BLUEFIN FISHING IN THE FRENCH AREA OF THE MEDITERRANEAN DEVELOPMENT AND CHARACTERISTICS

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1. BACKGROUND

There are indications of bluefin fishing dating back many, many years along the French Mediterranean coast (Fig. 1). In the beginning of the fishery, bluefin fishing was probably carried out by harpoons and gill and seine nets. Bluefin fishing later developed into the installation of many traps (Fig. 2). This gear type is especially abundant along the coasts of Provence and the Cote d'Azur, up to the Italian border. Their origin is confused with the arrival of the Gauls at the Mediterranean coast and it is known that the Greeks of the Phoenician colony of Massalia (Marseilles) were already using traps. At the beginning of the third century, Oppien mentions these fisheries, located at the mouth of the Rhone River and in the Marseilles area. A century later, Elien described the traps as the most extensive.

We do not have too much information concerning fishing activity carried out during the Middle Ages, when it seems that the activity was partially abandoned. At the beginning of the 15th century, the trap fishery appeared again. In the archives of the Villa of Marseilles there are documents referring to new concessions granted to the Provençal nobility after 1452. Actually, only the wealthy families had the necessary means to pay the exploitation taxes as well as the expenses of material and personnel, all essential to setting up and maintaining these hugh machines. Soon more than 20 traps were operating in the area close to Marseilles to Villefranche (close to Nice) and some on the coasts of Corsica (Fig. 3). During the same period, small groups of fishermen caught bluefin using small fixed nets or mesh or seine nets (Fig. 2).

Since the Renaissance, along with the re-establishment of the old fisheries and the installation of new ones, there was an increase in the protests by the small artisanal fishermen who favored their definitive abandonment. The traps thus became objects of continued controversy which lasted for about three centuries. The majority of the documents of the period which dealt with this subject indicate that the major reason for the long development of the trap fishery, which resulted in the supression of many traps in the 19th century, was due to the opposition of the few artisanal fishermen who protested against the operation of the traps by social classes which were not involved in marine life. In effect, the trap owners employed personnel who were mostly simple workers, and not professional fishermen.

These artisanal fishermen also opposed the opportunities for speculation which the traps offered, since the tuna could be held live and then landed at the market at the best possible moment according to market fluctuations. This same operation could also be carried out by the seine fishermen ("seinche") by storing the bluefin live close to the coast (Fig. 2), but not by means of the numerous small fixed nets ("thonaires de poste") nor by the gill nets ("courantilles"). In these

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cases, the fish had to be immediately placed on the market thereby provoking both saturation and low prices if the catch was abundant.

Because of their substantial dimensions, traps were also accused of hampering the handling of the drift nets and later on the trawlers. In the 17th century, Colbert, Louis XIV's Navy Minister, was violently opposed to the traps, alleging that they were an obstacle to the navegation of the sailing vessels close to the coast. This argument was refuted during the First Empire by Napoleam, who refused to supress these fisheries. During the Second Republic it was said that traps were dangerous for the steam ships and therefore finally in 1851 a considerable number of French traps were closed by official decree and were declared "an impediment to navegation".

Controversy started again between those in favor and those against the traps. In 1875, they were declared of use to the public, and various traps started operations again 24 years after their closure. However, since then, existing bibliographies point out that the tuna schools went farther from the coast from year to year. Then at the end of the 19th century the production of the nets used for deep sea areas was progressively superior to that of traps and small fixed nets ("thonaires de poste"). These observations, confirmed at the beginning of the 20th century led to many hypotheses: the noise of the steam engines, the felling of trees close to the coast, or the opening of the Durance Canal, which could have caused a decrease in the salinity of the coastal waters, etc. Whatever the causes, the new migratory routes of tuna caused grave losses and the definitive abandonment of the French traps. These traps were not mentioned again until the end of World War I. For 40 years bluefin tuna fishing was carried out only by means of seine nets ("seinches") and above all, gill nets or "courantilles" (referred to in documents of the time as "thonaille"). The number of these small gears increased, mainly along the French coast of the Gulf of Lion, which up to 1960-65 assured a production equal or superior to that of the old provençal traps. Similarly, the tuna schools continued to advance further off the coast, while the trawling vessels which operated up to the limits of the continental platform, noted regularly the passing of large tuna concentrations.

About 1950, Italian fishermen started using seine and gill nets to catch bluefin in the Mediterranean. After 1960, the use of seine nets was authorized on the French coast, first in Marseilles and later in Sète, Port-Vendres and neighboring ports. The rapid development of this type of fishing is related in part to the arrival of repatriated fishermen from the North of Africa who were becoming familiar with its use in catching small pelagic fish. The good results obtained from the first Italian and French intents assured within a few years the superiority of the seine method over the old techniques which are practically non-existent today. These experiences are the origin of the rapid growth of the effects and of the radius of a specialized fleet presently in action.

2. FISHING SEASONS AND GROUNDS

Bluefin tuna are only caught on the French coast after the spawning season (which generally extends from May to July). During this period, tuna migrate towards the spawning areas located mainly along the southern coasts of Italy and around Sicily, Sardinia and the Balearic Islands.

During the rest of the year, bluefin tuna go through feeding migrations which lead them to search for food along certain coasts. These are the concentrations of fish in an intergenetic phase which are possible to catch, essentially by means of seine nets since the tuna do not respond easily to the troll.

2.1 Gulf of Lion

During the major part of the year, bluefin are caught regularly in this area. They disappear during the months of June-August, which is most likely because of spawning migrations which affect equally very large fish as well as juveniles.

Fishing activities occur generally from the beginning of March to the end of May and from October to December. Because of the adverse weather conditions during the winter, the vessels are unable to go out to sea. During all the seasons fishing takes place in fishing grounds which rarely exceed 100 m in depth.

In September and October, the catches are obtained between Port-Vendres and Leucate and between Sète and the South of Marseilles, especially along the rocky banks located opposite Palavas

and Carnon from 20 to 25 m in depth. After November -and depending on the years- catches are obtained to the North of the Gulf, between Sète and the mouth of the Rhone River (Fig. 4).

2.2 Provence and the Gulf of Genoa

Bluefin tuna fishing using seine nets was introduced recently in this area. French baitboats carried out their first cruise in the summer of 1967. Before that time, two fishing vessels from Nice, a certain number of sport vessels and some trading vessels made catches using troll. The optimum fishing season for bluefin tuna is from July to October. From July 17 to August 31, 1967, an experimental fishing cruise using seine nets took place along the coasts of the eastern Mediterranean. This cruise was within the re-establishment plan organized by a boat owner from Marseilles, in collaboration with ISTPM. This cruise demonstrated the possibilities of successfully using this type of fishing in depths of over 1,000 m in the area of Provence-Cote d'Azur and the Gulf of Genoa.

After 1967, the summer fishing activities of the Mediterranean tuna fishermen have been concentrated in this area, starting from Nice, the port which is used as a base for the fleet, from July to the end of September or the beginning of October, depending on the year. The "Nice Cruise" (which has become traditional) accounts for approximately half the annual tonnage landed. Fishing activities occur at distances which vary from 5 to 50 miles from the coast, from St. Tropez to Cape Delle-Mele (Fig. 4).

Observations made since 1968 show that at the beginning of the summer fishing season tuna occur in the eastern area of the Ligurian Sea, generally in the area between the Tuscan archipielago, Cape Corsice and La Spezia. The schools extend quickly throughout the entire Gulf of Genoa, continue on to the coast of the Maritime Alps and rarely go beyond the Cap d'Antibes.

Within this overall panorama there are some varying dates in which the fish occur in the different areas. Therefore,"bluefin tuna fishing seasons" can be "early" or "late" by several weeks, depending on the years.

3. VESSELS AND FISHING GEAR

3.1 Vessels

The number of vessels which are involved in tuna fishing along the French coasts is 35. These vessels are based in the ports of the Gulf of Lion and are concentrated mainly in Agde, Sète, Port de Bouc and Marseilles. The first vessels to fish with seine were those that previously had participated in troll fishing. The most significant change in the equipment was the installation of an automotive block pulley of the "power-block" type to hoist the seine. Soon more important changes were introduced in the concept of on-deck structure and gear on the bridge in order to improve to the maximum the specific maneuvers of the seine. Since 1968 the new tuna vessels are purse seiners and are designed especially for this type of fishing (Fig. 5). The fleet can presently be divided into two large groups, according to the characteristics of the vessels and to their importance in the overall fishing effort.

The first group, which accounts for almost 90% of the total annual tuna production, is comprised of 24 vessels, dedicated essentially to tuna fishing, which catch small pelagic fish (sardines, anchovies - only during the low season and even then as a secondary activity). Twenty of these boats, constructed between 1965 and 1974, have a wooden hull, from 17 to 25 m total length and a 19 to 70 MT capacity. There are 12 crewmen and the diesel motors of the smallest vessels (less than 18 m) have 200 HP, while the larger vessels have 600 HP. There is now an inclination to install 800 or more HP engines.

In the last few years, the hulls have been made of a plastic material. The first tuna vessels of this type, launched in 1978, have 600 HP and a length of 23 m. Since 1978, several 27-meter vessels (made of plastic material) have been in operation (Table 1).

The hand-winches and the mechanically powered block, which were part of the initial equipment of the original purse seiners of this group, were replaced 10 years ago by more modern apparatus which work with hydraulic power. A mast equipped with an articulated telescopic arm with an automotive pully of the power block at the end was installed in the stern. This device, as well as the wide afterdeck (due to the very advanced position of the bridge) which is dominated by a fishing deck and by a crow nest (to spot the tunas on the surface) characterize the boats of this category.

The second group is comprised of 10 boats with a wooden hull with a total length of 14 to 17 m and are equipped with 150 to 200 HP motors and have an apparatus on deck, which is less complicated that that of the aforementioned vessels. These vessels are of relatively old construction (1947 to 1965) and can be considered as "occasional" tuna vessels. They are lampara (small seine) boats, essentially dedicated to sardine fishing and on occasion are equipped for tuna fishing when advised of large tuna concentrations in the waters close to their base ports. Their importance, therefore, on the French coasts is minimal, with regard to the yearly tuna production (estimated at 5%).

3.2 Gear

The first seine gears used for tuna fishing in the French Mediterranean were derived from the Italian "cincioli". The 700-meter nets have very large meshes (some have a 250 mm side). Their use is not too convincing since the medium-sized fish get gilled in them during the operations. For this reason the nets were dismantled. Later the use of more adequate seine nets with a smaller mesh was studied. These were an adaptation of the Italian "cincioli" and the "surrounding nets" of Portuguese origin (used in Morocco); in 1962, they measured 500 to 600 m in length and 50 to 80 m in depth. In 1970, their dimensions were increased to 800 m x 95 m. During the years, their measurements were again increased and presently they are 1,400-1,600 m x 150-200 m (Fig. 6).

3.3 Fishing for other species

As was mentioned earlier, tuna are not present on the French coasts during the spawning period. Besides this cyclical and regular absence of tuna, the schools may be more or less late in arriving, depending on the years. In order not to remain inactive during the aforementioned periods, the tuna vessels of the Group I category catch small pelagic fish (sardines and anchovies). This fishing is carried out using seine nets as are used for sardine fishing. Since 1977 these pelagic nets have been operated by a pair of vessels. The fleet immediately stops fishing for these small species as soon as the presence of tunas is noted.

4. DEVELOPMENT OF THE FISHING OPERATIONS

4.1 Description

The purse seiners work in groups to search for tuna in the fishing areas considered most favorable. Tuna concentrations are located by sight, of course, if the sea is clear and calm. In such conditions the fish jump as they go after small pelagic fish (especially sardines or euphansia) which are often found in the stomachs of fish. Large marine birds also circle above the tuna concentrations and these are also excellent indications for the lookout.

In the Gulf of Lion area, radio contacts with the numerous moving vessels scattered along the continental platform represent an important network of information to the tuna fishermen.

The surrounding and catching operations of the fish develop according to the classiscal system utilized with the seine gear: after detecting in which direction a school is headed, the purse seiner quickly lowers the net, surrounding the fish to cut off their route before returning to their departure point. The bottom of the purse seine net is closed (like a dam) and hoisted aboard with the fish obtained. The setting of the net lasts only a few minutes. The time it takes to hoist the net with the help of the "power block" varies according to the fish caught and is usually completed within several hours.

Frequently, the purse seine takes advantage of the concentration of a tuna school around an individual fish which is being caught by rod from its own boat or another boat. In effect, when the captured fish is held under the water, the entire school concentrates beneath the boat. Therefore,

such a situation can be used to set the net around said boat, traping at the same time the school of fish. There is a similar technique which consists of setting the net around the boats which remain inactive, under which without any apparent reason, the fish concentrate a few meters below the surface.

In 1967 and 1968 a number of small catches were taken in collaboration with vessels equipped for bait fishing. However, it seems that the scarce yield obtained from artifically attracting the fish in relation to the means used for catching the bait and conserving it (since it would suppose the necessity of installing a live bait tank on board) resulted in the professional fishermen renouncing the use of this technique.

Purse seine fishing is applied essentially to bluefin in the Gulf of Lion (where it is the only species present) as well as in the Gulf of Genoa, an area where albacore are also found.

The latter species submerge quickly when the boats approach, for which their capture by purse seine is rare. This behavior which occurs often, is the cause of many failures, since the presence of one or two albacore in a bluefin tuna school provokes the fleeing of the whole school who have been alerted to the presence of a boat by the albacore.

From 1974 to 1977, the tuna fleet utilized a plane to better detect the bluefin tuna schools, especially during the "Nice Cruise". A twin engine plane conducted daily systematic square cross-sections searching in the area between the latitudes of St. Tropez and Genoa, flying at 95 knots and at an altitude of 30 meters above the surface. The plane, equipped with good radio-communication and radio-navigational material stayed in permanent contact with the vessels, indicating the position, importance and movement of the schools. In addition to reducing the fuel expenses of the vessels, the technique was a contributing factor in obtaining a better distribution of fishing effort and allowed for a distribution of the fleet among the group of schools present in the zone. After 1978, this joint operation was suspended due to certain organizational difficulties especially because of the individualism of the Mediterranean fishermen.

4.2 Influence of the behavior of the fish

The observations carried out by the seiners indicate that bluefin can vary widely in their behavior from year to year, without any apparent reason. The most recent example was during the 1978 cruise, when strange phenomena were observed with respect to previous years in the area of the western Mediterranean basin: phenomena such as the "delayed" occurrence of the fish by approximately two months, the rare instability of the surface schools, frequent changes in the classical migratory routes.

On the other hand, significant tuna concentrations at various times during the summer and autumn were also noted. In this respect, the aerial operations carried out last year in the South of Italy by the "AIR PECHE" organization are significant. For example, the professional observers who took part in the flight of June 21, 1978, in the area of the Lipari Islands, detected and photographed an immence concentration of several hundred large tuna schools in a 15 mile radius. Other large concentrations have also been detected by boats during the month of November in the western Gulf of Lion area. In comparison to previous years when important catches were obtained by Italian and French purse seiners, catches in 1978 were considerably less due to the strange behavior of the schools, which did not stabilize as they usually did annually during several weeks in this sector.

4.3 Meteorological influences

The detection of tuna schools is done only on the surface, visually and without the use of ultrasonic or hydroacoustic detection aparatus. On the other hand, it should be pointed out that tuna remain at the surface and only jump when the sea is calm. Therefore, the purse seiners can only fish in good weather. If there are adverse weather conditions the boats remain at the ports.

4.4 Influence of hydrological conditions

From the group of hydrological cruises carried out in the Mediterranean, it is noted that tuna fishing takes place in areas where, at the surface, there is a thick layer of very warm (20 to 25°C) water which is limited at the bottom of the layer by a marked thermocline (4-6°C) and bordered by an area of contact. These conditions occur together at the beginning of the summer in the eastern part

of the Ligurian Sea and the Gulf of Genoa. The hot waters later move towards the West, along the Italian coast, where the tuna first occurred. Later these hot waters move towards the Cote d'Azur to the Cap d'Antibes. At the end of the summer and the beginning of the autumn, a progressive cooling of the waters of the eastern areas as well as a decrease in the catches can be noted.

In the Gulf of Lion, where the hydrological conditions are greatly influenced by the entry of fresh water from the Rhone and from the rivers of southern France, the presence of tuna depends to a great extent on the fluctuations in salinity produced by such waters. The inter-genetic movements of the tuna in the Gulf of Lion can be, in effect, related to the temporal movements of the contact areas between the desalted and the deep waters. In winter especially, when the temperatures are low (10 to 13°C) and the thermal contrasts are less significant, the tunas seem to prefer these areas with a strong degree of salinity, where they can find abundant food (sardines, anchovies). This can be considered as one of the most important influencial factors in tuna movements.

4.5 Duration of the trips

In the French Mediterranean, tuna fishing vessels carry our exclusively daily trips. They leave from the post closest to the area where they had found tuna the day before. The vessels remain at sea the entire day and return to the ports at sunset. If the catch was abundant, they return once the net lifting operation has ended.

There are on an average 100 to 150 fishing days annually. The catch obtained per set could vary between 0 and 80 tons; a 10-15 ton tuna catch per set is considered normal.

4.6 Transport and maintenance of the fish

The catch is placed on the deck or in the refrigerated fishholds. Immediately after arriving at the port, the fish are counted and weighed and are taken to cold storage or are loaded on refrigerated trucks, depending on where they are going.

5. CATCHES AND CATCH TENDENCIES

Through bibliographical data we can follow the history of bluefin tuna production in the French Mediterranean during approximately a century. Withoug taking into account the period between 1912 and 1935, we can reconstruct a historical series from 1881 (Table 2). After 1937 there are various sources of information available for each year. For a given year, the figures from the various sources differ from each other in one way or another. With some exceptions the differences noted up to 1960 are generally very small. Since then, the number of small traditional gears has slowly decreased. However, the statistical problems increased considerably, because of the great mobility of the purse seine fleet carrying out this new type of fishing. Data compiled to evaluate the total catch obtained by the vessels faced many obstacles; the most important of these obstacles is the multiplicity and variability of the landing points throughout the year. On the other hand, tries to obtain data from the logbooks or fishing records given to the professional fishermen met with little success, since it is very rare that these are up to date. In short, it is only possible to carry out a reasonably reliable evaluation of the production from verbal information and from data facilitated by some commercial companies, together with numerous direct observations and biometric extracts.

The figures given in Table 2 are not, in any case, from extrapolation or from substitutions. They are taken from a number of documents of a diverse nature, such as weight records from wholesale companies, declarations of the professional fishermen's committees, extracts obtained at the landing sites by biologists or by personnel of the Fisheries Administration. For various reasons, a part of the documents could have been missed during the research carried out by one or another of the organizations in charge of compiling statistics. For this reason we consider that the most complete data are represented by the highest values corresponding to each of the years of the table. The graphic representation of this information gives an overview of the development of the production in the course of the last 96 years (Fig. 7). It can be noted that the withdrawal of the traps has not caused a significant decrease in the average annual production, assured from 1925 to 1960 by the seine nets ("seinches") and by the gill nets ("thonailles"). On the contrary, the appearance of the seine quickly produced a considerable increase in the exploitation level. The accumulated catch of the 17 years from 1962 to 1978 is 20 times

greater than that of the preceding 17 years (1945-1961). However, the main result derived from the examination of this series is the great variability that exists between the successive results of the fishing cruises. The annual bluefin catch experienced very important chronological fluctuations, which on the one hand, have been observed during various centuries in all areas of the Mediterranean and the Atlantic. During the periods of decreasing production, certain observers, who based their information on limited temporal extracts, have shown a tendency to interpret this phenomenon as an indication of the decrease of bluefin tuna. However, the most important historical series show that abundance seems to follow a large periodical regularity (of about 50 to 100 years); each cycle is comprised of a series of small peaks to intervals of a few years. Figures 8-A and 8-B give an example of these series. Although the matter has been researched with considerable interest (especially in Spain and in Italy), an exact explanation has not yet been found for the cause of these fluctuations.

Due to the introduction of seine fishing we could have supposed that the great mobility of the seiners would stabilize the production curve. However, the results observed up to now show that this has not been the case. Although the present catches are much more abundant than those of the traps and other gears, they are still variable from year to year. The observations noted in section 5.2 concerning the behavior of bluefin allow for a relation of the fluctuations in the catches with fluctuations in catchability. This does not seem that it is possible to find an explanation for the latter factor.

6. FISHING EFFORT

6.1 Unit of effort

It would be useless in listing here the many difficulties that the scientists who research tuna fisheries encounter in trying to define a unit of effort. With regard to the French purse seine fishery in the Mediterranean, we will point out the following:

a) Because of the lack of fishing notebooks and logbooks we cannot know exactly (referring to the period 1960-1975) the proportion of the number of days fishing in relation to the number of trips a boat makes. During the last four years the ISTPM has been taking daily data, either directly (observing the movement of the vessels in the port) or indirectly (by means of telephone calls from the laboratory in Sete). A detailed analysis of this information is being carried out, in order to arrive at schemes which could be applied to the previous years, by means of substitution.

b) The evaluation of the unit of effort depends very directly on certain factors inherent to the type of exploitation developed by the French fleet in the Mediterranean: there is no boat owners association, since each boat owner equips his own boat. There are a certain number of more or less stable informal associations which look out for the interests of the small groups of vessels (whose owners are often related).

At the fishing grounds, the vessels pertaining to a given group carry out searching operations jointly or exchange information constantly (often by means of special codes). When a member of the group catches a tuna school, he shares the catch equally with his colleagues. At the time of landing often each one of the associated vessels registers his part of the catch under his own name. In this way, if the number of vessels is chosen as the unit of effort, significant bias is introduced in the calculations of the CPUE, since the amounts registered by a purse seiner were not necessarily caught by that vessel, at least not totally. For the same reason, the number of trip days per boat can also be an erroneous index.

c) All the vessels operate together in the same area with just a short distance between boats. Therefore a school can be seen simultaneously by various boats, which can go quickly to the site, or at intervals of just a few minutes. In such cases a rule of priority is applied, as follows: the vessel which arrives first can situate itself in the best position, with reference to the school, launch its auxiliary skiff and begin the seine operation. If another vessels reaches the skiff before the seine operation is completed then the two vessels share the catch equally. If, on occasion, various vessels reach the auxiliary skiff at the same time, then the very first vessel maintains 50% of the catch and the remainder is divided equally among the other boats. As in the case mentioned previously (associated vessels) it is evident that this practice can also result in considerable bias.

By observing constantly the activities of the fleet and by precise analization of the weight data, errors can, however, be eliminated. This task is being carried out by the ISTPM lab in Sete.

6.2 Distribution of fishing effort

The spatial expansion of the fishery continues developing towards new areas of exploitation, whose existence were unknown until only a few years ago. This factor should be taken into account since it has some influence on the CPUE. In the same way, the collaboration of a plane during the cruises from 1974 to 1977 should also be taken into account.

6.3 Effort tendencies

In spite of the numerous interactive factors which influence fishing effort, the number of vessels and their engine power can be considered, in an initial approximation, as representative of fishing effort. Development of the number of vessels and that of their total engine power are shown in Fig. 9.

These data indicate a regular increase in effort since 1966. Changes made in the propellants of some vessels after their initial launching were taken into account. Also taken into account were those vessels presently under construction, but whose construction was decided in 1975. The withdrawal of some vessels and the adquisition of others of more modern construction were also taken into account. The professional fishermen have adopted voluntary limits of tuna vessel effort after a new series of purse seiners measuring 27 m went into service (therefore, there are indications that effort will reach a stable level after the end of 1979).

Note: According to French legislation, when the tonnage of a vessel exceeds 50 tons, its captain should hold special navigational credentials. Besides, this vessel then comes under a superior fiscal class. Also, the use of special construction machines (especially with regard to the superstructures) allows for an increase in the size of the tuna vessels up to 27 m, while maintaining the tonnage at 49.9 GRT. Because of its purely administrative nature, this parameter cannot in any case be taken into account when estimating fishing effort.

7. BIOLOGICAL CHARACTERISTICS AND AGE COMPOSITION

The purse seine catches, when they are made up of fish of 18-20 kg, show that in the majority of the cases these catches are made up of fish of the same size. The hurls carried out on schools of larger fish often catch a mixture of sizes. In the landings weighing is carried out by small lots of 3-6 fish of similar size. In checking the files of wholesalers or by inspections made directly during the course of the fishing operations, these data can be obtained as well as the average individual weights of the fish which comprise each lot. Size data are also available at the ISTPM. On the other hand, some very detailed bibliographic documents contain biometric data through which we are able to know the composition of the bluefin catches along the French coasts for more than two centuries.

The transfer of these data into age classes gives the age composition of the catches. In this aspect the Sete laboratory has just completed a study on growth based on a sample of 186,000 bluefin from the 1970 to 1977 cohorts. This study has shown that there is an extraordinary similarity with the data given in 1919, and later in 1954, on the growth of this species in the Mediterranean. Growth rates have not shown any significant modifications in the last 50 years.

All these documents show considerable stability in the age composition of bluefin tuna caught in the French Mediterranean during 210 years. After 1769 the catches were comprised of fish of 1-10 years of age; individuals of 2-4 years were the most abundant in the stock, that is, those which had not yet reached (or had just reached) sexual maturity.

From one year to the next more or less significant variations can be found in the relative proportions of the various age groups which comprise the catches. These differences have been observed for about a century in the catches of the traps and other gears. They became more accentuated with the use of the purse seines, whose effort on certain age classes is not uniform and changes from one cruise to the next (as a function of the availability of the fish and of the movements of the fleet).

For this reason care should be taken when using the apparent variations in cohort abundance in two successive years as indices of the tendencies in the age development of the fishery. In this view, the most probable estimates are those which take into account the overall set of events which have been the cause of the results obtained in each of the fishing cruises.*

*ICCAT documents SCRS/76/84, SCRS/77/68, SCRS/77/69 and SCRS/78/48 should also be consulted.

Table 1. Inventory of Group I purse seiners

Nb.	LONG. (m)	Moteur(cv) Engine(hp)	Jauge(tjb) Displacement Tonellaje	Année Year Año
1	15.3	150	28	1951
1	17.7	200	28	1966
1	18.0	240	28	1966
1	18.0	300	29	1969
1	18.5	240	32	1965
1	19.6	420	33	1967
1	19.0	430	25	1969
1	20.0	430	48	1965
1	20.3	400	40	1967
1	20.8	800	30	1967
1	21.5	430	48	1972
1	22.0	400	49	1968
1	22.0	430	45	1968
1	22.0	500	39	1956
1	23.0	430	45	1971
1	23.0	600	?	1975
1	23.7	600	70	1969
3	25.8	430	49.9	1973/74
3	27.0	600	49.9	1977/78

Table 2. Total bluefin catch (MT) in the French Mediterranean, during the last 96 years.

Année Year Ano	Poids Weight Peso (T.M)	Source	Poids Weight Peso (T.M)	Source	Engin Gear Arte	Année Year Ano	Poids Weight Peso (T.M)	Source	Poids Weight Peso	Source	Poids Weight Peso	Source	Engin Gear Arte
1882/83	48.304	G	$		Trap	1938	552.400	I	596.834	M			.0.
1883/84	57.545	G	$		"	1939	273.07?	I					"
1884/85	40.328	G	$		0	1940	239.912	I					"
1885/86	27.730	G	$		"	1941	886.005	I	744.000*	M			"
1886/87	20.747	G	$		"	1942	-	I	1505.000*	M			"
1887/88	31.235	G	$		"	1943	117.39?	I	402.000*	M			"
1888/89	18.725	G	$		"	1944	165.40?	I	669.000*	M			"
1889/90	9.528	G	$		"	1945	759.400	I	325.703	M			"
1890/91	98.573	G	$		"	1946	650.200	I	588.606	M			"
1891/92	119.765	G	$		"	1947	759.259	I	678.654	M			"
-						1948	739.729	I	761.219	M			"
1896	572.360	B			"	1949	716.550	I	646.480	M			"
1897	893.240	B			"	1950	379.488	I	506.836	M			"
1898	1020.43	B			"	1951	816.534	I	626.352	M			"
1899	413.347	B			"	1952	965.668	I	855.848	M			"
1900	389.648	B			"	1953	899.081	I	745.339	M			"
1901	593.286	B			"	1954	798.403	I	659.538	M			"
1902	378.813	B			"	1955	782.804	I	677.108	M			"
1903	442.496	B			"	1956	328.565	I	291.000	M			"
1904	504.875	B			"	1957	614.671	I	590.000	M			"
1905	326.628	B			"	1958	294.386	I	273.000	M			"
1906	354.256	B			"	1959	384.210	I	155.733	M			"
1907	321.020	B			"	1960			274.000	M	400.000	C	"
1908	380.903	B			"	1961	447.221	I	588.000	M	599.000	C	"
1909	505.622	B			"	1962	214.606	I	205.000	M	200.000	C	"
1910	583.525	B			"	1963	326.300	I	311.000	M	687.993	C	"
1911	483.100	B			"	1964	953.600	I	953.000	M	511.721	C	"
-						1965	390.400	I	390.000	M			"
1925	601.400	I			.0.	1966	970.000	I	1200.000	M	1000.000	F	PSM
1926	492.150	I			"	1967			1200.000	M	1500.000	F	(+0)
1927	419.135	I			"	1968	1168.000	I	1300.000	M	2500.000	F	"
1928	893.848	I			"	1969			1200.000	M	1500.000	F	"
1929	701.706	I			"	1970	937.000	I	900.000	M	1100.000	F	"
1930	605.158	I			"	1971	1822.000	I	1800.000	M	2200.000	F	"
1931	775.378	I			"	1972			1000.000	M	1100.000	F	"
1932	110.887	I			"	1973			478.000	M	1400.000	F	"
1933	479.646	I			"	1974			2500.000	M	1800.000	F	"
1934	961.638	I			"	1975			1500.000	M	1600.000	F	"
1935	684.163	I			"	1976			3086.000	M	3800.000	F	"
1936	323.830	I			"	1977			3180.000	M	3180.000	F	"
1937	551.980	I	451.156	M	"	1978			1566.000	M	1566.000	F	"

Source: G = Gourret, 1889,1984. B = Bourge, 1915. I = OSTPM/ISTPM, (Rev. Trav.), 1925 to 1971. M = Marine Marchande (Ann.Stat.) 1937 to 1978. C = CIEM (ICES). F = Farrugio/ICCAT (SCRS/76/84) ;SCRS/77/68; SCRS//78/48 and Statistical Bulletin, Vol 8.

Gear: TRAP = traps. 0 = Other gears (thonaires, seinches, courantilles, thonailles). PSM = purse seine.

*Including Algeria.

"S"-Marseilles area only.

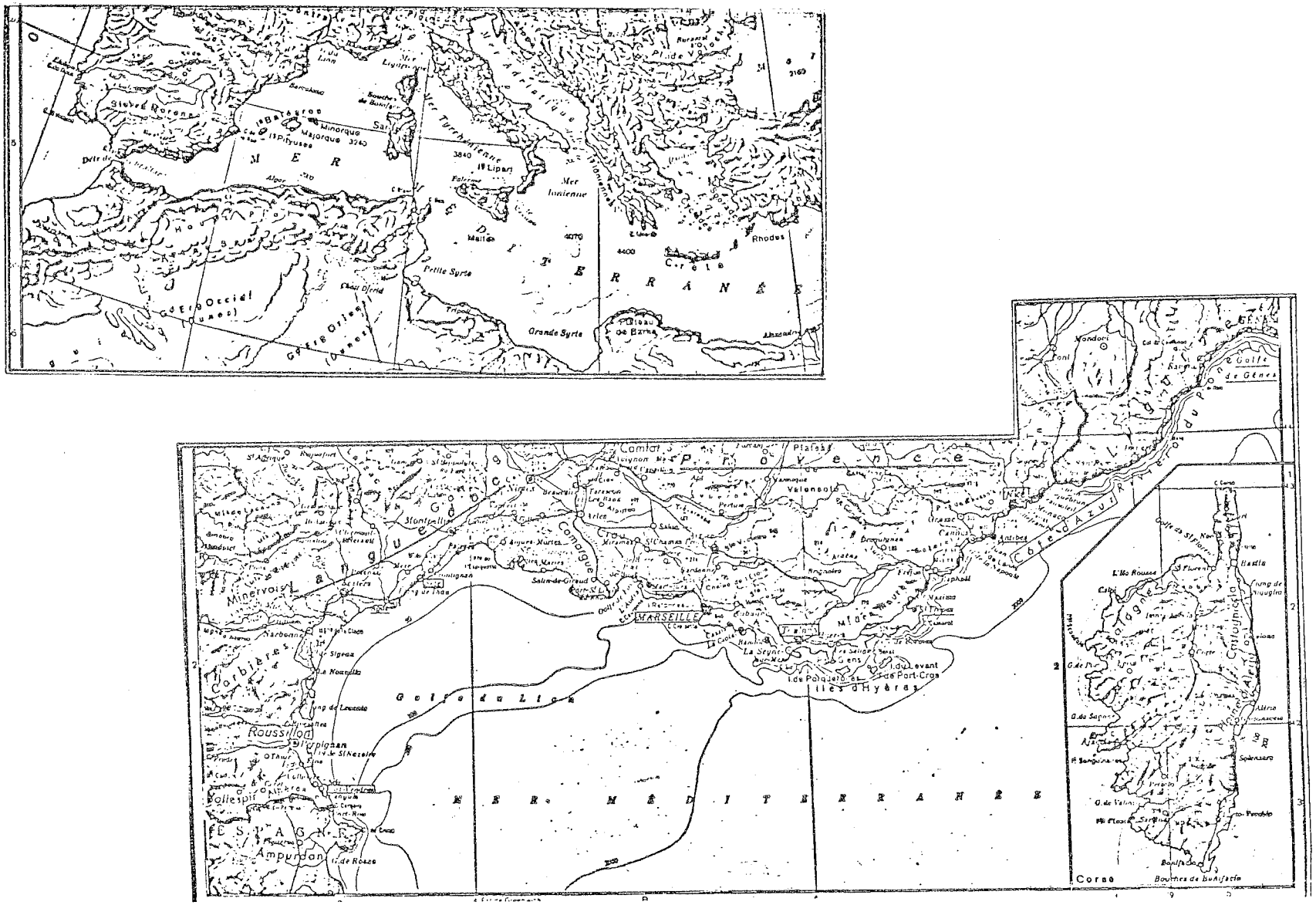
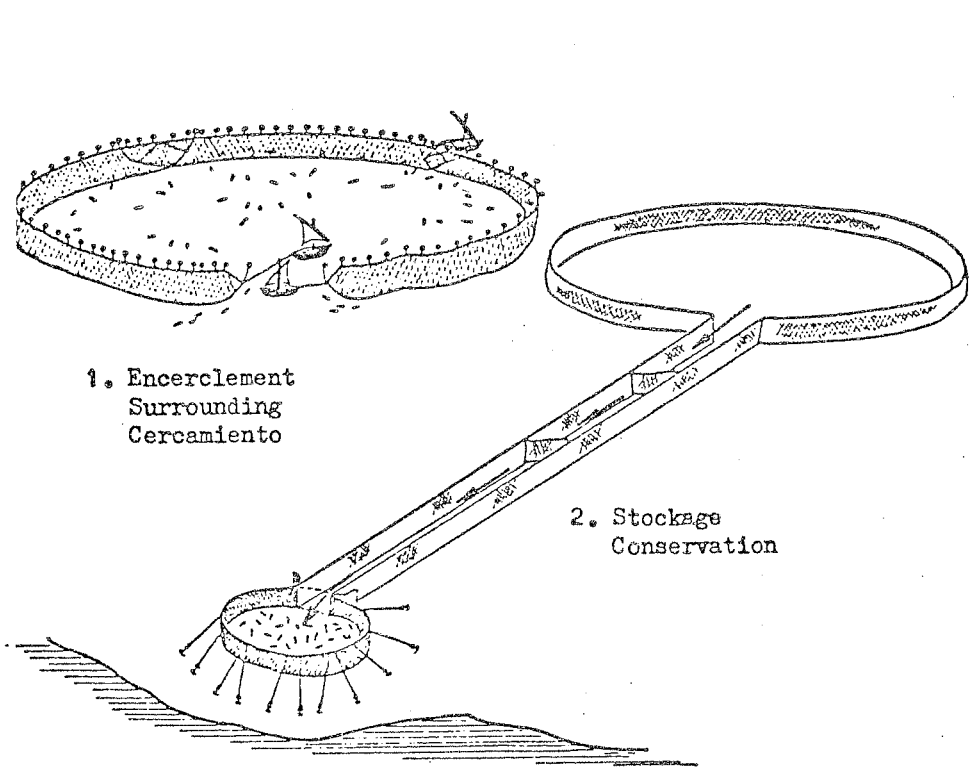
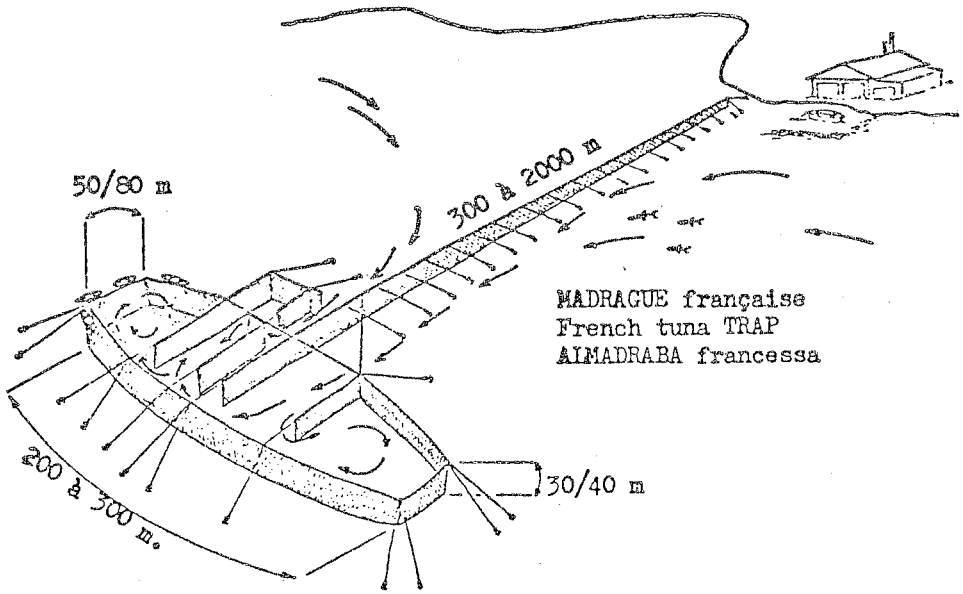


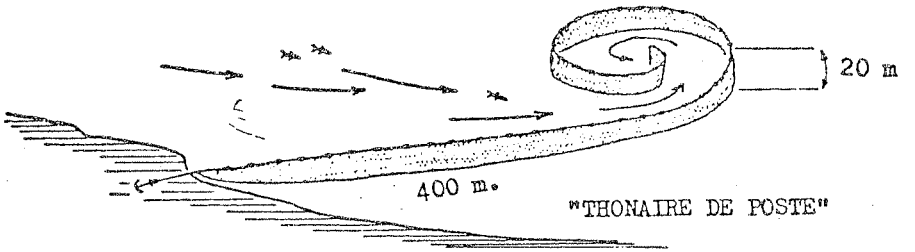
Fig. 1. Geographical position of the French Mediterranean coasts.



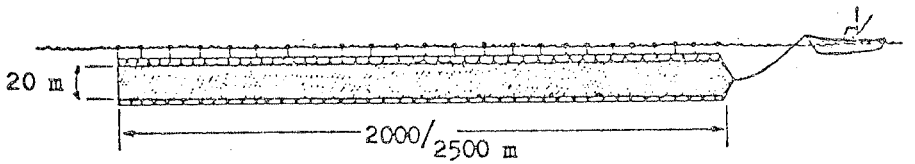
"SEINCHE"
Red de cerco. Surrounding net



MADRAGUE française
French tuna TRAP
AlMADRABA francessa



"THONAIRE DE POSTE"



"COURANTILLE","THONAILLE". Red de enmalle(de deriva). Gillnet(driftnet)

Fig. 2. Kinds of fishing gear cited in the text.

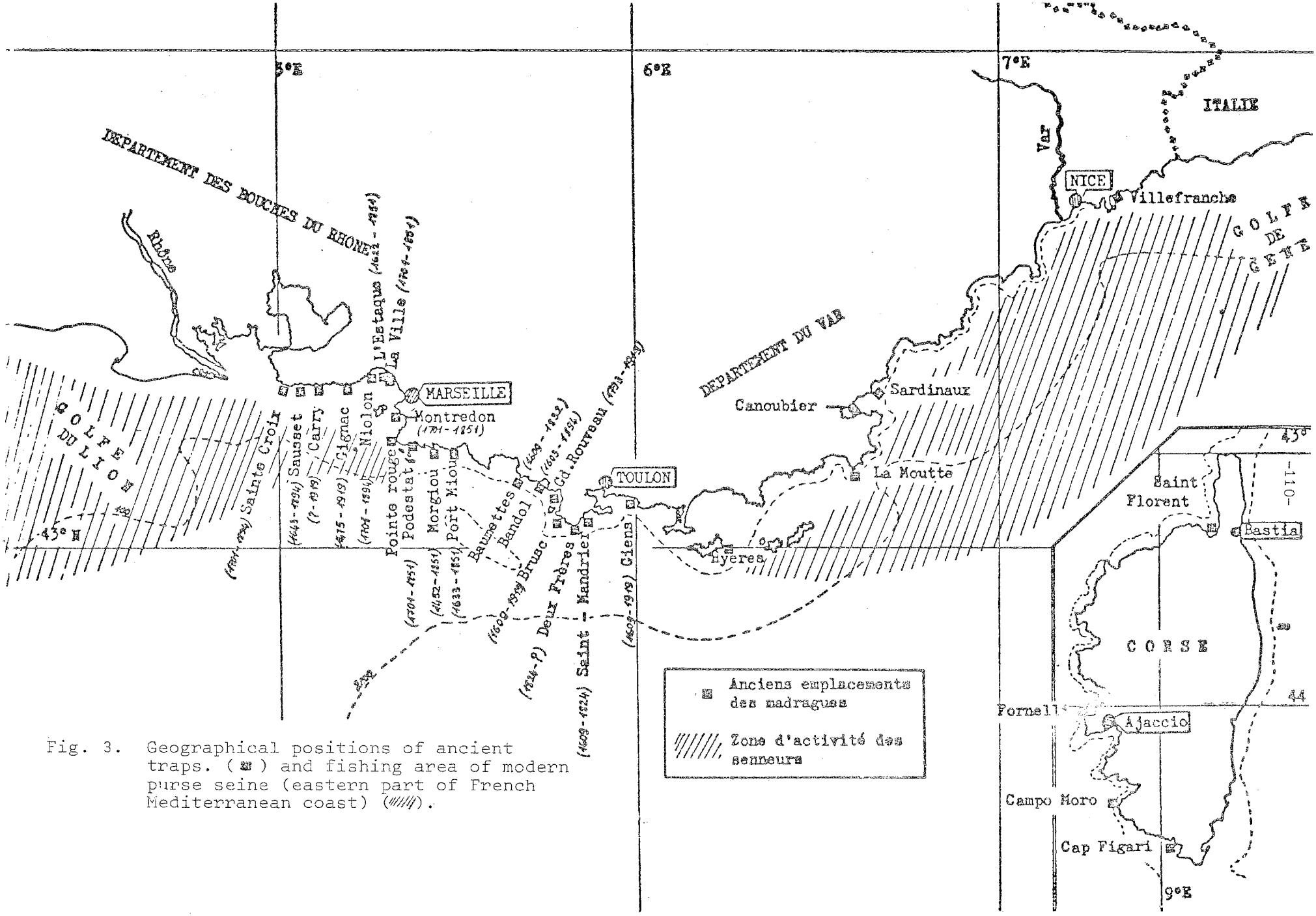


Fig. 3. Geographical positions of ancient traps. (▪) and fishing area of modern purse seine (eastern part of French Mediterranean coast) (////).

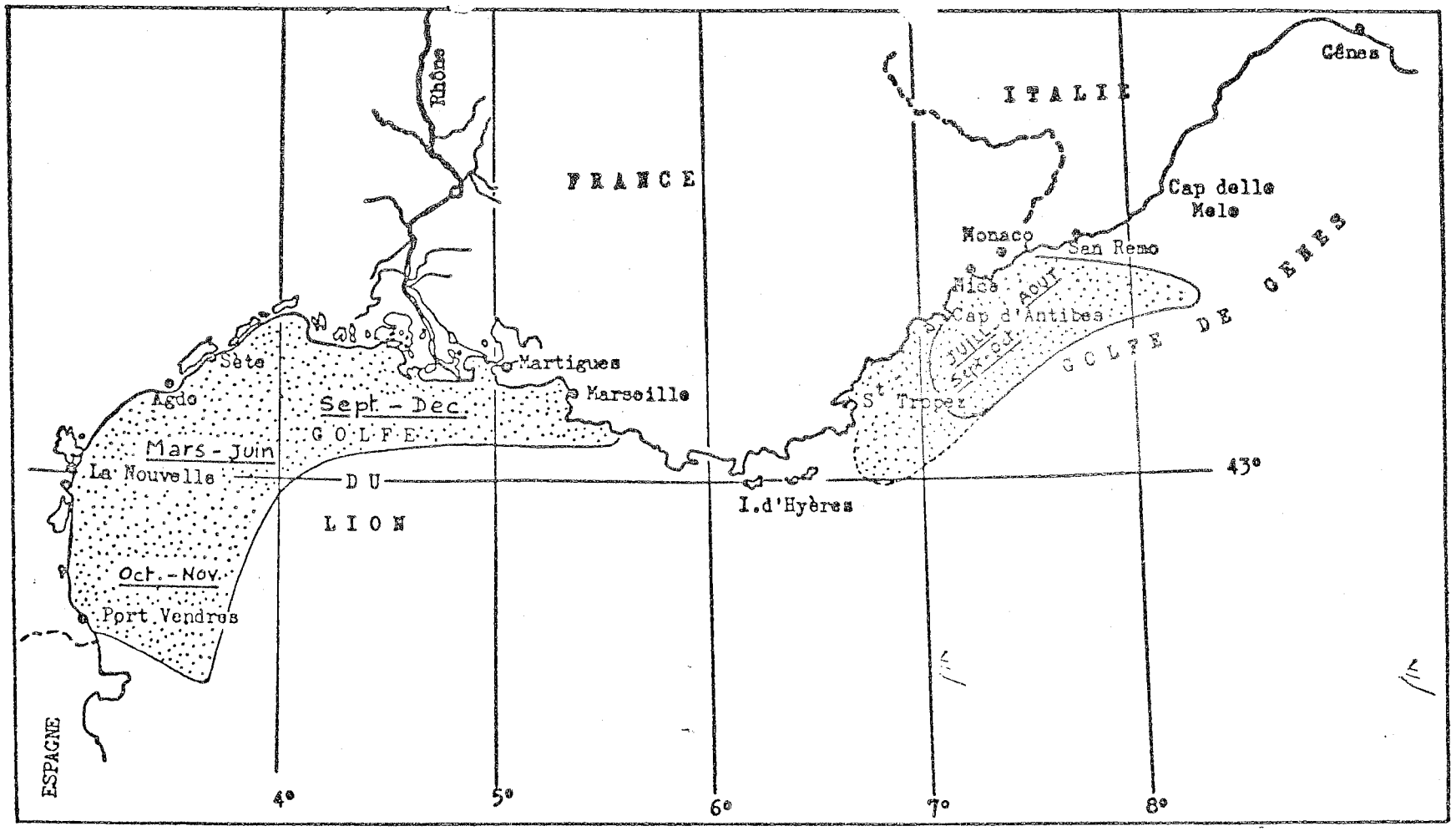


Fig. 4. Fishing seasons and fishing grounds (actual) of French purse seiners.

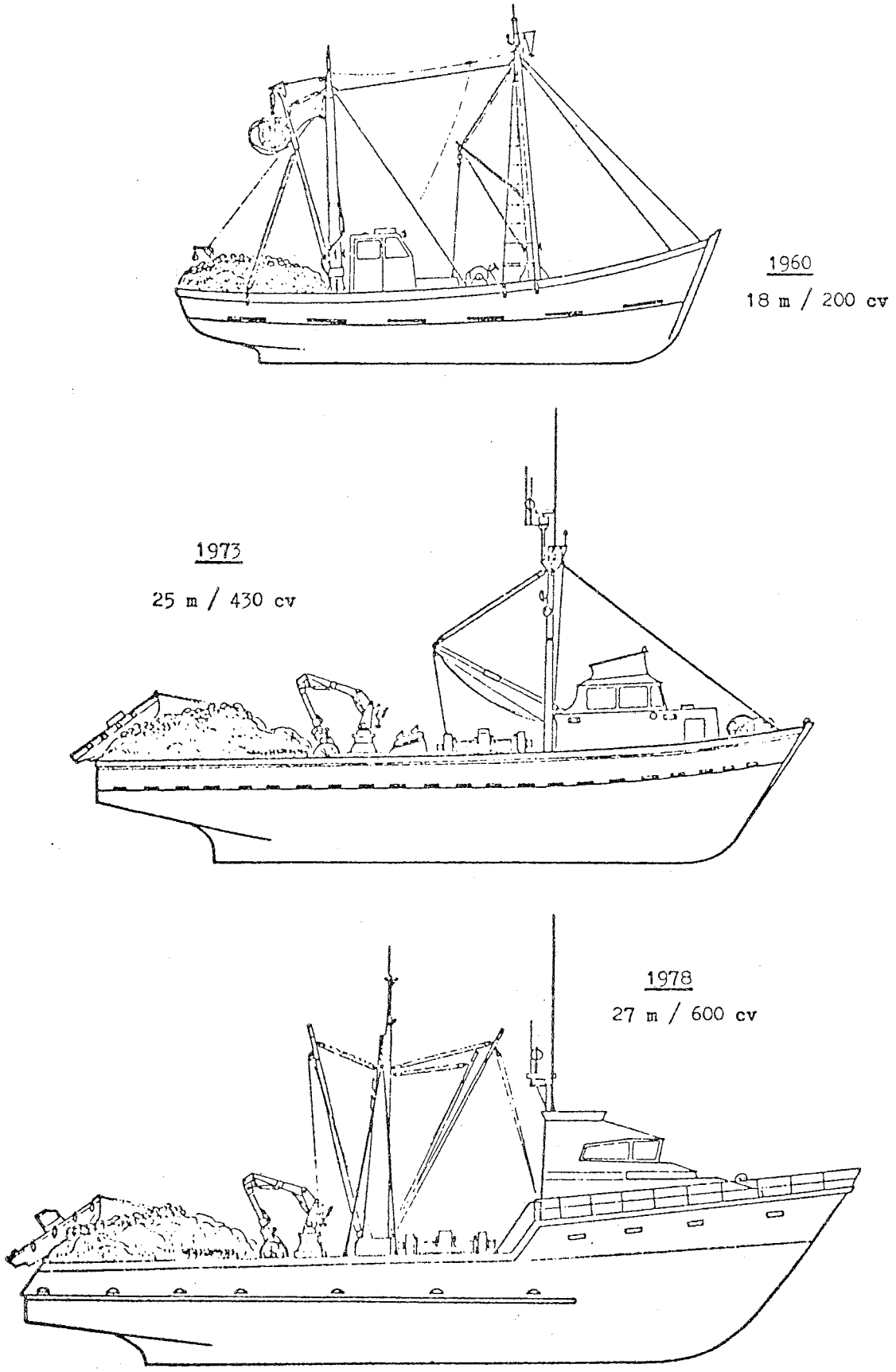
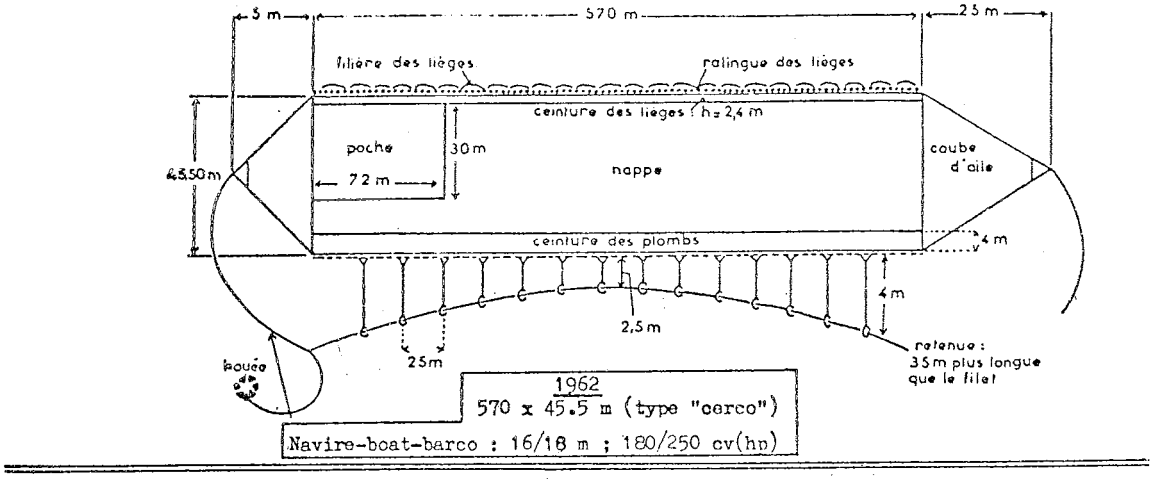
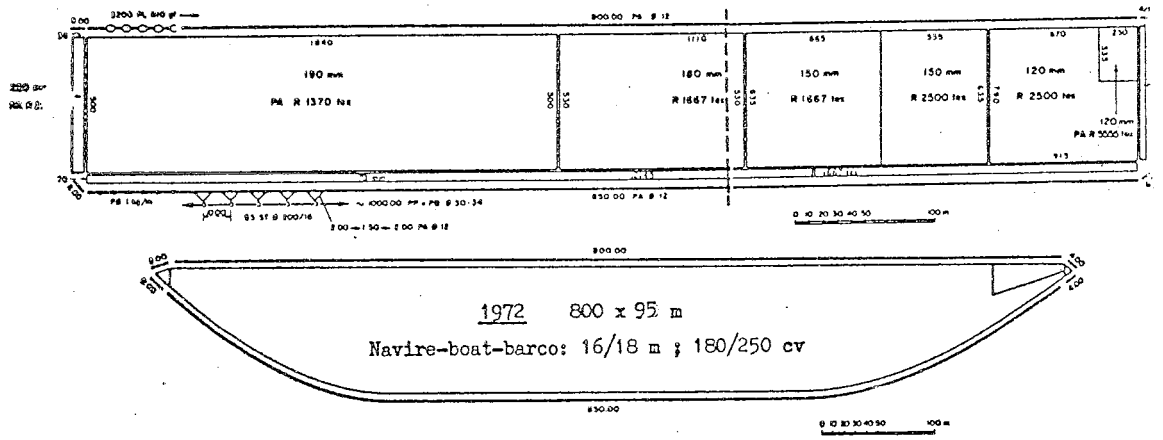


Fig. 5. Development of the French purse seiners in the Mediterranean.





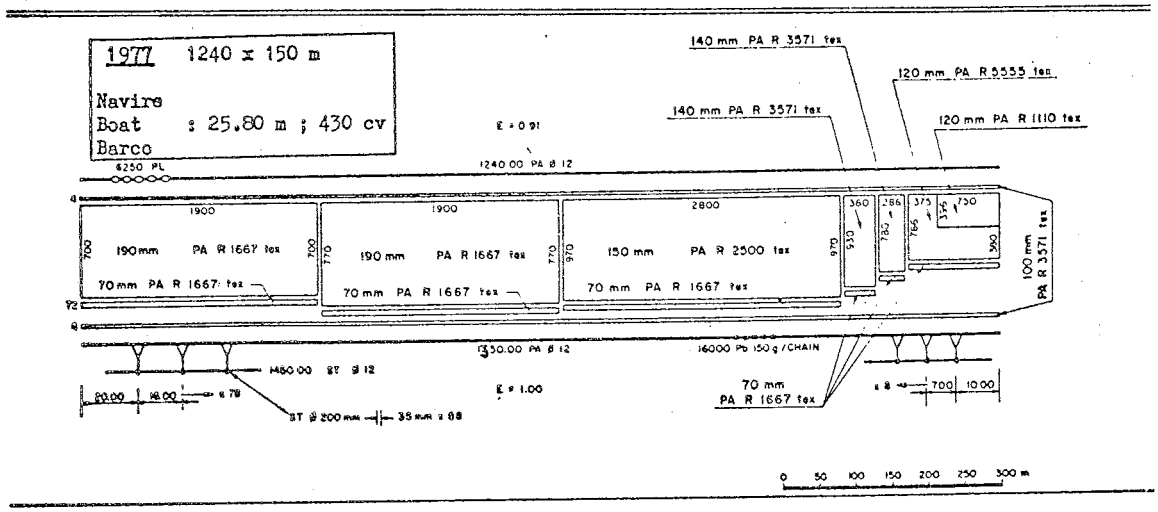


Fig. 6. Development of the characteristics of French Mediterranean purse seiners (Doc. ISTPM/Séte).

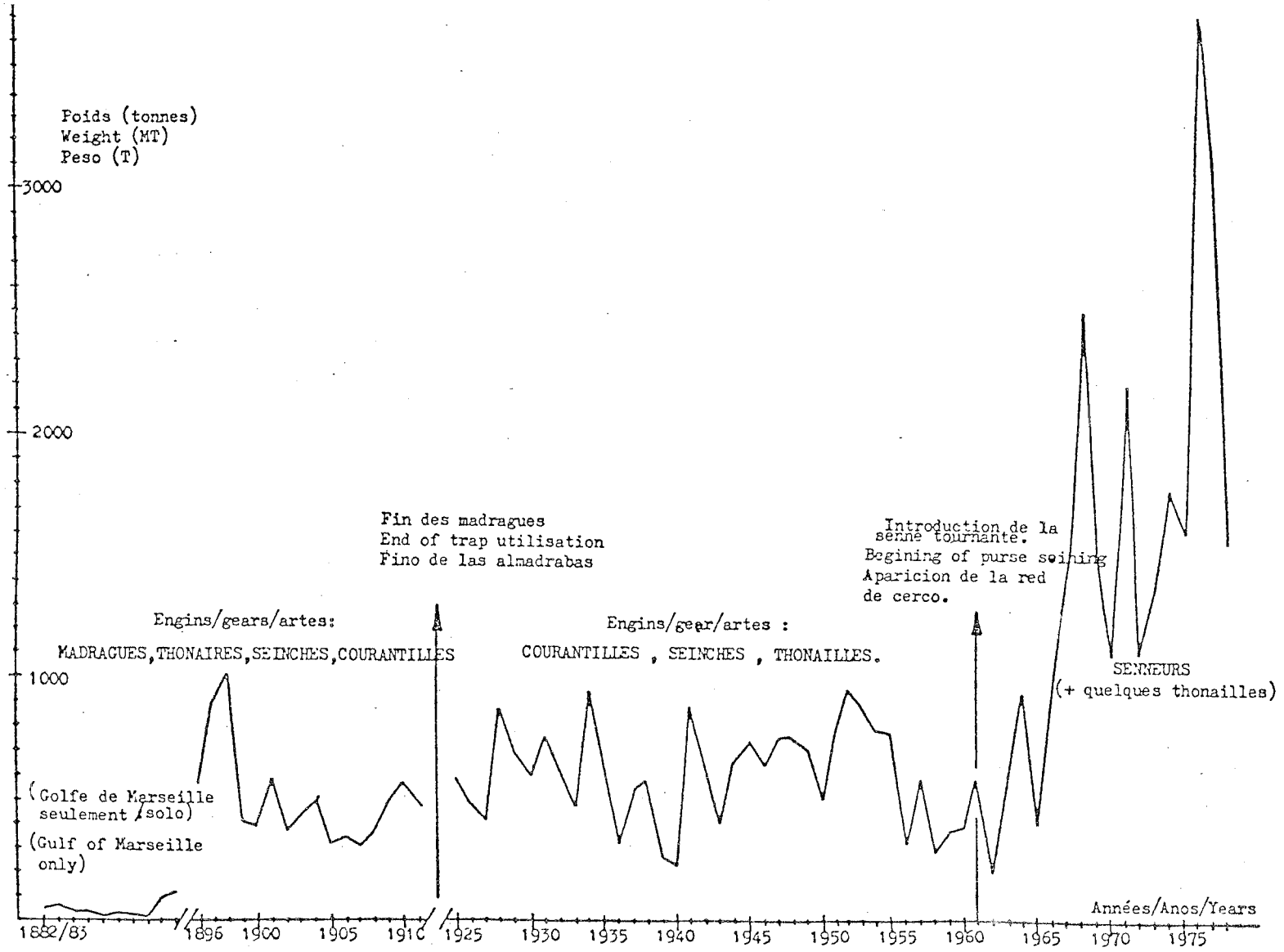
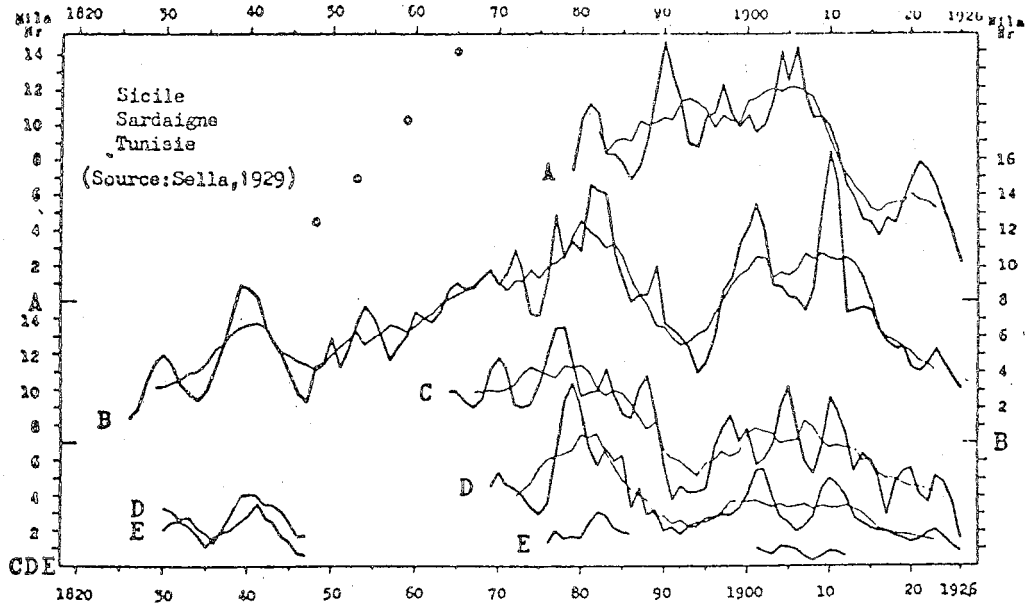
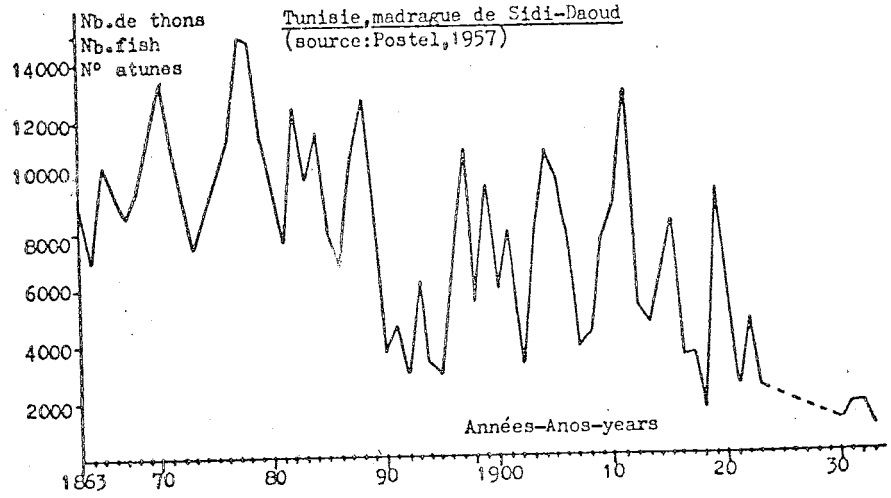


Fig. 7. Bluefin production of the French Mediterranean coasts during the last 96 years.





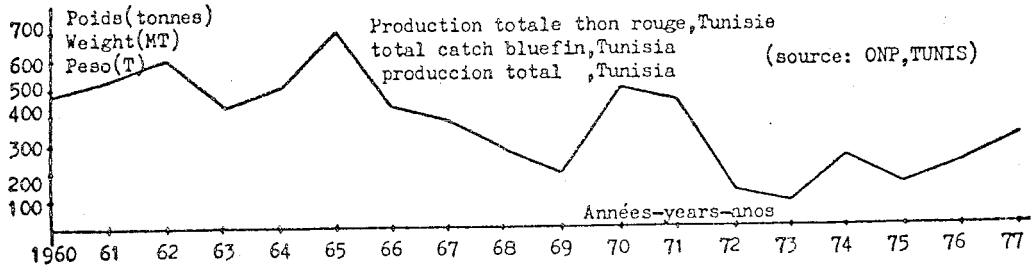
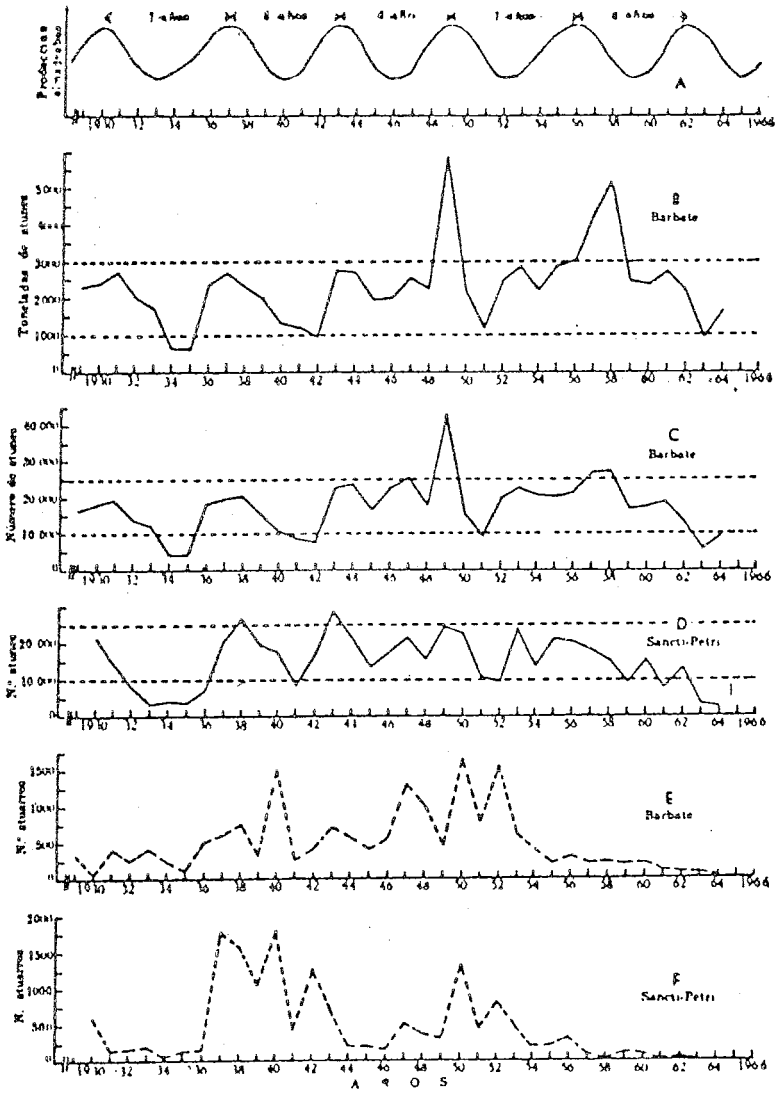


Fig. 8-A. Some examples of chronological variations of bluefin catches in several Mediterranean (and Atlantic, see Fig. 8-B) areas.



Producción anual de atunes y atuarros, durante treinta y seis años, 1929 a 1964, en las almadrabas de Barbate y Sancti-Petri. *A* = curva teórica. *B* = produción de atunes, en toneladas, en Barbate. *C* = producción de atunes, en número, en Barbate. *D* = producción de atunes, en número, en Sancti-Petri. *E* = producción de atuarros, en número, en Barbate. *F* = producción de atuarros, en número, en Sancti-Petri.

Madragues de la cote atlantique espagnole.

Atlantic spanish coast tuna traps.

Almadrabas de la costa sudatlantica de Espana.

(Source:Rodriguez - Rod… 1961.)

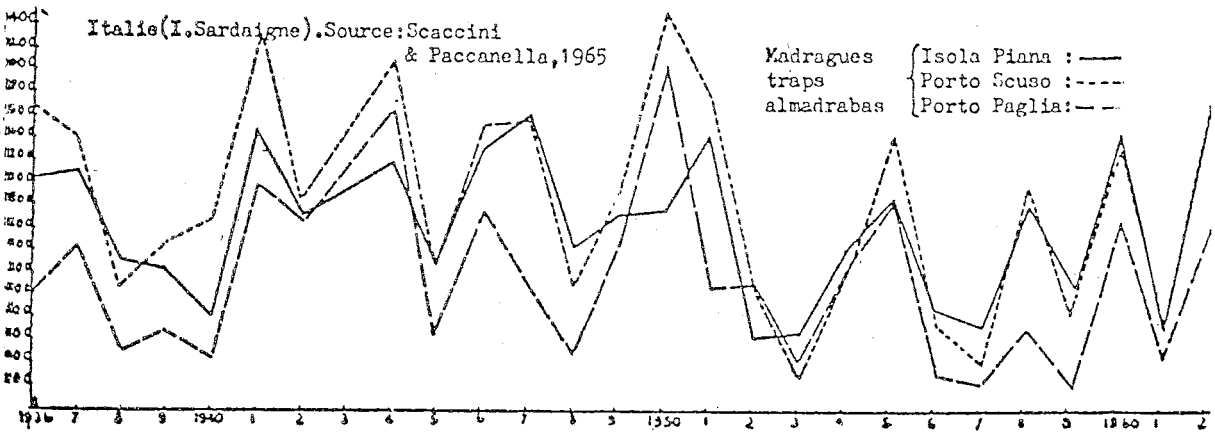
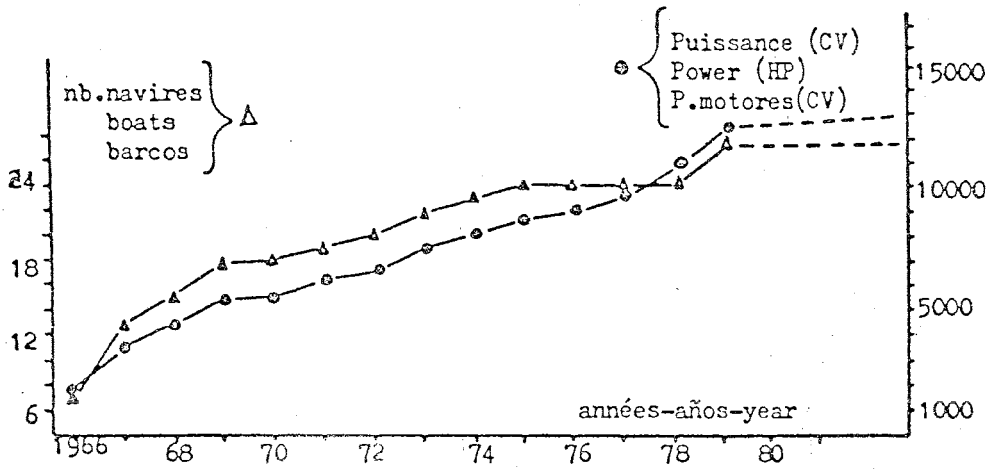


Fig. 8-B.



AN. YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Nb.	7	13	15	18	18	19	20	22	23	24	24	24	24	27
CV/HP	1610	3540	4300	5430	5430	6010	6440	7300	8000	8600	9040	9640	10680	12640

Fig. 9. Development of fishing effort (number of vessels and total engine power).