STUDY ON THE MIGRATIONS AND STOCK STRUCTURE OF ALBACORE (*Thunnus alalunga*) FROM THE ATLANTIC OCEAN AND THE MEDITERRANEAN SEA BASED ON CONVENTIONAL TAG RELEASE - RECAPTURE EXPERIENCES.

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SUMMARY

In this paper a study on the migrations of albacore from the North Atlantic Ocean and the Mediterranean Sea is made, based on the information from conventional tag release-recapture experiences. Information on 643 recaptured fish from a total of 23,777 tagged fish has been analyzed. This information highlights the long distance movements of albacore, their transoceanic migrations and the possibility of an interchange of fish between the North Atlantic and the Mediterranean.

RÉSUMÉ

Le présent document fait état d'une étude sur les migrations du germon de l'Atlantique nord et de la Méditerranée, d'après des informations provenant d'expériences de marquage et de recapture avec marques conventionnelles. L'information correspondant à 643 poissons recapturés sur un total de 23.777 poissons marqués a été analysée. Cette information révèle les déplacements du germon sur de grandes distances, ses migrations transocéaniques et l'éventualité d'échanges de poissons entre l'Atlantique nord et la Méditerranée.

RESUMEN

En este documento se hace un estudio de las migraciones del atún blanco del Atlántico norte y Mediterráneo en base a las informaciones procedentes de las experiencias de marcado-recaptura convencionales. Se ha analizado la información procedente de 643 peces recapturados de un total de 23.777 peces marcados. Con esta información se ponen de manifiesto los grandes movimientos del atún blanco, sus desplazamientos transoceánicos y la posibilidad de intercambio de peces entre el Atlántico norte y el Mediterráneo.

KEYWORDS
Tagging. Migrations. Population structure. Albacore. Thunnus alalunga.

1. INTRODUCTION

Albacore (*Thunnus alalunga*) is widely distributed. Adults appear mainly in tropical or subtropical waters while immatures are found in temperate waters from all the oceans, including the Mediterranean Sea. Distribution limits are parallels 55ºN and 45ºS (Joseph *et al.*, 1979; Foreman, 1980; Collette and Nauen, 1983; Hunter *et al.*, 1986, FAO, 1994).

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The existence of three different stocks is usually assumed in the Atlantic Ocean: northern and southern Atlantic stocks and a Mediterranean stock (ICCAT, 2001). Northern and southern Atlantic stocks are conventionally divided by the parallel 5ºN (ICCAT, 2001). This division is based on the distribution of albacore catches per unit of effort in the Japanese longline fisheries during the 1960s (Shiohama, 1971; Uozumi, 1996). In the North Atlantic population, heterogeneities were analyzed by coloration (Aloncle *et al*., 1974); coloration, length frequencies, tagging and parasitism (Aloncle and Delaporte, 1979; Hue, 1980a); electrophoresis (Hue, 1979, 1980b); and coloration, electrophoresis, length frequency and hard parts studies (Hue, 1980b). From these studies it was concluded that more than a subpopulation can exist in this area.

These subpopulations would probably be two, originated as a result of two periods of a greater spawning intensity during the reproduction season, that is supposed to take place from April to September (Le Gall, 1974). Nevertheless, it can be considered that the North Atlantic is formed by a single stock showing a degree of heterogeneity in its components. Therefore, any study on population dynamics considers the North Atlantic as a stock unity (Bard, 1981; ICCAT, 1996).

The North Atlantic stock is traditionally considered as independent from the Mediterranean stock (separated by the Strait of Gibraltar), (GFCM/ICCAT, 1990). Several facts seem to confirm this division, such as the independent spawning area existing in the western Mediterranean (Duclerc *et al*., 1973; Lalami *et al*., 1973; Dicenta *et al*., 1975; Dicenta, 1978; Dicenta and Piccinetti, 1978), different morphometric characteristics (Bard, 1978, 1981; GFCM/ICCAT, 1990), different growth rates and age of maturity (Arena *et al*., 1980), and serological differences (Keyuanfar, 1964).

Therefore, according to Bard (1981), it seems that there are enough evidences to consider that the northern Atlantic stock is independent from the Mediterranean stock. However, Di Natale (1991) relates the presence of big albacores (with a weight of more than 30 Kg.) in the Tyrrhenian Sea with a possible access from the Atlantic Ocean. Besides, Viñas *et al*. (1999) do not find genetic differences between albacores from the Mediterranean Sea and those from the Atlantic. Moreover, Aloncle and Delaporte (1976) and Aloncle *et al*. (1976) informed about the possible entrance of individuals from the North Atlantic to the Mediterranean after having recaptured in the Lipari Islands, next to Sicilian waters, an albacore tagged in the Azores area two years before.

This document aims to study the Atlantic albacore migrations and the possible interchanges of individuals between the mentioned stocks, based on the results of the tag release-recapture experiences carried out in the North Atlantic and in the Mediterranean during the last years.

2. MATERIALS AND METHODS

Tagging is a technique which consists of individualizing a series of samples from a species by means of artificial tags, to monitor its evolution and therefore deduce its behavior.

According to De Cárdenas (1995), the ideal conditions a fish tagging experience must meet are the following:

1. Tagged individuals must randomly mix with the rest of the population.
2. Tag and tagging must not affect the individuals survival, behavior or growth.
3. Tags must be difficult to detach.
4. There must be a fishing activity extended throughout the population distribution area, so that tags can be recovered.
5. All recaptures must be correctly notified.

In case these conditions are met, tagging can be very useful to learn about the individuals migrations, population parameters such as natural mortality (M), fishing mortality (F) or growth parameters.

In this paper, tagging is exclusively used to study the displacements and migrations, and to know more about the stock units, supposing that tagged fish as a whole have the same behavior as the rest of the population, and that are randomly distributed among it. We are nevertheless conscious of the fact that recaptures are highly influenced by the existence or absence of fisheries, which are generally seasonal, in each area.

Tag release-recapture database used in this paper has been obtained from González-Garcés and Arrizabalaga (2001), and includes data from the tagging made in the North Atlantic by the IEO: 13,603 fish tagged from 1976 to 1991; fish tagged by the former French ISTPM (Institut Scientifique et Technique des Pêches Maritimes), 6,026 individuals marked from 1968 to 1977, data from 7 fish tagged by the United States' National Marine Fisheries Service (Ortiz de Zárate and Cort, 1998); data from 3 fish tagged in the western Atlantic (ICCAT, personal communication); and tagging data from the Mediterranean Sea, 3,241 tagged from 1986 to 1992 (FAO, 1992), as well as 897 marked from 1990 to 1995 (661 in the Ionian Sea and 236 in the Adriatic Sea), reported by De Metrio *et al*. (1997).

Recapture data used have been also obtained from González-Garcés and Arrizabalaga (2001) and includes the IEO database, the International Commission for the Conservation of the Atlantic Tunas (ICCAT) database, supplied by the Secretariat from this international Commission; recaptures by the former ISTPM, supplied by Aloncle and Delaporte (1976, 1980); information about a tag recovered in the western Atlantic, reported by Prince *et al.* (1995); and information of recaptures reported by Metrio *et al.* (1997).

The minimum distance covered (in nautical miles) has been calculated by measuring the length of a straight line between the tagging point and the recapture point. Albacores' minimum movement speeds have been calculated dividing the minimum distance covered by the number of days in freedom.

3. RESULTS

From a total of 23,777 fish tagged between 1968 and 1995, information was obtained from 697 recaptures (González-Garcés and Arrizabalaga, 2001). Nevertheless, due to the fact that 18 reports were duplicated, there is only information about the recapture of 679 fish (2.86%). In 36 of these cases, information on the position of release (5 cases) or recapture (31 cases) was unknown, and therefore could not be used for our analysis. Consequently, information from 643 albacore tagged from 1968 to 1994 (no data has been obtained from albacores tagged in 1995) and recaptured from 1968 to 1999 has been used.

Tagging and recapture of the 643 recaptured fish about which there is a complete information was carried out by different countries (Table 1).

The great number of fish recaptured by "unknown" is due to the fact that recaptures reported by Aloncle y Delaporte (1980) do not indicate the country which informed about the recapture.

Figures 1 and 2 indicate temporal distribution of tagging and recapture for the 643 fish studied. Figures 3 and 4 respectively correspond to the histograms for the years of freedom (fish recaptured per calendar annual intervals) and days of freedom of the albacores studied.

Albacores tag release and recapture positions have been mapped and linked by straight lines. Points indicate the place of recapture. In figure 5, all the tag release and recapture positions studied are included, while in figures 6, 7 and 8 information relating transatlantic migrations (from one side to the other side of the ocean), information on albacores released or recaptured in the Mediterranean Sea, and information on albacores which crossed the Strait of Gibraltar from the Atlantic Ocean to the Mediterranean Sea, or vice versa, has been respectively filtered.

4. DISCUSSION

4.1. General discussion.

In recent years, two studies on the global migrations of Atlantic albacore based on the results of the tag release-recapture experiences have been published. In one of them (Ortiz de Zárate and Cort, 1998), analysed information of 595 fish recaptured from 1968 to 1995 released in the Atlantic Ocean, but recaptures of fish tagged in the Mediterranean Sea were not included. In the other one (González-Garcés, 1997), 627 tags recaptured between 1968 and 1996 are analyzed, including fish tagged in the Mediterranean Sea. The present paper studies 643 fish tag released and recaptured from 1968 to 1999, including information from fish tagged in the Mediterranean Sea.

In general, we can observe that most of the individuals studied were tagged during the months of August of 1988-1990 (Figure 1), while recaptures are more randomly distributed along the months and years (Figure 2). The greater number of recaptures took place from 1988 to 1992 (387 fish recaptured in this 5-year period from a total of 643). This period coincides with those years with a greater intensity of tagging, as from 1988 to 1991, 12,438 fish were tagged from a total of 23,777 fish tagged throughout the period of the study.

Recaptures per month are concentrated from July to October, period of greater fishing intensity for this species in the Bay of Biscay, area in which the greater number of recaptures takes place.

Recaptures per annual intervals of freedom (Figure 3), which indicates whether fish were recaptured the same calendar year in which it was tagged or in subsequent calendar years, shows that most recaptures have taken place in the calendar year following the tagging year, closely followed by the number of recaptures in the same calendar year in which fish was released. Afterwards, recaptures per annual intervals of freedom gradually decreased until 8 years of freedom. No fish in freedom for more than 8 calendar years was recaptured.

Figure 4 shows some periodicity in the occurrence of recaptures, which is due to the seasonal nature of the Bay of Biscay fishery. Occurrence and non occurrence of recaptures is observed with an annual periodicity, coincident with the summer season, in which the surface fishery occurs. Besides, each year's recaptures gradually increase as we enter the optimum fishing season, in which the best captures take place, and then gradually decrease as albacore follows the autumn migrations and leaves the Bay of Biscay. The fact that the most important tag release campaigns have taken place in August (specially due to the fact that it is a season in which albacore concentrate in this area relatively close to the coastline, and to the better climatic conditions during this time of the year which make tag release operations easier) causes the range of days of freedom for the first year to be narrower, as during the year of tag release recaptures only can be recorded from the date of tag release. This could explain why there are more fish recaptured in the natural year following the tagging year than in the year in which the tagging survey takes place.

4.2. General movements.

In Figure 5 movements from the release place (start of each line) to the recapture place (square at the end of the line) for the total of 643 fish recaptured are represented. In this figure it is evident that information is unclear due to the abundance of tags represented.

Nevertheless, this figure clearly shows that no albacore tagged in the North Atlantic or in the Mediterranean Sea was recaptured in the South Atlantic, which seems to strengthen the hypotheses of a southern Atlantic stock separated from the northern Atlantic and the Mediterranean stock.

This general figure also shows that several albacore have made transoceanic displacements and that some have moved from the North Atlantic to the Mediterranean Sea or vice versa. These matters will be more specifically analyzed later in this document.

4.3. Albacore tagged in the western North Atlantic.

In the northern hemisphere, fish tagged in the western area was also recaptured in the west, in areas relatively close to those in which fish was tagged (Figure 5). From the total of 10 fish studied for which there is a complete information on release and recapture, 5 were recaptured the same year in which they were released, 2 two years after the tag release, 1 three years after the tag release, 1 four years after the tag release and 1 six years after the tag release (Table 2). Although the number of tag released fish observed in this area is small to draw final conclusions, it is surprising the relatively scarce movement of albacores in this area, even when recaptures take place several years after the tag release. Most albacores released in the west are adults or sub-adults, fact which is in accordance with the migratory scheme assumed nowadays (although tagging areas do not exactly match the spawning areas assumed). Nevertheless, the presence of a juvenile albacore tagged and recaptured after two years of freedom in the same occidental area is more difficult to explain with this migratory scheme.

4.4. Albacores tagged in the eastern North Atlantic.

Most albacores were marked in the eastern Atlantic. Most recaptures studied also correspond to albacores tagged in the eastern Atlantic. Figure 5 clearly shows how most fish tagged in the eastern Atlantic were tagged and recaptured in the Bay of Biscay, *sensu lato*. Recaptures distribution is conditioned by the proximity of the tagging positions (most tagging surveys have taken place in the Bay of Biscay) and the general distribution of albacore fisheries in the Atlantic Ocean, as the smaller number of recaptures out of the Bay of Biscay could be influenced by the absence of fisheries in these areas.

4.5. Transatlantic migrations.

Many studied fish tagged in the eastern North Atlantic have been recaptured in areas distant from those in which they were tagged, even recording transatlantic migrations. If we draw an imaginary division between the eastern and western Atlantic, separated by the 35º W meridian (western extreme of the Azores), we can verify 6 displacements from east to west and 1 displacement from west to east.

Available information on the transatlantic migrations from east to west and the migration from west to east is presented in Table 3. These movements are also mapped in Figure 6. All these transatlantic migrations have been verified in albacores which have been in freedom between two and six years.

Table 3 shows information on the distance in miles between the tagging and the recapture points of each of the albacores which made transatlantic migrations. It is evident that these individuals did not move on a straight line and that in some cases they could have made several annual migrations. Information on distance aims to highlight the great distances albacores can cover which can even reach 3,383 nautical miles (approximately 6,269 km) according to these data.

These recaptures of fish at both sides of the North Atlantic are quite relevant as they validate the hypotheses on great displacements of this species in the North Atlantic and their migratory patterns. We must also highlight the fact that all the individuals recaptured in the western Atlantic which made transoceanic displacements on which there is available information about their size, were tagged as juveniles and recaptured as adults. This information agrees with the migratory movement described by previous studies (Aloncle and Delaporte, 1973, Bard, 1981, Cort *et al.*, 1992, Prince *et al.*, 1995, González-Garcés, 1997, Ortiz de Zárate and Cort, 1998), according to which juvenile individuals make trophic migrations from the central Atlantic area to more productive areas located in the north-eastern part of this Ocean, whereas as soon as they are sexually mature they annually migrate to regions off the American coastline in the spawning migration.

4.6. Mediterranean Sea

From a total of 4,138 fish tagged in the Mediterranean Sea on which there is information available, 39 recaptures have been reported (Figure 7). Most fish had been tagged in the Gulf of Leon and most of them were also recovered in this area during the tagging year or in subsequent years (even 8 years later). Several albacores show remarkable displacements. Four of them show displacements from the Gulf of Leon to the Alboran Sea (being in freedom between 1 and 2 years and covering approximately 500 miles). Two albacores show displacements from the Gulf of Leon to the eastern Mediterranean Sea reaching the north of Sicily, covering distances of approximately 500 miles (one of them was in freedom for 2 years and the other one 8 years).

We must also mention fish released in the Ionian Sea (Gulf of Taranto) and in the Adriatic Sea. The five individuals recovered in the Ionian Sea had been also tagged there (after being in freedom between 1 and 3 years). Likewise, the albacore recaptured in the Adriatic Sea after being in freedom for 7 years had been released about 90 nautical miles away from the point of recapture.

4.7. North Atlantic-Mediterranean and vice versa interchanges

Information on the displacements from the North Atlantic to the Mediterranean and vice versa are maybe the more remarkable among those obtained from the analysis of tag release-recapture experiences.

Two albacores which have moved from the North Atlantic to the Mediterranean have been recorded, and another two which have moved from the Mediterranean to the North Atlantic. Data corresponding to these four individuals are presented in Table 4. Figure 8 shows the release and recapture points linked by a straight line.

The first of the two reported recaptures of fish tagged in the North Atlantic and recaptured in the Mediterranean corresponds to the one reported by Aloncle and Delaporte (1976) and Aloncle *et al.* (1976). This report refers to an albacore tagged at the north of the Azores (39º 46' N – 27º 15' W) the 27th June 1973 and recaptured the 2nd June 1975 in the surrounding area of Sicily "in waters of the Lipari Islands". We must highlight the fact that these authors do not completely confirm this information in their general review on tuna (albacore, bluefin and bigeye) tagged by the ISTPM (Aloncle and Delaporte, 1980), as they offer a complete information on the tagging area but do not supply any information on the recapture area. In this document we keep the information the way it was supplied in 1976, interpreting "the waters of the Lipari Islands" as the coordinates 39º00'N - 15º00'E.

The second one corresponds to an albacore tagged in the Bay of Biscay in August 1990 and recaptured two years later, in November 1992, off the Catalonian coastline.

Apart from the fact that the first tag can be considered valid or invalid, information on the second one confirms the possibility that fish from the North Atlantic can cross the Strait of Gibraltar and penetrate the Mediterranean.

Information from the two fish tagged in the Mediterranean and recaptured in the North Atlantic constitute the first documented reports on the possibility of albacores crossing from the Mediterranean Sea to the Atlantic Ocean.

One of the fish was tagged in the Gulf of Leon in September 1989 and recaptured in the Bay of Biscay in August 1994. It was therefore in freedom for 5 years. The second fish was also tagged in the Gulf of Leon in September 1991and recovered in October 1994 at the southeastern Azorian Islands, after 3 years of freedom.

This information relative to fish marked in the Mediterranean Sea and recovered in the Atlantic Ocean and vice versa, confirms the possibility that albacores can cross the Strait of Gibraltar in both directions.

4.8. Displacements speed.

Point 4.5 of the present paper covers an analysis on the transoceanic migrations. Including the 8 cases mentioned in point 4.5, we have detected several long-distance movements. We must pay emphasis to the fact that these individuals did not move on a straight line and that may have made several annual migrations from the tag release to the recapture moment. Nevertheless, it is interesting to mention the great distances covered by albacores, which confirm their long migration.

As an indication of the great displacements detected, we have verified that, from the 643 albacores studied, 1 was recaptured at a distance of 3000 miles from the place in which it was tagged, 3 at a distance greater than 2000 miles; 15 at a distance greater than 1000 miles and 64 at a distance greater than 500 miles.

In order to avoid distortions due to the annual migrations, minimum speed has been calculated only for the albacores tagged and recaptured in the same year. The highest speed detected was 51 miles per day (equivalent to 2 miles per hour) and was recorded in an albacore which was in freedom for 4 days and covered a distance of 204 miles; the second highest speed was 18.6 miles per day, recorded in an albacore which was in freedom for 65 days and covered a distance of 1181 miles; and the third highest speed detected in these conditions was 13.9 miles per day in an albacore which was in freedom for 33 days and had covered a distance of 460 miles.

5. CONCLUSIONS

In general, we must say that the irregular space-time distribution of tagging surveys and fishing effort deployed to albacore, and the consequent low number of recaptures observed in some areas, makes it necessary to be cautious about the interpreting of the data obtained in the present analysis. Nevertheless, this analysis is useful to draw some conclusions which could be broadened in a future with new tag release-recapture data or using other approaches to weight up recaptures according to the number of tagged fish in each area, the fishing effort used, etc.

No albacore released in the North Atlantic or the Mediterranean has been recaptured in the South Atlantic. This fact seems to agree with the hypotheses on an albacore stock independent from the South Atlantic one accepted up to date.

Albacore migrations in the North Atlantic show a wide distribution of this species in this area, including migrations from the Gulf of Biscay to the Canary Islands, from the Canary Islands to the Azorian Islands and, in general, throughout the western North Atlantic. Long distance transoceanic movements of albacores are also confirmed, which means that a distribution of the stock throughout the North Atlantic exists. However, smaller migrations of albacores are observed in the western extreme of the Atlantic Ocean.

Two albacores tagged in the North Atlantic have been recaptured in the Mediterranean and two albacores released in the Mediterranean have been recaptured in the North Atlantic.

Both transatlantic migrations and Atlantic-Mediterranean (and vice versa) migrations observed do not initially contradict the stock structure assumed by ICCAT, although these recaptures confirm the possibility of movement of albacores through the Strait of Gibraltar in both directions. It would be therefore interesting to assess the interchange rate between the North Atlantic and the Mediterranean stocks. Besides, genetic analyses can provide complementary information on the stock structure and on the mixing rate between the different populations.

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Table 1. Distribution of recaptured fish about which there is a complete information per flag of vessels which tagged and recovered the tags.

Country	Tagged	Recaptured
Spain	465	421
France	155	80
United States	11	11
Italy	6	9
Japan	-	2
Portugal	-	1
Unknown	6	119
TOTAL	643	643

Table 2. Data on albacores recaptured which had been released in the western extreme of the North Atlantic.
**This tuna is recorded as an albacore at the release and as a bluefin at the recapture.*
***Information on this albacore weight is incoherent with its growth.*

Tagging date	Position	Weight (kg)	Recapture date	Position	Weight (kg)
*02.09.81	37º20'N-74º20'W	10	24.09.83	39º20'N-72º00'W	
06.02.93	35º45'N-74º45'W	2.7	23.06.95	36º36'N-75º22'W	7.7
15.09.82	39º00'N-72º00'W	12.7	11.10.88	39º00'N-71º00'W	20.4
25.08.90	40º00'N-72º00'W	12.7	19.09.90	40º03'N-70º32'W	
11.09.88	39º00'N-72º00'W	18.1	27.10.88	39º40'N-70º10'W	22.7
07.09.91	39º33'N-72º25'W	9.9	16.11.91	38º56'N-72º38'W	11.3
05.10.91	39º30'N-72º20'W	15.8	09.10.95	39º30'N-72º20'W	24.9
13.08.93	38º57'N-71º40'W	13.6	07.09.93	39º48'N-71º43'W	13.6
03.09.94	41º00'N-71º00'W		13.09.97	39º58'N-69º11'W	
14.07.90	40º00'N-69º00'W	20.4	15.10.90	39º33'N-72º26'W	15.4**

Table 3. Information on 7 east-west transatlantic migration and a west-east transatlantic migration.

Date of Tagging	Position	Size	Date of recapture	Position	Size	Displacement in miles
09.08.69	46º57'N-12º02'W	62	18.01.72	33º07'N-50º53'W		1943
14.07.72	44º07'N-24º19'W	63	08.07.78	16º45'N-50º40'W	100	2115
21.08.76	48º59'N-18º04'W	75	01.02.78	35º10'N-48º10'W		1560
17.08.78	43º47'N-02º47'W	60	30.12.84	40º00'N-70º00'W	102	2927
23.06.80	44º54'N-18º24'W	61	31.12.84	40º15'N-67º26'W	106	2151
18.08.90	44º13'N-03º16'W	56	15.10.95	39º28'N-72º06'W	101	2999
25.06.75	43º20'N-36º21'W	52	11.09.78	46º26'N-04º50'W	85	1345

Table 4. Information on the migrations of 4 albacores between the Atlantic Ocean and the Mediterranean Sea.

Tagging			Recapture		
Date	Position	Size	Date	Position	Size
	Mediterranean Sea			Atlantic Ocean	
21.09.89	42º43'N-05º20'E	70	20.08.94	44º08'N-02º40'W	74
15.09.91	42º31'N-04º20'E	73	23.10.94	36º05'N-22º10'W	77
	Atlantic Ocean			Mediterranean Sea	
27.06.73	39º46'N-27º15'W	60	02.06.75	39º00'N-15º00'E	?
30.08.90	44º16'N-03º05'W	59	04.11.92	40º55'N-02º35'E	77

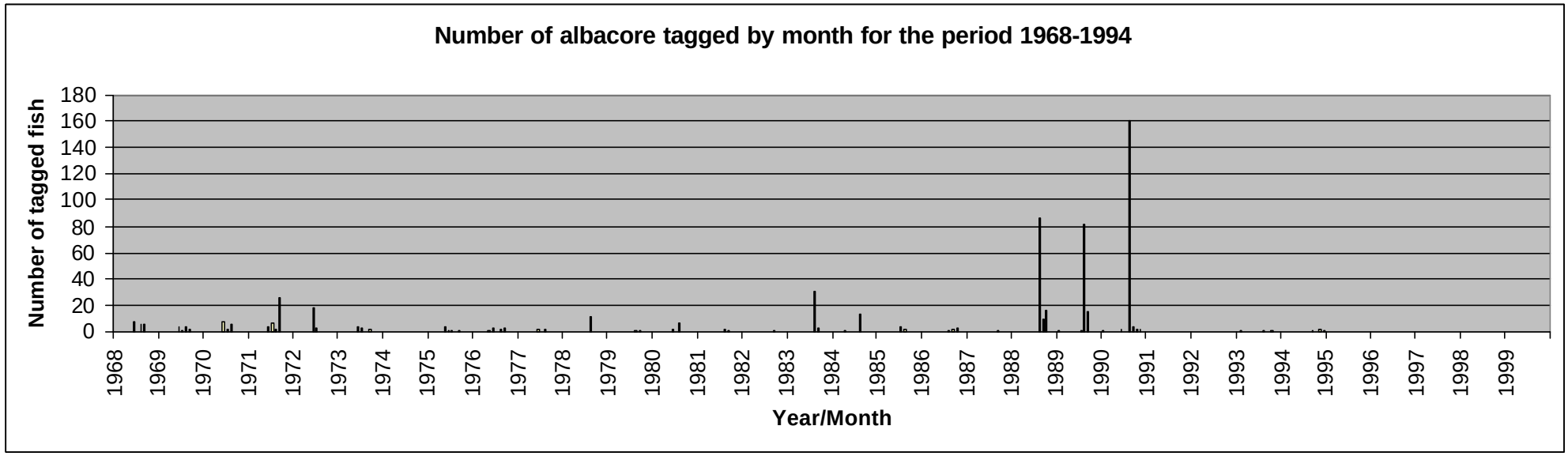

Figure 1: Number of albacore tagged and released during the period of study (1968-1994) which have been subsequently recaptured.

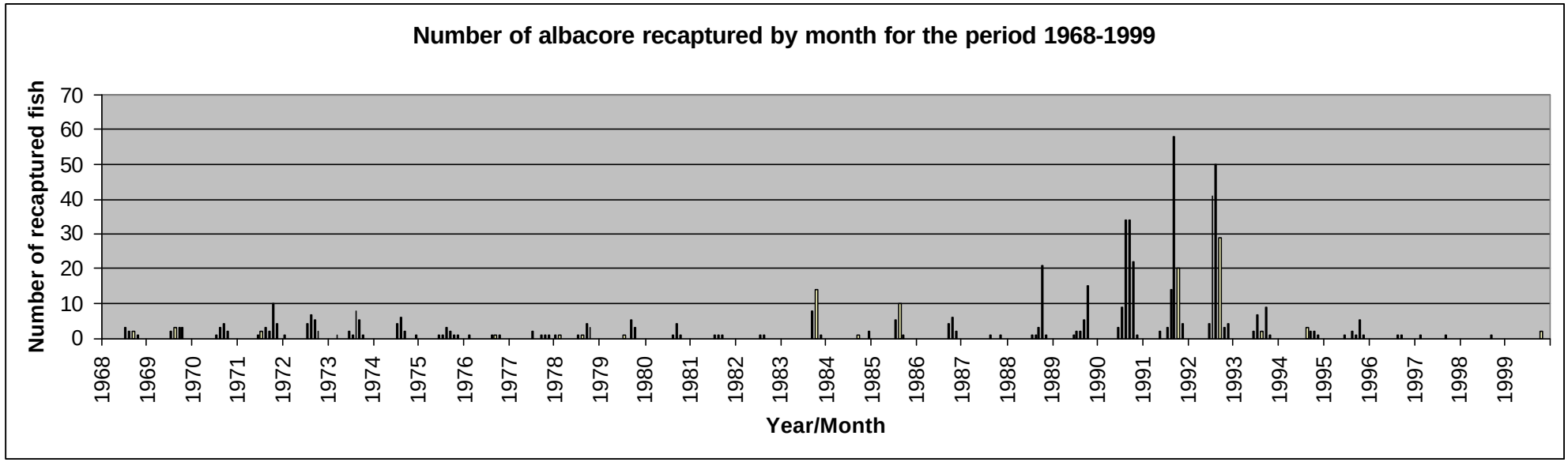

Figure 2: Number of albacore recaptured during the period of study (1968-1999).

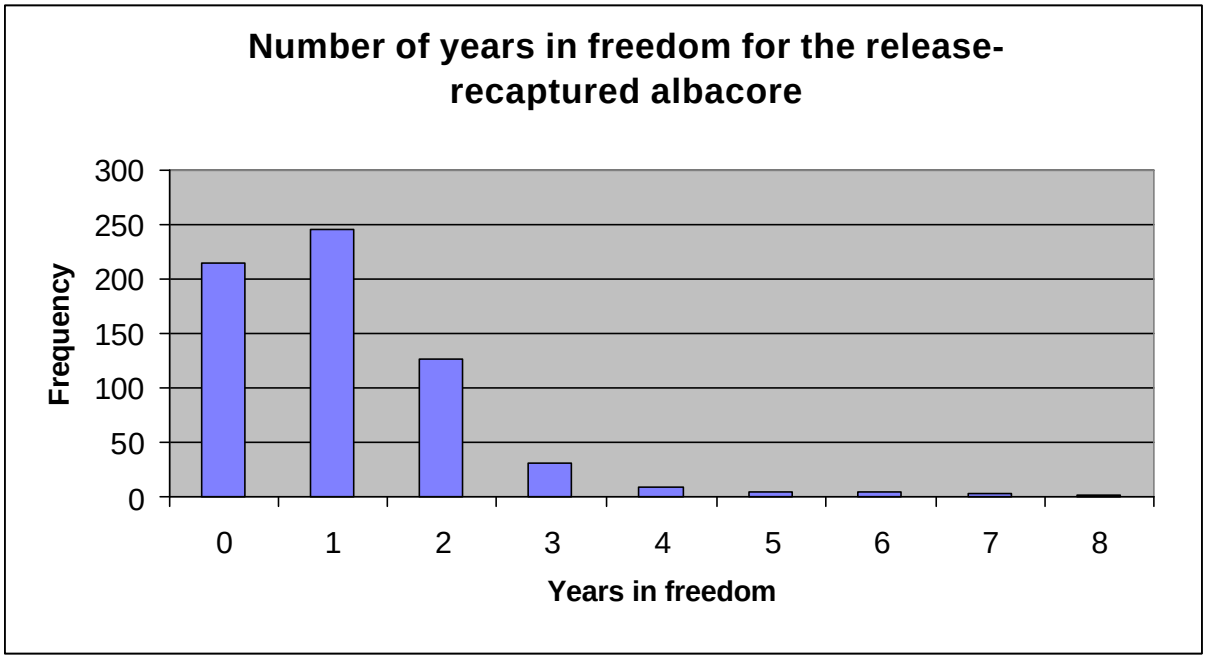

Figure 3: Number of years in freedom for the 644 fish recaptured.

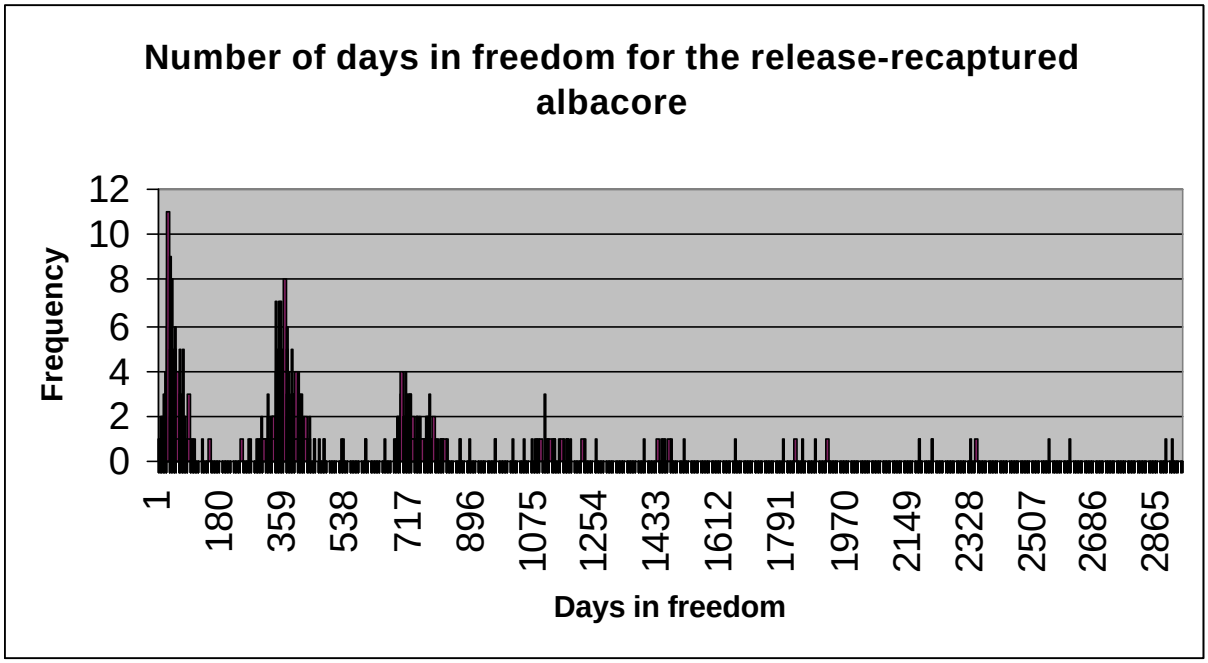

Figure 4: Number of days in freedom for the 644 fish recaptured.

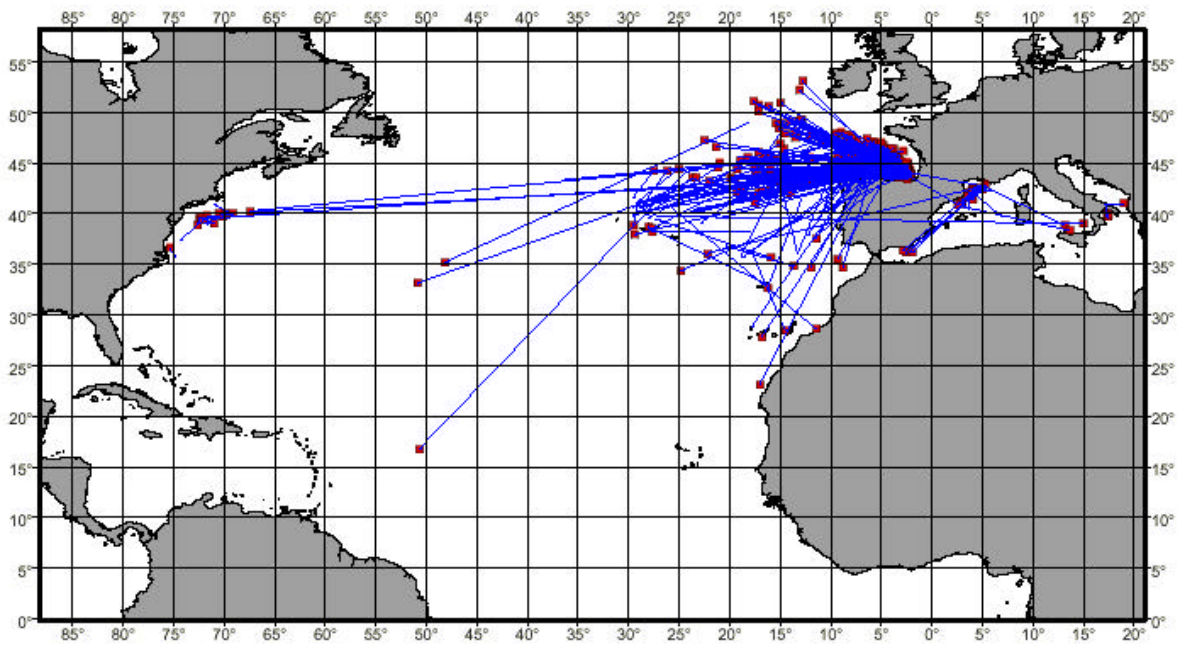

Figure 5: Albacore tagging and recapture positions in the North Atlantic and Mediterranean during the period of study (1968-1999).

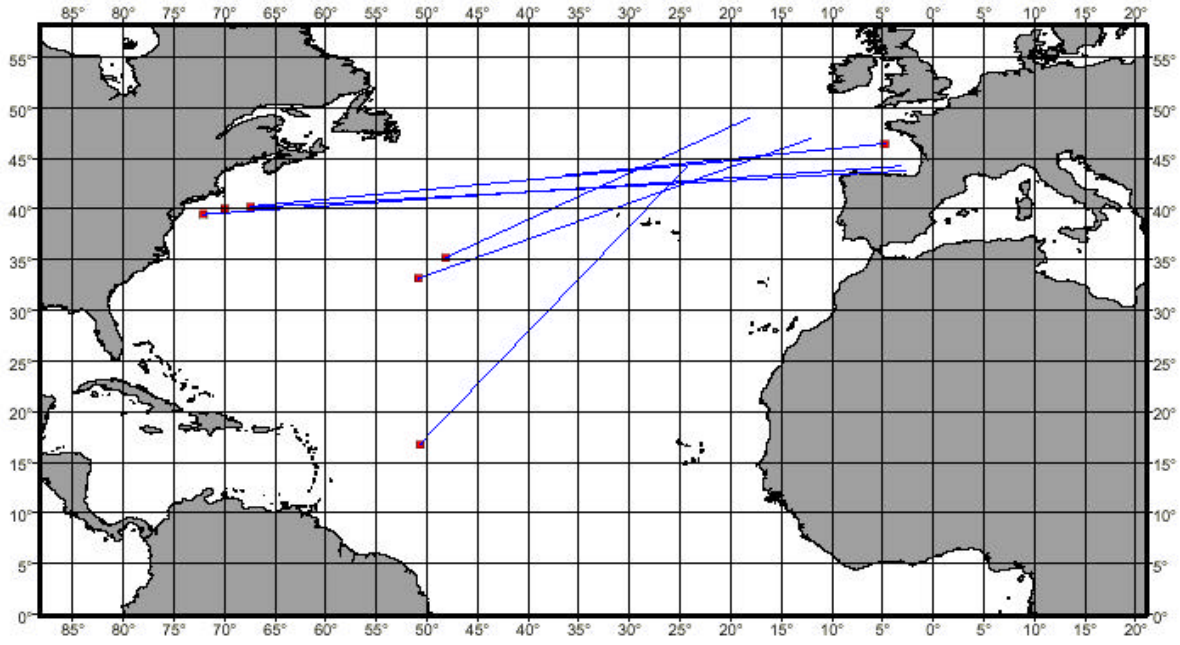

Figure 6: Tagging and recapture positions from northern Atlantic albacores which made transatlantic migrations during the period of study (1968-1999).

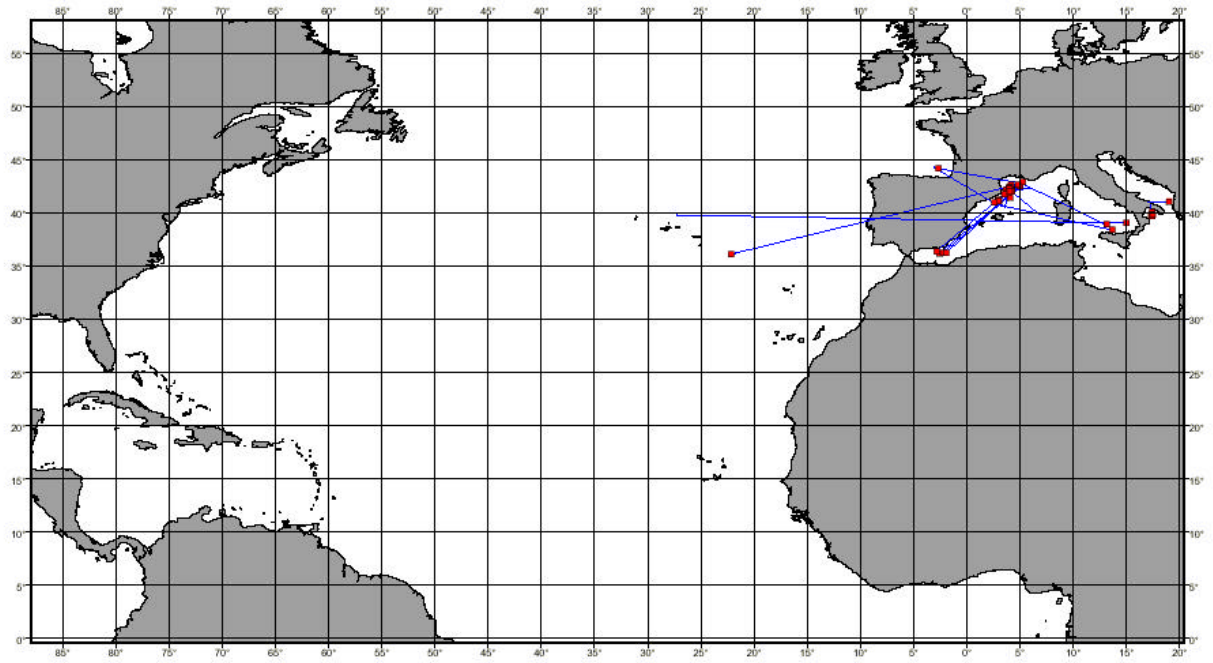

Figure 7: Tagging and recapture positions of albacores tagged or recaptured in the Mediterranean Sea during the period of study (1968-1999).

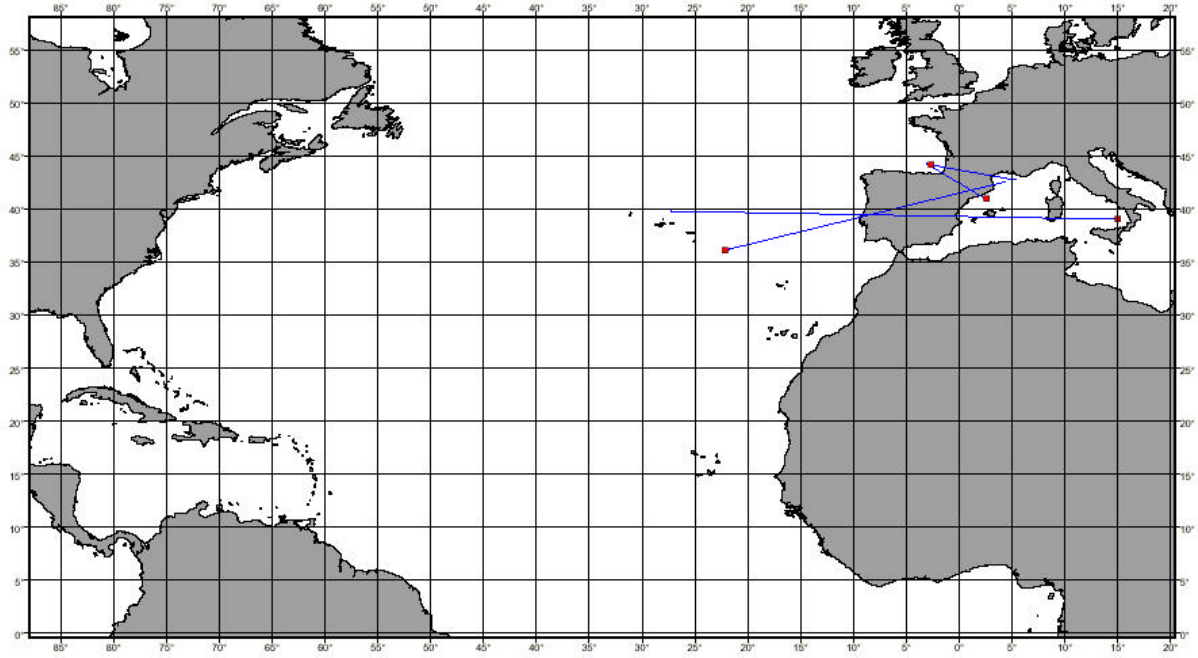

Figure 8: Tagging and recapture positions of albacores tagged in the Mediterranean Sea and recaptured in the Atlantic Ocean, or vice versa, during the period of study (1968-1999).