ALBACORE TUNA (*THUNNUS ALALUNGA*) CATCHES BY THE PORTUGUESE PELAGIC LONGLINE FLEET TARGETING SWORDFISH IN THE NORTH ATLANTIC (1999-2015)

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SUMMARY

*This working document presents the first overview on the catch, effort and nominal CPUE trends for albacore tuna (*Thunnus alalunga*) captured as bycatch by the Portuguese pelagic longline fleet targeting swordfish in the North Atlantic. The analysis was based on data collected from fishery observers, port sampling and skippers logbooks (self sampling), collected between 1999 and 2015. Overall, 90.1% of the trips or sub-trips considered in the study had zero albacore tuna catches in the North Atlantic. The area with the higher CPUEs was the northwest area of the operation of the fleet, northwest of the Azores Islands. In general there was a large variability in the nominal CPUE time series and no major noticeable trends during the period. The results presented in this document should be considered preliminary as this is the first overview of the bycatch of this tuna species by this fleet. Future work and analysis can be programmed as needed.*

RÉSUMÉ

*Ce document de travail présente le premier aperçu général des tendances de la prise, de l'effort et de la CPUE nominale du germon (*Thunnus alalunga*) capturé comme prise accessoire par la pêcherie palangrière pélagique de UE-Portugal visant l'espadon dans l'Atlantique Nord. L'analyse se basait sur les données collectées par les observateurs des pêcheries, l'échantillonnage au port et les carnets de pêche des capitaines (auto-échantillonnage), compilées entre 1999 et 2015. Dans l'ensemble, 90,1 % des sorties ou sous-sorties considérées dans cette étude se sont soldées par des captures zéro de germon dans l'Atlantique Nord. La zone présentant les CPUE les plus élevées se situait dans le Nord-Ouest de la zone d'activité de la flottille, au Nord-Ouest des Açores. En général, la série temporelle de la CPUE nominale présentait une variabilité importante et aucune tendance prédominante au cours de la période. Les résultats présentés dans ce document devraient être considérés comme préliminaires car il s'agit du premier aperçu général de la prise accessoire de cette espèce thonière de cette flottille. Des travaux et des analyses supplémentaires peuvent être programmés si nécessaire.*

RESUMEN

*En este documento de trabajo se presenta una primera percepción general de las capturas y las CPUE nominales de atún blanco (*Thunnus alalunga*) capturado de forma fortuita por la pesquería portuguesa de palangre pelágico que se dirige al pez espada en el Atlántico norte. El análisis se basó en datos recopilados por los observadores pesqueros, en los muestreos en puerto y en los cuadernos de pesca de los patrones (automuestreo), recopilados entre 1999 y 2015. En general, el 90,1% de todas las mareas o submareas consideradas en el estudio tuvieron cero capturas de atún blanco en el Atlántico norte. La zona con las CPUE más elevadas fue la zona noroeste del área de operaciones de la flota, al noroeste de las islas Azores. En general, se observó una gran variabilidad en la serie temporal de CPUE nominal y no se detectó ninguna tendencia constatable durante el periodo. Los resultados presentados en este documento deberían considerarse preliminares, ya que es la primera percepción de la captura fortuita de esta especie de túnido realizada por esta flota. Se pueden programar trabajos y análisis en el futuro, a medida que se requiera.*

KEYWORDS
Albacore tuna, bycatch, catch and effort, CPUEs, pelagic longline fisheries

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1. Introduction

The Portuguese pelagic longline fishery in the Atlantic Ocean started in the late 1970's. In the North Atlantic the fishery started to develop mainly after 1986, while in the South Atlantic it gained importance after 1989 (Santos et al., 2002). The Portuguese fleet usually deploys a shallow water pelagic drift longline during night sets targeting mainly swordfish (SWO, *Xiphias gladius*), and it can have important by-catches of pelagic shark, mainly blue shark (BSH, *Prionace glauca*) and shortfin mako (SMA, *Isurus oxyrinchus*). However, this is a multi-species fishery and other species, including bony fishes as some of the major tunas, are also captured occasionally.

The aim of this study is to provide the first characterization of the catches and nominal CPUEs of albacore tuna (*Thunnus alalunga*) captured by the Portuguese pelagic longline fishery targeting swordfish in the North Atlantic.

2. Material and methods

The data analyzed for this study refers to data from the Portuguese pelagic longline fishery targeting swordfish, and was analyzed between 1999 and 2015. The data was filtered for the North Atlantic (separated by 5ºN, as used in the ICCAT albacore tuna stock delimitation areas), as most of the effort and data from the fishery comes from the North Atlantic.

Data from a total of 1,846 trips or sub-trip (consecutive sets in the same trip, area and month) is available for the entire Atlantic (North and South). From that, a subset of 1,533 trips or sub-trip from the North Atlantic was filtered and used in this work, corresponding to 11,578 sets and 13,437,526 hooks. The percentage of the catch covered in the analysis as regards to the overall yearly albacore tuna catch in the North Atlantic was 0.6% (**Table 1**). It is important to emphasize that the sampling programs are designed mainly for the main target of the fishery and other species of interest, such as swordfish and the main pelagic sharks.

The data used in the study was collected by IPMA (*Portuguese Institute for the Ocean and Atmosphere*) from several different sources, namely 1) fishery observers onboard Portuguese pelagic longline vessels, 2) landings on Portuguese ports, and 3) skippers logbooks (self sampling) voluntarily provided to IPMA. The information on the total catch was provided by the Portuguese Fisheries Authority (DGRM).

The fishery observer data is the most complete and detailed as the data is collected at set level and there is also the collection of individual information on the catch sizes and sex for most specimens. During the landings, detailed information is also collected, although due to some procedure logistics sometimes it is difficult to collected individual size and/or sex data for some of the major species (e.g. blue shark). The skippers' logbooks have the data recorded and reported voluntarily by the vessel skippers, and usually also have detailed information regarding the catch, effort and location of the fishing sets. For some species, including the major fishery species (i.e. swordfish, major tunas and sharks such as blue and shortfin mako) detailed individual specimen information is usually also recorded, including individual specimen sizes or weights.

The CPUEs were calculated as Kg (live weight)/1000 hooks, and were mapped in 5*5 degrees to provide an overview of the catch locations. The effort was also mapped in the same 5*5 degrees grid. The yearly nominal CPUEs were calculated and the time series plotted as well as the yearly proportions of fishing sets with zero albacore tuna catches. The monthly variation in the CPUEs were also analyzed and plotted.

The analysis for this paper was carried out in the R language for statistical computing 3.2.0 (R Core Team, 2015). The plots were designed using library "ggplot2" (Wickham, 2009) and the maps using libraries "maps" (Becker et al., 2013), "maptools" (Bivand and Lewin-Koh, 2013), "mapplots" (Gerritsen, 2014) and "shapefiles" (Stabler, 2013).

3. Results and discussion

The albacore tuna is a relatively rare bycatch in the Portuguese pelagic longline fishery that targets mainly swordfish in the North Atlantic. The catches of this species are only occasional and spread along the North Atlantic stock area, but particularly concentrated in the northeast areas of operation of the fleet, north of the Azores islands and also in areas closer to the Madeira, Canary and Cabo Verde Islands. There are also captures,

to a less extent, in the area between Portugal mainland and the Azores, and in equatorial waters (**Figure 1**). Regarding the fishery, most of the effort that was sampled took place in the temperate northeast area, as that is a major area of operation of the Portuguese pelagic longline fleet in the Atlantic (**Figure 2**). However, the effort is also distributed along a wide spatial distribution, including both temperate and tropical waters mainly along the eastern Atlantic (**Figure 2**).

Overall, 90.1% of the trips or sub-trips considered in this study had zero albacore tuna catches in the North Atlantic. There were some noticeable trends along the study period, with general higher proportions of zeros in the earlier years and lower proportions in the more recent period (**Figure 3**). Overall the values of proportions of zeros varied between 97.8% (2002) and 69.1% (2013) (**Figure 3**).

The time series of the albacore tuna nominal CPUEs are presented in **Figure 4**. Overall the series is very variable and without any noticeable major trends along the years. There were some years with relatively higher catch rates, as 2000, 2004 and the period between 2011 and 2014; and other years and periods with lower catch rates as 2001-2002, 2006-2008 and 2014. The series is also characterized by relatively large standard errors is some of the years (**Figure 4**).

There were also some noticeable seasonal effects in the recorded albacore tuna CPUEs. Specifically, the CPUEs tended to be higher during the winter months, mainly between November and February, and lower in the warmer period, particularly between April and October (**Figure 5**).

The interpretation of those results should be careful as the data coverage for the albacore tuna by this fleet is low, noting that the sampling programs are designed mainly for the main targets of the fishery and other species of interest, such as the swordfish and the main pelagic sharks. The interpretation of the nominal CPUE time series also needs to be careful, as the series is not standardized and as such depends on the spatial and seasonal patterns of the fleet, as well as other fishery-dependant factors, that can vary through time.

4. Acknowledgments

Data used in this study was collected integrated in PNAB (*Programa Nacional de Amostragem Biológica*) as part of the EU-DCF (*Data Collection Framework*), and from other research projects and initiatives at IPMA. Special thanks are due to all skippers that voluntarily provided data from their fishing activities in the ICCAT convention area and to the fishery observers and technicians that collected the onboard and port sampling data. Rui Coelho is supported by an *Investigador-FCT* contract from the Portuguese Foundation for Science and Technology (FCT) supported by the EU European Social Fund and the *Programa Operacional Potencial Humano* (Ref: IF/00253/2014).

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Table 1. Annual albacore tuna catch (metric ton, MT) by the Portuguese pelagic longline fishery targeting swordfish in the North Atlantic, with a summary of the data coverage for the analysis: Catch (MT), relative percentage of the catch covered in the analysis, and effort (in sets and hooks) covered in the analysis.

Year	Total ALB catch (MT)	Covered in the analysis			
		ALB Catch (MT)	%	Effort (sets)	Effort (hooks)
1999	39.40	0.1	0.2	512	918,800
2000	21.50	1.5	6.9	928	1,418,610
2001	15.04	0.3	2.0	802	1,034,908
2002	8.58	0.1	1.0	647	783,850
2003	36.68	0.4	1.1	734	851,102
2004	287.27	0.5	0.2	792	876,482
2005	164.84	0.3	0.2	902	1,048,178
2006	98.09	0.1	0.1	464	522,917
2007	103.59	0.2	0.2	562	567,790
2008	90.73	0.2	0.2	619	640,946
2009	53.17	0.4	0.8	695	730,782
2010	13.05	0.3	2.5	783	817,542
2011	87.04	0.3	0.3	470	482,839
2012	168.46	0.8	0.5	663	712,567
2013	56.61	1.4	2.5	958	973,168
2014	6.65	0.2	3.6	489	515,191
2015	15.69	0.6	4.0	558	541,854

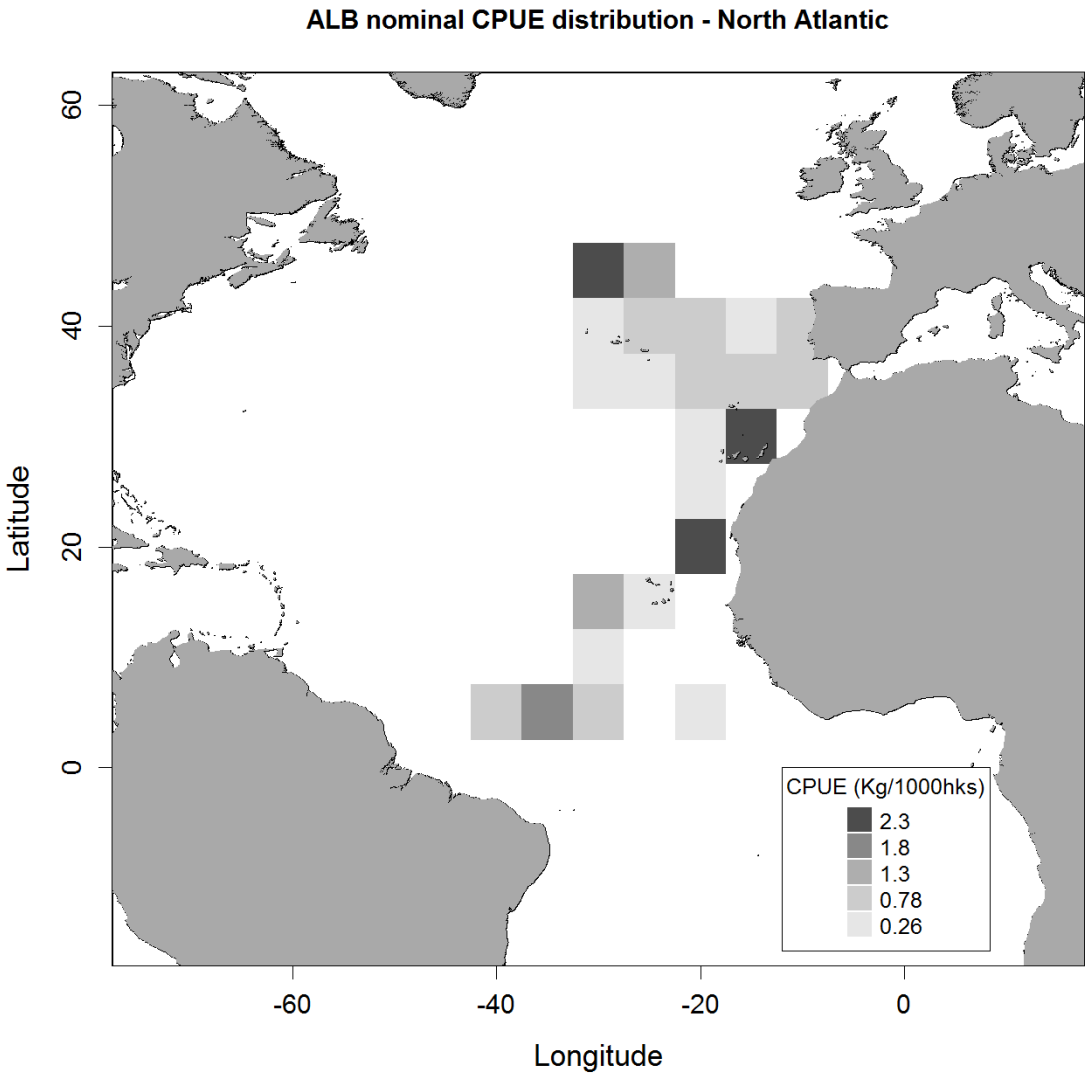

Figure 1. Spatial distribution of the nominal CPUEs of albacore tuna in the North Atlantic captured by the Portuguese pelagic longline fleet, between 1999-2015. The CPUE is represented in biomass (Kg/1000 hooks) in 5x5 degree grids.

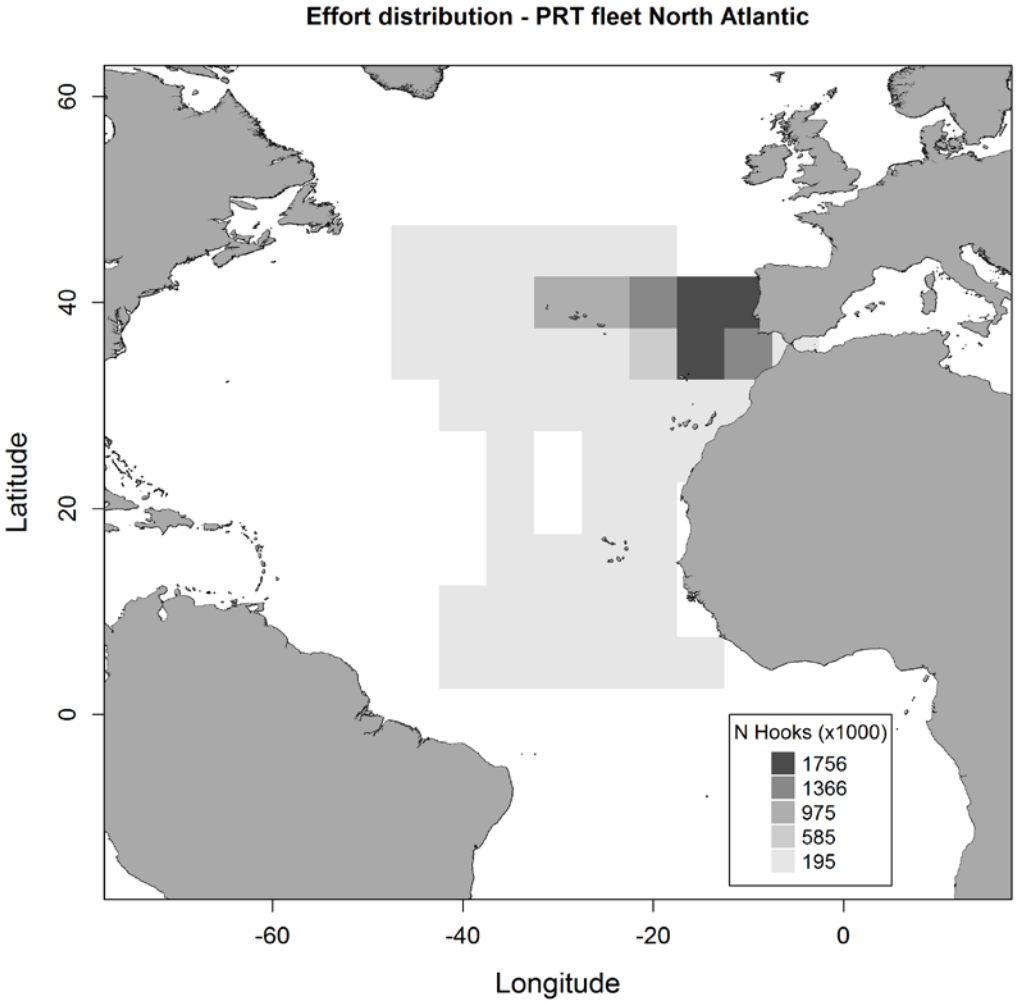

Figure 2. Effort distribution of the Portuguese pelagic longline fleet sampled in the North Atlantic used in this study, for the period 1999-2015. The effort is represented in number of hooks (x1000) in 5x5 degree grids.

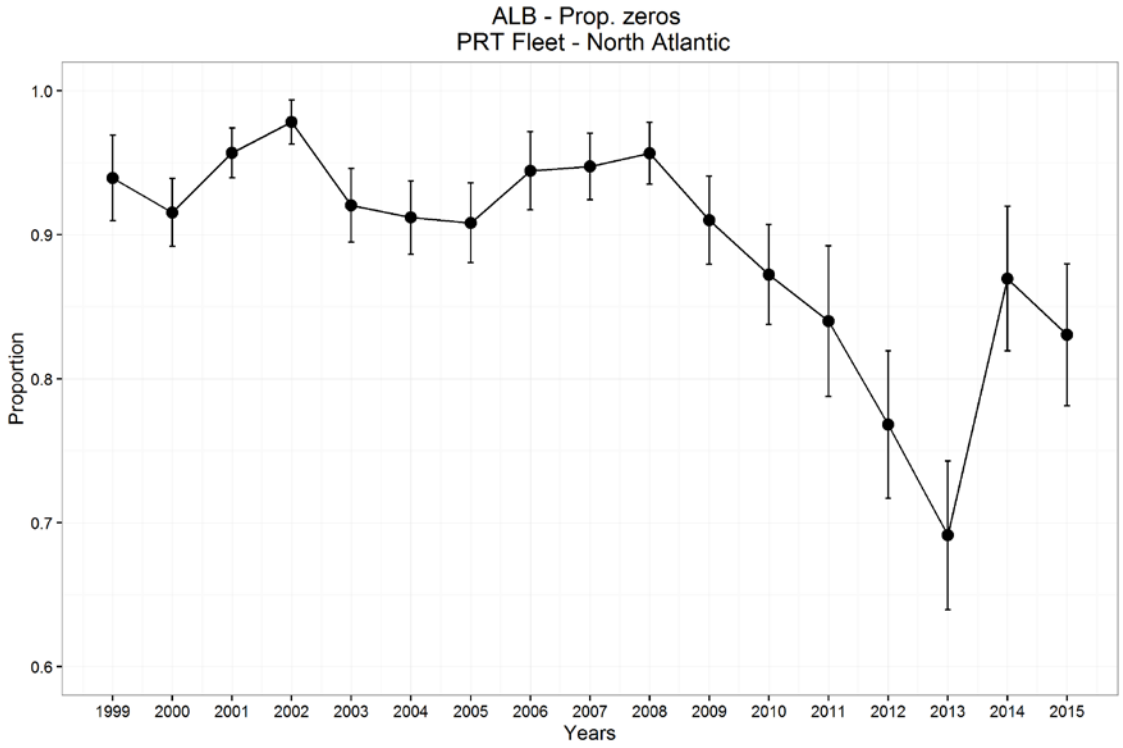

Figure 3. Proportion of trips or sub-trips with zero albacore tuna catches in the Portuguese pelagic longline fishery targeting swordfish in the North Atlantic between 1999 and 2015. The error bars refer to the standard errors.

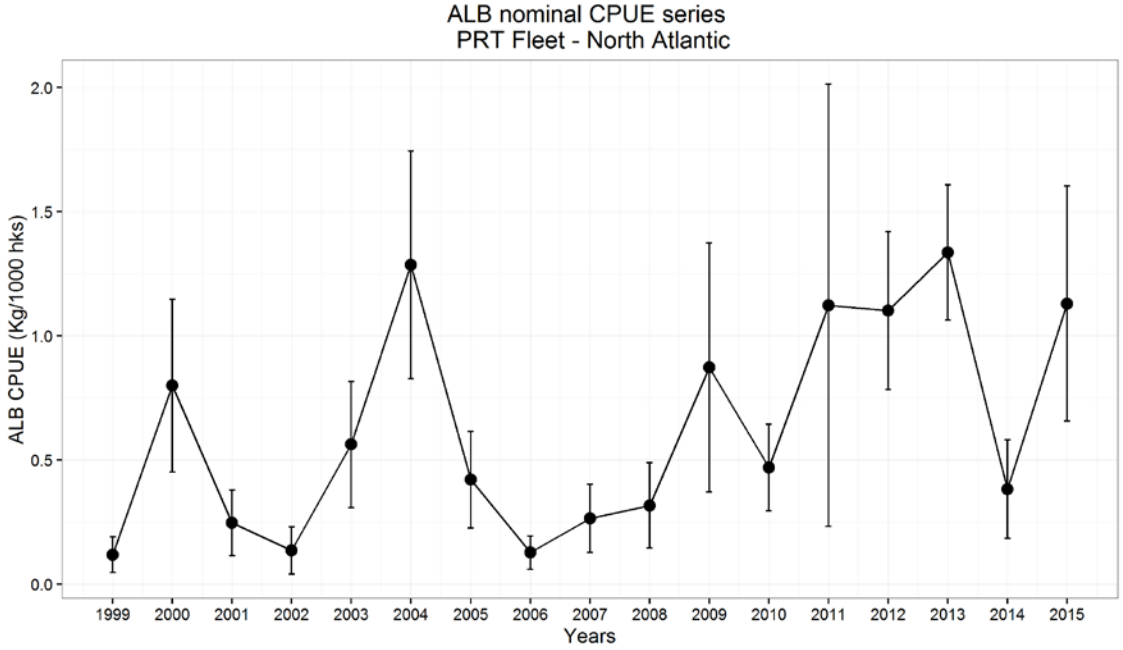

Figure 4. Nominal CPUE series (kg/1000 hooks) for albacore tuna captured by the Portuguese pelagic longline fishery in the North Atlantic targeting swordfish between 1999 and 2015. The error bars refer to the standard errors.

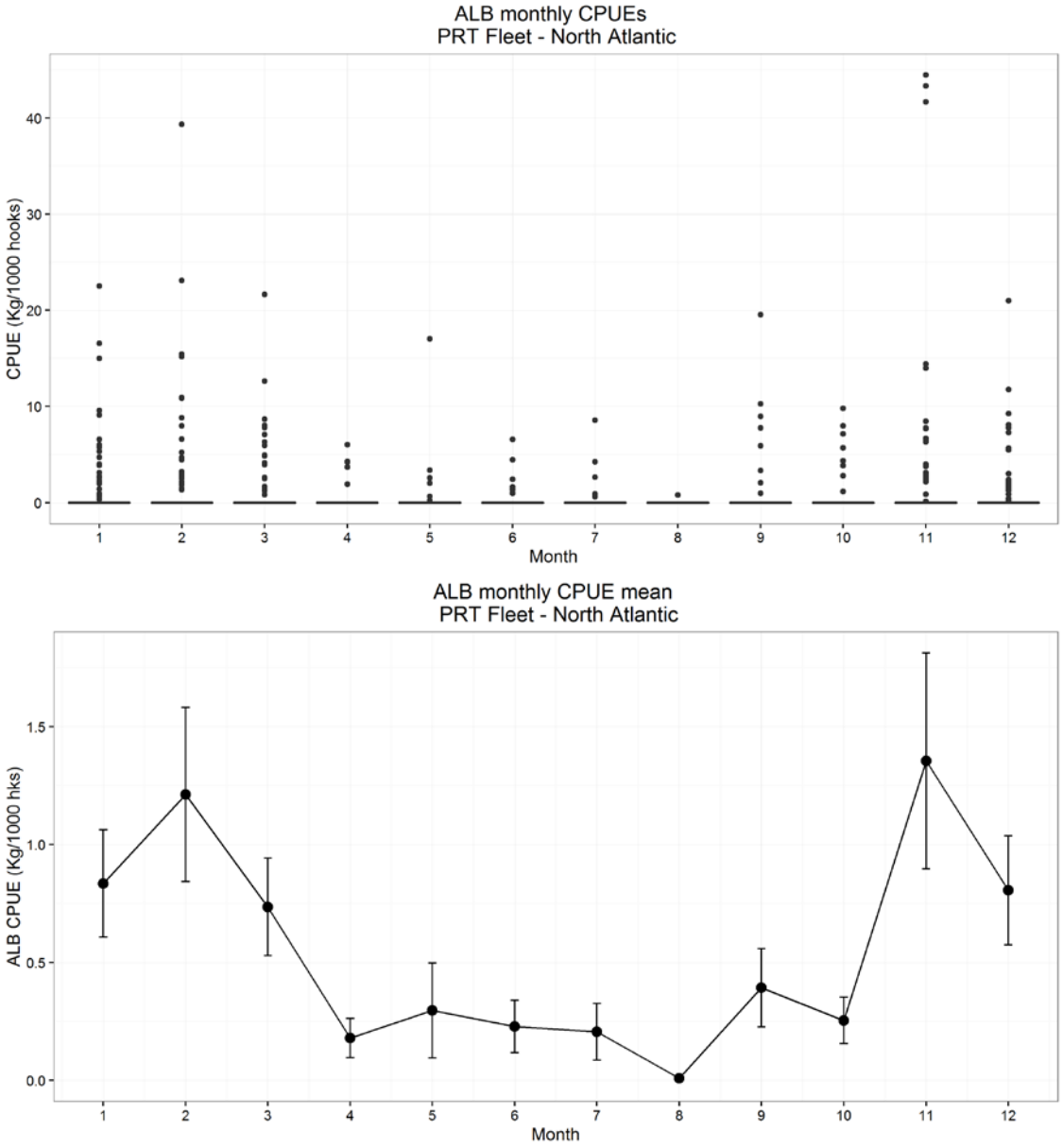

Figure 5. Monthly CPUE trend for the albacore tuna captured by the Portuguese pelagic longline fishery in the North Atlantic targeting swordfish. Data is grouped for 1999-2015. The plot on the top represents the monthly CPUE data in boxplots, and the plot in the bottom represents the mean monthly CPUEs (error bars refer to the standard errors).