Skin disease in seabass, *Lates calcarifer*, cultured in net-cages.

Jaruratt Booranapanichagit and Yaowanit Danayadol

INTRODUCTION

Skin disease occurred in cage-cultured seabass, *Lates calcarifer*, at NICA during June and July, 1984. After three days of grading and handling, the fish began to show shallow, grayish, irregular lesions on the body surface, fin rot, and hemorrhagic skin lesions. The approximate mortality rate was 60% of the total number of fish.

MATERIALS AND METHODS

Five diseased fish were collected, three serious cases, two light cases, and anesthetized in 20 ppm of quinaldine. After the fish were weighed and measured, their eyes were examined and their body surfaces, gill, and fins checked for parasites. The abnormal peritoneum was cut and the internal organs examined. The normal skin, infected skin, liver and kidney specimens were imprinted on slides and stained with Gram's stain. The slides were then examined under the microscope. Bacteria were isolated from infected skin, liver, and kidney by streaking on brain heart infusion agar (BHA), blood agar (BA), and Cytophaga agar (Anacker and Ordal, 1955), and then incubated at 20 and 30°C for 24–48 hours. Then bacteria were identified (Lennette et al., 1980). For histopathological studies, specimens were taken from the lesion area, fixed in 10% formalin buffer solution for 24 hours, dehydrated and embedded in paraffin, sectioned by microtome into 5–6 micron thicknesses and stained with hematoxylin and eosin (H&E) (Humason, 1979).

RESULTS AND DISCUSSION

Length and weight of examined fish are as follows:

No. of fish	length (cm)		Weight (g)
	Total length	Body length	
1	8.2	7.1	6.25
2	8.4	7.4	7.05
3	9.0	7.8	8.63
4	8.3	7.7	8.16
5	10.2	8.8	10.36

The general, clinical signs of this disease included a darkening of skin colour, body thickness, loss of appetite, and abnormal swimming behavior, i.e., fish swam lifelessly near the surface of the water. Also common was a loss of pigmentation within the lesion. In light cases, only a small area of the body were affected, the mucous area was damaged, and some skin and scale loss occurred (Fig. 1). In serious cases, a large area of the body was damaged (Fig. 2), fins, especially caudal fins, were sometimes lost, hemorrhagic skin lesions appeared (Fig. 3) and fish exhibited poor equilibrium.

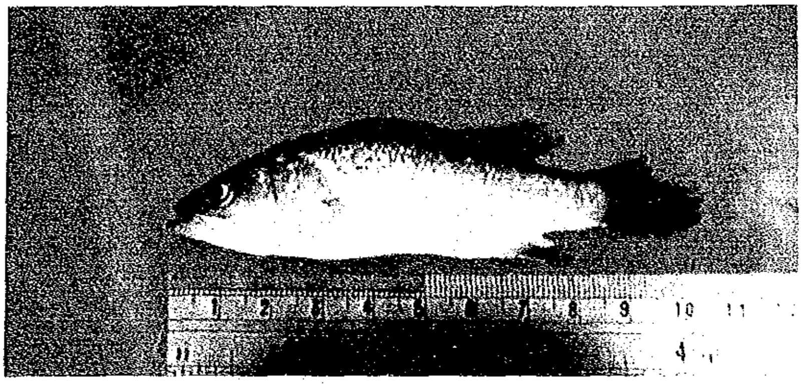

Fig. 1. Skin disease of seabass, a light case. Some skin and scale loss occurred.

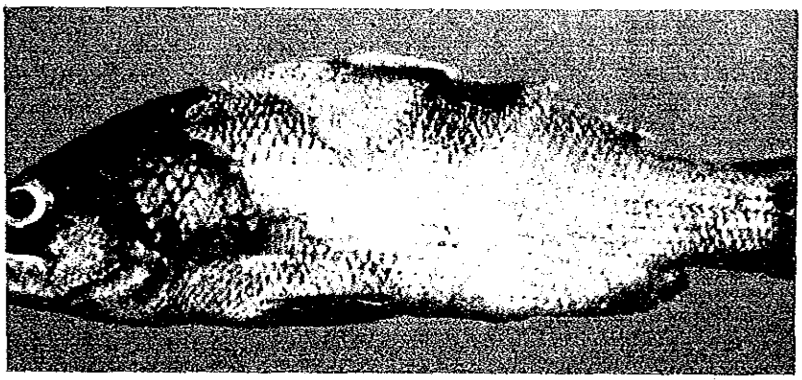

Fig. 2. Skin disease of seabass, a heavy case. A large area of the body was damaged.

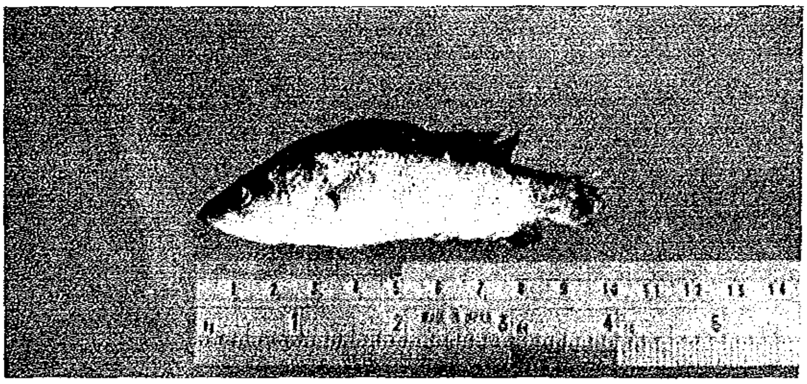

Fig. 3. Skin disease of seabass, a heavy case. The caudal fin was lost, and hemorrhagic skin lesion appeared.

No parasites were found on the body surface or gills. Internal organs were normal. Observations were made of skin smears and Gram's stain taken from both normal and infected skin, and from the edges surrounding the infected skin. They revealed the presence of two, Gram negative bacteria, filaments and rod, the number of which clearly varied in each area (Figs. 4, 5, 6). Attempts to isolate the bacteria succeeded only with the rod, identified as *Pseudomonas* sp. Bacteria were found in the liver of only one fish. Histopathological changes were observed in the skin. Epidermis and dermis were necrotized, accompanied by hemorrhaging and inflammation (Fig. 8).

Skin disease is well known in marine, brackishwater and freshwater fish. Skin disease in cage-cultured seabass has rarely been studied, but information on disease such as this is important for culturing seabass because disease sometimes does occur after netting and handling.

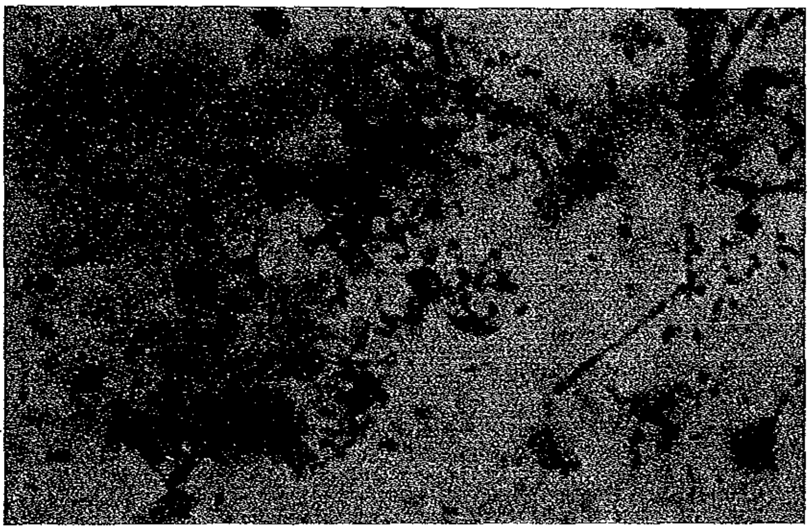

Fig. 4. Skin smears and Gram's stain taken from infected skin (x 1,000).

Fig. 5. Skin smears and Gram's stain taken from normal skin (x 1,000).

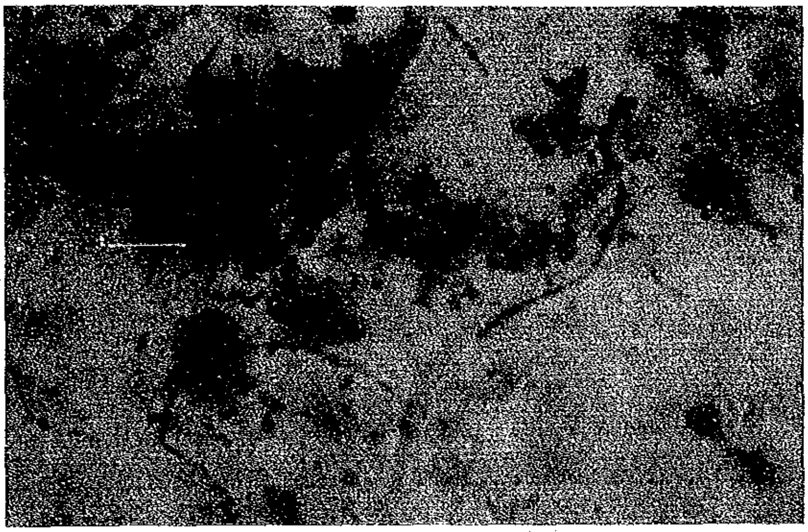

Fig. 6 Skin smears and Gram's stain taken from the edges surrounding the infected skin (x 1,000).

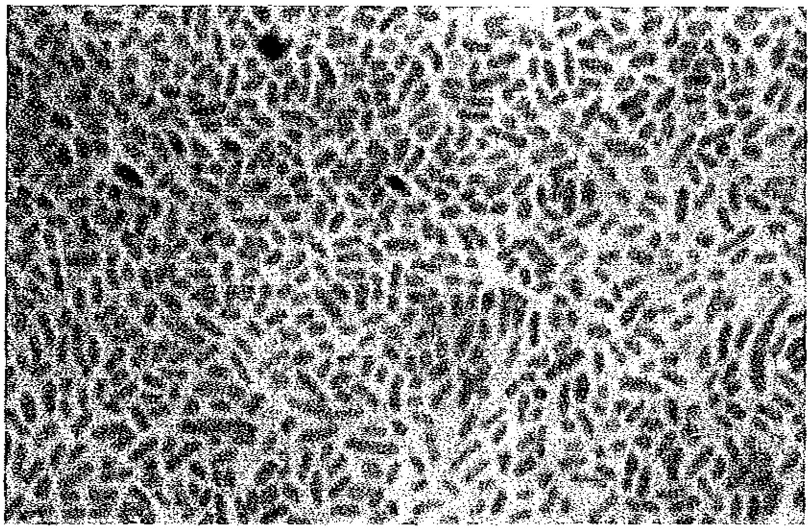

Fig. 7. 24 hour culture of *Pseudomonas* sp. on brain heart infusion agar (BHA) (Gram's stain x 1,000).

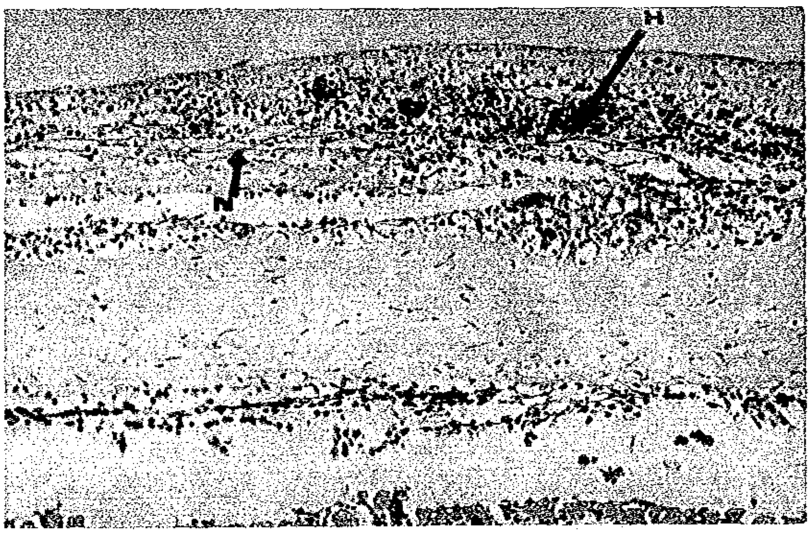

Fig. 8. Epidermis and dermis were necrotized (N), accompanied by hemorrhaging (H) (x235).

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Oodinium (Dinoflagellate) infestation of Mullet, *(Mugil dussumieri)*

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and Sathaporn Derekbussarakom

INTRODUCTION

Oodinium is one kind of Dinoflagellate protozoa which has a pear shape. It uses stalks or anchors to attach the host tissue. Some species have a red eye spot and an oval nucleus (Kudo, 1977). They are found in both fresh and seawater. The white spot of *Oodinium* on fish gills is smaller than an *Icthyophthirius* white spot. The sizes of the parasite stage are 15–50 x 15–70 μ. The trophont stage dies within 24 hrs if it cannot find a host (Reinchenbach–Klinke, 1965). The small white spot is quite distinct when the operculum is opened (Paperna, 1980).

An *Oodinium* outbreak in mullet, *Mugil dussumieri*, occurred at Borken substation in September, 1984.. The mullet were taken from Songkhla Lake and cultured in concrete tanks with supplemental feed. In all, about 2,000 of 5,000 total fish were lost.

This report describes the symptoms and treatment of the disease and presents environmental data gathered when the disease occurred.

MATERIALS AND METHODS

General Examination

Five diseased fish, about 5.1–6.8 cm in length and 1.35–4.05 g in weight, were taken to the pathology laboratory.

After anesthetising the fish by 20 ppm quinalidine, wet mount smears were prepared from gill cuts and skin smears and examined by microscope. Ten parasites were measured by micrometer.

Histopathology

The gills were fixed in buffer formalin and dehydrated in alcohol and xylene,then embedded in paraffin, sectioned with a microtome into about 6 μ thicknesses and stained in hematoxyline and eosin. Each slide was examined by microscope.

Treatment

All fish were bathed twice in a solution of 250 ppm formalin and 0.5 ppm $CuSO_4 \cdot 5H_2O$ for about 30 minutes on two alternate days.

RESULTS

The symptoms of the disease were gasping, inability to swim and body color becoming pale and yellowish velvet. After the operculum was opened , cloudy white spots were apparent on the gills and identified as *Oodinium* Fig. 1.

The *Oodinium* found were pear shaped and used rhizoid to attach themselves to the gills on the mullet (Fig. 2). The red spots and oval nucleus was about 15–20 and 50–60 μ, respectively.

The histopathological changes were hemorrhaging, hyperplasia and an increase of mucous.

The treatment was seemed to be effective because, after the first day of the treatment, the mortality decreased from 500 fish to 300 fish. The second treatment was given on the third day, and mortality decreased to 20 fish on the fourth day. There was no mortality after that. In all 3,000 fish recovered from the total of 5,000 fish.

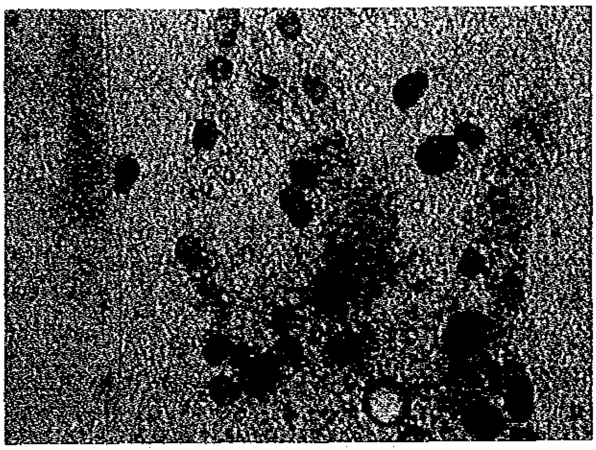

Fig. 1. Severe infestation of *Oodinium* sp. on gills of Mullet, *Mugij dussumieri* (100 x).

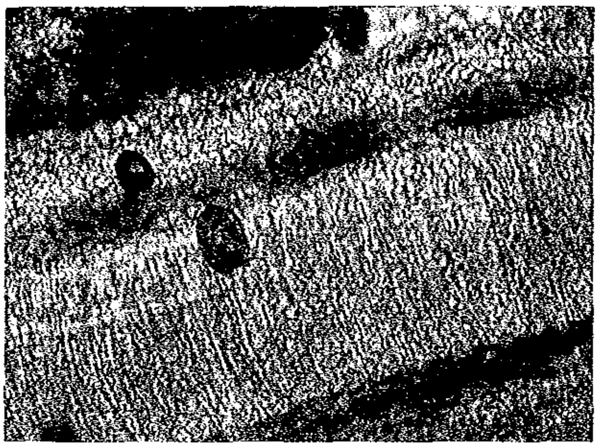

Fig. 2. *Oodinium* sp. using rhizoid to attach on the gills of Mullet, *Mugli dussumieri*. (400x).

DISCUSSION

Histopathological changes caused by the *Oodinium* infestation were hemorrhaging, hyperplasia and necrosis of the gill, as reported by Roger and Gaines (1975) and Paperna (1980). It may be that the *Oodinium* produced the toxin that could kill the fish in one week.

The disease may have been caused by several factors, such as high density (111 fish/m^3), poor pond management which allowed very little water to flow in and out and the sedimentation of waste feed day by day which after several months, produces low water quality. This causes the fish stress, weakens them and makes them susceptible to disease.

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Some blood parameters of healthy seabass, *Lates calcarifer*

Yaowanit Danayadol and Chaiyuth Chantanachooklin

INTRODUCTION

Haematological change is very important in the diagnosis of disease in humans, but the haematological changes of fish pathology have been little studied in the past. Some investigations have attempted to show the change in some parameters due to specific diseases, such as the effects of some parasites on the haematological changes in fish (Hines and Spira, 1974 and Nair and Nair, 1983), effects of some bacteria on haematological changes in fish (Harbell et al. 1979) and effects of some chemical reagents in fish (Bansal et al. 1979 and Williams and Wotten, 1981).

The establishment of standard haematological parameters is useful for comparison with haematological changes in diseased fish. The present report is the first study of the blood parameters in healthy seabass, *Lates calcarifer*. It includes data gathered from 77 samples.

But many more samples should be examined to eventually present exhaustive standard haematological parameters for seabass in southern Thailand.

MATERIALS AND METHODS

Seventy-seven seabass, 14.2–22.0 cm in length and 33.9–112.7 g in weight, were transported to the wet laboratory of the National Institute of Coastal Aquaculture. They were kept in 70 ℓ, rectangular glass tanks, three fish per tank, under normal culture conditions. The water salinity was 0 ‰, pH was 7.5-7.8 and temperature was 27.0-28.5°C. The fish were fed twice daily with trash fish mixed with Vitamin B complex. The experiment started after the fish were acclimatized to the conditions for two weeks.

Blood collection

Fish were netted from the tank and anesthetized with Ethylen-Aminobenzoate Methane-sulfonate (MS222) at 200 ppm, then 0.4 ml of blood was taken by cardiac puncture with a 1 ml disposable plastic syringe and 23 gauge disposable hypodermic needle. The syringe contained 0.05 ml liquid heparin (10,000 unit/ml). The blood samples then were gently discharged into dry vials and mixed gently but thoroughly. Samples were discarded if any difficulty was encountered in taking them, or clots were seen in the heparin bottles during inspection at the laboratory. All the fish samples were then returned to the net cage cultures.

Blood analysis

a). Erythrocyte and leucocyte count

Blood was diluted 1:100 in Yokoyama's solution (1960) prepared as follows:

Solution A	NaCl	4.0g
	KCL	200.0 mg
	Dextrox	1.25 mg
	$NaHCO_3$	250 ml
	40% formalin	50 ml
	Distilled water	200 ml
Solution B	Methyl violet	75 mg
	Pyroxin B	75 mg
	Distilled water	250 ml

(Immediately prior to use both solution were filtered and mixed in equal volumes.)

The cells were then counted on standard haematocytometer (improved Neubauer counting chamber). Erythrocytes were counted in five squares and leucocytes in four.

b) Haemoglobin

Haemoglobin concentration was measured by cyamethaemoglobin method (Sigma No. 525–2).

c). Differential cell counts

Thin blood films were prepared immediately after collection, and stained by Wrigh's stain after drying. A total of 300 leucocytes from three portions of the slides (Fig. 1) for each sample was counted and the numbers of lymphocyte, monocyte and neutrophil per 100 leucocyte were calculated (Figs. 2–4).

d) Haematocrit level

The haematocrit level was measured by haematocrit accessory after a capillary tube was filled with blood. Then the blood was spun in a haematocrit centrifuge at 11,000 rpm for 5 minutes.

e). Total protein

Total protein was measured by Hitachi Hand Protein Refractometer from the serum in the capillary tube after the haematocrit level was checked.

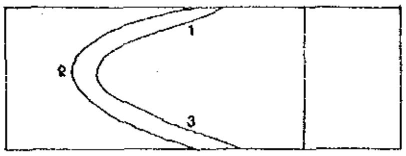

Fig. 1. Three portions of the slides for blood cell counting.

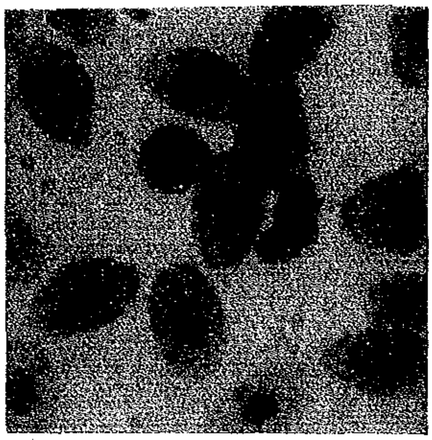

Fig. 2. Blood smear with round (left) and pseudopodia (right) lymphocyte.

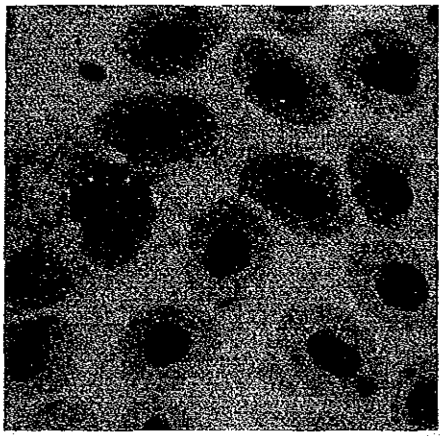

Fig. 3. Blood smear with a large cell of monocyte showing a vacuole in cytoplasm.

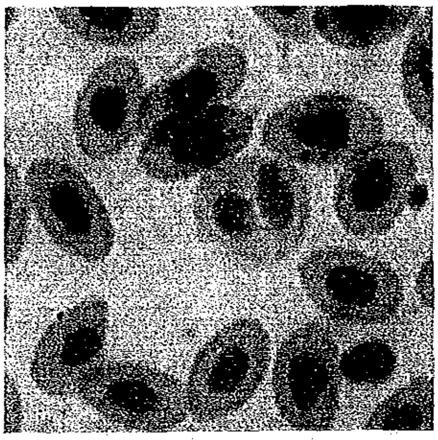

Fig. 4. The large cell in the center is a neutrophils with fine granules in cytoplasm.

RESULTS AND DISCUSSION

The results of measurements of blood parameters are shown in Table 1.

Table 1. Blood parameters of healthy seabass, *Lates calcarifer*, obtained from 77 sample fish.

Blood parameter	Range	Mean
Erythrocyte count (cells/mm^3)	2.0×10^6 - 4.7×10^6	3.2×10^6
Leucocyte count (cells/mm^3)	2.3×10^4 - 10.3×10^4	5.4×10^4
Haemoglobin (g/dl)	3.8 - 8.7	5.6
Relative incidence of leucocytes (%)		
Lymphocytes	90.5 - 99.7	97.1
Monocytes	0 - 3.4	0.5
Neurophilis	0.3 - 6.7	2.2
Haematocrit value (%)	16.0 - 30.5	21.8
Plasma total protein	3.0 - 5.5	3.9

1. The range of erythrocyte count was 2.0–4.7 million cells/mm^3, with a mean of 3.3 million cells/mm^3. This value was higher than value in Rohu, *Labeo rohita*, which was 2.19–2.32 million cells/mm^3 (Siddiqui and Naseem, 1979), in hibernating *Sphenodon punctatus*, 0.26 million cells/mm^3 (Desser, 1979), in rainbow trout, *Salmo gairdneri*, 0.71–1.73 million cells/mm^3, (McCarthy et al. 1973) and in pike, *Esox lucius*, 1.12–3.12 million cells/mm^3 (Mulcahy, 1970).

2. The range of leucocyte count was 2.3×10^4 - 10.3×10^4 cells/mm^3, with a mean of 5.4×10^4 cells/mm^3. It was similar to the value in pike, which ranged from 79,000–137,000 cells/mm^3, with a mean of 111,500 cells/mm^3 (Mulcahy, 1970). It was found that pike has a high leucocyte count relative to other fishes, such as the leucocyte count of Rohu (20.0–24.9 cm in length) which was 5,860 ± 1,372 cells/mm^3 (Siddiqui and Naseem, 1979).

3. The range of haemoglobin value was 3.8–8.6 g/dl with an average 5.6g/dl. Mulcahy (1970) gave 5.6–15.0 g/dl, mean 8.8g/dl as haemoglobin value of pike. Siddiqui and Nassem (1979) found that the value of haemoglobin in Rohu was 7.6–11.3g/dl, mean 3.0g/dl. McCarthy et al. (1973) reported that haemoglobin value in rainbow trout (Kamloop variety) was 7.5–11.0g/dl, mean 9.3g/dl.

4. The range of lymphocyte was 90.5–99.7% with a mean of 97.1%. The range of monocyte was 0–3.4%, mean 0.5%, and the range of neutrophils was 0.3–6.7%, mean 2.2%. Eosinophils and basiophils have never been found in seabass. This mean that seabass had a differential cell count of over 90% lymphocytes, and that monocytes were rare. The same result was reported in rainbow trout (McCarthy et al. 1973).

5. The range of haematocrit value was 16.0–30.0% with a mean of 21.7%. This range is within the range of the haematocrit values of other fishes. A range of 20.0–43.5%, mean 32.0%, was found in pike (Mulcahy, 1970), and a range of 11.0–41.0%, mean 30.0%, in rainbow trout (Shasta) (McCarthy et al. 1973).

6. The range of plasma total protein value was 3.0–5.5g/dl, with a mean of 3.87g/dl. It is similar to the range of plasma total protein in common carp, *Cyprinus carpio*, which was 4.3 ± 0.23g/dl (Sano, 1962) and lower than in rainbow trout, brown trout, atlantic salmon which were 6.5±0.3, 6.2±0.2, 7.5±0.3g/dl, respectively (Aledander and Ingram, 1980).

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Report on fisheries ecology survey in Pattani Bay

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INTRODUCTION

Pattani Bay is in the southern part of Thailand and has a surface area of approximately 5,000 rai, or 8 km^2. This bay opens onto the Gulf of Thailand in the Muang District of Pattani Province. The bay ecosystem includes freshwater, brackishwater and seawater. It is very shallow, about 1–2 m in average depth. From the survey of Jiso (1985), 2,733 families and 20,682 persons are living around the bay area. They earn their living by small scale fishing, such as by cast net or small dip net. It seems that the bay is very rich in coastal fisheries resources and can serve as a low cost protein source for the people around the bay, and some areas of Pattani Province as well.

The purpose of this study is to investigate the ecosystem of this bay the year round, from May, 1984 to May, 1985. The results can be used for coastal fisheries resource management.

MATERIALS AND METHODS

Water samples were collected every month from May, 1984 to May, 1985 at 7 survey stations (Fig. 1). The water samples were collected at the surface, and from bottom layers if the depth of water was more than 2 m. The water pH, salinity and conductivity were measured by portable pH meter and YSI meter. Water transparency was measured by secchi disc following the method of Boyd (1979).

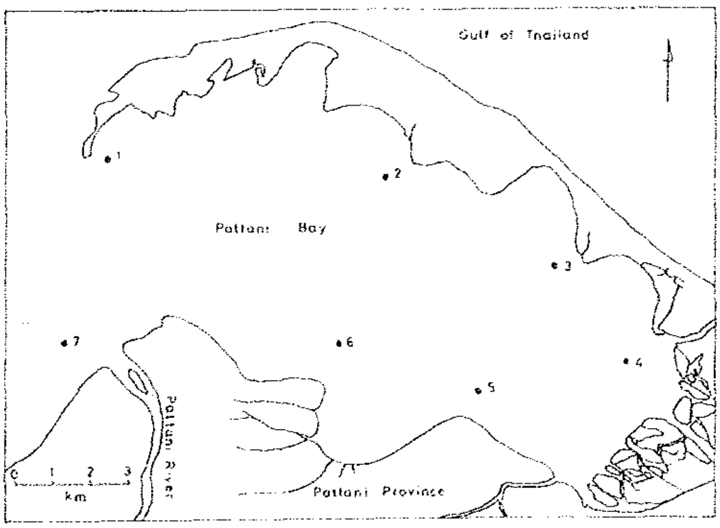

Fig. 1. Survey stations in Pattani lagoon.

Dissolved oxygen (DO) was fixed and then analyzed in laboratory within 6 hours by the method of APHA (1980). Water for biological oxygen demand (BOD) analysis was incubated at 20°C for 5 days in laboratory. The nutrient values, orthophosphate, nitrate-nitrogen, nitrite-nitrogen, and silicate were incubated at 5°C by ice box and then analyzed at laboratory within 6 hours by the methods of APHA (1980), Grasshoff (1976) and Strickland and Parsons (1972), respectively.

Fish population and standing crop were sampled in April, 1985 by encircling net, mesh size 1 cm, 25 m in length and 2.5 m in height. The fish population and standing crop were collected at survey stations 1 to 6 (Fig. 1).

RESULTS AND DISCUSSION

The water salinity was from 18.263 to 27.996‰ on average by station and ranged from 0 to 32.996‰ (Fig. 2). The salinity dropped to zero at survey stations 3, 4 and 5 in December, 1984. These survey stations were in the inner part of the bay, which would be influenced by freshwater runoff from canals and flood areas.

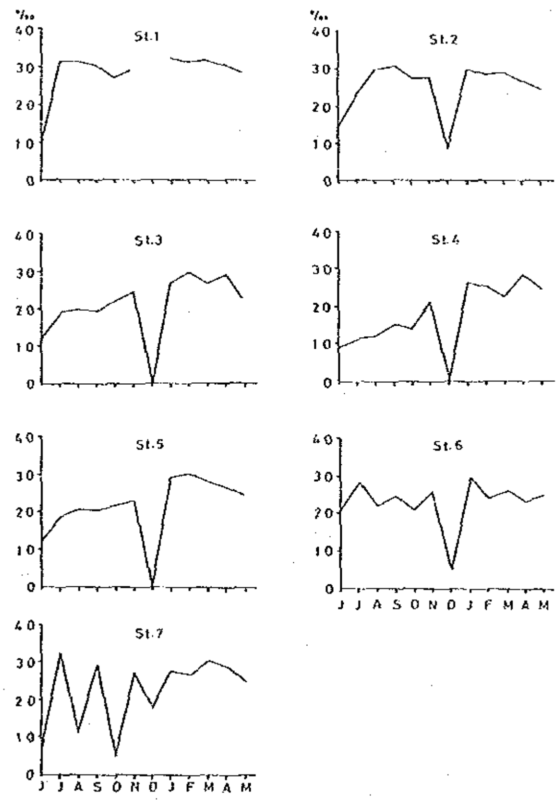

Fig. 2. Annual fluctuation of water salinity at survey stations in Pattani Bay.

The average transparency was less than 1 m at every survey stations, and water depth was from 0.84 to 2.87 m. It can be said that this bay is shallow and that light can penetrate only about 1 m, because sunlight penetration reaches twice as deep as the transparency according to Boyd's law.

Dissolved oxygen levels were high enough for aquatic life according to the recommendations of U.S. EPA (1972). BOD was very low and averaged from 0.94–1.55 mg/ℓ which also meet the standard criteria for water quality for aquatic life. The nutrient values were similar to the average values from other coastal areas of Thailand (Tookwinas et al. 1985).(Table 1).

Table 1. Water quality in Pattani lagoon (1984–85)

Station		Temp. °C	Depth m	Transparency m	Salinity ppt	pH	Conductivity μ mohs/cm	D.O. mg/ℓ	Alk mg/ℓ	PO_4 mg P/ℓ	NO_3 mg N/ℓ	B.O.D mg/ℓ	NO_2 mg N/ℓ	Si mg Si/ℓ
1	S B	30.19 28.0–33.5	2.87 1.0 –3.95	0.96 0.50–1.80	27.996 8.996–32.996 30.334 27.496–32.996 31.121 27.996–32.996	8.01 7.35–8.55 7.91 6.65–8.60	426×100 140×100–495×100 468×100 435×100–495×100 48.7×100 485×100–500×100	5.78 5.25–6.30 5.81 5.3 –6.7	24.62 4.0–76.10 27.88 3.20–76.0	0.012 4.0–76.10 0.024 0–0.050	0.009 0–0.0045 0.16 0–0.055	1.04 0.05–3.30 0.41 0.10–1.15	0.006 0 0.010 0.009 0–0.015	0.585 0–1.31 0.89 0–2.08
2	S B	29.22 27.0–32.1	1.30 0.91–1.56	0.74 0.19–1.33	23.596 8.196–30.996 22.121 8.496–29.496	8.0 7.45–8.35	352×100 120×100–455×100 348×100 121×100–455×100	5.9 5.2 –6.74	25.40 12.10–65.0	0.046 0–0.070	0.008 0–0.0085	1.20 0.08–3.55	0.009 0–0.0160	1.413 0–3.0
3	S B	29.78 27.0–32.1	1.06 0.80–1.45	0.61 0–1.26	22.105 0–31.496 24.784 0–28.996	7.84	342×100 170×100–460×100 382×100 300×100–455×100	5.90 4.30–7.10	21.72 2.3–67.0	0.062 0–0.248	0.015 0–0.0465	0.94 0.06–3.50	0.017 0–0.044	1.58 0.56–2.76
4	S B	30.39 27.5–35.5	0.84 0.48–1.20	0.56 0.17–1.10	18.263 0–27.996 21.596 0–27.996	7.73 6.95–8.10	280×100 130×100–430×100 307×100 178×100–430×100	5.86 4.19–6.60	21.28 1.20–64.0	0.031 0–0.060	0.013 0–0.041	1.09 0.20–2.60	0.016 0–0.035	2.11 0–3.80
5	S B	28.50 28.0–29.0 30.76 28.0–35.2	1.26 0.95–1.75	0.53 0–1.0	22.630 0–29.996 25.821 0–30.496	7.86 7.20–8.60	357×100 180×100–460×100 407×100 330×100–450×100	6.23 5.50–9.30	20.49 11.0 64.0	0.064 0–0.23	0.0167 0–0.0370	1.18 0.10–5.40	0.0442 0–0.050	1.547 0–3.80
6	S B	30.15 28.0–29.1 28.54 27.8–35.2	1.18 0.72–1.70	0.49 0.11–1.0	23.143 4.196-29.496 22.866 4.496–28.996	7.88 7.50–8.45	340×100 50×100–430×100 354×100 51×100–450×100	6.40 5.50–8.05	21.51 5.0–66.0	0.049 0.001–0.130	0.0154 0–0.035	1.13 0.10–3.90	0.0175 0–0.050	1.745 0–3.80
7	S B	28.90 28.0–29.5 30.92	0.92	0.38	22.671 3.996–32.996 22.682	7.85	373×100 80×100–500×100 353×100	5.89 4.85–7.0	21.17 3.40–27.0	0.053 0–0.10	0.0256 0–0.084	1.55 0.11–4.85	0.0134 0–0.031	2.128 0.02–3.80

38 species of fish were found (Table 2). The most abundant were the *Ambassis kopsii, Lutjanus russelli, Sciaema russelli, Stoloplonus* sp. and *Penaeus* shrimp species. The standing crop was 7.34 kg/rai (45.87 kg/ha) in average and ranged from 1.51 to 12.96 kg/rai (9.44–81.00 kg/ha) (Table 3).

Table 2. Species distribution of fish at survey stations in Pattani Bay.

Species	Survey station					
	1	2	3	4	5	6
1. *Ambassis kopsii*	+	+	–	+	–	–
2. *A. gymnocephala*	+	–	–	–	+	+
3. *Atherina valenciensis*	+	–	–	+	–	–
4. *Butis butis*	+	–	–	–	–	+
5. *Ctenogobius criniger*	+	+	–	–	+	–
6. *Cynoglossus cynoglossus*	–	–	–	–	+	+
7. *Dasyatis imbricatus*	–	+	–	–	+	–
8. *Engraulis* sp.	–	–	+	–	–	–
9. *Escualosa thoracata*	+	–	+	–	–	–
10. *Hemiramphus unifasciatus*	+	+	–	–	–	–
11. *Lates calcarifer*	+	–	–	–	–	–
12. *Leiognathus brevirostris*	–	–	+	+	–	–
13. *L. equulus*	+	+	–	–	–	–
14. *Lethrinus haematopterus*	+	+	–	–	–	–
15. *Lutjanus argentimaculatus*	+	–	–	–	–	–
16. *L. russelli*	+	+	–	+	–	–
17. *Mugil dussumieri*	+	–	–	–	–	–
18. *M. longimanus*	–	–	–	–	–	+
19. *Ophichthys* sp.	–	+	–	–	+	–
20. *Oxyurichthys microlepsis*	–	–	–	+	–	+
21. *Pomadasys hasta*	–	–	–	+	–	–
22. *Pseudapocryptes lanceolatus*	+	–	–	–	–	–
23. *Sciaena russelli*	–	+	+	–	+	+
24. *Siganus javus*	+	–	–	+	–	–
25. *S. oramin*	+	–	–	–	–	–
26. *S.* sp.	–	–	–	–	–	+
27. *Stolopionus* sp.	+	+	–	+	+	+
28. *Synaptura orientalis*	–	–	–	+	–	–
29. *Terapon puta*	+	+	–	+	–	–
30. *Tilapia mossambica*	+	–	–	–	–	–
31. *Triacanthus brevirostris*	–	–	–	+	–	–
32. *Trypauchen vigina*	–	–	–	–	+	–
33. *Penaeus monodon*	+	–	–	+	–	+
34. *Penaeus merguiensis*	+	–	+	+	+	+
35. *Metapenaeus monoceros*	+	–	+	+	–	+
36. *M. Brevicornis*	–	–	+	+	+	–
37. *Portunus pelagicus*	+	–	–	+	–	–
38. *Scylla serrata*	+	+	–	–	–	–

Table 3. Fisheries standing crop in Pattani Bay.

	Survey stations						Average
	1	2	3	4	5	6	
Standing crop (kg/rai)	12.96	3.45	1.51	9.52	7.65	8.99	7.34
Fish (%)	91.1	76.2	44.7	92.9	54.6	57.8	69.6
Shrimp (%)	3.3	–	55.3	6.0	45.4	42.2	25.4
Crab (%)	5.6	23.8	–	1.1	–	–	5.1

Note: 1 rai = 0.16 ha

CONCLUSION

It can be concluded that this bay is very shallow with average depth 1–2 m. The ecosystem includes freshwater, brackishwater and seawater. The water quality is still suitable for aquatic life. The bay is recommended for coastal aquaculture, such as mussel culture at survey station 1, cockle culture at survey station 6 and shrimp and fish pen culture may be recommended at survey stations 3, 4 and 5.

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Some aspects of fisheries ecology survey in Bang Nara River, Naratiwat Province

Siri Tookwinas, Pairoj Sirimontaporn and Paisak Saeju

INTRODUCTION

Bang Nara River, in Naratiwat Province, is located in southern Thailand at 101° 50′ to 102° 5′ E longitude, 6° 15′ to 6° 25′ N latitude, and is about 57 km in length. The river passes the biggest acid sulfate swamp in Thailand. This swamp, which is called Phru To Daeng, is 100,000 rai or 1,600 km^2, in area (Fig. 1). This river opens to the Gulf of Thailand at Muang District, at Tak Bai District, and by an irrigation canal called Man Baeng Canal, at Ban Ku Bu in Tak Bai District.

This study was an attempt to investigate the aquatic environment and fisheries resources of the river.

MATERIALS AND METHODS

Water samples were collected from 13 survey stations along the length of Ban Nara River on 21–22 August and 11–12 September, 1984 (Fig. 1). The water samples were treated and analyzed as follows:

Transparency was measured by secchi disc and visual observation (Boys, 1979). Salinity and conductivity were measured by YSI meter, model 33 S-C-T. Water pH was determined by portable, digital pH meter model 607, Sibata. Dissolved oxygen (DO) was fixed and then measured along the method of APHA (1980). Water hardness, acidity and alkalinity were treated by standard method (APHA, 1980). Orthophosphate, ammonia-nitrogen and nitrite-nitrogen were measured by portable photo-calorimeter F-25, Sibata, employing the methods of APHA (1980) and Grasshoff, respectively. Water samples were kept for one week in a cold box for silicate analysis at NICA laboratory employing the method of Strickland and Parson (1972).

Fish population and standing crop surveys in Bang Nara River were done in September, 1984. A nylon net, 200 m in length, 3 m in height, and 1 inch in mesh size, was laid in a circle (approx. 700 m^2) at each of 10 survey stations. The net was then pulled into a small circle and the fish and aquatic animals were collected.

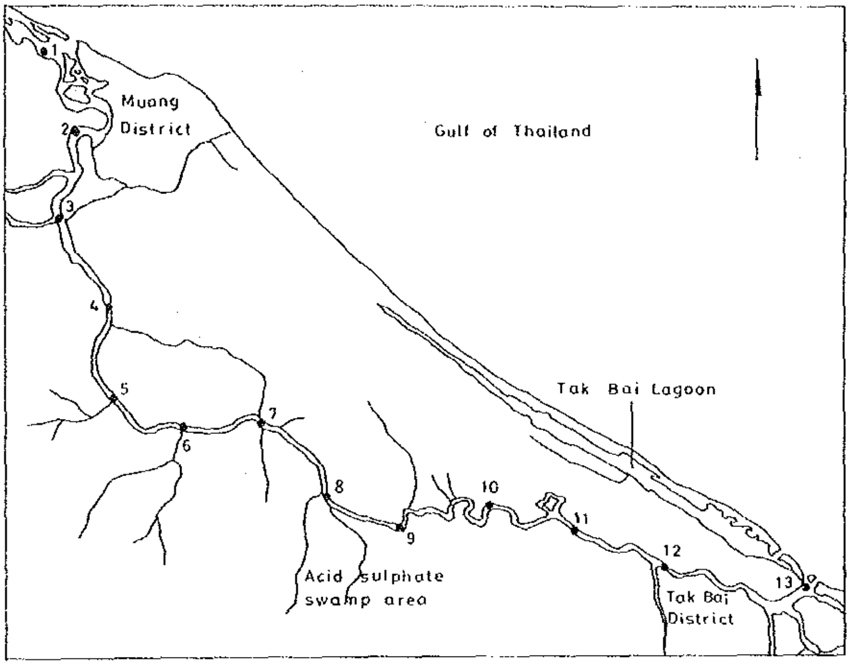

Fig. 1. Survey stations in Bang Nara River.

RESULTS

Results of water properties measurements are shown in Table 1 and Fig. 2. The average values and ranges of the water properties in Bang Nara River can be summarized as follows:

pH	5.7 (1.2–8.0)
DO	4.0mg/ℓ (1.4–6.4)
Salinity	19.9 ‰ (0–32.0)
Acidity	1.6mg/ℓ as $CaCO_3$ (0.1–5.5)
Alkalinity	40.55mg/ℓ as $CaCO_3$ (7.0–95.0)
Transparency	1.5m (0.5–3.85)
Orthophosphate	0.003mg P/ℓ (0–0.012)
Nitrite	0.007mg N/ℓ (0–0.015)
Silicate	0.92mg Si/ℓ (0.2–2.46)

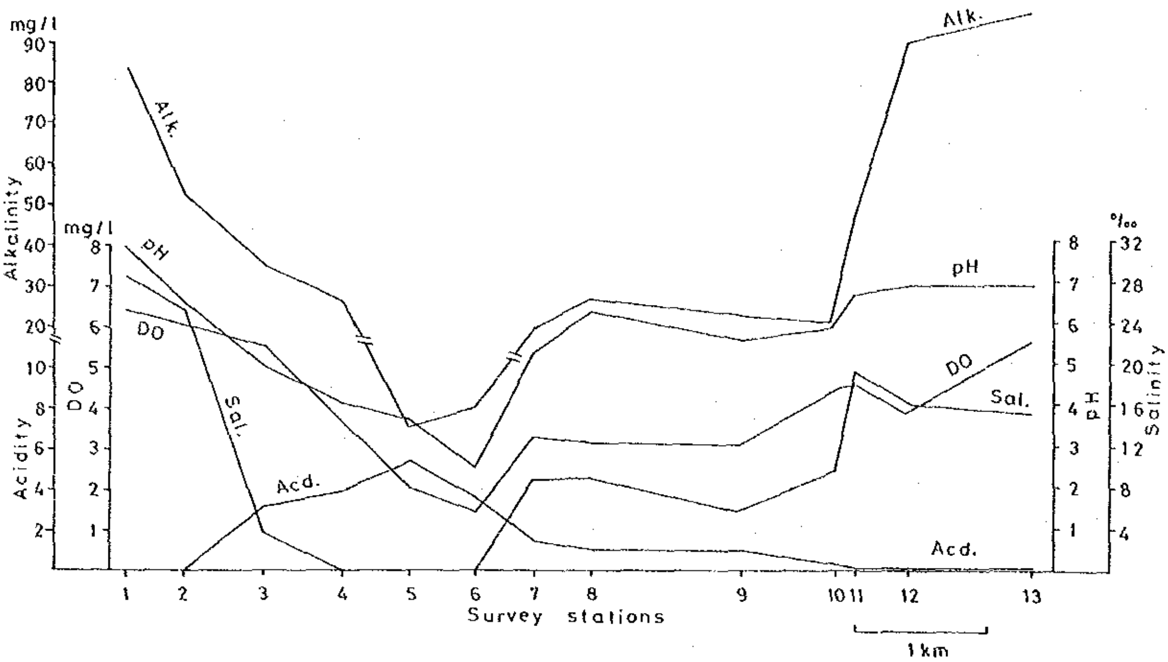

Fig. 2. Water properties along the length of Bang Nara River.

Table 1-a. Water properties in Bang Nara River from 13 survey stations in August and September, 1984.

Station	Water Temp. °C	Depth m	Transparency m	Conduc. μohms/cm	Salinity ‰	Acidity mg/ℓ.$CaCO_3$	Alkalinity mg/ℓ,$CaCO_3$	pH	Hardness mg/ℓ,$CaCO_3$
1	29.3 (29.0–30.0)	1.19 (0.82–1.56)	1.56	495x100	29.0 (26.0–32.0)	0.10	84.00	7.9 (7.8–8.0)	n.a.
2	29.8 (29.0–30.5)	2.55 (0.74–4.37)	2.50	167x100	26.0 (17.0–32.0)	0.10	52.00	6.7 (5.9–7.4)	n.a.
3	29.0 (28.5–30.0)	3.39 (2.11–4.68)	2.59 (2.05–3.85)	426.2x10	3.9 (2.1–5.6)	3.20 (2.6–3.8)	35.75 (13.0–50.0)	5.0 (3.9–6.5)	n.a.
4	28.7 (27.5–30.0)	2.55 (2.26–2.84)	> depth	327.5	0	3.95 (3.7–4.2)	26.10 (12.1–36.8)	4.1 (3.4–4.4)	84.0 (80.0–88.0)
5	27.7 (27.0–29.0)	3.24 (2.74–3.74)	1.53 (1.12–1.94)	305.0	0	5.35 (5.2–5.5)	7.0	3.7 (3.3–4.1)	78.0 (76.0–80.0)
6	27.7 (26.0–31.0)	3.55 (2.0–5.1)	0.67 (0.55–0.79)	128.7	0	3.6	8.0	2.5 (1.2–3.4)	76.0
7	29.4 (28.5–31.8)	4.44 (3.56–5.32)	1.09 (0.76–1.42)	128.4x100	9.0 (0–12.0)	1.5	18.25 (9.0–25.0)	5.3 (3.5–7.2)	n.a.
8	29.1 (28.0–31.0)	3.59 (1.76–5.42)	1.39 (1.0–1.78)	161x100	9.2 (0–18.0)	1.0 (0.8–1.2)	26.0 (25.0–27.0)	6.3 (3.2–8.3)	n.a.
9	28.8 (28.0–30.0)	5.33 (4.07–6.6)	1.5 (1.0–2.0)	113.9x100	6.2 (0–16.0)	1.0 (0.5–1.6)	22.0	5.6 (3.5–8.2)	n.a.
10	28.7 (27.0–30.0)	4.1 (3.66–4.54)	1.34 (1.27–1.42)	194.2x100	10.8 (5.5–20.0)	0.35 (0.3–0.5)	20.0	6.9 (5.8–8.7)	n.a.
11	30.4 (30.0–30.9)	4.32	2.50	291.6x100	16.3 (14.5–19.5)	0.2	45.0	6.7 (6.7–6.8)	n.a.
12	29.5	14.20	1.71	290x100	16.3 (12.5–23.5)	0.25 (0.2–0.3)	88.0	6.9 (6.6–7.2)	n.a.
13	28.8	3.62	2.14	266.6x100	15.3 (8.0–29.5)	0.20	95.0	6.9 (6.5–7.4)	n.a.

Table 1 -b.

Station	Orthophosphate mg P/ℓ	Silicate mg Si/ℓ	Nitrate-Nitrogen mg N/ℓ	Nitrite-Nitrogen mg N/ℓ	D.O. mg/ℓ
1	0.003 (0–0.006)	0.705 (0.69–0.73)	0.001	0.0065 (0–0.013)	6.4
2	0.002 (0–0.005)	0.565 (0.25–0.72)	0.078 (0.012–0.041)	0.005	6.0
3	0.001 (0–0.002)	1.258 (0.43–1.63)	0.019 (0.008–0.035)	0.005 (0–0.008)	5.5 (5.4–5.7)
4	0.001 (0–0.0015)	1.32 (0.83–1.72)	0.006 (0.003–0.008)	0.006 (0.005–0.008)	3.6
5	0.006 (0–0.012)	1.08 (0.69–1.52)	0.004 (0.001–0.007)	0.011 (0.007–0.015)	2.02 (2.0–2.05)
6	0.006 (0.002–0.01)	1.19 (0.8–1.4)	0.0025 (0–0.005)	0.015 (0.006–0.015)	1.4
7	0.003	0.91 (0.8–1.23)	0.005 (0–0.017)	0.0035 (0–0.004)	3.25 (3.2–3.3)
8	0.002 (0–0.004)	0.72 (0.5–1.03)	0.0175 (0.017–0.018)	0.005 (0.001–0.01)	3.1 (1.0–4.3)
9	0.007 (0.003–0.011)	1.48 (0.9–2.24)	0.016 (0.015–0.016)	0	3.0 (1.4–4.8)
10	0.006 (0.003–0.009)	1.26 (0.6–2.46)	0.009 (0.003–0.021)	0.001 (0–0.005)	4.35 (3.0–5.6)
11	0.006	0.4 ((0.2–0.6)	0.009 (0.004–0.014)	0	4.5 (4.4–4.6)
12	0	0.46 (0.2–0.72)	0.0075 (0.007–0.008)	0.0025 (0–0.005)	3.8 (3.6–4.0)
13	0.008	0.57 (0.21–0.93)	0.011 (0.001–0.021)	0.0025 (0–0.005)	5.5 (5.3–5.8)

Twenty-nine species of fish were recorded of which *Ambassis kopsii* was the dominant species. It amounted to 64.2% of the total, and was 6.94 cm in average length (Table 2). Seabass, *Lates calcarifer*, were the biggest fish collected and were found near the river mouth. The standing crop averaged about 53.0 g per 700 m^2, or 121 g per rai. Fish collected are classified into estuary and freshwater species, and in each group they are classified into carnivorous and herbivorous species according to their food habits in Table 3. No special tendency was observed in these classifications by the survey stations.

Table 2. Scpcies number and average length of fish in Bang Nara River.

No.	Species	Number (% to the total)	Average length (cm)
1.	*Siganus javus*	3.72	6.03
2.	*Leioganathus brevirostis*	7.22	6.47
3.	*L. equulus*	7.11	7.59
4.	*Lethrinus haematopterus*	1.20	9.75
5.	*Glossogobius giuris*	1.85	13.10
6.	*Amabassis kopsii*	64.21	6.94
7.	*Lates calcarifer*	0.10	19.80
8.	*Lutjanus argentimaculatus*	0.21	22.55
9.	*Siganus guttatus*	0.32	17.96
10.	*Lutjanus russelli*	2.07	10.39
11.	*Sillago sihama*	0.43	15.15
12.	*Hemiramphus* sp.	0.21	16.20
13.	*Sphyraena jello*	0.21	19.25
14.	*Liza longimanus*	0.43	15.10
15.	*Terapon puta*	0.32	6.26
16.	*Butis butis*	0.76	2.42
17.	*Pomadasys hasta*	0.43	9.10
18.	*Gerres abbreviatus*	0.54	7.30
19.	*Stolephorus tri*	0.32	5.00
20.	*Caranx sexfasciatus*	0.21	15.00
21.	*Monacanthus chinensis*	0.10	5.90
22.	*Scatophagus argus*	0.32	7.13
23.	*Rasbora* sp.	0.43	3.16
24.	*Trichogaster trichopterus*	0.21	7.75
25.	*Puntius fasciatas*	5.68	8.65
26.	*Pristolephis fasciatus*	0.10	7.15
27.	*Channa striatas*	0.10	21.20
28.	*Trichopsis vittatus*	0.65	4.16
29.	*Tetraodon fluviatilis*	0.54	3.72

Table 3. Fish standing crops in Bang Nara River at 10 survey stations (% by number of species).

Station	Standing crop g/700 m²	Estuary species		Freshwater species	
		carnivorous %	herbivorous %	carnivorous %	herbivorous %
1	240.0	84.37	15.63	–	–
2	100.0	28.24	71.76	–	–
3	30.0	–	–	–	100
4	40.0	–	–	–	100
5	n.a.	–	–	–	–
6	20.0	–	–	66.67	33.33
10	30.0	37.94	62.06	–	–
11	30.0	85.71	14.29	–	–
12	30.0	–	–	87.67	12.33
13	10.0	–	–	74.28	25.72
Average	53.00	–	–	–	–

DISCUSSION AND CONCLUSION

The water conditions, especially pH and DO are very poor in the middle part of the river. This is due to the acid sulfate swamp run-off which usually drains out into that part of the river. These poor water conditions improve slightly near the river mouths. A previous survey, by the Land Development Department in 1977–1978, showed the poor conditions of water pH in July through January, which is a period of heavy rainfall.

The fish population and standing crop are considered very low fish productivity, especially when compared to other parts of the country. Chukachorn et al. (1984) reported that the standing crop and fish species in the Tapi River, Surathani Province (upper south of Thailand), were 12.57 kg/rai and 48 species, respectively. Furthermore, a review of the literatures reveals that the fish productivity in rivers in other parts of the country were also above the productivity recorded in this study. Therefore, it can be stated that the Bang Nara River is very low in fish productivity compared to other parts of the country.

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Effects of nitrite-nitrogen and ammonia-nitrogen on the fry of tiger shrimp, *Penaeus monodon* and seabass, *Lates calcarifer*

Siri Tookwinas

INTRODUCTION

Armstrong et al. (1976) mentioned that coastal fry rearing would involve the decomposition of waste material, both in continuous flow systems and static systems. Ammonia-nitrogen formation will result from the decomposition process. Then, ammonia will be oxidized to nitrite and nitrate by bacteria in the nitrification process (Wetzel, 1975). Ammonia and nitrite can be toxic to aquatic organism; therefore, a knowledge of the toxic levels of both nitrogen compounds would be very useful in fry rearing and coastal aquaculture as well.

The purpose of this study is to conduct static bioassay tests for ammonia and nitrite in the fry of marine shrimp. *Penaeus monodon*, and seabass, *Lates calcarifer*. The results can then be applied to efforts for the prevention of the toxic effects of these compounds on aquatic organisms.

MATERIALS AND METHODS

The 24 hours static bioassays were set up using the standard method of APHA (1975). The sizes of fry were as follows:

	Shrimp	Seabass
Average length (cm)	1.36±0.15	$7.39 \times 10^{-1} \pm 6.5 \times 10^{-2}$
Average weight (g)	$9.96 \times 10^{-3} \pm 5.75 \times 10^{-3}$	$5.38 \times 10^{-3} \pm 1.79 \times 10^{-3}$
Age	P_{10}	18 days

The fry were contained in tanks at a density of 10 pieces per tank filled with one litre of diluted sea water.

Sodium nitrite ($NaNO_2$, A.R. grade) was diluted at concentrations of 312.03, 419.76, 543.79, 718.08 and 956.53 mg NO_2-N/ℓ in each tank for marine shrimp tests, and concentrations of 709.00, 971.98, 1,320.20, 1,751.63 and 2,348.00 mg NO_2-N/ℓ in each tank for seabass tests. Ammonium chloride (NH_4Cl, A.R. grade) was diluted at concentrations of 23.24, 31.38, 40.88, 53.77 and 95.26 mg NH_4/ℓ for marine shrimp tests.

Each concentration was tested in three replications. The mortality of fry was checked and dead fry were removed after 0.5, 1.0, 2.0, 4.0, 8.0, 16.0 and 24.0 hours. Then, the median tolerance limit (TLm) was calculated using the probit method of Finney (1972). The water quality was analyzed using the method of APHA (1975). The tests were conducted at room temperature.

Table 1. 24hr TLm of fry of marine shrimp and seabass to nitrite- and ammonia-nitrogen.

	NO_2-N mg NO_2-N/ℓ	TA-N mg NH_3-N/ℓ	UIA-N mg NH_3-N/ℓ
1. Marine shrimp fry			
TLm	618.49	57.05	3.99
95% confidence interval	494.05-775.76	53.22-61.67	3.71-4.29
Probit	y=-13.71+6.71x	y=-3.12+4.62x	y=-2.22+4.62x
2. Seabass fry			
TLm	933.50		
95% confidence interval	842.29-1,034.59		
Probit	y=-22.81+9.36x		

Notes: TA-N; Total ammonia (NH_3 or NH_4OH and NH_4^+).
UIA-N; Unionized ammonia (NH_3 and NH_4OH).

Table 2. Toxicity of nitrite and ammonia to various aquatic organisms.

Toxicant	TLm (LC 50) (mg/ℓ) 24 hr.	48 hr.	96 hr.	Species	Bioassay	References
Nitrite-N	130	–	8.6	*Macrobrachium* sp. (10–14 days)	Renewal (every 24 hr.)	2)
	–	–	0.27	Rainbow trout	–	13)
	–	–	1.5	*Ganbusia* sp.	–	2)
	–	–	330	*Mercenia mercenaria*	–	5)
	–	–	736	Oyster	–	5)
	–	35–60	–	Catfish (7–9cm)	Flowthrough	16)
	–	–	154 (27°C)	*Dicentrarchus labrax*	Static	14)
	–	–	812 (S=30‰)	*Anguilla anguilla*	Static	14)
	618.49	–	–	Marine shrimp	Static	This report
	933.5	–	–	Seabass (18 days)	Static	This report
Ammonia-N (TA-N)	–	15.78	–	Catfish (4.5–6.5cm)	Flowthrough	16)
	–	–	37.5ppm (7 days)	*Ictalurus punctatus* (4-6 inch)	Flowthrough	9)
	57.05	–	–	Marine shrimp	Static	This report
Ammonia-N (UIA-N)	–	0.41	–	Rainbow trout	–	16)
	0.45 (14 hr.)	–	0.45	Coho salmon	–	3)
	3.99	–	–	Marine shrimp	Static	This report

RESULTS

The 24 hr TLm of marine shrimp fry to nitrite was 618.49 mg NO_2-N/ℓ with a 95% confidence interval of 494.05–775.76 (Table 1). The highest concentration of nitrite which did not produce mortality in 24 hours was 312.0 mg NO_2-N/ℓ. The lowest concentration which killed all the fry in 24 hours was 956.53 mg NO_2-N/ℓ.

The 24 hr TLm of seabass fry to nitrite was 933.50 mg NO_2-N/ℓ with a 95% confidence interval of 842.29–1,034.59 (Table 1). The lowest concentration of nitrite which killed all fry in 24 hours was 2,348.5 mg NO_2-N/ℓ.

The 24 hr TLm of marine shrimp fry to ammonia was 57.05 mg NH_3-N/ℓ with a 95% confidence intervals of 53.22–61.67 (Table 1). However, ammonia-nitrogen can be ionized in solution as follows:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^- \quad \text{or}$$
$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$

unionized (undissociated) — ionized (dissociated)

The degree of ionization of these compounds in the dilution water would depend on water pH and temperature (Hrudey, 1979). The toxic form of the ammonium compound is unionized, and the ionized form does not have any toxic effect on aquatic organisms. Therefore, the unionized ammonia (UIA-N) was calculated at a water pH of 8.18. The percentage of UIA-N was 7.0%. The 24 hrs TLm of marine shrimp fry to UIA-N was 3.99 mg NH_3-N/ℓ with a 95% confidence interval of 3.71–4.29 (Table 1).

DISCUSSION AND CONCLUSION

When the fish came into contact with high concentrations of ammonia and nitrite, they could not control themselves, exhibiting behavior such as swimming very rapidly with loss of direction.

Douderoff et al. (1966) and Armstrong et al. (1976) mentioned that the toxic form of nitrite is unionized and non-polar nitrite (HNO_2). The ionization is very high in low pH water. The toxic form becomes attached to skin and gills, destructing the function of the gills. The haemoglobin is oxidized to methemoglobin (M-Hb) which cannot accept and transfer oxygen to other cells of the body. Armstrong et al. (1976) also indicated that the toxic effects of nitrite on shrimp would be less than those on fish. However, the results of these tests indicate the opposite; that is, seabass are more tolerate, possibly because they are able to go up to take dissolved oxygen from the water surface very well. On the other hand, Perrone and Meade (1977) also mentioned that the same kinds of aquatic animal might show different levels of tolerance to toxic substances. This is due to the differences in physiological function and behavior adaption to environment of each aquatic animal.

Brockway (1950) showed that ammonia has an effect on the oxygen acceptance of haemoglobin. The function of oxygen carrying becomes obstructed and the skin of the fish becomes pale. The toxicity of ammonia decreases very rapidly after the first period of test (Ball, 1967, quoted by Sripumum et al. 1983). The fish survived the toxicity tests resumed normal behavior very rapidly.

From the literatures reviewed, it can be concluded that the results of these tests do not differ from the norm (Table 2). Therefore the 96 hr LC50 can be extrapolated. The safe concentration levels for aquatic life can be calculated along the lines of the discussion by Spraque (1971). The safe concentration levels are as follows; nitrite-nitrogen, 0.4095 and 0.6182 mg NO_2-N/ℓ for marine shrimp and seabass, respectively, and unionized ammonia, 0.039 mg NH_3-N/ℓ for marine shrimp.

This calculated safe concentration level is in agreement with the standard line of the U.S. Environmental Protection Agency (1973).

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Experiment on artificial fishshelter at National Institute of Coastal Aquaculture, Songkhla, in 1984 and 1985.

Poonsin Parnichsuke, Yongyut Predalumpaburt,
Dusit Tunvilai and Putth Songsangjinda

INTRODUCTION

The use of artificial fishshelters to raise fish productivity in certain areas is not a new idea. In Japan, the history of fish shelters can be traced back 200 years. Scarrat (1968) reported that the Canadian government was successful in building a fishshelter for lobster, *Homarus americanus*. Chang (1984) also reported Taiwan's fishshelter project and proposed 4 criteria for site selection; 1) a site should not be closer than half a mile from nearest natural reefs, 2) have a depth of 20–30 m, 3) have a wide, flat substratum, and 4) avoid polluted or turbid water as well as current greater than 1.5 knots.

In Thailand, a project of fishshelter was started at Rayong in 1978. It was reported that some lower organisms especially bryozoa, coral and sea urchin, first came to live and grow up in the fishshelter area, and later fish came to live there for feeding and protection for themselves from predators (Boonkert 1979). The second fishshelter project was carried out in 1983 at Phangnga Bay (Lohakarn 1984). The results showed that perch, grouper etc. came to live in the shelter.

In the present study, fishshelters were installed on the sandy sea bed in front of NICA to determine the efficiency of artificial fishshelters as a mean to increase the fish production of the area.

MATERIALS AND METHODS

Fishshelters were set in front of NICA, about 400 m from the shore, at latitude 7° 10′ 46″ N and longitude 100° 38′ 2″ E. The depth of the location was 5.5–6 m. 900, pyramid shaped, concrete fishshelters and 200, cubic, concrete fishshelters were used (Fig. 1). The size of fishshelter is 80x80x80 cm for the former type and 80x80x80x80 cm for the later type. These fishshelters were arranged on the sea bed to form a fishshelter area of about 2,500 m^2 (Fig. 2).

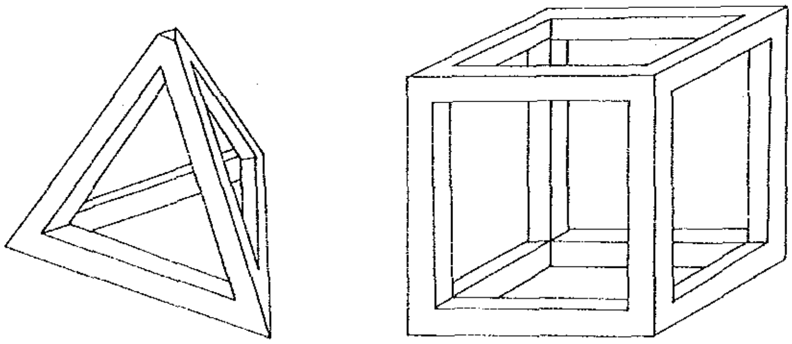

Fig. 1. Two types of fish shelter, pyramid shaped and cubic.

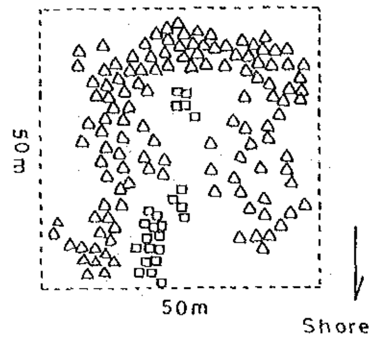

Fig. 2. Schematic diagram of arrangement of fishshelters in fishshelter area.

Observation of the conditions of the fishshelter area was done from time to time by diving. Fish were collected by fish trap of 1.2x1.2 m in size (Fig. 3), during two periods, from August to November, 1984 and from March to June 1985. During the northeast monsoon season between the two periods, we could not collect fish due to very rough sea conditions. For the fish trap operation, about 10 fish traps were set about 5–8 days before lifting them. After taking fish out of the trap, they were sunk again for the next operation.

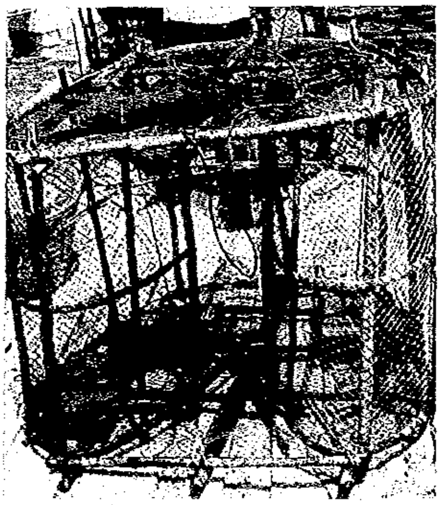

Fig. 3. Fish trap used in the study.

RESULTS AND CONCLUSION

1. Diving observation

From diving observations of the substratum under the fishshelters, we found that there were two types of sea bed; sand and muddy sand. In the muddy sand area, a muddy layer 10 cm deep covered a firm layer of fine sand, so that the fishshelters sank down about 10 cm. In the sand area, the fishshelters also sank down about 10 cm. The reason for this was thought to be the sand sedimentation around the fish shelters caused by blockage of tidal current which carries a large amount of sand. This sand sedimentation around the fish shelters was observed 9 months after their installation.

A survey was made of the bottom configuration around the shelters with an echo sounder, after the northeast monsoon season. It was found that the center of the fishshelter area was about 0.5 m deeper than the edge of the area.

We observed many organisms attached to the surface of the fishshelters. Coral spats and barnacles were most abundant in quantity. However, some coral spats were dying due to the high turbidity of the sea water which obstructs the penetration of sunlight to the surface of the fish shelters.

The fishshelters attracted many species of fish. *Ambassis* sp. and *Caranx sexfasciatus* were most frequently observed. *Lutjanus johnii, Siganus* spp., *Epinephelus* spp. and *Plotosus canius* were also observed often. *Rachycentron canadus* of 7–10 kg in body weight, searching for prey, were sometimes encountered.

2. Fish catch by trap

The species and quantity of fish caught by fish trap set in the fishshelter area are shown in Tables 1 and 2 for the periods of August–November, 1984 and March–June, 1985, respectively. 32 species were collected in the first period at a total weight of 307.4 kg. In the second period, 27 species were collected. 19 of these species were also collected in the first period, while 8 species were not. Total fish weight was 141 kg. The species and quantity of fish collected by the traps set

Table 1. Fish caught at fishshelter area in August – November 1984.

Species	Individual / weight (Kg)				Total
	August	September	October	November	
Caranx sexfasciatus		10/ 0.96	6/ 0.23	13/ 0.71	29/ 1.89
Carangoides praeustus		3/ 0.28			3/ 0.29
Caranx spp.		1/ 0.05			1/ 0.05
Cephalopolis pachycentront			4/ 0.01		4/ 0.01
Casio erythrogaster				1/ 0.13	1/ 0.13
Dicotylichthys punctulatus		3/ 0.29			3/ 0.29
Diodon liturosus			4/ 0.56	1/ 0.13	5/ 0.68
Epinephelus bleekeri	1/ 0.10	3/ 0.17	2/ 0.00	5/ 0.20	11/ 0.48
Epinephelus tauvina	2/ 0.40	3/ 0.00	4/ 0.54	2/ 0.19	11/ 1.13
Epinephelus spp.		3/ 0.00			3/ 0.00
Epinephelus malabaricus		1/ 0.12			1/ 0.12
Gerres macrosoma			1/ 0.03		1/ 0.03
Lutjanus johnii	20/ 12.69	16/ 10.00	23/ 9.75	26/ 10.46	85/ 42.89
Lutjanus russelli	20/ 1.23	100/ 5.36	76/ 4.31	10/ 0.61	206/ 11.51
Lutjanus malabaricus		3/ 0.15	1/ 0.08	2/ 0.16	6/ 0.39
Lutjanus vitta		102/ 0.09			102/ 0.09
Leiognathus equulus		2/ 0.14	7/ 0.53	49/ 3.51	58/ 4.18
Lethrinus haematopterus			11/ 0.57	4/ 0.19	15/ 0.76
Lethrinus nebulosus			1/ 0.04		1/ 0.04
Lutjanus fulvifamma			1/ 0.05		1/ 0.05
Monodactylus argenteus		2/ 0.09	3/ 0.11	3/ 0.13	8/ 0.32
Monacanthus spp.		1/ 0.00			1/ 0.00
Nibea solado			3/ 0.65	1/ 0.14	4/ 0.79
Plectorhynchus pictus		1/ 0.05	1/ 0.08	1/ 0.21	3/ 0.33
Plotosus canius		1/ 0.13	3/ 0.40		4/ 0.53
Plectorhynchus nigus			1/ 0.09		1/ 0.09
Siganus oramin	6/ 0.34	324/ 8.68	262/ 6.40	39/ 0.75	631/ 16.18
Siganus javus		1663/ 85.48	2359/113.50	442/ 17.14	4464/216.12
Scatophagus argus		35/ 1.95	57/ 4.35	6/ 0.37	98/ 6.67
Tetraodon stellatus			2/ 1.19		2/ 1.19
Therapon jabau			1/ 0.00		1/ 0.00
Upeneus tragura			2/ 0.16		2/ 0.16
TOTAL	49/ 14.76	2277/113.98	2835/143.62	605/ 35.02	5766/307.37

Table 2. Fish caught at fishshelter area in March – June 1985.

Species	Individual / Weight (Kg)				Total
	March	April	May	June	
Apogon auritus	1/ 0.02				1/ 0.02
Carangoides practus	4/ 0.16			4/ 0.31	8/ 0.47
Caranx sexfasciatus		14/ 0.57	409/ 17.27	63/ 2.51	486/ 20.35
Caranx macrurus		2/ 0.14			2/ 0.14
Caranx pratusus			18/ 0.96		18/ 0.96
Chiloscyllium puntatum			1/ 0.25		1/ 0.25
Dicotylicthys punctulatus		1/ 0.22		1/ 0.32	2/ 0.54
Epinephelus tauvina		17/ 6.06	10/ 0.92	7/ 1.16	34/ 8.15
Epinephelus bleekeri		9/ 2.89	6/ 0.62	6/ 0.70	21/ 3.40
Gerres sp.			1/ 0.03	2/ 0.07	3/ 0.10
Heniochus acuminatus				1/ 0.03	1/ 0.03
Lutjanus johnii	22/ 8.79	39/ 14.31	9/ 1.33	28/ 3.55	98/ 27.98
Lutjanus russelli		9/ 0.65	65/ 3.16	152/ 6.67	226/ 10.47
Lutjanus vitta		1/ 0.01	4/ 0.09	9/ 0.20	14/ 0.30
Lethrinus haematopterus			5/ 0.17	1/ 0.03	6/ 0.19
Megalapis cordyla	3/ 0.37				3/ 0.37
Monodactylus argenteus			35/ 0.92		35/ 0.92
Monacanthus sp.				1/ 0.01	1/ 0.01
Nebea solado	1/ 0.14	3/ 0.38	19/ 2.73	2/ 0.39	25/ 3.64
Plotosus canius	2/ 0.71	1/ 0.23		3/ 0.58	6/ 1.52
Platax teira	2/ 0.30				2/ 0.30
Plectorhynchus nigus			1/ 0.36		1/ 0.36
Rachycentron canadus				1/ 7.10	1/ 7.10
Siganus javus	4/ 0.25	315/ 17.96	203/ 8.74	659/ 14.21	1181/ 41.15
Scatophagus argus	9/ 0.51	92/ 5.31	30/ 2.17	57/ 3.13	188/ 11.12
Siganus oramin			4/ 0.10	15/ 0.27	19/ 0.37
Tetraodon stellatus			1/ 0.24		1/ 0.24
TOTAL	48/ 11.26	583/ 47.91	832/ 40.63	1012/ 41.21	2395/141.00

Table 3. Fish caught at surrounding area of fishshelter in March – June 1985.

Species	Individual / Weight (Kg)				Total
	March	April	May	June	
Apogon auritus	3/ 0.05				3/ 0.05
Apogon sp.	6/ 0.06		15/ 0.10	2/ 0.01	23/ 0.18
Apogon guadrifasciatus				5/ 0.03	5/ 0.03
Caranx pratusus			18/ 0.90	3/ 0.23	21/ 1.13
Caranx sexfasciatus			63/ 3.12	3/ 0.16	66/ 3.28
Chiloscyllium punctatum			1/ 0.56		1/ 0.56
Epinephelus bleekeri			2/ 0.26		2/ 0.26
Epinephelus tauvina				1/ 0.08	1/ 0.08
Gerres sp.	1/ 0.04		1/ 0.02		2/ 0.06
Lutjanus russelli	2/ 0.10		7/ 0.34	10/ 0.43	19/ 0.87
Lutjanus vitta			6/ 0.12	20/ 0.42	26/ 0.55
Lethrinus haematopterus				2/ 0.05	2/ 0.05
Monodactylus argenteus			2/ 0.08		2/ 0.08
Nebea solado	5/ 0.55				5/ 0.55
Plotosus lineatus			1/ 0.27		1/ 0.27
Scatophagus argus	11/ 0.53		32/ 1.29	29/ 1.11	72/ 2.93
Siganus javus	6/ 0.23		59/ 2.78	284/ 4.26	349/ 7.19
Siganus oramin			5/ 0.05	8/ 0.07	13/ 0.12
TOTAL	34/ 1.54		212/ 9.82	367/ 6.86	613/ 18.22

outside of the fishshelter area during a period from March to June 1985 are shown in Table 3. Only 18 species of fish, 18.2 kg in total weight, were collected in the area surrounding the fishshelters.

Number of species and catch per trap for each month from March to June, 1985 are compared between inside and outside of the fishshelter area in Table 4. A statistical test showed that figures for inside of the fishshelter area were significantly higher than for outside, both in number of fish species and weight of catch.

Six fish species were dominant among the catch from the fishshelter area in the first and second periods. They were *Caranx sexfasciatus, Lutjanus johnii, L. russelli, Siganus oramin, S. javus,* and *Scatophagus argus.* The first four species were caught in larger quantities in the first period than in the second period, while the other two species were caught in larger quantity in the second period (Table 5). These fluctuations in quantity of fish by month may be due to a migratory behavior of fish in and out of the fishshelter area.

Table 4. Comparison of fish catch between inside and outside of the fishshelter area in March – June 1985.

Item	March		April		May		June		Total	
	Inside	Outside	In	Out	In	Out	In	Out	In	Out
Number of species	9	7	12	7.7*	17	13	18	11	27	18
Number of fish trap used	9	9	19	--	44	21	54	25	126	55
Catch (kg)	11.26	1.54	47.91	--	40.63	9.82	41.21	6.86	141.0	18.2
Catch/trap (kg)	1.25	0.17	2.52	1.84*	0.92	0.47	0.76	0.27	1.12	0.33

Note: *; Value estimated by Yate method.

Table 5. Dominant fish species caught in the first period (Aug. – Nov., 1984) and the second period (Mar. – Jun., 1985).

Species	First period		Second period		Increase (%)
	Weight (kg)	% to total catch	Weight (kg)	% to total catch	
Siganus javus	216.12	71.4	41.15	29.2	-81.0
Lutjanus johnii	42.89	14.2	27.98	19.3	-34.8
Siganus oramin	16.18	5.4	0.37	0.3	-97.7
Lutjanus russelli	11.51	3.8	10.47	7.4	- 9.0
Scatophagus argus	6.67	2.2	11.12	7.9	66.62
Caranx sexfasciatus	1.89	0.6	20.35	14.4	977.6
Total	295.26	97.7	111.44	78.5	

In both periods, only a few, marketable size fish of economically important species were collected. This may be due to the shallow water of the location and the small size of the fishshelters.

The present study has proved that fishshelters have a significant ability to attract fish, even if the shelters are small in size and their setting location is shallow. Such small fishshelters offer young fish of commercially important species a safe shelter abundant with food, and thus help to conserve or even increase the fishing resources of a certain area.

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Preliminary study on socio-economics status and living conditions of the marine fishing households in Ban Boh It, Songkhla

Chulaporn Ratanachai, Suksom Wanicharoen and Arporn Meechookunt

INTRODUCTION

The Fisheries Department of Thailand plans to develop the fisheries industry in the rural areas of the country in accordance with the Fifth National Economic Development Plan. The present survey was made to collect fundamental information for the future development plan to upgrade the living conditions of the small fishing village.

Ban Boh It was selected as the study site. Ban Boh It is a fishing village located along the sea side of the lower Gulf of Thailand. It occupies an area of about 2,400 rai (384 ha) in Tambol Ko Taew of Songkhla Province, bounded to the north by Kao Roopchang, to the south by Tambol Tungwang, to the east by the western Gulf of Thailand, and to the west by Tambol Pawong (Fig. 1).

The present study especially aims:

1. To grasp the socio-economic conditions of the village.
2. To determine the status of fisheries industry of the village.
3. To point out problems requiring urgent solutions to improve the living conditions of the village.

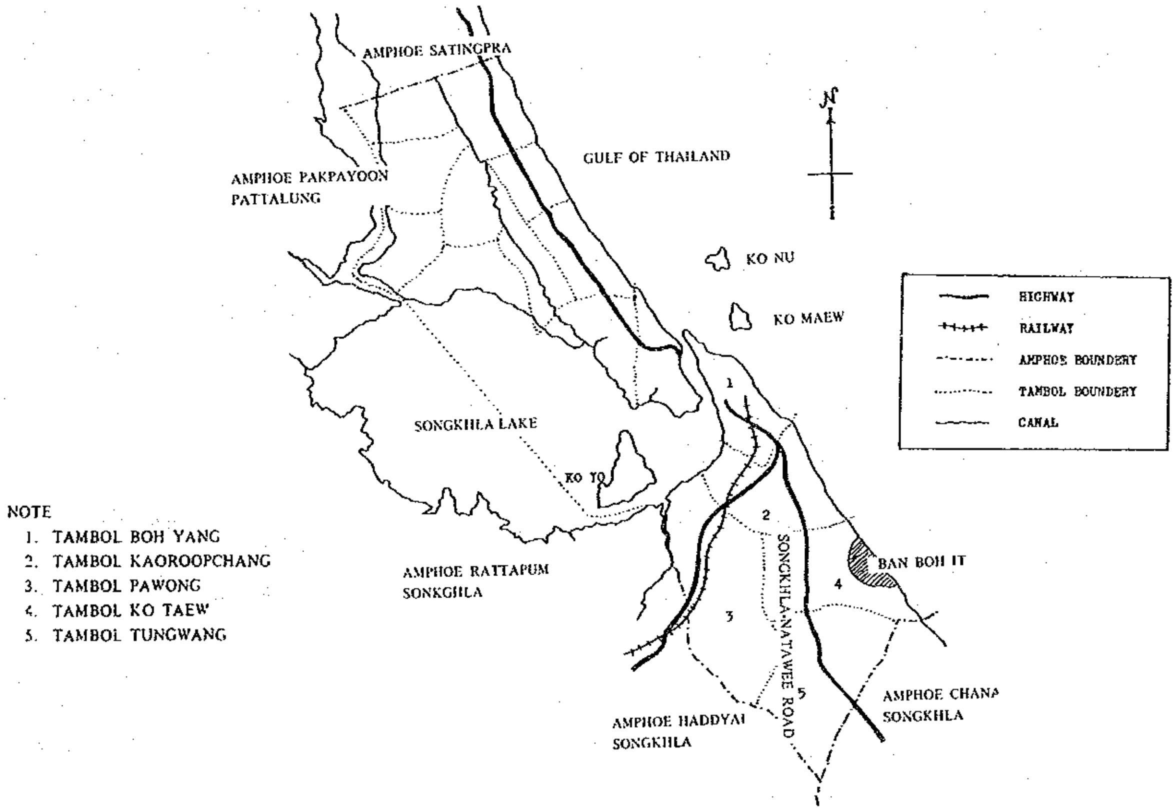

Fig. 1. Location of Ban Boh It.

METHODS OF THE SURVEY

120 households were sampled from 178 households of the village. The sampling ratio was 67.4%. Each sampled household was interviewed according to the questionnaire prepared by the present authors. The interviews were made during 1st–25th May, 1985. The catch data were collected monthly from September 1984 to August 1985.

RESULTS

I. Social conditions

1. Population

The village is comprised of 178 households having 424 (49.3%) men and 436 (50.7%) women. 95.8% of the heads of the households are men and only 4.2% of the heads are women (Table 1).

2. Religion

119 households (99.2%) adhere to the Muslim religion. Only one household (0.8%) is Buddhist, an immigrant family from another province (Table 1). There is only one Mosque for religious ceremonies (Fig. 2). The Mosque has been used also as a center of various activities as well as a convention hall for the villagers.

3. Education

One primary school and one secondary school are located west of the village (Fig. 2). Most children study in these schools except some children who are sent to the exclusive school for Muslim called Pono in Pattani Province. Most of the household heads have received education up to grade 4 (Table 1). The village also has a public information center, near the Mosque managed by the Informal Education Department of the Ministry of Education.

4. Public utilities

The village is connected to the Songkhla-Natawee principle highway at Ban Dan by a soil aggregate road. The distance from the village to Songkhla City is 16km. Besides, there is another road through the village reaching to Tambol Natap. The road will be asphalted in the near future.

There are three public water wells for human comsumption. Rain water is also used widely for human consumption. City water supply is not available in the village.

There is no electricity supply. Villagers use kerosene lamps or battery operated lamps as a source of light. However, the situation will be much improved in the near future, because construction of a power supply system to the village was under way at the time.

The village has no facility for medical service. Villagers have to go to nearby Tambol or Songkhla city for medical treatment. 32 households have Welfare for Low-income Cards which have been issued to low income people (less than ฿1,500/month for single and ฿2,000/month for married) by a joint project of the Ministry of Health and the Ministry of Interior, promoted by the Office of Prime Minister. Holders of this card can get free medical service 6 times in a year at the state hospital. Many villagers suffer from vesical calculi disease due to poor quality of drinking water.

5. Occupation

Villagers mainly engage in small scale fisheries. 90.6% are fisheries operating households and 9.4% are fisheries labourer households. In a fisheries related occupation, some households engage in fish drying. There are six fish dealers who offer loans to fishermen and buy whole catches from them. There are two grocery stores in the village. Car drivers are also found in the village.

Some fishermen cultivate rice for self consumption. Cultivation of coconuts and breeding of livestock are also done by some villagers on a small scale. Duck nursing is another side job for fishermen who utilize trash fish, a by-product of fishing, as duck food.

6. Housing and size of household

Houses are either in a clustered settlement or in a lined settlement. Most of them are built with wood and nipa which are not durable. A few houses are semi-concrete or concrete.

74.2% of the households are nucleus families, whereas only 25.8% are joint families. On average there are 5 family members per household, among them 1.3 persons are working member (Table 1). 99.2% of the households own their own house, while 0.8% rent (Table 2).

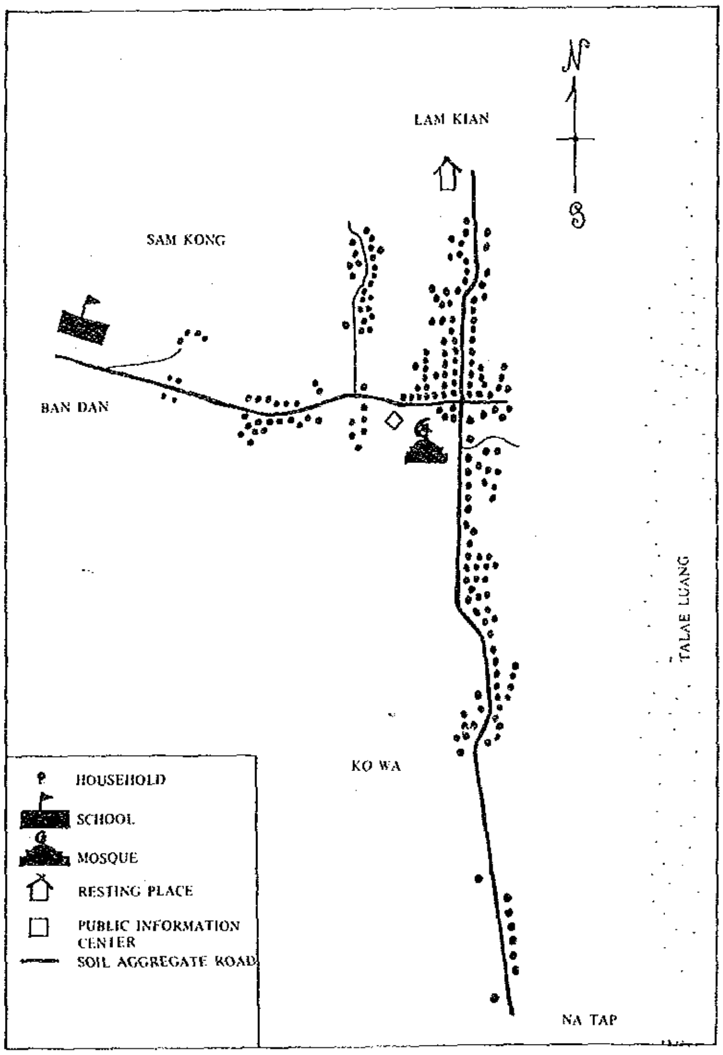

Fig. 2. Map of Ban Boh It.

Table 1. Selected social indicators.

Social indicators	
Sample size	120
Percent of community households engage in fishing	80
Head of household	
Sex (%)	
– Male	95.8
– Female	4.2
Age (%)	
– Less than 20 years	–
– 20–35 yrs	48.3
– 36–50 yrs	32.5
– Over 50 yrs	19.2
Marital status (%)	
– Single	–
– Married	93.3
– Widowed	6.7
Religion (%)	
– Buddhists	0.8
– Muslims	99.2
Formal Education (%)	
– None	34.2
– Grade 1–4	65
– Grade 5–7	0.8
– Beyond grade 7	–
Family size (%)	
– 1-2	6.7
– 3-5	55.8
– 6-8	30
– 9 and more	7.5
Average family size (persons)	5
Working members including household head (persons)	1.3

Table 2. Selected economic indicators.

Item	%
Sample size 120	100
1. Type of housing	
– Wooden and nipa	63.3
– Semi-concrete	19.2
– Concrete	17.5
2. Tenure of house	
– Owned	99.2
– Rented	0.8
3. Possession of durable consumer's goods	
– Sewing machine	5
– Radio	29.2
– T.V. (black and white)	15.8
– Motorcycle	14.2
– Bicycle	–

II. Fishing activities

1. Fishing gear

Mainly three kinds of fishing gear are presently used by the villagers; small trawling nets (18.3%), fish gill nets (19.2%), and shrimp gill nets (42.5%). There are also purse seine and cast nets, but only for minor use.

A trawl net is 20–30m in mouth opening and 50m long with 2.2–2.5cm mesh size. A fish gill net is 12m deep and 44m long with 4.5–5.5cm mesh size. Usually, about 25 nets are connected for a fishing operation. A shrimp gill net is a three layered net, 3m deep and 35–40m long, with 4.5–5.8cm as the mesh size of the middle layer net. About 25 nets are connected for a fishing operation.

These nets are operated by 2–3 persons, mostly family members. Fishing labourers are often employed in trawling.

With trawl net, velvet shrimp, *Metapenaeopsis* sp., is the most important species to catch, while bonito, *Euthynnus affinis*, and mackerel, *Rastrelliger brachysoma*, are most important with a fish gill net and banana prawn, *Penaeus merguiensis*, and mackerel are most important with a shrimp gill net.

2. Fishing boat

Size distribution of fishing boats being used in the village is shown in Table 3. Boats of less than 9.5m in length are most commonly used. A few boats larger than 17.5m are also used by some villagers not sampled in the study.

All fishing boats are motorized. Boats for gill netting are smaller, out-board engine boats. Boats with in-board engines are used for trawling.

Construction cost per boat ranges from Baht 22,000 to 45,000. Engines cost Baht 35,000–40,000 for trawling boats and Baht 11,800–31,000 for gill netting boats.

Table 3. Size distribution of fishing boat in Ban Boh It.

Size (m in length)	Number of boats	%
4–5.5	23	26.4
6–9.5	49	56.3
10–13.5	7	8.0
14–17.5	8	9.2
> 17.5	–	–

3. Fishing efforts

Trawl fishermen work 10–12 hours each fishing trip. Working hours per fishing trip for fish gill netting is 8–12 hours. Shrimp gill nets are operated 3–5 times a day, about 2 hours each time, totalling 8–10 hours work per day. Those fishing operations are mainly done at night, between 5 p.m. and 7 a.m.

Number of fishing days per year is 136.7 days for small trawling, 100.8 days for fish gill netting, and 154.3 days for shrimp gill netting. Fishing season is from April to October for trawling and fish gill netting. Shrimp gill netting is done almost throughout the year.

4. Fisheries production

The total annual production by the 120 sample households was 614.5 tons, or about 7 million Baht. Monthly catches by species are shown in Table 4. In quantity, velvet shrimp is the most important species for the village's fisheries, followed by mackerel.

Monthly catches by fishing gear are shown in Table 5. Small trawling caught the largest share (61.8%) of the total catch, followed by fish gill netting. In value, however, shrimp gill netting had the largest share (40.8%) of the total production. This is because shrimp gill netting catches large size shrimps which are traded at high price in the market.

Table 4. Monthly catch composition by species and quantity.

(Unit: tons)

	Sep 1984	Oct	Nov	Dec	Jan 1985	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
1. Banana prawn *Penaeus merguiensis*	–	–	3.3	1.59	3.9	2.2	0.06	0.01	0.32	–	–	0.02	11.7
2. Velvet shrimp *Metapenaeopsis* sp.	116.81	48.85	–	–	–	–	–	18.68	12.29	47.95	88.55	17.33	350.46
3. Greasyback shrimp *Metapenaeus monoceros*	0.83	–	–	–	0.8	0.86	1.15	0.52	–	–	–	–	4.16
4. Blue crab *Portunus pelagicus*	0.47	1.25	0.56	–	0.13	0.74	0.51	0.87	2.62	2.4	2.38	2.34	13.27
5. Kisslip cuttlefish *Sepia lycidas*	–	–	0.01	1.07	0.43	0.79	0.6	3.43	6.94	5.14	1.1	1.74	21.25
6. Spineless cuttlefish *Sepiella inermis*	–	–	0.56	–	0.42	0.88	–	–	–	–	–	–	1.86
7. Long barrel squid *Loligo singhalensis*	1.03	0.21	–	–	–	–	–	0.35	–	–	–	0.18	1.77
8. Mackerel *Rastrelliger brachysoma*	15.63	8.32	–	1.22	0.18	15.04	20.65	2.54	4.09	6.21	20.47	7.36	101.73
9. Wolf-herring *Chirocentrus dorab*	11.14	–	–	–	–	–	–	0.94	0.95	3.64	8.57	4.24	29.48
10. Bonito *Euthynnus affinis*	22.41	20.46	–	–	–	–	–	–	–	0.74	–	–	43.61
11. Spanish mackerel *Scomberomorus commerson*	2.11	–	–	–	–	–	–	0.86	0.46	0.29	0.58	0.76	5.06
12. Sand whiting *Sillago sihama*	–	–	–	–	–	0.16	0.04	0.45	0.32	0.16	0.15	0.21	1.49
13. Small crab	–	–	–	–	–	–	–	1.35	–	–	–	–	1.35
14. Trash fish	5.26	22.64	–	–	–	–	–		–	–	–	–	27.9
Total	175.69	101.73	4.43	3.68	5.86	20.67	23.01	30.00	27.99	66.53	121.8	33.18	614.57

Table 5. Monthly catch by gear.

(Quantity: Ton
Value : 1000 Baht)

Type of gear / Month	Shrimp gill net		Gill net		Small trawl		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Sep 1984	–	–	51.28	459.9	124.39	997.45	175.67	1457.35
Oct	–	–	28.78	227.41	72.94	526.48	101.72	753.89
Nov	4.43	508.2		–	–	–	4.43	508.2
Dec	3.68	243.91	–	–	–	–	3.68	243.91
Jan 1985	5.32	701.65		–	0.55	65.3	5.87	775.95
Feb	20.67	554.87		–		–	20.67	554.87
Mar	23.01	325.4		–		–	23.01	325.4
Apr	12.77	170.57	4.85	68.67	12.38	123.99	30	363.23
May	7.59	176.71	7.68	119.18	12.71	120.03	27.98	415.92
Jun	6.27	123.02	10.93	119.82	49.33	489.49	66.53	732.33
Jul	4.04	78.73	28.32	287.11	89.44	423.01	121.80	788.85
Aug	3.34	72.35	12	130.12	17.82	138.78	33.16	341.25
Total	91.12 (14.8)	2964.41 (40.8)	143.84 (23.4)	1412.21 (19.4)	379.56 (61.8)	2884.53 (39.7)	614.52	7261.15

5. Fish marketing

The catches are mostly sold to the regular dealers because of the debt obligation, or directly to the Songkhla market where they can receive higher prices than in the former case. In some seasons, fish traders from Pattani and Krabi come to the village to buy fish. The average prices for fish and shellfish are shown in Table 6.

Table 6. Production value by species.

Fish and shellfish	Quantity	Average Price/kg	Value
1 Banana prawn	11.2	162.50	1819.62
2 Velvet shrimp	350.47	8.83	3094.63
3 Greasyback shrimp	4.2	52.50	218.41
4 Blue crab	13.26	22.50	298.3
5 Kisslip cuttlefish	21.25	17.50	371.9
6 Japanese spineless cuttlefish	1.86	4	7.4
7 Long barrel squid	1.76	4	7.05
8 Mackerel	101.71	10	1017.13
9 Wolf-herring	29.48	8.50	250.55
10 Bonito	43.16	5.33	232.41
11 Spanish mackerel	5.06	22.67	114.62
12 Sand whiting	1.48	25	36.99
13 Small crab	1.35	5	6.76
14 Trash fish	27.9	0.50	13.95
Total	614.6		7489.72

6. Fisheries credit

Six fish dealers in the village control the price of the fish since they are also the source of loans to the fishermen. There is no interest change on the loans.

Agriculture Cooperatives is another source with provides financial assistance. Also, borrowing money from relatives is commonly practiced by the villagers.

III. Economic conditions

1. Income

Gross incomes by fishing and non-fishing activities are shown in Table 7 for each type of fishing gear. Gross fisheries income was highest for small trawling (Baht 131,114/year), and lowest for shrimp gill netting (Baht 58,125/year). From non-fishing activities, each household earned Baht 6357–9603/year. Thus, the total gross income per household was highest for trawling fisheries (Baht 140,350), and was almost the same for fish gill netting and shrimp gill netting (Baht 67,728–67,757).

Net income per household, however, could not be obtained in this survey, due to the lack of detailed information on operation expenditures for fishing and non-fishing activities.

Table 7. Annual household income by type of gear.

(Unit: Baht)

Type of gear	Fishing income		Non-fishing income		Total	
	Average	%	Average	%		%
Shrimp gill net	58125.6	85.8	9602.6	14.2	67728.2	100
Fish gill net	61400.4	90.6	6357.1	9.4	67757.5	100
Small trawl	131114.4	93.4	9237.5	6.6	140351.9	100

2. Expenditures

The average annual household expenditure was Baht 24,145 (Table 8). The expense per household divided in terms of food and non-food was 52.6% for food and 47.4% for non-food. Among non-food items, transportation was the largest item followed by utilities and medical care.

The utilities include charcoal, kerosene and other fuel for cooking and lighting. Villagers buy medicine from pharmacies by themselves for medical care, since there is no medical station in the village, which resluts in rather a high proportion for medical care in the annual expenditure. Religious donations are done 6 times a year and the total amount becomes as much as 10% of total annual expenditure.

Only 29.2% of households possessed a radio, while black and white TV is owned by even fewer households (15.8%) as shown in Table 2.

Table 8. Annual household expenditure.

(Unit: Baht)

Item	Average	%
Annual household expenditure	24145.14	100
– Food	12708.57	52.63
– Non-food	11436.57	47.37
– Clothing	907.41	7.9
– Transportation	2985.45	26.1
– Medical care	2146.67	18.8
– Utilities	2580	22.6
– Education	913.3	8
– House repairs	655	5.7
– Donation	1121.43	9.8
– Others	127.31	1.1

IV. Problems requiring urgent solution

There were two main problems raised by villagers.

Villagers felt difficulties in access to the governmental or semi-governmental loans with soft conditions. Some assistance should be extended to them to support their efforts to upgrade fishing activities on the financial side.

Another problem raised by villagers was the pair trawlers from nearby provinces which operated in the same fishing ground. They think that these pair trawlers are destroying fisheries resources in their traditional fishing ground. Some regulations or mediation between both parties should be arranged by the government authority.

Acknowledgement

We highly appreciate the advice of Mr. M. Masuo, JICA Team Leader, during the survey, and our thanks are also extended to the head of the village, who cooperated with us and gave us all the information we needed. Our sincere thanks are also due to Mr. Hiromu Ikenoue, a JICA Expert, who improved this report, and to many others who made this study complete.

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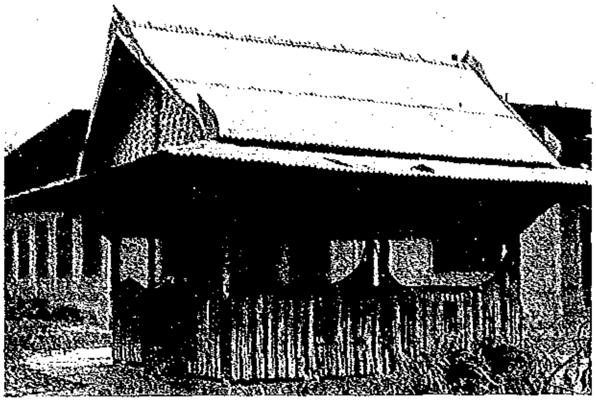

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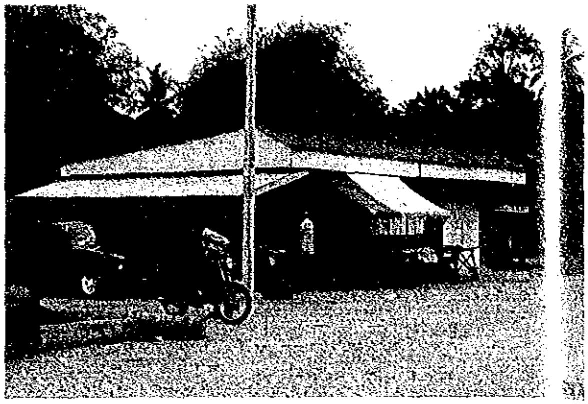

Grocery store

Typical fisherman's house

Shrimp gill net

Out-board engine fishing boats for gill netting.
Boats are called "KOLAE" in local term, and most of them are constructed in Pattani by Muslim boat builders.

Women is repairing shrimp gill net. She can earn ฿8-10 b by repairing one piece of gill net. Usually nets are repaired by fishermen themselves.

A preliminary study on microeconomics of seabass grow-out culture

Panit Sungkasem, Cherdsang Boontae and Hiromu Ikenoue

INTRODUCTION

The net cage culture of seabass, *Lates calcarifer*, has been practiced in southern Thailand for the last two decades. In the 1980's, both the number of fish farmers and the annual production of seabass culture have increased, due mainly to the success of artificial seed production at NICA in the late 1970's and the transfer of the technique to private and government hatcheries that followed.

The grow-out culture of seabass, however, are mainly operated as a side job of small scale fishermen and still has technical and economical constraints to be overcome for futher development. The present study is an attempt to point out some of the problems in seabass grow-out culture in southern Thailand through comparison with other types of coastal aquaculture which are operated as a full time job in the region.

SCALE OF CULTURE

1. Number of net cages and area used per farm

In Songkhla Province, 265 seabass farmers owned 688 net cages in total in 1984 (Sungkasem and Boontae, 1985). The average number of net cages per fish farm was only 2.6. In Pattalung Province, the culture scale was even smaller than this. There were 42 fish farmers possessing 70 net cages in total, only 1.7 net cage per farm in average.

The average water area occupied per fish farm is less than 100 m^2 in average, since farmers usually use net cage of 5 x 5x 2.5 m in dimension. When compared to areas occupied per farm engaging in other types of coastal aquaculture in southern Thailand, as shown below, the samllness of the seabass farm is very clear.

Cockle culture, Surat Thani Province	388 ha
Shrimp culture, Nakhorn Sri Thammarat Province	13–40 ha
Oyster culture, Surat-Thani Province	1.6 ha
Green mussel culture, Chumporn Province	5 ha

2. Initial investment

For a culture facility, seabass culture requires only net cages and wooden platforms beside the net cages for feeding and other work. As the east coast of southern Thailand, where fluctuation of sea level caused by tidal movement is small and calm water areas are shallow, net cages are fixed to wooden poles driven vertically into the sea bed. Whereas on the west coast, where tidal difference of sea level is large, and calm and deep water areas are available for seabass culture, net cages are hung from floating rafts.

Facilities and their costs required to operate an average size seabass culture farm with three grow-out net cages are as follows:

Item	Quality	Unit cost (Baht)	Cost (Baht)
Intermediate culture net case 1 x 2 x 0.8 m	10 pcs.	100	1,000
Intermediate culture net cage 2 x 3 x 1.5m	4 pcs.	600	2,400
Grow-out culture net case 5 x 5x 2.5m	4 pcs.	2,500	10,000
Wooden platform			6,000
Total			19,400

The initial investment, too, is very small compared to those for other types of aquaculture shown below:

Cockle culture	370,000 Baht
Shrimp culture	300,000–900,000 Baht (excluding land cost)
Oyster culture	40,000 Baht
Green mussel culture	33,000 Baht

3. Production

With three, grow-out net cages, 570–610 kg seabass grown to the marketable size are produced. Since ex-farm price of seabass is around Baht 70/kg, annual gross income for a farm of average size is Baht 33,000–36,000. Gross income per unit area is, therefore more than Baht 350/m^2.

Production and gross income per farm, and gross income per unit area for other types of aquaculture are as follows:

Type of aquaculture	Production (Qtty.)	Gross income (Value in Baht)	Gross income/m^2 (Baht)
Cockle culture	1,500 tons	9,000,000	2.3
Shrimp culture	4.5–14 tons	450,000–1,400,000	3.5
Oyster culture	100,000 pcs.	600,000	37.5
Green mussel culture	150 tons	450,000	9

Comparing seabass culture to other types of coastal aquaculture, it can be said that seabass culture is very small in gross income per farm, whereas it is very high in gross income per unit area.

COSTS FOR PRODUCTION

1. Cost for seed and feed

Fish farmers buy seabass seed from government and private hatcheries.

Seed fish of 2–2.5 cm in total length cost Baht 2–2.5/pc. To produce 470–510 kg of seabass, 0.8 kg in average body weight, 1,800–2,000 seeds are required, as the mean survival rate of seabass during culture period is about 31–34% (Sungkasem and Boontae, 1984, 1985). The seed cost is, therefore, estimated at Baht 3,600–5,000. The ratio of seed cost to gross income is 10–15%.

Trash fish are used as feed for seabass during the grow-out culture. Taking mortality of seabass and other losses of feed into account, 10 kg of trash fish is estimated to be required to produce 1 kg of seabass. Therefore, to produce 470–510 kg of seabass, 4,700–5,100 kg of trash fish is used. As the price of trash fish is Baht 3/kg, total feed cost is Baht 14,100–15,300, which is 39.2–46.4% of the gross income. Thus, total cost of seed and feed is 49.2–61.4% of gross income.

For cockle culture in southern Thailand, seeds are imported from Malaysia. The cost of cockle seed is as high as 46.7% of gross income. However, no feed cost is required in the cockle culture.

Shrimp culture still largely depends upon natural seeds which come into the culture pond with water. As for shrimp feed, the present shrimp cultures rely on the feed naturally propagating in the pond. Therefore, cost for seed and feed is practically nil for shrimp culture.

Cost for seed and feed is also nil in oyster and green mussel culture in which natural spats are collected and grown in the sea with natural planktons as feed.

The share of seed and feed cost in gross income is largest in seabass culture among the coastal aquaculture in southern Thailand. The profitability of seabass culture is very sensitive to the price fluctuations of seabass fry and trash fish.

2. Labour cost

Small scale seabass culture farms are usually operated as a side job of fishing households, and daily work is done by the housewife or other family members who have very few alternative employment opportunities in rural, coastal areas. Therefore, nothing is expended on labour in seabass culture.

The large scale cockle culture farm employs as many as 20 workers to guard the culture bed from poachers, to harvest, sort, and pack cockles, and to transport them to Bangkok. Wages paid to these employees account for 5% of gross income.

Two to three workers are employed to manage a shrimp culture pond of 16 ha (100 rai).

Share of wages paid to them in the gross income is around 7%. Besides the family labour, three persons are employed in an oyster farm of 1.6 ha, since transplantation of young oysters and harvest and cleaning of grown oysters are labour intensive work. The wages account for 12% of gross income in oyster culture. Green mussel culture is usually operated only by family members, so the labour cost is practically nil.

3. Fuel cost

Seabass culture does not consume any fuel, as it is operated in the vicinity of the fishermen's house. For other types of coastal aquaculture, fuel is essential either to pump seawater into the pond (shrimp culture) or to reach the culture ground (cockle, oyster and green mussel culture). Fuel cost accounts around 3% of gross income for these aquacultures.

4. Culture materials

No special culture materials are used in seabass culture. Cockle and shrimp culture also spend only negligible amounts on materials.

A large quantity of bamboo sticks and concrete cylinders are used to attach shells in oyster and green mussel culture. The share of these materials in the gross income is around 8% for both oyster and green mussel culture.

5. Other expenses

Miscellaneous expense including repair of net cages and purchasing small utencils accounts for about 4–5% of gross income in seabass culture.

In cockle culture, transportation cost of products to Bangkok is a big item, accounting for 11% of gross income. Other miscellaneous expense including maintenance of facilities account for around 8% of gross income. Miscellaneous costs also account for around 8% of gross income in shrimp culture, while they account for only 3% in oyster and green mussel culture.

6. Ratio of variable cost in the gross income

Summarizing the above discussion, the total share of variable costs in the gross income for each type of coastal aquaculture is as follows:

Type	Seed & Feed	Labour	Fuel	Materials	Others	Total
Seabass	49.2–61.4	–	–	–	4.0–5.0	53.2–66.4
Cockle	46.7	5.0	3.0	–	19.0	73.7
Shrimp	–	7.0	3.0	–	8.0	18.0
Oyster	–	12.0	3.0	8.0	3.0	26.0
Green mussel	–	–	3.0	8.0	3.0	14.0

It can be said that seabass culture involves a high percentage of variable cost in the gross income. Share of variable cost is highest in cockle culture, whereas it is very low in shrimp and green mussel culture and medium in oyster culture.

7. Depreciation of facilities

Net cages and wooden platforms, which cost Baht 19,400 in total, are supposed to be durable for three years. Depreciation of these facilities per year is, therefore, Baht 6,500, which is 18–20% of the gross income.

For cockle, oyster and green mussel culture, which do not require many facilities for operation, the depreciation of facilities account for only 0.7%, 1.3% and 1.6% of gross income, respectively.

Shrimp culture requires huge initial investment for construction of culture ponds. The culture ponds are durable for at least 10 years if maintained properly. The depreciation of facilities per year accounts for 6.5% of gross income under the 10 years depreciation schedule.

8. Cost for culture ground

No tax is revied on the exclusive use of water area for seabass culture which uses only very limited area. For cockle, oyster and green mussel culture, tax should be paid for the exclusive use of sea area. The rate of the tax is only Baht 80/rai in a year and its proportion in gross income is 2.2% for cockle culture and less than 1% for oyster and green mussel culture.

Cost of culture ground is high in shrimp culture in which ponds are constructed in the mangrove swamps. Price of land for shrimp culture has sharply increased in Nakhorn Sri Thammarat Province due to strong demand. It was Baht 2,000–5,000/rai in 1983.

NET FARM INCOME

The total production cost including depreciation of facilities of seabass culture is 71.2–86.4% of gross income. Net income per farm is, therefore, in the range of Baht 4,500–10,400. If a farm gets a loan to start the culture, interest should be paid from this amount, which makes the net income smaller.

The farm income, before paying interest for loan, of other types of coastal aquaculture are roughly estimated as follows:

Cockle culture	2,160,000 Baht
Shrimp culutre	34,000– 1,057,000 Baht
Oyster culture	420,000 Baht
Green mussel culture	380,000 Baht

Even after paying interest for loan, the net farm income of these aquacultures are much larger than that of seabass culture.

DISCUSSIONS

Characteristics of seabass culture operated at present in southern Thailand are summarized as follows:

1. It is mainly operated as a side job of small scale fishing households, utilizing manpower of family members who have no alternative employment opportunities.

2. It is operated in a very small scale, only with three grow-out net cages in average.

3. It requires a very small area of water, less than 100 m^2 in average.

4. It involves only a small initial investment for culture facilities. That is the reason why seabass culture is operated by fishermen earning low income.

5. Its production per farm is small, while production per unit area is high.

6. Proportion of cost for seed and feed is high in gross income. Also depreciation is high compared to gross income.

7. It provides only a small additional income to the fishing household.

As the average income from non-fishing activities for small scale fishing household is only about Baht 700/month (Ratanachai et al. in this volume), the additional income from seabass culture is still meaningful for fishing household, even if it is very small in amount.

The main constraint to obstucle further development of seabass culture is the high proportion of seed and feed cost in gross income. Seed cost can be lowered only through raising the survival rate of the fish. Feed cost can be lowered by raising feed conversion rate or replacing trashfish by a feed with a higher cost performance.

Further research on the nutritional requirements of seabss is essential to achieve the aim. Nutritionally perfect feed will maintain the good health conditions of seabass and thus raise the survival rate. Also feed stuffs which replace the trash fish will be developed through the research on the fish nutrition.

By solving this problem, seabass culture can be a full time occupation operated on a larger scale.

Furthermore, studies on financial aspects and marketing system of seabass culture are necessary for healthier development of seabass culture in future.

Energy saving efficiency of wind turbine generator for newly constructed fish brood stock culture tank system

Yoshibumi Yashiro

INTRODUCTION

Japan International Cooperation Agency (JICA) had provided a fish brood stock culture tank system equipped with a wind turbine generator to the National Institute of Coastal Aquaculture (NICA), at its expense as a "Pilot Infrastructure Project," to make land-based fish brood stock culture possible.

Composition of the entire system is as follows.

1. Concrete brood stock culture tank	:	500 tons	:	3 units
2. Concrete water reservoir tank	:	430 tons	:	1 unit
3. Water pump	:	2.2 Kw	:	1 unit
		7.5 Kw	:	1 unit
4. Wind turbine generator	:	12.5 KVA	:	2 units
5. Storage battery	:	2.0 V	:	8 units
	:	6.0 V	:	32 units
6. Housing for control unit and battery	:	2 rooms	:	1 unit
7. Wind powered water wheel			:	3 units

Construction of the entire system was completed in May, 1985.

From 22 Jan. to 17, Feb, after the completeion of repair and adjustment by the maker's engineer, a study on the efficiency of the wind turbine generator was conducted to look into the level of energy saving by its introduction.

METHODS

1. Power consumption of water pumps (2.2Kw, 7.5Kw) was checked by operating pumps with only city line power source (22-24, Jan.)
2. Other miscellaneous power consumption of the system (battery charging, recorder) was checked during the sample period and under the same conditions.
3. Power consumption of water pumps was again checked under the usage of the wind turbine generator (24-26, Jan.).
4. Daily recording of power consumption under normal operation of the entire system was undertaken (27, Jan.-17, Feb.).
5. Data obtained from 1–4 above was analysed to determine the power saving efficiency of the wind turbine generator.

RESULTS

1. Estimated power consumption of water pumps with the city line as power source.

Pump (Kw)	Power consumption (Kw/hr)
2.2	1.95
7.5	3.60

2. Estimated miscellaneous power consumption.

   0.5 Kw/hr

3. Estimated power consumption per day by the entire system with city line as power source (at the pump operation rate of 8 hrs per day).

Pump (Kw)	Power consumption (Kw/day)
2.2	$1.95 \times 8 + 0.5 \times 16 = 23.6$
7.5	$3.60 \times 8 + 0.5 \times 16 = 36.8$

4. Power consumption of entire system under the operation of wind turbine generator.

   Total power consumption during the period of 27, Jan. to 17, Feb. (20 days) was 421.0 Kw (mean consumption per day: 21.05 Kw, range: 4.5–36.1 Kw). Only the 7.5 Kw pump was used during the period.

5. Energy saving efficiency of wind turbine generator.

   Based on the results of 1–4 above, energy saving efficiency could be estimated as follows:

$$E.\,S.\,E = 100 - \left(\frac{421.0}{36.8 \times 20} \times 100 \right) = 42.8\%$$

6. Wind condition during observation period.

   The anemometer installed with the system is designed for weather observation and the values obtained are the mean of every 10 minutes. For this reason value of daily power consumption is used as indicator.

D.P.C. (Kw/day)	Days	Percent	Remark
$1 \leqslant n < 10$	5	25	*1 Strong wind
$10 \leqslant n < 20$	4	20	*2
$20 \leqslant n < 30$	5	25	*3
$30 \leqslant n < 40$	6	30	*4 No wind

*1 Wind turbine generator is quite effective but its operation is often cut off to either AC or DC over voltage.

*2 Wind turbine generator normally operated and effective.

*3 Wind turbine generator less effective, city line source help operating pumps.

*4 Wind turbine generator ineffective, city line source mainly operates pumps.

CONCLUSION AND DISCUSSION

During this period wind turbine generator showed good energy saving rate of 42.8%, but the period was too short to conclude its efficiency. Therefore, at least one year of continuous observation is needed to draw conclusions about its performance.

Problems to be considered and solved are as follows:

1. As of now, the operation of this water supply system is only during the day time (8:00–16:00) due to the operation cost and operation noise of wind turbine generator. This effects the water exchange rate of brood stock culture tank.
2. As of now, the capacity of the storage batteries, even if fully charged, is good for only one to two hours of pump operation and this also effects the efficiency of the system.
3. The engineer of the maker has given guidance and practical training to the local staff which can now undertake basic maintenance activities, but close contact and exchange of information are still needed for the betterment and establishment of operational techniques for this system.