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REPORT ON A CRUISE BY THE R.V. "G.O. SARS" TO THE AÇORES AND THE COAST OF PORTUGAL NOVEMBER/DECEMBER 1975

edited by

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INTRODUCTION

As part of an agreement between Portugal and Norway on co-operation in fisheries development, the Norwegian research vessel "G. O. Sars" from the Institute of Marine Research, Bergen operated in the bank areas southwest of Portu al, around the Açores and along the coast of Portugal in November-December 1975.

The programme was planned and carried out in co-operation with scientists from research institutes in Lisbon under Secretaria de Estado das Pescas, who also had consulted with fishing administration and active fishing skippers from the Açores.

The purpose of the cruise was to make an assessment of distribution and abundance of fish in the areas of particular importance for Portuguese fishing vessels, giving highest priority to a survey near the Açores and to obtain a general picture of the einvironment in relation to fish distribution.

Responsible for preparing parts of the report have been

Hydrography: R. Leinebø
Plankton: Kr. Fr. Wiborg
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NARRATIVE

"G. O. Sars" sailed from Bergen 1 November and arrived 8 November in Lisbon where the research staff from institutes under the Secretaria de Estado das Pescas in Portugal joined.

After departure from Lisbon 9 November, a survey was made on Gettysburg Bank, Ampère Bank and Josephine Bank. From Josephine Bank a direct course was set to the Açores where fishing banks and shelf areas were surveyed between 11 November and 1 December. During the cruise "G. O. Sars" called at the following ports in the Açores: Ponta Delgada 17-18 November, Horta 25 November and Angra do Heroismo 30 November where masterfishermen from the Açores joined the expedition.

"G. O. Sars" returned to Lisbon on 4 December. From 5-9 December an acoustic survey was made along the Portuguese coast after which "G. O. Sars" sailed directly to Bergen where she arrived 14 December.

The scientific and technicial staff participating in the cruise or part of it were:

Norway, Institute of Marine Research (Bergen):

B. Brynildsen, K. Hansen, L. Kalvenes, H. P. Knudsen, O. Knutsen, R. Leinebø (5 Nov. -6 Dec.), S. Myklevoll, K. Olsen (16 Nov. -14 Dec.), A. Romslo, K. F. Wiborg (5-16 Nov.), O. J. Østvedt (5 Nov.-6 Dec.).

Portugal, Secretaria de Estado das Pescas (Lisbon):

Maria Emilia Cunha, M. Lima Dias, M. Helia Diniz, Fernando Lima, L. Gomes Sintra, M. Sobral, Maria da Graça Vilarinho, G. Afonso dos Santos (5-9 Dec.).

Açores (Master fishermen):

A. Costa, J. Gil, M. André.

INSTRUMENTS AND METHODS

Hydrography

The hydrographic investigations were based on observations with Nansen reversing bottles and bathythermograph. The salinity of the water samples collected with the Nansen bottles will be determined with an inductive salinometer. Apart from a section near the Açores, the maximum depth for the Nansen bottle casts was 500 m. The bathythermograph was used to a depth of 250 m.

Hydrographic stations were also taken in connection with all fishing stations. In all 34 hydrographic stations and 37 bathythermograph stations were taken.

During the whole cruise particle density was recorded continuously at 5 m depth using a recording transparencymeter.

Zooplankton and fish larvae

The following gears were used:

1. Juday net, 36 cm diameter (0.1 m^2) mesh size 180 µ with closing mechanism (J 36).

2. Bongo net, 60 cm diameter, double net, mesh size 500 µ (B 60).

3. Otter surface sampler, 40 cm square opening, mesh size 263 µ (OSS 40).

4. Isaacs Kidd mesopelagic trawl, 3' opening (appr. 1.1 m^2) mesh size 3 mm square (IKMT 3').

The Bongo net (B 60) and Otter surface sampler (OSS 40) were equipped with Japanese TSK flow meters. The Juday net (J 36) was used in vertical hauls, most often from 200-50 m and 50 (70)-0 m. The Bongo net was hauled according to the description in the CINECA-programme: lowered with 300 m wire at a rate of 50 m per min. and retrieved with a wire angle of 45° at a rate of 20 m per min. while the ship moved at a speed of 1.5 to 2 knots. The water volume filtered varied between 350-800 m^3. The Otter surface sampler was towed at the surface for 10 minutes at a speed of 5 knots, covering a distance of about 1500 m equivalent to 600 m^2 of sea surface.

The Isaacs Kidd trawl (IKMT 3') was towed at 4 knots for 10-20 minutes in varying depths according to recordings on the echo sounder.

The volumes of the plankton samples from the J 36 and B 60 hauls were measured on board with a modified Usachev-Robertson apparatus. The samples were afterwards inspected cursorily under a Wild 5 stereoscopic microscope.

Medusae such as Pelagia perla and other large species were removed before volume measurements.

Fish eggs, larvae, young fish and Myctophid fish were sorted and determined if possible, and all material preserved with 5 % of formaldehyde.

Tar balls were separated from the OSS 40 samples and deep-frozen if present in any quantity, otherwise preserved together with the plankton samples.

Fish distribution and abundance investigations

The principal method applied throughout the cruise was the use of the hydroacoustic instrumentation onboard the ship, echo sounders and sonar, in combination with trial fishing for identification of echo traces. In addition exploratory bottom fishing was undertaken at several bank areas. Cruise tracks and positions of fishing stations are given on Figs 1, 2, 3, 4 and 5 and in Table 1.

For identification of echo traces pelagic trawls were normally used. When conditions for trawling were unfavourable, the traces were attempted identified by relating them to species known to occur in the area by the experience of local fishermen.

a) Hydroacoustic survey method

The hydroacoustic equipment onboard R.V. "G.O.Sars" consists of:

Survey sonar (SU - 18 kHz)
" (SK - 120 kHz)
Echo sounder (EK - 38 kHz)
" (EK - 50 kHz)
" (EK - 120 kHz)
" (EK - 12 kHz)
Three two-channel echo integrators (EQ II)
Netsonde (50 kHz)

During the survey the EK-38 kHz sounder was connected to the echo integrators and also to computersystem for logging of data. Integrated fish echo intensities can later be used for relative estimates of fish abundance in the area. The method is based on the following main principles (Midttun and Nakken, 1971):

Considering a distribution of a fish species within an area, the total amount of fish is found by an area integration, given by the expression

$$T = \int_A \rho_A \cdot dA \qquad (1)$$

where

ρ_A is the average fish density
A total area
T total amount of fish in the area

It can be demonstrated that the output of an echo integrator is proportional to fish density, when the echo sounder used has a certain depth compensation of the received echoes.

When one species alone is considered, we can write

$$\rho_A = CM \qquad (2)$$

where M is the integrator deflection and C is a factor determined by the acoustic properties of the fish under investigation.

Combining the equations (1) and (2) gives:

$$T = \int_A \rho_A \cdot dA = C \int_A M \cdot dA$$

$\int_A M \cdot dA$ is a relative measure of the amount of fish within the area A. Absolute estimates are obtainable if the equipment is properly calibrated and the average target strength is known, either by direct measurements at sea or through controlled experiments.

When several species of fish of various size groups are present, the estimation of the absolute fish abundance becomes considerably more complicated, but is in principle always possible with sufficient knowledge of the target strength distribution of the fish.

As a routine programme the three echo integrators were connected to the EK-38 kHz sounder. The six channels were set to integrate in 50 m depth intervals in two integrators and 100 m and 200 m intervals in the third data recorder for each nautical mile and an average over five nautical miles plotted.

The echo sounder recordings were analysed every day and corrected for false echoes. Whenever possible the corrected echo intensity was separated into plankton and fish and plotted on separate charts.

"G. O. Sars" is equipped with satellite navigation system and generally the positions were fixed every third hour.

b) Exploratory fishing

The exploratory fishing and fishing for identification of echo traces were done by trawling, long-lining, deep-sea trap fishing and fishing with handline. Positions of fishing stations are given on Figs 1-5 and in Table 1.

A 100 feet groundrope "Granton"-trawl was available for bottom trawling. For pelagic trawling a 1400 meshes "Engel"-trawl and a 15 fathoms semipelagic trawl ("Bas"-trawl, Norwegian construction) were used. All trawls were equipped with small meshed sampling nets inside the codend.

The long-lines were of common Norwegian type used for dogfish fishing. In each setting was used 3200 hooks baited with mackerel.

The traps were of a newly developed construction. Fig. 6 shows a sketch of the construction (Valdemarsen, 1975). In each setting a number of traps were linked together by rope and set like a long-line. Usually a setting consisted of 16 traps, each separated by a distance of 50 m.

On a few occasions handline fishing was applied mainly for identification of echo traces. Also handlining for squids was tried, both with and without light, but with no results.

RESULTS

Hydrography

The hydrographic conditions found in the area confirm what was known in general from previous investigations published both in scientific journals and in various atlas.

There is a sharp thermocline between 50 and 100 m deep both on the banks off the Portuguese coast (Gettysburg Bank, Ampère Bank, Josephine Bank) and in the region around the Açores. The surface temperature was generally between 18 and 20°C. Surface temperatures higher than 20°C were observed only in the southernmost part of the region of the cruise (Ampère Bank). There was a fairly small variation in the depth of the thermocline from station to station, so it is a reasonable assumption that internal waves were not particularly prominent. Echo sounder observations of plankton concentrations also contained no evidence of internal waves.

Fig. 7 shows a section along the meridian 19°W. The bottom is quite irregular, a feature which is typical for the whole area since, as is well-known, the Açores are of volcanic origin and lie on the Mid-Atlantic Ridge. These topographical conditions are of great importance for the local circulation, and indicate the presence of local upwelling. The hydrographic investigations were, however, not designed to undertake proper studies of these phenomena.

Zooplankton

In all the vertical hauls with Juday net the sampled volumes of zooplankton were generally small. The data are listed in Table 2. Per m^2 of sea surface, the volumes at the 40 stations were distributed as follows:

ml per m^2	5-10	11-20	21-30
No. of st.	7	29	4

The plankton consisted mostly of small copepods and siphonophores. A detailed analysis will be carried out later.

All the oblique hauls with Bongo 60 were taken in the area around the Açores. The plankton consisted of larger copepods, euphausiids, siphonophores and salps. Data are listed in Table 3.

In the 19 hauls the average volumes of the two nets were as follows:

ml per 1000 m^3	6-9	10-15	16-30	66
No. of st.	6	8	4	1

Fish eggs, larvae, young fish and lantern fish

The number of eggs and larvae of fish, young fish and lantern fish are recorded in Table 4. The eggs have not yet been identified. In the vertical hauls with Juday net eggs were taken singly at five stations. In the surface samples with the Otter sampler, 124 eggs

were taken on the Josephine Bank, 30 NW off San Miguel, 26 and 15 respectively SW of Terceira, in other areas very few or none at all. In the Bongo net fish eggs were taken rather regularly in the area around the Açores, maximum 92 numbers in one haul on the Açores Bank, in other areas 2-53 eggs per haul. The eggs have not yet been identified.

Fish larvae were taken regularly in the surface hauls with Otter sampler, 1-16 per haul. Most of them were identified as Scombresox saurus. In the B 60 hauls very few fish larvae were taken, and only singly.

Seven Maurolicus muelleri were taken in an IKMT 3' haul 100-0 m on the Josephine Bank. Myctophids, probably Hygophum sp., were taken at night with the OSS in numbers of 1-4 per haul in most of the areas.

Tar balls

The Otter surface sampler was not used until station P10 on the Ampère Bank. Later it was used regularly on 46 plankton stations. Tar balls were present at practically all stations, but in varying amounts. Small amounts were preserved together with the plankton samples, but in some samples the tar balls were so large that they could easily be separated and deep-frozen for eventual chemical analysis. All tar balls were later separated from the samples and weighed. The results are given in Table 5. The highest figures (35.8 - 38.8 mg per m^2) recorded between the Gettysburg Bank and the Josephine Bank agree very well with those found by Erhardt and Derenbach (1975) in the same area in January-February 1975 (23.9 - 48 mg per m^2).

Acoustic survey

Figs 8-13 show the distribution of fish and plankton densitites along the course line based on integrated echo intensity. Four different density categories are used as indicated on the charts. Fig. 14 and Fig. 15 show the average integration values in 10 x 10 n. miles squares off the Portuguese coast where the course grid were sufficiently narrow for such a presentation.

Both pelagic and semipelagic concentrations of fish are included in the charts. The bottom living species are only occasionally recorded and the fish charts will not be representative for these species. It should also be noted that Myctophids usually recorded in midwater at daytime and in upper layers at night, often are extremely difficult to separate from plankton and therefore mainly have been referred to as plankton instead of fish.

a) Banks and the Açores

Plankton distribution

The distribution of plankton according to the acoustic survey are shown in Figs. 8-10.

The plankton concentrations were generally low. Only a few small areas with higher values were observed. These relatively dense concentrations may partly be due to Myctophids and other small mesopelagic fishes which at night ascended to surface layers from depths even below 500 m, i.e. maximum depth used for integration. No attempts have so far been made to separate the recordings in day and night observations.

2) Fish distribution

The main concentrations of fish in the Acores area (Fig. 12 and Fig. 13) and in the Bank area (Fig. 11) are typically found very close to the narrow shelf of the islands and close to the edges of the banks.

The highest abundance was recorded on Josephine and Ampère Bank, in Açores waters east and west of S. Miguel Island, around the Graçiosa Island and the Princess Alice Bank area southwest of Pico Island.

Except for Myctophids, hardly any recordings of fish were made above deep water. Surface schools were only occasionally seen and then only in coastal areas. Typical vertical migration between day and night were not observed.

The most abundant fish species found in the Acores area was Boar fish (Capros aper, ca 9 cm). Especially good concentrations of this fish were found at the southwestern shelf of the Graçiosa Island and the Terceira Island. Also near these islands some dense schools of Horsemackerel (Trachurus trachurus) were observed. At the Princess Alice Bank some concentrations of chumb (Spanish mackerel, Scomber colias) were observed.

b) Coast of Portugal

1) Plankton

The distribution of plankton along the coast of Portugal is shown on Fig. 14 by squares.

The values were generally low near the coast in shallo waters. In this area the values are probably more representative for plankton since also mesopelagic fish were included in the relative higher values obtained off the shelf.

2) Fish distribution

The highest integrator values of fish were observed in the region 20-30 miles off the coast southwest of the City of Figueira da Foz. Relative good recordings were also made northwest of Lisbon off the coast of Sines and off Porto (Fig. 15).

The most abundant species was trumpet fish (Macroramphosus sp.) (Tab. 6). Good concentrations of this species were found especially in the shallow part of the Bay of Setubal. In the shelf area out of Nazaré some concentrations of Rays bream (Brama raji) were recorded and at the coast of Porto some good surface schools of pilchard (Sardina pilchardus) were observed.

More detailed information about the species caught at the various trawling and handline fishing stations for identification of echo traces can be read from Table 6.

Exploratory fishing

a) Trawling

Trawling was mainly carried out for identification of echo recordings, and the result has therefore only limited value for assessing the fish potentital available for trawl. In the area covered by the present survey, except along the coast of Portugal, the bottom was too rocky for fishing with bottom trawl. Only one haul with bottom trawl was tried on the Josephine Bank, but with poor results and severe difficulties in getting loose the trawl doors.

Also pelagic trawling was often difficult since the fish mainly was distributed along steep shelves or above shallow rocky bottoms.

The result of the trawlings is shown in Table 6 and the position of the trawl stations depicted on the respective figures (1-5). As is seen in Table 6 most of the trawl-hauls gave only few fish of various species. Capros aper and Lepidopus caudalus were the only species caught in relative large numbers.

Trawling on midwater registrations supposed to be Myctophids or squid were tried west of Formigas bank at depth down to 450-500 m. The catch consisted of a variety of deep water species of lantern fish and only one squid.

b) Long-line catches

In Table 7 is presented the catch compositions obtained in the different settings (6 totally). Although there is some variations between the various fishing stations, a limited number of species dominated in the catches. Sharks, mainly tope, (Galeorhinus galeus) and skates were always caught in great number. Species of commercial interest commonly caught were red bream (Pagellus centrodontus), common sea bream (Pagrus pagrus), rock fish (Helicolenus dactylopterus), forkbeard (Phycis phycis) and conger eel (Conger conger).

In some of the settings there seem to be clear indications of a correlation between the species caught and the bottom conditions. On smooth bottom skates and sharks often dominated the catch while on more rough (rocky) bottom catches of other species increased. An example of such changing bottom conditions with an observed corresponding change in catch is illustrated in Fig. 16, which shows the bottom contour at one line setting (line station No. 5) where the line crosses a rough ridge on the bottom.

The number of fish caught in the different part of each setting also varied considerably. The amount of fish caught were thus observed to vary between zero and up to 150-200 kg per line unit (400 hooks). This indicates a distribution of the fish in rather local concentrations.

Fish hooks on the line were often seen having been attacked and seriously damaged by sharks. This occured even if the line had been fishing only for two hours and became an increasing plague if the line fished for more than a few hours.

c) Trap fishing

In Table 8 is presented the catch composition obtained in the different settings (7 totally). The main species caught was conger eel (Conger conger). Catches up to 150 kg per single trap were obtained. The total catch figures given, especially in trapsetting R 4, are not really representative for the fish caught as large catches on several occations resulted in breakage of the locking system of the trap. When lifted out of the water, the trap then was emptied.

The amount of catch varies considerably even withing approximately the same fishing area. The two settings R 4 and R 5, at depths of 200 m and 400 m respectively, indicate that depth might be an important factor to such variation.

The shape of the tunnel in the trap was modified (made more open) in 8 of the traps from setting No. 5. There seem to be indications that this made the traps catch more of the Perciformes fish species, but the small number of settings do not allow a statistical test.

DISCUSSION AND CONCLUSION

Direct fish stock assessment by use of echo integration have certain limitations and several conditions must be fullfilled in order to obtain useful results. The necessity of detailed information on echo target strength of the fish has already been mentioned. Other factors of importance are the distribution of the fish in relation to bottom conditions and the abundance of fish in the surveyed area in relation to the total fish population.

Species identification and size group determination of the fish recorded, may be used for absolute estimates of the amount of fish present, if the relative estimate based on the integrated echo intensities is reliable. This estimate is depending on instrument calibration and to some extent on environmental factors. Unfavourable conditions, sharp shelf edges and rough bottom, se example in Fig. 16, give false echoes and the automatic discrimination between fish echo and bottom echo and the more subjective corrections which then must be applied, may have some influence on the precision of the estimate.

Several fish species show great seasonal variation in distribution and the estimated fish abundance obtained during a short survey period may therefore not be representative for the total fish population normally inhabiting the area. Information on seasonal variation of the fish species is therefore required. Such information refers mainly to oceanic species, e.g. tuna which undertake long distance

migrations. Fishing for tuna near the Açores usually take place from May to November. Such species were absent during the present survey. Also other species that at the time of the year of the present survey may be distributed in deep waters below the normal recording depth of the echo sounders (i.e.500 m) would reduce the precision of the estimate.

During this investigation very few fish concentrations were found in the oceanic area while fish were more abundant in the shelf and bank areas. A relatively good stock assessment for these concentrations should be possible using the echo integration values, provided data on target strength of the most common fish species can be obtained later.

The trial fishing carried out for species identification, especially the pelagic trawling, were often hampered by the topography of the bottom. Abrupt and large variations in depth, sharp and steep shelf-edges with the fish generally distributed in close contact to the bottom, made trawling difficult and sometimes even impossible. In addition, easily scared and fast swimming scombroid fish, which only can be caught by pelagic trawls if "squeezed" towards the bottom, were common and made the sampling difficult. An illustration of such a fishing situation is shown in Fig. 17 where the fish concentration recorded by the ship's echo sounder above the bottom (Fig. A) is seen escaping under the passing trawl (Fig. B).

The exploratory fishing with long-line and deep-sea traps gave valuable information about the fish fauna, but the catch rate should only be regarded as indicative. Both fishing methods suffered from poor knowledge of fishing conditions in the areas. The rapidly changing bottom conditions made it difficult to find suitable fishing places for long-lines and traps. Also, on several occasions the banks were difficult to locate, because of uncorrect positions on the maps. In order to find grounds with good fishing more experimental fishing is highly needed.

The trap catches of conger eel in the southern part of the Açores Bank may indicate a fishing method of potentital commercial interest. It is believed that a further development of the technique could lead to a commercial fishery for this species.

On the basis of the obtained results on fish distribution and abundance in the investigated areas, the following conclusions can be drawn:

a) In order to obtain the necessary knowledge for a reliable estimate of the fish resources in the investigated area more surveys are needed at other seasons of the year, and information on seasonal migration of different species is required.

b) The main fish concentrations were found to be closely related to the bottom topography of the bank and shelf areas. Commercial exploitation of the resources will need fishing vessels equipped with good navigation instruments and echo sounders.

c) A number of the bank areas surveyed were found to have uncorrect positions on the maps and their position need to be updated.

d) Among the different fishing methods applied during the survey, long-lining and trap fishing seem to have the better prospect for a commercial development. Bottom trawling is generally very difficult or impossible in the bank and the Açores regions. Pelagic trawling is also difficult, mainly due to the fish distribution at least during the investigated period. The concentrations of schooling pelagic fish may give hopes for purse seine fishing, but most probably at other seasons.

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Table 1. List of stations.

Station number	Date	Hour start GMT	Position North West	Nansen bottles	Bathythermograph	Pelagic trawl	Bottom trawl	Isaacs-Kidd 3'	Long-line	Traps	Juday 180/36	Bongo 60	Otter surface sampler
1176, P 1	10/11	0040	36°57' 11°00'	X	X						X		
1177, P 2	10/11	0445	36°30' 10°48'	X	X						X		
P 3	10/11	0830	36°40' 11°08'					X			X		
1178, P 4	10/11	1035	36°48' 11°17'	X	X						X	X	
L 1	10/11	1730	36°31' 11°30'						X				
R 1	10/11	1855	36°31' 11°30'							X			
P 5	10/11	1940	36°31' 11°34'					X					
1179, P 6	10/11	2255	36°40' 11°39'	X							X		
R 1	11/11	0730	hauling										
L 1	11/11	1015	hauling										
1180, P 7	11/11	1505	36°14' 11°24'	X							X		
T 327	11/11	2100	36°31' 11°39'			X							
1181, P 8	12/11	0025	36°27' 12°02'	X							X		
1182, P 9	12/11	0425	36°00' 11°50'	X							X		
P10	12/11	0730	35°43' 11°48'										X
P11	12/11	0930	35°22' 11°48'										X
1183, P12	12/11	1220	34°50' 11°50'	X	X						X		X
1184, P13	13/11	1620	35°12' 12°07'		X						X		X
1185, P14	12/11	2015	35°05' 12°45'	X				X			X		X
1186, P15	13/11	0235	35°05' 13°33'	X							X		X
1187, P16	13/11	0655	35°35' 13°45'		X								X
1188, P17	13/11	1020	36°10' 13°55'		X								X
1189, P18	13/11	1335	36°42' 14°10'		X								X
T 328	13/11	1615	36°40' 14°15'				X						
P19	13/11	2130	36°45' 14°16'					X					
1190, P20	14/11	0050	36°45' 14°46'	X							X		X
1191, P21	14/11	0722	36°45' 16°04'										X
T 329	14/11	1415	36°47' 17°17'			X							
1192, P22	14/11	1540	36°47' 17°17'		X								X
1193, P23	14/11	2110	36°47' 18°35'										X
1194, P24	15/11	0155	36°50' 19°48'										X
1195, P25	15/11	0655	36°50' 21°02'										X
1196, P26	15/11	1155	36°52' 22°18'										X
1197, P27	15/11	1725	36°55' 23°34'		X								X
1198, P28	15/11	2245	36°55' 24°50'		X								X
1199, P29	16/11	0030	36°47' 25°02'		X						X		X
1200, P30	16/11	0420	37°05' 25°03'		X								X
1201, P31	16/11	0900	37°30' 24°36'	X							X	X	X
1202, P32	16/11	1145	37°30' 24°50'	X							X	X	X
1203, P33	16/11	1455	37°17' 25°03'	X							X	X	X
1204, P34	16/11	1755	37°30' 25°03'	X							X	X	X
1205, P35	16/11	2110	37°40' 24°53'		X								X
1206, P36	16/11	2335	37°55' 24°36'		X								X
1207, P37	17/11	0310	37°46' 25°03'	X							X	X	X
1208, P38	17/11	0705	37°30' 25°20'	X							X	X	X
R 2	17/11	1240	37°44' 25°48'							X			
R 2	18/11	1630	hauling										
T 330	19/11	0015	37°50' 25°07'			X							
T 331	19/11	1025	37°44' 25°46'			X							
1209, P39	19/11	1405	37°30' 25°52'	X							X	X	X
L 2	19/11	2300	37°16' 25°41'						X				
R 3	19/11	2340	37°17' 25°41'							X			
1210, P40	20/11	0230	37°30' 25°36'	X	X						X	X	X
L 2	20/11	1650	hauling										
R 3	20/11	2015	hauling										
1211, P41	21/11	0455	38°00' 26°00'		X						X	X	X
1212, P42	21/11	0855	38°19' 26°25'		X						X	X	X
1213, P43	21/11	1230	38°37' 26°49'		X						X	X	X
T 332	22/11	0250	38°41' 26°54'			X							
1214, P44	22/11	0645	38°35' 27°09'		X						X	X	X
1215, P45	22/11	0925	38°34' 27°27'		X						X	X	X
1216, P46	22/11	1600	38°31' 27°46'		X						X	X	X
1217, P47	22/11	1905	38°24' 27°59'		X						X	X	X
1218, P48	23/11	0045	38°20' 29°00'	X							X		X

(continues next page)

Table 1. (continued)

Station number	Date	Hour start GMT	Position North	Position West	Nansen bottles	Bathythermograph	Pelagic trawl	Bottom trawl	Isaacs-Kidd 3'	Long-line	Traps	Juday 180/36	Bongo 60	Otter surface sampler
1219, P49	23/11	0655	38°12'	29°00'	X							X	X	X
1220, P50	23/11	1410	38°05'	29°00'	X							X		X
R 4	23/11	1730	37°59'	29°14'							X			
1221, P51	23/11	2005	37°59'	29°00'	X							X	X	X
1222, P52	24/11	0335	37°52'	29°00'	X							X		X
L 3	24/11	0630	37°43'	29°00'						X				
L 3	24/11	1145	hauling											
1223, P53	24/11	1425	37°45'	29°00'	X							X	X	X
1224, P54	24/11	1900	37°37'	29°00'	X							X		X
1225, P55	24/11	2250	37°30'	29°00'	X							X	X	X
R 4	25/11	0500	hauling											
1226, P56	25/11	0745	38°33'	29°01'	X							X		X
1227, P57	25/11	2230	38°26'	29°00'	X							X	X	X
L 4	26/11	0648	38°06'	29°06'						X				
R 5	26/11	0935	38°05'	29°04'							X			
L 4	26/11	1050	hauling											
T 333	26/11	1740	38°11'	28°55'			X							
R 5	26/11	2020	hauling											
1228, P58	27/11	1155	38°52'	29°00'	X							X		
R 6	27/11	1700	38°42'	28°15'							X			
L 5	28/11	0730	38°59'	28°03'						X				
L 5	28/11	1010	hauling											
T 334	28/11	1555	39°03'	28°05'			X							
R 6	28/11	2030	hauling											
R 7	28/11	2345	38°34'	28°33'							X			
T 335	29/11	0535	39°03'	28°05'			X							
L 6	29/11	0940	39°05'	28°05'						X				
L 6	29/11	1300	hauling											
R 7	29/11	1910	hauling											
T 336	1/12	1050	37°22'	24°54'			X							
1229	6/12	0030	38°00'	09°03'		X								
1230	6/12	0250	38°00'	09°33'		X								
T 337	6/12	1105	38°21'	08°56'			X							
1231	6/12	2015	38°46'	09°50'		X								
1232	6/12	2200	38°46'	10°12'		X								
T 338	7/12	0340	38°58'	09°30'				X						
T 339	7/12	1315	39°08'	09°58'			X							
T 340	8/12	0820	39°52'	09°26'			X							
1233	8/12	1410	40°05'	08°57'	X									
1234	8/12	1530	40°05'	09°10'	X									
1235	8/12	1650	40°05'	09°23'	X									
1236	8/12	1815	40°05'	09°38'	X									

Table 2. Zooplankton displacement volumes. Juday net, diameter 36 cm (0.1 m^2) (J 36), mesh size 180 µ.

St. no.	Date	Position North	Position West	Area	Volume ml 200-50 m	Volume ml 50-0 m	Volume ml Total	Remarks
P 1	10 Nov	36°57'	11°00'	Gettysburg Bank	0.5	0.7	1.2	Some phytoplankton
P 2	10 Nov	36°30'	10°48'	Gettysburg Bank	1.0x	0.7	1.0	x) 200-0 m
P 3	10 Nov	36°40'	11°08'	Gettysburg Bank	0.4x	0.6	1.0	x) 110-50 m
P 4	10 Nov	36°48'	11°17'	Gettysburg Bank	0.2	1.5	1.7	Salps
P 6	10 Nov	36°40'	11°39'	Gettysburg Bank	0.5	0.9	1.4	
P 7	11 Nov	36°14'	11°24'	Gettysburg Bank	0.6	1.0	0.6x	x) 200-0 m Phytoplankton
P 8	12 Nov	36°27'	12°02'	Gettysburg Bank	1.0	0.6x	1.6	x) Siphonophora
P 9	12 Nov	36°00'	11°50'	Gettysburg Bank	1.3	-	1.3	Siphonophora
P 12	12 Nov	34°50'	11°50'	Ampere Bank	0.5	0.5	1.0	200-70 m / 70-0 m
P 13	12 Nov	35°12'	12°07'	Ampere Bank	0.8	1.6	2.4	200-70 m / 70-0 m
P 14	12 Nov	35°05'	12°45'	Ampere Bank	0.3	1.5	1.8	200-70 m / 70-0 m
P 15	13 Nov	35°05'	13°33'	Ampere Bank	1.1	0.6	1.7	
P 20	14 Nov	36°45'	14°46'	Josephine Bank	0.5	2.0	2.5	Siphonophora, copepods
P 29	16 Nov	36°47'	25°02'	S of Sta. Maria	0.6	0.6	1.2	Siphonophora
P 31	16 Nov	37°30'	24°36'	NE of Formigas	0.6x	0.7	0.6x	x) 200-0 m
P 32	16 Nov	37°30'	24°50'	N of Formigas	0.6	0.7	1.3	
P 33	16 Nov	37°17'	25°03'	W of Formigas	0.6	-	0.6x	x) 200-50 m
P 34	16 Nov	37°30'	25°03'	SE of S. Miguel	0.3	0.8	1.1	
P 37	17 Nov	37°46'	25°03'	E of S. Miguel	0.9	0.3	1.2	
P 38	17 Nov	37°30'	25°20'	S of S. Miguel	0.5	1.1	1.6	Siphonophora (?)
P 39	19 Nov	37°30'	25°52'	S of S. Miguel	0.7	0.7	1.4	
P 40	20 Nov	37°30'	25°36'	S of S. Miguel	0.15	1.7	1.85	
P 41	21 Nov	38°00'	26°00'	NW of S. Miguel	0.7	0.7	1.4	
P 42	21 Nov	38°19'	26°25'	NW of S. Miguel	0.6	0.4	1.0	Copepods, siphonophora
P 43	21 Nov	38°37'	26°49'	SE of Terceira	0.3	0.4	0.7	Copepods, siphonophora
P 44	22 Nov	38°35'	27°09'	S of Terceira	0.3	0.8	1.1	
P 45	22 Nov	38°34'	27°27'	SW of Terceira	0.4	0.6	1.0	
P 46	22 Nov	38°31'	27°46'	SE of Sao Jorge	0.2	0.7	0.9	
P 47	22 Nov	38°24'	27°59'	E of Pico	1.8	0.7	2.5	
P 48	23 Nov	38°20'	29°00'	Acores Bank	0.7	1.0	1.7	
P 49	23 Nov	38°12'	29°00'	Acores Bank	0.2	0.3	0.5	
P 50	23 Nov	38°05'	29°00'	Acores Bank	0.6	1.1	1.7	
P 51	23 Nov	37°59'	29°00'	Acores Bank	0.2	0.3	0.5	Copepods
P 52	24 Nov	37°52'	29°00'	Acores Bank	0.6	0.7	1.3	
P 53	24 Nov	37°45'	29°00'	Acores Bank	0.3	0.4	0.7	Copepods
P 54	24 Nov	37°37'	29°00'	Acores Bank	0.4	0.4	0.8	
P 55	24 Nov	37°30'	29°00'	Acores Bank	2.0	0.5	2.5	
P 56	25 Nov	38°32'	29°01'	Castelo Bank	0.2	0.8	1.0	
P 57	25 Nov	38°26'	29°00'	Castelo Bank	0.6	0.5	1.1	Copepods, "krill"
P 58	27 Nov	38°52'	29°00'	Castelo Bank	-	0.7	0.7x	x) 50-0 m

Table 3. Zooplankton displacement volumes. Bongo net, diameter 60 cm, mesh size 500 µ, (B 60), oblique haul 200 - 0 m. x) Night haul.

St. no.	Date	Position North	Position West	Area	Plankton volumes ml A	Plankton volumes ml B	Average	m^3 filtered	Plankton volume ml/1000 m^3
P 31	16 Nov	37°30'	24°36'	NE of Formigas	3.8	2.7	3.3	540	6
P 34	16 Nov	37°30'	25°03'	SE of S.Miguel	10.8	5.0	7.9	560	14 x
P 37	17 Nov	37°46'	25°03'	E of S.Miguel	9.6	8.0	8.8	900	10 x
P 38	17 Nov	37°30'	25°20'	S of S.Miguel	6.0	6.7	6.4	500	13
P 39	19 Nov	37°30'	25°52'	S of S.Miguel	5.0	5.1	5.1	570	9
P 40	20 Nov	37°30'	25°36'	S of S.Miguel	43.2	37.0	40.1	600	67 x
P 41	21 Nov	38°00'	26°00'	NW of S.Miguel	2.2	4.8	3.5	340	10 x
P 42	21 Nov	38°19'	26°25'	NW of S.Miguel	2.5	3.4	3.0	330	9
P 43	21 Nov	38°37'	26°49'	SE of Terceira	6.2	5.6	5.9	360	17
P 44	22 Nov	38°35'	27°09'	S of Terceira	4.8	5.0	4.9	420	12
P 45	22 Nov	38°34'	27°27'	SW of Terceira	9.1	17.0	13.0	580	22
P 46	22 Nov	38°31'	27°46'	SE of Sao Jorge	7.3	2.7	5.0	580	9
P 47	22 Nov	38°24'	27°59'	E of Pico	6.3	8.8	7.5	500	13 x
P 49	23 Nov	38°12'	29°00'	Açores Bank	3.2	3.5	3.4	360	9
P 51	23 Nov	37°59'	29°00'	Açores Bank	9.6	10.2	9.9	700	14 x
P 53	24 Nov	37°45'	29°00'	Açores Bank	3.0	4.5	3.8	460	9
P 55	24 Nov	37°30'	29°00'	Açores Bank	6.0	6.2	6.1	430	14 x
P 57	25 Nov	38°26'	29°00'	Castelo Bank	20.0	12.5	16.3	500	33 x

Table 4. Number of fish eggs and larvae, young fish and lanternfishes taken in hauls with Juday net (J 36), Bongo net (B 60), Otter Surface Sampler (OSS 40) and Isaacs-Kidd Pelagic Trawl (IKMT 3'). For positions of stations see Table 1.

St. no.	Date	Area	Gear	Depth m	Eggs	Larvae	Young fish Lantern fish
P 3	10 Nov	Gettysburg Bank	J 36	50-0	1		
P 4	"	"	J 36	200-50		2	
P 9	12 Nov	"	J 36	200-0		3	
P 10	"	Ampere Bank	OSS 40	0		10	
P 11	"	"	OSS 40	0		9	
P 12	"	"	OSS 40	0	4	6	
P 13	"	"	OSS 40	0		7	
P 14	"	"	OSS 40	0		18	12
"	"	"	IKMT3'	25-50		1	3 M
P 15	13 Nov	"	J 36	200-50		1	
P 16	"	"	OSS 40	0			
P 17	"	Josephine Bank	OSS 40	0		4	
P 18	"	"	OSS 40	0	124		
P 19	"	"	IKMT3'	100-0			7 Ma
P 20	14 Nov	"	OSS 40	0		1	2 M
P 22	"	W of Josephine Bk	OSS 40	0		3 S	
P 24	15 Nov	"	OSS 40	0		2 S	4 M
P 25	"	E of Santa Maria	OSS 40	0	2	8 S	1 M
P 28	"	"	OSS 40	0		15 S	2 M
P 29	16 Nov	S of Santa Maria	OSS 40	0		16 S	1 M
P 30	"	N of Santa Maria	OSS 40	0		4 S	1 M
P 31	"	NE of Formigas	OSS 40	0		2 S	
"	"	"	B 60	200-0		1 S	
P 32	"	N of Formigas	OSS 40	0		2 S	
"	"	"	B 60	200-0		1	
P 33	"	W of Formigas	OSS 40	0		5 S	
"	"	"	B 60	200-0	10		
P 34	"	SE of Sao Miguel	B 60	200-0	2	1	
P 36	"	E of Sao Miguel	OSS 40	0			1
P 37	17 Nov	"	OSS 40	0		2	1 M
"	"	"	B 60	200-0	9		
"	"	"	B 60	200-0	5		
P 38	"	S of Sao Miguel	B 60	200-0	2		
"	"	"	OSS 40	0		1 S	
P 39	19 Nov	"	B 60	200-0	4		
"	"	"	B 60	200-0	3	2 S	
P 40	20 Nov	"	OSS 40	0	1	5	1 M
P 41	21 Nov	NW of Sao Miguel	OSS 40	0	30	4	
"	"	"	B 60	200-0	4	1	
"	"	"	B 60	200-0	5		
P 42	"	"	OSS 40	0		3 S	
P 43	"	SE of Terceira	B 60	200-0	26		
"	"	"	B 60	200-0	27	1	
"	"	"	OSS 40	0	26		
P 45	22 Nov	SW of Terceira	J 36	200-50	1		
"	"	"	B 60	200-0	14		
"	"	"	B 60	200-0	14		
"	"	"	OSS 40	0	15	1	
P 47	"	E of Pico	B 60	200-0	4	1	
"	"	"	OSS 40	0	3		
P 48	23 Nov	Acores Bank	OSS 40	0	3	4	2
P 49	"	"	OSS 40	0		2 S	
"	"	"	B 60	200-0		1 S	
P 50	"	"	OSS 40	0	4	7	
P 51	"	"	B 60	200-0	11		
"	"	"	OSS 40	0	3	5 S	3 M
P 53	24 Nov	"	J 36	50-0	1		
"	"	"	B 60	200-0	5		
"	"	"	B 60	200-0	14		
P 54	"	"	OSS 40	0	5		2 M
P 55	"	"	J 36	50-0	1		
"	"	"	OSS 40	0	5	1 S	
"	"	"	B 60	200-0	55	1	
"	"	"	B 60	200-0	37	1	
P 56	25 Nov	Castello Bank	J 36	200-50	1		
"	"	"	OSS 40	0	1		

M: Myctophids, Ma: Maurolicus muelleri, S: Scombresox saurus

Table 5. Weight of tar balls from Otter Surface Sampler. Area sampled approx. 600 m^2.

Station number	Date	Position North	Position West	Area	Weight of sample mg	Concentration mg/m^2
P 12	12 Nov	34°50'	11°50'	Ampere Bank	21 464.2	35.8
P 13	12 Nov	35°12'	12°07'	Ampere Bank	1 050.2	1.8
P 14	12 Nov	35°05'	12°45'	Ampere Bank	2 665.2	4.4
P 15	13 Nov	35°05'	13°33'	Ampere Bank	5 532.1	9.2
P 17	13 Nov	36°10'	13°35'	Josephine Bank	23 250.0	38.8
P 18	13 Nov	36°42'	14°10'	Josephine Bank	216.1	0.4
P 20	14 Nov	36°45'	14°46'	Josephine Bank	170.3	0.3
P 21	14 Nov	36°45'	16°04'	W of Josephine Bank	750.0	1.3
P 22	14 Nov	36°47'	17°17'	W of Josephine Bank	1 111.5	1.9
P 23	14 Nov	36°47'	18°35'	W of Josephine Bank	1 785.3	3.0
P 24	15 Nov	36°50'	19°48'	W of Josephine Bank	228.8	0.4
P 25	15 Nov	36°50'	21°02'	E of Santa Maria	229.3	0.4
P 26	15 Nov	36°52'	22°18'	E of Santa Maria	4 210.0	7.0
P 27	15 Nov	36°55'	23°34'	E of Santa Maria	2 061.6	3.4
P 28	15 Nov	36°55'	24°50'	E of Santa Maria	1 400.0	2.3
P 29	16 Nov	36°47'	25°02'	S of Santa Maria	2 422.1	4.0
P 30	16 Nov	37°05'	25°03'	N of Santa Maria	4 440.0	7.4
P 31	16 Nov	37°30'	24°36'	NE of Formigas	1 295.6	2.2
P 32	16 Nov	37°30'	24°50'	N of Formigas	1 155.2	1.9
P 33	16 Nov	37°17'	25°03'	W of Formigas	1 750.4	2.9
P 34	16 Nov	37°30'	25°03'	SE of Sao Miguel	151.3	0.3
P 35	16 Nov	37°40'	24°53'	SE of Sao Miguel	709.8	1.2
P 36	16 Nov	37°55'	24°36'	E of Sao Miguel	133.6	0.2
P 37	17 Nov	37°46'	25°03'	E of Sao Miguel	2 114.8	3.5
P 38	17 Nov	37°30'	25°20'	S of Sao Miguel	1 157.7	1.9
P 39	19 Nov	37°30'	25°52'	S of Sao Miguel	657.7	1.1
P 40	20 Nov	37°30'	25°36'	S of Sao Miguel	286.3	0.5
P 41	21 Nov	38°00'	26°00'	NW of Sao Miguel	1 486.7	2.5
P 42	21 Nov	38°19'	26°25'	NW of Sao Miguel	76.8	0.1
P 43	21 Nov	38°37'	26°49'	SE of Terceira	0.2	0.0
P 45	22 Nov	38°34'	27°27'	SW of Terceira	4 307.0	7.2
P 46	22 Nov	38°31'	27°46'	SE of Sao Jorge	1 562.7	2.6
P 47	22 Nov	38°24'	27°59'	E of Pico	27.4	0.0
P 48	23 Nov	38°20'	29°00'	Acores Bank	5 162.6	8.6
P 49	23 Nov	38°12'	29°00'	Acores Bank	1 157.0	1.9
P 50	23 Nov	38°05'	29°00'	Acores Bank	182.8	0.3
P 51	23 Nov	37°59'	29°00'	Acores Bank	3 156.3	5.3
P 52	24 Nov	37°52'	29°00'	Acores Bank	8 321.5	13.9
P 53	24 Nov	37°45'	29°00'	Acores Bank	1 744.6	2.9
P 54	24 Nov	37°37'	29°00'	Acores Bank	113.0	0.2
P 55	24 Nov	37°30'	29°00'	Acores Bank	3 394.3	5.7
P 56	25 Nov	38°32'	29°01'	Castelo Bank	18.3	0.0
P 57	25 Nov	38°26'	29°00'	Castelo Bank	154.4	0.3

Table 6 A. Composition of catch at trawl stations in the Gettysburg-Ampere-Josephine Bank area and the Acores area.

BOT: bottom trawl, LPT: large pelagic trawl, W: weight in kilos, N: number, x: species present, not weighed/counted.

Date Trawl station no. Type of gear	11 Nov T.327 LPT	13 Nov T.328 BOT	14 Nov T.329 LPT	19 Nov T.330 LPT	19 Nov T.331 LPT	22 Nov T.332 LPT	26 Nov T.333 LPT	28 Nov T.334 LPT	29 Nov T.335 LPT	1 Dec T.336 LPT
Total catch, kg.	17.0	26.0	0	x	0	106.5	3.0	129.0	0	x
Species	W/N	W/N	W/N	W/N	W/N	W/N	W/N	W/N	W/N	W/N
Galeorhinus galeus						13.8 1				
Maurolicus muelleri						- 2	3.0 -			
Argyropelecus aculeatus							- 1	- 1		- 8
Diaphus metopoclampus										- 16
Diaphus sp.										- 2
Gonostoma denudatum										- 4
Lampanyctus maderensis										- 7
Lampanyctus resplendens										- 1
Myctophum humboldti										- 7
Myctophum rissoi										- 20
Bathophilus vaillanti										- 1
Chauliodus sloani										- 1
Lampadena chavesi										- 1
Macrorhamphosus scolopax	- 15	1.0 -						- 3		
Macrorhamphosus gracilis	↑ incl.	↑ incl.						↑ incl.		
Beryx decadactylus	0.8 2									
Trachurus trachurus	11.3 32	2.2 41		- 3						
Boops boops		- 60								
Lepidopus caudatus	4.3 3	10.6 22				92.5 70				
Helicolenus dactylopterus		1.8 3								
Pontinus acraensis		1.6 1								
Capros aper		2.3 42								
Anthias anthias		4.5 112								
Scomber japonicus		- 5								
DECAPODA										x

Table 6 B. Composition of catches at trawl stations on the coast of Portugal.

BOT: bottom trawl, LPT: large pelagic trawl, SPT: small pelagic trawl, W: weight, N: number, x: species present, not weighed/counted.

Date Trawl station no. Type of gear	6 Dec T.337 LPT	7 Dec T.338 BOT	7 Dec T.339 SPT	8 Dec T.340 SPT
Total catch, kg.	70.0	61.0	21.5	81.5
Species	W/N	W/N	W/N	W/N
Scyliorhinus canicula	- 3			
Raja miraletus	- 1			
Raja montagui	- 1			
Sardina pilchardus		6.5 77		
Argentina sphyraena	- 6			
Maurolicus muelleri		x		
Conger conger	- 1			
Gadus luscus		1.5 9		
Merluccius merluccius		1.5 47		
Macrorhamphosus scolopax	69.0 -	50.0 -		75.0 -
Macrorhamphosus gracilis	↑ incl.	↑ incl.		↑ incl.
Trachurus trachurus		- 2		
Brama raji			21.5 31	6.5 4
Lepidopus caudatus		- 1		
Trigla lucerna		2.4 2		
Trigla cuculus		- 5		
Lepidorhombus boscii	- 1			
Monochirus hispidus	- 1			
Buglossidium luteum		- 1		
Pagurus sp.	- 1			
OPHIUROIDEA	x			
HOLOTHUROIDEA	x			
Octopus sp.	- 1			

Table 7. Composition of catch at bottom long-line stations in the Gettysburg-Ampere-Josephine Bank area and the Acores area. W: weight, N: number, x: species present, not weighed/counted.

Date Station number Depth in metres	10-11 Nov L 1 240	19-20 Nov L 2 360	24 Nov L 3 360	26 Nov L 4 280	28 Nov L 5 275	29 Nov L 6 120
Total catch, kg.	122.0	208.0	488.5	160.0	473.0	470.0
Species	W/N	W/N	W/N	W/N	W/N	W/N
Heptranchias perlo			9.5 1			
Galeus melanostomus	- 1					
Etmopterus pusillus		124.0 95				
Acanthidium calceus		↑ incl.				
Galeorhinus galeus	33.0 3	13.0 2	203.5 22	10.5 1	162.0 15	120.0 18
Dalatias licha			41.0 5	11.0 1		
Raja microcellata	31.0 12	52.5 23	36.5 23	3.5 2	204.0 94	102.5 29
Raja batis		14.0 1				
Raja fullonica			30.0 7			
Dasyatis pastinaca						- 1
Muraena helena	x					45.0 13
Conger conger	30.0 9	4.4 1	9.0 2	13.5 4		
Molva macrophthalma			- 1			
Coelorhynchus coelorhynchus		0.7 3				
Physis physis	33.5 14	5.0 3		- 1	46.0 16	7.5 8
Polyprion americanum		4.0 1	3.0 1	18.0 2		
Serranus guaza						27.0 2
Caranx ascencionis						7.0 2
Trachurus trachurus					1.6 6	
Pagrus pagrus					45.5 10	128.0 37
Pagellus centrodontus		7.7 9	117.5 65	45.5 40	5.0 8	20.0 17
Diplodus sargus						- 1
Lepidopus caudatus			5.4 2	- 1		

(continues next page)

Table 7. (continued)

Station number	L 1	L 2	L 3	L 4	L 5	L 6
Scorpaena scrofa					- 1	- 1
Helicolenus dactylopterus	- 1	82.0 116	33.0 39	22.0 40	3.5 3	
Pontinus kuhlii				- 4	5.5 3	- 4
Trigla cuculus	- 2				- 3	- 4
Balistes (Capriscus) carolinensis						- 2
Cancer pagurus			x			

Table 8. Composition of catch at fish trap stations in the Gettysburg-Ampere-Josephine Bank area and the Acores area.
W: weight in kilos, N: number.

Date Station number Depth in metres	10-11 Nov R 1 80	18-19 Nov R 2 220	20 Nov R 3 350	23 Nov R 4 310	26 Nov R 5 400	27-28 Nov R 6 110	28-29 Nov R 7 90
Total catch, kg.	101.0	73.0	71.0	703.5	160.0	43.0	10.0
Species	W/N	W/N	W/N	W/N	W/N	W/N	W/N
Muraena helena	83.5 31						
Conger conger	17.5 2	60.5 9	34.0 3	698.0 61	75.0 11	7.5 2	
Physis physis		10.0 5		5.5 2		10.0 5	- 2
Physis blennoides			2.0 1				
Polyprion americanum			11.5 1		38.0 3		
Anthias anthias							- 1
Pagrus pagrus						22.0 20	
Pagellus centrodontus			- 2		24.0 20		
Pseudolepidaplois scrofa						- 1	- 1
Scorpaena scrofa						- 1	- 1
Helicolenus dactylopterus			11.0 29		23.0 55		
Pontinus kuhlii		2.5 2	- 2				
Balistes (Capriscus) carolinensis						- 8	
Maja sp.	- 2						
Cancer bellianus		- 8	10.0 -		- 4		
Paramola cuvieri	- 2						
Palinurus vulgaris		- 2					
ECHINOIDEA						- 1	

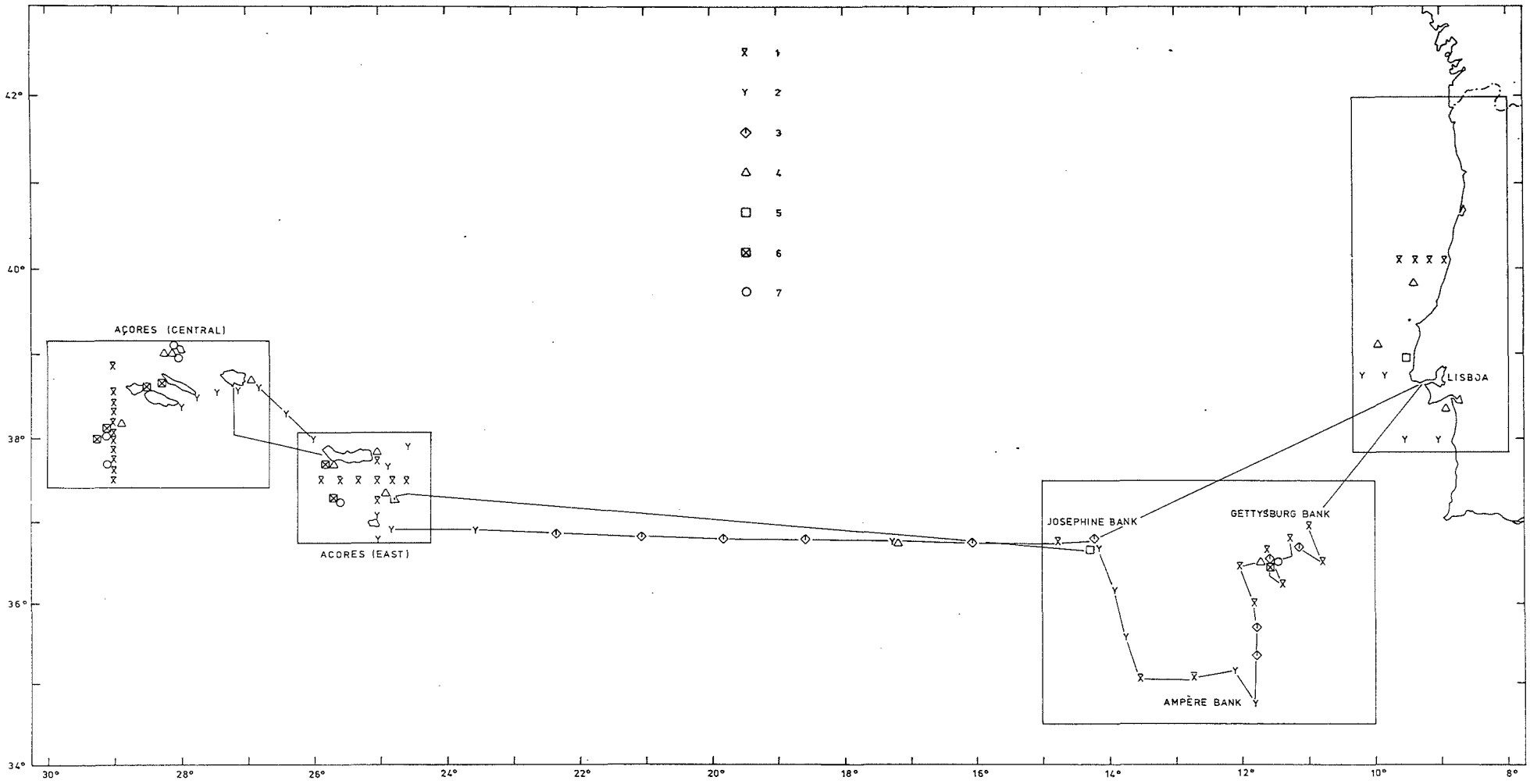

Fig. 1 Survey routes and stations

1) Nansen cast
2) Bathy termograph
3) Plankton
4) Pelagic trawl
5) Bottom trawl
6) Fish traps
7) Long line

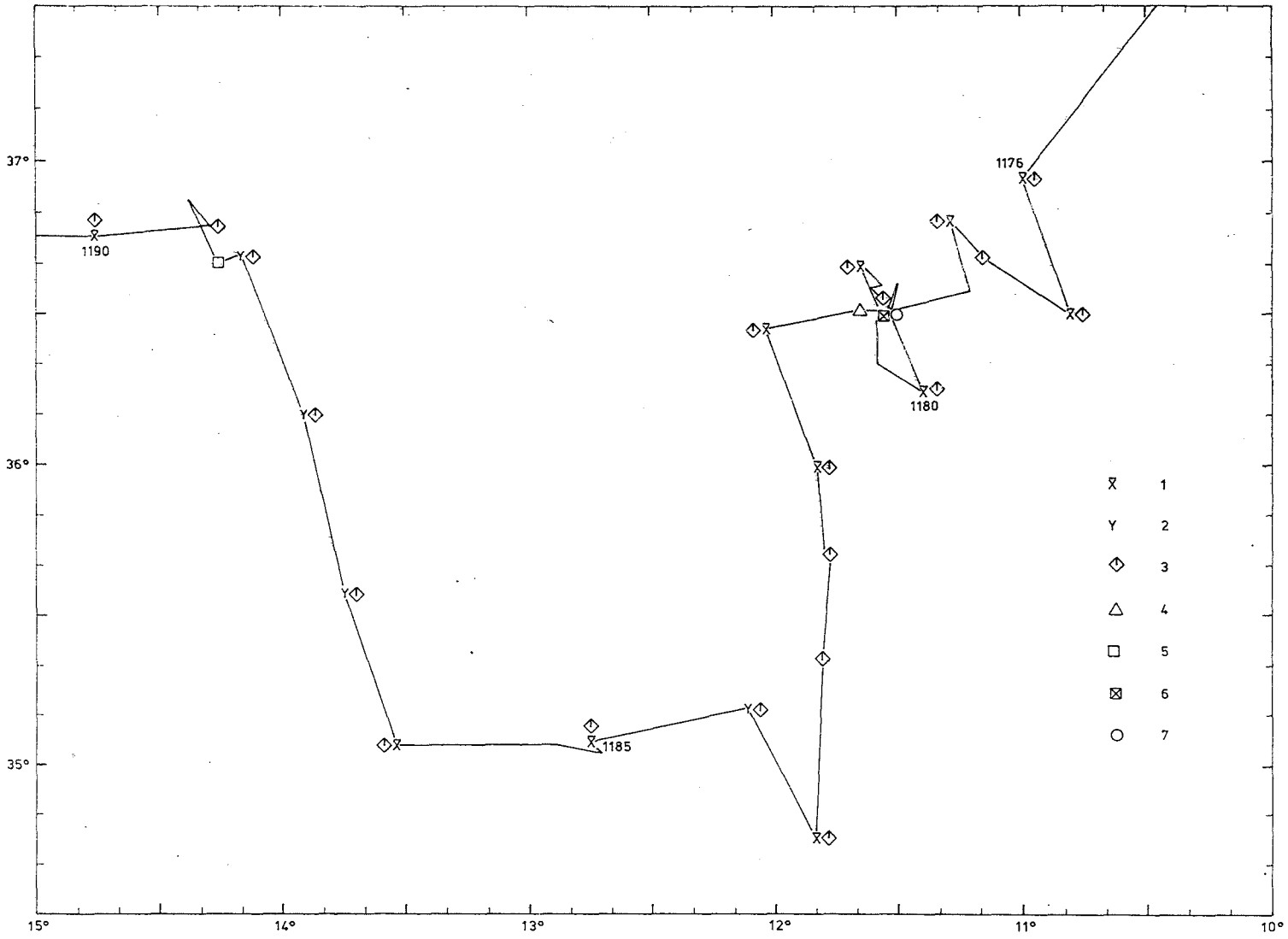

Fig. 2 Bank area. Survey routes
and stations (Legend see Fig. 1).

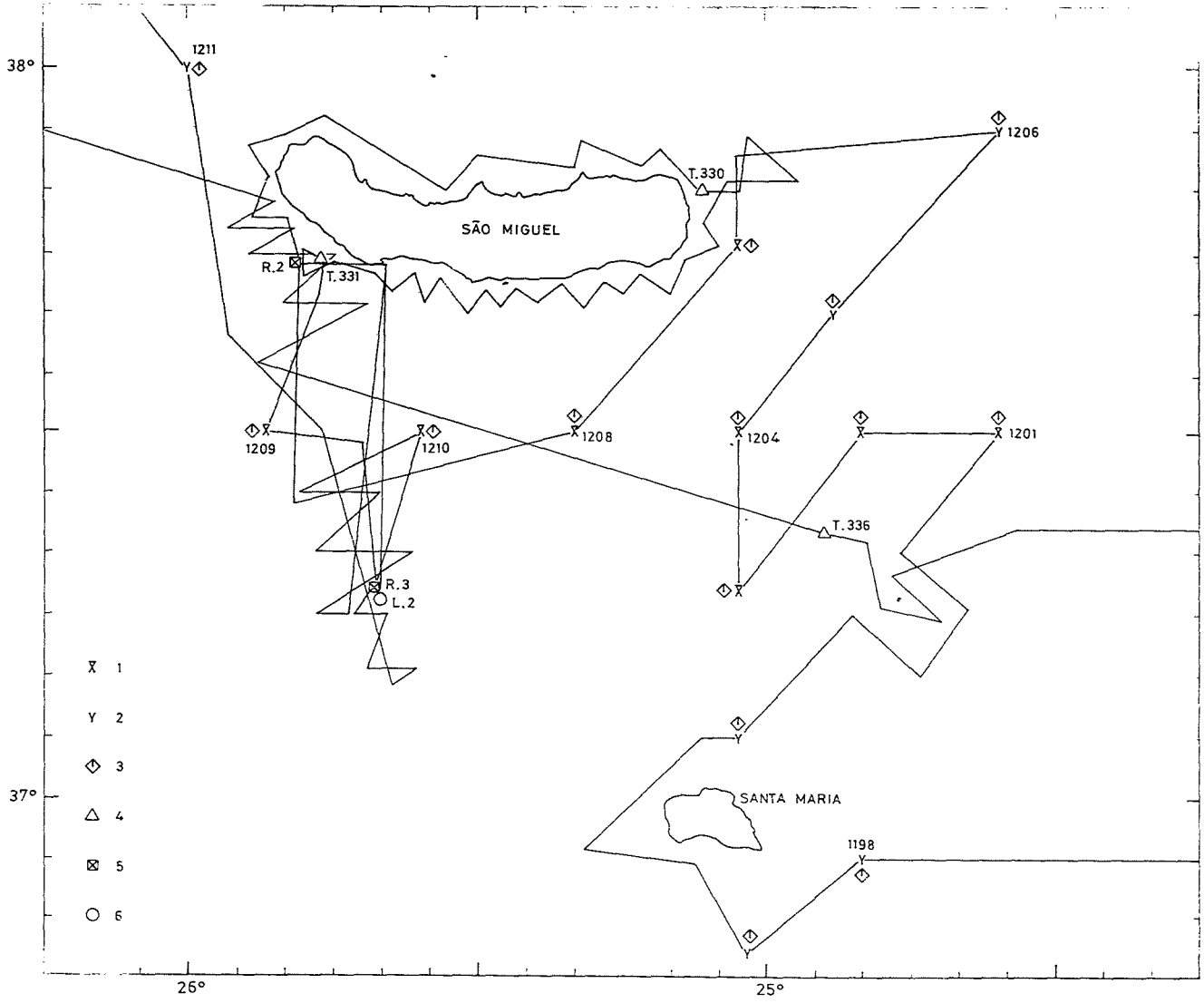

Fig. 3 Acores (east) survey routes and stations (Legend see Fig. 1).

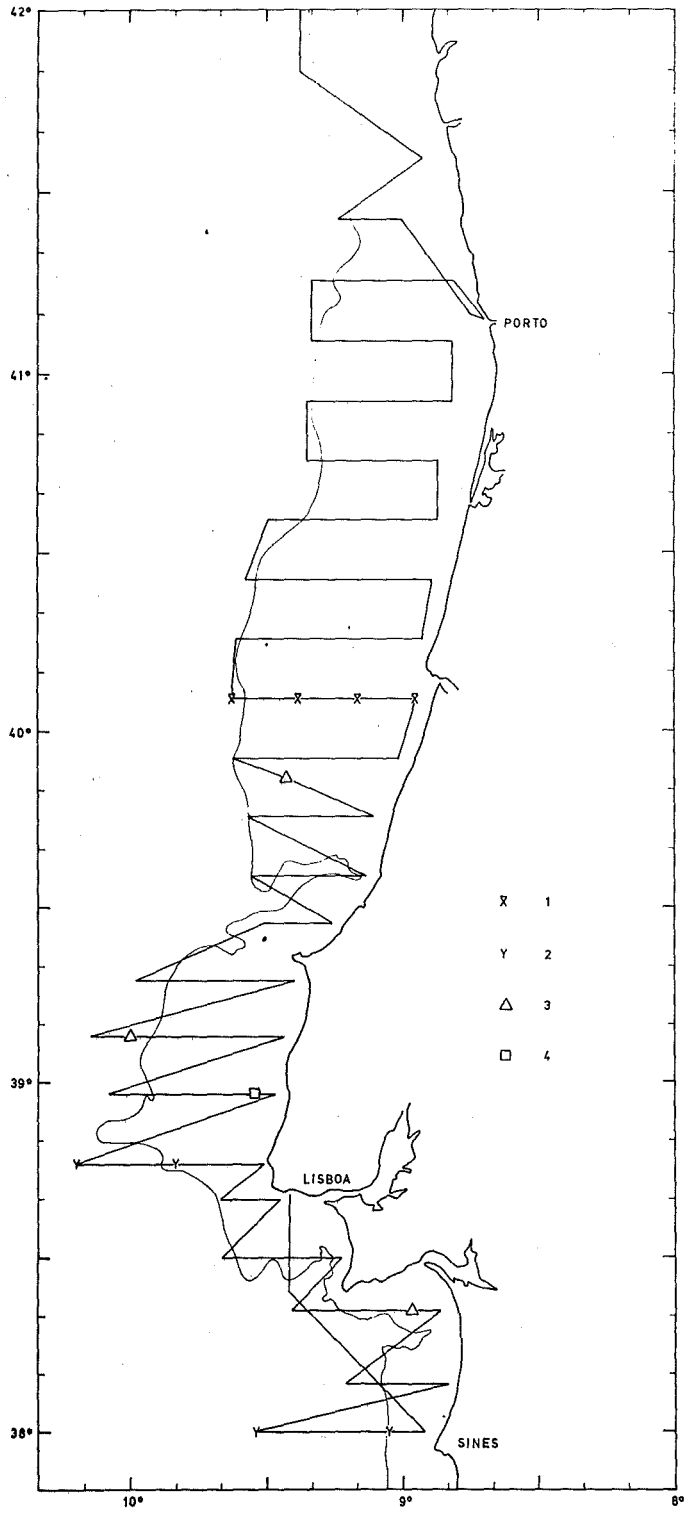

Fig. 5 Coast of Portugal. Survey routes and stations (Lengend see Fig. 1).

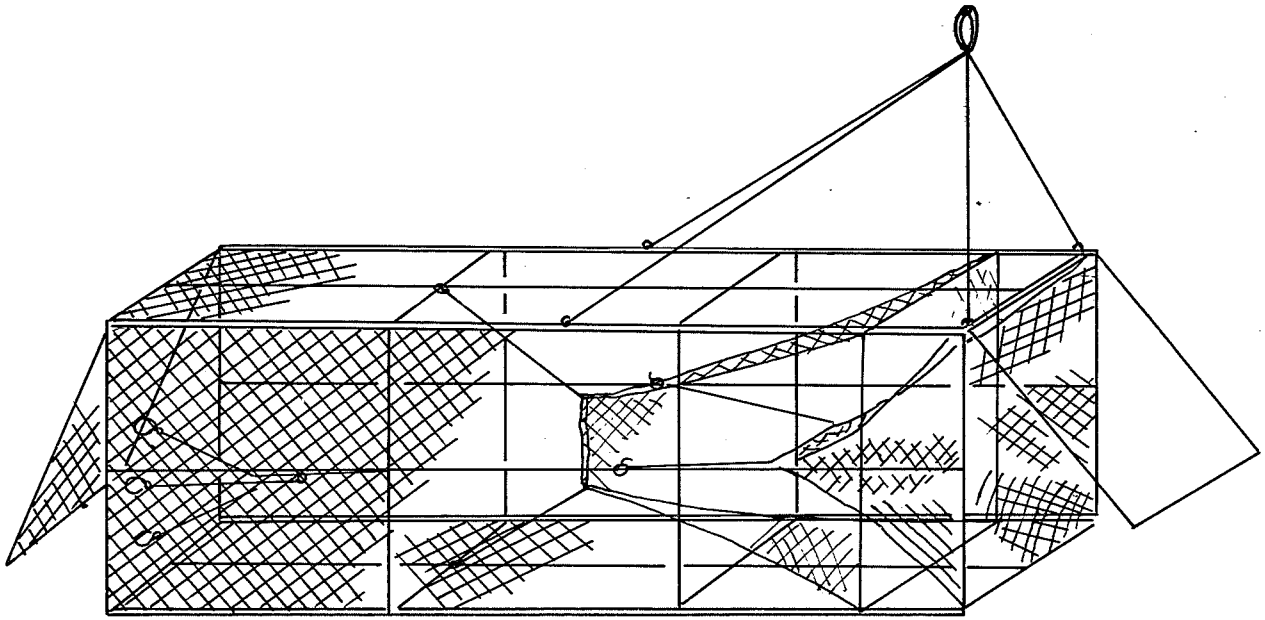

Fig. 6 Deep sea fish trap, size 0,75 x 0,75 x 2,25 m

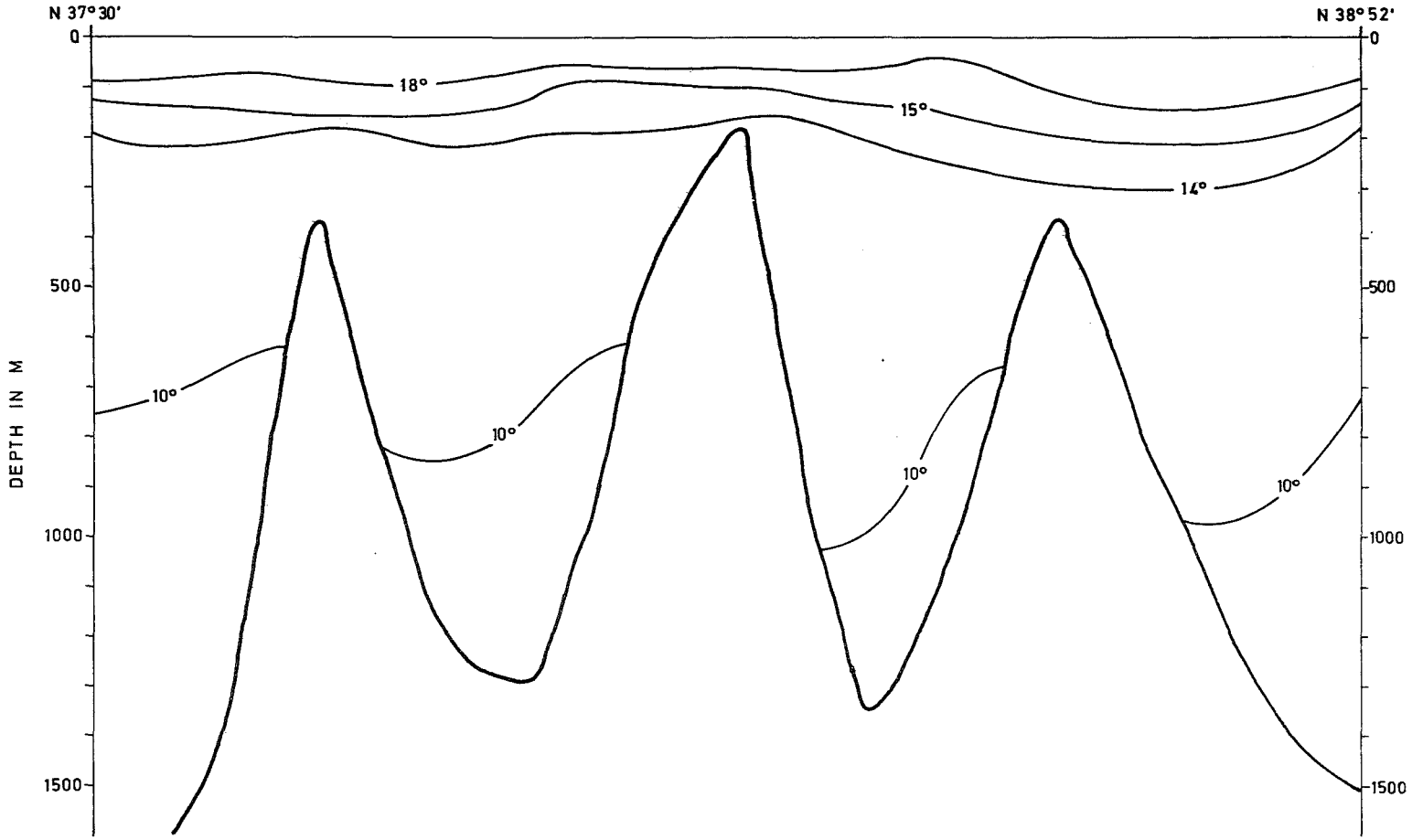

Fig. 7 Profiles of temperatures, t°C along longitude 29°W across the Bank of Acores.

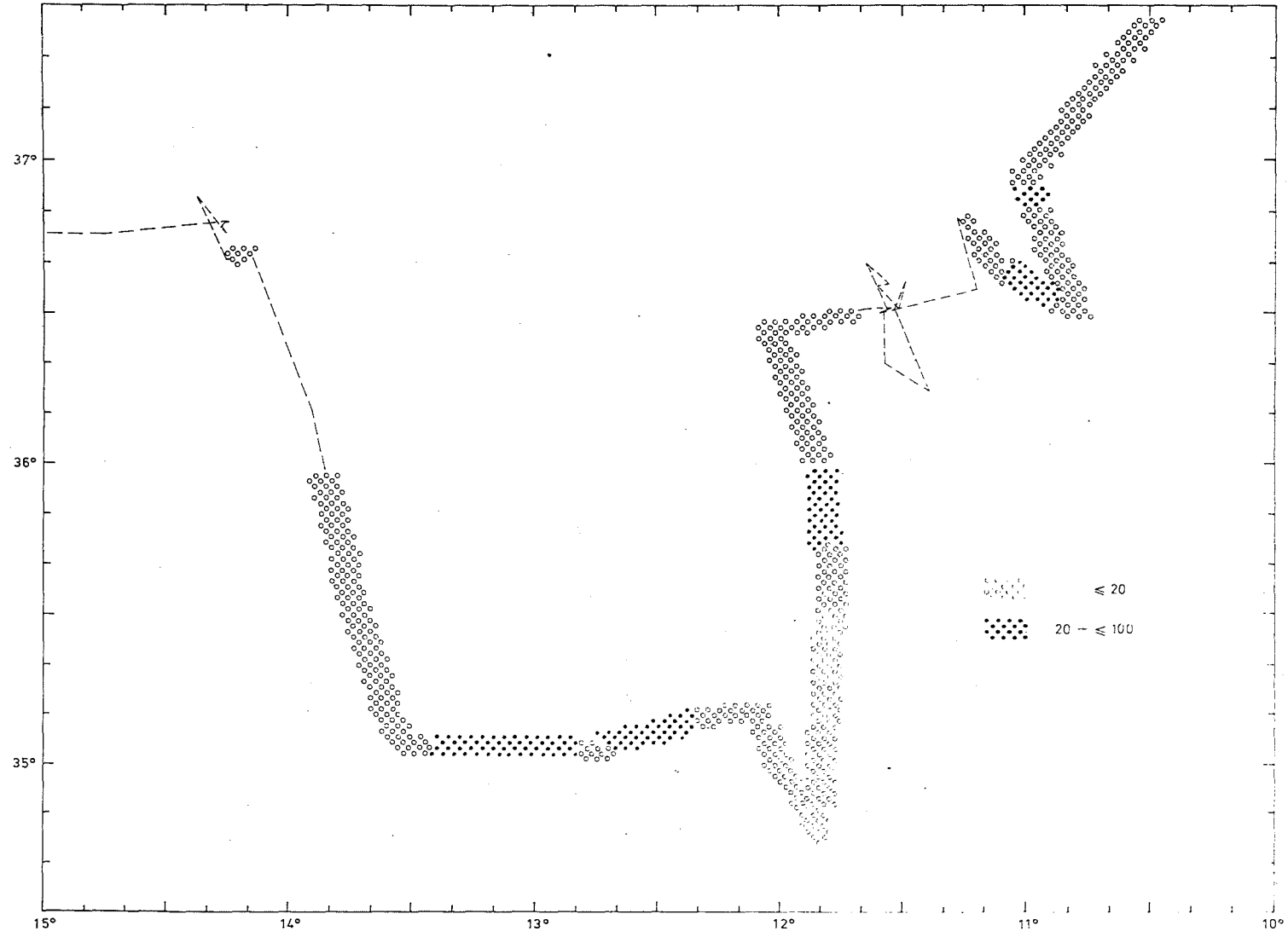

Fig. 8 Bank area. Plankton abundance. Relative units.

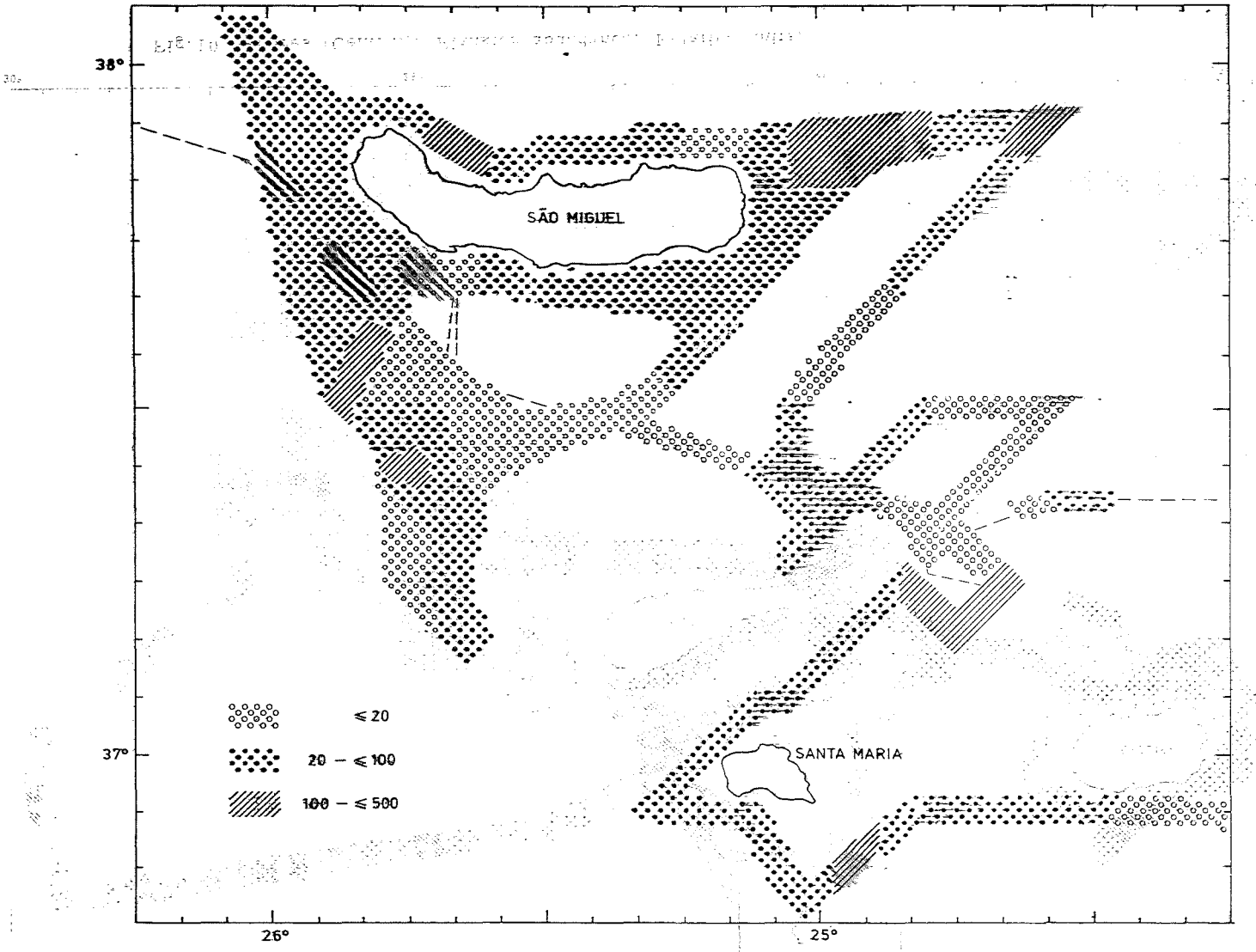

Fig. 9 Acores (east). Plankton abundance. Relative units.

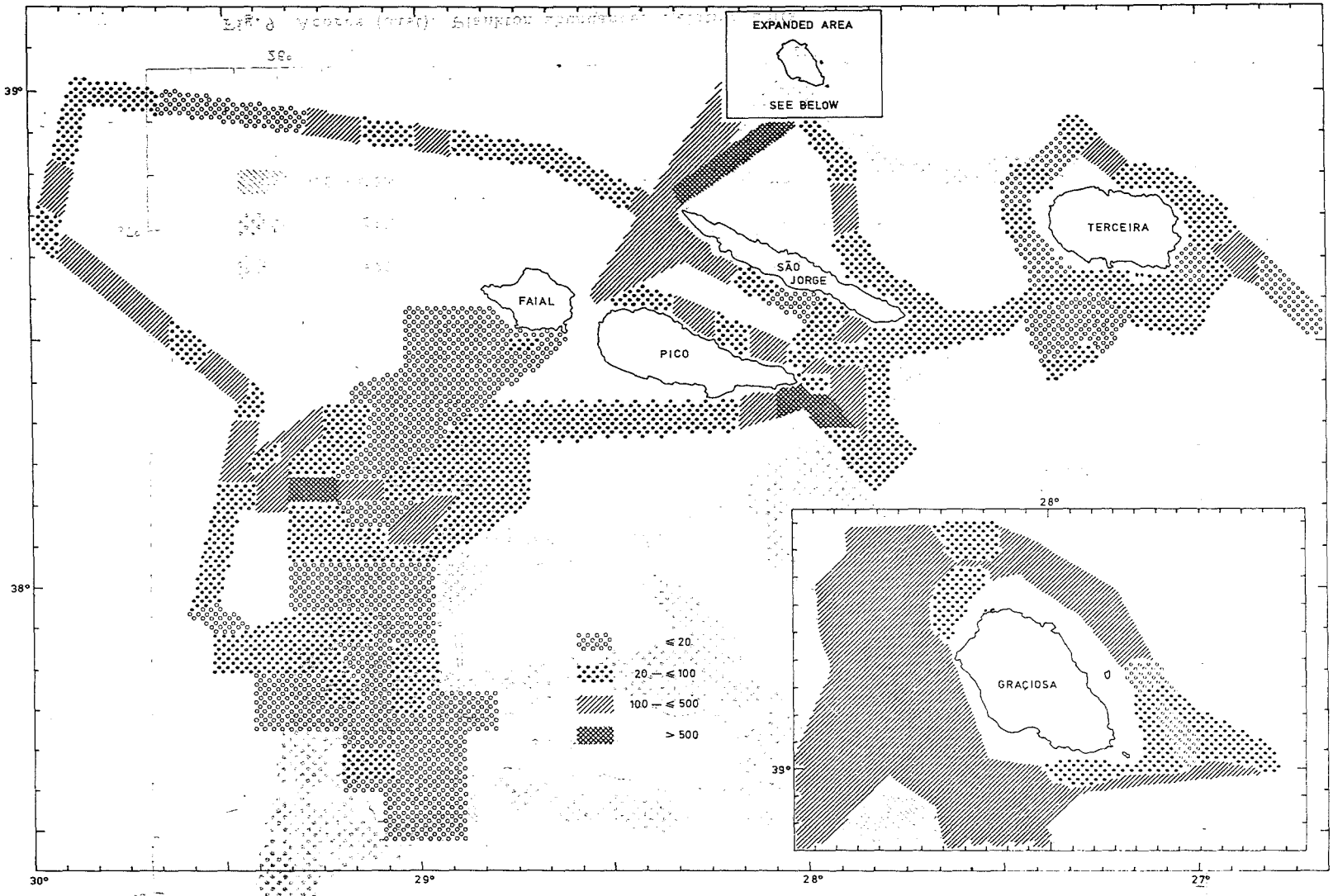

Fig. 10 Açores (Central). Plankton abundance. Relative units.

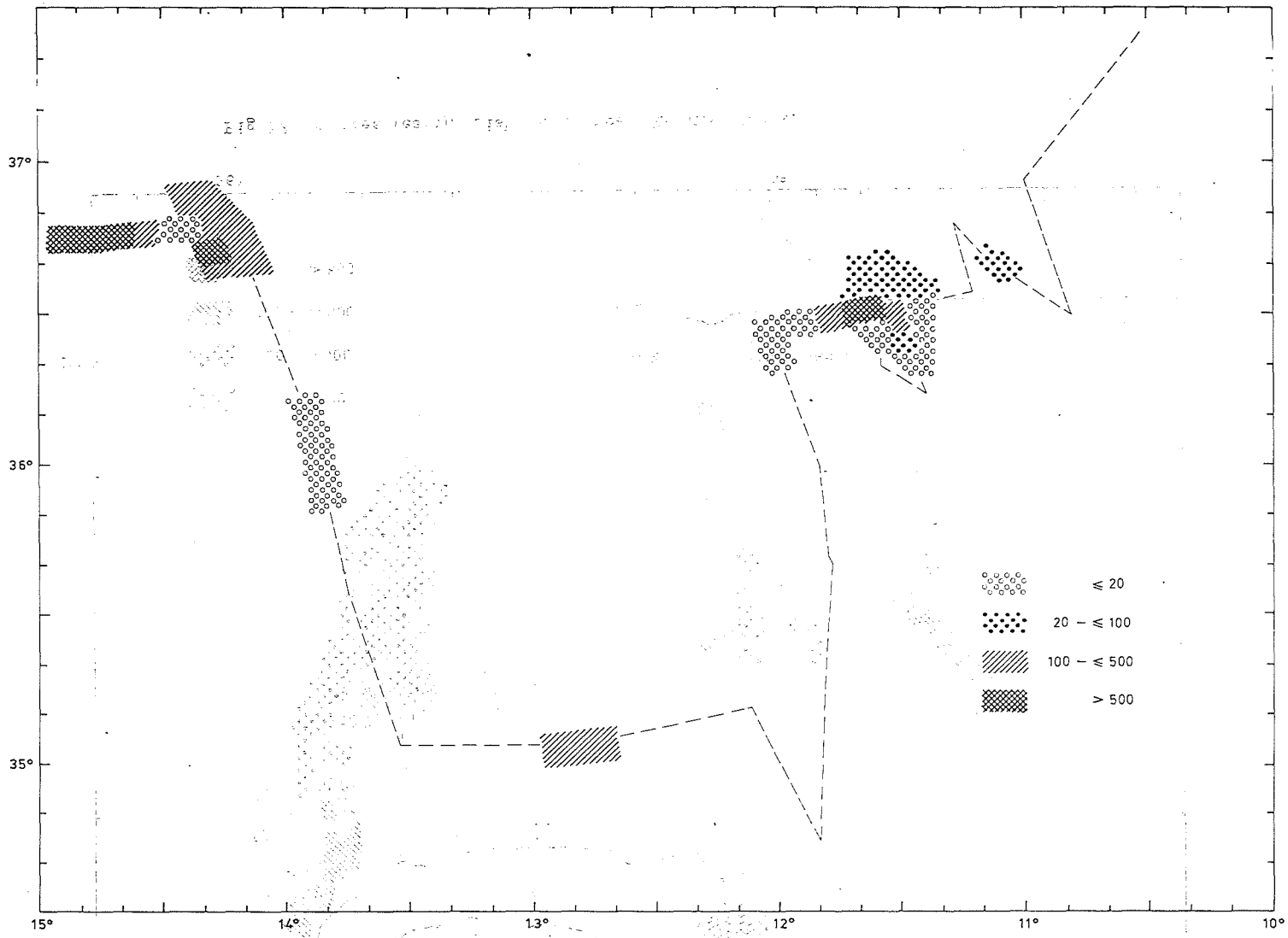

Fig. 11 Bank area. Fish abundance. Relative units.

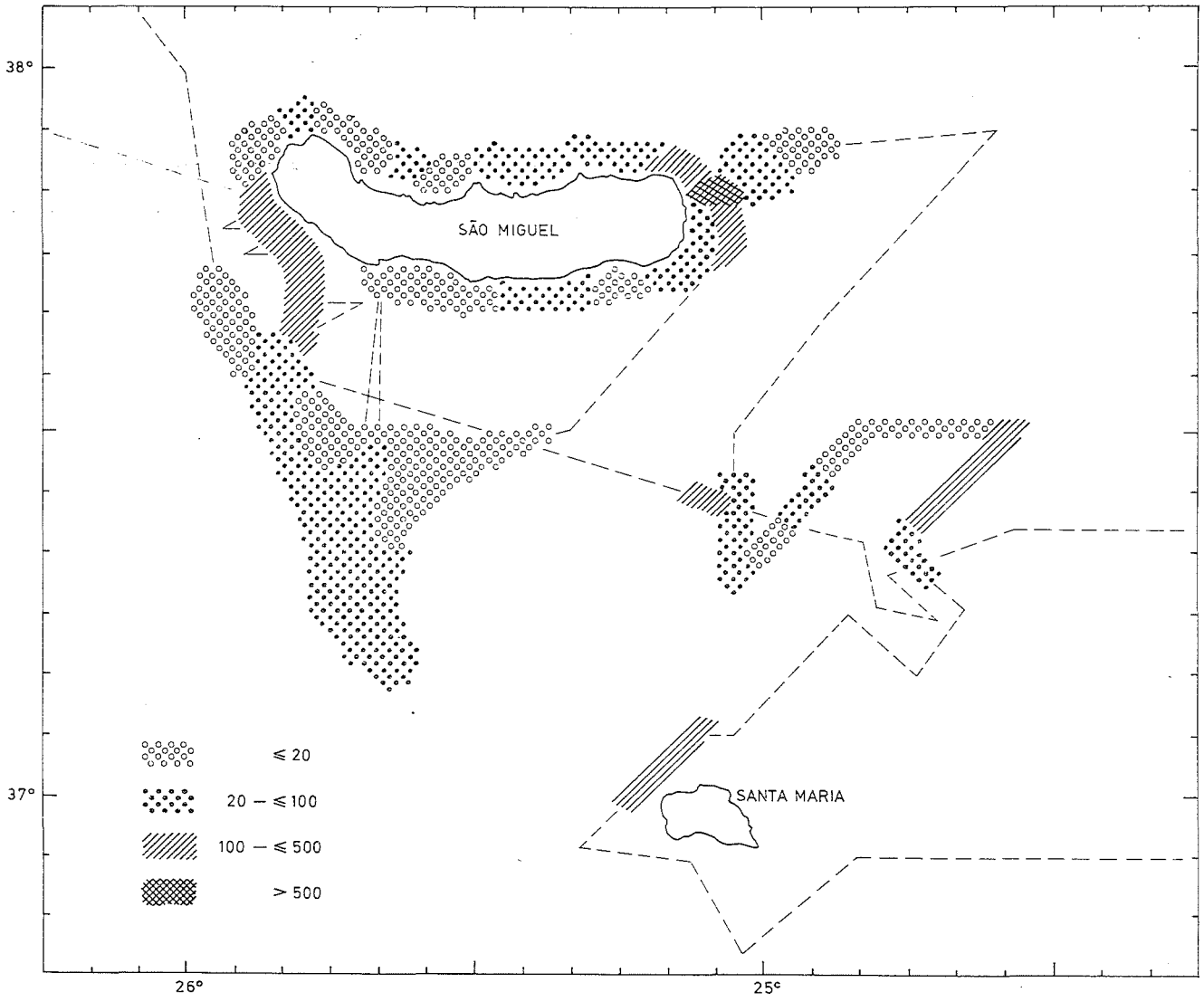

Fig. 12 Acores (east). Fish abundance. Relative units.

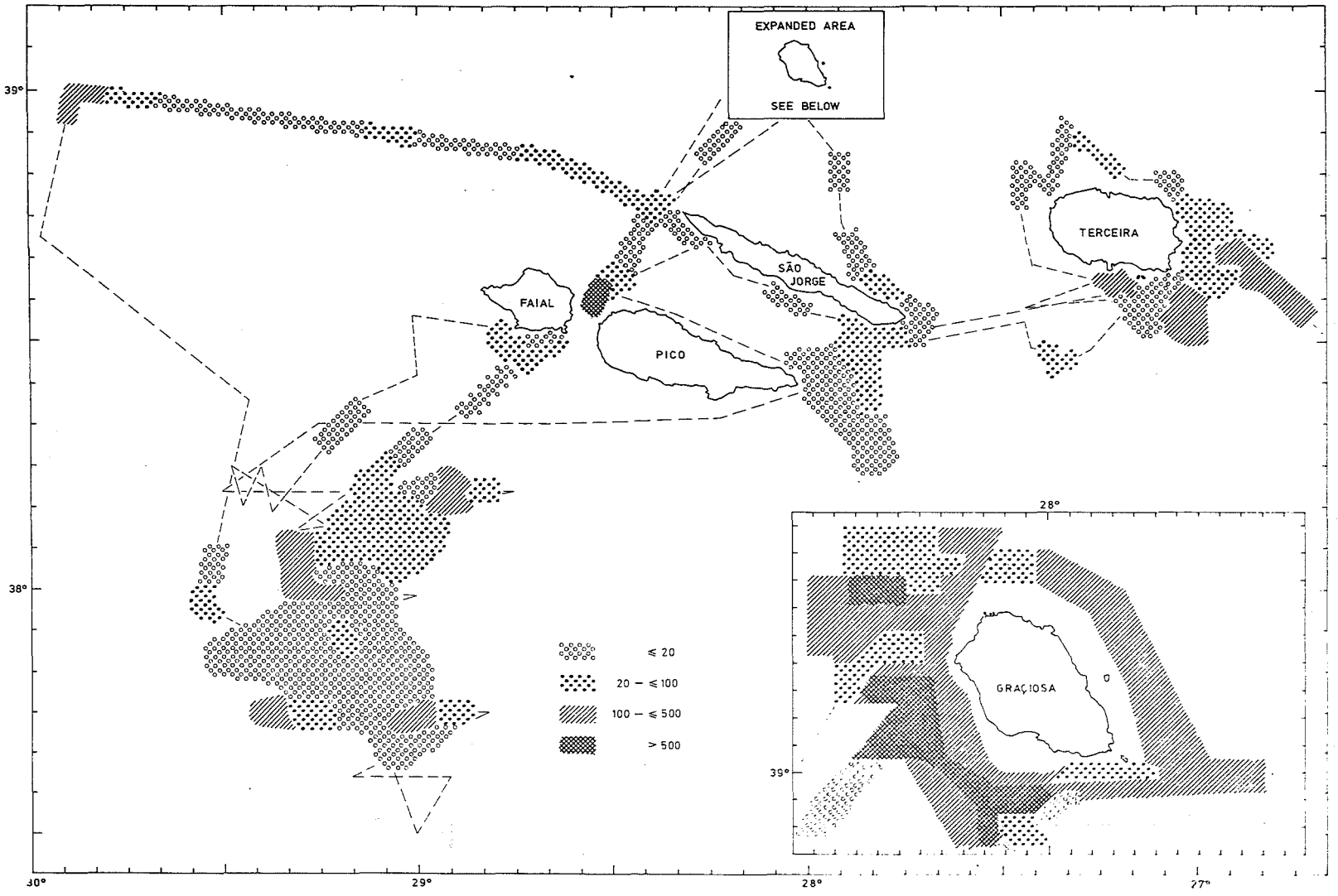

Fig. 13 Acores (central). Fish abundance. Relative units.

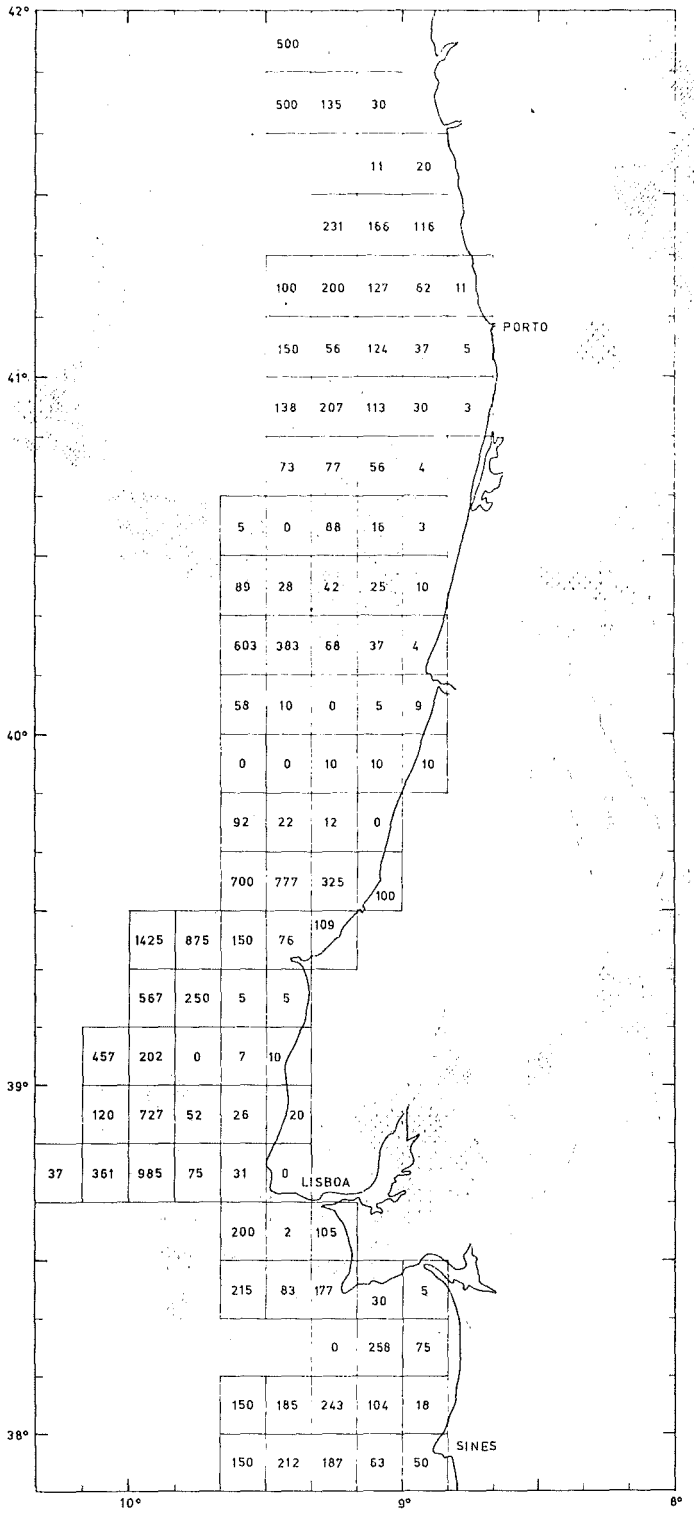

Fig. 14 Coast of Portugal. Plankton abundance. Relative units.

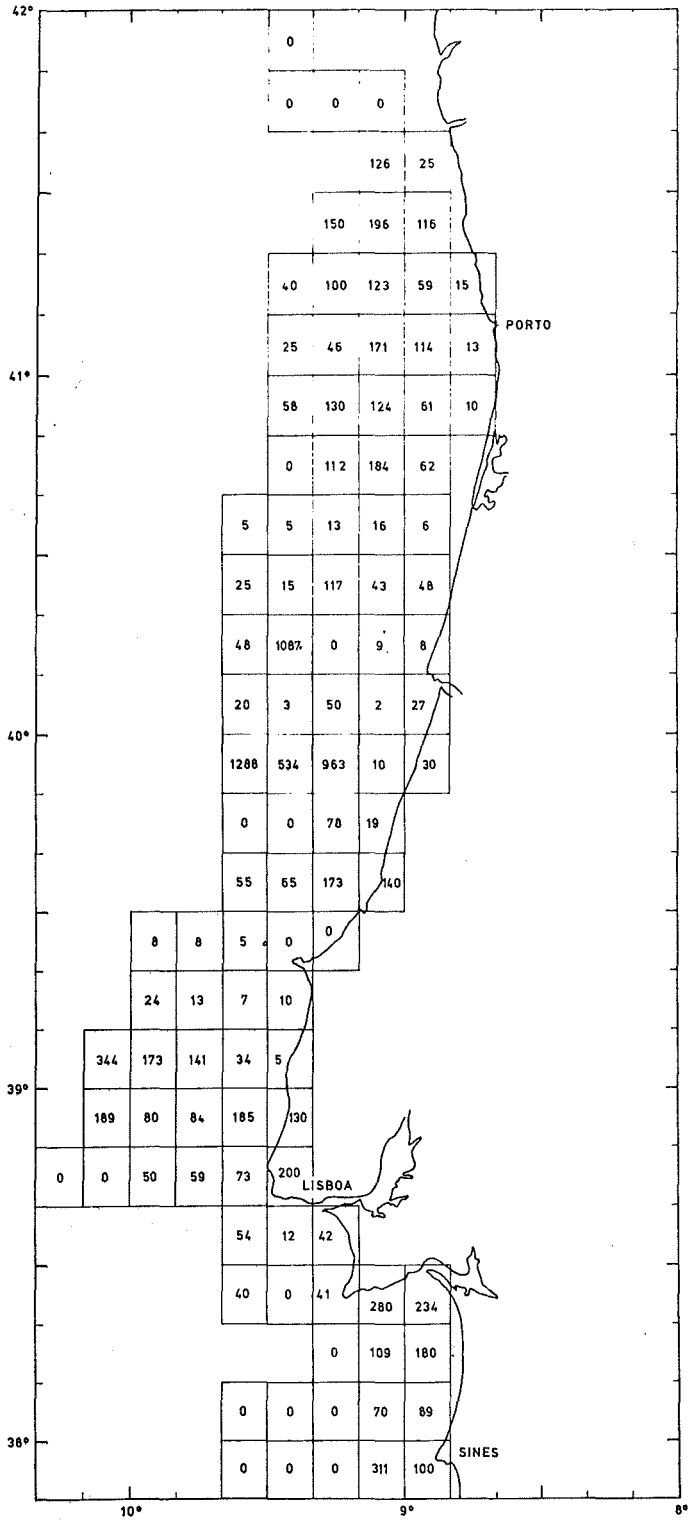

Fig. 15 Coast of Portugal. Fish abundance. Relative units.

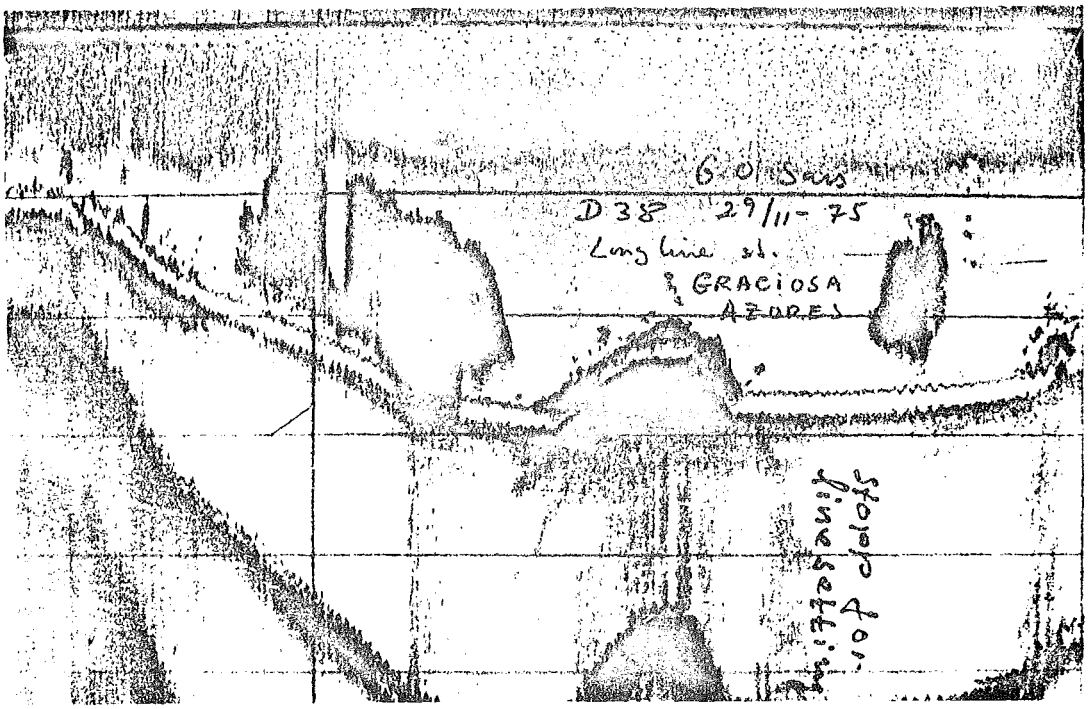

Fig. 16 Echo recordings from long line station near Graciosa, Acores.

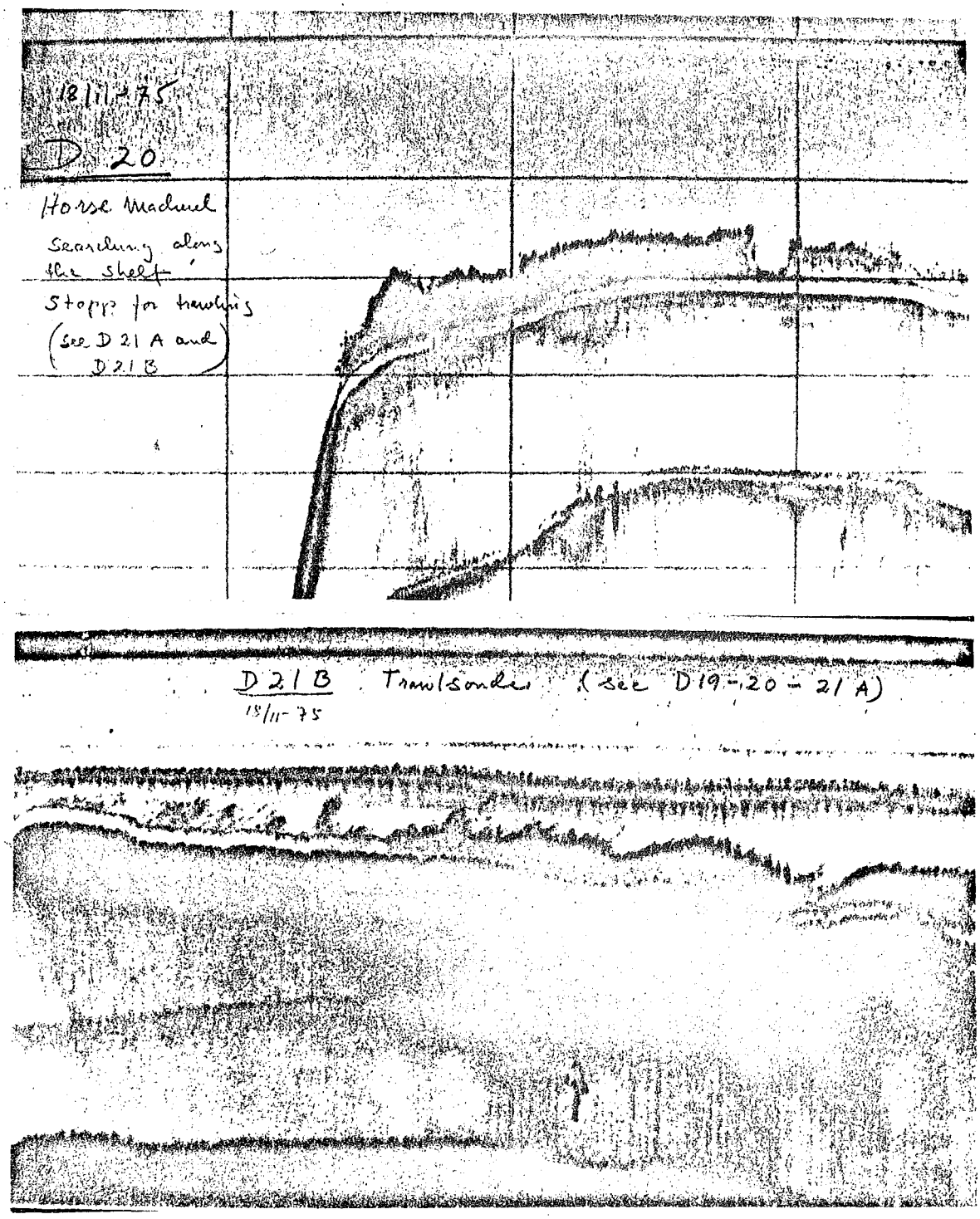

Fig. 17. Echo recordings from pelagic trawl station.