

## Diversity of Echinoderms in Had Khanom: South Sea Islands National Park, Nakhon Si Thammarat Province

Arom Mucharin <sup>\*1</sup>, Sumaitt Putchakarn <sup>2</sup>, Pattareena Komkham <sup>3</sup> and Wanchai Sukkasem <sup>1</sup>

<sup>1</sup> Natural History Museum, National Science Museum, Thailand, Technopolis, Khlong 5, Khlong Luang, Pathum Thani 12120 Thailand

<sup>2</sup> Marine Biodiversity Research Unit, Institute of Marine Science, Burapha University, Bangsaen, Chonburi 20131 Thailand

<sup>3</sup> Tropical Ecology Laboratory Biology Science, Faculty of Science, Chulalongkorn University Phayathai Rd., Pathumwan, Bangkok 10330 Thailand

**ABSTRACT:** Echinoderms of Had Khanom – Mo Ko Thale Tai National Park, Nakhon Si Thammarat Province, located in the southern part of the Gulf of Thailand were studied at 12 sites namely, Ko Tan (4 sites), Ko Mudsum (2 sites), Ko Wang Nai (2 sites), Ko Wang Nok (2 sites) and Ko Rab (2 sites) in November, 2006 and May 2008. The investigations were carried out by SCUBA diving in the daytime and random searching throughout the reefs. The results yielded 24 species of Echinoderms from 5 classes, 10 orders, 14 families and 20 genera. The most abundant echinoderms in the study area are: *Lamprometra palmata*, *Ophiothrix (Ophiothrix) exigua*, *Holothuria (Metensiothuria) leucospilota*, and *Diadema setosum*. All observed species were commonly found in the Gulf of Thailand and the Indo-Pacific.

**KEY WORDS:** Echinoderm, Khanom Beach, South Sea Islands National Park, Nakhon Si Thammarat, Thailand.

### INTRODUCTION

Some of the most familiar seashore animals are members of the Phylum Echinodermata. The phylum contains about 7,000 living species and 13,000 or so species known from a rich fossil record dating back to early Cambrian times (Brusca & Brusca, 2003). Echinoderms include animals commonly known as feather stars and sealilies (Crinoidea); starfish or sea stars (Asteroidea); brittle and basket stars (Ophiuroidea); sea urchins, sand dollars and heart

urchins (Echinoidea); and sea cucumbers (Holothuroidea). They play an important role in marine ecosystems, and some are of economic importance, used as sources of natural products and medicinal substances.

Had Khanom – Mo Ko Thale Tai National Park, Nakhon Si Thammarat Province is located in the upper western part of the Gulf of Thailand and encompasses a portion of the shallow Sunda shelf which extends the South China Sea. This

---

\*Corresponding author.  
E-mail: arom@nsm.or.th

area forms a small part in the Indo-Malayan sub-region of the Indo-west Pacific Zoogeographic Region, which contains a very high diversity of marine animals (Hooper, 1997). Mo Ko Thale Tai was declared as a marine protected area by the National Park, Wildlife and Plant Conservation Department to act as a nursery ground and breeding site for marine organisms of the Gulf of Thailand. The Islands have important marine ecosystems such as coral reefs, seagrass beds, seaweed communities and also provide important economic marine resources, especially shrimps, crabs, fishes, and mantis shrimps.

The first study of Echinoderms in the Gulf of Thailand was conducted during the reign of King Rama V by the Danish scientist, Dr. Th. Mortensen, who had surveyed and collected sea animals and reported four new sea urchins in the Gulf of Siam, namely: *Chaetodiadema granulatum*, *Pleurechinus doderleini*, *Pleurechinus siamensis*, *Gymnechinus pulchellus* (Mortensen, 1904).

Sriyakorn (1970) reported fifty-four species of echinoderms collected during the fifth Thai-Danish expedition along the west coast of peninsular Thailand. Klinasak (1965) recorded forty-nine echinoderm species in the Gulf of Thailand. Satayamas (1982) listed twenty-seven species of echinoderms in Songkhla province. Waiyaniya (1984) notified

twelve species of starfishes from Ao Pattaya and Mu Koh Phai, Chon Buri Province. Waiyaniya (1985-1986) also reported twenty-four species of echinoderms from the Gulf of Thailand. Rodma (1996) reported fifty-nine echinoderms from Chon Buri and Rayong Provinces. Putchakarn (1998) reported fifty-six echinoderms from the eastern coast of Thailand. Mucharin (1998) reported seventeen species of sea cucumbers from Mu Ko Lan and Mu Ko Phai, Chon Buri Province. Putchakarn, *et al.*, (2000) provided the details of thirteen species of sea cucumbers (Aspidochirotida) from Mu Ko Lan and Mu Ko Phai, Chon Buri Province. Putchakarn and Sonchaeng (2004) compiled Thai echinoderm checklist. Mucharin and Putchakarn (2005) added a new record of holothurian in Thailand, i.e. *Holothuria (Stauropora) discrepans* Semper, 1868. Lastly, Mucharin *et al.*, (2005) gave an account of thirty-four sea cucumbers from the eastern coast of Thailand.

## OBJECTIVES

This study set out to determine the diversity and distribution of Echinoderms in the coral reef habitats of the Mo Ko Thale Tai areas in the Had Khanom – Mo Ko Thale Tai National Park, Nakhon Si Thammarat Province, the Gulf of Thailand to serve as a baseline with updated data for the diversity and distribution of coral reef marine fauna in the Gulf of Thailand.

## MATERIALS AND METHODS

### Survey and collection sites

Specimen collection was

carried out in November 2006 in the coral reef habitats in Mo Ko Thale-Tai, covering 12 sites as shown in Table 1 and Figure 1.

**Table 1.** List of specimen collection sites of the study.

Field code	Locality	DATE	Latitude (UTM)	Longitude (UTM)
TAN-A	North east side of Ko Tan	7.11.06	47 P 0604554 N	1037590 E
TAN-B	South east side of Ko Tan	7.11.06	47 P 0605256 N	1036139 E
TAN-C	North side of Ko Tan	6.11.06	47 P 0603632 N	1038152 E
TAN-D	Ao Tok, southwest side of Ko Tan	6.11.06	47 P 0602527 N	1035689 E
MUS-A	North side of Ko Mudsum	8.11.06	47 P 0607301 N	1037100 E
MUS-B	South west side of Ko Mudsum	8.11.06	47 P 0606843 N	1036039 E
WON-A	North side of Ko Wong Nai	10.11.06	47 P 0597652 N	1029920 E
WON-B	South west side of Ko Wong Nai	10.11.06	47 P 0597709 N	1029171 E
WOK-A	South west side of Ko Wong Nok	11.11.06	47 P 0600061 N	1029358 E
WOK-B	North side of Ko Wong Nok	11.11.06	47 P 0600047 N	1030043 E
RAB-A	North side of Ko Rab	12.11.06	47 P 0605411 N	1029603 E
RAB-B	North west side of Ko Rab	12.11.06	47 P 0604280 N	1029397 E

### Collection, fixation and preservation

The field surveys were conducted at 12 sites of Mo Ko Thale-Tai (Figure 1). The echinoderm specimens were collected by SCUBA diving during the daytime and random sampling throughout the coral reefs. Specimens were photographed *in situ* and kept in zip lock plastic bags with sea water. Field notes were made on morphology, colour, host organisms (brittle stars) and essential ecological aspects such as depth, and substrates. The specimens were relaxed in menthol and then preserved in 70%

alcohol. The specimens were deposited in the collection of the Natural History Museum (THNHM), National Science Museum, Thailand, Khlong Luang, Pathum Thani province, Thailand.

### Laboratory Work

The feather stars, sea stars, brittle stars and sea urchins were specifically identified, mainly on their morphological characteristics using a stereo microscope and scanning electron microscope. The sea cucumbers were identified mainly on the basis of spicules and morphological characteristics such as

form and number of tentacles, distribution of tube feet and papillae, color, shape, body length, calcareous ring and the presence or absence of cuvierian tubules. For spicule examination, thin sections of the dorsal and ventral body walls, tentacle and tube feet were digested in sodium hypochlorite (chlorox), dissolving the tissues and leaving the

calcareous spicules intact. These were then washed three times with distilled water, then dried on a hotplate, and finally mounted in permount. The samples were then examined under a microscope at 100-400x magnification and photos were taken. The echinoderm taxonomic scheme used in this paper follows that of Clark and Rowe (1971).



**Figure 1.** Specimen collection sites along Had Khanom – Mo Ko Thale Tai National Park, Nakhon Si Thammarat Province.

## RESULTS

Four hundred and fifty-three specimens were collected, including twenty-four species of echinoderms

from 5 classes, 10 orders, 14 families and 20 genera. Their respective distribution among the collection sites is shown in Table 2.

## TAXONOMIC ACCOUNT

Phylum Echinodermata Jacob Klein, 1734

I. Class Crinoidea Müller, 1821

I.I Order Comatulida A.H. Clark, 1908

- I.I.I Family Mariametridae A.H. Clark, 1909
  - 1. *Lamprometra palmata* J.Müller, 1841
  - 2. *Liparometra regalis* (P.H. Carpenter, 1888)
- II. Class Asteroidea de Blainville, 1830
  - II.I Order Paxillosida Perrier, 1884
    - II.I.I Family Astropectinidae Gray, 1840
      - 3. *Astropecten polyacanthus* Müller & Troschel, 1842
  - II.II Order Valvatida Perrier, 1884
    - II.II.I Family Oreasteridae Fisher, 1911
      - 4. *Anthenea chinensis* Gray, 1840
      - 5. *Culcita novaeguineae* Müller & Troschel, 1842
      - 6. *Goniodiscaster forficulatus* (Perrier, 1875)
- III. Class Ophiuroidea Gray, 1840
  - III.I Order Phrynophiurida Matsumoto, 1915
    - III.I.I Family Euryalidae Gray, 1840
      - 7. *Euryle aspera* Lamarck, 1816
  - III.II Order Ophiurida Müller & Troschel, 1840
    - III.II.I Family Ophiactidae Matsumoto, 1915
      - 8. *Ophiactis savinyi* (Müller & Troschel, 1842)
    - III.II.II Family Ophiotrichidae Ljungman, 1866
      - 9. *Ophiopsammium semperi* Lyman, 1874
      - 10. *Ophiothela danae* Verrill, 1869
      - 11. *Ophiothrix (Ophiothrix) exigua* Lyman, 1847
    - III.II.III Family Ophiocomidae Ljungman, 1867
      - 12. *Ophiocomella sexradia* (Duncan, 1887)
- IV. Class Echinoidea Leske, 1778
  - IV.I Order Diadematoida Duncan, 1889
    - IV.I.I Family Diadematidae Gray, 1855
      - 13. *Diadema setosum* (Leske, 1778)
      - 14. *Echinothrix calamaris* (Pallas, 1774)
  - IV.II Order Temnopleuroidea Mortensen, 1942
    - IV.II.I Family Temnopleuridae A. Agassiz, 1872
      - 15. *Salmacis sphaeroides* (Linnaeus, 1758)
  - IV.III Order Echinoida Claus, 1876
    - IV.III.I Family Laganidae A. Agassiz, 1873
      - 16. *Laganum decagonale* (de Blainville, 1827)
  - IV.IV Order Spatangoida Claus, 1876
    - IV.IV.I Family Loveniidae Lambert, 1905
      - 17. *Lovenia elongata* (Gray, 1845)
- V. Class Holothuroidea de Blainville, 1834
  - V.I Order Aspidochirotida Grube, 1840
    - V.I.I Family Holothuriidae Ludwig, 1884



**Table 2** (continued).

Taxa	Distribution											
	1	2	3	4	5	6	7	8	9	10	11	12
8. <i>Opiactis savinyi</i> (Müller & Troschel,1842)	-	-	-	X	-	-	X	-	-	-	-	-
Family Ophiotrichidae												
9. <i>Ophiopsammium semperi</i> Lyman, 1874	-	-	-	X	-	-	-	-	-	-	-	-
10. <i>Ophiothela danae</i> Verrill,1869	-	-	X	-	-	X	-	-	-	-	-	-
11. <i>Ophiothrix exigua</i> Lyman,1847	-	-	-	X	-	X	X	-	-	-	-	-
Family Ophiocomidae												
12. <i>Ophiocomella sexradia</i> (Duncan,1887)	-	-	-	-	-	-	-	-	-	-	-	X
Class ECHINOIDEA												
Order DIADEMATOIDA												
Family Diadematidae												
13. <i>Diadema setosum</i> (Leske, 1778)	-	X	X	X	X	-	X	X	-	X	-	-
14. <i>Echinothrix calamaris</i> (Pallas, 1774)	-	-	-	X	-	-	-	-	-	-	-	-
Order TEMNOPLEURIDAE												
Family Temnopleuridae												
15. <i>Salmacis sphaeroides</i> (Linnaeus, 1758)	-	-	-	X	-	-	-	-	-	-	-	-
Order ECHINOIDEA												
Family Laganidae												
16. <i>Laganum decagonale</i> (de Blainville, 1827)	-	-	-	X	-	-	-	-	-	-	-	-
Order SPATANGOIDA												
Family Loveniidae												
17. <i>Lovenia elongata</i> (Gray, 1845)	-	-	-	X	-	-	-	-	-	-	-	-
Class HOLOTHURIOIDEA												
Order ASPIDOCHIROTIDA												
Family Holothuriidae												
18. <i>Holothuria (Halodeima) atra</i> Jaeger, 1833	X	-	X	-	X	X	-	X	-	-	-	-
19. <i>H. (Metensiothuria) leucospilota</i> Brandt, 1835	-	X	X	X	X	X	-	X	X	-	X	X
20. <i>H. (Semperothuria) flavomaculata</i> Semper, 1868	-	-	-	-	-	-	-	-	X	-	-	-
21. <i>H. (Stauropora) fuscocinerea</i> Jaeger, 1868	X	X	-	-	-	-	-	-	-	-	-	-
Family Stichopodidae												
22. <i>Stichopus horrens</i> Selenka, 1867	-	-	X	X	X	-	-	-	-	-	-	-
Order APODIDA												
Family Synaptidae												
23. <i>Synaptula recta</i> (Semper, 1867)	X	-	-	X	-	-	-	X	-	-	-	-
24. <i>Synaptula</i> sp.”white”	X	-	-	X	X	X	-	X	-	X	-	-

**DISCUSSION**

The study of the echinoderms in Had Khanom – Mo

Ko Thale Tai National Park, Nakhon Si Thammarat Province, Thailand was conducted by actual hand collecting techniques throughout the

field trips. In total, 453 specimens were classified into 5 classes, 10 orders, 14 families, 20 genera and 24 species. Only two of the specimens have not yet been identified down to the species level. Most species are common in coral reefs in the Gulf of Thailand. The most abundant echinoderms in this area are: *Lamprometra palmata* J.Müller, 1841; *Diadema setosum* (Leske, 1778) and *Holothuria* (*Metensiothuria*) *leucospilota* Brandt, 1835. All species found are inhabitants of the South China Sea in the Pacific Ocean.

Echinoderms in the study area distributed throughout the reef zones. They are most abundant in the reef slope zone, because the environmental factors in this zone: temperature, depth and water transparency are most suitable.

Since echinoderms are benthic marine animals, most species are found on a sandy bottom both in the coral reef zones and in the outer reefs nearby. The sea cucumbers, *Holothuria* (*Halodeima*) *atra* and *H.* (*Metensiothuria*) *leucospilota* were found on sand between coral heads in the flat reef zone. The starfish, *Astropecten polyacanthus*, *Anthenea chinensis*, and *Goniodiscaster forficulatus* and the sea urchin, *Salmacis sphaeroides* live on sandy bottoms outside the reef and hunt their prey on sand. The sand dollars, *Laganum decagonale* and the heart urchin, *Lovenia elongata* are found buried in the sand. During the survey, both sand dollars and heart urchins

were of adolescent size so we could assume that the rainy season in the study area is the breeding season of these species. The feather star, *Lamprometra palmata* and *Liparometra regalis* and the sea cucumbers, *Holothuria* (*Semperothuria*) *flavomaculata*, *H.* (*Stauropora*) *fuscocinerea* and *Stichopus horrens* are nocturnal and remain hidden between coral heads or under hard substrates during the daytime. The pin-cushioned starfish, *Culcita novaeguineae* and the sea urchin, *Diadema setosum* and *Echinothrix calamaris* are distributed throughout the reef and are active at night.

Some echinoderms associate with other living organisms. The basket star, *Euryale aspera*, the gorgonian brittle star *Ophiopsammium semperi* are rare species of the Gulf of Thailand associated with gorgonians. This survey found many gorgonians distributed along the reef slope and to the outer reef of the study area. The brittle stars, *Ophiothrix* (*Ophiothrix*) *exigua*, *Opiactis savinyi* and *Ophiocomella sexradia* live inside the exhalant pores of sponges while the sea cucumbers, *Synaptula recta* and *Synaptula* sp. "white" infest the surface of sponges. These echinoderms used associated sponges for different purposes. The brittle stars use sponges as hosts for shelter and feed on suspended particles in water current made by sponges, while sea cucumbers feed on the sponge surface.

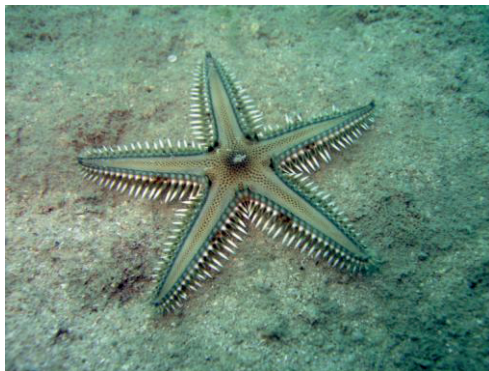




*Lamprometra palmata* J.Müller, 1841



*Liparometra regalis* (P.H. Carpenter, 1888)



*Astropecten polyacanthus* Müller & Troschel, 1842



*Anthenea chinensis* Gray, 1840



*Culcita novaeguineae* Müller & Troschel, 1842

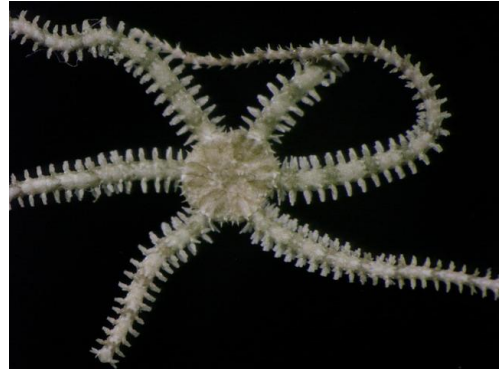


*Goniodiscaster forficulatus* (Perrier, 1875)

**Plate I.** Echinoderms found at Khanom Beach, South Sea Islands N.P.



*Euryle aspera* Lamarck, 1816



*Opiactis saviny* (Müller & Troschel, 1842)



*Ophiopsammium semperi* Lyman, 1874



*Ophiothela danae* Verrill, 1869

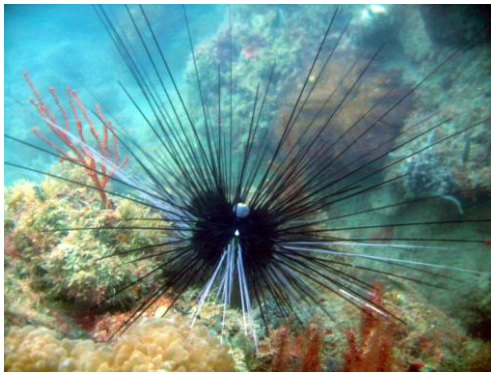


*Ophiothrix exigua* Lyman, 1847

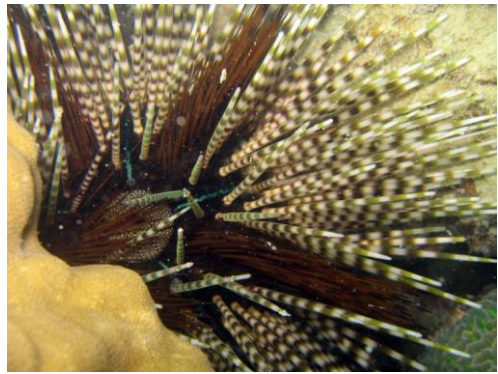


*Ophiocomella sexradia* (Duncan, 1887)

**Plate II.** Echinoderms found at Khanom Beach, South Sea Islands N.P.



*Diadema setosum* (Leske, 1778)



*Echinothrix calamaris* (Pallas, 1774)



*Salmacis sphaeroides* (Linnaeus, 1758)



*Laganum decagonale* (de Blainville, 1827)



*Lovenia elongata* (Gray, 1845)



*H. (Halodeima) atra* Jaeger, 1833



*H. (Metensiothuria) leucospilota* Brandt, 1835



*H. (Semperothuria) flavomaculata* Semper, 1868



*H. (Stauropora) fuscocinerea* Jaeger, 1868



*Stichopus horrens* Selenka, 1867



*Synaptula recta* (Semper, 1867)



*Synaptula* sp. "white"

## ACKNOWLEDGEMENTS

This work was supported by the TOTAL Coporate Foundation, TOTAL E&P Thailand and the Biodiversity Research and Training Program (BRT). We express our gratitude to Dr. Jarujin Nabhitabhata, director of the Thailand Natural History Museum, National Science Museum, Pathum Thani, for his kindness in providing useful comments on the manuscript.

## REFERENCES

- Brusca R.C. & G. J. Brusca, 2003. *Invertebrates*. Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, U.S.A. 936 pp.
- Clark, A.M. and F.W.E. Rowe, 1971. *Monograph of shallow-water Indo-West Pacific echinoderms*. British Museum (Natural History), London. 238 pp.
- Hooper, J. N. A. (1997). *Sponge guide*. Australia:Queensland Museum.
- Klinasak, L. 1965. Some echinoderms collected in the Gulf of Thailand. Senior project, Faculty of Science, Chulalongkorn University. 67 pp.
- Lane, D.J.W., L.M. Marsh, D.V. Spiegel and F.W.E. Rowe, 2000. Echinoderm Fauna of the South China Sea : An Inventory and Analysis of Distribution Patterns. *The Raffles Bulletin of Zoology*, Supplement 8: 459-493.
- Mortensen, T. 1904. The Danish Expedition to Siam, 1899-1900. II. Echinoidea. *K danske Vidensk Selsk Skr* (7)1(I): 1-124.
- Mucharin, A and S. Putchakarn. 2005. New Thai record : *Holothuria (Stauropora) discrepans* Semper, 1868. *The Thailand Natural History Museum Journal* 1(1): 1-8, January 2005.
- Mucharin, A., S. Putchakarn and P. Sonchaeng 2005. Holothurians (Holothuroidea : Echinodermata) of the Eastern Coast of Thailand. *The Thailand Natural History Museum Journal* 1(2): 97-136.
- Putchakarn, S. 1998. Taxonomic study on echinoderms from the eastern coast of Thailand. Report submitted to the National Research Council Thailand. 109 pp.
- Putchakarn, S., A. Mucharin and P. Sonchaeng. 2000. Coral reef aspidochirotes (Holothuroidea, Echinodermata) from Lan and Phai Islands, Chonburi Province, Gulf of Thailand. Paper for oral presentation in the 38<sup>th</sup> Kasetsart University Annual Conference. February 1-4, 2000. 8 pp.
- Putchakarn, S. and P. Sonchaeng. 2004. Echinoderm Fauna of Thailand: History and Inventory Reviews. *Science Asia* 30: 417-428.
- Rodma, P. 1996. *Echinoderms from Chonburi and Rayong*

- provinces. Special problem in biological science.* Faculty of Science, Burapha University. 60 pp.
- Satayamas, K. 1982. *Study on echinoderms in Songkla province. Special problem in biological science.* Faculty of Science, Prince of Songkla University. 70 pp.
- Sriyakorn, S. 1970. *A taxonomic study on echinoderms collected during the Fifth Thai-Danish Expedition along the west coast of peninsular Thailand.* M.Sc. Thesis, Faculty of Science, Chulalongkorn University. 144 pp.
- Waiyaniya, W. 1984. Starfishes from Ao Pattaya and Koh Chang, Conburi Province. *Technical paper of Marine Fisheries Research station 26/2*, Marine Fisheries Division, Department of Fisheries. 16 pp.
- Waiyaniya, W. 1985. Echinoderms from the Gulf of Thailand. *Technical paper of Marine Fisheries Research station 27/2*, Marine Fisheries Division, Department of Fisheries. 33 pp.
- Waiyaniya, W. 1986. Echinoderms from the Gulf of Thailand II. *Technical paper of Marine Fisheries Research station 28/3*, Marine Fisheries Division, Department of Fisheries. 51 pp.