Trawl surveys with the double-rigged trawl net were conducted three times. The surveys were conducted in depths of from 50 to 150 m, but the third survey had an expanded Region including depths of up to 200 m. There were 50 survey stations, with the positioning of stations and the method of operation based upon those of the single-rigged trawl survey. These surveys differed from the single-rigged surveys in that they were conducted at night. Actual survey stations were almost according to the plan, being from 50 to 55 in number. Figs. 7 and 8, as well as Appendix Tables 4, 5a, and 5b present the survey dates, positions, and records of all single- and double-rigged trawl surveys. In addition, the species of fish for which biomass were estimated in the single- and double-rigged trawl surveys are shown in Tables 16 and 17, respectively.

(2) Methods of fish biomass estimation

Based on stratified random sampling method, biomass (stock size in weight) and the coefficient of variation are estimated in the following formulas.

$$dij = Yij \cdot \overline{a} / aij$$

$$Bi = Ai \cdot \overline{d}\,i / \overline{a}$$

$$SBi = Ai \frac{Sdi}{\sqrt{ni}} / a$$

$$B = \Sigma\, Bi$$

$$SB = \sqrt{\Sigma\, SB^2}$$

$$C.V. = SB/B$$

Where dij=catch per mean swept area at the j-th station in the i-th stratum, Yij=catch at the j-th station in the i-th stratum, a=mean swept area, aij=area swept by the tow at the j-th station in the i-th stratum, Bi=biomass in the i-th stratum, Ai=area of the i-th stratum, di=mean catch per mean swept area for the i-th stratum, SBi=standard error of biomass in the i-th stratum, Sdi=standard deviation of the catch per mean swept area in the i-th stratum, ni=number of tows in the i-th stratum, B=overall biomass, SB=standard error of the overall biomass, and C.V.=coefficient of variation.

The swept area was calculated as the product of the distance trawled and the width between the net wing tips (for the single-rigged trawl net, this was 11.6 m on the first round, 12.0 m on the second and third rounds, and 14.9 m on the fourth round of the survey; for the double-rigged trawl net it was 24 m). In calculating the biomass, the catch efficiency of the net was assumed to be 1, thus making for an underestimated value.

Each species has its own peculiar ecology (population structure, horizontal and vertical distributions, diurnal activities, reaction to net, etc.), and this means that in actuality with the fishing equipment presently being used it is almost impossible to have a catch efficiency of 1. Furthermore, the catch efficiency of even the same equipment will vary greatly depending upon the species of fish. This efficiency is extremely difficult to determine. Due to these circumstances, therefore, the equipment is

generally used with an assumed efficiency of 1. Let us note here that if the efficiency is 2/3 or 1/2, the values estimated under an assumed efficiency of 1 become, respectively, 1.5 and 2 times what they would have been.

③ Selection of principal species for biomass estimation

Principal species were selected for the single-rigged trawling by assuming these species to be those for which 10 kg or more were taken by one haul in the first round of the survey (standardized data), and for the double-rigged net they were determined to be the most common species; the numbers of species were 28 and 29 for the single- and double-rigged trawl nets, respectively (see Appendix Tables 6 and 7).

④ Estimated biomass

A. Single-rigged trawl net

i Total biomass

Table 16 shows the survey results for the 28 principal species, and for the total biomass to which other species have been added, for the four surveys in each Region and each depth zone. Following are the total biomass estimates.

First round (November through January):	20,633 tons
Second round (January, February):	22,880 tons
Third round (June, July):	59,372 tons
Fourth round (September, October):	47,888 tons

The figures vary widely from 20,000 to 60,000 tons, but this may indicate seasonal changes in stock size. It may be an indication of the movements of migrating demersal species, which shall be treated below. Subtracting the figures for *Pleuronectodes sp.*, *Peprilus snyderi*, and *P. medius*, which have plentiful biomass, the values for the first through the fourth rounds of surveys are, respectively, 12,147 tons, 14,128 tons, 26,084 tons, and 15,625 tons, thus not showing such great variation.

The biomass by depth zone reflect the distributions of species with large catches. Biomass are greatest at 150 to 200 m, relatively high in the 200 to 300 m and 100 to 150 m depths, followed by depths of 75 to 100 m, 50 to 75 m, 300 to 400 m, and 400 to 500 m. Extremely few fish were taken below depths of 300 m. It is also noteworthy that the value for 50 to 100 m is small.

The ratios of the biomass by Region are as follows: Region 1, 60 to 82%; Region 2, 14 o 17%; and Region 3, 4 to 17%. Biomass in Region 1 are overwhelmingly large. Also, densities (catch per unit of area swept) by Region were, for Region 1, 11.6 to 28.0 tons/n.m^2; for Region 2, 6.1 to 21.1 tons/n.m^2; and for Region 3, 2.8 to 28.8 tons/n.m^2. The density for all Regions combined was 9.25 to 26.6

tons/km^2, with the density by area showing a trend in which Region 1 was the greatest, followed in order by Regions 2 and 3.

Comparisons with existing data shows the following.

During the months of February and March, May and June, August and September, and November and December, 1987, the FAO (NORAD/UNDP/FAO Program) conducted four trawling and acoustic surveys of demersal and pelagic fish biomass in the waters from Mexico to Colombia. According to the results obtained, demersal fish biomass for the entire Pacific Region off Costa Rica were estimated at 14,000 tons, and pelagic fish biomass at 81,000 tons (Table 18).

Compared with other waters, demersal fish abundance is moderate, and density value (CPUE) (excluding *Pleuroncodes sp.*) for 0 to 200 m and 150 to 500 m is second only to those for Nicaragua and eastern Panama. This same survey, by dividing the area off Costa Rica into two sections, north and south, with a westerly line from Cabo Blanco and calculating the CPME, came up with 481 kg for the north, and 534 kg for the south (both values exclude *Pleuronectodes sp.* and Langostino). Thus, since our survey corresponds roughly to the north section of the FAO survey, it would not be far in error to consider demersal fish biomass for the entire Pacific Region off Costa Rica to be about twice the estimated value for total biomass which we obtained.

ii Estimated biomass by species

Table 16 shows the estimated biomass by species, depth, and ocean region.

The order follows that of the greatest values during the four rounds of surveys. The six fish species for which values of 1,000 tons or greater were obtained are *Pleuronectodes sp.*, 7,236 to 17,624 tons; *Peplirus snyderi*, 357 to 17,496 tons; *Peprilus medius*, 58 to 9,556 tons; *Argentina aliceae*, 1,429 to 7,947 tons; *Prionotus stephanophrys*, 329 to 4,300 tons, and *Merliccius angustimanus*, 352 to 2,215 tons. All of them exhibit great seasonal variation. Except for *Prionotus stephanophrys*, a common characteristic is that many of them are found in the Region 1 deep layer of 100 to 300 m.

The six species which had values of 500 tons or greater were *Citharichthys platophrys*, 191 to 945 tons; *Epinephelus nigritus*, 18 to 901 tons; *Pontinus sierra*, 430 to 713 tons; *Loligopsis diomedeae*, 163 to 636 tons; *Mustelus lunulatus*, 177 to 517 tons; and *Trichiurus nitens*, 81 to 506 tons.

The rest are less than 500 tons. The principal species include *Heterocarpus vicarious* at 6 to 338 tons, which was found mainly in depth zone of 200 to 300 m, and particularly at 300 to 400 m; *Solenocera agassizii*, with values of 93 to 147 tons, was plentiful in the 150 to 300 m depth range. On the other hand, *Penaeus brevirostris* was 5 to 24 tons, and *Penaeus californiensis* was 0 to 1 ton,

making for extremely low biomass of shallow water-dwelling shrimps.

It is also important to note the small stock sizes of Serranidae and Lutjanidae, which are sought most by artisanal fishermen.

iii Biomass and distributions of each species by depth

Fig. 18 shows the biomass distributions of each species by depth zone, with the data arranged beginning in the shallow layers.

The species found in the shallow layer of 50 to 75 m are *Calamus bachysomus*, *Lutjanus peru*, *Pomadasys branikii*, and *Selene oerstedii*, etc.

Common species in depth zone of 75 to 100 m are *Mustelus lunulatus*, *Paralabrax loro*, and *Selene peruviana*. Common fish in the depth zone of 75 to 150 m were, among others, *Prionotus stephanophrys* and Portunidae.

A great many species of fish were found in depth zone of 100 to 150 m, including *Cithrichthys platophrys*, *Diplectrum eumelum*, *Epinephelus nigritus*, *Hemanthias peruanus*, *Lologopsis diomedeae*, *Peprilus medius*, *Peprilus snyderi*, *Brotula clarkae*, and *Synodus scituliceps*.

Common species in depth zone of 150 to 200 m were *Argentina aliceae*, and *Trichiurus nitens*; common in depth

zone of 150 to 300 m were species such as *Solenocera agassizii*.

Common in depth zone of 200 to 300 m were species such as *Heterocarpus vicarius*, *Pleuronetodes sp.*, *Merluccius angutimanus*, *Pontinus sierra*, and *Physiculus rastrelliger*.

Hardly any species are common in depths of more than 300 m, but those found here are, for example, *Heterocarpus vicarius*, *Merluccius gayi*, and *Physiculus rastrelliger*.

As noted above, total biomass by depth zone reflect the extent of biomass by species; biomasses are greatest in depth zone of 150 to 300 m, followed in order by depth ranges of 100 to 150 m, 75 to 100 m, 50 to 75 m, 300 to 400 m, and 400 to 500 m.

B. Double-rigged trawl net

The structure of the double-rigged trawl net differs from that of the single-rigged net, and the surveys were conducted at night; in addition, the surveyed depths were limited to 50 to 150 m (200 m in the third round of survey). Therefore, as the species and amounts captured are considerably different, we would like to limit the quantitative assessment to a reference for the single-rigged trawling assessment.

i Total biomass

The following estimates were obtained for total biomass (Table 17).

First (December and January): 1,491 tons (50 to 150 m)
Second (February and March): 1,096 tons (50 to 150 m)
Third (July and August): 5,396 tons (50 to 200 m)

Biomass by depth zone were, in order from greatest to least, 150 to 200 m, 100 to 150 m, 75 to 100 m, and 50 to 75 m, thus showing that biomass lessened as depths became shallower.

Biomasses by Region were greatest in Region 1, followed in order by Regions 2 and 3.

ii Biomass by species

Table 17 shows estimates for each of 29 species by depth and Region.

The species with values of 100 tons or more were *Solenocera agassizii, Pontinus sierra, Physiculus nematopus, Cytharichthys platophrys, Brotula clarkae, Prionotus stephanophrys,* and *Penaeus brevirostris.* It is worthy of note that *Solenocera agassizii* showed values of 105 to 477 tons.

The species with values of 50 tons or more were *Hippoglosina tetrophthalmus*, *Synodus evermanni*, *Synodus scituliceps*, and *Mustelus lunulatus*. The other 18 species were all less than 50 tons.

iii Biomass and distributions of each species by depth

Species distributed abundantly at depth zone of 50 to 75m included *Cyclopsetta panamensis*, *C. querna*, *Haemulon maculicauda*, *Lutjanus argentiventris*, *L. guttatus*, *Penaeus californiensis*, *Pomadasys macracanthus*, *P. branickii*, and *P. panamensis*.

The species *Panaeus brevirostris* is widely distributed in depth zone of 50 to 100 m, and species such as *Synodus evermanni* and *Prionotus stephanophrys* are widely distributed in depth zone of 50 to 200 m.

Species which are abundant at 75 to 100 m include Camaron colindra, *Cynoponticus coniceps*, *Diplectrum eumelun*, *Hippoglossina tetrophthalmus*, *Lutjanus colorado*, *Portunidae* sp., *Paralabrax loro*, and *Synodus scituliceps*.

Species which are abundant at 100 to 200 m include *Cytharichthys platophrys*, *Pontinus sierra*, *Solenocera agassizii*, *Physiculus nematopus*, and *Brotula clarkae*.

(8) Catch on experimental basis using bottom long lines and shrimp pots

In areas where it was impossible to trawl, i. e., reef zones and the vicinity, the survey conducted with bottom long line type 1 (25 times), bottom long line type 2 (26 times), and shrimp pots (23 times) (Fig.9). As many as 50 species were taken by these three types of gear (Table 19). The fish taken by the two long lining gear included such demersal fish as *Caulolatilus affinis*, Serranidae, *Lutjanus*, and Scorpaenidae, as well as pelagic fish such as those from the family Scombridae; these fish were of large varieties. To be noted in particular here is the fact that quite a number of pelagic species were taken. Results on catch efficiency for bottom long lines type 1 and type 2 show that the latter is superior (Table 20), but it is not possible to make any definite conclusion concerning efficiency on the basis of the data from this survey alone.

In the test with shrimp pots, many *Opichthus pacificus* and *Gymnothorax equatorialis* were taken in depths of less than 200 m, but not very many Penaeidae were taken. However, at 200 to 300 m *Heterocarpus* sp. and Calappidae were taken, albeit in small numbers.

Enhanced catches can probably be expected with improvements in the equipment for bottom long lining, by searching out good fishing grounds, and by modifying operating techniques (such as shortening the time for placing of equipment). It would seem that, for the present, one should not have good hopes for shrimp pots.

(9) Changes in catch by day and night with the single-rigged trawl net

In estimating demersal fish stock sizes in this survey, we used mainly data obtained in daytime operations with the single-rigged trawl net, and as a reference we used the data obtained in night operations with the double-rigged trawl net. It is known that, in general, the behaviors of marine organisms are different for day and night, that is to say, they have diurnal activities. Thus, in performing a quantitative assessment using data from daytime operations, it was necessary to ascertain the actualities of diurnal activities for the species sought, and to consider the catch efficiency of the fishing equipment used. However, it is extremely difficult to determine catch efficiency. An attempt was made to learn something of the diurnal activities of the principal species by repeating operations at the same location every four hours.

① Survey method

The survey was conducted three times on July 21 and 22, September 22 and 23, and October 1 and 2. As a general rule, a 30-minute tow with a single-rigged trawl net repeated seven times at four-hour intervals during both day and night times. The surveyed depth was about 100 m, and the survey was conducted one time each in Regions 1, 2, and 3. Appendix Table 8 is a record of the survey. In addition, the catches are standardized for a 30-minute tow. On account of insufficient data, the analysis was performed

by grouping one to three operations and making divisions only to night and day. Day and night distinctions were made by considering the period from first light through daylight hours to twilight to be day, and all other times to be night. The number of tows by day and night hours are as shown below.

	Region 1	Region 2	Region 3	Total
Day	4	3	4	11
Night	3	3	3	9
Total	7	6	7	20

② Survey results

More than 60 species of fish were taken in this survey (Appendix Table 8), but the analysis was performed on the 11 principal species so far taken at a depth of approximately 100 m. Table 21 shows the number of stations where fish were found by day/night and species, the average catch, and the standard deviation. Judging by this table, the differences in catch by day/night are as follows.

i Species often taken during the day

Loligolopsis diomedeae (Calamar)
Peprilus medius (Salema)
P. snyderi (Salema)

ii Species often taken at night

Brotula clarkae (Congrio)
Physiculus nematopus
Solenocera agassizii (Camaron fidel)

iii Species for which a day/night distinction was not discerned

Citharichtys platophrys (Lenguardo)
Musutelus lunulatus (Tiburon)
Portunidae sp.
Prionotus albirostris (Cabro)
P. stephanophrys (Cabro)

The totals for these 11 species shows that daytime catches were much higher (on the whole, the result obtained was the same as past information). There were also, however, some species of fish for which catches are left unclear by the data from this survey due to the small number of tows made, the large variations, and other factors. It is therefore hoped that a substantial, carefully planned survey be conducted on these species in future.

(10) Distribution and ecology of larvae of principal species (CIMAR)

(Now under analysis by CIMAR)

(11) Fluctuations in abundance as indicated by fisheries statistics

There is insufficient data regarding Costa Rican fisheries production, thus making it impossible to perform an adequate analysis, but conjectures using the data for 1982 to 1986 yields the figures below (Table 22).

Catch by major categories (tons):

fish	(8,000 - 13,000)	increase in recent years
white-meat fish	(5,000 - 9,000)	increase in recent years
sardines	(1,000 - 2,000)	large fluctuation
skipjack/tuna	(200 - 15,000)	declining recently
sharks	(700 - 900)	little fluctuation

This indicates that fishing principally for white-meat fish is flourishing.

crustaceans/ mollusks (total)	(4,000 - 8,000)	tends to increase
shrimp	(3,000 - 8,000)	recent large increase
squid/octopus/ shellfish	(50 - 140)	small quantities

There is a major dependence upon shrimp within crustaceans and mollusks.

Catch by subcategories (tons):

fish (total)	(8,000 - 13,000)	
white-meat fish	(5,000 - 9,000)	increase in recent years
large high-ranked fish	(470 - 300)	tends to diminish
small high-ranked fish	(1,500 - 1,700)	stable
sorted fish	(1,700 - 600)	tends to diminish
misc. fish	(1,300 - 4,000)	steady state, but rapid increase in 1985
catfishes	(700 - 900)	stable
groupers	(700 - 1,300)	diminishing
high-ranked snapper	(500 - 1,200)	tends to increase

Exact determinations are difficult without examining catches by species in detail, but there is a trend toward diminishing biomass of high-ranked fish with a high marketability, while there is a trend toward increases in catches of fish which would seem to have a low marketability. It might be said that the increase during recent years in the production of white-meat fish is dependent upon fish with a somewhat low marketability. Inasmuch as most of the high-ranked fish find their habitats in rocky Regions, the decrease in catches urges attention with regard to stock status.

	(tons)	
crustaceans/ mollusks	(4,000 - 8,000)	tends to increase
shrimps (total)	(3,000 - 8,000)	increase in recent yrs
white	(150 - 850)	rapid increase in 1986
brown	(12 - 70)	"
pink	(500 - 1,000)	"
fidel	(1,100 - 5,000)	increase in recent yrs
chakarin	(500 - 900)	"
deep-sea shrimp (camello)	(0-1,300)	"

High-ranked shrimps living in shallow waters decreased rapidly from a peak in 1984 and 1985, and in their place the deep-sea shirimps with low marketability, fidel and camello, have showed rapid increases, and these may therefore support the total shrimp catch. This is quite apparent from the shift of shrimp trawlers out of the coastal Regions to the deeper offshore fishing grounds.

Most shrimp have short lifespans, whereby fluctuations in quantity are strongly affected by environmental variations, and this results in large annual fluctuations. However, by our conjectures, one cannot ignore the effects of over-fishing in the declining of shallow-dwelling shrimp during recent years.

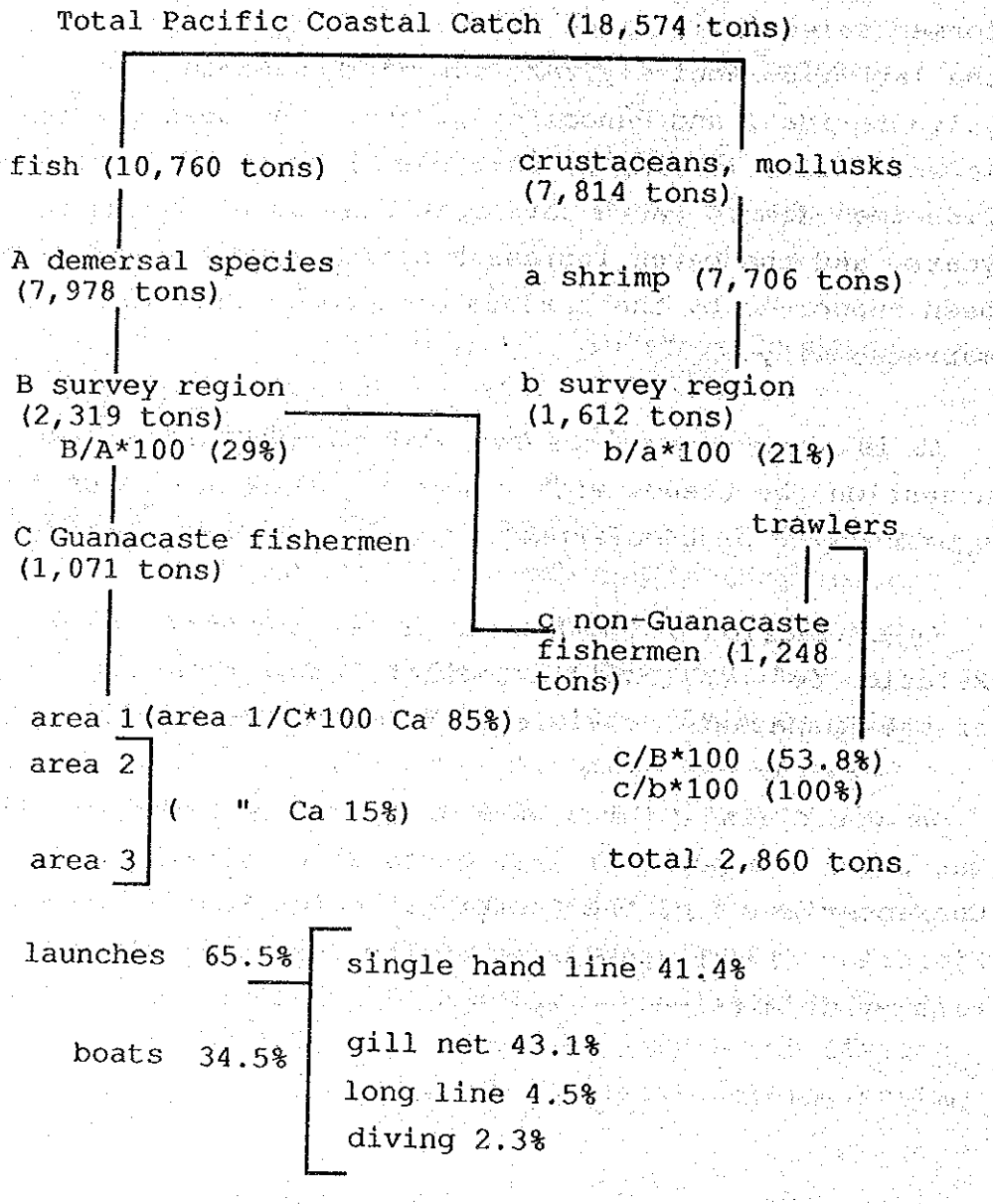
To express this in another way, Costa Rican fisheries production is based principally upon small-scale coastal fishing (handlining, gill netting, long lining, etc.) and shrimp trawling, which take mainly demersal species. The

former selectively catch Serranidae, Lutjanidae, etc., and the latter selectively take shrimp (Penaeidae, Solenoceridae, and Pandalidae), etc. The species with high marketability (shrimp in particular) which both groups of fishermen aim to catch have been decreasing during recent years, and the catch increases during recent years have been supported by the catches of species with low marketability.

It is necessary to observe with particularly close attention the trends with regard to stock status of fish species with high marketability.

An Evaluation of Production in the Surveyed Region in Relation to total Pacific Coastal Fisheries Production, and of the Guanacaste Province Fishermen's Production

We would like to make some conjectures concerning this matter on the basis of 1985 catch statistics, and Characteristics of the Chorotega Region Pacific Coastal Fisheries (1986), published by the Chorotega Regional Fishing Commission.


Total Pacific Coastal Catch (18,574 tons)
fish (10,760 tons)
crustaceans, mollusks (7,814 tons)
A demersal species (7,978 tons)
a shrimp (7,706 tons)
B survey region (2,319 tons)
B/A*100 (29%)
b survey region (1,612 tons)
b/a*100 (21%)
trawlers
C Guanacaste fishermen (1,071 tons)
c non-Guanacaste fishermen (1,248 tons)
area 1 (area 1/C*100 Ca 85%)
area 2
area 3
(" Ca 15%)
c/B*100 (53.8%)
c/b*100 (100%)
total 2,860 tons
launches 65.5%
boats 34.5%
single hand line 41.4%
gill net 43.1%
long line 4.5%
diving 2.3%

That is to say, the catches of demersal fish species and shrimp in the survey Region are 29% and 21%, respectively, of those on the Costa Rican Pacific coast.

One-half of the catch of demersal species in the survey area is taken by fishermen from Guanacaste Province, and the other half by fishermen from Puntarenas Province.

Guanacaste fishermen take 65.5% of their catch by launches, and 34.5% by boats; in terms of fishing gear the percentages are 41.4% for single hand lines, 43.1% for gill nets, and 4.5% for long lines, namely 85% being taken by single hand lines and gill nets.

The catch in the survey area was, according to the data obtained, 3,931 tons (demersal fish: 2,319 tons; shrimp: 1,612 tons), of which 2,361 tons (60%) were taken by shrimp vessels, and 1,570 tons (40%) were taken by launches and boats.

The demersal fish catch by Puntarenas Province fishermen are calculated at 749 tons by trawlers, and 499 tons by launches and boats.

Since the shrimp trawlers use fine-mesh nets they catch small fish, and there are many instances in which these small fish are discarded at sea. Thus conjecture has it that the shrimp trawlers have a catch substantially larger than the 479 tons of demersal fish.

These conjectures are based upon the data of the aforementioned commission; since much data is inferred there are some problems with reliability.

(12) Conclusion

① Seabed topography and sounding depth

The 200-meter isobath running through the survey area extends from about 10 nautical miles west of Cabo Blanco in a nearly northwesterly direction. Thus the width of the continental shelf is, taking into consideration the configuration of the coast line, narrow in Regions 2 and 3, and wide in Region 1. The depth at the beginning of the continental slope is about 200 m in Region 1, but very shallow at 120 to 140 m in Regions 2 and 3. In addition, the slope is characterized by its steepness and its very irregular topography. The area percentage of each Region in total 2,229 n.m^2 surveyed (50 to 500 m) is: Region 1, 65%; Region 2, 21%; and Region 3, 14%.

Most of the continental shelf seabed is mud, but reefs are scattered throughout Regions 2 and 3 (Figs. 10a, 10b, and 10c). The detailed maps of depth and seabed composition obtained in this survey will be useful for commercial fisheries operations.

② Guardian banks

Two searches were made for the Guardian banks during the survey, but we were unable to confirm their existence. It will be necessary in the future to confirm their existence in a detailed survey.

③ Oceanographic conditions

i It is thought that the surface layer in the survey area is affected all the year by the North Equatorial Countercurrent which flows east into the area and then north at the Costa Rican coast (Costa Rica Current, high temperature, low salinity), and that in the winter it is affected in the northern Region by the southward flow of the California Current.

ii The lower layers are affected all the year round by the Costa Rica Dome (low temperature, high salinity, low oxygen, high nutrient salts).

iii Between the surface and lower layers is a marked thermocline with a great temperature gradient. It appears to begin at depths of 10 to 20 m, and to extend to depths of 50 to 75 m. This means that the surface layer is very thin, and that the upwelling of the lower layer extends up to shallow depths.

iv Based upon the relationship between water temperature and oxygen content, the following benchmarks can be effected for the distinctions among the water masses of surface and lower layers: for 26°C or more, about 6 ml/l oxygen; for 18°C, 2 ml/l.

v No trends toward temperature differences in particular were discerned among the Regions within the survey area. This suggests that there are monthly or seasonal variations in the places where the Costa Rica Dome upwells.

vi The effects of the El Niño phenomenon, which were manifested from the autumn of 1986 to 1988, appeared even in the coastal waters of the survey area, and during the period of the manifestation its effects were seen mainly as higher temperatures in the surface layer and thermocline.

vii It is conjectured that the Costa Rica Dome water mass upwell extends to shallow depths, and that the way in which it approaches the coast largely affects the distribution and ecology of demersal fish dwelling in the lower layer.

④ Observed species

Judging by the species distributed in the surface layer, the survey area belongs to the tropics, and from the distribution of the deep-sea family Macrouridae it belongs to the Panama District of zoogeographic division. The single- and double-rigged trawling operations of the survey confirmed the distributions of 80 families and 168 species, as shown in Table 15.

⑤ Size composition of principal species

A total of over 600 size composition measurements were conducted for more than 55 species taken in the single- and double-rigged trawl net surveys. Results show that these species can be roughly classified into some modal types by size composition, but the survey obtained little data, making it possible to infer growth by keeping track of modes by month. The reason for this is thought to be that, as this Region belongs to the tropics thus making for minor seasonal temperature fluctuations, the spawning season of the species here lasts all year, or for long periods of time. Another characteristic of this Region is that there are rather few large body species of 30 cm or more in body length, and that most of these species dwell near the surface or in shallow waters, with hardly any being seen among the deep sea fish. The relationship between such characteristics and the Costa Rica Dome is a task for future research.

⑥ Comparison of catches for day and night with the single-rigged trawl net

As a way of assisting the elucidation of the diurnal activities of fish species and estimating catch efficiencies, continuous day/night catch tests were conducted three times, but with the small number of operations it was not possible to obtain satisfactory results. However, fish species can be roughly classified by whether they are taken mostly during the day, at night,

or whether there is no day/night difference. This is thought to be an indication of different swimming depths for day and night. Thus it is possible to regard this as showing that catch efficiencies with the equipment used in this survey differ by species, meaning that the catch efficiency cannot be 1.

⑦ Catch by two types of bottom long lines, and shrimp pots on experimental basis

A test survey was conducted with the above three kinds of gear in the rocky-bottomed Regions where it was not possible to conduct a trawling survey, and results of great interest were obtained. With the two bottom long lines, we caught 11 to 17 demersal and pelagic fishes of 14 to 24 kg in weight per 100 hooks. Although the few number of tests during this survey precludes definite statements, one might very well be able to expect improved production by making improvements in the selection of fishing grounds, deployment time, and number of lines set out.

⑧ Biomass estimation for demersal fish

A Survey method

The swept Region method was used for estimating the biomass, and stratified random sampling was applied in selecting the survey stations. The survey consisted of single-rigged trawling (repeated four rounds) and double-rigged trawling (three rounds).

B Estimated total biomass

The estimated value for total species biomass at depth range of 50 to 500 m in the survey area with the single-rigged trawl net (daytime) is 20,000 to 59,000 tons. As this value assumes a catch efficiency of 1, it is in any case an underestimate. There was considerable variation among the estimated values for each of the four rounds of survey, and this depends substantially on the number of migrating species of which many are taken.

C Comparisons of total biomass and distribution density with other areas

According to the biomass survey covering various areas which was conducted from Mexico to Colombia by the 1987 NORAD/UNDP/FAO Program, demersal fish biomass for depths of less than 500 m in the total Pacific Region off Costa Rica were estimated to be 14,000 tons (pelagic fish biomasses were 81,000 tons). Demersal fish biomass of 14,000 tons is not a large value when compared with other Regions in the same survey.

However, the catch per hour towed with the same equipment and same method of operation shows the highest value after Nicaragua and eastern Panamá (Table 18).

The distribution densities for the Costa Rican Pacific Region as divided into north and south by a westerly line from Cabo Blanco show almost the same values for both the

north and south sections. Therefore the total demersal fish biomass for the Costa Rican Pacific Region are roughly estimated to be more than about twice the total estimated demersal fish biomass in the survey area.

Distribution density in the survey area is estimated at 9.3 to 26.6 tons per 1/nm^2. This is lower than those for distribution densities obtained in surveys of Argentina's mid-latitude Patagonia Region, which is said to be an excellent fishing ground, and the New Zealand area, which were conducted on almost the same scale with regard to vessels and equipment (Table 23).

D Biomass estimation by species

Biomass by Region and depth zone were calculated for 28 species on the basis of data from single-rigged trawling, and 29 species on the basis of data from double-rigged trawling.

Estimated biomass by species for single-rigged trawling yielded values of 1,000 tons or more for six species including *Pleuronectodes* sp., two species in the genus *Peprilus*, *Argentina aliceae*, and *Prionotus stephanophrys*. Biomasses are low for species of fish with a high marketability in Costa Rica, such as those from the families Serranidae and Lutjanidae. There were also very low estimates for species such as *Penaeus brevirostris* and *Penaeus californiensis*, those which shrimp trawlers target. Thus it can be said that species with low marketability

show high values, while those with high marketability show low values.

Biomass for each species by Region were greatest for Region 1, followed in descending order by Regions 2 and 3. The particularly high ratio for Region 1 is conspicuous.

⑨ Distribution of demersal fish

Appendix Figs. 4 and 5 show the catch (standardized) at all survey stations in the single- and double-rigged trawl net surveys.

As the figures clearly show, there are few survey stations on the continental slope, with the low number of species caught and the low catches being characteristic. This survey therefore sees little possibility for development in the deep Regions of this Region. It may also be said that each species is distributed in its own particular habitat depth zone. In other words, they are thought to live by habitat segregation.

It also appears as though there is a relationship between the distribution of species living in deep waters and oceanographic conditions, particularly the Region where the upwelling of the Costa Rica Dome makes contact with the coast, but an adequate analysis was not possible. This is a task for future research.

⑩ Stock trends based upon fisheries statistics

A. The main portion of Costa Rica's fisheries production is on the Pacific coast.

B. Fishery consists mainly of small-scale fishing by gill netting, long lining, or handlining from boats and

launches, as well as large-scale shrimp trawling. All shrimp trawling is based in the port of Puntarenas.

C. According to the seasons, the small-scale fishing industry uses whatever methods are appropriate from among those listed above, and selectively take species with a high marketability in domestic and foreign markets. On the other hand, shrimp trawlers take mainly shrimps.

D. An analysis of fisheries statistics for 1982 to 1986 yields the following.

i The catch of white-meat fish (mainly demersal species) tends to increase year by year, but that of large, high-ranked fish with high marketability tends to decrease. This is thought to engender the increase in the catch during recent years of species with a low marketability. Many large and small high-ranked fish with high marketability are species which generally live in the reef zones. In the future, therefore, it will be necessary to closely monitor stock trends.

ii During recent years there has been an explosive increase in the shrimp catch. However, an examination by species shows that shallow-dwelling high-grade shrimps are decreasing, and that increasing in their places are the deep-dwelling, low-marketability species fidel and camello. This

is a veracious indication of the shrimp trawlers' switch of fishing grounds from the coastal areas to the deep waters. It is not an overstatement to say that the future situation for shallow-dwelling shrimps gives cause for worry, and this means that shrimp trawlers do not face a bright future.

iii On the other hand, most offshore demersal fish biomass remain in an almost unexploited state.

iv The above leads to the conclusion that Costa Rica's demersal fish resources are, unlike other resources, underexploited, thus making for an extremely unbalanced state.

Table 16 Biomasses by Species, Round of Survey, Region and by Depth Zone, Estimated from Single-Rigged Trawl Survey

Species (30) All species

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	405	702	2664	7081	5984	133	-	16970
	2	69	163	912	1484	222	-	-	2850
	3	325	37	198	-	-	241	11	812
	Total	800	902	3774	8565	6206	374	11	20633
									(C.V. = 15 %)
II	1	148	499	1195	7887	4011	55	-	13769
	2	155	265	1700	743	4686	-	-	7546
	3	111	121	217	785	262	12	30	1538
	Total	414	885	3112	9415	8958	67	30	22880
									(C.V.= 19 %)
III	1	332	1247	4209	30950	4021	2	-	40761
	2	222	233	2385	2474	4634	-	-	9948
	3	347	955	5472	1485	384	8	13	8064
	Total	900	2436	12066	34009	9040	10	13	59372
									(C.V.= 16 %)
IV	1	181	213	5298	9777	13946	3317	-	32733
	2	136	1042	2980	1088	1587	-	-	6834
	3	157	5363	2597	71	107	7	-	8320
	Total	493	6619	10875	10937	15641	3324	0	47888
									(C.V.= 15 %)

Species (10) 10 Hunidae (Pleuronectodes sp.) コミガリエビ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	0	0	2674	4538	12	-	7223
	2	0	2	0	0	4	-	-	6
	3	0	0	0	-	-	16	0	16
	Total	0	2	0	2674	4542	27	0	7244
									(C.V. = 34 %)
II	1	0	0	0	4511	0	0	-	4511
	2	0	0	0	196	3622	-	-	3817
	3	0	0	0	0	0	0	0	0
	Total	0	0	0	4707	3622	0	0	8329
									(C.V.= 46 %)
III	1	0	0	0	3997	2389	0	-	6386
	2	0	0	0	22	827	-	-	650
	3	0	0	0	0	0	0	0	0
	Total	0	0	0	4019	3216	0	0	7236
									(C.V.= 37 %)
IV	1	0	10	0	2773	11260	3317	-	17360
	2	0	0	0	4	269	-	-	273
	3	0	0	0	0	9	0	-	9
	Total	0	10	0	2777	11538	3317	0	17642
									(C.V. = 29 %)

Table 16 Continued

Species (17) 17 Peprilus snyderi シス

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	12	13	94	824	0	0	-	944
	2	2	10	3	19	0	-	-	34
	3	7	0	9	-	-	0	0	16
	Total	21	23	106	843	0	0	0	994
								(C.V. = 43 %)	
II	1	30	13	91	101	44	0	-	280
	2	0	4	57	3	5	-	-	70
	3	0	0	3	5	0	0	0	8
	Total	30	18	151	109	49	0	0	357
								(C.V.= 22 %)	
III	1	38	226	93	13354	3	0	-	13714
	2	6	2	151	19	6	-	-	184
	3	23	807	1768	0	0	0	0	2598
	Total	67	1034	2013	13373	9	0	0	16496
								(C.V.= 46 %)	
IV	1	0	0	2333	1898	273	0	-	4504
	2	0	367	1250	71	3	-	-	1697
	3	0	1310	1832	0	0	0	-	3142
	Total	0	1677	5415	1969	276	0	0	9343
								(C.V. = 26 %)	

Species(16) 16 Peprilus medius シス

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	2	7	177	53	0	0	-	239
	2	0	4	0	4	0	-	-	9
	3	0	0	0	-	-	0	0	0
	Total	3	11	177	57	0	0	0	248
								(C.V. = 42 %)	
II	1	1	3	23	0	0	0	-	27
	2	0	0	30	0	0	-	-	30
	3	0	1	1	0	0	0	0	1
	Total	1	4	58	0	0	0	0	58
								(C.V.= 56 %)	
III	1	8	30	798	7143	0	0	-	7980
	2	0	0	1	0	0	0	-	1
	3	0	0	1574	0	0	0	0	1575
	Total	8	31	2373	7143	0	0	0	9556
								(C.V.= 42 %)	
IV	1	0	2	2374	1924	82	0	-	4382
	2	5	41	95	0	0	-	-	141
	3	0	245	509	0	0	0	-	754
	Total	5	289	2978	1924	82	0	0	5278
								(C.V. = 37 %)	

Table 16 Continued

Species (1) 01 Argentina aliceae ニギス

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	107	806	487	0	-	1400
	2	0	1	266	921	23	-	-	1211
	3	0	0	12	-	-	0	0	12
	Total	0	1	385	1727	509	0	0	2623
									(C.V. = 20 %)
II	1	2	0	127	1976	75	0	-	2181
	2	0	0	2	405	557	-	-	964
	3	0	0	0	691	137	0	0	828
	Total	2	0	129	3073	763	0	0	3972
									(C.V.= 33 %)
III	1	0	0	25	2778	120	0	-	2923
	2	0	0	363	1366	3060	-	-	4789
	3	0	0	78	152	6	0	0	235
	Total	0	0	465	4296	3186	0	0	7947
									(C.V.= 40 %)
IV	1	0	0	43	992	160	0	-	1194
	2	0	0	225	4	0	-	-	230
	3	0	0	3	2	0	0	-	5
	Total	0	0	271	998	160	0	0	1429
									(C.V. = 64 %)

Species (28) 28 Prionotus stephanophrys ホ-ボ-

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	14	73	1676	1547	0	0	-	3309
	2	4	4	0	0	0	-	-	8
	3	3	7	0	-	-	0	0	10
	Total	20	84	1677	1547	0	0	0	3327
									(C.V. = 40 %)
II	1	6	110	34	59	0	0	-	208
	2	0	18	20	0	0	-	-	38
	3	0	41	41	0	0	0	0	82
	Total	6	168	96	59	0	0	0	329
									(C.V.= 37 %)
III	1	112	93	1504	2	0	0	-	1711
	2	17	2	0	0	0	-	-	18
	3	0	1	1621	0	0	0	0	1022
	Total	129	96	3125	2	0	0	0	3352
									(C.V.= 64 %)
IV	1	130	151	3	0	0	0	-	283
	2	3	4	520	0	0	-	-	520
	3	6	3481	4	0	0	0	-	3491
	Total	138	3635	527	0	0	0	0	4300
									(C.V. = 79 %)

Table 16 Continued

Species (12) 12 Herluccius angustimanus ｽﾒﾗｼﾞ

Survey No.	Region	Depth (m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	0	0	278	114	67	-	459
	2	0	1	2	363	19	-	-	385
	3	0	0	0	-	-	58	0	58
	Total	0	1	2	641	133	125	0	902
									(C.V. = 21 %)
II	1	0	0	5	33	30	28	-	96
	2	0	0	4	47	177	-	-	228
	3	0	0	0	10	18	0	0	28
	Total	0	0	10	90	225	28	0	352
									(C.V.= 32 %)
III	1	0	0	0	150	45	0	-	196
	2	0	0	0	28	162	-	-	190
	3	0	0	0	0	0	0	0	0
	Total	0	0	0	178	207	0	0	385
									(C.V.= 50 %)
IV	1	0	0	0	56	358	0	-	414
	2	0	0	0	817	942	-	-	1759
	3	0	0	0	34	7	1	-	42
	Total	0	0	0	907	1307	1	0	2215
									(C.V. = 27%)

Species(3) 3 Citharichthys platophrys ﾋﾗﾒ

Survey No.	Region	Depth (m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	1	37	47	3	0	0	-	87
	2	0	3	101	0	0	-	-	104
	3	0	0	0	-	-	0	0	0
	Total	1	40	147	3	0	0	0	191
									(C.V. = 31 %)
II	1	0	36	47	21	0	0	-	105
	2	1	24	215	5	0	-	-	244
	3	0	0	3	0	0	0	0	3
	Total	1	60	264	27	0	0	0	352
									(C.V.= 46 %)
III	1	9	220	473	43	0	0	-	745
	2	14	14	125	20	0	-	-	173
	3	1	7	19	0	0	0	0	27
	Total	24	242	616	63	0	0	0	945
									(C.V.= 18 %)
IV	1	1	1	47	22	0	0	-	71
	2	5	290	4	0	0	-	-	298
	3	1	20	11	0	0	0	-	32
	Total	6	311	62	22	0	0	0	401
									(C.V. = 64 %)

Table 16 Continued

Species (5) 5 Epinephelus nigritus ハタ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	0	11	0	0	0	-	11
	2	0	44	14	0	0	-	-	59
	3	0	0	0	-	-	0	0	0
	Total	0	44	25	0	0	0	0	69
									(C.V. = 49 %)
II	1	0	0	11	0	0	0	-	11
	2	0	0	35	0	0	-	-	35
	3	0	0	0	0	0	0	0	0
	Total	0	0	45	0	0	0	0	45
									(C.V. = 75 %)
III	1	0	0	3	0	0	0	-	3
	2	0	11	887	0	0	-	-	898
	3	0	0	0	0	0	0	0	0
	Total	0	11	890	0	0	0	0	901
									(C.V. = 98 %)
IV	1	2	0	0	0	0	0	-	2
	2	1	0	0	0	9	-	-	10
	3	0	4	2	0	0	0	-	6
	Total	3	4	2	0	9	0	0	18
									(C.V. = 57 %)

Species(19) 19 Pontinus sierra アヲカノ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	3	45	87	174	1	-	309
	2	0	0	0	0	138	-	-	138
	3	0	0	0	-	-	0	0	0
	Total	0	3	45	87	312	1	0	448
									(C.V. = 35 %)
II	1	0	0	31	92	334	0	-	457
	2	0	0	7	5	166	-	-	178
	3	0	0	0	15	27	0	0	42
	Total	0	0	38	111	528	0	0	677
									(C.V. = 18 %)
III	1	0	0	24	226	165	0	-	415
	2	0	0	2	11	106	-	-	119
	3	0	0	0	66	114	0	0	179
	Total	0	0	26	302	385	0	0	713
									(C.V. = 25 %)
IV	1	0	0	1	84	226	0	-	311
	2	0	0	7	50	28	-	-	85
	3	0	0	0	0	25	0	-	34
	Total	0	0	8	142	279	0	0	430
									(C.V. = 25 %)

Table 16 Continued

Species (8) 8 Loligopsis diomedeae ヤリイカ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	25	38	38	19	0	0	-	121
	2	2	13	19	0	0	-	-	34
	3	2	6	0	-	-	0	0	8
	Total	28	58	57	19	0	0	0	163
								(C.V. = 17 %)	
II	1	7	20	53	31	0	0	-	110
	2	7	31	31	7	0	-	-	77
	3	4	14	77	0	0	0	0	95
	Total	18	85	162	37	0	0	0	283
								(C.V. = 15 %)	
III	1	62	100	115	17	0	0	-	294
	2	5	19	47	2	0	-	-	73
	3	35	62	172	0	0	0	0	269
	Total	103	180	335	19	0	0	0	636
								(C.V. = 15 %)	
IV	1	0	0	64	6	0	0	-	70
	2	11	4	19	0	0	-	-	35
	3	9	81	44	0	0	0	-	134
	Total	20	86	127	6	0	0	0	239
								(C.V. = 26 %)	

Species(11) 11 Kustelus lunulatus ホシザメ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	12	284	160	36	3	0	-	495
	2	12	3	4	0	0	-	-	19
	3	0	1	2	-	-	0	0	3
	Total	25	287	167	36	3	0	0	517
								(C.V. = 30 %)	
II	1	65	167	61	8	0	0	-	302
	2	28	22	31	0	0	-	-	81
	3	0	2	1	0	0	0	0	2
	Total	93	191	92	8	0	0	0	385
								(C.V. = 17 %)	
III	1	25	71	7	0	0	0	-	103
	2	18	88	61	0	0	-	-	166
	3	125	0	12	0	0	0	0	137
	Total	168	159	80	0	0	0	0	407
								(C.V. = 22 %)	
IV	1	0	0	3	55	0	0	-	58
	2	12	44	2	0	0	-	-	59
	3	28	28	4	0	0	0	-	60
	Total	41	72	9	55	0	0	0	177
								(C.V. = 40 %)	

Table 16 Continued

Species (27) 27 Trichiurus nitens タチウオ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	2	9	440	55	0	-	506
	2	0	0	0	0	0	-	-	0
	3	0	0	0	-	-	0	0	0
	Total	0	2	9	440	55	0	0	506
									(C.V. = 68 %)
II	1	0	0	5	310	11	0	-	326
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	0	0
	Total	0	0	5	310	11	0	0	326
									(C.V. = 26 %)
III	1	0	2	24	268	26	0	-	319
	2	0	0	0	15	6	-	-	21
	3	0	0	0	0	0	0	0	0
	Total	0	2	24	282	32	0	0	340
									(C.V. = 53 %)
IV	1	0	0	1	19	8	0	-	27
	2	0	0	0	14	30	-	-	43
	3	0	0	0	0	10	0	-	10
	Total	0	0	1	33	48	0	0	81
									(C.V. = 44 %)

Species(7) 7 Heterocarpus vicarius カメ-ヴォ(エビ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	0	0	0	148	48	-	196
	2	0	0	0	0	2	-	-	2
	3	0	0	0	-	-	134	0	134
	Total	0	0	0	0	150	182	0	333
									(C.V. = 50 %)
II	1	0	0	0	0	267	0	-	267
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	39	1	1	40
	Total	0	0	0	0	306	1	1	307
									(C.V. = 49 %)
III	1	0	0	0	0	18	0	-	18
	2	0	0	0	0	147	-	-	147
	3	0	0	0	0	173	0	0	173
	Total	0	0	0	0	338	0	0	338
									(C.V. = 64 %)
IV	1	0	0	0	0	6	0	-	6
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	-	0
	Total	0	0	0	0	6	0	0	6
									(C.V. = 100 %)

Table 16 Continued

Species (26) 28 Synodus scituliceps マカエソ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	8	34	18	0	0	0	-	60
	2	10	8	48	0	0	-	-	66
	3	0	1	0	-	-	0	0	1
	Total	18	43	66	0	0	0	0	127
								(C.V. =	34 %)
II	1	2	2	0	0	0	0	-	3
	2	6	3	0	0	0	-	-	10
	3	0	0	0	0	0	0	0	0
	Total	8	5	0	0	0	0	0	0
								(C.V.=	20 %)
III	1	6	42	50	0	0	0	-	98
	2	28	38	30	0	0	-	-	105
	3	3	29	66	0	0	0	0	93
	Total	38	108	156	0	0	0	0	302
								(C.V.=	19 %)
IV	1	0	0	0	0	0	0	-	0
	2	1	0	0	0	0	-	-	1
	3	0	0	0	0	0	0	-	0
	Total	1	0	0	0	0	0	0	1
								(C.V. =	100 %)

Species (20) 20 Portunidae ワタリガニ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	26	22	0	11	0	-	59
	2	0	21	46	0	0	-	-	67
	3	1	8	10	-	-	0	0	18
	Total	1	55	78	0	11	0	0	144
								(C.V. =	23 %)
II	1	1	29	69	0	0	0	-	99
	2	1	61	31	0	0	0	-	93
	3	0	19	46	0	0	0	0	65
	Total	2	109	146	0	0	0	0	257
								(C.V.=	15 %)
III	1	2	1	5	0	0	0	-	8
	2	11	0	0	0	0	-	-	11
	3	7	0	0	0	0	0	0	7
	Total	19	1	5	0	0	0	0	26
								(C.V.=	36 %)
IV	1	9	11	11	0	0	0	-	30
	2	34	43	9	0	0	-	-	86
	3	6	56	20	0	0	0	-	82
	Total	49	110	40	0	0	0	0	199
								(C.V. =	16 %)

Table 16 Continued

Species (9) 9 LutJanus peru スナッパー(バルビン)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	183	10	0	0	0	0	-	192
	2	2	0	10	0	0	-	-	12
	3	8	0	0	-	-	0	0	8
	Total	192	10	10	0	0	0	0	212
								(C.V. =	86 %)
II	1	0	0	0	0	0	0	-	0
	2	8	0	0	0	0	-	-	12
	3	1	0	0	0	0	0	0	1
	Total	8	0	0	0	0	0	0	0
								(C.V.=	93 %)
III	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	1
								(C.V.=	71 %)
IV	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. =	- %)

Species (25) 25 Solenocera agassizii アガシーエビ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	6	9	51	17	0	-	83
	2	0	1	1	2	14	-	-	18
	3	0	0	0	-	-	0	0	0
	Total	0	7	10	53	31	0	0	100
								(C.V. =	24 %)
II	1	0	3	20	66	39	0	-	129
	2	0	1	0	1	6	-	-	8
	3	0	0	0	0	11	0	0	11
	Total	0	4	20	67	56	0	0	147
								(C.V.=	21 %)
III	1	0	0	4	17	46	0	-	67
	2	0	1	0	5	19	-	-	25
	3	0	1	0	0	1	0	0	2
	Total	0	1	5	22	65	0	0	93
								(C.V.=	26 %)
IV	1	0	0	1	56	21	0	-	78
	2	0	0	0	4	11	-	-	15
	3	0	0	1	0	0	0	-	1
	Total	0	0	2	60	32	0	0	94
								(C.V. =	30 %)

Table 16 Continued

Species (22) 22 Physiculus rastrelliger ヤリ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	1	11	9	55	0	-	76
	2	0	0	0	0	0	-	-	1
	3	0	0	0	-	-	13	0	14
	Total	0	1	12	9	55	13	0	90
								(C.V. =	30 %)
II	1	0	0	0	0	21	0	-	21
	2	0	0	0	0	3	-	-	3
	3	0	0	0	0	7	0	0	7
	Total	0	0	0	0	30	0	0	30
								(C.V.=	38 %)
III	1	0	0	0	10	15	0	-	25
	2	0	0	0	1	13	-	-	14
	3	0	0	0	0	28	0	0	28
	Total	0	0	0	12	56	0	0	67
								(C.V.=	48 %)
IV	1	0	0	0	16	118	0	-	134
	2	0	0	0	1	3	-	-	4
	3	0	0	0	0	8	0	-	8
	Total	0	0	0	17	129	0	0	146
								(C.V. =	36 %)

Species (23) 23 Selene peruviana ヒイラギ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	143	1	0	-	-	0	0	144
	Total	143	1	0	0	0	0	0	144
								(C.V. =	64 %)
II	1	2	0	0	0	0	0	-	2
	2	0	1	0	0	0	-	-	1
	3	14	16	0	0	0	0	0	31
	Total	16	17	0	0	0	0	0	34
								(C.V.=	55 %)
III	1	0	0	0	0	0	0	-	0
	2	3	0	0	0	0	-	-	3
	3	0	0	0	0	0	0	0	0
	Total	3	0	0	0	0	0	0	3
								(C.V.=	100 %)
IV	1	0	0	0	0	0	0	-	0
	2	0	54	0	0	0	-	-	54
	3	0	0	0	0	0	0	-	0
	Total	0	54	0	0	0	0	0	54
								(C.V. =	100 %)

Table 16 Continued

Species (18)18 Pomadasys branickii イボダイ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	1	0	0	0	-	1
	2	1	1	1	0	0	-	-	3
	3	98	0	24	-	-	0	0	122
	Total	99	1	28	0	0	0	0	126
								(C.V. =	73 %)
II	1	11	0	0	0	0	0	-	11
	2	0	1	0	0	0	-	-	1
	3	1	1	0	0	0	0	0	2
	Total	12	2	0	0	0	0	0	13
								(C.V.=	80 %)
III	1	0	1	0	0	0	0	-	1
	2	0	0	1	0	0	-	-	1
	3	0	1	0	0	0	0	0	1
	Total	0	2	1	0	0	0	0	2
								(C.V.=	53 %)
IV	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. =	- %)

Species (4) 4 Diplectrum eumelum オオスジ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	1	20	26	0	0	0	-	47
	2	3	6	1	0	0	-	-	10
	3	0	1	6	-	-	0	0	7
	Total	4	26	34	0	0	0	0	65
								(C.V. =	25 %)
II	1	0	0	0	0	0	0	-	0
	2	1	1	4	0	0	-	-	5
	3	0	1	1	0	0	0	0	2
	Total	1	2	5	0	0	0	0	8
								(C.V.=	52 %)
III	1	1	0	0	0	0	0	-	1
	2	1	1	3	0	0	-	-	5
	3	3	0	0	0	0	0	0	3
	Total	5	1	3	0	0	0	0	9
								(C.V.=	46 %)
IV	1	0	0	0	0	0	0	-	0
	2	3	2	27	0	0	-	-	32
	3	2	0	0	0	0	0	-	2
	Total	5	2	27	0	0	0	0	34
								(C.V. =	80 %)

Table 16 Continued

Species (13) 13 Paralabrax loro ハタ(カブリージャ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	5	24	6	0	0	0	0	35
	2	0	15	9	0	0	-	-	24
	3	0	2	0	-	-	0	0	2
	Total	5	41	15	0	0	0	0	61
								(C.V. =	32 %)
II	1	0	10	1	0	0	0	-	12
	2	0	17	8	0	0	-	-	24
	3	0	0	0	0	0	0	0	0
	Total	0	27	9	0	0	0	0	36
								(C.V.=	43 %)
III	1	0	9	18	0	0	0	-	28
	2	1	5	10	0	0	-	-	17
	3	1	4	1	0	0	0	0	5
	Total	2	18	30	0	0	0	0	50
								(C.V.=	29 %)
IV	1	0	0	8	0	0	0	-	8
	2	4	22	0	0	0	-	-	25
	3	1	0	2	0	0	0	-	2
	Total	4	22	10	0	0	0	0	36
								(C.V. =	38 %)

Species(6) 6 Hemanthias peruanus ハナダイ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	5	17	23	4	0	-	50
	2	0	5	1	0	0	-	-	6
	3	0	0	5	-	-	0	0	5
	Total	0	10	24	23	4	0	0	61
								(C.V. =	25 %)
II	1	0	8	22	5	0	0	-	35
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	0	0
	Total	0	8	23	5	0	0	0	35
								(C.V.=	36 %)
III	1	0	5	22	2	0	0	-	29
	2	1	0	2	0	0	-	-	3
	3	0	0	12	0	0	0	0	12
	Total	1	5	36	2	0	0	0	44
								(C.V.=	33 %)
IV	1	0	0	2	0	0	0	-	2
	2	0	3	0	0	0	-	-	3
	3	0	0	0	0	0	0	-	0
	Total	0	3	2	0	0	0	0	5
								(C.V. =	48 %)

Table 16 Continued

Species (21) 21 Brotula clarkae イタチウオ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	-	-	0	0	0
	Total	0	0	0	0	0	0	0	0
								(C.V. =	100 %)
II	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0
								(C.V.=	- %)
III	1	2	9	11	23	0	0	-	44
	2	0	0	4	0	0	-	-	4
	3	0	0	0	0	0	0	0	0
	Total	2	9	15	23	0	0	0	48
								(C.V.=	38 %)
IV	1	0	0	5	14	0	0	-	19
	2	0	26	0	0	0	-	-	26
	3	0	12	1	1	0	0	-	14
	Total	0	38	6	15	0	0	0	59
								(C.V. =	49 %)

Species(24) 24 Selene oerstedli ヒラアジ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	43	0	0	0	0	0	-	43
	2	0	0	0	0	0	-	-	0
	3	14	0	0	-	-	0	0	14
	Total	57	0	0	0	0	0	0	57
								(C.V. =	39 %)
II	1	2	0	0	0	0	0	-	2
	2	0	0	0	0	0	-	-	0
	3	17	0	0	0	0	0	0	17
	Total	19	0	0	0	0	0	0	19
								(C.V.=	72 %)
III	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0
								(C.V.=	- %)
IV	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. =	- %)

Table 16 Continued

Species (2) 2 Calanus brachysomus キンダイ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	3	0	0	0	0	0	-	3
	2	3	0	0	0	0	-	-	3
	3	21	0	0	-	-	0	0	21
	Total	27	0	0	0	0	0	0	27
								(C.V. =	61 %)
II	1	0	0	0	0	0	0	-	0
	2	19	0	0	0	0	-	-	19
	3	2	0	0	0	0	0	0	2
	Total	21	0	0	0	0	0	0	21
								(C.V.=	90 %)
III	1	1	0	0	0	0	0	-	1
	2	0	0	0	0	0	-	-	0
	3	8	0	0	0	0	0	0	8
	Total	8	0	0	0	0	0	0	8
								(C.V.=	93 %)
IV	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. = - %)	

Species(14) 14 Penaeus brevirostris ビシ(エビ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	4	6	5	0	0	0	-	15
	2	3	5	0	0	0	-	-	8
	3	0	1	0	-	-	0	0	1
	Total	6	12	6	0	0	0	0	24
								(C.V. =	21 %)
II	1	2	5	0	0	0	0	-	7
	2	3	4	0	0	0	-	-	7
	3	0	2	1	0	0	0	0	3
	Total	5	11	1	0	0	0	0	17
								(C.V.=	18 %)
III	1	5	1	2	0	0	0	-	8
	2	1	0	0	0	0	-	-	1
	3	0	0	1	0	0	0	0	1
	Total	5	1	3	0	0	0	0	10
								(C.V.=	35 %)
IV	1	0	0	0	0	0	0	-	0
	2	1	1	0	0	0	-	-	1
	3	1	1	1	0	0	0	-	3
	Total	2	1	1	0	0	0	0	5
								(C.V. =	45 %)

Table 16 Continued

Species (15) 15 Penaeus californiensis ブラウン(エビ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	1
	3	0	0	0	-	-	0	0	0
	Total	0	0	0	0	0	0	0	1
								(C.V. =	75 %)
II	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0
								(C.V.=	- %)
III	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0
								(C.V.=	- %)
IV	1	0	0	0	0	0	0	-	0
	2	0	0	0	0	0	-	-	0
	3	0	0	0	0	0	0	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. =	- %)

Table 17 Biomasses by Species, Round of Survey, Region and Depth Zone, Estimated from Double-Rigged Trawl Survey

Species (30) 30 All species total

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	71	289	585	-	-	-	-	946
	2	68	175	-	-	-	-	-	243
	3	225	77	-	-	-	-	-	302
	Total	365	541	585	0	0	0	0	1491
								(C.V. =	10 %)
II	1	92	163	580	-	-	-	-	835
	2	45	133	-	-	-	-	-	178
	3	40	43	-	-	-	-	-	83
	Total	177	339	580	0	0	0	0	1096
								(C.V.=	9 %)
III	1	498	449	1347	2308	-	-	-	4601
	2	88	416	-	-	-	-	-	504
	3	105	158	-	-	-	-	-	264
	Total	691	1024	1347	2308	0	0	0	5369
								(C.V.=	13 %)

Species(24) 24 Solenocera agassizii ﾃｲｷｰﾅ(ｴﾋﾞ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	16	88	-	-	-	-	103
	2	1	8	-	-	-	-	-	9
	3	0	5	-	-	-	-	-	5
	Total	1	29	88	0	0	0	0	117
								(C.V. =	16 %)
II	1	0	11	74	-	-	-	-	85
	2	2	17	-	-	-	-	-	19
	3	0	1	-	-	-	-	-	1
	Total	2	30	74	0	0	0	0	105
								(C.V.=	17 %)
III	1	0	1	100	318	-	-	-	419
	2	1	42	-	-	-	-	-	43
	3	0	14	-	-	-	-	-	14
	Total	1	58	100	318	0	0	0	477
								(C.V.=	31 %)

Table 17 Continued

Species (22) 22 Pontinus sierra ﾒﾊﾞﾙ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	1	29	-	-	-	-	30
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	1	29	0	0	0	0	30
								(C.V. =	22 %)
II	1	0	0	18	-	-	-	-	18
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	18	0	0	0	0	0
								(C.V.=	27 %)
III	1	0	0	16	390	-	-	-	406
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	15	390	0	0	0	406
								(C.V.=	24 %)

Species(27) 27 Physiculus nematopus ﾀﾗ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	1	54	-	-	-	-	55
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	1	54	0	0	0	0	55
								(C.V. =	22 %)
II	1	0	1	32	-	-	-	-	33
	2	0	1	-	-	-	-	-	1
	3	0	0	-	-	-	-	-	0
	Total	0	2	32	0	0	0	0	34
								(C.V.=	30 %)
III	1	0	5	124	200	-	-	-	329
	2	0	1	-	-	-	-	-	1
	3	0	0	-	-	-	-	-	0
	Total	0	6	124	200	0	0	0	330
								(C.V.=	40 %)

Table 17 Continued

Species (5) 5 Citharichthys platophrys ヒラメ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	1	44	55	-	-	-	-	100
	2	0	6	-	-	-	-	-	6
	3	0	2	-	-	-	-	-	2
	Total	1	52	55	0	0	0	0	108
								(C.V. = 27 %)	
II	1	0	16	15	-	-	-	-	31
	2	0	5	-	-	-	-	-	5
	3	0	0	-	-	-	-	-	0
	Total	1	21	15	0	0	0	0	37
								(C.V.= 21 %)	
III	1	6	38	124	120	-	-	-	288
	2	0	19	-	-	-	-	-	10
	3	0	2	-	-	-	-	-	2
	Total	6	58	124	120	0	0	0	309
								(C.V.= 18 %)	

Species(29) 29 Brotula clarkae イズチウオ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	2	27	-	-	-	-	29
	2	1	7	-	-	-	-	-	8
	3	2	0	-	-	-	-	-	2
	Total	4	9	27	0	0	0	0	39
								(C.V. = 27 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= 89 %)	
III	1	8	7	128	123	-	-	-	266
	2	2	5	-	-	-	-	-	7
	3	2	1	-	-	-	-	-	3
	Total	12	12	128	123	0	0	0	275
								(C.V.= 39 %)	

Table 17 Continued

Species (28) 28 Prionotus stephanophrys ホーボー

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	2	19	5	-	-	-	-	26
	2	2	0	-	-	-	-	-	2
	3	2	3	-	-	-	-	-	5
	Total	6	22	5	0	0	0	0	33
								(C.V. = 42 %)	
II	1	26	16	74	-	-	-	-	115
	2	2	14	-	-	-	-	-	15
	3	6	9	-	-	-	-	-	15
	Total	33	39	74	0	0	0	0	145
								(C.V.= 21 %)	
III	1	108	8	111	0	-	-	-	227
	2	6	2	-	-	-	-	-	8
	3	6	25	-	-	-	-	-	31
	Total	120	35	111	0	0	0	0	266
								(C.V.= 32 %)	

Species(17) 17 Penaeus brevirostris ビシク(エビ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	28	25	3	-	-	-	-	56
	2	13	25	-	-	-	-	-	38
	3	1	18	-	-	-	-	-	19
	Total	42	67	3	0	0	0	0	112
								(C.V. = 10 %)	
II	1	35	7	0	-	-	-	-	42
	2	9	6	-	-	-	-	-	15
	3	4	2	-	-	-	-	-	7
	Total	48	15	0	0	0	0	0	64
								(C.V.= 16 %)	
III	1	10	1	0	0	-	-	-	11
	2	9	2	-	-	-	-	-	11
	3	18	0	-	-	-	-	-	19
	Total	37	3	0	0	0	0	0	40
								(C.V.= 20 %)	

Table 17 Continued

Species (9) 9 Hippoglossina tetrophthalmus ダルマガレイ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	3	28	-	-	-	-	31
	2	0	3	-	-	-	-	-	3
	3	0	5	-	-	-	-	-	5
	Total	0	10	28	0	0	0	0	39
								(C.V. =	19 %)
II	1	0	6	14	-	-	-	-	20
	2	5	13	-	-	-	-	-	18
	3	0	7	-	-	-	-	-	7
	Total	5	26	14	0	0	0	0	45
								(C.V.=	17 %)
III	1	0	0	0	0	-	-	-	0
	2	0	35	-	-	-	-	-	35
	3	0	51	-	-	-	-	-	51
	Total	0	85	0	0	0	0	0	85
								(C.V.=	20 %)

Species(26) 26 Synodus evermanni アカエソ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	5	13	18	-	-	-	-	36
	2	0	3	-	-	-	-	-	3
	3	0	5	-	-	-	-	-	5
	Total	5	21	18	0	0	0	0	44
								(C.V. =	27 %)
II	1	11	14	16	-	-	-	-	41
	2	3	3	-	-	-	-	-	6
	3	5	3	-	-	-	-	-	9
	Total	19	20	16	0	0	0	0	56
								(C.V.=	20 %)
III	1	24	7	15	8	-	-	-	54
	2	9	12	-	-	-	-	-	22
	3	3	4	-	-	-	-	-	7
	Total	36	24	15	8	0	0	0	83
								(C.V.=	17 %)

Table 17 Continued

Species (25) 25 Synodus scituliceps マカエソ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	1	14	8	-	-	-	-	24
	2	7	24	-	-	-	-	-	31
	3	3	14	-	-	-	-	-	17
	Total	11	53	8	0	0	0	0	72
								(C.V. = 25 %)	
II	1	1	1	0	-	-	-	-	1
	2	4	3	-	-	-	-	-	6
	3	1	0	-	-	-	-	-	1
	Total	5	3	0	0	0	0	0	8
								(C.V.= 33 %)	
III	1	0	0	0	0	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	4	0	-	-	-	-	-	4
	Total	4	0	0	0	0	0	0	4
								(C.V.= 100 %)	

Species(14) 14 Hustelus lunulatus ホシザメ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	1	33	0	-	-	-	-	34
	2	1	5	-	-	-	-	-	6
	3	0	0	-	-	-	-	-	0
	Total	2	38	0	0	0	0	0	40
								(C.V. = 38 %)	
II	1	3	12	1	-	-	-	-	16
	2	8	7	-	-	-	-	-	14
	3	0	0	-	-	-	-	-	0
	Total	10	18	1	0	0	0	0	30
								(C.V.= 24 %)	
III	1	0	4	40	0	-	-	-	44
	2	0	1	-	-	-	-	-	1
	3	8	2	-	-	-	-	-	10
	Total	8	6	40	0	0	0	0	54
								(C.V.= 64 %)	

Table 17 Continued

Species (10) 10 Hemanthias peruanus ハナダイ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	5	29	-	-	-	-	35
	2	0	5	-	-	-	-	-	5
	3	0	1	-	-	-	-	-	1
	Total	0	11	29	0	0	0	0	40
								(C.V. = 24 %)	
II	1	0	6	19	-	-	-	-	24
	2	0	2	-	-	-	-	-	2
	3	0	2	-	-	-	-	-	2
	Total	0	9	19	0	0	0	0	28
								(C.V.= 15 %)	
III	1	2	6	18	0	-	-	-	26
	2	0	12	-	-	-	-	-	12
	3	0	9	-	-	-	-	-	9
	Total	2	27	18	0	0	0	0	47
								(C.V.= 29 %)	

Species(7) 7 Diplectrum eumelum ハタ(メンタ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	7	0	-	-	-	-	7
	2	10	20	-	-	-	-	-	30
	3	1	4	-	-	-	-	-	5
	Total	11	31	0	0	0	0	0	42
								(C.V. = 31 %)	
II	1	1	2	1	-	-	-	-	4
	2	0	3	-	-	-	-	-	4
	3	2	1	-	-	-	-	-	3
	Total	3	7	1	0	0	0	0	10
								(C.V.= 28 %)	
III	1	0	0	0	0	-	-	-	0
	2	4	2	-	-	-	-	-	6
	3	0	4	-	-	-	-	-	4
	Total	4	7	0	0	0	0	0	11
								(C.V.= 30 %)	

Table 17 Continued

Species (12) 12 Lutjanus guttatus スナッパー(バルゴテラマンチャ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	42	0	-	-	-	-	-	0
	Total	42	0	0	0	0	0	0	42
								(C.V. = 51 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. = - %)	
III	1	0	0	0	0	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. = - %)	

Species(18) 18 Pomadasys macracanthus イサキ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	36	0	-	-	-	-	-	36
	Total	36	0	0	0	0	0	0	36
								(C.V. = 100 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. = - %)	
III	1	0	0	0	0	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. = - %)	

Table 17 Continued

Species (4) 4 Cyclopsetta querna ヒラメ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	1	0	0	-	-	-	-	1
	2	3	0	-	-	-	-	-	3
	3	29	1	-	-	-	-	-	29
	Total	33	1	0	0	0	0	0	33
								(C.V. = 67 %)	
II	1	1	0	0	-	-	-	-	1
	2	0	0	-	-	-	-	-	0
	3	2	0	-	-	-	-	-	2
	Total	3	0	0	0	0	0	0	3
								(C.V.= 67 %)	
III	1	0	0	0	0	-	-	-	0
	2	3	0	-	-	-	-	-	3
	3	4	0	-	-	-	-	-	4
	Total	6	0	0	0	0	0	0	6
								(C.V.= 41 %)	

Species(11) 11 Lutjanus argentiventris マナツバー(バルゴアマリーラョ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	0	0	-	-	-	-	0
	2	1	0	-	-	-	-	-	1
	3	31	0	-	-	-	-	-	31
	Total	32	0	0	0	0	0	0	32
								(C.V. = 55 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	
III	1	0	0	0	0	-	-	-	0
	2	1	0	-	-	-	-	-	1
	3	0	0	-	-	-	-	-	0
	Total	1	0	0	0	0	0	0	1
								(C.V.= 100 %)	

Table 17 Continued

Species (21) 21 Paralabrax loro ハタ(カブリ-ジャ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	4	2	-	-	-	-	6
	2	1	12	-	-	-	-	-	13
	3	0	0	-	-	-	-	-	0
	Total	1	16	2	0	0	0	0	19
								(C.V. =	27 %)
II	1	0	5	8	-	-	-	-	13
	2	0	7	-	-	-	-	-	7
	3	0	0	-	-	-	-	-	0
	Total	0	11	8	0	0	0	0	20
								(C.V.=	24 %)
III	1	4	6	5	0	-	-	-	15
	2	2	14	-	-	-	-	-	16
	3	1	0	-	-	-	-	-	1
	Total	7	20	5	0	0	0	0	32
								(C.V.=	28 %)

Species(23) 23 Sicyonia sp. シャコ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	5	16	-	-	-	-	22
	2	0	0	-	-	-	-	-	0
	3	0	2	-	-	-	-	-	2
	Total	0	8	16	0	0	0	0	24
								(C.V. =	24 %)
II	1	0	6	12	-	-	-	-	17
	2	0	1	-	-	-	-	-	1
	3	0	0	-	-	-	-	-	0
	Total	0	7	12	0	0	0	0	18
								(C.V.=	17 %)
III	1	3	1	9	0	-	-	-	13
	2	0	7	-	-	-	-	-	7
	3	0	5	-	-	-	-	-	6
	Total	4	13	9	0	0	0	0	26
								(C.V.=	21 %)

Table 17 Continued

Species (13) 13 Lutjanus colorado スナッパー(ホムラコウライ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	-	-	-	-	0
	2	2	16	-	-	-	-	-	18
	3	8	0	-	-	-	-	-	8
	Total	10	16	0	0	0	0	0	26
								(C.V. = 41 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	5	-	-	-	-	-	5
	Total	0	5	0	0	0	0	0	5
								(C.V.= 100 %)	
III	1	0	18	0	0	-	-	-	18
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	18	0	0	0	0	0	18
								(C.V.= 100 %)	

Species(15) 15 Portunidae sp. ワタリガニ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	9	6	-	-	-	-	15
	2	0	4	-	-	-	-	-	4
	3	0	1	-	-	-	-	-	1
	Total	0	14	6	0	0	0	0	20
								(C.V. = 30 %)	
II	1	0	2	3	-	-	-	-	5
	2	1	2	-	-	-	-	-	3
	3	0	0	-	-	-	-	-	1
	Total	2	4	3	0	0	0	0	9
								(C.V.= 23 %)	
III	1	3	1	2	0	-	-	-	6
	2	1	1	-	-	-	-	-	2
	3	2	3	-	-	-	-	-	5
	Total	5	5	2	0	0	0	0	13
								(C.V.= 25 %)	

Table 17 Continued

Species (6) 6 Cynoponticus coniceps ハモ

Survey No.	Region	Depth (m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	13	0	-	-	-	-	13
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	13	0	0	0	0	0	13
								(C.V. = 100 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. = - %)	
III	1	0	0	0	0	-	-	-	0
	2	5	0	-	-	-	-	-	5
	3	0	0	-	-	-	-	-	0
	Total	5	0	0	0	0	0	0	5
								(C.V. = 100 %)	

Species(19) 19 Pomadasys branickii イサキ

Survey No.	Region	Depth (m) 50-	75-	100-	150-	200-	300-	400-	Total (ton)
I	1	0	0	0	-	-	-	-	0
	2	0	1	-	-	-	-	-	1
	3	11	1	-	-	-	-	-	11
	Total	11	2	0	0	0	0	0	12
								(C.V. = 77 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. = 100 %)	
III	1	0	0	0	0	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. = - %)	

Table 17 Continued

Species (20) 20 Pomadasys panamensis イサキ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	-	-	-	-	0
	2	6	1	-	-	-	-	-	8
	3	4	0	-	-	-	-	-	4
	Total	10	1	0	0	0	0	0	11
								(C.V. = 66 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	
III	1	0	0	0	0	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	

Species(8) 8 Haemulon maculicauda イサキ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	7	0	-	-	-	-	-	7
	Total	7	0	0	0	0	0	0	7
								(C.V. = 100 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	
III	1	0	0	0	0	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	

Table 17 Continued

Species (3) 3 Cyclopsetta panamensis ヒラメ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	6	0	-	-	-	-	-	0
	Total	6	0	0	0	0	0	0	6
								(C.V. = 100 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	
III	1	0	0	0	0	-	-	-	0
	2	1	0	-	-	-	-	-	1
	3	0	0	-	-	-	-	-	0
	Total	1	0	0	0	0	0	0	1
								(C.V.= 100 %)	

Species(1) 1 Camaron colindra エビ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	-	-	-	-	1
	2	0	2	-	-	-	-	-	2
	3	0	2	-	-	-	-	-	2
	Total	1	4	0	0	0	0	0	5
								(C.V. = 39 %)	
II	1	1	0	0	-	-	-	-	1
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	2	0	0	0	0	0	0	2
								(C.V.= 42 %)	
III	1	0	0	0	0	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	

Table 17 Continued

Species (16) 16 Penaeus californiensis ブラウン(エビ)

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	1	0	-	-	-	-	-	0
	Total	1	0	0	0	0	0	0	1
								(C.V. = 85 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	
III	1	0	0	0	0	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	

Species(2) 2 Camaron aserrin エビ

Survey No.	Region	Depth(m) 50-	75-	100-	150-	200-	300-	400-	Total(ton)
I	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V. = 100 %)	
II	1	0	0	0	-	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	
III	1	0	0	0	0	-	-	-	0
	2	0	0	-	-	-	-	-	0
	3	0	0	-	-	-	-	-	0
	Total	0	0	0	0	0	0	0	0
								(C.V.= - %)	

Table 18 Catch per Unit of Effort and Demersal Fish Biomass Estimated by Trawl Survey in the Area from Mexico to Colombia

Item / Area	Coast Line (mile)	Continental Shelf (mile)	Catch per Unit by Trawl Net(kg/hr.) (0 ~ 200m)	Catch per Unit by Trawl Net(kg/hr.) (150 ~ 500m)	Demersal Fish Biomass (ton)
Mexico	215	8571	13.08 *	16.50 *	56,000
Guatemala	125	4116	12.31 *	24.52 *	22,000
El Salvador	150	5186	12.47 *	22.19 *	10,000
Hondurus	25	400	10.01		
Nicaragua	170	6739	35.42 *	79.52 *	30,000
Costa Rica	340	4068	21.67 *	69.72 *	14,000
Panama-Eeast	300	8359	29.88	98.41	112,000
Panama-Vest	160	3543	5.97	17.59	9,000
Panama-C **	60	368	23.38	6.84	5,000
Colombia	420	5602	8.99	7.34	24,000

* Removed Pleuroncodes Planiceps(コオロギエビ・ Langostino) (after Report of NORAD/ UNDP/ FAO Programme)

** Punta Mala - Golfo Coiba

Table 19 Species Taken with Long Lines and Shrimp Pots

Pisces			No. of Catch Times
Mustelus	lunulatus	ネンガメ	3
Opichthus	pacificus	ウミヘビ	21
Echiophis	sp.	ウミヘビ	2
Gymnothorax	equatorialis	ウツボ	21
Coryphaena	hippurus	シイラ	1
Thunnus	albacores	キハダ	4
Sarda	orientalis	ハガツオ	7
Sarda	chiliensi	ハガツオ	8
Katsuvonus	pelamis	カツオ	2
Auxis	thazard	フタリーダ	2
Caranx	vinctus	ネイワリ	1
Caranxoides	otrynter	ヒラマナアジ	1
Seriola	viuoliana	カンパチ	7
Caulolatilus	affinis	アマダイ	30
Epinephelus	nigritus	ミゾレハタ	14
E.	niveatus	ユキボンハタ	12
E.	acanthistius	ハタ	4
E.	dioxyli	ハタ	
Paralabrax	loro	ハタ	9
Hemanthias	signifer	ハタ	14
H.	peruanus	ハタ	2
Diplectrum	euryplectrum	フデハタ	5
D.	pacificum	フデハタ	1
D.	labarum	フデハタ	1
Serranus	aequidens	フデハタ	3
Lutjanus	peru	フエダイ	15
Pomadasys	macracanthus	イシナ	1
Haemulidae	sp.	イシナ	1
Pronotogramus	eos	オナガハナダイ	1
Decodon	melasma	イラ	2
Brotula	clarkae	イタチウオ	1
Pontinus	sierra	カサゴ(ヒオドシ)	4
P.	furcichinus	カサゴ(ヒオドシ)	9
P.	sp.	カサゴ(ヒオドシ)	3
Scorpaena	russula	フタカサゴ	2
Bothidae	sp.	ヒラメ	1
Citharichthys	platophrys	カレイ	1
Syaphurus	sp.	アカマカレイ	1
Physiculus	nematopus	チゴダラ	4
Antennarius	avalonis	イッテンイダリウオ	1
Phorichthus	pacifica	イダビゴラアンコウ	2

Crustacea			No. of Catch Time
Penaeus	brevirostris	ビンク	1
Solenocera	agassissi	フイゲール	1
Heterocarpus	sp.	カメジョ	5
Pleuronectodes	sp.	コシオリエビ	5
Squilla	sp.	シャコ	4
Calappidae	sp.	カラッパ	24
Dorippidae	sp.	ヘイケガニ	4
Illiacantha	sp.	コブシガニ	6
Majidae	sp.	クモガニ	15
Portunidae	sp.	ワタリガニ	6
Parthenopidae	sp.	ヒシガニ	2
Mollusca			
Gastropoda	sp.	ツブ	1
Octopodidae	sp.	タコ	2
Chelonia			
Chelonia	sp.	カメ	3
Echinoidea			
Regularia	sp.	ウニ	

Table 20 Catch by Region Taken by Bottom Long Lines and Shrimp Pots

Region	Bottom Long Line								Pot		
	SOKOHAEHAVA				SOKOTATEHAVA						
	No. of Haul	No. of Hook	No. of Catch	Weight of Catch(kg)	No. of Haul	No. of Hook	No. of Catch	Weight of Catch(kg)	No. of Haul	No. of Pot	Weight of Catch(kg)
1	2	120	1	2.2	2	150	0	0	2	70	19.4
	Catch/Unit		0.5	1.83			0	0			0.28
2	13	720	84	82.5	13	885	162	230.0	13	473	763.4
	Catch/Unit		11.86	11.45			18.30	25.98			1.61
3	10	660	79	128.6	11	501	103	153.4	8	289	255.5
	Catch/Unit		11.96	19.48			17.42	27.34			0.88
Total	25	1500	164	213.3	26	1551	283	383.4	23	832	1038.3
	Catch/Unit		11.11	14.21			17.08	24.73			1.24

Remarks : Catch/Unit SOKOHAEHAVA ····100 Hooks
SOKOTATEHAVA····100 Hooks

Pot ····· 1 Pot

Table 21 Day/Night Catches According to Species with the Single Trawl Net

fish species	day			night		
	No of where collected	average catch	standard deviation	No of where collected	average catch	standard deviation
		kg			kg	
Brotula clarkae	3	1	1.8	6	6	7.3
Citharichthys platophrys	10	32	43.1	9	24	26.9
Loligopsis diomedeae	11	16	27.9	5	0	0.8
Mustelus lunulatus	3	0	0.5	6	1	1.3
Portunidae sp.	11	3	2.1	7	2	2.4
Peprilus medius	11	189	391.7	5	1	1.2
Peprilus snyderi	11	175	261.0	6	2	2.1
Physiculus nematopus	9	3	2.3	9	11	8.9
Prionotus albirostris	6	2	5.4	8	1	1.0
P. stephanophyrys	5	4	8.6	5	2	2.6
Solenocera agassizii	9	2	2.8	9	7	5.4
all species	11	446	524.2	9	93	73.5

Table 22 Fish Landing in Costa Rica

(units: tons)

item	1982			1983			1984			1985			1986		
	Pacific side	Caribbean side	total	Pacific side	Caribbean side	total	Pacific side	Caribbean side	total	Pacific side	Caribbean side	total	Pacific side	Caribbean side	total
1. total of all fish	8.813	57	8.870	8.146	53	8.199	10.064	40	10.104	10.760	35	10.795	12.826	59	12.885
1-1 subtotal for white-meat fish	5.187	39	5.226	8.228	28	8.256	8.154	26	8.180	7.101	28	7.127	9.421	28	9.449
large, class I fish	466	-	466	608	2	610	460	1	461	304	-	304	299	1	300
small, class I fish	1.644	12	1.656	1.652	8	1.660	1.050	6	1.056	1.543	8	1.551	1.684	7	1.691
sorted fish	996	-	996	1.653	13	1.666	585	10	596	710	14	725	569	14	583
misc. fish	1.335	27	1.362	1.395	5	1.400	1.304	9	1.313	1.477	4	1.481	4.217	5	4.222
Ariidae (catfishes)	747	-	747	920	-	920	938	-	938	864	-	864	681	1	682
*ara							1.342	-	1.342	1.212	-	1.212	739	-	739
snapper							474	-	474	990	-	990	1.232	-	1.232
1-2. sardines	1.902	-	1.902	969	-	969	2.160	-	2.169	1.283	-	1.283	1.309	-	1.309
1-3. subtotal for skipjack, tuna	963	-	963	189	-	189	812	-	812	1.499	-	1.499	1.424	-	1.424
taken by Costa Rican vessels	963	-	963	189	-	189	812	-	812	196	-	196	39	-	39
purchased from foreign vessels										1.303	-	1.303	1.385	-	1.385
1-4. sharks	761	18	779	760	25	785	929	14	943	877	9	886	672	31	703
2. total for crustaceans, mollusks	4.091	7	4.098	2.419	220	2.639	3.880	226	4.106	7.814	382	8.196	8.145	110	8.255
2-1. subtotal for shrimp	4.036	-	4.036	2.350	2	2.352	3.825	22	3.847	7.706	5	7.711	7.701	-	7.701
white	366	-	366	150	-	150	392	-	392	837	-	837	412	-	412
brown	12	-	12	40	2	42	70	20	90	45	5	50	17	-	17
pink	509	-	509	478	-	478	1.101	-	1.101	1.000	-	1.000	773	-	773
fidel	2.348	-	2.348	1.116	-	1.116	1.365	-	1.365	5.047	-	5.047	4.736	-	4.736
*chacalin	801	-	801	566	-	566	892	2	894	770	-	770	464	-	464
deep-sea shrimp							5	-	5	7	-	7	1.299	-	1.299
2-2. lobster	9	7	16	22	218	240	4	204	207	49	377	426	309	110	419
2-3. subtotal for mollusks	46	-	46	47	-	47	52	-	52	59	-	59	135	-	135
squid	8	-	8	10	-	10	20	-	20	19	-	19	7	-	7
octopus	7	-	7	3	-	3	3	-	3	9	-	9	85	-	85
shellfish	31	-	31	34	-	34	29	-	29	31	-	31	43	-	43
3. turtles	-	176	176	-	88	88	-	127	127	-	160	160	-	188	188
total	12.904	240	13.144	10.565	361	10.926	13.945	393	14.337	18.574	577	19.151	20.071	266	21.237

Table 23 Comparison of Biomass per Unit Ares in Trawl Biomass Survey

Comparision of Biomass per Unit Area by Region
Trawl Net Survey

Region	Vessel Name	Year	Area ($mile^2$)	Demersal Fish Biomass (10^3 ton)	Biomass/Area (ton)
Coast Rica Pacific North Area	Nisshin maru No.201	1987/1988	2104	20 ~ 59	9.3 ~ 26.6
Argentine Patagonia Area	Shinkai maru	1978/1979	348,647	1400~2500	40.2~71.7 ＊
New Zealand E·F Region	Shinkai maru	1982	99,856	2792	27.8 ＊＊
		1983		2326	23.3
D Region		1983	32,819	2086	63.5
		1983	31,673	1285	40.6
		1986	32,819	1391	42.4

＊ JARMAC Report No.11 1978

＊＊ JARMAC Report No.21, 1981

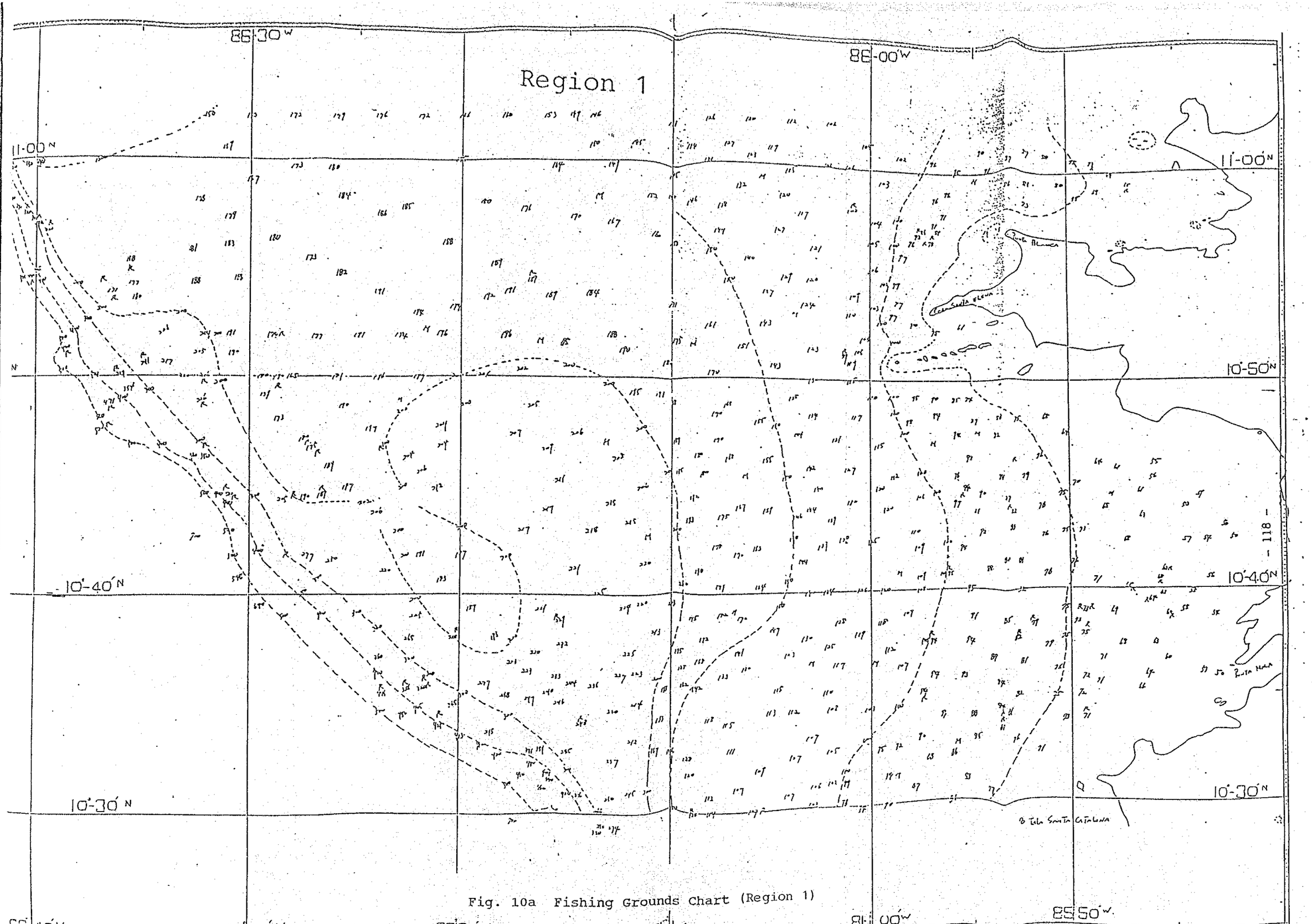


Fig. 10a Fishing Grounds Chart (Region 1)

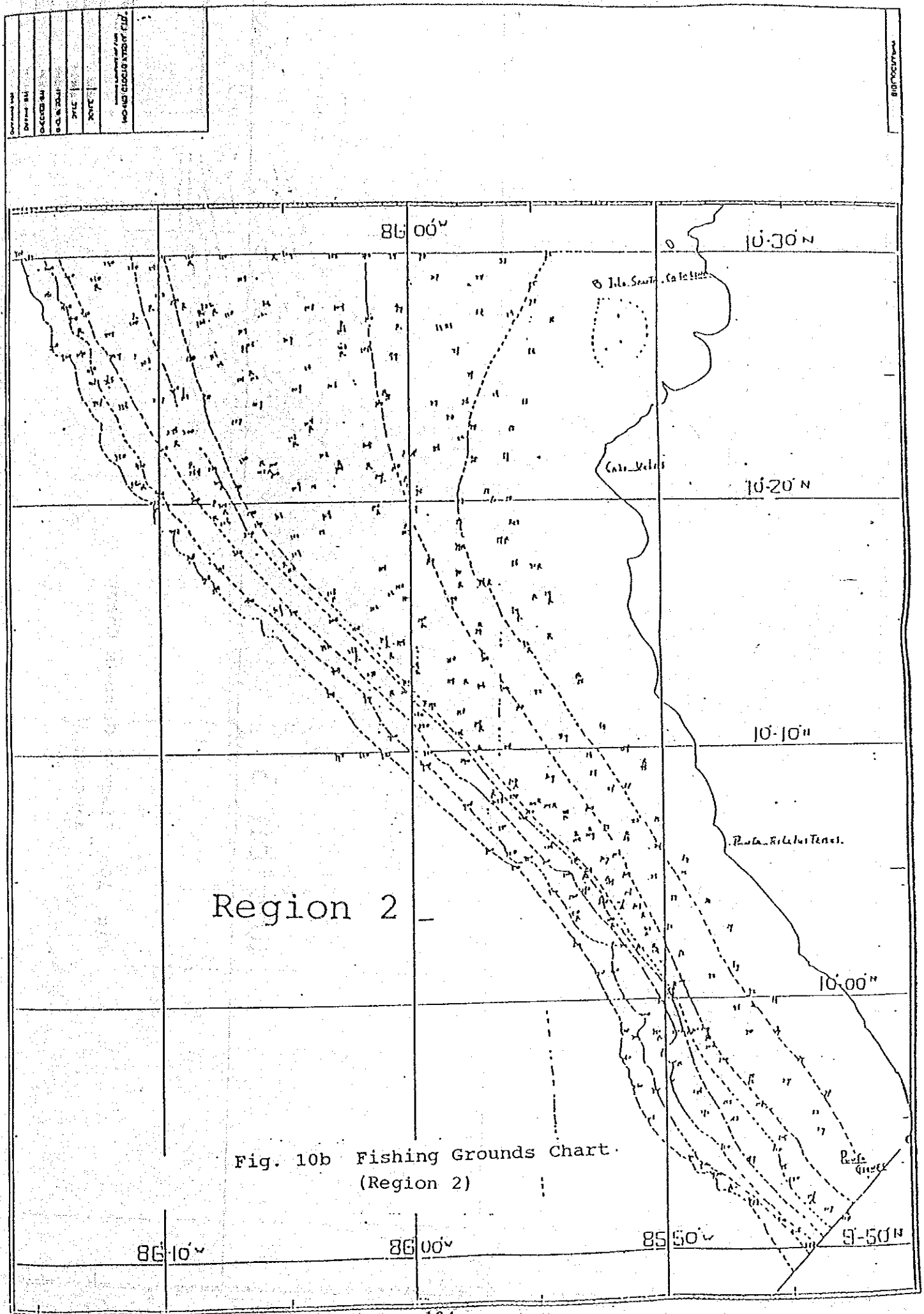


Fig. 10b Fishing Grounds Chart
(Region 2)

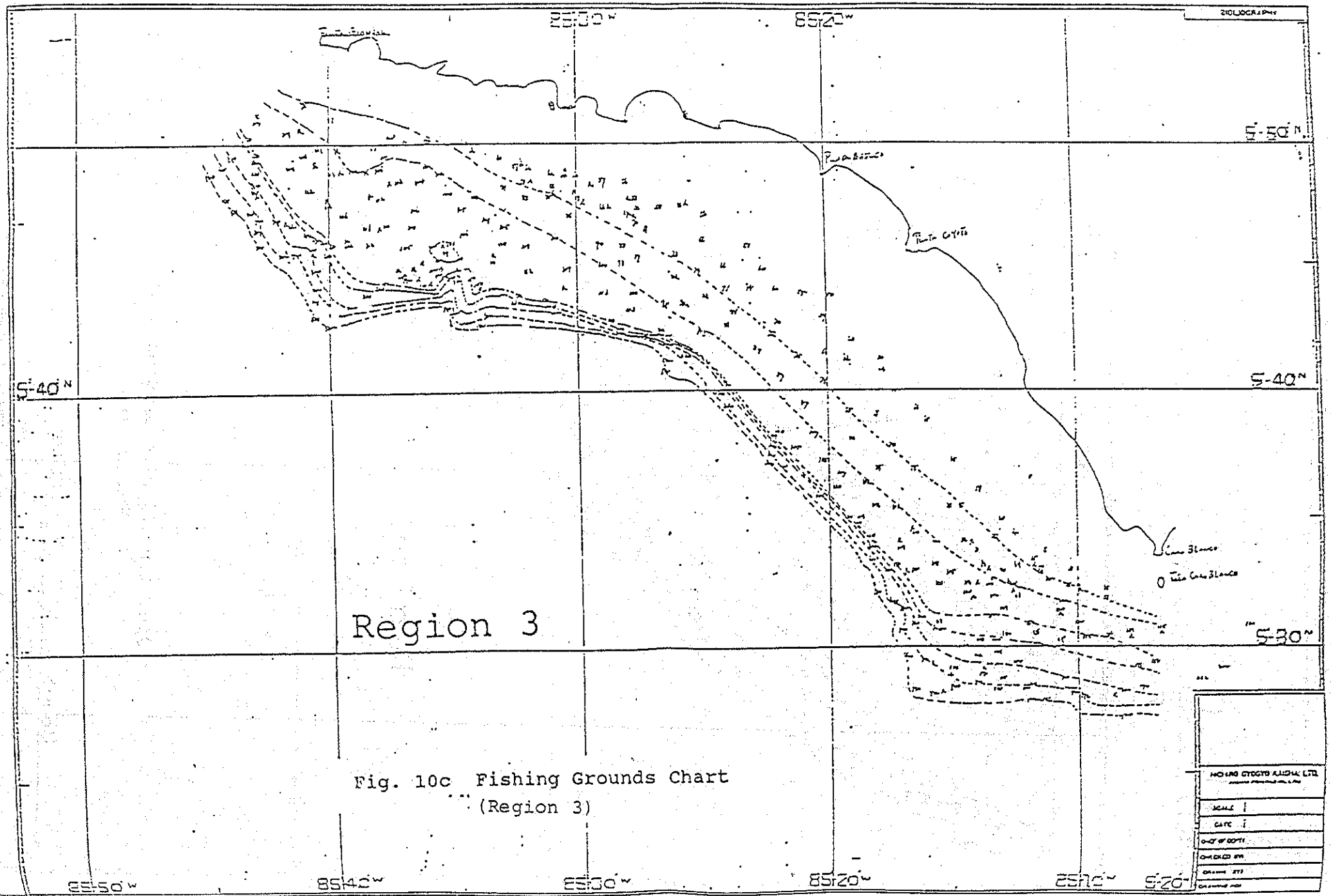


Fig. 10c Fishing Grounds Chart
(Region 3)

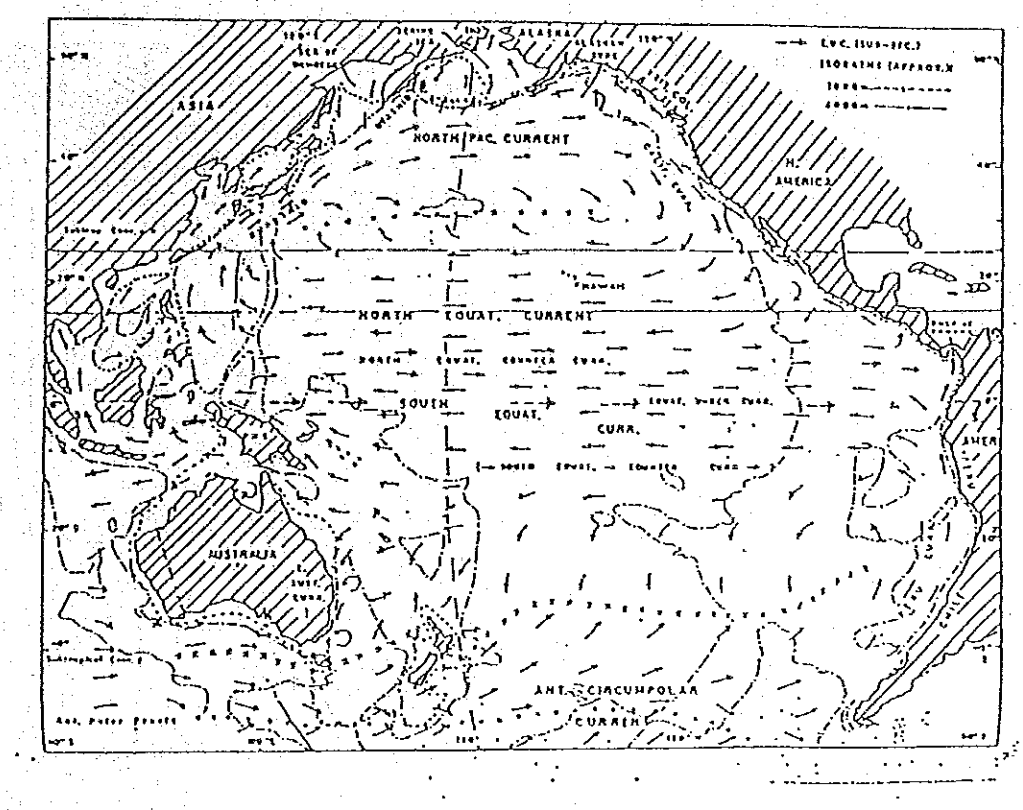


Fig. 11 Pacific Surface Currents
(after Pichard, G. L. et W. L. Emery, 1982)

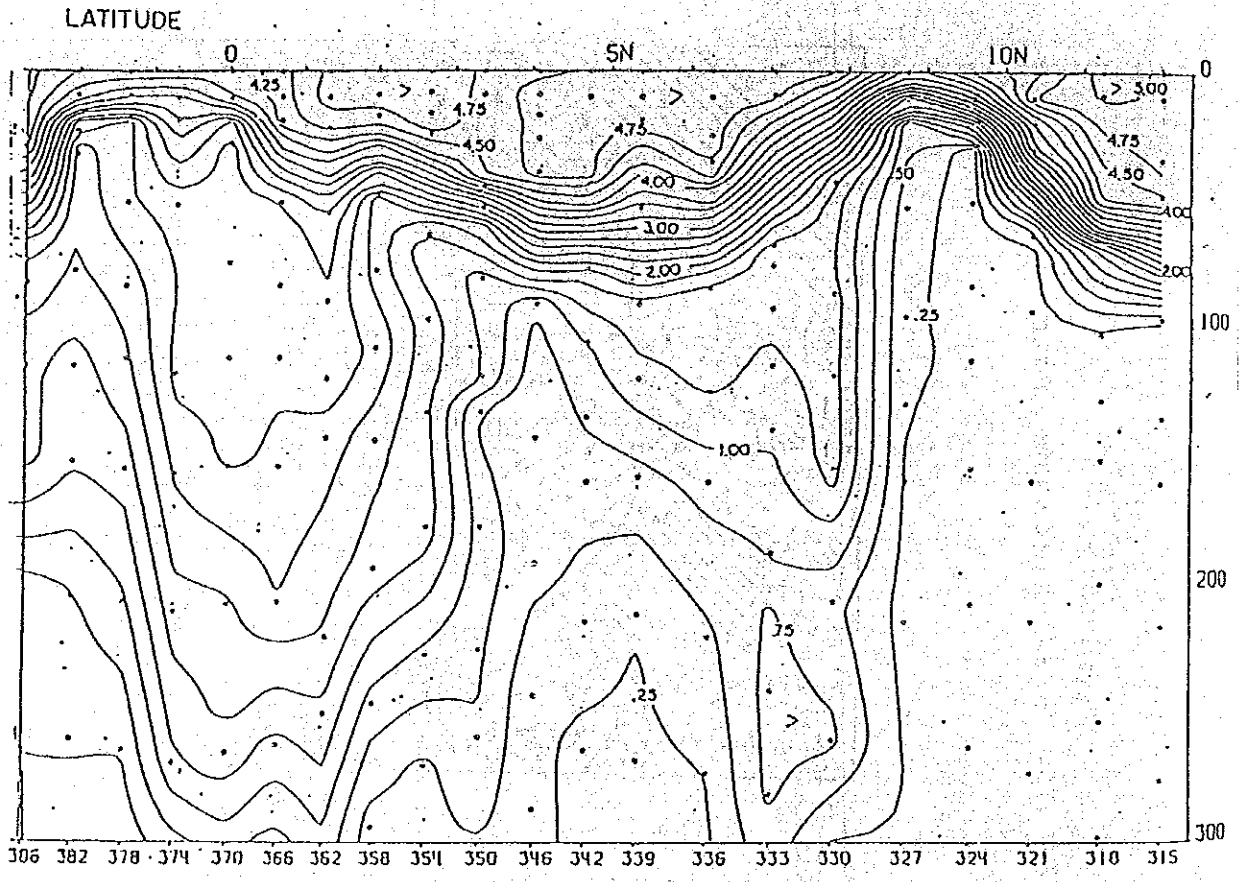


Fig. 12 Vertical Distribution of Oxygen at 88°30' W. (from Estropic Atlas, 1975, NMFS Circular 330, vol. 9)

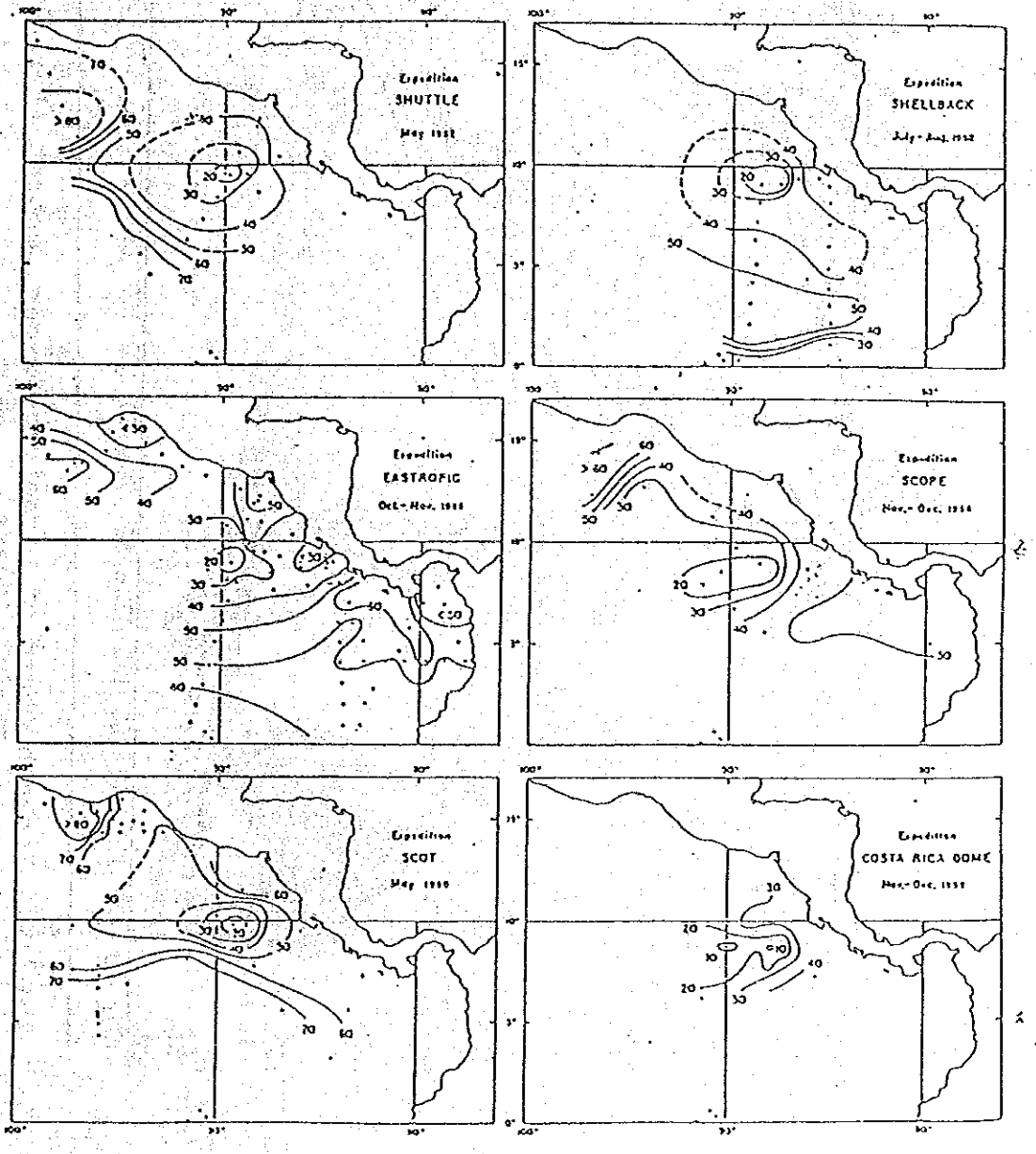


Fig. 13 Isobath Chart of the Costa Rica Dome at 19 1/2C (after WYRTKI, 1964)

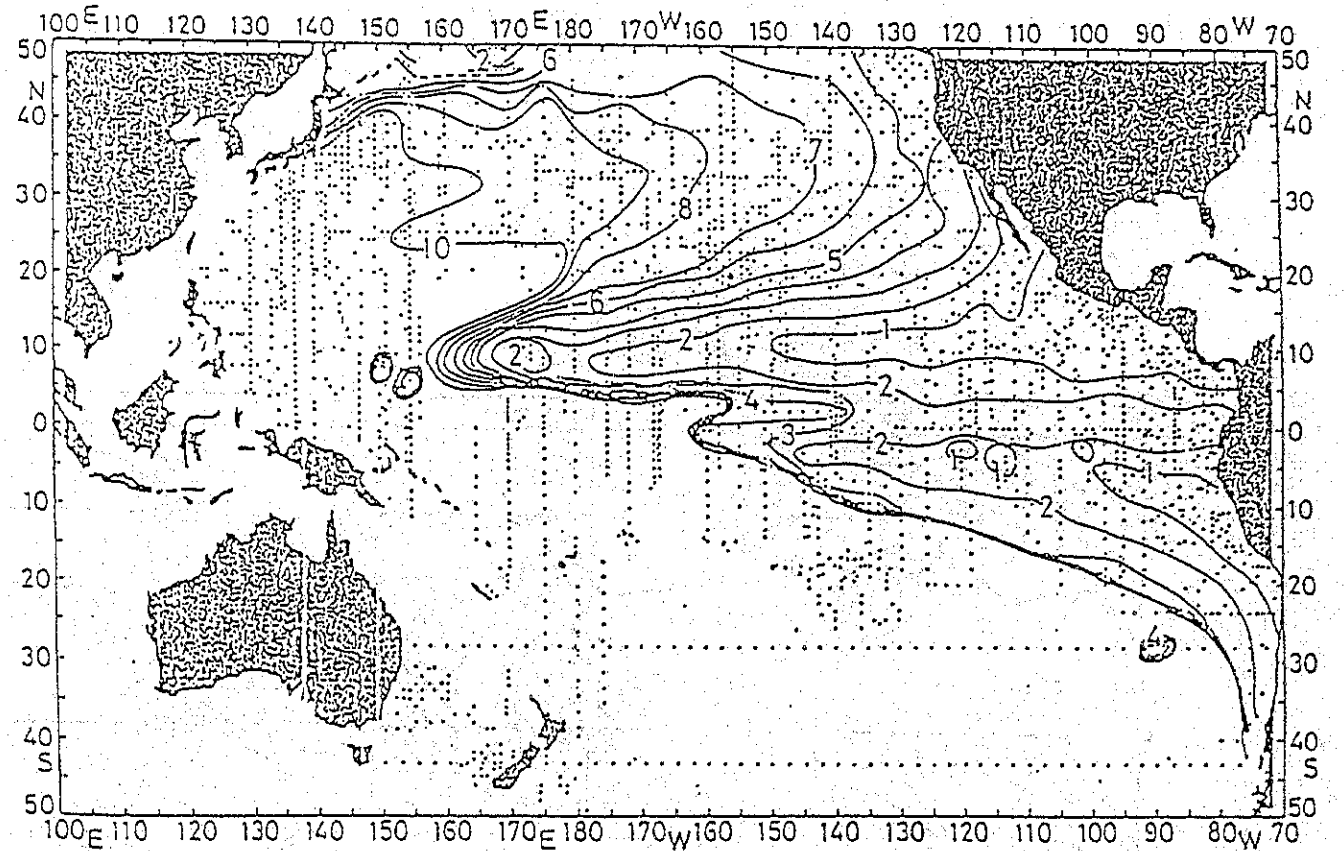


Fig. 14 Isobath Chart of Dissolved Oxygen Content (1 ml/l) in the Pacific Ocean

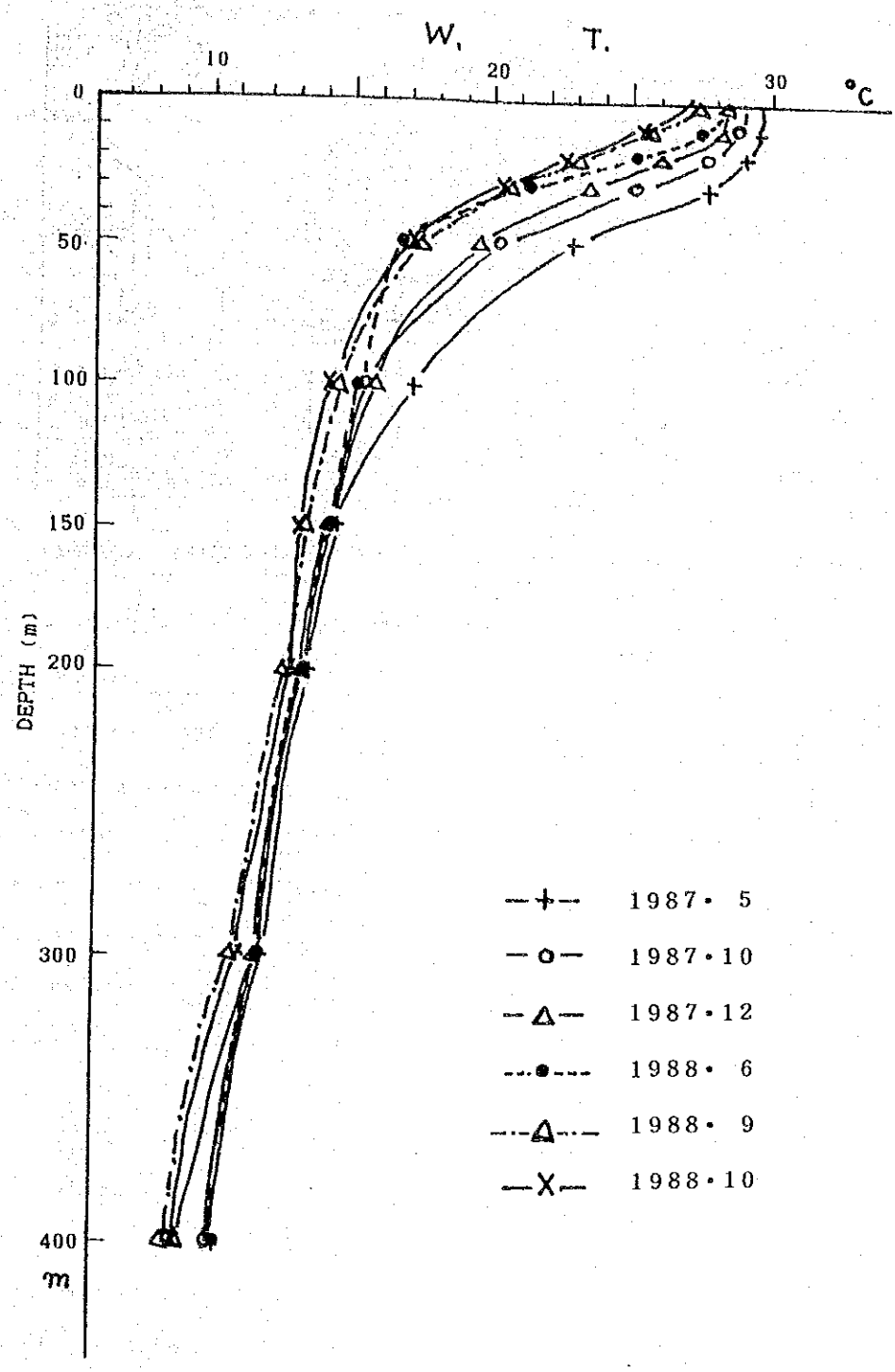


Fig. 15 Average Monthly Vertical Temperature Distribution in the Survey area.

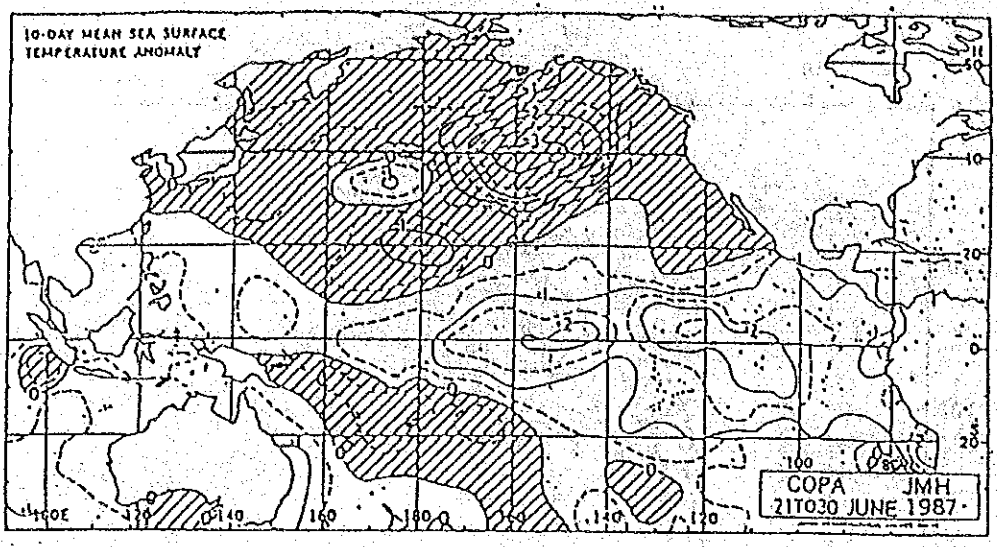


Fig. 16 Ten-Day Mean Sea Surface Temperature Anomaly (June 20-30, 1987)
(Crosshatched areas were lower than the average year)

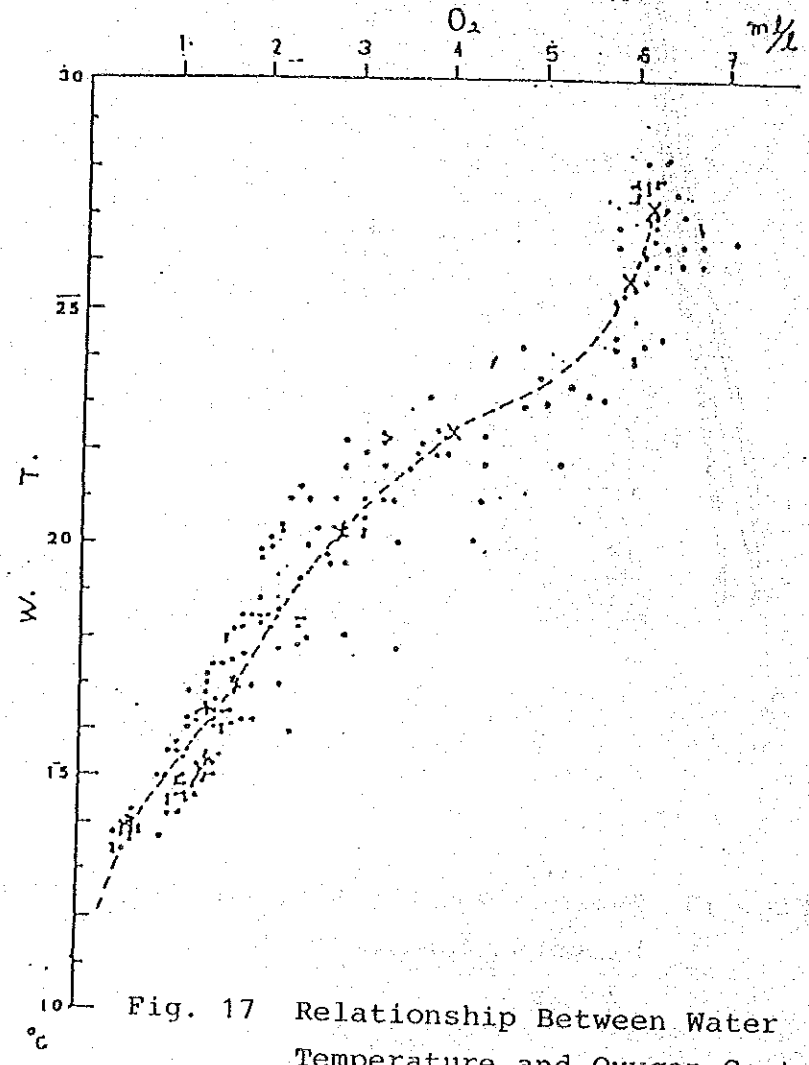


Fig. 17 Relationship Between Water Temperature and Oxygen Content in Survey Area during October, 1988

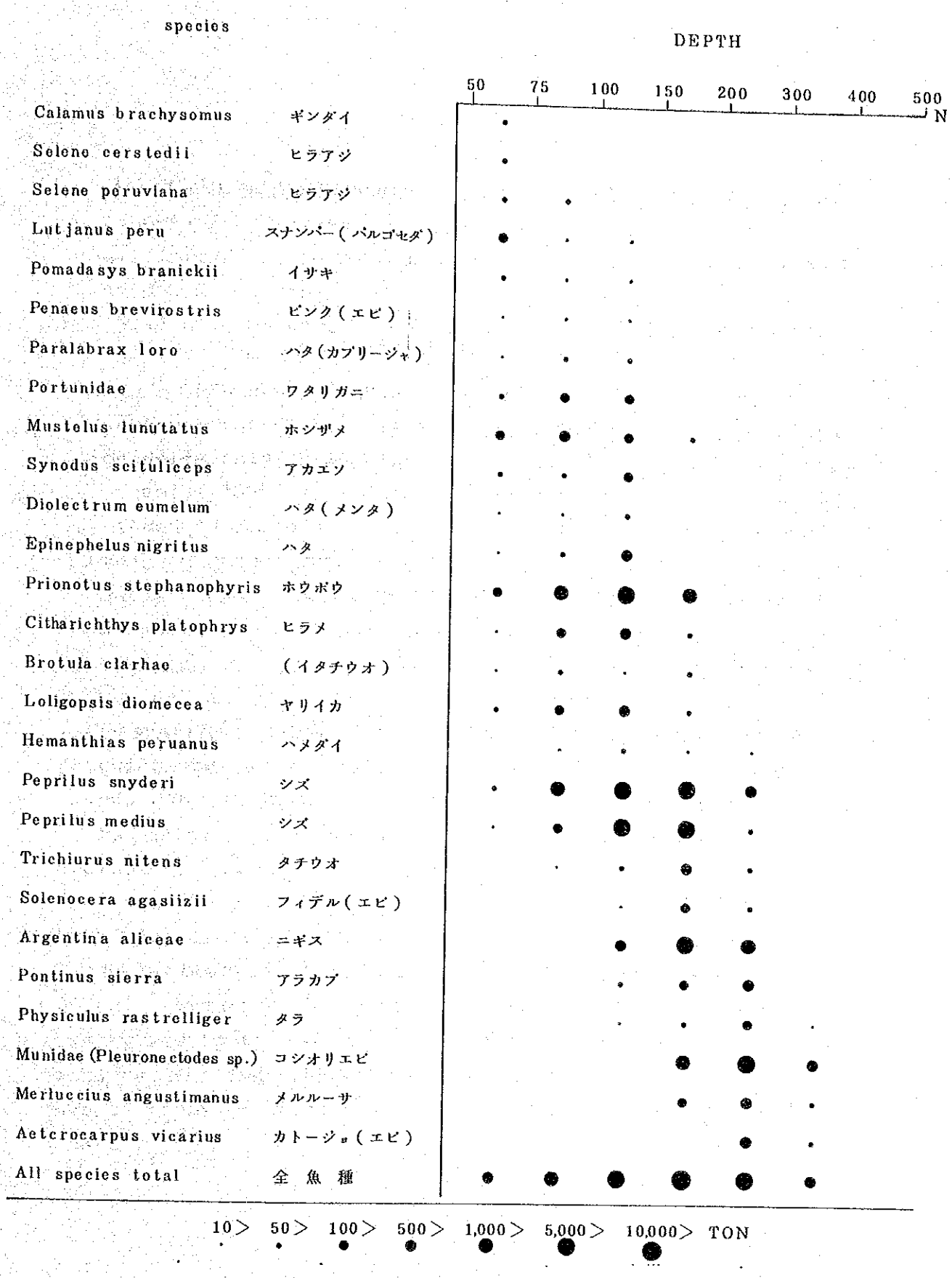


Fig. 18 Distribution of Species by Depth Zone caught by Single-Rigged Trawl Net