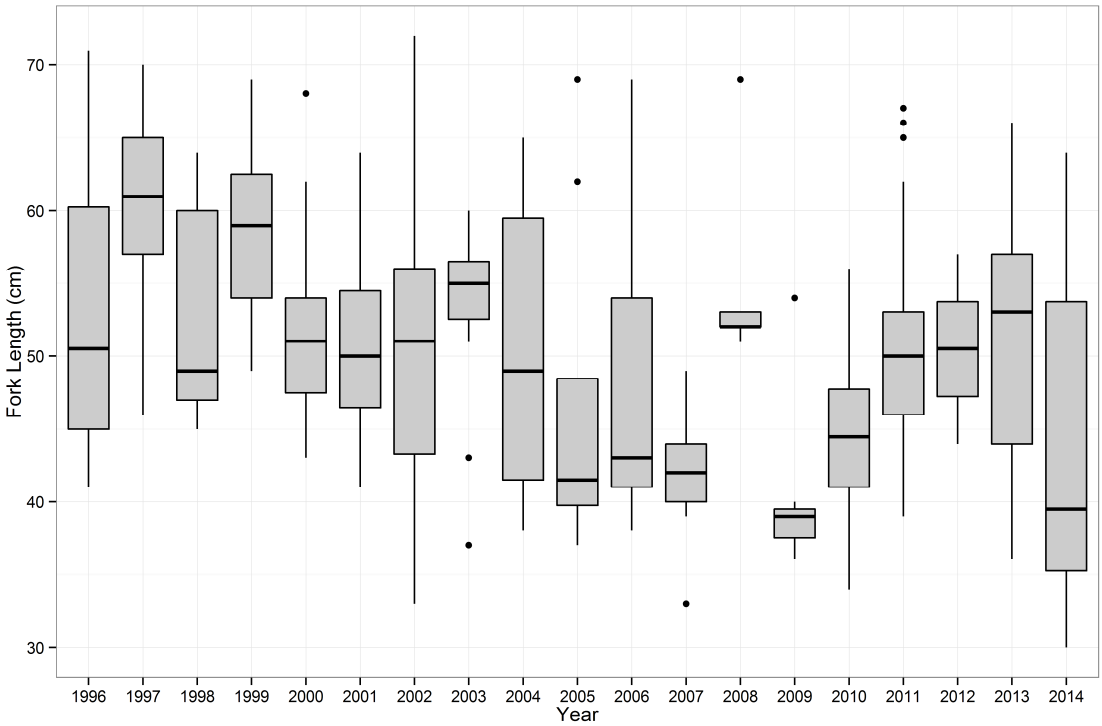


**Figure 6**. Annual sizes of *Sarda sarda* caught in the tuna trap off the Algarve, represented as boxplots with the median, inter-quartile range, and non-outlier range. Outliers are represented as points.

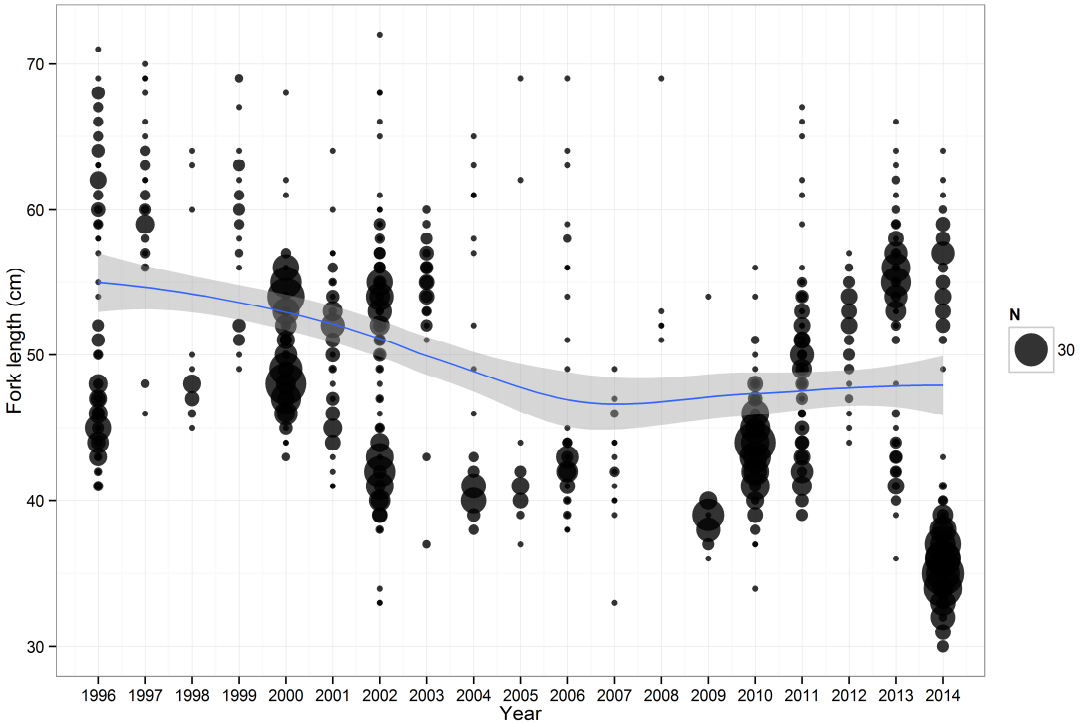


**Figure 7**. Annual size distribution of the captured *Sarda sarda* (by 1 cm FL size classes) along the study period (1996 to 2014). A Loess (locally weighted scatterplot smoothing) regression line and the respective 95% confidence intervals (grey shadow) is also shown.

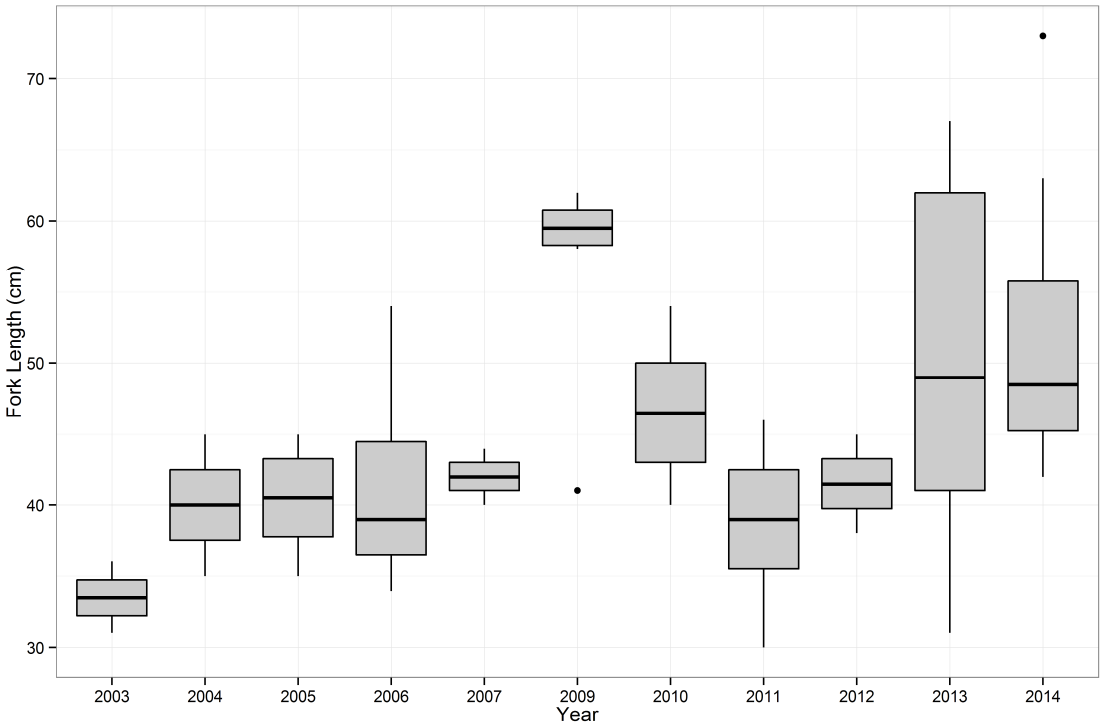


**Figure 8**. Annual sizes of *Euthynnus alletteratus* caught in the tuna trap off the Algarve, represented as boxplots with the median, inter-quartile range, and non-outlier range. Outliers are represented as points.

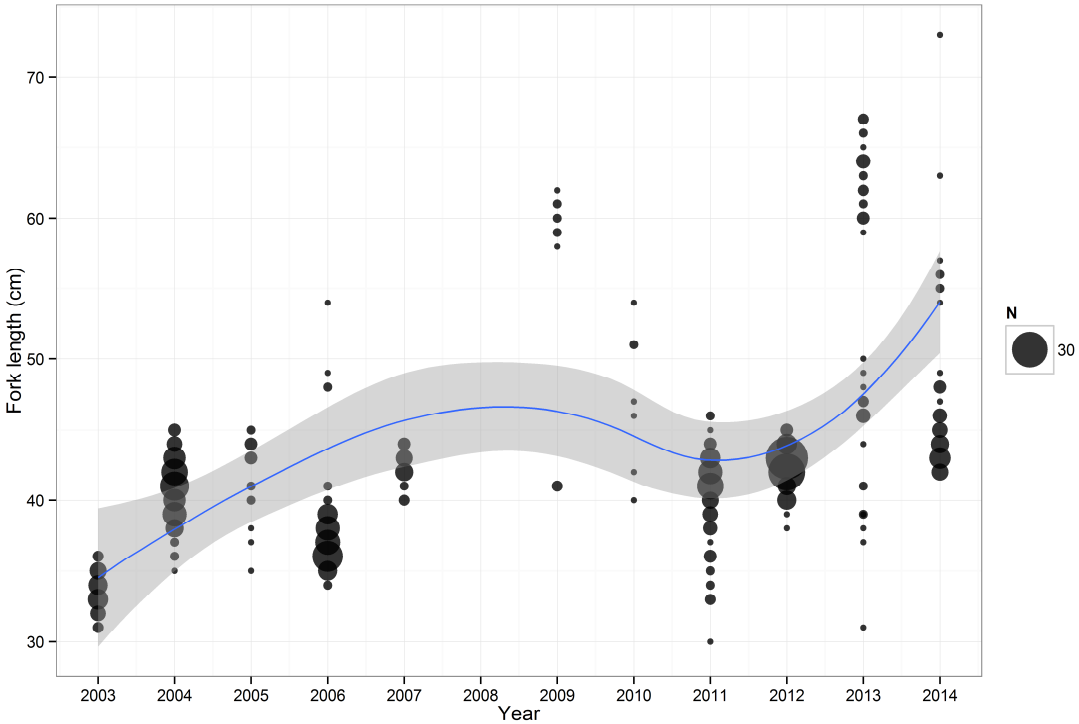


**Figure 9**. Annual size distribution of the captured *Euthynnus alletteratus* (by 1 cm FL size classes) along the study period (1996 to 2014). A Loess (locally weighted scatterplot smoothing) regression line and the respective 95% confidence intervals (grey shadow) is shown.

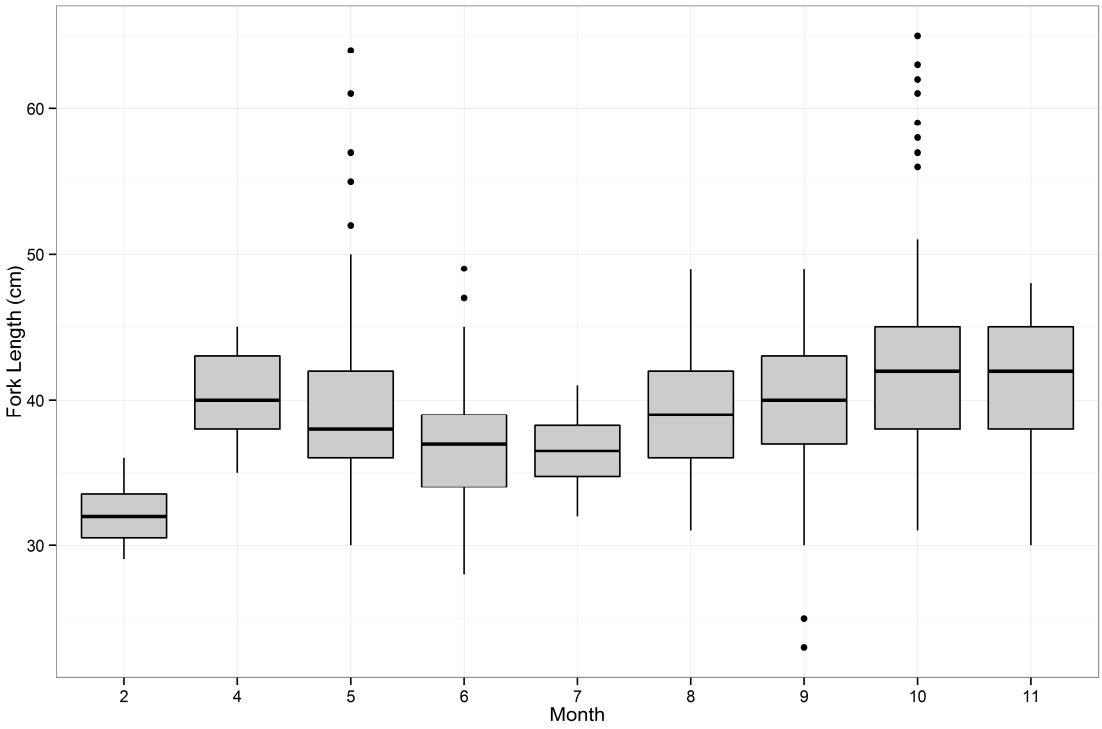


**Figure 10**. Monthly sizes of *Auxis rochei* caught in the tuna trap off the Algarve, represented as boxplots with the median, inter-quartile range and non outlier range. Data between the years 1996 and 2014 was pooled per month. Outliers are represented as points.

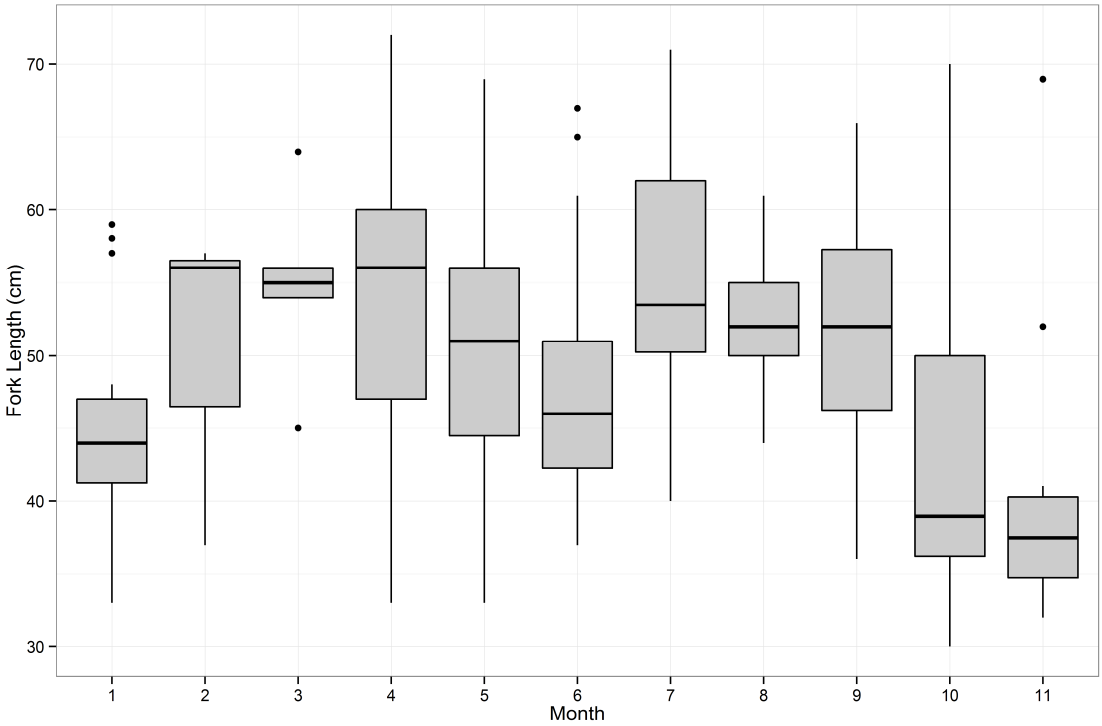


**Figure 11**. Monthly sizes of *Sarda sarda* caught in the tuna trap off the Algarve, represented as boxplots with the median, inter-quartile range and non outlier range. Data between the years 1996 and 2014 was pooled per month. Outliers are represented as points.

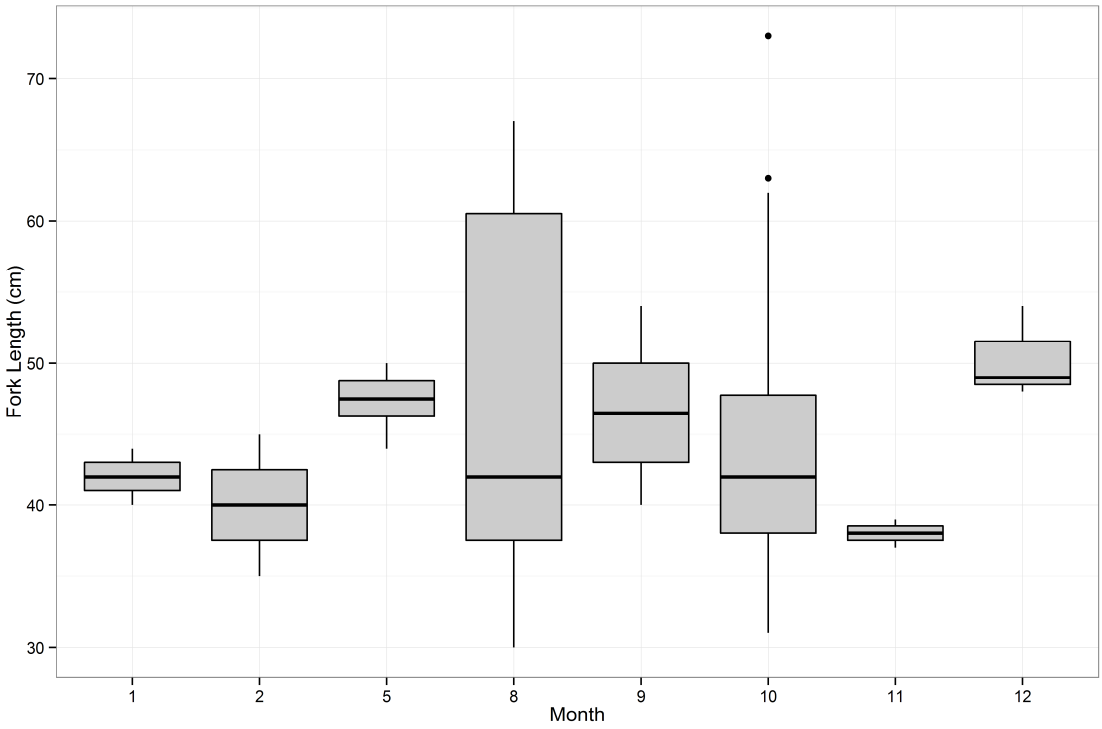


**Figure 12**. Monthly sizes of *Euthynnus alletteratus* caught in the tuna trap off the Algarve, represented as boxplots with the median, inter-quartile range and non outlier range. Data between the years 1996 and 2014 was pooled per month. Outliers are represented as points.