

**EVOLUTION OF SPATIAL DISTRIBUTION OF FISHING  
GROUND FOR THE SPANISH ALBACORE (*THUNNUS ALALUNGA*)  
TROLL FLEET IN THE NORTH EASTERN ATLANTIC, YEARS: 2000 TO 2013**

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*SUMMARY*

*Annual geographical distribution of Spanish troll fleet activity is estimated by means of sampling scheme based on a number of interviews to skippers carried out at landings in main fishing ports of the Spanish Atlantic and Bay of Biscay coast. The compiled geographical position by trip on latitude and longitude (1x1 degrees) is mapped on monthly bases for each year. Troll fleet targets albacore (*Thunnus alalunga*) from June to November operating in offshore waters of the northeast Atlantic and Bay of Biscay. Based on the compiled information of the interviews, the spatial evolution of the troll fleet fishing ground for the fishing seasons from 2000 to 2013 is presented.*

*RÉSUMÉ*

*La répartition géographique annuelle de l'activité des flottilles de ligneurs espagnols est estimée au moyen d'un plan d'échantillonnage basé sur un certain nombre d'entretiens réalisés auprès des capitaines au débarquement dans les principaux ports de pêche de la côte atlantique espagnole et du golfe de Gascogne. La position géographique compilée par sortie par latitude et longitude (1° x 1°) est illustrée sur une carte sur une base mensuelle pour chaque année. Les flottilles de ligneurs ciblent le germon (*Thunnus alalunga*) de juin à novembre, opérant dans les eaux au large du Nord-Est de l'Atlantique et du golfe de Gascogne. D'après les renseignements obtenus des entretiens, l'évolution spatiale de la zone de pêche de la flottille de ligneurs pour les saisons de pêche de 2000 à 2013 est présentée.*

*RESUMEN*

*La distribución geográfica anual de la actividad de la flota de cacea española se estima por medio del esquema de muestreo basado en un número de encuestas realizadas a los patronos en el momento de la descarga de las capturas en los principales puertos de la costa atlántica española y del golfo de Vizcaya. La información geográfica en latitud y longitud (1°x1°) por marea se representa en mapas mensuales para cada año. La flota de cacea se dirige al atún blanco (*Thunnus alalunga*) desde junio a noviembre en las aguas oceánicas del Atlántico nordeste y del golfo de Vizcaya. Con la información recogida en las encuestas, se presenta la evolución espacial del área de pesca de la actividad pesquera de la flota de cacea desde 2000 hasta 2013.*

*KEYWORDS*

*Thunnus alalunga, Troll fishery,  
Fishing ground, Spatial evolution, Northeast Atlantic, Albacore*

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## 1. Introduction

Albacore (*Thunnus alalunga*) has been targeted by the Spanish surface fleet, with baitboat and troll vessels for decades in the North eastern Atlantic and Bay of Biscay offshore waters (Arrizabalaga *et al.*, 2010, Ortiz de Zárate and Barreiro, 2010). The albacore fishery represents an important resource from the socio-economical activity reported in the north-western and northern fishing ports. In spring and early summer, as the water temperature rises, immature albacore migrates from the central Atlantic waters towards the north-eastern Atlantic and Bay of Biscay temperate surface waters, (Aloncle et Delaporte, 1973; Bard, 1981; Ortiz de Zárate and Cort, 1998; Arrizabalaga, 2003) where forage prey are abundant (Pusineri *et al.*, 2005). The oldest fleet targeting albacore in the Bay of Biscay area and Atlantic waters is the troll fleet (Bard and Santiago, 1999). In his historical compilation, they recovered Spanish troll catches since 1930.

Concerning the activity of both fleets: alive bait boat (BB) and trolling (TR), no major changes were observed during last decades (ICCAT, 2014). The number of boats involved varies among years; the annual averaged number is 450 vessels (80% troll and 20% bait boat). The troll vessels are of lesser tonnage (mean of 50 GRT) than those of bait boat (mean 120 GRT). The catch composition by age is mainly made up of immature albacore 1 to 4 age groups, corresponding to 50 to 90 cm fork length fish.

The troll fleet operated mainly in the offshore waters of the North eastern Atlantic from June to October. Only partially in September and during October the activity of this fleet took place in the Bay of Biscay area. The geographical distribution of bait boat catches in the last two years has been reduced and concentrated mainly in the Bay of Biscay area closer to the coast line. In 2012 and 2013 years, the monthly spatial distribution of troll vessels interviewed shown a presence of the albacore resource, in offshore Atlantic waters at early fishing season beginning in June until the end of summer season in September, when some few troll trips showed a distribution in the Bay of Biscay that continued in October. Similar troll fleet behaviour was observed in 2011 fishing season (Ortiz de Zárate *et al.*, 2013)

Fonteneau (2008) hypothesized about a possible shrinking fishing zones of both albacore longline and surface fisheries, and/or to decline in targeting albacore for the longline fleets.

The aim of this paper is to present an overall description of the geographical distribution of catches obtained by the Spanish troll fleet from 2000 to 2013 fishing seasons. Geographical information was collected from the monitoring of the fishery, by means of interviews to skippers that reported an approximate location of 1° by 1° degree within the seasonal albacore fishing grounds in the North Eastern Atlantic and Bay of Biscay area.

## 2. Material and Methods

The monitoring of the Spanish troll fleets activity was done by means of collecting information through interviews to skippers at main fishing ports located along North western coast and the Cantabrian coast. The information, based on individual trip samples by fleet, that was collected included: number of days at sea, number of fishing days, catch in number of fish and weight (kg) and an approximate location of catch by 1° x 1° degrees latitude and longitude, recording at least one position per trip.

The catch and nominal fishing effort expressed in fishing days information was processed for troll fleet on monthly basis following raising procedures to estimate the Task I (catch and effort) statistics of ICCAT (ICCAT, 2006-2010). Thus, the catches presented in this document had been communicated to ICCAT and are included in ICCAT data base. However, nominal catch information (Task I) is assimilated to 5° x 5° degrees squares, due to the lack of logbooks available, for this fishery.

The geographical position of collected information of catches in weight and fishing effort by trip was aggregated by 1° x 1° latitude and longitude for each month. Fishing season covered from June to October all years and some years extended the fishing activity until November. Likewise, the annual troll (kg) catch was calculated in percent respecting the total catch of surface fishery vessels in the area: baitboats and trollers. Additionally monthly percentage of catch in weight was calculated for each year analysed from 2000 to 2013, to describe the temporal evolution of catches within each year. Likewise, the number of 1° x 1° squares by month were added and the equivalent area transformed in km<sup>2</sup> (1x1 sq = 12,321 km<sup>2</sup>) for time period examined.

### 3. Results and Discussion

According to the information collected and processed, the total albacore nominal catch (Task I data) obtained by the troll fleet represented a variation on percentage of both fleets, between 45-50% in most of the years, being the lowest catch in 2000 and at the contrary the highest troll catch was registered in 2013. Looking at the nominal catch, the highest levels registered were obtained in 2005 and 2006 years, representing a record on the years described (**Table 1**). Concerning the percentage of annual troll catch, it is observed in same **Table 1**, that most of the catch is taken from July to September, approximately from 75 % to 85 % and the remaining percentage of catch are scattered between both months: June and October. There is an extension of the fishing season to November in some years, but the catch represented less than 1%.

Due to the catch been mostly taken in the summer months July to September in the period described, only these months were chosen to represent the geographical distribution accordingly to the information gathered from interviewed skippers, only one position per trip is shown. Results are shown in **Table 2**. There is not a clear trend from 2000 to 2013, although both 2006 and 2008 years, shown the highest and the lowest number of 1° by 1° degrees squares reported. Last 2013 year would represent and average between the lowest and the highest number of squares covered.

The temporal evolution by month of the geographical representation in 1° by 1° degrees for June, July and August for the time period described, 2000 to 2013 years, is shown in **Figure 1.a**. It can be stressed that the overall area concerning latitudinal displacement has been quite stable, reaching 50 ° North and over along the time series.

However, the Bay of Biscay shown a decrease of presence of trollers beginning in 2009. This separation between both fishing grounds: oceanic and Bay of Biscay, is more apparent when looking at **Figure 1.b**, that represents the September trip locations beginning in 2009 until 2013. Moreover, there is a discontinuity appearing between the area of Bay of Biscay and the oceanic waters of North Eastern Atlantic fishing grounds, also initiating in 2010. Fewer number of locations are displayed those years. This is in agreement with the lowest percentage of catches taken in the Bay of Biscay area during the highest season months represented by July and August in **Table 3**. As shown, less than the 10% of catch for the highest season months (July and August) was taken in the Bay of Biscay from 2009 to 2013, but 2012, were catches represented 31% and 23% of the total taken in July and August respectively in that year

The inter annual changes observed in the troll fishery concerning the spatial distribution that had been observed since 2009 until 2013, in this document merit to be studied in relation to factors such the availability of prey to forage, the habitat utilization by immature albacore (Pusineri *et al.*, 2005; Goñi *et al.*, 2009) along with knowledge of climatic and oceanographic conditions in the northeast Atlantic waters and Bay of Biscay off shore waters. All these related variables impacting the migratory behaviour of albacore (Dufour *et al.*, 2010). Albacore migratory behaviour component in relation with the physical environment requires comprehensive studies.

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**Table 1.** Nominal match of Troll fleet, percent of surface fishery, fishing effort and monthly percentage.

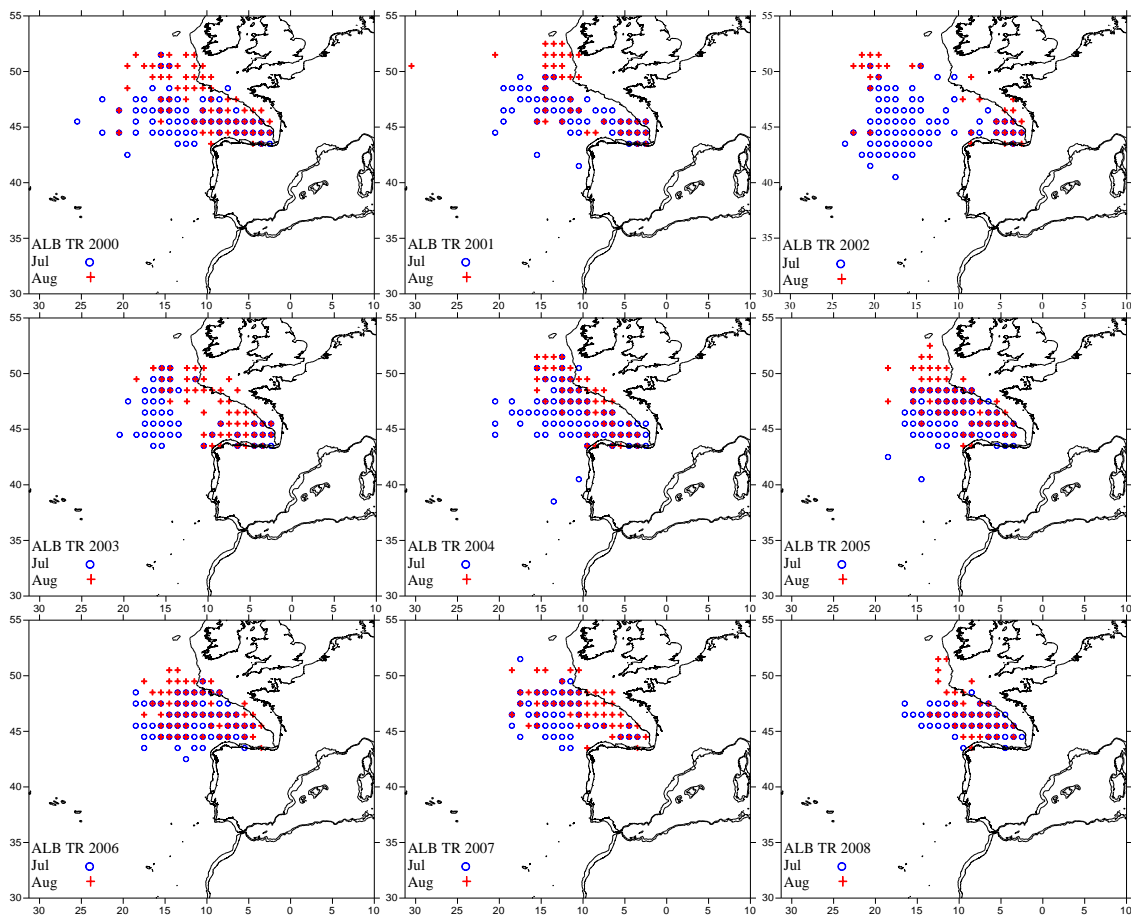
Years	TR+BB	Troll (TR)	Effort (TR)	Monthly TR Catch %					
	Catch (%)	Catch (Kg)	Fish Days	6	7	8	9	10	11
2000	32.3	5,012,643	12,023	13.4	40.0	38.2	7.6	0.7	0.0
2001	55.4	4,244,596	8,512	16.0	26.3	36.3	20.3	1.1	0.0
2002	52.5	3,976,390	11,067	8.3	33.1	33.5	18.9	6.1	0.1
2003	46.4	5,192,711	11,142	5.0	36.1	37.5	14.2	7.2	0.0
2004	51.1	7,476,716	10,101	6.0	48.4	27.4	11.4	6.5	0.4
2005	52.2	10,164,611	11,733	9.3	34.7	30.5	18.4	7.1	0.0
2006	42.6	10,276,785	12,484	6.7	35.3	36.3	15.6	6.0	0.0
2007	42.9	6,088,754	10,652	6.8	31.0	31.6	16.5	14.0	0.1
2008	44.0	5,233,415	6,628	5.3	52.1	19.7	19.0	3.7	0.2
2009	47.6	4,437,192	5,875	13.3	47.5	23.1	6.5	8.9	0.7
2010	56.3	7,009,462	8,548	6.4	48.0	31.4	7.3	6.5	0.5
2011	45.1	3,564,082	6,910	8.3	47.9	20.4	16.6	6.4	0.4
2012	48.5	5,832,738	7,630	10.2	27.7	29.1	21.7	10.6	0.7
2013	63.1	5,863,839	6,935	4.3	50.2	32.2	10.5	2.6	0.1

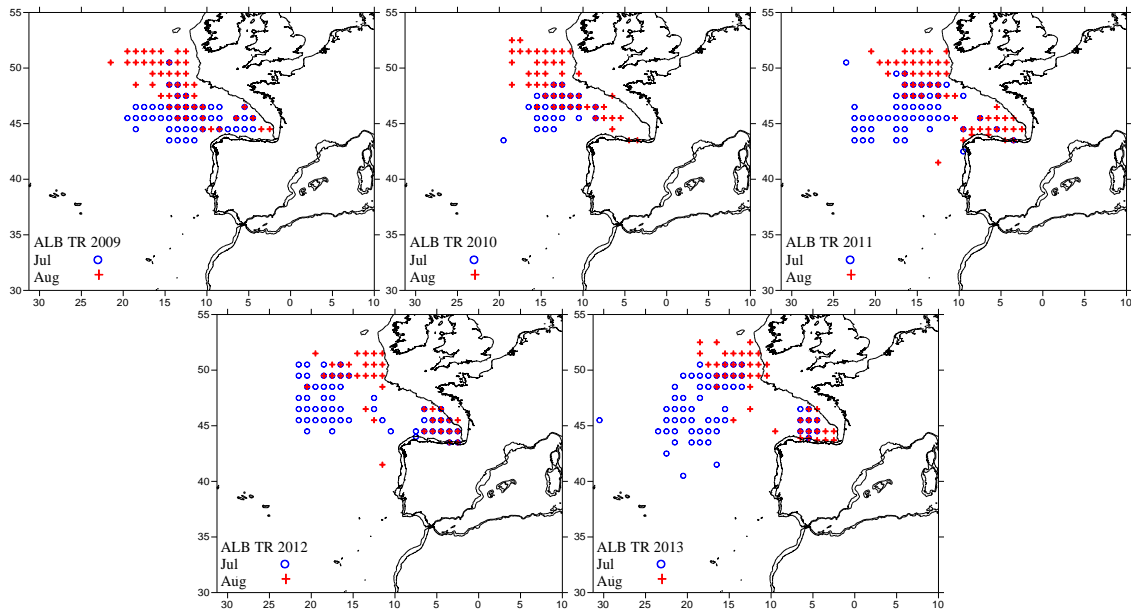
**Table 2.** Information collected from monthly number of 1°N x 1°W squares and area covered.

Years	N 1°x1° sq				Area (Km <sup>2</sup> ) (1°x1° sq=12,321 km <sup>2</sup> )			
	Jul	Aug	Sep	Total	Jul	Aug	Sep	Total
2000	62	66	28	156	763,902	813,186	344,988	1,922,076
2001	52	40	33	125	640,692	492,840	406,593	1,540,125
2002	73	34	26	133	899,433	418,914	320,346	1,638,693
2003	47	56	16	119	579,087	689,976	197,136	1,466,199
2004	69	49	39	157	850,149	603,729	480,519	1,934,397
2005	61	54	50	165	751,581	665,334	616,050	2,032,965
<b>2006</b>	60	60	50	<b>170</b>	739,260	739,260	616,050	<b>2,094,570</b>
2007	44	53	37	134	542,124	653,013	455,877	1,651,014
<b>2008</b>	41	35	24	<b>100</b>	505,161	431,235	295,704	<b>1,232,100</b>
2009	47	48	12	107	579,087	591,408	147,852	1,318,347
2010	26	47	36	109	320,346	579,087	443,556	1,342,989
2011	51	54	35	140	628,371	665,334	431,235	1,724,940
2012	53	38	26	117	653,013	468,198	320,346	1,441,557
2013	58	44	37	139	714,618	542,124	455,877	1,712,619
<b>Total</b>	<b>744</b>	<b>678</b>	<b>449</b>	<b>1871</b>	<b>9,166,824</b>	<b>8,353,638</b>	<b>5,532,129</b>	<b>23,052,591</b>

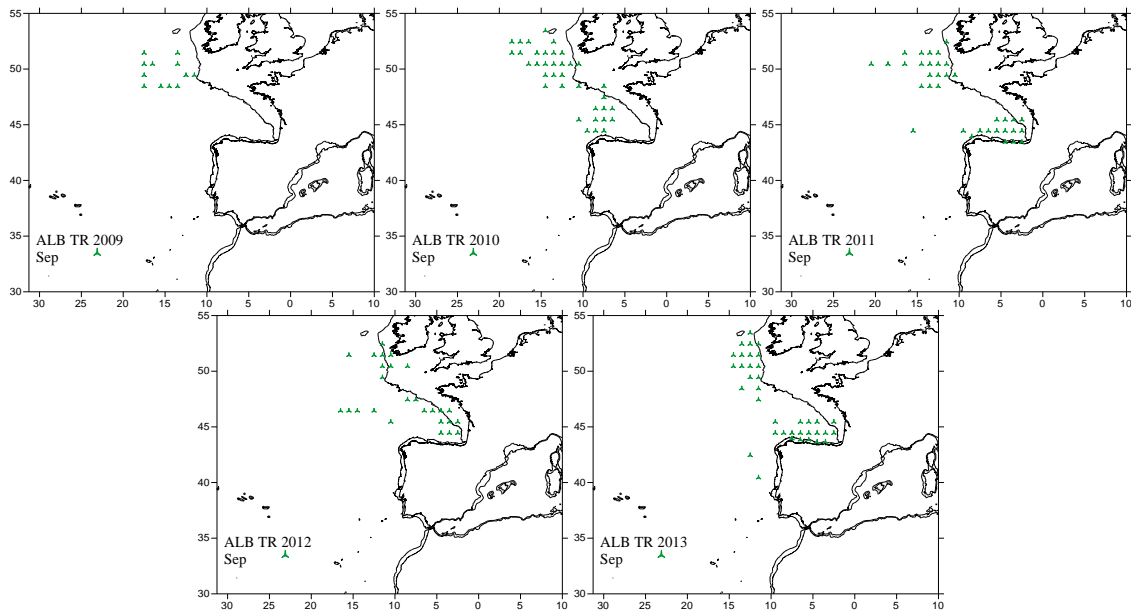
**Table 3.** Catch reported in Bay of Biscay area (43°- 47°N / 0°- 10°W, BofB) for Troll fleet.

	July			August		
	<i>BofB (kg)</i>	<i>Total (kg)</i>	<i>% BofB</i>	<i>BofB (kg)</i>	<i>Total (kg)</i>	<i>% BofB</i>
2010	61,283	2,631,827	2	93,384	1,849,512	5
2011	13,711	1,602,605	1	32,865	570,672	6
2012	233,967	745,985	31	314,205	1,367,979	23
2013	31,844	381,317	8	33,559	292,166	11





**Figure 1.a.** Distribution of the Spanish fleet trolling from 2000-2013 fishing season (July-August) derived from interviews to skippers.



**Figure 1.b.** Distribution of the Spanish troll fleet in the fishing season (September) derived from interviews to skippers. Years: 2009-2013.