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Fish assemblages in coral communities at Chao Lao Beach, Chanthaburi Province, Thailand

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Abstract Fish assemblages at 3 different coral communities at Chao Lao Beach, Chanthaburi province, Thailand were investigated using fish visual census and line intercept transect techniques. Three different coral communities were surveyed; included Ai Lao Nai reef, Ai Lao Klang reef and Ai Lao Nok reef, which were located from the nearshore to outward respectively. At Ai Loa Nai reef, 53% of the area was covered by live massive coral form and 10% was sand, while at Ai Lao Klang reef, 35% was live massive and submassive corals and 25% was sand. For Ai Lao Nok reef, 57% was live corals, which were tabulate and branching forms. The results showed that the dominant fish families were Pomacentridae and Labridae. Ai Lao Nok reef had higher fish diversity and abundance compared to other areas because this area had more habitat complexity. In addition, there was a correlation between fish species and coral forms. Small size fish tended to be found on branching and foliose coral forms. Thus, coral structures can influence the diversity and density of reef fish species.

Keywords Coral form, Fish assemblage, Thailand, Habitat complexity, Fish diversity

Introduction

Fish move to exploit reefs mainly for food and shelters. As a result, reef fish assemblages can be influenced by the structures of reefs and other factors. Those factors include depth, habitat complexity, coral diversity, distance from coast, reef zone, continuous habitat and coverage of live corals (Manthachitra and Sudara, 1991, Chabanet et al. 1997, Friedlander and Parrish, 1998, Khalaf and Kochzius, 2002, Nanami and Nishihira, 2002, Lecchini et al. 2003). The structural complexity of coral reefs provides a variety of habitats, thus it increases microhabitats for living fish (Chabanet et al. 1997, Beukers and Jones, 1997, Connell and Kingsford, 1998, Friedlander and Parrish, 1998, Holbrook et al. 2002, Khalaf and Kochzius, 2002, Friedlander et al. 2003, Nanami and Nishihara, 2004). Characteristics of habitats also play an important role in fish distribution. Some fish such as damselfish and butterflyfish can be found in higher density at a continuous habitat than an isolated reef (Nanami and Nishihira, 2002). Studies have shown that high coral diversity and high percent coverage of live corals also led to high diversity of fish (Manthachitra and Sudara, 1991, Chabanet et al. 1997, Connell and Kingsford, 1998, Khalaf and Kochzius, 2002, Lecchini et al. 2003). In addition, zonations of reefs can have an effect on fish diversities. Reef edges tend to have more fish diversity and abundance than reef flats (Connell

and Kingsford, 1998, Manthachitra and Sudara, 2002, Satapoomin, 2002, Lecchini et al. 2003).

The purpose of this study was to examine the relationship between fish assemblages and difference coral habitat characteristics. In addition, the correlation between fish species and coral life forms were studied.

Materials and Methods

Sampling sites were located at Chao Lao Beach in Chantaburi province, which is in the east coast of Thailand (Fig. 1). This area is an important area for both fishery and tourism activities in the province. Three different coral communities; Ai Lao Nai reef, Ai Lao Klang reef, and Ai Lao Nok reef locating from the nearshore to outward were surveyed. The distances from the shore ranged from 1.5 kilometers to 5 kilometers, and the depths of the study sites were from 2−9 m depths. Abundance of fish on hard substrates was assessed using the fish visual census technique as per English et al. 1997, and line intercept transect technique was used for determining coral coverage in the areas. The coral substrates were categorized into 6 types: dead coral (DC), massive coral/submassive coral (MC), foliose coral (FC), branching coral (BC), sand (S) and others (O) (Table 1). The data were collected during February, April, September and November of 2004. Shanon – Wiener diversity index (H') and Sørensen's similarity coefficient were used to describe the differentiation of fish in each station and Pearson correlation coefficient was used to examine the relationships between each fish species and coral structures.

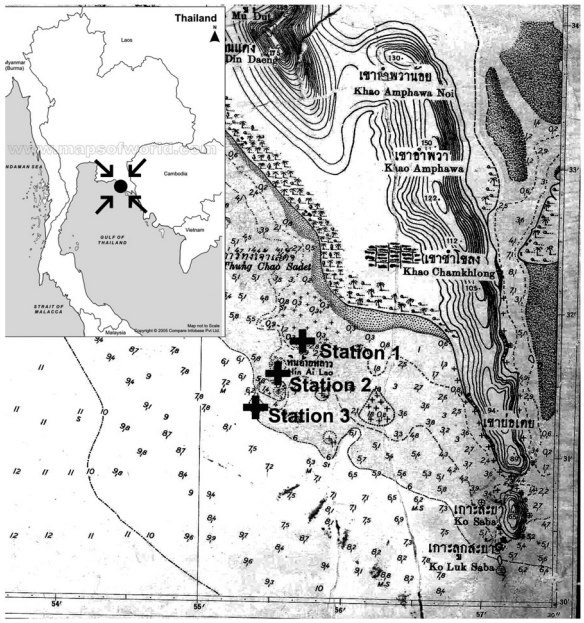

Fig. 1 Three study sites at Chao Lao Beach in Chantaburi Province (Station 1＝Ai Lao Nai reef ; Station 2＝Ai Lao Klang reef; Station 3＝Ai Lao Nok reef).

Table 1 Coral life forms in each coral species

Life forms	Coral species
Massive/ Submassive	*Porites* spp., *Platygyra* spp., *Favites* spp., *Favia* spp., *Goniastrea* spp.
Foliose	*Pavona* spp.
Branching	*Acropora* spp., *Pocillopora damicornis*

Results

A total of 41 fish species from 14 families of fish were enumerated (Table 2). *Neopomacentrus cyanomos* (Bleeker, 1856) was the dominant species. From the surveys, there was no difference in species composition between seasons. Families Pomacentridae and Labridae were the most abundance family groups.

In addition, the highest fish diversity and highest abundance occurred at Ai Lao Nok reef compared to other reefs. *Caesio cunning* (Bloch, 1791) and *Chaetodon octofasciatus* Bloch, 1787 were often found. However, the number of individuals varied substantially, with an overall mean density of 54 individuals per 100 m^2. Analysis using Shannon-Weiner diversity index showed that fish diversity is high at Ai Lao Nok reef (Table 3); however, there was no significant difference on the diversity of fish between 3 sites ($p > 0.05$). Using the Sorensen similarity coefficiency, the results showed that the highest similarity of fish communities occurred between between Ai Lao Nai and Ai Lao Nok reef (Table 3).

The results from the substrate surveys showed that at Ai Loa Nai reef, 53% of the area was covered by live massive coral form and 10% was sand while at Ai Lao Klang reef, 35% was live massive and submassive corals and

Table 2 Number of fish found in 3 study sites.

Species	Ai Lao Nai Reef				Ai Lao Klang Reef				Ai Lao Nok Reef			
	Feb	Apr	Sep	Nov	Feb	Apr	Sep	Nov	Feb	Apr	Sep	Nov
Family Holocentridae												
Sargocentron rubrum (Forsskål, 1775)	0	0	0	0	0	0	0	2	1	0	0	0
Family Serranidae												
Cephalopholis boenak (Bloch, 1790)	3	2	0	1	3	1	4	0	1	7	3	1
Cephalopholis formosa (Shaw, 1812)	0	1	0	0	1	0	0	0	1	0	5	0
*Diploprion bifasciatum** (Cuvier, 1828)	0	0	0	0	0	0	0	0	0	1	0	0
Family Apogonidae												
Apogon cookii Maclaey, 1881)	0	15	0	0	6	12	0	1	0	1	0	1
Archamia fucata (Cantor, 1849)	0	30	20	20	0	0	0	0	0	0	0	0
Cheilodipterus quinquelineatus (Cuvier ,1828)	15	0	0	0	0	5	0	0	0	0	0	0
Family Leiognathidae												
Leiognathus sp.	0	5	0	0	0	0	0	0	0	0	15	4
Family Echeneidae												
*Echeneis naucrates** (Linnaeus, 1758)	0	0	0	0	0	0	0	0	0	1	0	0
Family Lutjanidae												
Lutjanus 3ecu (Quoy and Gaimard, 1824)	1	0	1	0	1	0	0	0	2	0	0	0
Lutjanus johnii (Bloch, 1792)	1	0	0	0	2	0	0	0	1	0	0	1
Lutjanus carponotatus (Richardson, 1842)	1	4	2	1	0	0	0	2	0	0	1	0
*Lutjanus 3ecussates** (Cuvier, 1828)	0	0	0	0	0	0	0	0	0	0	1	0
Caesio cunning (Bloch, 1791)	0	0	10	1	113	66	0	166	20	55	84	5
Family Nemipteridae												
Scolopsis affinis (Peters, 1877)	2	0	0	0	0	0	0	0	1	2	0	0
Scolopsis monogramma (Cuvier, 1830)	2	0	2	0	0	0	0	0	1	0	2	0
Scolopsis vosmeri (Bloch, 1872)	4	1	2	3	1	1	6	5	9	1	10	5
Scolopsis cilliatus (Lacepède,1802)	0	0	0	0	0	0	5	0	0	0	0	0
Family Mullidae												
*Upeneus tragula** (Richardson, 1846)	0	0	0	0	0	0	1	0	0	0	0	0
Family Pomacantidae												
Pomacanthus annularis (Bloch, 1787)	0	2	0	0	0	0	0	0	1	0	0	0
Family Monodactylidae												
Monodactylus argenteus (Linnaeus, 1758)	0	0	0	0	0	0	0	0	0	5	0	0
Family Chaetodontidae												
Chaetodon octofasciatus (Bloch, 1787)	4	2	5	4	3	3	7	5	6	3	4	4
Chelmon rostratus (Linnaeus, 1758)	1	4	0	0	0	0	0	0	0	0	0	1
Family Pomacentridae												
Abudefduf bengalensis (Bloch, 1787)	6	8	8	3	27	0	6	0	1	0	4	2
Abudefduf sexfasciatus (Lacepède, 1801)	0	2	8	4	2	5	0	0	0	0	6	7
Abudefduf vaigiensis (Qouy *and* Gaimard, 1825)	3	0	0	10	1	0	0	0	0	0	10	0

* Found only once undividual

Table 2 (cont.)

Species	Ai Lao Nai Reef				Ai Lao Klang Reef				Ai Lao Nok Reef			
	Feb	Apr	Sep	Nov	Feb	Apr	Sep	Nov	Feb	Apr	Sep	Nov
Family Pomacentridae												
Neopomacentrus cyanomos (Bleeker, 1856)	194	97	118	225	115	191	53	31	105	590	90	216
Chromis cinerascens (Cuvier, 1830)	0	25	0	0	0	70	15	0	43	55	74	0
Neopomacentrus bankieri (Richardson ,1846)	0	22	0	0	0	6	0	3	0	7	0	1
Hemiglyphidodon plagiometapon (Bleeker ,1852)	12	12	13	29	9	0	9	5	3	0	35	10
Pomacentrus cuneatus (Allen, 1991)	73	2	2	36	37	1	9	39	65	0	18	29
Pomacentrus chrysurus (Cuvier, 1830)	4	12	2	4	47	4	0	0	73	0	23	13
Pomacentrus sp.	28	64	37	0	59	53	41	0	0	40	44	0
Pomacentrus coelestis (Jordan and Starks, 1901)	0	0	0	0	0	0	0	0	0	0	0	3
Family Labridae												
Halichoeres nigrescens (Bloch and Schneider, 1801)	52	20	19	15	78	13	24	16	31	22	57	46
Halichoeres chloropterus (Bloch, 1791)	2	4	1	3	7	2	0	0	0	1	0	1
Hemigymnus melapterus (Bloch ,1791)	3	0	0	0	1	0	1	0	0	0	0	1
Halichoeres melanurus (Bleeker, 1851)	1	0	2	0	0	0	0	0	0	0	0	0
Family Siganidae												
Siganus guttatus (Bloch, 1787)	18	11	1	0	0	10	0	1	0	0	1	0
Siganus javus (Linnaeus, 1766)	0	0	0	13	2	1	2	0	4	52	2	0
*Siganus virgatus** (Valenciennes, 1835)	1	0	0	0	0	0	0	0	0	0	0	0

*Found only once individual

Table 3 Shannon-Weiner diversity index and Sørensen's similarity coefficient comparing fish diversity between three study sites.

Sites	Shannon-Weiner diversity index	Sørensen's similarity coefficient
Ai Lao Nai	0.9886	0.735
Ai Lao Klang	0.9997	0.906
Ai Lao Nok	1.1926	0.806

25% was sand. For Ai Lao Nok reef, 57% was live corals, which were tabulate and branching forms (Fig. 2).

Discussion

In this study, structures of reefs differed among sites and reef fishes in the study appeared to demonstrate some distinct assemblage structures and characteristics based on specific coral habitats. Ai Lao Nai and Ai Lao Nok reefs had high percentage of live coral coverage (53% and 57% respectively). Thus, similarities of fish communities were shown. Habitat structure has been shown to play a major role in structuring ecological communities (Friedlandera and Parrish, 1998, Brokovich et al. 2006). The habitats provide shelters from physical stress, restrain foraging predators and supply food sources (Choat and Bellwood, 1991). It had been shown that high habitat complexity led to high fish diversity because more cavities and complex structures provide more small and juvenile fish to hide from their predators (Beukers and Jones, 1997). In addition, physical parameters such as depth and temperatures are considered to be important factors influencing fish species and communities (Friedlander and Parrish, 1998; Nanami and Nishihira, 2002). However, three sites in this study had a similar environmental condition; therefore, those physical parameters may not be major contributing factors on differences in fish communities in this study.

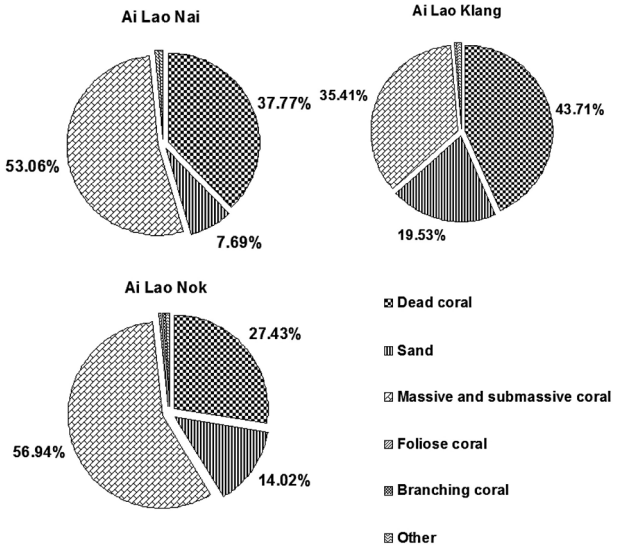

Fig. 2 Percentage of benthic coverage at three study sites. The relationship between fish species and coral lifeforms were analyzed using Pearson correlation. Single individual of fish species that was found (*Lutjanus decussatus* (Cuvier, 1828)*, Diploprion bifasciatus* Cuvier, 1828*, Echeneis naucrates* Linnaeus, 1758*, Siganus virgatus* (Valenciennes, 1835) and *Upeneus tragula* (Richardson, 1846) during the whole surveys was not included for the analysis, thus, only 36 species of fish were used in comparisons. The results showed positive correlations between 5 fish species and coral lifeforms. Those positive correlations were *Chelmon rostratus* (Linnaeus, 1758) and folliose form; *Lutjanus carponotatus* (Richardson, 1842) and folliose form; *Neopomacentrus cyanomos* and massive form; *Neopomacentrus bankieri* (Richardson, 1846) and folliose form; and *Archamia fucata* (Cantor, 1849) and folliose form.

Shapes or forms of live corals can affect distributions of organisms associated with reefs (Nanami et al. 2005). Corals provide not only habitats but also food for other reef invertebrates, which fish prey upon (Connell, 1998). The results in this study found that there were positive correlations between 5 fish species and coral lifeforms. Thus, habitat selections by reef fish can also depend on food availability (Choat and Bellwood, 1991; Stewart and Jones, 2001).

Pomacentridae and Labridae were the most dominant groups found during the surveys. These groups were reported as major components in Gulf of Thailand's coral reefs (Mongkolprasit and Songsirikul, 1988, Manthachitra, 1991). *Neopomacentrus cyanomos* was also found as a dominant species in reefs in this study. This is consistency with other studies (Allen, 1991; Webster, 2002) since it has a widespread distribution (Randall et al. 1997).

In conclusion, we found that fish assemblages vary among reef in localities characterized by coral structures and coverage. Differences in fish abundance seem to be responsible for this pattern. Further studies are needed for understanding factors influencing the diversity of fish and fish communities.

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