



Assessment of Relative Abundance of Fishes Caught by Gillnet in Vietnamese Waters

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ABSTRACT

The fisheries resources in near shore waters of Vietnam are reported to be overexploited resulting on the decrease of CPUE. It is important to develop the off-shore fisheries in Vietnam now. However information on off-shore fisheries resources in Vietnam was still very limited. This study was designed in order to supply such kind of information.

The study area was in off-shore waters of Vietnam. R/V BIEN DONG(1500 Hp) with gillnet of 5 different mesh-size (73, 95, 123, 150 and 160 mm) was used for survey.

The species and catch composition, distribution of promising species, relative abundance of target species were described. As a results, 98 species belonged to 32 families have been identified. Skipjack tuna was dominant (18.5 %). Distribution of relative abundance of some major species were given.

Key words : Composition, catch, abundance, mesh-size

Introduction

The marine capture fisheries of Vietnam has developed rapidly in last decade by increasing number of both artisanal and motorized fishing boats.

At the end of 1998, number of motorized fishing vessels was around 72,000 units with the total engine capacities of nearly 2 millions Hp. The total production of marine capture fisheries of Vietnam in 1998 was exceeded one million tons. [MOFI,1999].

Due to the almost of fishing vessels are concentrated their activities only in near-shore waters, the fisheries resources in near-shore waters seemed to be overexploited resulting on the decrease of the catch per unit of effort (CPUE).

As a result of these facts, the Ministry of Fisheries of Vietnam is planning to make a sustainable fisheries development program relating to coastal and off-shore fisheries in order to manage sustainable coastal fisheries and at the same time to develop off-shore fisheries.

One of the important issue for development of off-shore fisheries is to identify the species and catch composition, the distribution of economically promising species, to determine their relative abundance as well as estimate the potential of fisheries resources herein and then to develop the appropriate fishing fleets. However, information on off-shore fisheries resources in Vietnam was very limited.

Since 1995, the Research Institute of Marine Products (RIMP) has been conducting some research programmes on off-shore fisheries resources under the support of the Vietnamese Government or with the assistance of JICA , DANIDA and SEAFDEC. This paper presents some results of those studies.

Materials and Methods

The materials were collected mainly during the implementation of the Project entitled “ Study on the marine resources study in Vietnam ” in 1995-1997. This project was carried out jointly by the Vietnamese-Japanese Study Team on R/V “ BIEN DONG ” (1500 Hp) of RIMP. Drift gillnets of 5 different mesh-size were used : mesh-size of 73mm, 95 mm, 123 mm, 150 mm and 160 mm. Construction of used gillnets was shown in Fig. 1.

The study area was limited by 8⁰⁰’ N to 18⁰⁰’ N and from 40 m depth to 112⁰⁰’ E within the Exclusive Economic Zone (EEZ) of Vietnam and was divided into 35 one-degree quadrangles.

One test fishing by gillnet and an oceanographic station were conducted at each station. The gillnets were set before sunset and hauled at sunrise of the next day. It was intended to set 100 tans of 5 mesh-sized nets, each consisting of 20 tans. (one tan is about 50m long)

The time of soaking of gillnets were standardized by mean time of all operation and Catch Per Unit of Effort of each operation was converted to the value of 100 tans of standardized by soaking time and then to calculate CPUE per tan.

Species composition and catch rate of each haul were recorded by mesh-size. For species composition, catches of four cruises conducted in yeas of 1995-1997 were used. However, for relative abundance assessment , only catches in the Southwest monsoon and Northeast monsoon of 1966 were used.

The relative abundance (in term of weight of fish caught by one tan of drift gillnet) is synonyms of the Catch per Unit of Efforts (CPUE) and was estimated as follows:

$$\mathbf{RAi (weight) = Wij / Nij}$$

Where:

RAi : Relative abundance in term of weight (kg) of fish caught by all mesh- size of gillnets used in survey.

Wij : Weight of specimen of a species caught by gillnet of J-mesh-size employed at i-th station.

Nij : Number of nets of J-mesh-size employed at i-th station

The passages of the R/V BIEN DONG during the S-W monsoon and N-E monsoon in 1996 were shown in [Fig.2 and Fig.3].

Results

Species composition

98 species belonged to 32 families have been identified, of which 96 fish species belonged to 30 families and 2 squid species belonged to two cephalopods families [Table 1]. Besides, 3 species of sea turtles and 5 species of Dolphin were incidentally caught also.

The highest number of species was Carangidae(18 species), followed by Scombridae(12 species) and Exocoetidae(10 species).

Catch rate

Catch rate of species caught by gillnets with 5-different mesh-size in the S-W and N-E monsoons 1996 was shown in the [Table 2] and the 14 major species of highest catch rate was shown in [Table3].

In the S-W monsoon, 62 species belonged to 22 families and in the S-W 48 species of 23 families have been identified. It is clear that the number of families was similar but number of species



in N-E monsoon was less than in the S-W monsoon.

However, catch rate of species caught in the N-E was higher than in the S-W monsoon, it was 92.40% and 84.20 % respectively.

For the whole year, catch rate of Skipjack tuna was highest (18.51 %), then followed by Devil ray (15.60%), Common dolphinfish (9.07%), etc [Fig. 4] . Catch of only 14 species accounted for 86.80% of the total catch by gillnets of 5-mesh-size used.

Above species are considered as the most promising target pelagic species in off-shore waters of Vietnam. Therefore, appropriate fishing gears and method should be developed for off-shore fishing program of Vietnam.

Relative abundance of major species caught by gillnets

In the S-W monsoon period, the lowest catch per haul/night was 2.0 kg and highest was 288.0 kg with the average of 100 kg. The lowest relative abundance per tan was 0.1 kg/tan, highest was 3.5 kg/tan and average catch was 1.2 kg/tan. Distribution of relative abundance (kg/ tan) of all species of pelagic fishes caught by gillnets of 5 different mesh-size was shown in the [Fig. 5].

It was clear that in the S-W monsoon, the highest CPUE (kg/tan) for all combined species was distributed in the quadrangles B-28; B- 33 and B-13, then followed by quadrangles B-6; B-8; B-12; B-15 and B-16.

In the Northeast monsoon, the lowest catch was 3.2 kg /haul/night and highest catch was 302.6 kg, average catch was 88.7 kg. The average CPUE by kg/tan was 0.84 kg/tan, lower than in the S-W monsoon. Distribution of relative abundance (kg/tan) of all combined species caught by 5 mesh size gillnet was shown in [Fig. 6]. The highest CPUE was found in the quadrangles B-26; B-27 and B-03, then followed by quadrangles B-13; B-14; B-15; B-16; B-18; B-22 and B-33.

Relative abundance of major species by kg/tan were as follow:

Skipjack tuna (*Katsuwonus pelamis*):

[Fig. 7] shows CPUE in weight in each quadrangle in S-W monsoon. The highest CPUE was obtained in the quadrangles B-10; B-17; B-28; B-29 and B-33 and ranged 0.5-1.0 kg/tan.

[Fig. 8] shows CPUE in weight in each quadrangle in N-E monsoon. The highest CPUE was found in the quadrangles B-11; B-16; and B-33 and ranged 0.5-1.0 kg/tan.

Frigate mackerel (*Auxis thazard*):

The higher CPUE in S-W monsoon was obtained only in the quadrangle B-06(1.0 kg/tan) [Fig.9], and in N-E monsoon in the quadrangle B-26 (1.0 kg/tan) [Fig. 10].

Common dolphinfish (*Coryphaena hippurus*)

In S-W monsoon [Fig. 11], the CPUE was highest in the quadrangles B-8 (0.4 kg/tan) and in N-E monsoon [Fig. 12] in the quadrangles B-3, B-13 where CPUE ranged 0.4-0.5 kg/tan.

Bigtooth pomfret (*Brama orcini*)

Bigtooth pomfret did not appear near the Gulf of Tonkin in the North and near the Mekong Delta in the South, it indicated that this species avoid low salinity and distributed mainly in high salinity waters.

In S-W monsoon [Fig. 13], low CPUE (< 0.1 kg/tan) was obtained in whole survey area and In N-E monsoon [Fig. 14], the higher CPUE was in the quadrangles B-12, B-18 and B-23 (ranged 0.1-0.3 kg/tan).

Triple tail (*Lobotes surinamensis*)

The highest CPUE was obtained in the S-W monsoon [Fig. 15] in the quadrangles B-6 and B-29, where CPUE ranged 0.1-0.5 kg/tan and in N-E monsoon [Fig. 16] only found in the quadrangles B-3 (0.12 kg/tan).

Flying squid (*Sthenoteuthis oualaniensis*)

Like bigtooth pomfret, flying squid did not appear in the vicinity of the Gulf of Tonkin in the North nor the Mekong Delta in the South of Vietnam.

In S-W monsoon [Fig. 17], the higher CPUE (ranged 0.04-0.1 kg/tan) was observed in the quadrangles B-10, B-12, B-28 and B-25 and in N-E monsoon [Fig. 18] only in central waters of Vietnam in the quadrangles B-17 and B-18 (0.1-0.2 kg/tan).

Discussion

It was the first time, study on off-shore pelagic fish by using different mesh-size gillnets was conducted in Vietnam. The results showed the similar species composition in off-shore waters of Vietnam compared with adjacent waters of the South China Sea.

Although more than 100 species were identified, some of 14 species have had high catch rate only, among them Skipjack tuna, Frigate mackerel, Dolphinfin, Devil ray, Marlin, Swordfish, Bigtooth pomfret, Flying squids ,etc. were the most promising target species for off-shore pelagic fish capture fishery of Vietnam.

According to the results of the Japan Marine Resources Research Center (JAMARC) obtained from trial fishing conducted with surface gillnets of different mesh-size (73-250 mm) in different areas of the Pacific Ocean during 1978-1990, the CPUE of catch in weight for some species like Bigtooth pomfret, Slender tuna, Albacore, Blue shark was ranged from 3.8 to 20.0 kg/tan.

The results obtained from our survey by gillnets of 5 mesh-size in off-shore waters of Vietnam in 1996 showed lower value of CPUE (0.84 - 1.2 kg/tan). Low CPUE in off-shore waters of Vietnam was caused by different reasons: Due to the scattered concentration of pelagic fishes schools in off shore waters of Vietnam, gillnet's selectivity, and in appropriate fishing methods, etc.

Therefore for pelagic fish exploitation in off-shore waters of Vietnam, fishing gears like gillnet, purse seine, long line, lift net, etc. were in the first priority.

For purse seine , it is important to concentrate fish by fish aggregating devices (FAD) and payao's . For gillnet, selectivity of different mesh-size to different species and for lift net, the reaction of different species on light should be studied.

Table 1. Species composition of catch by gillnets in offshore waters of Vietnam.

Ord.	Scientific name of Families and species	Common English name
I	ACANTHURIDAE	
1	<i>Naso brevirostris</i> (Valenciennes)	Spotted unicornfish
II	BELONIDAE	
2	<i>Ablennes hians</i> (Valenciennes)	Flat needlefish
3	<i>Tylosurus acus melanotus</i> (Bleeker)	Blackfin needlefish
III	BRAMIDAE	
4	<i>Brama orcinii</i> Cuvier	Bigtooth pomfret
IV	CARANGIDAE	
5	<i>Alectis ciliaris</i> (Bloch)	Threadfin trevally



Table 1. (Continued).

Ord.	Scientific name of Families and species	Common English name
6	<i>Atule mate</i> (Cuvier)	Slender-scaled scad
7	<i>Carangoides ferdau</i> (Forsskal)	Blue travelly
8	<i>C. orthogrammus</i> (Jordan et Gilbert)	Yellow-spotted crevalle
9	<i>Decapterus maruadsi</i> (Temminck et Schlegel)	Round scad
10	<i>D. kurroides</i> Bleeker	Red-tail scad
11	<i>D. macrosoma</i> Bleeker	Layang scad
12	<i>Elagatis bipinnulata</i> (Quoy et Gaimard)	Rainbow runner
13	<i>Megalaspis cordyla</i> (Linnaeus)	Hard-tail scad
14	<i>Naucrates ductor</i> (Linnaeus)	Pilot fish
15	<i>Scomberoides lysan</i> (Forsskal)	Double dotted queenfish
16	<i>S. commersonianus</i> Lacepede	Talang queenfish
17	<i>S. tol</i> (Cuvier)	Leatherskin queenfish
18	<i>Selar crumenophthamus</i> (Bloch)	Bigeye scad
19	<i>Seriola rivoliana</i> Valenciennes	Almaco jack
20	<i>Seriolina nigrofasciata</i> (Ruppell)	Black band jack
21	<i>Trachinotus bailloni</i> (Lacapede)	Black-spotted dart
22	<i>Uraspis helvola</i> (Forster)	Whitemouth kingfish
V	CALLIONYMIDAE	
23	<i>Pseudocalliurichthys</i> sp.	Variegated dragonet
VI	CARCHARHINIDAE	
24	<i>Carcharinus brevipinna</i> (Muller et Henle)	Spiner shark
25	<i>C. falciformis</i> (Bibron)	Silky shark
26	<i>C. sorrah</i> (Valenciennes)	Spot-tail shark
27	<i>Galeocerdo cuvier</i> (Perdo et Le Sueur)	Tiger shark
28	<i>Prionace glauca</i> Linnaeus	Blue shark
29	<i>Pseudocarcharias kamoharai</i> (Matsubara)	Crocodile shark
VII	CHIROCENTRIDAE	
30	<i>Chirocentrus dorab</i> (Forsskal)	Wolf herring
VIII	CORYPHAENIDAE	
31	<i>Coryphaena equiselis</i> Linnaeus	Pompano dolphinfish
32	<i>C. hippurus</i> Linnaeus	Common dolphinfish
IX	DALATIIDAE	
33	<i>Isistius brasiliensis</i> (Quoy et Gaimard)	Black shark
X	DIODONTIDAE	
34	<i>Diodon eydouxii</i> Brissout et Barneville	Porcurine fish
35	<i>D. hystrix</i> Linnaeus	Porcurine fish
36	<i>D. holocanthus</i> Linnaeus	Fleckled sucker
XI	ECHENEIDIDAE	
37	<i>Echeneis naucrates</i> Linnaeus	Shark sucker
38	<i>Remora remora</i> (Linnaeus)	Remora
39	<i>Remorina albescens</i> (Temminck et Schlegel)	White remora
XII	EXOCOETIDAE	
40	<i>Cypselurus atrisignis</i> (Jenkins)	Greater spotted flyingfish
41	<i>C. cyanopterus</i> (Valenciennes)	Margined flyingfish
42	<i>C. longibarbus</i> (Parin)	Coast flyingfish
43	<i>C. naresii</i> (Grunther)	Uchida's flyingfish
44	<i>C. poecilopterus</i> (Valenciennes)	Yellowfin flyingfish
45	<i>C. sp.</i>	Flyingfish
46	<i>C. spilonopterus</i> (Bleeker)	Flyingfish
47	<i>C. unicolor</i> (Valenciennes)	Bigeye flyingfish
48	<i>Exocoetus volitant</i> Linnaeus	Cosmopolitan flyingfish

Table 1. (Continued).

Ord.	Scientific name of Families and species	Common English name
49	<i>Paraexocoetus</i> sp.	Sailfin flyingfish
XIII	GEMPYLIDAE	
50	<i>Gempylus serpens</i> Cuvier	Snake mackerel
51	<i>Lepidocybium flavobrunneum</i> (Smith)	Escolar
52	<i>Promethichthys prometheus</i> (Cuvier)	Snake-mackerel
53	<i>Ruventus pretiosus</i> Cocco	Oil fish
XIV	ISTIOPHORIDAE	
54	<i>Istiophorus platypterus</i> (Shaw et Nodder)	Indo-Pacific sailfish
55	<i>Makaira indica</i> (Cuvier)	Black marlin
56	<i>M. mazara</i> (Jordan et Snyder)	Blue marlin
57	<i>Tetrapterus audax</i> (Philippi)	Striped marlin
XV	KYPHOSIDAE	
58	<i>Kyphosus vaigiensis</i> (Quoy et Gaimard)	Bass seachub
XVI	LOBOTIDAE	
59	<i>Lobotes surinamensis</i> (Bloch)	Tripletail
XVII	MENIDAE	
60	<i>Mene maculata</i> (Bloch et Schneider)	Moon fish
XVIII	MOBULIDAE	
61	<i>Manta birostris</i> (Donndoff)	Manta ray
62	<i>Mobula japonica</i> (Muller et Henle)	Devil ray
XIX	MONACANTHIDAE	
63	<i>Aluterus monoceros</i> (Linnaeus)	Unicom leatherjacket
64	<i>A. scriptus</i> (Osbeck)	Leatherjacket
65	<i>Canthidermis maculata</i> (Bloch)	Ocean triggerfish
XX	MYCTOPHIDAE	
66	<i>Diaphus gigas</i> Gibert	Brightnose headlightfish
67	<i>D. watasei</i> Jordan et Starks	Latern fish
XXI	NOMEIDAE	
68	<i>Arioma indica</i> (Day)	Indian driftfish
69	<i>Cubiceps baxteri</i> McCulloch	Drift fish
70	<i>C. pauciradiatus</i> Gunther	Chunky fathead
71	<i>C. squamiceps</i> (Lloyd)	Fathead
72	<i>Nomeus gronovii</i> (Gmelin)	Man-of-War fish
73	<i>Psenes arafurensis</i> Grunther	Eyebrowfish
74	<i>P. cyanophrys</i> Valenciennes	Black driftfish
75	<i>P. maculatus</i> Lutken	Blue eyebrowfish
XXII	ORECTOLOBIDAE	
76	<i>Stegostoma fasciatum</i> (Hermann)	Zebra shark
XXIII	PRIACANTHIDAE	
77	<i>Priacanthus macracanthus</i> Cuvier	Large-spined bigeye
XXIV	RACHYCENTRIDAE	
78	<i>Rachicentron canadum</i> (Linnaeus)	King fish
XXV	SCOMBRIDAE	
79	<i>Acanthocybium solandri</i> (Cuvier)	Wahoo
80	<i>Auxis rochei</i> (Risso)	Bullet tuna
81	<i>A. thazard</i> (Lacepede)	Frigate mackerel
82	<i>Euthynnus affinis</i> (Cantor)	Eastern little tuna
83	<i>Katsuwonus pelamis</i> (Linnaeus)	Skipjack tuna
84	<i>Rasbrelliger kanagurta</i> (Cuvier)	Indian mackerel
85	<i>Thunnus albacares</i> (Bonnaterre)	Yellowfin tuna
86	<i>T. obesus</i> (Lower)	Bigeye tuna
87	<i>T. tonggol</i> (Bleeker)	Longtail tuna

Table 1. (Continued).

Ord.	Scientific name of Families and species	Common English name
88	<i>Sarda orientalis</i> (Temminck etSchlegel)	Striped bonito
89	<i>Scomber australasicus</i> Cuvier	Blue mackerel
90	<i>Scomberomorus commerson</i> Lacepede	Spanish mackerel
XXVI	SPHYRNIDAE	
91	<i>Sphyrna lewini</i> (Griffth et Smith)	Hammerhead shark
XXVII	SYNODOTIDAE	
92	<i>Saurida undosquamis</i> Richardson	True lizardfish
XXVIII	TETRADONTIDAE	
93	<i>Lagocephalus</i> sp.	White-tail blowfish
94	<i>L. oceanicus</i> Jordan et Flower	Spotted blowfish
XXIX	THERAPONIDAE	
95	<i>Therapon jarbua</i> (Forsskal)	Jarbug terapon
XXX	XIPHIIDAE	
96	<i>Xiphias gladius</i> Linnaeus	Broadbill swordfish
XXXI	OMMASTREPHIDAE	
97	<i>Sthenoteuthis ovalaniensis</i> Lesson	Flying squid
XXXII	THYSANOTEUTHIDAE	
98	<i>Thysanoteuthys rhombus</i> Troschel	Diamonback squid

Table 2. Catch rate by gillnet in offshore waters of Vietnam in S-W and N-E monsoons of 1996.

Ord.	Scientific name of Families and species	Common English name	Catch rate (%)	
			S-W monsoon	N-E monsoon
I	ACANTHURIDAE		0.01	
1	<i>Naso brevirostris</i> (Valenciennes)	Spotted unicornfish	0.01	
II	BELONIDAE		0.09	0.18
2	<i>Ablennes hians</i> (Valenciennes)	Flat needlefish	0.01	0.18
3	<i>Tylosurus acus melanotus</i> (Bleeker)	Blackfin needlefish	0.08	
III	BRAMIDAE		1.42	5.20
4	<i>Brama orcini</i> Cuvier	Bigtooth pomfret	1.42	5.20
IV	CARANGIDAE		0.70	0.56
5	<i>Alectis ciliaris</i> (Bloch)	Threadfin trevally	0.01	
6	<i>Carangoides ferdau</i> (Forsskal)	Blue trevly	0.003	
7	<i>C. orthogrammus</i> (Jordan et Gilbert)	Yellow-spotted crevalle	0.01	0.09
8	<i>Decapterus maruadsi</i> (Temminck et Schlegel)	Round scad	0.01	
9	<i>D. kurroides</i> Bleeker	Red-tail scad		0.001
10	<i>D. macrosoma</i> Bleeker	Layang scad		0.03
11	<i>Elagatis bipinnulata</i> (Quoy et Gaimard)	Rainbow runner	0.13	
12	<i>Megalaspis cordyla</i> (Linnaeus)	Hard-tail scad	0.03	
13	<i>Naucrates ductor</i> (Linnaeus)	Pilot fish	0.02	0.07
14	<i>Scomberoides lysan</i> (Forsskal)	Double dotted queenfish	0.13	
15	<i>S. tol</i> (Cuvier)	Leatherskin queenfish	0.08	
16	<i>Selar crumenophthamus</i> (Bloch)	Bigeye scad	0.02	0.03
17	<i>Seriola rivoliana</i> Valenciennes	Almaco jack	0.20	0.31

Table 2. (Continued).

Ord.	Scientific name of Families and species	Common English name	Catch rate (%)	
			S-W monsoon	N-E monsoon
18	<i>Uraspis helvola</i> (Forster)	Whitemouth kingfish	0.06	0.03
V	CARCHARHINIDAE		3.67	2.84
19	<i>Carcharinus brevipinna</i> (Muller et Henle)	Spiner shark	0.02	
20	<i>C. falciformis</i> (Bibron)	Silky shark	0.50	2.30
21	<i>C. sorrah</i> (Valenciennes)	Spot-tail shark	0.15	
22	<i>Galeocerdo cuvier</i> (Perdo et Le Sueur)	Tiger shark	0.72	
23	<i>Prionace glauca</i> Linnaeus	Blue shark	2.28	
24	<i>Pseudocarcharias kamoharai</i> (Matsubara)	Crocodile shark		0.54
VI	CHIROCENTRIDAE		0.04	0.13
25	<i>Chirocentrus dorab</i> (Forsskal)	Wolf herring	0.04	0.13
VII	CORYPHAENIDAE		7.04	12.01
26	<i>Coryphaena equiselis</i> Linnaeus	Pompano dolphinfish	0.20	0.72
27	<i>C. hippurus</i> Linnaeus	Common dolphinfish	6.84	11.29
VIII	DALATIIDAE		0.01	
28	<i>Isistius brasiliensis</i> (Quoy et Gaimard)	Black shark	0.01	
IX	DIODONTIDAE		0.04	0.02
29	<i>Diodon eydouxi</i> Brissout et Barneville	Porcurine fish	0.04	0.02
X	ECHENEIDIDAE		0.04	0.04
30	<i>Echeneis naucrates</i> Linnaeus	Shark sucker	0.04	0.04
XI	EXOCOETIDAE		0.08	0.08
31	<i>C. cyanopterus</i> (Valenciennes)	Margined flyingfish	0.04	0.08
32	<i>C. poecilopterus</i> (Valenciennes)	Yellowfin flyingfish	0.003	
33	<i>C. sp.</i>	Flyingfish	0.01	0.001
34	<i>C. pilonotopterus</i> (Bleeker)	Flyingfish	0.01	0.003
35	<i>C. unicolor</i> (Valenciennes)	Bigeye flyingfish	0.01	
36	<i>Exocoetus volitant</i> Linnaeus	Cosmopolitan flyingfish	0.004	
XII	GEMPYLIDAE		0.20	0.24
37	<i>Gempylus serpens</i> Cuvier	Snake mackerel	0.03	0.20
38	<i>Lepidocybium flavobrunneum</i> (Smith)	Escolar	0.15	
39	<i>Ruventtus pretiosus</i> Cocco	Oil fish	0.02	0.04
XIII	ISTIOPHORIDAE		21.77	22.38
40	<i>Istiophorus platypterus</i> (Shaw et Nodder)	Indo-Pacific sailfish	7.79	5.10
41	<i>Makaira indica</i> (Cuvier)	Black marlin	5.24	10.38
42	<i>M. mazara</i> (Jordan et Snyder)	Blue marlin	8.74	6.90
XIV	KYPHOSIDAE			0.01
43	<i>Kyphosus vaigiensis</i> (Quoy et Gaimard)	Bass seachub		0.01
XV	LOBOTIDAE		2.59	2.60
44	<i>Lobotes surinamensis</i> (Bloch)	Tripletail	2.59	2.60
XVI	MENIDAE			0.03
45	<i>Mene maculata</i> (Bloch et Schneider)	Moon fish		0.03
XVII	MOBULIDAE		23.76	13.00
46	<i>Manta birostric</i> (Donndoff)	Manta ray	5.56	
47	<i>Mobula japonica</i> (Muller et Henle)	Devil ray	18.20	13.00
XVIII	MONACANTHIDAE		0.11	1.10
48	<i>Aluterus monoceros</i> (Linnaeus)	Unicom leatherjacket	0.06	0.99
49	<i>A. scriptus</i> (Osbeck)	Leatherjacket	0.04	0.01
50	<i>Canthidermis maculata</i> (Bloch)	Ocean triggerfish	0.01	0.07
XIX	MYCTOPHIDAE			0.001
51	<i>Diaphus gigas</i> Gibert	Brightnose headlightfish		0.001
XX	NOMEIDAE		0.70	0.11

Table 2. (Continued).

Ord.	Scientific name of Families and species	Common English name	Catch rate (%)	
			S-W monsoon	N-E monsoon
52	<i>Cubiceps baxteri</i> McCulloch	Drift fish	0.01	0.09
53	<i>C. pauciradiatus</i> Gunther	Chunky fathead	0.01	
54	<i>Psenes arafurensis</i> Grunther	Eyebrowfish	0.03	
55	<i>P. cyanophrys</i> Valenciennes	Black driftfish	0.04	0.02
56	<i>P. maculatus</i> Lutken	Blue eyebrowfish	0.01	
XXI	PRIACANTHIDAE		0.06	0.02
57	<i>Priacanthus macracanthus</i> Cuvier	Large-spined bigeye	0.06	0.02
XXII	RACHYCENTRIDAE		0.15	
58	<i>Rachicentron canadum</i> (Linnaeus)	King fish	0.15	
XXIII	SCOMBRIDAE		24.21	36.12
59	<i>Acanthocybium solandri</i> (Cuvier)	Wahoo	0.13	0.04
60	<i>Auxis rochei</i> (Risso)	Bullet tuna	1.83	0.71
61	<i>A. thazard</i> (Lacepede)	Frigate mackerel	4.81	8.93
62	<i>Euthynnus affinis</i> (Cantor)	Eastern little tuna	0.57	1.21
63	<i>Katsuwonus pelamis</i> (Linnaeus)	Skipjack tuna	16.21	20.80
64	<i>Rasbrelliger kanagurta</i> (Cuvier)	Indian mackerel		0.02
65	<i>Thunnus albacares</i> (Bonnaterre)	Yellowfin tuna	0.39	2.60
66	<i>T. obesus</i> (Lower)	Bigeye tuna	0.19	0.35
67	<i>T. tonggol</i> (Bleeker)	Longtail tuna		1.42
68	<i>Sarda orientalis</i> (Temminck et Schlegel)	Striped bonito	0.07	
69	<i>Scomber australasicus</i> Cuvier	Blue mackerel	0.01	
70	<i>Scomberomorus commerson</i> Lacepede	Spanish mackerel		0.04
XXIV	SYNODOTIDAE		0.002	0.03
71	<i>Saurida undosquamis</i> Richardson	True lizardfish	0.002	0.03
XXV	TETRADONTIDAE			0.02
72	<i>Lagocephalus oceanicus</i> Jordan et Flower	Spotted blowfish		0.02
XXVI	OMMASTREPHIDAE		1.06	2.57
73	<i>Sthenoteuthis ovalaniensis</i> Lesson	Flying squid	1.06	2.57

Table 3. Catch rate(%) of major species caught by gillnet in off-shore waters of Vietnam in S-W and N-E monsoons 1996.

Ord.	Common English name/ Scientific name	S-W monsoon	N-E monsoon
1	Skipjack tuna (<i>Katsuwonus pelamis</i>)	16.21	20.80
2	Devil ray (<i>Mobula japonica</i>)	18.20	13.00
3	Common dolphinfish (<i>Coryphaena hippurus</i>)	6.84	11.29
4	Black marlin (<i>Makaira indica</i>)	5.24	10.38
5	Blue marlin (<i>M. mazara</i>)	8.74	6.90
6	Frigate mackerel (<i>Auxis thazard</i>)	4.81	8.93
7	Indo-pacific sailfish (<i>Istiophorus platypterus</i>)	7.79	5.10
8	Bigtooth pomfret (<i>Brama orcini</i>)	1.42	5.20
9	Manta ray (<i>Manta biostric</i>)	5.56	0.00
10	Triptail (<i>Lobotes surinamensis</i>)	2.59	2.60
11	Flying squid (<i>Sthenoteuthis ovalaniensis</i>)	1.06	2.57
12	Yellowfin tuna (<i>Thunnus albacares</i>)	0.39	2.60
13	Silky shark (<i>Carcharinus falciformes</i>)	0.50	2.30
14	Bullet tuna (<i>Auxis rochei</i>)	1.83	0.71
	Grand total	81.20	92.40

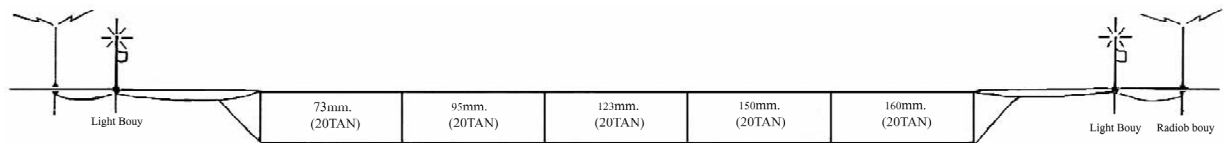


Fig. 1. Construction of surface gillnets of five mesh-sizes used for study.

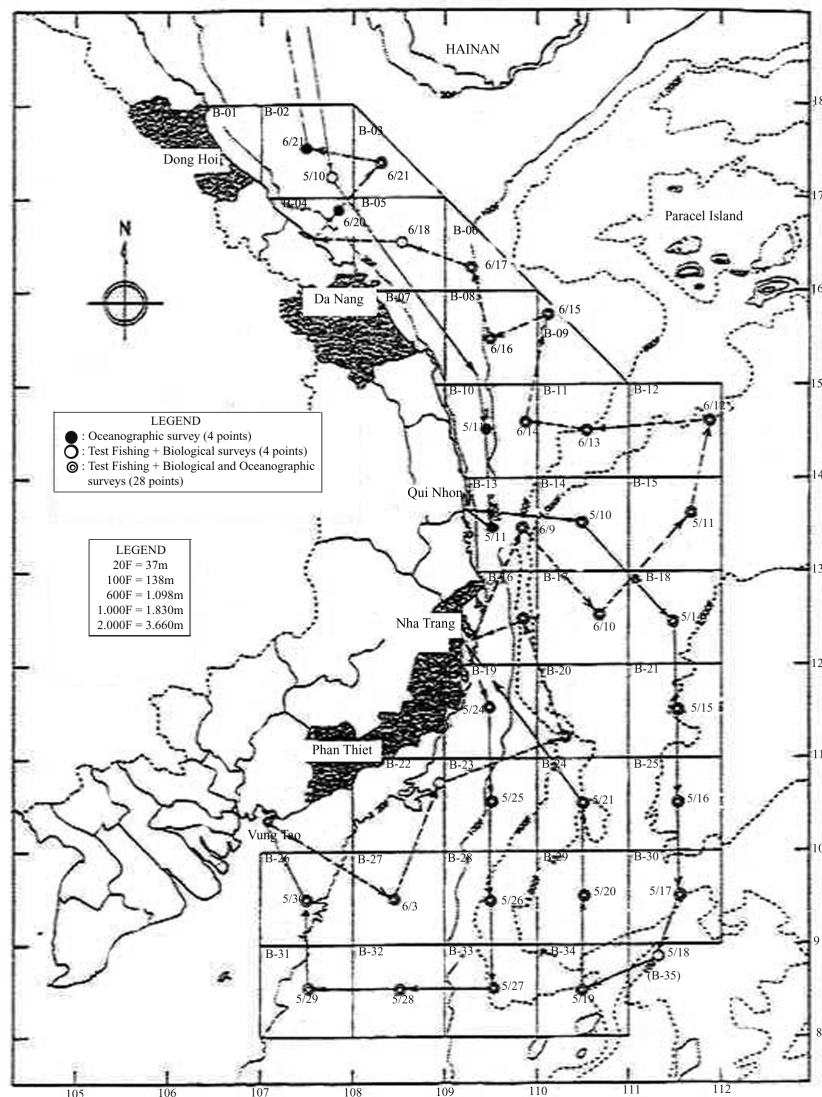


Fig. 2. Sailing track and test fishing stations in S-W monsoon.

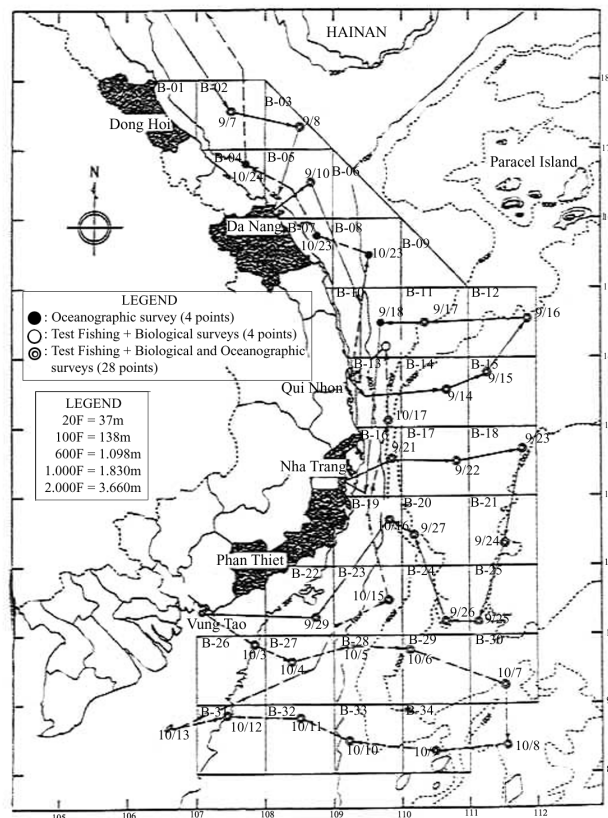


Fig. 3. Sailing track and test fishing stations in N-E monsoon.

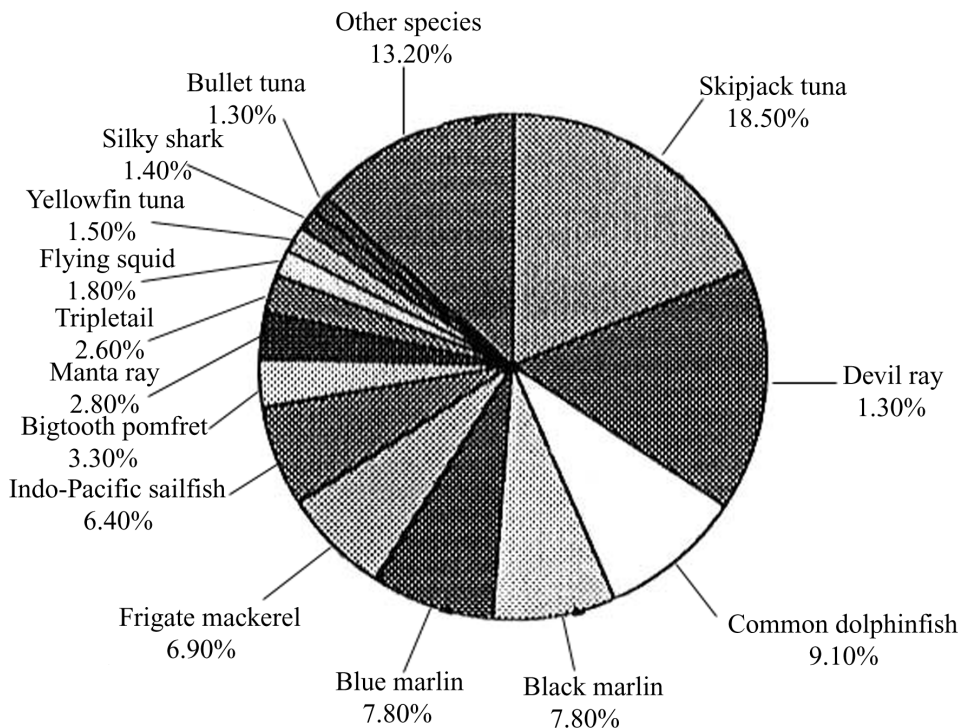


Fig. 4. Catch rate of major species caught by gillnet in 1996.

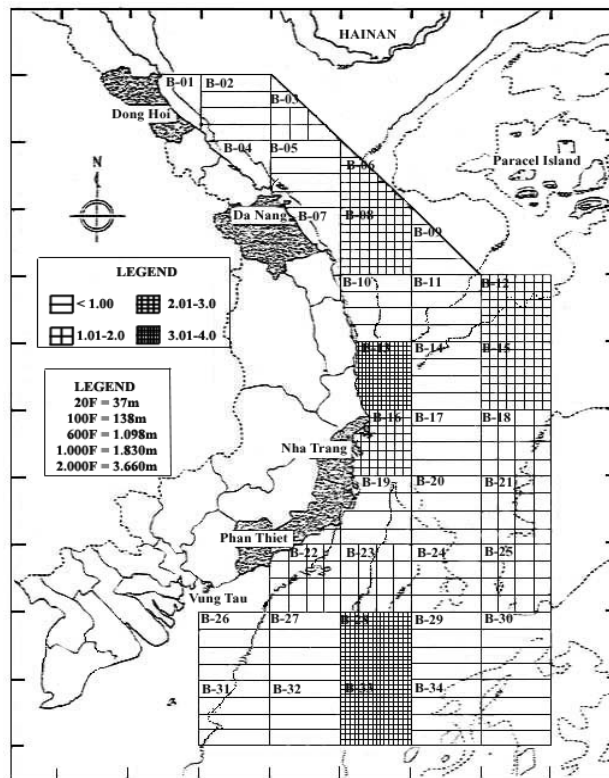


Fig. 5. Distribution of CPUE (kg/tan) in S-W monsoon.

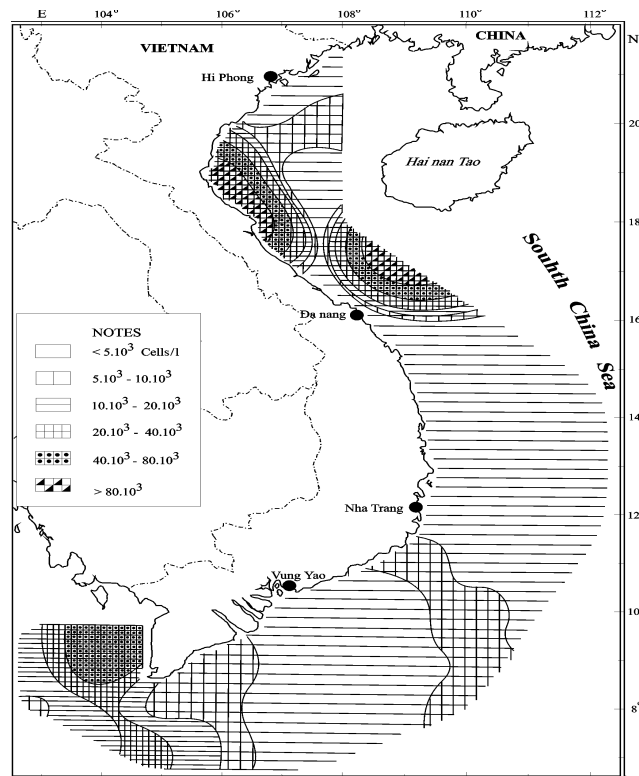


Fig. 6. Distribution of CPUE (kg/tan) in N-E monsoon.

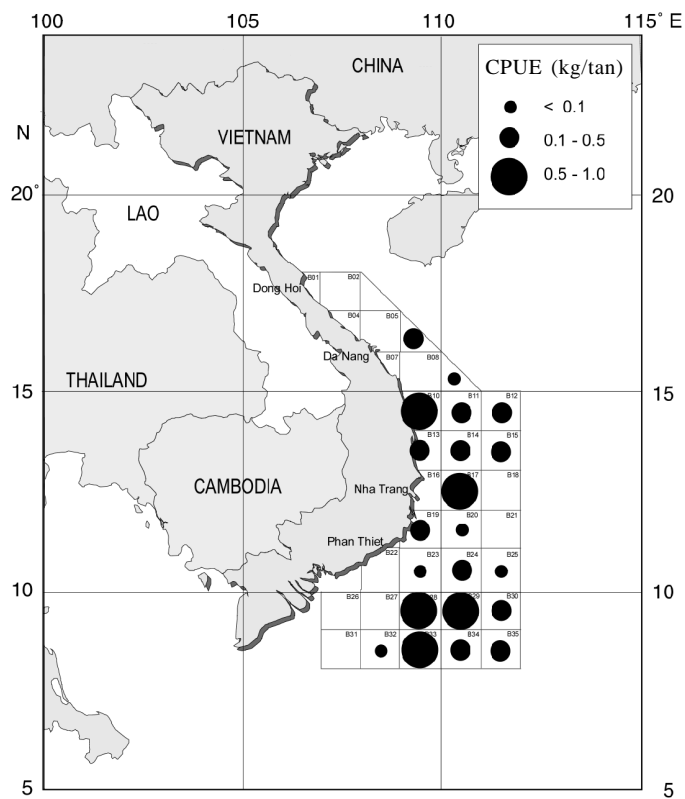


Fig. 7. Distribution of CPUE (kg/tan) of skipjack tuna in S-W monsoon.

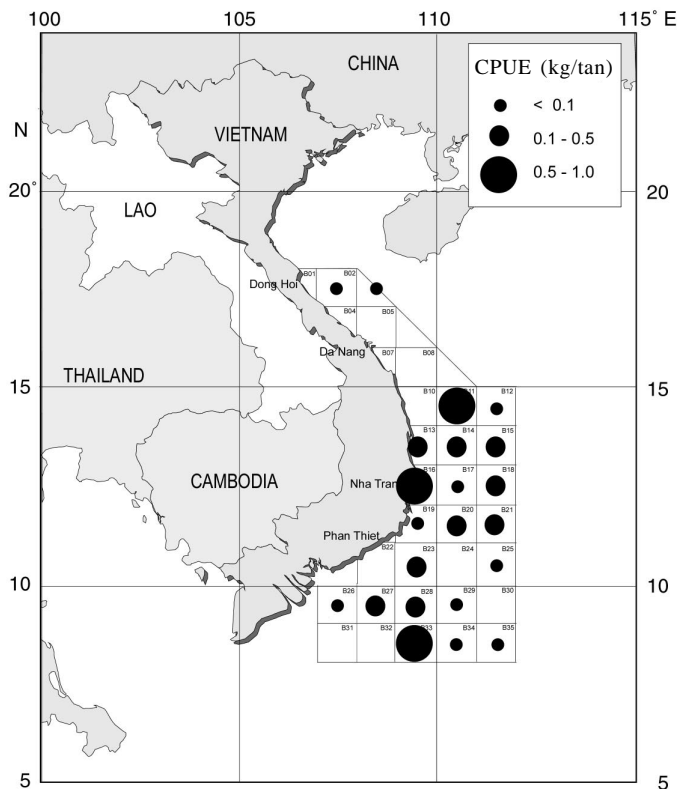


Fig. 8. Distribution of CPUE (kg/tan) of Skipjack tuna in N-E monsoon.

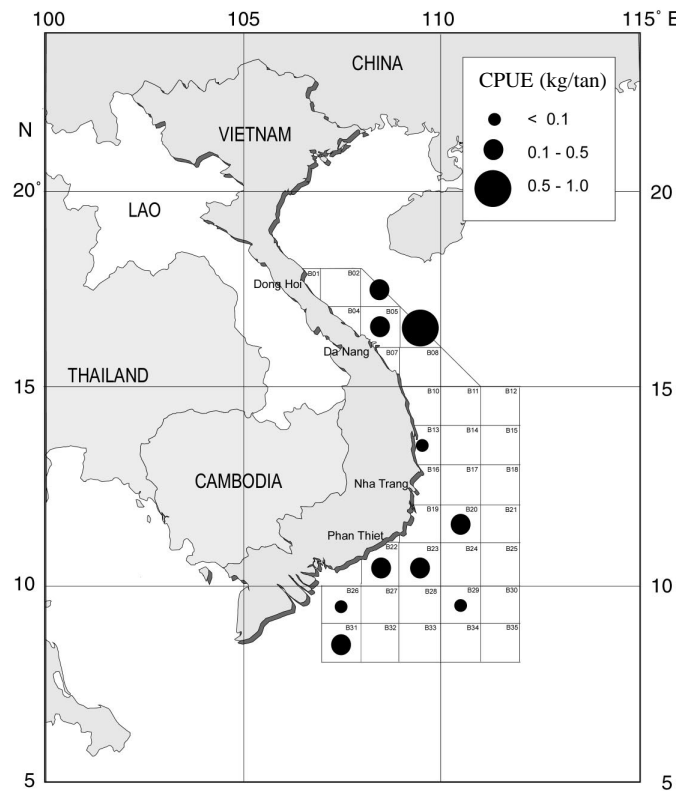


Fig. 9. Distribution of CPUE (kg/tan) of Frigate mackerel in S-W monsoon.

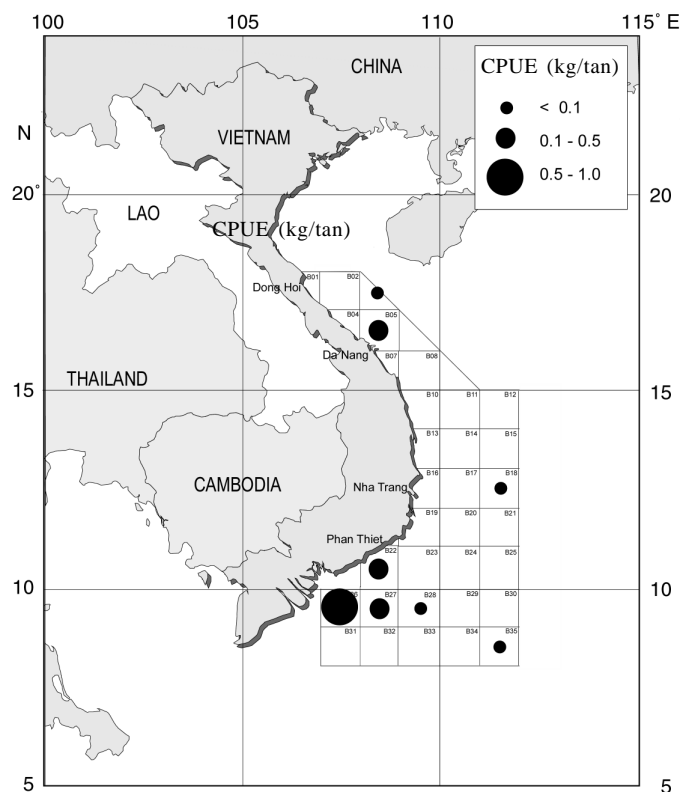


Fig. 10. Distribution of CPUE (kg/tan) of Frigate mackerel in N-E monsoon.

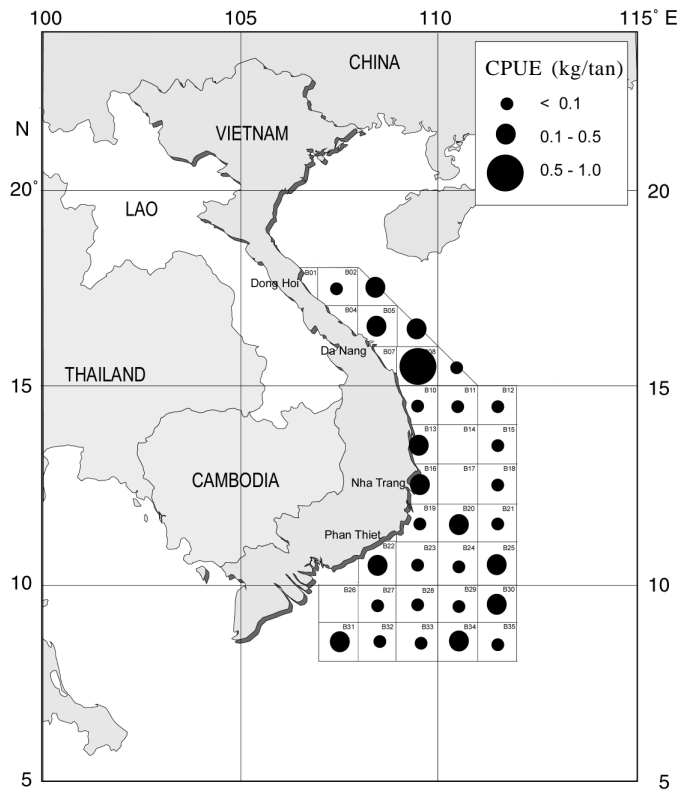


Fig. 11. Distribution of CPUE (kg/tan) of common Dolphinfish in S-W monsoon.

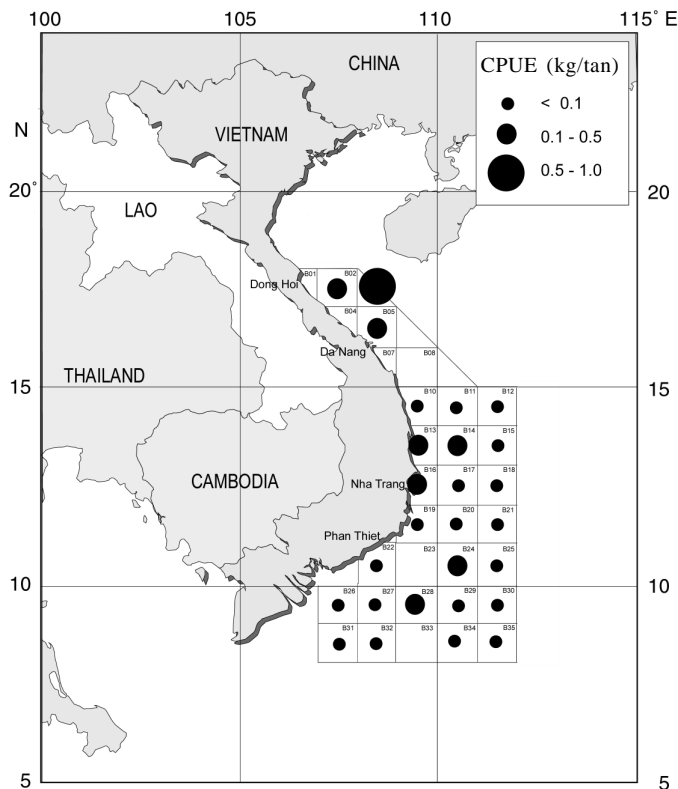


Fig. 12. Distribution of CPUE (kg/tan) of common Dolphinfish in N-E monsoon.

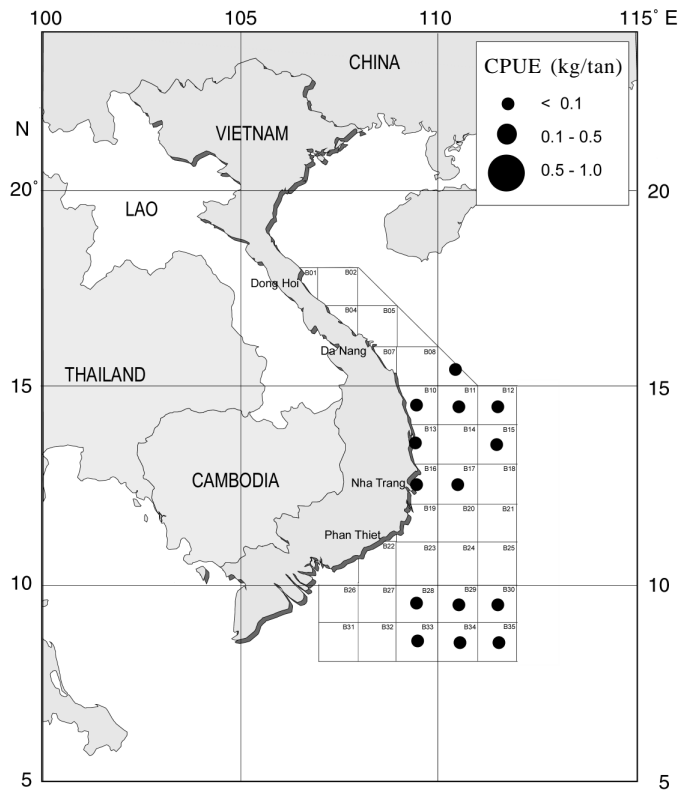


Fig. 13. Distribution of CPUE (kg/tan) of Bigtooth pomfret in S-W monsoon.

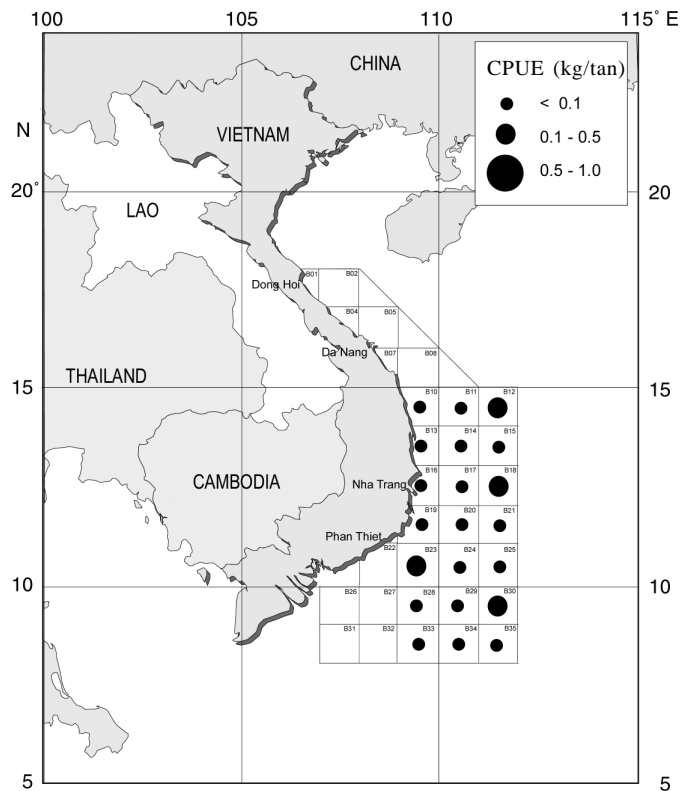


Fig. 14. Distribution of CPUE (kg/tan) of Bigtooth pomfret in N-E monsoon.

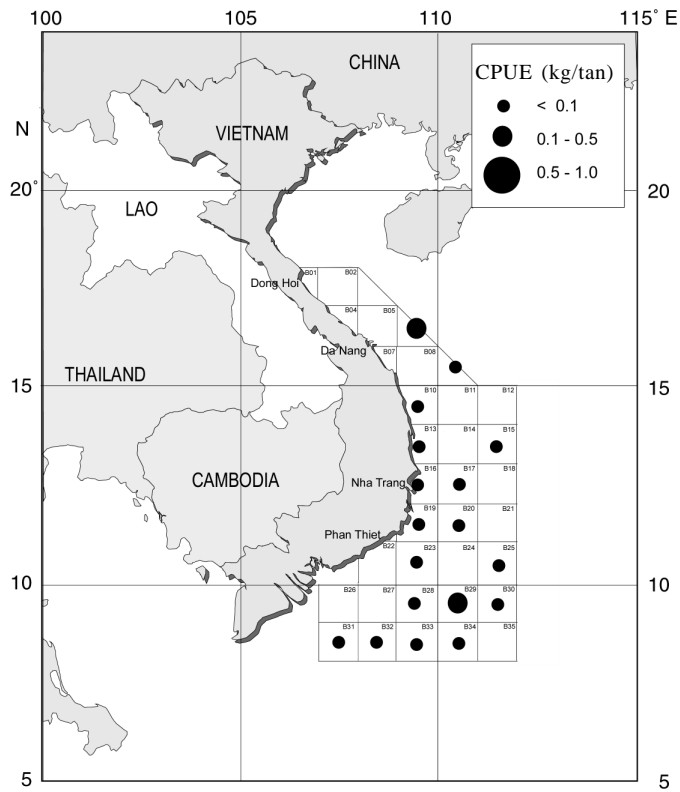


Fig. 15. Distribution of CPUE (kg/tan) of Tripletail in S-W monsoon.

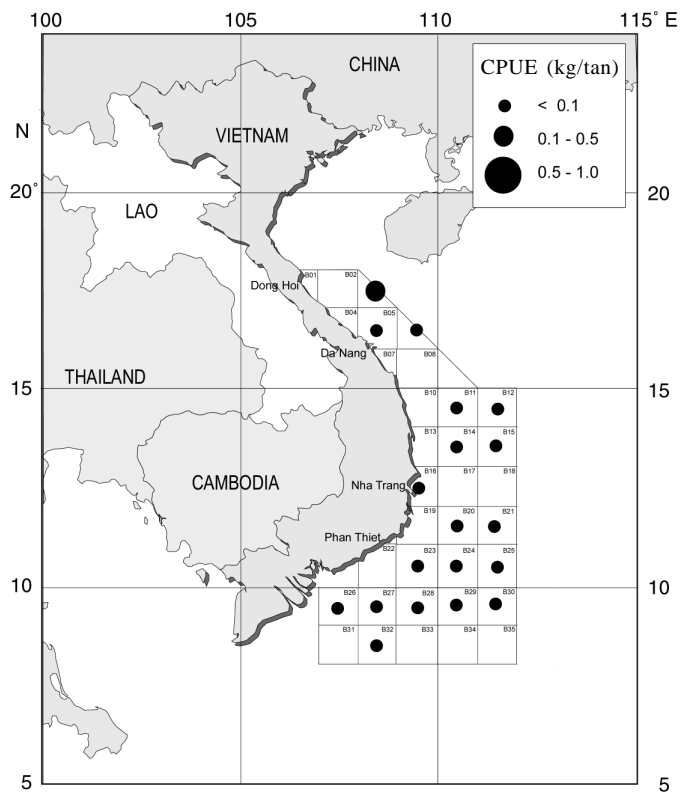


Fig. 16. Distribution of CPUE (kg/tan) of Tripletail in N-E monsoon.

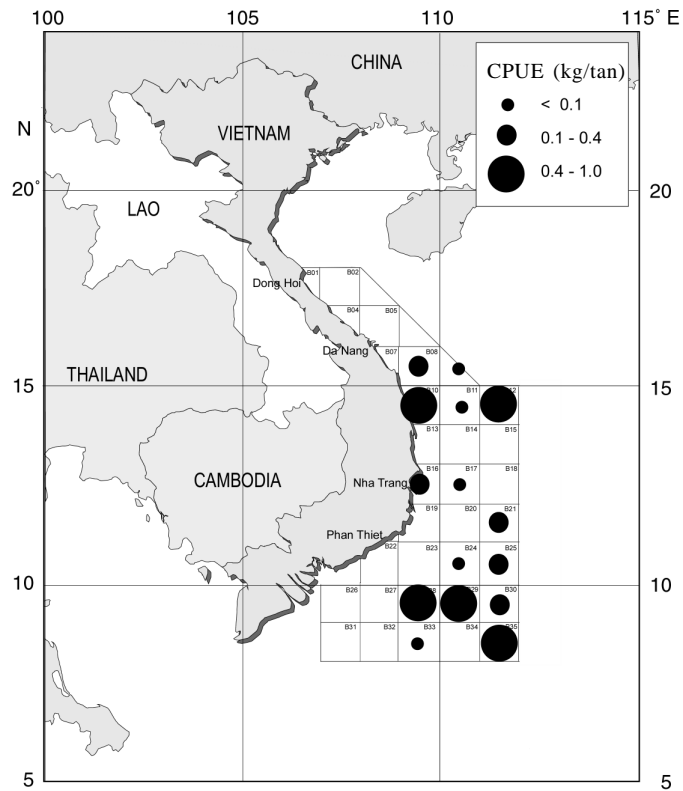


Fig. 17. Distribution of CPUE (kg/tan) of Flying squid in S-W monsoon.

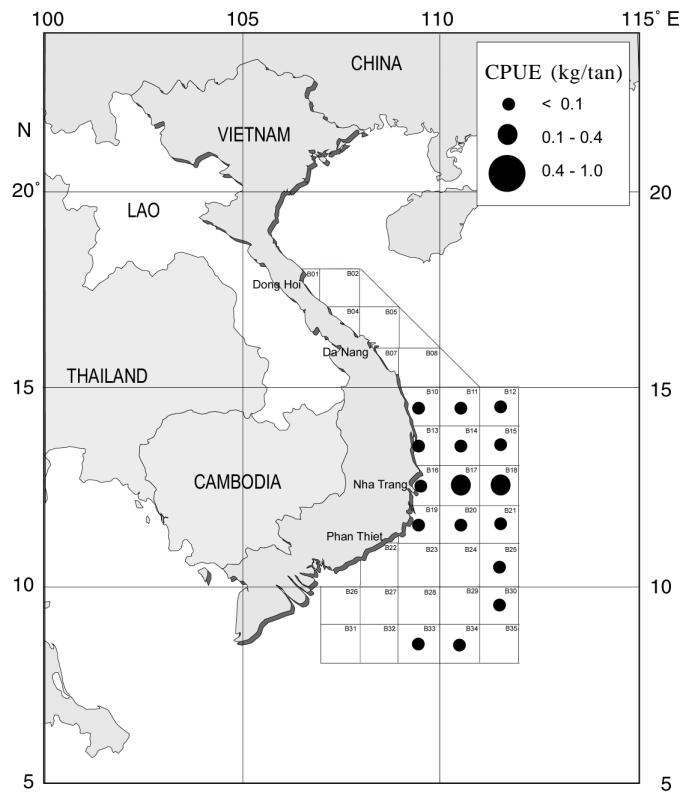


Fig. 18. Distribution of CPUE (kg/tan) of Flying squid in N-E monsoon.



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