The 4th Thailand International Symposium on Natural History Museums:
Era of Ecosystem Restoration, 77–84.

Crab communities habitat changes due to human impact on sandy and rocky beaches around Mu Ko Tao, Surat Thani Province

Kamonchanok Wongissarakul[1], Puntip Wisespongpand[2], Wachirah Jaingam[2] and Thalvimol Muktha[2]

[1]Office of Natural Science Research, National Science Museum Thailand, Thailand
[2]Department of Marine Science, Faculty of Fisheries, Kasetsart University, Thailand

Article History
Received: 4 March 2024
Accepted: 25 June 2024
Published Online: 2 August 2024

Corresponding author
Puntip Wisespongpand
E-mail: ffisptp@ku.ac.th

Editor
Dr. Weeyawat Jaitrong
E-mail: polyrhachis@yahoo.com/
weeyawat@nsm.or.th

Abstract

Sandy and rocky beaches are important habitats for crabs, which humans most likely utilize. Characteristics of the crab community depend on the shape of beaches, environmental factors, pollution, habitat loss caused by human threats, and climate change. The structure of the crab community on sandy and rocky beaches of Ko Tao and Ko Nang Yuan consisting of a total of 20 stations with different levels of human threats were studied. The species richness of crabs on sandy beaches were made up of five families, seven genera, and nine species while eight families, 15 genera, and 17 species of crabs were found on rocky beaches. Ao Chalok had the highest Shannon-diversity index on sandy and rocky beaches at 1.922 and 1.561, respectively, due to its habitat diversity. It has been found that human threats affect the crab community on sandy beaches, especially the prevalence of ghost crab. The crab community in each station on rocky beaches was separate, depending on characteristics of the crab habitats.

Keywords
crab community, human impact, beach, Ko Tao, Gulf of Thailand.

Introduction

Crabs play an important role in marine ecosystems. They dwell in burrows along rocky shores, and sandy beaches and live with various other organisms in intertidal zones and coral reefs, making coastal marine ecosystems one of high crab biodiversity (Wisespongpand *et al*., 2007; Warner, 1977). The marine ecosystem is suffering a continuous loss of biodiversity in marine life. Crabs are experiencing a decline in biodiversity, mainly due to human activities such as urban expansion, tourist infrastructure development, overfishing, and pollution, leading to habitat alteration and loss. Additionally, climate change contributes to alterations in marine ecosystems, further exacerbating the loss of crab diversity. Despite their adaptability to diverse

Citation. Wongissarakul, K., P. Wisespongpand, W. Jaingam and T. Muktha. 2024. Crab communities habitat changes due to human impact on sandy and rocky beaches around Mu Ko Tao, Surat Thani Province. In *The 4th Thailand International Symposium on Natural History Museums: Era of Ecosystem Restoration* on 21–22 December 2023 at Rama 9 Museum Thailand: 77–84 pp.

habitats, crabs face habitat loss issues, leading to declining biodiversity. Some crab species could encounter extinction in the future due to these challenges.

Mu Ko Tao is located on the northeastern coast of Surat Thani Province, which has important coastal ecosystems. Recently, tourism has expanded in these areas becoming world-class, threatening the crab habitat and leading to declining biodiversity. Sandy and rocky beaches are important habitats for crabs, which humans most likely utilize. Characteristics of the crab community depend on the shape of beaches, environmental factors, pollution, habitat loss caused by human threats, and climate change. This study focuses on the species diversity and community of crabs on the sandy and rocky beaches of Ko Tao and Ko Nang Yuan, where humans threaten the habitat.

Materials and methods

Study Area

The study area comprised ten stations along the sandy beach and ten stations along the rocky beach with different levels of human threats in Ko Tao (Table 1).

Table 1. Stations and locations for this study in Ko Tao.

Stations	Location
Mae Haad Beach	10°05’10”N 99°49’29”E
Sairee Beach	10°05’39”N 99°49’39”E
Ao Chalok Bay	10°04’01’’N 99°49’33’’E
Ao Tanote Bay	10°05’06”N 99°50’53’’E
Ao Leuk Beach	10°04’19”N 99°50’20”E
Sai Daeng Beach	10°03’56’’N 99°50’22”E
Ao Hin Wong Bay	10°06’12.5’’N 99°50’45.5’’E
Ao June Juea	10°04’02’’N 99°49’11’’E
Sai Nuan Beach	10°04’21”N 99°48’58”E
Nang Yuan Beach	10°07′19″N 99°48′46″E

Specimens collecting

Specimens were collected from 23–27 May and 19–25 June 2023. Most specimens were obtained in the lowest tide period. All specimens were preserved in 70% Ethanol. The crab identification followed Dai and Yang (1991), Komai *et al*. (1995), Mendoza *et al*. (2014), and Shih *et al*. (2016).

Crab community

The study of crab community structure involved comparing the characteristics of communities in areas experiencing habitat loss in various ecosystems against those that remain relatively intact. This comparison was based on a species diversity assessment using univariate methods and an analysis of community structure similarity using multivariate approaches (Clarke and Warwrick, 1994) with the Primer 5 software package. Species diversity parameters included the species diversity index (Shannon- Wiener diversity index). Community grouping was conducted using dendrogram and ordination techniques analyzed through cluster analysis and multidimensional scaling (MDS) using the Bray-Curtis similarity matrix.

Results and discussion

Crab diversity

The total numbers of crabs were 13 families, 22 genera, and 26 species around Mu Ko Tao, Surat Thani Province. The biodiversity richness of crabs on sandy beaches were five families, seven genera, and nine species while eight families, 15 genera, and 17 species were found on rocky beaches (Table 2).

Crab Diversity on Sandy Beaches

Nine species of crabs were found on sandy beaches. The most abundant and commonly found species was the Ghost crab, *Ocypode ceratophthalmus*. The sentinel crabs, *Macrophthamus* spp., were found on sandy beaches. In general, these species are found in muddy beaches and mangroves. Moreover, they were found on some beaches and also with different species. *Macrophthalmus brevis* was found on Sairee Beach, while *Macrophthalmus convexus* was found at Ao Chalok Bay. This information could be important for monitoring the change in crab habitats at the sandy beach on Ko Tao. Two moon crab species, *Matuta victor* and *Asthoret lunaris*, were found on Sairee Beach and at Ao Chalok Bay. Generally, only one species was found in any particular area. Moreover, the land crab species *Gecarcoidea lalandii*, a rare crab species, was found during the nighttime. This crab has only been found previously on remote islands such as the Surin and Similan Islands (Wisespongpand *et al*., 2007).

The highest crab species diversity on the sandy beach was at Ao Chalok Bay, with nine species found at 31% (Figure 1A), followed by Sairee Beach, where nine species were found. The study revealed that those stations with a higher threat level, such as Mae Haad Beach, Sairee Beach, and Ao Chalok Bay, had more diverse crab species than low-threat level stations. This could be attributed to their larger size, smaller polluted areas, and potentially less tourist disturbance on Ko Tao. There should be no effect on the decline of crab biodiversity.

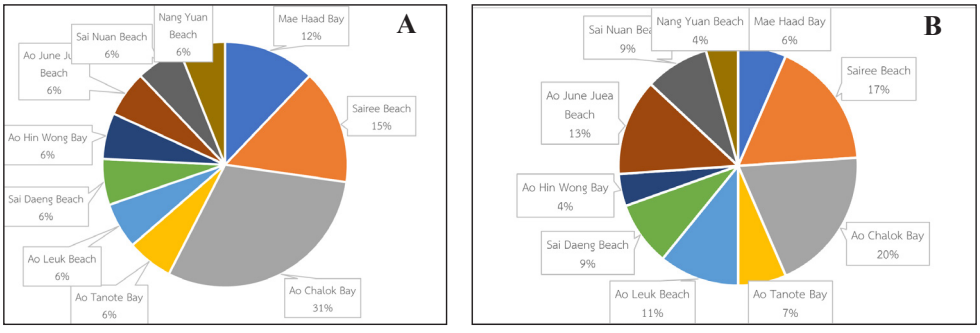


Figure 1. Percentage of crab diversity among ten stations in the Ko Tao area. (A=Sandy beach, B = Rocky Beach)

Table 2. Crab Diversity and abundance in the sandy and rocky beach ecosystem. (+++, ++ , +The number of crabs found on each station; +++ > 10, ++ 4–10 and + < 3).

Species	Stations										Beach
	Mae Haad	Sairee	Ao Chalok	Ao Tanote	Ao Leuk	Sai Daeng	Ao Hin Wong	Ao June juea	Sai Nuan	Nang Yuan	
Family Coenobitidae (1 genus 1 species)											
Coenobita rugosus	-	-	+	-	-	-	-	-	-	-	Sandy
Family Diogenidae (1 genus 2 species)											
Clibanarius longitarsus	-	-	+	-	-	-	-	-	-	-	Rocky
Clibanarius virescens	-	+++	+++	+++	-	++	-	+++	++	-	
Family Matutidae (2 genera 2 species)											
Ashtoret lunaris	-	+	++	-	-	-	-	-	-	-	Sandy
Matuta victor	-	+	++	-	-	-	-	-	-	-	Sandy
Family Oziidae (1 genus 1 species)											
Ozius rugolosus	-	-	-	-	-	+	-	-	-	-	Rocky
Family Pilumnidae (1 genus 1 species)											
Pilumnidae sp.1	-	+	-	-	-	-	-	-	+	-	Rocky
Family Portunidae (2 genera 3 species)											
Portunus pelagicus	-	-	++	-	-	-	-	-	-	-	Rocky
Thalamita crenata	-	+	+++	-	-	-	-	-	-	-	Rocky
Thalamita prymna	-	-	+	-	-	-	-	+	-	-	Rocky
Family Xanthidae (6 genera 6 species)											
Atergatis floridus	-	-	+	-	-	-	-	+	-	-	Rocky
Leptodius affinis	-	+	+++	-	-	+	-	-	+	-	Rocky
Actiomera sp.	-	-	-	-	-	-	-	-	-	+	Rocky
Liomera sp.	-	-	-	-	-	-	-	-	-	+	Rocky
Xanthidae sp.1	-	+	-	-	-	-	-	-	-	-	Rocky
Xanthidae sp.2	-	+	-	-	-	-	-	-	-	-	Rocky
Family Gecarcinidae (1 genus 1 species)											
Gecarcoidea lalandii	-	-	+	-	-	-	-	-	-	-	Sandy
Family Macrophithalmidae (1 genus 3 species)											
Macrophthalmus brevis	-	+++	+	-	-	-	-	-	-	-	Sandy
Macrophthalmus convexus	-	-	+++	-	-	-	-	-	-	-	Sandy
Macrophthalmus milloti	-	-	+	-	-	-	-	-	-	-	Sandy

Table 2. Crab Diversity and abundance in the sandy and rocky beach ecosystem. (+++, ++ , +The number of crabs found on each station; +++ > 10, ++ 4–10 and + < 3). (continuous)

Species	Stations										Beach
	Mae Haad	Sairee	Ao Chalok	Ao Tanote	Ao Leuk	Sai Daeng	Ao Hin Wong	Ao June juea	Sai Nuan	Nang Yuan	
Family Ocypodidae (2 genera 2 species)											
Ocypode ceratophthalmus	++	+	+	+	+	+	+	+	+	+	Sandy
Ocypode cordimana	+++	+	++	-	-	-	-	-	-	-	Sandy
Family Grapsidae (2 genera 2 species)											
Grapsus albolineatus	-	++	++	-	++	+	+	++	++	-	Rocky
Metopograpsus frontalis	-	+	+	-	-	-	-	-	-	-	Rocky
Family Plagusiidae (1 genus 1 species)											
Plagusia immaculata	-	-	-	-	+	-	-	+	-	-	Rocky
Family Varunidae (1 genus 1 species)											
Varuna yui	-	-	-	++	-	-	-	+	-	-	Rocky

Many structures have been built on Ko Tao, such as a road on the island, a waterspout, seawalls, and many future projects will be invested in the islands. This has resulted in a reduction and fragmentation of the natural habitat of the land crabs, *Gecarcoidea lalandii*, cutting off the spawn migration path, and impacting other activities in the land crab lifecycle (Figure 2A–C).

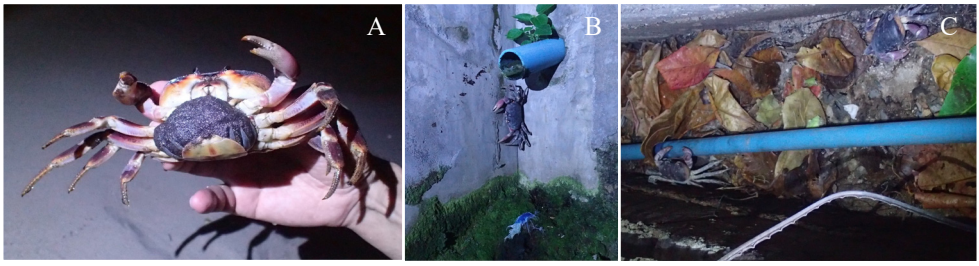


Figure 2. Human threats to *Gecarcoidea lalandii* (A=Ovigerous female crossing road on the way to breeding, B=Land crab on seawall, C=Land crab in waterspout).

Crab Diversity on Rocky Beaches

There were 17 species of crabs found on rocky beaches. In contrast, crab diversity was higher on Ao Chalok Bay and Sairee Beach, 20% and 17%, respectively (Figure 1B). Among these, the dominant species and most abundant crabs were *Clibanarius virescens*, *Leptodius affinis*, and *Grapsus albolineatus*. A rare crab species *Plagusia immaculata* was also found on the rocks. Poisonous crab species *Atergatis floridus* was also found along the rocky areas adjacent to the coral reef. Figure 2

The highest crab species diversity on a rocky beach was at Ao Chalok Bay. Ao Chalok Bay has various small and flat rocks, with low slopes on the northern part of the beach. These characteristics provide hiding places for crabs. When turning over rocks, a large number of Hermit crab species, *Clibanarius virescens*, were found together.

Crab Communites on Sandy and Rocky Beaches

The study of crab communities on sandy beaches revealed that Ao Chalok Bay had the highest Shannon-diversity index, 1.922 (Figure 3). When comparing the characteristics of community structure between areas with different levels of human threat, it was found that stations with high levels of threat, Mae Haad Beach, Sairee Beach, and Ao Chalok Bay, was separated from the medium and low level of threat groups and the three high threat stations (Figure 4). Additionally, all three levels of human threat provided isolated community structures. The ability of crabs to survive in different ecosystems is due to habitat changes caused by human threats and climate change. Furthermore, factors such as beach morphology, physical and chemical characteristics, pollution, and crab adaptability also affect crab survival. For example, crabs move quickly to escape human disturbances and dig burrows into the sand for shelter. The beach's slope and the sand grains' size impact crabs' burrowing behavior.

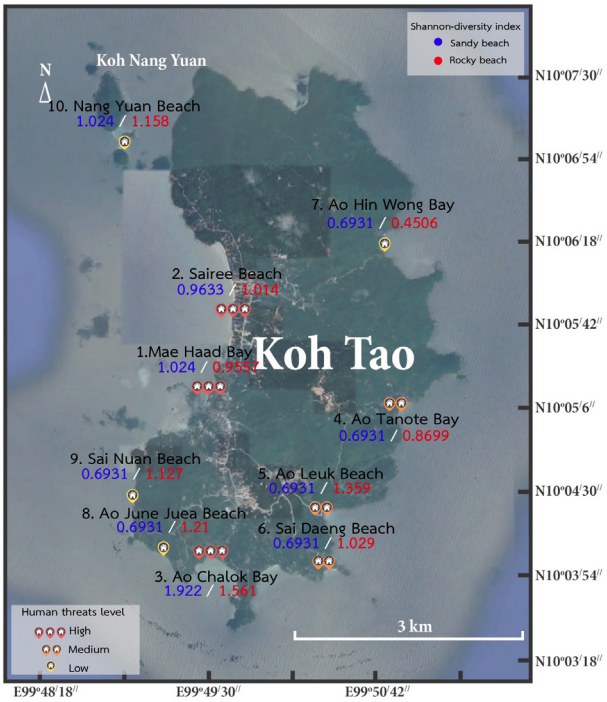
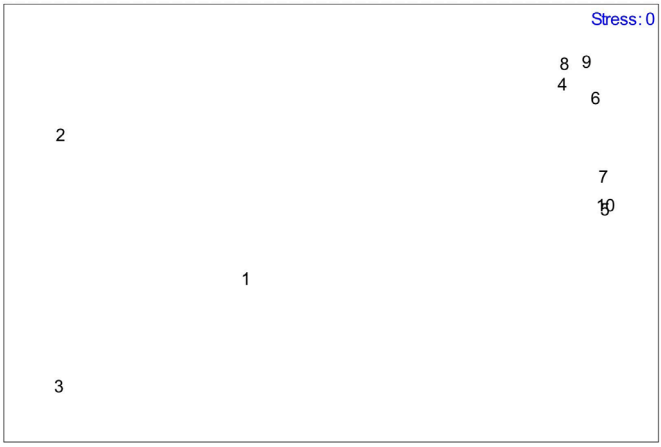


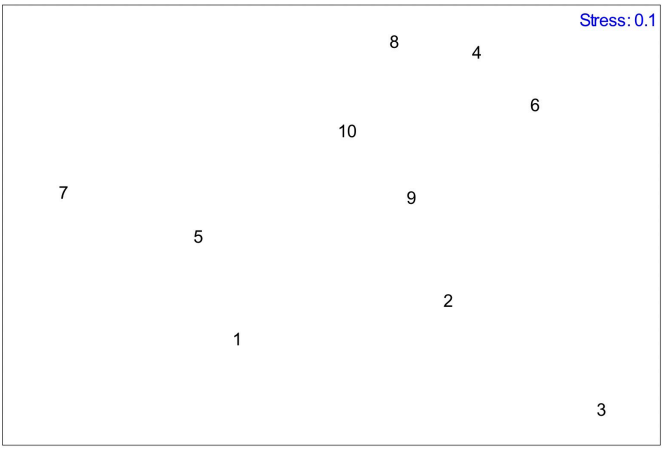
Figure 3. Map showing the levels of human threat and the Shannon-diversity index of crabs on sandy and rocky beaches in Ko Tao.



No.	Station
1	Mae Haad Bay
2	Sairee Beach
3	Ao Chalok Bay
4	Ao Tanote Bay
5	Ao Leuk Beach
6	Sai Daeng Beach
7	Ao Hin Wong Bay
8	Ao June Juea Beach
9	Sai Nuan Beach
10	Nang Yuan Beach

Figure 4. PCA analysis with MDS technique comparing crab communities from ten stations on sandy beaches.

From the study of the crab communities on the rocky beaches, it was found that Ao Chalok Bay demonstrated the highest Shannon diversity index, 1.561 (Figure 3). When comparing the characteristics of community structure between areas with different levels of human threat, it was found that Mae Haad Bay, with high disturbance levels, and Nang yuan Beach, with low disturbance levels, had distinct community structures separated from other groups (Figure 5). Meanwhile, other stations presented similar community structures (Figure 5). The varying crab communities in rocky beaches were more dependent on beach characters rather than human threat, as rocky beaches have little human utilization.



No.	Station
1	Mae Haad Bay
2	Sairee Beach
3	Ao Chalok Bay
4	Ao Tanote Bay
5	Ao Leuk Beach
6	Sai Daeng Beach
7	Ao Hin Wong Bay
8	Ao June Juea Beach
9	Sai Nuan Beach
10	Nang Yuan Beach

Figure 5. PCA analysis with MDS technique comparing crab communities from ten stations on rocky beaches.

Summary

The diversity richness of crabs on sandy beaches was five families, seven genera, and nine species, while eight families, 15 genera, and 17 crabs were found on rocky beaches. Ao Chalok had the highest Shannon diversity index on sandy and rocky beaches due to its complex habitat diversity. It has been found that human threats have less effect on the crab community

because crabs move and change their habitat. The crabs' community in each station on rocky beaches was separated depending on the characteristics of crab habitats, such as the beach's shape, sediment size, and beach slope.

Acknowledgments

The research is part of the research project The Diversity of Crabs under Habitat Destruction and Climate Change at Mu Koh Tao, Surat Thani Province, which receives funding from the National Research Council of Thailand (NRCT).

References

Dai, A. and S. Yang. 1991. **Crabs of the China Seas**. Beijing: China Ocean Press.

Komai, T., S. Goshima and M. Murai. 1995. Crabs of the genus Macrophthalmus of Phuket, Thailand (Crustacea: Decapoda: Ocypodidae). **Bulletin of Marine Science** 56(1): 103–149.

Mendoza, J.C., Jr, R.M.L. and P.K.L. Ng, 2014. New rock crab records (Crustacea: Brachyura: Xanthidae) from Christmas and Cocos (Keeling) Islands, Eastern Indian Ocean. **Raffles Bulletin of Zoology Supplement** 30: 274–300.

Wisespongpand, P., W. Jaingarm and T. Thamrongnawasawat. 2007. **Biodiversity of crabs in Mu Ko Surin national park**. *In* Proceedings of 45th Kasetsart University Annual Conference: Fisheries, 613–624.

Shih, H., P.K.L. Ng, P.J.F. Davie, C.D. Schubart, M. Türkay, R. Naderloo, D. Jones and M. Liu. 2016. Systematics of the family Ocypodidae Rafinesque, 1815 (Crustacea: Brachyura), based on phylogenetic relationships, with a reorganization of subfamily rankings and a review of the taxonomic status of Uca Leach, 1814, sensu lato and its subgenera. **Raffles Bulletin of Zoology** 64: 139–175.

Warner, G.F. 1977. **The Biology of Crabs**. Paul Elek (Scientific Books) Ltd., Great Britain. 201 pp.