A FINAL REPORT ON

Stake Trap Mesh Size Selectivity in Cau Hai Lagoon of Thua Thien - Hue

For Integrated Management of Lagoon Activities (IMOLA) Project
of Thua Thien – Hue Province
(FAO, GCP/VIE/029/ITA)

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Contents

I. Introduction into the importance of the study

The study is a follow-up activity of the one conducted by Nguyen Phong Hai et al., to complement the study on selectivity of mesh size. This study, conducted by Nguyễn Văn Động and his collaborators from the University of Nha Trang (Tran Van Phuoc) and RIA III (Nguyen Van Giang, Nguyen Xuan Truong, and Tran Van Hao), is entitled "Selectivity of Stake Trap Mesh Size in Cau Hai lagoon of Thua Thien Hue".

Compared to the situation over 2 years ago, fishing activities in Cau Hai lagoon in particular, and in Tam Giang-Cau Hai in general, has undergone no change in fishing capacity (i.e. number of fishing gears remains as it was two years ago) fishing patterns (i.e. gear parameters, techniques and fishermen remain unchanged) and location of fishing gears. However, catch from stake traps signals growing degradation of fish resources, and decreased size of fishes in the catch. It is confirmed by many biological studies that Tam Giang-Cau Hai lagoon is the breeding and nursery spot of many species of fish and crustaceans[1]. Eggs of these species, either bred by migrating partental fish or following the marine current into the lagoon, are hatched in the lagoon[2]; young fishes upon full growth migrate back to the sea. The protection of juvenile fish in the lagoon is important in both scientific and social aspects. This study is expected to offer local governance of fisheries a background to adjust fishing behaviors of the fishing communities (here this implies fishing capacity and parameters of fishing tools). To be integrated with rationalized social policies, the outcome of this study is expected to promote stable and sustainable lagoon fisheries in Hue.

II. Objective of the study

Designed as supplementary to a previous effort, this study aims to study:

- Target species of stake trap (catch composition, quantity, abudance and individual size, in both trap and outer net); and
- Degree of selectivity of certain mesh sizes that have been experimented in the previous effort.

III. Study time and location

1. Study time

The study was conducetd from March 25 to April 6, 2010. After two years of the previous effort, this study might be sufficient to provide necessary information on the change of the fisheries resources and impacts of the stake trap.

2. Study site

The sampling stations are selected on the following criteria:

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[1] Lê Văn Miên & Tôn Thất Pháp, 1998; Lê Văn Miên, 2004; UBND – Sở TS Thừa Thiên – Huế, 3/2007.
[2] *ibid*

- Supplying additional information on catch composition, abudance and selectivity of the stake trap.
- Better coverage of study site so that situation of resources can be assessed on a wider scale.

The three sampling stations, selected in Cau Hai where the previous study was conducted, are displayed in the map below. Out of the three stations, two are selected anew, namely the stake trap (max. depth 1.2 meter) of Mr. Phan Choac towards the inlet of Tu Hien, and the stake trap (max. depth 2.2 meter) of Mr. Tran Xuan Tam in the middle of the lagoon. The third station is selected towards the south-western coast of Cau Hai, at a maximum depth of 3.2 meters, on the stake trap of Mr. Tran Sao. This third station is about 7 km from the second station.

Table 1 Location of sampling stations

Trap owner	Station	Longitude	Latitude
Phan Choắc	1	E107° 54' 7.001"	N16° 20' 3.367"
Trần Xuân Tám	2	E107° 52' 34.099"	N16° 19' 32.637"
Trần Sao (Thuyên)	3	E107° 49' 29.282"	N16° 18' 51.261"

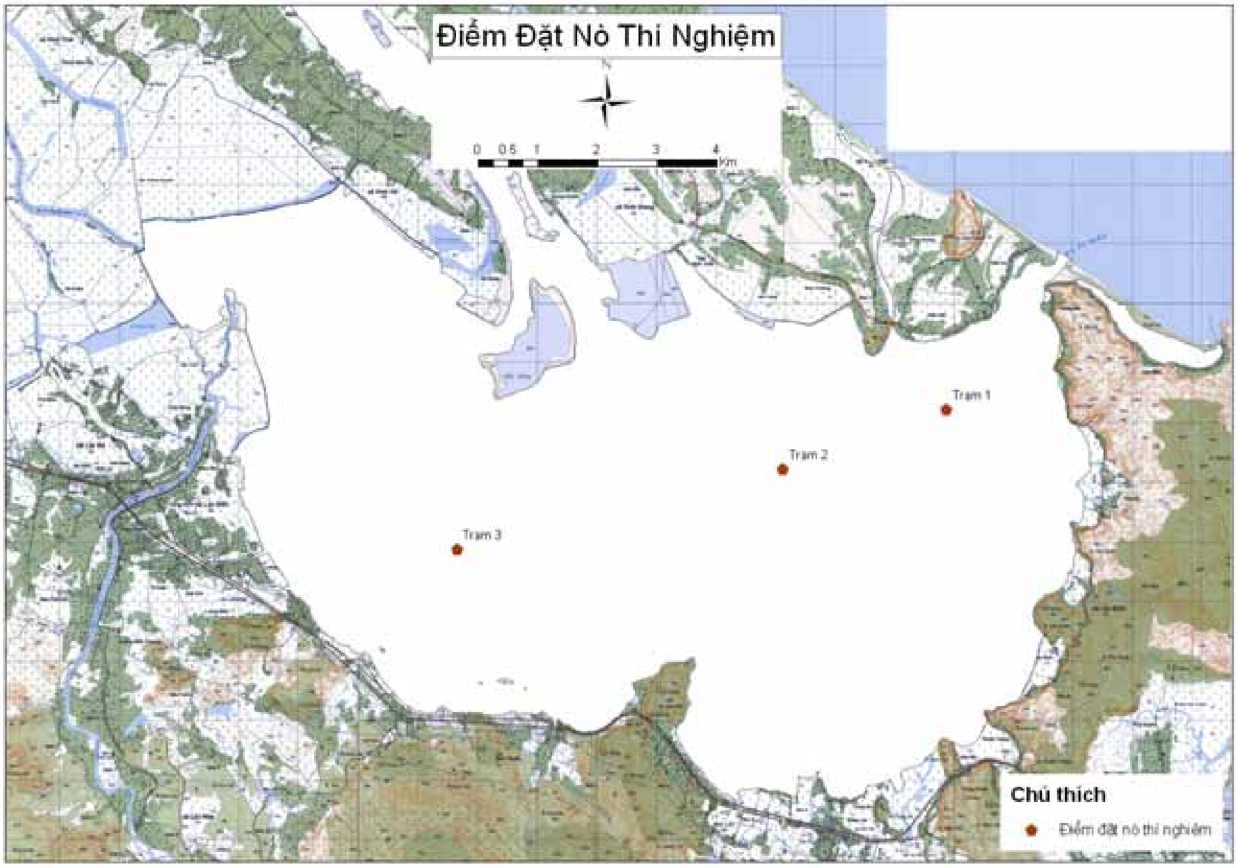

Figure 1 Location of sampling stations

IV. Methodology

1. Study subjects

The trap used in this study is identical, in shape and size, to the real trap used by fishermen. It is cylinderical, diameter 90 – 100 cm; this fluctuation of 10 cm does not affect the overal catch of the trap. Height of the trap depends on the maximum water depth of the sampling site; however traps are designed in such a way that they can be used in rotation among the sampling sites.

An outer net was put in place to trap those fish escaping from the trap. It is a cubic and closed system attached to the trap. Area of the bottom side of the outer net is $3m^2$, which is larger than that in the previous experiment. This allows a space of minimum 0.5 m between the trap and the side-walls of the outer net.

Six traps were built, three for rotating use between station 1 and station 2 where water depths are similar. These three traps are 40cm in diameter and 2.2 m in height; their mesh sizes are 12, 15, and 18 mm. Each of these trap are rendered A_{12}; A_{15}; A_{18}. The other three traps, used in the third station, are 40cm in diameter and 2.2 m in height. Same in mesh size as the first three, these traps are rendered B_{12}; B_{15}; B_{18}.

2. Sampling agenda

Due to objective conditions, sampling at the third station was one day after the first two stations. Traps were installed at 17 – 19.00 p.m, and catches were collected the day after at 4.30 – 6.30 a.m. Table 2 displays the sampling agenda at three stations.

Table 2 Sampling agenda at three stations

Station	Sampling date		Trap					
	Start	End	A_{12}	A_{15}	A_{18}	B_{12}	B_{15}	B_{18}
1	26/3	29/3	x					
	30/3	2/4		x				
	3/4	5/4			x			
2	26/3	29/3		x				
	30/3	2/4	x					
	3/4	5/4			x			
3	27/3	29/3						x
	30/3	2/4					x	
	3/4	5/4				x		

3. Sample monitoring and data recording

Steps in the process were strictly monitored to ensure the reliability of the final data.

3.1. Monitoring of trap installation

Trap installation was monitored by one of the study team members who also stayed in the boat during night sampling. This is to guarantee protection of the natural catch from being modified or manouvered.

3.2. Monitoring of catch download

Catch download is among the most important steps. Supervision was necessary to keep a separate from catch in the trap and catch in the outernet. Since the total catch is not abundant it is necessary not to miss or drop any fish from the catch. Catch from each trap varied from several hundred grams to several kilograms.

To avoid unintentional mixture of catch from trap and catch from outer net, plastic bags with index label were prepared. Information on the label includes date, location of trap, catch type (in trap or outer net), and mesh size of trap. For instance, 1- $IN_{-15}^{27/3}$ means that the catch is within the trap, collected on 27 March, mesh sized 15mm.

3.3. Catch weighing and specimen measurement

Catches in the trap and outside the trap was weighed separately. Species sorting was done based on taxanomic features. Length of every specimen of the catch was measured. For species prevailing in quantity, 10% or more of the species weight was selected randomly for lenght measurement. Fishes were sorted and classified into Species, Genus, Family, and Order.

4. Equipments

a) Metric ruler to measure fish length
b) Scales to measure fish weight: The manual scales (Cân Nhân Hòa, 4 kg and 1 kg) were used at large with accuracy of 5 – 10g. To measure the weight of small specimen, an electric scale was used with an accuracy of a milligram.

5. Data processing

5.1. Taxanomic identification

Species identification of fishes and others was based on comparison body features, with definitions determined by Mai Đình Yên (1992) [12], Nguyễn Văn Chung et al. (2000), [6],[5]; Nguyễn Văn Hảo and Ngô Sỹ Vân (2001) [7], and Nguyễn Nhật Thi (2008) [10]. Taxonomic classification relied on the system by T.R .Rass [14], G.U. Lindberg (1971), and Eschmeyer (1998) [13].

5.2. Absolute escape rate (AER)

This AER is the percentage of catch retained in the outernet on the total catch. It is calculated by this formula. (5-1)

$$\%E = \frac{M_{out}}{M_{out} + M_{in}} 100\% \qquad \text{(IV-1)}$$

In which:

%E is the AER.

M_{out} (in kg) is the weight of catch escaping the trap and retained in the outernet

M_{in} (in kg) is the weight of catch in the trap.

5.3. Definition of selectivity of trap net mesh size

Selectivity of trap net mesh size is represented by:

- Length of the same species in retained in the trap and in the outer net; and
- Selectivity coefficient and graph, determined by length of specimens retained in traps of different mesh sizes (12, 15, 18 mm).

To build the selectivity graph, a retain rate in the trap is needed; this rate is to be determined by the following formula.

$$R_{os\text{-}L} = \frac{N_{in}}{N_{in} + N_{out}} \qquad \text{(IV-2)}$$

In which: $R_{os\text{-}L}$ is the retain rate of specimen of lengh L retained in the trap;

N_{in} is the number of specimen of length L retained in the trap;

N_{out} is the number of specimen of length L retained in the outer net

Formula (IV-2) is applied respectively for every mesh size.

The species selectivity graph is determined by the Wileman formula (IV-3) [13]:

$$r(l) = \frac{\exp(a + b.l)}{1 + \exp(a + b.l)} \qquad \text{(IV-3)}$$

In which: *r(l)* is the rate of length *l* retained in the trap;

l is the length of the species in concern retained in the trap;

a, b are selectivity constants, to be determined during data processing.

Displaying the data collected in a logarithm function can produce a selectivity graph for the species and mesh size under study.

With constants a and b, it is possible to calculate:

- length L_{50}, which is the fish body length at which 50% of the specimen can be retained within the trap of the studied mesh size; and
- selectivity range (SR). In theory, the smaller SR, the better selectivity of the mesh size is.

L_{50} and SR are determined by the formulas hereafter given:

$$L_{50} = \frac{a}{b} \quad \text{(IV-4)}; \qquad SR = \frac{2.\ln 3}{b} \quad \text{(IV – 5)}$$

The Tokai spreadsheet (Tokai, 2003) is used in MS Excel to process data of the experiment and determine selectivity indicator. The Solver tool in MS Excel is used to solve the above logarithm function problem.

V. Study results

1. Weight of finfish and crustacean groups

Weight of the fish groups was different for the trap and outernet, and varied depending on sampling location, and mesh size. Table 3 presents weight of species groups.

Table 3 Weight of species groups

Mesh size (mm)	**Total weight in the trap (kg)**		**Total weight in the outer net (kg)**		**Total catch (kg)**
	Crustanean	**Finfish**	**Crustanean**	**Finfish**	
12	1.4362	5.5600	0.2643	0.5827	7.8432
15	4.0674	5.1544	1.2838	20.7870	31.2926
18	0.5261	5.0467	0.5249	14.6580	20.7557

Comment. The overall catch in trap 2a = 15 mm is highest (i.e. 31.3 kg); next comes the catch in trap 2a = 18 mm and finally, catch in trap 2a = 12 mm. However, it could not be concluded that the mesh size 2a = 15 mm is the most productive. Its high catch in this case can be attributed to many factors, including trap location and movement of fish schools (which in this case are *S. canaliculatus*, cá kình).

2. Drainage rates, calculated by weight of catch

The drainage rate is calculated for for two most common groups, namely finfish and crustacean, based on the drainage catch weight. Be it that P_{in} ; P_{out} ; Q_{in} ; Q_{out} are respectively the weight of crustacean and finfish catches collected in the trap and in the outer net. We have the following drainage rates.

Absolute crustacean drainage rate $$\zeta = \frac{P_{out}}{P_{in} + P_{0ut}} \quad \text{(V-1)}$$

Absolute finfish drainage rate $$\boldsymbol{\eta} = \frac{Q_{out}}{Q_{in} + Q_{out}} \quad \text{(V-2)}$$

And similarly,

Relative crustacean drainage rate $$\boldsymbol{\beta} = \frac{P_{out}}{P_{in}} \quad \text{(V-3)}$$

Relative finfish drainage rate $\gamma = \frac{Q_{out}}{Q_{in}}$ (V-4)

Feeding these formulas with data from Table 3 we have the drainage rate for each group, corresponding to each mesh size, in Table 4.

Table 4 Drainage rate (DR) of species, for different mesh sizes.

Mesh size 2a (mm)	DR			
	ζ	η	β	γ
12	0.16	0.10	0.18	0.11
15	0.24	0.80	0.32	4.03
18	0.50	0.74	1.00	3.80

Comments:

- The larger the mesh size of the trap, the higher the drainage rate, for both crustacean and finfish. This is particularly demonstrated by crustacean, for which species the drainage rate gets higher as the mesh size increases.
- Relative drainage rate of finfish rose drastically, with change of mesh size from 2a = 12 mm to 2a = 18 mm. This should be explained by the accidental abudant flocks of juvenile *S. canaliculatus* (cá kình) (Park, 1797), 3 – 6 mm in length) during the season when cá kình (cá Rò by local name) swims back to the sea.
- The migration of *S. canaliculatus* juvenile back to the sea is obstructed by stake traps. Trap with mesh size of 2mm as presently used by local fishermen will catch completely all these migrant flocks. This poses a risk for *S. canaliculatus*, a valuable fish at commercial size. Assessment is needed to evaluate the impact of present fishing effort on this juvenile fish.

3. Classification of fish and crustaceans

3.1. List of species

Fish species found in this study are listed in Table 5.

Table 5 Classification of fish and crustaceans in the sample catches

Sno	Vietnam name	Latin name
	I. Bộ cá Trích	**Clupeiformes**
	1. Họ cá trích	***Clupeidae***
1	Cá Mòi cờ chấm	*Clupanodon punctatus* (Temminck & Schlegel, 1846)
2	Cá Mòi mõm tròn	*Nematalosa nasus* (Bloch, 1795)
	2. Họ cá Trỏng	***Engraulidae***
3	Cá Cơm thường	*Stolephorus commersonii* Lacepede, 1803
	II. Bộ cá Chình	**Anguilliformes**
	3. Họ cá Chình rắn	***Ophichthidae***
4	Cá Chình rắn	*Ophichthus apicalis* (Bennett, 1830)
	III. Bộ cá Chép	**Cypriniformes**
	4. Họ cá Chép	***Cyprinidae***

5	Cá Chép	*Cyprinus carpio* (Linnaeus, 1758)
	IV. Bộ cá Suốt	**Atheriniformes**
	5. Họ cá Suốt	***Atherinidae***
6	Cá Suốt nhiệt đới	*Atherinomonus duodecimalis* (Valenciennes, 1835)
	V. Bộ cá Kìm	**Beloniformes**
	6. Họ cá Lìm kìm	***Hemiramphidae***
7	Cá Kìm thân tròn	*Hyporhamphus quoyi* (Valenciennes, 1847)
	7. Họ cá Nhói	***Belonidae***
8	Cá Nhói đuôi chấm	*Tylosurus strongylurus* (Van Hasselt, 1823)
	VI. Bộ cá Mù làn	**Scorpaeniformes**
	8. Họ cá Chai	***Platycephalidae***
9	Cá Chai Ấn độ	*Platycephalus indicus* (Linnaeus, 1758)
	VII. Bộ cá Đối	**Mugiliformes**
	9. Họ cá Nhồng	***Sphyraenidae***
10	Cá Nhồng tù	*Sphyraena obtusata* Cuvier & Valenciennes, 1829
	10. Họ cá Đối	***Mugilidae***
11	Cá Đối mục	*Mugil cephalus* Linnaeus, 1758
	VIII. Bộ Lươn	**Synbranchiformes**
	11. Họ Lươn	***Flutidae***
12	Lươn đồng	*Monopterus albus* (Zuiew, 1793)
	IX. Bộ cá Vược	**Perciformes**
	12. Họ cá Sơn	***Ambassidae***
13	Cá Sơn	*Ambassis buruensis* Bleeker, 1856
	13. Họ cá Đục	***Sillaginidae***
14	Cá Đục bạc	*Sillago sihama* (Forsska'l, 1775)
	14. Họ cá Hồng	***Lutjanidae***
15	Cá Hồng chấm	*Lutjanus russelli* (Bleeker, 1849)
	15. Họ cá Móm	***Gerridae***
16	Cá Móm Nhật bản	*Gerres japonicus* Bleeker, 1854
17	Cá Móm gai dài	*G. filamentosus* Cuvier, 1829
	16. Họ cá Bống đen	***Eleotridae***
18	Cá bống đen	*Eleotris melanosoma* Bleeker, 1852
	17. Họ cá Bống trắng	***Gobiidae***
19	Cá Bống tro	*Acentrogobius caninus* (Valenciennes, 1837)
20	Cá Bống chấm mắt	*Oxyurichthys microlepsis* Bleeker, 1849
21	Cá Bống exy	*Exyrias puntang* (Bleeker, 1851)
	18. Họ cá Thòi lòi	***Periophthalmidae***
22	Cá Thòi lòi	*Periophthalmus cantonensis* Prince Akihito, 1984
	19. Họ cá Dìa	***Siganidae***
23	Cá Dìa công	*Siganus guttatus* (Bloch, 1787)
24	Cá kình	*S. canaliculatus* (Park, 1797)
	20. Họ cá Căng	***Teraponidae***
25	Cá Căng vảy nhỏ	*Terapon puta* Cuvier, 1829
26	Cá Căng đàn	*T. jarbua* (Forsskal, 1775)
	21. Họ cá Khế	***Carangidae***
27	Cá khế 6 sọc	*Caranx sexfasciatus* (Quoy & Gaimard, 1825)
	22. Họ cá Liệt	***Leiognathidae***
28	Cá Liệt lớn	*Leiognathus equulus* (Forsska'l, 1775)
29	Cá Liệt mõm ngắn	*L. brevirostris* (Valenciennes, 1835)
30	Cá Liệt vằn lưng	*Secutor ruconius* (Hamilton, 1822)
	23. Họ cá Thu ngừ	***Scombridae***
31	Cá Thu chấm	*Scomberomonus guttatus* (Bloch & Schneider, 1801)
	24. Họ cá Tráp	***Sparidae***
32	Cá Hanh	*Acanthopagrus latus* (Houttuyn, 1782)
	25. Họ Cá mào gà	***Blenniidae***
33	Cá Mào gà	*Omobranchus banditus* Smith, 1959

34	**X. Bộ cá Bơn** ***26. Họ cá Bơn*** Cá Bơn lá mít	**Pleuronectiformes** ***Soleidae*** *Synaptura ortentalis* (Bloch & Schneider, 1795)
35 36 37	**XI. Bộ cá Nóc** ***27. Họ cá Bò giấy*** Cá Bò một gai lưng ***28. Họ cá Nóc*** Cá Nóc vàng Cá Nóc vằn	**Tetraodontiformes** ***Monacanthidae*** *Aluterus monoceros* (Linnaeus, 1758) ***Tetraodontidae*** *Lagocephalus lunaris* (Bloch & Scheneider, 1801) *Takifugu oblongus* (Bloch, 1786)
38	**XII. Bộ cá Cháo** ***29. Họ cá Cháo*** Cá Cháo lớn	**Elopiformes** ***Megalopidae*** *Megalops cyprinoides* (Broussonet, 1782)
39 40 41 42 43 44	**XIII. Bộ Mười chân** ***30. Họ Tôm gõ mõ*** Tôm Tít (nước ngọt) ***31. Họ Tôm gai*** Tôm Càng xanh ***32. Họ Cua bơi*** Cua Xanh ***33. Họ Tôm he*** Tôm đất Tôm sú ***34. Họ Ruốc*** 43. Ruốc	**Decapoda** ***Alpheidae*** *Alpheus bellulus* Miya & Miyake, 1969 ***Palaemonidae*** *Macrobrachium rosenbergii*, De Man 1879 ***Portunidae*** *Scylla serrata* (Forsskal, 1775) ***Penaeidae*** *Metapenaeus ensis* (De Haan, 1844) *Penaeus monodon* (Fabricius, 1798) ***Sergestidae*** *Acetes sp.*
45	**XIV. Bộ Chân miệng** ***35. Họ Tôm bọ ngựa*** Tôm tít (biển)	**Stomatopoda** ***Squillidae*** *Harpiosquilla harpax* De Haan, 1884

3.2. Composition of order and family

With the information in Table 4, the catch composition could be classified by Order and Family:

Table 6 Catch by order, family, genus, and species

Sno	Latin name (of Order)	Vietnam name	Family		Genus		Species	
			Catch	%	Catch	%	Catch	%
1	Clupeiformes	Bộ cá Trích	2	5.71	3	7.32	3	6.67
2	Anguilliformes	Bộ cá Chình	1	2.86	1	2.44	1	2.22
3	Cypriniformes	Bộ cá Chép	1	2.86	1	2.44	1	2.22
4	Atheriniformes	Bộ cá Suốt	1	2.86	1	2.44	1	2.22
5	Beloniformes	Bộ cá Kìm	2	5.71	2	4.88	2	4.44
6	Scorpaeniformes	Bộ cá Mù làn	1	2.86	1	2.44	1	2.22
7	Mugiliformes	Bộ cá Đối	2	5.71	2	4.88	2	4.44
8	Synbranchiformes	Bộ Lươn	1	2.86	1	2.44	1	2.22
9	Perciformes	Bộ cá Vược	14	40.00	17	41.46	21	46.67
10	Pleuronectiformes	Bộ cá Bơn	1	2.86	1	2.44	1	2.22
11	Tetraodontiformes	Bộ cá Nóc	2	5.71	3	7.32	3	6.67

12	Elopiformes	Bộ cá Cháo	1	2.86	1	2.44	1	2.22
13	Decapoda	Bộ Mười chân	5	14.29	6	14.63	6	13.33
14	Stomatopoda	Bộ Chân miệng	1	2.86	1	2.44	1	2.22
Total			**35**	**100**	**41**	**100**	**45**	**100**

Forty-five species of fish and crustaceans have been identified to belong to forty-one Genera, under thirty-five Families and fourteen Orders. For fish, there are 38 species under 34 Genera, 29 Families in 12 Orders. For crustaceans, there are seven species under 7 Genera, under 6 Families of 2 Orders. The most dominant are species under *Perciformes* (Bộ cá Vược), which are represented in this study by 14 Families (accounting for 40% of the families appearing in this study); 17 Genera (41.46% of all genera), and 21 species (46.67% of all species). The diversity of species is high; on average, each Order is represented by 2.5 families, 2.93 genera, and 3.21 species; each family by 1.17 genera and 1.29 species; and each genus by 1.1 species. Of 45 species appearing in this study, seven are not listed in the inventory of fish species of Tam Giang Cau Hai. (2)

4. Selectivity of the mesh sizes under study

In this study we could be able to develop the graph of selectivity of each mesh size for greasyback shrimp (*Metapenaeus ensis*, tôm đất). Other species are scarcely represented, or representedy by individuals of same body-length range, making it difficult to determine selectivity of mesh size. For important species and for which species selectivity of mesh size is not possible to determine, a graph of catch by body-length is provided instead, for both in-trap catch and in-outernet catch.

4.1. Selectivity of mesh sizes for greasyback shrimp

Selectivity of each mesh size for greasyback shrimp is provided in Figure 2 and Table 7.

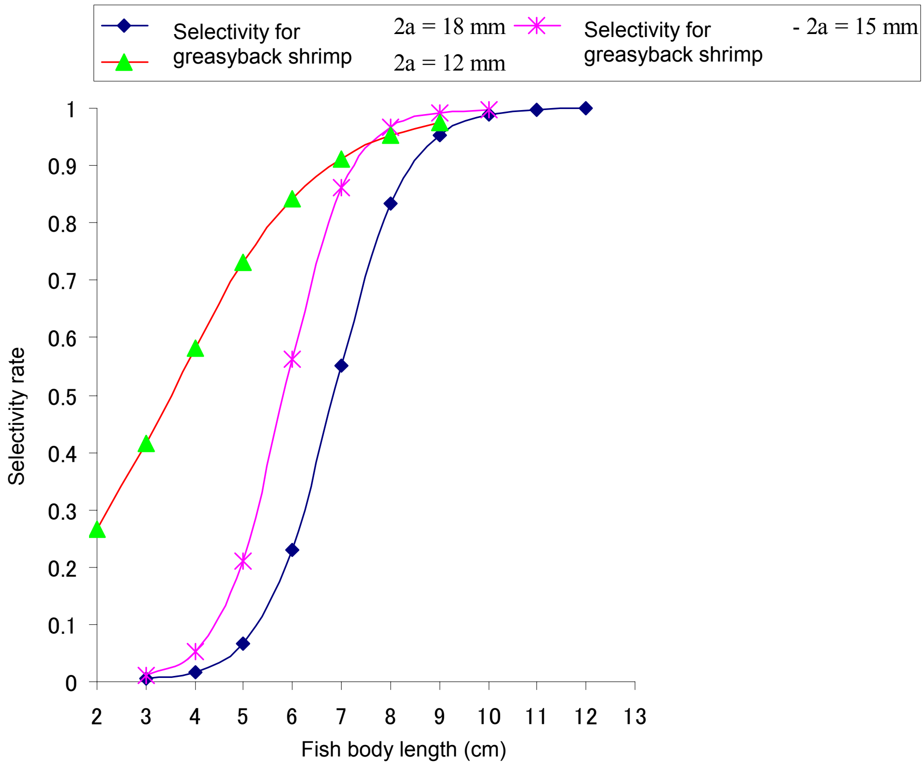

Figure 2 Selectivity for greasyback shrimp, of different mesh sizes- 2a = 12, 15, 18 mm

Table 7 Selectivity for greasyback shrimp, of different mesh sizes- 2a = 12, 15, 18 mm

Mesh size (mm)	constant a	constant b	L50	SR
12 mm	-2.36	0.67	3.51	3.27
15 mm	-9.18	1.57	5.84	1.4
18 mm	-9.70	1.42	6.85	1.55

The L50 is in proportion with the trap's mesh size. The L50 for greasyback shrimp is 3.51 cm, 5.84 cm and 6.85 cm respectively for mesh sizes 12, 15 and 18 mm. The Selectivity Range (SR) for greasyback shrimp decreases from 3.24 cm to 1.40 cm when mesh size increases from 12 mm to 15 mm. However, increasing mesh size to 18 mm, the SR drops by 0.15 cm.

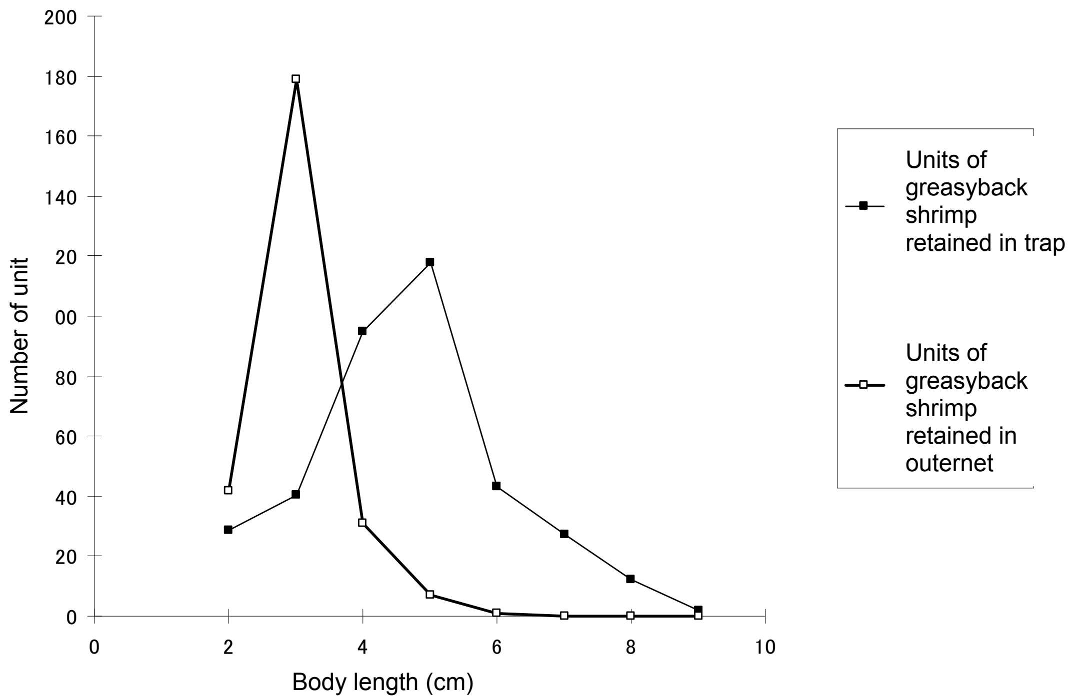

Figure 3a Catch of greasyback shrimp in trap and in outernet (mesh size 2a = 12 mm)

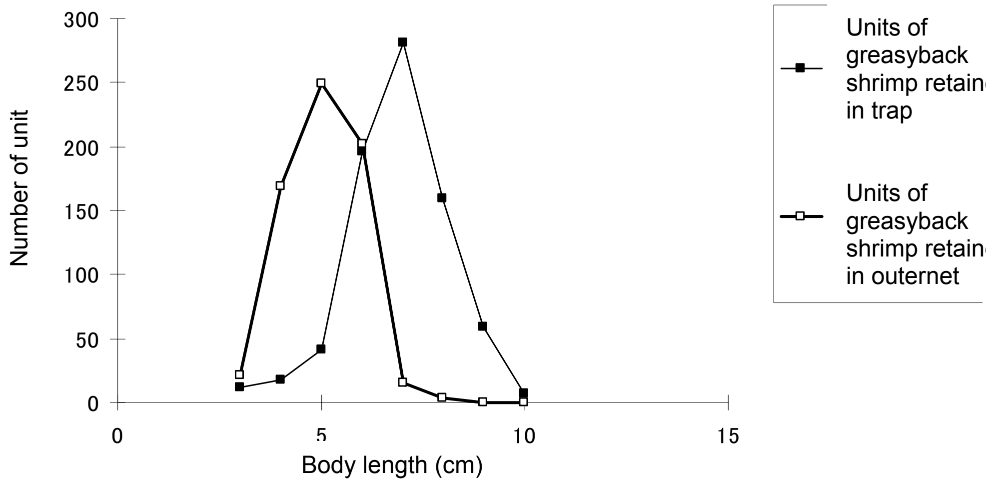

Figure 3b Catch of greasyback shrimp in trap and in outernet (mesh size 2a = 15 mm)

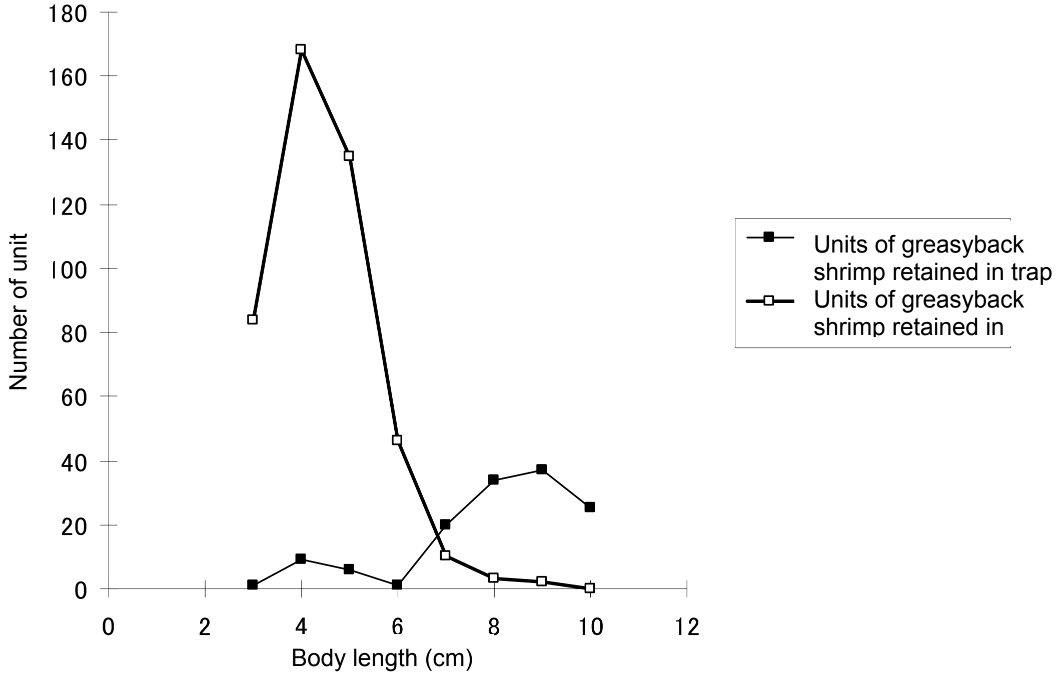

Figure 3c Catch of greasyback shrimp in trap and in outernet (mesh size 2a = 18 mm)

Figures 3a, b, c display body length distribution of greasyback shrimp in trap of mesh sizes 2a = 12, 15 and 18 mm. Body length of shrimps escaping the trap is shorter than that of shrimps retained in the trap. The average body length of shrimps retained in the trap is 4.67; 6.89 and 8.08 cm for three mesh sizes; this length in the outernet is 3.02; 5.05 và 6.32 cm.

4.2 Catch of white-spotted rabbitfish (*S. canaliculatus)* by body length

Figures 4a, b, c display catch of *S. canaliculatus* in the trap and in the outernet by body length. Body length of fish caught in the trap is longer than that of fish retained in the outernet. The average body length of *S. canaliculatus* is provided in Table 8. As the mesh size increases, the average body lenght of fish escaping the trap increases.

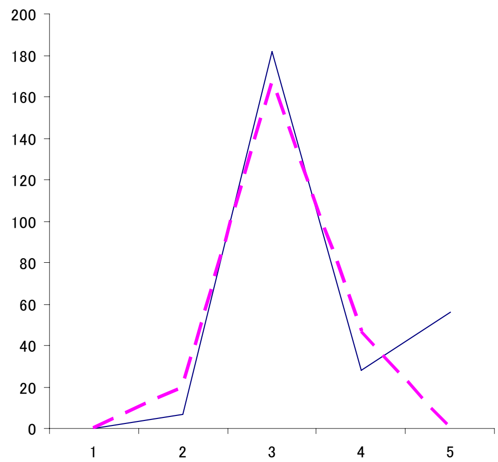

Figure 4a Catch of *S. canaliculatus* in trap and in outer net (2a=12mm). 273 units in trap and 234 units in outer net.

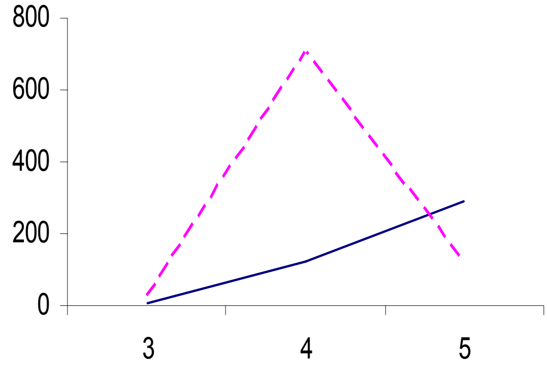

Figure 4b Catch of *S. canaliculatus* in trap and in outer net (2a=15mm). 416 units in trap and 844 units in outer net.

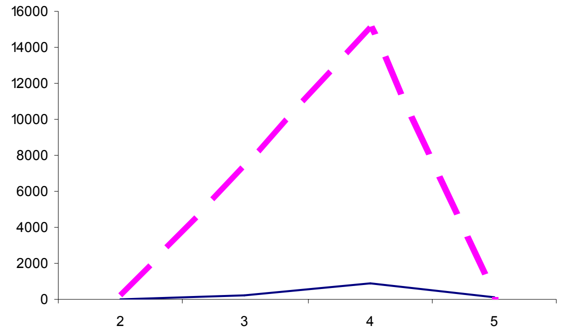

Figure 4c Catch of *S. canaliculatus* in trap and in outer net (2a=18mm). 1,262 units in trap and 22,790 units in outer net.

Notes:

Unbroken line: catch in trap.
Broken line: catch in outer net.
X-axis: body length of fish (cm).
Y-axis: number of units.

Table 8 Average body length of *S. canaliculatus* caught in trap and in outernet

	2a = 12 mm	2a = 15 mm	2a = 18 mm
Average body length in trap	3.49(273)	4.69(416)	3.92(1262)
Average body length in outernet	3.16(234)	4.16(844)	3.65(22790)
(number in bracket is the number of units)			

4.3 Catch of Mullet (*Mugiliformes*) by body length

Figures 5a, b, c display catch of fishes under *Mugiliformes* in the trap and in the outernet by body length. Body length of fish caught in the trap is longer than that of fish retained in the outernet. The average body length of *Mugiliformes* is provided in Table 9. As the mesh size increases from 12 mm to 15 mm, the average body lenght of fish escaping the trap increases. However, this body length decreases as the mesh size increases from 15 mm to 18 mm.

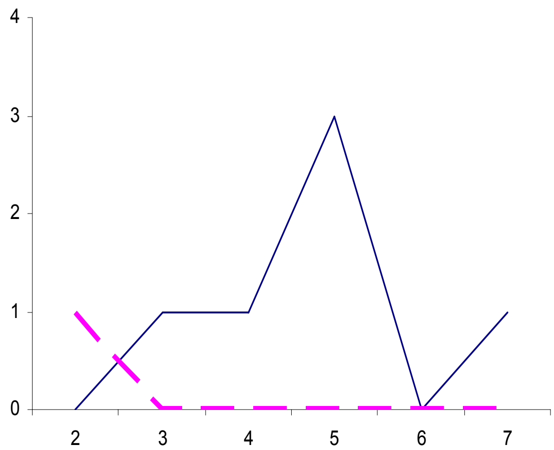

Figure 5a Catch of fishes under Mugiliformes (cá Đối) in trap and in outer net (2a=12mm). 6 units in trap and 1 unit in outernet.

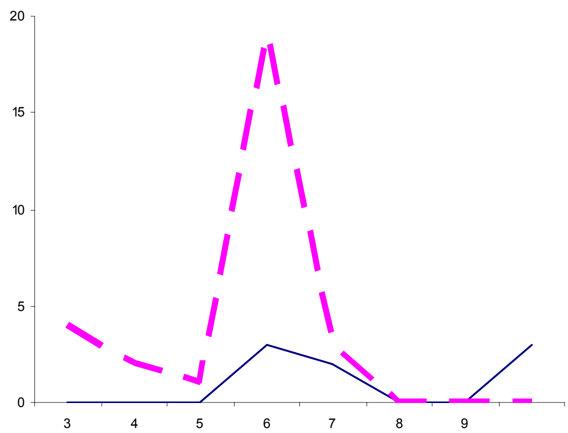

Figure 5b Catch of fishes under Mugiliformes (cá Đối) in trap and in outer net (2a=15mm). 8 units in trap and 29 units in outernet.

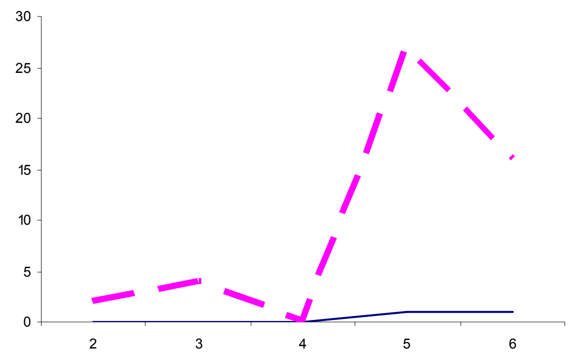

Figure 5c Catch of fishes under Mugiliformes (cá Đối) in trap and in outer net (2a=18mm). 1,262 units in trap and 22,790 units in outernet.

NOTES:

Unbroken line: catch in trap.
Broken line: catch in outer net.
X-axis: body length of fish (cm).
Y-axis: number of units.

Table 9 Average body length of fishes under Mugiliformes caught in trap and in outernet

	2a = 12 mm	2a = 15 mm	2a = 18 mm
Average body length in trap	4.80(6)	7.75(8)	5.5(2)
Average body length in outernet	2.00(1)	5.52(29)	5.04(49)
(number in bracket is the number of units)			

4.4 Catch of goby (cá Bống) by body length

Figures 6 a, b, c display catch of goby in the trap and in the outernet by body length. Quantity of goby caught during the study time was meager, making it impossible to build selectivity graph as well as determine selectivity parameters for this species. Body length of this fish caught in the trap is longer than that of those retained in the outernet. The average body length of goby in the trap as well as in the outernet is provided in Table 10. Figure 6a shows that gobys of </=6 cm in total length (TL) all escape the trap of 12 mm mesh size. For the trap of 15 or 18 mm mesh size, goby of </=7 cm in total length escape the trap.

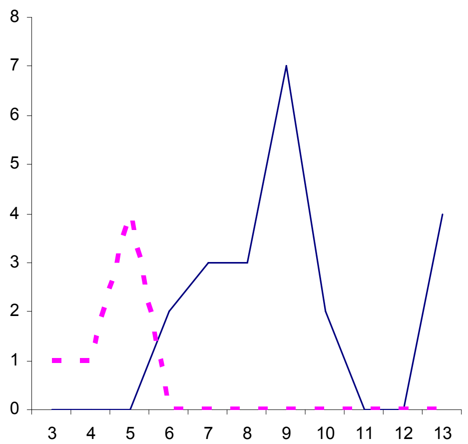

Figure 6a Catch of goby (cá Bống) in trap and in outer net (2a=12mm). 21 units in trap and 6 units in outernet.

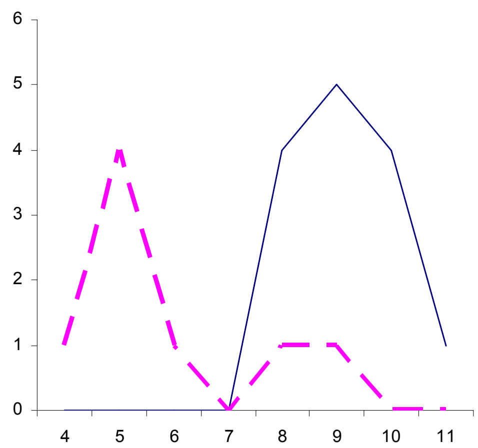

Figure 6b Catch of goby (cá Bống) in trap and in outer net (2a=15mm). 14 units in trap and 8 units in outernet.

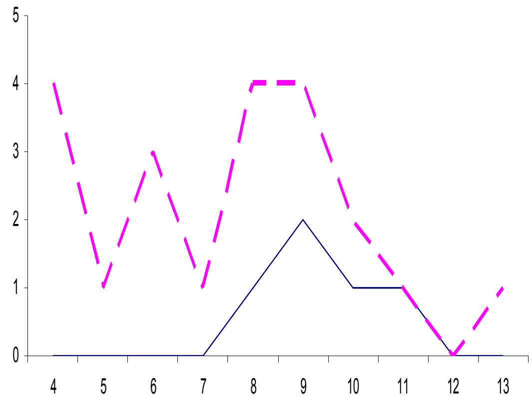

Figure 6c Catch of goby (cá Bống) in trap and in outer net (2a=18mm). 5 units in trap and 16 units in outernet.

NOTES:

Unbroken line: catch in trap.
Broken line: catch in outer net.
X-axis: body length of fish (cm).
Y-axis: number of units.

Table 10 Average body length of goby caught in trap and in outernet

	2a = 12 mm	2a = 15 mm	2a = 18 mm
Average body length in trap	9.14(21)	9.14(14)	9.40(5)
Average body length in outernet	4.50(6)	5.90(8)	6.94(16)
(number in bracket is the number of units)			

4.5 Catch of giant tiger prawn (*P.monodon*) by body length

Figures 7 a, b, c display catch of giant tiger prawn in the trap and in the outernet by body length. Average body length of giant tiger prawn escaping the trap increases significantly from 2.86 cm for mesh size of 15 mm to 7.45 cm for mesh size of18 mm. However, the average body length of giant tiger prawn in the trap of 18 mm mesh size is shorter than those escaping the trap of same mesh size.

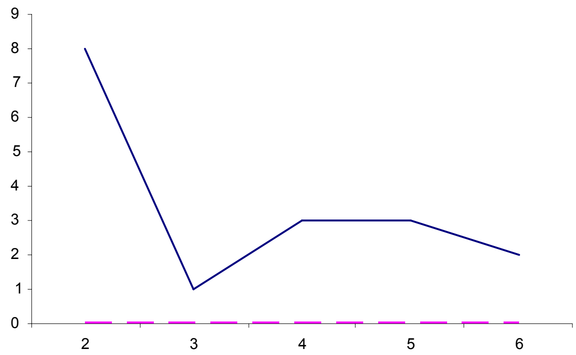

Figure 7a Catch of giant tiger prawn (tôm sú) in trap and in outer net. 17 units in trap and 0 units in outernet.

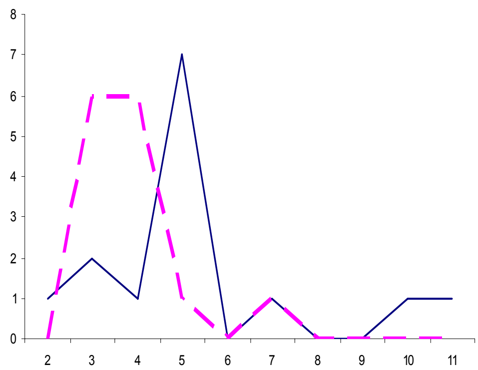

Figure 7b Catch of giant tiger prawn (tôm sú) in trap and in outer net. 14 units in trap and 14 units in outernet.

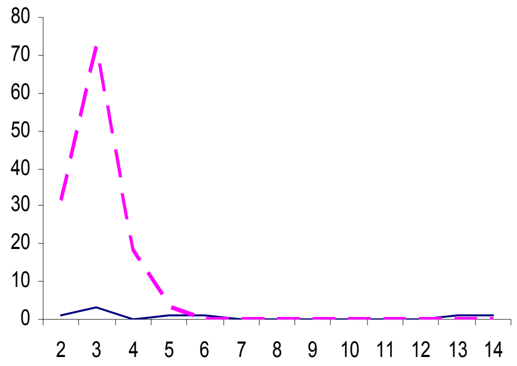 **Figure 7c Catch of giant tiger prawn (tôm sú) in trap and in outer net.** 8 units in trap and 124 units in outernet.	**NOTES:** **Unbroken line: catch in trap.** **Broken line: catch in outer net.** **X-axis: body length of fish (cm).** **Y-axis: number of units.**

Table 11 Average body length of giant tiger prawn caught in trap and in outernet

	2a = 12 mm	2a = 15 mm	2a = 18 mm
Average body length in trap	3.11(17)	5.36(14)	6.13(8)
Average body length in outernet	--(0)	3.86(148)	7.45(124)
(number in bracket is the number of units)			

VI. Conclusion

1- The study came up with 45 species of 35 families under 14 orders. Seven of these species are not in the inventory of fishes in Tam Giang – Cau Hai lagoon (2).
2- L50 for greasyback shrimp increases as the mesh size is enlarged. However, selectivity range (SR) of 2a = 15 mm is smallest. Concerning resource protection and sustainable use, 2a = 15 mm is the acceptable mesh size for stake trap.
3- The short period of the study did not allow an abudant catch for better analysis. Catch of certain fish species (Kình, Sơn, Liệt) is abundant, but is composed by fish of certain length range, making it difficult to develop a selectivity graph with proper accuracy.
4- More time should be allocated to evaluate the selectivity of mesh sizes 2a = 12; 15 and 18 mm for the species mentioned in the previous comment.
5- Regarding *S. canaliculatus*, as initiated by the graph of body length distribution, the use of larger mesh size would not improve the release of young stock. This is because of the taxanomic characteristics of this fish: body compressed and hight, making it difficult for them to escape the trap. The installment of tấm song would improve the release of this young fish.
6- The mesh size 2a = 18 mm is quite large for giant tiger prawn. If it is adopted, catch of giant tiger prawn would drop.
7- Regarding goby, as indicated by the graph of body length distribution of this species, mesh size 2a = 15mm or 2a = 18 mm would release units under 7 cm in length. This could be acceptable by fishermen since goby smaller than 7 cm are low in value. The adoption of 2a = 15 and 18 mm would not cause a drastic decrease of catch of goby.
8- The study fell off the productive fishing season, and samples collected were meager in abudance. This is one reason restricting the effectiveness of the study.

VII. References

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