

Species diversity of marine sponges dwelling in coral reefs in Had Khanom—Mo Ko Thale Tai National Park, Nakhon Si Thammarat Province, Thailand

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The species diversity and distribution of demosponges dwelling in the coral reefs, at Had Khanom—Mo Ko Thale Tai National Park on the southern coast of the Gulf of Thailand, was investigated, with field surveys undertaken at 12 sites in November 2006 using SCUBA diving and random observation. Forty-five species of demosponges from 10 orders, 24 families and 34 genera were recorded. The most abundant and common sponges in this area are: *Oceanapia sagittaria*; *Neopetrosia* sp. ‘blue’; *Xestospongia testudinaria*; and *Haliclona* (*Gellius*) *cymaeformis*. Most species are common representatives of the Indo-Pacific fauna found throughout the Gulf of Thailand.

INTRODUCTION

Had Khanom—Mo Ko Thale Tai National Park, in the Nakhon Si Thammarat Province of the upper southern part of the Gulf of Thailand is approximately 200 km² in area and sits on the shallow Sunda shelf, opening into the South China Sea (Figure 1). This area is part of the Indo-Malayan sub-region of the Indo-West Pacific zoogeographical region, which contains a very high diversity of marine animals including sponges (Hooper & Lévi, 1994). Mo Ko Thale Tai is a marine protected area as a National Park, controlled by the Wildlife and Plant Conservation Department for the purposes of sanctuary and breeding of living resources of the Gulf of Thailand. The Islands contain productive marine ecosystems such as coral reefs and sea grass beds and also provide a nursery for economically important fauna such as shrimps, crabs, fish and mantis shrimps. The coral reef system in this area is distinct from the other coral reefs in the Gulf of Thailand in having a wide reef flat and associated algae and sea grass beds.

The literature on sponges in the Gulf of Thailand is so far sparse (see review in Hooper et al., 2000), but includes notably Topsent (1925) describing the first new sponge species from the Gulf of Siam, *Prostylissa siamensis* Topsent, 1925 (= *Amorphinopsis siamensis* (Topsent, 1925)). McCauley et al. (1993) reported on four species of sponges in the Suratthani province area. Hooper et al. (1993) redescribed *Oceanapia sagittaria* Sollas, 1888 from the Gulf of Thailand. Chaitanawisuti et al. (2002) reported 126 species of coral reef sponges in the eastern Gulf of Thailand. Putchakarn et al. (2004a) reported 52 demosponge species and two species of calcareous sponges in the coral reef habitats along Chonburi province. Putchakarn et al. (2004b) described a new species, *Cladocroce burapha* from Bangsae Beach, Chonburi and also reported on another 56 demosponge species from the Gulf of Thailand in his dissertation (Putchakarn, 2006). Moreover, Putchakarn et al. (2006) reported 37 species of demosponges from Ko Kharm, Sattahip area, Chonburi provinces. Most of these inventories, however, contain identifications only to generic and ‘operational taxonomic unit’ (OTU) level. The present paper is the first to provide a comprehensive species-level inventory for the Gulf of Thailand.

The objective of the present study was to investigate the diversity and distribution of demosponges in the coral reef habitats along the Mo Ko Thale Tai area and it serves as a baseline study for subsequent investigations on the diversity and distribution of coral reef-associated marine sponges in the Gulf of Thailand.

MATERIALS AND METHODS

Collections

Collections were made from in the coral reef habitats along Mo ko Thale-Tai, covering 12 sites, in November 2006 (Table 1; Figure 1). Specimens were collected using SCUBA diving and by random sampling, photographed *in*

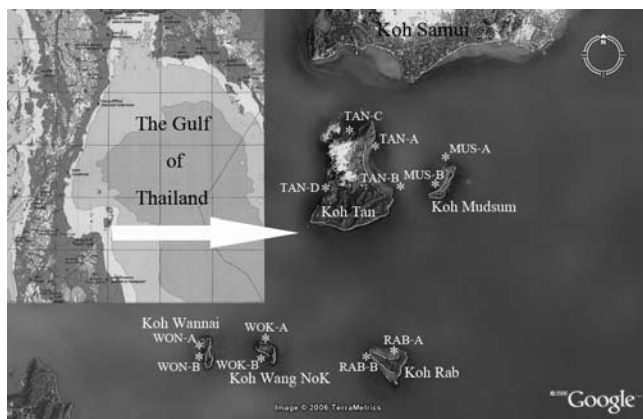


Figure 1. Specimen collection sites of the study along Mo Ko Thale Tai.

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

Field code	Locality	Latitude	Longitude
TAN-A	North-east side of Ko Tan	09° 23'07.02"N	99° 57'08.08"E
TAN-B	South-east side of Ko Tan	09° 22'19.77"N	99° 57'30.98"E
TAN-C	North side of Ko Tan	09° 23'25.46"N	99° 56'37.88"E
TAN-D	Ao Tok, south-west side of Ko Tan	09° 22'05.32"N	99° 56'01.45"E
MUS-A	North side of Ko Mudsum	09° 22'50.89"N	99° 58'38.08"E
MUS-B	South-west side of Ko Mudsum	09° 22'16.31"N	99° 58'22.94"E
WON-A	North side of Ko Wong Nai	09° 18'57.93"N	99° 53'21.18"E
WON-B	South-west side of Ko Wong Nai	09° 18'33.59"N	99° 53'22.97"E
WOK-A	South-west side of Ko Wong Nok	09° 18'39.48"N	99° 54'40.06"E
WOK-B	North side of Ko Wong Nok	09° 19'01.75"N	99° 54'39.62"E
RAB-A	North side of Ko Rab	09° 18'46.91"N	99° 57'35.45"E
RAB-B	North-west side of Ko Rab	09° 18'40.38"N	99° 56'58.31"E

Table 2. Species list and distribution of sponges from the 12 study sites at Mo Ko Thale Tai, Gulf of Thailand.

Taxa	Distribution											
	1	2	3	4	5	6	7	8	9	10	11	12
Class DEMONSPONGIAE Sollas, 1885												
Order SPIROPHORIDA Bergquist & Hogg, 1969												
Family TETILLIDAE Sollas, 1886												
1. <i>Cinachyrella australiensis</i> (Carter, 1886)	X	X	-	-	-	X	-	-	-	-	-	-
2. <i>Paratetilla bacca</i> (Selenka, 1867)	-	-	X	-	-	-	-	-	-	-	-	-
Order CHONDROSIDA Boury-Esnault & Lopès, 1985												
Family CHONDROSIIDAE												
3. <i>Chondrilla australiensis</i> (Carter, 1873)	-	-	-	X	-	-	-	-	-	-	-	-
4. <i>Chondrosia reticulata</i> (Carter, 1886)	-	-	-	-	-	X	-	-	-	-	-	-
Order HADROMERIDA Topsent, 1894												
Family CLIONAIDAE D'Orbigny, 1851												
5. <i>Cervicornia cuspidifera</i> (Lamarck, 1814)	X	-	-	-	-	-	-	-	-	-	X	-
Family SPIRASTRELLIDAE Ridley & Dendy, 1886												
6. <i>Spirastrella solida</i> (Ridley & Dendy, 1886)	-	X	-	-	-	-	-	-	-	-	-	-
Family SUBERITIDAE Schmidt, 1870												
7. <i>Terpios granulosa</i> (Bergquist, 1967)	-	-	X	-	-	-	-	-	-	-	-	-
Order POECILOSCLERIDA Topsent, 1928												
Suborder MICROCIONINA Hajdu, van Soest & Hooper, 1994												
Family MICROCIONIDAE Carter, 1875												
8. <i>Clathria (Microciona) aceratoobtusa</i> (Carter, 1887)	-	X	X	X	-	X	-	-	-	X	-	-
9. <i>Clathria (Thalysias) toxifera</i> (Hentschel, 1912)	-	-	X	-	-	-	X	-	-	-	-	-
Family RASPAILIIDAE Hentschel, 1923												
10. <i>Thrinacophora incrustans</i> (Kieschnick, 1896)	-	-	X	-	-	X	-	-	-	-	-	-
11. <i>Echinodictyum conulosum</i> Kieschnick, 1900	-	-	-	X	-	-	-	-	-	-	-	-
Suborder MYCALINA Hajdu, van Soest & Hooper, 1994												
Family MYCALIDAE Lundbeck, 1905												
12. <i>Mycale (Aegogropila) grandis</i> Gray, 1867	-	X	-	X	-	X	-	-	-	-	-	-
13. <i>Mycale (Zygomycale) parishii</i> (Bowerbank, 1875)	-	-	-	-	X	-	-	-	-	-	-	-
14. <i>Mycale (Carmia) sp.</i>	-	-	-	-	-	X	-	-	-	-	-	-
Family DESMACELLIDAE Ridley & Dendy, 1886												
15. <i>Bienna tubulata</i> (Dendy, 1905)	-	X	-	-	-	-	-	-	-	-	-	-
Suborder MYXILLINA Hajdu, van Soest & Hooper, 1994												
Family IOTROCHOTIDAE Dendy, 1922												
16. <i>Iotrochota baculifera</i> Ridley, 1884	-	-	X	-	-	-	-	-	-	-	-	-
Order HALICHONDRIDA Gray, 1867												
Family HALICHONDRIIDAE Gray, 1867												
17. <i>Axinyssa sp.</i>	-	-	-	-	-	-	X	-	X	X	-	-
18. <i>Halichondria sp.</i>	X	-	-	-	-	-	-	-	-	-	-	-
19. <i>Topsentia sp.</i>	-	-	-	-	X	-	-	-	-	-	-	-

Table 2. (Continued.)

Family DICTYONELLIDAE van Soest, Diaz & Pomponi, 1990												
20. <i>Scopalina australiensis</i> Pulitzer-Finali, 1982	-	-	-	-	X	-	-	-	-	-	-	-
Family AXINELLIDAE Carter, 1875												
21. <i>Dragnacidon australis</i> (Bergquist, 1970)	-	-	-	-	-	X	-	-	-	-	-	-
Order HAPLOSCLERIDA Topsent, 1928												
Suborder HAPLOSCLERINA Topsent, 1928												
Family CALLYSPONGIIDAE De Laubenfels, 1936												
22. <i>Calyspongia</i> (<i>Toxochalina</i>) <i>pseudofibrosa</i> Desqueyroux-Faúndez, 1984	-	-	-	X	X	X	-	-	-	-	-	-
Family CHALINIDAE Carter, 1875												
23. <i>Haliclona</i> (<i>Gellius</i>) <i>cymaeformis</i> Esper, 1794	X	-	X	X	-	-	X	X	-	-	X	-
24. <i>Haliclona</i> (<i>Reniera</i>) <i>infundibularis</i> (Ridley & Dendy, 1886)	-	-	-	-	-	-	-	-	-	-	-	X
25. <i>Haliclona</i> (<i>Reniera</i>) sp. 'pink'	-	-	-	-	X	-	-	-	-	-	-	-
26. <i>Haliclona</i> (<i>Reniera</i>) sp. 'brown'	-	-	-	X	-	-	-	-	-	-	-	-
27. <i>Haliclona</i> (<i>Halichoelona</i>) sp. 'orange'	-	-	-	-	-	-	-	X	-	-	-	-
28. <i>Haliclona</i> (<i>Halichoelona</i>) sp. 'white'	-	-	-	-	-	-	X	X	-	-	-	-
Family NIPHATIDAE van Soest, 1980												
29. <i>Gelliodes petrosioides</i> Dendy, 1905	-	X	-	-	-	-	-	-	X	X	-	-
Suborder PETROSINA Boury-Esnault & van Beveren, 1982												
Family PETROSIIDAE van Soest, 1980												
30. <i>Neopetrosia</i> sp. 'blue'	X	X	X	X	X	X	X	X	X	X	-	X
31. <i>Petrosia</i> (<i>Petrosia</i>) <i>hoeksemai</i> de Voogd & van Soest 2002	-	X	-	-	-	-	-	-	X	X	-	-
32. <i>Xestospongia testudinaria</i> (Lamarck, 1814)	-	X	X	X	X	X	X	X	X	X	-	X
33. <i>Xestospongia</i> sp. 'purple'	-	X	X	-	-	-	-	-	-	-	-	-
Family PHLOEODICTYIDAE Carter, 1882												
34. <i>Aka mucosa</i> (Bergquist, 1965)	X	-	-	X	-	-	-	X	-	-	-	-
35. <i>Aka</i> sp.	-	X	-	-	-	-	-	-	-	-	-	-
36. <i>Oceanapia sagittaria</i> (Sollas, 1902)	X	X	X	X	X	X	X	X	X	X	X	X
Order DICTYOCERATIDA Minchin, 1900												
Family DYSIDEIDAE Gray, 1867												
37. <i>Dysidea</i> sp. 'pink'	-	-	-	-	X	X	X	-	-	X	-	-
38. <i>Lamellodysidea herbacea</i> (Keller, 1889)	X	-	X	X	-	-	-	-	-	-	-	X
Family IRICINIIDAE Gray, 1867												
39. <i>Ircinia mutans</i> (Wilson, 1925)	-	-	X	-	-	-	-	-	-	-	-	-
Family SPONGIIDAE Gray, 1867												
40. <i>Hyattella intestinalis</i> (Lamarck, 1814)	-	X	-	-	-	X	-	-	-	-	-	-
41. <i>Spongia</i> sp.	X	X	-	-	X	-	X	-	-	-	-	X
Family THORECTIDAE Bergquist, 1978												
42. <i>Hyrtios erecta</i> (Keller, 1889)	-	-	X	-	-	-	-	-	-	-	-	-
Order DENDROCERATIDA Minchin, 1900												
Family DARWINELLIDAE Merejkowsky, 1879												
43. <i>Aphysilla</i> aff. <i>rosea</i> Barrios, 1876	-	X	-	-	-	-	-	-	-	-	-	-
Order VERONGIDA Bergquist, 1978												
Family PSEUDOCERATINIDAE Carter, 1885												
44. <i>Pseudoceratina</i> sp.	-	-	-	X	-	-	-	-	-	-	-	-
Order HALISARCA Bergquist, 1996												
Family HALISARCIDAE Bergquist, 1996												
45. <i>Halisarca ectofibrosa</i> Vacelet et al., 1976	-	-	X	-	-	-	-	-	-	-	-	-

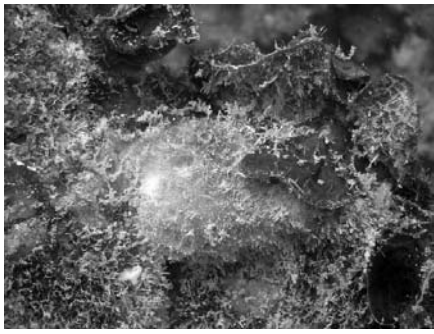
1, TAN-A; 2, TAN-B; 3, TAN-C; 4, TAN-D; 5, MUS-A; 6, MUS-B; 7, WON-A; 8, WON-B; 9, WOK-A; 10, WOK-B; 11, RAB-A; 12, RAB-B. X, present; -, absent

situ and notes made on some morphological and ecological features such as colour, depth, and substrate. Specimens were preserved in 70% alcohol and deposited at the Institute of Marine Science, Burapha University, Thailand.

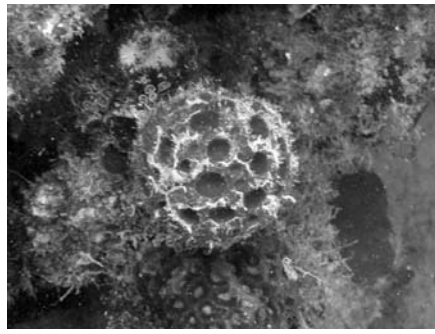
Laboratory preparation

Tangential and perpendicular histological sections of sponges were made with a scalpel. Thick sections were dried

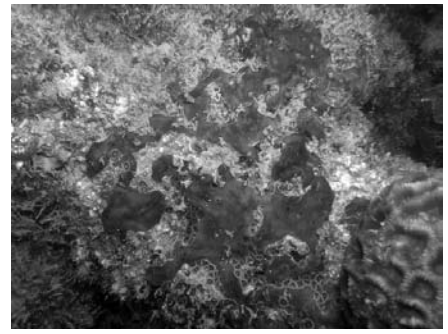
on a hotplate, mounted in Canada balsam and examined using light microscopy. Spicule preparations were made by boiling a fragment of sponge in concentrated nitric acid solution, washing and centrifuging 3 times in distilled water and 3 times in 95% alcohol, and suspending in 95% alcohol; spicule suspensions were pipetted onto glass microscope slides, dried and mounted in Canada balsam for light microscopy. Spicule size data are based on 25



1. *Cinachyrella australiensis*



2. *Paratetilla bacca*



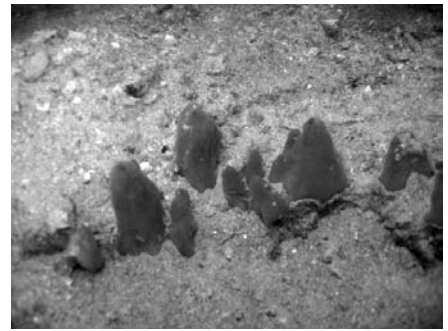
3. *Chondrilla australiensis*



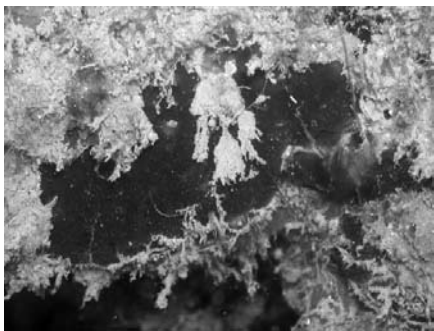
4. *Chondrosia reticulata*



5. *Cervicornia cuspidifera*



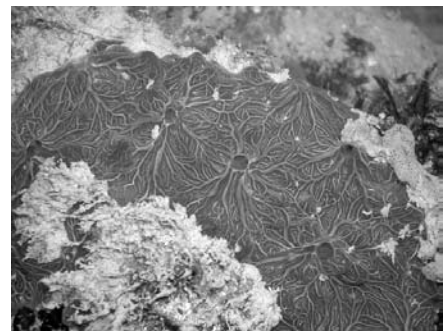
6. *Spirastrella solida*



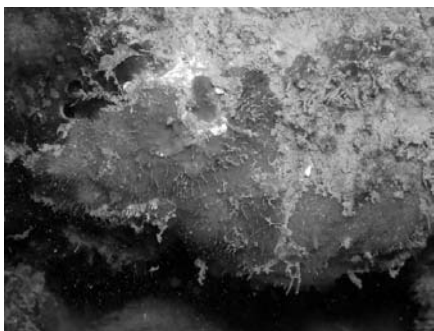
7. *Terpios granulosa*



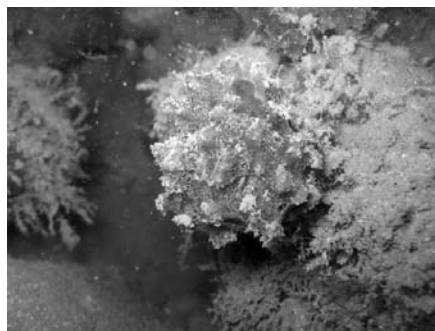
8. *Clathria (Microcionia) aceratoobtusa*



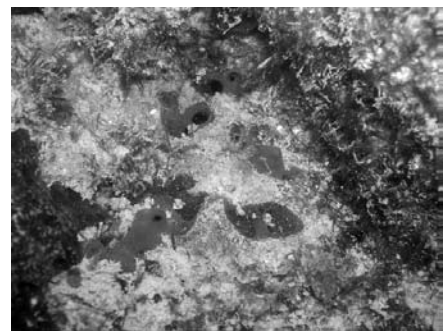
9. *Clathria (Thalysias) toxifera*



10. *Thrinacophora incrustans*



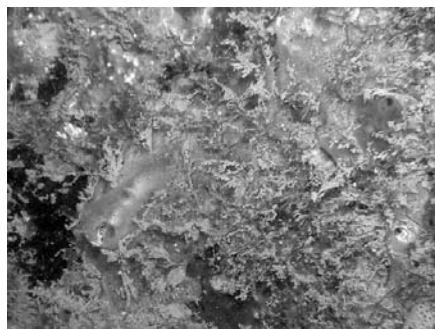
11. *Echinodictyum conulosum*



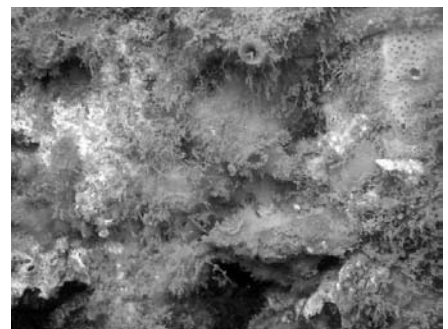
12. *Mycale (Aegogropila) grandis*



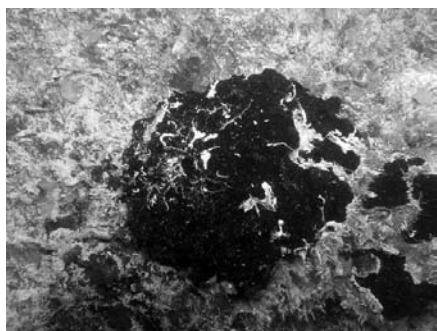
13. *Mycale (Zygomycale) parishii*



14. *Mycale (Carmia) sp.*



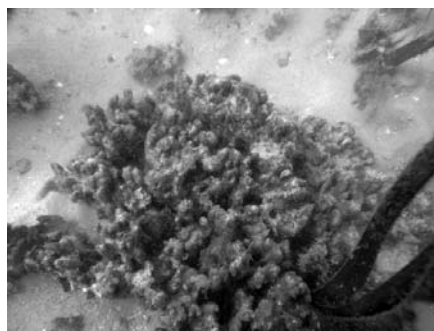
15. *Bienna tubulata*



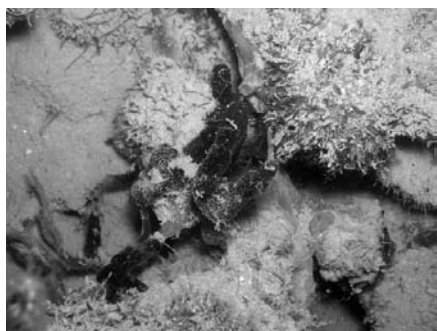
16. *Iotrochota baculifera*



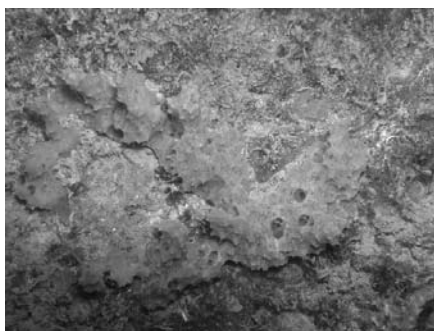
17. *Axinyssa* sp.



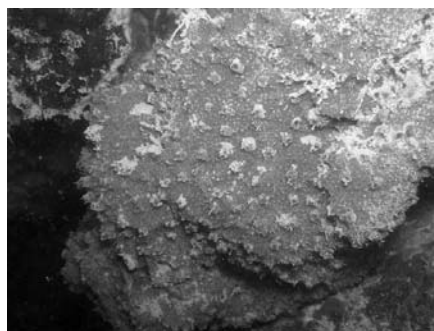
18. *Halichondria* sp.



19. *Topsentia* sp.



20. *Scopalina australiensis*



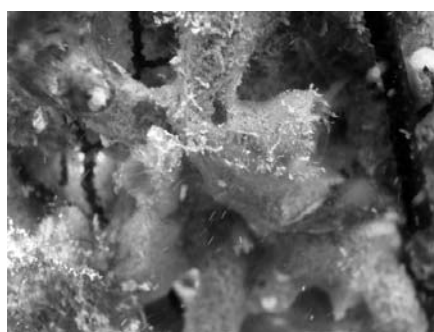
21. *Dragmacidon australis*



22. *Callyspongia (Toxochalina) pseudofibrosa*



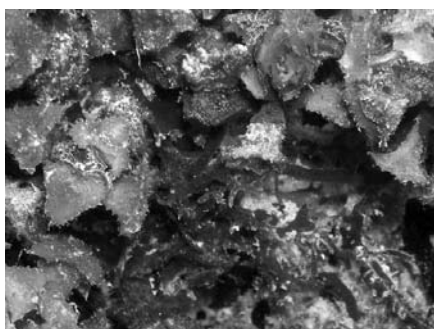
23. *Haliclona (Gellius) cymaeformis*



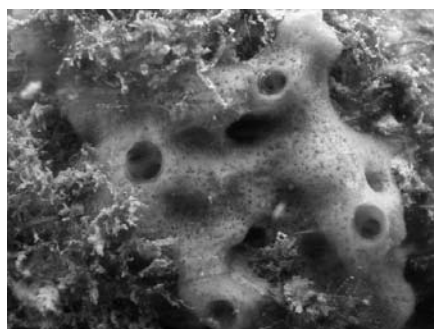
24. *Haliclona (Reniera) infundibularis*



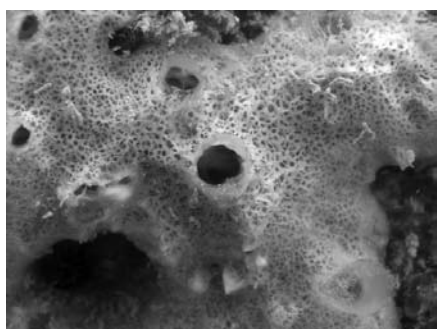
25. *Haliclona (Reniera)* sp. 'pink'



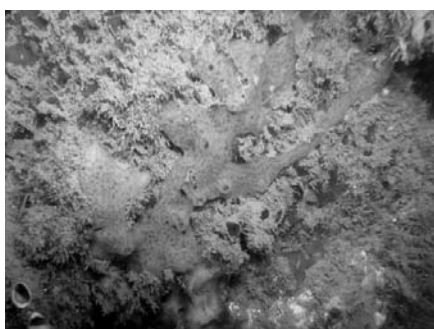
26. *Haliclona (Reniera)* sp. 'brown'



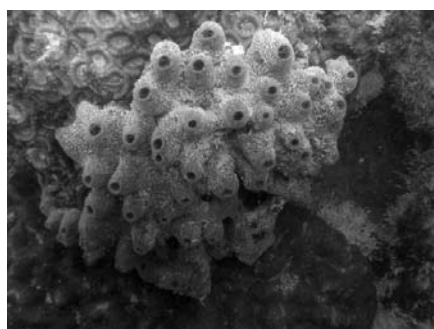
27. *Haliclona (Halichoelona)* sp. 'orange'



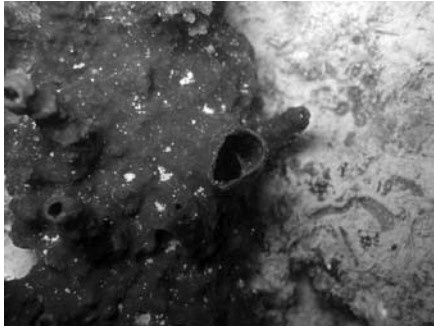
28. *Haliclona (Halichoelona)* sp. 'white'



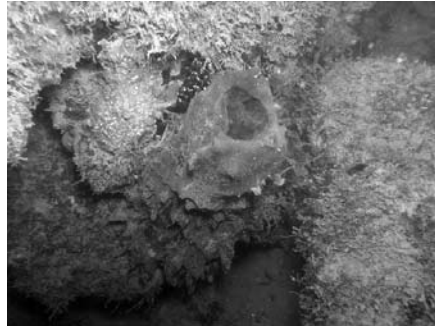
29. *Gelliodes petrosioides*



30. *Neopetrosia* sp. 'blue'



31. *Petrosia (Petrosia) hoeksemai*



32. *Xestospongia testudinaria*



33. *Xestospongia* sp. 'purple'



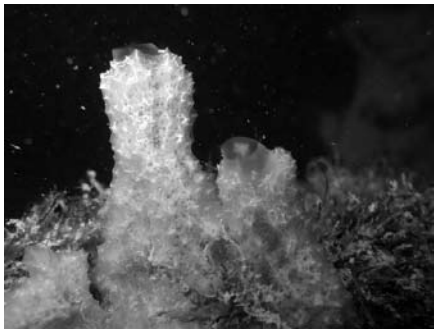
34. *Aka mucosa*



35. *Aka* sp.



36. *Oceanapia sagittaria*



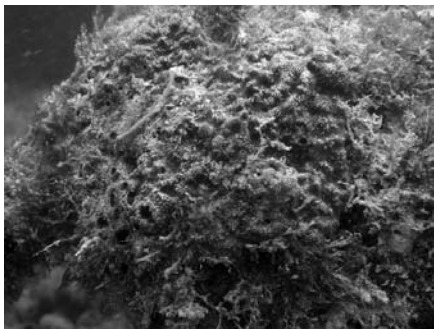
37. *Dysidea* sp. 'pink'



38. *Lamellogysidea herbacea*



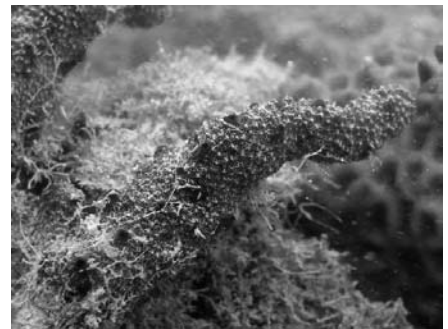
39. *Ircinia mutans*



40. *Hyattella intestinalis*



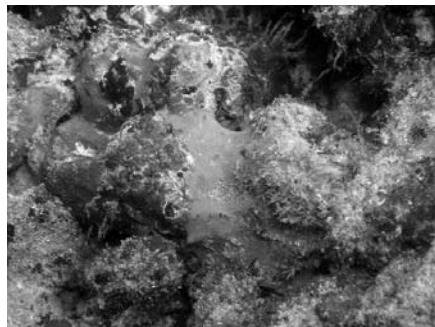
41. *Spongia* sp.



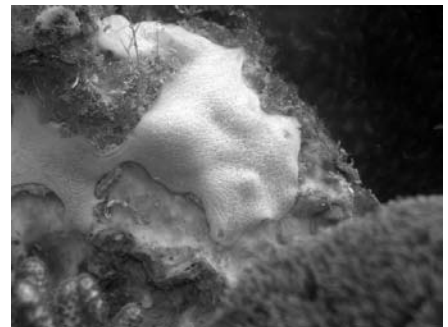
42. *Hyrtios erecta*



43. *Aphysilla* aff. *rosea*



44. *Pseudoceratina* sp.



45. *Halisarca ectofibrosa*

measurements of randomly chosen spicules for its category. Higher taxonomy follows Hooper & van Soest (2002) and a glossary of technical terms follows Boury-Esnault & Rützler (1997).

RESULTS & DISCUSSION

During this study, 45 species of 25 families and 10 orders of Demospongiae were found (Table 2; Figure 2) and most species are common components of coral reefs in the Gulf of Thailand and in the South China Sea (Hooper et al., 2000; Chaitanawisuti et al., 2002; Putchakarn, 2006). The most abundant and common sponges in this area are: *Oceanapia sagittaria* (Sollas); *Neopetrosia* sp. 'blue'; *Xestospongia testudinaria* (Lamarck); and *Haliclona* (*Gellius*) *cymaeformis* Esper. Almost all of these species are found eastward of the Indo-Australian region in the Pacific Ocean. This result supports Lévi's (1963) suggestion that the Indo-Malay archipelago might be the centre of dispersal for Indo-West Pacific sponge species (Hooper et al., 2000).

The sponges from this study yielded the following remarks. *Cinachyrella australiensis* and *Paratetilla bacca* are known as the golf-ball sponge and appear to be particularly found in shallow depths and somewhat turbid water. Both species are very similar when they are covered by sediment. However, *C. australiensis* was found exposed to the light in the intertidal zone and was a light yellow colour whereas *P. bacca* was found in more sheltered, deeper zones and is more or less brown in colour. *Cervicornia cuspidifera* is commonly found on the sandy bottom of reef flat areas especially in association with sea grass. *Mycale* (*Aegogropila*) *grandis* and *M.* (*Zygomycal*) *parishii* are common and widely distributed in the Gulf of Thailand. *Mycale* (*Aegogropila*) *grandis* is a burrowing sponge and inhabits space between rocks or dead coral but *M.* (*Zygomycal*) *parishii* is an encrusting sponge and usually is associated with live shells or barnacles and dead gorgonians. *Callyspongia* (*Toxochalina*) *pseudofibrosa* was in this study found only associated with live corals. *Haliclona* (*Reniera*) sp. 'brown' is found associated with the brown algae *Turbinaria* sp. *Petrosia* (*Petrosia*) *hoeksemai* has differential morphology and is common in high sedimentation areas. *Ircinia mutans* occurs also in high sedimentation habitats and was found on the reef slope and outer reef on soft-bottom. *Haliclona* (*Gellius*) *cymaeformis* and *Lamellodysidea herbacea* are common in the sub-intertidal zone of the coral reefs, which is exposed to sunlight. *Xestospongia* sp. 'purple' is a thickly encrusting sponge and was usually found in the shelter or in the cave of big coral head.

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Figure 2. Underwater photos of the sponges found from Mo Ko Thale Tai in the study.

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