ANALYSIS OF THE MEDITERRANEAN (INCLUDING NORTH AFRICA) DEEP-SEA SHRIMPS FISHERY: CATCHES, EFFORT AND ECONOMICS

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ABSTRACT

The project assesses the true status of basic data on catches, effort, and economic significance of the deep-water shrimps (*Aristeus antennatus* –rose shrimp-) and *Aristaeomorpha foliacea* –red shrimp-) fisheries over the entire area of exploitation. The study area encompasses the Mediterranean (coasts of Spain, and Italy) and adjacent areas of the Atlantic (Algarve, Portugal), including North Africa (Tunisia, Algeria, Morocco). It represents a first opportunity for simultaneous and comparative co-operation with the countries of North Africa. COPEMED (FAO) agreed to fund the corresponding part of the study in North Africa. A total of 31 ports around the Western and Central Mediterranean were sampled. The collected data are: catch (biomass) and fishing effort data for the target species (*Aristeus antennatus, Aristaeomorpha foliacea*), the species composition and abundance (biomass) catch data for the major by-catch species, the seasonal size-frequency distributions of the target species, the location of the main fishing grounds in each subsector of the study area throughout the year, and the economic aspects of the fishery, costs and benefits. The primary purpose of the methodology employed was more to collect qualitatively accurate data than quantitative data *per se*, with a view to being able to put forward advisory and management strategies based on reliable information. Visits by observers to the fishing ports for purposes of sampling were conceived as a method of validating/calibrating the quality of the data supplied by the skippers through the logbooks and also as a method of collecting first-hand information where logbooks could not be accepted by fishermen. To that end, once or twice a week sampling was performed in the ports considered when the fishing vessels returned to port, to record the size of landings together with supplementary information from skippers on the number of hauls, towing duration, fishing locations, etc. in the period just previous to the sampling date. Results indicate that the deep-water shrimps fishing fleet consists of trawlers and multi-purpose vessels equipped with trawl nets. Catch per unit effort data on *A. antennatus* are most abundant for the Western Mediterranean, off mainland Spain and North Africa. High catches of this species in these areas coincide with low catches of *A. foliacea*. Generally the location of rose shrimp (*A. antennatus*) fishing grounds varied seasonally and were located between 400 and 950 m. Spatio-temporal movements are well described in the literature and submarine canyons play and important role as fishing grounds. For each area the fishing ground locations have been described and its concrete location can be found in the data bank. The profit margin after cost coverage is quite low in most ports. The residual amount has to be used to cover financial costs (depreciation and opportunity cost- interests) and, above all, to remunerate the managerial factor. In fact the highest profit margins are recorded in the ports of Almeria, Mazara del Vallo and Villa Real di San Antonio, i.e. where the rose shrimp fishing fleet is managed at industrial level. All collected data are given in a GIS presentation in the attached CD and in a data bank. Along the development of this project on the Mediterranean deep-sea shrimp fishery we faced a general major problem: the difficulty to collect reliable data to characterise the targeted parameters. These referred to a vast array of concepts necessary to deal with the main features of the fishery, and ranged from the amount of catches to the power of the engines or the actual value of landings.

Key words: *Aristeus antennatus*, *Aristaeomorpha foliacea*, Deep-sea, Red shrimp, Rose shrimp, Fisheries, Catches, Efforts, Economics, Mediterranean Sea, North Africa

SUMMARY FOR SPECIALISTS AND NON-SPECIALIST.

This proposal is directed at the study of an economically important resource for which knowledge is scant and has not previously been analysed: the deep-water shrimps. The project assesses the true status of basic data on catches, effort, and economic significance of the deep-water shrimps (*Aristeus antennatus* –rose shrimp-) and *Aristaeomorpha foliacea* –red shrimp-) fisheries over the entire area of exploitation.

The study area encompasses the Mediterranean (coasts of Spain, and Italy) and adjacent areas of the Atlantic (Algarve, Portugal), including North Africa (Tunisia, Algeria, Morocco) (Figure 1). It represents a first opportunity for simultaneous and comparative co-operation with the countries of North Africa. COPEMED (FAO) agreed to fund the corresponding part of the study in North Africa. A total of 29 effective ports around the Western and Central Mediterranean were sampled (Table I).

The collected data are: catch (biomass) and fishing effort data for the target species (*Aristeus antennatus, Aristaeomorpha foliacea*), the species composition and abundance (biomass) catch data for the major by-catch species, the seasonal size-frequency distributions of the target species, the location of the main fishing grounds in each subsector of the study area throughout the year, and the economic aspects of the fishery, costs and benefits.

The primary purpose of the methodology employed was more to collect qualitatively accurate data than quantitative data *per se*, with a view to being able to put forward advisory and management strategies based on reliable information.

Visits by observers to the fishing ports for purposes of sampling were conceived as a method of validating/calibrating the quality of the data supplied by the skippers through the logbooks and also as a method of collecting first-hand information where logbooks could not be accepted by fishermen. To that end, once or twice a week sampling was performed in the ports considered when the fishing vessels returned to port, to record the size of landings together with supplementary information from skippers on the number of hauls, towing duration, fishing locations, etc. in the period just previous to the sampling date.

Generally the location of rose shrimp (*Aristeus antennatus*) fishing grounds varied seasonally and were located between 400 and 950 m. (Table II). Spatio-temporal movements are well described in the literature and submarine canyons play an important role as fishing grounds. For each area the fishing ground locations have been described and its concrete location can be found in the data bank.

In the study area the effective fleet comprised 548 vessels in the 29 ports sampled. Total GRT was 36 478 mt, and engine power exceeded 133 000 kW. (Table III). The average size of these vessels is large, above all in comparison with the average characteristics for the Mediterranean fleet overall. The average vessel in the effective rose shrimp fishery fleet has an engine power of 243 kW and a GRT of 66 tons and is 21 m long. The average engine power of a North African shrimper is 231 kW as opposed to the average of 245 kW of a vessel from the European Mediterranean; the average GRT of a North African vessel (62 tons) is 5 tons less than the average of a European vessel (67 tons). Table III.

Catch per unit effort data on *A. antennatus* are most abundant for the Western Mediterranean, off mainland Spain and North Africa. High catches of this species in these areas coincide with low catches of *A. foliacea*.

In the Ligurian Sea, Eastern Italy, and the islands of Sardinia and Sicily, catch per unit effort (CPUE) data on *A. antennatus* are not as readily available, while CPUE data on *A. foliacea* become increasingly available. Taking these two species together, mean yields are around 4.2 kg/h, with peak values of 9 kg/h, which translates into approximate mean daily yields of about 50 kg/day. (Fig. 2 & 3). On the whole, the data indicate that there is a tendency to catch the species *A. antennatus* alone in the westernmost part of the Mediterranean, whereas the two species are mixed in the easternmost portion of the study area.

There were seasonal variations in catches both within species and between species. Throughout the Mediterranean, the highest rose shrimp (*A. antennatus*) yields were attained in summer, the lowest yields in autumn. (Figure 4) In contrast, the highest red shrimp (*A. foliacea*) yields were attained in winter and spring. On the whole, in the Western and Central Mediterranean *A. antennatus* yields were higher than *A. foliacea* yields. (Figures 5 & 6).

The range of the length frequency distribution for the total annual catch at each port studied may seem similar, but the relative importance of each size in the total catch varies. The size distribution of the total annual catch represents both different conditions of exploitation and particular aspects of species biology. (Figures 7 & 8).

In the UE countries (no data are available from North Africa), the economic results of a fishing business are directly related to its fishing effort (Tables IV & V). A correct economic analysis must then relate the economic variables to the effort data. The most efficient port was the port of Almeria (Table VI). Efficiency is surely positively related to the size of the vessels (when the size increases, output increases more than proportionally); however it is also affected by other factors, such as the age of the fleet, modernization, equipment, and last but not least, the opportunity of choosing different fishing areas without being forced to share the same area with all vessels coming from the same port or from neighbouring ports (as it is the case in the Ionian channel).

Revenues per unit of effort (RPUE) is the most meaningful parameter as it provides a measurement of the revenues gained in one working day. The highest value was recorded in the port of Almeria with round 2.02 thousand € of value of landings per day Table VII). Also with respect to this efficiency parameter a high variability related to the average size of the vessels is observed. In the period investigated the average price of the rose shrimp in all the investigated ports was round 20 € per kg. The producer price of other species was instead 5.8 € per kg. (Table VIII). This high producer price is due to the high commercial value of the investigated resource and the sustained demand for this specie.

Along the development of this project on the Mediterranean deep-sea shrimp fishery we faced a general major problem: the difficulty to collect reliable data to characterise the targeted parameters. These referred to a vast array of concepts necessary to deal with the main features of the fishery, and ranged from the amount of catches to the power of the engines or the actual value of landings.

CONCLUSIONS AND RECOMENDATIONS

CONCLUSIONS

This proposal is directed at the study of an economically important resource for which knowledge is scant and has not previously been analysed: the deep-water shrimps. The project assesses the true status of basic data on catches, effort, and economic significance of the deep-water shrimps (rose shrimp, *Aristeus antennatus* and red shrimp, *Aristaeomorpha foliacea*) fisheries over the entire area of exploitation.

The study area encompasses the Mediterranean and adjacent areas of the Atlantic (Algarve, Portugal), including North Africa. It represents a first opportunity for simultaneous and comparative co-operation with the countries of North Africa. COPEMED (FAO) agreed to fund the corresponding part of the study in North Africa.

The collected data are: catch (biomass) and fishing effort data for the target species (*Aristeus antennatus, Aristaeomorpha foliacea*), the species composition and abundance (biomass) catch data for the major by-catch species, the seasonal size-frequency distributions of the target species, the location of the main fishing grounds in each subsector of the study area throughout the year, and the economic aspects of the fishery, costs and benefits. All collected data are given in a GIS presentation in the attached CD and in a data bank.

From an administrative standpoint, the largest area of exploitation of rose shrimps is located in Spain and Italy. In Tunisia, fishery of deep-water shrimps is performed in the northern part of the country (Cap Bon). In Algeria, most shrimpers are located in the central part of the country (Central Algeria). Lastly, in Morocco, the main ports where shrimp fisheries (*P. longirostris*) are carried out are located in the northern part of the country, between Tangier and Nador.

The deep-water shrimps fishing fleet consists of trawlers and multi-purpose vessels equipped with trawl nets. The target species in the fisheries investigated were not only deep-water shrimps in Italy. The wide range of species caught is typical of the multi-species fishery in the Tyrrhenian Sea while in the W. Mediterranean becomes almost mono-specific.

Investments in equipment and repairs made by deep-water shrimps fishing fleets are higher than those made by trawl fleets which do not fish for shrimps. This higher level of investment is due to the nature of the rose shrimp fishery (fishing areas far from the coastal, deep waters, uncertain weather–sea conditions). The technical characteristics of trawl fleets and of rose shrimp fishing fleets are different.

In the study area the effective fleet comprised 548 vessels in the 29 ports sampled. Total GRT was 36 478 mt, and engine power exceeded 133 000 kW. The average size of these vessels is high, above all in comparison with the average characteristics for the Mediterranean fleet overall. The standard vessel in the effective rose shrimp fishery fleet has an engine power of 243 kW and a GRT of 66 tons and is 21 m long. The average engine power of a North African shrimper is 231 kW as opposed to the average of 245 kW of a vessel from the European Mediterranean; the average GRT of a North African vessel (62 tons) is 5 tons less than the average of a European vessel (67 tons). Thus, on average, a trawler in the rose shrimp fishery is larger than a general trawler in terms of tonnage, length and engine power.

The activity rate (number of shrimpers versus total trawlers) was 48.7%. In Spain and Italy, the activity rate ranged between 7 % (the Italian fleet in Trapani) to 73 % (the Spanish port of Palma). The variability of this indicator is due to the high degree of heterogeneity at the ports sampled. Additionally, the lower the average size of the port fleet, the fewer the vessels which are technically capable of participating in the rose shrimp fishery. In Portugal, the high activity rate (93 %) was due to the fact that the fishery of interest is crustacean trawling, which accounts for near all the trawl activity in the areas under investigation; along the southern coast there is only one trawler targeting fish. For Morocco and Tunisia, the activity rate was 100 % in the ports sampled. In Morocco, white shrimps are caught together with other species; hence the trawl fleet was not specialised in the deep-water shrimps fishery only. In Tunisia, the fleet (8 vessels) is specialised in the fishery on deep-water resources in the Sicily Channel. In Algeria, only round 60 % of the trawlers were catching rose shrimps all year round.

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In the Ligurian Sea, Eastern Italy, and the islands of Sardinia and Sicily, catch per unit effort (CPUE) data on *A. antennatus* are not as readily available, while CPUE data on *A foliacea* become increasingly available. Taking these two species together, mean yields are around 4.2 kg/h, with peak values of 9 kg/h, which translates into approximate mean daily yields of about 50 kg/d. On the whole, the data indicate that there is a tendency to catch the species *A. antennatus* alone in the westernmost part of the Mediterranean, whereas the two species are mixed in the easternmost portion of the study area.

There were seasonal variations in catches both within species and between species. Throughout the Mediterranean, the highest rose shrimp (*A. antennatus*) yields were attained in summer, the lowest yields in autumn. In contrast, the highest red shrimp (*A. foliacea*) yields were attained in winter and spring. On the whole, in the Western and Central Mediterranean *A. antennatus* yields were higher than *A. foliacea* yields.

The relative proportions of rose shrimps in the catches varied substantially among the different regions considered and in some cases among the different seasons of the year within a given region as well. Generally speaking, the highest contributions of rose shrimps were recorded in autumn and spring, as well as in summer in the Northern Alborán Sea and Algerian regions. Except in the Southern Tyrrhenian region and the regions in which rose shrimps were prevalent in the catches all year long, the share of rose shrimps in the catches tended to be low in winter.

Rose shrimps were the predominant category in the commercial catches in the following regions: Northern Alborán Sea, Balearic Islands, Catalonia, Northern Sicily, and the Gulf of Taranto. The contribution of the category other shrimps was especially high in the Algarve and Algerian regions, where it sometimes accounted for most of the catches. Certain by-catch species, such as hake, blue whiting, and forkbeards, contributed modest yet significant shares to the catches in a number of the regions studied (with certain exceptions such as the virtual absence of forkbeards in the Gulf of Taranto region and of blue whiting in the Northern Sicily region). Catches of certain other species, such as conger eel and flying squid, were higher in the easternmost

regions, whereas those species were entirely absent from the catches in many other regions.

The range of the length frequency distribution for the total annual catch at each port studied may seem similar, but the relative importance of each size in the total catch varies. The size distribution of the total annual catch represents both different conditions of exploitation and particular aspects of species biology.

The minimum size of females in the catches was between 15 mm and 16 mm, which was the minimum size at most of the sampling ports. Sagres and Sines were the ports with the largest minimum sizes for females, 24 mm. They were followed by Almería with a minimum size of 20 mm and Porto Ercole with a minimum size of 19 mm. Maximum sizes reached 71 mm at Sintes, 70 mm at Sagres, 69 mm at Olhão and Porto Ercole, and 67 mm at Blanes. There were small differences in the minimum size for males.

It would initially seem that the differences in the size ranges observed in the different regions and in the different ports within each region are indicative of a pronounced geographic shift from the area off Portugal to the area off the ports in Italy. This effect is more marked in the case of the minimum size in the catches. Comparison of the exploitation pattern in the different regions considered would appear to indicate that the area off the ports of Barcelona and Palma in Spain is the area where the smallest females, between 15 and 35 mm, mostly immature, are taken.

Generally the location of rose shrimp (*A. antennatus*) fishing grounds varied seasonally and were located between 400 and 950 m. Spatio-temporal movements are well described in the literature and submarine canyons play and important role as fishing grounds. For each area the fishing ground locations have been described and its concrete location can be found in the data bank.

The fishing activity of the deep-water shrimps fishing fleet implies taking on an operational and technical risk. Simultaneously it demands experience, know-how and higher skills. To analyse whether the propensity to risk and know how are re-paid by this specific fishery, a comparison was made between the vessels of the rose shrimp fishing fleet (“shrimpers”) and the trawlers which do not carry out rose shrimp fishery (“others”).

The profit margin after cost coverage is quite low in most ports. The profit margin (difference between output value and total costs) can be viewed as a margin of contribution to cover operational and fixed costs. The residual amount has to be used to cover financial costs (depreciation and opportunity cost- interests) and, above all, to remunerate the managerial factor. In fact the highest profit margins are recorded in the ports of Almería, Mazara del Vallo and Villa Real di San Antonio, i.e. where the rose shrimp fishing fleet is managed at industrial level.

The economic results of a fishing business are directly related to its fishing effort. A correct economic analysis must then relate the economic variables to the effort data. The most efficient port was the port of Almería, with a value of landings of round 31 thousand € per meter, while the most inefficient one was the Italian port of Gallipoli, with just 2.3 thousand € per unit of effort. Efficiency is surely positively related to the size of the vessels (when the size increases, output increases more than proportionally); however it is also affected by other factors, such as the age of the fleet, retrofitting, equipment, and last but not least, the opportunity of choosing different fishing areas without being forced to share the same area with all vessels coming from the same port

or from neighbouring ports (as it is the case in the Ionian channel).

Revenues per unit of effort (RPUE) is the most meaningful parameter as it provides a measurement of the revenues gained in one working day. The highest value was recorded in the port of Almería with round 2.02 thousand € of value of landings per day. Also with respect to this efficiency parameter a high variability related to the average size of the vessels is observed.

With respect to ports, the difference between "shrimpers" and "others" revenues is higher above all in the ports with an average higher size of the vessels. This is due not only to the higher profitability of the "shrimpers", but also to the lower efficiency of the "others" vessels (due to their size and equipment, and to lower skills of the crew).

The impact of this cost item on total costs accounts for 14%, while the impact on gross cash flow accounts for 10%. However there is a high variability amongst the ports investigated. In general in small sized-vessels the labour cost has a higher impact as fixed costs are lower.

With respect to the Spanish and Italian ports only, the total number of employees is estimated to be round 5,106 unit, 48% out of which (2,460 units) works on board of vessels of the rose shrimp fishing fleet. The average number of workers per vessel is 4 units, with an average maximum number of 7 workers in the port of Mazara del Vallo.

In several countries (i.e. Italy), the national collective labour agreement regulates the relations between fishery businesses, whatever the form of the company, and the crew. The agreement is entered into and renewed by the most important trade unions representing the ship-owners and the fishermen. In general the agreement provides for four fishery activities: local coastal fishing vessels, in-shore coastal fishing vessels, Mediterranean fishing vessels, overseas and ocean-going fishing vessels. The labour agreement is a long-term agreement, but an agreement for only one season or for a specific type of fishery can also be entered into.

In all sectors of the rose shrimp fishing fleet income is fully or mostly linked to the revenues of the vessel. The collective labour agreement may also provide for a minimum wage based upon specific tables. Then if the crew's share is lower than the minimum wage, it is increased up to the minimum legal wage. As to social security contributions, share fishermen and other wage workers comply with the national social security regulations. Social security contributions are usually paid by both ship-owners and crew; the shares to be paid by each of the two parties are set out by the regulation in force.

Usually the crew's share is near half of the total gross revenues of the vessel after deducting running expenses. Each crew member is given an equal share of the revenues, although in some cases skippers and mates may be given an additional share. The remainder half of the net earnings of the voyage is credited to the Owners Account.

In the period investigated the average price of the rose shrimp in all the investigated ports was round 20 € per kg. The producer price of other species was instead 5.8 € per kg. This high producer price is due to the high commercial value of the investigated resource and the sustained demand for this specie. The variability of the average price of the rose shrimp in the ports investigated is high, ranging from 28 € per kg, in the port of Almería to 11 € per kg in the port of Terrasini. This price variability is due to the

different quality of the harvest, the typology of the landed product (fresh or frozen), and the distribution channels.

Data for this project were collected over a short time period (one year). Thus they represent a snapshot of the fishery as it was during that time. All fisheries change with circumstances such as the technical development of fleets and the state of the exploitable resources. One sample at one time gives little information for the long term guidance of fishery management. We should take into account, however, that Mediterranean slope fisheries are multispecific, and that in this context they are quite stable. Is has been only during the last 6-8 years that the rapid development of new technologies have increase in fishing catchability. These circumstances, however, have not affected the general features of the fishery, including the depth range exploited.

RECOMMENDATIONS

Along the development of this project on the Mediterranean deep-sea shrimp fishery we faced a general major problem: the difficulty to collect reliable data to characterise the targeted parameters. These referred to a vast array of concepts necessary to deal with the main features of the fishery, and ranged from the amount of catches to the power of the engines or the actual value of landings. Interviews and personal observations made during the time span of the project (not included in this report) led to consider biases in the official records of landings being higher than 70% in certain seasons and regions, thus strongly underestimating actual figures. In this same context, official records for the power of the engines have proved to be completely skewed, what points to the need to adopt alternative parameters to describe fishing power. In view of these considerations, we recommend making the emphasis on the following points in order to improve the management of this fishery:

1) Improving the collecting of reliable statistical data through the enforcement and amelioration of existing regulations. The adoption of supplementary monitoring measures such as the regular estimation of landings, the development of new methods to reliably measure the actual power of the engines, etc .

2) Redesigning the fleet in order to reduce its size and, at the same time, improving the efficacy of the remaining vessels in order to increase their economic fitness.

3) Making a very cautious use of data originating from official statistics, especially concerning assessment-related purposes

4) Encourage new studies on the dynamics of this resource and that of the associated fishery, with the end of achieving its better management and sustainable use. Whilst in the North Mediterranean EC countries fishing grounds are fully exploited, shrimp stocks have been harvested less intensively in the South. These and other social and economic considerations make deep-sea shrimps a strategic resource potentially enhancing a regional North-South integration concerning research and management policies.

Area of deep-sea shrimps exploitation

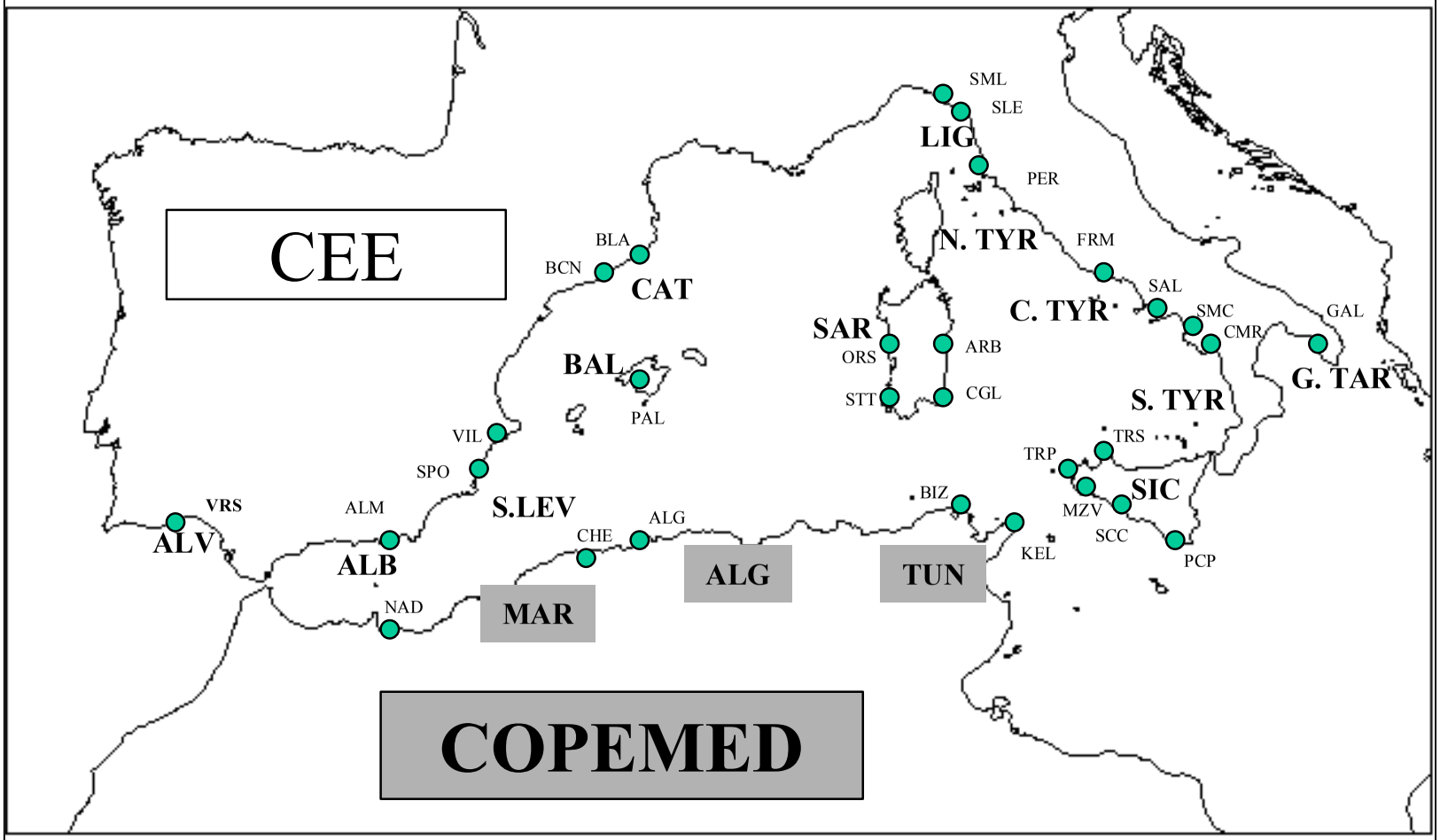


Figure 1

TABLE I
ECONOMIC ANALYSIS
LIST OF SELECTED PORTS IN THE AREA OF RESEARCH

COUNTRY CODE	REGION	PORT	PORT CODE	ADMINISTRATIVE REGION	REGION CODE NUMBERS*
PO	Algarvian	Vila Real de Santo Antonio	VRS	Algarve	26
SP	N. Alboran	Almeria	ALM	Andalucía	16
SP	S. Levant	Santa Pola	SPO	País Valencià	19
SP	S. Levant	Vila Joiosa	VIL	País Valencià	19
SP	Catalonian	Barcelona	BCN	Catalunya	17
SP	Catalonian	Blanes	BLA	Catalunya	17
SP	Balearic	Palma	PAL	Illes Balears	20
IT	Ligurian	Santa Margherita Ligure	SML	Liguria	07
IT	Ligurian	Sestri Levante	SLE	Liguria	07
IT	N. Tyrrhenian	Porto Ercole	PER	Toscana	13
IT	C. Tyrrhenian	Formia	FRM	Lazio	06
IT	S. Tyrrhenian	Salerno	SAL	Campania	03
IT	S. Tyrrhenian	S. Maria di Castellabate	SMC	Campania	03
IT	S. Tyrrhenian	Marina di Camerota	CMR	Campania	03
IT	N. Sicilian	Terrasini	TRS	Sicilia	12
IT	N. Sicilian	Trapani	TRP	Sicilia	12
IT	Sardinian	Oristano	ORS	Sardegna	11
IT	Sardinian	Sant'Antioco	STT	Sardegna	11
IT	Sardinian	Cagliari	CGL	Sardegna	11
IT	Sardinian	Arbatax	ARB	Sardegna	11
IT	G. Taranto	Gallipoli	GAL	Puglia	10
IT	S. Sicilian	Mazara del Vallo	MZV	Sicilia	12
IT	S. Sicilian	Portopalo di Capopassero	PCP	Sicilia	12
IT	S. Sicilian	Sciacca	SCC	Sicilia	12
TU	Tunisian	Bizerte	BIZ	Tunisie Nord	38
TU	Tunisian	Kelibia	KEL	Tunisie Nord	38
AL	Algerian	Algiers	ALG	Centre	31
AL	Algerian	Cherchell	CHE	Centre	31
MO	Moroccan	Nador	NAD	Eastern Mediterranean	35

*code numbers are related to those of figure 1

TABLE II GENERAL INFORMATION BY REGION																
Region	**Alv.**	**Alb.**	**S.L.**	**Cat.**	**Bal.**	**Lig.**	**N. T.**	**C. T.**	**S. T.**	**N.Si.**	**Sar.**	**Tar**	**S. Si.**	**Tun.**	**Alg.**	**Mar.**
Max. Bethymetic distribution catches	650	800	800	980	800	800	800	700	800	800	800	720	800	¿?	500	400
Specific shrimpers	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N
Is *Aa* a target species	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N
Usual and abundant	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N
Is *Af.* a target species	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N
Usual and abundant	N	N	N	N	N	Y	N	Y	Y	Y	Y		Y	N	N	N
Shrimp fishing grounds	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	N	N	Y	N
Fishing grounds exploited by different fleets	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N
Max. effective work (h)	18	12-72	12	12	13	11	11	11-72	11	8-96	14	14	8-96	48-72	18	N
Effort is know exactly	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
…and means controllers?	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N
Catches are know exactly	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N
…and means controllers	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N
Sold in different ports	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Official landings reliables	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N
Logbooks acceptable	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N

TABLE III - DEEP-WATER SHRIMPS FLEET
SELECTED PARAMETERS OF THE EFFECTIVE FLEET

	N. vessels	kW	GRT	LENGTH
		EU ports		
Total	464	113742	31282	9849
Mean		245.13	67.42	21.23
C.V.		0.512	0.583	0.202
		North Africa ports		
Total	84	19424	5196	1710
Mean		231.24	61.85	20.36
C.V.		0.397	0.349	0.126
		Total area of study		
Total	548	133167	36478	11560
Mean		243.00	66.57	21.09
C.V.		0.489	0.536	0.187

FIG. 2 CPUE BY SPECIES

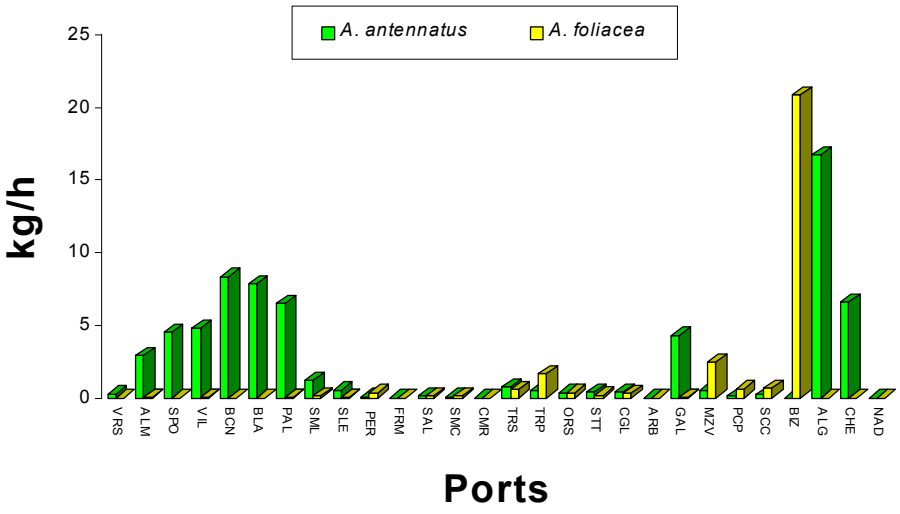


FIG. 3 CPUE BY SPECIES

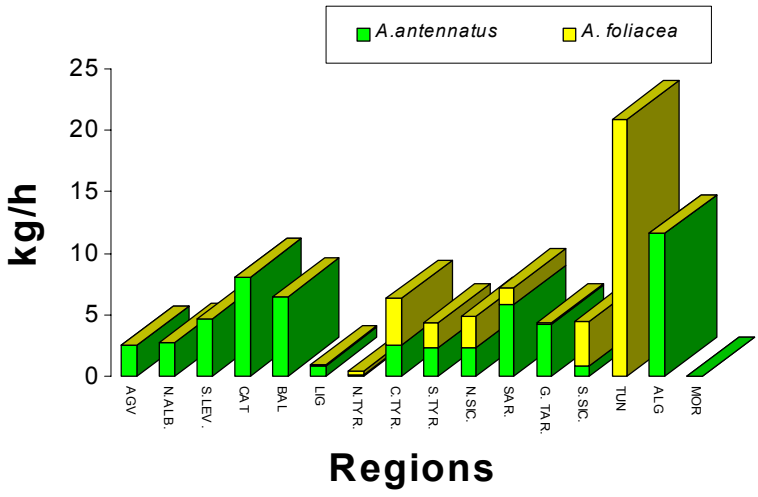


FIG. 4 CPUE

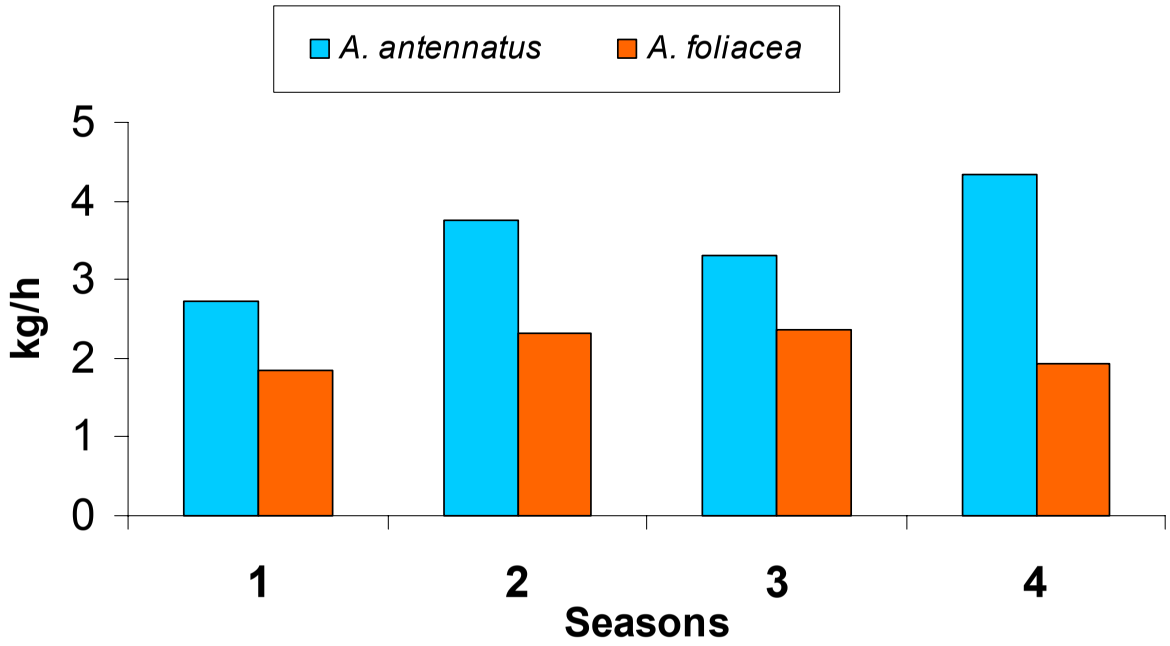


FIG. 5 CPUE *A. antennatus*

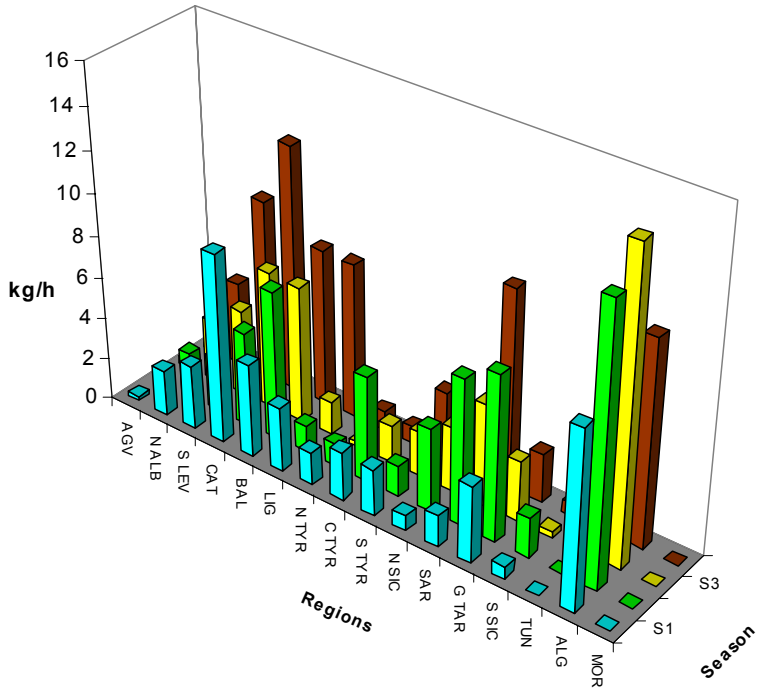
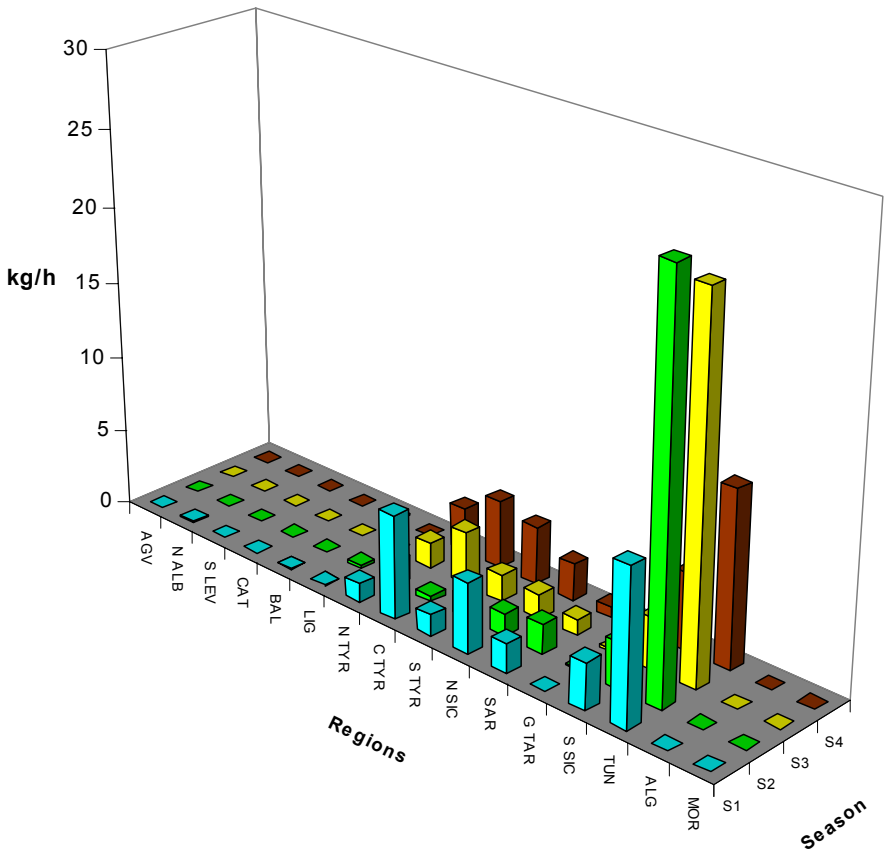


FIG. 6 CPUE *A. foliacea*



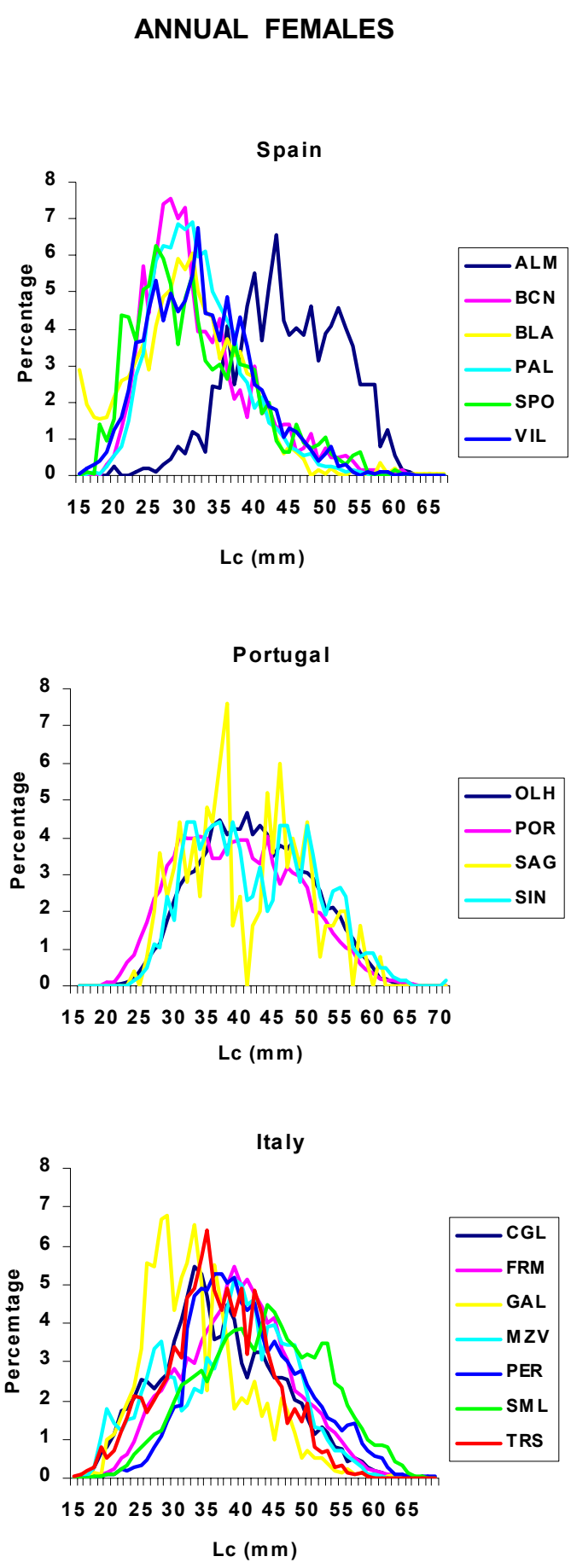


Figure 7. Annual size distribution of *A. Antennatus* females for each port an each area.

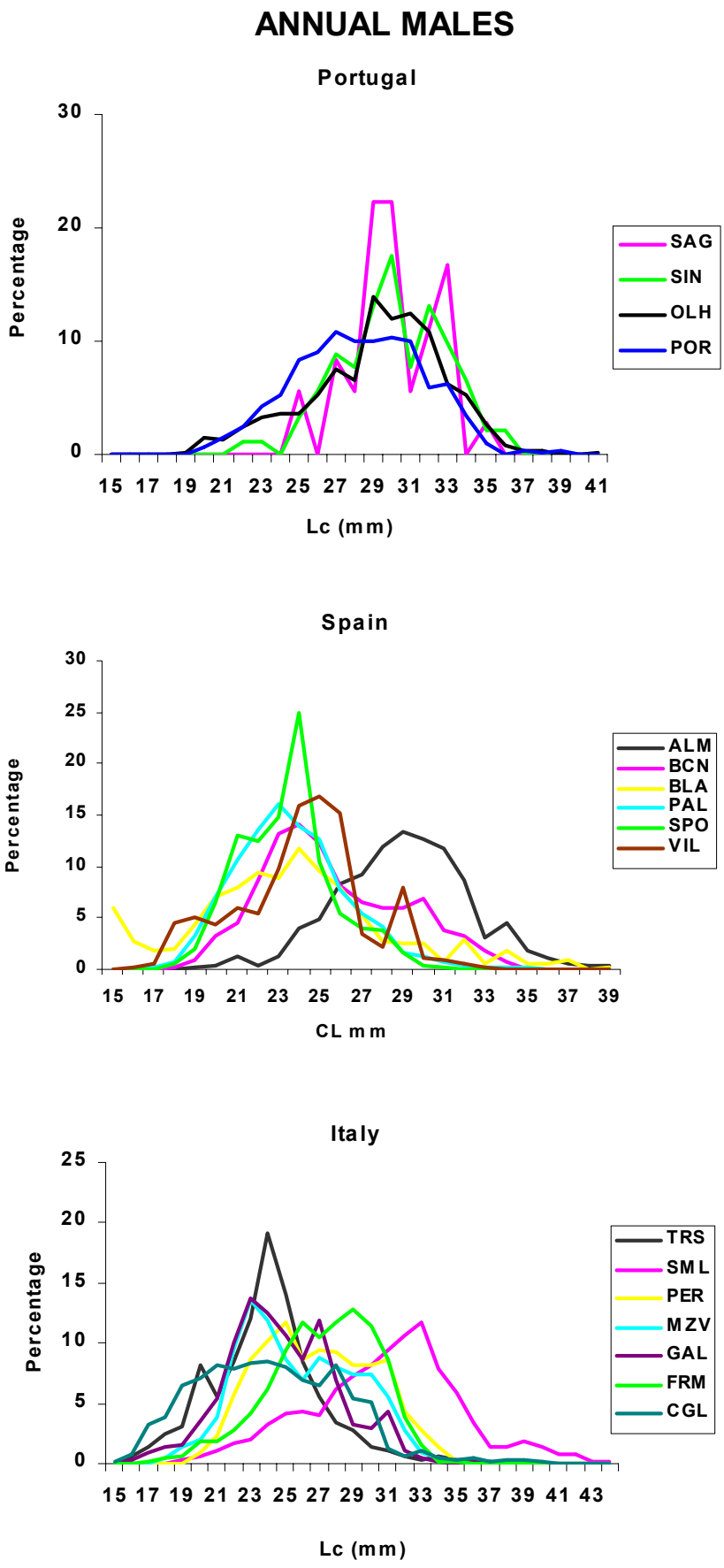


Figure 8. Annual size distribution of *A. Antennatus* males for each port an each area.

TABLE IV
ECONOMIC AND TECHNICAL EFFICIENCY OF THE DEEP-WATER SHRIMPS FISHING FLEET
AVERAGE VALUES PER SELECTED PARAMETERS
000 EURO period 11/98-10/99

Selected parameters	revenues	operative costs + vessel costs	labour costs	gross cash flow
N.RO	198.86	71.86	11.60	115.40
GRT	2.88	0.59	0.17	1.67
KW	0.75	0.15	0.04	0.43
LENGTH	9.10	1.85	0.53	5.28
DAY	1.00	0.20	0.06	0.58

TABLE V
FLEET, ECONOMIC AND CAPACITY
INDICATORS OF THE SELECTED PORTS BY COUNTRY
000 EURO period: 11/98-10/99

	Italian selected ports	Spanish selected ports	Portuguese selected ports	Total selected ports
Costs and earnings (EURO) - AVERAGE VALUE PER VESSEL				
Value of landings	112.9	247.0	498.8	198.9
Fuel costs	17.2	25.1	56.9	31.4
Other running costs	16.2	27.1	68.6	29.3
Vessel costs	4.6	12.1	19.0	11.2
Crew share	9.2	9.4	12.4	11.6
Gross cash flow	65.7	173.3	341.9	115.4
Gross value added	74.9	182.7	354.3	127.0
Capacity indicators - ports of the study area - TOTAL VALUES				
Fleet - number of ves	332	143	16	464
Fleet - total GRT	23363.3	8071.9	1423.0	31282.0
Fleet - total kW	80307.8	32985.1	5338.2	113742.0

TABLE VI

ECONOMIC ACCOUNT OF THE DEEP-WATER SHRIMPS FISHING FLEET

Values of landings (VAL), costs (COSTOT), gross cash flow (GCF) and gross value added (GVA) PER VESSEL

000 EURO period: 11/98-10/99

Country Code	Region	Ports	Code ports	VAL	OPCOS	VESCOS	LABCOS	COSTOT	GCF	GVA
PO	Algarvian	Vila Real de Santo Antoni	VRS	498.80	125.50	18.95	12.40	156.86	341.95	354.35
SP	N. Alboran	Almeria	ALM	564.66	38.90	10.44	6.22	55.56	509.10	515.32
SP	S. Levant	Santa Pola	SPO	196.63	18.26	8.34	5.72	32.33	164.30	170.02
SP	S. Levant	Vila Joiosa	VIL	180.72	17.81	5.47	3.95	27.22	153.50	157.44
SP	Catalonian	Barcelona	BCN	168.54	86.46	13.94	13.24	113.64	54.90	68.14
SP	Catalonian	Blanes	BLA	193.40	95.52	16.77	13.25	125.53	67.87	81.12
SP	Balearic	Palma	PAL	177.81	56.06	17.87	13.74	87.67	90.14	103.87
IT	Ligurian	Santa Margherita Ligure	SML	67.43	20.65	19.26	8.26	48.17	19.26	27.52
IT	Ligurian	Sestri Levante	SLE	79.57	11.51	3.96	10.38	25.85	53.72	64.10
IT	N. Tyrrhenian	Porto Ercole	PER	173.34	13.76	2.09	19.63	35.47	137.87	157.49
IT	C. Tyrrhenian	Formia	FRM	45.32	14.58	1.52	3.10	19.20	26.12	29.22
IT	S. Tyrrhenian	Salerno	SAL	157.32	53.10	1.53	6.20	60.83	96.49	102.69
IT	S. Tyrrhenian	S. Maria di Castellabate	SMC	162.11	51.48	2.53	5.58	59.59	102.51	108.09
IT	S. Tyrrhenian	Marina di Camerota	CMR	101.04	31.33	1.04	2.48	34.85	66.19	68.67
IT	N. Sicilian	Terrasini	TRS	76.91	8.40	0.67	10.33	19.40	57.51	67.84
IT	N. Sicilian	Trapani	TRP	100.90	20.77	2.56	12.33	35.65	65.25	77.57
IT	Sardinian	Oristano	ORS	149.07	49.62	5.58	7.44	62.64	86.43	93.87
IT	Sardinian	Sant'Antioco	STT	132.83	53.59	6.28	8.26	68.13	64.70	72.97
IT	Sardinian	Cagliari	CGL	156.78	58.11	6.15	7.85	72.11	84.67	92.52
IT	Sardinian	Arbatax	ARB	89.16	24.65	1.46	3.64	29.74	59.42	63.05
IT	G. Taranto	Gallipoli	GAL	34.79	9.02	1.01	1.95	11.98	22.81	24.76
IT	S. Sicilian	Mazara del Vallo	MZV	439.87	153.57	26.76	23.29	203.62	236.25	259.54
IT	S. Sicilian	Portopalo di Capopassero	PCP	115.80	70.27	2.87	16.41	89.55	26.25	42.66
IT	S. Sicilian	Sciacca	SCC	120.49	38.75	8.98	9.26	56.99	63.50	72.76
		Total area of study		**198.86**	**60.69**	**11.17**	**11.60**	**83.46**	**115.40**	**127.00**

TABLE VII
ECONOMIC ACCOUNT OF THE DEEP-WATER SHRIMPS FISHING FLEET
SELECTED EFFICIENCY PARAMETERS
000 EURO period: 11/98-10/99

Country Code	Region	Ports	Code ports	VALDAY=RPUE	COSTOTDAY	GVADAY	GCFDAY
PO	Algarvian	Vila Real de Santo Antonio	VRS	1.77	0.56	1.26	1.21
SP	N. Alboran	Almeria	ALM	2.02	0.20	1.84	1.82
SP	S. Levant	Santa Pola	SPO	0.99	0.16	0.86	0.83
SP	S. Levant	Vila Joiosa	VIL	1.17	0.18	1.02	0.99
SP	Catalonian	Barcelona	BCN	0.68	0.46	0.27	0.22
SP	Catalonian	Blanes	BLA	0.78	0.50	0.33	0.27
SP	Balearic	Palma	PAL	0.84	0.41	0.49	0.43
IT	Ligurian	Santa Margherita Ligure	SML	0.45	0.32	0.18	0.13
IT	Ligurian	Sestri Levante	SLE	0.53	0.17	0.42	0.36
IT	N. Tyrrhenian	Porto Ercole	PER	0.92	0.19	0.84	0.74
IT	C. Tyrrhenian	Formia	FRM	0.22	0.09	0.14	0.13
IT	S. Tyrrhenian	Salerno	SAL	0.77	0.30	0.50	0.47
IT	S. Tyrrhenian	S. Maria di Castellabate	SMC	0.79	0.29	0.53	0.50
IT	S. Tyrrhenian	Marina di Camerota	CMR	0.50	0.17	0.34	0.32
IT	N. Sicilian	Terrasini	TRS	0.54	0.14	0.48	0.40
IT	N. Sicilian	Trapani	TRP	0.89	0.31	0.68	0.57
IT	Sardinian	Oristano	ORS	0.93	0.39	0.59	0.54
IT	Sardinian	Sant'Antioco	STT	0.81	0.42	0.45	0.40
IT	Sardinian	Cagliari	CGL	0.97	0.45	0.57	0.53
IT	Sardinian	Arbatax	ARB	0.59	0.20	0.41	0.39
IT	G. Taranto	Gallipoli	GAL	0.25	0.09	0.18	0.16
IT	S. Sicilian	Mazara del Vallo	MZV	2.00	0.93	1.18	1.07
IT	S. Sicilian	Portopalo di Capopassero	PCP	0.65	0.50	0.24	0.15
IT	S. Sicilian	Sciacca	SCC	0.67	0.31	0.40	0.35
		Total area of study		**1.01**	**0.42**	**0.64**	**0.58**

Legenda:
VALDAY=value of landings per total days of activity
COSTOTDAY=total costs per total days of activity
GVADAY=gross value added per total days of activity
GCFDAY=gross cash flow per total days of activityt

TABLE VIII

LANDING PRICES OF THE DEEP-WATER SHRIMP FISHING FLEET

Red shrimp (PMRS), other species (PMOS) and total (PMTOT)

values in EURO/kg period: 11/98-10/99

Country Code	Region	Ports	Code ports	PMRS	PMOS	PMTOT
PO	Algarvian	Vila Real de Santo Antonio	VRS	17.61	7.52	8.71
SP	N. Alboran	Almeria	ALM	27.70	5.25	12.70
SP	S. Levant	Santa Pola	SPO	23.62	4.80	11.34
SP	S. Levant	Vila Joiosa	VIL	19.68	4.90	10.07
SP	Catalonian	Barcelona	BCN	26.30	4.30	11.50
SP	Catalonian	Blanes	BLA	26.30	4.30	11.50
SP	Balearic	Palma	PAL	20.18	3.75	8.58
IT	Ligurian	Santa Margherita Ligure	SML	23.97	7.67	12.97
IT	Ligurian	Sestri Levante	SLE	20.65	9.31	10.95
IT	N. Tyrrhenian	Porto Ercole	PER	13.57	8.04	8.30
IT	C. Tyrrhenian	Formia	FRM	25.48	6.01	6.01
IT	S. Tyrrhenian	Salerno	SAL	17.00	5.64	6.32
IT	S. Tyrrhenian	S. Maria di Castellabate	SMC	16.99	5.57	6.19
IT	S. Tyrrhenian	Marina di Camerota	CMR	23.20	5.30	5.30
IT	N. Sicilian	Terrasini	TRS	10.96	7.36	8.00
IT	N. Sicilian	Trapani	TRP	11.97	6.60	7.13
IT	Sardinian	Oristano	ORS	22.40	9.07	11.43
IT	Sardinian	Sant'Antioco	STT	22.10	6.03	8.57
IT	Sardinian	Cagliari	CGL	21.65	7.82	9.70
IT	Sardinian	Arbatax	ARB	24.62	4.45	14.06
IT	G. Taranto	Gallipoli	GAL	20.32	4.20	9.70
IT	S. Sicilian	Mazara del Vallo	MZV	13.56	4.83	5.79
IT	S. Sicilian	Portopalo di Capopassero	PCP	11.41	3.54	4.08
IT	S. Sicilian	Sciacca	SCC	15.41	3.66	4.27
			Total area of study	**19.86**	**5.83**	**8.88**