

Results of Bottom Trawl Surveys Carried Out in Vietnamese Waters (20-200 m) in 1996-1997

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Abstract

Bottom trawl surveys were conducted in the southwest monsoon season in 1996 (survey 1) and in the northeast monsoon season in 1996-97 (survey 2) throughout Vietnamese waters. The surveys mainly covered the depth zone 50-200 m but in the northeast monsoon season the depth zone 20-50 m was included in the northern and southern areas. Overall, 273 trawl hauls were conducted. The total biomass for Vietnamese waters in the depth zone 20-200 m was estimated at 700 000 t. Biomass estimates are given for the most abundant species. A relatively higher mean catch-per-unit effort (CPUE) was obtained from survey 2 than from survey 1 and in particular at depth ranges 50-100 and 100-200 m in south Vietnam. Overall, the dominant families were Monacanthidae (34%), Carangidae (15%), Trichiuridae (9%) and Synodontidae (6%).

Introduction

Fishing in Vietnamese waters is conducted mainly using small vessels (<50 hp) in shallow waters of less than 50 m. A decline in catch rate and changes in fish community structure indicate that this shallow area is overexploited (Thuoc and Long 1997). Being concerned about this situation, the government of Vietnam has adopted a policy to relocate fishing effort towards deeper waters. However, increasing fishing effort in the offshore area should only be done if the offshore resources can sustain an increase in fishing pressure.

The only existing data on the offshore resources are from the period 1977-85, when the former USSR in collaboration with Vietnamese scientists conducted 42 surveys throughout Vietnamese waters in the depth zone from 20 to 300 m. A total of 9 219 trawl hauls

were conducted during these surveys (Thuoc and Long 1997). From 1987 until 1996 no surveys covering Vietnamese waters have been carried out.

With this background, two surveys were conducted throughout Vietnamese waters in 1996/97 covering mainly the depth zone 50-200 m. These surveys were a part of the project 'Assessment of the Living Marine Resources in Vietnam' (ALMRV) supported by the Government of Denmark. A commercial stern trawler was selected as survey vessel in order to obtain catch rates which were comparable to commercial catch rates. The main objective of the surveys was to provide biomass estimates of the fishery resources within the Vietnamese Exclusive Economic Zone (EEZ). This paper presents the main results of the surveys, including biomass estimates, catch rates and catch

composition. Furthermore, biomass estimates are given for the most abundant species.

Materials and Methods

The surveys were carried out using the stern trawler *Halong 408B* (32 m, 600 hp) during the periods August to October 1996 (survey 1) and November 1996 to February 1997 (survey 2), i.e. in the southwest and the northeast monsoon seasons, respectively. The fishing gear used was a commercial otter board high opening trawl of the Danish design 'Cosmos Hi-Lift trawl'. The mesh size in the cod-end was 22 mm and the wingspread was 18.5 m. The average haul duration was 1 hr and towing speed varied from 2.7 to 3.7 knots. All hauls were made during the daytime. The catch was sorted into species or species groups and the number and weight of each species (or species group)

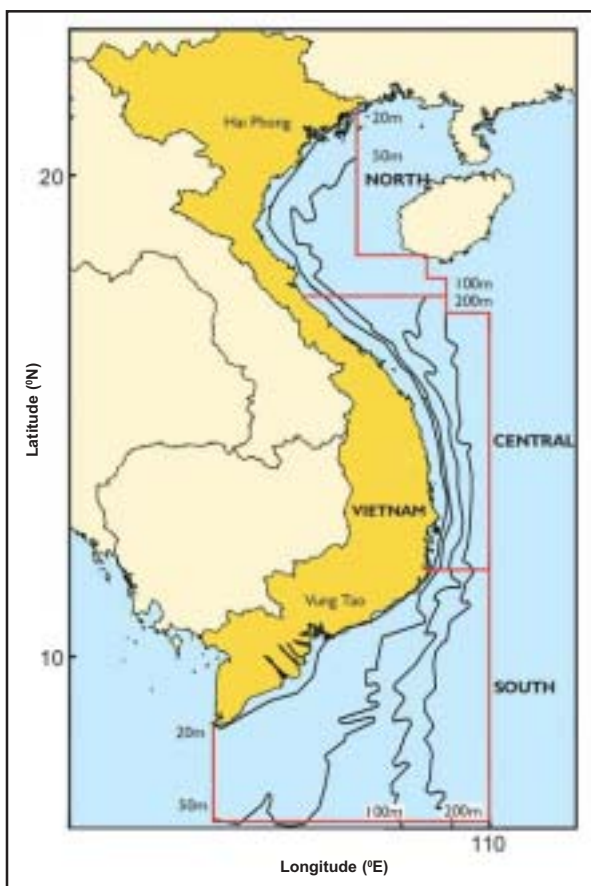


Fig. 1. Stratification design for random bottom trawl surveys carried out in Vietnamese waters (20-200 m) in 1996-1997.

Table 1. Area (km²) and number of hauls by strata for each bottom trawl survey carried out in Vietnamese waters in 1996-1997.

Survey Area	Area (km ²)	Number of hauls (Survey 1)	Number of hauls (Survey 2)
North: 20 -50 m	44074	-	15
50 -100 m	47511	27	30
Central: 50 -100 m	12728	20	11
100 - 200 m	22661	11	-
South: 20 - 50 m	115492	-	38
50 - 100 m	59567	40	39
100 - 200 m	356607	21	21

were recorded. Body lengths of all individuals were measured.

The selection of trawl stations followed a stratified random sampling design. The total survey area was divided into strata according to three sub-areas (north, central and south Vietnam waters) and three depth zones (20–50 m, 50–100 m and 100–200 m) (Fig. 1). In survey 2, the depth zone 20–50 m was included in order to compare catch rates between shallow and deeper waters. Table 1 indicates the

area of each stratum together with the number of hauls made in each stratum.

The catch rate or catch-per-unit effort (CPUE = catch (kg) per hr of a haul) and the catch per unit area (CPUA = catch (kg) per square kilometer) were calculated for all species combined. For all species combined, CPUE and CUPA could be assumed to be log-normally distributed. Therefore, the data were transformed logarithmically (base e) and the mean and standard deviation

on a log scale were calculated for each stratum. The mean was calculated by back transforming the mean on the log scale by the exponential function (calculations are only shown for CUPA data but are similar for CPUE)

$$\text{Mean CUPA} = \text{EXP}(\text{mean CUPA}_{\log\text{-scale}} + \text{variance CUPA}_{\log\text{-scale}}/2)$$

The standard deviation of CUPA on a log scale is approximately equal to the coefficient of variation (standard deviation divided by mean) on the original scale.

In the case of the CUPA by species, several zero catches occurred. Preliminary analysis showed that the CUPA by species could be assumed to be delta distributed. The delta distribution gives special account to zero catches and the nonzero catches are assumed to be log-normally distributed. Therefore the nonzero CUPA data were log-transformed (base e). The mean of CUPA and variance of CUPA following the delta distribution are given by Pennington (1983, 1986).

Total biomass estimates and the biomass of selected species have been computed using the ‘swept area method’. This method assumes that the mean catch in weight per unit area is an index of stock abundance (Gulland 1969, Pauly 1984). The area swept by the trawl is: $a = DW$ (km²) where D is the distance covered by the trawl during one haul and W the width of the path swept by the trawl. The biomass (B) for each stratum is calculated as $B = S(\text{mean CUPA}/Q)$ where S is stratum area and Q is catchability factor. In the present study Q = 1 was applied.

The catch rate data were analyzed by a three-way analysis of variance (ANOVA) with survey, area and depth zone as main factors and including all first order interactions.

Results and Discussion

Overall mean catch rates

Table 2 shows mean catch rates and coefficients of variation by survey, area and depth zone. Combining results from both surveys, the highest mean CPUE (410 kg/hr) was found in the southern area in the depth zone 100-200 m and the next highest (286 kg/hr) in the depth zone 20-50 m. The lowest catch rates were found in the central area.

In the first survey, the highest mean CPUE (560 kg/hr) was found in the depth zone 100-200 m in the southern area and the second highest value (123 kg/hr) was in the depth zone 50-100 m in the northern area. In the second survey a relatively high mean CPUE was again found in these strata as well as in the depth zone 20-50 m both in the northern and the southern areas. In general, the lowest catch rates were obtained in the central area for both the depth zones 50-100 m and 100-200 m.

The mean CPUE was significantly ($p < 0.05$) higher during the second survey than during the first survey. The mean CPUE decreased with depth in the northern and central areas, but tended to increase with depth in the southern area (above 50 m), resulting in a significant ($p < 0.05$) interaction effect between area and depth zone.

The coefficient of variation of mean CPUE by strata ranged from 77% to 210% in the first survey and from 40% to 131% in the second survey. For the two surveys combined, the coefficient of variation ranged from 49% to 177%. The high coefficients of variation are typical of many trawl surveys.

Biomass estimates

The total biomass estimates by survey, area and depth zone are presented in Table 3. Comparing the total biomass in strata covered by both surveys, a higher biomass was observed during survey 2 than during survey 1 in the strata: north

50-100 m, south 50-100 m and south 100-200 m, while the opposite was the case for the central 50-100 m stratum. However, no statistically significant differences were observed.

Table 4 shows the biomass estimates for the main species caught during the surveys conducted in 1996-1997. Collectively, these species contribute a major part of the total catch in the Vietnamese trawl fishery.

Among these species, largehead hairtail (*Trichiurus lepturus*), round scad (*Decapterus maruadsi*), brushtooth lizardfish (*Saurida undosquamis*), yellowstripe trevally (*Selaroides leptolepis*) and modest filefish (*Thamnaconus modestus*) contributed a major part of the total biomass. For some species (yellowstripe trevally, modest filefish and largehead hairtail), the biomass was found to be considerably higher during survey 2 than during survey 1. Only the biomass of round scad was considerably higher during survey 1 than during survey 2. These observed differences between the two surveys might be caused by migration, especially for pelagic species such as yellowstripe trevally and round scad, but may also be due to the different areas covered during the two surveys.

Catch composition

A total of 361 species belonging to 253 genera and 132 families were observed during the surveys. With regard to the number of species, 4 families dominated: Carangidae (14 genera, 28 species), Serranidae (8 genera, 22 species), Lutjanidae (3 genera, 18 species) and Nemipteridae (3 genera, 15 species). Beside fish families, 20 non-fish families were observed: Calappidae, Hydrophiidae, Limulidae, Loliginidae, Medusae, Nephropidae,

Table 2. Overall catch rates (kg/hr) and coefficient of variation (CV) by area and depth zone for bottom trawl surveys 1, 2 and 1 and 2 combined, carried out in Vietnamese waters in 1996-1997.

Survey Area	Survey 1			Survey 1			Survey 1+2		
	Hauls	CPUE	CV	Hauls	CPUE	CV	Hauls	CPUE	CV
North:									
20 - <50 m	-	-	-	15	185	49	15	185	49
50 - <100 m	27	123	77	30	132	40	57	128	61
Central:									
50 - <100 m	20	96	77	11	74	77	31	87	77
100 - 200 m	11	52	152	-	-	-	11	53	152
South:									
20 - <50 m	-	-	-	38	286	123	38	286	123
50 - <100 m	40	117	103	39	119	66	79	119	88
100 - 200 m	1	560	210	21	287	131	42	410	177

Table 3. Estimates of the total biomass ($\times 10^3$ t) by survey, area and depth zone from bottom trawl surveys carried out in Vietnamese waters in 1996-1997¹.

Survey Area	Survey 1	Survey 2	Survey 1+2 combined
North:			
20 - 50 m	-	126 (50)	126 (50)
50 - 100 m	78 (81)	104 (40)	91 (61)
Central:			
50 - 100 m	19 (82)	13 (77)	16 (80)
100 - 200 m	7 (151)	-	7 (151)
South:			
20 - 50 m	-	299 (123)	299 (123)
50 - 100 m	84 (103)	108 (65)	96 (84)
100 - 200 m	43 (216)	82 (132)	63 (174)
Total	231 (124)	732 (88)	698 (103)

¹Coefficient of variation (%) is given in parentheses.

Table 4. Biomass estimates ($\times 10^3$ t) of the main species comprising the catch in bottom trawl surveys carried out in Vietnamese waters in 1996-1997¹

Species	Survey 1	Survey 2
<i>Trichiurus lepturus</i>	18.3 (48)	32.4 (52)
<i>Decapterus maruadsi</i>	20.6 (145)	6.8 (65)
<i>Saurida undosquamis</i>	5.1 (54)	22.0 (38)
<i>Selaroides leptolepis</i>	<0.1 (69)	129.9 (69)
<i>Thamnaconus modestus</i>	6.3 (160)	68.1 (94)
<i>Saurida tumbil</i>	8.1 (40)	15.2 (30)
<i>Decapterus kurroides</i>	1.7 (118)	5.9 (104)
<i>Trachinocephalus myops</i>	6.2 (41)	14.3 (65)
<i>Upeneus sulphureus</i>	1.2 (378)	9.2 (62)
<i>Priacanthus macracanthus</i>	4.9 (41)	6.8 (37)

¹Coefficient of variation (%) is given in parentheses.

Table 5. Catch composition (% of total catch) by family in surveys 1 and 2 (depth strata combined) and in north, central and south Vietnamese waters in 1996-1997 (surveys 1 and 2 combined).

Family	Survey 1	Survey 2	North	Central	South
Apogonidae	1.8	2.5	3.9	1.7	1.8
Carangidae	25.9	9.4	3.7	4.3	19.2
Leiognathidae	4.6	5.9	12.8	7.9	3.0
Loliginidae	3.9	2.4	4.0	4.8	2.4
Lutjanidae	1.8	2.9	1.6	0.2	3.0
Monacanthidae	9.8	35.0	1.1	1.2	365.0
Mullidae	3.5	3.9	5.6	2.6	3.3
Nemipteridae	3.2	3.0	3.1	1.3	3.2
Priacanthidae	3.4	1.6	3.0	5.5	1.7
Scombridae	0.0	0.6	0.9	1.4	0.2
Sepiidae	1.6	1.6	0.9	1.4	1.8
Synodontidae	8.3	7.9	8.3	6.6	8.1
Trichiuridae	8.5	5.2	17.1	25.4	1.4
Others	23.7	18.1	33.7	35.8	14.4

Octopodidae, Ommastrephidae, Palinuridae, Pectidae, Pinnidae, Penaeidae, Portunidae, Scyllaridae, Sepiidae, Sepiolidae, Sergestidae, Solenoceridae, Squillidae and Volutidae. Among the non-fish families, the most commercially important in terms of weight and/or value were Portunidae, Loliginidae, Palinuridae, Octopodidae, Penaeidae and Sepiidae.

Table 5 shows the catch composition obtained in the surveys. The composition is given as the total weight of selected families as a percentage of the total catch during each survey. In general, the catch composition differed considerably between the two surveys. The Carangidae made up 26% of the total weight during survey 1 and 9% during survey 2,

whereas the Monacanthidae constituted 10% during survey 1 and 35% during survey 2. The trichiurids also showed a considerable difference between survey 1 (9% of the total weight) and survey 2 (5%). Among these families, the Monacanthidae (mainly *Thamnaconus modestus*) has recently become a commercially important species due to high catch rate and value.

The leiognathids and trichiurids constituted a major part of the catches in the northern and the central areas, while the monacanthids and carangids were predominant in the southern area (Table 5). Synodontid species seemed to constitute a similar proportion of the catches in all three areas.

Acknowledgements

This work has been implemented as part of the project 'Assessment of the Living Marine Resources in Vietnam' (ALMRV) under the Fisheries Sector Programme Support of Danish International Development Assistance (DANIDA) granted by the Danish Government. The authors wish to thank Dr. Bui Dinh Chung (National Project Director), Mr. Per Sparre, and Mr. Sten Munch-Petersen who participated in planning the surveys and preliminary analysis. We also thank Dr. Bui Dinh Chung and Dr. Steen Christensen for their valuable comments and suggestions on an earlier draft.

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