INTERGRATED MANAGEMENT OF LAGOON ACTIVITIES
IMOLA PROJECT

Final Report

ENVIRONMENT AND RESOURCES IN THE TAM GIANG - CAU HAI LAGOON

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Index

1. Introduction

The Tam Giang - Cau Hai lagoon system is located far from Hue capital about 7km on the north-east, within coordinate $16^0$14' - $16^0$42' N and $107^0$22' - $107^0$57' E, elongating 70km from Phong Dien to Phu Loc with total area is about 21,620ha, the widest is 10km and the narrowest is less than 1km. The Tam Giang - Cau Hai lagoon is connected to the East Sea through two mouths Thuan An on the north and Tu Hien on the south. The huge sandy dunes are located on the coast that likes seawalls divide between the lagoon and sea. This is the largest lagoon in Vietnam. At here containing hundreds of animal and plant species they are high economic value and create thousands ton of production which are main nutrient source for 500 thousand people living in 5 districts around the lagoon. Exploitation of natural resources and aquaculture in the lagoon for socio-economic development are normal activities. But over-exploitation or unsuitable exploitation leads to exhaustion of some high value species (such as mud crap, grouper, seabass, shrimp...) are main problems. Study on resources and environment in the Tam Giang - Cau Hai lagoon have been mentioned by some scientists in the recent years (1, 2, 3, 6, 9, 13, 14), but some issues have not still cleared yet. In order to contribute a planning for integrated management of the Tam Giang - Cau Hai lagoon we focus on assessment status of environment, resources, forecast threatens and changes in natural resources to proposal some ideas on sustainable utilization, resource and environmental conservation in the area.

2. Location, document and method

2.1. Location and document

- *Time and location*

Four survey trips were carried in April, May, August and November 2006. Total of 37 sites on 12 transects along the lagoon from north to south have repeatedly surveyed (figure 1, table 1). Select pilot research sites for implementation of environmental capacity. Site selection criteria would include consideration of the following factors :

- Represent of important ecological conditions.

- Represent of social and economical activities in the lagoon

- Potential for replication to other areas in the lagoon.

The surveyed transects were regularly spread on the whole lagoon and divided into 4 zones:

- Zone 1: Tam Giang lagoon: including 5 transects (from A to E), area is about 5,200ha, length 27km, average of width 2km (0.6-3.5km). The Tam Giang lagoon looks like a sub-tidal channel with average depth is 2m and deeper toward Thuan An mouth 4 to 5m in depth.

- Zone 2: Sam - Chuon lake: Area is 1.620ha, depth 1,5m at Hoa Duan, 0,5m in Phu An and An Truyen and there is a sub-tidal channel 2m in depth and more deeper toward Thuan An mouth reach to 4 to 5m.

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- Zone 3: Thuy Tu lake: area is about 3600ha, length 24km, average width over 1km and create a sub-tidal channel with 2m in depth and more deeper toward Cau Hai and deepest at Ha Trung 4m.

- Zone 4: Cau Hai lake: area is 11.200ha, formed semi-cicular shape with arc toward Phu Loc direction. Width of the lake is north-west and south-east from Thuy Tu to basement of Vinh Phong mountain about 11km, from Da Bac to Tuy Van about 6km and from Dai mouth to basement of Phuoc Tuong mountain about 17km, average depth of the Cau Hai lake is about 1 to 1,5m and the deepest over 2m gentle slope toward Da Bac (south)

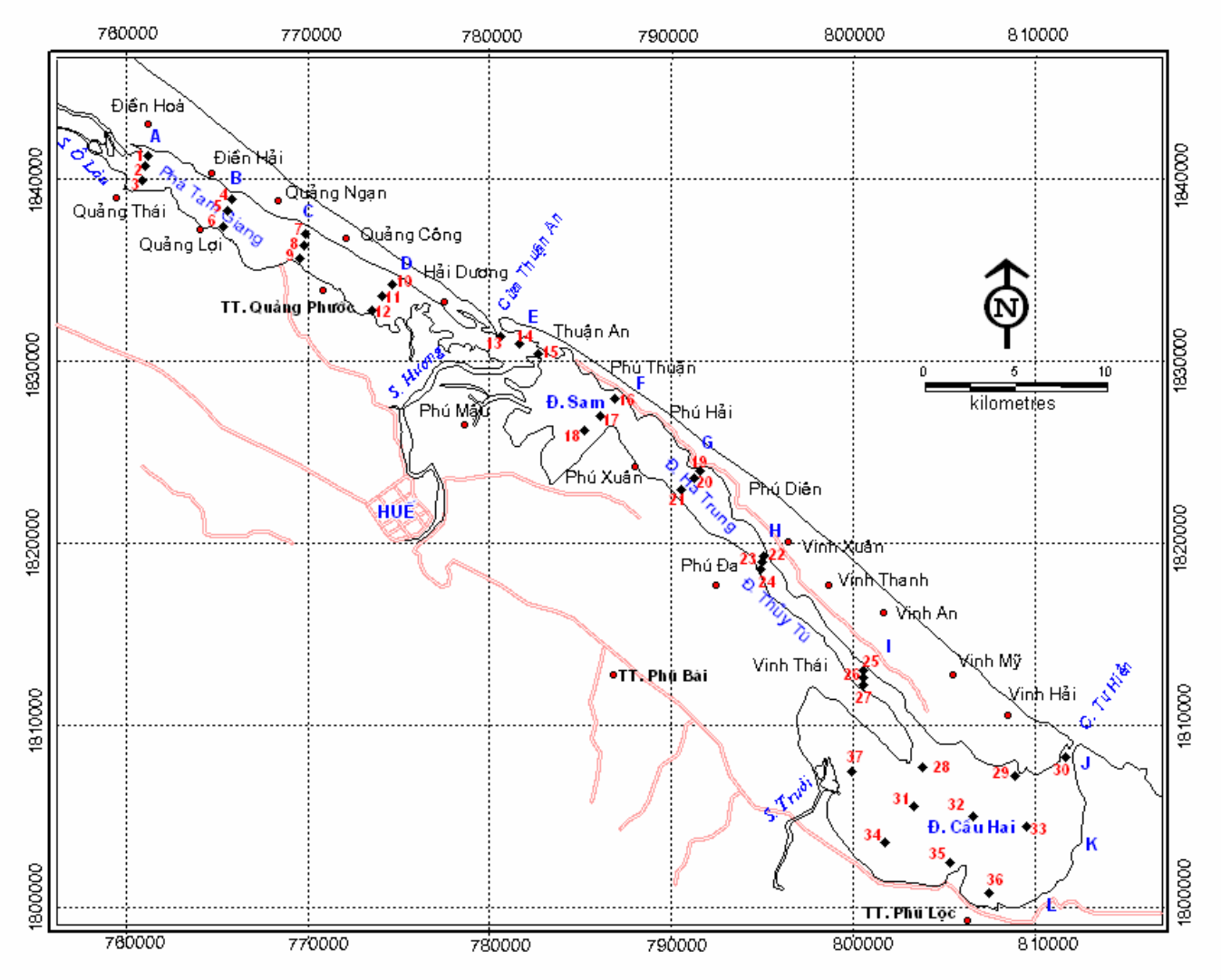

Figure 1. Sampling station in the Tam Giang - Cau Hai lagoon

- *Documents*

There are three sources of document:

- The results of analysis samples from 4 survey trips of IMOLA project (2006) in April, May, August and November; 3 survey trips of Vietnam - Italia bilateral project in 2003, 2004 and 2005.

- The results have been published from themes, projects that were carried out in the Tam Giang - Cau Hai lagoon from 1995 to now

- Further information on socio-economic, aquaculture and exploitation on the lagoon were also collected.

Table 1. Sampling locations for Marine Environment and Biological resources on Tamgiang - Cauhai Lagoon

SITE	STATIONS	EAST	NORTH
A	1	$107^0$26' 44"	16^0 39' 03"
	2	$107^0$26' 37"	16^0 38' 38"
	3	$107^0$26' 30"	16^0 38' 20"
B	4	$107^0$29' 54"	16^0 37' 53"
	5	$107^0$29' 34"	16^0 37' 32"
	6	$107^0$29' 20"	16^0 37' 05"
C	7	$107^0$31' 48"	16^0 36' 41"
	8	$107^0$31' 45"	16^0 36' 45"
	9	$107^0$31' 40"	16^0 36' 23"
D	10	$107^0$34' 13"	16^0 35' 35"
	11	$107^0$33' 56"	16^0 35' 14"
	12	$107^0$33' 39"	16^0 34' 55"
E	13	$107^0$37' 21"	16^0 33' 53"
	14	$107^0$37' 48"	16^0 33' 33"
	15	$107^0$38' 14"	16^0 33' 10"
F	16	$107^0$40' 50"	16^0 32' 04"
	17	$107^0$40' 30"	16^0 31' 43"
	18	$107^0$40' 06"	16^0 31' 05"
G	19	$107^0$43' 43"	16^0 29' 34"
	20	$107^0$43' 32"	16^0 29' 13"
	21	$107^0$43' 14"	16^0 29' 06"

H	22	$107^0$46' 19"	16^0 26' 21"
	23	$107^0$46' 06"	16^0 26' 13"
	24	$107^0$45' 57"	16^0 26' 09"
I	25	107.76369	16.43864
	26	107.76156	16.43750
	27	107.80631	16.39983
J	28	107.80506	16.39572
	29	107.80497	16.39192
	30	107.85489	16.34019
K	31	$107^0$50' 41"	16^0 19' 28"
	32	$107^0$52' 23"	16^0 19' 03"
	33	$107^0$54' 06"	16^0 18'39"
	37	$107^0$49' 05"	16^0 20' 00"
L	34	$107^0$59' 00"	16^0 18' 04"
	35	$107^0$52' 41"	16^0 17' 27"
	36	$107^0$52' 58"	16^0 17' 08"

- *Equipment: Used equipments provided by IMER (see bellowtable)*

Rank	Item	Models	Functions	Number	Production	Current status	Source
1	Microscope	Leica DMLS	Analyzing biological taxon	3	German	Good	IMER
2	Stereo - microscope	GZ6		3	German	Good	IMER
3	Analytical balance	Wd 500	To weigh samples	1	Poland	Good	IMER
4	Grab	Ponna-dredge	Sediment sampling; Micro benthos sampling	3	France	Good	IMER
5	Quadrate		See grass collection	2	Vietnam	Good	IMER
6							
7	Wire - mesh sieves	0.5 – 3	Collection benthos	3	Vietnam	Good	IMER

8	plastic bathometer		Water sampling	2		Good	IMER
9	Nylon -net phytoplankton	0.02 mm	Phytoplankton collection	2	Japanese	Good	IMER
10	Nylon-net zooplankton		Zooplankton collection	2	Japanese	Good	IMER
11	Dredge	Sarcot Dredge	collection Mollusks stocks	2	USA	Good	IMER
12	Photometric disc	-	Turbidity measurement	1	USA	Good	IMER
13	Fluorometer		Chl-a	1		Good	Hue
14	Water quality Checker TOA	TOA	Water chemical parameter	2		Good	IMER
15	Turbidity meter pH OX	pH OX	Water turbidity measuring	1		Good	IMER
16	Quadrate frame	-	collecting water plant and sea grass	2		Good	IMER
17	Chemical substances for neutralizing oil		For oil sampling				IMER
18	JPS		JPS position	2	France	Good	IMER
19	Photo camera						IMOLA
20	Boat		Sampling				IMOLA
21	Car		Transport				IMER
22	Lab. facilities		Analysis				Chemistry Faculty
23	Computers	Compaq S550	Analysis of results	3	Asian	Good	IMER
24	Printers	hp 1200	Printing	3	Asian	Good	IMER
25	Chemical substances for preserving specimens (Alcohol, formalin)						IMOLA + IMER
26	Glass vases		for marine water preserving				IMOLA
27	Ruler	0.1 mm		3		Good	IMER
28	Plastic bottles	0.5-1.0 litter	for marine benthos preserving	33		Good	IMER
29			Oil analyzis			Good	IMER

2.2. Method for collecting sample and Analyzing

- *Zoobenthos collecting samples and Analyzing*

- Use sampler grab "Ponnar - Dredge" 0.05 m^2. Grab sampling for infaunal analysis shall be undertaken at the 36 stations (3 samples for every satations) , penetrating depth can be as great as 15-16 cm when using this grab. Its penetrating depths range from sample to sample with sediment types (for example: clay or mud with sand or sand with mud) three samples shall be collected from each of sample locations on. The collected samples shall be stored temporarily in 1.0 litre or 0.5 litre plastic laboratory bottles in which shall be put a waterproof label indicated sample location and number of grab samples
- Use quadrate methods shall be undertaken zoobenthos on littoral and phytobrnthos on the bootom of lagoon. Quadrate areas varies from 1/ 16, 1/4, 1/2, 1 m^2
- Sledge, dredge, trawl have recommended for taking sample of macrobenthos on soft-bottom
- Samples shall be sieved through from 0.5mm - 3 mm scientific sieves, and organisms not passing the sieves will collect.
- The collected samples shall be fixed in a 5% buffered formalin for preservation and stored temporarily in 1.0 litre or 0.5 litre plastic laboratory bottles in which shall be put a waterproof label indicated sample location and number of grab samples. Samples should remain in 5% buffered formalin for a minimum of 24 h to allow proper fixation and transfer to alcohol 70%, stored in the plastic boxes.

Taxonomy: Analysing to rank of species

Organisms shall count and identified to the lowest possible taxon by a group of qualified specialists in marine benthic fauna.

- Biomass of Zoobenthos was calculated by number of individuals and Ash-free dry weights per m^2 of location.
- Species diversity based on Shannon - Weaner H'

H' = - Sum Pi Log_2 Pi Where Pi = ni/ N

ni = number of individuals of species i_1,i_2.i_3....

N = Total number of individuals.

- *Plankton collecting samples and Analyzing*

- The qualitative phytoplankton samples had been collected by plankton nets with mesh size of 20 μm (for phytoplankton) and 200μm (for zooplankton) . Net haul was undertaken from the bottom to surface in water column several times. The samples had been fixed *insitu* by formalin (2-3%) or neutral lugol solutions (3mL per litre of sample).

- The quantitative Plankton samples were collected by water sampler (Van Dorn bottle) at the different water layers with collected water volume of 1 litre and then fixed by lugol with the rate of 3 mL lugol per 1 litre of water sample (for phytoplankton) and 200 litters and fixed by formalin 3 % (For zooplankton.)

- Observing and identifying the qualitative and quantitative samples under OLYMPUS with magnification of 100 to 1000X and fluorescent inverted LEICA (40-400X)

microscopes. For quantitative samples, the sieves with mesh size of 250, 125, 38 and 20 micrometer have been used to remove the sediment or organic matters before counting.

- For Plankton, the density was calculated by number of individs/m^3 as Zooplankton and individs/litter as Phytoplankton

- *Fisheries collecting and analyzing*

- Catching of fisheries by push net

The 12 transects were fishing by push net on the 3 sub zone. The first is Thuan An to Olau named transect 2.1, 2-2, 2-3 and 2-4. The second sub zone is laying from Dam Sam to Chuon and Thuy Tu named transect 3-1,3-2,3-3 and 3-4 . The last sub zone is distribution from Thuy Tu to Cau Hai and named transect 4-1, 4-2, 4-3 and 4-4. Average of Speed of the boat 6.0 - 7.5 km/h. Fishing time 1 hour/ time. The width of push net is 7.5 m

- Catching by Sarcot Dredge: Using to catch benthos fisheries. The Sarcot Dredge has 0.45 m in width and 0.25 m in height. The fishing was procced one time per one transect. The fishing time 10 minutes with the speed 5 Km/h

- Estimating the Biomass of Fishery stocks: In areas where the sea bottom is smooth enough for trawling, standing stock sizes was obtained by relationship as

$$B = c/f * A/ a * x1$$

B- Fishery stock

c/f - the mean catch per effort obtained during the surveys

A- total area

a - Area swept by the net during one unit of effort

x1- being the proportion of the fish in the path of the gear that are actuallly retained by the net (in Southeast Asian water, a value of x1 = 0.5 is commonly used (Isarankura, 1971; Seager el al, 1976; Pauly, 1979a)

The Area swept by the net during one unit of effort (a) is computed from the expression

$$a = t * v * h * x2$$

Where v is the velocity of the trawler over ground when trawling, h is the length of the trawl'head rop, t is the time spent trawling and a value of x2 = 0.5 is commonly used (Pauly, 1979a)

- *Water collecting sample and Analyzing*

- The water samples have been collected at surface and bottom layers using 5L plastic bathometer at 12 horizontal sites from Tam Giang to Cau Hai lagoon . The samples have been treated and maintained for analyzing operations at the methods described by APHA 1995. Some water parameters were immediately measured on the survey time on lagoon. The total waters parameters was collected and measured per one fild trip as:

- Collected 10 parameters x 37 stations = 370 samples/first survey for Analyzing operations

- Measured 5 parameters x 37 stations x 4 samples = 740 samples

The detail sample contains for every survey such as:

1- BOD5; COD: 37 station x 1 samples/ station = 37 samples

2- N-NO3; P-PO4: 37 station x1 samples/ station = 37 samples

3- TN; TP: 37 station x 1 samples/ station = 37 samples

4- NO2; NH3/NH4: 37 station x 1 samples/ station = 37 samples

5- NO3 : 37 station x 1 samples/ station = 37 samples

6- Cu, Pb, Cd, Zn*: 37 station x 2 samples/ station

7- Photosynthetic pigments*: 37 station x 2 samples/ station

8- Chlorophyll - a*: 37 station x 2 samples/ station

9- Persistent organic pollutant*: 37 station x 2 samples/ station

10- Oil pollution*: 12 station x 1 samples/ station

Chimicals paremeters measuring on the survey

- Turbidity (measuring): 37 station x 2 samples/ station

- PH(measuring): 37 station x 2 samples/ station

- Salinity (measuring): 37 station x 2 samples/ station

- DO (measuring): 37 station x 2 samples/ station

- Temperature(measuring): 37 station x 2 samples/ station

2.3. Methods of sample analysis

- *Organism samples*

- Sample analysis: Samples were identified to species level and counted the number of each species at each site. Additionally, benthos samples were weighted each species. Zooplankton was weighted each sample. Resource samples were identified to species level and weighted for typical species or groups.

Fish stock was calculated by following equation (Pauly, 1979)

$$B = (c/f * A)/a * x1$$

Where:

x1: Coefficient of escape (capture coefficient) for tropical area is 0.5

B – Fish stock; c/f – medium weight of captured fisheries in experimental batches.

A - Research area

a - trail area of net by equation a = t * v * h * x2

(t - time; v – speed of boat, h – net's mouth, x2 - interrupted coefficient of pulled net area, normally is 0.5)

- *Chemical water samples*

- Nitrite concentration: based on colorimetric method by Gries - Ilosway

- Nitrate (NO_3^-): also based on colorimetric method after deoxidizing to nitrate by Cadmium-copper column.

- Phosphate (PO_4^{3-}): based on colorimetric method with reagent ammonia molipdat and deoxidize agent was tin II clorua

- Ammoniac: used phenat colorimetric method

- Oil concentration: by spectrometer DR/2000 (HACH, USA).

- Sedimentation was analyzed concentration of organic carbon (C), total nitrogen (N) and phosphor (P) concentration. In addition, mechanics components of sediment were also analyzed by size of fine sand >0.063mm and mud clay < 0.063mm

2.4. Data analyses

All analyzed results were combined and analyzed by specific regulation of each group. The sample-analyzed results were updated and analyzed on professional software.

3. RESULTS

3.1. Meteorology and hydrography in the lagoon

- *Meteorology*

The Tam Giang - Cau Hai lagoon is located at the end of the monsoon region in the northern Vietnam and is hidden by the Great Mountain results in the climate in the area is harsher than other regions in the north of Vietnam.

- Wind: The Tam Giang- Cau Hai lagoon is affected by monsoon regime, the direction of wind is northeast (in winter) and southwest (in summer). Due to affect by mountain topography consequently northeast pattern is deformed both direction and velocity when comparing with itself in the Tonkin Gulf. Similarly, in summer this area is adverse suffered by hot wind from southwest (or Laos wind). In winter, prevalent direction is northwest at average velocity about 1.6m/s. By the same time, at Con Co Island the prevalence of wind is northwest and north direction at speed of about 5m/s and at the Tonkin Gulf's mouth is dominated by northeast direction. In summer prevalent direction is southwest and east in the lagoon, at Con Co Island is southwest and at Tonkin Gulf mouth is south and southwest direction.

- Rainfall: lies near by Bach Ma rainy forest where is center of heavy rain (average of rainfall > 3000mm/year). The lagoon belongs to high rainfall area, annual average of rainfall is about 2.744mm/year, higher than the average of rainfall in whole country (1.900mm/year). Typical characteristic of this region is rainy season often in late period of the year (in winter from September to December) with total of rainfall is

2000mm (72.8%). High rainfall concentrates in October and November at peak on October (740mm, 26,96%). The rainfall of the rest months is not noticeable. Due to high rainfall concentrate in a few months lead to flood may occur in winter. In summer it is often dry because of low rainfall.

- Storm: Annually, there are 0 to 4 storms those influence to this region with wind velocity from 20 - 40m/s. In the past (98 years) there was 0,8 storm/year. Normally heavy rainfall and long period of time were often happened during storm (from 2-5 days) consequently the whole lagoon was flooded. Storm season is annual from June to November, mostly from July to October. According to statistic data from 1884 to 2000, frequency of storm in September was highest (35%), the next was October (28%), August (8,7%), July (7,6%), November (5%). Strong wind and water rising during storm are severe damage to coastal area particularly the coastal area from Quang Binh to Thua Thien Hue is the most dangerous. During the past 10 years (1977 to 1986) damaged by storm in this area was 1000 dead people (41,5% compare to entire country), 3.572 fishing boats were sunk (50.8%) and 45.057 ha land were flooded (11%).

- Sunlight, air temperature, evaporation, and drought: Annual total of sunlight is high from 19,000 to 2,000 hours due to annual average of temperature is high (25,2^{o}C)

In summer, lower cloud layer is occupy approximately 40% of the sky, average 170 - 240 hours/month, the amount of sunlight concentrates from May to August that correlates with high temperature period, evenly it is may reach to 39 - 40^{0}C. High temperature in the dry season increases evaporation proceeds that are cause of the drought in summer.

In winter, cloud covers on the sky from 70 to 80% and sunlight is less than in summer from 100 - 110 hours per month. The lowest of sunlight is in December, the low average of temperature is about 11.4^{0}C and minimum in December (8.8^{0}C). In these months, water evaporation is about 37 - 74mm/moth, but high rainfall (2000mm) that is cause of flooding in this area.

- *Hydrography*

The Tam Giang - Cau Hai lagoon system is directly suffered by both river hydrographic regime discharge from mainland and marine hydrographic regime from the sea.

River hydrography: The Tam Giang - Cau Hai lagoon system is convergence of O Lau and Huong (including Bo, Ta Trach, Huu Trach river), Nong, Truoi and Cau Hai river. Each year there are about 5,171 million cubic meters of water run off to the lagoon and accompany with 620,000 tones of sandy mud. Ranking by order of catchment area from large to small: Huong river has catchment area about 2,830 square kilometers and occupy 80% amount of volume water, the next is O Lau that has 900km^2 of catchment area, Truoi river (149km^2), Dai Giang river (99km^2) and Cau Hai river (29km^2). Almost above 5 rivers have high slope so that in rainy season velocity of water is strong contract to dry season current velocity is slow that is cause of salinization invading up to 30km (reach to Van Nien, Van Trinh and Phu Oc).

- Oceanography: The oceanography of the lagoon is strongly suffered by the sea through Thuan An and Tu Hien months. Because it is located along the coast of open sea therefore oceanographic regime of the lagoon depend on oceanography of the Tonkin Gulf. In winter, surface layer temperature of marine water is less than 24^0C and in summer is always higher than 26^0C. Salinity of marine surface water range from 32 to 34‰ and increasing from shore to off shore, in summer is higher than winter 1‰ because of raining. The tidal regime in Thuan An area belongs to irregular semi-diurnal, the lowest of fluctuation of tide is 0.35 to 0.5m but at Tu Hien mounth is gradually increase from 0.55 to 1,0m. Wave direction prevails by northeast in winter with frequency is 99% and 0.25 - 3m in height. In summer, the wave prevails with eastern direction with frequency is about 93% and height of wave from 0.25 to 1m. The coastal current in the area is very complicated, including stable current, tidal current and wave current. Among them, velocity of stable current at surface is double higher than itself on the bottom and often flow by south direction with speed of 5 - 10cm/s at near shore to 10m in depth and 30-50cm/s at deeper than 10m. Component tidal currents have velocity within 25-40cm/s for semi-diurnal current and 3 - 35cm/s Speed of wave current ranges from 30 to 100cm/s and direction depends on seasons.

Therefore, hydrographic characteristics of lagoon are affected by river hydrography and oceanography. Fluctuation of water level in the lagoon is irregular between locations inside the lagoon and between lagoon and the sea. In dry season, water level in the lagoon is always lower than sea level from 5 - 15cm (comparing to tidal peak) in Tam Giang and 25 - 30cm in Cau Hai. In flooding season, water level in the lagoon is always higher than the sea and may up to 70 cm in Cau Hai.

Current in the lagoon is mixed between river, wind and tidal current with speed and direction depend on seasons. In rainy season, the outlet current from the lagoon is higher than inlet current whereas the inlet current is higher than outlet current in the dry season. The results at monitoring stations (for 23 hours) at Thuan An mouth in dry season, average of velocity in outlet was 23cm/s, inlet current was 38cm/s.

Wave: Wave in the lagoon is created by wind with direction and height depends on direction and intensity of wind. Geometric characteristics of the lagoon water surface is large enough for height of wave reach to 1m and based on the real observation height of wave was 0.3 to 0.7m was recorded in Cau Hai.

- *Assessing water exchange between lagoon and sea*

Water exchange between lagoon and sea through Thuan An and Tu Hien was calculated by mathematic model Delft-3d from Institute of Hydraulic Power Delf, Holland.

In May, inflow from the sea was stronger than outflow due to flow in rivers was very low. The inflow at Thuan An was 56.3% and outflow was 43.7%. The highest inflow at Thuan An may reached to 975.7 m^3/s and outflow was 868.1 m^3/s. Similarly, at Tu Hien the inflow was 62.5% and outflow was 37.5%, the highest inflow was 15m^3/s and outflow was 10.4m^3/s.

In September, due to flow in rivers higher so that the outflow was dominated, the highest outflow at Thuan An was 2215 m^3/s and inflow was 1877m^3/s. At Tu Hien was

67m^3/s and 43 m^3/s. The outflow at Thuan An was higher 4.8 times than inflow, at Tu Hien outflow higher than 2.7 times inflow. (Table 2)

According to Nghiem Tien Lam (2000), the water exchange between the lagoon and sea was calculated by DUFFLOW model. Maximum flow at Thuan An was 2400m^3/s and at Tu Hien was 718m^3/s. Comparing the calculated results on maximum value of flow by Delft-3d model and DUFFLOW model at Thuan An was similar. But at Tu Hien have a different; the DUFFLOW model was much more higher than Delft-3d model. The reason was the time for calculating DUFFLOW model was in 2000 by that time it was still remaining Hoa Duan mouth. Whereas calculate time of the Delft-3d was after building Hoa Duan dam and Tu Hien mouth was shallower than in 2000. Based on the calculated results showed that, in dry season the invasion of salt water into the lagoon was very strong that was the reason of salinization by that time.

Table 2. Water exchange between the lagoon and sea

		5/2004		9/2005	
		Thuan An	**Tu Hien**	**Thuan An**	**Tu Hien**
Time (%)	In	56,3	62,5	17,2	27,3
	Out	43,7	37,5	82,8	72,7
Maximum flow (m^3/s)	In	975,7	15,2	1877,1	67,8
	Out	868,1	10,4	2215,7	43,5
Minimum flow (m^3/s)	In	2,1	0,0	17,3	5,7
	Out	3,5	0,0	28,6	13,1
Balance (%)		+12,6	+25,0	-65,6	-45,4

Note: "-" outflow; "+" inflow

3.2. Water environmental characteristics of the Tam Giang - Cau Hai lagoon

- *Temperature*

Average of air temperature in the area is 25,2^{0}C the same as air temperature in the whole country, but it is higher than the north of Vietnam, the highest in July (29,6^{0}C) and the lowest in December (19,9^{0}C). Because of locating behind the Great Mountain lead to circulation of air is low result in high air temperature. In February 2004 average of water temperature was 25,2^{0}C, in April 2006 the surface temperature in average was 28,9^{0}C and on bottom was 27,9^{0}C. In May 2006 the temperature was increase more than 2^{0}C, at surface was 31,2^{0}C and bottom 30,7^{0}C. Particularly, in Cau Hai area there was partial hot in the south of Cau Hai ranged from 32 - 33^{0}C. (table 3,4). In late August and early of September the trend of temperature was lower, average at surface was 30,8^{0}C. End of November and early December 2006 the temperature was less than in May and August, average at surface 29,6^{0}C and bottom layer 30,4^{0}C. Hence, change in water temperature in

the lagoon 2006 was very low and it was not exceed $2,5^0$C. Stability of water temperature is good condition for thriving of aquatic organisms in the lagoon (figure 2)

Table 3. The main environmental parameters in 2006

Table 4. Average values of environmental parameters measured at the field in 2006

Month	pH		S‰		DO (mg/L)		T°C	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
4	8.02	8.08	11.0	12.4	6.87	6.61	28.7	27.7
5	8.09	8.09	18.17	19.18	6.50	6.24	31.20	30.71
8	7.35	7.18	9.2	12.1	6.45	6.08	30.8	30.0
11	7.91	7.92	8.31	12.69	6.36	6.07	29.66	30.47

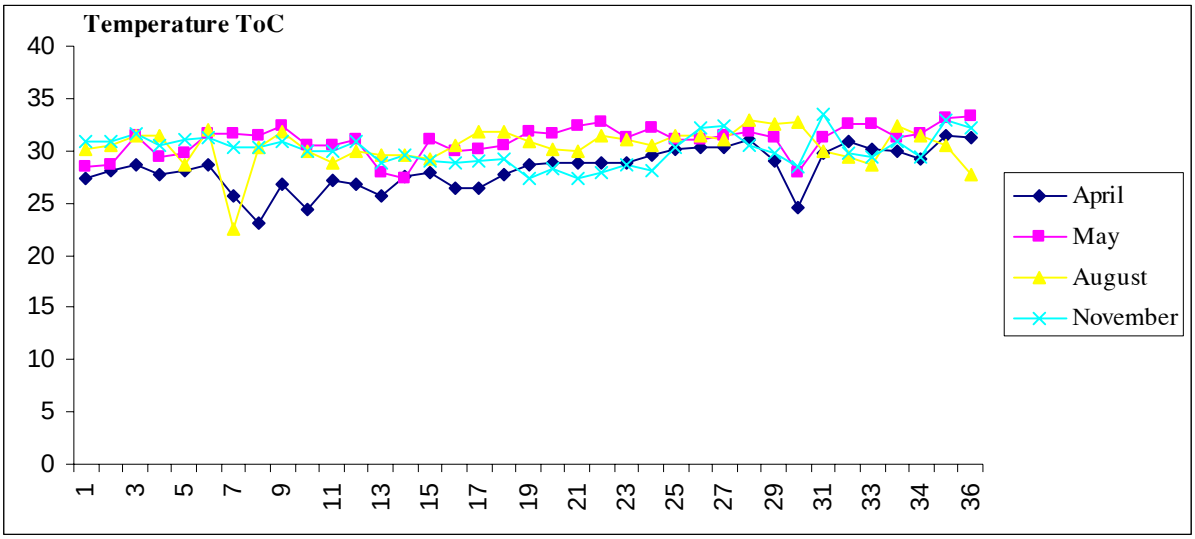

Figure 2. Changing in water temperature in 4 survey trips.

- *Salinity*

The analysis results showed that changes in salinity were very complex, some areas have been clearly found stratification. In April salinity changed from less than 1‰ to 31.5‰, surface average was 11.0‰0 and bottom was 12.4‰. After one month (May, 2006) salinity increased from <1‰ to 34‰, surface average was 18,17‰ and bottom 19,18‰ (table 3,4 and figure 3). Salinity increased quickly in the short time it may damage to soil by salinization in dry season. In late August and early September 2006, salinity in the lagoon decreased to 9.2‰ at surface and 12.1‰ at bottom, it was same results in April. In November and December was also the same in August, average surface was 8,31‰ and bottom 12,69‰ The main cause was low water current from O Lau, Huong, Dai Giang, and Truoi river discharge into the lagoon so that marine current was dominated and flowed into the lagoon and quickly salinization at the lagoon mouths and more and more invading deeply into the mainland through

river mouths. Due to interfere between two water bodies (fresh water from rivers and saline water from the sea) that creates areas have different in saline concentration. For example, at the O Lau estuary in February 2004 salinity at some sites were from 0,2 to 0,6‰ and both two sampling collected times (in April and May) were less than 1‰. Whereas by the same time at the Thuan An mouth salinity was 27‰ and the Tu Hien mouth 31,5‰ sometimes reach to 34‰. The mixture between fresh and saline water bodies created abundance of organisms and biodiversity in the lagoon.

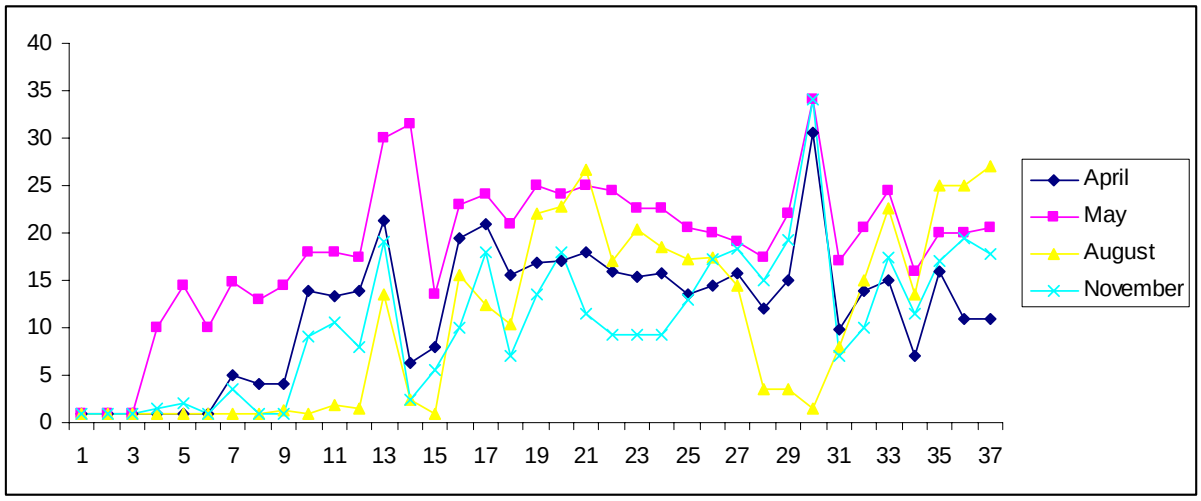

Figure 3. Changes in salinity 2006

- *pH*

In April 2006, average of pH in the whole lagoon was 8.02 at the surface and 8.08 on the bottom, in May 2006 pH was 8.09 on both surface and bottom. In August and November pH was declined, surface 7,35 and bottom 7.18 (in August), surface 7,91 and bottom 7,92 (in November and December) (table 3 and 4). Hence, pH value always lied within limitation of alkaline and weak alkaline, and has a little difference between seasons and suitable for growing of organisms. However, the result collected in 4 fieldtrips in both dry and rainy seasons in O Lau were always lower than the other, some sites were only 5.5 (figure 4) that was lower than Vietnam's standard TCVN (6.5 - 8.5). The partial acidity event should be warmed on water environmental quality for the lagoon.

- *Dissolved oxygen*

Average of dissolved oxygen concentration was from 6,07 - 6,87 mg/L, in February 2004 was 6,0 mg/L. In April at surface layer was 6,87mg/L and bottom was 6.61mg/L in average. In May 2006 concentration of DO was 6.5mg/L and bottom 6.24mg/L in average. In August was 6.05 at surface and 6.08 on bottom, similarly in November and December were 6,36 and 6,07 mg/L (Figure 5 table 3 & 4). Obviously, concentration of DO in the lagoon was high and suitable for growing of aquatic organisms.

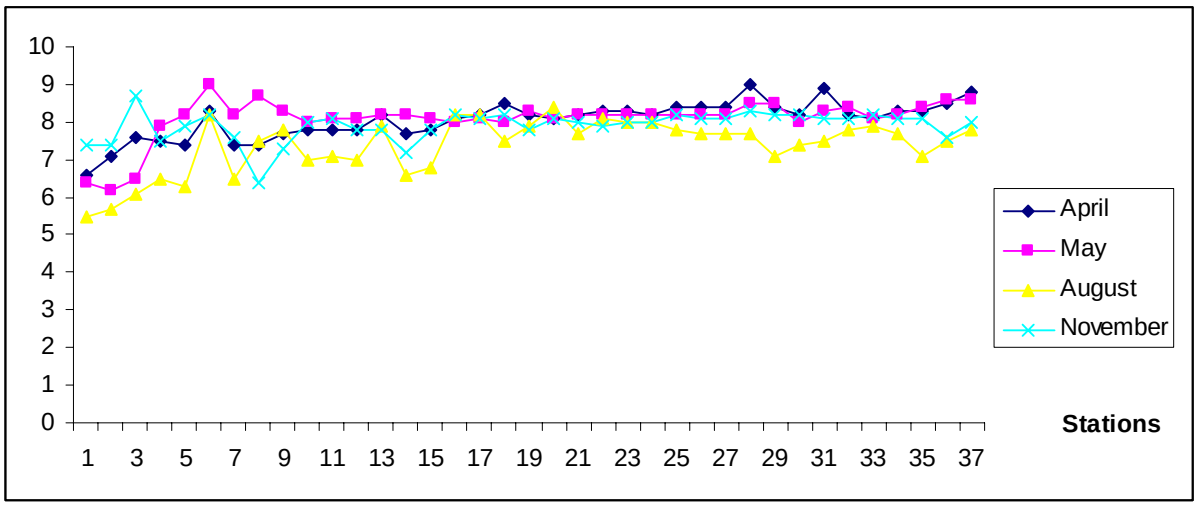

Figure 4. Changes in pH in the whole lagoon in 2006

However it should be noted that in the several locations, DO decreased quickly from April to May 2006 (4.96 at site 18 and 4.72 at site 31) was evidences to warming on partial organic pollution in the lagoon. (figure 6,7).

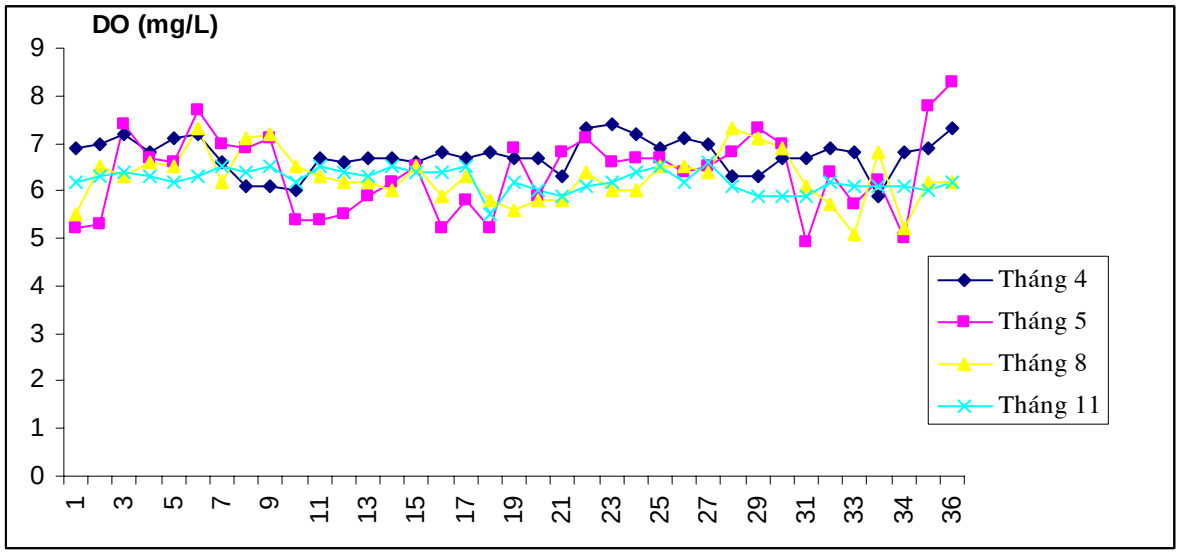

Figure 5. Changes in DO in the whole lagoon in 2006

- *Ecological zoning*

From above results showed that the most importance of water environmental parameter that controls all aquatic organisms in the lagoon was salinity. The salinity complex changes by time (season, period, day) and space (layer, zone) consequently it was forming 4 sub-zones of aquatic ecology of the Tam Giang - Cau Hai lagoon (table 5 figure 6).

+ *Fresh water sub-zone*: O Lau area (Dien Hai). At O Lau river mouth the water seem to fresh in rainy season and does not stratify

- salinity: is only from 0.02 to 0,2‰ and in dry season less than 1‰.
- pH: is lower than other sub-zones, sometimes decreased to 6.35 (in May, 2006) and remain until to August 2006, average surface layer is 5.69 and bottom 5.85.
- DO concentration: DO concentration are range directly proportional to acidification. In April, 2006 DO at surface layer was 7.19mg/L and bottom was 6.89mg/L. In May 2006 while pH declining, DO both surface and bottom layers also decreased to 5.93mg/L and in August 2006 was 6.26 at surface and 5.86 at bottom.
- Temperature: Average temperature at surface was 28.3 - 29.6^{0}C and on bottom was 27.6 – 29.7^{o}C in April and May. In August and November temperature ranged from 30 - 31^{0}C.

+ *Fresh- brackish water sub-zone*: From Quang Ngan to Quang Cong.

- Salinity of this area is change very quickly. In April 2006 the salinity at both surface and bottom layer was less than 1‰, but in May 2006 was increase to 11.6‰ at surface and 11.3‰ on bottom in average. Particular at the site 5, salinity reaches to 15‰. From August to December salinity was quickly declined to 1 – 2 ‰.
- pH was also increase parallel with salinity. In April 2006 it was 7.67 (at surface) and 7.75 (on bottom). In May 2006 high salinity concentration that elevated pH to 8.32 at surface and 8.34 on bottom. From August to December following the declination of salinity, pH also decreased and ranged from 6.9 – 7.9.
- DO concentration was stable and high range from 6.86 - 7.19mg/L.
- Annual average of temperature is stable and high about 30^{0}C. The results measured at field was 27.9^{0}C (bottom) and 28.3^{0}C (surface) in April, 29.6^{0}C and 30.9^{0}C (in May), 30.53 ^{o}C and 30.86^{o}C (in August), 30.8 and 31.7^{0}C (in November).

Table 5. Typical environment of 4 ecological sub-zones in the Tam Giang - Cau Hai lagoon

St	Tran.	pH		Salinity		DO		T^{o}C	
		Surface	Bottom	S.	B.	S.	B.	S.	B.
	Fresh Water								
4-2006	0.73	7.12	7.10	1	1	7.1	6.94	28.3	27.6
5-2006	0.7	6.40	6.35	1	1	5.93	5.93	29.26	29.7
8-2006		5.69	5.85	1	1	6.26	5.86	30.93	30.46

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	0.9								
11-2006	1.05	7.83	7.88	1.00	1.00	6.37	6.17	31.03	31.13
	Fresh - Brackish water								
4-2006	0.8	7.67	7.75	1	1	7.19	6.89	28.4	27.9
5-2006	1.06	8.32	8.34	11.6	11.3	6.86	7.14	30.9	29.6
8-2006		6.94	7.0	1	1	6.9	6.63	30.86	30.53
11-2006	1.00	7.93	7.82	1.33	1.67	6.40	6.10	31.07	30.80
	Brackish water								
4-2006	1.5	8.19	8.22	12.7	13.8	6.85	6.55	28.9	27.9
5-2006	1.10	8.25	8.24	19.7	20.1	6.47	6.19	31.7	31.3
8-2006	1.14	7.64	7.04	12.27	14.86	6.41	5.81	30.82	29.96
11-2006	1.66	7.92	7.94	9.21	13.52	6.37	6.07	29.43	30.68
	Salt water								
4-2006	1.51	7.97	8.13	14	18	6.65	6.58	27.9	27
5-2006	1.52	8.18	8.18	23.5	28.33	6.71	6.18	30.2	29.2
8-2006	0.99	7.21	7.34	5.17	9.67	6.50	6.07	30.88	29.78
11-2006	1.22	7.88	7.95	11.83	20.75	6.32	5.98	29.17	29.15

+ *Brackish sub-zone*: this is the largest area in the lagoon.

- Salinity: In April 2006 the salinity in the surface was 14%o and on the bottom was 13.8%o in average. In May 2006, the salinity increased to 19.7%o in the surface and 20.1%o on the bottom in average. In August and November 2006, the salinity decreased to 7 - 8%o in the surface and 9 -12 %o on the bottom.
- Concentration of DO was at medium level, ranged from 6.37 to 6.85mg/L (surface) and 5.81 – 6.55 mg/L (bottom).
- pH was from 8.19 to 8.25 (alkaline) and stable in both two months April and May. In August and November 2006 pH decreased to 7.04 – 7.94.
- Temperature: In April 2006 average of temperature was 28.9^0C (surface) and 27.9^0C (bottom). In May 2006 the average of temperature was 31.7^0C (surface) and 31.3^0C (bottom) that increased about 3^0C when comparing to April. In August and November water temperature ranged about 30^0C in both surface and bottom layers.

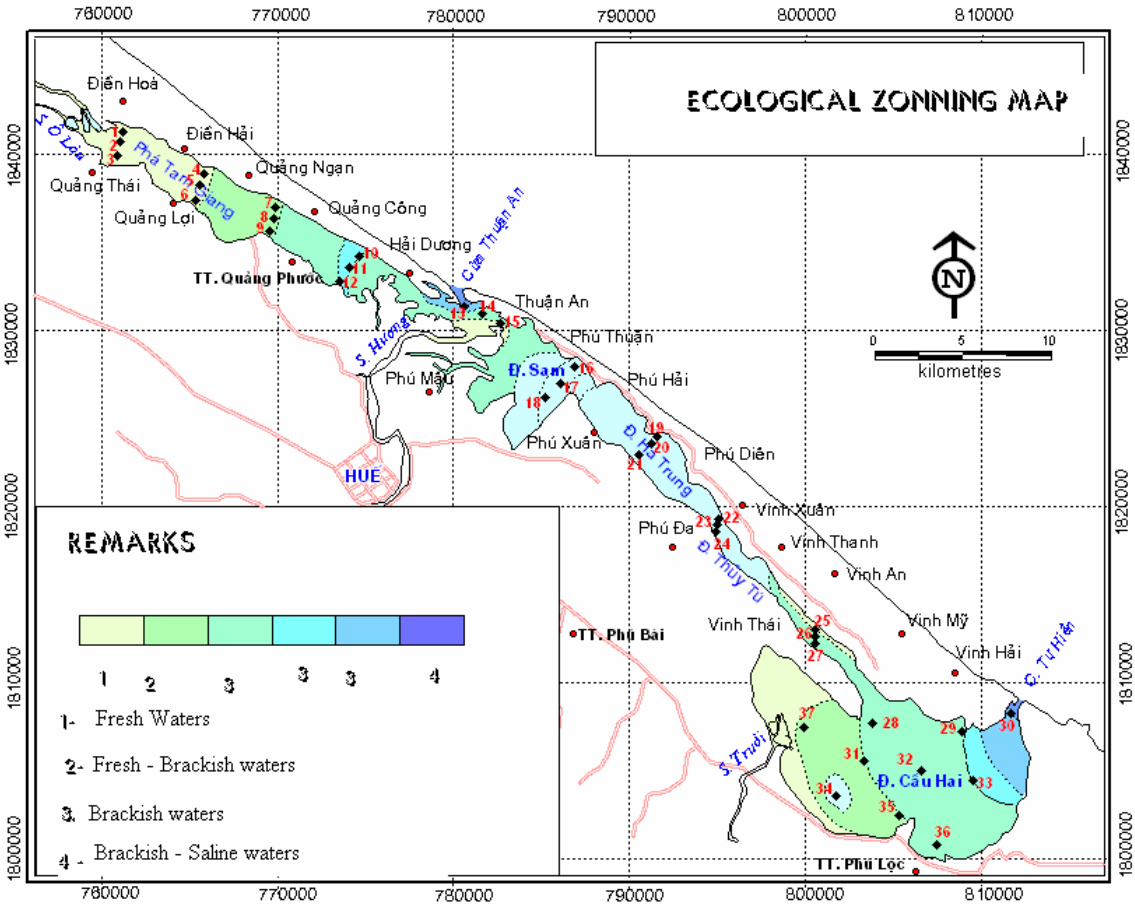

Figure 6. Ecological zoning in the Tam Giang - Cau Hai lagoon

+ *Brackish-saline water sub-zone*: That area is small at the lagoon mouths.

- Salinity: The typical characteristic of this zone is stratification of salinity. In April 2006 ranging in salinity was from 14‰ (at surface) to 18‰ (on bottom) and in May 2006 the salinity was increased to 23.5‰ (at surface) and 28.3‰ (on bottom). In August 2006 there was a stratification of salinity at Thuan An mouth (station 13) with salinity in surface was 2‰ and on bottom 25‰ which reduced average value of salinity to 5.17‰ (surface) and 9.67‰ (bottom). In November the salinity was higher 11.83‰ at surface and 20,75‰ on the bottom. The maximum of salinity concentration was reached to 33-34‰ at sites where located at center of two mouths.
- Concentration of DO was moderate level (6.18 - 6.71mg/L).
- pH ranged within 7.21 to 8.18, belong to alkaline or weak alkaline
- Average temperature in April 2006 was 27.9^{0}C (at surface) and 27^{0}C (on bottom), in May 2006 the average of temperature was 30.2^{0}C (at surface) and

29.2^{0}C (on bottom) that increased about 2^{0}C when comparing to April. The temperature was also similarly in August and November.

3.3. Some warnings on water quality in the Tam Giang - Cau Hai lagoon

The results of two surveys conducted in April and May 2006 were discovered warnings on water environmental quality in the lagoon such as acidification, salinization, reduction of DO, high oil concentration, and microorganism pollution.

- *Acidification*

It was quite clearly in O Lau area, after one-month pH was reduces from alkaline to acid. The results in the survey (April 2006) showed that pH at the surface of three sites were from 6.65 to 7.7 and ranged within allowable standard. In May 2006 pH decreased to 6.34 - 6.45 at surface and lower than allowable standard (figure 7).

On the bottom, the trend of pH changed similarly to the surface, the result in April 2006 pH at the surface of three sites were 6.57 - 7.6, that was within allowable standard. In May 2006, pH at surface reduced to 6.13 - 6.5 and lower than the allowable standard. It was continuously reduced to August 5.69 at surface and 5.85 on bottom and remains until to late of November after that pH was reached to weak alkaline (figure 7).

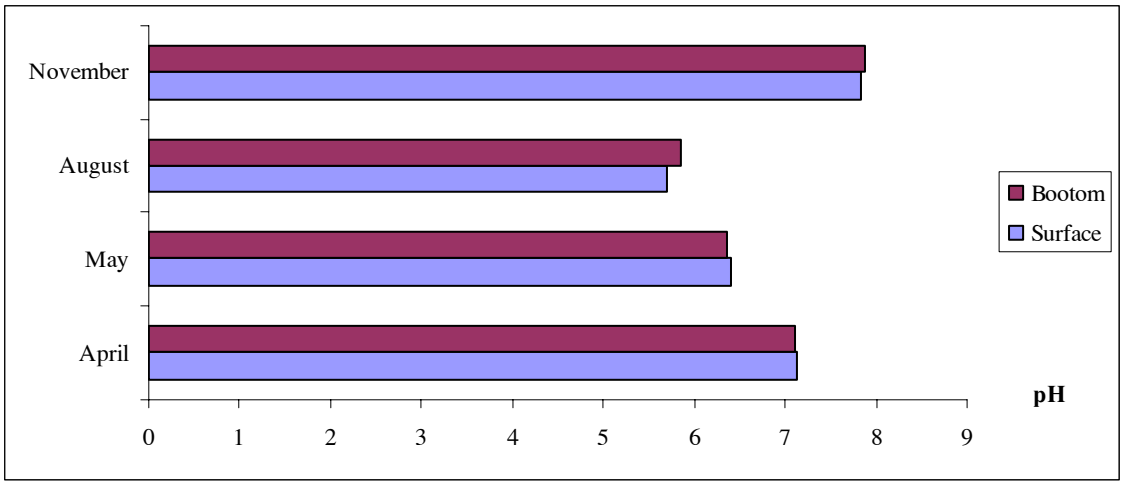

Figure 7. Comparison of pH in O Lau area, 2006

- *Salinization*

- O Lau river mouth: only one month (from April to May 2006) in Quang Ngan - Quang Cong area was change from fresh water (salinity less than 1‰) to brackish water (salinity from 10 - 15‰ (figure 8). Salinity was become normal condition in months from August to November. Therefore, it can see that the invasion of saline water from sea to the lagoon was very quickly, but if it has heavy rainfall on upper catchments area this area will become sweetness quickly.

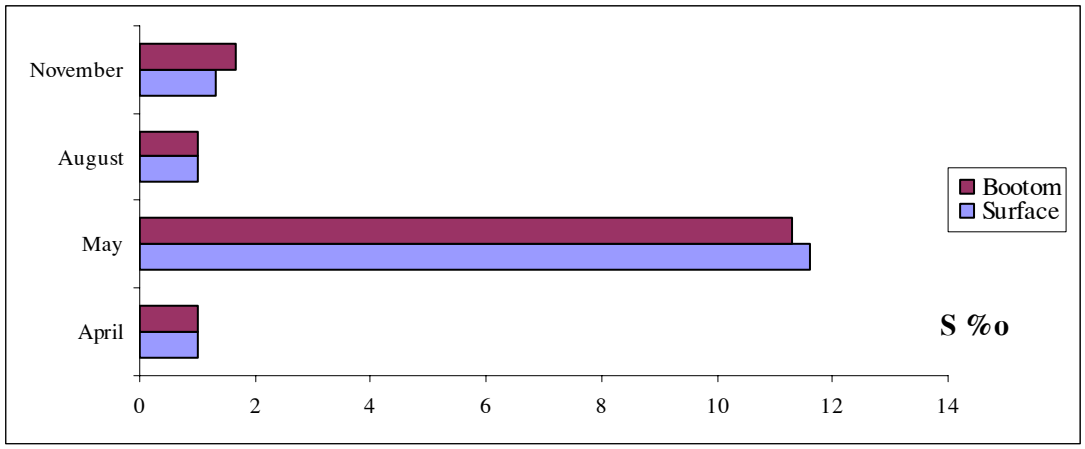

Figure 8. Changing in salinity in O Lau

- Huong river mouth: this area was directly suffered by two water bodies: fresh and saline water. The fresh water body runs off from Huong river and saline water from the sea through Thuan An mouth. In April 2006, salinity concentration was low from 4.5 - 8‰, but in May salinity was increase to13.5 – 31.5‰. In next months August and November salinity decreased very low from 1 – 5.5‰ (figure 9)

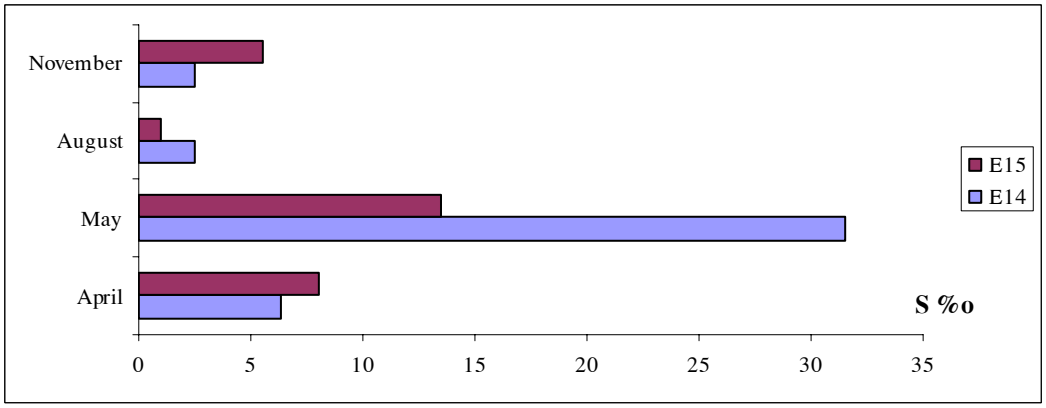

Figure 9. Changing in salinity in Huong river mouth

- *Decrease of DO*

The decrease of DO in the lagoon water will obstruct respiration process of organisms and result in suffocating. In May 2006 the data recorded on DO decrease at 10 sites in O Lau, Hai Duong, Thuy Tu and two sites in Cau Hai showed that decrease of DO was partial reduction (figure 13). At these sites, DO concentration was 6 – 7mg/L in April 2006. In May reduced to 4.9 – 5.2mg/L that was less than minimum threshold of organism on DO demand. The results in August and November showed that DO concentration was normal as previous months (figure 10).

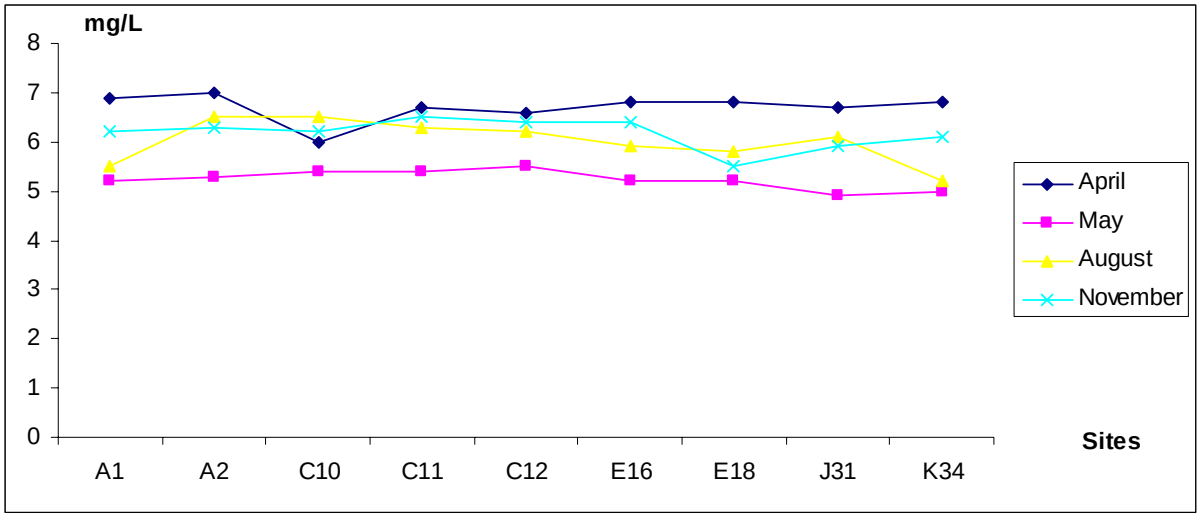

Figure 10. DO concentration at major sites

- *Microorganism pollution*

This pollution is should be alarm for water environment in the lagoon. Microorganism pollution was higher than allowable standard from 3 to 30 times. At the sites B5, E14, H23, F17, K33, K37 total coliform was higher from 110 - 240 times than allowable standard. (figure 11)

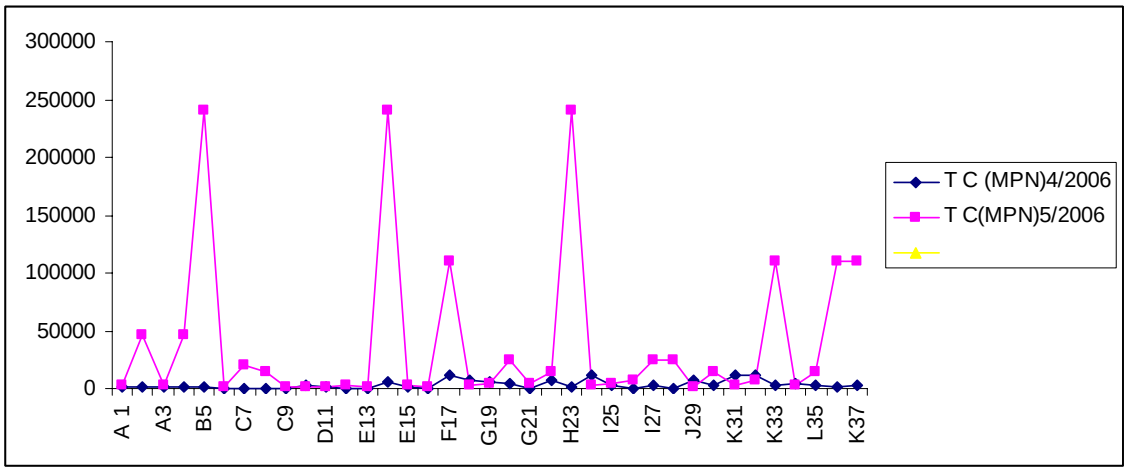

Figure 11 Total coliform in the lagoon

- *Increasing oil concentration*

In the Tam Giang - Cau Hai lagoon oil concentration was classified as high level. In April 2006 evarage of oil concentration was 0.305mg/L, in May was 0.402mg/L that was higher than April and remain until August (0.402). Late November and early December oil concentration reduced to 0.346mg/L (table 6 & figure 12.)

Particularly, at the sites E13, E15, K31, L36 were very high 0.6 – 0.8mg/L. At these values it may effect to grow of organisms.

Table 6. Oil oncentration in water 2006

Station	*April*	*August*	*November*
A – 1		0.185	0.208
A – 3	0.357	0.250	0.189
B – 4		0.537	0.447
B – 5	0.225	0.289	0.350
C – 7		0.235	0.190
C - 8	0.417	0.347	0.208
D – 10		0.450	0.189
D – 11	0.284	0.311	0.447
E – 13	0.455	0.730	0.350
E – 15		0.807	0.190
F – 16	0.198	0.390	0.427
F – 18		0.490	0.421
G – 19	0.259	0.513	0.500
G – 21		0.268	0.198
H – 23	0.281	0.200	0.195
I – 27	0.385	0.210	0.310
J – 29	0.242	0.420	0.508
J – 30		0.191	0.200
K – 31	0.503	0.610	0.708
L – 34	0.200	0.196	0.295
L – 36	0.166	0.822	0.756
Average	**0.305**	**0.402429**	**0.346952**

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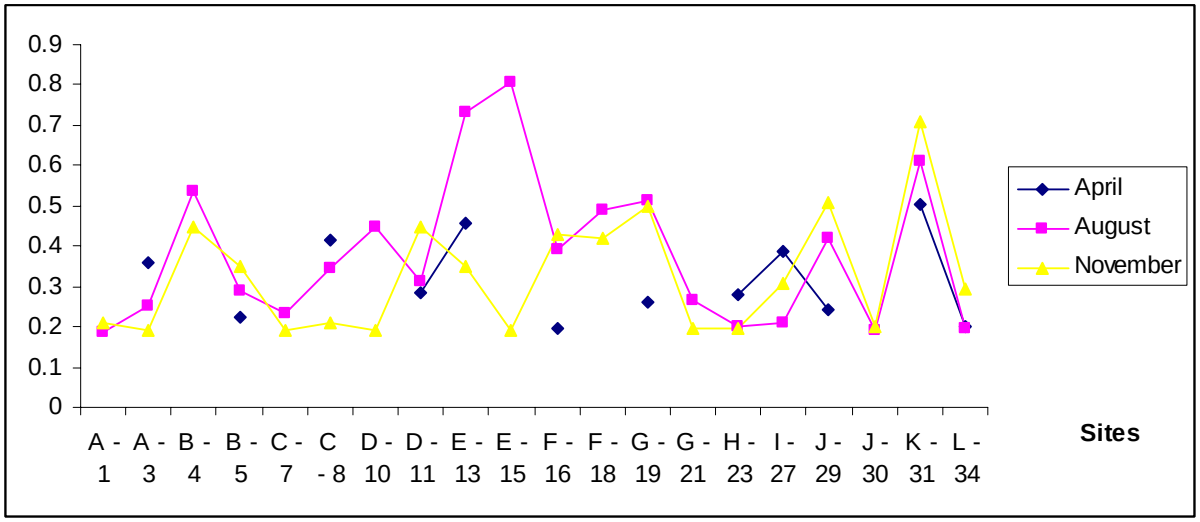

Figure 12. Concentration of oil in April, August and November 2006

3.4. Biodiversity in the Tam Giang - Cau Hai lagoon

3.4.1. Variety of ecosystems

The TG-CH lagoon is a lagoon system with total area about 21.876ha, semi-closed, connect to the sea through 2 mouths Thuan An and Tu Hien. The lagoon system is combination of such components that are Tam Giang (from O Lau to Huong river mouth), Sam - An Truyen lake or Sam lake (south of Huong river mouth), Thuy Tu-Ha Trung or Thuy Tu lake and Cau Hai lake in the south.

- *Topography of the lagoon*

There are 4 basic types of topography: shore topography, bottom topography, topography of lagoon mouth and sand banks.

+ Shore topography

Total length of lagoon shoreline is 183km, of which 12% is original rock (granite and gabro) that covers on east and south of Cau Hai lagoon. The rest is constituted by loose sediment of coastal flat. The shoreline topography behind the lagoon is a little differentiation, its height is not exceed 10m, the most of them are accumulated from sea - river, sea and creates sandy flat with altitude from 4- 10m and delta flat with common altitude from 3 - 6m. In the modern delta flat around the lagoon appears a swamp with altitude less than 1m cover by pasture, some areas are used for growing rice one crop. In the lagoon shore appears terrace type discontinuously, 1m in height and flooded in the rainy season likely warp flats in south of Thuy Tu.

+ Bottom topography

The bottom topography of the lagoon is relative flat, depth ranges from 0.5-2m, the deepest near Thuan An mouth is 5-6m. The detail of the lagoon's bottom topography is given below:

- Tam Giang area is 5.200ha, length 27km, average width about 2km (0.6-3.5km). Tam Giang creates a submerge tidal channel with 2m in depth and deeper toward Thuan An mouth 4-5m.

- Sam lake: area is 1.620ha, depth 1.5m in Hoa Duan and 0.5m in Phu An, An Truyen and there is a submerge tidal channel 2m in depth and deeper toward THuan An mouth 4-5m.

- Thuy Tu: length 24km, average width over 1km, area is 3.600ha and there is a submerge tidal channel 2m in depth, deeper toward Cau Hai, the highest in Ha Trung 4m.

- Cau Hai: semicircle shape with arc toward Phu Loc, area about 11.200ha. Width is 11km by northwest - southeast direction (from Thuy Tu to Vinh Phong mountain) and Da Bac to Tuy Van about 6km, from Dai Giang to Phuoc Tuong about 17km. Average depth from 1-1.5m, the deepest over 2m and toward Da Bac (south).

+ Topography of the lagoon mouth

The lagoon system has got two mouths Thuan An (in middle) and Tu Hien (in southern). The Thuan An mouth is main mouth by north-northwest and south-southeast direction, length is 600m, width is 350m and depth is 11m. Outside the mouth has a delta unsymmetry at depth of 2m. The Tu Hien mouth is secondary mouth with direction of channel is northeast – southwest, length is 100m, width is 50m, and the deepest is 1m. It was filled up in December 1994 water flows around mountain base in length of 3,500m and connect to the sea at depth of less than 1m and 40m in width.

+ Sand bank

Sand bank includes a system of sand dunes and modern beaches, prolong 102km from Cua Viet (Quang Tri) to Tu Hien (Thua Thien Hue). The segment from Cua Viet to Thuan An is 60km, 4,5km in width. From Cua Viet to Dien Huong (north of O Lau) average height is less than 10m and narrower and higher toward Thuan An. From O Lau to Thuan An, average height over 10m and the highest is 32m. The length of segment from Thuan An to Vinh Thanh is 37km, 2m in width and average height is 10m, the highest peak is 20m, narrower and lower toward Thuan An (2m in height). The length of segment from Vinh Thanh to Tu Hien is 5km, 300m in average width and 2.5m in height.

- *Classification of wetland in Tam Giang - Cau Hai*

According to Ramsar Convention on classification of wetland that was agreement in Switzerland in 1990, the Tam Giang – Cau Hai lagoon is classified as J type – wetland brackish coastal lagoon. Based on original source, the lagoon belongs to natural wetland. Based on differentiation and ecological function it is may classified into 15

types (figure 13 & Table 7). Eight types of habitat were selected and specific described as following:

Type 1: the swamp where growing rice irregularly, with area is 1,648.96 (6.94% total of the lagoon) that was lower than in 1998 (3.881ha occupied 15,6% total of wetland area), main distribution in O Lau, Huong, Truoi - Dai Giang river mouth area and around the lagoon.

Type 2: the swamp with mangrove, with area about 3ha (0.01%) and most in Tan My area (Thuan An town, Phu Vang district) and Ru Cha (Huong Phong commue, Huong Tra district).

Type 3: Warp flat with grass flooded in rainy season, with area 1408.5 ha (5.93%), distributed in southern Thuy Tu.

Type 4: tidal flat, with area 599.08 ha (2.52%) distribute around Sam and Thuy Tu.

Type 5: water grass bed, area about 11,420.44 ha (48.08%) mostly distributed in around basin of the lagoon to depth of 1m or 1.5m

Type 6: muddy bottom, area is about 711.92 ha (2.99 %), distributed in basin of the lagoon and Dai Giang river mouth area.

Type 7: the bottom is sandy mud, area 3673.67ha (15.46%), distributed in around the lagoon mouth.

Type 8: Aquaculture ponds, area is 4287,44ha, occupied 18.05% total area of the lagoon, that is higher than in 1998 (579ha and 2,33%). distributed in almost districts around the lagoon but more concentrated in Dam Sam and Cau Hai.

Comparing to the data in 1998 showed that after 8 years aquaculture area is increase about 8 times from 579ha (2,33%) to 4287,44ha and irregular rice land area is reduced from 3.881ha (in 1998) to 1648.96ha (table 7)

Table 7. Comparison area of habitats in the lagoon area

Area	Area in 1998 (Thanh TD, 1998)		Area in 2006	
Type	(ha)	(%)	(ha)	(%)
1. Irregular rice land area	3881	15,6	1648.96	6,9421
2. Mangroves	7	0,03	3.13	0,0132
3. Warp flat with grass flooded in rainy season	692	2,78	1408.50	5,9298

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4. Sandy mud tidal flat	282	1,13	599.08	2,5221
5. high density of water grass	9215	37,04	11420.44	48,08
6. Mudy bottom	1406	5,65	711.92	2,9972
7. Sandy mud bottom	3810	15,32	3673.67	15,4661
8. Aquacultural pond	579	2,33	4287.44	18,0501
II. Edge of the lagoon				
9. Rice field			43868.86	
10. Sand dune			5673.28	
11. River, lake			1652.51	
12. Beach			916.97	
13. Sea floor			94956.61	
14. Resident area			18613.36	
15. Vegetation			7861.64	

- *Sub-ecosystems in the lagoon*

The Tam Giang - Cau Hai lagoon system lies on the coastal zone of Central, there are many types of habitat that is basement to create typical sub-ecosystems of wetland. Excluding coral reef ecosystem, in the area has all typical ecosystems for the coastal zone of Vietnam. Particularly, the swamp with seagrass sub-ecosystem plays an important role in term of attracting waterfowls and aquatic species that procedures biological production for the lagoon. It is suggested that the Tam Giang - Cau Hai is typical coastal lagoon system in Vietnam.

- Estuarine sub-ecosystem: The lagoon is directly affected by 4 river mouths such as O Lau, Huong, Dai Giang and Truoi river. The O Lau river rises from mountain area of Tay Tri Thien and discharge into the O Lau by northwest - southeast direction. The Huong river is the biggest river run off into the Tam Giang by northeast - northwest direction. Both Truoi and Dai Giang river run off to Cau Hai area and connect to the East sea through Tu Hien mouth. Consequently the salinity is very low sometime reducing to 0‰ for example in O Lau. Due to strong effected by rivers the lagoon was formed estuarine and coastal sub-ecosystems which have nutrient enrichment but low salinity that was suitable environment for growing of submerge grass and water fowl immigration from the Northern.

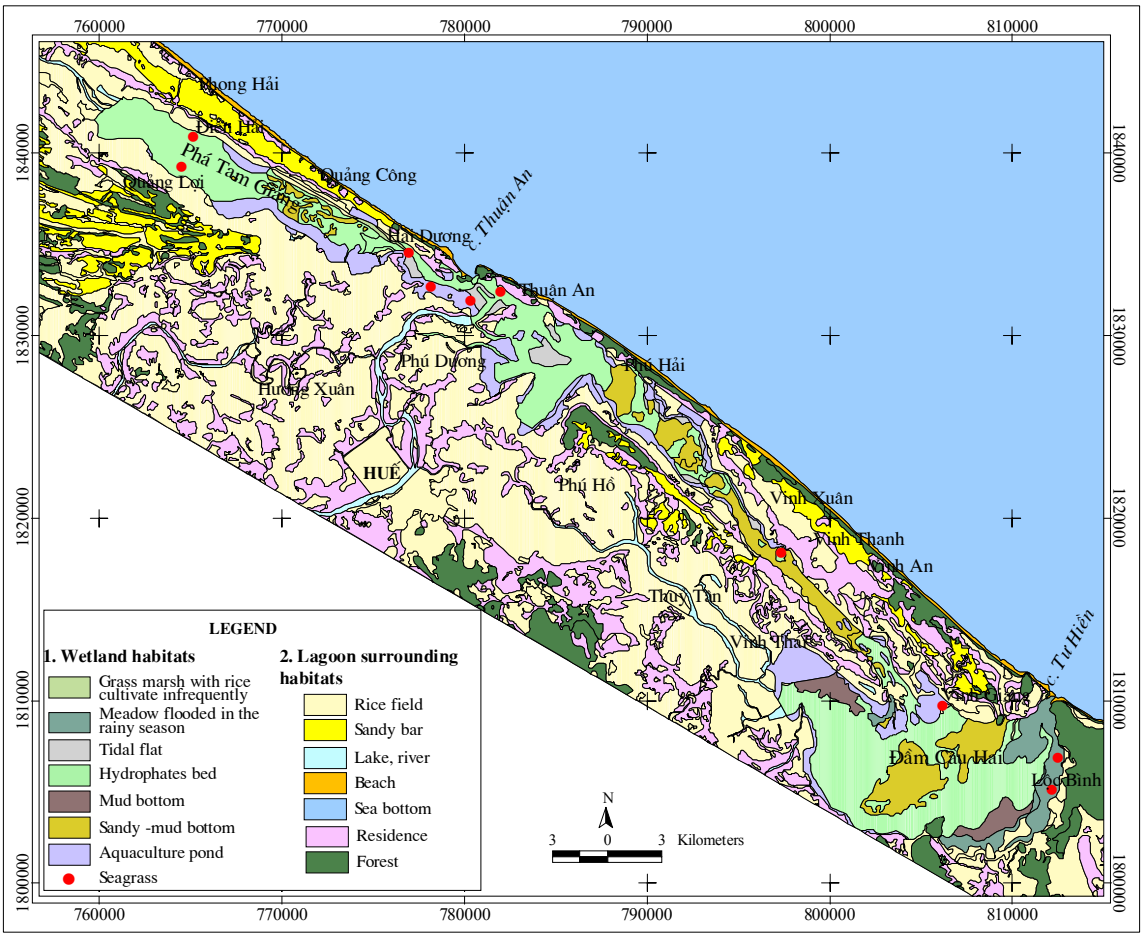
- Sub-ecosystem of water grass: Area of water grass is 1762ha, occupying 50% of total area of the lagoon, that is most important sub-ecosystem of the lagoon. Water grass grows around the lagoon and most concentrates at depth from 0.5 to 1.5m or growing into blanket that covers islets. The sub-ecosystem plays an important role in term of food chain in the lagoon. It transforms a huge of organic and inorganic matters into available foods for other organisms (stock of water grass in the lagoon about 190,000

ton, Tien N.V., 2000). Many fish, shrimp, crab species are directly use water grass as their food, so that it may shorten the food chain result in high productivity in the lagoon. The function of seagrass is a habitat of marine and fresh water migrant organism. Therefore, this is source of fry (seed) for whole area.

Sub-ecosystem of soft bottom: Occupying about 30% of total area of the lagoon, it is located from 2m to 9m in depth. Because of high depth and salinity (sometime reach to 30‰) thus brackish and fresh water grass cannot grow. Sediment structure of the bottom is mostly sandy mud or muddy sand. The analyzed result shows that bottom sedimentation is dominated by fine sand or coarse sand (md>0.05mm), muddy granule sediment (md<0.05mm) is dominated in deeper channel. The main function of soft bottom sub-ecosystem is metabolism process and clean out the bottom based on circulation of water current between see and lagoon through Thuan An and Tu Hien. The soft bottom is a place where small mollusck, crustacean, echinodermata, polychaeta are thriving hence this area is also an ideal place for attracting bottom fishes come to hunt for prey. Noticeably, on soft bottom in Thuan An and Tu Hien mouth are main distribution of marine products from the sea.

- Tidal sub-ecosystem: this area is narrow, mainly is small sand flats lie along the sand dunes between the lagoon and the sea. In term of biodiversity the tidal sub-ecosystem is not as diversity as the others but it is significant role in term of scenery and environment. Especially, fine sandy beaches and clean water are valuable for tourist activities in the future. The sand dunes lie along the shoreline has function on protecting penetration of salinity into the mainland.

Map of habitat distribution in Tam Giang - Cau Hai lagoon



Institute of Marine Environment and Resource, 2006

Figure 13. Types of habiats in the Tam Giang - Cau Hai lagoon

- Agricultural sub-ecosystem: The land areas where are adjacent to river mouths, low salinity in water may reclaim for raising rice and other plants. The main function of this sub-ecosystem is produce foodstuff for local resident around the lagoon (production 122,000 tones rice/year). Sometimes this area is a hunting place of many migrant waterfowls.

- Mangrove sub-ecosystem: there is small area in Tam Giang forming a mangrove forest. The main mangrove tree is *Avicennia mariana, Rhizophora apiculata, Bruguiera sexangula* ... the main function of mangrove is scenery, habitat of waterfowls as well as protection of shoreline.

Among the above sub-ecosystems, the function of the water grass, soft bottom and estuarine sub-ecosystems are three main ecosystems of the Tam Giang - Cau Hai lagoon.

3.3.2. Species richness

By estimating, there are about 1000 species living in the Tam Giang - Cau Hai lagoon, among them 938 - 953 species have been named. Probably this lagoon was the most fully study. Phytoplankton has the highest in number of species - 287 species, fish – 215 - 230 species, bird - 73 species, zooplankton 72 species, benthos 193 species, seaweed 46, higher plant 31, water grass 18 (of which 7 sea grass species) (table 8 & figure 14). Particularly, small bottom plant has 54 species but the source is unknown so that it is not in the list. This list of species is higher than other lagoons for example Dam Nai (309 species), Thi Lai (686 species).

Table 8. Number of organism recorded in the Tam Giang - Cau Hai lagoon in 4 survey times 2006

Organism group	4/2006	5/2006	8/2006	11/2006	Total	Remark
Sea grass	7	7	7	7	7	7
Seaweed and and other water plants						88
Phytoplankton	180	160	123	123	287	287
Zooplankton	44	49	33	34	72	72
Benthos	125	135	102	101	193	205
Fish						215 - 230
Bird						73
Total						938 - 953

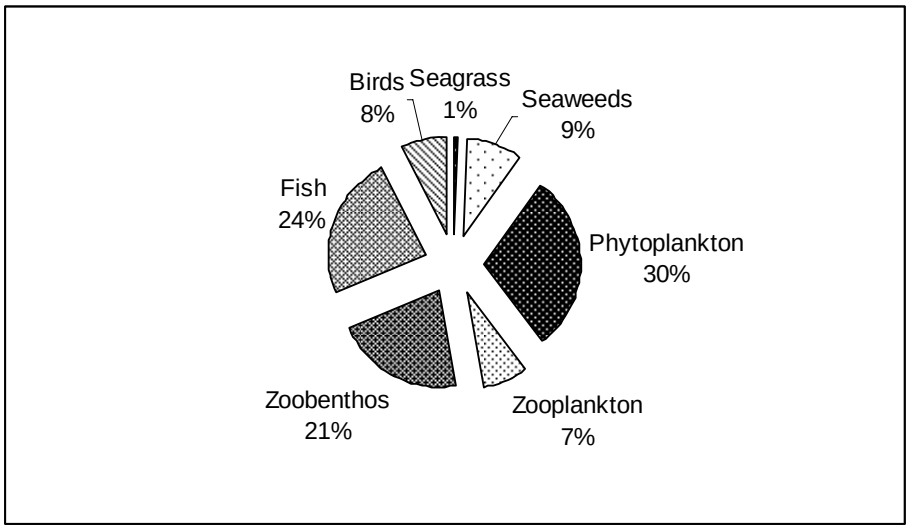


Figure 14. Number of organism groups in the lagoon

The main reason of high biodiversity on number of species in the lagoon is complex changes in environment. Particular, the changing in salinity between two seasons (dry and rainy season) that affected to genetic origin of biota. For example in rainy season, the freshwater grass *Valisneria spiralis* is dominated accompany with thriving of *Macrobranium spp, Palaemonetes spp, Corbicula spp*. In contrast, in the dry season, brackish species are dominated such as squids *Loligo sp, Sepia sp,* shrimp *Penaeus spp,* crab *Portunus spp,* fish *Siganus sp ...* the thriving of organism is regularly alternate between seasons and biota (fresh and saline water) that create a sustainable ecosystem and resource for the area.

The specific characteristic of the lagoon is growth of water grass thus this area is habitat of many migrant waterfowls, among them there are about 30 species protected by EU such as *Ardae purpurea, Pandion haliaetus, Falco tinnunculus,* and one species *Limnodromus sesmipalmatus* is recorded in the Vietnam Red Book.

Hereunder are detailed results on some typical organism groups that are present for biodiversity of the lagoon.

3.4.3. Some main characteristics of organism communities in the Tam Giang - Cau Hai lagoon

- *Phytoplankton*

+ Number of species: In April 2006, 180 species had been recorded, in May - 160 species, in August – 123 species, in November – 123 species. Total 287 species have been recorded in four survey trips.

+ Density of phytoplankton: average density in 4 field trips was 13221 cell/L, the lowest was 240 cell/L (station 37 in April) and the highest was 232320cell/L (station 5 in August) (table 7). That evident showed that the density of phytoplankton in the lagoon was very high. Stations have the highest density were 1, 5, 7, 28 and 30 and often occur in August (table 8 & figure 15)

Table 8. Density of phytoplankton at stations in the Tam Giang - Cau Hai lagoon (4 survey trips 2006)

Transect	Station	4/2006	5/2006	8/2006	11/2006
A	1	1540	47300	183540	7240
	2	3160	11460	117760	2320
	3	380	10780	79520	10800
	TBA	**1693**	**23180**	**126940**	**6786**
B	4	2550	4080	181780	9420
	5	5100	1270	232320	

	6	340	1940	4600	7920
	TBB	**2663**	**2430**	**139566**	**8670**
C	7	3440	970	170640	460
	8	3100	1230	40060	1700
	9	10830	1740	18560	4100
	TBC	5790	1313	76420	2086
D	10	920	700	53840	1140
	11	1590	1330	21580	700
	12	1010	610	6200	1140
	TBD	**1173**	**880**	**27206**	**993**
E	13	1870	2150	14640	560
	14	3140	2860	4960	
	15	6500	960	6900	620
	TBE	**3836**	**1990**	**8833**	**590**
F	16	3120	1950	**10380**	
	17	2770	1740	6840	5960
	18	810	3120	26160	1240
	TBF	**2233**	**2270**	**14460**	**3600**
G	19	3730	1400	26600	3000
	20	8120	1280	**9660**	
	21	3650	2710	6680	4540
	TBG	**5166**	**1796**	**14313**	**3770**
H	22	3430	2840	**11220**	
	23	1280	1390	9040	8260
	24	970	1280	9780	4660
	TBH	**1893**	**1836**	**10013**	**6460**
I	25	1490	470	15380	3120
	26	710	540	**13520**	
	27	1210	880	**14640**	
	TBI	**1136**	**630**	**14513**	**3120**
J	28	470	500	46080	

	29	240	770	27900	5560
	30	4800	1510	28760	57700
	TBJ	**1836**	**926**	**34246**	**31630**
K	31				
	32	390	490	5600	4880
	33	310	1030	2140	
	37	240	520		
	TBK	**313**	**680**	**3870**	**4880**
L	34	3490	580		
	35	7850	500	4780	11680
	36	12500	450	6860	
	TBL	**7946**	**510**	**5820**	**11680**
Average		***2973***	***3203***	***39683***	***7022***

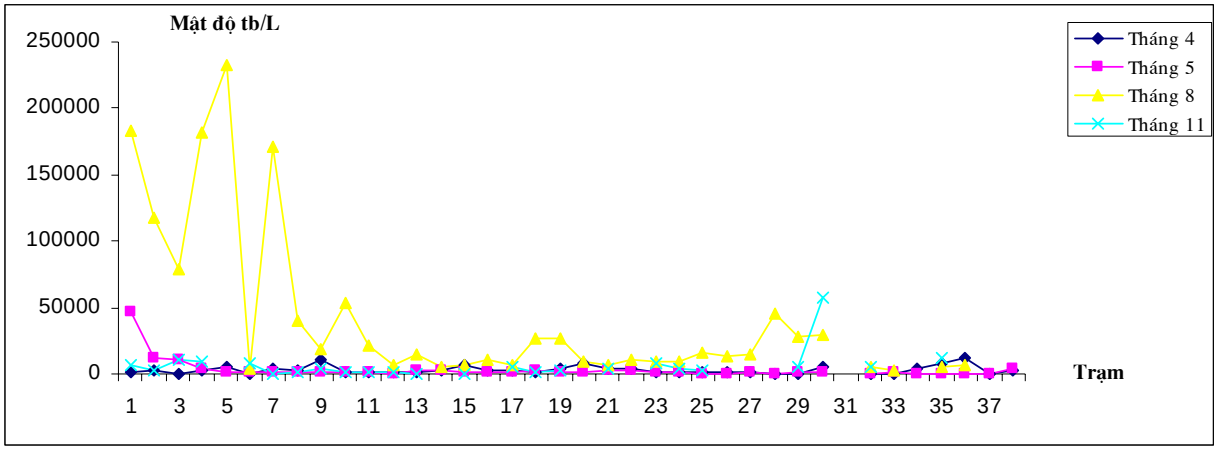


Figure 15. Density of phytoplankton in four survey trips, 2006

- Changing by time: The results showed that density of phytoplankton was inceased from April to August. The highest in August was 39683cell/L and the lowest was 2973 cell/L in April. In November the density decreased to 7022 cell/L (table 9 & figure 16)

Table 9. Average density of phytoplankton in the lagoon 2006

Transect	Density of phytoplankton **(cell/L)**				**Average**
	Apr-06	May-06	Aug-06	Nov-06	
TBA	1693	23180	126940	6786	39650
TBB	2663	2430	139566	8670	38332
TBC	5790	1313	76420	2086	21402

TBD	1173	880	27206	993	7563
TBE	3836	1990	8833	590	3812
TBF	2233	2270	14460	3600	5641
TBG	5166	1796	14313	3770	6261
TBH	1893	1836	10013	6460	5051
TBI	1136	630	14513	3120	4850
TBJ	1836	926	34246	31630	17160
TBK	313	680	3870	4880	2436
TBL	7946	510	5820	11680	6489
Average	***2973***	***3203***	***39683***	***7022***	***13221***

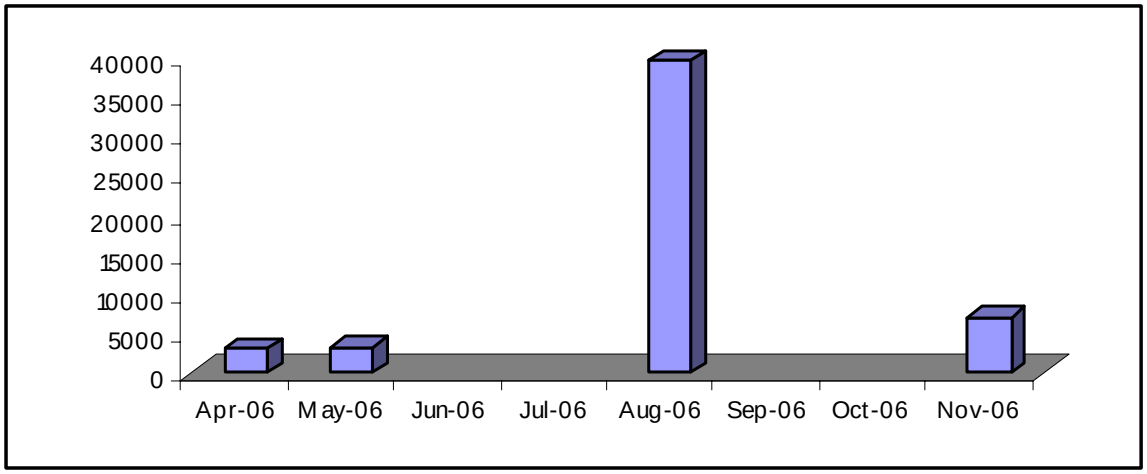


Figure 16. Changing in density of phytoplankton 2006

- Spatial changes: In 4 survey trips, density of phytoplankton at stations from transects A (O Lau mouth) to transect D (Thuan An mouth) were the highest, average from 7563 cell/L - 39650 cell/L. The next stations from transect E (Phu Xuan) to transect I (Vinh Thai) were the lowest, average from 3812 cell/L (transect E) to 6261 cell/L (transect G). The medium area from transect J to L, density of phytoplankton was from 2436 cell/L - 17160 cell/L (figure 17).

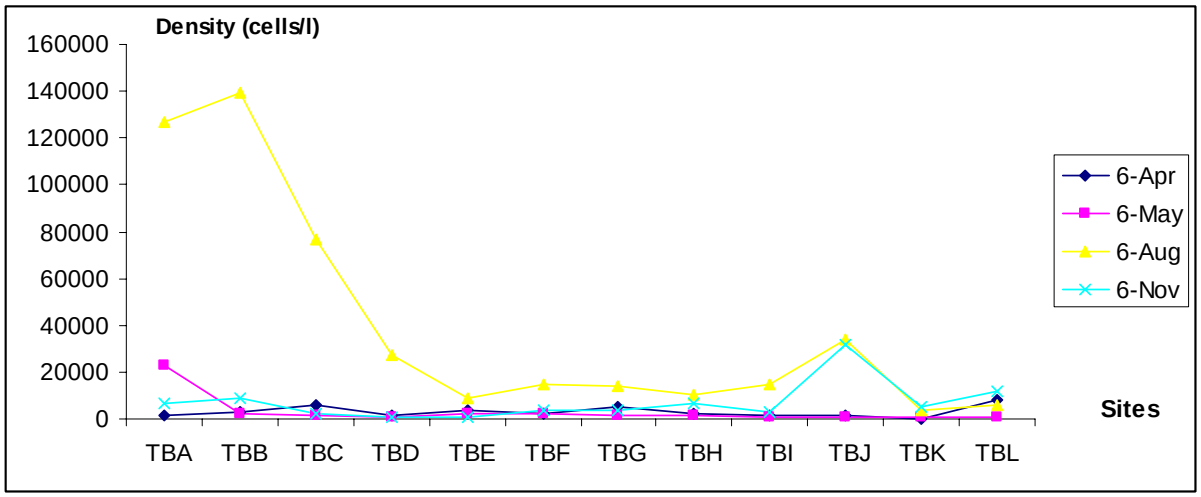


Figure 17. Spatial change of phytoplankton density

- Changing in sub-ecosystem zone: The results in four survey trips showed that density of phytoplankton in fresh-brackish water was the highest, ranged from 2430 cell/L to 139,567 cell/L. The next is fresh zone from 1693 cell/L to 126,940 cell/L and the lowest is brackish- salt water density from 1378 cell/L to 17103 cell/L (table 10 & Figure 18) This trend reflects clearly ecological zonation accompany with growth of phytoplankton.

Table 10. Distribution of phytoplankton by ecological zone, 2006

	April	May	August	November
Fresh water zone	1693	23180	126940	6787
Fresh-brackish water zone	2663	2430	139567	5780
Brackish water zone	3394	1260	23490	7143
Brackish-salt water zone	2088	1378	17103	2247

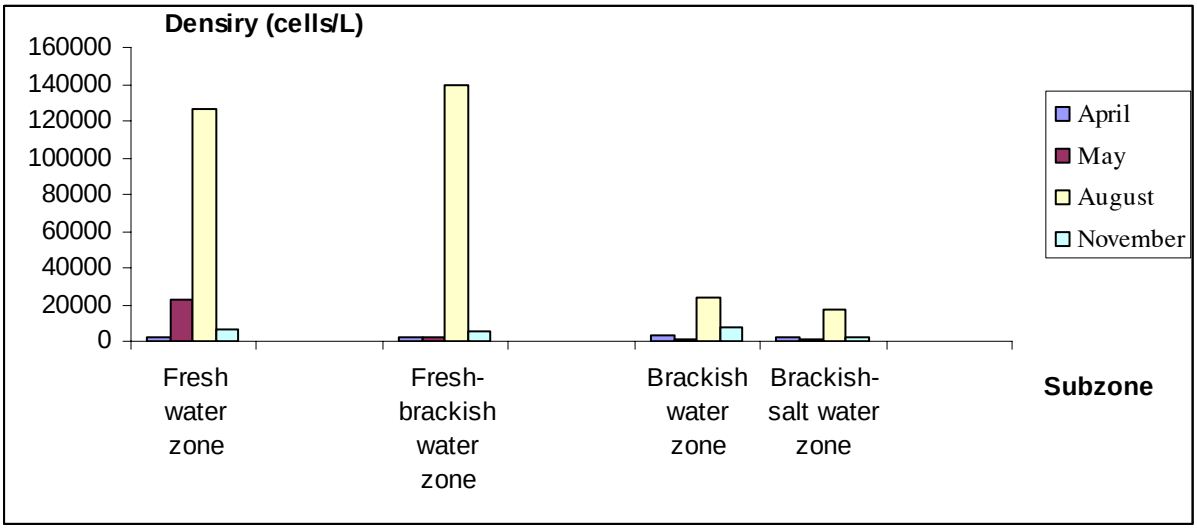


Figure 18. Changing in density of phytoplankton by ecological zones

- *Zooplankton*

+ Species composition: In April 2006, 44 species of zooplankton had been found, in May – 49 species, in August – 33 species and in November – 34 species. Total in four survey trips have been recorded 72 species of zooplankton.

+ Density of zooplankton: similar to phytoplankton, the Tam Giang - Cau Hai lagoon has high density of zooplankton, in whole the lagoon density ranged from 2313 - 25946 ind/m^3, average was 847-ind/m^3, the lowest station was 50-50ind/m^3 (station 36, 15 in April 2006). The highest stations were 5, 9, 18, 20, 33, 34 and 35. Particular, at station 33 the density of zooplankton was 250,000ind/m^3 (in August 2006) (table 11 & figure 19)

Table 8. Density of Zooplankton at stations in the Tam Giang - Cau Hai lagoon (4 survey trips 2006)

Station	zooplankton **(ind/m^3)**			
	4/2006	5/2006	8/2006	11/2006
1	2850	5600	2550	500
2	150	5300	10500	2280
3	2550	80	10100	2600
AA* (Average of A site)	**1850**	**3660**	**7716**	**1793**
4	3300	3500	2100	1000
5	40400	700	2250	1950
6	14300	70	6800	15750
AB	**19333**	**1423**	**3716**	**6233**

7	3700	550	5550	2200
8	550	160	4100	1600
9	170	2250	9000	37250
AC	**1473.33**	**986**	**6216**	**13683**
10	-	3800	1050	90
11	1020	650	7450	110
12	1650	1050	1450	360
AD	**1335**	**1833**	**3316**	**186**
13	330	6100	2050	600
14	-	2650	3500	220
15	50	850	160	80
AE	**190**	**3200**	**1903**	**300**
16	430	5500	1060	120
17	950	2100	4500	150
18	140	3300	38400	110
AF	**506**	**3633**	**14653**	**126**
19	2200	2200	1500	130
20	750	2500	191600	2040
21	1650	2850	18300	800
AG	**1533**	**2516**	**70466**	**990**
22	4900	12900	37000	400
23	1900	22300	30800	200
24	1000	5300	67400	590
AH	**2600**	**13500**	**45066**	**396**
25	850	650		720
26	600	680	13400	920
27	1150	700	2450	640
AI	**866**	**676**	**7925**	**760**
28	2100	3250	1500	130
29	150	3670	14200	370
30	740	3850	11200	6600

AJ	**996**	**3590**	**8966**	**2366**
31				90
32	140	1850	40200	1720
33	140	2000	250000	490
37	190	270	12400	
AK	**156**	**1373**	**100866**	**766**
34	850	9000	52000	280
35	140	3000	44800	430
36	40	5200	6800	160
AL	**343**	**5733**	**34533**	**290**
Average of lagoon	**2707**	**3511**	**25946**	**2313**

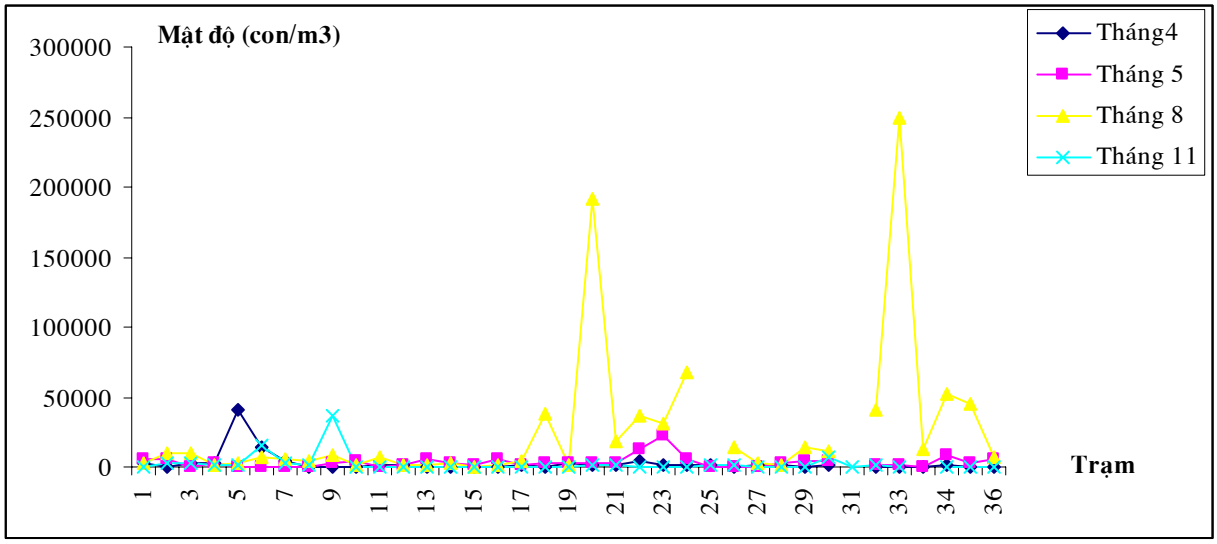
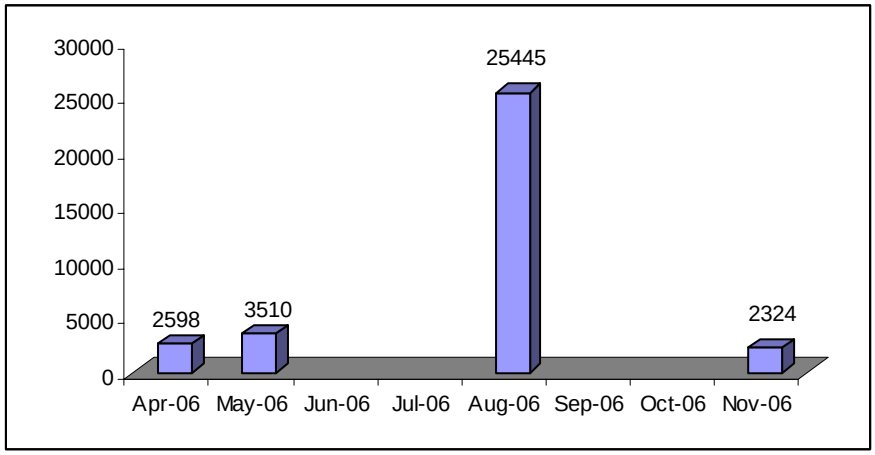


Figure 19. Density of zooplankton in the Tam Giang - Cau Hai lagoon (ind/m^3)

+ Changing by time: The results showed that the trend of zooplankton density was increase from April to August. In August 2006 density of zooplankton was the highest 25 445 ind/m^3 and in April the density was 2598 ind/m^3. In November the density decreased 23 24 ind/m^3 average in the whole lagoon. (table 12 figure 20)

Table 12 Average density of zooplankton on transects
(from 4 to 11/2006)

Station	zooplankton **(ind/m^3)**				Average
	6-Apr	6-May	6-Aug	6-Nov	
TBA	1850	3660	7716	1793	3755
TBB	19333	1423	3716	6233	7676
TBC	1473	986	6216	13683	5590
TBD	1335	1833	3316	186	1668
TBE	190	3200	1903	300	1398
TBF	506	3633	14653	126	4730
TBG	1533	2516	70466	990	18876
TBH	2600	13500	45066	396	15391
TBI	866	676	7925	760	2557
TBJ	996	3590	8966	2366	3980
TBK	156	1373	100866	766	25790
TBL	343	5733	34533	290	10225
Average	**2598**	**3510**	**25445**	**2324**	**8470**



Figre 20. Changing in density of zooplankton by time

+ Spatial change: Density of zooplankton was complex changes in four survey trips. In months April and November the density of zooplankton was lowest on transect A (O Lau mouth), but on transect B (Quang Loi) and C (Quang Ngan) presented peaks with density 19333 ind/m^3 (in April) and 13683 ind/m^3 (in November). From May to August the peaks moved towards South direction on the transect G, H and K with

density were 70466 ind/m^3, 45066 ind/m^3 and 100866 ind/m^3 respectively. Thus, change of zooplankton density nearly conversed with phytoplankton (fig .21).

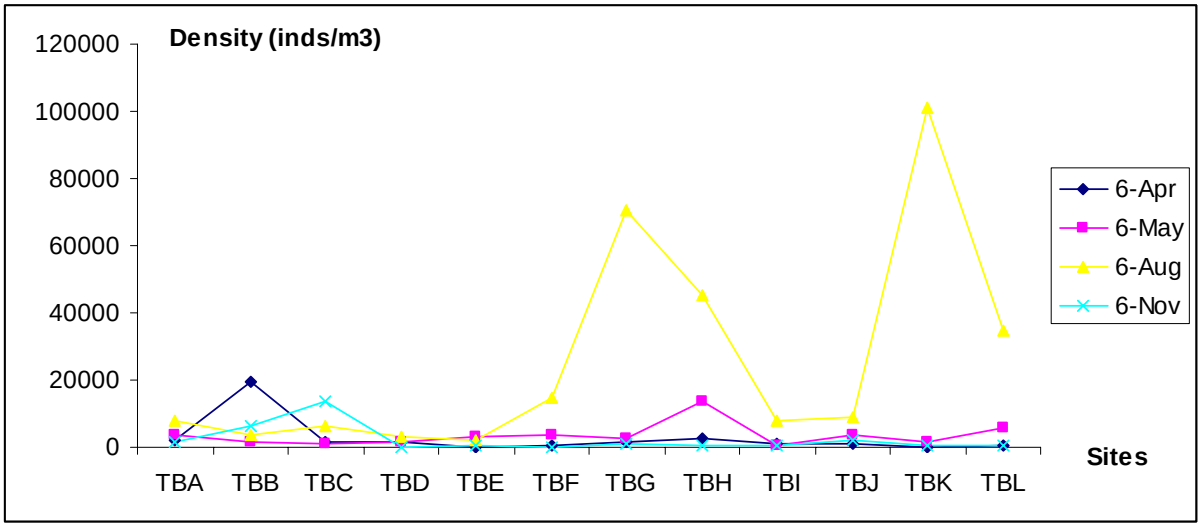


Figure 21.Everage of Density of zooplankton on transects 2006

+ Change by sub-ecological zone: Analysis results in four survey trips on density of zooplankton showed that the density of zooplankton increased from low saline to high saline ecological zone. Low saline zone in O Lau has average density of zooplankton in 4 survey trips was 3755 ind/m^3 , whereas in brackish – salt water zone average density was 12298 ind/m^3, fresh-brackish water was 7527 ind/m^3 and brackish water was 8116 ind/m^3. Change of zooplankton density nearly conversed with phytoplankton. (table 13 & figure 22)

Table 13. Zooplankton density in ecological zones

Sub-zones	April	May	August	November	Average
Fresh water	1850	3660	7717	1793	3755
Fresh-brackish water	19333	1423	3117	6233	7527
Brackish water	1118	3859	25100	2387	8116
Brackish – salt water	554	3087	45235	315	12298

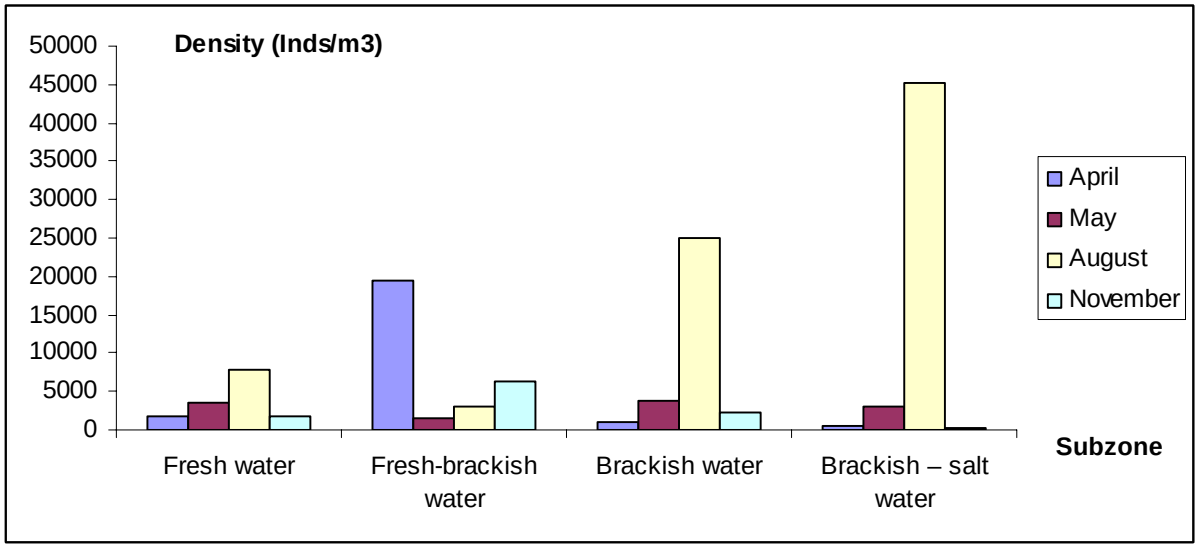


Figure 22. Comparison of zooplankton density between subecological zones

3.4.4. Benthos

+ Species composition: Based on sample analyzed result in 4 survey trips (Apri, May, August and November 2006) there were 205 species have been found in the lagoon. The detail of each survey trip is given follow: in April had been found 125 species, in May – 135 species, in August – 102 species and in November – 101 species. Structure of species composition includes Mollusca – 92 species, Crustacea- 51 species, worm 49 species, Echinodermata – 3 species and others – 8 species. So that there are two significial groups that are Mollusca, Crustacea dominated in the structure of benthos species composition in the lagoon.

+ Density: Density of benthos was classified as high level and their distribution were typical for each sub-ecological zone. The Average of Laggon 485.6 individs/ m^2 (April - 483.9 inds/m^2, May - 484.1 inds/m^2, August - 392.8 inds/m^2. The high density are tendency from site D (Hai duong) to Cau Hai. The highest density is from station F18 (1066.4 inds/m^2) and L37(1874.9 inds/m^2) and the lowest density from stations nearly Olau as B4, B5, B6, C7, C8)) (Table 14 & Fig. 23)

Table 14. Density of benthos in 2006

St	**4/2006**	**5/2006**	**8/2006**	**11/2006**	**Average**
	Inds/m2	Inds/m2	Inds/m2	Inds/m2	
1	826	800	540	926.7	773.2
2	140	426.7	400	453.3	355.0
3	406	373.3	386	413.3	394.7
4	246	233.3	380	166.7	256.5

5	286	106.7	420	160.0	243.2
6	113	113.3	120	226.7	143.3
7	133	173.3	93	186.7	146.5
8	240	326.7	200	233.3	250.0
9	266	300	613	413.3	398.1
10	440	273.3	253	293.3	314.9
11	540	273.3	166	560.0	384.8
12	540	860	233	393.3	506.6
13	93	193.3	80	73.3	109.9
14	180	193.3	193	986.7	388.3
15	380	686.7	386	533.3	496.5
16	746	533.3	480	673.3	608.2
17	226	166.7	200	366.7	239.9
18	806	520	473	2466.7	1066.4
19	1226	960	1086	473.3	936.3
20	333	180	246	640.0	349.8
21	1266	1246.7	300	933.3	936.5
22	340	1140	933	740.0	788.3
23	360	193.3	146	486.7	296.5
24	360	300	1086	680.0	606.5
25	553	373.3	393	340.0	414.8
26	193	313.3	146	1366.7	504.8
27	273	240	360	893.3	441.6
28	593	333.3	626	260.0	453.1
29	586	420	660	606.7	568.2
30	120	253.3	210	106.7	172.5
31	-	-	-	800.0	
32	213	613.3	273	780.0	469.8
33	226	500	1020	360.0	526.5
34	160	326.7	153	386.7	256.6
35	140	213.3	253	780.0	346.6
36	273	500	493	586.7	463.2

37	3793	2766.7	140		1874.9
Aver.	**489.3**	**484.1**	**392.8**	**582.3**	**485.6**

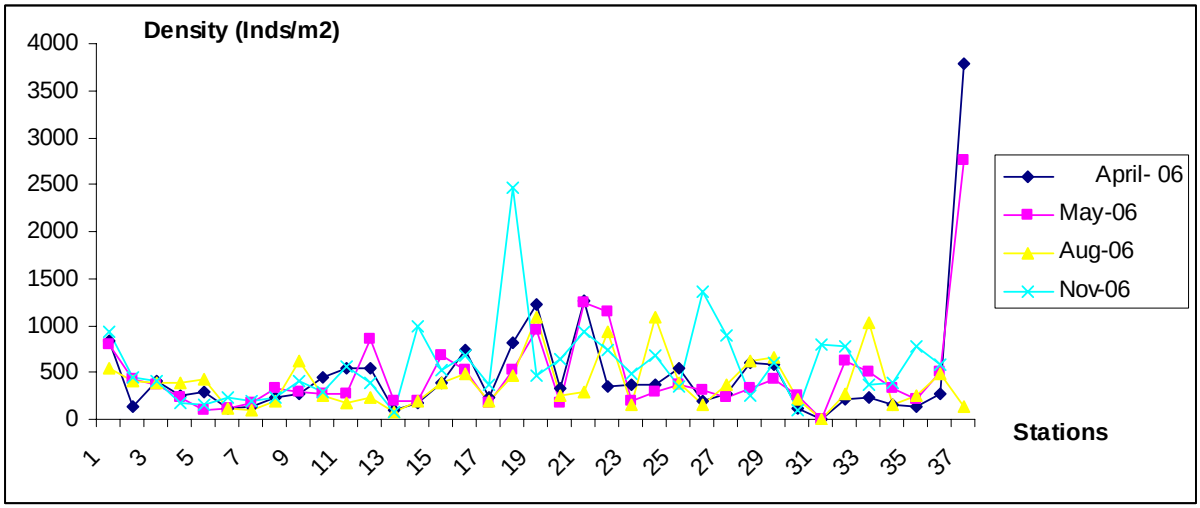


Figure 23. Density of zoobenthos in the Tam Giang - Cau Hai lagoon (ind/m)

- Change by sub-ecological zone: Analysis results in four survey trips on density of zoobenthos showed that the density of zoobenthos in the Brackis water is highest and changing from 372 - 649 inds/m^2; The next, it is in the fresh water (nearly Olau) with 442 inds/m^2 - 597 inds/m^2; The lowest in Fresh - brackish water with average 214.3 inds/m^2; Similarity, in the brackish - salt water, the density is low with 423.7 inds/m^2 (table 15 & figure 24)

Table 15. Zoobenthos density in ecological zones

Subzones	4/2006	5/2006	8/2006	11/2006	Average
Fresh waters	457.3	533.3	442.0	597.8	507.6
Fresh-Brackis waters	215.0	151.1	306.7	184.5	214.325
Brackis waters	564.2	543.6	372.0	649.2	532.25
Brackis - Salt waters	343.0	387.8	494.2	470.0	423.75

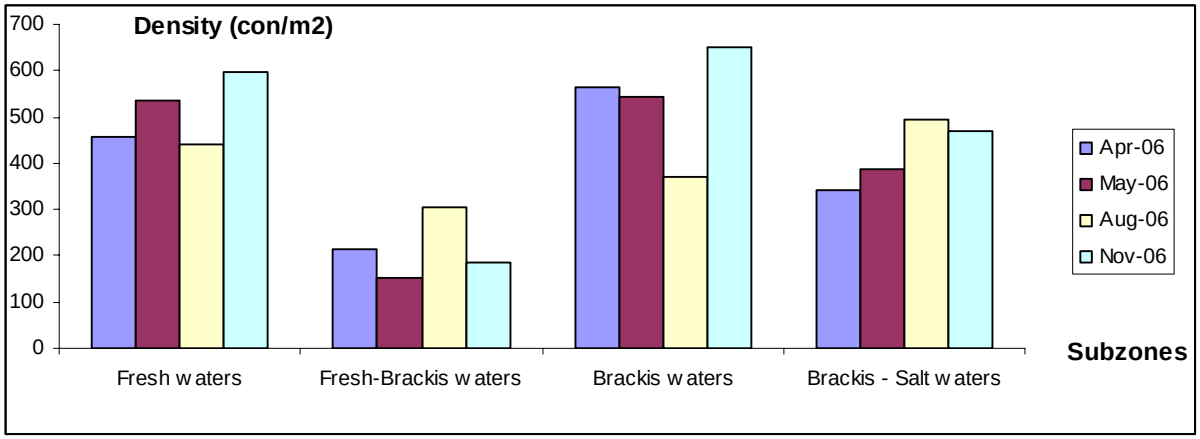


Figure 24. Comparison density of benthos in sub-ecological zones

+ Weight: The highest weight is seing in the April (134.4 g/m^2) and November (119.4 g/m^2). The Average of year 109.6 g/m^2, showing the lagoon has high eight of Zoobenthos in Vietnam (table 16 & fig. 25)

Table 16. Weight of Zoobenthos in 2006

Stations	April	May	August	November	Average
	g/m^2	g/m^2	g/m^2	g/m^2	g/m^2
A1	343.8	291	48.9	89.7	193.4
A2	84.7	111	171.2	51.3	104.6
A3	280.2	354.7	105.4	116.7	214.3
B4	211.4	5.8	16.1	10.4	60.9
B5	7.9	10.9	7.1	13.6	9.9
B6	224.7	3.8	140.1	170.3	134.7
C7	5.5	201.5	5.7	6.5	54.8
C8	21.5	6.6	15.1	8.9	13.0
C9	17.6	16.6	14.7	217.2	66.5
D10	80.4	33.7	40.8	36.5	47.9
D11	57.8	26.8	10	42.8	34.4
D12	60.7	13	81.8	37.5	48.3
E13	27.5	11	14.6	17	17.5
E14	14.8	21.3	4.7	149.1	47.5
E15	98.5	111.6	132.3	103.8	111.6
F16	642.6	514.6	502.8	60.5	430.1
F17	17.9	32.5	81.1	7.4	34.7
F18	334.1	160.2	123.2	301	229.6
G19	48.5	84.2	359.2	225.1	179.3
G20	72.2	11.9	47.9	14.1	36.5
G21	1038.9	410.8	146.8	204.1	450.2
H22	52.9	178.4	368.9	153.3	188.4
H23	10.2	11.1	65.3	15.8	25.6

H24	10.2	25.3	25.5	51.4	28.1
I25	306.5	75.4	6.8	65.6	113.6
I26	6.6	7.4	6.8	418.7	109.9
I27	23.3	15.8	14.5	220.5	68.5
J28	63.3	53.9	24.6	63.7	51.4
J29	315.8	188.2	32.6	195.1	182.9
J30	14.4	26.7	27.9	388.6	114.4
K31	-	-	-	141.1	
K32	78.2	143	39.3	205.3	116.5
K33	52.6	105.8	72.7	76.7	77.0
L34	36.7	73.5	21.3	171.8	75.8
L35	80.6	136.6	159.8	108.2	121.3
L36	65.9	89.6	123.3	116.3	98.8
K37	31.1	40.2	5.5	141.1	54.5
TB	**134.4**	**100.1**	**85.1**	**119.4**	**109.6**

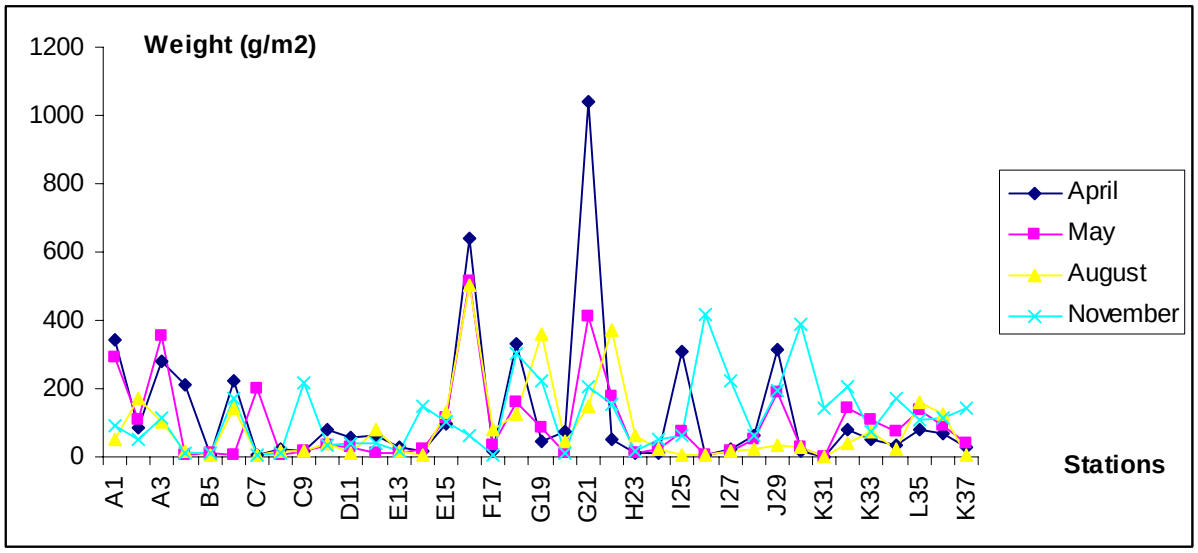


Figure 25. Weight of zoobenthos in the Tam Giang - Cau Hai lagoon (ind/m^2)

- Change by sub-ecological zone: Analysis results in four survey trips on weight of zoobenthos showed that the weght of zoobenthos in the fresh water is highest with average 170.7g/m^2; The next, it is in the brackish water with average 114.2g/m^2; Similarity, in the brackish - salt water 81.3 g/m^2 and the lowest weight in the fresh - brackis waters with only 68.5 g/m^2 (table 17 & figure 26)

Table 17. Zoobenthos weights in ecological zones (g/m^2)

Subzones	4/2006	5/2006	8/2006	11/2006	Average
Fresh waters	236.2	252.2	108.5	85.9	170.7
Fresh-Brackis waters	148.0	6.8	54.4	64.8	68.5

Brackis waters	129.8	97.3	95.6	134.1	114.2
Brackis - Salt waters	95.4	82.0	46.9	100.9	81.3

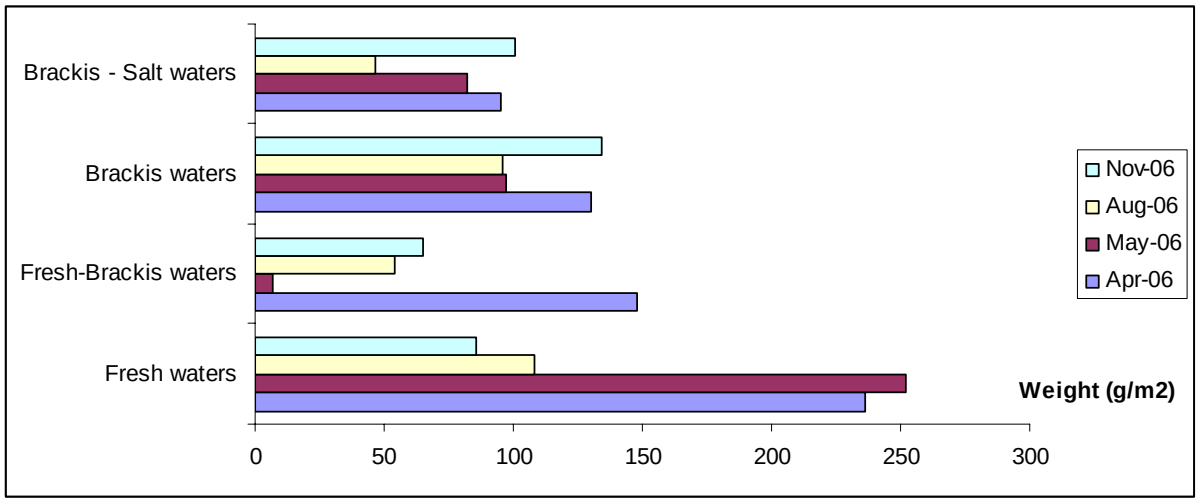


Figure 26. Comparing weight of benthos between sub-zones (g/m^2)

3.4.5. Seaweed and seagrass bed

- Species composition: The sample analyzed result in two survey trips in April and May 2006 shown that, there were 5 seagrass species in 4 genera and 4 families. The Tam Giang lagoon had 5 species, Thuy Tu had 4, Cau Hai had 5. The family *Hydrocharitacae* had 2 species, other three families *Cymodoceaceae, Zosteraceae and Ruppiaceae* had 1 species for each. Three species dominated in the lagoon were *Zostera japonica, Halophila beccarii* and *Halodule pinifolia.* In addition, we have found 9 species of fresh water plant with high biomass and 2 seaweed species *Hydrilla verticillata* and *Valisneria spiralis* used to as a food for fresh fishes (table 18).

- Distribution: water grass and other water plants cover almost surface water area. They grow at depth of 0.7 to 1.4m, however, different sub-zone has a different distribution of aquatic plant. For example, in April 2006 the sites from 1 to 9 and from 34 to 37 were dominated by fresh water grass, the other sites (from 10 - 33) was dominated by seagrass. In May 2006, the salinity at sites 6, 7, 8, 9, 34, 35, 36 and 37 increased result in fresh water grass was died and replaced by seagrass. Probably, dead grass made polluted water and alkaline in this area. The survey result estimated that there are about 1021ha seagrass and mostly concentrated in Con Noi, Con Dai and Ba Con (table 19)

Since distribution of aquatic plant is closely related with salinity in the lagoon, therefore it may divides into different ecological groups that correlates changing in salinity:

- Oligohaline species (0.5- 4‰): *Hydrilla verticillata, Valisneria spiralis, Myriophyllum spicatum, Potamogeton crispus*
- Euryhaline species (5-32‰): *Zostera japonica, Halodule pinifolia.*
- Mixohaline species (below 25‰): *Halophila beccarii, Ruppia maritima*
- Euhaline species (over 25‰): *Halophila ovalis.*

Table 18. Species composition of seagrass and water plants in the Tam Giang – Cau Hai lagoon

STT	Loài	Tam Giang	Thuy Tu	Cau Hai
	Fam. HydroCharitaceae Juss. 1789			
1	*Halophila beccarii* Asch.	+	+	+
2	*H. ovalis* (R.Br.) Hooker	+	+	+
	Fam. CymodoCeaceae Taylor 1909			
3	*Halodule pinifolia* (Miki) D. Hartog	+	+	+
	Fam. Zosteraceae			
4	*Zostera japonica* Ash.	+		+
	Fam. Ruppiaceae Hutch. 1934			
5	*Ruppia maritima* Lin.	+	+	+
	Total	5	4	5
	Hydrophytes			
1	*Hydrilla verticillata*	+		+
2	*Valisneria spiralis*	+		+
3	*Ceratophyllum demersum*	+	+	+
4	*Myriophyllum spicatum*	+	+	+
5	*Potamogeton malaianus*	+		+
6	*Potamogeton maackianus*	+		
7	*Potamogeton crispus*	+		

8	*Najas indica*	+	+	+
9	*Utricularia aurea*	+	+	+
	Total	9	4	7

Table 19. Area of seagrass in Tam Giang-Cau Hai Lagoon

No	Location	Area (ha)	Name of species
1	Con Dai-Con Noi	300	*Zostera japonica*
2	Ba Con	230	*Halophila beccarii, Halophila ovalis, Ruppia maritima, Halodule pinifolia*
3	Hai Duong	35	*Halodule pinifolia, Zostera japonica,*
4	Con Son	10	*Halodule pinifolia, Zostera japonica, Halophila ovalis*
5	Hop Chau	15	*Zostera japonica, Ruppia maritima,*
6	Con Te	5	*Zostera japonica*
7	Hai Tien	3	*Zostera japonica*
8	Phu Thuan	80	*Zostera japonica, Halodule pinifolia*
9	Vinh Xuan	150	*Halodule pinifolia*
10	Vinh Hung	50	*Zostera japonica, Halodule pinifolia*
11	Loc Binh	35	*Zostera japonica, Halodule pinifolia*
12	Vinh Phong	28	*Zostera japonica, Halodule pinifolia*
13	Cu Dai	50	*Halodule pinifolia*
14	Phu Xuan	5	*Halodule pinifolia*
15	Con Lay	25	*Zostera japonica, Halodule pinifolia*
		1021 ha	

3.3.6. Biological resources

There are over 100 species that are economic production for local resident around the lagoon. Annually, local people in 5 districts exploited about 2500 tones of aquatic product and provide to the market (excepting some low economic weeds). Among them, there were 23 economic fish species, particular bream (*Siganus sp*) was considered as a symbol of the lagoon, and 34 benthic species that were valuable

commodities and processing local special foods like Tom Chua (sour shrimp), Com Hen (clam rice) from shrimp and clam in the lagoon. Among 73 bird species there are 5 migrant species such as *Fulica atra, Anas poecilorhyncha, Anser anser, Tringa erythropus, Anas querquedura* with tens of thousands individual that are interested foodstuff. The other aquatic plants like seaweed are exploited and increase income for local people. (table 20)

However, studies on biological resources in the lagoon are still limited, just focus on species composition and estimate exploitable production. It is should be supplemented data on stock and distribution of resources. In May 2006 (dry season) we were carried out the survey by using push net on 13 transects in 5 areas (O Lau, Hai Duong - Thuan An, Dam Sam, Thuy Tu and Cau Hai) that made clearly status of resources in the lagoon.

- *Appearance frequency of valuable species*

Based on captured frequency, we are divided biological resources into groups below (table 21):

- High appearance frequency group: Result of the survey trip shown that there were 42 economic species captured by push net, of which 7 species were wide distribution appearing at all transects with frequency from 78- 100%. They were mullet *Mugil cephalus*, *Gerres philamentos, Tricanthus brevirostris*, *Hemirhamphus sinensis*, *Ambassis kopssi*, bream *Siganus guttus*, *Siganus oramin*, shrimp *Metapenaeus ensis*. Especially, two economic species (mullet and bream) are symbol of the lagoon appear at all surveyed transects.

Table 20. Estimate exploitable production of some economic species in Tam Giang - Cau Hai

No	Species	Exploitable production (ton)
1	Seaweed *Gracilaria tenuispitata*	400
2	Other seaweeds	150.000
3	Crab *Scylla serrata*, *Portunus spp*	20 - 30
4	Shrimp (*Penaeus monodon, P. merguensis, Metapenaeus ensis*)	1000
5	Fish *Cyprinus centralis*, bream *Siganus guttatus*, mullet *Mugil cephalus* ...	> 1000
6	Bivalvia *Corbicula spp*, *Anomalocardia flexuosa*, *Gafrarium sp*	> 100
7	Squid *Loligo spp, Sepia spp*	Unknown
8	Migrant bird: black coot (*Fulica atra*), spot-billed duck (*Anas poecilorhyncha*), grey-lag	20,000 individual

	goose (*Anser anser*), redshank (*Tringa erythropus*) and common teal (*Anas querquedura*)	

- Medium appearance frequency group: with appearance frequency from 46 - 70% of total transects, including 10 species they were *Varuna litteratus*, *Leiocasis hanamensis*, *Sparus latus*, *Terapon jarbua*, *Platichephalus indicus*, *Leiognathus brevirostris*, *Oxyurichthys tentacularis*, *Pissodonopsis boro*, *Stolephorus commersonii*.

- Low appearance frequency group: there were 11 species with appearance frequency from 25-40%, they were *Portunus pelagicus*, *Corbicula spp*, *Chirocentrus nudus*, *Tetradon ocenlatus*, *Silago maculatus*, white goby *Aboma lactipes*, *Clupanodon punctatus*, *Sardinella jussieu*, shrimp *Penaeus merguiensis*, *Penaeus monodon*. In this group some economic value species such as shrimp, crab had high appearance frequency about 38.5%.

- Very low appearance frequency group: there were about 14 species appeared on 1 or 2 transects. These species are restricted distribution and indicator for each area. For example shrimp *Macrobranchium spp* apprears in fresh water O Lau and adjacent areas, *Squilla spp* only found in salt water around the lagoon mouths, flattened goby (rare species) was found in Dam Sam and Huong Tra.

- *Distribution of number of aquatic product species in the lagoon*

Based on the number of aquatic product species caught by push net in May 2006 (dry season), the aquatic product species were mostly concentrated from Quang Cong to Phu Hai (Tam Giang, Sam Chuon) with number of species from 30 to 32. The lowest number of species caught in O Lau (20 species) the next was Thuy Tu 23, Cau Hai 26 (figure 25).

The detail for each species and their proportion are given in table 21 and figure 27. The analyzed result for each area is given below:

- O Lau: Among 20 species collected, the rate of low value species *Leocasis hanamensis* was 60.096%, *Leiognathus brevirostris* was 15.028%. The ratio of high value species was normally low for example, mullet *Mugil cephalus* 1.12%, *Sparus latus* 1.12%, *Gerres filamentossus* 3.368%, *Hemirhamphus sinensis* 6,92 %, Dua fish 1.488%, shrimp 4.644%, bream 0%. So that natural resources in O Lau were low, the large ratio of captured fishes was low value species, there were only 5 high value species e.g. shrimp *Metapenaeus ensis,* fish *Sparus latus*, mullet *Mugil cephalus*, *Gerres filamentossus*, *Corbicula spp* but exploitative production only 1,2 - 4,6 %

- Tam Giang (exclude O Lau): From Dien Hai to Thuan An: In this area there were 32 species captured in total of 42 species on all transects in the lagoon. That is evident for abundance of aquatic product resources in the area. Exploitative rate of economic value species has trend increasing. For example crab 2,618 %, mullet *Mugil cephalus* 2,384 %), *Gerres philamentos* (3,92 %), *Chirocentrus nudus* (2,618%), *Platichephalus indicus* (2,618 %), *Hemirhamphus sinensis* (11,62 %), *Siganus guttus* (11,6 %), *Clupanodon punctatus* (2,079%), *Metapenaeus ensis* (12,572 %)

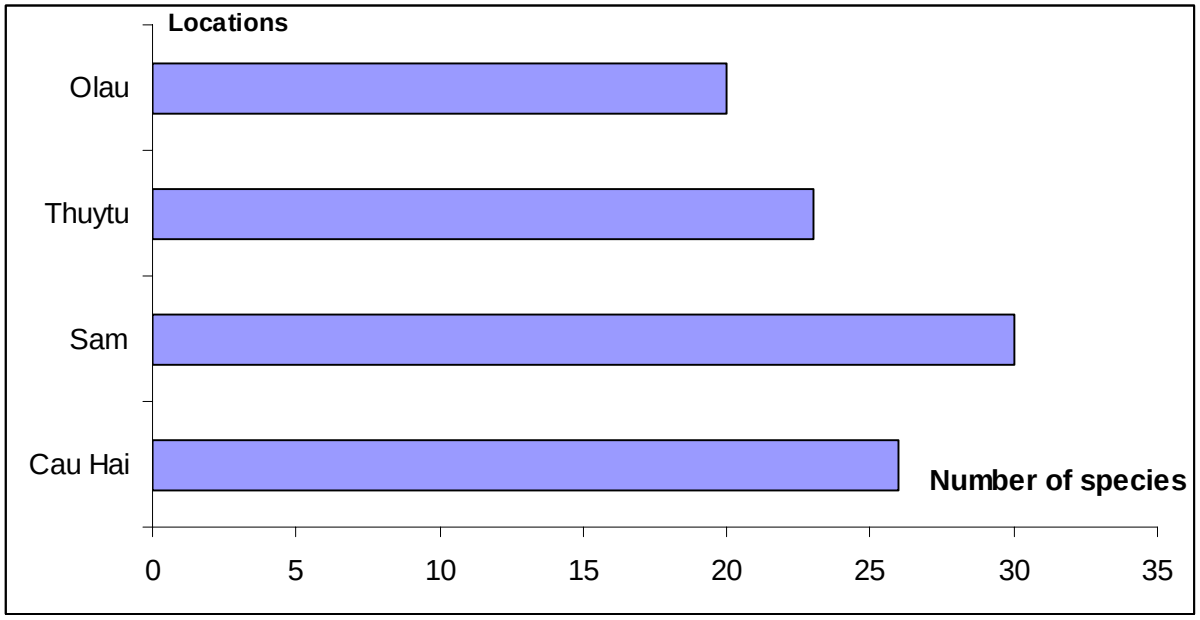


Figure 26. Distribution of number of aquatic product species in the lagoon

- Sam Chuon: there were 30/42 total species have been caught. For this reasons Sam Chuon was also abundant area. Noticeably, the ratio of valuable species collected higher than the other areas. For example crab *Varuna litteratus* (2,696 %), *Mugil cephalus* (5,390 %), *Gerres philamentos* (12,578 %), *Tricanthus brevirostris* (6,649 %), *Siganus oramin* (9,882 %), *Siganus guttus* (1,976 %), *Siganus oramin* (2,874 %), *Stolephorus commersonii* (22,819 %. Especially prawn *Metapenaeus ensis* had high ratio 4 - 69 %.

- Thuy Tu: there was 23 species have been caught in the surveyed trip. Although numbers of species were not high but the weight of high value species were equally and low valuable species were not occupy a high ratio like the other areas. The ratio was: sea crab 2,713 %, mullet 9,865 %, *Sparus latus* 6,165 %, *Gerres philamentos* 12,330%, *Terapon jarbua* 1,356%, *Tricanthus brevirostris* 8,630%, *Hemirhamphus sinensis* 21,085%, *Siganus guttus* 4,932%, *Siganus oramin* 4,932%, *Metapenaeus ensis* 8,630%.

Table 21. Aquatic product resources collected by push net in May 2006

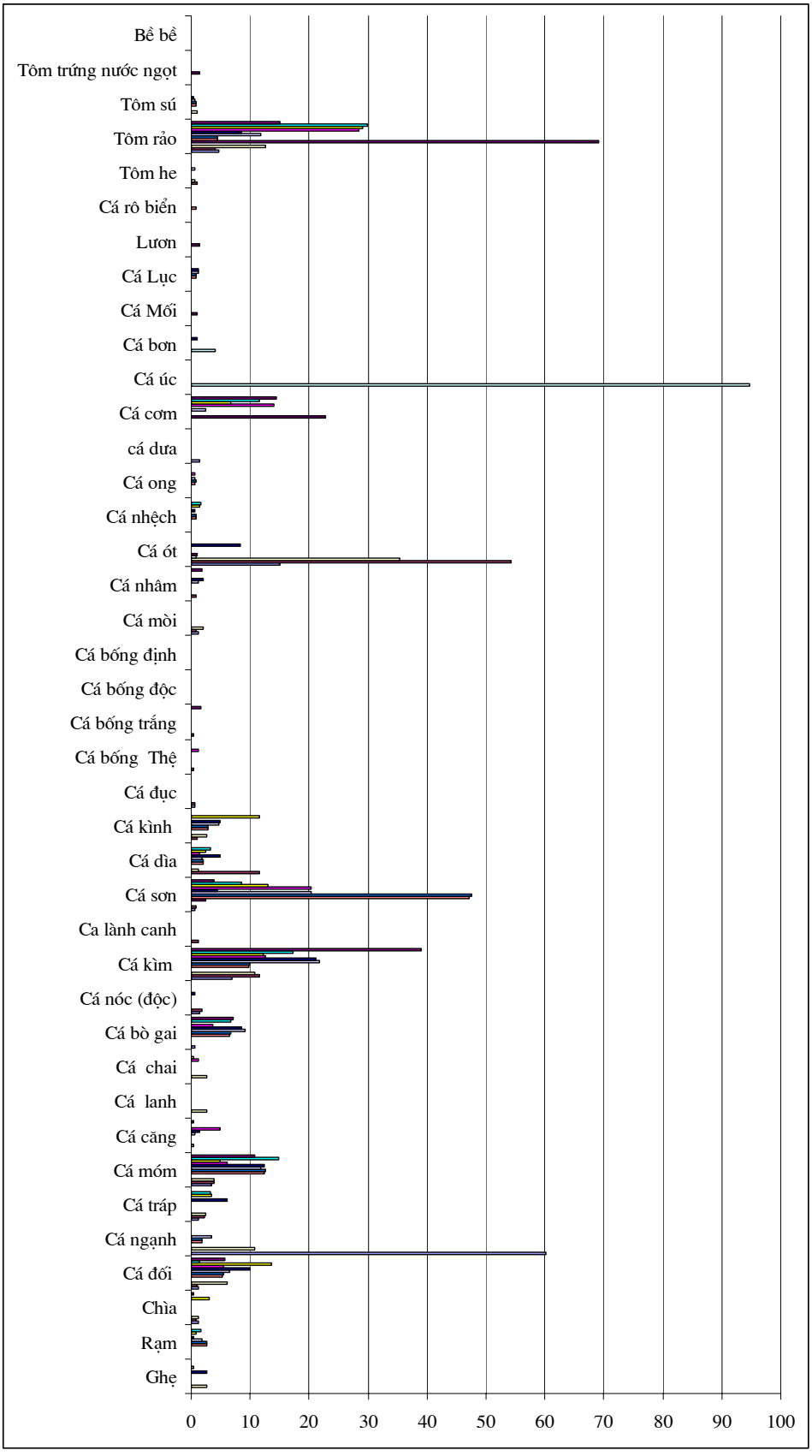


Figure 27. Ratio on weight of aquatic product species in the lagoon

- Cau Hai: That is end of the lagoon on the southern. In Tu Hien mouth they are carrying a constructive project that must be affected to natural resources of the lagoon. There were 26 species have been collected on 4 transects and ranking in third abundance after Tam Giang and Sam Chuon. In the structural characteristic of resources the prawn *Metapenaeus ensis* dominated on all transects (15-29% of total weight). The other valuable species were also higher than low value species in the area. The detail was: *Varuna litteratus* 1,656%, *Mugil cephalus* 13,56%, *Sparus latus* 3,393%, *Gerres philamentos* 14,893%, *Tricanthus brevirostris* 7,013%, *Siganus oramin* from 12 to 39%, *Siganus guttus* 3,306%, 11,627%, *Stolephorus commersonii* 6 - 14%, *Metapenaeus ensis* 15 - 29,78%.

- *Fishery stock*

Since we have just only one survey trip carried out in May 2006 (dry season) thus this data is initial result, in order to ensure more accurate we will have a supplemental survey trip in rainy season in November or December. The initial result shown that fishery stock mainly concentrated from Dam Sam to Thuy Tu and the lowest in the O Lau (table 22 and figure 28). Exploitative product in each location was different, from 3,293 kg - 190,200kg/h. Based on exploited production we estimated fishery stock for each location and building distribution map of stock (figure 29). The specific fishery stock for each area is following:

Table 22. The results of survey fisheries stocks on the Lagoon in May 2006

No	Locations	Fishery stock	Estimate stock
1	Olau 2-2	3.293	13172
2	Nam Thuan an 2-1	17.562	70248
3	Dong Thuan an 2-3	5.193	20772
4	Tay Thuan an 2-4	8.849	35396
5	Tay Dam Sam	4.837	19348
6	Bac Dam Sam 3-1	190.200	760800
7	Huong Tra 3-3	71.862	287448
8	Dong Dam Sam 3-4	36.997	147988
9	Thuy Tu 3-2 (2)	47.104	188416
10	Nam Cau hai 4-1	16.300	65200
11	Dong Cau hai 4-2	22.103	88412
12	Bac Cau hai 4-3	16.907	67628
13	Tay Cau hai 4-4	8.526	34104

- O Lau area: with a special reason we have just carried out only one transect in O Lau and estimated fishery stock about 13,172kg

- Tam Giang area: (Quang Dien district): aquatic product stock ranged from 772 kg - 70.248 kg, higher than O Lau.

- Sam Chuon area: ranged from 19348 kg to 760.800 kg

- Thuy Tu area: 188,416kg

- Cau Hai area: ranged from 34,104 - 88,412kg

Therefore, from Sam Chuon to Thuy Tu is center of aquatic product resources in the Tam Giang - Cau Hai lagoon. However, it is clearly that the natural resources have been decreasing in recent years, total of fishery stock in the lagoon estimated about 1,408,496kg in May 2006. If fishery stock is stable we should exploit no more than 1,000ton per year. If we divide this product for 100,000 fishermen, each fisherman will get less than 10kg of fish per year.

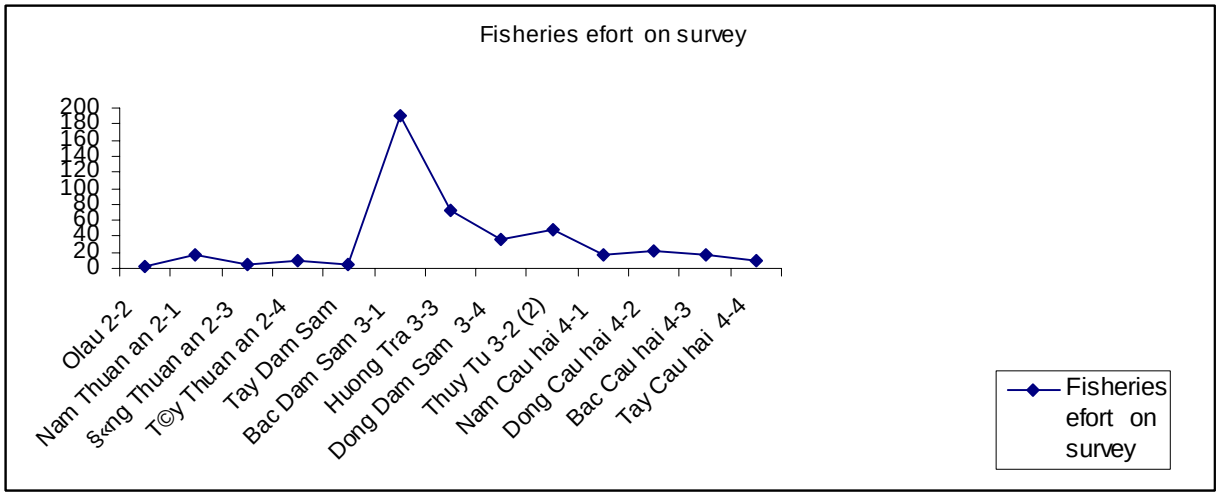


Figure 28. Comparing captured production by pull net between transects in May 2006

- *Benthic resources in Tam Giang - Cau Hai*

The analyzed results of the survey trip showed that benthic resources were very abundance in April and May 2006. Total of macrobenthic stock (including seaweed and seagrass) were 14,523 tones. Of them seaweed was 3,594 tones, snail 8075 tones, bivalve 2729 tones, crustacean 81 tones, fish 45 tones (table 23, figure 30). But in the November Total of macrobenthic s tocks remaintences only 4698 tones. We were also determined the transect F, G and A had the highest benthic biomass. Fishery stock caught in $40m^2$ at the transect F was 12,62kg, at G - 9kg and at A - 6kg (figure 31). The detailed distribution of each group will be shown in figure 32. In the structure of natural resources except seaweed and marine snail were used as food for fish, livestock and fertilizer the rest were economic value groups such as bivalve, crab, and shrimp.

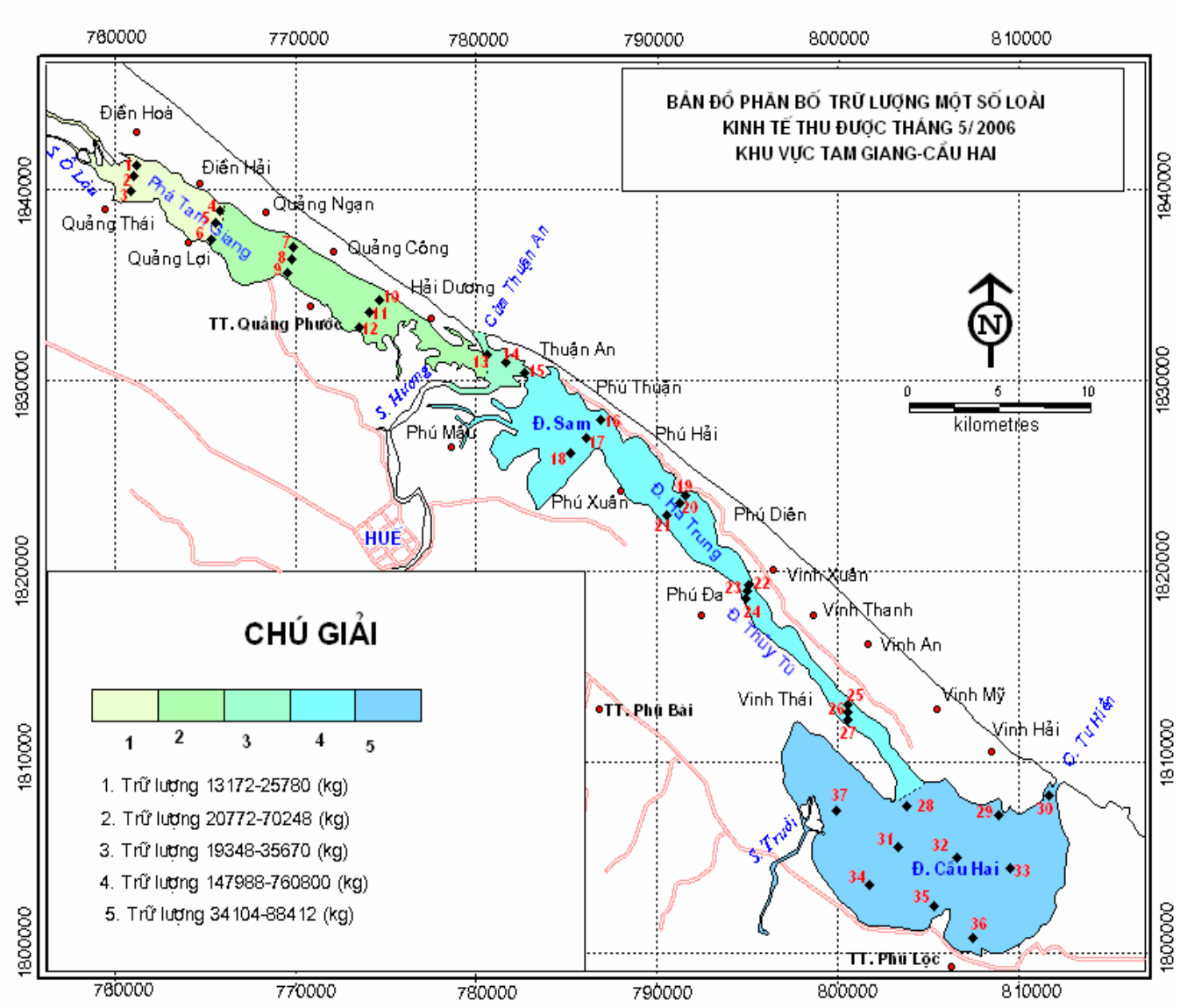


Figure 29. Distribution of fishery stock in the lagoon (May 2006)

Distribution of benthic resources was irregular and depends on their living environment.

- O Lau area (area 649.3ha). Majority is fresh water plants such as *Valisneria spiralis, Hydrilla verticillata, Corbicula spp*. Total of productivity was high about 6.6kg/m^2, and ranking in the second of 12 transects.

- Thuan An area (Tam Giang). This is large area and concentrated many economic benthic species. Beside *Solen sp,* there was *Meretrix meretrix* thriving from the transect D to E (Hai Duong to Thuan An). Particular in Huong Tra area (station E14) was found *Meretrix* in both two survey times. Concentration of some economic species *Corbicula lamarkiana, Sanguinolaria violacea, Meretrix meretix* created special grounds in the area. *Portunus pelagicus, P. trituberculatus Gracilaria sp* were found in the area. Biomass ranged from 0.5 - 3.52kg/40m^2 and more higher in the transect D.

- Dam Sam area: this is also large area (7617ha) and concentrated numerous economic fish species and biomass of the benthos was the highest 12.62kg/m^2. Beside *Corbicula* there was a flat of economic benthic species *Crassostrea belcheri* and *Crassostrea lungubris*. *Portunus* was also found in here. Noticeably there was a large flat of snail *Cerithidea cingulata*, high density (10-12kg/40m^2), this snail is low nutrient food for human but it is food for many of fish, shrimp, and crab species. That is reason for the highest of fishery stock in the area.

- Thuy Tu: lies between Dam Sam and Cau Hai. Benthic resources were less than Da Sam but higher than the other areas. The surveyed result in April 2006 shown that a flat of *Sacostrea belcheri* elongates from the site 16 to 21 has been found with biomass were 6kg/40m^2. In this area also appeared the snail *Cerithidea cingulata* with high density (2kg/40m^2) that is food for fish species. In two survey trips the highest total weight of benthos were 9.2kg/40m^2, average 5kg/40m^2.

Table 23. Distribution of the benthic resources in the lagoon (kg/40m^2)

Transect	Algae		Gastropod		Bivalve		Crustacean		Fish		Total	
	5/06	**11/06**	**5/06**	**11/06**	**5/06**	**11/06**	**5/06**	**11/06**	**5/06**	**11/06**	**5/06**	**11/06**
A	5.3	4.00	0	0.22	1.2	0.001	0.05	0	0.05	0	6.6	4.022
B	0	0	0	0	1.0	0.205	0	0	0	0	1.0	0.205
C	0	0	0	0	0.5	0.048	0.1	0	-	0	0.6	0.048
D	0	0	1.0	0.5	2.31	0.003	0	0	0	0.006	3.52	0.506
E	0	0	0	0.009	0.15	0.148	0.1	0	0.25	0	0.50	0.157
F	0.16	0	12.2	1.00	0.22	0.018	0.02		0.02		12.62	1.018
G	-	1.400	3	0.032	6.0	0.002	-		-	0.001	9.0	1.435
H	1.2	0	2.0	0.046	0	0.020	0	0	0.02	0.02	3.22	0.066
I	0	0	0.01	0.066	0	0.001	0	0	0	0	0.01	0.067
J	0	0	0.02	0.044	0.82	0.516	0.01	0.01	0.01	0.01	0.86	0.561
K	1.2	0	0.5	0.012	0	0.018	0	0	0	0	1.7	0.030
L	0.12	0.800	1.3	1.514	0.01	0.003	0	0	0	0	1.43	2.317
TS	7.98	6.2	17.93	3.443	6.06	0.983	0.18	0.01	0.1	0.037	32.96	10.432
Tones	**3.594**	**2.792**	**8.075**	**1.550**	**2.729**	**442**	**81**	**4**	**45**	**16**	**14.525**	**4.698**

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No. 246, Da Nang Str., Hai Phong City

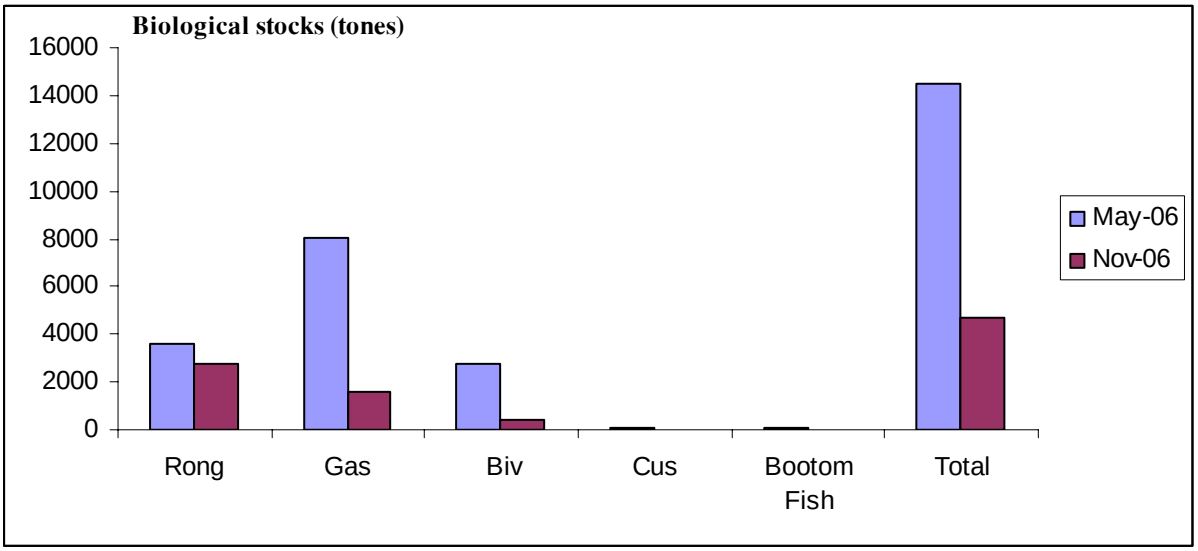

Figure 30. Comparing stock between benthic groups

- Cau Hai: the weight of benthic group was low, from 0.86 to 1.7kg/40m^2, *Corbicula* dominated and ubiquitous. Distribution of the *Saccostrea belcheri* was narrow in Tu Hien mouth only, in the area has also found many mud crabs *Scylla serrata*.

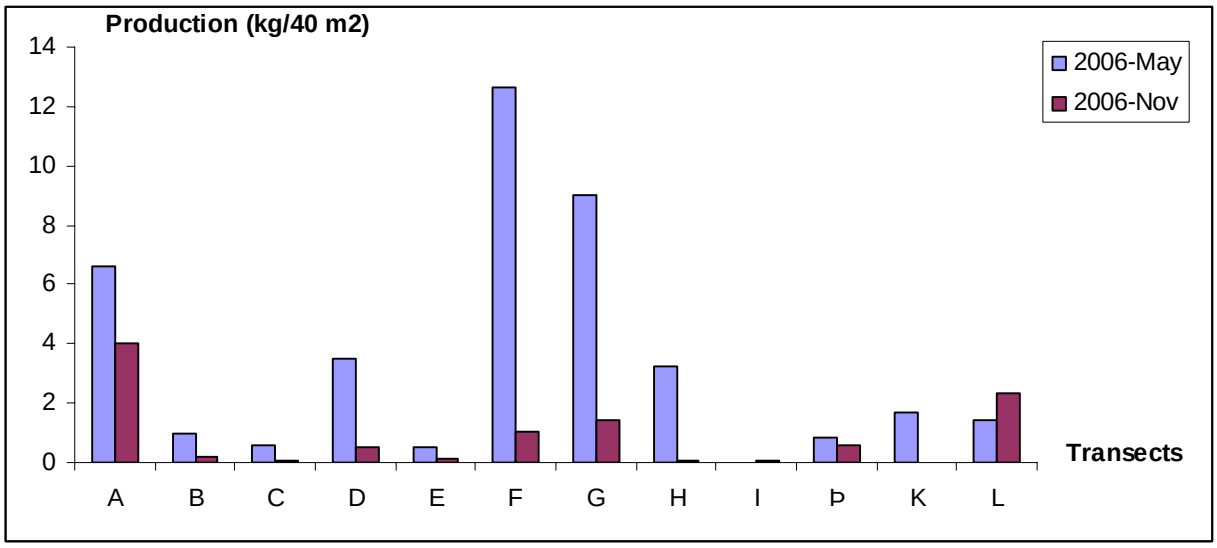

Fig 31. The distribution of the benthos resources in the lagoon (May 2006)

3.5. Orientation of Sustainable management

In order to sustainable management of activities on the lagoon with aims is biodiversity conservation, we need to fully estimate strength and weakness of the lagoon. Based on that we suggest solutions to impulse advantages and obstacle weakness (table 24).

- *Strength of biodiversity in the Tam Giang - Cau Hai lagoon*

- The Tam Giang - Cau Hai lagoon is a typical and biodiversity ecosystem for both Vietnam and on the world. As above mentioned, sub-ecosystems of the lagoon were classified as abundant ecosystems of the area, especially there are some typical sub-ecosystems for the Central such as sub-ecosystem of sand dune, seagrass bed, estuary, agricultural ecosystem includes antiquated village as well as traditional trade villages those create specific characteristics for Tam Giang - Cau Hai

- The abundant level of species, source, gene accompany with high valuable species for gastronomy for example bream, shrimp, squid, sea crab are contributed for abundance of natural resources of the Tam Giang - Cau Hai lagoon.

- Water environment of the lagoon is regularly changed by season and repetitively through centuries subsequently forming a flexible ecosystem and sustainable existence if has not destructive activities from human.

- The area of the lagoon is large enough to carry out activities in order to minimize directly effects to biodiversity.

- *Threats to biodiversity*

Based on real observation at field as well as combination of research results socio-economic from previous projects (1,2,3,8), we divide threatening factors to biodiversity into following groups:

- Anthropogenic factors: The first mention regarded to increase of population about 2%/year subsequent to high density (population in 1997 was 588,848, density was 339 people/km^2) and low standard of living. Qualification of education was only at secondary school level in average, income from 200,000-300,000VND/month (13-19USD). Because of wretched life, fishermen used all kind of fishing gears even that is destructive method to exploit natural resources on the whole lagoon. Evenly the sand dunes have been extracting or converting into aquaculture ponds those activities adverse changes sandy sub-ecosystem in this area. By increasing of fishing boats and waterway transportation in the lagoon, which presents local oil pollution in several areas.

- This area has low infrastructure, old traffic roads, and lack of sanitation. Waste water from villages and factories discharge directly into the lagoon without any treatment that is reason for blooming of algae and organic pollution that killed a lot of fish in the lagoon.

Career of local people is simple and there are only two main careers they are agriculture and capture fishery or aquaculture. The others such as service and transportation are slowly development.

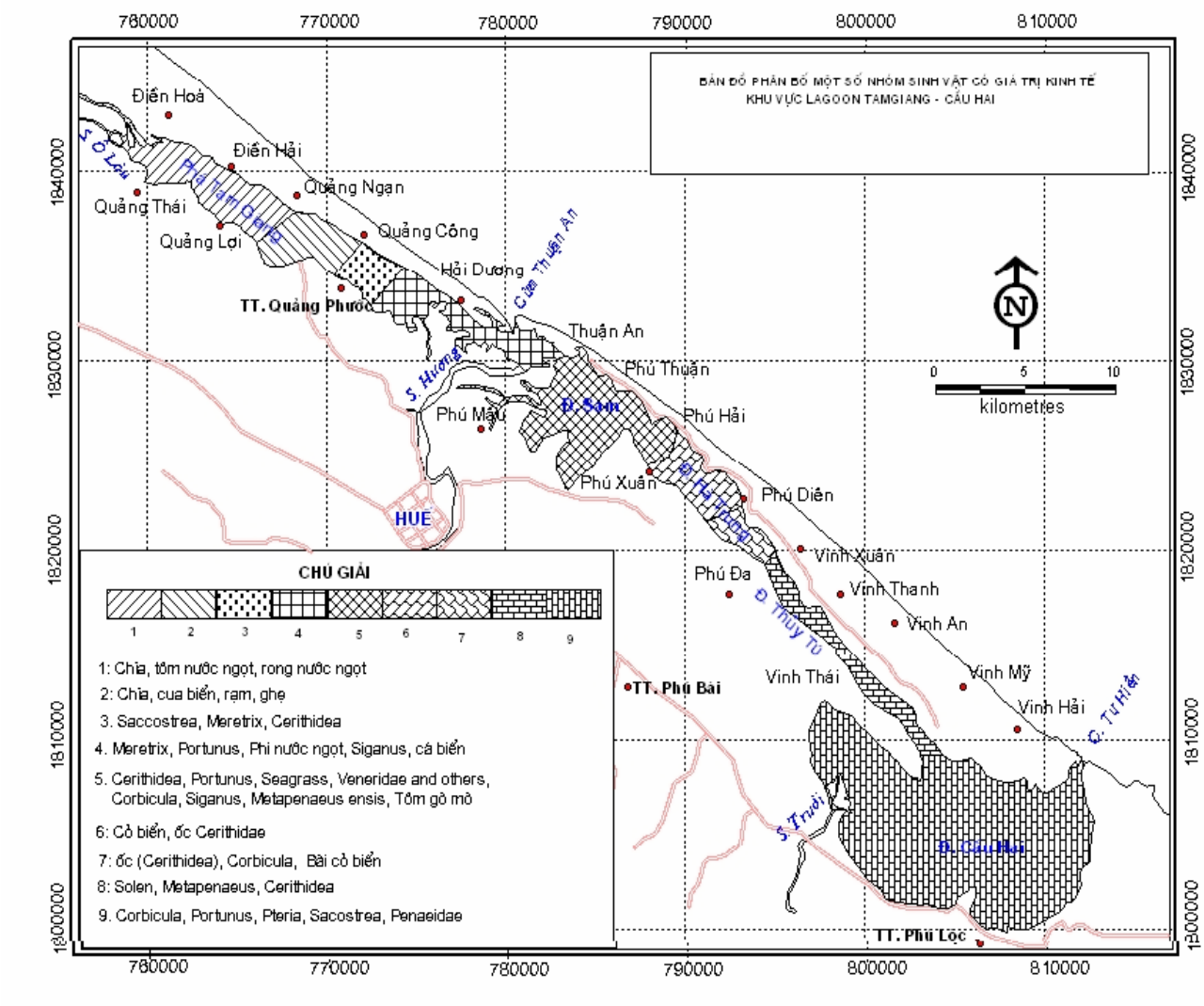

Figure 32. Distribution of benthic species in the lagoon

Table 23. Statistic of threatening factors to biodiversity in Tam Giang - Cau Hai

Or.	Factors	Characteristics	Level	Note
	Advantages			
1	Typical sub-ecosystems	San dune, seagrass, river mouth	+++	
2	High richness species and rare species	There are about 1000 species and high nutrient value species	+++	
3	Flexible biota, adaptable to environmental changes	Biota change from brackish salt to fresh brackish biota correlative with dry and rainy season	++	

4	Large area suitable for carrying out subsidized activities to minimize over exploitation		+++	
Disadvantages				
5	Unbalance of resource structure	Stock of high value species are much more lower than low value species	+++	
6	Sweetness, acidification, salinization phenomenon	Saline water penetrates into inland water through river mouths, acidification aquaculture areas...		
7	Population	588.848 people, density339 people/ km^2	+++	Very high
8	Infrastructure	low, poor sanitary water	++	High
9	Career	Simple, mainly agriculture and capture fishery	+++	
10	Living level	Low average income 2000.000 - 300.000 VND/month	++	Medium
11	Environmental pollution	Oil, organic, microorganism pollution	++	
12	Fishery exploitation	Some aspects unsuitable	+++	
13	Aquaculture	Rapid growth of shrimp farming on sand, aquaculture ponds, fish traps obstruct water flow and natural resources come in the lagoon	+++	

- Unbalance in resource structure: There are total of 14,525 tones of benthos in the lagoon, among them there are 3594 tones of fresh and brackish water weed, 8075 tones of snail but both of them are low economic value species. There are only about 4218 tones are high economic value, including 2729 tons of mollusk, 81 tons of sea crab, 1408 tons of fish. Therefore proportion of high economic value species was low occupying 29.04% total of natural resources in the lagoon so that the high economic value species were over exploited and rapid exhaustion of natural resources. The evidence of the exhaustion was exposed by small size of captured fishes. The measured result on 217 individuals belongs to 10 species caught in the lagoon shown that the measurement of all fishes was very small and in juvenile stage (table 25). The highest measurement was *Hemirhamphus sinensis* 14.95cm, mullet *Mugil cephalus* and bream *Siganus guttus* was 7 - 9 cm and 7,4 cm respectively. The other species such as *Terapon jarbua, Gerres philamentos, Sparus latus, Siganus oramin, Silago maculatus* were the same situation. It is clear that fish resource was not enough for demand of exploitation so that it was caught since juvenile stage.

- Natural threats: flood and drought are often bring on salinization and sweetness, and decrease oxygen concentration in the lagoon and killed a lot of species that inadaptable to sudden changes of environment such as fresh weed, *Corbicula spp,* violet clam... or in rainy season some fishes migrated from lagoon to the sea these are reasons of reducing biodiversity and natural resources in the lagoon.

- Oil pollution: If we have not effective management amount of oil leaking into the lagoon it would be massive dead occurring larvae and juvenile in the lagoon and aquaculture ponds. High nitrogen pollution was recorded at all surveyed sites in 2004. This is potential danger threatening to biodiversity in the Tam Giang - Cau Hai lagoon.

Table 25. Measurement of some main fish species in the lagoon (May 2006)

Species	**Maximum length (cm)**										**Aver.**
Transect 2-1											
Hemirhamphus sinensis	16	12	10	10	10	20	8	10	20	10	12.6
Moi	12	7.5	10	8	9	8	9	12	7	8	9.05
Nham	5.5	5.5	6.5	6.0	6.0	5.5	5.5	5.5	5.5	5.5	5.7
Goby	11	12.5	9	6	7	-	-	-	-	-	9.1
Ambassis kopssi	7.0	6.0	7.0	8.0	3.5	7.5	6.0	4.5	5.5	5.5	6.05
Siganus guttus	8.0	9.0	6.0	7.5	8.0	7.5	9.0	10	5	4.5	7.45
Sparus latus	13	9	9	11	9.5	10	11	10	9	10	10.15
Silago	13	7.5	7.0	8.5	13.0	7.5	8.0	11.5	9.0	12.0	9.7

maculatus											
Mugil cephalus	13.5	11.0	12.0	5.5	13.0	12.0	11.0		-	-	9.21
Transect 2-3											
Hemirhamphus sinensis	17.0	17.0	9.5	33.0	9.5	12.0	10.5	15.0	15.0	11.0	14.95
Mugil cephalus	6.0	13.0	6.0	9.0	6.0	5.5	5.5	5.5	11.5	5.5	7.35
Gerres philamentos	12.0	6.5	9.0	10.0	11.0	10.0	10.0	9.5	11.0	11.0	10
Siganus oramin	7.5	5.5	5.5	7.0	12.0	4.0	4.0	4.0	8.5	8.0	6.6
Transect 4-3											
Hemirhamphus sinensis	16.0	14.0	17.0	6.5	6.0	6.0	8.5	8.5	15.0	24.0	12.15
Gerres philamentos	8.0	8.0	10	6	5.5	6.0	12.0	8.0	13	11	8.75
Transect 4-1											
Terapon jarbua	6.0	4.5	5.5	5.0	4.0	5.5	4.5	8.0	9.5	-	5.83
Gerres philamentos	9.0	7.0	8.0	5.5	4.0	4.0	6.0	7.0	5.5	3.8	5.98
Mugil cephalus	8.7	9.5	10.0	11.0	7.5	7.7	9.0	8.5	11	9.0	9.19
Hemirhamphus sinensis	11.0	12.0	15.0	13.0	12.0	11.0	12.0	10.0	20.0	16.0	13.2
Goby	8.0	7.0	6.8	6.8	7.5	7.0	7.0	4.5			6.82
Trai	9.0	7.5	7.0	7.0	7.5	7.0	6.5	7.5	6.0	6.0	7.1
Transect 4.2											
Terapon jarbua	9.0	6.5	7.5	11.5	5.7	5.2	5.0	5.0	3.7	-	6.56
Mugil cephalus	8.5	7.2	11.0	10.0	12.5	6.5	8.8	9.5	10.0	-	9.33

Microorganism pollution: As above mention, density of pathogenic microorganism in the lagoon was higher than tens or hundreds time when comparing to the standard. This is directly damage to public health and may infect to aquatic species in the

lagoon. By our point of view, warning on microorganism pollution is big problem of the lagoon.

- Spontaneously rapid growth of aquaculture and unplanned in the lagoon have threatened to biodiversity. According to statistic data from Fisheries Department of Thua Thien Hue up to 2005, total of shrimp farming area in the lagoon were 4000ha, increasing 2 times when comparing to 2000 (Viet, 2006). Based on satellite image Landsat recorded in 2003, total of aquaculture area in the lagoon were 4287ha increase 8 times when comparing previous ten years (from 1995 to 1998 there was only 527ha). Especially, rapid growth of aquaculture system on sand and fence fish traps in the lagoon were deformed the habitat map of the lagoon. Appearance of such small ponds and fence fish traps that reaches out near mid-channel from Thuy Tu to Cau Hai, it looks like barriers obstruct water current and immigration of marine organism into the lagoon.

- **Orientation of sustainable management of biodiversity**

All activities in the lagoon are livelihood of 1/2 million resident, therefore orientation activities should be careful determined sensitiveness of socio-economic situation around the lagoon. That is traditional careers exist for long ages. Cultural characteristics were in deep soul of each person and pass from the age to the age and subsequence formed two groups of career: petty trader and big business. Both two groups were mainly effect to all activities on the lagoon. Therefore effective management these groups will decide stable of the lagoon. In order to contribute effective management we bring out two different scenarios for selecting:

+ Scenario 1: Keep original status as present, intensify management to traditional career groups

In general view, all living activities on the lagoon are bring out potential dangers for environmental changes and threaten to sustainable biodiversity. Nevertheless, we have not seen clearly changes of resources and environment of the lagoon yet. The basis of that was flexible system structure, water often exchange between mainland - lagoon - open sea. This exchange supplemented what was lost and obtained balance for the lagoon. However the balance itself is limited, in the near future if we haven't got orientation of sustainable exploitation it will be severe decreased biodiversity in the lagoon. Up to now both petty trader and big business have not met the need for livelihood of local resident. Expansion of aquaculture area and fence fish trap has been severely increasing and difficult to control. Fence fish traps and aquaculture ponds obstructed the circulation of water that increase sedimentation on bottom and result in the lagoon bottom will be elevated and lagoon more and more smaller. Types of culture will rapid development for example aquaculture ponds, raise shrimp on sand, cage culture and fence culture. When the bottom elevated, water exchange capacity will be restricted and it must be serious pollution and consequently massive dead culture objects will unavoidable. Completely lost and failure of owners may be occur, fishermen won't have place and fishery resources to exploit. If we keep this scenario, in the near future the Tam Giang - Cau Hai lagoon will be deformed and may loss its distinguishing characteristics of the typical lagoon in the Southeast Asia.

+ Scenario 2: Changing in professional structure by an initial supervised planning closely on the lagoon

Since natural resources in the lagoon is limited, it is not meet the need for livelihood of 1/2 million resident around the lagoon so that it needs to find out a career that a little bit effects to environment and ecosystem of the lagoon is an important orientation. During study on variety of ecosystems of the lagoon, the strength of typical sub-ecosystems like sand dune, seagrass, agriculture and ancient villages should be noticed. That is strengthening to develop eco-tourism activities on the lagoon. Our idea is gradually change big business group takes part in eco-tourism activities on the lagoon and petty trader group joins in tourist service. Thus, in the future if we implement by this scenario the framework of activities on the lagoon will be: eco-tourism activities, limited aquaculture, aquatic product exploitation.

- Eco-tourism activities: development of tourist must be based on ecosystems and harmless to environment, this is new issue for the area and should have some more specific researches. Preliminary, it should be establish tourist route visiting sand dunes, ancient villages..., tourist route will visit and take picture or video beautiful sceneries, waterfowl flocks in O Lau area. Tourist routes such as fishing, pull net must be attracting tourists. Other kinds of tourist such as boat racing, surfing at lagoon mouths should be take into plan. The experiences from tourism management in the Poo river mouth (Italy) and Tong de Tow lagoon (Monpelia, French) should be applied for the Tam Giang - Cau Hai lagoon.

- Fishery exploitative activities: Due to natural resources in the lagoon is limited so fishery exploitation is considered as secondary career. In the socio-economic development strategy of the lagoon it should be encourage change activities in the lagoon into offshore capture fishery. In the lagoon should have regulation on exploitative size, forbid capture juvenile and brood stock in breeding season. It should be drastic change 1/2 resident exploiting on the lagoon into tourism and service activities or other activities. In order to create favourable conditions for waterway transportation and water circulation it should be minimize or remove fence fish traps completely in mid-lagoon area. Bottom harvest has been acting in Thu Hien and Thuan An mouth should be move to inside. The aim of these activities are exchange fisheries source between inside and outside the lagoon.

- Aquaculture activities: It should be more focus on aquaculture than exploitation. But management on culture area, kind of culture, culture objects should be takes care. Encourage raises aquatic filter species on racks like green mussel, oyster or in ponds for *Meretrix*, *Corbicula*... to minimize environmental pollution. In order to reduce expanding aquaculture area on sand it should be application of high technology for culture, particular tiger shrimp *Penaeus monodon*. It is necessary to research cultivated experiment some special food species such as crab *Portunus pelagicus,* bream *Siganus guttus* in cage and in small scale on some areas to provide food for tourist.

- Environmental hygiene activities: It is necessary to have a project for enhancing public awareness on environmental sanitation, improving the standard of living for poor households in order to minimize sewage pollution by local people. Unless the lagoon will become a big basket contains all waste and sewage from factories, firms,

and households. These pollutions will severe reduce value that can be exploited such as shrimps, fishes and lost natural sceneries of the lagoon.

Especially, in order to promote position of the Tam Giang - Cau Hai lagoon, it should be building this area become a biosphere reserve of the world and will have suitable plans for economic development and environmental protection.

4. Remark and recommendation

- **Remark**

1. Changes in salinity, pH that divided the lagoon into 4 sub-zones where have difference in function and specific characteristics. Including fresh, fresh-brackish, brackish and brackish saline sub-zone.

2. Preliminary, 4 damage factors that threatened to the lagoon have been determined, comprising salinitation, acidity, low oxygen concentration and environmental pollution.

3. The Tam Giang - Cau Hai lagoon system has high biodiversity with over 1000 species of which 947 species have named. Probably, this area has been well documented and the most abundance among coastal lagoon system of Vietnam. Sub-ecosystems of the lagoon are specific characteristic and favourable for expanding and development of suitable professions

4. Over 100 economic species that lives in the lagoon provided annually thousands of tones of fishery and were major source of income of local resident. Nevertheless, unbalance between economic and non-economic species is clearly. Over exploitation of natural resources was cause of reducing biodiversity of this area.

5. In ways of suitable use of biodiversity, variety of profession issue, particular development of lagoon ecotourism, unstop channel and prevent environmental pollution are the first priority.

- **Recommendation**

1. In order to suitable utilization of natural resources of the Tam Giang - Cau Hai lagoon, study on integrated assessment of resources and environment should be implemented.

2. Proposing the Tam Giang - Cau Hai lagoon system become a biosphere reserve of the world.

3. Assessing effectiveness of raising shrimp on sand and their effects to environment. Based on that has suitable planning on culture area

4. We have spend a lot of money, time and method to overcome incident close and open Thuan An and Tu Hien, but why don't think the best way to live with this natural event?

Index of report

I. Enviromentals parameters

Table 1. Enviromental parameters 4/2006

ST	TRAN.	pH		SALINITY		DO		T°C	
		FACE(1)	BOTOOM (2)	1	2	1	2	1	2
1	0.5	6.65	6.57	1	1	7.23	6.47	27.8	27
2	1	7.11	7.15	1	1	7.01	7.07	28.3	27.8
3	0.7	7.61	7.6	1	1	7.06	7.29	28.9	28.2
A	**0.73**	**7.12**	**7.11**	**1.00**	**1.00**	**7.10**	**6.94**	**28.33**	**27.67**
4	0.9	7.47	7.5	1	1	7.1	6.51	27.9	27.5
5	1.1	7.29	7.51	1	1	7.19	7	28.4	27.8
6	0.4	8.26	8.26	1	1	7.28	7.18	28.9	28.5
B	**0.80**	**7.67**	**7.76**	**1.00**	**1.00**	**7.19**	**6.90**	**28.40**	**27.93**
7	1.2	7.34	7.45	5	5	6.63	6.47	26.1	25.2
8	1.3	7.37	7.48	4	4	6.22	6.01	23.1	23.1
9	0.7	7.58	7.87	4	4	6.18	6.09	26.7	26.9
C	**1.07**	**7.43**	**7.60**	**4.33**	**4.33**	**6.34**	**6.19**	**25.30**	**25.07**
10	1	7.76	7.82	12.5	15	6.1	5.81	26.9	21.7
11	1.8	7.76	7.92	11	15.5	6.71	6.68	27.4	26.7
12	1.4	7.67	7.84	12	15.5	6.4	6.78	27.3	26
D	**1.40**	**7.73**	**7.86**	**11.83**	**15.33**	**6.40**	**6.42**	**27.20**	**24.80**
13	2.5	8.09	8.23	15	27.5	7.03	6.35	27	24.1
14	1	7.52	7.9	4.5	8	6.68	6.63	27.8	27.1
15	0.8	7.65	7.92	5	11	6.75	6.5	28.2	27.7
E	**1.43**	**7.75**	**8.02**	**8.17**	**15.50**	**6.82**	**6.49**	**27.67**	**26.30**
16	1	8.09	8.07	19	20	6.81	6.78	26.4	26.3
17	1.8	8.18	8.2	21	21	6.86	6.47	27.1	25.7
18	0.9	8.5	8.49	15.5	15.5	7.08	6.44	27.9	27.5
F	**1.23**	**8.26**	**8.25**	**18.50**	**18.83**	**6.92**	**6.56**	**27.13**	**26.50**
19	1.3	8.19	8.24	17.5	16	6.89	6.5	29.7	27.6
20	1.9	8.13	8.13	17	17	7.14	6.16	29.3	28.3
21	0.3	8.2	8.19	18	18	6.33	6.28	29.2	28.3
G	**1.17**	**8.17**	**8.19**	**17.50**	**17.00**	**6.79**	**6.31**	**29.40**	**28.07**
22	1.4	8.24	8.28	16	16	7.65	6.88	29.5	28.1

23	2.5	8.25	8.25	15	15.5	7.86	6.97	29.7	28.1
24	2.5	8.25	8.18	15	16.5	7.62	6.81	30.2	28.8
H	**2.13**	**8.25**	**8.24**	**15.33**	**16.00**	**7.71**	**6.89**	**29.80**	**28.33**
25	2	8.37	8.4	13.5	13.5	7.13	6.65	30.6	29.7
26	2.7	8.58	8.19	13	16	7.22	7	31.2	29.5
27	2.6	8.44	8.38	13	18.5	7.21	6.77	31	29.5
I	**2.43**	**8.46**	**8.32**	**13.17**	**16.00**	**7.19**	**6.81**	**30.93**	**29.57**
28	0.8	8.97	8.96	12	12	6.36	6.29	31.3	30.9
29	1	8.38	8.44	15	15	6.32	6.26	29.2	29
30	2.5	8.13	8.2	29.5	31.5	6.34	6.97	24.8	24.3
J	**1.43**	**8.49**	**8.53**	**18.83**	**19.50**	**6.34**	**6.51**	**28.43**	**28.07**
31	1.2	8.84	8.87	10	9.5	6.91	6.57	29.8	29.5
32	1.8	8.1	8.36	13.5	14	6.92	6.94	31	30.6
33	1.3	8.1	8.11	15	15	6.81	6.77	30.5	29.8
37	1.6	8.36	8.3	7	7	6.09	5.7	30.3	29.4
K	**1.18**	**6.14**	**6.19**	**8.88**	**9.00**	**4.96**	**4.85**	**22.95**	**22.45**
34	2.1	8.26	8.43	12	20	6.88	6.73	29.5	29
35	1.9	8.51	8.49	11	11	7.03	6.67	31.7	31
36	1.3	8.8	8.82	11	11	7.23	7.46	31.4	31
L	**1.77**	**8.52**	**8.58**	**11.33**	**14.00**	**7.05**	**6.95**	**30.87**	**30.33**
AVERAGE FOR WHOLE LAGOON	***1.4***	***8.02***	***8.08***	***11.0***	***12.4***	***6.87***	***6.61***	***28.7***	***27.7***

Table 2. Enviromental parameters 5/2006

ST	TRAN.	PH		SALINITY		DO		T^oC	
		FACE(1)	BOTTOM (2)	1	2	1	2	1	2
1	0.6	6.45	6.44	1	1	5.2	5.2	28.5	28.5
2	0.5	6.34	6.13	1	1	5.3	5.2	27.9	29.3
3	1	6.43	6.5	1	1	7.3	7.4	31.4	31.3
A	**0.70**	**6.41**	**6.36**	**1.00**	**1.00**	**5.93**	**5.93**	**29.27**	**29.70**
4	1	7.86	7.92	10	10	6.7	6.7	31.2	27.5
5	1.2	8.13	8.17	15	14	6.3	6.94	29.9	29.7
6	1	8.97	8.95	10	10	7.6	7.8	31.6	31.6
B	**1.07**	**8.32**	**8.35**	**11.67**	**11.33**	**6.87**	**7.15**	**30.90**	**29.60**
7	1.8	8.21	8.22	14	15.5	7.14	6.88	31.7	31.5
8	1	8.64	8.71	13	13	6.98	6.88	31.9	31

9	-	8.26	8.26	14	15	7.24	6.9	32.4	32.4
C		**8.37**	**8.40**	**13.67**	**14.50**	**7.12**	**6.89**	**32.00**	**31.63**
10	1	7.99	7.98	18	18	5.58	5.18	30.8	30.3
11	1.2	8.1	8.08	18	18	5.68	5.18	30.6	30.4
12	1	8.08	8.07	16	19	5.76	5.24	31.2	31
D	**1.07**	**8.06**	**8.04**	**17.33**	**18.33**	**5.67**	**5.20**	**30.87**	**30.57**
13	2	8.14	8.19	26	34	6.36	5.44	29	26.9
14	1.5	8.23	8.23	30	33	6.2	6.28	28.1	26.4
15	1.1	8.03	8.25	8	19	6.88	6.14	31.7	30.5
E	**1.53**	**8.13**	**8.22**	**21.33**	**28.67**	**6.48**	**5.95**	**29.60**	**27.93**
16	0.9	8.06	8	23	23	5.28	5.18	30	30
17	1	8.09	8.06	24	24	5.94	5.74	30.3	30
18	1	7.97	7.95	21	21	5.36	4.96	30.5	30.5
F	**0.97**	**8.04**	**8.00**	**22.67**	**22.67**	**5.53**	**5.29**	**30.27**	**30.17**
19	1.4	8.37	8.32	25	25	7	6.8	32.2	31.4
20	1.1	8.08	8.11	24	24	6.04	5.84	32.2	31
21	0.6	8.21	8.21	25	25	6.8	6.8	32.3	32.3
G	**1.03**	**8.22**	**8.21**	**24.67**	**24.67**	**6.61**	**6.48**	**32.23**	**31.57**
22	0.9	8.16	8.23	25	24	7.3	6.84	32.8	32.7
23	1	8.17	8.14	22	23	6.92	6.18	32.2	30.1
24	1	8.21	8.19	22	23	7.02	6.38	32.1	32.1
H	**0.97**	**8.18**	**8.19**	**23.00**	**23.33**	**7.08**	**6.47**	**32.37**	**31.63**
25	1.2	8.22	8.22	20	21	6.9	6.56	31.2	31
26	1.5	8.22	8.15	20	20	6.5	6.2	31.3	30.9
27	1.3	8.25	8.18	19	19	6.64	6.34	31.6	31.2
I	**1.33**	**8.23**	**8.18**	**19.67**	**20.00**	**6.68**	**6.37**	**31.37**	**31.03**
28	0.8	8.5	8.49	17.5	17.5	6.8	6.8	31.8	31.7
29	1	8.63	8.34	19	25	7.84	6.7	31.5	31.1
30	2	8.03	8.03	34	34	7.24	6.84	28	28
J	**1.27**	**8.39**	**8.29**	**23.50**	**25.50**	**7.29**	**6.78**	**30.43**	**30.27**
31	1.3	8.31	8.35	17	17	5.12	4.72	31.3	31.2
32	-	8.42	8.38	20	21	6.5	6.26	32.8	32.4
33	-	8.06	8.07	24	25	5.74	5.7	32.8	32.1
37	-	8.23	8.14	16	16	6.36	6.06	31.2	31.1
K		**8.25**	**8.23**	**19.25**	**19.75**	**5.93**	**5.68**	**32.02**	**31.7**
34	-	8.25	8.53	20	20	5	5	31.9	31.2
35	-	8.62	8.62	20	20	7.8	7.7	33.3	33.1
36	-	8.63	8.65	20	21	8.3	8.26	33.3	33.2

L		**8.50**	**8.60**	**20.00**	**20.33**	**7.03**	**6.99**	**32.83**	**32.50**
AV		**8.09**	**8.09**	**18.17**	**19.18**	**6.50**	**6.24**	**31.20**	**30.71**

Table 3. Enviromental parameters 8/2006

ST	TRAN.	pH		SALINITY		DO		$T^{O}C$	
1		5.3	5.69	1	1	5.5	5.4	30.1	30.1
2	0.8	5.67	5.8	1	1	6.8	6.1	31.2	30
3	1.1	6.11	6.08	1	1	6.5	6.1	31.5	31.3
A		**5.69**	**5.85**	**1**	**1**	**6.26**	**5.86**	**30.93**	**30.46**
4	1	6.39	6.56	1	1	6.7	6.4	31.5	31.3
5	0.8	6.25	6.31	1	1	6.6	6.3	29.1	28.3
6	1	8.2	8.27	1	1	7.4	7.2	32	32
B		**6.94**	**7.0**	**1**	**1**	**6.9**	**6.63**	**30.86**	**30.53**
7	0.7	6.4	6.51	1	1	6.3	6.1	25.6	19.4
8	0.8	7.47	7.44	1	1	7	7.1	30.8	30
9	0.8	7.76	7.74	1.5	1	7.2	7.2	32.4	31.3
C		**7.21**	**7.23**	**1.16**	**1**	**6.8**	**6.8**	**29.6**	**26.9**
10	0.8	6.96	7.11	1	1	6.5	6.4	29.8	30
11	0.85	7.06	7.11	1.5	2	6.4	6.2	29.2	28.5
12	1	7	6.94	1.5	1.5	6.3	6	29.9	29.8
D		**7.00**	**7.05**	**1.3**	**1.5**	**6.4**	**6.2**	**29.63**	**29.43**
13	1	7.78	8	2	25	7.1	5.3	30.3	28.6
14	0.75	6.49	6.65	2	3	6	6	30	29.1
15	0.7	6.67	6.92	1	1	6.3	6.6	30.2	28.1
E		**6.98**	**7.19**	**1.66**	**9.66**	**6.46**	**5.96**	**30.16**	**28.6**
16	1.4	8.22	8.2	13	18	6	5.8	31.6	29.5
17	1	8.15	8.2	12.5	12.5	6.6	6	31.8	31.8
18	1	7.62	7.44	4.5	16	6.2	5.4	32.5	31
F		**7.99**	**7.94**	**10**	**15.5**	**6.26**	**5.73**	**31.96**	**30.76**
19	1.3	7.95	7.92	22	22	5.7	5.5	30.8	30.7
20	1	7.89	8.89	23	22.5	5.8	5.7	30.5	29.6
21	1.1	7.67	7.76	21.2	32	6.3	5.2	30.5	29.5
G		**7.83**	**8.19**	**22.06**	**25.5**	**5.93**	**5.46**	**30.6**	**29.93**
22	1.2	8.1	8.05	17	17	6.4	6.3	31.4	31.4
23	1.3	8.05	7.85	19	21.5	6.3	5.6	31.6	30.5
24	1	8.05	7.95	18	19	6.2	5.8	31.3	29.7
H		**8.06**	**7.95**	**18**	**19.16**	**6.3**	**5.9**	**31.43**	**30.53**

25	1.5	7.95	7.68	13.5	21	6.5	6.4	32	30.9
26	1.7	7.87	7.57	13.5	21.5	6.7	6.3	32	31
27	1.5	7.67	7.69	11	18	6.7	6.1	31.5	30.6
I		**7.83**	**7.64**	**12.66**	**20.16**	**6.6**	**6.2**	**31.8**	**30.8**
28	1.5	7.67	7.81	1	6	7.4	7.1	32.9	32.9
29	1.1	7.01	7.2	1	6	7.4	6.8	33	32.2
30	1.3	7.46	7.42	1	2	7.3	6.4	32.9	32.4
J		**7.38**	**7.47**	**1**	**4.6**	**7.3**	**6.7**	**32.93**	**32.5**
31	1.7	7.55		16	-	6.9		30	30
32	1	7.79	7.77	15	15	5.7	5.7	29.4	29.4
33	1.1	7.87	7.86	24	21	4.9	5.3	28.9	28.3
37	1.3	7.67	7.66	3	24	7.2	6.3	32.8	32
K		**7.72**	**7.76**	**14.5**	**20**	**6.17**	**5.77**	**30.2**	**29.9**
34	0.7	7.1	7.12	25	25	5.3	5	31.1	31.8
35	1.8	7.48	7.49	25	25	6.3	6	30.9	30.3
36	0.5	7.8	7,83	26	28	6.4	6	28.1	27.3
L		**7.4**	**7.48**	**25.3**	**26**	**6**	**5.67**	**30.03**	**29.8**
AV	**1.08**	**7.35**	**7.18**	**9.2**	**12.1**	**6.45**	**6.08**	**30.8**	**30.0**

Table 4. Enviromental parameters 11/2006

ST	TRAN.	pH		SALINITY		DO		T^oC	
		FACE(1)	BOTOOM (2)	1	2	1	2	1	2
1	1	7.41	7.48	1	1	6.3	6	30.8	30.9
2	1.2	7.41	7.48	1	1	6.3	6.3	30.8	30.9
3	0.95	8.68	8.67	1	1	6.5	6.2	31.5	31.6
A	**1.05**	**7.83**	**7.88**	**1.00**	**1.00**	**6.37**	**6.17**	**31.03**	**31.13**
4	1	7.62	7.46	1	2	6.4	6.2	30.8	30.4
5	1.2	7.93	7.88	2	2	6.3	6	31.1	30.9
6	0.8	8.24	8.12	1	1	6.5	6.1	31.3	31.1
B	**1.00**	**7.93**	**7.82**	**1.33**	**1.67**	**6.40**	**6.10**	**31.07**	**30.80**
7	1.5	7.58	7.62	3	4	6.7	6.2	30.4	30.3
8	1.2	6.31	6.51	1	1	6.5	6.3	30.8	30
9	1	7.22	7.38	1	1	6.7	6.2	31	30.7
C	**1.23**	**7.04**	**7.17**	**1.67**	**2.00**	**6.63**	**6.23**	**30.73**	**30.33**
10	1.3	7.97	7.97	9	9	6.2	6.1	29.9	29.9
11	1.2	7.93	8.21	7	14	6.7	6.2	29.9	29.8
12	1.2	7.82	7.82	8	8	6.5	6.3	31	30.8

D	**1.23**	**7.91**	**8.00**	**8.00**	**10.33**	**6.47**	**6.20**	**30.27**	**30.17**
13	1.5	7.58	8.1	5	33	6.4	6.2	29.4	28.4
14	0.7	7.22	7.21	1	4	6.5	6.4	29.8	29.4
15	1.2	7.67	8.02	2	9	6.6	6.2	28.8	29.1
E	**1.13**	**7.49**	**7.78**	**2.67**	**15.33**	**6.50**	**6.27**	**29.33**	**28.97**
16	1.6	8.22	8.19	10	10	6.5	6.3	28.9	28.7
17	1.5	8.15	8.06	11	25	6.7	6.3	28.9	29
18	1.2	8.21	8.23	7	7	5.5	5.4	29.3	29.2
F	**1.43**	**8.19**	**8.16**	**9.33**	**14.00**	**6.23**	**6.00**	**29.03**	**28.97**
19	1.9	7.82	7.73	13	14	6.4	5.9	27.3	27.2
20	2.2	8.14	8.09	11	25	6.2	5.8	28	28.5
21	1.6	8	7.99	12	11	6	5.8	27.3	27.2
G	**1.90**	**7.99**	**7.94**	**12.00**	**16.67**	**6.20**	**5.83**	**27.53**	**27.63**
22	1.4	7.96	7.93	9.5	9	6.1	6	28	28
23	2.3	7.98	7.99	9	9.5	6.3	6.1	28.5	28.6
24	1.6	8.03	7.97	8.5	10	6.5	6.3	28.1	28
H	**1.77**	**7.99**	**7.96**	**9.00**	**9.50**	**6.30**	**6.13**	**28.20**	**28.20**
25	1.5	8.23	8.2	9	17	6.7	6.3	29.2	31.4
26	2	8.08	8.1	13	21.5	6.4	6	29.6	34.7
27	2.3	8.19	8.08	11	25.5	6.7	6.5	29.4	35.2
I	**1.93**	**8.17**	**8.13**	**11.00**	**21.33**	**6.60**	**6.27**	**29.40**	**33.77**
28	1.5	8.26	8.25	11	19	6.2	5.9	29.7	31.4
29	1.1	8.43	8.02	13	25.5	5.9	5.8	29	30.3
30	1.3	8.19	8.18	34	34	6.1	5.6	28.5	28.4
J	**1.30**	**8.29**	**8.15**	**19.33**	**26.17**	**6.07**	**5.77**	**29.07**	**30.03**
31	2.5	8.04	8.14	7	7	6.1	5.7	30.3	36.4
32	2	8.08	8.07	10	10	6.3	6.1	29.7	29.7
33	1.5	8.2	8.18	16	19	6.4	5.7	29.5	29.3
K	**2.00**	**8.11**	**8.13**	**11.00**	**12.00**	**6.27**	**5.83**	**29.83**	**31.80**
34	2.3	8.06	8.34	8	26	6.5	6.3	30.8	37.1
35	1.6	8.1	8.1	17	17	6.3	5.9	29.4	29.4
36	1.5	7.76	7.52	15	24	6.2	5.8	31	35
L	**1.80**	**7.97**	**7.99**	**13.33**	**22.33**	**6.33**	**6.00**	**30.40**	**33.83**
AV	**1.48**	**7.91**	**7.92**	**8.31**	**12.69**	**6.36**	**6.07**	**29.66**	**30.47**

Table 5. Oil parameters in 2006

§Þa ®iÓm	*April*	*August (mg/L)*	*November*
A - 1		0,185	0,208
A-2	0.357		
A - 3		0,250	0,189
B - 4		0,537	0,447
B - 5	0.225	0,289	0,350
C - 7		0,235	0,190
C - 8	0.417	0,347	0,208
D - 10		0,450	0,189
D - 11	0.284	0,311	0,447
E - 13	0.455	0,730	0,350
E - 15		0,807	0,190
F - 16	0.198	0,390	0,427
F - 18		0,490	0,421
G - 19		0,513	0,500
G - 21	0.259	0,268	0,198
H - 23	0.281	0,200	0,195
I - 27	0.385	0,210	0,310
J - 29	0.242	0,420	0,508
J - 30		0,191	0,200
K - 31	0.503	0,610	0,708
L - 34	0.200	0,196	0,295
L - 36	0.166	0,822	0,756
TB	0.3055	**0.402429**	**0.346952**

II. Planckton in 2006

Tram	Zooplankton (Inds/m^3)				Phytoplanckton (cell/lÝt)			
	4/2006	5/2006	8/2006	11/2006	4/2006	5/2006	8/2006	11/2006
1	2850	5600	2550	500	1540	47300	183540	7240
2	150	5300	10500	2280	3160	11460	117760	2320
3	2550	80	10100	2600	380	10780	79520	10800
TBA	**1850**	**3660**	**7716**	**1793**	**1693**	**23180**	**126940**	**6786**
4	3300	3500	2100	1000	2550	4080	181780	9420
5	40400	700	2250	1950	5100	1270	232320	
6	14300	70	6800	15750	340	1940	4600	7920
TBB	**19333**	**1423**	**3716**	**6233**	**2663**	**2430**	**139566**	**8670**

7	3700	550	5550	2200	3440	970	170640	460
8	550	160	4100	1600	3100	1230	40060	1700
9	170	2250	9000	37250	10830	1740	18560	4100
TBC	**1473.33**	**986**	**6216**	**13683**	**5790**	**1313**	**76420**	**2086**
10	-	3800	1050	90	920	700	53840	1140
11	1020	650	7450	110	1590	1330	21580	700
12	1650	1050	1450	360	1010	610	6200	1140
TBD	**1335**	**1833**	**3316**	**186**	**1173**	**880**	**27206**	**993**
13	330	6100	2050	600	1870	2150	14640	560
14	-	2650	3500	220	3140	2860	4960	
15	50	850	160	80	6500	960	6900	620
TBE	**190**	**3200**	**1903**	**300**	**3836**	**1990**	**8833**	**590**
16	430	5500	1060	120	3120	1950	**10380**	
17	950	2100	4500	150	2770	1740	6840	5960
18	140	3300	38400	110	810	3120	26160	1240
TBF	**506**	**3633**	**14653**	**126**	**2233**	**2270**	**14460**	**3600**
19	2200	2200	1500	130	3730	1400	26600	3000
20	750	2500	191600	2040	8120	1280	**9660**	
21	1650	2850	18300	800	3650	2710	6680	4540
TBG	**1533**	**2516**	**70466**	**990**	**5166**	**1796**	**14313**	**3770**
22	4900	12900	37000	400	3430	2840	**11220**	
23	1900	22300	30800	200	1280	1390	9040	8260
24	1000	5300	67400	590	970	1280	9780	4660
TBH	**2600**	**13500**	**45066**	**396**	**1893**	**1836**	**10013**	**6460**
25	850	650		720	1490	470	15380	3120
26	600	680	13400	920	710	540	**13520**	
27	1150	700	2450	640	1210	880	**14640**	
TBI	**866**	**676**	**7925**	**760**	**1136**	**630**	**14513**	**3120**
28	2100	3250	1500	130	470	500	46080	
29	150	3670	14200	370	240	770	27900	5560
30	740	3850	11200	6600	4800	1510	28760	57700
TBJ	**996**	**3590**	**8966**	**2366**	**1836**	**926**	**34246**	**31630**
31				90				
32	140	1850	40200	1720	390	490	5600	4880
33	140	2000	250000	490	310	1030	2140	
37	190	270	12400		240	520		
TBK	**156**	**1373**	**100866**	**766**	**313**	**680**	**3870**	**4880**
34	850	9000	52000	280	3490	580		
35	140	3000	44800	430	7850	500	4780	11680
36	40	5200	6800	160	12500	450	6860	
TBL	**343**	**5733**	**34533**	**290**	**7946**	**510**	**5820**	**11680**

III. Zoobenthos in 2006

Density zoobenthos in 2006

St	4/2006	5/2006	8/2006	11/2006	Average
	Inds/m2	Inds/m2	Inds/m2	Inds/m2	
1	826	800	540	926.7	773.2
2	140	426.7	400	453.3	355.0
3	406	373.3	386	413.3	394.7
4	246	233.3	380	166.7	256.5
5	286	106.7	420	160.0	243.2
6	113	113.3	120	226.7	143.3
7	133	173.3	93	186.7	146.5
8	240	326.7	200	233.3	250.0
9	266	300	613	413.3	398.1
10	440	273.3	253	293.3	314.9
11	540	273.3	166	560.0	384.8
12	540	860	233	393.3	506.6
13	93	193.3	80	73.3	109.9
14	180	193.3	193	986.7	388.3
15	380	686.7	386	533.3	496.5
16	746	533.3	480	673.3	608.2
17	226	166.7	200	366.7	239.9
18	806	520	473	2466.7	1066.4
19	1226	960	1086	473.3	936.3
20	333	180	246	640.0	349.8
21	1266	1246.7	300	933.3	936.5
22	340	1140	933	740.0	788.3
23	360	193.3	146	486.7	296.5
24	360	300	1086	680.0	606.5
25	553	373.3	393	340.0	414.8
26	193	313.3	146	1366.7	504.8
27	273	240	360	893.3	441.6
28	593	333.3	626	260.0	453.1
29	586	420	660	606.7	568.2
30	120	253.3	210	106.7	172.5
31	-	-	-	800.0	
32	213	613.3	273	780.0	469.8
33	226	500	1020	360.0	526.5
34	160	326.7	153	386.7	256.6

35	140	213.3	253	780.0	346.6
36	273	500	493	586.7	463.2
37	3793	2766.7	140		1874.9
TB	**489.3**	**484.1**	**392.8**	**582.3**	**485.6**

Weight in 2006

St	4/2006	5/2006	8/2006	11/2006	Average
	g/m2	g/m2	g/m2	g/m2	
A1	343.8	291	48.9	89.7	193.4
A2	84.7	111	171.2	51.3	104.6
A3	280.2	354.7	105.4	116.7	214.3
B4	211.4	5.8	16.1	10.4	60.9
B5	7.9	10.9	7.1	13.6	9.9
B6	224.7	3.8	140.1	170.3	134.7
C7	5.5	201.5	5.7	6.5	54.8
C8	21.5	6.6	15.1	8.9	13.0
C9	17.6	16.6	14.7	217.2	66.5
D10	80.4	33.7	40.8	36.5	47.9
D11	57.8	26.8	10	42.8	34.4
D12	60.7	13	81.8	37.5	48.3
E13	27.5	11	14.6	17	17.5
E14	14.8	21.3	4.7	149.1	47.5
E15	98.5	111.6	132.3	103.8	111.6
F16	642.6	514.6	502.8	60.5	430.1
F17	17.9	32.5	81.1	7.4	34.7
F18	334.1	160.2	123.2	301	229.6
G19	48.5	84.2	359.2	225.1	179.3
G20	72.2	11.9	47.9	14.1	36.5
G21	1038.9	410.8	146.8	204.1	450.2
H22	52.9	178.4	368.9	153.3	188.4
H23	10.2	11.1	65.3	15.8	25.6
H24	10.2	25.3	25.5	51.4	28.1
I25	306.5	75.4	6.8	65.6	113.6
I26	6.6	7.4	6.8	418.7	109.9
I27	23.3	15.8	14.5	220.5	68.5
J28	63.3	53.9	24.6	63.7	51.4
J29	315.8	188.2	32.6	195.1	182.9
J30	14.4	26.7	27.9	388.6	114.4
K31	-	-	-	141.1	
K32	78.2	143	39.3	205.3	116.5

K33	52.6	105.8	72.7	76.7	77.0
L34	36.7	73.5	21.3	171.8	75.8
L35	80.6	136.6	159.8	108.2	121.3
L36	65.9	89.6	123.3	116.3	98.8
K37	31.1	40.2	5.5	141.1	54.5
TB	**134.4**	**100.1**	**85.1**	**119.4**	**109.6**

IV. Waters plants

Table 1. Distribution of the Waters plants in Tam Giang-Cầu Hai

STT	Tên loài	Tam Giang*	Sam-An Truyền	Thuỷ Tú	Cầu Hai
1	*Halophila ovalis*	+		+	+
2	*H. beccarii*	+	+	+	+
3	*H. minor*		+	+	
4	*Ruppia maritima*	+		+	+
5	*Zostera japonica*	+	+	+	+
6	*Halodule pinifolia*	+	+	+	+
7	*Utricularia aurea*	+	+		+
8	*Ceratophyllum demersum*	+	+	+	+
9	*Myriophyllum spicatum*	+	+	+	+
10	*Hydrilla verticillata*	+	+		+
11	*Valisneria spiralis*	+	+		+
12	*Blyxa aubertii*	+	+	+	+
13	*Potamogeton malaianus*	+			+
14	*P. maackianus*	+			
15	*Najas indica*	+	+	+	+
16	*Nymphaea pubescent*	+	+		+
17	*Paspalum scrobiculatum*	+			+
	Tæng céng	**16**	**12**	**10**	**15**

* Chú thích: Phá Tam Giang gồm các mặt cắt A, B, C, D , E; đầm Sam-An Truyền: mặt cắt F; đầm Thuỷ Tú: mặt cắt G, H, I; đầm Cầu Hai: mặt cắt J, K, L.

Table 2: Chiều dài (L) và sinh lượng trung bình (B) của cỏ lươn *Zostera japonica* ở phá Tam Giang - Cầu Hai

S TT	Địa điểm	Trạm	Mùa khô		Mùa mưa	
			L (cm)	B (g./m^2)	L (cm)	B (g./m^2)
1	Quảng Thanh	D12	17,6*	2790,0	15,3	2667,0
			17,5**	2687,0	16,2	2487,0
2	Cồn Đâu	8	17,9	2777,0	17,5	2778,0
			19,5	4250,0	17,7	2168,0
3	Cồn Tè	10	20,6	5000,0	14,5	2223,0
			21,2	3000,0	19,0	3000,0

4	Hải Tiến	E14	19,2 28,9	4944,0 3650,0	10,8 20,1	2500,0 3250,0
5	Cồn Sơn	14	10,7 46,0	1557,0 5000,0	- 12,4	- 2650,0
6	Hợp Châu	15	22,1 41,0	3723,0 4750,0	15,8 17,0	2500,0 3075,0
7	Cồn Dài	18	29,7 42,6	3777,0 3800,0	16,6 24,6	3022,0 3650,0
8	Phú Xuân	F18	23,5 24,2	2565,0 2544,0	19,7 20,7	1950,0 2007,0
9	Cồn Lậy	J30	23,5 22,8	2110,0 1989,0	19,2 21,3	1800,0 2008,0
	Trung bình		20,5 29,3	3249,2 3518,8	16,2 18,7	2431,3 2699,4

Ghi chú: * hàng trên là tài liệu năm 2000; ** hàng dưới là tài liệu năm 2006

Table 3: Biomass of the *Halodule pinifolia* ở đầm phá Tam Giang- Cầu Hai

STT	Địa điểm	Trạm	Mùa khô		Mùa mưa	
			L (cm)	B(g./m^2)	L (cm)	B(g./m^2)
1	Quảng Thanh	D12	10,5* 9,9**	1500,0 1400,0	8,5 9,8	1000,0 956,0
2	Cồn Sơn	14	9,5 6,6	1300,0 2555,0	8,3 12,4	880,0 2650,0
3	Phú Xuân	F18	8,6 19,5	1867,0 3150,0	8,0 19,1	1200,0 2000,0
4	Phú Hải		8,7 12,5	1950,0 2730,0	8,2 17,1	2000,0 2650,0
5	Mục Trù (Vinh Xuân)	H22	8,6 8,2	2010,0 2100,0	8,0 8,2	1764,0 2060,0
6	Cồn Lậy (Vinh Hiền)	J30	16,2 11,8	2220,0 2600,0	12,3 8,7	1750,0 2500,0
7	Lộc Bình	K33	13,0 12,6	2010,0 2295,0	9,3 12,8	1500,0 2075,0
	Trung bình:		10,7 11,6	1836,7 2404,3	8,9 13,8	1442,0 2127,3

Table 4: Biomass of *Halophila ovalis in* Tam Giang – CÇu Hai

S TT	Địa điểm	Mùa khô		Mùa mưa	
		L (cm)	B(g./m^2)	L (cm)	B(g./m^2)
1	Hoà Duân	3,8*	387,0	3,2	355,0
		3,7**	340,0	3,4	366,0
2	Cồn Sơn	3,5	330,0	3,3	246,0
		3,4	390,0	3,4	365,0
3	Phú Hải	3,1	358,0	3,2	412,0
		3,3	445,0	4,2	375,0
4	Cồn Lậy (Vinh Hiền)	3,2	420,0	3,3	344,0
		3,5	494,0	3,7	450,0
5	Cửa Tư Hiền	4,2	490,0	4,1	484,0
		4,3	489,0	4,0	491,0
	Trung bình	3,6	397,0	3,4	368,2
		3,7	431,6	3,7	409,2

Ghi chú: * hàng trên là tài liệu năm 2000; ** hàng dưới là tài liệu năm 2006

Table 5: Biomass of the others waters plants (5/2000 and 4/2006)

No	Species	Location	Station	Lenght (cm)	Sinh lượng (g. t-¬i/m^2)
1	*Ruppia maritima (Cá kim)*	Quảng Phước	B 6	11,0*	1500,0
				15,0**	1450,0
		Phú Thuận	19	10,8	1900,0
				13,5	1860,0
		Cầu Trường Hà	I 27	13,2	2200,0
				14,4	2405,0
		Tuý Vân	J 29	15,2	1800,0
				18,0	1900,0
		Đá Bạc	T 34	12,1	1600,0
				16,7	2200,0
			Mean:	12,4	1800,0
				15,5	1963,0
2	*Halophila beccarii (Cá nµn)*	Quảng Thái	A 3	3,4	200,0
				3,3	189,0
		Điền Hải	B 4	3,5	198,0

				3,4	196,0
		Vinh Hưng	J 29	3,4 3,5	540,0 850,0
		Ba Cồn	J 28	3,2 3,8	380,0 885,0
		Cầu Trường Hà	I 27	3,6 3,5	510,0 725,0
		Đá Bạc	T 34	3,7 4,1	450,0 500,0
		Đồi 30(gần Đá Bạc)		3,5 3,8	650,0 1500,0
		Trung An	L 36	3,7 3,9	685,0 950,0
			Mean:	3,5 3,6	379,7 557,5

Table 6: ***Biomass of Valisneria spiralis*** **ở đầm phá Tam Giang - Cầu Hai (2006)**

STT	Địa điểm	Mùa khô		Mùa mưa	
		L (cm)	B(g./m^2)	L (cm)	B(g./m^2)
1	Điền Hoà (A1)	35,0	2000,0	75,7	6000,0
2	Quảng Thái (A2)	25,3	3750,0	85,5	6500,0
3	Quảng Thái (A3)	25,5	3808,0	80,3	6000,0
4	Quảng Lợi (B 6)	28,0	2250,0	48,5	5000,0
5	Quảng Lợi (B 5)	41,0	4000,0	58,0	5600,0
6	Quảng Ngạn (B 4)	29,8	3100,0	49,6	4996,0
7	Quảng Phước (C9)	13,6	1250,0	33,6	2500,0
8	Quảng Công (C7)	19,9	1540,0	29,8	1995,0
9	Đại Giang (K37)	50,7	3580,0	61,4	5500,0
10	Cát Thượng Hà	53,2	3776,0	66,2	5995,0
	Trung bình	32,2	2904,4	58,9	5008,6

Table 7: *Biomass of Hydrilla verticillata* ở đầm phá Tam Giang - Cầu Hai (2006)

STT	Địa điểm	Mùa khô		Mùa mưa	
		L (cm)	B(g./m^2)	L (cm)	B(g./m^2)
1	Điền Hoà (A1)	26,4	2250,0	39,5	6500,0
2	Quảng Thái (A2)	25,0	2500,0	39,1	4250,0
3	Quảng Thái (A3)	15,9	1750,0	123,0	8000,0
4	Quảng Lợi (B 6)	28,0	2250,0	68,2	6123,0
5	Quảng Lợi (B 5)	38,0	3348,0	70,8	6600,0
6	Quảng Ngạn (B 4)	27,9	2880,0	58,9	5995,0
7	Quảng Phước (C9)	23,6	2525,0	39,8	5500,0
8	Quảng Công (C7)	21,2	1995,0	26,8	2450,0
9	Đại Giang (K37)	50,7	4580,0	40,4	6500,0
10	Cát Thượng Hà	53,2	5276,0	35,5	7195,0
	Trung bình	31,0	2935,4	54,2	5911,3

Table 8: *Biomass of waters plants in* 2006

STT	Loài/Địa điểm	Mùa khô		Mùa mưa	
		L (cm)	B(g./m^2)	L (cm)	B(g./m^2)
	Potamogeton malaianu (Cỏ nhãn tử mã lai)				
1	Quảng Thái (A2)	25,1	1850,0	75,4	5215,0
2	Quảng Thái (A3)	35,9	1950,0	72,8	4250,0
3	Quảng Lợi (B 6)	28,4	1250,0	54,0	3250,0
4	Quảng Lợi (B 5)	24,0	1355,0	79,7	5600,0
5	Đại Giang (K37)	30,0	2055,0	73,3	6500,0
6	Cát Thượng Hà	29,2	2105,0	64,2	5900,0
	Trung bình	27,8	1760,8	69,9	5119,2
	Najas indica (Rong tử)				
1	Điền Hoà (A1)	28,0	2250,0	40,0	2000,0

2	Quảng Thái (A2)	37,5	1500,0	61,3	2500,0
3	Quảng Thái (A3)	16,3	2000,0	50,0	3195,0
4	Điền Hải (B 4)	7,2	2000,0	49,7	3036,0
5	Quảng Lợi (B 6)	15,5	1600,0	67,3	3250,0
6	Đại Giang (K37)	12,8	1350,0	38,6	2900,0
7	Cát Thượng Hà	18,6	2160,0	33,7	2187,0
8	Thôn Định Cư (F18)	-	-	32,7	5500,0
9	Đồi 30 (trên L34)	-	-	36,3	4125,0
10	Ba Cồn	-	-	30,5	3989,0
	Trung bình	19,4	1837,1	44,0	3268,2

Table 9: Areas of the seagrass beds

TT	Địa điểm	Diện tích (ha)	Cỏ biển đặc trưng
1	Quảng Thành	20	*Zostera japonica* *Halodule pinifolia*
2	Cồn Đâu	5	*Zostera japonica*
3	Hải Dương	35	*Halodule pinifolia*
4	Cồn Tè	8	*Zostera japonica*
5	Hải Tiến	7	Zostera japonica
6	Hợp Châu	30	*Zostera japonica* *Ruppia maritima*
7	Cồn Dài-Cồn Nổi	300	*Zostera japonica*
8	Cồn Thờ	25	*Zostera japonica,*
9	Phú Xuân	200	*Halodule pinifolia* *Halophila beccarii* *Ruppia maritime* *Halophila ovalis*
10	Phú Thuận	180	*Halodule pinifolia* *Halophila beccarii* *Ruppia maritime* *Halophila ovalis*
11	Phú Hải	120	*Halophila beccarii* *Ruppia maritime* *Halophila minor* *Halodule pinifolia*
12	Phú Diên	50	*Halodule pinifolia* *Halophila beccarii* *Ruppia maritime* *Halophila minor*
13	Vinh Xuân	80	*Halodule pinifolia* *Halophila beccarii* *Ruppia maritime*

			Halophila minor
14	Vinh Thanh	100	*Halodule pinifolia* *Halophila beccarii* *Ruppia maritime* *Halophila minor*
15	Vinh Giang	150	*Halophila beccarii* *Ruppia maritima*
16	Ba Cồn	230	*Halophila beccarii,* *Halophila ovalis,* *Ruppia maritime,* *Halodule pinifolia* *Najas indica*
17	Lộc Bình	35	*Haloduel pinifolia*
18	Cồn Lậy	25	*Halodule pinifolia* *Halophila ovalis* *Zostera japonica*
19	Trung An	50	*Halophila beccarii,*
20	Đá Bạc	80	*Halophila beccarii,*
21	Đồi 30	70	*Halophila beccarii,*
	Tổng cộng	1800 ha	

Table 10: Waters plants stocks

TT	Tên loài	Sinh lượng * (kg/m^2)	Trữ lượng (tấn tươi)
1	Cỏ lươn *(Z.japonica)*	3,25	35.000
2	Hẹ tròn *(H.pinifolia)*	2,40	30.000
3	Cỏ kim *(R. maritima*)	2,20	15.000
4	Cỏ nàn *(H. beccarii)*	0,56	4.500
5	Rong mái chèo *(V. spiralis)*	5,00	40.000
6	Cỏ nhãn tử *(P. malaianus)*	5,12	8.000
7	*Rong đen lá vòng (H. verticillata)*	5,91	20.000
8	*Rong từ* (N. indica)	3,27	35.000
9	*Rong xương cá* (*M. spicatum)*	3,50	7.000
10	*Hẹ nước (B. aubertii)*	1,70	2.500
	Những loài khác		23.000
		Tổng cộng:	**220.000**

V. Fishery analyzing

Bảng 1. Bảng phân bố nguồn lợi

Vietnamese names	1	2	3	4	5	6	7	8	9	10	11	12	13
Ghẹ	0	0.153	2.618	0	0	0	0	0	2.713	0	0.484	0	0
Rạm	0.06	0	0	0	0.0006	2.666	2.696	1.767	0.491	0	0.728	1.656	0
Chìa	1.212	0.772	1.309	0	0	0	0	0	0	0	3.148	0	0.316
Cá đối	1.12	1.084	6.026	0.02	0.048	5.333	5.390	6.477	9.865	5.408	13.56	1.324	5.676
Cá ngạnh	60.096	0.152	10.743	0	0.117	1.777	1.796	3.533	0.245	0	0	0	0
Cá tráp	1.12	2.32	2.348	0.04	0	0	0	0	6.165	0	3.393	3.306	0
Cá móm	3.368	3.876	3.927	0.064	0.179	12.466	12.578	11.778	12.330	6.003	4.845	14.893	10.720
Cá căng	0	0.152	0.385	0.002	0.003	0	0	0.588	1.356	4.807	0.244	0	0.316
Cá lanh	0	0.304	2.618	0.02	0	0	0	0	0	0	0	0	0
Cá chai	0.12	0.152	2.618	0.008	0	0	0	0	0	1.201	0.484	0	0
Cá bò gai	0.516	0.152	0.250	0.004	0.083	6.574	6.649	9.070	8.630	3.605	0.244	6.618	7.013
Cá nóc (độc)	1.364	1.78	0	0.048	0	0	0	0	0.616	0	0	0	0
Cá kìm	6.92	11.624	10.743	0	0.297	9.778	9.882	21.790	21.085	12.613	12.111	17.205	39.115
Ca lành canh	0.06	1.312	0	0.02	0	0	0	0	0	0	0.244	0	0
Cá sơn	0.604	0.772	0.250	0.048	2.368	47.178	47.618	20.259	4.562	20.419	13.079	8.605	3.788
Cá dìa	0	11.624	1.309	0	0.054	1.943	1.976	1.767	4.932	1.502	2.420	3.306	0
Cá kình	0	1.08	2.618	0.052	0.021	2.832	2.874	4.711	4.932	0	11.627	0	0
Cá đục	0.604	0.54	0	0.008	0	0	0	0	0	0	0	0	0
Cá bống Thệ	0.06	0.384	0.250	0	0.0006	0.186	0.180	0	0	1.201	0.244	0	0
Cá bống trắng	0	0.384	0	0	0	0.186	0.180	0	0	0	0	0	1.571
Cá bống độc		0				0.186	0.180						
Cá bống định	0	0	0	0	0	0	0	0	0	0	0.244	0	0
Cá mòi	1.12	0.772	2.079	0.01	0	0	0	0	0	0	0	0	0
Cá nhâm	0	0.772	0.250	0.016	0.007	0	0	1.177	1.973	0	0.199	0	1.888
Cá ót	15.028	54.264	35.369	0.76	1.037	0	0	0	8.262	0	0.244	0	0
Cá nhệch	0	0.224	0	0.02	0	0.888	0.898	0	0.616	0	1.452	1.656	0
Cá ong	0.148	0	0	0	0.007	0.702	0.719	0.5886	0	0.600	0	0	0
cá dưa	1.488	0	0	0	0	0	0	0	0	0	0	0	0
Cá cơm	0.3	0	0	0	22.819	0	0	2.3559	0	14.115	6.781	11.581	14.508
Cá úc	0	0	0	94.644	0	0	0	0	0	0	0	0	0

Cá bơn	0	0	0	4.112	0	0	0	0	0.986	0	0	0	0
Cá Mối	0	0	0	0	1.037	0	0	0	0	0	0	0	0
Cá Lục	0	0	0	0	0	0.888	0.898	1.177	1.232	0	0	0	0
Lươn	0	0	0	0	1.382	0	0	0	0	0	0	0	0
Cá rô biển	0	0	0	0	0	0.888	0	0	0	0	0	0	0
Tôm he	0	0.928	0.519	0	0	0.268	0.269	0.5886	0	0	0	0	0
Tôm rảo	4.644	4.024	12.572	0.08	69.14	4.444	4.494	11.778	8.630	28.525	29.068	29.78	15.141
Tôm sú	0	0	1.039	0	0	0.888	0.898	0.588	0.370	0	0	0	0
Tôm trứng nước ngọt	0	0.304	0	0	1.382	0	0	0	0	0	0	0	0
Bề bề	0	0	0	0	0	0	0	0	0	0	0	0.065	0

Ghi chú: *1- Ô Lâu, 2 - Nam Thuận An, 3- Đông Thuận An, 4- Tây Thuận An, 5- Tây Đầm Sam; 6- Bắc Đầm Sam ; 7- Hương Trà; 8- Đông Đầm Sam; 9 - Thuỷ Tú; 10- Nam Cầu Hai; 11 - Đông Cầu Hai; 12 - Bắc Cầu Hai; 13 - Tây Cầu* Hai

Bảng 2. kích thước một số loài cá thường gặp

Tên loài	**Chiều dài tối đa (cm)**										**TB**
Mặt cắt 2-1											
Cá kìm	16	12	10	10	10	20	8	10	20	10	12.6
Cá mối	12	7.5	10	8	9	8	9	12	7	8	9.05
Cá nhâm	5.5	5.5	6.5	6.0	6.0	5.5	5.5	5.5	5.5	5.5	5.7
Cá bống	11	12.5	9	6	7	-	-	-	-	-	9.1
Cá sơn	7.0	6.0	7.0	8.0	3.5	7.5	6.0	4.5	5.5	5.5	6.05
Cá dìa	8.0	9.0	6.0	7.5	8.0	7.5	9.0	10	5	4.5	7.45
Cá tráp	13	9	9	11	9.5	10	11	10	9	10	10.15
Cá đục	13	7.5	7.0	8.5	13.0	7.5	8.0	11.5	9.0	12.0	9.7
Cá đối	13.5	11.0	12.0	5.5	13.0	12.0	11.0		-	-	13
Mặt cắt 2-3											
Cá kìm	17.0	17.0	9.5	33.0	9.5	12.0	10.5	15.0	15.0	11.0	14.95
Cá đối	6.0	13.0	6.0	9.0	6.0	5.5	5.5	5.5	11.5	5.5	7.35
Cá móm	12.0	6.5	9.0	10.0	11.0	10.0	10.0	9.5	11.0	11.0	10
Cá kình	7.5	5.5	5.5	7.0	12.0	4.0	4.0	4.0	8.5	8.0	6.6
Mặt cắt 4-3											
Cá kìm	16.0	14.0	17.0	6.5	6.0	6.0	8.5	8.5	15.0	24.0	12.15
Cá móm	8.0	8.0	10	6	5.5	6.0	12.0	8.0	13	11	8.75
Mặt cắt 4-1											
Cá căng	6.0	4.5	5.5	5.0	4.0	5.5	4.5	8.0	9.5	-	5.83
Cá móm	9.0	7.0	8.0	5.5	4.0	4.0	6.0	7.0	5.5	3.8	5.98
Cá đối	8.7	9.5	10.0	11.0	7.5	7.7	9.0	8.5	11	9.0	9.19
Cá kìm	11.0	12.0	15.0	13.0	12.0	11.0	12.0	10.0	20.0	16.0	13.2
Cá bống	8.0	7.0	6.8	6.8	7.5	7.0	7.0	4.5			6.82
Cá trai	9.0	7.5	7.0	7.0	7.5	7.0	6.5	7.5	6.0	6.0	7.1
Mặt cắt 4.2											

Cá căng	9.0	6.5	7.5	11.5	5.7	5.2	5.0	5.0	3.7	-	6.56
Cá đối	8.5	7.2	11.0	10.0	12.5	6.5	8.8	9.5	10.0	-	9.33

Tổng số 217 cá thể

Bảng 3. Kết quả khảo sát trữ lượng cá đầm phá Tam Giang - Cầu Hai (5-2006)

No	**Địa điểm thu mẫu**	**Sản lượng**	**Trữ lượng**
1	Olau 2-2	3.293	13172
2	Nam Thuan an 2-1	17.562	70248
3	Đông Thuan an 2-3	5.193	20772
4	Tây Thuan an 2-4	8.849	35396
5	Tay Dam Sam	4.837	19348
6	Bac Dam Sam 3-1	190.200	760800
7	Huong Tra 3-3	71.862	287448
8	Dong Dam Sam 3-4	36.997	147988
9	Thuy Tu 3-2 (2)	47.104	188416
10	Nam Cau hai 4-1	16.300	65200
11	Dong Cau hai 4-2	22.103	88412
12	Bac Cau hai 4-3	16.907	67628
13	Tay Cau hai 4-4	8.526	34104

Bảng 4. Phân bố nguồn lợi động vật đáy đầm phá Tam Giang - Cầu Hai (kg/40m^2)

Mặt cắt	Rong biển	ốc	Thân mềm hai mảnh vỏ	Giáp xác	Cá đáy	Tổng
A	5.3	0	1.2	0.05	0.05	6.6
B	0	0	1.0	0	0	1.0
C	0	0	0.5	0.1	-	0.6
D	0	1.0	2.31 (0.21Meretrix)	0	0	3.52
E	0	0	0.15 (meretrix)	Portunus 0.1	Siganus 0.25	0.50
F	0.16	12.2	0.22	0.02	0.02	12.62

G	-	3	6.0 (Saccostrea)	-	-	9.0
H	1.2	2.0	0	0	0.02	3.22
I	0	0.01	0	0	0	0.01
J	0	0.02	0.82	0.01	0.01	0.86
K	1.2	0.5	0	0	0	1.7
L	0.12	1.3	0.01	0	0	1.43
TS	**7.98**	**17.93**	**6.06**	**0.18**	**0.1**	**32.96**
Trữ lượng (kg)	**3.594.325**	**8.075.971**	**2.729.525**	**81.075**	**45.041**	**14.525.938**

VI. Checklist of the biological groups

Table 1. Phytoplankton

STT	T£N Loµi	®Þnh tÝnh
1	Paralia sulcata	*
2	Melosira moniliformis	*
3	Melosira nummuloides	*
4	Melosira granulata	*
5	Melosira granulata v. angustissima	*
6	Melosira varians	*
7	Melosira sp.	*
8	Cyclotella striata	*
9	Cyclotella comta	*
10	Cyclotella sp.	*
11	Coscinodiscus asteromphalus	*
12	Coscinodiscus oculus-iridis	*
13	Coscinodiscus jonesianus	*
14	Coscinodiscus jonesianus v. commutata	*
15	Coscinodiscus bipartitus	*
16	Coscinodiscus nodulifer	*
17	Coscinodiscus gigas	*
18	Coscinodiscus gigas v. praetexta	*
19	Coscinodiscus granii	*
20	Coscinodiscus cf. subtilis	*
21	Coscinodiscus sp.	*
22	Asteromphalus cleveanus	*
23	Actinoptychus undulatus	*
24	Actinoptychus splendens	*
25	Thalassiosira eccentrica	*
26	Thalassiosira lineata	*

27	Thalassiothrix elongatum	*
28	Thalassiosira sp.	*
29	Thalassiosira spp.	*
30	Lauderia borealis	*
31	Skeletonema costatum	*
32	Stephanopyxis palmeriana	*
33	Leptocylindrus danicus	*
34	Guinardia flaccida	*
35	Guinardia striata	*
36	Bacteriastrum varians	*
37	Bacteriastrum elongatum	*
38	Bacteriastrum hyalinum	*
39	Rhizosolenia styliformis v. longispina	*
40	Rhizosolenia crassispina	*
41	Rhizosolenia cylindrus	*
42	Rhizosolenia setigera	*
43	Rhizosolenia robusta	*
44	Rhizosolenia bergonii	*
45	Rhizosolenia hyalina	*
46	Rhizosolenia imbricata	*
47	Rhizosolenia imbricata v. shrubsolei	*
48	Rhizosolenia sp.	*
49	Pseudosolenia calcar-avis	*
50	Proboscia alata	*
51	Proboscia alata f. gracillima	*
52	Proboscia alata f. genuina	*
53	Chaetoceros affinis	*
54	Chaetoceros affinis v. willei	*
55	Chaetoceros abnormis	*
56	Chaetoceros curvisetus	*
57	Chaetoceros coarctatus	*
58	Chaetoceros compressus	*
59	Chaetoceros constrictus	*
60	Chaetoceros denticulatus	*
61	Chaetoceros diversus	*
62	Chaetoceros distans	*
63	Chaetoceros eibenii	*
64	Chaetoceros lorenzianus	*
65	Chaetoceros peruvianus	*
66	Chaetoceros socialis	*
67	Chaetoceros subtilis	*
68	Chaetoceros sp.	*
69	Chaetoceros spp.	*
70	Biddulphia regia	*
71	Biddulphia dubia	*
72	Biddulphia longicruris	*
73	Biddulphia pulchella	*

74	Biddulphia reticulum	*
75	Biddulphia sp.	*
76	Odontella mobiliensis	*
77	Odontella sinensis	*
78	Triceratium sp. (dai)	*
79	Hemiaulus sinensis	*
80	Hemiaulus hauckii	*
81	Hemiaulus membranaceus	*
82	Cerataulina bergonii	*
83	Ditylum sol	*
84	Ditylum brightwellii	*
85	Eucampia cornuta	*
86	Eucampia zoodiacus	*
87	Climacodium biconcavum	*
88	Palmeria hardmaniana	*
89	Hemidiscus cuneiformis	*
90	Diatoma elongatum	*
91	Thalassionema nitzschioides	*
92	Thalassiothrix frauenfeldii	*
93	Thalassiothrix longissima	*
94	Asterionella japonica	*
95	Asterionella sp.	*
96	Synedra sp.	*
97	Synedra pulchella	*
98	Synedra ulna	*
99	Synedra gaillonii	*
100	Grammatophora marina	*
101	Climacosphenia moniligera	*
102	Achnanthes longipes	*
103	Cocconeis sp.	*
104	Cocconeis scutellum	*
105	Navicula sp	*
106	Navicula palpebralis	*
107	Navicula lyra	*
108	Navicula membranacea	*
109	Navicula cancellata	*
110	Navicula elegans	*
111	Navicula sp.2. (h.thoi, trong suot)	*
112	Cymbella sp.	*
113	Trachyneis aspera	*
114	Mastogloia sp.	*
115	Cymbella sp.	*
116	Diploneis bombus	*
117	Diploneis smithii	*
118	Diploneis crabro	*
119	Diploneis sp.1	*
120	Gyrosigma balticum	*

121	Gyrosigma spenceri	*
122	Gyrosigma strigile	*
123	Gyrosigma sp.	*
124	Gyrosigma sp.1	*
125	Pleurosigma affine	*
126	Pleurosigma angulatum	*
127	Pleurosigma elongatum	*
128	Pleurosigma spp.	*
129	Pleurosigma sp	*
130	Pleurosigma naviculaceum	*
131	Pleurosigma pelagicum	*
132	Pleurosigma cf. fasciola	*
133	Pleurosigma normanii	*
134	Amphiprora alata	*
135	Amphora lineata	*
136	Amphora hyalina	*
137	Amphora quadrata	*
138	Nitzschia lorenziana	*
139	Nitzschia longissima	*
140	Nitzschia longissima v. reversa	*
141	Nitzschia sigma	*
142	Nitzschia sigma v. intercedens	*
143	Nitzschia closterium	*
144	Nitzschia panduriformis	*
145	Nitzschia palpebralis	*
146	Nitzschia sp.1	*
147	Nitzschia sp.	*
148	Bacillaria paxillifera	*
149	Pseudonitzschia spp.	*
150	Pseudonitzschia sp.1 (to)	*
151	Pseudonitzschia sp.2 (nho)	*
152	Surirella ovalis	*
153	Surirella gemma	*
154	Surirella tenera	*
155	Surirella tenera v. nervosa	*
156	Surirella sp.	*
157	Campylodiscus echeneis	*
158	Campylodiscus undulatus	*
159	Campylodiscus biangulatum	*
160	Campylodiscus sp.	*
161	Prorocentrum micans	*
162	Prorocentrum mexicanum	*
163	Prorocentrum sigmoides	*
164	Prorocentrum minimum	*
165	Prorocentrum emarginatum	*
166	Prorocentrum rhathynum	*
167	Prorocentrum gracile	*

168	Prorocentrum sp.	*
169	Prorocentrum sp.1 (hinh qua ot)	*
170	Metadinophysis sinensis	*
171	Dinophysis caudata	*
172	Dinophysis asymmetrica	*
173	Dinophysis diegensis	*
174	Dinophysis cf. fortii	*
175	Dinophysis tripos	*
176	Dinophysis mitra	*
177	Dinophysis cf. rotundata	*
178	Dinophysis rudgei	*
179	Dinophysis sp.	*
180	Phalacroma sp.	*
181	Histioneis costata	*
182	Gymnodinium sp	*
183	Gymnodinium sanguineum	*
184	Gyrodinium spirale	*
185	Polykrikos schwartzii	*
186	Noctiluca scintillans	*
187	Ceratium breve	*
188	Ceratium deflexum	*
189	Ceratium falcatum	*
190	Ceratium furca	*
191	Ceratium fusus	*
192	Ceratium kofoidii	*
193	Ceratium trichoceros	*
194	Ceratium cf. lunula	*
195	Ceratium macroceros	*
196	Ceratium massiliense	*
197	Ceratium tripos	*
198	Ceratium sp.	*
199	Gonyaulax sp	*
200	Gonyaulax polygramma	*
201	Gonyaulax spinifera	*
202	Gonyaulax verior	*
203	Gonyaulax rotundata	*
204	Protoperidinium steinii	*
205	Protoperidinium abei	*
206	Protoperidinium conicum	*
207	Protoperidinium claudicans	*
208	Protoperidinium crassipes	*
209	Protoperidinium divergens	*
210	Protoperidinium depressum	*
211	Protoperidinium oceanicum	*
212	Protoperidinium ovum	*
213	Protoperidinium pellucidum	*
214	Protoperidinium pentagonum	*

215	Protoperidinium punctulatum	*
216	Protoperidinium latissimum	*
217	Protoperidinium leonis	*
218	Protoperidinium subinerme	*
219	Protoperidinium sphaeroides	*
220	Protoperidinium sp.1 (to, dinh ngan)	*
221	Protoperidinium sp.2	*
222	Protoperidinium sp.	*
223	Protoperidinium spp.	*
224	Peridinium quinquecorne	*
225	Peridinium sp.	*
226	Scrippsiella sp.	*
227	Scrippsiella cf. trochoidea	*
228	Scrippsiella spinifera	*
229	Protoceratium sp	*
230	Alexandrium sp	*
231	Alexandrium spp.	*
232	Alexandrium leei	*
233	Alexandrium minutum	*
234	Alexandrium ostenfeldii	*
235	Alexandrium tamiyavanichii	*
236	Alexandrium pseudogonyaulax	*
237	Alexandrium acatenlla	*
238	Fragillidium sp.	*
239	Goniodoma polyedra	*
240	Lingulodinium polyedra	*
241	Lingulodinium sp.	*
242	Diplopsalis sp.	*
243	Zygabikodinium sp.	*
244	Oblea sp	*
245	Pyrophacus horologicum	*
246	Pyrophacus sp	*
247	Podolampas elegans	*
248	Podolampas palmipes	*
249	Blepharocysta splendor-maris	*
250	Dinobryon sp.	*
251	Dictyocha fibula	*
252	Dictyocha speculum	*
253	Hermesium sp.	*
254	Oscillatoria sp1	*
255	Oscillatoria sp2	*
256	Lyngbya sp	*
257	Spirulina sp	*
258	Anabaena sp	*
259	Microcystis sp	*
260	Pediastrum simplex	*
261	Pediastrum simplex v. simplex	*

262	Pediastrum boryanum v. boryanum	*
263	Pediastrum duplex	*
264	Pediastrum sp.	*
265	Scenedesmus sp.	*
266	Scenedesmus spp.	*
267	Scenedesmus quadricauda	*
268	Scenedesmus armatus	*
269	Scenedesmus acuminatus var. acuminatus	*
270	Spirogyra sp	*
271	Spirogyra ionia	*
272	Staurastrum sp.	*
273	Staurastrum sp.2	*
274	Cosmarium sp	*
275	Closterium sp	*
276	Closterium setaceum	*
277	Euglena sp1.	*
278	Euglena sp2.	*
279	Trichodesmim hythrocun	*
280	Phacus sp2.	*
281	Phacus cf. longicauda	*
282	Phacus sp1.	*
283	Gloeotila pelagicum	*
284	Gloeotila spp	*
285	Tảo giáp dẹt	*
286	Tảo silic	*
287	Nhãm Dino bĐ	*

Table 2. Zooplanckton

No.	Species name	note
1	Sagitta delicata	*
2	Sagitta enflata	*
3	Sagitta crassa	*
4	Sagitta sp.	*
5	Evadne tergestina Claus	*
6	Evadne nordmani	*
7	Podon schmackeri	*
8	Penilia schmackeri	*
9	Conchocia imbricata	*
10	Conchocia sp.	*
11	Canthocalanus pauper	*

12	Undinula vulgaris Dana	*
13	Harpaticoda	*
14	Acrocalanus gilber	*
15	Eucalanus subcrassus Giesb.	*
16	Paracalanus parvus	*
17	Paracalanus spp.	*
18	Paracalanus crassirostris	*
19	Calocalanus pavo	*
20	Centropages orsini	*
21	Centropages furcatus	*
22	Pseudodiaptomus marinus	*
23	Pseudodiaptomus insisus	*
24	Pseudodiaptomus sp.	*
25	Schmackeria gordioides	*
26	Scolecithrix spp.	*
27	Temora turbinata Dana	*
28	Labidocera kroyeri	*
29	Labidocera minuta	*
30	Acartia pacifica	*
31	Acartia sp.	*
32	Acartia clausi	*
33	Acartia erythraea	*
34	Pontellina plumata	*
35	Oithona sp.	*
36	Oithona nana	*
37	Oithona fallax	*
38	Oithona similis	*
39	Oithona brevicornis	*
40	Oithona flumifera	*
41	Thermocyclops hyalinus	*
42	Oncaea venusta	*
43	Oncaea conifera	*
44	Corycaeus andrewsi	*
45	Corycaeus dalhi	*
46	Corycaeus sp.	*
47	Microcetella norvegica	*
48	Macrocetella gracilis	*
49	Clytemnestra scutellata	*
50	Clytemnestra sp.	*
51	Euterpina acutifront	*
52	AT Lucifer	*
53	Lucifer typus	*
54	Amphipoda	*
55	Hyalocylis striata	*

56	Oikopleura dioica	*
57	Oikopleura rufescen	*
58	Creises spp.	*
59	AT Brachyura	*
60	AT Bivalvia	*
61	AT Gastropoda	*
62	AT Balanus	*
63	AT Actinotrocha	*
64	Copepoda	*
65	C¸ con	*
66	AT .T«m	*
67	Diaphanosoma sarsi	*
68	Moinadapnhia macleayii	*
69	Microcyclops varicans	*
70	Cypridina noctiluca	*
71	Acarbella sinemis	*
72	Bosmina sp.	*

Table 3. Zoobenthos in 2006

TT	**Taxon**	DI	DII	DIII	DIV
	Polychaeta (49)				
	Fam.Aphoroditidae				
1	*Euleanira ehlersi*	+			
2	*Pontogenia sp*		+	+	
	Fam.Opheliidae				
3	*Tachytrypane sp*	+	+	+	+
	Fam.Paraonidae				
4	*Arcidea suecica simplex*	+			
	Fam.Lacydoniidae				
5	*Paralacydonia paradoxa*	+	+		
6	*Paralacydonia sp*		+		
	Fam.Nereidae				
7	*Dendronereis arborifera*	+	+	+	+
8	*Dendronereis aestuarina*	+	+	+	+
9	*Dendronereis heteropoda*	+			
10	*Leptonereis laevis*	+	+	+	+
11	*Lycastis indica*	+	+	+	+
12	*Lycastis sp*	+	+		
13	*Nereis (Nereis) chingrighatta*	+			
14	*Nereis (Ceratonereis) costae*	+	+		
15	*Nereis (Nereis) sp*	+	+	+	+
	Fam.Nephtyidae				
16	*Nephtys (Nephtys) paradoxa*	+	+	+	
17	*Nephtys (Aglaophamus) dibranchis*	+	+	+	+

18	*Nephtys (Nephtys)1*	+	+	+	+
19	*Nephtys (Nephtys)2*	+	+		+
	Fam.Eunicidae				
20	*Eunice sp*	+			
	Fam.Pilargidae				
21	*Ancytrosyllis parva*	+	+		+
	Fam.Scalibregmidae				
22	*Sclerocheilus sp*	+	+		
	Fam.Sabellidae				
23	*Potamilla leptocheata*		+	+	
24	*Sabellidae genus*				+
	Fam.Spionidae				
25	*Prionospio cinrifera*	+			
26	*Prionospio polybranchiata*		+	+	
27	*Spiophanes sp*	+			
28	*Laonice cirrata*	+	+		
	Fam.Glyceridae				
29	*Goniada gracilis*	+	+		+
30	*Glycera alba*	+			+
31	*Glycera alba*				+
	Fam.Phyllodocidae				
32	*Protomystides capensis*	+			
	Fam.Capitellidae				
33	*Pseudocapitella sp*	+	+	+	+
34	*Capitella sp*		+		
	Fam.Sternaspidae				
35	*Sternaspis scutata*	+	+	+	+
	Fam.Cirratulidae				
36	*Cirratullus filiformis*	+	+		
	Fam.Maldanidae				
37	*Paralacydonia sp*	+	+		
38	*Maldanidae*	+	+	+	+
	Fam.Tereberidae				
39	*Lysilla pambaensis*	+	+	+	+
40	*Hauchiella tribulata*	+	+		
	Fam.Hesionidae				
41	*Hesione splendida*	+	+		
42	*Syllida sp*		+	+	
	Fam.Pectinariidae				
43	*Pectinaria sp*		+	+	
	Fam.Pisionidae				
44	*Pisionidens sp*	+	+	+	
	Fam.Owenidae				
45	*Owenia fusiformis*	+	+	+	
46	*Owenia sp*		+	+	
	Fam.Trochochaetidae				
47	*Poecilocheatus sp*	+	+	+	

	Onuphidae				
48	*Onuphis sp*		+		+
	Lumbrinereidae				
49	*Ophiuricola cyrnips*				+
	Mollusca				
	Scaphopoda (3)				
	Dentalidae				
50	*Cadulus esphans*		+	+	
51	*Dentalium aprinum*		+	+	
52	*Dentalium elephantinum* Linne			+	
	Gastropoda (38)				
	Cyclophoridae				
53	*Cyclophorus sp.*	+	+		
54	*Pupina flava* Moellendorff	+			
	Viviparidae				
55	*Auguliagra sp*	+			+
56	*Sinotaia reevei*				+
	Planobidae				
57	*Gynaulus hendei (Cl.)*		+		
58	*Gyraulus convexiusculus*				+
	Bithyniidae				
59	*Digoniostoma siamensie* (Lea)	+	+		
	Epitonidae				
60	*Epitonium fucatum* (Pease)			+	+
61	*Epitonium scalare* Linnaeus	+			
	Thiaridae				
62	*Thirea scabra* (Miiler)		+		
63	*Antimelania swinhoei* (Adams)	+	+	+	+
64	*Antimelania siamensis*	+		+	+
65	*Melanoides tuberculatus* (Muler)	+	+	+	
66	*Sermyia tornatella* (Lea)	+	+	+	
67	*Stenomelania reevei*	+		+	+
68	*Stenomelania sp.*		+		+
	Stenothyridae				
69	*Stenothyra messageri* Bavay et Da.	+		+	+
	Lymnaeidae				
70	*Lymnaea swinhoei* Adams	+	+	+	+
	Potamididae				
71	*Barbatia zonalis* (Bruguiere)	+	+	+	+
72	*Cerithidae cingulata* Gmelin	+	+	+	+
	Cerithidae				
72	*Batillaria multiformis* Lischker	+	+		
74	*Rhinoclavis kochi* (Philippi)	+	+	+	+
75	*Cerithium sp*	+		+	+
	Hydrobiidae				
76	*Stenothyra sp.*	+	+		
77	*Stenothyra glabra* A.Adams			+	+

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	Nassaridae				
78	*Nassarius livescens* (Ph.)	+		+	+
79	*Nassarius nodiferus* Dunker	+	+		
80	*Nassarius stotus*			+	+
	Neritidae				
81	*Clithon retropictus* (Mortens)	+	+		
82	*Clithon oualaniensis* (Lesson)	+	+	+	+
83	*Nerita albicilla* Linna.		+	+	+
84	*Dostia violacea* (Gmelin)	+	+		
	Bucinidae				
85	*Siphonania sp.*		+		
	Rissoidae				
86	*Rissoilina plicatula* (Gould)	+	+		+
	Atydae				
87	*Atys cylindricus* Helbling	+	+	+	+
	Pyramidellidae				
88	*Pyramidella sp.*	+	+	+	+
89	*Pyramidella sulcata* (Ad.)	+			
90	*Turbonilla sp.*			+	
	Bivalvia (51)				
	Arcidae				
91	*Anadara sp.*		+		+
	Mytilidae				
92	*Limnoperna siamensis* (Morelet)	+	+		+
93	*Limnoperna sp.*		+		
94	*Modiolus sp.*	+	+		
95	*Branchydontes sp*	+		+	+
	Ostreidae				
96	*Ostrea lugubris*			+	+
97	*Ostrea hyotis* Linne	+			
98	*O. mordax* Gould	+	+		
99	*Alectryonella plicatula* (G.)		+	+	+
	Margaritiferidae				
100	*Trapezoidens mieellus* Morelet	+	+		+
101	*Trapezoides sp*	+	+	+	+
	Lucinidae				
102	*Austriella sordida* (R. Pland)	+	+	+	+
103	*Codakia punctata*			+	+
104	*Lucina philipiana* Reeve	+	+		
	Veneridae				
105	*Meretrix meretrix* (Gmelin)	+	+		+
106	*Meretrix lusoria*			+	+
107	*Gomphina sp.*		+		
108	*Chione imbricata* S.	+	+		
109	*Placamen (Chione) isabellina* Philippi	+	+	+	+
110	*Dosinia orbiculata* (Dunker)	+	+		
111	*Dosinia sp.*	+	+		+

112	*Katelysia sp.*	+			
	Tellinidae				
113	*Tellina virgata* (Gmelin)	+	+	+	+
114	*Tellina jedoensis* Lischke	+	+	+	+
115	*Tellina diaphana*	+	+	+	+
116	*Tellina timorensis* Lamarck	+		+	
117	*Macona galathaea* Lamarkc		+	+	+
118	*Tellina sp.*	+	+	+	+
	Corbiculidae				
119	*Geloina coanxans* (Gmelin)	+	+	+	+
120	*Corbicula baudoni* Morelet	+	+	+	+
121	*C. cyremiformis* Prine	+	+	+	+
122	*C. lamarckiana* Prine	+	+	+	+
123	*C. blandiana* Prine	+	+	+	+
124	*Corbicula sp. (Con non)*	+	+	+	+
	Semelidae				
125	*Semela sp.*			+	+
	Donacidae				
126	*Donax faba* Gmelin		+		+
126	*Donax trumculus* Linaensis	+		+	+
	Psammobiidae				
128	*Sanguinolaria planulata* (Reeve)	+	+		+
129	*Sanguinolaria sp.*		+		
130	*Sanguinolaria (Psammotacea) violacea*	+		+	
131	*Psammobia radiata* Ph.	+	+	+	+
	Nucunidae				
132	*Nuculana taphria*			+	+
	Solenidae				
133	*Solen sloanii* Gray	+	+	+	+
134	*Solen strictus*	+	+		+
135	*Siliqua sp.*		+		
	Corbulidae				
136	*Corbula erythrodon* Lamarck	+	+	+	+
137	*Aloidis laevis* (Hinds)	+	+	+	+
	Glaucomydae				
138	*Glaucomya chinensis* (Gray)			+	+
	Ungulinidae				
139	*Diplodonta sp.*	+			
	Laternulidae				
140	*Laternula pechiliensis* (Grabou and King)	+	+	+	+
	Nuculanidae				
141	*Nuculana acuta (*Conrad)			+	+
	Crustacea (42) + 9 = 51				
	Panaeidae				
142	*Penaeus indicus*	+	+	+	+
143	*Penaeus merguiensis*	+			
144	*Metapenaus ensis* (de Haan)	+	+	+	+

145	*Metapenaeus dobsoni*		+		
146	*Parapenaenpsis hardwiekii*				
	Palaemonidae				
147	*Leptocarpus potamiscus* (Kemp)	+	+		
148	*Leandrites indicus* Halth		+	+	+
149	*Exapalaemon mani* (Solland)			+	
150	*Exapalaemon vietnamian*			+	+
151	*Palaemon sennelinkii*	+	+		
152	*Palaemon tonkinensis* (Solland)			+	+
153	*Palaemon curinostric* N.V.Xuan			+	+
154	*Palaemon sp.*		+	+	
	Pinnotheridae				
155	*Xenophthalmus pinnotheroides* White	+			
	Leucosiidae				
156	*Paraphiculus marinae*		+	+	+
157	*Paraphiculus coronatus*		+		+
158	*Nursia sinica*		+		
	Callionymidae				
159	*Elentherochirus sp*	+			
	Grapsidae				
160	*Helice tridens* Sakai	+	+		
	Goneplacidae				
161	*Carcinoplax vestitus* (de Haan)		+		+
162	*Carcinoplax sp*			+	
	Euphausidae				
163	*Thysanopoda sp*	+		+	
	Atyidae				
164	*Caridina sp.*		+	+	
	Vibiliidae				
165	*Vibilia sp*	+	+		
	Paguridae				
166	*Pagunus sp*	+	+	+	
167	*Eupagurus sp*	+	+		
	Mysidae				
168	*Neomysis sp.*	+	+		
	Hyperiidae				
169	*Hyperia sp.*	+	+	+	+
170	*Hyperoche sp*			+	
	Dorippidae				
171	*Dorippe dorsipes* (Linne)	+	+		
	Diogenidae				
172	*Diogenus sp*		+		
	Phronimidae				
173	*Phronima sp1*	+	+		+
174	*Phromina sp2*		+	+	
	Ocypodidae				
175	*Camptamodrium sexdentatum* Stiapsor		+	+	

176	*Cleistostoma dilatcetum* de Hoars			+	
	Oxycephalidae				
177	*Oxycephalus sp.*	+			
	Isopoda				
178	*Isopod gen sp.*	+	+	+	+
179	*Porcellio sp.*	+			
	Atyidae				
180	*Caridina sp.*	+			
	Squillidae				
181	*Onatosquilla oratona* (Haan)			+	
	Balanidae				
182	*Balanus sp*	+		+	
	Ecinodermata (2)				
	Amphiuridae				
186	*Amphioplus praestans*		+		+
	Ophiocomidae				
187	*Ophiocoma scolopendrina*		+		
	Hymenosomidae				
188	*Rhychoplax messor* Stimpson	+			
	C¸c nhãm kh¸c (8)				
	C¸				
189	C¸ bèng - Gobidae	+			
190	*Bathygobius fuscus* (R.)	+	+	+	
191	*Gobius sp.*	+	+	+	
192	*C¸ c¨ng*	+	+	+	
193	*C¸ N¸m*	+		+	+
	Êu trïng				
194	*Au trïng Chuån chuån*	+	+	+	
195	*Au trïng l-¬n*	+	+	+	
196	*¸u trïng Acetec*	+	+	+	+

197	*Echinodermata*				

	Họ Cua Đồng Grapsidae	**3**	
1	*Rạm Varuna litterata*		
2	**Cua *Hemigrapsus sp.***		
3	**Cua *Potamon sp.***		
	Họ Cua Bơi Portunidae	**5**	
4	**Cua Bùn/Rèm Scylla serrata**		
5	**Ghẹ Cá *Thalamita crenata***		
6	**Ghẹ Cá *Thalamita spp.***		
7	**Ghẹ Cát Portunus trituberculatus**		
8	**Ghẹ Ba Mắt P. sanguinolentus**		
9	**Ghẹ xanh: *Portunus pelagicus***		

92 + 49 + 51+3+ 8= 203 species

Table 5. . The checklist of fishes in Tam Giang - Cầu Hai Thừa Thiên Huế

STT	Tên khoa học	Vùng phân bố
	5. Họ cá đuối bồng DASYATIDAE	
1	*D. sinensis* (Steindachner)	+
	11. Họ cá trích CLUPEIDAE	
2	*S. jussieu* (Lac.)	+
3	*Clupanodon thrissa* Linn.	+
4	*C. punctatus* Temm. & Schl.	+
5	*Harengula ovalis* (Benn.)	+
6	*H. dussumieri* (Cuv. & Val.)	+
	12. Họ cá trỏng ENGRAULIDAE	
7	*S. commersonii* (Lac.)	+
8	*S. tri* (Blkr.)	+
9	*S. indicus* (van Hasselt)	+
10	*Thryssa dussumieri* (Cuv. & Val.)	+
11	*Th. setirostris* (Broussonet)	+
12	*Septipinna taty* (Cuv. & Val.)	+
	15. Họ cá mối SYNODONTIDAE	
13	*Saurida tumbil* (Bl. & Schn.)	+
14	*S. elongata* (Temm. & Schl.)	+
15	*S. vaigiensis* (Bl.)	+
	16. Họ cá khoai HARPODONTIDAE	
16	*Harpodon nehereus* (Ham.- Bucha.)	+
	17. Họ cá thát lát NOTOPTERIDAE	
17	*Notopterus notopterus* (Pallas)	+
	18. Họ cá chình ANGUILLIDAE	
18	*Anguilla bicolor* Schmidt	+
19	*A. marmorata* Q. & G.	+
	19. Họ cá lịch biển MURAENIDAE	
20	*Echidna polyzona* (Rich.)	+
21	*Gymnomuraena* concolor (Rupp.)	+
	20. Họ cá dưa MURAENESOCIDAE	
22	*Muraenesox cinereus* (Fors.)	+
23	*M. talabon* (Cantor)	+
24	*M. talabonoides* (Blkr.)	+
	21. Họ cá chình biển CONGRIDAE	

25	*Conger cinereus* (Rupp.)	+
	22. Họ cá chình rắn OPHICHTHIDAE	
26	*Ophichthus apicalis* (Benn.)	+
27	*Pisoodonophis boro* (Hamil.)	+
	23. Họ cá chép CYPRINIDAE	
28	*Cyprinus carpio* Linn.	+
29	*C. centralus* Nguyen & Mai	+
30	*Carassioides cantonensis* (Heineke)	+
31	*Crassius auratus* Linn.	+
32	*Rasbora lateristriata* (Blkr.)	+
33	*Squaliobarbus curriculus* (Rich.)	+
34	*Puntius leiacanthus* (Blkr.)	+
35	*P. semifasciatus* (Gun.)	+
36	*Spinibarbus caldwelli* (Nichols)	+
37	*Hemicuter leucisculus* (Blkr.)	+
	24. Họ cá ngạch BAGRIDAE	
38	*Leiocassis hainanmensis* Tchang	+
39	*Hemibagrus elongatus* (Gun.)	+
	25. Họ cá trê CLARIIDAE	
40	*Clarias fuscus* (Lac.)	+
41	*C. macrocephalus* Gun.	+
	26. Họ cá úc ARIIDAE	
42	*Arius sinensis* Lac.	+
43	*A. falcarius* Rich.	+
	27. Họ cá ngát PLOTOSIDAE	
44	*Plotosus anguillaris* Forsk.	+
	28. Họ cá suốt ATHERINIDAE	
45	*A. bleekeri* Gun.	+
	29. Họ cá kìm HEMIRHAMPHIDAE	
46	*Hemirhamphus sinensis* (Gun.)	+
47	*H. georgii* (Cuv. & Val.)	+
48	*H. melanurus* (Cuv. & Val.)	+
	30. Họ cá nhói BELONIDAE	
49	*Tylosurus strongylurus* (Van Hasselt)	+
50	*T. anastomella* (Cuv. &Val.)	+
	33. Họ cá ngựa SYNGNATHIDAE	
51	*Syngnathus pelagicus* Linn.	+
	35. Họ cá nhồng SPHYRAENIDAE	
52	*Sphyraena obtusata* Cuv.	+

	37. Họ cá đối **MUGILIDAE**	
53	*Mugil engeli* Blkr.	+
54	*M. vaigiensis* Q. & G.	+
55	*M. cephalus* Linn.	+
56	*M. anpinensis* Val.	+
57	*M. carinatus* Val.	+
58	*M. kelaarti* Val.	+
59	*M. nepalensis* Blkr.	+
60	*M. strongylocephalus* Val.	+
61	*M. affinis* Gun.	+
62	*Liza parra* Ham.	+
63	*L. macrolepsis* (Smith)	+
	38. Họ cá nhụ **POLYNEMIDAE**	
64	*Eleuteronema tetradactylus* (Shaw)	+
65	*Polynemus sextarius* (Bl. & Schn.)	+
	39. Họ cá mang liền **SYMBRANCHIDAE**	
66	*Symbranchus albus* (Zuiew)	+
	40. Họ cá sơn biển **CENTROPOMIDAE**	
67	*Ambassis gymnocephalus* Lac.	+
68	*Ambassis kopsii* Blkr.	+
69	*A. urbtaena* Lac.	+
	41. Họ cá mú **SERRANIDAE**	
70	*E. malabaricus* (Bl. et Schl.)	+
71	*E. maculatus* (Bl.)	+
72	*E. awoara* Temm. & Schl.	+
73	*E. fascoguttatus* (Peters)	+
74	*E. epistictis* (Cuv. & Val.)	+
75	*E. brunneus* (Bl.)	+
76	*Psammoperca waigiensis* (Cuv.)	+
	42. Họ cá căng **TERAPONIDAE**	
77	*Therapon theraps* Cuv.	+
78	*Th. jarbua* (Fors.)	+
79	*Helotes sexlineatus* Cuv.	+
80	*Pelates quadrilineatus* Cuv.et Val.	+
	43. Họ cá trác **PRIACANTHIDAE**	
81	*P. hamrur* Fors.	+
	44. Họ cá sơn **APOGONIDAE**	
82	*A. lineolatus* (Temm. & Schl.)	+
83	*Helotes sexlineatus* Q. & G.	+
	45. Họ cá đục **SILLAGINIDAE**	
84	*Sillago sihama* (Fors.)	+

85	*S. maculata* (Fors.)	+
	49. Họ cá khế ***CARANGIDAE***	
86	*A. ciliaris* (Bl.)	+
87	*C. selar* Cuv.	+
88	*Selaroides leptolepis* (Cuv.)	+
89	*S. aureovittata* (Temm. & Schl.)	+
	50. Họ cá lưỡi búa ***MENIDAE***	
90	*Mene maculata* (Bl. & Schn.)	+
	51. Họ cá ngãng ***LEIOGNATHIDAE***	
91	*Leio. equulus* (Fors.)	+
92	*Leio. leuciscus* (Gun.)	+
93	*Leio. brevirostris* Cuv. & Val.	+
	52. Họ cá hồng ***LUTJANIDAE***	
94	*Lutjanus russellii* (Blkr.)	+
95	*L. johnii* (Bl.)	+
96	*L. (rangus) bohar* (fors.)	+
97	*L. vaigiensis* Q. & G.	+
98	*L. fulviflammus* (Fors.)	+
99	*L. argentimaculatus* (Fors.)	+
	54. Họ cá móm ***GERRIDAE***	
100	*Gerres filamentosus* Cuv.	+
101	*G. lucidus* (Cuv.)	+
102	*G. limbatus* (Fors.)	+
103	*G. oyena* (Fors.)	+
104	*G. japonicus* Blkr.	+
	55. Họ cá sạo ***HAEMULIDAE***	
105	*Plectorhynchus maculatus* (Bl.)	+
106	*P. hasta* (Bl.)	+
	57. Họ cá tráp ***SPARIDAE***	
107	*Rhabdosargus sarba* (Fors.)	+
108	*Sparus macrocephalus* (Basil.)	+
109	*S. latus* Houtt.	+
	58. Họ cá đù ***SCIAENIDAE***	
110	*A. argentatus* (Houtt.)	+
111	*Dendrophysa russelii* (Cuv.)	+
112	*N. albiflora* (Rich.)	+
113	*Johnius dussumieri* (Cuv.)	+
	59. Họ cá phèn ***MULLIDAE***	
114	*Upeneus tragula* Rich.	+
115	*U. sulphureus* Cuv. & Val.	+
	63. Họ cá chim mắt to	

	MONODACTYLIDAE	
116	*Monodactylus argenteus* (Linn.)	+
	64. Họ cá tai tượng ***EPHIPPIDAE***	
117	*Platax taira* (Fors.)	+
	65. Họ cá nâu ***SCATOPHAGIDAE***	
118	*Scatophagus argus* (Linn.)	+
	68. Họ cá rô biển ***POMACENTRIDAE***	
119	*Pomacentrus nigricans* (Lac.)	+
	70. Họ cá ép ***ECHENEIDAE***	
120	*Echeneis naucrates* Linn.	+
	71. Họ cá bàng chài ***LABRIDAE***	
121	*Halichoeres minatus* (Val.)	+
122	*H. cyanopleura* (Blkr.)	+
	78. Họ cá bống đen ***ELEOTRIDAE***	
123	*Butis butis* (Han.)	+
124	*Bostrychus sinensis* (Lac.)	+
125	*Eleotris fusca* (Schneider & Forster)	+
	79. Họ cá bống trắng ***GOBIIDAE***	
126	*Cryptocentrus filifer* (Cuv. & Val.)	+
127	*Glossogobius giuris* (Hamilton)	+
128	*G. brunneus* Bl.	+
129	G. grammepomus	+
130	*O. microlepis* (Blkr.)	+
131	*O. tentacularis* (Val.)	+
132	*O. omabilis* (Blkr.)	+
133	*O. ophthalmonemus* (Blkr.)	+
134	*Rhinogobius cianomos* (Cuv.)	+
	80. Họ cá thòi lòi ***PERIOPHTHALMIDAE***	
135	*Periophthalmus cantonensis* (Osb.)	+
	81. Họ cá bống dài ***TAENIOIDIDAE***	
136	*Amoya hainanensis* (Chu.)	+
137	*C. chinensis* Stei.	+
138	*Odontamalyopus rubicundus* (Bl.)	+
	82. Họ cá dìa ***SIGANIDAE***	
139	*Siganus canaliculatus* (Park)	+
140	*S. fuscescens* (Houtt.)	+
141	*S. guttatus* (Bl.)	+
142	*S. oramin* (Bl. & Schn.)	+
143	*S. rostratus* (Val.)	+
	83. Họ cá hố	

	TRICHIURIDAE	
144	*Tri. haumela* (Fors.)	+
	91. Họ cá rô ***ANABANTIDAE***	
145	*Anabas testudineus* (Bl.)	+
146	*Trichogaster trichopterus* (Pallas)	+
147	*Macropodus opercularis* (Linn.)	+
	92. Họ cá quả ***OPHIOCEPHALIDAE***	
148	*Ophiocephalus striatus* Bl.	+
149	*O. maculatus* Lac.	+
	93. Họ cá chai ***PLATYCEPHALIDAE***	
150	*Platycephalus indicus* (Lin.)	+
	94. Họ cá bơn vĩ ***BOTHIDAE***	
151	*Pseudorhombus cinnamoneus* (Temm. & Schl.)	+
152	*P. arsius* (Hamil. & Bucha.)	+
	95. Họ cá bơn sọc ***SOLEIDAE***	
153	*Solea ovata* Rich.	+
154	*S. humilis* Cantor	+
155	*Synaptura orientalis* (Bl. & Schn.)	+
	97. Họ cá nóc ba gai ***TRIACANTHIDAE***	
156	*Triacanthus brevirostris* (Temm. & Schl.)	+
	101. Họ cá nóc mít ***TETRAODONTIDAE***	
157	*Tetraodon patoca* (Hamilton)	+
158	*T. immaculatus* Bl. & Schn.	+
159	*T. aerostaticus* Blkr.	+
160	*T. ocellatus* Blkr.	+
		160

***The Checklist of the Fishes in sam and Chuon* (Le van Mien)**

Tt	**Tên Việt nam**	**Tên khoa học**	**Mã số mẫu lưu ở PTN**	Cá c **1**	côn g **2**	bố **3**	khá c **4**
1	**I. Bộ cá trích** **1. Họ cá trích** Cá mòi cờ chấm	**I. Clupeiformes** ***1. Clupeidae*** *Clupanodon punctatus* (Schlegel)	*121*	*x*	*x*	*x*	
2	**2. Họ cá cơm** Cá cơm sông	***2.Engraulidae*** *Stelephorus tri* (Bleeker)	*102*	*x*	*x*	*x*	
3	Cá cơm thường	*Stolephorus commersonii* (Lacepede)	*38*	*x*	*x*	*x*	
4	Cá cơm Ấn Độ	*Stolephorus indicus* (Van Hasselt)	*155*	*x*	*x*	*x*	
5	**II. Bộ cá thửng** **3. Họ cá thửng**	**II. Myctophiformes** ***3. Synodontidae***	*94*				

	Cá thửng nhiều răng	*Saurida tumbil* (Bloch & Schneider)		*x*	*x*	*x*	
6	Cá thửng nhẵn	*Synodus gracilis* (Weber)	*91*			*x*	
7	**III. Bộ cá thát lát** **4. Họ cá thát lát** Cá thát lát	**III.Osteoglossiformes** ***4. Notopteridae*** *Notopterus notopterus* (Pallas)	*fbt01*	*x*		*x*	
8	**IV. Bộ cá chình** **5. Họ cá chình** Cá chình mun	**IV. Anguilliformes** ***5. Anguillidae*** *Anguilla bicolor pacifica* Schmidt	*154*	*x*			
9	Cá chình hoa	*Anguilla marmorata* Qouy & Gaimard.	*fbt02*	*x*		*x*	*x*
10	**6. Họ cá lịch** Cá lịch mắt trắng	***6. Muraenidae*** . *Siderea thyrsoidea* (Richardson)	*7*				
11	Cá lịch rắn	*Echidna polyzona* (Richardson)	*4.2*	*x*		*x*	
12	**7. Họ cá lạc** Cá lạc	***7.Muraenesocidae*** *Muraenesox talabon* (Cantor)	*fbt03*	*x*	*x*	*x*	
13	Cá lụy	*Muraenesox cinereus* (Forskal)	*20*	*x*	*x*	*x*	*x*
14	**8. Họ cá lích biển** Cá lệch cú	***8. Ophichthyidae*** *Pisoodonophis boro* (H.& B)	*fbt04*	*x*	*x*	*x*	*x*
15	Cá chình râu Trung Hoa	*Cirrhimuraena chinensis* (Kaup)	*f49*		*x*		
16	Nhệch răng một hàng	*Muraenichthys malabonensis* (Herre)	*147*		*x*		
17	Cá chình mõm nhọn	*Ophichthus apicalis* (Bennett)	*12*	*x*		*x*	
18	Chình rắn răng hai hàng	*Ophichthus rutidodermatoides* (Bl.)	*126*			*x*	
19	**9. Họ cá chình giun** Chình giun đầu to	***9.Moringuidae*** *Moringua macrocephala* (Bleeker)	*35*		*x*		
20	**10. Họ cá chình biển** Cá chình bạc	***10. Congridae*** *Anago anago* (Temminski. & Schlegel)	*f56*	*x*	*x*	*x*	
21	**V. Bộ cá chép** **11. Họ cá chép** Cá chép	**V. Cypriniformes** ***11. Cyprinidae*** *Cyprinus carpio* Linnaeus	*f113b*	*x*		*x*	*x*
22	Cá dầy	*Cyprinus centralus* (Nguyen et Mai)	*f113*	*x*		*x*	
23	Cá diếc vàng	*Carassius auratus* (Linnaeus)	*fbt05*	*x*		*x*	*x*
24	Cá dưng	*Carassioides cantonensis* (Heinke)	*fbt07*	*x*			
25	Cá đòng đong	*Puntius leiacanthus* (Bleeker)	*fbt08*	*x*			
26	Cá mại sọc bên	*Rasborinus lineatus* Pellegrin	*fbt09*	*x*		*x*	
27	Cá mại	*Rasbora lateristriata* (Bleeker)	*fbt10*	*x*		*x*	
28	Cá cấn	*Puntius semifasciatus* (Gunther)	*f114*	*x*			
29	Cá sứt môi	*Garra orientalis* Nichols	*fbt11*			*x*	
30	Cá trắm cỏ	*Ctenopharyngodon idellus* (C.&V.)	*fbt12*			*x*	
31	Cá lúi	*Osteochilus salsbury* N.& P.	*fbt13*			*x*	
32	Cá trôi	*Cirrhina moritorella* (C. & V.)	*fbt14*		*x*		
33	Cá mương	*Hemiculter leucisculus* (Basilewsky)	*fbt15*	*x*		*x*	
34	**12. Họ cá chạch** Cá chạch đồng	***12. Cobitidae*** *Misgurnus anguillicaudatus* (Cantor)	*153*			*x*	*x*
35	**VI. Bộ cá nheo** **13. Họ cá ngạnh** Cá nganh	**VI. Siluriformes** ***13. Cranoglanidae*** *Cranoglanis sinensis* Peters	*fbt16*			*x*	

36	Cá ngạnh Hải nam	*Leiocassis hainanensis* Tchang	*61*	*x*			
37	**14. Họ cá trê** Cá trê vàng	***14. Clariidae*** *Clarias macrocephalus* Gunther	*4.3*	*x*			
38	Cá trê đen	*Clarias fuscus* (Lacepede)	*fbt17*	*x*		*x*	
39	**15. Họ cá ngát** Cá ngát	***15. Plotosidae*** *Plotosus anguillaris* (Forscal)	*17*	*x*	*x*	*x*	
40	**16. Họ cá úc** Cá úc	***16. Aridae*** *Arius sinensis* (Lacepede)	*44*	*x*	*x*	*x*	
41	**VII. Bộ cá suốt** **17. Họ cá suốt** Cá suốt	**VII. Atheriniformes** ***17. Atherinidae*** *Atherina bleekeri* (Gunther)	*9*	*x*	*x*	*x*	
42	**VIII. Bộ cá kìm** **18. Họ cá kìm** Cá kìm dưới	**VIII. Beloniformes** ***18. Hemirhamphidae*** *Hemiramphus sinensis* (Gunther)	*85*	*x*		*x*	
43	**19.Họ cá nhoái** Cá nhoái mõm tròn	***19. Belonidae*** *Tylosurus strongylurus* (van Hasselt)	*f79*	*x*	*x*	*x*	
44	**20. Họ cá chuồn** Cá chuồn vây ngắn	***20. Exocoetidae*** *Paraexocoetus brachypterus* (Rich.)	*74*			*x*	
45	**IX. Bộ cá đèn** **21. Họ cá sơn biển** Cá sơn đá	**IX. Beryciformes** ***21. Holocentridae*** *Holocentrum rubrum* (Forscal)	*f100*				
46	**X.Bộ cá chìa vôi** **22. Họ cá chì vôi** Cá chìa vôi	**X. Syngnathiformes** ***22. Sygnathidae*** *Syngnathus pelagicus* (Linnaeus)	*f57*	*x*			
47	**XI. Bộ cá đối** **23. Họ cá nhồng** Cá nhồng thường	**XI. Mugiliformes** ***23. Sphyraenidae*** *Sphyraena langsar* (Bloch)	*f28*		*x*	*x*	
48	Cá nhồng tù	*Sphyraena obtusata* (Cuvier & V.)	*47*	*x*	*x*	*x*	
49	**24. Họ cá đối** Cá đối môi dày	***24. Mugilidae*** *Crenimugil crenilabis* (Forscal)	*115*		*x*	*x*	
50	Cá đối liza vẩy to	*Liza macrolepis* Schmidt	*111*	*x*	*x*	*x*	
51	Cá đối liza	*Liza parva* (Oshima)	*109*	*x*			
52	Cá đối mục	*Mugil cephalus* Linnaeus	*fbt18*	*x*	*x*	*x*	
53	Cá đối lưng gồ	*Mugil carinatus* (C. & V.)	*fbt19*	*x*	*x*		
54	Cá đối nhọn	*Mugil stronglocephalus* (Richardson)	*fbt20*	*x*	*x*	*x*	*x*
55	Cá đối lá	*Mugil kelaarti* Gunther	*4.5*	*x*		*x*	
56	**XII. Bộ lươn** **25. Họ lươn** Lươn	**XII.Symbranchiformes** ***25. Flutidae*** *Symbranchus albus* (Zuiew)	*f88*	*x*		*x*	
57	**XIII. Bộ cá quả** **26. Họ cá quả** Cá tràu/ cá lóc	**XIII. Ophiocephaliformes** ***26. Ophiocephalidae*** *Ophiocephalus striatus* Bloch.	*fbt22*	*x*			*x*
58	Cá lóc / cá sộp	*Ophiocephalus maculatus* (Lacepede)	*fbt23*	*x*			
59	**XIV. Bộ cá vượt** **27. Họ cá sơn** Cá sơn	**XIV. Perciformes** ***27. Centropomidae*** *Ambassis kopsi* (Bleeker)	*f7*	*x*		*x*	*x*
60	Cá sơn biển đuôi vằn	*Ambassis urotaenia* (Bleeker)	*fbt24*				
61	Cá chẽm	*Lestes calcarifer* (Bloch)	*fbt25*	*x*	*x*	*x*	*x*
62	**28. Họ cá mú**	***28. Serranidae***	*27*				

	Cá mú sao	*Epinephelus fario* (Thunb)			*x*	*x*	
63	Cá mú gio	*Epinephelus awoara* (Temm. & Schl.)	*49*	*x*	*x*	*x*	
64	Cá mú	*Epinephelus sp.*	*26*				
65	Cá mú điểm đai	*Epinephelus malabaricus* (Bl. & Schn.)	*73*	*x*	*x*		
66	Cá mú chấm đen	*Epinephelus epistictus* (T. & Schl.)	*70*	*x*	*x*	*x*	*x*
67	Cá mú cỏ	*Epinephelus moara* (Temm. & Schl.)	*114*		*x*		
68	**29. Họ cá căng** Cá căng sáu sọc	***29.Theraponidae*** *Helotes sexlineatus* (Qouy & Gaimard)	*119*	*x*	*x*	*x*	
69	Cá căng bốn sọc	*Pelates quadrilineatus* (Bloch)	*31*	*x*	*x*	*x*	
70	Cá căng	*Therapon theraps* (C. & Valencienne)	*92*	*x*	*x*	*x*	
71	Cá căng ánh bạc	*Therapon argenteus* (C. & V.)	*78*				
72	Cá căng đàn	*Therapon jarbua* (Forskal)	*11*	*x*	*x*	*x*	*x*
73	Cá ong thảnh	*Therapon oxyrhynchus* Temm. & Schl.	*4.11*	*x*	*x*		
74	**30. Họ cá trác** Cá trác	***30.Pricanthidae*** *Priacanthus boops* (Bloch & Schn.)	*97*		*x*		
75	**31. Hộ cá sơn** Cá sơn ki	***31. Apogonidae*** *Apogon kiensis* (J. & S.)	*14*		*x*		
76	Cá sơn một màu	*Apogon monochrous* (Bleeker)	*133*	*x*	*x*		
77	**32. Họ cá đục biển** Cá đục biển	***32. Sillaginidae*** *Sillago sihama* (Forskal)	*118*	*x*	*x*	*x*	
78	Cá đục chấm	*Sillago maculatus* (Qouy & Gaimard)	*4.6*	*x*	*x*	*x*	*x*
79	**33. Họ cá ngãng** Cá gaza	***33. Leiognathidae.*** *Gazza minuta* (Bloch)	*104*		*x*	*x*	
80	Cá ngãng bạc	*Leiognathus argentatus* (Lacepede)	*103*				
81	Cá liệt	*Leiognathus brevirostris* (C.& V.)	*f55*	*x*	*x*	*x*	
82	Cá ngãng dô ra	*Leiognathus daura* (C.& V.)	*61*		*x*		
83	Cá ngãng sao	*Leiognathus ruconius* (H & Buchanan)	*60*	*x*	*x*	*x*	
84	Cá ngãng ngựa	*Leiognathus equulus* (Forskal)	*22*	*x*	*x*	*x*	
85	**34. Họ cá hồng** Cá hồng chấm	***34. Lutjanidae.*** *Lutjanus russelli* Bleeker	*110*	*x*	*x*	*x*	
86	Cá hồng bạc	*Lutjanus argentimaculatus* (Forskal)	*fbt26*	*x*	*x*	*x*	*x*
87	Cá hồng	*Lutjanus johnii* (Bloch)	*fbt27*	*x*	*x*	*x*	*x*
88	Cá hồng trơn	*Lutjanus limbatus* Cuvier	*fbt28*			*x*	
89	**35. Họ cá móm** Cá móm gai dài	***35. Gerridae.*** *Gerres filamentosus* (Cuvier)	*f65*	*x*	*x*	*x*	*x*
90	Cá móm Nhật	*Gerres japonicus* (Bleeker)	*93*	*x*	*x*		
91	Cá móm dẹp	*Gerres lucidus* (Cuvier)	*32*	*x*	*x*	*x*	*x*
92	Cá móm lông	*Gerres setifer* (H. & B.)	*131*			*x*	
93	Cá móm gạo	*Gerres oyena* (Forskal)	*4.7*	*x*		*x*	
94	**36. Họ cá sạo** Cá sạo bạc	***36. Pomadasyidae.*** *Pomadasys argenteus* (Forscal)	*65*		*x*	*x*	
95	Cá sạo chấm	*Pomadasys maculatus* (Bloch)	*24*	*x*	*x*	*x*	
96	**37. Họ cá tráp**	***37. Sparidae.***	*4.20*				

	Cá tráp đen	*Sparus sarba* Forskal		x		x	
97	Cá tráp	*Sparus latus* Houttuyn	*4.21*	x	x	x	
98	**38. Họ cá đù** Cá đù bạc	***38. Sciaenidae.*** *Argyrosomus argentatus* (Houttuyn)	*f8*	x	x		
99	Cá đù kẽ	*Sciaena russelli* (Cuv. & Val.)	*f37*	x	x	x	
100	**39. Họ cá chim trắng** Cá chim bạc mắt to	***39. Psettidae*** *Psettius argenteus* (Linnaeus)	*84*	x	x	x	
101	**40. Họ cá chim** Cá chim chàng	***40. Ephippidae*** *Platax teira* (Forskal)	*142*	x	x		
102	**41. Họ cá nâu** Cá nâu	***41. Scartophagidae*** *Scartophagus argus* Linnaeus	*39*	x	x	x	x
103	**42. Họ cá bống ao** Cá bống cáu	***42. Eleotridae*** *Butis butis* (Buch. & Ham.)	*19*	x	x	x	
104	Cá bống cáu nhăn	*Butis caperatus* (Cantor)	*89*				
105	Cá bống đen	*Eleotris fusca* (Bloch & Schneider)	*98*	x	x	x	
106	**43. Họ cá bống trắng** Cá bông tro	***43. G obiidae*** *Acentrogobius canius* (C. & V.)	*138*		x	x	
107	Cá bống sáu màu	*Bathygobius fuscus* (Ruppell)	*16*	x	x	x	
108	Cá bống xanh	*Cottogobius bilobatus* (Koumara)	*144*		x		x
109	Cá bống vân sao	*Cryptocentrus russus* (Cantor)	*f30*		x		
110	Cá bống độc	*Yongeichthys nebulosus* (Forskal)	*1*		x		
111	Cá bống lưỡi màu nâu	*Glossogobius brunneus* (C. & V.)	*f31*	x	x		
112	Cá bống cát	*Glossogobius giuris* (Hammilton)	*40*	x	x		x
113	Cá bống trắng	*Gnatholepis calliurus* (J. & S.)	*2*			x	
114	Cá bống van mắt	*Oxyurichthys tentacularis* (C. & V.)	*129*	x	x	x	x
115	Cá bống chấm mắt	*Oxyurichthys microlepis* (C.& V.)	*f83*	x	x	x	
116	Cá bống nhiều râu	*Parachaeturichthys polynema* (Bleeker)	*77*		x		
117	**44. Họ cá rô phi** Cá rô phi	***44. Cichlitidae*** *Oreochromis mosambicus* Peters				x	
118	**45. Họ cá thòi loi** Cá thòi loi	***45. Periophthalmidae*** *Periophthalmus cantonnensis* (Osbeck)	*fbt32*	x	x		
119	**46. Họ cá bống rễ cau** Cá nhàm xám	***46.Taenioididae*** *Taenioides eruptionis* (Bleeker)	*100*				
120	Cá bống rễ cau	*Ctenotrypauchen chinensis* (Steind.)	*18*	x			
121	Cá bống vây đuôi lõm	*Odontamlyopus rubicundus* (Ham.)	*72*	x	x		
122	Cá bống sói mù	*Taenioides caeculus* (Bloch & Schn.)	*80*				
123	**47. Họ cá dìa** Cá dìa tro	***47. Siganidae.*** *Siganus fuscescens* (Houttuyn)	*116*	x	x	x	
124	Cá kình chấm vàng	*Siganus oramin* (Bloch & Schneider)	*f10*	x	x	x	
125	Cá dìa sọc	*Siganus guttatus* (Bloch)	*136*	x	x		
126	**48. Họ cá hố** Cá hố trắng	***48. Trichiuridae*** *Trichiurus haumela* (Forscal)	*f18*	x	x	x	
127	**49. Họ cá chim** Cá chim hoa	***49. Stromateidae*** *Pampus maculatus* (Gunther)	*29*				
128	Cá ch. trắng vây tròn	*Stromateoides sinensis* (Euphr.)	*71*		x		

129	**50. Họ cá rô đồng** Cá rô đồng	***50. Anabantidae*** *Anabas testudineus* (Bloch)	*fbt33*	*x*		*x*	*x*
130	Cá đuôi cờ	*Macropodus opercularis* (Linnaeus)	*fbt34*	*x*		*x*	
131	**51. Họ cá sặc** Cá sặc rằn (Thia tho)	***51. Belontidae*** *Trichogaster pectoralis* (Richardson)	*fbt35*	*x*		*x*	*x*
132	**XV. Bộ cá đèn** **52. Họ cá chai** Cá chai gai bên	**XV.Scorpaeniformes** **52.*Platycephalidae*** *Grammoplitus neglectus* (Temminski)	*75*		*x*		
133	Cá chai Ấn độ	*Platycephalus indicus* (Linnaeus)	*130*	*x*	*x*	*x*	
134	**53. Họ cá chuồn đất** Cá chuồn đất	***53. Dactyloperidae*** *Dactylopterus sp*	*fbt36*				
135	**XVI. Bộ cá bơn** **54. Họ cá bơn vĩ** Cá bơn vĩ răng to	**XVI. Pleuronectiformes** ***54. Bothidae*** *Pseudorhombus arsius* (H. & B.)	*13*	*x*	*x*	*x*	
136	**55. Họ cá bơn** Cá bơn nhỏ	***55. Soleidae*** *Solea humilis* (Cantor)	*34*	*x*			
137	Cá bơn trứng	*Solea ovata* (Richardson)	*135*	*x*	*x*		
138	Cá bơn lá mít	*Synaptura orientalis* (B. & S.)	*10*	*x*		*x*	
139	Cá bơn sọc	*Zebrias zebra* (Bloch)	*f16*		*x*	*x*	
140	**56. Họ cá bơn lưỡi** Cá bơn lưỡi đầu chấm	***56. Cynoglossidae*** *Cynoglosus puncticeps* (Richardson)	*139*		*x*	*x*	
141	**XVII. Bộ cá nóc** **57. Họ cá nóc 3 gai** Cá nóc 3 gai mõm ngắn	***XVII.* Terodontiformes** ***57. Triacanthidae*** *Triacanthus brevirostris* (T.& S.)	*8*	*x*	*x*	*x*	*x*
142	Cá nóc 3 gai đầu nhọn	*Triacanthus biaculatus* Bloch	*ndc*		*x*		
143	**58. Họ cá nóc** Cá nóc một gai TQ	***58. Balistidae*** *Monacanthus chinensis* (Osbeck)	*41*		*x*		
144	**59. Họ cá nóc hòm** Cá nóc hòm đuôi dài	***59. Ostraciontidae*** *Lactoria cornutus* (Linnaeus)	*79*		*x*	*x*	
145	Cá nóc hòm	*Ostracion immaculatus* (T. & S.)	*53*		*x*		
146	**60. Họ cá nóc thường** Cá nóc răng mỏ chim	***60. Tetraodontidae*** *Spheroides inermis* (T .& S.)	*151*		*x*	*x*	
147	Cá nóc tròn tối	*Spheroides obscurus* (Abert)	*56*		*x*		
148	Cá nóc tròn gai đều	*Spheroides spinosissimus* (Regan)	*99*		*x*		
149	Cá nóc chấm sao	*Spheroides niphoble* (Jordal)	*fbt37*		*x*	*x*	
150	Cá nóc xanh	*Spheroides spadiccus* Richardson	*ndc*		*x*	*x*	
151	Cá nóc vằn	*Spheroides oblongus* Bloch	*ndc*		*x*	*x*	
152	Cá nóc ru bi	*Spheroides rubripes* T. & S.	*ndc*			*x*	
153	Cá nóc áp bốt	*Spheroides abbottii* Jordal & Snyder	*ndc*		*x*		
154	Cá nóc 1mũi chấm	*Tetrodon aerostaticus* (Jenyns)	*36*	*x*	*x*		
155	Cá nóc 1mũi kh chấm	*Tetrodon immaculatus* (Bloch)	*128*	*x*	*x*		
156	Cá nóc một chấm	*Tetraodon meleagris* Lacepede	*ndc*				
157	Cá nóc pa tô	*Tetraodon patoca* Hammilton	*ndc*	*x*			
158	Cá nóc ô xen	*Tetraodon ocenlatus* Linnaeus	*ndc*				
159	**61. Họ cá nóc nhím** Cá nóc nhím	***61. Diodontidae*** *Diodon holacanthus* Linnaeus	*fbt38*		*x*	*x*	
160	Cá nóc nhím gai tròn	*Cyclichthys orbicularis* (Bloch)	*fbt39*		*x*	*x*	

			160	*99*	*100*	*99*	*24*

Table 6. The Checklist of the Birds

Tên Việt Nam	Tên Khoa học	G. chú
1. Le hôi	Tachybaptus ruficollis poggei	*1*
2. Diệc xám	*Ardea cinerea rectirostris*	2, 3
3. Diệc lửa	*A. purpurea manilensis* (X)	1, 3
4. Cò ngàng nhỏ	*Egretta .i. intermedia*	1, 3
5. Cò trắng	*E. g. garzetta* (X)	1, 3
6. Cò bợ	*Ardeola bacchus*	1, 3
7. Cò bợ Java	*A. speciosa*	1, 3
8. Cò ruồi	*Bubulcus ibis coromandus* (X)	1, 3
9. Cò xanh	*Butorides striatus actophilus*	1, 3
10. Cò lửa lùn	*Ixobrychus. s. sinensis*	2, 3
11. Cò lửa	*I. cinnamomeus*	1, 4
12. Le nâu	*Dendrocygna javanica*	1, 3
13. Ngỗng trời	*Anser anser*	2, 3
14. Vịt đầu vàng	*Anas penelope*	2, 3
15. Vịt trời	*A. poecilorhyncha Haringtoni*	2, 3
16. Mòng két mày trắng	*A. querquedura*	2, 3
17. Mòng két mày xanh	*A. c. crecca Linnaeus*	2, 3
18. ó cá	*Pandion. h. haliatus* (X)	2, 4
19. Cắt lưng hung	*Falco tinnunculus interstinctus* (X)	2, 3
20. Cuốc ngực trắng	*Amaurornis phoenicurus chinensis*	1, 4
21. Gà đồng	*Gallicre. c. cinererea*	1, 3
22. Sâm cầm	*Fulica. a. atra*	2, 3
23. Xít, cuống	*Porphyrio porphyrio viridis* (X)	1, 3
24. Cà kheo	*Hinantopus. h. hinantopus*	2, 3
25. Dô nách nâu	*Glareola maldivarus*	1, 4
26. Te cựa	*Vanellus davaucelii*	2, 3
27. Choi choi xám	*Pluvialis squatarola*	2, 3
28. Choi choi nhỏ	*Charadrius dubius curanicus*	2, 3
29. Choi choi khoang cổ	*Ch. alexandrius dealbatus*	2, 3
30. Choắt mỏ thẳng đuôi vằn	*Limosa lapponica baueri*	2, 3
31. Choắt mỏ cong bé	*Numenius phaeopus variegalus*	2, 3
32. Choắt chân đỏ	*Tringa erythropus*	2, 3
33. Choắt đốm đen	*T. stagnatilis* (X)	2, 3
34. Choắt bụng xám	*T. glareola* (X)	2, 3
35. Choắt nhỏ	*T. hypoleucos* (X)	2, 3
36. Choắt chân màng lớn	*Limnodromus semipalmatus* (SĐ)	2, 3
37. Rẽ cổ xám	*Calidris alba* (X)	2, 3
38. Mòng bể	*Larus ridibundus*	2, 4

39. Nhàn xám	*Chlidonias hybrida* (X)	2, 4
40. Nhàn chân đen	*Gelochelidon nilotica* (X)	2, 4
41. Nhàn	*Caxpia Hydroprogne. c. caspia* (X)	2, 4
42. Cu gáy	*Streptopelia chinensis tigrina*	1, 3
43. Tìm vịt	*Cacomantis merulinus querulus*	1, 4
44. Bìm bịp lớn	*Centropus sinensis intermedius*	1, 3, 4
45. Cú muỗi ấn Độ	*Caprimulgus indicus* (X)	1, 3
46. Cú muỗi đuôi dài	*C. macrurus burmaculatus* (X)	1, 3
47. Bói cả nhỏ	*Ceryle rudis insignis* (X)	1, 4
48. Bòng chanh	*Alcedo atthis bengalensis* (X)	1, 4
49. Sả đầu nâu	*Halcyon smyrnensis perpulchra* (X)	1, 4
50. Sả khoang cổ	*H. chloris armstrongi*	1, 4
51. Trẩu ngực nâu	*Merops superciliosus* (philippinus)	2, 3, 4
52. Chim sơn ca java	*Mirafra javanica williamsoni*	1, 4
53. Nhạn bụng trắng	*Hirundo rustica saturata* (X)	2, 4
54. Chìa vôi vàng	*Motacilla flava macronyx* (X)	2, 4
55. Chìa vôi trắng	*M. alba ocularis* (X)	2, 4
56. Chim manh lớn	*Anthus novaeseelandae* (X)	2, 4
57. Bách thanh	*Lanius. s. schach* (X)	1, 3, 4
58. Bách thanh nhỏ	*L. c. collurioides* (X)	1, 3, 4
59. Chích choè	*Copsychus. s. saularis*	1, 3, 4
60. Sẻ bụi đen	*Saxicola caprata burmanica*	1, 3, 4
61. Liếu điếu	*Garrulax perspicillatus*	1, 4
62. Chích đầu nhọn mày đen	*Acrocephalus bistrigiceps* (X)	2, 3, 4
63. Chích đầu nhọn phương đông	*A. orientalis* (X)	2, 3, 4
64. Chích lông cánh vàng	*Orthotomus atrogularis nitidus* (X)	1, 3, 4
65. Chích đuôi dài	*O. sutorius maculicollis* (X)	1, 3, 4
66. Chiền chiện đầu nâu	*Prinia. r. rufescens* (X)	2, 3, 4
67. Chim sâu vàng lục	*Dicaeum concolor olivaceum*	1, 3, 4
68. Vành khuyên họng vàng	*Zosterops japonica simplex*	1, 3, 4
69. Sẻ đồng ngực vàng	*Emberiza aureola ornata* (X)	2, 4
70. Sẻ nhà	*Passer montanus malaccensis*	1, 3, 4
71. Sáo mỏ vàng	*Acridotheres grandis*	1, 3, 4
72. Chèo bẻo rừng	*Dicrurus. a. aeneus*	2, 3, 4
73. Chèo bẻo	*D. macrocercus cathoecus*	1, 3, 4

Ghi chú: 1- Loài định cư
2 - Loài di cư
3 - Loài có giá trị kinh tế
4 - Loài chim cảnh
(X) - Loài trong danh sách bảo vệ nghiêm ngặt của Cộng đồng châu Âu
SĐ - Loài trong Sách Đỏ Việt Nam

Table 7. Waters plants

STT	Tên loài
	Seagrass
	Họ Thuỷ thảo Hydrocharitaceae
1	Cỏ nàn *Halophila beccarii* Asch.
2	Cỏ xoan *H. ovalis* Hooker
3	Cỏ xoan nhỏ *H. minor* (Zoll.) den Hartog
	Họ Hải rong Zosteraceae
4	Cỏ lươn *Zostera japonica* Asch. & Graebn.
	Họ Xuyên màn Ruppiaceae
5	Cỏ kim *Ruppia maritima* Lin.
	Họ Hải kiều Cymodoceaceae
6	Cỏ hẹ tròn *Halodule pinifolia* (Miki) den Hartog
	Fresh waters plants
	Họ Lentibulariaceae
7	Rong li *Utricularia aurea* Lour.
	Họ Ceratophylaceae
8	Rong đuôi chó *Ceratophyllum demersum* L.
	Họ Haloragaceae
9	Rong xương cá *Myriophyllum spicatum* L
	Họ Hydrocharitaceae
10	Rong đen lá vòng *Hydrilla verticillata* (L.) Royl.
11	Rong mái chèo, *Valisneria spiralis* Graebn.
12	Cỏ lá he *Blyxa aubertii* Rich
	Họ Potamogetonaceae
13	Cỏ nhãn tử Mã lai *Potamogeton malaianus* Miq.
14	Cỏ nhãn tử bẹ *Potamogeton maackianus* A. Benett
	Họ Najadaceae
15	Rong từ *Najas indica* Cham
	Họ Nymphaeceae
16	Cây súng *Nymphaea pubescent* willd.
	Họ cỏ Poaceae
17	Cỏ gà nước *Paspalum scrobiculatum* L.