CHAPTER 3.1.5: POLE-LINE	AUTHOR: IEO	LAST UPDATE: Jan. 28, 2008

3.1.5 Description of the fisheries with pole and line

1. General description of the pole and line gear and boats

The first experience of fishing with live bait in northern Atlantic waters dates back to 1948 when French fishermen introduced this gear fishing albacore and bluefin tuna at the ports of the Bay of Biscay, having imported it from the Pacific Ocean (Pommerau, 1955). This new fishing gear rapidly spread throughout all the ports of the Basque Country in the 1950s (Santiago, 2004). The fishing gear also spread to other areas of the Atlantic Ocean, where major fisheries for temperate (bluefin and albacore) and tropical species (mainly bigeye in the waters of Madeira and the Azores) were started for part of the live bait fleet. At the end of this decade, some European baitboats (French and Spanish) started fishing close to the African coasts (Senegal and Congo), using local ports as their base. At the end of the 1960s, this gear spread to other areas of the eastern tropical Atlantic, targeting yellowfin and skipjack tunas. One of the areas of the Atlantic that has experienced the greatest growth is the Gulf of Guinea, with Tema (Ghana) as the base. In the western Atlantic, live bait fishery was developed in the 1970s in Brazilian waters (Miyake *et al*. 2004, Wise 1987).

1.a Description of the pole and line gear

Category of gear: Pole and line
Standard abbreviation: BB
ISSCFG code: 09.9.0

Fishing with a hook, fixed to the end of a line is, together with harpoons and traps, the oldest gear used to catch aquatic species (several thousand years old).

The fishing method known as *live bait* is carried out with a tackle consisting of a pole and a line with a hook on it.

The hook, which is a simple one, is fixed to the end of a line or carrying the bait. Although in the past, hooks were made from stone, bone, shell or wood (Rodriguez 1923) they are now made from different stainless alloys. They are shaped like a "J" and are made up of the following parts: pole, where the line is fixed (some have an *eye* through which the line is threaded), shank, bight and gaff or barb, which is where the hook is baited and where the fish bites (**Figure 1**).

For live bait, the hook usually carries a barb (sharp extension to the gaff) that prevents the loss of the bait.

The dimensions of the hook vary, depending on the size and species to be fished. Sometimes decoys are attached (feathers, colored line, etc.). When decoys are used, the barb is usually removed to make it easier to unhook the fish once it is hauled aboard.

The line is a single filament line that the fisherman holds with his hand, or with a pole, and attaches a hook with live bait. The length of the line will depend on what it is to be used. The diameter of the line varies from 0.1 to 0.25 mm.

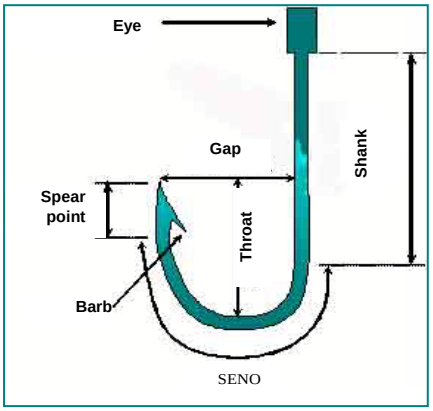


Figure 1. Diagram of the parts of a simple hook.

When the aim is to cast the hook a greater distance, a pole is used, which has the line and the hook attached to one end and the other end is held by the fisherman, or it is fixed to a platform situated o Bend le of the fishing boat or on the deck.

The poles are made from wood, bamboo or fiberglass. For tuna fishing, they are usually between 2-5 m long (Fonteneau y Marcille 1993) (some can reach 10 m) and the thickness varies, as does the gear that they carry. Wooden poles are usually coated with fiberglass to enhance their resistance. The size of the pole and the line will depend on the target species. In some boats, a piece of leather or cork is fixed to the shank of the pole to make it easier to hold.

A pulley is used to catch large fish. The pole has a bight at one end that is used to attach a halyard that passes through a pulley to help handle the gear.

Currently, the handling of the pole is often mechanized on the most modern boats, using reels or drums which, in turn, are connected to a series of hydraulic mechanisms to make them easier to use.

Depending on the eagerness of the tuna, artificial bait or decoys can be used. These are metal or plastic with a fixed hook, or the fishermen simply attach a few feathers to the shank of the hook.

1.b Description of live bait boats

Vessel type: Baitboats
Standard abbreviation: BB
ISSCFV category: 07.3.0

Maximum length: 45 m
Maximum hold capacity: 900 t

Pole and line boats can vary from 3-4 m up to 45 m total length (FAO/FIIT 2000-2007), although they usually measure 10-30 m. The average capacity of the holds does not usually exceed 150 t, although there are vessels with Namibian, Senegalese and South African flags with a hold capacity of 300-900 t (Anon. 2007).

Many of these vessels are multi-purpose boats, so they can use seine gear to fish off the port side (to catch the live bait) and fish with pole and line off the starboard side. They are fitted with winches to hoist the catch and a windlass for the seine gear. Some boats have lateral fold-away platforms on either side for pole fishing. Apart from the seining gear they need to ensure a constant supply of live bait, the boat has from one to six or more open circuit sea water holding tanks in which to keep the live bait. The boat has water spray systems and a crew that varies in number depending on the size of the vessel. The number of crewmen can vary from two to fifteen or more. The entire starboard side is devoted to fishing with live bait, with closed drain holes to prevent any blood spilling into the water.

On American type pole and line vessels (**Figure 2**) the fishing platform for the fishermen is located around the stern, as are the bait tanks. There is often an additional platform for the crew off the side of the boat, over the water. The larger vessels also usually have a central refrigerated hold.

Japanese type pole and line vessels are longer and lower. They have a narrow platform around the vessel for the crew to fish. This is set close to the water to make it easier to transfer the catch to the interior of the boat. The bridge and the engine room are located in the stern and the holds are in the central section, as are the live bait tanks (FAO 1986).

The Bermeo or multi-purpose bonito type pole and line vessels (**Figure 3**) very wide spread in the Spanish fleet, have the bridge forward and the bait tanks can be either or aft of the bridge. The average tonnage of these vessels, which fish in the Cantabrian Sea, is about 120 GRT (Ortiz de Zárate and Rodríguez-Cabello 2006).

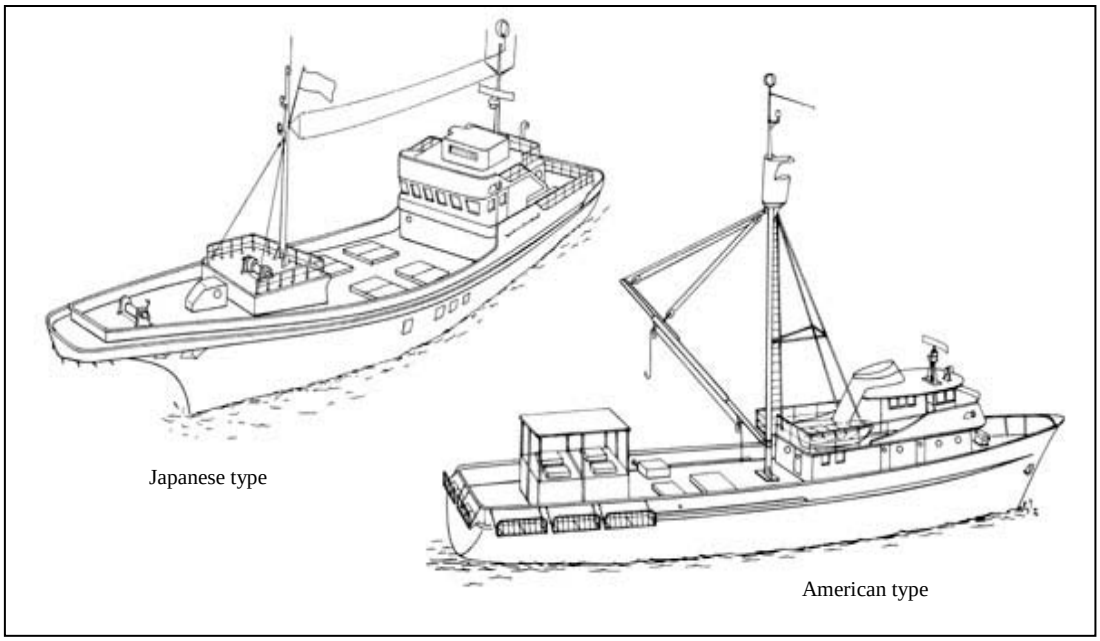


Figure 2. Most frequent types of vessel using pole and line (FAO 1986).

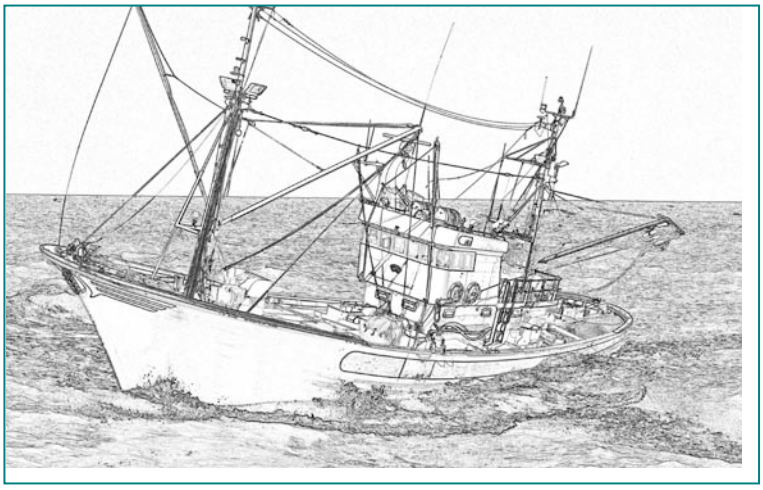


Figure 3. Bermeo type vessel (Túnidos IEO 2007).

2. General description of fishing operations with pole and line

The pole and line gear used in catching tuna is used in artisanal, semi-industrial and industrial fisheries (Majkowski 2003).

Below is a sequential description of the operation to catch tuna with live bait.

Fishing starts by catching the bait in areas close to the coast, such as beaches and bays. The bait is comprised basically of small pelagic species (anchovies, sardines or any other local species) that are kept alive on board the fishing boat in tanks with open sea water circuits, with the water renewed 4 to 6 times an hour (Fonteneau *et al.*

1991) and lit by artificial light to prevent the fish from coming to the surface, where they would die from asphyxia.

Different bait is used, depending on the species and the size of the fish to be caught. A purse seine net is used to catch the bait, or with the aid of a shrimp net. The gear known as *shrimp net* consists of a steel ring, highly flexible to make it easier to stow aboard, with a bag shaped, small mesh net hanging from it. The ring, the diameter of which can vary, is attached to a wooden pole by lines to haul it aboard.

The bait is usually caught at night. The exact time depends on the phase of the moon. Once the bait has been put in the bait tanks, great care must be taken to keep the bait alive, because fishing depends on it.

When the bait is available, the boat can then start the search for tuna. This usually occurs at dawn, with the boat moving in search of signs that lead them to the tuna. Visual searches are made for signs, either directly or using binoculars, looking for the presence of sea birds or fish jumping which disturbs the surface of the sea ("splashes"). There are other signs that are used to detect tuna, like frothing, a different color of the surface of the sea, etc. Since the mid-1970s, sonar has been used as well as traditional detection methods (fleet targeting bluefin in the Bay of Biscay and albacore in the Cantabrian Sea) (Bard 2003, Rodríguez-Marín *et al*. 2002) and since the 1990s, the Ghanaian fleet has been using fish aggregating devices (FADs) (Bannerman and Bard, 2001). In some Atlantic fisheries, the fishing vessel itself is used as a fish "aggregating" device (Canary Islands and Senegal) (Fonteneau and Diouf 1994). The more modern bait boats have the support of bird detection radar (Anon. 2000, Kwei and Bannerman 1993).

Once the school is located, the actual fishing starts (**Figure 4**). The live bait caught before is transferred to small tanks on the side of the boat and the fishermen take up station on the platform or deck, close to the poles.

The maneuver consists of attracting and retaining the school of fish close to the boat, with the aid of the live bait that is thrown into the sea. Besides the sea water, the spray pumping system is also activated. This system consists of metal or plastic tubes with several holes in them. These run from stern to bow all along the starboard rail. This hides the poles and the shadows of the boat and simulates a school of small fish on the surface. This creates a favorable atmosphere, leading the tuna to think there is abundant food around which, in turn, gets them excited and into a feeding frenzy such that they even bite un-baited hooks. The bait is placed on the hook towards which the tuna swim and jump on the surface of the sea. The tuna, attracted by the movement, bites the bait and pulls the pole which is then gradually pulled close to the boat to prevent the fish from getting off the hook. If the fishing is good, in 10-20 minutes an average boat can catch 1-4 t of tuna.

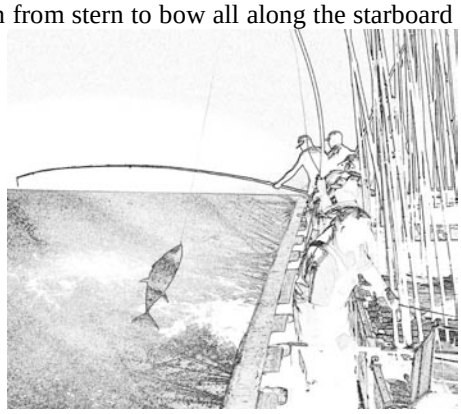


Figure 4. Fishing with live bait (Túnidos IEO 2007).

To hoist large fish aboard, there are other poles, called *gallows* that are maneuvered by pulleys (Delgado de Molina *et al*. 1990). This system makes it possible to use longer poles (5 m) and a single crewman (Cort and Iguiñez 1980). Two poles and a single line can also be used.

If the tuna is to be marketed fresh, a club (like a wooden baseball bat) or an iron bar is used to kill the fish as soon as it is hoisted aboard. The fish are usually stored unprocessed in freezers or lockers (divided by wooden panels), or kept in the now empty and clean refrigerated bait tanks.

Some boats, (e.g. Azores) use collector chutes to transfer the fish from the deck to the holds, and they put them in tanks of cold water to conserve them.

3. Main Atlantic fisheries

3.a Specific characteristics of the gear/vessels

As concerns tropical tuna fishing, some baitboats (Dakar and Canary Islands fleets) have undergone a major modification in their fishing method in the Atlantic Ocean since the 1990s, as compared to other oceans. The boat acts as a fish aggregating device that keeps the school of tuna together so that it can be caught in successive fishing operations. Hence, when one boat completes its load, another takes its place to carry on fishing from the

same school. This means that the school of fish can be gradually caught and it even extends the fishing season (e.g. Canary Islands) (Fonteneau and Diouf 1994, Hallier and Delgado de Molina 2000).

The Ghanaian fleet uses floating objects (FADs). This fishery was started by Japanese boats in the early 1960s, targeting skipjack tuna (Bannerman and Bard 2001). The introduction of FADs in the early 1990s changed the strategy of the baitboat fleets that operated in this area, increasing the proportion of yellowfin and bigeye tuna caught. The introduction of purse seine boats in 1997, and co-operation between purse seiners and the pole and line fleet has led to important changes in the exploitation of tunas in this area (Anon. 2004a).

3.b Flag States involved

Table 1 below presents a list of the countries that have presented catches for the different tuna species in live bait and hand line fisheries (1950-2005), with the countries that have recorded an annual catch from 2000 to 2005 highlighted in bold type:

Table 1. Flags involved in baitboat (BB) and hand line (HL) fishing in the period 1950-2005 (ICCAT database).

	SPECIES (FAO Code)												
COUNTRY	BFT	SBF	YFT	ALB	BET	BLF	LTA	SKJ	BON	BOP	WAH	SSM	KGM
Angola			**x**		**x**		**x**	**x**	x				
Algeria	**x**						**x**		**x**				
Brazil			**x**	**x**	**x**	**x**	**x**	**x**	x		**x**		**x**
Cape Verde	x	**x**	**x**	**x**	**x**		**x**	**x**			**x**		
Cyprus	x												
Croatia	x												
Cuba			**x**			x	**x**	**x**	x				
Spain	**x**		**x**	**x**	**x**		**x**	**x**	**x**		**x**		
USA	**x**		**x**	**x**	**x**	**x**	**x**	**x**	**x**		**x**	x	
France	**x**		**x**	**x**	**x**		**x**	**x**	**x**				
Gabon			x					x					
Ghana			**x**		**x**		**x**	**x**					
Greece	**x**			**x**									
Italy	**x**												
Japan			**x**		**x**			**x**					
Morocco	**x**							**x**	x	**x**			
Namibia			**x**	**x**	**x**			**x**					
Panama			**x**		**x**		**x**	**x**					
Portugal	**x**		**x**	**x**	**x**		**x**	**x**	**x**		**x**		
United Kingdom				x									
R. of Korea			**x**	**x**	**x**			**x**					
Senegal			**x**		**x**		**x**	**x**	x	x	x		
Sta. Helena (UK)			**x**	**x**	**x**			**x**					
Sta. Lucia	x		**x**	**x**	**x**	**x**	**x**	**x**	x	x	**x**	**x**	**x**
South Africa		**x**	**x**	**x**	**x**		**x**	**x**					
Tunisia	**x**												
Venezuela			**x**	**x**	**x**	**x**	**x**	**x**					

As concerns the baitboat catches of temperate tuna by species, Spain is the country that catches THE most bluefin tuna (*Thunnus thynnus*), as well as the most catches of albacore (*Thunnus alalunga*) from the northern stock. With regard to bigeye (*Thunnus obesus*), Spain, Portugal, Ghana and France are the main flags. Brazil and Venezuela in the western Atlantic and Ghana in the eastern Atlantic contribute the largest catches of yellowfin (*Thunnus albacares*), and Brazil and Ghana provide the largest catches of skipjack tuna (*Katsuwonus pelamis*).

3.c Areas where baitboats operate

The baitboat fleet operates mainly in the coastal areas of the Atlantic Ocean. The temperate tunas (albacore and bluefin tuna) are caught mostly in the northeast Atlantic (Bay of Biscay) and the Mediterranean Sea, or off the west coasts of South Africa (Tripp and western Cape sea mounts basically) (Penney *et al*. 1992). The tropical tuna fisheries (yellowfin, bigeye and skipjack) are carried out in the tropical strip of the Atlantic, mainly in the

island chains of the eastern Atlantic, coasts of Senegal and Mauritania, Gulf of Guinea, coasts of Brazil and Venezuela.

A small baitboat fishery has been noted in the waters southwest of Cuba and northeast of Brazil, where the target species are blackfin tuna *(Thunnus atlanticus*), skipjack and yellowfin (Valle *et al*. 1986).

3.c.1 Temperate tunas: albacore (Thunnus alalunga*) and bluefin (*Thunnus thynnus*)*

The baitboat fleet that catches **albacore** throughout the Atlantic Ocean, fishes mainly between latitudes 25ºN-50ºN and 20ºS-40ºS off the African and American coasts of the Atlantic Ocean and in the northeast Atlantic, in the Bay of Biscay and adjacent waters (**Figure 5**) and in the waters of the archipelagos of the Azores, Madeira and the Canary Islands.

The surface fleets that exploit the North stock (above 5ºN latitude) are mainly European (Spain, France, Portugal and Ireland) and they fish in the Bay of Biscay (to the north of the 40ºN parallel), in the adjacent waters of the northeast Atlantic and around the archipelagos of the eastern Atlantic (Canary Islands and Azores during the summer and autumn). The Spanish fleet has extended its activities towards the Azores and the southern Atlantic coast of the Iberian Peninsula since 1990 (Anon. 2004b).

The South stock is exploited mainly by the baitboat fleets of South African and Namibia (South stock) (Penney *et al*. 1992). In general, catches of this species have fallen in this area since 2001, probably due to a reduction in the fleet (e.g. Chinese Taipei, China and Brazil) and to the preference for other species (i.e. yellowfin in the case of the South African fleet). The baitboats operating in the South Atlantic are mostly Portuguese boats fishing in Angolan waters (Anon. 2004b).

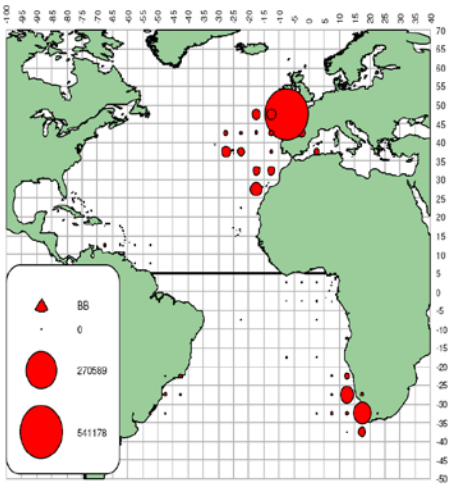


Figure 5. Geographic distribution of albacore (*Thunnus alalunga*) catches, 2000-2004, from the major baitboat tuna fisheries (ICCAT 2006)

There has been a decline of almost 60% in catches in the Mediterranean Sea and there are practically no baitboats targeting this species (ICCAT 2006).

In the eastern Atlantic, **bluefin tuna** are caught almost exclusively in the Cantabrian Sea and, to a lesser extent, in the Canary Islands, Madeira and the Azores (seasonal) and in the Mediterranean Sea.

In the western Atlantic, bluefin tuna fishing is distributed in specific areas of the North American coast (Gulf of Maine and Gulf of St. Lawrence) (**Figure 6**).

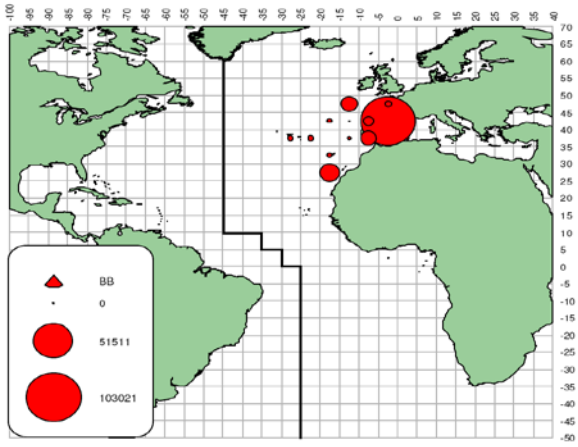


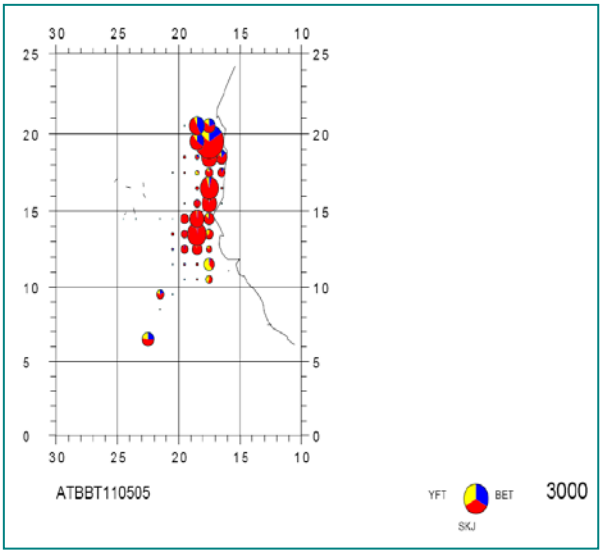
Figure 6. Geographic distribution of bluefin tuna (*Thunnus thynnus*) catches from the main temperate tuna baitboat fisheries, 2000-2004 (ICCAT 2006).

*3.c.2 Tropical tunas: yellowfin (*Thunnus albacares*), bigeye (*Thunnus obesus*) and skipjack (*Katsuwonus pelamis*)*

Although this group of species is caught throughout the tropical Atlantic Ocean, between 45ºN-45ºS, the eastern Atlantic baitboat fleet fishes mainly between the equator and 30ºN, off the coasts of Africa.

In the case of **yellowfin**, the major baitboat fleet based in Tema (Ghana) fishes in the coastal waters of Côte d'Ivoire, Ghana, Sierra Leone and Cape Lopez. The fleet based in Dakar (Senegal), which started operating in 1956, fishes in the coastal waters of Senegal and Mauritania. Other baitboat fisheries operate in the archipelagos of the Azores, the Canary Islands, Madeira and Cape Verde (Anon. 2004a) **(Figure 7**).

The main baitboat fisheries catching **bigeye** are located in the waters of Ghana, Senegal, the Canary Islands, Madeira and the Azores (Anon. 2005).



S**kipjack** are caught mainly in the Gulf of Guinea and off the African coasts between Senegal and Mauritania (Anon. 2000).

In the western Atlantic, baitboat catches of **yellowfin** are also widely distributed in the tropical strip off the South American coasts (mainly in waters of Venezuela and Brazil) (Anon. 2004a).

In the case of **bigeye**, the areas where the highest catches are reported are in waters of Venezuela and Uruguay; although the figures are not comparable with those for the East Atlantic (Anon. 2005).

S**kipjack** are also caught abundantly in Brazilian waters and, to a lesser extent, in Venezuela (Anon. 2000).

Figure 7. Geographic distribution of tropical tuna catches by the European baitboat fleet in 2005 (Pianet *et al.* 2007).

3.d Seasonality

3.d.1 Temperate tunas

Albacore *(North Atlantic)*

The North stock is exploited by the surface fishing fisheries that mainly target immature fish (50 to 90 cm FL). The main surface fisheries are exploited by the European Community fleets (EC-Spain, EC-France, EC-Portugal and EC-Ireland) in the Bay of Biscay, in adjacent waters of the northeast Atlantic and close to the Canary Islands and Azores in summer and autumn (**Figure 8**).

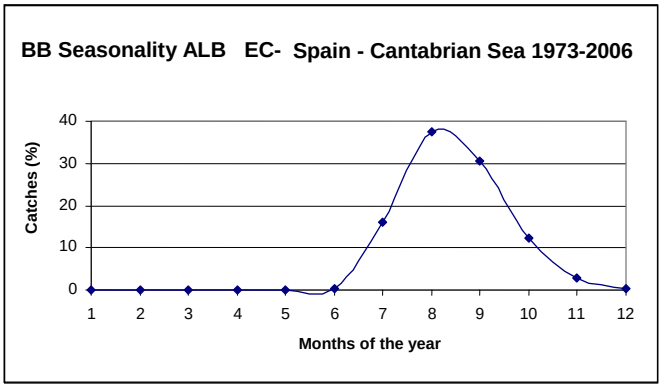


Figure 8. Monthly distribution of albacore (*Thunnus alalunga*) catches, (in %), for the Spanish baitboat fleet in the Cantabrian Sea, 1973-2006 (ICCAT database).

The seasonality observed for the Canary Islands albacore baitboat fleet, where the largest catches are made (60%), occurs from February to May (Delgado de Molina *et al*. 2006) (**Figure 9**).

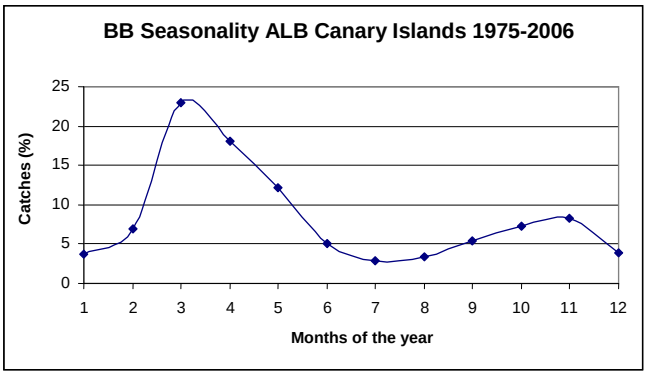


Figure 9. Monthly distribution of albacore (*Thunnus alalunga*) catches (in %), for the Canary Islands baitboat fleet, 1975-2006 (ICCAT database).

Live bait and troll fishing in the **western Mediterranean** is carried out sporadically during the months of October and November (**Figure 10**), with the participation of a variable number of boats from the north of Spain (Camiñas *et al*. 1986). Baitboat fishing is carried out principally in the Hispano-Algerian basin and Alboran Sea. Troll fishing is mainly carried out in the north of the Balearic Islands and the Balearic thermo-haline front (de la Serna *et al*. 2003).

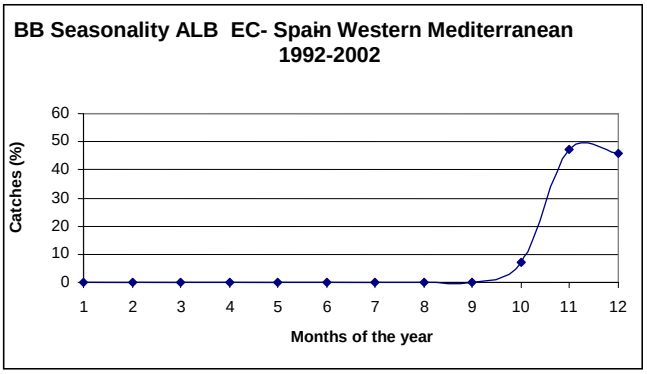


Figure 10. Monthly distribution of albacore (*Thunnus alalunga*) catches, (in %), for the Spanish baitboat fleet in the western Mediterranean, 1975-2006 (ICCAT database).

Albacore *(South Atlantic)*

The recent total annual landings of albacore from the South Atlantic are attributed in large measure to four fisheries, namely, the surface baitboat fleets of South Africa and Namibia and the longline fleets of Brazil and Chinese Taipei. The surface fleets only target albacore and catch mostly juveniles (70-90 cm FL). These surface fisheries operate seasonally from October to May when there are albacore in coastal waters (**Figure 11**) (ICCAT 2006).

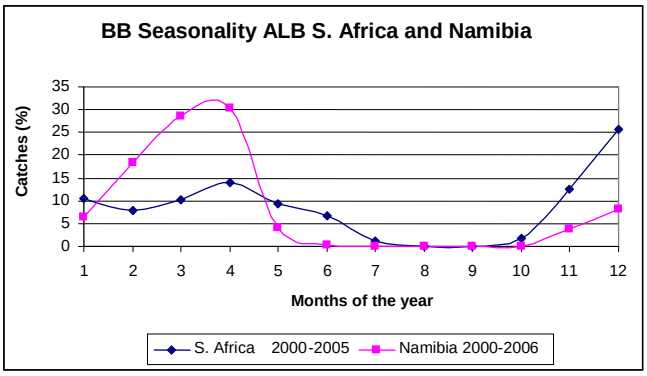


Figure 11. Monthly distribution of albacore (*Thunnus alalunga*) catches (in %), for the South African baitboat fleet, 2000-2005, and the Namibian baitboat fleet, 2000-2006 (ICCAT database).

Bluefin tuna

Several fisheries have developed on the basis of the seasonal availability of tuna and tuna-like species in the area of the Strait of Gibraltar and adjacent marine regions. Hence, we can point out the trap, hand line and pole and line with live bait as the main bluefin tuna fisheries.

The most important hand line fishing in the Mediterranean takes place in the Strait of Gibraltar between July and October (**Figure 12**), coinciding with the feeding migration of bluefin tuna. This fishery targets large sized fish of this species (García-Soto, 2005).

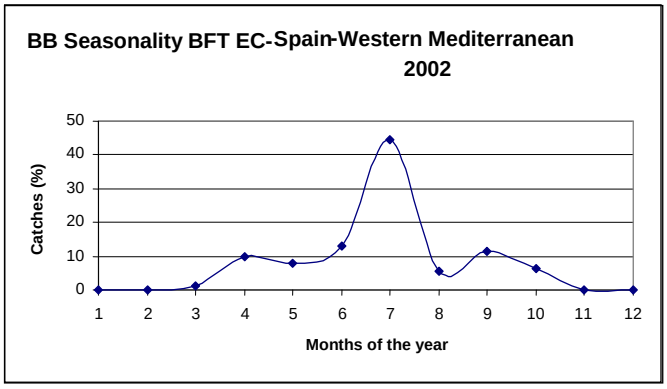


Figure 12. Monthly distribution of bluefin tuna (*Thunnus thynnus*), (in %), for the Spanish hand line fleet in the Mediterranean, 1975-2006 (ICCAT database).

Bluefin are caught sporadically in the Canary Islands fishery, although there are two times of the year when the largest catches are made (**Figure 13**): March and April (38%) and November and December (27%) (Delgado de Molina *et al*. 2006).

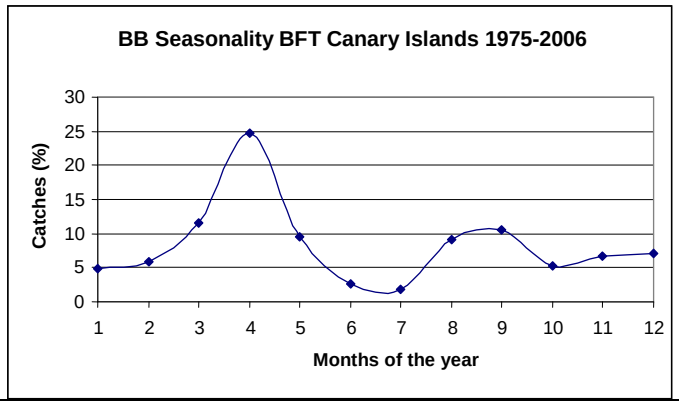


Figure 13. Monthly distribution of bluefin tuna (*Thunnus thynnus*) catches, (in %), for the Canary Islands baitboat fleet, 1975-2006 (ICCAT database).

The largest baitboat fishery is carried out in the Bay of Biscay, where a varied range of bluefin tuna between 6 and 150 kg are caught from June to November (García-Soto 2005). Peak catches are reached in July and August (**Figure 14**).

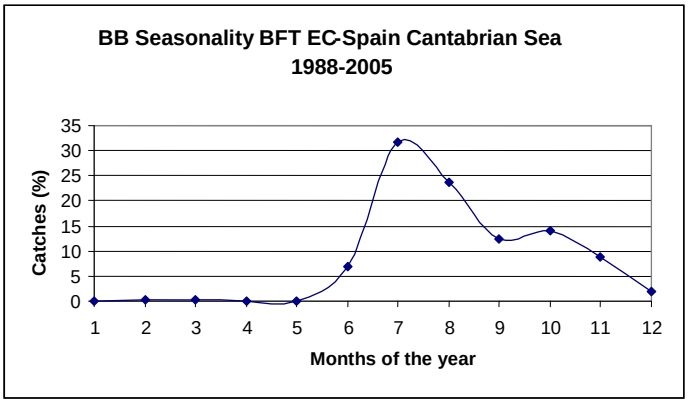


Figure 14. Monthly distribution of bluefin tuna (*Thunnus thynnus*) catches, (in %), for the Spanish baitboat fleet in the Cantabrian Sea, 1988-2005 (ICCAT database).

3.d.2 Tropical tunas

Yellowfin

In the *western Atlantic*, Brazilian baitboats catch yellowfin tuna all year round, but the maximum catches are made in the summer months, with a peak in the month of May, after which catches decline, with minimum catches between the months of August and November, while the Venezuelan baitboat fleet records maximum yellowfin catches between the months of September and November, and minimum catches in the months of March and April (**Figure 15**).

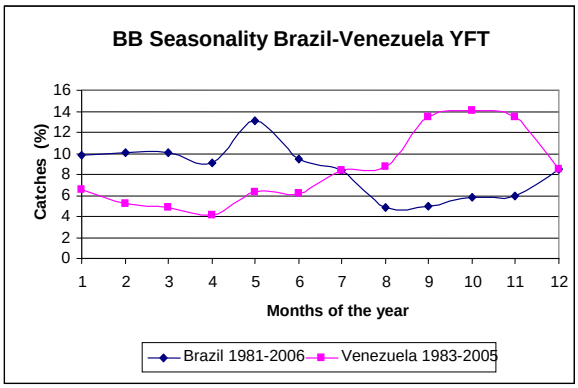


Figure 15. Monthly distribution of yellowfin tuna (*Thunnus albacares*) (in %) by the Brazilian baitboat fleet, 1981-2006, and the Venezuelan baitboat fleet, 1983-2005 (ICCAT database).

There is no pronounced seasonality in the catches of the Ghanaian baitboat fleet, as they fish yellowfin all year round, mainly small sized fish, with a series of fluctuations that show a peak in the months of September, October and November (**Figure 16**).

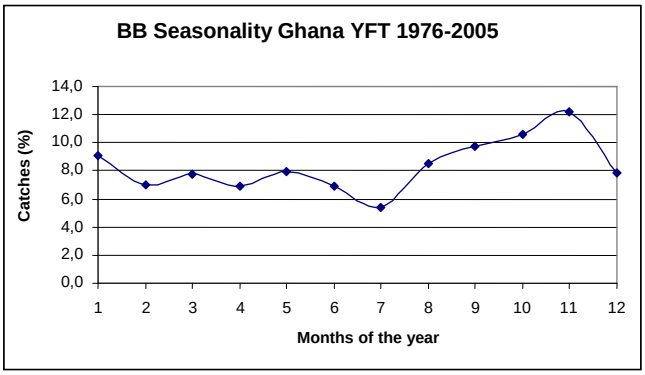


Figure 16. Monthly distribution of yellowfin tuna (*Thunnus albacares*) catches, (in %), by the Ghanaian baitboat fleet, 1975-2006 (ICCAT database).

Both the Spanish and the French baitboat fleets based in Dakar mainly catch yellowfin mainly between the months of July and November, coinciding with minimum catches between March and May (**Figure 17**).

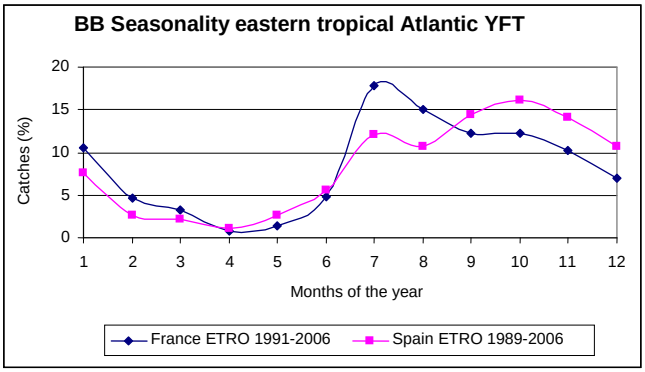


Figure 17. Monthly distribution of yellowfin tuna (*Thunnus albacares*) catches, (in %), by the French baitboat fleet (ETRO), 1991-2006 and the Spanish baitboat fleet (ETRO), 1989-2006, in the eastern tropical Atlantic (ICCAT database).

According to Delgado de Molina *et al*. 2006, the Canary Islands baitboat fleet obtains its most important catches (67%) between the months of September and November (**Figure 18**).

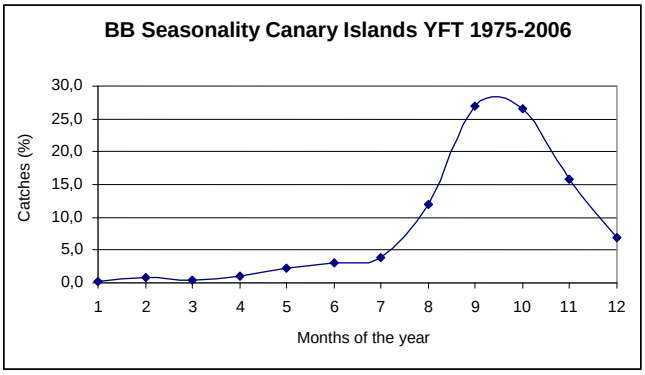


Figure 18. Monthly distribution of yellowfin tuna (*Thunnus albacares*) catches, (in %), by the Canary Islands baitboat fleet during the period 1975-2006 (ICCAT database).

Bigeye tuna

The main **live bait fisheries** are in Ghana, Senegal, Canary Islands, Madeira and Azores. These fisheries started in the early 1960s. There are several fishing grounds along the African coasts. One of these, with a base in Dakar, started operations in 1956 in the coastal areas of Senegal and Mauritania, where bigeye fishing is seasonal from March to November (**Figure 19**) (Anon. 2005).

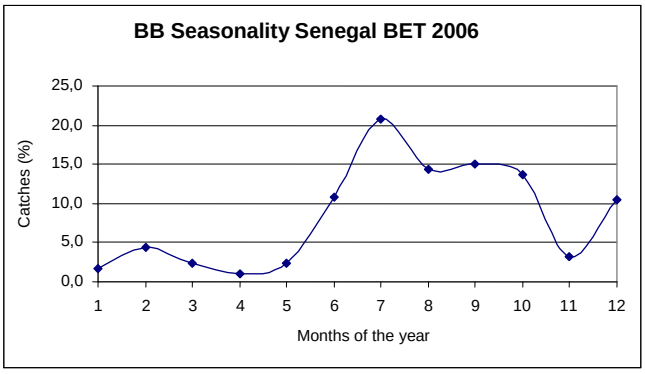


Figure 19. Monthly distribution of bigeye tuna (*Thunnus obesus*) catches (in %) for the Senegalese baitboat fleet, 1976-2005 (ICCAT database).

Catches in Ghana are made up mainly of small-sized tuna, including bigeye, caught in free schools. These catches are made throughout the year, with a series of fluctuations, including peaks in the months of September and October (**Figure 20**).

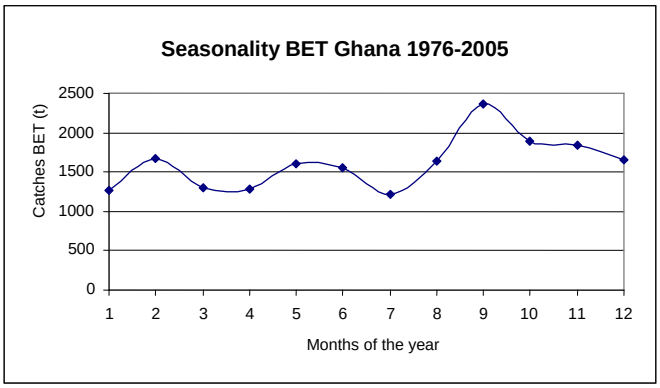


Figure 20. Monthly distribution of bigeye tuna (*Thunnus obesus*) catches (in %) for the Ghana baitboat fleet, 1976-2005 (ICCAT database).

In several eastern Atlantic archipelagos, the target tuna species show seasonal variation. The average weight of the bigeye caught is about 19-20 kg. The largest catches of bigeye are observed in the months of April to July in the Azores and from March to July in Madeira. In the Canary Islands, the season of maximum fishing is from March to October (Anon. 2005), although the largest catches are made between the months of April and June (50% of catches in the last 20 years) (Delgado de Molina *et al*. 2006) (**Figure 21**).

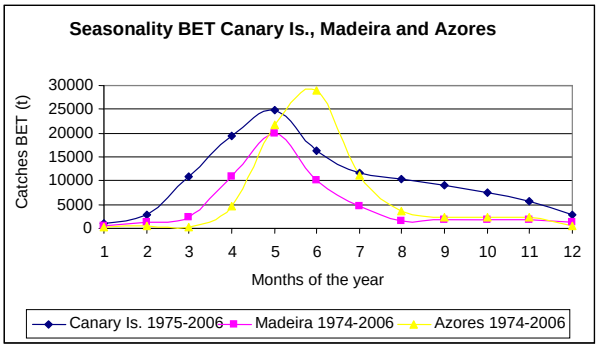


Figure 21. Monthly distribution of bigeye tuna (*Thunnus obesus*) catches (in %) for the Canary Islands baitboat fleet (1975-2006), Madeira baitboat fleet (1974-2006) and Azores baitboat fleet (1963-2006) (ICCAT database).

Skipjack tuna

In the *eastern Atlantic*, the most important live bait fisheries for this species are those of Ghana, EC-Spain and EC-France. Ghana takes part of its catches on floating objects and the two latter fleets are similar in that the baitboat acts as the floating object, fixing and fishing a school (made up of bigeye, yellowfin and skipjack) throughout the fishing season in waters of Senegal, Mauritania and the Canary Islands (Anon. 2005) (**Figure 22**).

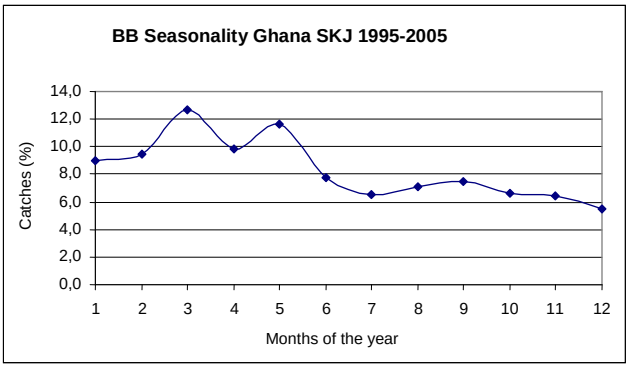


Figure 22. Monthly distribution of skipjack tuna (*Katsuwonus pelamis*) catches, (in %), for the Ghana baitboat fleet, 1995-2005 (ICCAT database).

In the Canary Islands, the most important catches are traditionally obtained from July to October (64% of catches of this species) (Delgado de Molina *et al*. 2006). In the case of the Azores, there is a far more pronounced seasonality in skipjack catches, with a strong increase from March to June, reaching a peak between July and August, followed by a rapid decline until October. Madeira records its highest catches in the month of August (**Figure 23**).

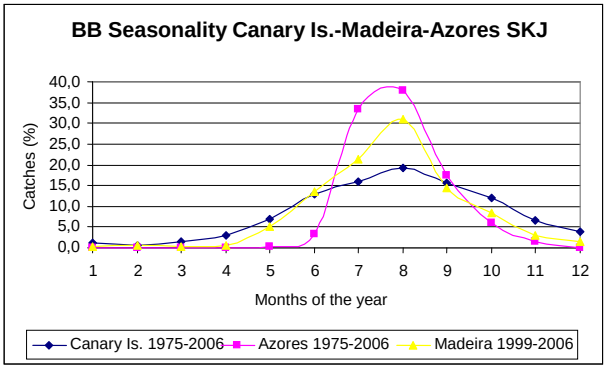


Figure 23. Monthly distribution of skipjack tuna (*Katsuwonus pelamis*) catches (in %) for the Canary Island baitboat fleet (1975-2006), the Madeira baitboat fleet (1999-2006) and the Azores baitboat fleet (1975-2006) (ICCAT database).

In the *western Atlantic*, the first tuna fishery was the live bait fishery in the 1950s. Traditionally, the highest catches have been made by this fleet, with the Brazilian baitboat fishery being the most important in the west (Anon. 2000). In this fishery, catches vary considerably depending on the season, with the highest levels in summer, between the months of December and May, and the lowest levels in winter (Meneses de Lima *et al*. 2000a) (**Figure 24**).

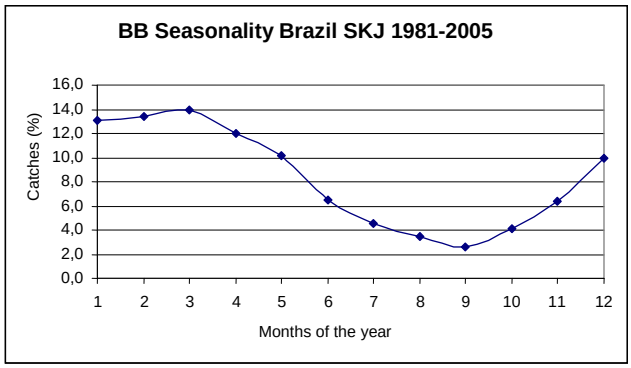


Figure 24. Monthly distribution of skipjack tuna (*Katsuwonus pelamis*) catches, (in %), for the Brazilian baitboat fleet, 1981-2005 (ICCAT database).

3.e Target species and size composition

The major tuna species caught by boats using live bait are the following:

- Albacore (*Thunnus alalunga*)
- Bluefin tuna (*Thunnus thynnus*)
- Yellowfin tuna (*Thunnus albacares*)
- Bigeye tuna (*Thunnus obesus*)
- Skipjack tuna (*Katsuwonus pelamis*)

Up to the end of the 1950s, the baitboat fisheries caught mainly bluefin tuna and albacore intensively in the Atlantic Ocean, although there were also important catches of tropical tunas (mainly bigeye). With the development of fisheries such as the large-scale longline fishing (from 1950) and the surface fisheries (from 1970), catches of albacore and yellowfin tuna increased. The catch rate of skipjack tuna exceeded that of yellowfin in 1991 (Miyake *et al.* 2004) (**Figure 25**).

In 2002, 23% of the total catch of tropical tunas and 20% of the total catch of temperate tunas in the Atlantic Ocean were made using live bait gear (Leiva and Majkowski 2004).

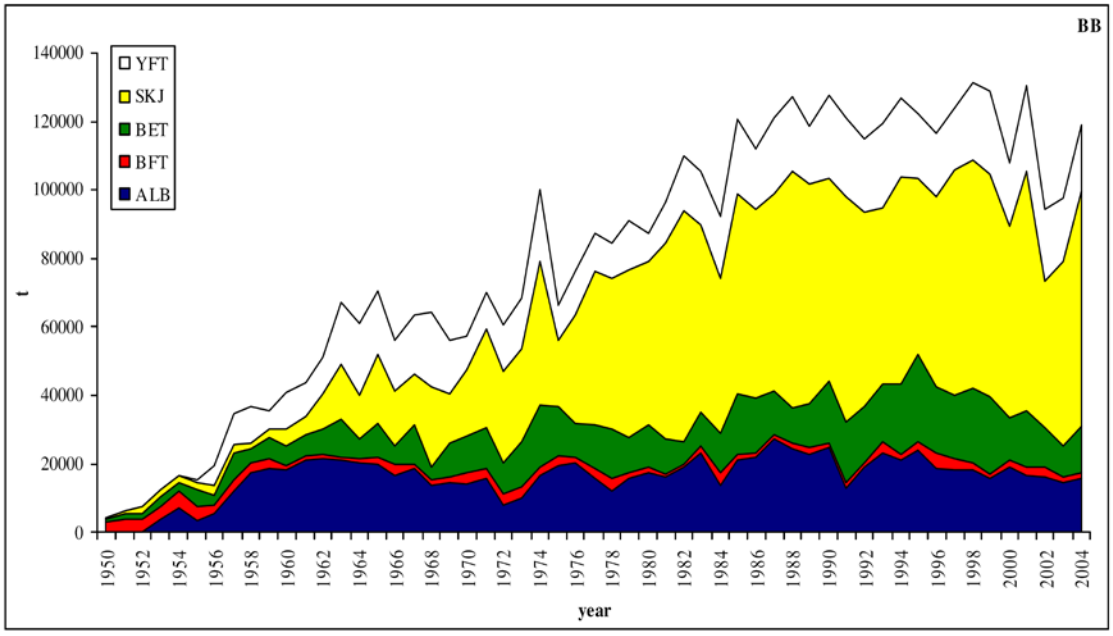


Figure 25. Accumulated annual catches of the main tuna target species of baitboats (ICCAT 2006).

*3.e.1 Temperate tunas: bluefin tuna (*Thunnus thynnus*) and albacore (*Thunnus alalunga*)*

In the case of the **albacore**, surface fisheries generally direct their effort on juvenile, sub-adult and adult fish of the North stock (50-90 cm FL), with a predominance of fish around 65 cm FL. Catches from the South stock mainly consist of sub-adults and adults (70-90 cm FL), with a predominance of individuals of around 80 cm FL (**Figure 26**) (ICCAT 2006).

The Spanish fleet usually catches the juvenile and sub-adult component of the North stock in the area of the Canary Islands (means of about 80 to 97 cm FL, Delgado de Molina *et al.* 2006), with inter-annual variations, while the Portuguese fleet catches large and adult fish, with an average weight of 25 kg (102 cm FL) in Madeira and Azores (Anon. 2004b).

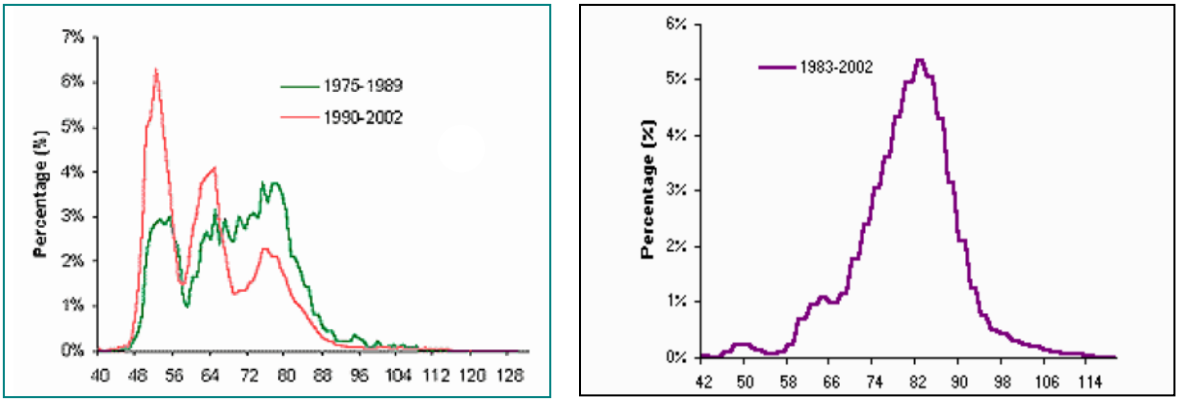
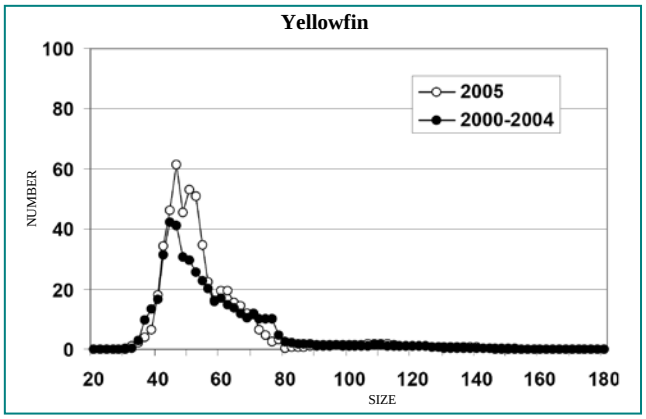


Figure 26. Distribution of sizes (cm) of albacore (*Thunnus alalunga*) catches by the baitboat fleet in the North (A) and South (B) stock of the Atlantic Ocean (ICCAT 2007-2009).

The most important baitboat fishery targeting **albacore** is carried out in the Bay of Biscay where a wide range of weights are caught, between 6 and 150 kg (65 to 168 cm FL) (Cort 2005). The fleet that operates in the Mediterranean Sea records catches with a larger average size of close to 103 cm FL (Com. pers. Rodríguez-Marín 2007).

*3.e.2 Tropical tunas: yellowfin (*Thunnus albacares*), bigeye (*Thunnus obesus*) and skipjack (*Katsuwonus pelamis*)*

The sizes of **yellowfin** tuna caught range from 30 to 170 cm FL (**Figure 27**). The baitboat fishery in equatorial zones catches juvenile yellowfin in coastal waters, together with skipjack, juvenile bigeye and other small tunas (ICCAT. 2007-2009).



In the East Atlantic, the major catches of yellowfin by the baitboat fleet are landed at Tema (Ghana). This fishery catches fish that are about 2.5 kg (50 cm FL), whilst the fish caught by baitboats that fish in waters of Senegal and Mauritania vary between 7 and 10 kg (70-80 cm FL). In the Azores, Madeira, Canary Islands and Cape Verde, the average sizes are quite variable, ranging between 7 and 30 kg (70-115 cm FL) (Anon. 2004a).

In the West Atlantic, the Brazilian and Venezuelan fleets catch fish that weigh an average of about 14 kg (90 cm FL) together with skipjack and small tunas (Anon. 2004a).

Figure 27. Distribution of sizes of yellowfin tuna (*Thunnus albacares*) catches (in number) in the baitboat fishery in Dakar, for the European and associated fleets, in 2005 and between 2000-2004 (Pianet *et al.* 2007).

In general, the average sizes of **bigeye** tuna show fluctuations and a slight decrease in the recent years. The baitboat fleet of the northeastern Atlantic and eastern tropical waters catch fish weighing between 20-30 kg (97-112 cm FL) (Anon. 2005).

The fishery in coastal waters of Senegal and Mauritania, based in Dakar, catches fish that weigh an average of 8 kg, whilst the baitboat fleets that fish in the waters of the northeastern Atlantic archipelagos (Azores, Madeira, Canary Islands and Cape Verde) catch fish weighing an average of about 20 kg (**Figure 28**) (Anon. 2005).

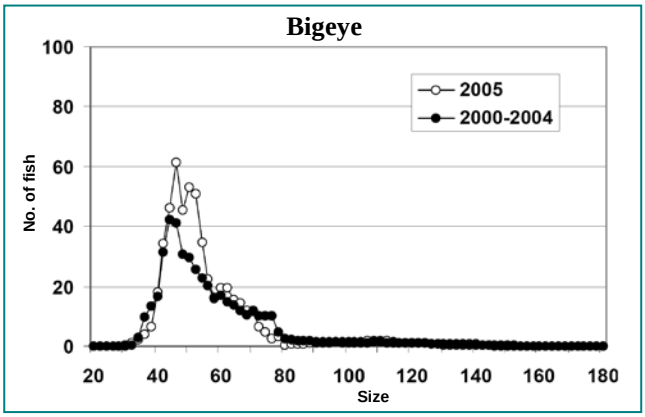


Figure 28. Distribution of sizes of bigeye tuna (*Thunnus obesus*) catches (in number) in the baitboat fishery in Dakar, for the European and associated fleets, in 2005 and between 2000-2004 (Pianet *et al.* 2007).

The sizes of **skipjack** in the East Atlantic are between 35-55 cm FL, with a predominance of individuals measuring close to 45 cm FL, whilst in the West Atlantic, fish measure between 40-70 cm FL (**Figure 29**), with a clear predominance of fish measuring about 55 cm FL (Anon. 2000).

In the Mediterranean Sea, mainly in Turkey's coastal waters, Atlantic black skipjack (*Euthynnus alletteratus*) are caught with sizes between 45-80 cm FL (2.5-7.0 kg) (Kahraman 2005). This species is also caught in waters off southeastern United States, in the Gulf of Mexico and in the Caribbean Sea (Miyake 1990).

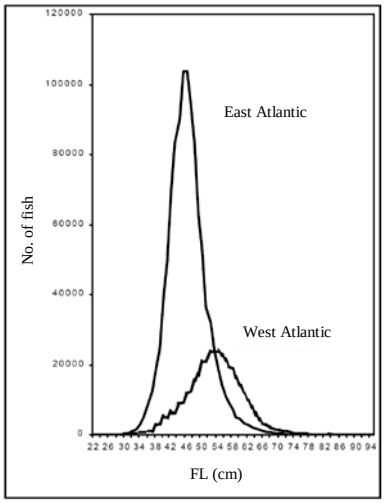


Figure 29. Distribution of sizes for skipjack tuna (*Katsuwonus pelamis*) (in number) for the East and West Atlantic (average for the period between 2000-2004) (Anon. 2000).

3.f Storage and tuna processing

The tuna caught by baitboats and handline are used both for fresh consumption and for canning, depending on the species. In some cases, some species such as bluefin and bigeye tuna are used for sashimi in the Japanese market and other industrialized countries.

Once the catches have been landed at the port, the commercialization process of the fish has two fundamental sources for distribution: the fish markets and the wholesalers.
In Europe and in the majority of countries, the organizations of producers and associations organize the first sale at their respective fish markets, either directly or by means of a downward system of auctions (also known as Dutch auctions) where the operators responsible for the purchase and distribution to the various interested buyers can go and bid on the fish. In some cases the fishermen's associations and cooperatives can operate as the first point of sale. The most important operators in this second level of intermediation are the wholesalers, the canners and agents of super stores and distribution chains. Although part of the catches is marketed without going through the fish market, most of them do.

An important segment of the fish products is later marketed and distributed through wholesale markets where distribution of food products is managed (perishable food in particular) and put at the disposal of average users to guarantee the supplemental activities (storage, loading and landing logistics, sanitation controls etc.). Specialized stores, restaurant owners, and small and large distributors have access to such wholesale markets.

In the case of Senegal, the central market of Dakar has become over the years a center for the distribution of fish from the entire country and from fleets of neighboring countries. All the fish that are supplied to areas of the interior comes from Dakar, both fresh and dried, and salted or smoked. The industrial sector of processing and marketing of fish products has been reduced to three canneries and a series of companies that process the fish generally for export as refrigerated and frozen product. The most common industrial processes are freezing, filleting and canning of products, which are mainly destined for Europe. Abidjan (Côte d'Ivoire) and Tema (Ghana) also have canning factories that process the fish that are unloaded in these ports.

For the western Atlantic, in the north and northeastern regions of Brazil in the recent years tuna have been included in the line of frozen products destined for the foreign market. The processing of refrigerated products is noteworthy, mainly bigeye and swordfish. In the south and southeastern regions, the structure of the industries is orientated towards the production of canned sardines and canned tuna (among other species), as well as refrigerated and frozen products (fillets), mostly for the domestic market, in particular, the processing of refrigerated products is geared mainly towards bigeye and swordfish (FAO 2001).

In Brazil, the production of the coastal industrial fleet in particular supplies the canning, refrigerated and frozen products industries that produce different types of fillets and headless fish for export and, to a lesser extent, for the domestic market.

The most popular final product is canned tuna, in tins or glass, preserved in olive oil, vegetable oil, brine or water, in 80, 120, 160, 185 y 200 g (net weight) containers. The best quality canned tropical tuna is yellowfin caught in the Atlantic and Indian Oceans, followed by yellowfin caught in the Pacific Ocean, and skipjack that is generally of lesser quality and cheaper. Canned albacore is a specialty and has better quality and a higher price than other tunas.

Higher quality canned tuna (yellowfin and albacore, also skipjack) are processed in solid cuts, while skipjack of inferior quality is presented in pieces or flaked. Tuna salads and tuna in sauce are among the categories of canned tuna. A recent product, which was developed in the United States and introduced in Europe, is tuna in air tight plastic bags.

Sashimi is obtained from the largest bluefin tuna. This is raw, fresh, refrigerated or frozen at -40ºC that is highly valued in the Japanese market and successfully exported to North America and Europe. High quality sashimi comes from the largest bluefin tuna. Other factors that determine the quality are the firm texture of the meat, the high fat content and the transparent color. In the last 10 years, due to the high demand of tuna for sashimi and the shortage of the resources that are subject to quotas, the main bluefin tuna producers such as Spain, Italy, France, Croatia, Turkey, Australia and New Zealand, more or less succeeded in developing fattening farms for bluefin tunas destined for export to Japan and other consumer countries.

Other products are dry and smoked tuna, consumed preferably in Japan (fushi), as well as fillets, paste and, in the Mediterranean area, dried tuna eggs (bottargo). The remains of the tuna processing are transformed into food for animals (Catarci 2003).

The worldwide tuna market

The worldwide imports of fresh, refrigerated and frozen tuna increased since 1976 from 145,000 t to 1.5 million in 2001, and the imports of canned tuna (net weight) increased from 89,000 t in 1976 to 836,000 t in 2001.

Japan is the largest producer in the world and has the largest market for fresh and frozen tuna and products based on tuna (excluding canned tuna). While a small amount of the raw material comes from its coastal waters for local fresh consumption, la major part is supplied by Japanese industrial tuna fleets that fish in international waters and through direct imports.

During the 1989-1998 period, a very stable demand throughout the entire period was greater than the supply of raw materials to produce canned tuna, which led to an increase in imports of the raw material for the canning industry and caused a rise in prices of both the raw material and the canned tuna.

Between 1999 and 2000 an increase in catches caused a decrease of 8% and 30%, respectively, in the average prices due to the excess supply of raw materials. At the end of 2000, there is an attempt to eliminate this excess with the subsequent increase in prices in 2001 and 2002, at a rate of more than 10% per year, but in 2003 a new excess caused a 5% drop.

As regards international commerce, it should be noted that the following are the major producers of canned tuna: Thailand (19.3%), United States (16.5%) and Spain (16.4%). Furthermore, the main importers are the United States, as well as the United Kingdom and France. Thailand is, by far, the main exporter followed by Spain and Equador (Núñez 2006).

At the worldwide level the European Union is the most important market for canned tuna. The average consumption in the European Union is 1.5 kg per person per year. In Spain this consumption reaches 2.18 kg (data from the *Fédération Française des Industries d'Aliments Conservés*, FIAC, France). France and Spain are two of the most important worldwide tuna importers as regards canned production (Catarci 2003).

In the African subsidiaries of the European processing industries, traditional products such as tuna in brine or in vegetable oil is canned, while the more sophisticated products, such as tuna in olive oil or tuna salads are produced in Europe. On the other hand, the European processing industries have been using semi-processed tuna loins from Central America more and more. Thus, the EU can make good use of the profitability from the production factors of developing countries and, at the same time, protect employment in its own canning industry.

3.g Landing ports

Regarding temperate tunas in the eastern Atlantic, the baitboat fleet directed at bluefin tuna that operates in the Cantabrian Sea is mainly Spanish and lands its catches in the ports of Hondarribia (Fuenterrabía), Guetaria and Bermeo (100-150 GRT vessels), while the Spanish baitboat fleet that operates in the Mediterranean Sea targeting bluefin tuna unloads at the ports of Algeciras and Tarifa (30-40 GRT vessels).

Unloadings of albacore are carried out mainly at the Spanish ports of the Basque country where the fleet is mainly baitboat (Guetaria, Fuenterrabía and Ondarroa), and at Cantabrian ports (Colindres and Santoña). In the South Atlantic the major unloading port of albacore by the baitboat fleet is located in Durban (South Africa).

The major ports where tropical tunas are landed from the baitboat fleet are located in Tema (Ghana), Dakar (Senegal) and Canary Islands (Spain) for the East Atlantic. There are also important unloading ports located in the Azores Islands, Madeira and Cape Verde.

In the West Atlantic, the Brazilian baitboat fleet mainly unloads at Itajaí (Santa Catarina) and Navegantes (Meneses de Lima *et al*. 2000b; Teixeira Santos and Agrelli Andrade 2003), while the Venezuelan fleet unloads catches in Cumaná.

3.h Historical development

3.h.1 Nominal effort

− East Atlantic

The units of nominal effort generally used are days at sea and fishing days. Their development is related to the number of vessels present in the fishery. Another unit of nominal effort is the carrying capacity, in tons.

The development of nominal effort of the European rod and reel and associated fleets that fish in eastern Atlantic waters, in fishing days, since 1991, shows a similar trend to that of carrying capacity in recent years (**Figure 30**).

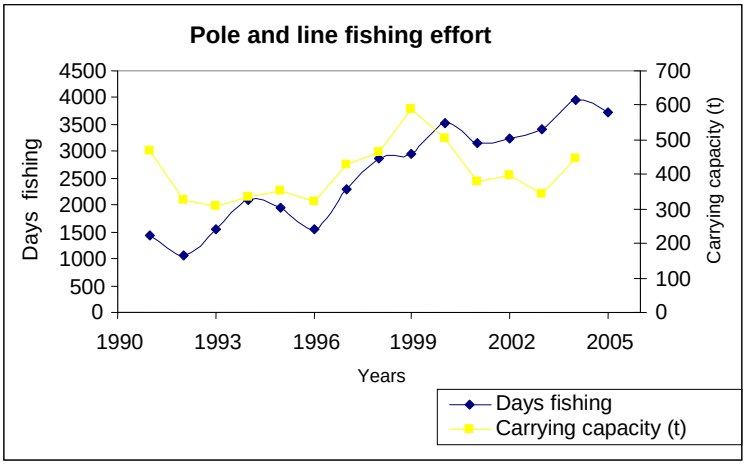


Figure 30. Carrying capacity and fishing effort (in days fishing), by year, of the European and associated rod and reel fleets, 1991-2006 (Pianet *et al.* 2007).

As can be seen in **Figure 31**, in the North Atlantic there is a declining trend in nominal effort for one of the major fleets that operates in the North Atlantic, in number of days fishing, throughout the period with a certain tendency to stabilize in recent years, with a maximum in 1975, and minimums in 2001 and 2002.

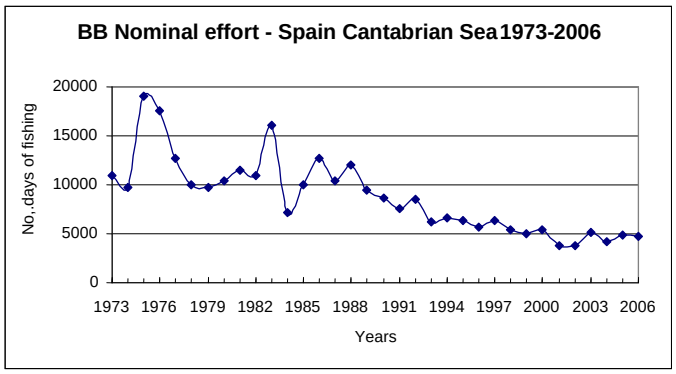


Figure 31. Development of nominal effort, in days fishing, of the Spanish baitboat fleet fishing in the Cantabrian Sea, 1973-2006 (ICCAT database).

In the case of the South Atlantic albacore baitboat fishery, **Figure 32** shows the development of fishing effort (days fishing) carried out by the South African baitboat fleet. Effort is currently very similar to that of the early 1980s, i.e., at very low levels.

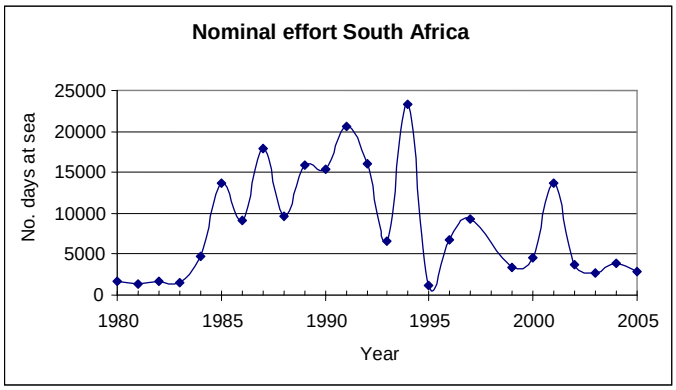


Figure 32. Development of nominal effort, in number of days at sea, of the South African baitboat fleet for the period 1980-2005 (ICCAT database).

− West Atlantic

According to Meneses de Lima *et al*. (2000a), fishing effort of the Brazilian baitboats was reduced by half between 1985 and 1996, although an increase was observed in 1997 and 1998. However, this overall decrease

did not occur for all the components of the Brazilian fleet and there is clear evidence that the average size and carrying capacity of the vessels increased during this same period. There is no evidence to suggest that this fleet has incorporated more efficient fishing equipment onboard the boats (with the exception of the recent increase in the use of satellite images).

Fishing effort of the Brazilian baitboats, which represent the main skipjack fishery of the western Atlantic, seems to have stabilized in the course of the last 20 years (Anon. 2007b).

Effort of the Venezuelan baitboat fleet has remained more or less stable over time, with the exception of a maximum in 1987 followed by a sharp decline the following year (**Figure 33**).

Figure 33. Development of nominal fishing effort (number of days fishing) of the Venezuelan baitboat fleet during the period 1983-2005 (ICCAT database).

3.h.2 Technological changes in the gear and in the vessels

The technological development of the baitboat fleet cannot be compared to that of other fleets, such as purse seine fleets, for example. However, there have been some important changes, such as the change in the materials used to build the boats, the increase in the size of the boats and the improvements to their engines and machinery. Moreover, new navigation and positioning systems have been incorporated.

In the 1950s, these boats started to fit refrigeration systems for fish storage and water aeration systems to keep the live bait in the tanks. In the 1960s, the first baitboat was built with an automatic system to renew the water. During the following two decades, closed cooling systems were installed for the bait tanks (Miyake 2004).

In the East Atlantic in the early 1990s, some baitboat fleets started to use floating objects (Ghana) (Bannerman *et al.* 2005), while the fleets that fish in waters of the Canary Islands and Dakar used their own boats as fish aggregating devices that concentrate different species of tuna in "spots" or rafts (Ariz *et al*. 1994, Fonteneau and Diouf 1994, Hallier and Delgado de Molina 2000, IEO 2003).

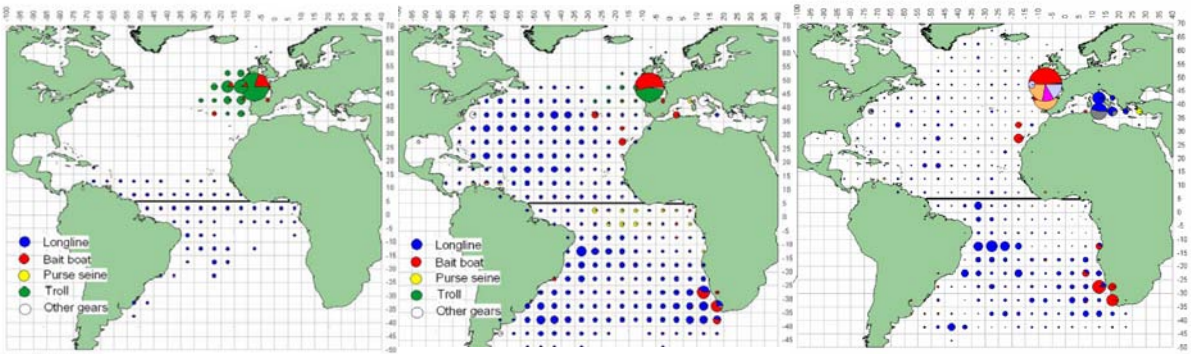
In the West Atlantic, the Brazilian live bait fishery, mainly targeting skipjack tuna, developed rapidly since the 1980s. Initially, these were small wooden boats (10-15 m), without any navigation systems to operate at sea. For this reason, sets were made close to the many oil rigs situated off the coast of Rio de Janeiro. This activity was banned in 1980 to prevent accidents. Since then, the larger boats (more than 15 m) started to fish in the open sea in search tuna schools. At the same time some of the characteristics of the boats changed, such as the addition of bait tanks, refrigeration systems and even an auxiliary launch to catch their own bait. The main landing port became Santa Catarina (Meneses de Lima *et al*. 2000b).

3.h.3 Fishing areas

Below are a series of maps showing the geographic distribution of temperate tuna catches: albacore and bluefin tuna; and tropical tuna catches: yellowfin, bigeye and skipjack tunas.

The following figures show the fishing areas for each species by gear and for three ten-year periods from the time data were first recorded to today.

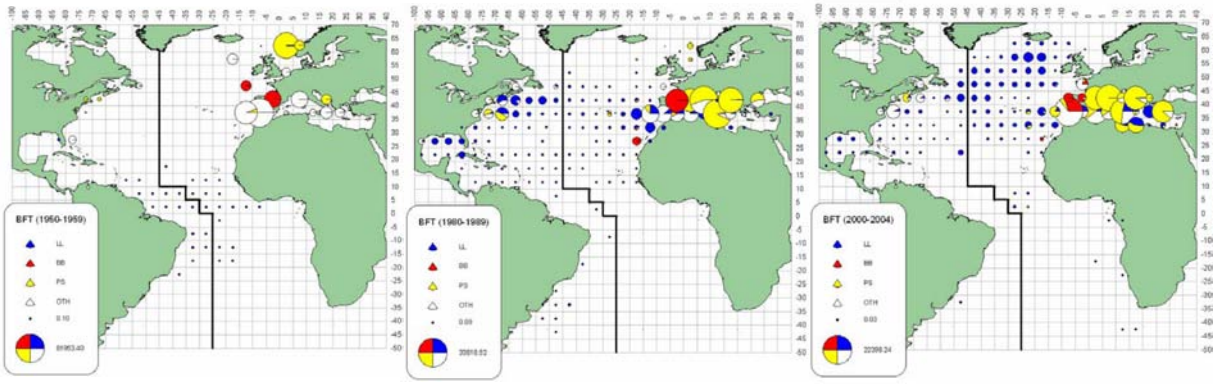
Albacore



a. ALB (1950-1959) b. ALB (1980-1989) c. ALB (2000-2005)

Figure 34. Geographic distribution of albacore (ALB) catches, by major gears and for three decades between 1950 and 2005 (ICCAT 2008a).

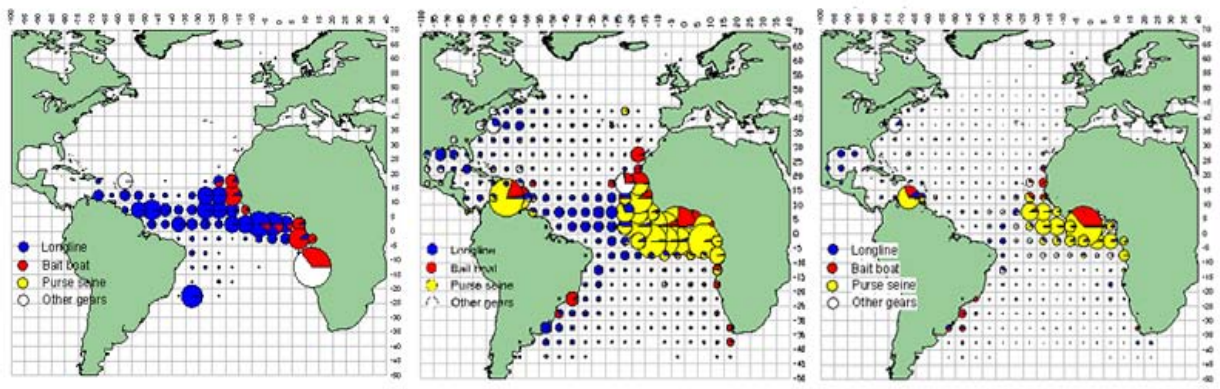
Bluefin tuna



a. BFT (1950-1959) b. BFT (1980-1989) c. BFT (2000-2004)

Figure 35. Geographic distribution of bluefin tuna (BFT) catches, by major gears and by decades (1950-2005) (ICCAT 2008a).

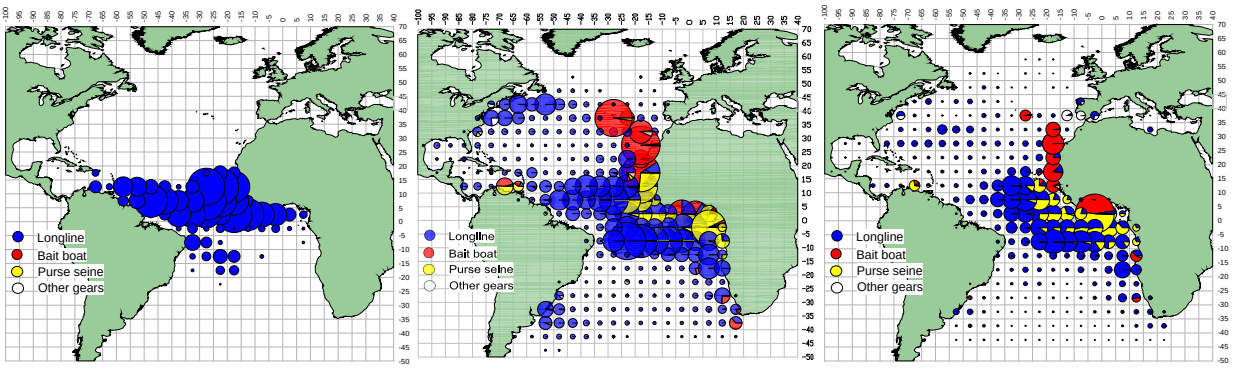
Yellowfin tuna



a. YFT (1950-59) b. YFT (1980-89) c. YFT (2000-04)

Figure 36. Geographic distribution of yellowfin tuna (YFT) catches, by major gears and by decades (1959-2004) (ICCAT 2006).

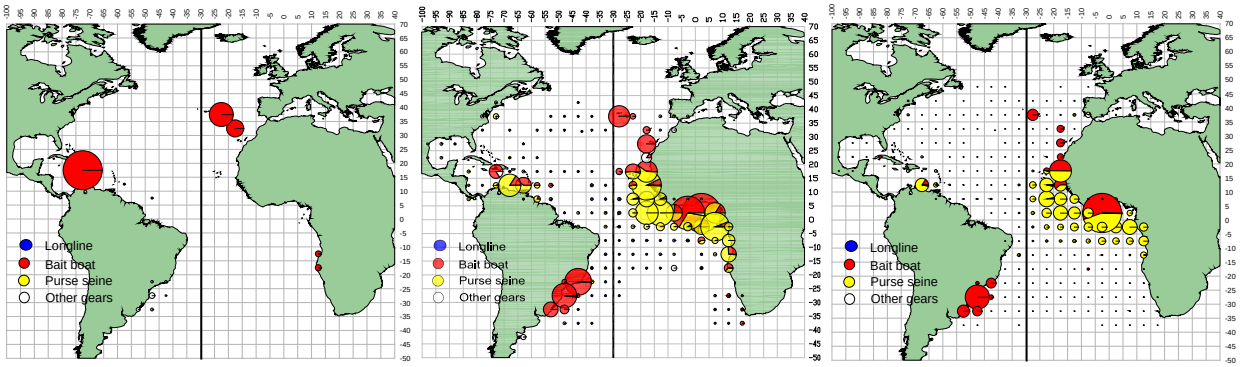
Bigeye tuna



a. BET (1950-1959) b. BET (1980-1989) c. BET (2000-2004)

Figure 37. Geographic distribution of bigeye tuna (BET) catches, by major gears and by decades (1959-2004) (ICCAT 2006).

Skipjack tuna



a. SKJ (1950-1959) b. SKJ (1980-1989) c. SKJ (2000-2004)

Figure 38. Geographic distribution of skipjack tuna (SKJ) catches, by major gears and by decades (1959-2004) (ICCAT 2006).

3.h.4 Catches by species, area, season, year

In terms of tuna landings, baitboat is the third gear in importance in the Atlantic Ocean, after the purse seine and surface longline fleets (ICCAT 2005).

Prior to the 1950s, tuna fisheries were local and the developed mainly in coastal areas. The activity of the fleet was seasonal, catching fish only at certain stages of their life cycle. One example of this seasonality was the fishery for bluefin tuna (*Thunnus thynnus*) off the Norwegian coasts (Miyake *et al*. 2004). They fished for this species when they migrated, between the months of August and October, from the coasts of Portugal and North Africa, up to Scandinavia.

In the 1950s, the first European live bait boats started fishing for tropical tunas in the area of Dakar, Senegal. These were French and Spanish pole and line boats that fished seasonally during the winter, alternating with fishing for albacore in the northeast Atlantic in the summer (Bay of Biscay) (Joseph 1998, Fonteneau *et al*. 1991).

The first fishery to develop in the western Atlantic, at the beginning of the 1950s, was live bait fishing that was directed at tunas (Anon. 2000).

During this decade, this gear caught more tuna in the Atlantic Ocean than purse seine gear (188,954 t vs. 86,426 t) (ICCAT database).

In the 1960s, the French introduced a large fleet of baitboats with freezers that fished throughout the eastern tropical Atlantic.

At the same time, the Japanese freezer baitboats started to fish the Gulf of Guinea in search of skipjack tuna (the other fleets targeted yellowfin). The fisheries directed at temperate tunas, mainly in the northeast Atlantic, continued to increase their catches (especially of albacore).

Fishing effort of the baitboats based in Tema (Ghana) reached a high level after 1970, with a gradual change to Korean and Ghanaian flag, while French and Senegalese freezer boats started to decline. The number of French baitboats equipped with systems to store the catch on ice, remained more or less constant (Fonteneau *et al.* 1991). In the Mediterranean Sea, a baitboat fishery was developed in the 1980s, with some baitboats from the Cantabrian Sea that shift to the Mediterranean during the autumn months, once the summer fishery ends in the Bay of Biscay (ICCAT database). The average catches hardly exceed 3,000 t.

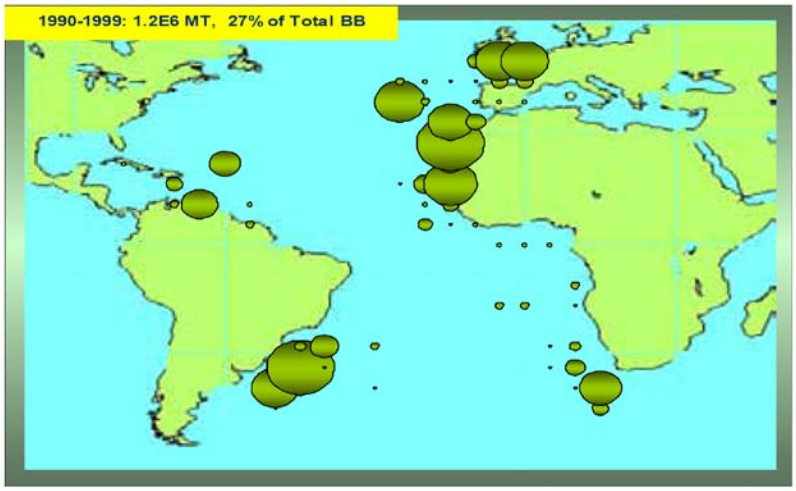


Figure 39. Baitboat effort directed at tunas in the Atlantic Ocean between 1990-1999 (ICCAT 2005).

Presently, the main areas of the eastern Atlantic Ocean, where the baitboat fleet fishes, are located in the Bay of Biscay, in the Azores, Madeira, Canary Islands and Cape Verde, off the coasts of Mauritania and Senegal, and in areas close to Ghana and South Africa (**Figure 39**).

In the western Atlantic Ocean, the baitboat fleet fishes mainly in waters of Venezuela and Brazil. The fishing seasons depend on the target species (see chapter 3.4).

Baitboat catches in the Atlantic Ocean and the Mediterranean Sea have increased progressively, until they stabilized in the last 15 years at about 120,000 t (**Figure 40**) (ICCAT database).

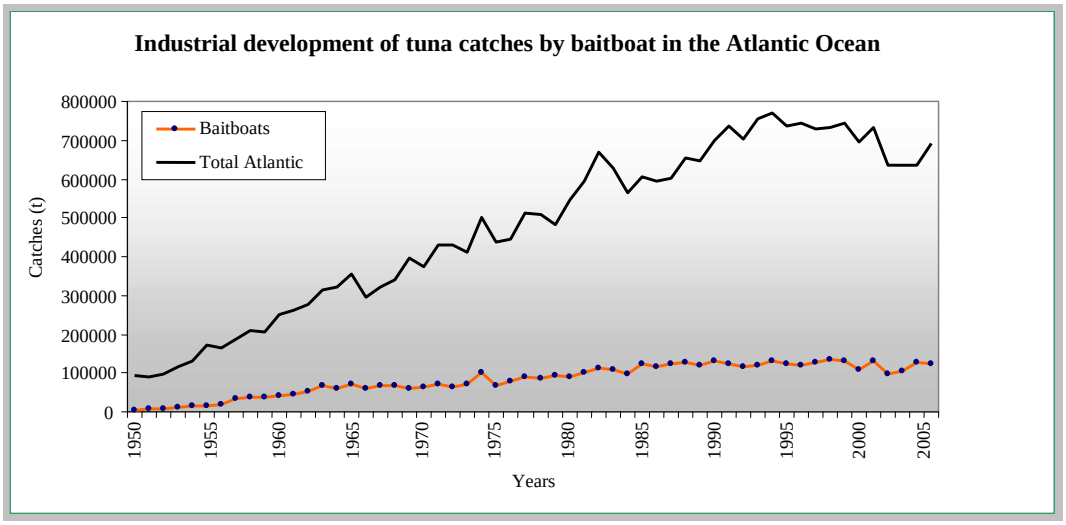


Figure 40. Tuna catches, in tons, by the baitboat fleet in the Atlantic Ocean between 1950 and 2005. These figures are compared with those obtained for all the gears used in the Atlantic Ocean (ICCAT database).

By species, catches of albacore (ALB) and bluefin tuna (BFT) have remained more or less stable in the last 50 years, with albacore catches being higher until the 1970s, when skipjack tuna (SKJ) started to become the most caught species. Thus, in 2004, the largest catches were skipjack tuna. In recent years, tropical tunas represent the largest component of tuna catches by baitboats, although bigeye (BET) and yellowfin (YFT) catches have remained practically stable in recent decades (**Figure 41**).

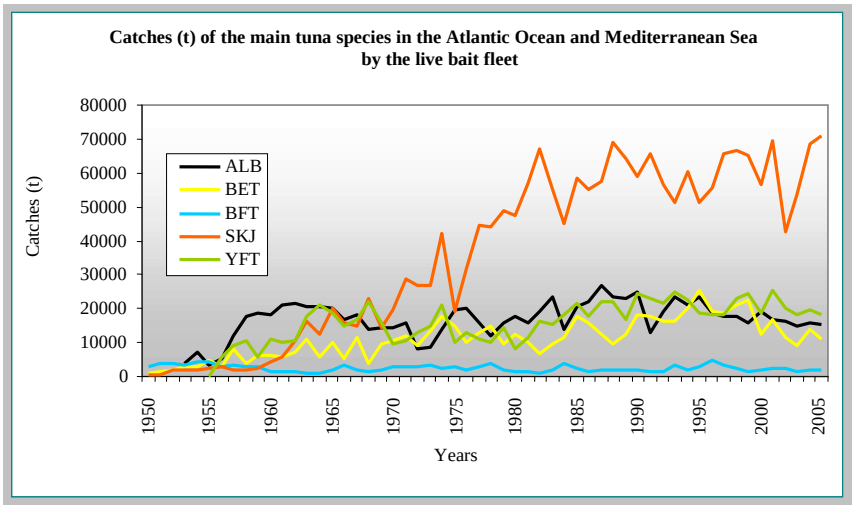


Figure 41. Historic trends of tuna catches by the live bait fleet in the Atlantic Ocean, by major species (ICCAT database).

Albacore

For assessment purposes in ICCAT, two albacore stocks are considered, North and South, separated at 5ºN in the Atlantic Ocean, and a third stock in the Mediterranean Sea (ICCAT 2008a). The North stock has traditionally been fished in the Bay of Biscay and adjacent waters of the northeast Atlantic, using troll since the 1930s, and simultaneously using live bait since the 1950s. The live bait fleet is directed at albacore in the Bay of Biscay between July and October. In the last decade, about 7,000 tons a year on average have been caught. There are also baitboat fisheries directed at albacore in the Azores, Madeira and Canary Islands.

The live bait fleet that has historically caught the largest amounts of albacore is the Spanish fleet, followed by Portuguese flag boats.
In general, albacore catches from the North stock show important annual fluctuations, between 3,000 and 21,000t approximately, with average catches of about 8,000 t a year over the last six years (ICCAT database) (**Figure 42**).

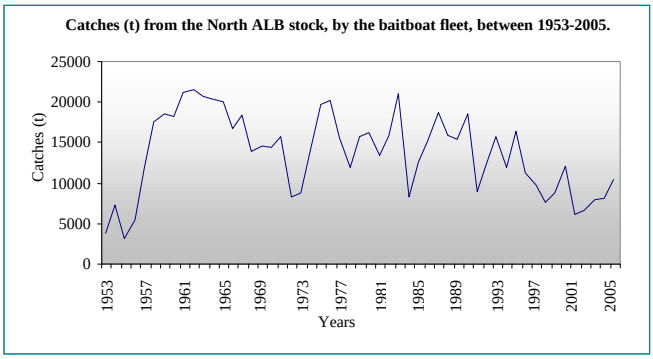


Figure 42. Landings (t) from the North stock of albacore (*Thunnus alalunga*) by the baitboat fleet in the Atlantic Ocean, between 1953-2005 (ICCAT database).

Fishing of the South stock started to develop in the 1980s and 1990s (**Figure 43**), with Namibian and South African live baitboats making most of the catches of albacore with live bait (around 5,000 t in 2005).

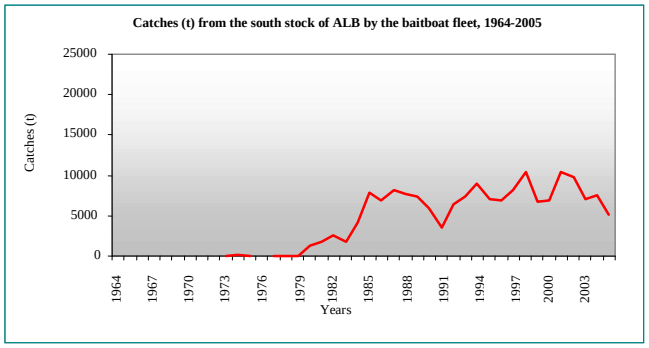


Figure 43. Landings form the South stock of albacore (t) (*Thunnus alalunga)* by the baitboat fleet between 1964 and 2005 (ICCAT database).

Albacore catches in the Mediterranean Sea are far lower than those obtained in the Atlantic. The data obtained are only from the Spanish baitboat fleet and catches have been decreasing over the years, from some 700 t in the 1980s to about 50 t in recent years.

Bluefin tuna

Bluefin tuna fisheries with live bait started in the eastern Atlantic. Specifically, fleets have been fishing in the Bay of Biscay since the 1930s, and later extended their activities to the Mediterranean, Canary Islands, Madeira and occasionally to the Azores. In the Mediterranean Sea, some local fisheries were developed by coastal countries, but their catches are minor (**Figure 44**).

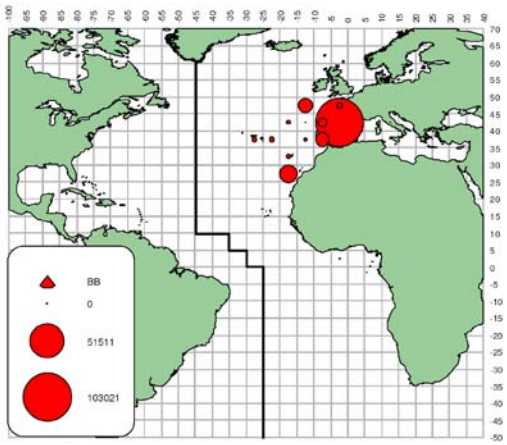


Figure 44. Geographic distribution of catches of bluefin tuna (*Thunnus thynnus*), by gear, between 1950 and 2004 (ICCAT 2006).

In general, in the last 50 years, bluefin tuna catches in the Atlantic and the Mediterranean have undergone fluctuations between 1,500 and 3,500 t, with current catches at about 2,000 t (ICCAT database). Catches in the Azores, Canary Islands and Madeira reached a maximum of about 1,000 t in the 1970s, before gradually decreasing to an average of about 30 t in the last five years.

Since the 1950s, the highest catches are obtained in the northeast Atlantic, although the average rates by decades have gradually decreased (3,500 t in the 1950s vs. 2,000 t in the last six years) (**Figure 45**).

In the western Atlantic, there is only one fishery similar to the baitboat fishery, which has been developed since the mid-1980s, in Canadian waters, with minor catches.

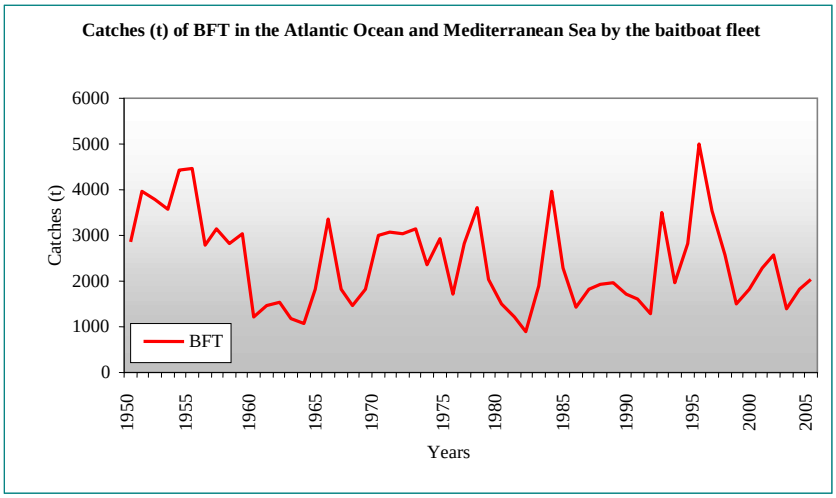


Figure 45. Catches (t) of bluefin tuna (*Thunnus thynnus*) in the Atlantic Ocean and Mediterranean Sea by the live bait fleet 1950-2005 (ICCAT database).

Yellowfin tuna

The highest baitboat catches are made along the African coasts in the eastern Atlantic and off the coasts of Venezuela and Brazil in the western Atlantic (**Figure 46**).

The first available data on catches of this species are from Angolan and French baitboats in the mid-1950s. In the 1960s, Japanese baitboats started to fish in the area of Ghana. Yellowfin catches doubled in comparison to previous years (7,000 t vs. 15,000 t). Fleets under Korean and Panamanian flags then started to exploit this fishery, although they would later adopt Ghanaian flag (ICCAT database).

Currently, the most important fishery is based in Tema and fishes in the coastal waters of Côte d'Ivoire, Ghana, Sierra Leone and Gabon (Cape Lopez). There is another fleet based in Dakar that fishes in the coastal waters of Senegal and Mauritania, as well as in several Atlantic archipelagos (Azores, Madeira, Canary Islands and Cape Verde) (ICCAT 2004a).

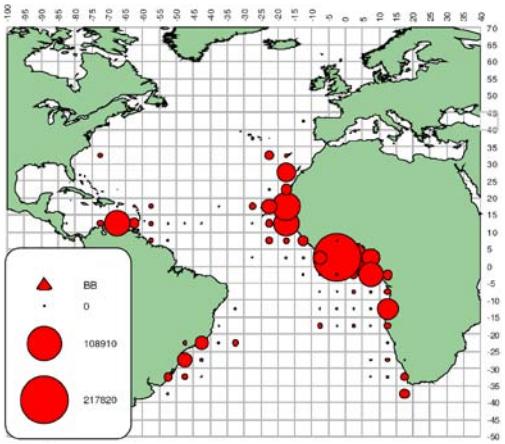


Figure 46. Geographic distribution of catches of yellowfin tuna (*Thunnus albacares*) by the baitboat fleet 1950-2004 (ICCAT 2006).

Yellowfin catches in the eastern Atlantic have remained relatively stable between 1950-2000, at about 15,000 t, although catches reached almost 20,000 t in 2001. Development has been different for the different fisheries. The boats from Angola, Cape Verde and Japan, which made large catches between 1961 and 1975, now catch less, unlike the baitboats from Ghana, which increased their catches spectacularly, from about 2,000 t in 1980 to more than 11,000 t in 2005 (ICCAT database).

In the western Atlantic, Venezuelan and Brazilian baitboats catch yellowfin together with skipjack and other small tunas. These fisheries started in 1974 and catches went from 1,300 t in that year to 7,000 t in 1994, before stabilizing at about 5,000 t in recent years (**Figure 47**).

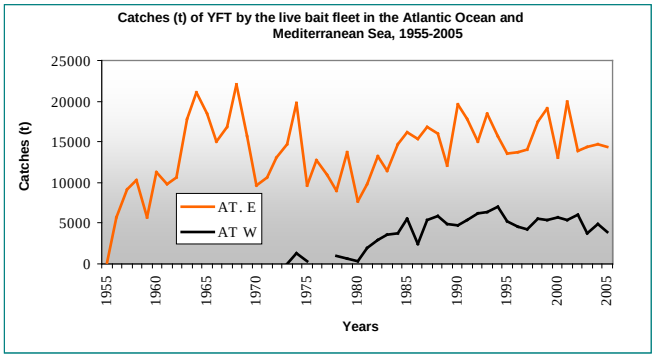


Figure 47. Catches (t) of yellowfin tuna in the Atlantic Ocean and Mediterranean Sea by the live bait fleet 1950-2005. Landings made in the eastern Atlantic (E.AT) and western Atlantic (W.AT) are shown (ICCAT database).

Bigeye tuna

This species is mainly caught by baitboats from the European Union (Spain, France and Portugal) and Ghana in the eastern Atlantic, while in the western Atlantic it is fished by the Venezuelan fleet. The major live bait fisheries are located in Ghana, Senegal, Canary Islands, Madeira and Azores (Anon. 2005) (**Figure 48**).

Various changes have occurred in some fisheries. Hence, the Ghanaian fleet started to use floating objects (FADs), while the fleets in Dakar and the Canary Islands started using the boat itself as an object ("spots") under which to concentrate the tunas (since 1992, Ariz *et al*. 1994).

Bigeye catches with live bait in the northeastern archipelagos (Azores, Canary Islands and Madeira) increased irregularly and moderately until 1995 (from about 1,000 t in 1950 to nearly 17,000 t in 1995), before later decreasing to about 6,000 t in recent years (ICCAT database).

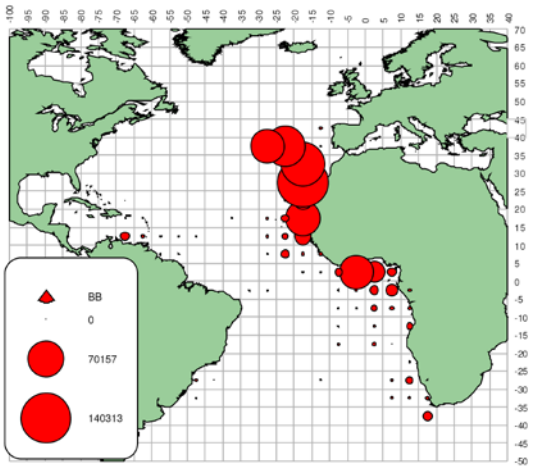


Figure 48. Geographic distribution of catches of bigeye tuna (*Thunnus obesus*) by the baitboat fleet 1950-2004 (ICCAT 2006).

Along the African coasts, from Senegal to South Africa, bigeye catches are less important than in the island groups, although they gradually increased from 1962 to the early 2000s, reaching a maximum of almost 14,000 t in 1998. In recent years, catches have declined to about 4,000 t in 2005 (ICCAT database).

In the western Atlantic, the live bait fleet catches minor amounts of bigeye tuna (127 t in 2005), mainly in waters of Venezuela and Brazil (ICCAT database).

Figure 49 presents the bigeye catches for the entire Atlantic Ocean.

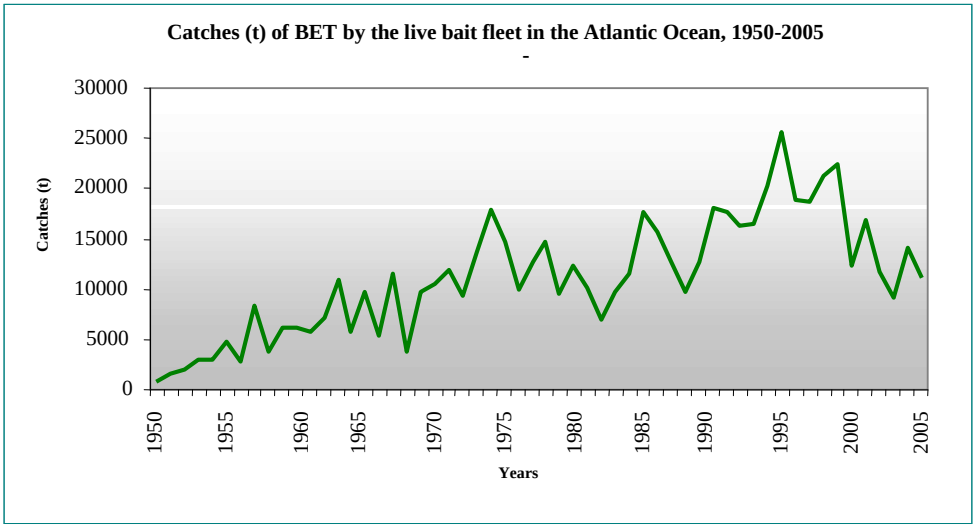


Figure 49. Catches (t) of bigeye tuna (*Thunnus obesus*) by the baitboat fleet in the Atlantic Ocean between 1950-2005 (ICCAT database).

Skipjack tuna

In the eastern Atlantic, the live bait fleet (Ghana, Spain and France) is currently second in importance, after the purse seine fleet, in terms of catches of this species. In the western Atlantic, however, the major fishery is the Brazilian baitboat fishery, followed by the Venezuelan purse seine fleet (ICCAT 2007b) (**Figure 50**).

In the eastern Atlantic, skipjack catches progressively increased until the end of the 1980s (from about 600 t in 1950 to a maximum of 48,000 t in 1988). After that time, catches stabilized (37,000 t on average). In 2005, 45,000 t of skipjack tuna were caught (**Figure 51**).

In the western Atlantic, catch data have been available since the 1950s from the Cuban fleet, although the fishery only started to develop in the early 1980s (2,000 t on average for the first period and 22,000 t for the latter) (ICCAT database).

Catches are presently around 25,000 t (**Figure 51**).

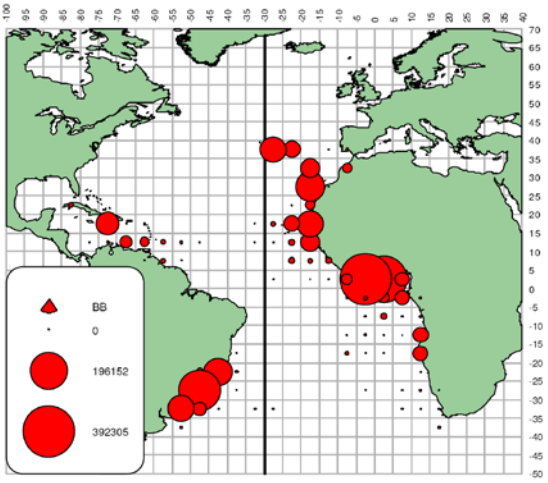


Figure 50. Geographic distribution of catches of skipjack tuna (*Katsuwonus pelamis*) by the baitboat fleet in the Atlantic Ocean and the Mediterranean Sea between 1950-2004 (ICCAT 2006).

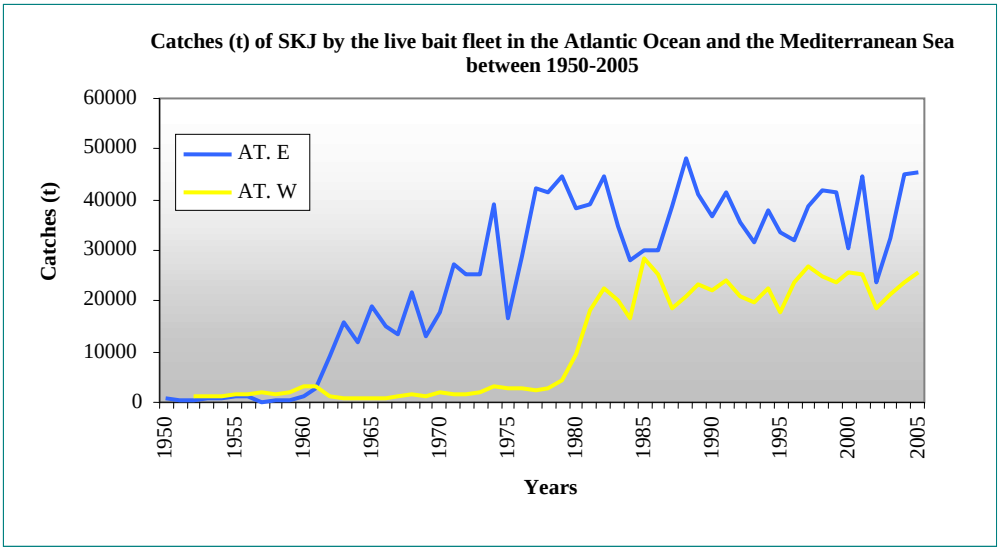


Figure 51. Catches of skipjack tuna (t) (*Katsuwonus pelamis*) by the baitboat fleet in the Atlantic Ocean and the Mediterranean Sea between 1950-2005. Two stocks, east (E.AT) and west (W.AT) are shown (ICCAT database).

3.i Special considerations for sampling

In the sampling of baitboats, conducted on shore, the sampling unit is the boat. In general, a single sample is taken, although two can be taken at times, depending on the characteristics of the catches and their storage aboard.

The captain provides the basic information necessary to the sampler to fill in the sample data, such as fishing area (latitude and longitude), days at sea, etc. Moreover, based on this information, a sampling plan is developed for each boat.

In the event that the catch is not separated, random sampling is taken on the catch, but when the catch is separated according to size, species of commercial category prior to unloading, or if the catch is accessible to the sampler, the sample is taken on a fraction of the fish, so random samples should be made of all the categories in the catch.

Depending on the circumstances in which the unloading takes place, if sampling cannot be taken, it can be done in the cannery, provided that the origin of the catch is documented.

3.j Potential impacts on the ecosystem, including by-catch

Pole and line fishing is a highly selective gear, so catches by this gear are almost exclusively limited to the target tuna species. The only species presently indicated by ICCAT (bony fish, condroychthae, birds, mammals and marine turtles) as those associated with live bait fisheries (non scombriforme), are white trevally and the yellowtail amberjack (http://www.iccat.int/en/bycatchspp.htm) although catches of *Coryphaena* sp have been documented (J. Ariz, per. Com. 2007).

The list below includes the main taxa associated with live bait fishing in the Atlantic Ocean and Mediterranean Sea (in this Manual):

Teleost species (ICCAT species) caught in BB fisheries

Scientific name	***Common name***	***Code***
Auxis rochei	Frigate tuna	BLT
Euthynnus alletteratus	Atlantic black skipjack	LTA
Katsuwonus pelamis	Skipjack	SKJ
Sarda sarda	Atlantic bonito	BON
Thunnus alalunga	Albacore	ALB
Thunnus albacares	Yellowfin	YFT

Thunnus atlanticus	Blackfin tuna	BLF
Thunnus obesus	Bigeye tuna	BET
Thunnus thynnus	Bluefin tuna	BFT

Excluding scombrids and billfish

Pseudocaranx dentex	White trevally	TRZ
Seriola lalandii	Yellowtail amberjack	YTC

As a possible indirect effect on the environment, the use of boats as FAD by the Senegalese and Canary Islands fleets (fishing with "spots"), could validate some hypotheses posed in purse seine fisheries using floating objects:

- There is also evidence to suggest that floating objects affect the dynamics and the structure of the tuna schools, their feeding ecology and they possibly act as a barrier to natural movements and migrations (Marsac *et al*. 2000).
- These effects appear to be more intense in stocks of young or small sized fish (Fonteneau *et al*. 2000), since as the vulnerability and catch rate of the juvenile stocks increase, the very structure of the stock and its potential breeding are affected.

3.k Environmental impacts on fishing operations

The environmental conditions of the oceans (temperature, food, oxygen, currents, etc.) have a direct influence on the local abundance of the tuna stocks and therefore on their catchability. These conditions, together with the feeding and spawning areas, can therefore affect the migratory patterns of these species (Miyake, 1990). The major environmental variables to take into consideration are:

- Surface temperature, since the majority of adult tunas is found at the level of the thermocline or above it (Stretta, 1988). Thus, the 21ºC isotherm is a frequent limiting factor for tropical tunas, while temperate tunas are caught in areas with temperatures above 20ºC or between 10 and 20ºC.
- Structure of the thermocline and the depth gradient which affect the distribution of the biomass of tunas.
- Prevailing winds, which affect recruitment and seasonal availability of the resources.
- Oceanic currents, a consequence of the winds and a probable factor related to migratory movements (Gulf Stream, up-welling off the African and American coasts, for example).
- Geographic and bathymetric distribution of oxygen, which affects the distribution of the species.
- Bathymetrics, since tuna are caught more frequently in specific areas of the ocean (continental shelves, submarine canyons, islands, sea mounts, etc.).
- Nutrients, since juveniles in particular are abundant in nutrient rich zones.

Temperate tunas

There are very few studies on the environmental effects on Atlantic tunas. However, it is thought that the environment could play an important role on temperate tunas, bluefin and albacore, such as, for example, the reproduction strategy of Atlantic bluefin tuna (spawning, occurs within a narrow window of time and space), which makes recruitment vulnerable to local environmental changes, resulting in local variations in abundance (Anon. 2000).

Tropical tunas

The tropical tunas of the Atlantic make long seasonal migrations due to environmental conditions, and although this influence appears to be less important for tropical tunas than for temperate species, short-term effects have been observed, especially with regard to catchability. A clear example is observed in the western Atlantic, in the area south of Brazil, where oceanographic characteristics (a pronounced thermocline at a depth of 50 m, among others) and the presence of skipjack tuna almost all year round, favor surface fishing of skipjack tuna (Anon. 2000).

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