TIGER AND ENDEAVOUR PRAWN CLOSURE STUDY
WESTERN GULF OF CARPENTARIA
NOVEMBER 1982 - MARCH 1983

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ABSTRACT

Systematic trawl sampling of areas within and adjacent to western Gulf of Carpentaria fishing grounds which were closed to prawn trawling was undertaken at monthly intervals between November 1982 and March 1983.

Data collected on species and size composition of tiger prawns (Penaeus esculentus and P. semisulcatus) and endeavour prawns (Metapenaeus endeavouri and M. ensis) were used to assess the effectiveness of seasonal and area closures in the Groote Eylandt and Sir Edward Pellew (Vanderlin Islands) regions.

It was concluded that the closures satisfied the objective of protecting stocks of prawns of sub-optimal size and were thus effective in increasing the net economic yield although several recommendations for slight modifications to future closures are included.

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I INTRODUCTION

Since the initial development of the Northern Prawn Fishery in the mid to late 1960's there has been a considerable increase in fishing effort on the tiger and endeavour prawn stocks, particularly since 1976. (Department of Primary Industry 1982)

The western Gulf of Carpentaria fishing grounds have provided the majority of landings for these species from the fishery in recent years and this led to requests from the industry to declare seasonal closures in the region to protect juvenile prawns and to optimize the size at first capture.

These proposals culminated in 1981 with a recommendation from the Northern Prawn Fishery Advisory Committee to close waters west and south of a defined line between Mornington Island, the Vanderlin Islands and west of Groote Eylandt to near Cape Shield (see Figure 1a & b).

This recommendation was accepted by the appropriate State, Northern Territory and Commonwealth Ministers and the closures were declared in Northern Territory, Queensland and Commonwealth waters on 31 December 1981 until 15 March 1982. (Closures designed to protect small banana prawns were declared in the eastern Gulf of Carpentaria over the same period).

During the initial discussions regarding the closures there was some disagreement about where the defined limit should be marked according to prawn sizes based on anecdotal information and only limited scientific data, and the agreed limits represented a compromise based on opinion.

In 1982 there was further debate in the light of the apparent effectiveness (or lack of it) of the 1981/82 closures and this resulted in further recommendations regarding the area and timing of these closures. Subsequently they were introduced on 1 November 1982 until 1 April 1983 over essentially the same area except for a small change south west of Groote Eylandt, and the long term closure of North West Bay (Figure 1a & b).

Recognizing the need to provide some real information on the size composition of tiger and endeavour prawns in the regions subject to closure, a programme was designed with the following objectives:

1. to determine the size composition of the principal tiger prawn species (Penaeus esculentus and P. semisulcatus) and endeavour prawn species Metapenaeus endeavouri and M. ensis) on the commercial fishing grounds subject to seasonal closure in the western Gulf of Carpentaria, and

2. to undertake these determinations at monthly intervals between October 1982 and March 1983 inclusive, using a chartered prawn trawler, and

3. to assess and report on the size composition of prawns on fishing grounds within or adjacent to the closed area with reference to the effectiveness of the closures in space and time.

In addition to the above, the opportunity was taken to gather information on other aspects of the fishery in the region including biological observations on other prawn and fish species and observations on the physical environment (much of this data will be analysed as part of ongoing studies on the fisheries in this region).

The study was undertaken by staff from the Fisheries Division, Northern Territory Department of Primary Production and funded from three sources.

A grant from the Commonwealth Fishing Industry Research Trust Account ($90,000) was used for the charter of the commercial prawn trawler and some of this amount (approximately $26,000) was offset by sales of product.

The Northern Territory Fishing Industry Research and Development Trust Fund provided funding for the time of the consultant scientist (R. Buckworth) and operational expenditure and salaries for the Fisheries Division staff was drawn from the Northern Territory Fisheries Division allocations.

As mentioned above, some amendments were made to the area and timing of the closures from 1981/82 to 1982/83 with the result that some modifications were made to the original proposal to enable the additional areas to be covered.

Financial and administrative constraints resulted in the decision to exclude October from the monthly sampling although this was compensated for by the addition of other data collection during the remaining surveys.

The results reported in this paper cover the tiger prawn and to a lesser extent the endeavour prawn populations, although additional data is available for other commercial species, ie banana and king prawns. It is anticipated that these will be included in the final report on the ongoing Groote Eylandt prawn fishery monitoring programme to be published subsequently.

These results were presented at the Closure Sub Committee of the Northern Fisheries Committee in June 1983 and subsequently taken into consideration in determining the recommendations to the Northern Prawn Fishery Advisory Committee and the Northern Fisheries Committee for closures for 1983/84.

II METHODS

The survey was undertaken using the 15.8 m prawn trawler F.V. "PAULWIN", towing standard double-twin rig otter trawls. Vessel and gear specifications are detailed in Appendix 1.

The areas trawled (see Fig. 2a & b) were chosen on the basis of their location within or adjacent to the closed areas, their suitability for trawling and reasonable proximity to Groote Eylandt. Priority was accorded to those areas which are most subject to commercial fishing.

A more detailed map of the survey area showing the localities mentioned in the text is attached as Appendix 2.

The basic strategy was to make one trawl within each 6 (nautical) mile by 6 mile grid in the study area and to repeat this at intervals of approximately one lunar month during the study period (dates of each cruise are presented in Table 1). Surveys were conducted from north to south, beginning in the vicinity of Cape Shield and concluding near the Sir Edward Pellew group. Remaining funds allowed further trawls in the fifth cruise, after the normal survey was completed. These were used to provide information on stocks in heavily fished grounds outside the survey area, and to supplement sample sizes within the normal study area from those grids which had yielded only small sample sizes earlier in the cruise.

Where the master of the vessel was not familiar with the trawling conditions in a particular grid, the grounds were surveyed briefly with the echo sounder before trawling.

The main operational objective of each shot was to produce a sample of at least 100 prawns of each sex of the dominant prawn species in that shot. The duration of each trawl was thus adjusted in the light of catch rates of preceding shots on that night and, for the second and later survey cruises, for previous shots in that grid. Shot duration was also varied due to operational considerations, eg bottom type, mechanical problems etc. Trawling time was limited by the amount of steaming and surveying required. For this reason, trawls conducted during the first cruise were shorter on average than for subsequent cruises. Duration of trawls was also limited when large trash catches were anticipated (for example, large catches of "sea eggs" (echinoids) caused some shots of the fourth and fifth cruises to be abbreviated). Where catch rates were low, it was often necessary to accept samples of less than optimum size, so that sufficient grids could be covered within the time available.

Data on several physical parameters was collected during each shot (the data sheet used is included as Appendix 3). The position of the vessel was fixed using radar and/or the satellite navigator, and the exact locations of start, finish, direction and any variations in course recorded. The

officer of the watch also recorded sounder depths at the start, midway and at the finish position of each shot. The mean of these depths was used for data analysis. Notes were made on wind strength and direction, sea state and general weather conditions.

A sample of the substrate was taken at the completion of most shots in Cruises 2 to 5, with the view to providing information on the relationship between bottom type (in terms of particle size composition) and prawn species and size composition.

Sea surface temperature was measured with a mercury thermometer to the nearest 0.1°C.

Sea surface salinities were also determined using a TPS salinity meter, or an Auto Lab model 602 salinity-temperature bridge.

Total by-catch (ie all non-prawn catch including commercial species such as bugs, squid, etc.) was estimated using a standard fish basket (mean weight per basket = 43.3 kg, S.D. = 1.14, n = 11). For the purposes of this survey, and within the time constraints operating, more accurate determinations were not possible.

Catch weights of principal commercial species contained in the by-catch were recorded.

The presence of all trash components was recorded, usually to family level for fish species but only to major divisions for sharks, rays and invertebrates (see Appendix 4). The principal trash taxa were ranked according to dominance, both by weight and by numbers, for subsequent analysis.

Samples of all commercial species of prawns were taken. All prawns sampled were identified, sexed, and measured. The total weight for each species, by sex, was measured to ±5g using an Ohaus Triple Beam balance. Where the catch of a species or group exceeded the amount required for a sample, the excess was weighed (up to 10 kg) or its weight estimated from volume (greater than 10 kg). The presence of "coral" prawn genera were noted, and their weight estimated if more than about 0.5 kg. Carapace length was chosen as the easiest and most reliable measure of size, and was measured to the nearest millimetre using Helios dial calipers. All sample prawns were characterized as "hard" or "soft" shelled. Females were examined for the presence of maturing or ripe ovaries and externally obvious spermatophore implants. Males were classified as mature or immature when the petasmata were joined or unjoined respectively.

Classification and measurement of prawns was performed on board, usually immediately after catch sorting was completed and during the following shot. The delay between bringing the shot aboard and the completion of measurement of samples was usually about 1 hour (the maximum delay of 5 hours occurred when bad weather interrupted normal routines).

Length frequency data was recorded onto cassette tape, using microphone headsets with a dual input. This enabled very rapid data recording, obviated the problems of sample storage and the associated possibilities of data loss, and enabled easy communication above the noise of engines and weather. This procedure enabled the rapid processing of fresh prawns without loss in quality and hence ensured good prices for product landed. Tapes were transcribed to data sheets, usually before the next shot was completed. Data from one shot could thus be used in decisions about trawl duration etc, for following shots.

Prawn length frequency data were returned to Darwin at the completion of each cruise, and entered for data processing. This enabled preliminary analysis of the data to be carried out immediately, so that subsequent sampling strategies could be optimized.

Large samples of major prawn species (Penaeus esculentus, P. semisulcatus, P. latisulcatus and Metapenaeus endeavouri) were frozen and retained for later morphometric analyses. For the purposes of these analyses, carapace lengths were recorded to the nearest 0.1 mm and weights to the nearest 0.1 g using Helios dial calipers and a Mettler PC4000 electronic balance.

The raw data collected during the survey were in the form of carapace length frequency composition by species and sex for each of the grids sampled over the five monthly cruises. This is most appropriate for future accurate assessment of biological trends, and was most convenient for ship-board measurements. However, this information is not in the most appropriate form for assessment by industry, as the commercial measure of size composition is normally by weight in count per pound whole prawns (not per kilogramme). Thus a procedure for converting carapace-length frequencies to weight as count per pound whole was required. In order that individual weights could be predicted from given carapace lengths, a relationship between carapace length and total weight was determined, using the method of least squares. Weight frequencies were thus predicted from length frequencies. The determined weight frequency composition data was then grouped into count per pound categories according to the following commercially accepted grades : less than 10 per pound, 10 - 20, 21 - 30, more than 30 per pound (1 pound = 453.6 g).

In addition, as the industry does not differentiate between species within the major commercial groups, the data for each species were grouped accordingly ie P. esculentus and P. semisulcatus into "tiger" prawns, Metapenaeus endeavouri and M. ensis into "endeavour" prawns and Penaeus latisulcatus and P. longistylus into "king" prawns.

Thus the carapace length frequencies of samples of several species of prawns taken from a shot were converted into a size frequency composition of percentage count per pound, by major species group.

Catch rates for each shot were determined as kg per hour trawled for each major species group.

All statistical analyses were performed using the methods of Nie et al (1975).

III RESULTS

A total of 282 trawls were made in 68 different grids. An additional 7 were surveyed, but not trawled due to bad bottom conditions. 5 shots were abortive (3 due to gear damage, 2 due to excessive trash catches, where the gear could not be brought aboard).

In the five cruises a total of 81,828 prawns were sampled for species, sex and length frequency composition. Dates of cruises and the numbers of each species sampled are presented in Table 1.

A listing of details of each cruise according to grids sampled is provided in Appendix 5.

A summary of results giving size composition by grade expressed as a percentage by weight of the total catch for the principal species groups (tiger and endeavour) by grid and by month is presented as Tables 2 and 3. The data for the over 30 count per pound category for tiger prawns are graphically illustrated as Figures 3(a) to 7(b). These results provide a guide to the observed proportion of small tigers in the catches from each grid sampled per month.

Figures 8(a) and (b) illustrate a summary of the results of the surveys, by indicating those grids where at any time during the study the proportion by weight of the small tiger prawns (over 30 count) in the catch exceeds 10% of the total. The months when that occurs are indicated by letter within the grid.

While this information provides a guide to those grids which contained a relatively high proportion by weight of juveniles it is appropriate to assess this in terms of catch rates. An area with a low proportion of juveniles but a high catch rate overall could have a larger concentration of

juveniles than another area with a high proportion of juveniles but very low catch rates. In order to examine this the catch rates (in grams per hour) were determined for small prawns, namely those of over 30 count per pound, for each grid by month..

This has been carried out for both tiger and endeavour species groups and the results are illustrated in figures 9(a) to 18(b). These figures illustrate the most appropriate assessment of the abundance of juveniles within the study area in respect of geographic area and time.

IV DISCUSSION

Biological data on the western Gulf of Carpentaria tiger and endeavour prawn fisheries is as yet insufficient to provide a quantitative assessment of the net economic benefit of seasonal closures. However, closures in those areas and times where small prawns are abundant should nevertheless provide an ultimate net gain to the fishery. Assessment of the effectiveness of the 1982/83 closure must therefore include an examination of whether or not the timing and location afforded adequate "protection" to the stocks of small prawns, and yet did not significantly preclude access to significant concentrations of larger prawns.

The results of this study indicate that with respect to the above criteria, the closures declared in 1982/83 were generally effective, ie stocks of small prawns were adequately protected in most areas, and the closed period encompassed the greater part of the offshore migration of small prawns in most areas. Improvements in catch rates by the end of the study and observations made after the closure period suggest that net catch value was probably increased. Once again, further data is required before the real benefit can be assessed.

Several aspects of the results warrant further comment and consideration, especially in that they bear upon increasing the effectiveness of future closures. Discussion here is chiefly restricted to tiger prawns, as they comprised the bulk of the catch and are of primary interest to the fishery. Endeavour prawn catch rates were often so low as to have little or no bearing upon the effectiveness of the closure.

Sea-grass beds constitute nursery areas for tiger and endeavour prawns (Staples, pers. comm) and the proximity, extent and production of these beds would appear to be the dominant factors in providing high concentrations of small prawns in any area.

Two areas showed both high proportions and high catch rates of small prawns each month surveyed, namely North West Bay (grid 3765) and the West Island - North Island area (grids 5566, 5567, 5568) These areas are both relatively shallow embayments and are characterized by their immediate proximity to the sea-grass beds.

The consistently high proportions and catch rates of small prawns in these areas, reflect direct recruitment from the nursery areas, while the increasing proportions with time in nearby grids reflect subsequent growth and offshore migration.

The characterization of sea grass beds in the western Gulf region is the subject of present studies, (Poiner, Staples, pers. comm) and the relationship between recruitment and particular sea grass beds should thus be clarified.

A distinctive feature of three areas within the study is the marked increase in abundance of small prawns from December onwards. The mouth of Blue Mud Bay, the Alagna Shoal area and those grids immediately to the north of the Vanderlins (ie grids 5366 to 5370) are fairly shallow areas that are not directly adjacent to sea grass beds, although they are in reasonable proximity. The abundance of small prawns in these areas, and subsequently in areas adjacent to them, is thus dependent upon the strength over time of the offshore migration. The Blue Mud Bay area well illustrates this point; though proportions of small prawns are high in November (61% in grid 3362), catch rates are fairly low. From the December survey, the proportions were high and catch rates of small prawns increased, reflecting the increasing strength of the offshore migration of recruits.

The north Vanderlins area is separated from the West Island - North Island area by concentrations of "larger" prawns (see Figs. 3 - 8). This separation is most likely a result of the actual direction of the offshore migration and may be a result of the direction of currents or may reflect a difference in bottom type preference between the size/age groups (this will be investigated in the course of sediment analyses).

With regard to the area to the north of Groote Eylandt, grids to the east of the closure line, ie outside the 1982/83 closure area, showed high abundance of small prawns for at least part of the survey. Conversely, the Rutland Shoal - South Point area (grids 4063, 4163, 4263, 4162, 4262) was characterized by consistently low proportions of small prawns, and relatively high catch rates.

The consistently low catch rates achieved for endeavour prawns means that the results with respect to these species can only be discussed in general terms. However, there are indications of slight differences in both the timing of recruitment and location of concentrations of small prawns between the endeavour and tiger groups. Reference to catch rates for endeavour prawns (Figs. 14 - 18) suggests that recruitment may begin earlier and be more protracted for endeavour prawns than tiger prawns. It is important to note here, however, that the apparently protracted recruitment period for endeavour prawns may be an artefact resulting from lower growth rates.

Concentrations of small endeavour prawns occurred in the Southern Blue Mud Bay - Bickerton Is. region, Alagna Shoal, West Island - North Island area and, in contrast to tiger prawns, the Rutland Shoal - South Point region. The area to the north of the Vanderlins appeared less important to endeavour prawns than tiger prawns.

These differences between tiger and endeavour prawns may reflect differences in habitat preference of the recruits, or differential contributions from nursery areas.

V FUTURE CLOSURES

When applying the results of the 1982/83 Closure Study to future closures it is important to note that Conclusions as to the timing of recruitment and the position of stocks of small prawns can only be made with reference to factors in operation during that study. In particular the 1982/83 "wet" season was unusual in the delay in its onset, and the below-average rainfall received. Though the effect of rainfall or related climatological factors on recruitment of tiger and endeavour prawns has yet to be fully assessed, further fine tuning for "average" years, or particular years, may be of benefit. Most grids were trawled at intervals of approximately one lunar month, and lunar effects on size composition or catch rate could possibly render some conclusions as to the abundance of small prawns inaccurate. Fortunately, those grids retrawled in the fifth survey cruise (at periods of 6 - 12 days after first trawling) did not show appreciable differences in catch size composition, and though catch rates were enhanced (see Figs. 13 and 18), the conclusions drawn should remain valid.

(a) Timing of Closures

Only two areas showed a high abundance of small prawns in the November trawls: North West Bay and the West Island - North Island area. Providing that these two areas are protected, there would appear to be no justification in declaring a general closure until December, thus allowing fishing access to the larger prawns present throughout the remainder of the region. North West Bay is presently closed until 30 June, 1985. The West Island - North Island area could possibly be subject to a separate seasonal closure beginning in November, although it may be avoided by fishermen in this period simply because larger prawns are available in other areas.

For the areas in general, the opening date of 1 April appears to be appropriate (although without survey results for April, it is possible that an extension might be warranted). The trend in size composition suggests that the bulk of the catch would be in the less than 30 per pound size classes by this time.

(b) Location of closures

The results indicate that the effectiveness of the seasonal closure may be enhanced in future by some slight adjustments to the positioning of the closure boundaries.

For the area north of Groote Eylandt, inclusion in future closures of those areas which showed an abundance of small prawns, yet were slightly to the east of the closure as declared in 1982/83, would be to advantage.

A northward repositioning of the closure line in the area to the north of the Vanderlins, (to include grids 5366, 5367, 5368, 5369 and 5370), so as to effectively protect the small tiger prawns in this area may be warranted although catch rates in this region were relatively low.

The Rutland Shoal - South Point area consistently produced low proportions of small tiger prawns and relatively high catch rates of large tiger prawns. Though proportions of small endeavour prawns are high, the benefit of allowing access to the large tiger prawns by adjusting the closure line westwards would ultimately be of benefit to the fishery, particularly at a time of year when catch rates are often depressed generally. Endeavour catch rates were so low that there would be no benefit in protecting the small endeavours in this region. The remaining concentrations of small endeavours would be protected by measures taken to protect small tiger prawns.

In summary: North West Bay is protected until 30 June 1985 and further seasonal closures would be appropriate after that date. It would be to advantage to close West Island - North Island from November 1 to April 1 each year and the remaining area from December 1 to April 1; the closure lines should be redefined slightly to the east in the north of Groote Eylandt, slightly to the westward in the Rutland Shoal - South Point area, and possibly slightly to the north in the Vanderlins area.

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VIII TABLES

TABLE 1 SUMMARY OF SAMPLING CRUISES - WESTERN GULF CLOSURE STUDY

Cruise	Dates	Days Fishing	Total Trawls or surveys	Total sampled prawns
1	3.xi.82 - 17.xi.82	13	61	13,568
2	2.xii.82 - 15.xii.82	12	58	15,801
3.	31.xii.82 - 14. i .82	13	51	14,898
4.	31. i .83 - 10.ii.83	10	49	14,879
5.	26.ii.83 - 14.iii.83	16	70	22,682
TOTALS		64	289	81,828

TABLE: 2(a)	TIGER PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983																			
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH			
Grid\Grade	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10
3165	0	0	48	52	0	1	51	48	1	4	59	36	7	3	47	21	8	16	40	35
3264	0	3	42	55	1	43	56	39	4	9	42	44	31	19	29	22	40	34	15	5
3265	0	0	36	64	1	3	40	56	5	9	52	34	33	43	20	4	26	34	26	14
3362	61	38	0	0	32	26	33	9	41	27	18	14	31	17	25	27	53	18	18	12
3363	4	4	64	28	7	9	49	35	14	16	44	26	15	16	43	27	37	36	20	7
3364	1	0	57	42	1	2	50	47	8	20	48	24	24	35	27	15	17	35	28	20
3462	8	8	39	45	24	14	35	27	35	30	19	16	13	22	33	31	32	31	26	12
3463	0	4	40	55	7	14	44	35	5	20	51	24	20	23	36	21	25	37	31	7
3464	1	14	59	26	3	19	57	21	9	19	47	26	21	47	30	9	7	42	42	9
3465																	3	22	63	12
3562	2	12	43	42	10	22	45	23	32	31	28	8	20	41	29	10	17	47	33	3
3563	1	8	42	49	12	28	45	15	8	23	52	17	16	30	42	12	22	41	36	2
3564	1	8	72	19	5	13	45	37	9	16	55	20	5	12	56	27	10	36	46	8
3565																	5	11	70	14
3663	6	31	49	14	17	32	43	8	19	29	36	16	18	20	49	13	9	29	53	8

TABLE: 2(b)	TIGER PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983																			
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH			
Grid\Grade	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10
3664		2	51	47	1	2	47	50	4	6	60	30	3	2	63	33	1	13	67	18
3665																	0	4	70	26
3765					18	30	42	0	23	43	34		29	42	28	1	14	40	46	
3861	2	10	75	13	13	22	51	13	36	24	32	8	15	44	37	4	8	52	46	
3862	0	0	100	0																
3960	4	24	64	8	27	22	39	13	18	32	46	4	8	22	58	13	3	35	61	1
3961	1	14	67	17	16	22	53	9	11	32	53	3	2	19	70	9	2	33	62	3
3962	6	17	67	10	13	17	65	5	19	28	43	10	5	28	61	6	3	23	71	4
4060	2	18	45	35	17	25	36	21	7	32	54	8	3	27	64	7	2	18	76	4
4061	12	1	68	19	6	12	62	21	3	25	66	6	2	10	68	21	1	17	76	7
4062	1	10	77	13	21	22	51	6	12	36	48	5	5	27	62	6	1	13	77	9
4063	1	4	61	34	3	7	67	23	15	21	48	16					3	15	76	6
4160	1	17	54	27	2	9	64	25	4	14	57	24	4	19	59	19	2	18	68	13
4161	1	9	56	35	1	4	70	25	3	15	63	19	3	9	72	17	2	14	76	8
4162	1	6	65	29	4	10	58	28	3	16	57	25	1	15	68	16	1	6	66	27

TABLE: 2(c)	TIGER PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983																			
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH			
Grid\Grade	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10
4163	2	8	72	19	9	15	62	15	8	22	57	14	2	11	68	20	1	8	75	16
4260	2	11	52	35	19	25	43	13	22	42	34	1	13	45	37	6	5	32	57	6
4261	1	17	64	17	3	14	66	18	5	18	68	9	3	30	61	6	2	25	69	4
4262	0	3	62	35	2	1	59	38	1	4	61	33	1	7	69	23	1	17	61	21
4263	0	0	30	70	1	0	33	66	3	1	32	64		7	73	20	0	4	42	54
4360	2	5	44	50	4	5	35	56	30	24	27	19	21	48	23	8	7	18	45	31
4361	1	11	56	22	6	11	53	30	16	43	33	8	3	31	65	2	2	33	54	12
4362																	1	13	69	17
4363																	0	17	56	26
4364																	0	0	0	100
4460	1	2	47	50	9	18	49	24	3	1	42	54	13	15	44	28	13	29	48	10
4464																	0	12	63	25
4465																	2	16	38	44
4558	1	2	60	37																
4559	0	5	55	40	7	22	51	19	1	2	61	28	7	40	48	5	5	44	47	4

TABLE: 2(d)	TIGER PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983																			
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH			
Grid\Grade	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10
4560	1	7	63	29	5	11	65	20	1	4	63	33	10	20	51	19	2	11	63	25
4659	1	14	58	27	9	24	58	9	9	43	43	5	7	33	54	7	5	38	52	6
4660	0	0	57	43	2	0	43	54												
5366	2	10	67	20	11	22	61	6												
5367	9	14	50	26	39	26	24	11	23	20	41	16	34	46	17	3	6	26	55	13
5368	9	14	51	26	58	37	5	0	50	30	12	8	20	29	38	13	5	23	63	9
5369	10	23	31	36	50	29	5	16	61	30	3	6	28	52	21	0	29	36	17	18
5370	4	5	56	34	18	10	35	37	26	14	42	18	17	16	28	39	10	11	26	53
5465	4	33	57	6	19	40	35	6	5	9	50	36								
5466	1	15	57	27	13	33	50	4												
5468	4	14	58	25	5	20	56	20	7	22	62	9	6	10	65	19	25	26	42	6
5470	2	6	60	33	14	13	47	26	10	56	41	43	5	1	44	51	8	4	39	50
5471	1	1	27	71	4	3	29	64	7	0	30	64					8	4	41	47
5566	55	35	7	4	62	23	15	0					49	32	16	4	51	39	9	1
5567	27	47	25	1	58	27	14	0	85	12	3		37	46	16	1	46	44	10	0

TABLE: 2(e)	TIGER PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983																			
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH			
Grid\Grade	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10
5568	22	40	36	2	41	35	22	2	37	28	28	8	10	30	51	9	21	34	40	5
5570	2	1	31	66	3	2	44	51	6	5	49	41	11	4	56	28	8	2	40	50
5571	1	1	41	57	4	2	30	64	19	1	27	53	4	2	54	40	4	1	44	52
5671	3	2	34	60	42	19	25	14	14	20	54	12	5	4	66	26	9	5	65	20
5771	6	8	47	40	6	16	55	23	8	7	63	21	4	5	7	24	6	3	71	19
5871	35	18	30	17																

TABLE: 3(a)	ENDEAVOUR PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983															
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY			
Grid\Grade	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10
3165		8	81	11		P				P				P		
3264		P			1	2	59	39	8	9	66	18		P		
3265						P				P				P		
3362		P				P				P				P		
3363		P			4	2	62	32		P				P		
3364		P				P				P				P		
3462		P				P				P				P		
3463		P				P				P				P		
3464	1	6	85	9		P				P				P		
3465																
3562		P			9	7	71	13	25	6	47	21		P		
3563	2	11	79	8	6	10	81	3		P			13	23	49	15
3564		P				P			16	10	64	10		P		
3565																
3663	6	26	65	3	3	15	75	8	14	8	67	11	16	2	52	13

MARCH				
⟩30	21-30	10-20	⟨10	
	P			
	P			
	P			
	P			
	P			
	P			
	P			
	P			
	P			
	P			
	P			
	P			
	P			
20	23	55	2	
	P			
	P			
11	19	63	7	

P = samples where n is less than 50.

TABLE: 3(b)	ENDEAVOUR PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983																			
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH			
Grid\Grade	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10
3664					24	6	60	10	20	11	54	15	P				P			
3665																	17	17	63	4
3765	P				P				P				P				P			
3861	P				16	35	49	0	50	25	24	0	P				P			
3862	40	35	26	0																
3960	P				12	27	61	0	28	25	41	0	P				P			
3961	P				P				P				P				P			
3962	P				17	25	58	0	47	20	31	2	P				27	9	61	3
4060	P				P				23	23	54	0	14	23	63	0	44	26	30	0
4061	4	20	72	5	7	19	71	4	P				P				P			
4062	5	23	63	9	13	17	61	10	54	23	22	0	39	28	28	5	P			
4063	19	28	53	0	P				85	7	8	0					P			
4160	P				68	17	9	6	88	5	7	0	63	26	11	0	P			
4161	P				65	14	21		80	4	16		P				P			
4162	P				P				P				P				P			

P = samples where n is less than 50.

TABLE: 3(c)	ENDEAVOUR PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983															
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY			
Grid\Grade	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10
4163	P				P				P				P			
4260	3	20	75	2	P				P				72	13	15	0
4261	P				28	15	57	0	31	13	56	0	24	5	58	13
4262	4	15	77	4	47	14	34	4	40	1	39	12	P			
4263	2	7	89	2	5	3	74	17	P							
4360	P				P				P				P			
4361	P				P				P				P			
4362																
4363																
4364																
4460	P				P				P				P			
4464																
4465																
4558	P															
4559	P				P				P				P			

MARCH			
⟩30	21-30	10-20	⟨10
P			
71	15	14	0
42	7	51	0
54	4	26	16
P			
P			
P			
P			
12	2	74	11
P			
P			
1	3	87	9
1	4	89	5
P			

P = samples where n is less than 50.

TABLE:3(d)	ENDEAVOUR PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983															
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY			
Grid\Grade	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10	)30	21-30	10-20	(10
4560	P				P				P				P			
4659	P				P				P				P			
4660	P				P											
5366	P				4	6	90	0								
5367	26	4	68	3	P				P				P			
5368	P				P				P				P			
5369	P				P				P				P			
5370	3	8	75	13	5	5	83	7	P				P			
5465	P				41	30	30	0	P							
5466	P				P											
5468	P				13	6	63	18	P				P			
5470	P				1	1	80	18	P				P			
5471	P				0	2	85	12	P							
5566	P				74	9	12	5					P			
5567	P				P				P				P			

P = samples where n is less than 50.

TABLE:3(e)	ENDEAVOUR PRAWN % COMPOSITION BY WEIGHT BY GRADE : NOVEMBER 1982 - MARCH 1983															
Month	NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH			
Grid\Grade	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10	⟩30	21-30	10-20	⟨10
5568	P				54	22	24	0	35	11	54	0	P				P			
5570	P				P				5	5	81	9	P				P			
5571	P				3	2	82	14	P				P				P			
5671	P				P				P				P				P			
5771	P				P				5	2	88	6	P				P			
5871	P																			

P = samples where n is less than 50.

IX FIGURES

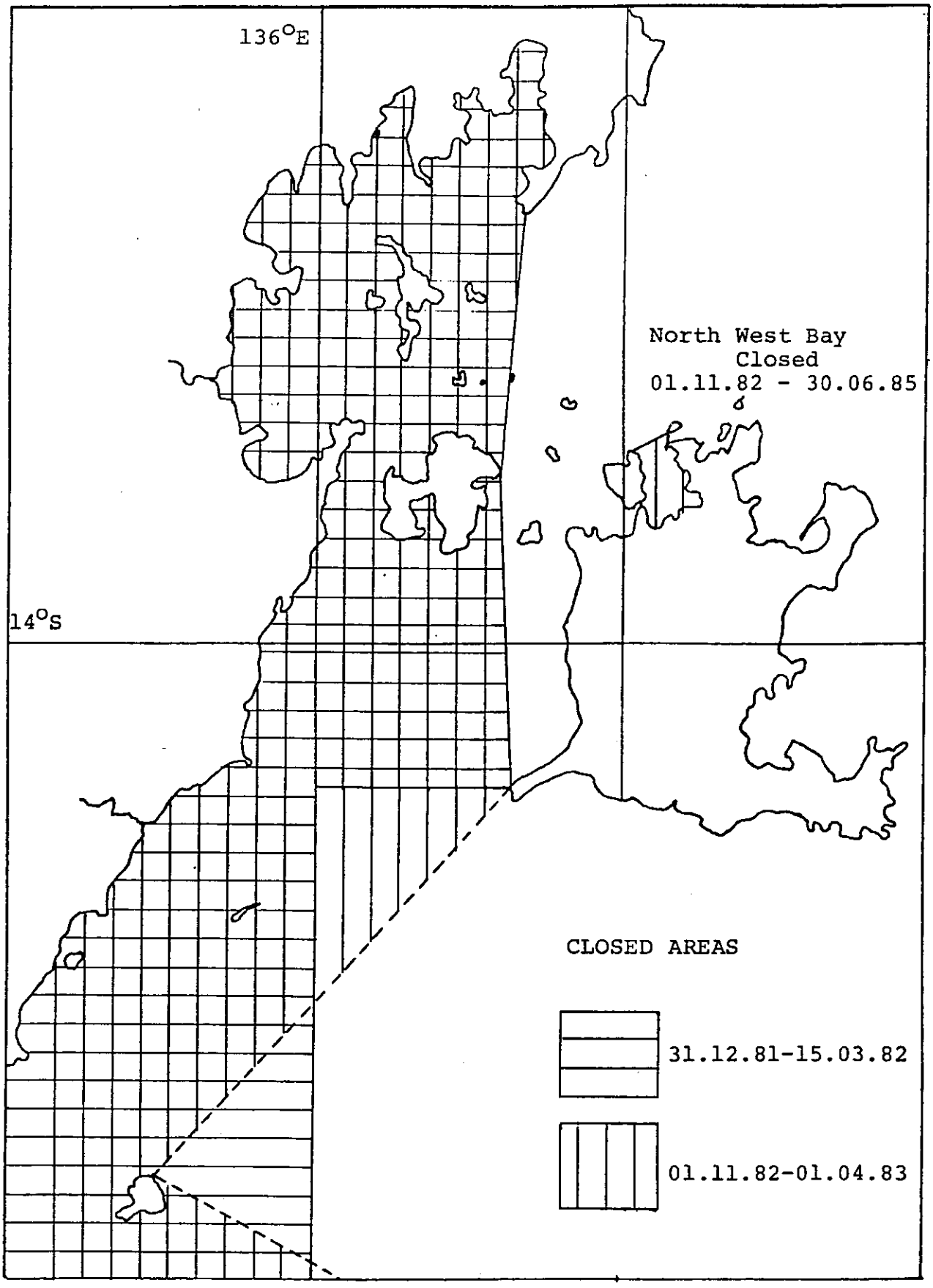


Figure 1(a) Tiger and endeavour prawn closures central western Gulf of Carpentaria 1981/82 and 1982/83.

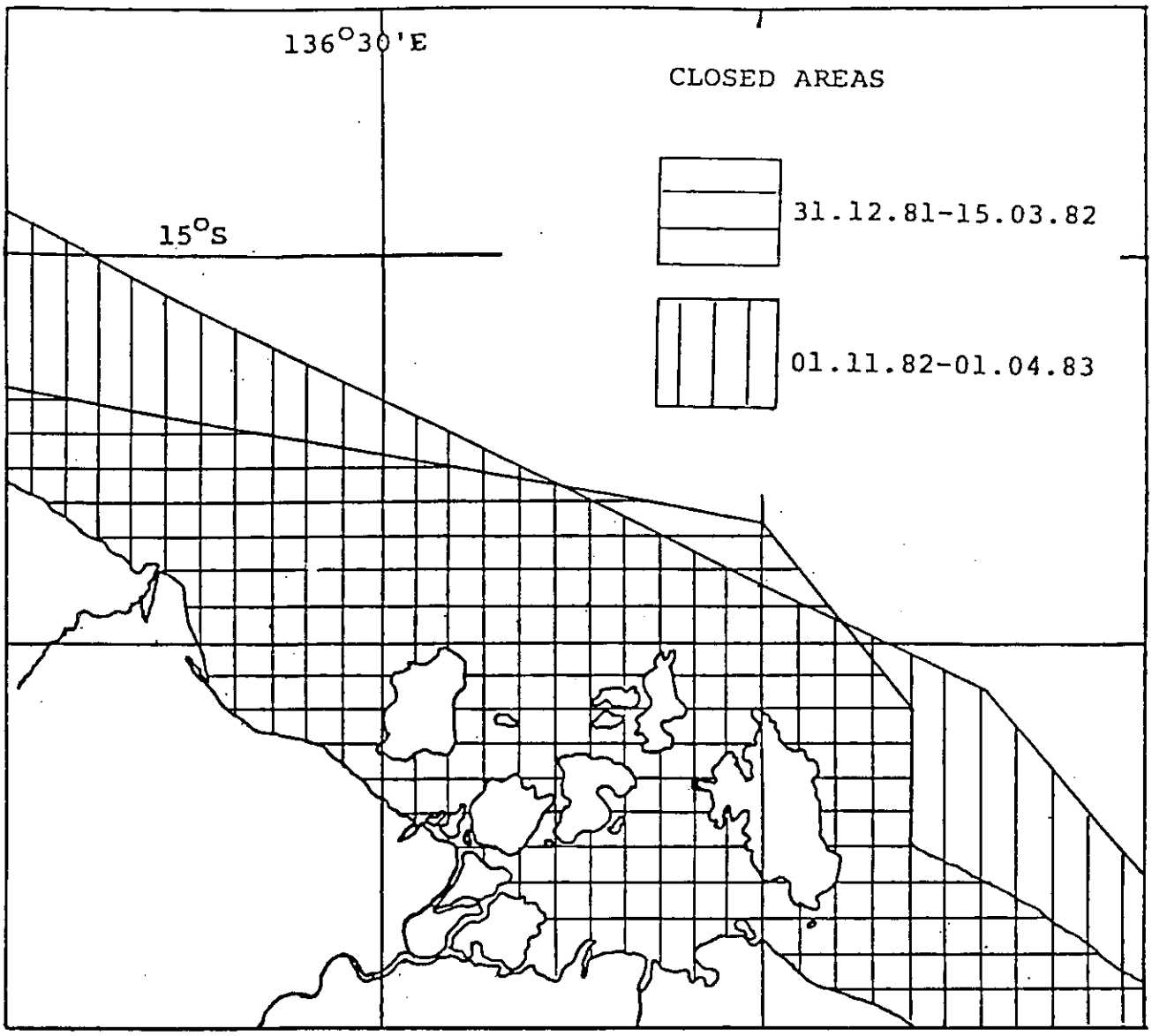


Figure 1(b) Tiger and endeavour prawn closures south western Gulf of Carpentaria 1981/82 and 1982/83.

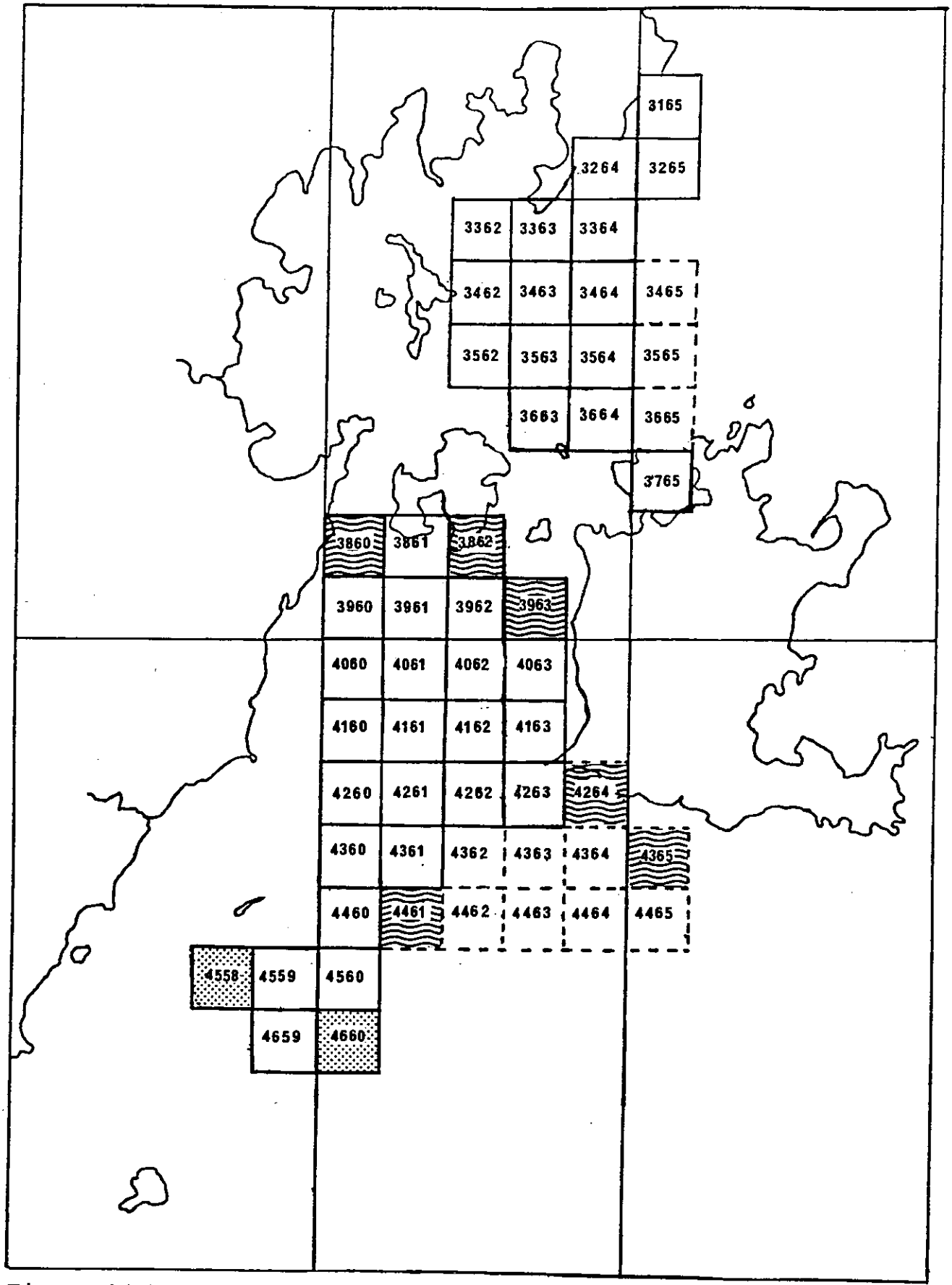


Figure 2(a) Sampling areas - central western Gulf of Carpentaria.

Grids not sampled rough bottom

Grids not sampled consistently due to rough bottom

Grids surveyed or sampled March 1983 only

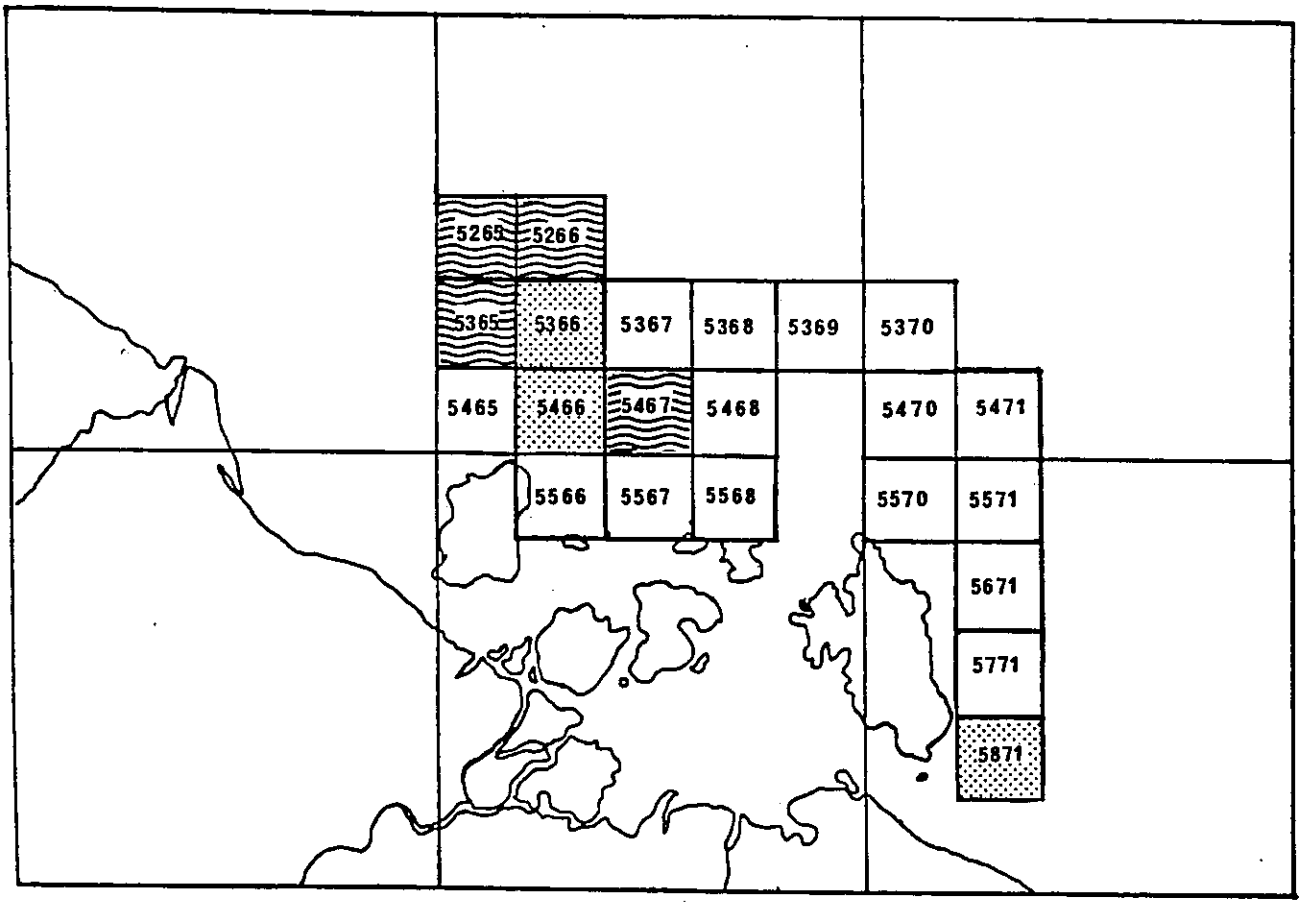


Figure 2(b) Sampling areas - south western Gulf of Carpentaria.

Grids not sampled, rough bottom

Grids not sampled consistently due to rough bottom.

Grids surveyed or sampled, March 1983 only.

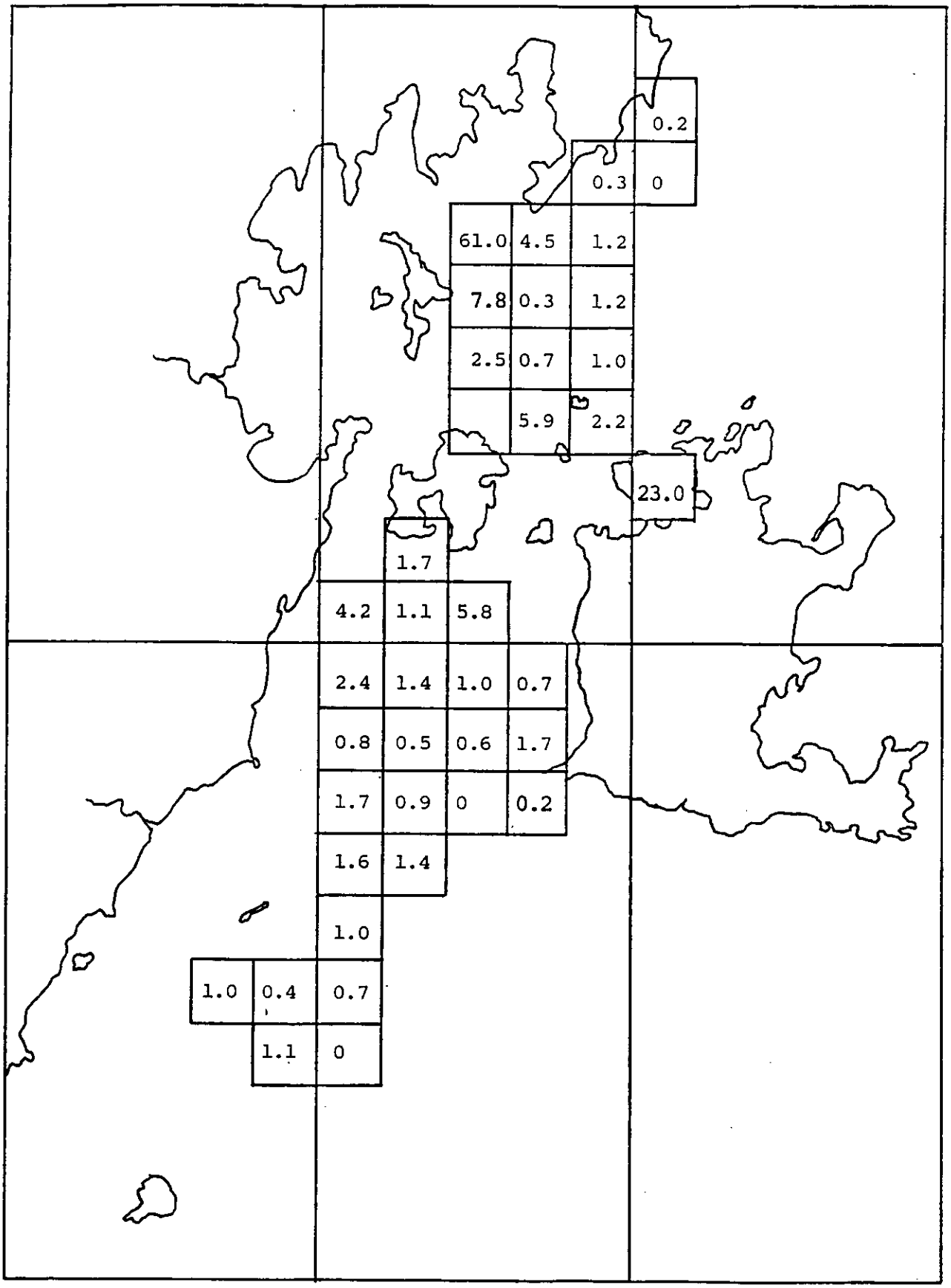


Figure 3(a) Tiger prawn size composition November 1982
% by weight of prawns over 30 count per pound.
- Central western Gulf of Carpentaria.

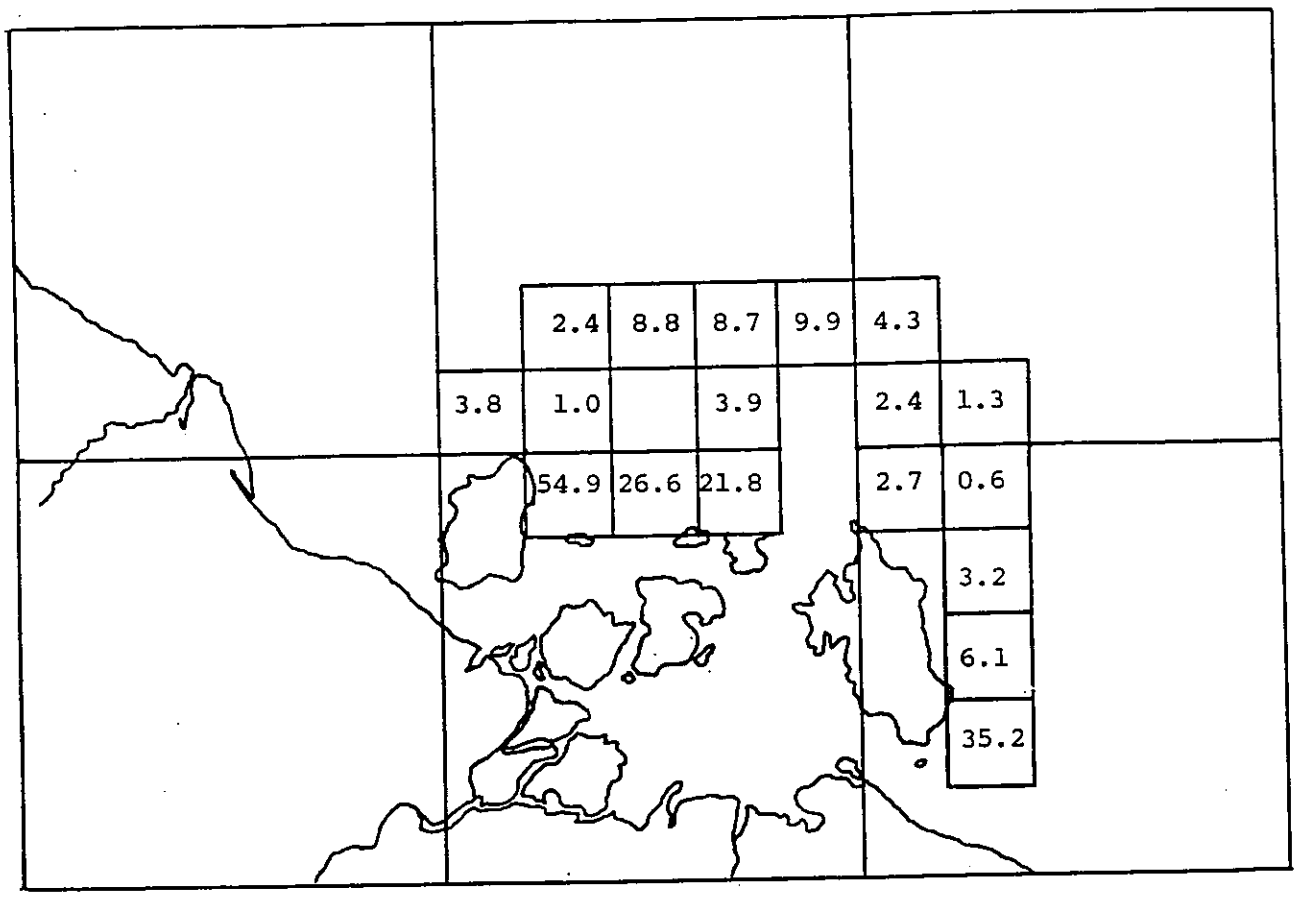


Figure 3(b) Tiger prawn size composition November 1982
% by weight of prawns over 30 count per pound.
- South western Gulf of Carpentaria.

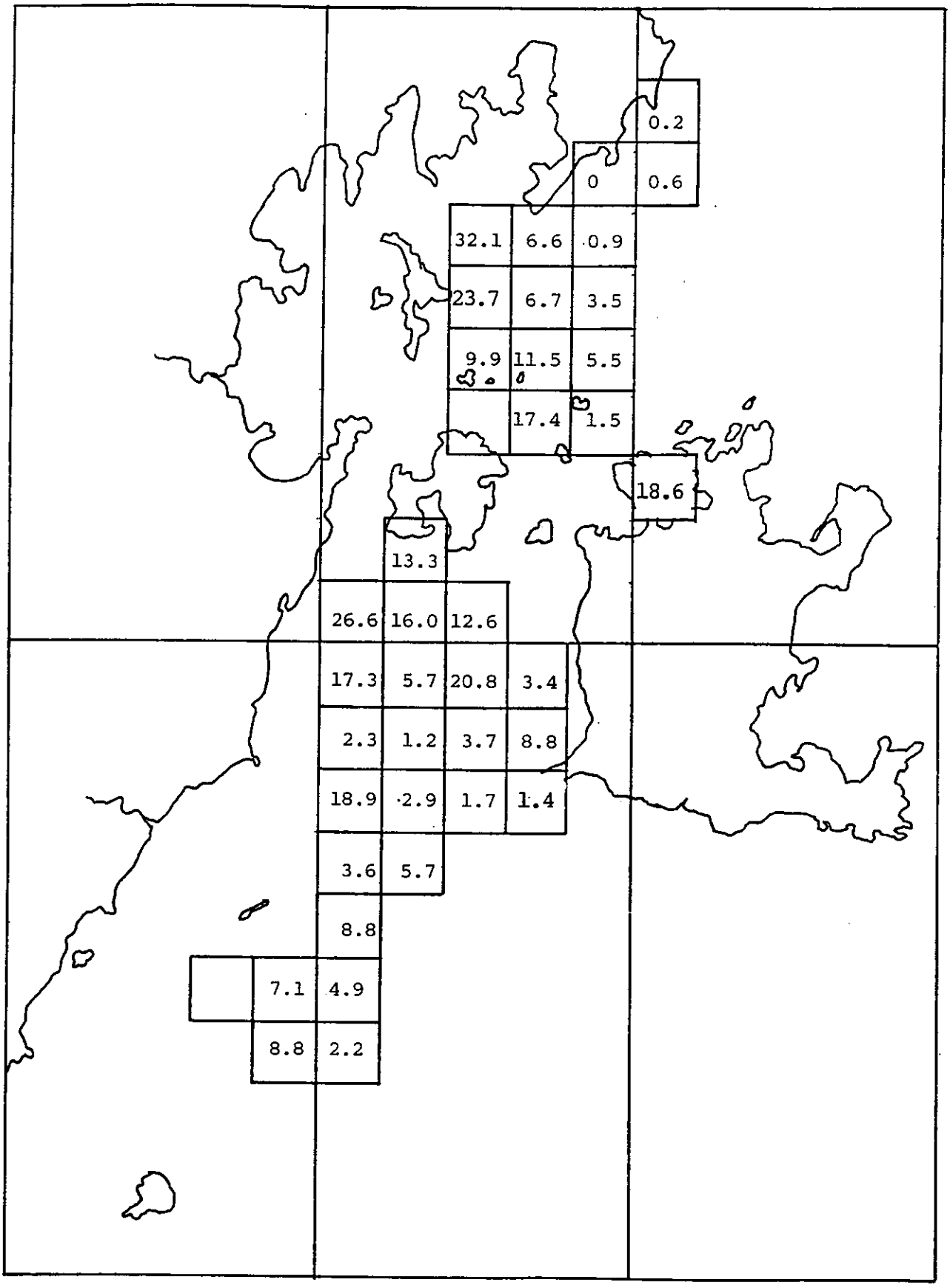


Figure 4(a) Tiger prawn size composition December 1982
% by weight of prawns over 30 count per pound.
- Central western Gulf of Carpentaria.

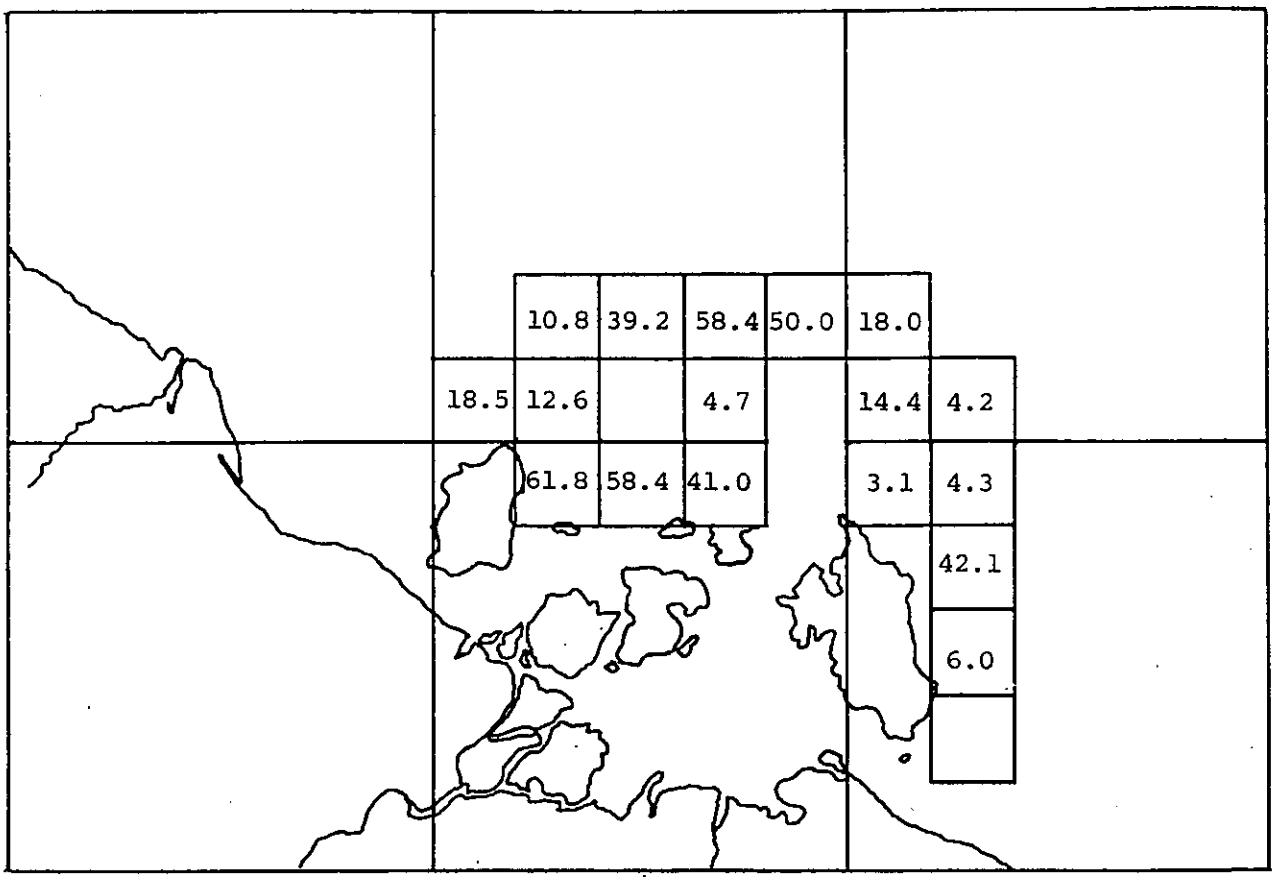


Figure 4(b) Tiger prawn size composition December 1982
% by weight of prawns over 30 count per pound.
- South western Gulf of Carpentaria.

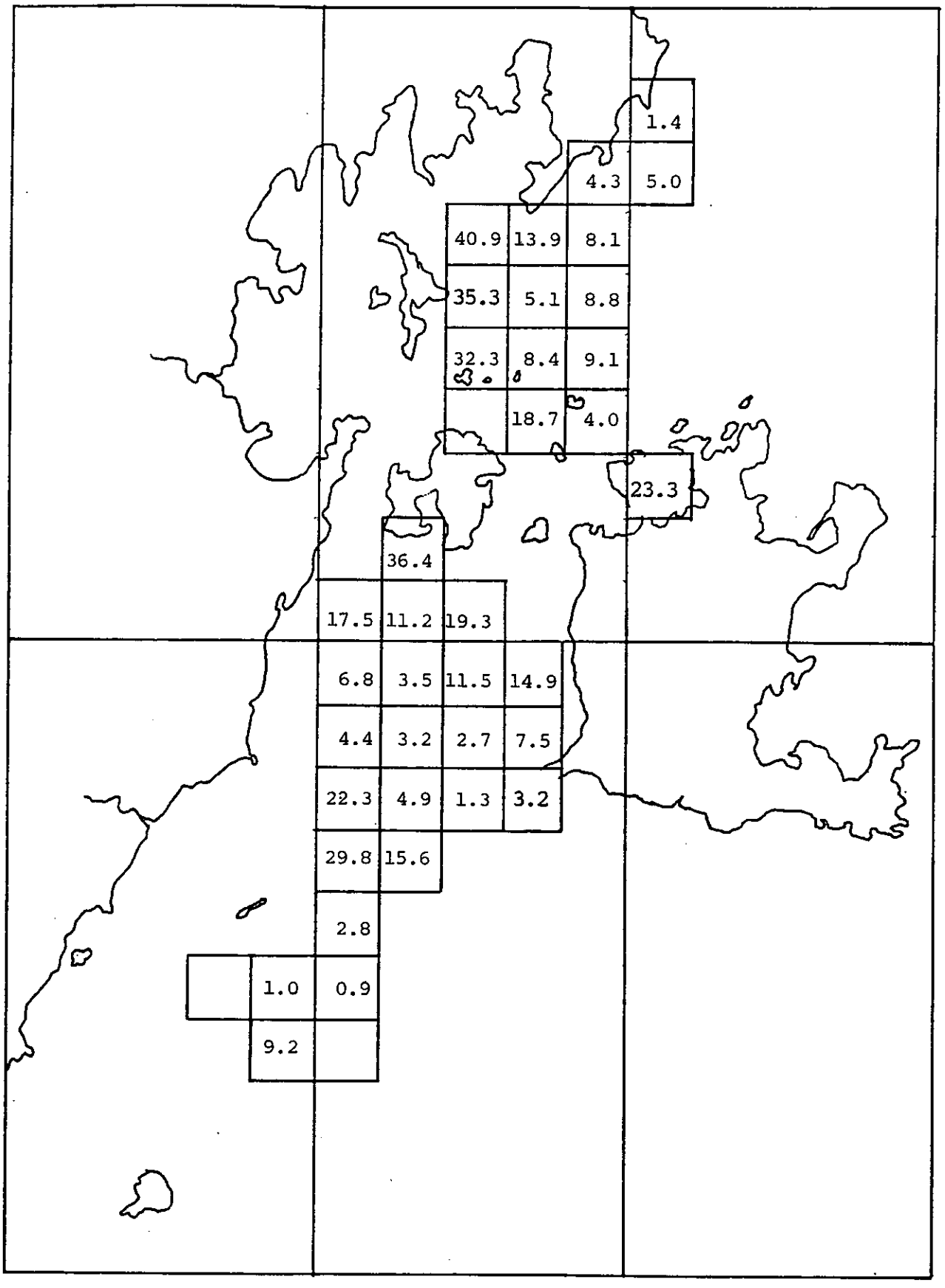


Figure 5(a) Tiger prawn size composition January 1983
% by weight of prawns over 30 count per pound.
- Central western Gulf of Carpentaria.

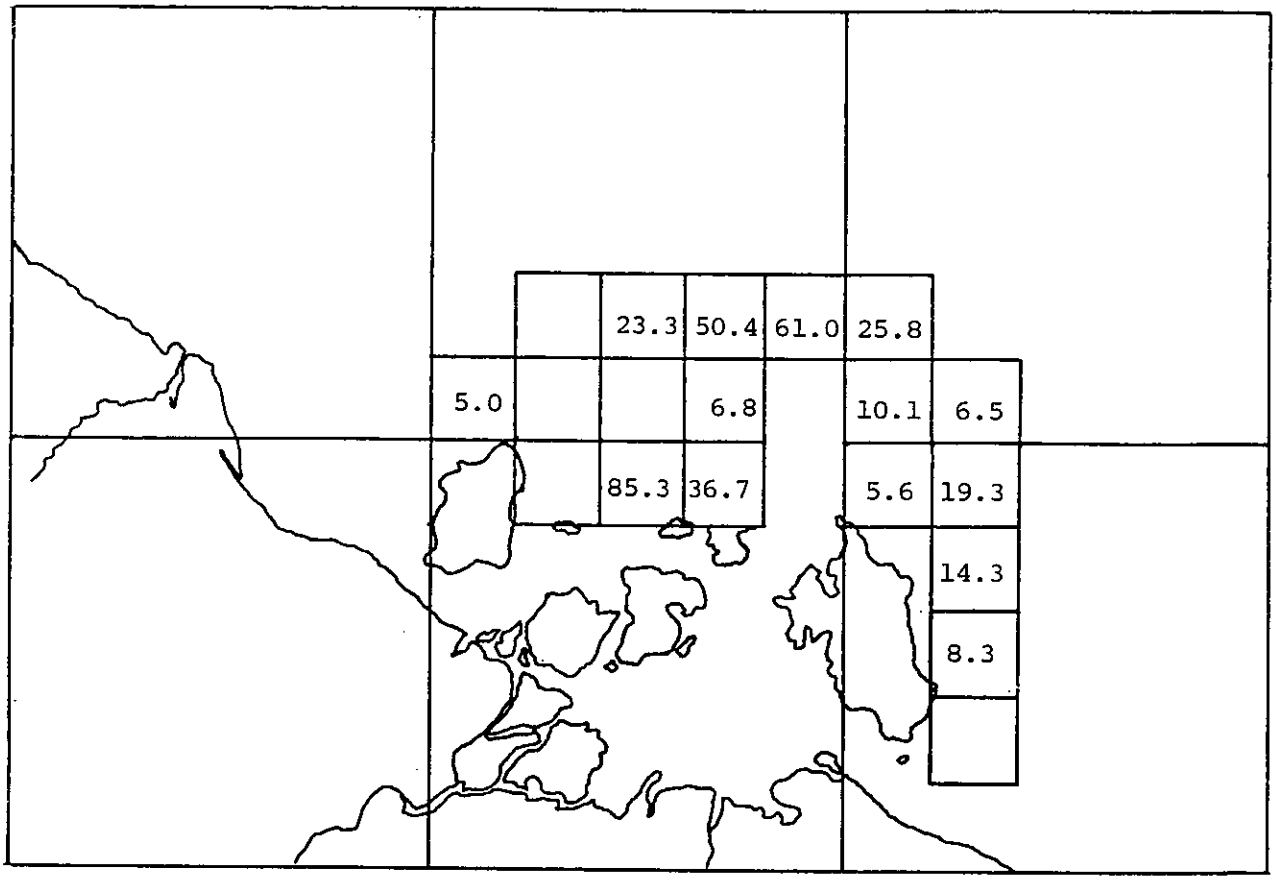


Figure 5(b) Tiger prawn size composition January 1983
% by weight of prawns over 30 count per pound.
- South western Gulf of Carpentaria.

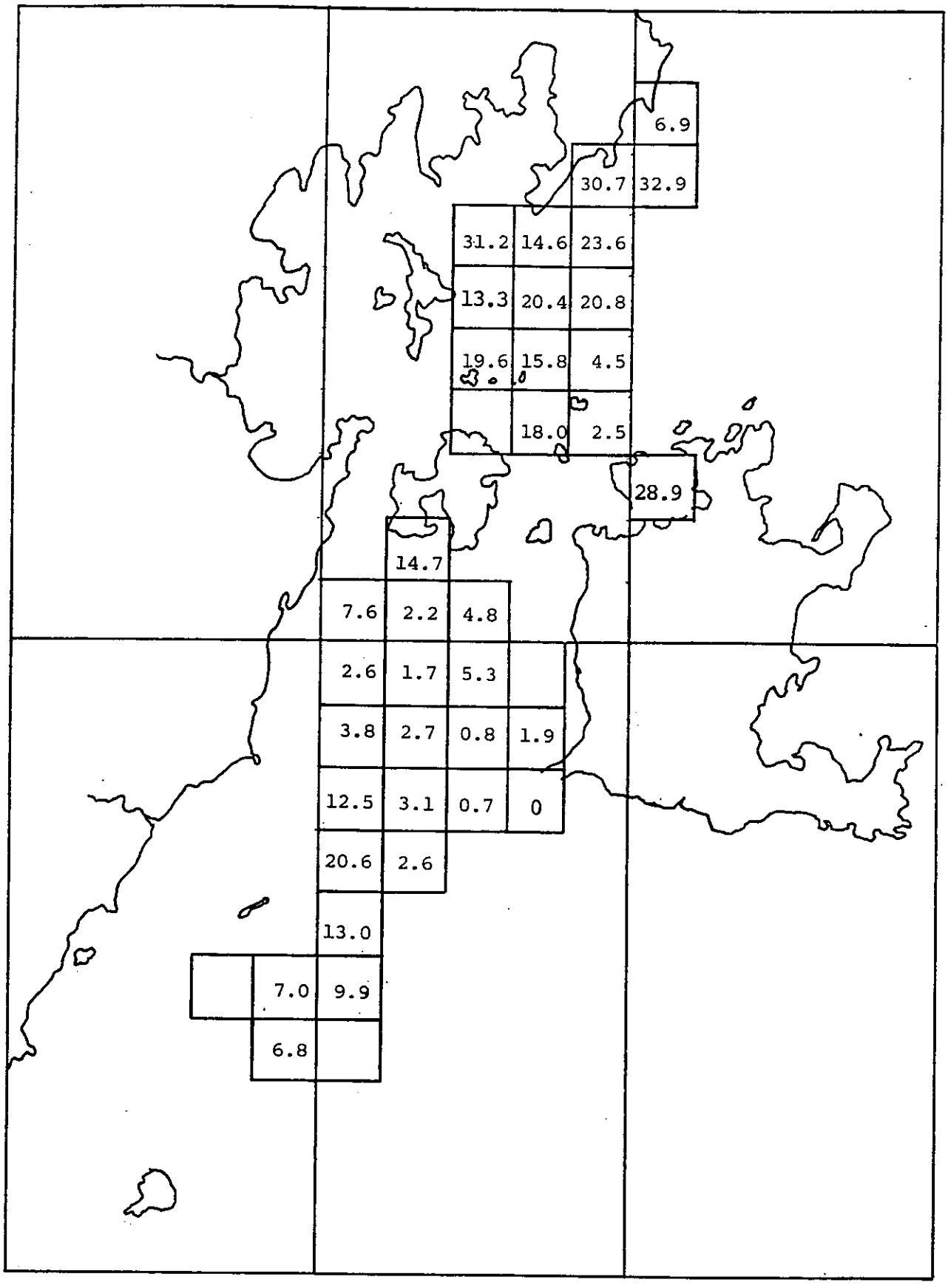


Figure 6(a) Tiger prawn size composition February 1983
% by weight of prawns over 30 count per pound.
- Central western Gulf of Carpentaria.

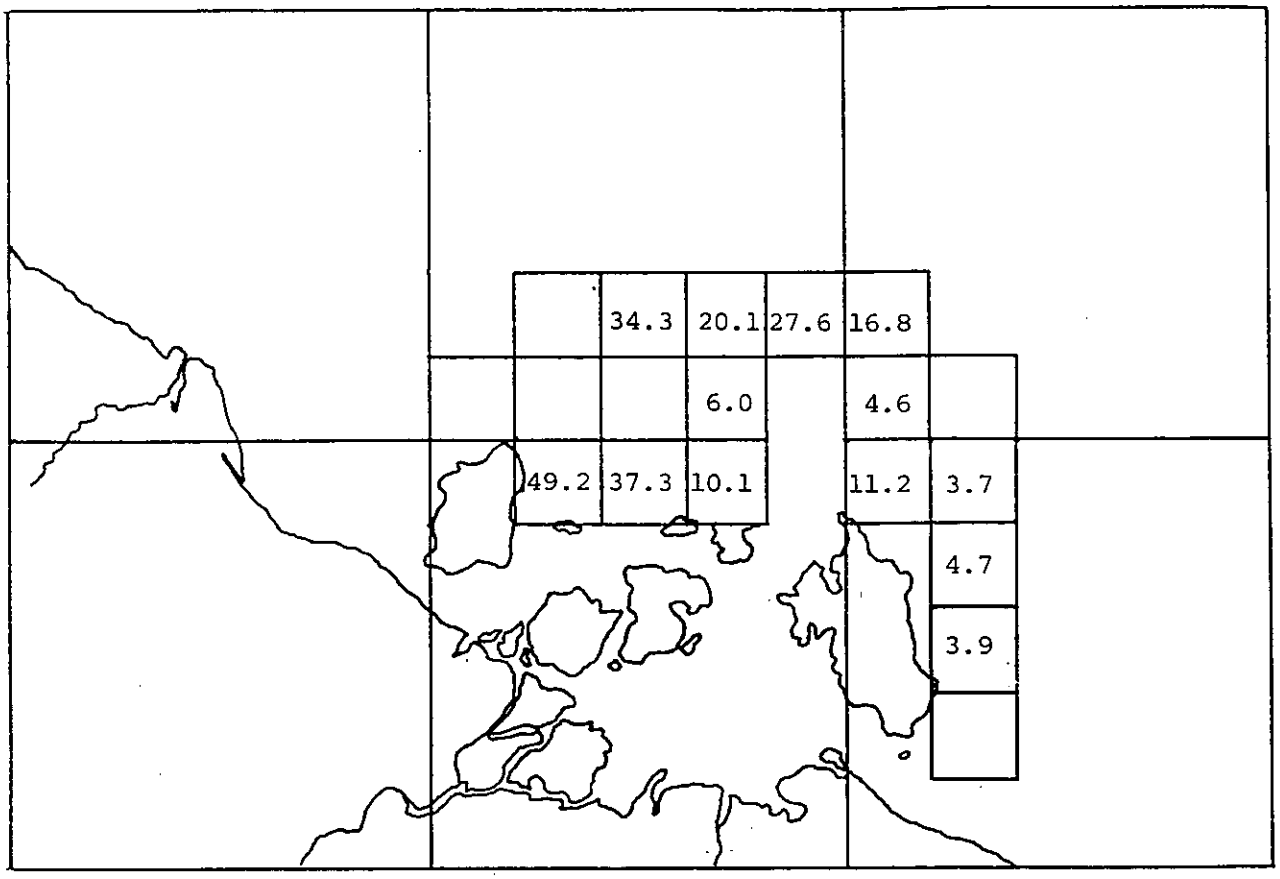


Figure 6(b) Tiger prawn size composition February 1983
% by weight of prawns over 30 count per pound.
- South western Gulf of Carpentaria.

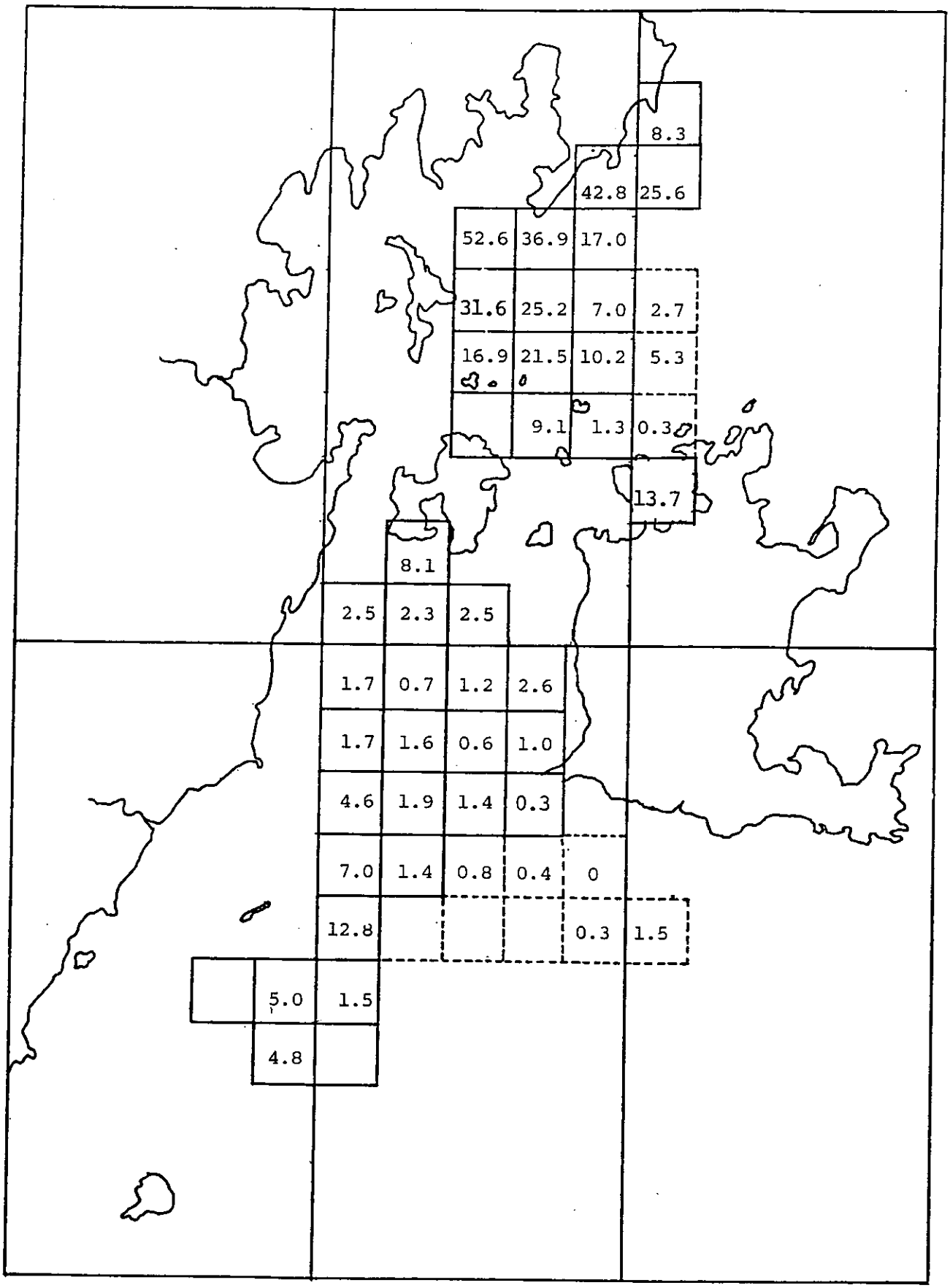


Figure 7(a) Tiger prawn size composition March 1983
% by weight of prawns over 30 count per pound.
- Central western Gulf of Carpentaria.

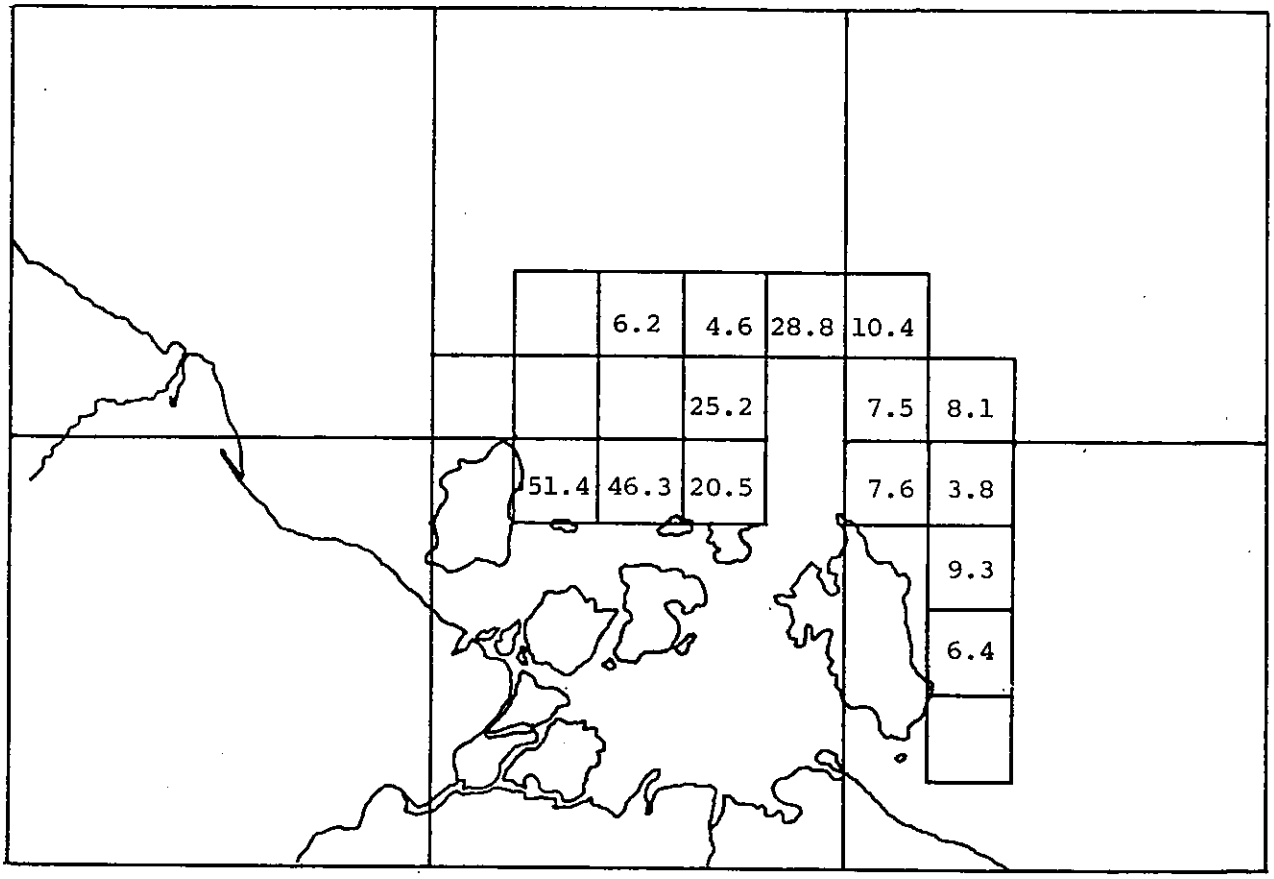


Figure 7(b) Tiger prawn size composition March 1983
% by weight of prawns over 30 count per pound.
- South western Gulf of Carpentaria.

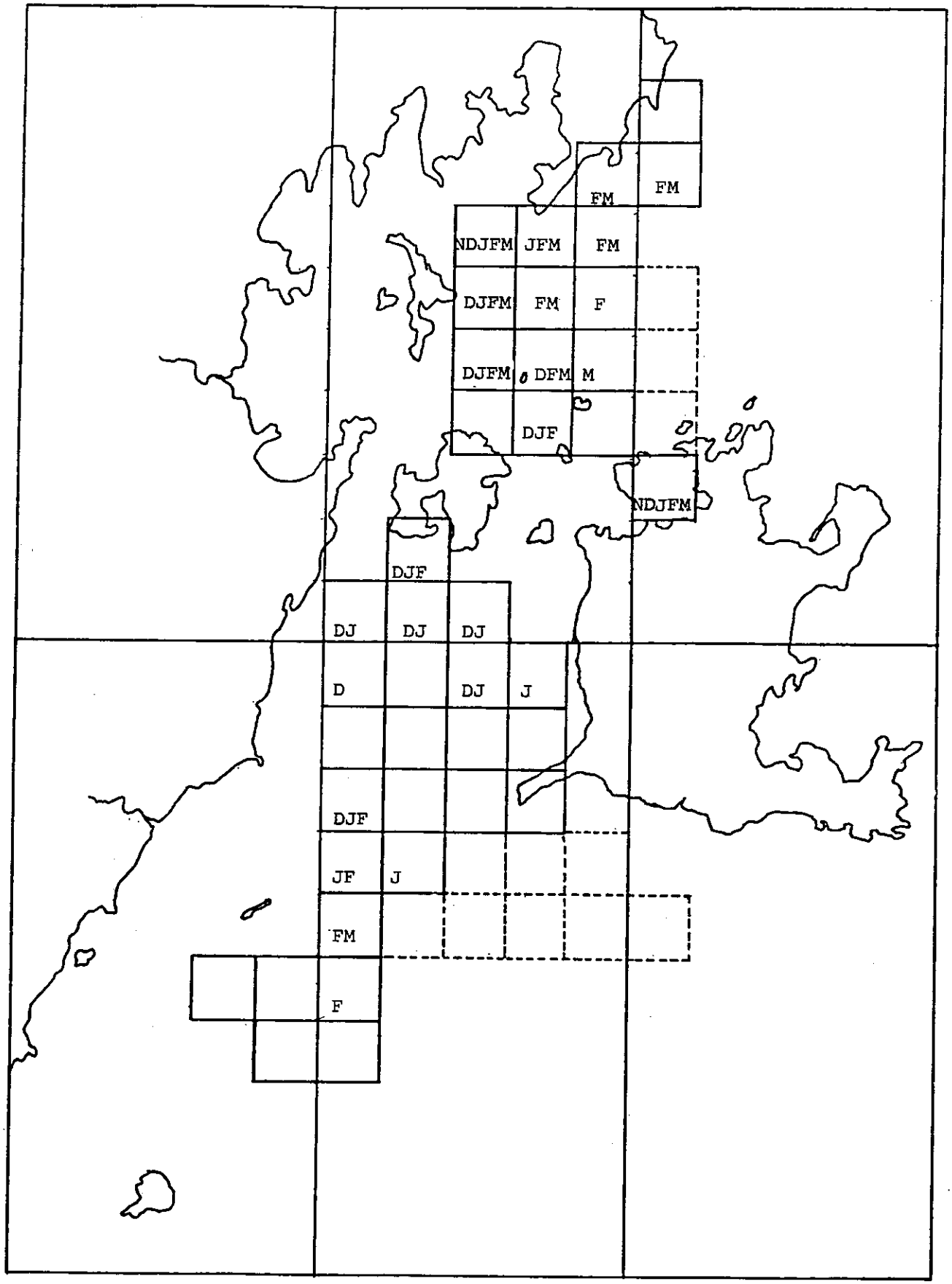


Figure 8(a) Tiger prawn size composition November 1982 - March 1983
Grids where prawns over 30 count per pound comprised over 10% of the total weight in the months indicated.
- Central western Gulf of Carpentaria.

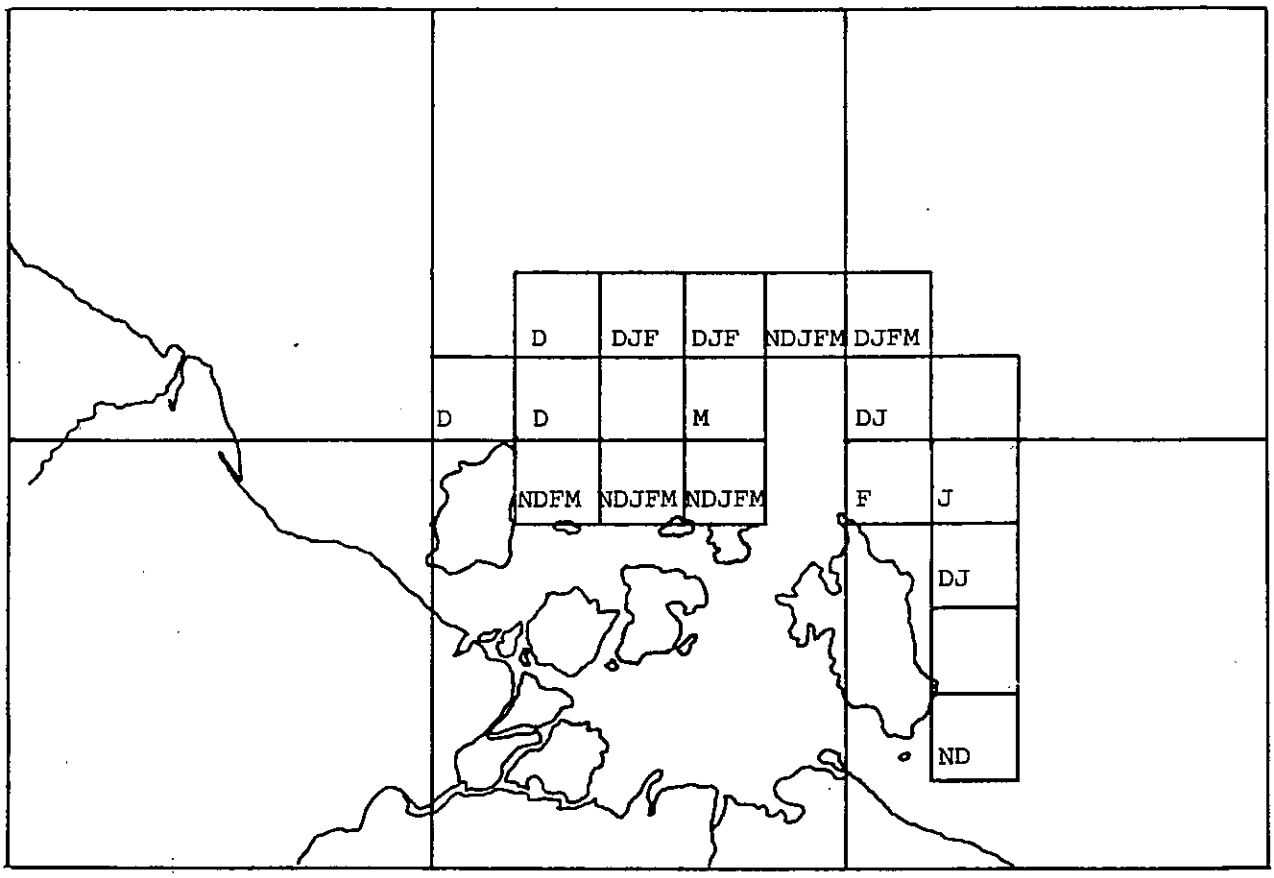


Figure 8(b) Tiger prawn size composition November 1982 - March 1983
Grids where prawns over 30 count per pound comprised over 10% of the total weight in the months indicated.
- South western Gulf of Carpentaria.

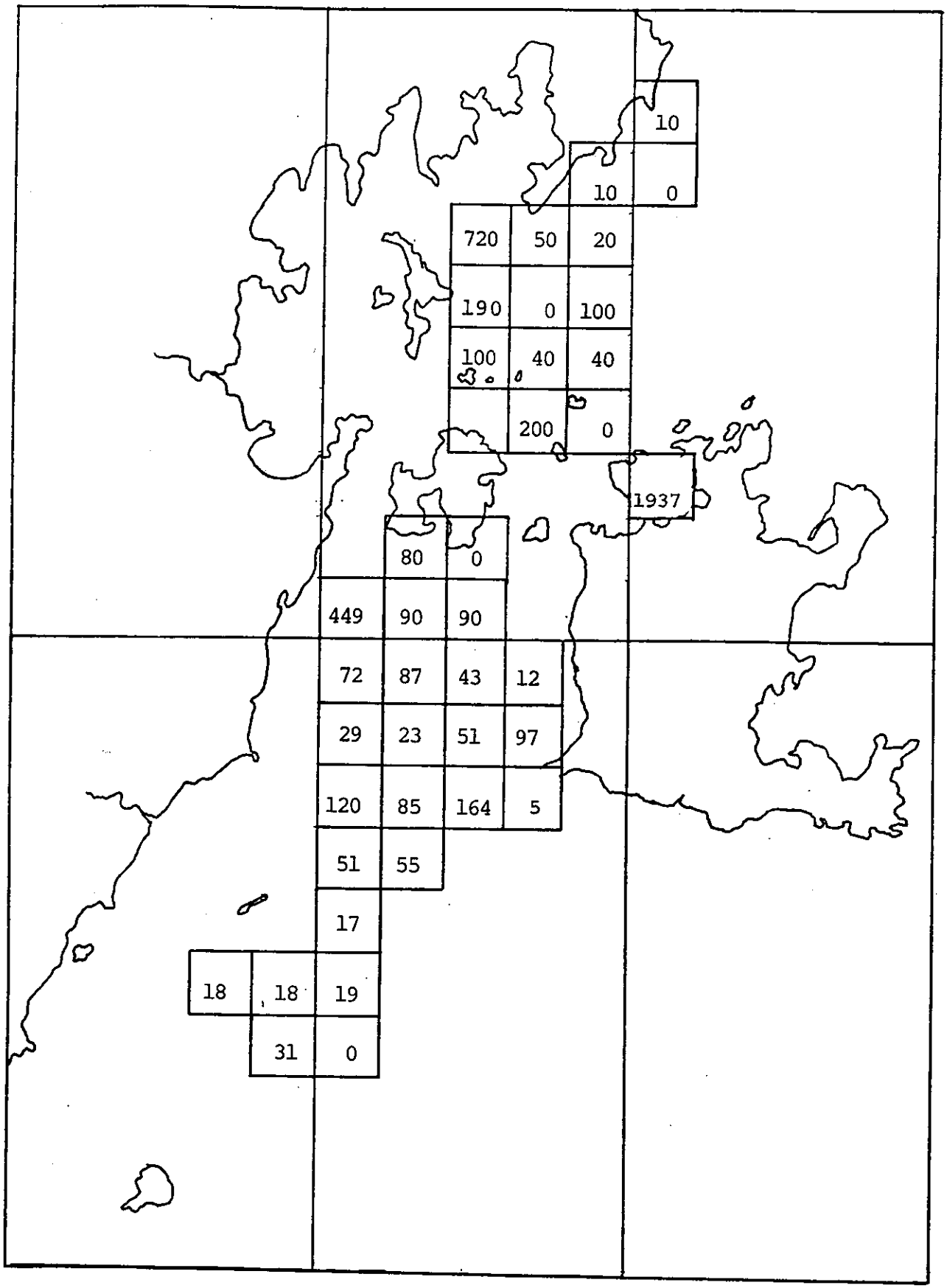


Figure 9(a) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for November 1982.
- Central western Gulf of Carpentaria.

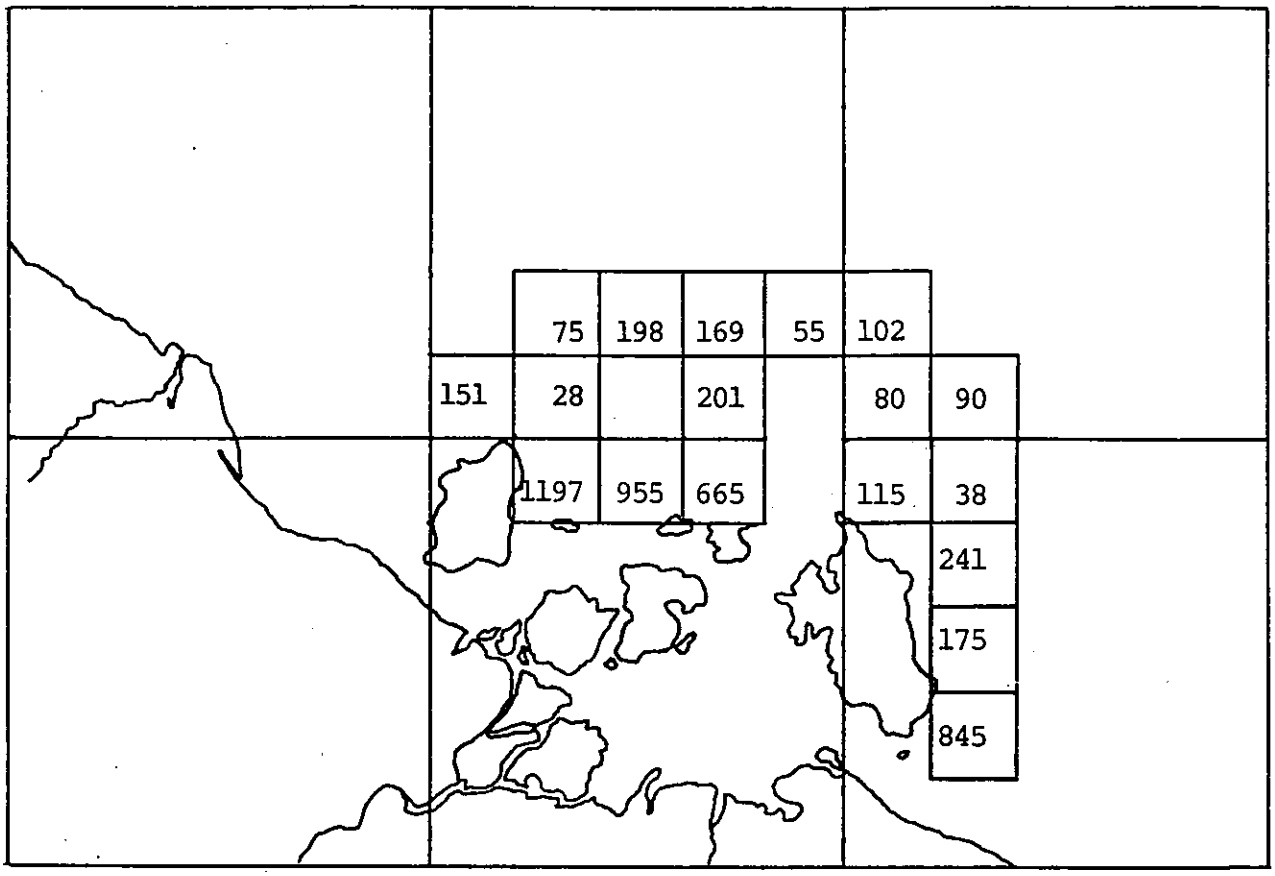


Figure 9(b) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for November 1982.
- South western Gulf of Carpentaria.

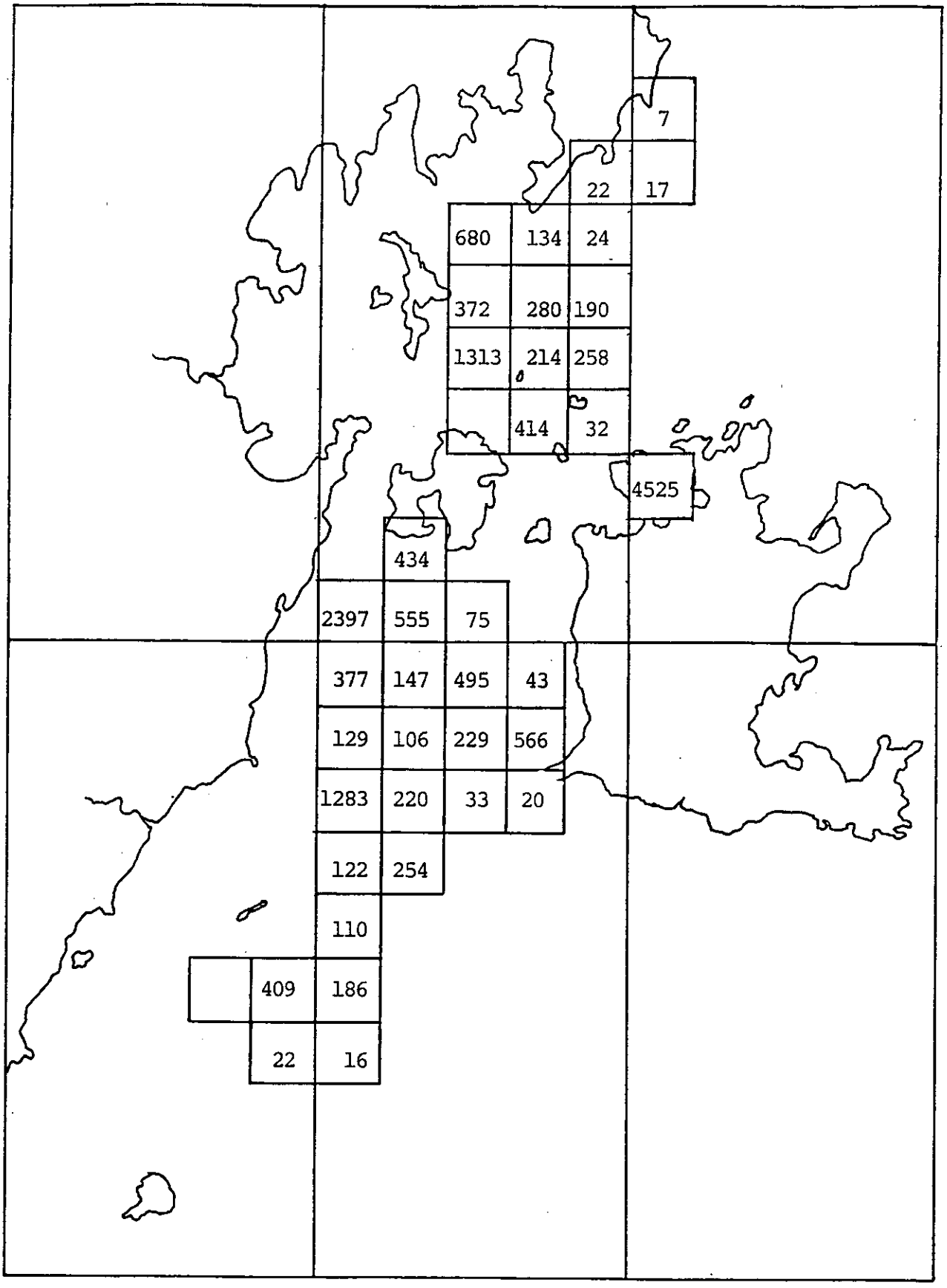


Figure 10(a) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for December 1982.
- Central western Gulf of Carpentaria.

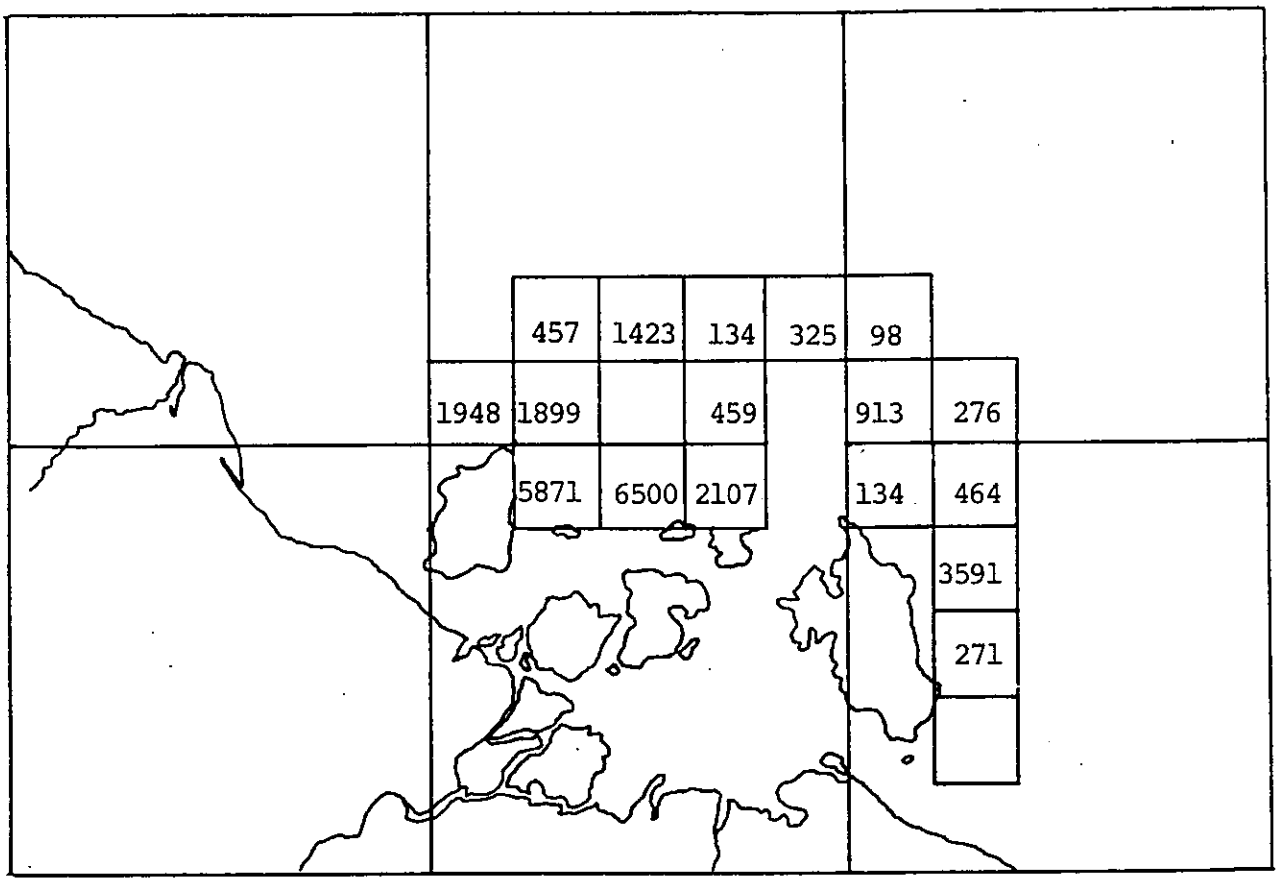


Figure 10(b) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for December 1982.
- South western Gulf of Carpentaria.

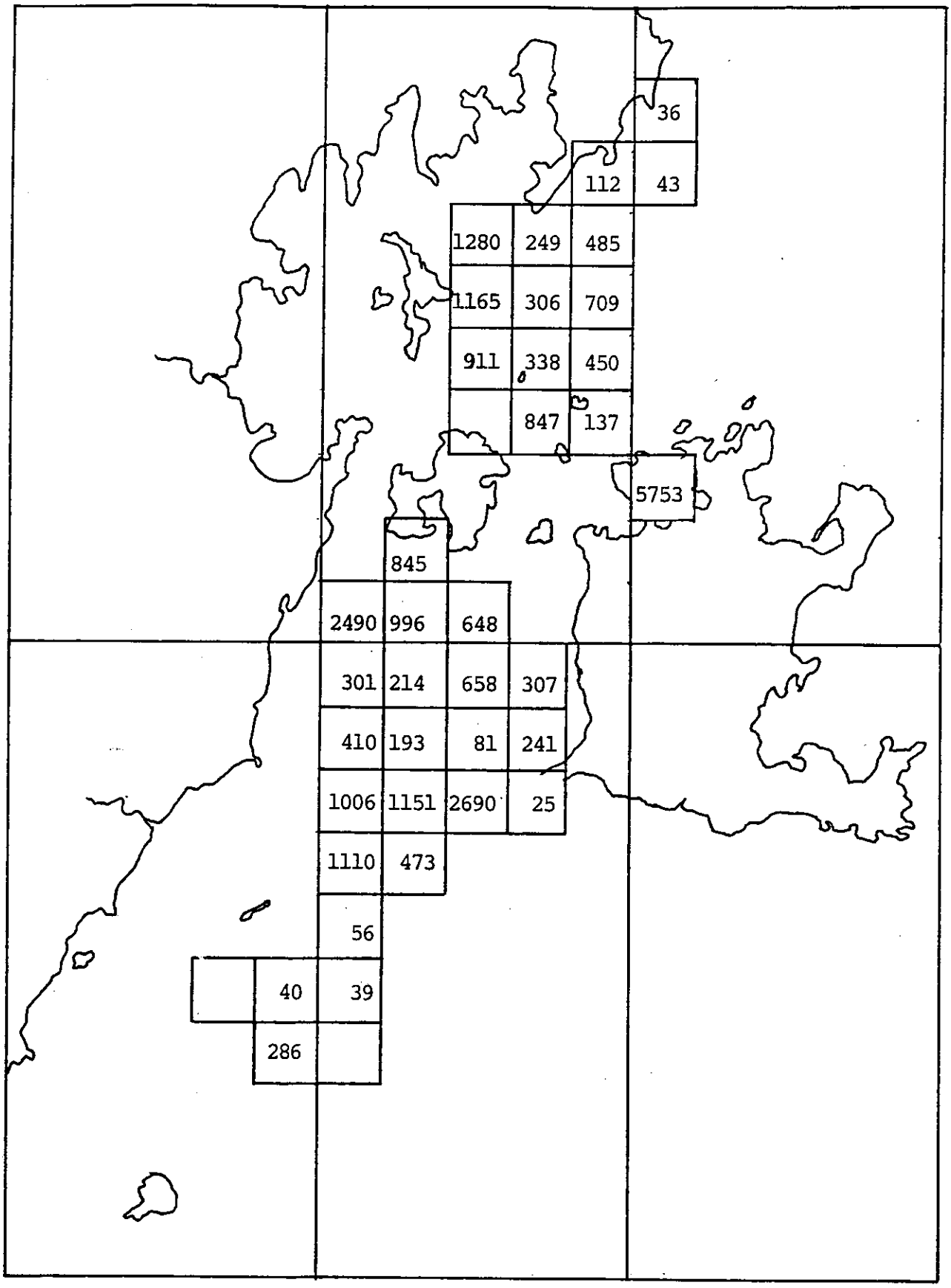


Figure 11(a) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for January 1983.
- Central western Gulf of Carpentaria.

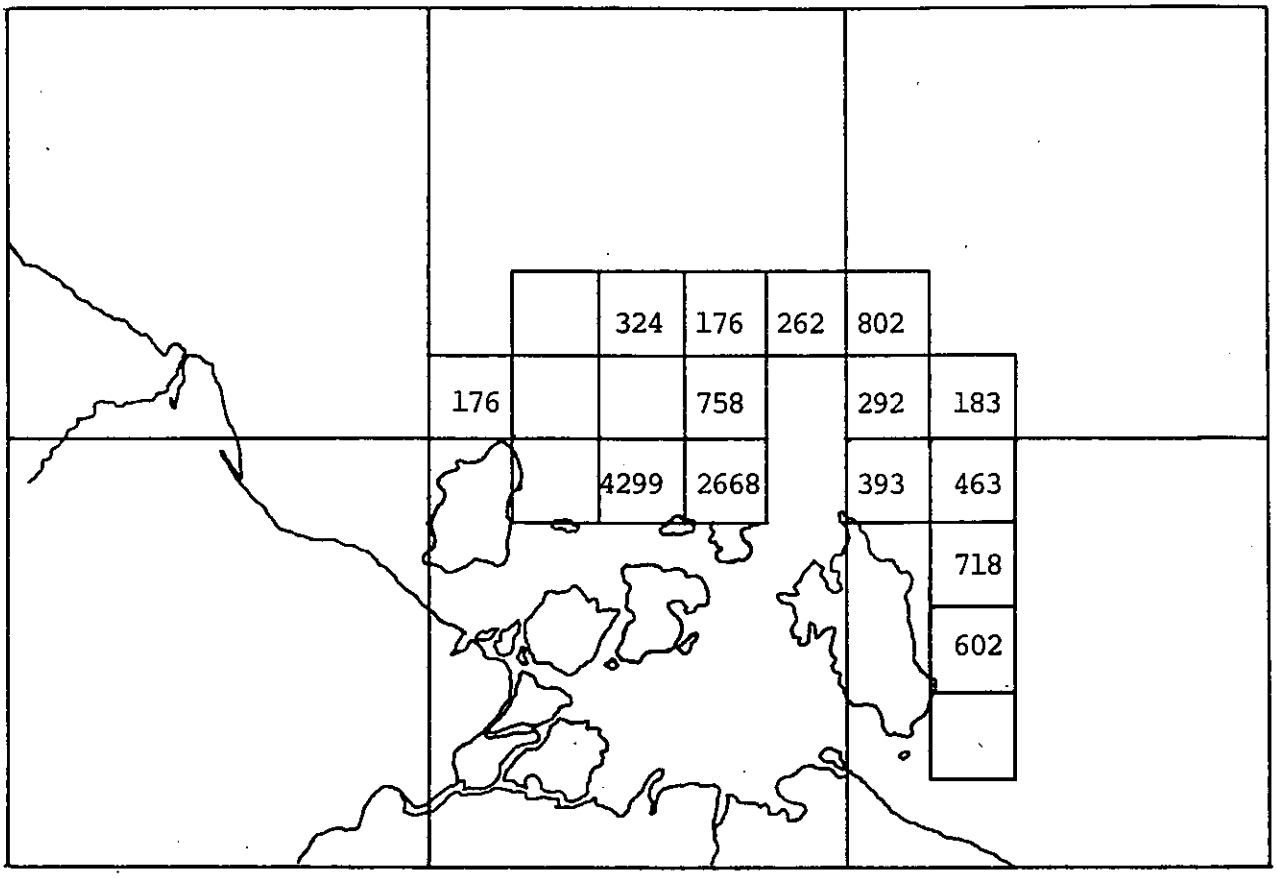


Figure 11(b) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for January 1983.
- South western Gulf of Carpentaria.

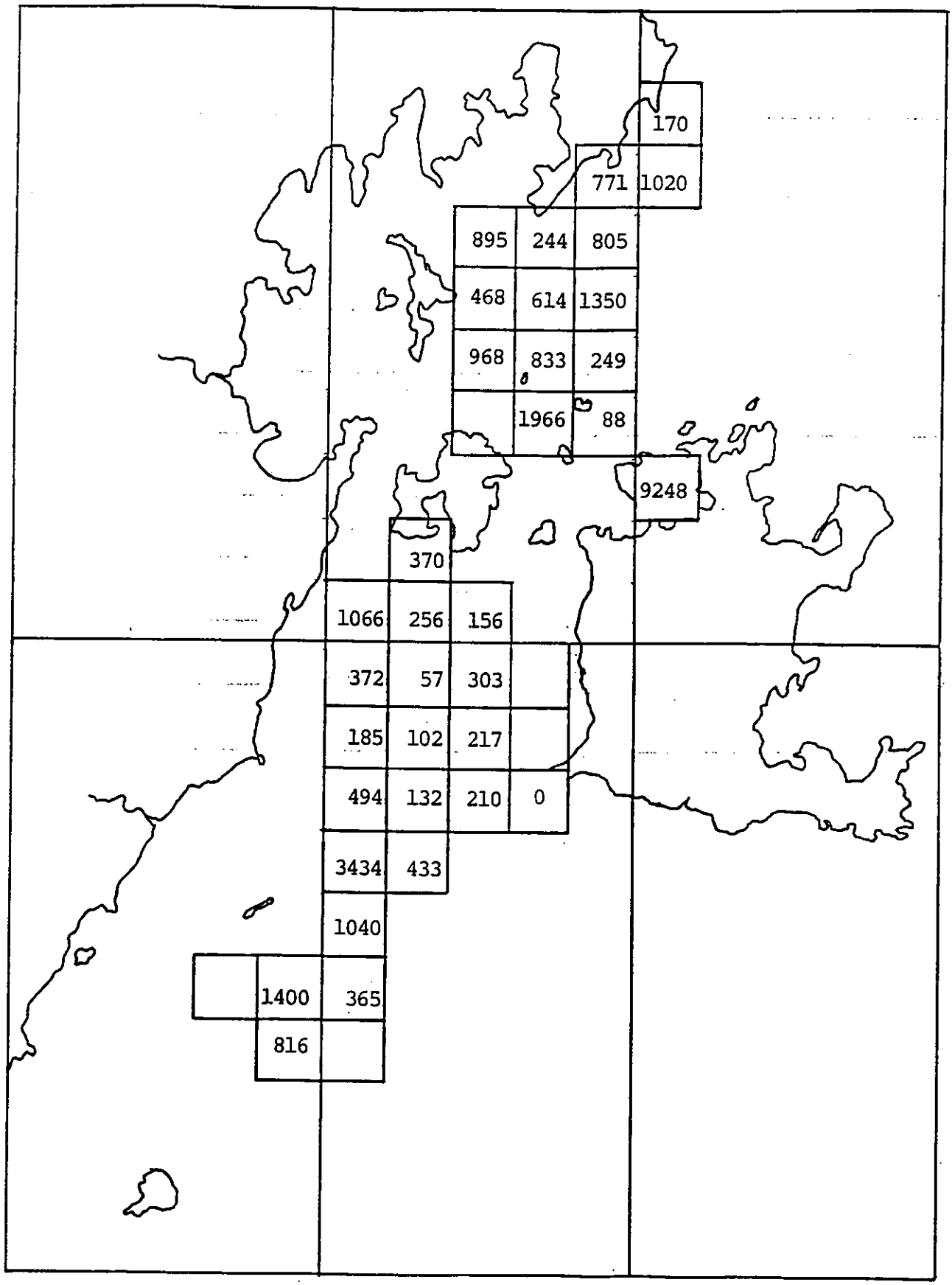


Figure 12(a) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for February 1983.
- Central western Gulf of Carpentaria.

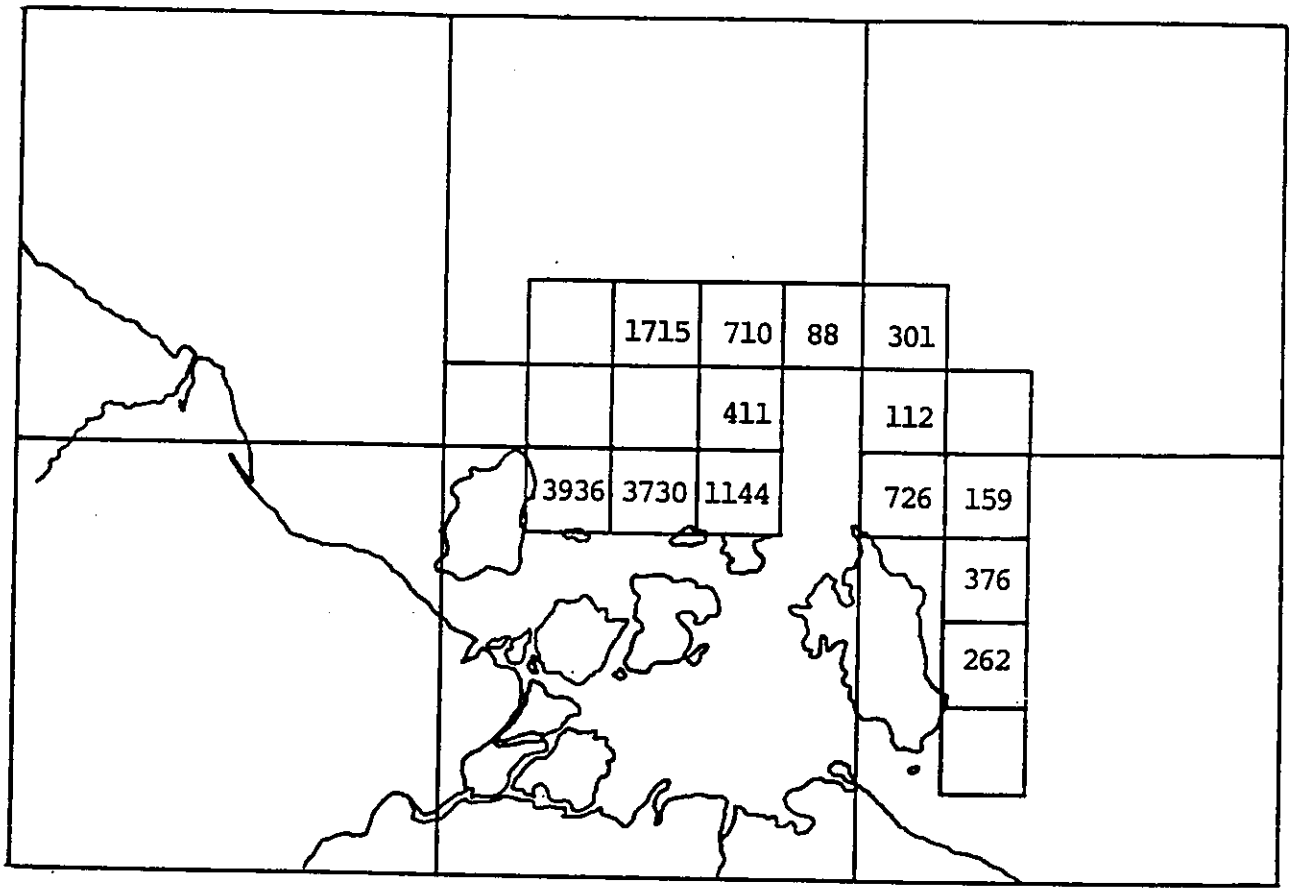


Figure 12(b) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for February 1983.
- South western Gulf of Carpentaria.

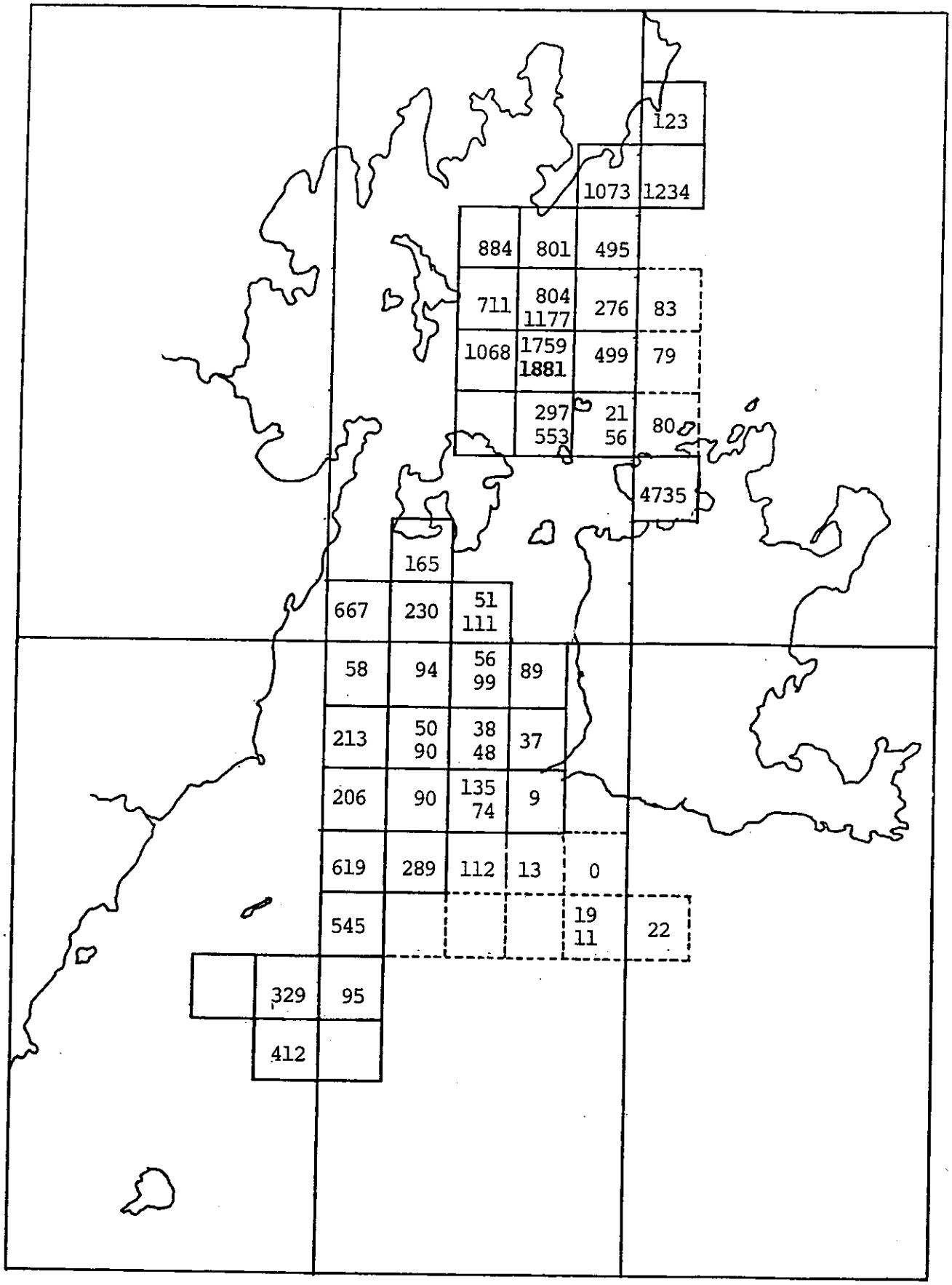


Figure 13(a) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for March 1983.
- Central western Gulf of Carpentaria.

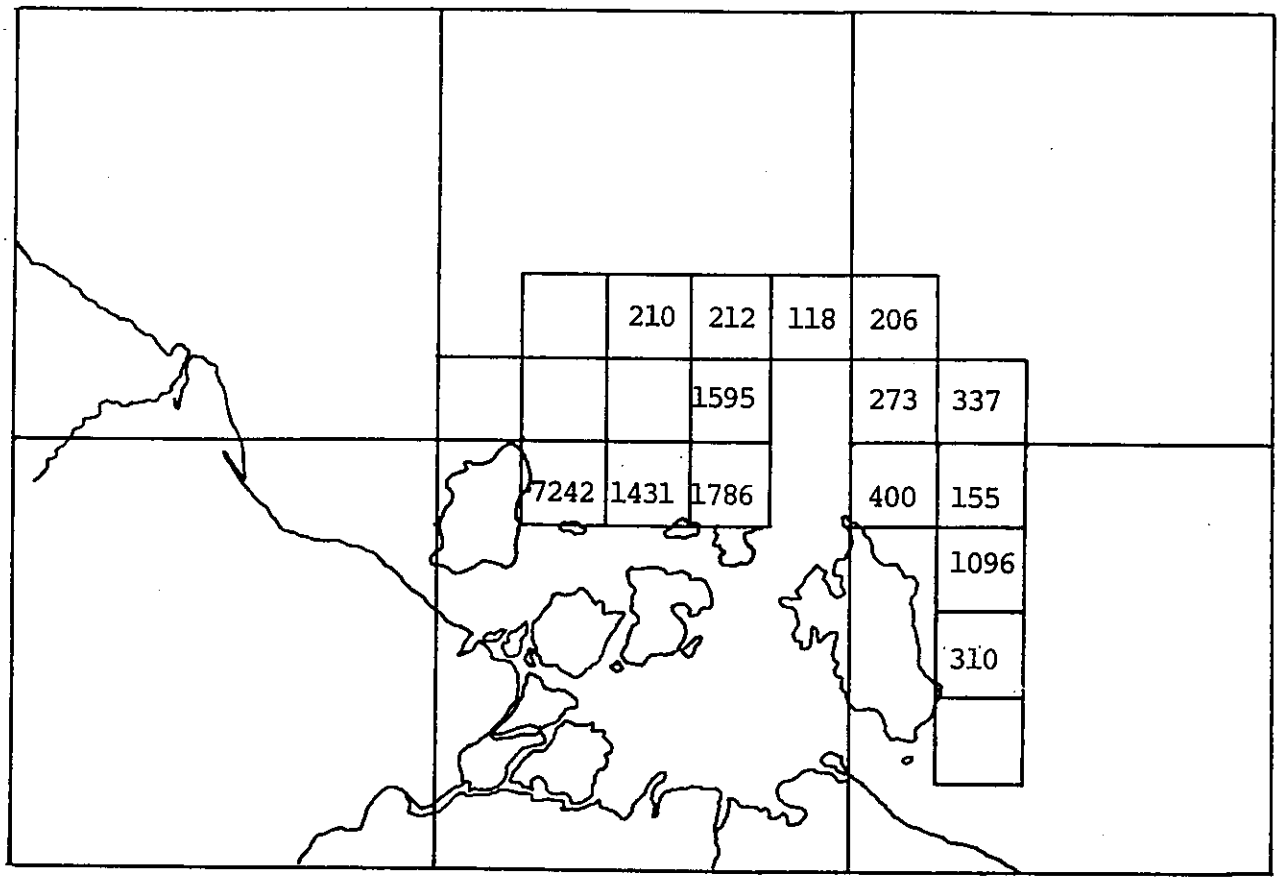


Figure 13(b) Catch rates of tiger prawns of over 30 count per pound (in grams per hour) for March 1983.
- South western Gulf of Carpentaria.

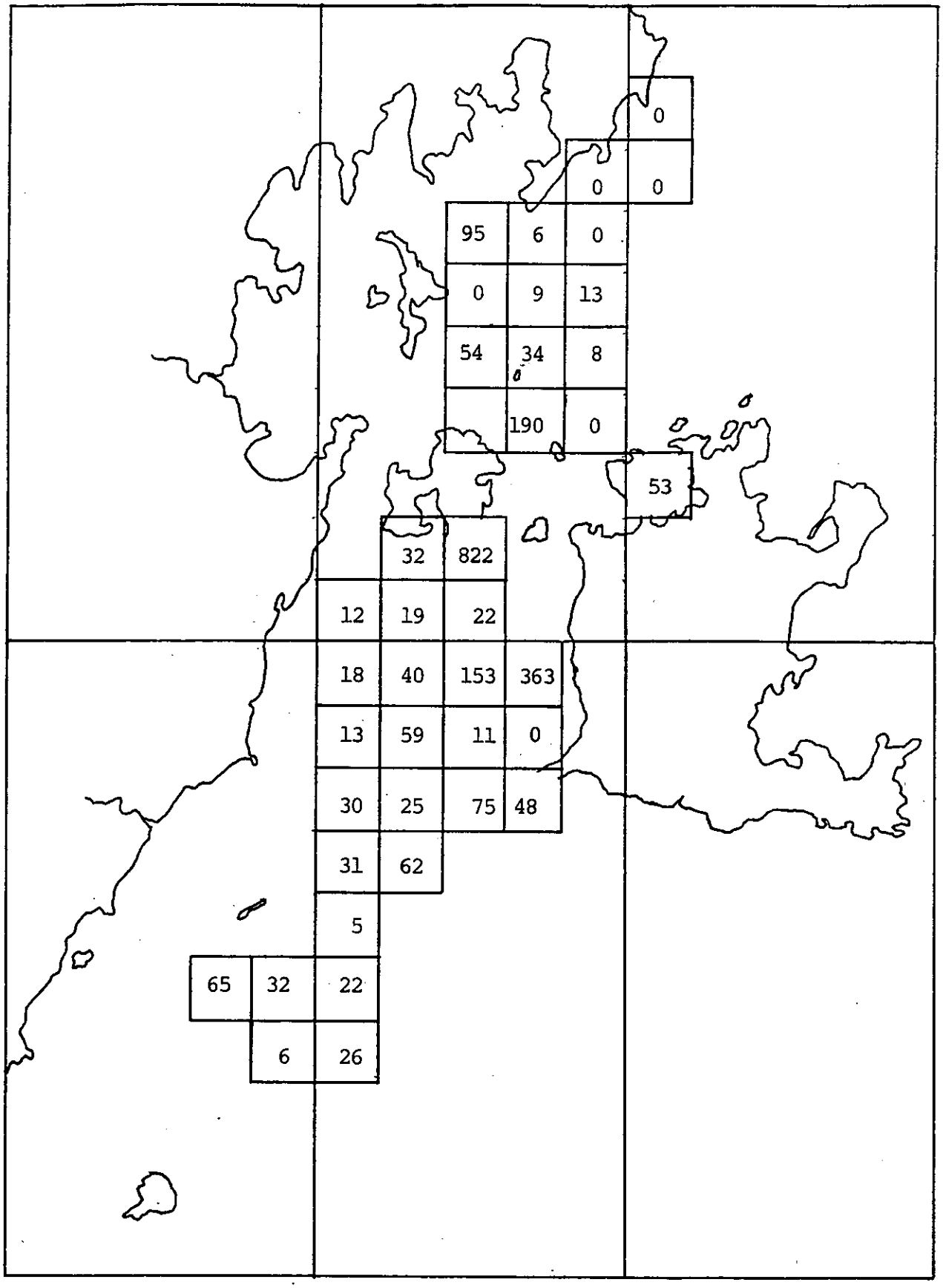


Figure 14(a) Catch rates of endeavour prawns over 30 count per pound (in grams per hour) for November 1982. - Central western Gulf of Carpentaria.

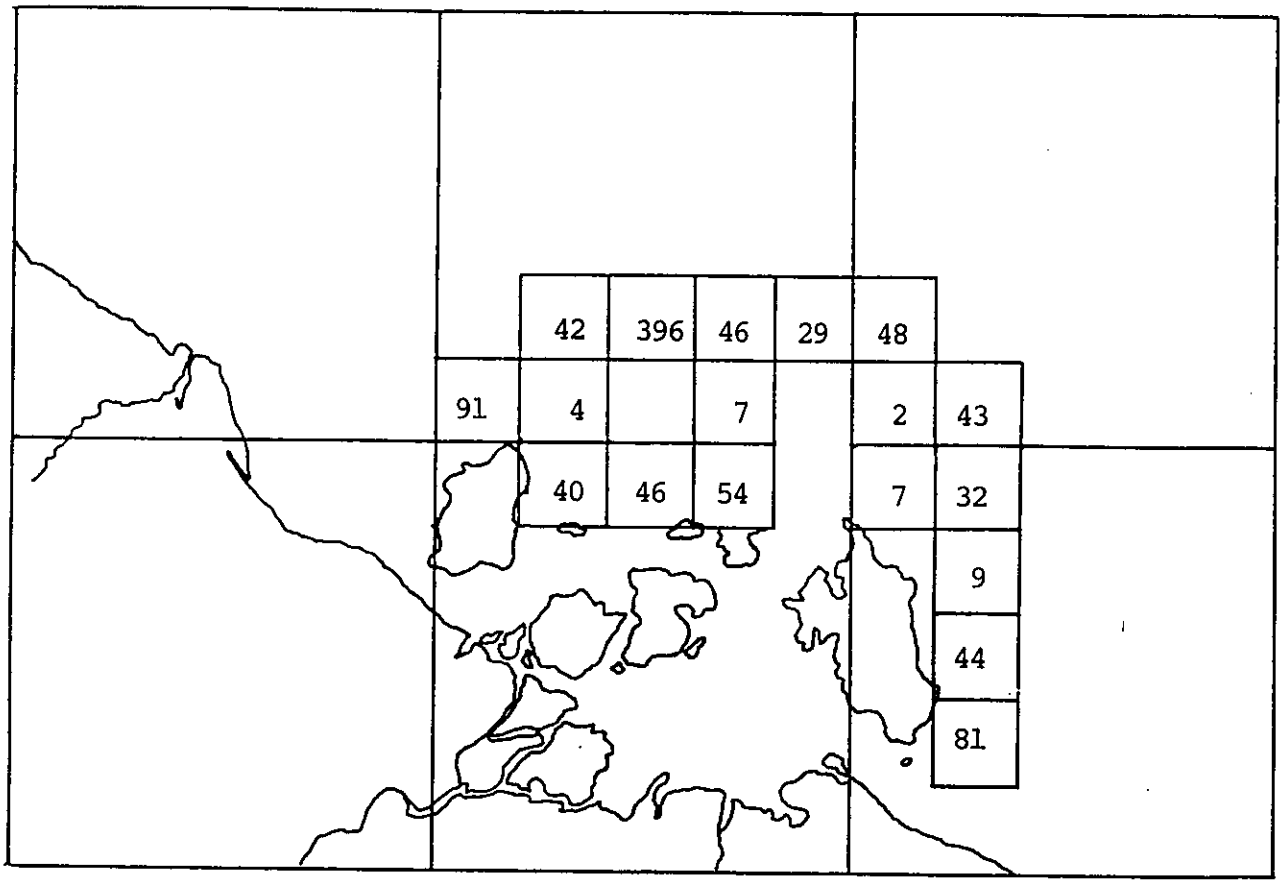


Figure 14(b) Catch rates of endeavour prawns over 30 count per pound (in grams per hour) for November 1982. - South western Gulf of Carpentaria.

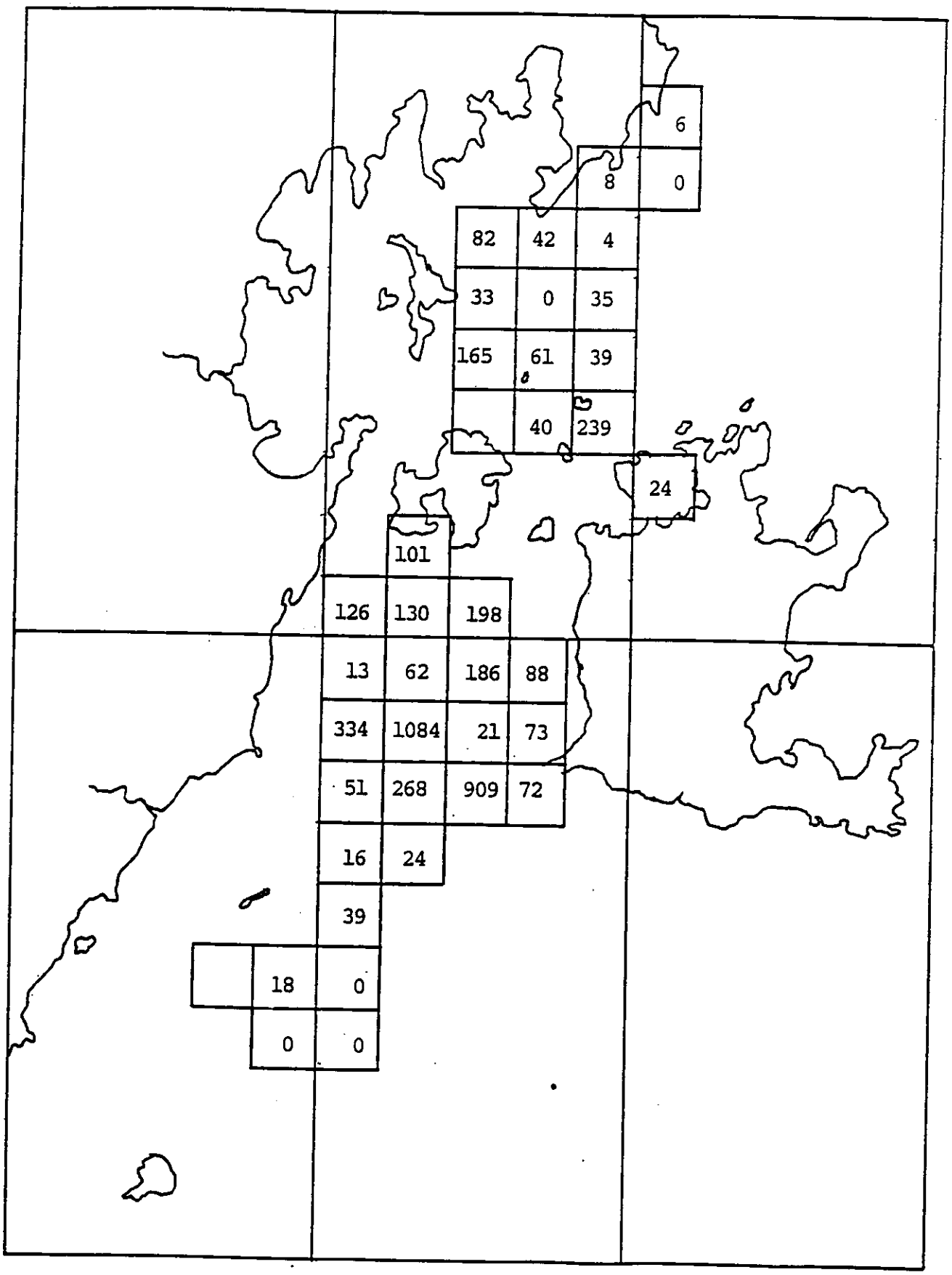


Figure 15(a) Catch rates of endeavour prawns over 30 count per pound (in grams per hour) for December 1982. - Central western Gulf of Carpentaria.

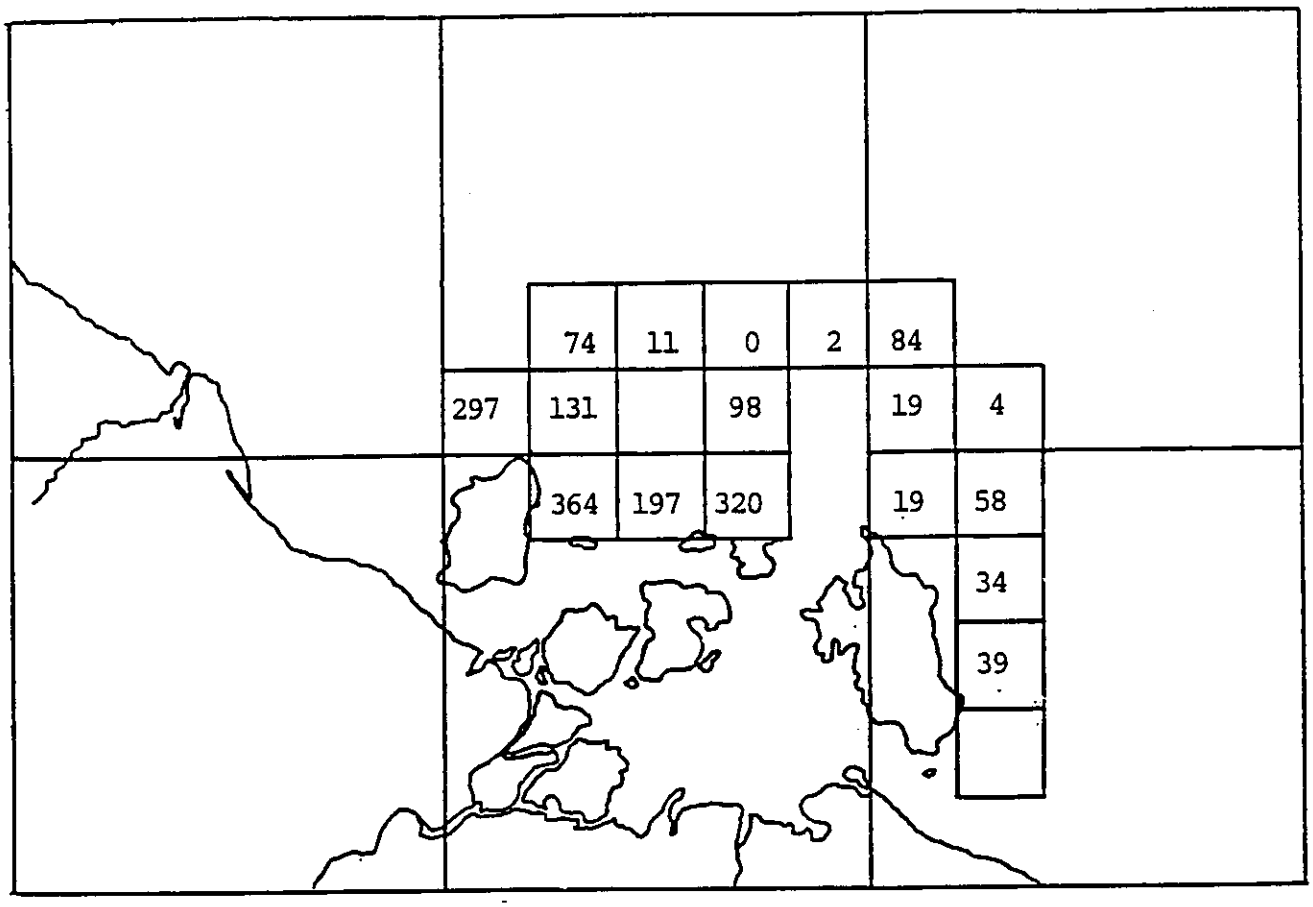


Figure 15(b) Catch rates of endeavour prawns over 30 count per pound (in grams per hour) for December 1982. - South western Gulf of Carpentaria.

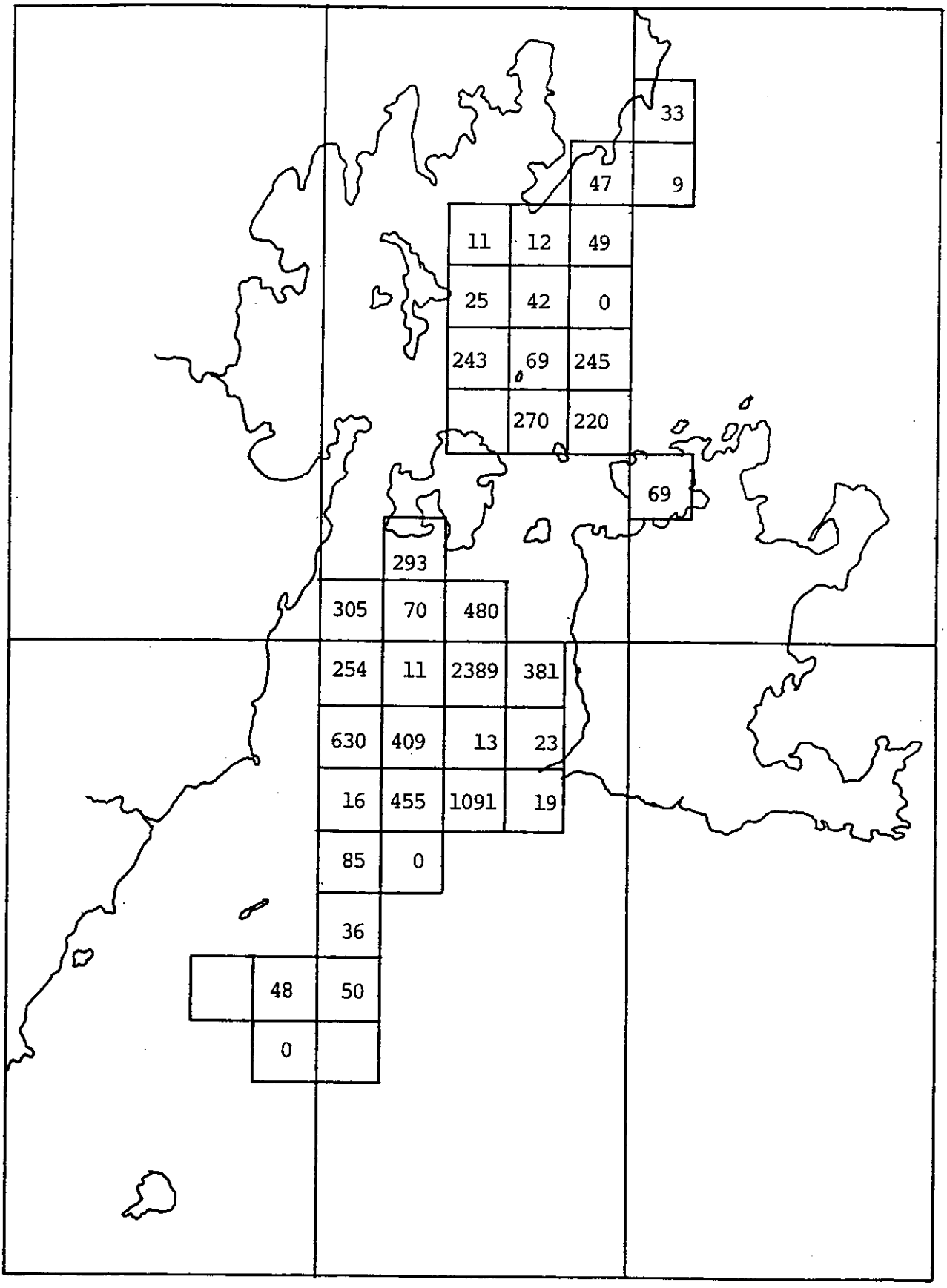


Figure 16(a) Catch rates of endeavour prawns over 30 count per pound (in grams per hour) for January 1983. - Central western Gulf of Carpentaria.

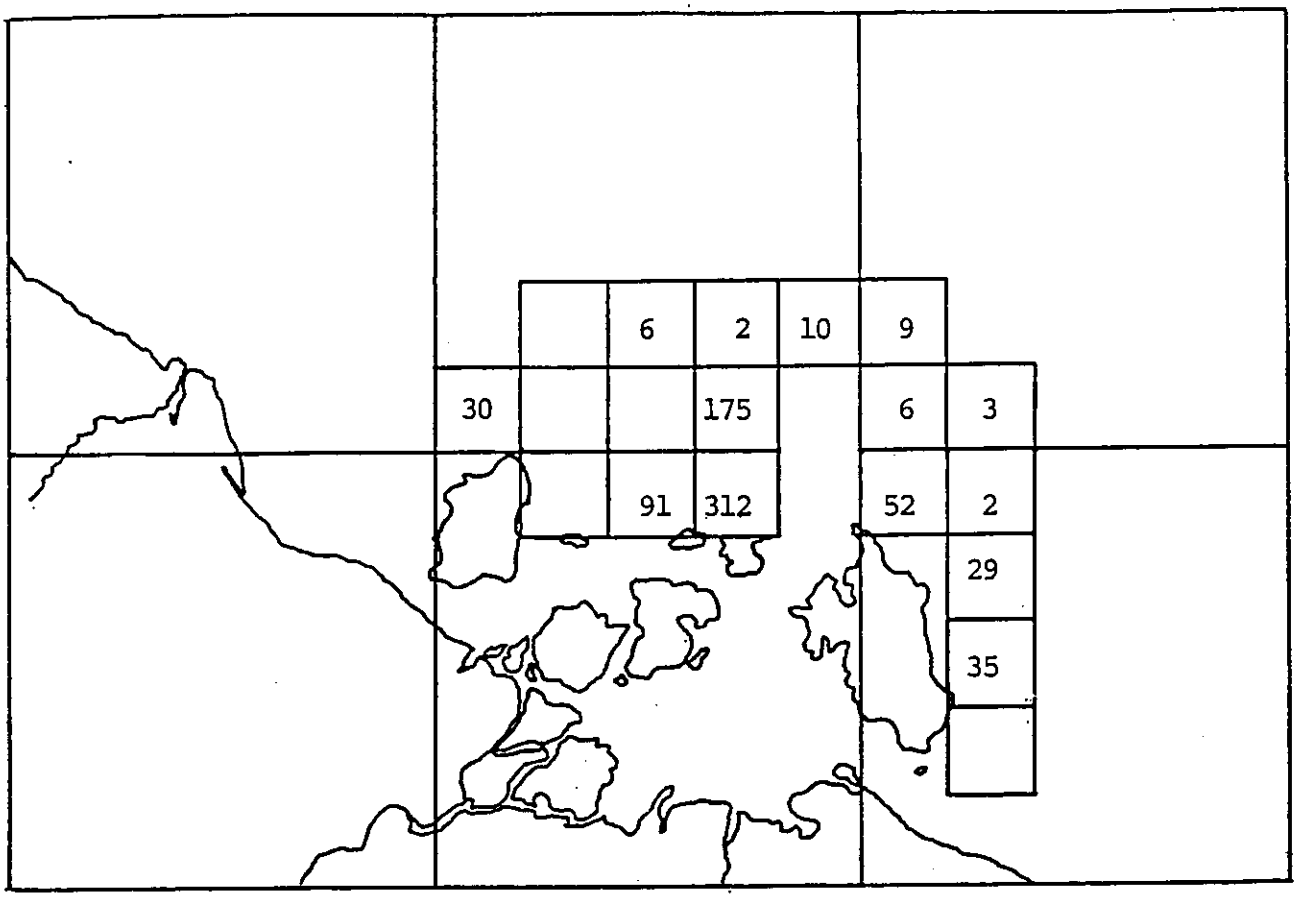


Figure 16(b) Catch rates of endeavour prawns over 30 count per pound (in grams per hour) for January 1983. - South western Gulf of Carpentaria.

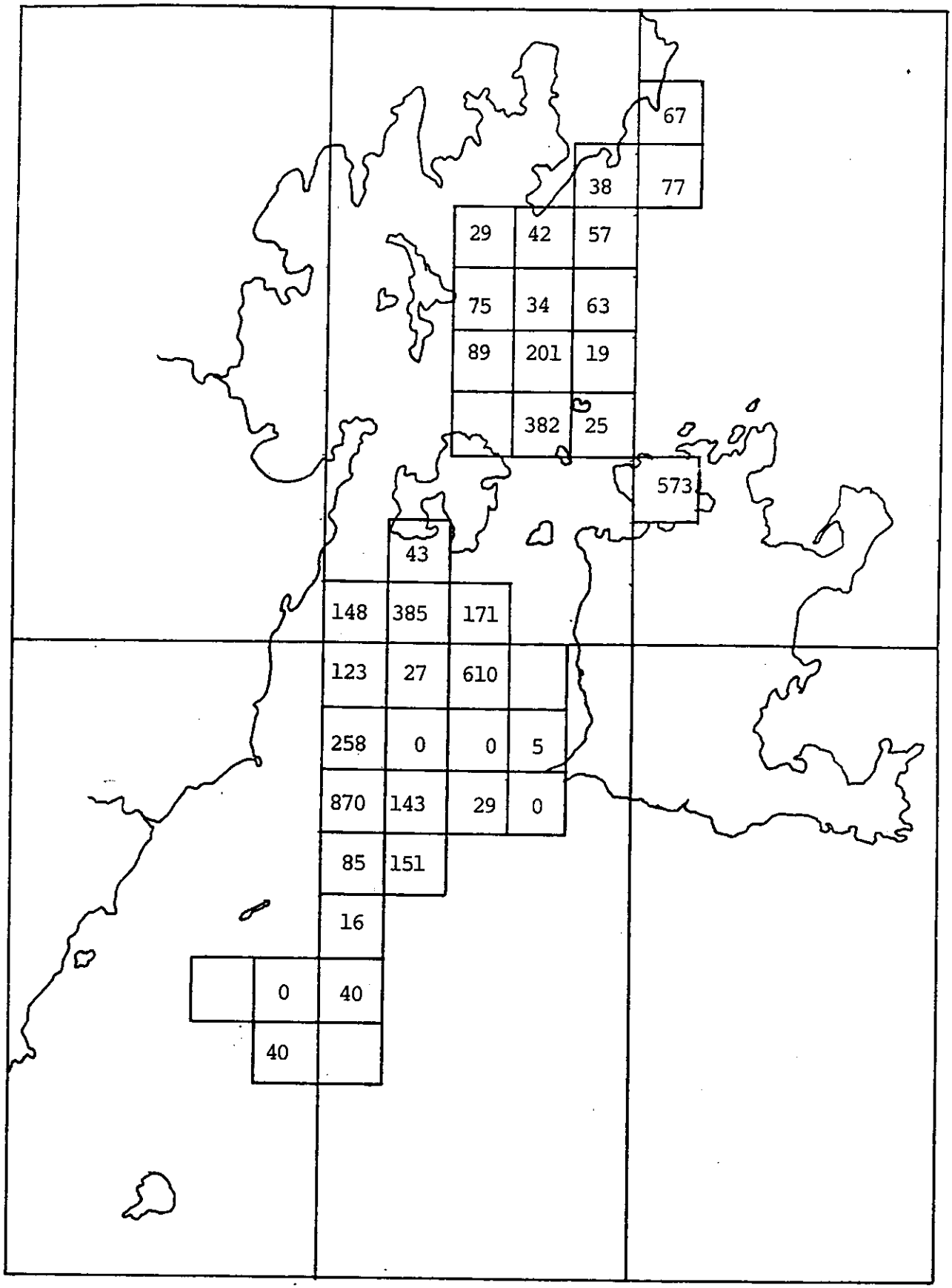


Figure 17(a) Catch rates of endeavour prawns over 30 count per pound (in grams per hour) for February 1983. - Central western Gulf of Carpentaria.

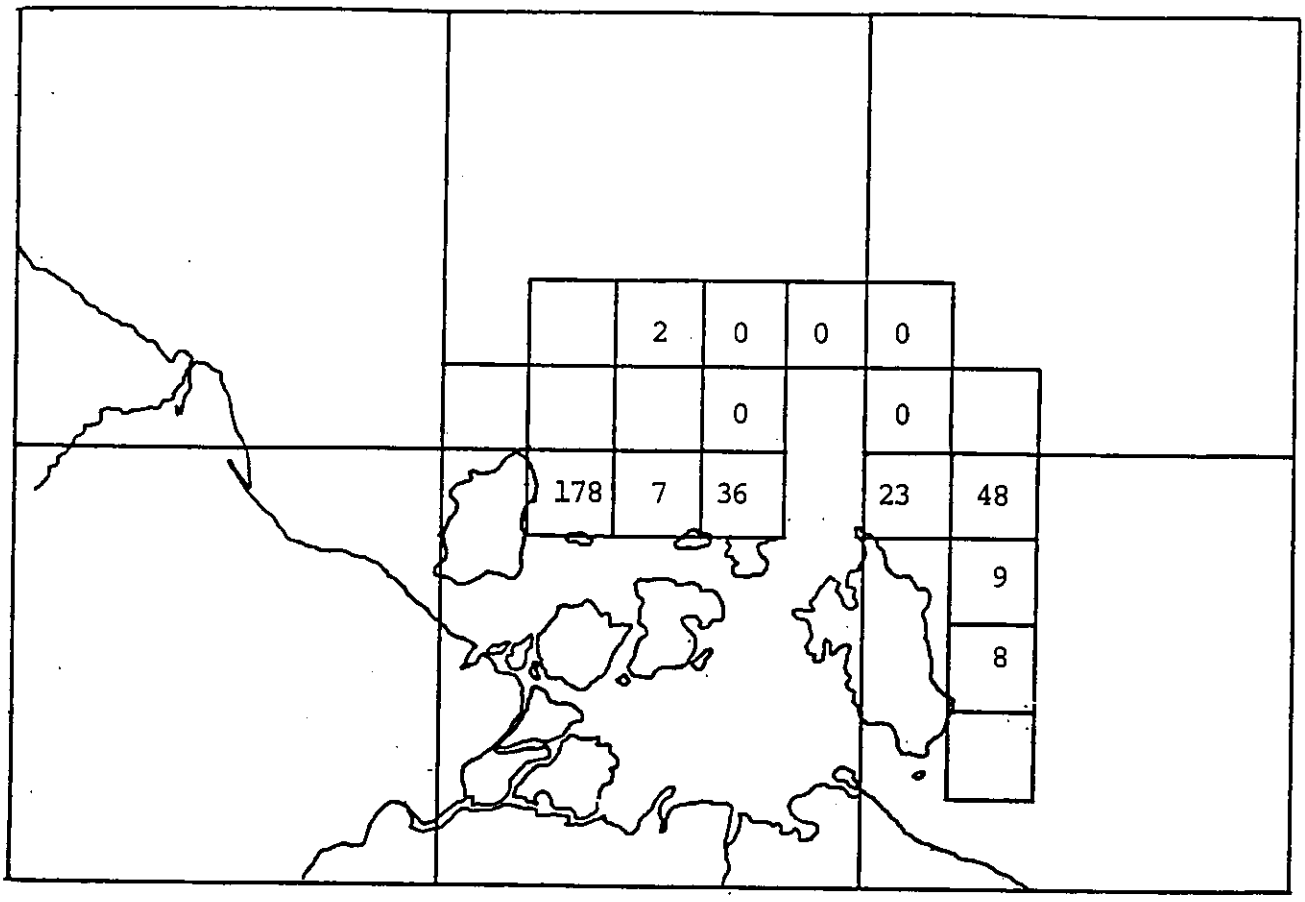


Figure 17(b) Catch rates of endeavour prawns over 30 count per pound (in grams per hour) for February 1983. - South western Gulf of Carpentaria.

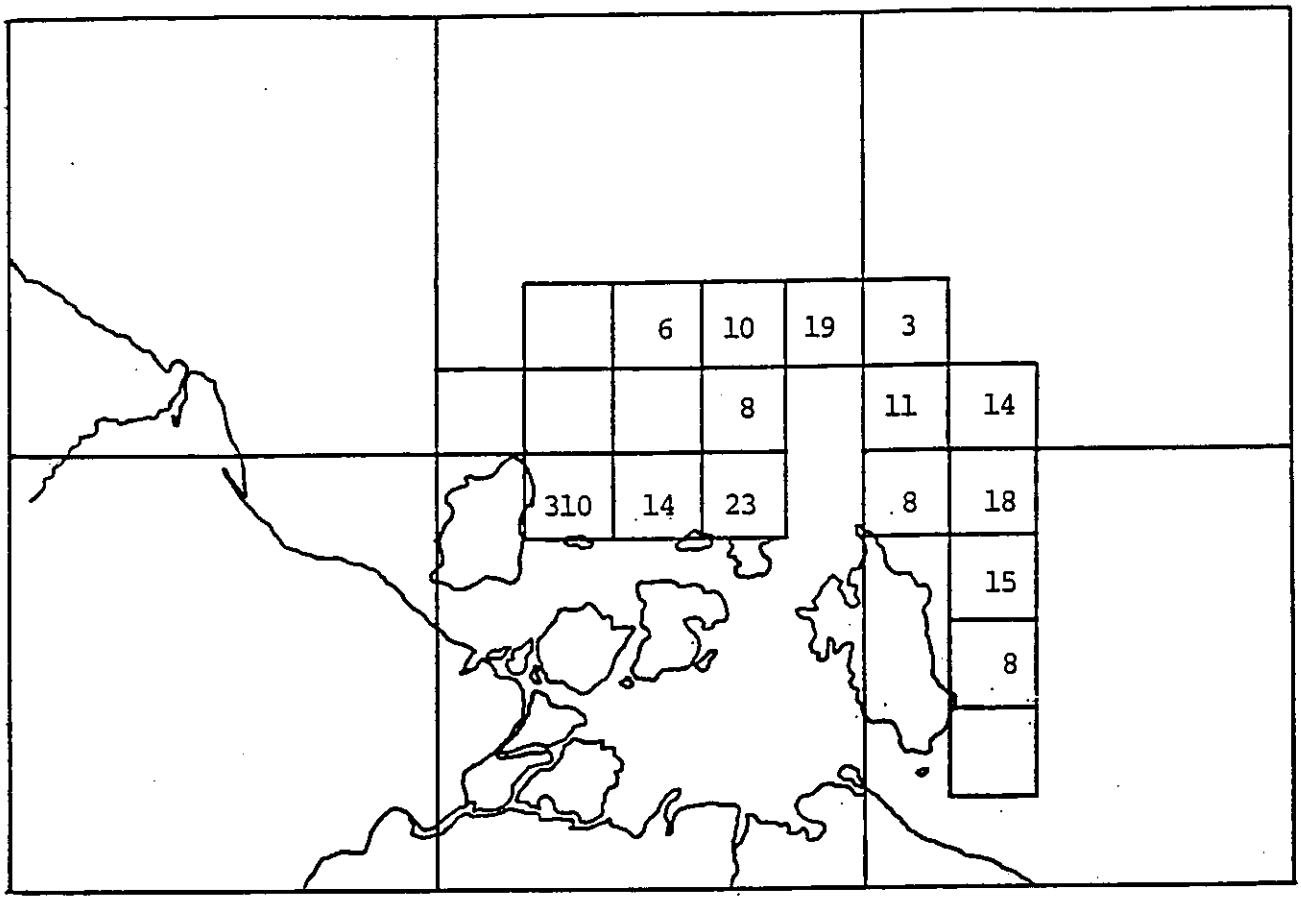


Figure 18(b) Catch rates of endeavour prawns over 30 count per pound (in grams per hour) for March 1983. - South western Gulf of Carpentaria.

X APPENDICES

APPENDIX 1

VESSEL SPECIFICATIONS

Name: "PAULWIN"
Reg. No.: FNZZ

Overall length: 15.84 m Beam 5.3 m
Gross Displacement: 33.56 tonnes Draught 2.74 m
Motor: Detroit Diesel, 871 rated at 179.04 Kw
Auxiliary: Detroit Diesel, 353
Dry freezer: 7,000 kg
Brine: 2,000 kg (IQF)

Main Gear: 4x4½ fathom (8.1 m) (Sandikans) nets
4 x 1.8m x 0.75m otter boards, 2 skids

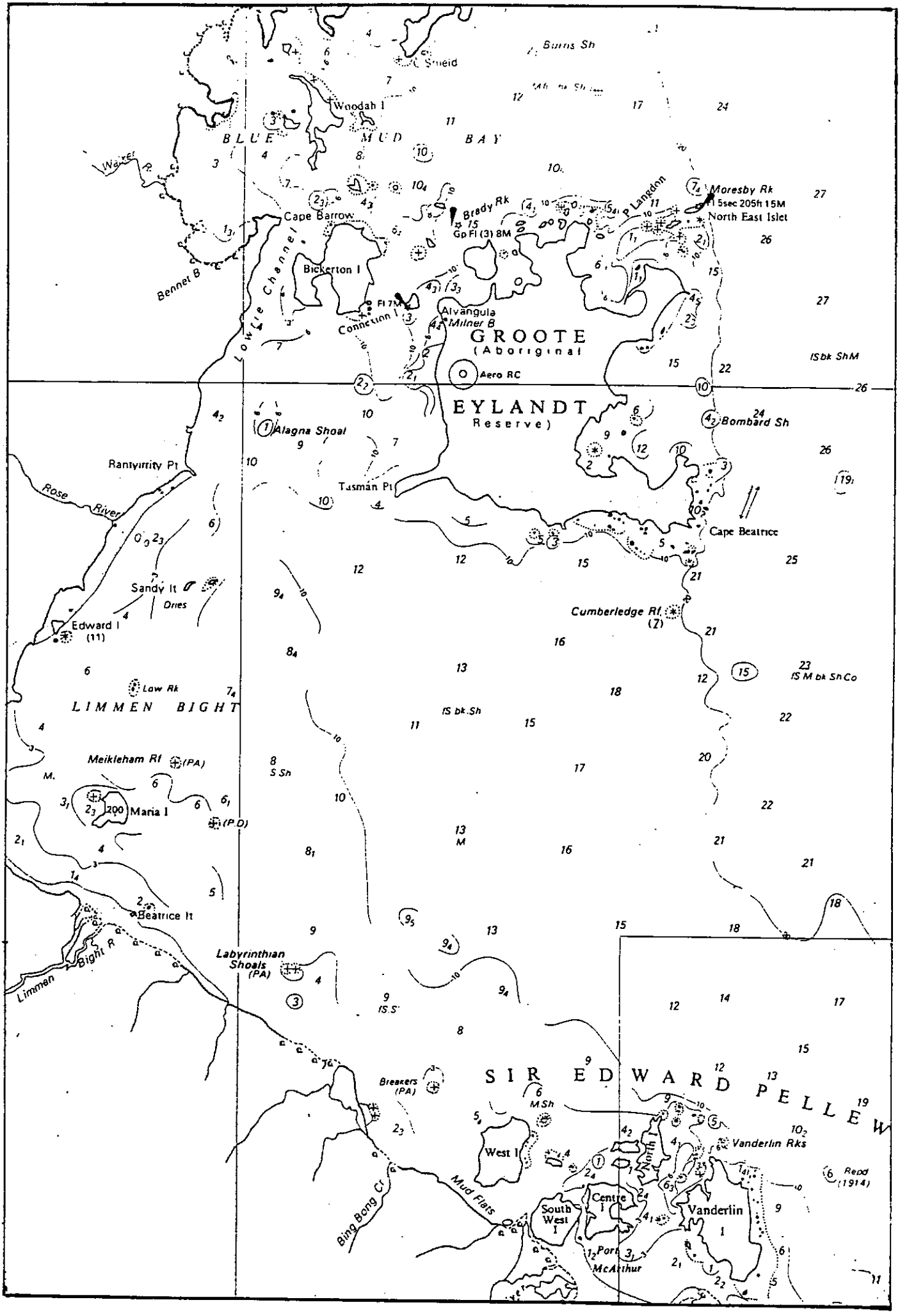
Try gear: 2 fathom (3.6m) nets;
boards: 1.8m x 0.45m
Mesh size 5 cm.

Sounders: Koden CVS 886 MK2 Colour video
Furuno FG-200 MkIII, dry paper

Radar: JRC JMA 310-6
Range: 64 nautical miles.

Satellite Navigator: Shipmate Rs 5000 DS.

APPENDIX 2
Survey area - map of localities



APPENDIX 3

SHOT DATA

VESSEL NAME:.....

SHOT NO:	DATE:	TIME: to Hrs.	PERIOD: Hrs.

START POS.:

TO:

FINISH POS.:

LENGTH OF TRAWL LINE: N.M. BEARING: 1st 2nd

DEPTH: 1 m. 2 m. 3 m. GRID: TRAWL SPEED:

WEATHER CONDITIONS: WIND - CLOUD/CLEAR

SEA COND.: SWELL - OPACITY COLOUR - GREEN/BLUE

SURFACE WATER TEMP: - °C SALINITY -

SIZE OF NETS: TYPE OF NETS:

MUD SAMPLE: COLOUR : Ooze, Mud, Sand, Shell, Gravel

	TIGERS	ENDEAVOURS	BANANAS	OTHERS	TOTAL
CATCH (kg)					
CATCH RATE (kg/hrs)					

CORAL PRAWN CATCH: kg.

COMMENT (PRAWN SIZE/CONDITION):

BY PRODUCTS:

BUGS SCALLOPS

SQUID REEF FISH

NUMBER OF VESSELS IN AREA:

NAME OF VESSELS IN AREA:

COMMENTS:

APPENDIX 4

CRUISE NO:

DATE: SHOT: TRAWL: TIME: TO: GRID: DEPTH: m

CATCH COMPOSITION BY NUMBERS

SPECIES	>1/2	>1/4	>1/8	<1/8	SPECIES	>1/1	>1/4	>1/8	<1/8
POMADASYIDAE:Javelinfish					SIGANIDAE:Rabbitfish				
THERAPONIDAE:Therapon,Grunters					CENTRISCIDAE:Razorfish				
NEMIPTERIADAE:Threadfin Bream					PLECTORHYNCHIDAE:Swetlips				
SCOLOPSIDAE:Monocle Bream					OSTRACIIDAE:Boxfish				
ALUTERIDAE:Leather Jackets					LABRIDAE:Tuskfish				
APOGONIDAE:Cardinalfish					Eels				
TETRADONTIDAE:Pufferfish					FISTULARIIDAE:Flutemouths				
Pseudorhombus arsius:Old Halibut					GERRIDAE:Silver-Biddies				
BOTHIDAE:L/H Flounder					CHAETODONTIDAE:Coralfish				
PLEURONECTIDAE:R/H Flounder					POMACANTHIDAE:Angelfish				
CYNOGLOSSIDAE:L/H Sole					CALLIONYMIDAE:Dragonets				
SOLEIDAE:R/H Sole					PEGASIDAE:Dragonfish				
Saurida Spp:Lizardfish,Grinners					PLATACIDAE:Batfish				
CARANGIDAE:Trevally etc.					SCOMBRIDAE:Mackerel etc				
LEIOGNATHIDAE:Ponyfish					SPHYRAENIDAE:Barracudas				
CLUPEIDAE:Herrings					Crayfish/Lobsters				
ENGRAULIDAE:Anchovies					Portunus. Crabs				
MULLIDAE:Goatfish					Charybdis. Crabs				
MUGILLIDAE:Mullet					Squilla:Prawn Killers				
TRIACANTHIDAE:Tripodfish					Bugs				
SHARKS/RAYS					Scallops				
TACHYSURIDAE:Catfish					Other Shellfish				
PLOTOSIDAE:Eeltail Catfish					Squid				
GOBIIDAE:Gobies					Cuttlefish				
ELEOTRIDAE:Gudgeons					Octopus				
BLENNIIDAE:Blennies					Echinoderms Sea Slugs				
PLATYCEPHALIDAE:Flathead					Eggs				
SCORPAENIDAE:Scorpionfish					Stars				
PRIACANTHIDAE:Bullseyes					Sponges				
Sillago Spp:Whiting					Hard Coral				
POLYNEMIDAE:Salmons					Soft Coral				
LUTJANIDAE:Perch					Gorgonian Coral				
SCIAENIDAE:Jewfish					Ascidians				
LETHRINIDAE:Emperors					Hydroids				
SERRANIDAE:Cods					Medusas - Blubber				

TOTAL TRASH: APPROXIMATE BASKETS	
TRASH DOMINANCE BY MASS	1.
COMMENTS:	2.
	3.
	4.
TOTAL CATCH OF PRAWNS	5.

COMMENTS:

APPENDIX 5

GRIDS TRAWLED OR SURVEYED

GRID NO.	CRUISE NO.				
	1	2	3	4	5
3165	*	*	*	*	*
3264	*	*	*	*	*
3265	*	*	*	*	*
3262	*	*	*	*	*
3363	*	*	*	*	*
3364	*	*	*	*	*
3462	*	*	*	*	*
3463	*	*	*	*	**
3464	*	*	*	*	*
3465					*
3562	*	*	*	*	*
3563	*	*	*	*	**
3564	*	*	*	*	*
3565					*
3663	*	*	*	*	**
3664	*	*	*	*	**
3665					*
3765	*	*	*	*	*
3860	#				
3861	*	*	*	*	*
3862	*				
3960	*	*	*	*	*
3961	*	*	*	*	*
3962	*	*	*	*	**
3963	#				
4060	*	*	*	*	*
4061	*	*	*	*	*
4062	*	*	*	*	**
4063	*	*	*		*
4160	*	*	*	*	*
4161	*	*	*	*	**
4162	*	*	*	*	**
4163	*	*	*	*	*
4260	*	*	*	*	*
4261	*	*	*	*	*
4262	*	*	*	*	**
4263	*	*	*	*	*
4264					#
4360	*	*	*	*	*
4361	*	*	*	*	*
4362					*
4363					*
4364					*
4365					#
4460	*	*	*	*	*
4461					#
4462					*

APPENDIX 5 (cont)

GRID NO.	CRUISE NO.				
	1	2	3	4	5
4463					*
4464					**
4465					*
4558	*				
4559	*	*	*	*	*
4560	*	*	*	*	*
4659	*	*	*	*	*
4660	*O	*O			
5265		#			
5266		#			
5365		#			
5366	*	*			
5367	*	*	*	*	*
5368	*	*	*	*	*
5369	*	*	*	*	*
5370	*	*	*	*	*
5465	*	*	*O	*	
5466	*	*			
5467	#				
5468	*	*	*	*	*
5470	*	*	*	*	*
5471	*	*	*	#	*
5566	*	*		*	*
5567	*	*	*	*	*
5568	*	*	*	*	*
5570	*	*	*	*	*
5571	*	*	*	*	*
5671	*	*	*	*	*
5771	*	*	*	*	*
5871	*				

* - trawled

- surveyed, not trawled

O - hooked up/ripped out (severe gear damage)

**- trawls duplicated

G. L. DUFFIELD, Government Printer of the Northern Territory