

GENERAL REVIEW OF BLUEFIN TUNA FARMING IN THE MEDITERRANEAN AREA

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SUMMARY

Bluefin tuna farming has developed very quickly in the Mediterranean area, particularly in the 1990's. Initially, large lean fish captured in the trap were used for farming but later small to medium size fish caught by purse seiners were mostly used. Except for a few experimental cases where fish are kept over years, they are fattened only for several months and mostly exported to the Japanese Sashimi market. This product created a medium quality tuna market in Japan and also encouraged the Mediterranean fishermen to concentrate efforts on bluefin tuna. Farming is causing many problems in collecting accurate catch statistics, as well as giving some impacts on the management of fish stocks and the environment.

RÉSUMÉ

L'élevage du thon rouge s'est développé très rapidement dans la zone méditerranéenne, notamment dans les années 90. Au début, des grands poissons maigres pris dans les madragues ont été utilisés pour l'élevage, mais plus tard ce sont majoritairement des poissons de petite à moyenne taille capturés à la senne qui ont été utilisés. Sauf dans quelques cas expérimentaux où les poissons sont conservés pendant plusieurs années, les poissons sont engraisés seulement pendant quelques mois et pratiquement tous exportés vers le marché japonais du Sashimi. Ce produit a créé au Japon un marché thonier de qualité moyenne et a également encouragé les pêcheurs méditerranéens à concentrer leurs efforts sur le thon rouge. L'élevage entraîne de nombreux problèmes dans la collecte des statistiques de captures précises et a également certaines répercussions sur la gestion des stocks de poissons et sur l'environnement.

RESUMEN

La cría de atún rojo se ha desarrollado muy rápidamente en la zona del Mediterráneo, sobre todo en los noventa. Inicialmente, los peces grandes y delgados capturados en las almadrabas se utilizaban para la cría, pero más tarde se utilizaron peces de tallas pequeña a mediana capturados por los cerqueros. Con la excepción de unos pocos casos de carácter experimental en los que se mantuvieron los peces durante años, se suelen engordar sólo durante varios meses y se exportan sobre todo al mercado de sashimi japonés. Este producto creó un mercado de túnidos de calidad media en Japón y también ha impulsado el que los pescadores mediterráneos concentren sus esfuerzos en el atún rojo. La cría está causando varios problemas en la recopilación de estadísticas de captura exactas, y también está teniendo un cierto impacto en la ordenación de los stocks de peces y en el medio ambiente.

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1. INTRODUCTION

In this report, tuna farming is defined as rearing tuna for a short period in order to increase its commercial value by increasing fat contents. There have been several trials of bluefin aquacultures, in which case, tuna are kept for few years in a cage until they reach a good commercial size. The concept of the aquaculture is different from that of farming and hence they have to be considered separately

Tuna farming started in Canada in the late 1960s by a Japanese farm. The farming is motivated by a highly specialized and categorized Japanese tuna market, where bluefin tuna have the highest commercial value if the meat contains proper fat contents. In the past, the highest value attached to such a bluefin tuna was about US \$900.00 per kilogram at the Tsukiji market auction (more commonly sold at US \$200 to 300 per kg). On the other hand, daily in the same market, a large quantity of lean bluefin tuna is sold for a few dollars. Thus the idea was to convert the lean cheap tuna into expensive fat tuna. Originally, large but lean bluefin tuna (generally post-spawning) captured by the trap fishery were kept in a cage (pen) for a few months during which period bait are fed to tuna to increase fat contents. Almost all these tuna were shipped to the Japanese market, particularly at the time the price is peaked (i.e. towards the end of the year). In this way, the tuna value increases sometimes more than hundred fold during a few months.

In the Mediterranean Sea, the tuna farming started in late 1970s in Ceuta (near Gibraltar), which were very similar type as the Canadian farming. Until 1980s, the small to medium (under 120 kg) sized tuna caught in the Mediterranean by purse seiners were sold at the local market at a price range much less than the prime large tunas which were exported to the *Sashimi* market, mainly because of its lower fat contents and for their less brilliant red color. However, it was discovered in late 1980s that even those medium sized tuna could be sold for a reasonably good price if the fat contents were high.

In mean time, the southern bluefin tuna of the medium size caught by the Australian purse seine fishery went into the farming in the 1980s. These products established a completely new market in Japan. Stimulated by the success of southern bluefin farming, the Japanese farms started similar type of operations in the Mediterranean Sea, in the mid-1990s. The concept of this new type of farming is different from the farming operated near Ceuta. This new type of farming spread very rapidly throughout the western Mediterranean Sea and is now carried out in various countries and the quantities are increasing very rapidly as well (see **Figure 1**).

The bluefin tuna farming has a lot of socio-economic impact to the Japanese market as well as to the Mediterranean fishing industry. It also has impacts on stock managements. In this paper, the historical development of farming in the Mediterranean is reviewed and its socio-economic impacts and possible effects on the managements are discussed.

2. REVIEW OF THE HISTORY OF BLUEFIN TUNA FARMING

In **Figure 1**, the total reported landings of bluefin tuna by purse seiners in the Mediterranean Sea is compared with the reported (partly estimated) amount of the farmed tuna and reported quantity of the Japanese imports. Japanese imports are complete until 2001 but the catches, quantity of farming are not complete for 2001. Reported amount of farming is given in principle as the total weight of fish when introduced into the cage. However, since much of reported quantities were not clearly defined, hence the weight of fish at the end of farming (harvest) can be included as well as that at the start. Japanese imports are given as estimated round weight; applying conversion factors for the products (see section on Bluefin Statistical Documents). Therefore, the quantities of farmed tuna and Japanese imports are not directly comparative. Besides, the imports are by the years of arrival at the Japanese customs and there can be time lag from the year of landing (particularly major part of exports occurred during the end of the year). Nevertheless these two values are very similar and the trends shown are the same.

While the catch of purse seine fishery are decreasing through these years except for 2000, mostly due to the ICCAT catch limits, the total amount of farmed bluefin has continuously increased and the proportion of farmed tuna in the total purse seine catches has also increased annually. In 1999, 2000 and 2001, the 30, 37 and over 50% respectively, of the officially reported purse seine catches were introduced to the farming.

In **Table 1**, the summary of the Mediterranean farming is given by country and locations. These are briefly reviewed by locations (for location, please refer to the **Figure 2**).

Ceuta (Spain)

This is the first commercial tuna farming operation in the Mediterranean area, which started in 1979. The operation is a traditional type, i.e. to keep large post-spawned lean tuna captured in traps on their way out of the Mediterranean in a large pen and to fatten them. The pen is the old Japanese type of about 70 meters x 40 meters rectangle, anchored to the bottom of the sea. Fish are kept from July-August until they are sold, latest in December of the same year.

As the fish were provided from the trap, the quantities raised every year were quite limited to maximum 200 MT. Most of the fish were large post-spawners (mostly over 150 kg). Hence the adding value is quite significant and the final products were sold as the top quality prime products in the Japanese market. To the current authors, the accurate data on farming were not available and the quantities given in the **Table 1** is the estimates.

Croatia

The fishermen who were engaged in the southern bluefin tuna farming in the Australia returned to their home country and started the operation in 1996. This farming is based on the new concept, i.e. to obtain small to medium sized fish caught by purse seiners and get it fattened until shipped. Generally, the fish supplied to the Croatian farms are small fish (20 kg to 80 kg), caught by the Croatian and Italian purse seiners in the Adriatic Sea. As the farming has grown so much and the demands for fish for farming well exceeded the catch quota assigned to Croatia, much of the fish entered into cages have been from the catches made by other countries vessels. Extremely small fish (less than 10 kg) are kept in the cage over a year and those amounts are increasing. Therefore, in the case of Croatia, there can be a large gap between the amount of fish introduced into the cage and that harvested in the same year.

These Croatian farmed fish are aimed at the less quality category in the Japanese market than those large farmed tuna. The type of the cages developed in Australia and adjusted to the local circumstances is used for holding fish, that is a floating circular cage with a 50 m diameter, suspending the net of about 20 to 25 meters depth. They are only anchored partially and hence can be moved from one location to the other. Fish are transshipped from the purse seine fishing grounds to the farms, using a smaller cage, tugged by a boat. The distance can be as far as a few hundred miles if fish are captured within the Adriatic Sea or even more if fish are captured in the other areas of the Mediterranean Sea. Due to the fact that the cage cannot be tugged at a velocity higher than 1.5 knots, this operation can last from several days to several weeks. Since the fish are provided by the purse seiners, the supply is much less limited than by traps but on the contrary, the size of the fish are much smaller than those by traps and most of them are pre-matured fish. Recently, all the Croatian purse seine catches of bluefin tuna are being used for farming.

Murcia (Spain)

Tuna farming also started in 1996 in the Province of Murcia. Since the late 1980s, Cartagena (in the Province of Murcia) was the major Mediterranean landing port for purse seine caught bluefin tuna and was the center of exports of these fish to Japan. Since the fish were relatively small, only selected fish were accepted by the Japanese market, or only belly meat (which has a higher fat content) were

shipped to Japan. The idea of farming was the same as Croatia, i.e. to add value to those small or medium size fish generally rejected by the Japanese market.

The fish supply comes mostly from purse seiners in the western Mediterranean, particularly near the Balearic Islands. The fish are from small (20 to 80 kg) to medium size (80 kg to 120 kg) and mostly premature but also include some matured fish of larger size. As this landing location is close to the major Mediterranean seine fishing grounds, there has been no limitation in fish supply for the farms. The fish are captured mostly by Spanish, French and Italian seiners and they are all kept together once introduced into the pen. Therefore, the origins of fish in the cages cannot be traced.

The statistics for this farming are relatively uncertain, as some of the figures for input and/or the amount farmed represent only the limit of the licensed amount and not necessarily the actual. The number of cages and the amount of farmed might both underestimated. As can be seen in **Table 1**, farming increased rapidly in the last several years. Had there been no limit in the government permit given for such operations, it could have increased even more rapidly. The fish are sent via air to the Japanese market and again aimed at the secondary value market (see later discussion). Up to now, no fish are kept more than 10 months in this location.

Malta

Farming in Malta started in 2000 following the system adopted in Croatian and Spanish (Murcia) farming. The bluefin tuna are captured mostly in the international waters, are entered to the cages in May to July, and are kept in the cages until October to January, as they are ready to be exported. Until the process is repeated the following year, there is about a five-month lag. It is in Malta's interest to keep abreast with new developments both for socio-economic and technical reasons. Malta's position is strategically located with respect to the migratory path of the highly priced bluefin tuna and therefore is the perfect site for this activity.

Only one farm with 4 cages operated in 2000 in Malta and all its products were exported to the Asian markets. In 2001, there were 2 farms, with 12 cages together, in operation. There is a possibility that more farms might enter into the operation in 2002. When those fish were originally brought in, even though the fish were alive, the Maltese Government requested ICCAT BFD to be submitted by the flag state of the vessels that captured the fish. Therefore when the fish are harvested and exported after farming, the Department issues an ICCAT Re-Export Statistical Document.

Italy

Test fish farming took place in 1999 to 2000 in southwest Sicily and in 2001 in the central Adriatic Sea. They used smaller cages of 23 to 30 m diameter and 15 to 18m depth. In 1999, 100 medium size tuna (about 4 MT) were farmed in Sicily, and in 2001, 500 small tunas (4 tons) were farmed in the Adriatic Sea. In 2001, one standard commercial cage of 50 m x 20 m was set near Trapani, Sicily, on the Tyrrhenian coast, and 400 MT of medium to large tunas were farmed. There were 4 more cages set in eastern Sicily but they were not operative for various reasons. It seems that there is keen interest in bluefin farming in Italy and the potential for increase is great.

Experimental fish culture

In the past, several experimental bluefin tuna cultures were carried out in the Mediterranean Sea. In 1978 to 1982, 5 large bluefin tuna (0.9 tons) were cultured using a 12 m x 10 m floating cage in the ancient tuna trap of Scopello (Sicily, southern Tyrrhenian Sea). The operation was for scientific experimental purposes and the tuna were supplied from the trap catches.

In Morocco, also an old type net was used for experimental culture of bluefin tuna since mid 1990s. About 10 large fish were kept for several years for scientific purposes.

Though it is not strictly a scientific experiment, recently, Croatia started bluefin culture keeping fish over a year. The idea is to culture small fish (<10 kg) for 2-3 years, increasing the quality and quantity of tuna meat. Since such increase is not involved in fishing effort, it is hoped that the wastage of catching small tunas might be avoided and serve for better use of bluefin stocks.

During the year 2000, 20 individual tunas were kept in a cage for research in Malta. The problem was that the average weight of the tuna was less than 100 kg and therefore were far from the spawning season. Therefore these were changed during 2001 with 12 tunas having an average weight of 300 kg. These are still being kept in a cage for research purposes.

3. BLUEFIN STATISTICAL DOCUMENT PROGRAM (BFS)

The ICCAT started the BFS Program for frozen tuna in 1993 and fresh tuna in 1994. According to the Program, all the ICCAT members have to request any bluefin products, when imported to their lands, to be accompanied by a BFS in which the weight of products by flag of the fishing vessels, general area and type of the products have to be recorded. The major objective of the Program is to identify unreported catches of bluefin tuna (mostly by IUU fishing vessels).

While carrying out the Program, the needs for several adjustments and modifications became obvious. One of these was related to farmed tuna. In 1999 (implemented since 2000), the ICCAT decided to use a specific form for the importation of farmed bluefin tuna to distinguish from the normal fish directly from capture. In reality, since 1996, farmed tuna have been marked to that effect in the BFS. The authors examined the BFSs received and reported to the ICCAT by the Japanese Government and calculated the round weight of farmed fish imported to Japan. It is known that some fish were exported to Korea but most of them have been re-exported to Japan. Therefore, the import to Japan covers most of the farmed fish exported on the world market. The estimated quantities of the farmed tuna imported to Japan are also given in the **Table 1** for the comparison. For the products, the following conversion factors were used and the increase during farming is not back calculated. Therefore the estimated value represents the harvest (landing) live weight.

Dressed x 1.25 = Round

Filletted x 1.67 = Round

Gilled and gutted x 1.13 = Round (Andreina, it has been 1.13)

Others x 2 = Round

Belly meat x 10.29 = Round.

The products are assigned to the country that issued the BFS and not necessarily to the country of the catches. These factors would explain the difference between the quantities reported for each country as farmed tuna and Japanese imports (see more discussions in later sections).

4. SOCIO-ECONOMICAL AND BIOLOGICAL IMPACTS

Japanese market

The impacts of the increase in farming products sent to the Japanese market have been significant. Until the early 1990s, the Japanese tuna *sashimi* market was extremely specialized into two major categories: one for very expensive, high quality prime products and another for popular price and quality. Though there is a wide price range in the latter category, the difference between prime quality products and this category is so much wider than the range. Only fat bluefin and southern bluefin of pre-spawning entered into the high quality market. Those are served at top-class Sushi restaurants or Japanese restaurants. All the rest of tunas were sold for a much reduced price and served at public restaurants and supermarkets.

However, since bluefin and southern bluefin tuna of smaller size that had been accepted only at the less quality market before, now fattened by farming and available in abundance, they started to constitute a middle quality category in the market, filling the gap between two extreme categories. The price for the middle quality tuna is still much less than the top quality meat but considerably better than lean red meat tunas.

These fish (fattened farmed tuna) provided the public with fatty meat called “toro” which only rich people could have purchased before. Those farmed tuna are now sold even in the supermarkets and used in the popular and inexpensive *sushi* bars such as rotating sushi bars (sushi being carried on conveyors which customers pick up). In a way, it brought the “toro” taste to the public and enriched the Japanese people’s food habits, though to some extent it destroyed the taste with a new unnatural flavor. On the other hand, it dragged down the price of high quality meat tuna, as well as pushing down the lower quality meat tuna.

The fishing industry

Tuna farming brought a revolutionary change to the Mediterranean fishing industry. It created a lot of new jobs for farming, tuna fish prices went up for fishermen, and farming changed the operational procedure completely (including fishing area and season as well as net lifting procedures). The fish caught by purse seiners used to be sold at the local markets for canning and a little for fresh fish consumption. Therefore the price was quite low. Now there is a whole new field of farming and there is an increasing demand for purse seine caught fish with much higher prices paid. The demand for bait fish (such as sardine, mackerel, squids, etc.) also increased, as 3 to 5% of the mass of the fish farmed are required daily for feeding. In the Italian market, since 1998, the prices for frozen mackerel for bait increased by about 75%, frozen squid by 40 to 110% depending on the size and quality; and sardines by 80%. Even though it is believed that these increases were partially due the increase in demand for bait for farming tunas, they are also partially due to the shift in fishing effort from driftnets to longlines, in accordance with the progressive ban of driftnet adopted by the EC.

5. POSSIBLE DIFFICULTIES ASSOCIATED WITH FARMING

- a) ***Increasing effort: As the increase in price and the demand for the purse seine caught small and medium sized fish have resulted from tuna farming, fishing effort has been also concentrating on the bluefin tuna that are suitable for farming. This may cause some shifting of effort from one element of the stock to another. One possibility is that more effort for smaller fish and a possible consecutive increasing proportion of smaller fish in the total catches would result in lower yield per recruits. Secondly the east bluefin tuna had already attained the level of a maximum sustainable yield when farming started massively. Therefore if the high price and demand cause the increasing effort, it may increase the catches and can further reduce the stock size. The Commission has taken a strict catch restriction policy since 1995 but implementation of a quota system is getting harder and harder and non-compliance seems to be increasing already, as is the demands for bluefin tuna.***
- b) ***Possibility of tuna laundering: Another serious problem is the increasing uncertainties in statistics. Unfortunately, the ICCAT BFSD is required for only dead fresh or frozen tuna products, and the international trade of live tuna is not the subject of the documents. In other words, live tuna can be imported from any country without any documentation.***

Some countries, such as Malta as described earlier, require a BFSD, even if the fish are alive, and to issue a re-export BFSD when the products are shipped out of the country. Other countries oblige fishermen to report catches and register the sales of live fish, even though a BFSD is not required. On the other hand, trade between EC countries is not considered as foreign trade and hence there is no need for such actions regardless the condition of fish (live or dead).

Once fish are entered to the cage, the identities of origin of the fish are lost. When these tuna are lifted, killed and exported to other countries, a BFSD has to go with it and the authority of the country where the farming took place must sign such a document. In other words, the catching countries are not necessarily signing the documents. Consequently, the quantities of bluefin tuna exports from one country can exceed their real (reported) catches by a significant quantity. The origins of these fish are lost. The only exception is the case where the country requests a BFSD even when the fish are imported live (e.g. Malta). At present, there are no IUU purse seiners known fishing in the Mediterranean. Therefore, it is hoped that an intentional tuna laundry is not taking place. However, if one country caught over their quota and exported as live fish, finding out such overage of the quota would be difficult.

- c) **Weight increase in farming:** As the fat content increases, tuna are expected to increase their body weight during the farming. Tuna farmers expect at least a 25% increase in body weight during the few months farming. Therefore, in order to estimate the original live weight of fish at the beginning of farming, the weight of lifting at the end of farming has to be converted by applying a factor of increase; also, the morph-metric characters, such as length-weight relationship, are assumed to be different from the fish in natural conditions. The Commission requested the SCRS to investigate these conversions and such work is under the way.
- d) **Catch vs. landing (or harvest):** The ICCAT scientific requirements are to report "catches" in weight. Therefore in principle, even if the fish are captured and sold live to the fish farmers of other countries, the catches in weight (as the time of the capture) must be reported by the flag states. Actually most of the countries are implementing reporting of all the captures. If they are reported correctly, then the landing (lifting) data of farmed fish should not be added to the bluefin catches. However, if the implementation of such a rule is not really effective and they are not reported, the landing weight less growth during the farming must be estimated and added to the reported catches. On the other hand, if there is large mortality during the farming, landing can be even less than the weight of the fish entered into the cage when farming started.

Also, an increasing amount of fish is now kept over a year, such as in Croatia. This means that only a part of the catches of one year is landed in that year and the rest will be landed in the following 2-3 years. On the contrary, some catches from 2-3 years back can be landed. Therefore, the landing (or harvest from the farming) has no relation with the catches. These elements all add up to the increasing uncertainties of the bluefin catch statistics.

- e) **Conversion from products to live weight:** Generally, the farmed tuna products are exported to the Japanese market and reported in the weight of products (such as gilled and gutted, in loin, etc.) The SCRS established conversion factors from products weight to live weight for bluefin tuna. However, those are based on fish captured under natural conditions. Therefore, it is apparent that the conversion would be different for farmed tunas. The Commission also recommended the SCRS to investigate the conversions and the research is under way (e.g. SCRS/2001/124⁸)
- f) **Difficulties in sampling;** Bluefin size data came from size measurements of the catches made by various gears such as purse seine, trap, etc. However, once farming becomes popular, such sampling from the catches is getting more and more difficult, because live tunas are moved from purse seines or traps directly to the cages. As the SCRS pointed out, this may lead to inadequate sampling and hence affect stock assessments. As fishing patterns in terms of area and time have undergone the changes, according to the demand of live stock for farming, sampling the size of the catches is more important for those fish.
- g) **Effects on environment:** Dense farming might cause water pollution in two aspects: one from leftover of bait and cultured fish and another from processing. Malta reported that in 2000-2001,

⁸ Cunnighan, E.M; Restrepo, V.R; de la Serna, J.M.; Atunes de Mazarrón S.L" en Murcia (Spain): "Update estimates of conversion factors for bluefin tuna from product weight to live weight.

no massive pathological problems have arisen. Malta has had stringent Environmental Impact Assessments carried out prior to the start up. These data have been used as the benchmark. Water and sediment analysis has been carried out on a regular basis together with benthic surveys. In the following period, a *restitutio ad integrum* of the site utilized has been observed. Spain is limiting the number of cages that can be operated in a certain area, in order to control pollution. However, as the operations expand all over the Mediterranean, this problem will be a very important and urgent issue to be studied further, including the methods to reduce the pollution.

Further, there have been discussions of the effects on human sanitation of the chemicals and/or medicines possibly used with baits. In most places, the use of chemicals and medicines (*e.g.* hormones, antibiotics) for farming is prohibited by law. However, the implementations are not well studied. This should also be studied and carefully monitored.

Table 1 . General overview of bluefin tuna farming (data for 2001 is partial or incomplete).

	No. Units	Number of cages used for tuna farming.										
	Input	Quantity of fish entered into the cages (in MT). Estimates										
	Flags	Flags of fishing vessels who made catches entered into the cage										
	Gear	Fishing gear used in capturing the fish entered.										
	Harvest	Quantity of fish harvested from the cages.										
	Period	Perid during which fish are in the cage										
	Size	Size range or average size of fish when entered into the cages.										
	Jpn import	Imported into Japan (converted round weight from BFSD data)										
Country		1979-91	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Spain (Ceuta)	No. Units	2-3										
	Input	200-800										
	Flags	Spain	Spain	Spain	Spain							
	Gear	Trap	Trap	Trap	Trap							
	Harvest	200-800	<50	<50	<50							
	Period	July-Dec	July-Dec	July-Dec	July-Dec							
	Size	80-300kg	80-300kg	80-300kg	80-300kg							
	Jpn import								17	39		
Spain (Murcia)	No. Units						2	5	10	16	16	38
	Input							300				
	Flags						Spain/France	Spain/France	Spain/France	Spain/France	Spain/France	Spain/France
	Gear						PS	PS	PS	PS	PS	PS
	Harvest						77	173	1779	3196	3660	5000
	Period						July-Dec	July-Dec	July-Dec	July-Dec	July-Mar	July-Mar
	Size						20-152Kg	20-153Kg	20-154Kg	20-155Kg	20-156Kg	20-157Kg
	Jpn import							263	2894	3366	4524	5848
Malta	No. Units										4	12
	Input										330	1108
	Flags										Italy, Libya	Italy
	Gear										PS	PS
	Harvest										330	1108
	Period										June-Dec	June-Dec
	Size										80-250kg	50-620kg
	Jpn import											

Table 1. Cont.

Country		1979-91	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Croatia	No. Units (BFT farms)						1	2	6	6	9	9
	No of cages										28	43
	Input (mt)							1088	889	1371	1960	1946
	Flags (catch quota from:)						Croatia	Croatia	Croatia	Croatia/Italy	Croatia/EC	
	Gear						PS	PS	PS	PS	PS	PS
	Peirod (middle to big fish)						Jul-Dec	Jul-Dec	Jul-Dec	Jul-Dec	Jul-Dec	Jul-Dec
	(small fish)						2-3 years	2-3 years	2-3 years	2-3 years	2-3 years	2-3years
	Fish size (from Adriatic Sea)						5-100Kg	5-100Kg	5-100Kg	5-100Kg	5-100Kg	5-100 kg
	Fish size (from Mediterranean)									20-160 kg	20-160 kg	20-160 kg
	Harvest (MT)-product weight						39	390	400	672	1090	
Jpn import (MT)							405	212	277	662	985	
Italy	No. Units	Some experimental fish cultures								1 (esperimental	1 (esperimental	5
	Input									4	4	
	Flags											
	Gear											PS
	Harvest											400
	Period											June-Dec
	Size											Med-large
	Jpn import											115
Morocco??	No. Units	Since 1983 some experimental fish culture is being conducted but no commercial productions.										
	Input											
	Flags											
	Gear											
	Harvest											
	Period											
	Size											
	Jpn import											

Note: Malta requires BFSD when live fish are purchased from foreign fleet and ehnce BFSD received by Japan specify products originating from other flags.
 Many of fish entered into the cage in Croatia are fish less than 10kg and kept over 2-3 years.

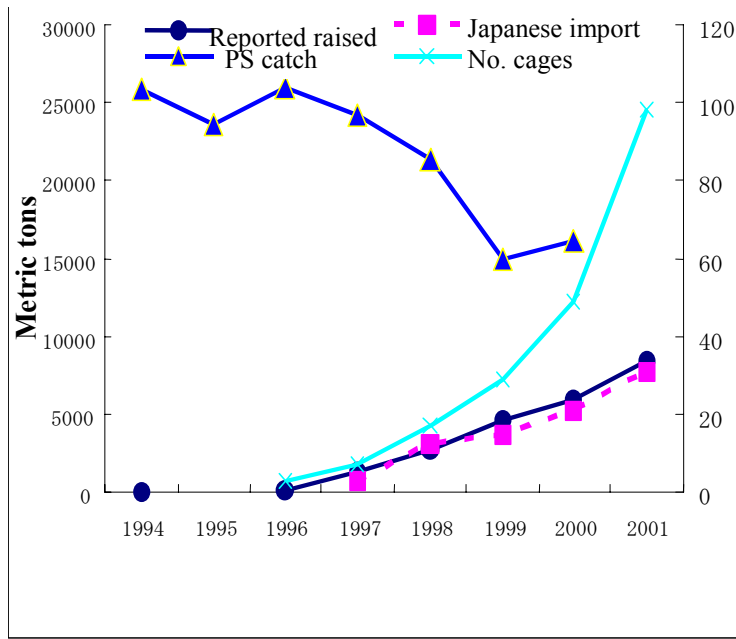


Figure 1. Reported PS catch and farmed bluefin tuna (data for 2001 is incomplete)

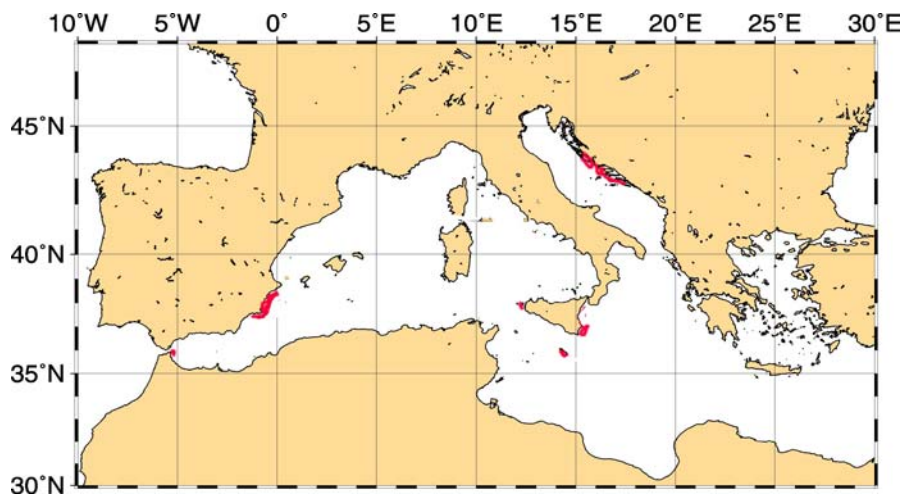


Figure 2. Distribution of bluefin tuna farming sites in the Mediterranean Sea.