Progress report II

Species composition, habitat uses, and the influence of predator on habitat selection of *Acetes* spp.

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CONTENTS

CHEPTER 1

INTRODUCTION

The species of the genus *Acetes* are small planktonic shrimp (Omori, 1975). They are holoplankton that spend all their time in the water column (Levinton, 2001). Change of light, temparature and salinity may effect on migration of zooplankton in water column (Levinton, 2001). Light is primary factor initiating nocturnal vertical migration of zooplankton (Forward's, 1988 cited in Xiao and Greenwood, 1993). Zooplanktons were migrating to the surface water at night but spent the daytime at some depth beneath the surface for predatory avoidance (Levinton, 2001). In addition, migration of *Acetes* was induced by change in water temperature and salinity (Xiao and Greenwood, 1993). Increasing of surface water could speed down of ascendant of *Acetes* vertical migration (Forward's, 1988 cited in Xiao and Greenwood, 1993). More over, food availability, that vary considerably seasonally, also affect to *Acetes* migration (Xiao and Greenwood, 1993).

Acetes plays important roles in food web of coastal ecosystems, especially in shallow lagoons, seagrass beds, and mangroves (Omori, 1975). They are considered the multitrophic organism level. They prey as well as the zooplankton; copepod, *Sagita* sp. and molluscan larvae (Levinton, 2001, Xiao and Greenwood, 1993). They feed phytoplankton, zooplankton, detritus for food (Xiao and Greenwood, 1993). They link the detritus, phytoplankton and zooplankton to the higher trophic levels (Xiao and Greenwood, 1993). They are also prey by number of predators such fishes, protozoans, ctenophores, cephalopods, crocodiles and human (Xiao and Greenwood, 1993).

In daytime, predators (i.e. fish) use vision to capture prey, so zooplanktons leave the surface waters during the day to avoid being seen (Levinton, 2001). Escapes from consumers often imply avoidance in time, in space, or in both time and space (Bertness *et. al.*, 2000). An especially impressive example

involves the daily vertical migration *Acetes* showed the nocturnal migration vertical migration in order to avoid predators (Chiou *et. al.*, 2000). In contrast, *Acetes sibogae* also exhibited both nocturnal and tidal vertical movement in the water body, with greater numbers being only found near surface rather than near bottom during flood tide and nighttime (Xiao and Greenwood, 1992). *Acetes* avoid the predator by using the tail-flip escape response. In aquaria, when they are disturbed or frightened, they were rapidly backwards to the water surface (Xiao and Greenwood, 1993). Bioluminescence is a common feature of many zooplankton species (Levinton, 2001). If bioluminescence present in *Acetes*, they are relate to prey attraction or predator avoidance (Xiao and Greenwood, 1993).

This study aims to figure out the information about species composition, habitat exploited, and predation on *Acetes* spp. Influence of predatory fish on habitat selection of *Acetes* spp. will be investigated. The results would lead to further research questions and/or would be useful in the implementation of management plan for sustainable fisheries of *Acetes* spp. in this area.

CHAPTER 2

LITERATURE REVIWE

2.1 The biology and importance of *Acetes* spp.

The genus *Acetes* belongs to Family Sergestidae. In spite of being a minor planktonic crustacean group with small number of species, *Acetes* spp. are economically important in Asian and East African waters as a major protein source for people in these regions (Omori, 1975).

In addition, *Acetes* spp. have been exploited in many activities. In aquaculture, seahorse (*Hippocampus kuda*) showed the highest survivorship when fed by *Artemia* enriched with an emulsion derived from *Acetes* sp. (Job *et al*, 2002). In human nutrition, shrimp paste potentially provides polyunsaturated fatty acid for people who consume them regularly (Montaño *et al*, 2001).

2.2 Species of *Acetes* recorded in Thai waters

In Thailand, there are 6 species of 14 species worldwide have been found spatial and temporal distribution. They are as *A. erythraeus, A. vulgaris, A. sibogae, A. serrulatus, A. japonicus,* and *A. indicus* (see Table. 1 for more detail) (Pengchumrus and Upanoi, 2005; Xiao and Greenwood, 1993; Chaitiamvongse *et al*., 1977 and Omori,1975)

Table 1 Species of *Acetes* recorded in Thai waters.

Species	Location								References
	East coast of the Gulf of Thailand	Peaked months	**Inner Gulf of Thailand**	Peaked months	**West coast of the Gulf of Thailand**	Peaked months	**Andaman Sea**	Peaked months	
Acetes erythraeus	Rayong				Chumphon		Phangnga		Omori (1975)
	Trat Chanthaburi Rayong	Jul-Nov Jun-Jul, Sep-Nov, Nov-Dec May-Nov	Samut Prakan Samut Sakhon	Throughout the year Jun-Jul, Nov-Dec					Chaitiamvong *et al.* (1977)
	Chanthaburi								Suvatti (1950) cited in Chaitiamvong *et. al.* (1977)
	Trat Chanthaburi Rayong	} May-Nov			Prachuap Khiri Khan Chumphon	} Feb-Jun			Tiensongrusmee (1972) cited in Chaitiamvong *et al.* (1977)
	Trat Chanthaburi Rayong		Chachoengsao Samut Prakan						Chaitiamvong and Boonyanate (1978)
	Trat Chon Buri Rayong		Chachoengsao Samut Prakan Samut Songkhram Phetchaburi		Prachuap Khiri Khan Chumphon Songkhla Nakhon Si Thammarat Narathiwat Pattani				Omori (1975), Chaitiamvong (1980) and Chaitiamvong and Yoodee (1982) cited in Xiao and Greenwood (1993)
							Phuket Krabi Phangnga		Pengchumrus and Upanoi (2005)

Table 1 (continued) Species of *Acetes* recorded in Thai waters.

Species	Location								References
	East coast of the Gulf of Thailand	Peaked months	**Inner Gulf of Thailand**	Peaked months	**West coast of the Gulf of Thailand**	Peaked months	**Andaman Sea**	Peaked months	
Acetes vulgaris	Trat Chon Buri Rayong		Samut Prakan						Omori (1975)
			Samut Prakan Phetchaburi	Mar-Jul, Nov-Dec Throughout the year					Chaitiamvong *et al.* (1977)
	Trat Chanthaburi Rayong	May-Nov			Prachuap Khiri Khan Chumphon	Feb-Jun			Tiensongrusmee (1972) cited in Chaitiamvong *et al.* (1977)
			Samut Prakan Samut Sakhon Phetchaburi		Surat Thani				Chaitiamvong and Boonyanate (1978)
	Trat Chanthaburi Rayong Chon Buri		Chachoengsao Samut Prakan Samut Sakhon Samut Songkhram Phetchaburi		Prachuap Khiri Khan Chumphon Surat Thani Songkhla Pattani				Chaitiamvong (1980) and Chaitiamvong and Yoodee (1982) cited in Xiao and Greenwood (1993)
	Trat Chanthaburi Rayong	Aug-Sep	Chachoengsao Samut Prakan Samut Sakhon Samut Songkhram Phetchaburi	Mar-Jun May-Aug Jun-Jul, Nov- Dec	Prachuap Khiri Khan Chumphon Surat Thani Songkhla Pattani	Mar-Apr Mar-Apr, Jul-Aug Jan-Mar			Chaitiamvong and Yoodee (1979) cited in Vongsungyang (2007)

Table 1 (continued) Species of *Acetes* recorded in Thai waters.

Species	Location								References
	East coast of the Gulf of Thailand	Peaked months	**Inner Gulf of Thailand**	Peaked months	**West coast of the Gulf of Thailand**	Peaked months	**Andaman Sea**	Peaked months	
Acetes sibogae							Krabi Phangnga		Omori (1975)
							Krabi Phangnga Trang	Apr Mar and May May	Arunrojprapai *et al.* (2005)
Acetes serrulatus	Trat Chanthaburi Rayong	May-Nov			Prachuap Khiri Khan Chumphon	Feb - Jun			Tiensongrusmee (1972) cited in Chiatiamvong *et al.* (1977)
			Chachoengsao						Suvatti (1950) cited in Chiatiamvong *et al.* (1977)
Acetes japonicus							Phangnga		Omori (1975)
	Trat Chanthaburi	Jul – Nov Jun – Jul, Nov - Dec	Samut Prakan Samut Sakhon Phetchaburi	Throughout the year Mar – Jul, Nov-Dec Throughout the year					Chiatiamvong *et al.* (1977)
	Chanthaburi Rayong Trat	May - Nov			Prachuap Khiri Khan Chumphon	Feb - Jun			Tiensongrusmee (1972) cited in Chiatiamvong *et al.* (1977)
			Samut Sakhon						Suvatti (1950) cited in Chiatiamvong *et al.* (1977)

Table 1 (continued) Species of *Acetes* recorded in Thai waters.

Species	Location								References
	East coast of the Gulf of Thailand	Peaked months	**Inner Gulf of Thailand**	Peaked months	**West coast of the Gulf of Thailand**	Peaked months	**Andaman Sea**	Peaked months	
Acetes japonicus	Trat Chanthaburi		Chachoengsao Samut Prakan Phetchaburi						Chaitiamvong and Boonyanate (1978)
	Trat Chanthaburi		Chon Buri Chachoengsao Samut Prakan Samut Sakhon Samut Songkhram Phetchaburi		Songkhla Nakhon Si Thammarat Pattani		Phuket Krabi		Omori (1975), Chaitiamvong (1980) and Chaitiamvong and Yoodee (1982) cited in Xiao and Greenwood (1993)
							Phuket Krabi		Pengchumrus and Upanoi (2005)
	Trat Chanthaburi	Aug - Sep	Chachoengsao Samut Prakan Samut Sakhon Samut Songkhram Phetchaburi	Mar – Jun May – Aug Jun – Jul Nov - Dec	Songkhla Pattani	Jan-Mar			Chaitiamvong and Yoodee (1979) cited in Vongsungyang (2007)
Acetes indicus			Samut Prakan						Omori (1975)
	Rayong	May - Nov	Samut Prakan Samut Sakhon Phetchaburi	Throughout the year Jun - Jul, Nov – Dec Throughout the year					Chiatiamvong et al. (1977)
	Trat Chanthaburi Rayong	May - Nov			Prachuap Khiri Khan Chumphon	Feb-Jun			Tiensongrusmee (1972) cited in Chiatiamvong et al. (1977)

Table 1 (continued) Species of *Acetes* recorded in Thai waters.

Species	Location								References
	East coast of the Gulf of Thailand	Peaked months	**Inner Gulf of Thailand**	Peaked months	**West coast of the Gulf of Thailand**	Peaked months	**Andaman Sea**	Peaked months	
Acetes indicus			Chachoengsao						Suvatti (1950) cited in Chiatiamvong et al. (1977)
	Rayong		Samut Prakan Samut Sakhon Phetchaburi						Chaitiamvong and Boonyanate (1978)
	Rayong		Chon Buri Chachoengsao Samut Prakan Samut Sakhon Phetchaburi		Pattani				Omori (1975), Chaitiamvong (1980) and Chaitiamvong and Yoodee (1982) cited in Xiao and Greenwood (1993)
							Phuket Krabi Phangnga		Pengchumrus and Upanoi (2005)
			Chachoengsao Samut Prakan Samut Sakhon Samut Songkhram Phetchaburi	Mar-Jun May-Aug } Jun-Jul Nov-Dec					Chaitiamvong and Yoodee (1979) cited in Vongsungyang (2007)

2.3 Predation on *Acetes* spp.

Predators of *Acetes* spp. are widely diverse groups of animals, including protozoans, ctenophores, cephalopods, crustaceans, fishes, baby crocodiles, and human. Fishes are the most important predators. There are more than 151 fish species of at least 48 families (*e.g.* Carangidae, Clupeidae, Sciaenidae, Lactariidae, Polynemidae, Engraulidae), include *Acetes* spp. in their diets. (Xiao and Greenwood, 1993).

2.3.1 Fish predation on *Acetes* spp.

There are 4 fish species of the Family Leiognathidae (*Gazza minuta, Leiognathus bindus, L. ruconin and Secutor insidiator*) recorded consuming *Acetes* spp. (Tham, 1950 and Jayabalan, 1988 cited in Xiao and Greenwood, 1993). Stomach contents of *Trichiurus lepturus, Leiognathus bindus* and myctophids contained *Acetes intermedus* that recognized as a major food source for the fishes (Chiou *et al.*, 2000).

CHAPTER 3

METERIALS AND METHODS

3.1 Study sites

Taladyai Bay, a part of Had Khanom Mu Ko Thaletai National Park, is located on the northern part of Khanom District, Nakhon Si Thammarat Province. This area composes of various types of habitat, *i.e.* mangrove forests, seagrass beds, rocky shores, sandy beaches, and muddy beaches.

Study site is classified into 5 habitats (Figure.1).

3.1.1.Seagrass bed (approx. 132,393 square meters or 16.35 %). There are 4 species of seagrasses recorded, as *Enhalus acoroides, Thalassia hemprichii, Halophila ovalis*, and *Halodule uninervis* (Prathep and Mayakun, 2007).

3.1.2.Muddy flat (approx.193,148 square meters or 23.85 %).

3.1.3.Coarse sand flat (approx. 37,505 square meters or 4.63 %).

3.1.4.Mangrove (approx. 34,344 square meters or 4.24 %).

3.1.5.Open water (approx. 412,360 square meters or 50.92 %).

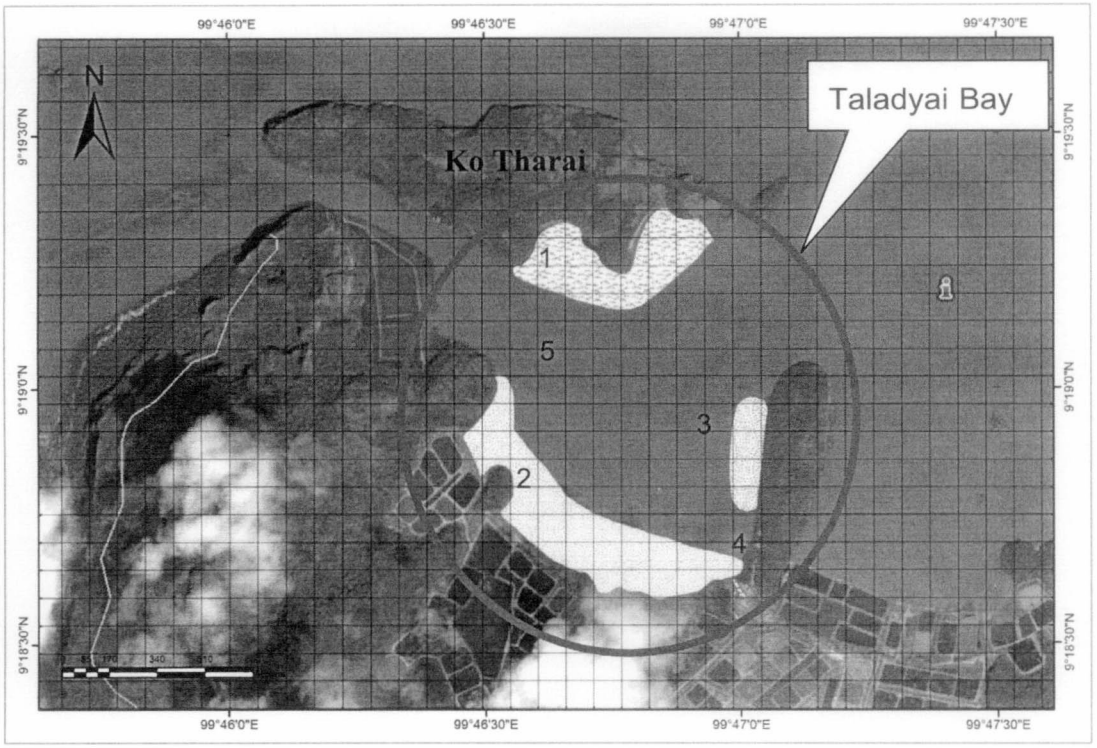


Figure.1 Classified habitats of the study site at Taladyai Bay Had Khanom Mu Ko Thaletai National Park:1) Seagrass bed, 2) Muddy flat, 3) Coarse sand flat, 4) Mangrove creeks, and 5) Open water.

3.2 Fishing gear

Darumas net was used to collect the *Acetes* (Figure. 2, for specification see Table. 2). Darumas net was modified from Irukandji net and hole-in-belly net. The hole-in-belly net was designed based on the tail-filp escape behavior. Because of *Acetes* shrimps can rapidly backwards and can often carry them above the water surface when disturbed.

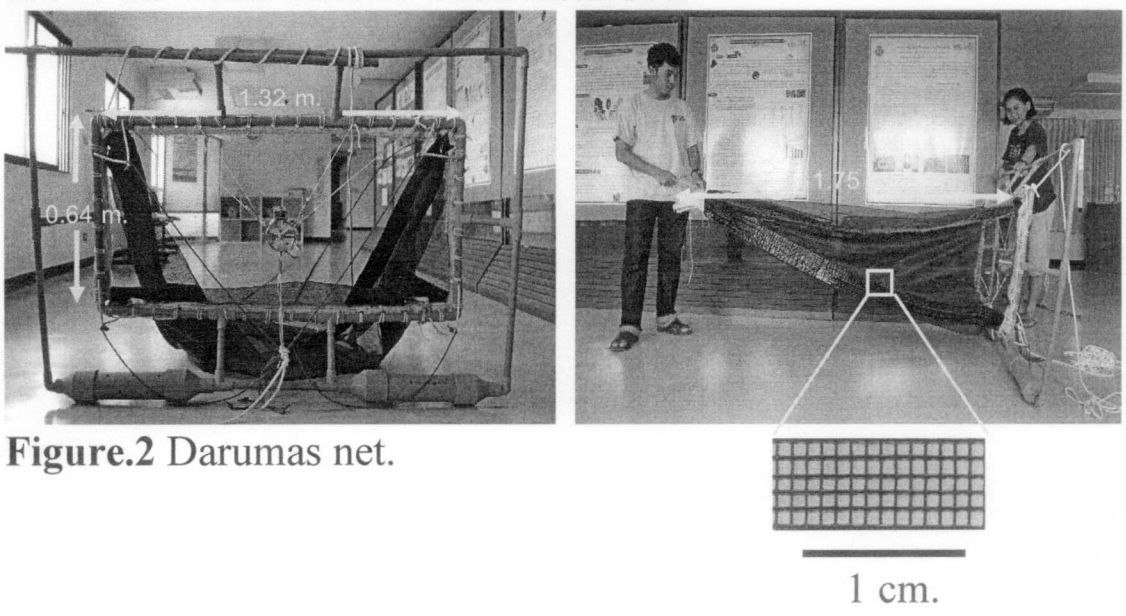


Figure.2 Darumas net.

Table. 2 Specification of Darumas net.

Specification	Values
1) Shape of net mouth	A rectangle
2) Net dimension (m)	0.64 x 1.32
3) Mouth opening area (m^2)	0.85
4) Depth : Length Ratio	1:2.73
5) Total filtering area (m^2)	2.22
6) Net material	Fiber net
7) Cod end	PVC (∅ 101.6 mm) and Ball valve
8) Material and size of frame (∅ mm)	PVC (∅ 12.7 mm)
9) Total weight (kg)	8.4
10) Mesh size (μm)	1424.93
11) Colour of net	Black

3.3 Specimens collection

According to the preliminary survey, the study area was divided into 133 grids (10,000 square meters each grids) (Figure. 3). The proportions of coverage area of each habitat were listed below.

3.3.1. Seagrass bed covers 26 grids (19.55 %).

3.3.2. Muddy flat covers 38 grids (28.57 %).

3.3.3. Coarse sand flat covers 8 grids (6.01 %).

3.3.4. Mangrove covers 4 grids (3 %).

3.3.5. Open water covers 59 grids (44.36 %).

In each habitat, the grids were randomly chosen separately for each sampling occasion for sample collection. The amounts of grids chosen for each habitat are relatively proportioned to other habitats. For example, if the distance of Darumas net used for *Acetes* collection in Mangrove was 20 meters trawled., the trawled distance for seagrass bed will be ((19.55/3)X20) = 130.33 meter. In each grid, three replicates of *Acetes* were collected.

Either the catching method is operated by long-tailed boat complied with a Darumas net. The fishing gear was operated in daytime and nighttime during the high tide. For each sample, the net was trawled for a distance of 100 meters. The calculation of

water volume filtered through the net is equaled to "A x flometer read:, in which "A" is the calibrated water volume filtered through the net per a distance unit of 1 meter. After collection, samples were then preserved in 4% formalin and transport to the laboratory for further investigation. In the laboratory, samples were taxonomically identified followed Omori (1975).

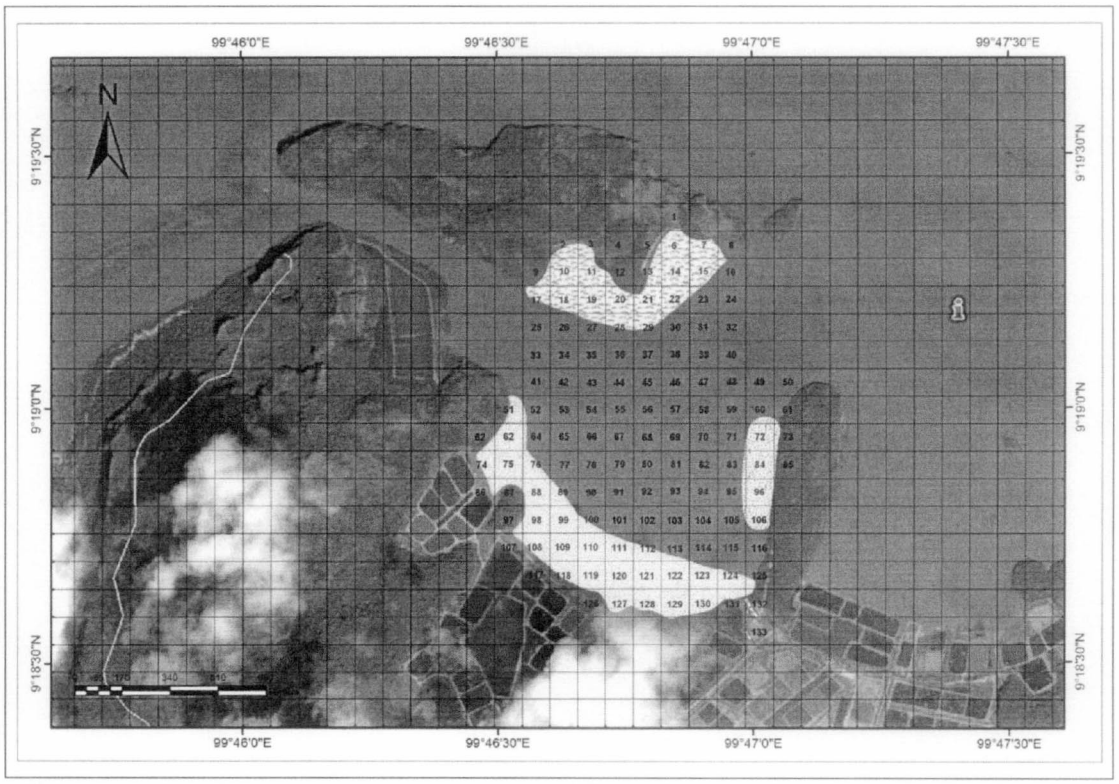
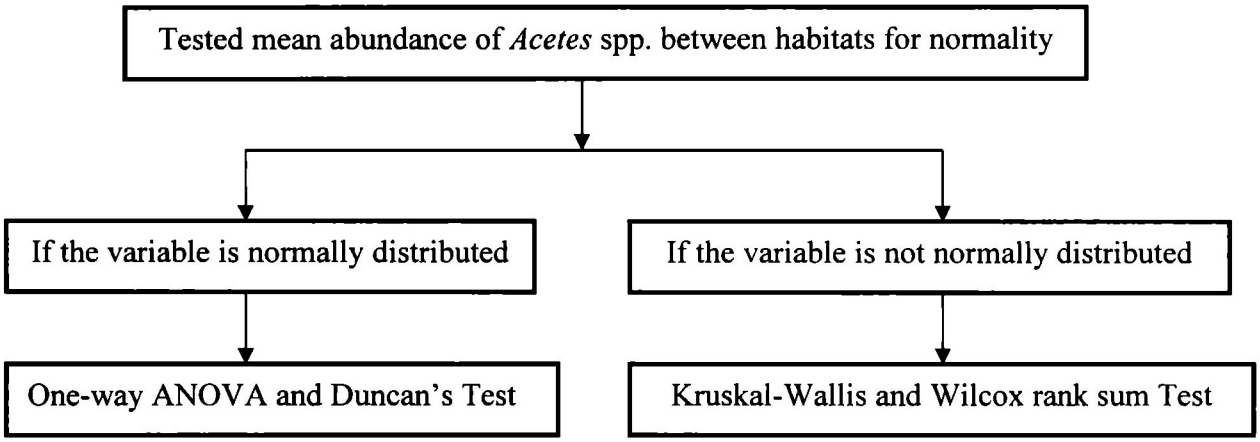


Figure.3 The study area at Taladyai Bay which was divided into 133 grids of 10,000 square meters each.

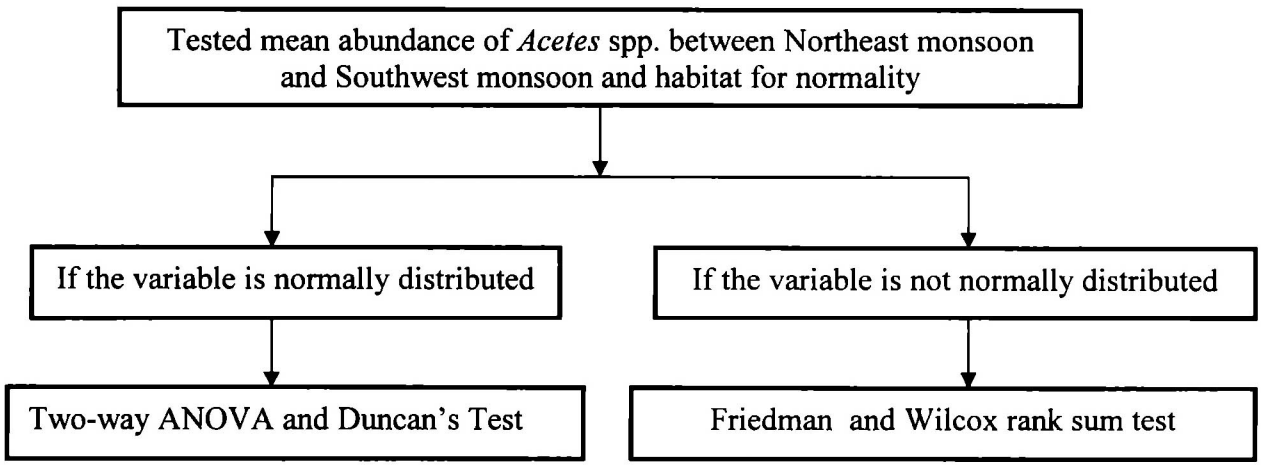
3.4 Statistical analysis

Abundance of *Acetes* was expressed as number per 100 m^3. Before analysis, each variable was tested for normality (Shapiro and Wilk, 1965)

3.4.1. The differences in mean abundance of *Acetes* spp. between habitats.



3.4.2. The differences in mean abundance of *Acetes* spp. between Northeast monsoon and Southwest monsoon and habitat.



Significance was considered to be at $\alpha = 0.05$ for all statistical results presented above. All statistical analyses were performed using the statistical software R 2.11.1 (R Development Core Team 2010).

3.5. Measurements of water qualities

In each grids, the physical and chemical parameters of sea water, such as dissolved oxygen (DO), water temperature, salinity, and chlorophyll a concentration, were measured (3 replicates per habitat), The method for measuring each parameter is defined below.

3.5.1.Dissolved oxygen, water temperature and salinity

Dissolved oxygen, water temperature and salinity were measured using a YSI Model 85 equipment. The equipment was calibrated prior to use. Dissolved oxygen, water temperature and salinity were recorded at the mid-of water column depth.

3.5.2.pH was measured by using a HANNA pH meter (pHep HI 98107) at the sampling sites from the water collected from sea level depths. The equipment was calibrated prior to use in 4.0 , 7.0 and 10.0 standard buffer. The value of the pH was then recorded from the meter reading.

3.5.3.Chlorophyll a concentration

In each habitat, seawater was collected at surface seawater (ca. 0.5 m) and filled in a 1,000 milliliters plastic bottle. Three replicates were collected per habitat. Samples were kept away from heat and light to prevent degradation of the chloroplast. Water samples were filtered as soon as possible, and were temporarily stored in a cooler with ice or refrigerated (not frozen). Analysis was conducted at the Marine Laboratory in Walailak University, following the spectrophotometric methods (Strickland and Parson, 1972). Analysis and calculation for chloroplast using a Spectronic Model 20 Genesys Spectrophotometer.

Chlorophyll a concentration were calculated as follows (Strickland and Parson, 1972):

$$C_a = 11.64D_{663} - 2.16D_{645} + 0.10D_{630}$$

Where Ca is concentration of chlorophyll a in the extract (mg/l) and D_{663}, D_{645} and D_{630} are optical densities (with a 1-cm light path) at the respective wavelengths.

When the concentration of pigment in the extract has been determined, calculate the amount of pigment per unit volume of sample as follows:

$$\text{Chlorophyll a } (mg/m^3) = \frac{C_a \text{ x volume of extract (l)}}{\text{Volume of sample } (m^3)}$$

3.5.4.Depth was measured by using a speedtech echo sounder (SM-5) at the sampling sites from sea level depths. The value of the depth was recorded from the 10^{-1} meter reading.

CHAPTER 4

RESULTS

4.1 Environmental parameters

Salinity and temperature were high, ranging from 33.5 – 26.5 (‰) and 31.4 – 28.0 (^{0}C) respectively. These decreased in value in the rainy season. The Dissolved oxygen showed minor fluctuation from 6.0 to 4.3(mg/L) while pH showed major fluctuation from 10.4 – 6.4. The highest of Dissolved oxygen and pH occurred in May (2011). Chlorophyll-a concentration showed highest value in July (2010) (3.6 mg/m^3) and lowest value in December (2010) (0.5 mg/m^3). The highest water depth was 1.3 meters in January (2011) (see more detail in Table. 3).

Table. 3 Mean, minimum and maximum values of selected environmental parameters at Taladyai Bay.

Variables	Mean ± SD	Range	Month	
			Minimum	Maximum
Salinity (‰)	30.8 ± 0.2	33.5 – 26.5	Dec (2010)	Aug (2010)
Temperature (^{0}C)	30.3 ± 1.1	31.4 – 28.0	Jan (2011)	Sep (2010)
Dissolved oxygen (mg/L)	5.4 ± 0.5	6.0 – 4.3	Jun (2010)	May (2011)
pH	8.0 ± 1.0	10.4 – 6.4	Apr (2011)	May (2011)
Chlorophyll-a (mg/m^3)	2.0 ± 1.0	3.6 – 0.5	Dec (2010)	Jul (2010)
Depth (m)	1.1 ± 0.2	1.3 – 0.9	Dec (2010)	Jan (2011)

4.2 Species composition and abundance

4.2.1 Seagrass beds

Four species of *Acetes* that there were *A. japonicus, A. erythraeus, A. vulgaris and A. indicus.* , were encountered in seagrass beds. *A. japonicus* was the dominant species in this habitat. The highest peak of abundance occurred in June 2010 (629 ind/100 m^3), while the lowest peak abundance were recorded in October 2010 and May 2011 (4 ind/100 m^3) (Figure. 4).

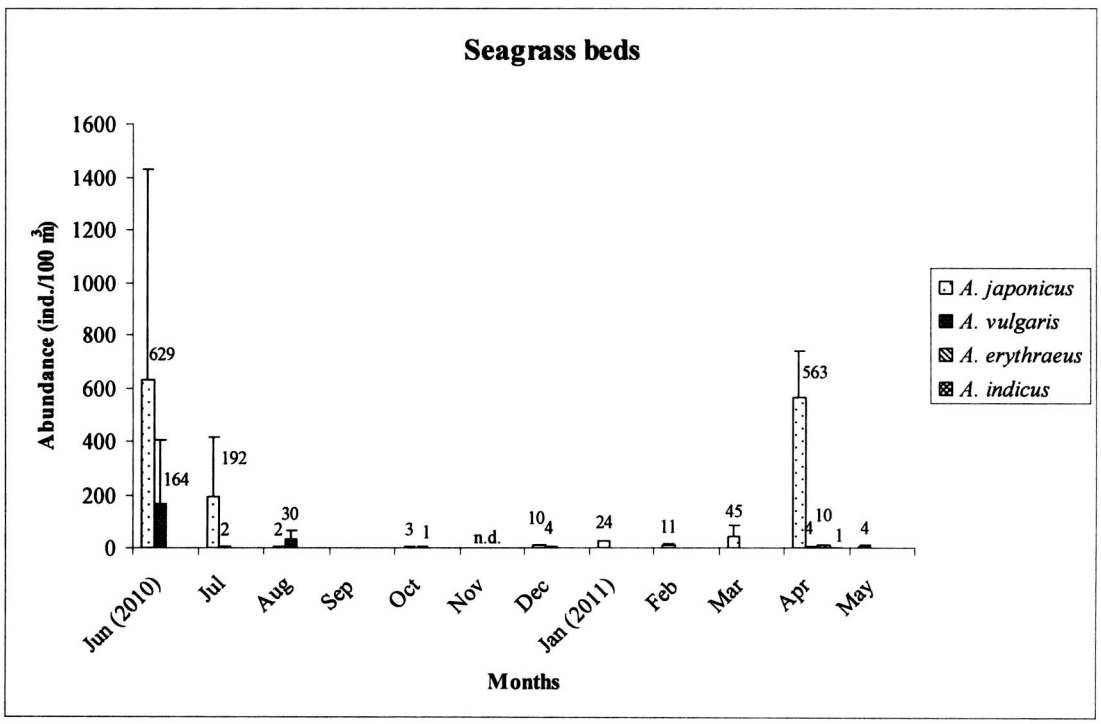


Figure. 4 Mean abundances of *Acetes* shrimps (ind/100 m^3) in seagrass beds.

- n.d. = no sample were collected due to bad wheather

4.2.2 Open sea

There were *A. japonicus, A. erythraeus, A. vulgaris and A. indicus*, were founded in open sea. *A. japonicus* was the dominant species in this habitat. The highest peak of abundance occurred in April 2011 (1,501 ind/100 m^3) and the lowest peak of abundance were founded in October 2010 (2.4 ind/100 m^3) (Figure. 5).

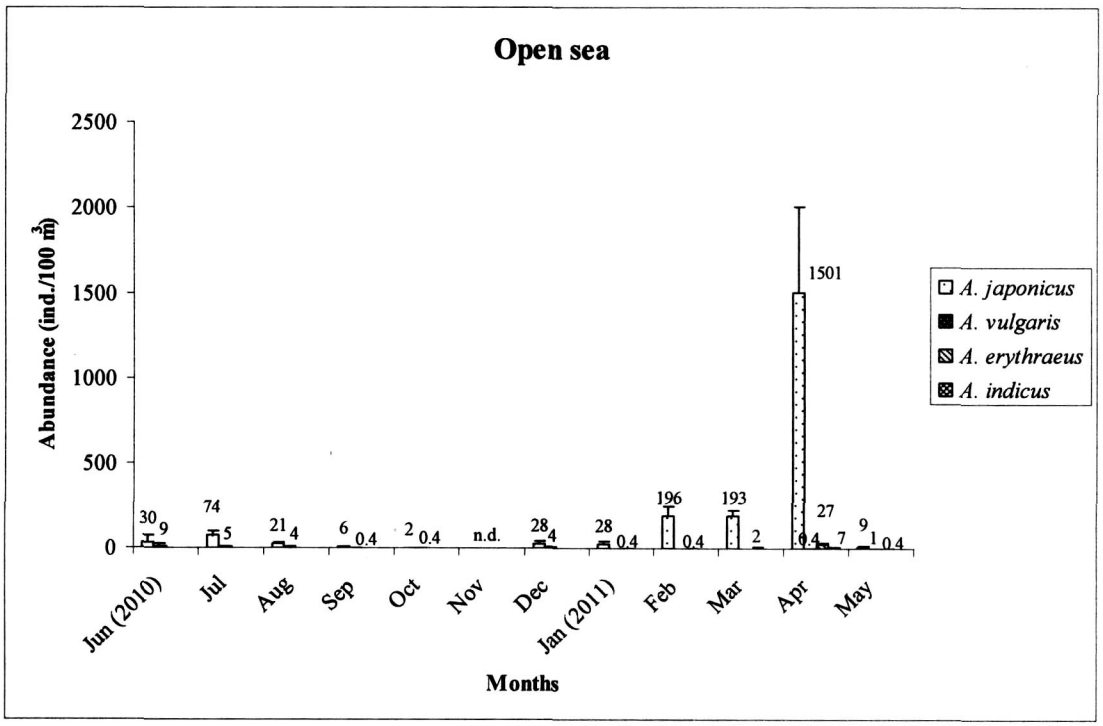


Figure. 5 Mean abundances of *Acetes* shrimps (ind/100 m^3) in open sea.

- n.d. = no sample were collected due to bad wheather

4.2.3 Coarse sand flat

In coarse sand flat, there were four species were found that including *A. japonicus, A. erythraeus, A. vulgaris and A. indicus*. *A. japonicus* was the dominant species in this habitat.

There were two peak in total *Acetes* shrimps were investigated in this habitat. The highest peak occurred in July 2010 (1,746 ind/100 m^3). The other peak occurred in March 2011 (1,134 ind/100 m^3). *A. japonicus* was associated with these peaks (Figure. 6).

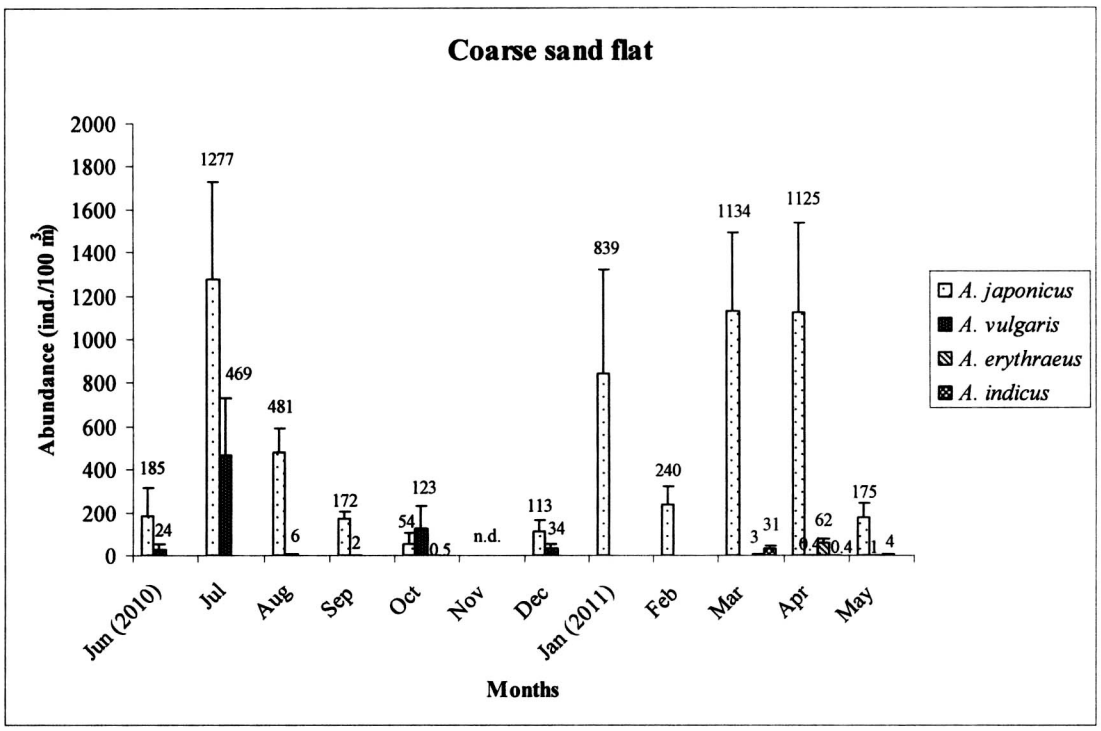


Figure. 6 Mean abundances of *Acetes* shrimps (ind/100 m^3) in coarse sand flat.

- n.d. = no sample were collected due to bad wheather

4.2.4 Mangrove

There were four species were found in mangrove that including *A. japonicus, A. erythraeus, A. vulgaris and A. indicus*. *A. japonicus* was the dominant species in this habitat.

The highest peak occurred in August 2010 (1,057 ind/100 m^3) and the other peak occurred in January 2011 (771 ind/100 m^3). *A. japonicus* was associated with these peaks (Figure. 7).

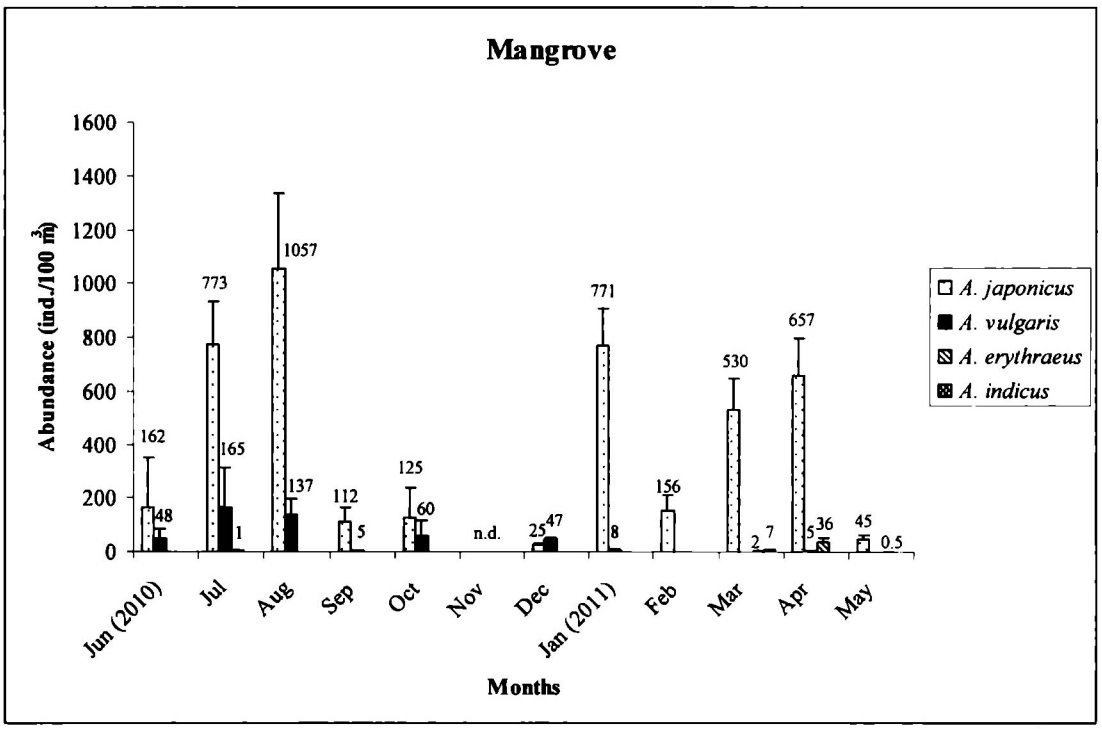


Figure. 7 Mean abundances of *Acetes* shrimps (ind/100 m^3) in mangrove.

- n.d. = no sample were collected due to bad wheather

4.2.5 Muddy flat

There were four species were found that including *Acetes japonicus, A. erythraeus, A. vulgaris and A. indicus*. *Acetes japonicus* was the dominant species in this habitat.

The highest peak occurred in April 2011 (542 ind/100 m^3) and the lower peak occurred in August 2010 (348 ind/100 m^3). *Acetes japonicus* was associated with these peaks (Figure. 8).

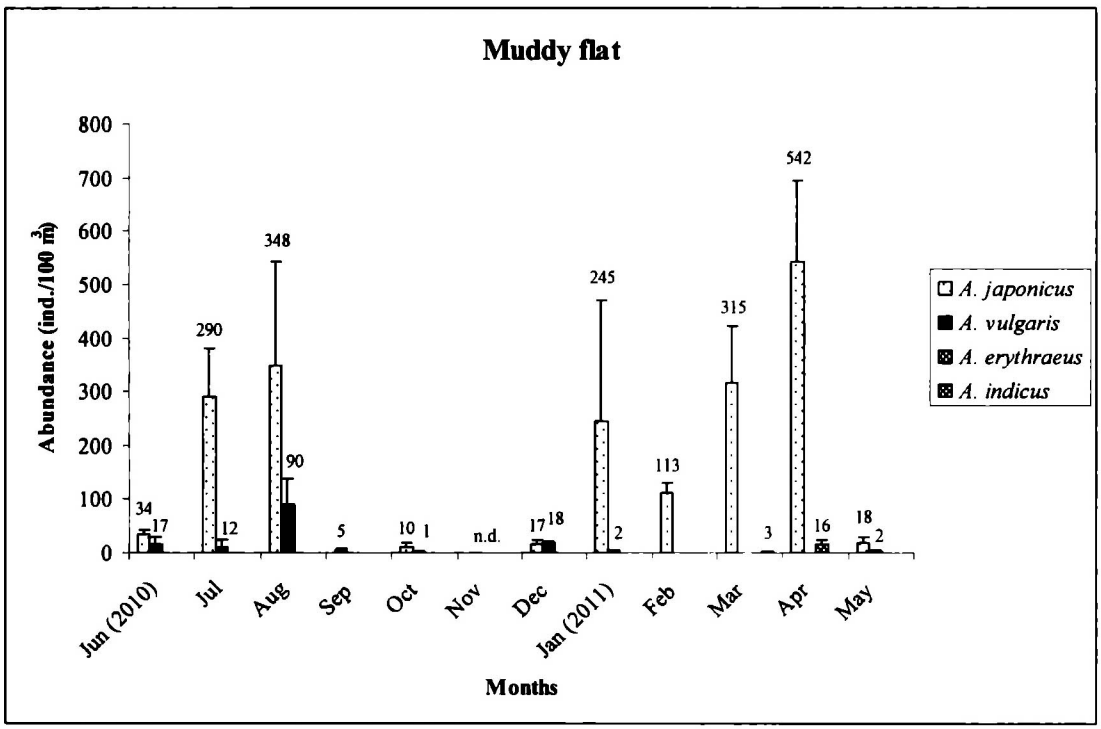


Figure.8 Mean abundances of *Acetes* shrimps (ind/100 m^3) in muddy flat.

- n.d. = no sample were collected due to bad wheather

4.3 Statistical analysis

4.3.1 The differences in mean abundance of *Acetes* spp. between habitats.

The mean abundance of *Acetes* spp. between habitats showed highly significantly difference between habitats ($\chi^2 = 48.579, p < 0.01$).

Table. 4 Wilcoxon rank sum test of mean density of *Acetes* spp. between habitats: *p < 0.05, **p < 0.01.

Habitat	*p-values*
Seagrass vs Open sea	0.287
Seagrass vs Coarse sand flat	< 0.01**
Seagrass vs Mangrove	< 0.01**
Seagrass vs Muddy flat	0.027*
Open sea vs Coarse sand flat	< 0.01**
Open sea vs Mangrove	< 0.01**
Open sea vs Muddy flat	0.112
Coarse sand flat vs Mangrove	0.256
Coarse sand flat vs Muddy flat	< 0.01**
Mangrove vs Muddy flat	< 0.01**

4.3.2 The differences in mean abundance of *Acetes* spp. between northeast monsoon and southwest monsoon and habitat.

The mean abundance of *Acetes* spp. between northeast monsoon and southwest monsoon and habitat were not differenced ($\chi^2 = 48.579, p > 0.05$).

CHAPTER 5

DISCUSSIONS

5.1 Species composition of *Acetes* spp.

In this study, there are four species of *Acetes* spp. (*A. japonicus, A. erythraeus, A. vulgaris and A. indicus*). In Nakhon Si Thammarat Province, there are two species (*A. japonicus* and *A. erythraeu*) have been reported (Omori,1975; Chaitiamvong, 1980 and Chaitiamvong and Yoodee, 1982 cited in Xiao and Greenwood 1993).

A. japonicus was the dominant species in every habitat. Other dominant *Acetes* spp. were *A. vulgaris, A. erythraeus and A. indicus* respectively. They were the dominance species in coarse sand flat (Figure. 9).

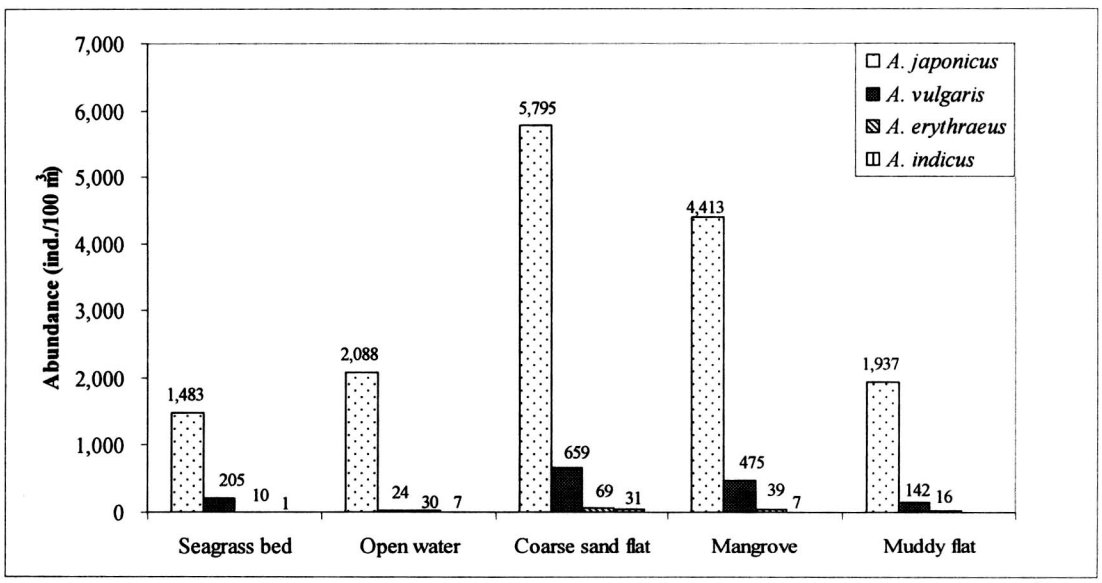


Figure. 9 Species compositions and abundances (ind/100 m^3) of *Acetes* shrimps in each habitat.

5.2 The abundance of *Acetes* spp.

The abundance of *Acetes* spp. in Taladyai Bay follow closely the fishing season. The highest abundance of *Acetes* shrimps occurred in April 2011 and lowest in August (Figure. 10). In Nakhon Si Thamarat Province, the fishing season occurs from January to April and the peak months from February to March (Chaitiamvong and Boonyanate, 1978).

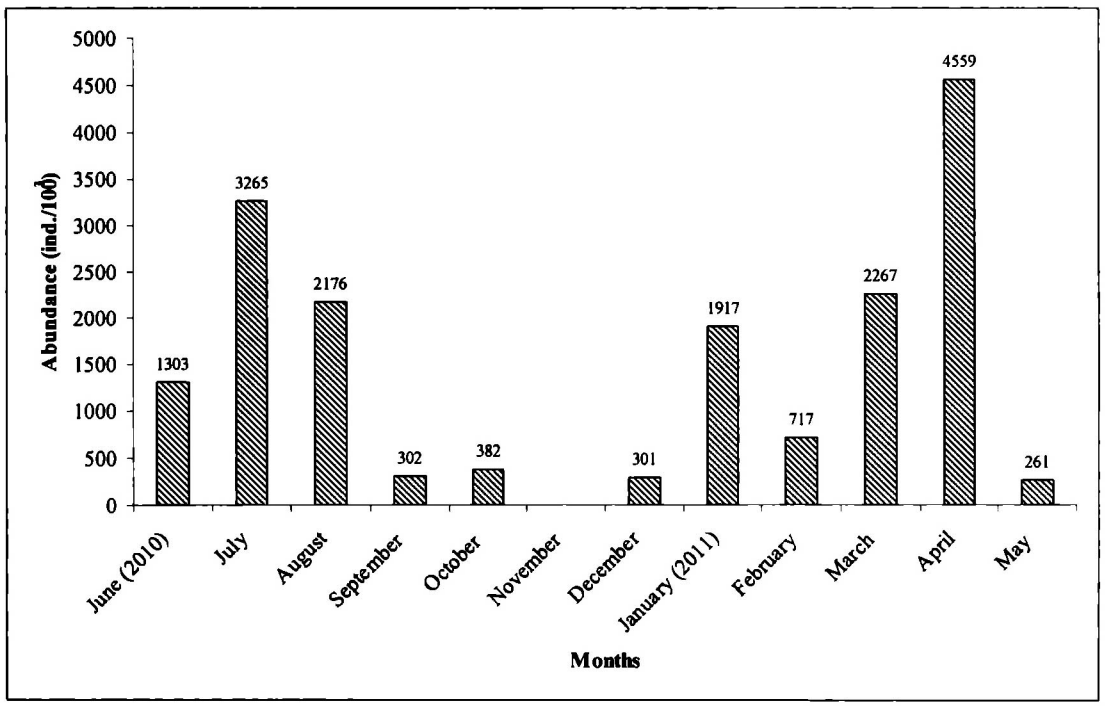


Figure. 10 *Acetes* shrimps abundance (ind/100 m^3) in Taladyai Bay.

REFERENCE

Arunrojprapai, C., Reunprim, T., and Keaw-Khaeiw, P. 2005. Sergestid push net fishery in the Andaman Sea. Proceeding the conference on fisheries 2005. Andaman Sea Fisheries Research and Development Center. 14 p.

Bertness, M.D., Gaines, S.D., and Hay M.E. 2000. Marine Community Ecology. Sunderland: Sinauer Associates.

Chaitiamvong, S., Boonyanate, P., and Banasopit, T., 1977. Annual Report of the Invertebrate Fisheries Unit of Marine Fisheries Division, Bankok, 32 p.

Chaitiamvong, S., and Boonyanate, P. 1978. Annual Report of the Invertebrate Fisheries Unit of Marine Fisheries Division, Bankok, 26 p.

Chan, T.Y.1998. Shrimps and Prawns In: Carpenter, K.E. and V.H. Niem (eds.) FAO species identification guide for fishery purpose. The living marine resources of the Western Central Pacific. Volume 2. Cephalopod, crustaceans, holothurians and sharks. Rome, FAO. 1998. pp. 851 – 1043

Chiou, W.D., Wu C.C., and Cheng, L.Z. 2000. Spatio-temporal distribution of sergestid shrimp *Acetes intermedius* in the coastal water of southwestern Taiwan. *Fisheries Science.* 66: 1014 – 1025.

Chiou, W.D., Hwang, J.J., Chang, L.Z., and Chen, C.T. 2005. Food and feeding habit of Taiwan mauxia shrimp *Acetes intermedius* in the coastal water of southwestern Taiwan. *Fisheries Science Tokyo.* 71(2): 361 – 366.

Job, S.D., Do, H.H., Meeuwig, J.J. and Hall, H.J. 2002. Culturing the oceanic seahorse, *Hippocampus kuda. Aquaciture.* 214(1-4): 333 – 341.

Levinton, J.S. 2001. Marine Biology. New York: Oxford University Press.

Montaño, N., Gavino,G., and Gavino, V.C. 2001. Polyunsaturated fatty acid contents of some traditional fish and shrimp paste condiments of the Philippines. *Food Chemistry.* 75(2): 155 – 158.

Omori, M. 1975. The systematics, biogeography and fishery of epipelagic shrimps of the genus *Acetes* (Crustacean, Decapoda, Sergestidae). *Bull. Ocean Res Inst. Univ. Tokyo*. 7: 1 – 91.

Prathep, A. and Mayakun, J. 2007. Diversity, distribution and abundance of seagrass at Khanom-Mu koh Thale Tai National Park, Nakhon Si Thammarat Province, Thailand. Abstracts: Reseach and Thesis. 11th BRT Annual Conference, October 15-18th 2007 Udonthani.

Pengchumrus, W., and Upanoi,T. 2005. Species and distribution of Acetes shrimps in seagrass beds and mangrove canals in the Andaman Sea. Technical Paper no. 12/2005. Phuket Marine Biological Center. Department of Marine and Coastal Resources. Ministry of Natural Resources and Environment. 21p.

Shapiro, S. S., and Wilk, M. B. 1965. An Analysis of Variance Test for Normality (Complete Samples). *Biometrika*, 52: 591-611.

Strickland, J. D. H. and Parsons, T. R. 1972. A practical handbook of seawater analysis. Second Edition, Bulletin 167. Fisheries Research Board of Canada, Ottawa.

Vongsungyang, V. 2007. Diversity and abundance of Sergestids and Mysids in coastal area of Ban Khun Samut Chin, Samut Prakarn Province. Department of Marine Science, Faculty of Science, Chulalongkorn University. 45p.

Xiao, Y., and Greenwood, J.G. 1993. The biology of *Acetes* (Crustacea : Sergestidae). *Oceanogr. Mar. Biol. Annu.*