

MSMS

Malaysian Society of Marine Sciences
Persatuan Sains Lautan Malaysia

The State of Marine Ecosystem Observations in Malaysia

Presented at:
11th Asia Pacific Biodiversity Observation Network
(APBON) Workshop
Double Tree by Hilton, Kuala Lumpur
26th June 2019

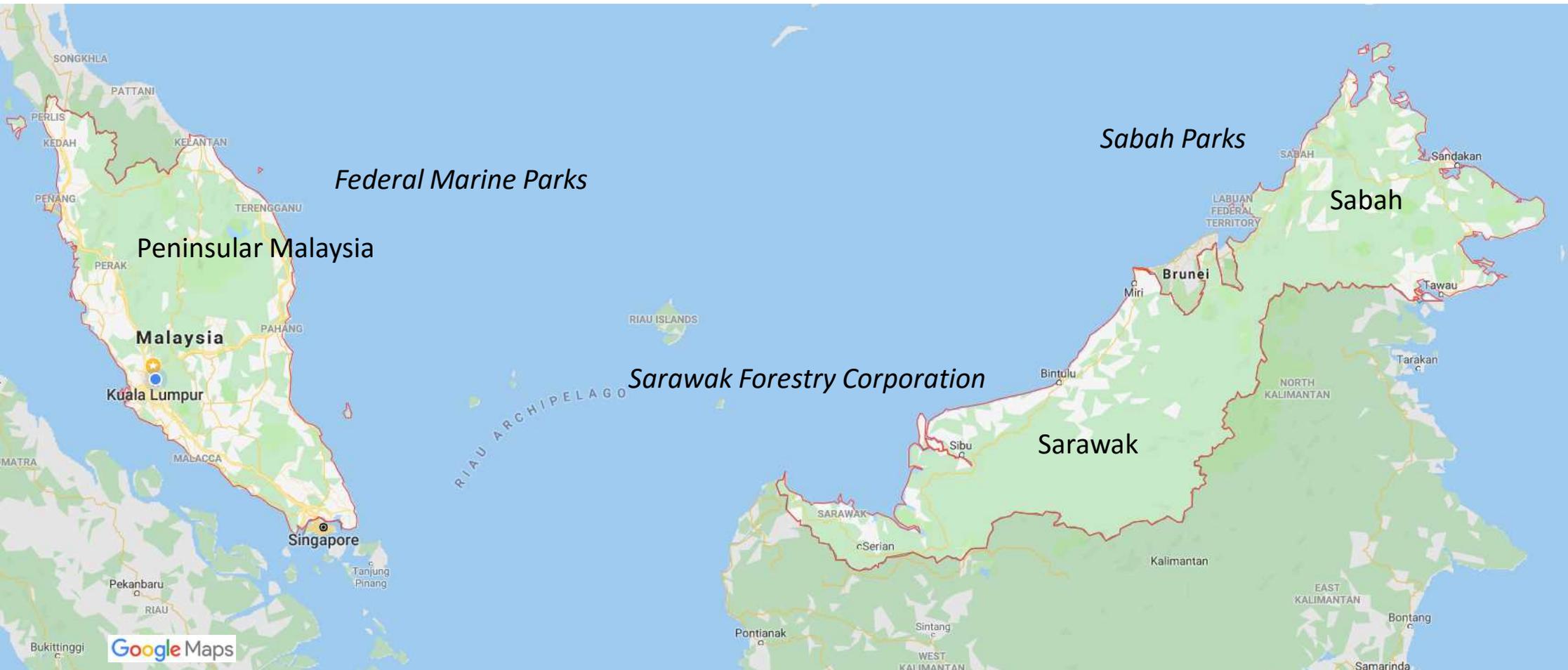
Presented by:
Affendi Yang Amri
President
Malaysian Society of Marine Sciences (MSMS)
msms.society@gmail.com

Introduction

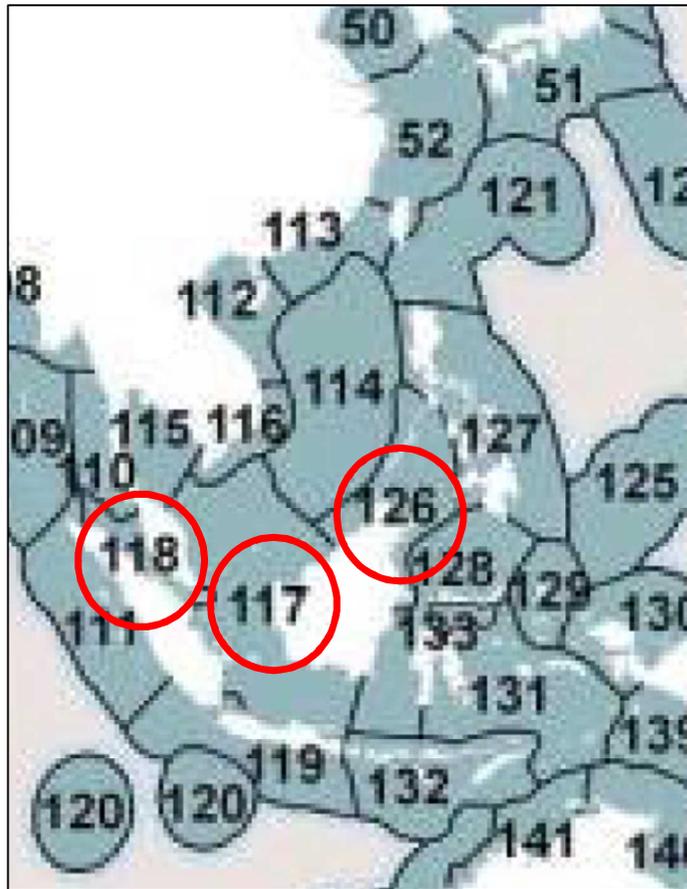


Pulau Boheydulang, Tun Sakaran MPA, Sabah, Malaysia

MALAYSIA (PM, SBH, SRWK): DIFFERENT MANAGEMENT AND ISSUES



MALAYSIA: DIFFERENT MEOWs



Spalding et. al. (2007)

Realm : Central Indo-Pacific

Province : Sunda Shelf

Ecoregion : 117 – Sunda Shelf/Java Sea
118 – Malacca Strait

Province : Western Coral Triangle

Ecoregion : 126 – Palawan/North Borneo

Observations of global biogeographic patterns
of coastal and shelf areas

USD
5,000/
ha/year

USD
190,000/
ha/year

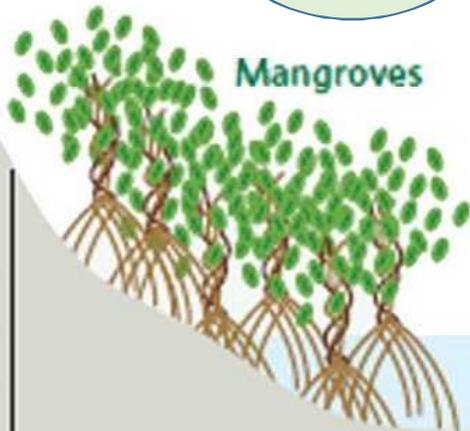
USD
30,000/
ha/year

USD
350,000/
ha/year

The richest
marine region



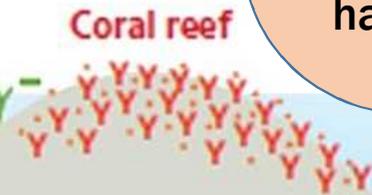
Land



Mangroves



Seagrasses



Coral reef

Offshore
waters

Costanza et al (2014)

PRESENTATION FLOW



Mangrove Forests



Coral Reefs



Seagrass Meadows

- Related organisms:
- Seaweeds
 - Marine mammals
 - Seahorses

STATE OF OBSERVATIONS

| Ecosystem | Location | Species Diversity | Area size | Related organisms (SW, MM, SH) |
|------------------|----------|-------------------|-----------|--------------------------------|
| Mangrove forests | | | | |
| Coral reefs | | | | |
| Seagrass meadows | | | | |

Mangrove Forests



Current State of Mangrove Forest Reserves

Status of Mangrove Forest Reserves in Malaysia (2016)



Sabah

403,873 ha

Sarawak

72,545 ha

Peninsular
Malaysia

105,726 ha

Grand Total

582,144 ha

Malaysia: The Diversity of Mangrove Plant Species

| # | Species | Family | Conservation Status | Malaysia |
|----|------------------------------------|----------------|---------------------|--------------|
| 1 | <i>Acanthus ilicifolius</i> | Acanthaceae | - | / |
| 2 | <i>Acanthus ebracteatus</i> | Acanthaceae | - | / |
| 3 | <i>Acanthus volubilis</i> | Acanthaceae | - | / |
| 4 | <i>Acrostichum aureum</i> | Pteridaceae | - | / |
| 5 | <i>Acrostichum speciosum</i> | Pteridaceae | - | / |
| 6 | <i>Aegiceras comiculatum</i> | Myrsinaceae | - | / |
| 7 | <i>Aegiceras floridum</i> | Myrsinaceae | EN (Malaysia) | /(Sabah) |
| 8 | <i>Aglaiia cucullata</i> | Meliaceae | DD (Global) | / |
| 9 | <i>Avicennia alba</i> | Acanthaceae | - | / |
| 10 | <i>Avicennia marina</i> | Acanthaceae | - | / |
| 11 | <i>Avicennia officinalis</i> | Acanthaceae | - | / |
| 12 | <i>Avicennia rumphiana</i> | Acanthaceae | - | / |
| 13 | <i>Brownlowia tersa</i> | Tiliaceae | - | / |
| 14 | <i>Brownlowia argentata</i> | Tiliaceae | CR DD (Global) | /(Kerian) |
| 15 | <i>Bruguiera cylindrica</i> | Rhizophoraceae | - | / |
| 16 | <i>Bruguiera gymnorhiza</i> | Rhizophoraceae | - | / |
| 17 | <i>Bruguiera parviflora</i> | Rhizophoraceae | - | / |
| 18 | <i>Bruguiera hainesii</i> | Rhizophoraceae | CR (Global) | / |
| 19 | <i>Bruguiera sexangula</i> | Rhizophoraceae | - | / |
| 20 | <i>Bruguiera X rhyndhopetala</i> | Rhizophoraceae | EN (Malaysia) | / |
| 21 | <i>Campostemon philippinense</i> | Bombaceae | EN (Global) | /(Sabah) |
| 22 | <i>Ceriops decandra</i> | Rhizophoraceae | EN (Malaysia) | / |
| 23 | <i>Ceriops tagal</i> | Rhizophoraceae | - | / |
| 24 | <i>Ceriops zippeliana</i> | Rhizophoraceae | - | / |
| 25 | <i>Cynometra iripa</i> | Fabaceae | - | / |
| 26 | <i>Dolichandrone spathaceae</i> | Bignoniaceae | - | / |
| 27 | <i>Excoecaria agallocha</i> | Eurphobiaceae | - | / |
| 28 | <i>Heritiera fomes</i> | Malvaceae | CR (Malaysia) | / |
| 29 | <i>Heritiera globosa</i> | Malvaceae | EN (Global) | / |
| 30 | <i>Heritiera littoralis</i> | Malvaceae | - | / |
| 31 | <i>Kandelia candel</i> | Rhizophoraceae | - | / |
| 32 | <i>Lumnitzera littorea</i> | Combretaceae | - | / |
| 33 | <i>Lumnitzera racemosa</i> | Combretaceae | - | / |
| 34 | <i>Nypa fruticans</i> | Arecaceae | - | / |
| 35 | <i>Osbornia octodonta</i> | Myrtaceae | EN (Malaysia) | /(Sabah) |
| 36 | <i>Phoenix paludosa</i> | Arecaceae | VU | / |
| 37 | <i>Pemphis acidula</i> | Lythraceae | - | / |
| 38 | <i>Rhizophora apiculata</i> | Rhizophoraceae | - | / |
| 39 | <i>Rhizophora mucronata</i> | Rhizophoraceae | - | / |
| 40 | <i>Rhizophora stylosa</i> | Rhizophoraceae | - | / |
| 41 | <i>Rhizophora X annamalayana</i> | Rhizophoraceae | EN (Malaysia) | / |
| 42 | <i>Rhizophora X lamarckii</i> | Rhizophoraceae | VU | / |
| 43 | <i>Scyphiphora hydrophyllaceae</i> | Rubiaceae | - | / |
| 44 | <i>Sonneratia alba</i> | Lythraceae | - | / |
| 45 | <i>Sonneratia caseolaris</i> | Lythraceae | - | / |
| 46 | <i>Sonneratia griffithii</i> | Lythraceae | CR (Global) | / |
| 47 | <i>Sonneratia ovata</i> | Lythraceae | - | / |
| 48 | <i>Sonneratia hybrid?</i> | Lythraceae | EN (Malaysia) | / |
| 49 | <i>Xylocarpus granatum</i> | Meliaceae | - | / |
| 50 | <i>Xylocarpus moluccensis</i> | Meliaceae | - | / |
| | TOTAL | | | 50 (46+4) |

Iconic Mangrove Conservation Sites

Malaysia's Mangrove RAMSAR sites:

PM, Johor: Tg. Piai; Pulau Kukup; Sg. Pulai.

Sarawak: Kuching Wetlands National Park.

Sabah: Lower Kinabatangan-Segama Wetlands; Kota Kinabalu Wetlands.

Langkawi Mangroves of Kedah: A UNESCO Global Geopark. Total conservation for mangroves, pressured by steady increase in tourists and tourism activities.

Matang Mangroves of Perak: Sustainable Mangrove Forest Management. Dubbed the **world's best managed mangroves**. Expanded in size 39,821 ha in 1970 to 40,466 ha in 2015.

Merbok Mangroves of Kedah: Nominated for UNESCO Man and the Biosphere Reserve & UNESCO Global Geopark.

Table 2. Percentage of the total deforested mangrove (2000–2012) converted to different land uses

| Country | Aquaculture | Rice | Oil palm | Mangrove forest | Urban | Other category |
|-------------|-------------|------|----------|-----------------|-------|----------------|
| Indonesia | 48.6 | 0.1 | 15.7 | 22.6 | 1.9 | 11.2 |
| Myanmar | 1.6 | 87.6 | 1.1 | 0.5 | 1.6 | 7.6 |
| Malaysia | 14.7 | 0.1 | 38.2 | 17.6 | 12.8 | 16.7 |
| Thailand | 10.8 | 5.6 | 40.0 | 5.1 | 14.4 | 24.1 |
| Philippines | 36.7 | 0.9 | 11.1 | 7.3 | 2.7 | 41.3 |
| Cambodia | 27.7 | 1.5 | 8.9 | 9.8 | 4.6 | 47.6 |
| Vietnam | 21.0 | 10.4 | 0.5 | 0.6 | 62.5 | 4.9 |
| Brunei | 29.2 | 0 | 27.7 | 12.5 | 15.9 | 14.8 |
| Timor-Leste | 0 | 26.1 | 0 | 0 | 0 | 73.9* |
| Singapore | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 29.9 | 21.7 | 16.3 | 15.4 | 4.2 | 12.3 |

Countries are ordered by total mangrove lost. Percentages might not sum to 100 owing to rounding.
 *The small amount of mangrove deforestation in Timor-Leste is due mainly to shoreline erosion.

Coral Reefs



WHERE? EXTENT?

“Reefs at Risk in South East Asia” Burke et al. (2002)

Malaysia has **4,006 km²** of reef area
(87% at medium or higher threat)
Only 7% of reefs are in MPA's

“Status of coral reefs of the world” GCRMN (2004)

Malaysia has **3,600 km²** of reef area
Only 34% of reefs are in MPA's

Shallow clear water reefs are easy to observe

Submerged, deep or turbid water reefs?



Current Knowledge on Scleractinian Coral Diversity of Peninsular Malaysia

*Affendi Yang Amri & Faedzul Rahman Rosman

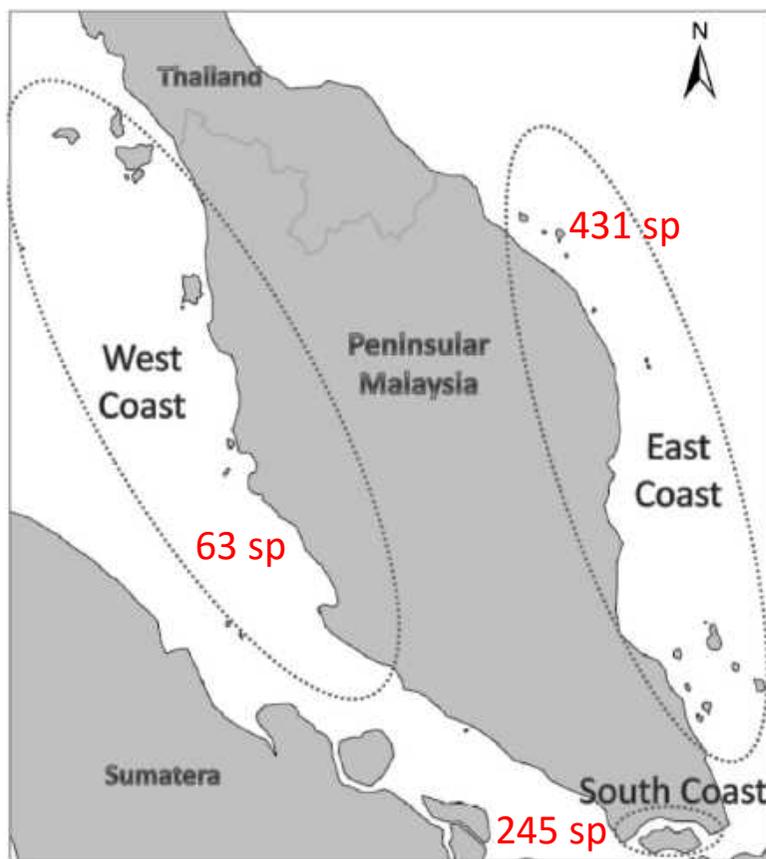


FIGURE 1: Map of Peninsular Malaysia Showing the Three Areas: the West Coast, the East Coast and the South Coast

Total number of Scleractinian coral species in Peninsular Malaysia is 480 species

The Status of Hard Coral Diversity in Sabah

¹Zarinah Waheed, ¹Ridzwan Abdul Rahman &
²Affendi Johari Ariff

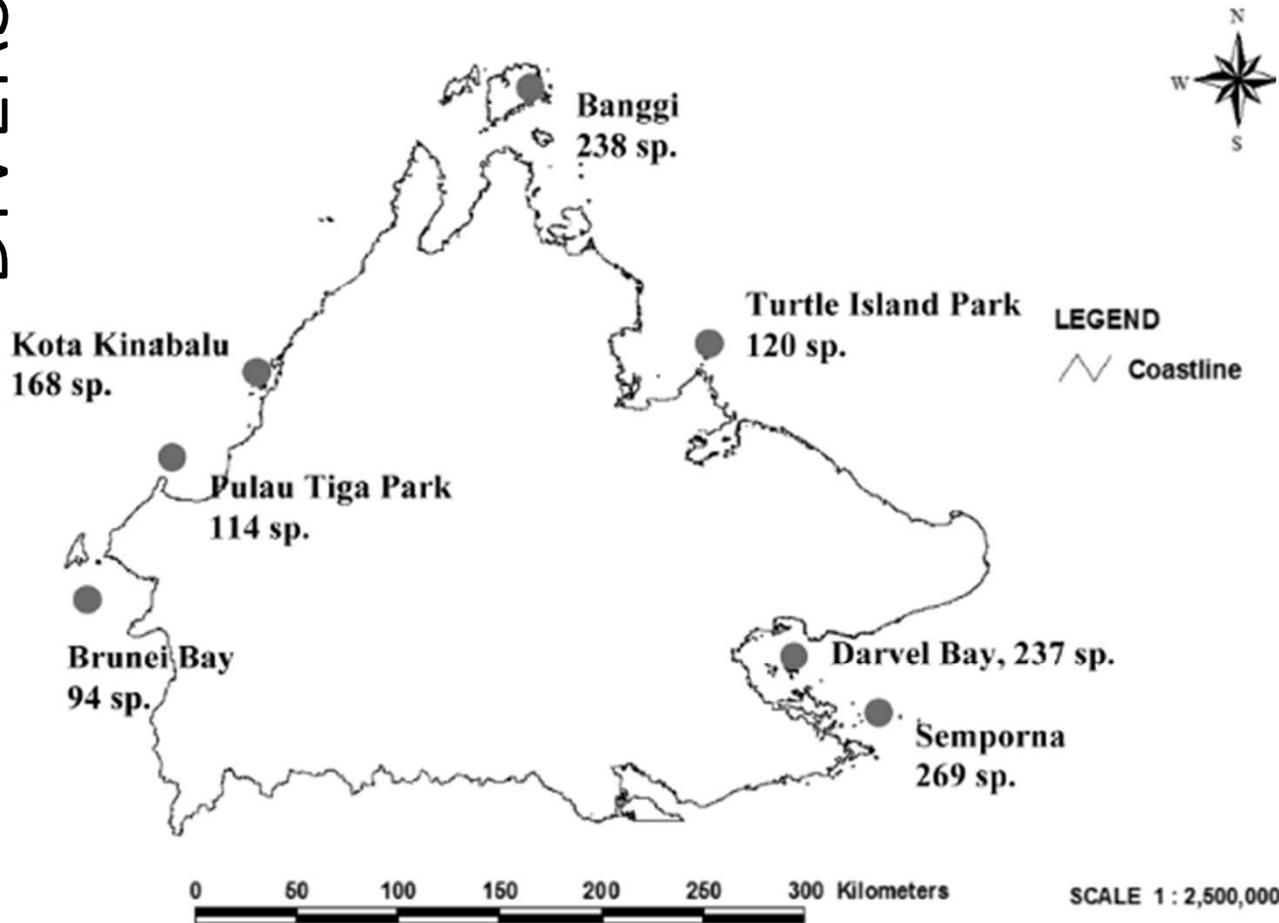


TABLE 3: New Coral Species Collected from Darvel Bay During Ekspedisi Galaxea '98 (Ditlev, 2003)

| Family | Species |
|-------------|--------------------------------|
| Acroporidae | <i>Enigmopora darveliensis</i> |
| Acroporidae | <i>Acropora ridzwani</i> |
| Fungiidae | <i>Lithophyllon ranjiti</i> |
| Pectinidae | <i>Pectinia crassa</i> |
| Pectinidae | <i>Mycedium spina</i> |
| Euphyllidae | <i>Plerogyra multilobata</i> |
| Euphyllidae | <i>Plerogyra diabolotus</i> |
| Euphyllidae | <i>Plerogyra cauliformis</i> |

Sabah has a total of 471 species of hard corals (including 4 families of non-scleractinian corals)

FIGURE 3: Hard Coral Species Distribution in Sabah

IMPORTANCE

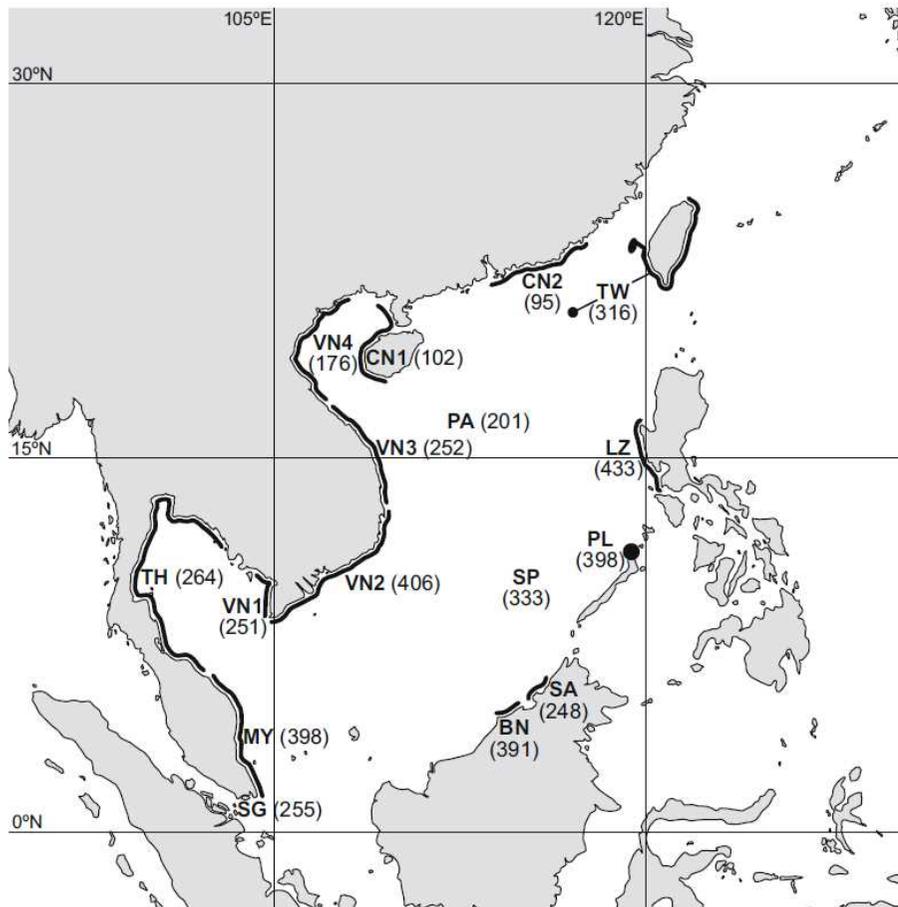


Fig. 1 South China Sea reef areas examined in this study, indicating the respective species richness of stony corals

Huang et al (2015)

East coast of PM one of the highest rare hard coral species (70)

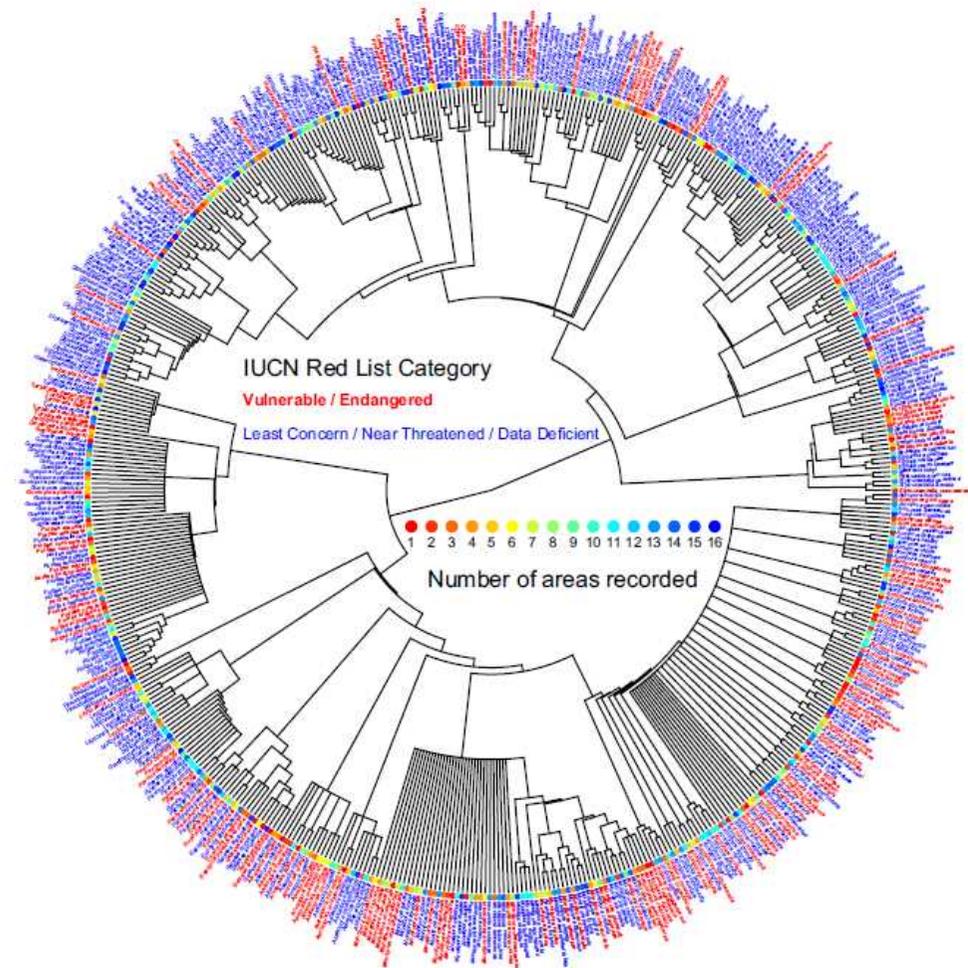


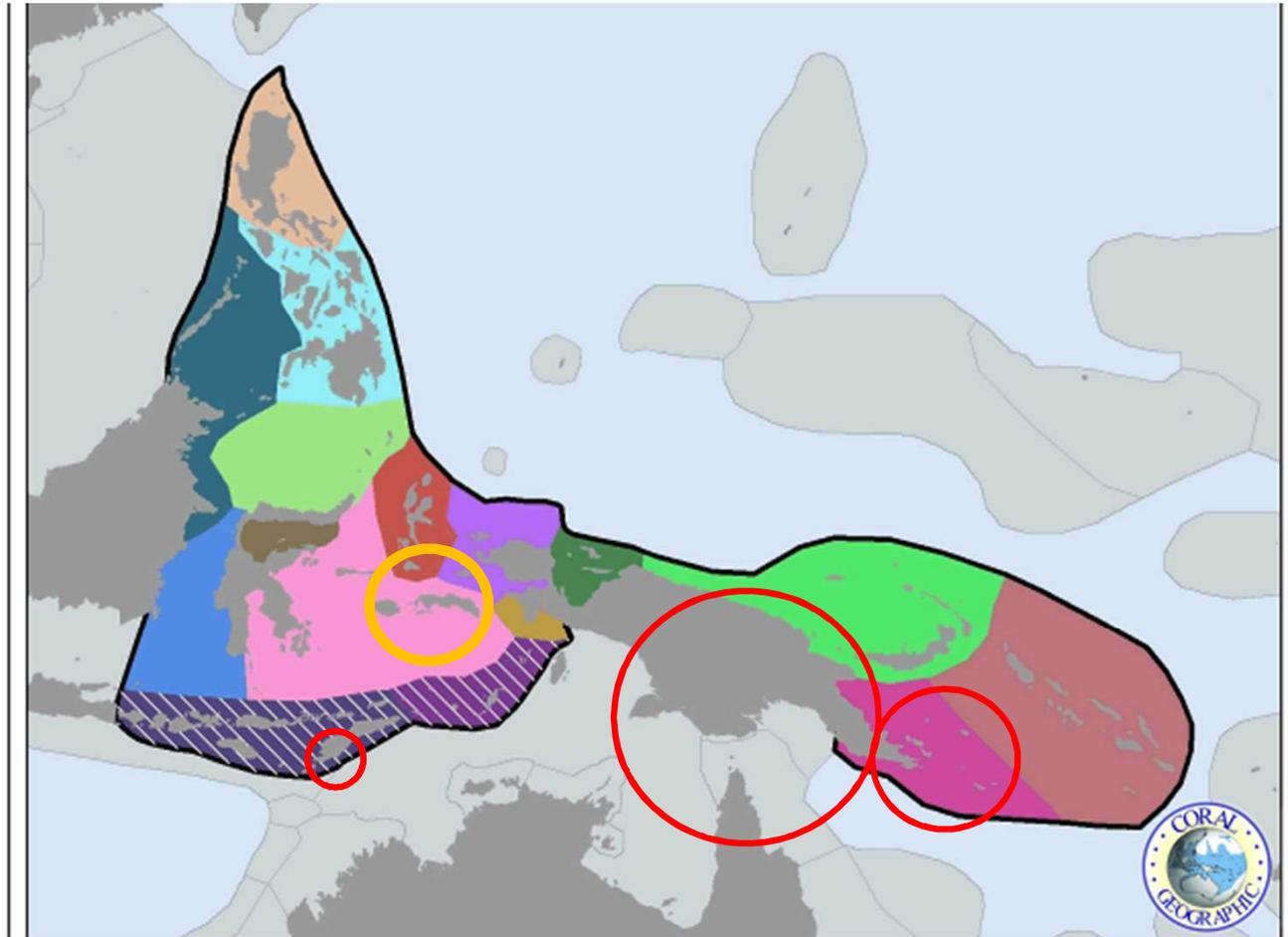
Fig. 2 Strict consensus phylogenetic tree of reef corals in the South China Sea. The number of reef areas recorded for each species is shown using a coloured circle, with IUCN Red List threat status denoted as red (threatened) or blue (non-threatened) tip label

Huang et al (2016)

The Coral Triangle of the World

Veron et al (2009) *Delineating the Coral Triangle*. *Galaxea* 11:91-100

Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, Timor-Leste



IMPORTANCE

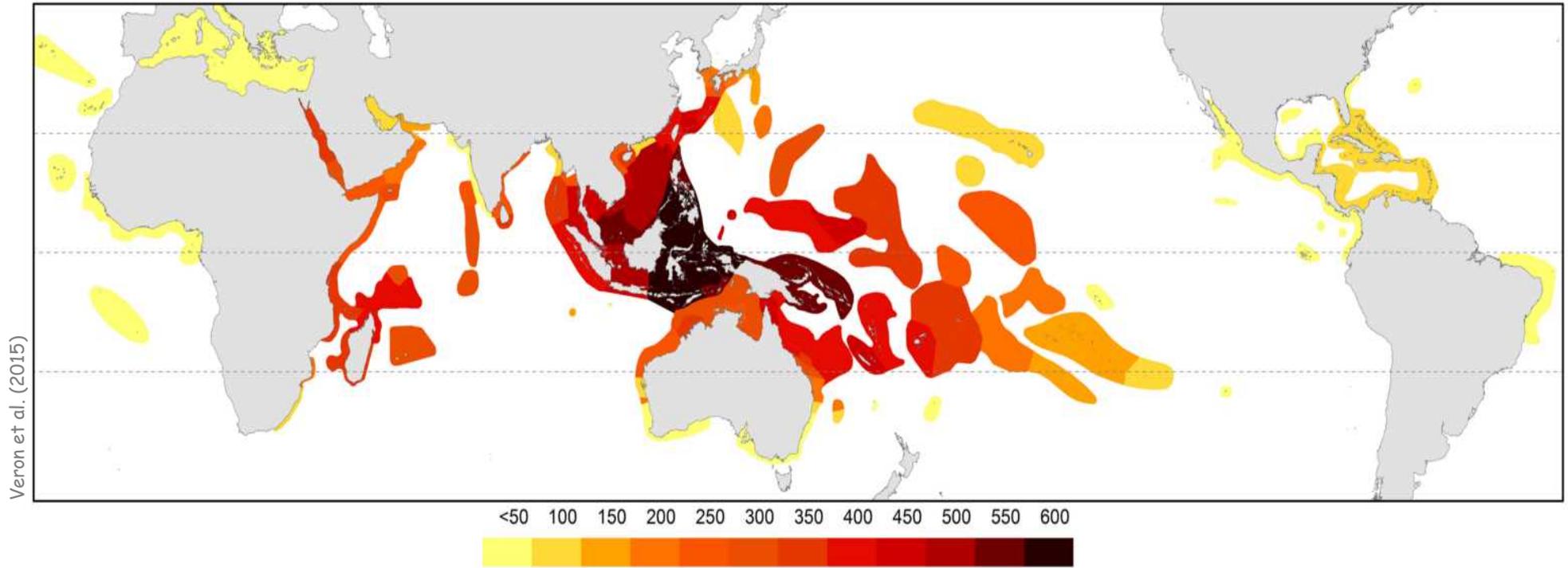


FIGURE 4 | Global diversity indicated by all records of occurrences. Diversity values were derived from GIS layering of all species maps.

“Sunda shelf ecoregion now qualifies for inclusion in the Coral Triangle”

Veron et al. (2015)

MONITORING AND CONSERVATION



Sabah

- 1) Tunku Abdul Rahman Park – 1974
 - 2) Turtle Islands Park – 1977
 - 3) Pulau Tiga Park – 1978
 - 4) Tun Sakaran Marine Park – 2004
 - 5) Sipadan Island Park – 2004
 - 6) Tun Mustapha Park – 2016 (nearly 9000 km²)
- * Sugud Islands Marine Conservation Area (SIMCA) - 2001

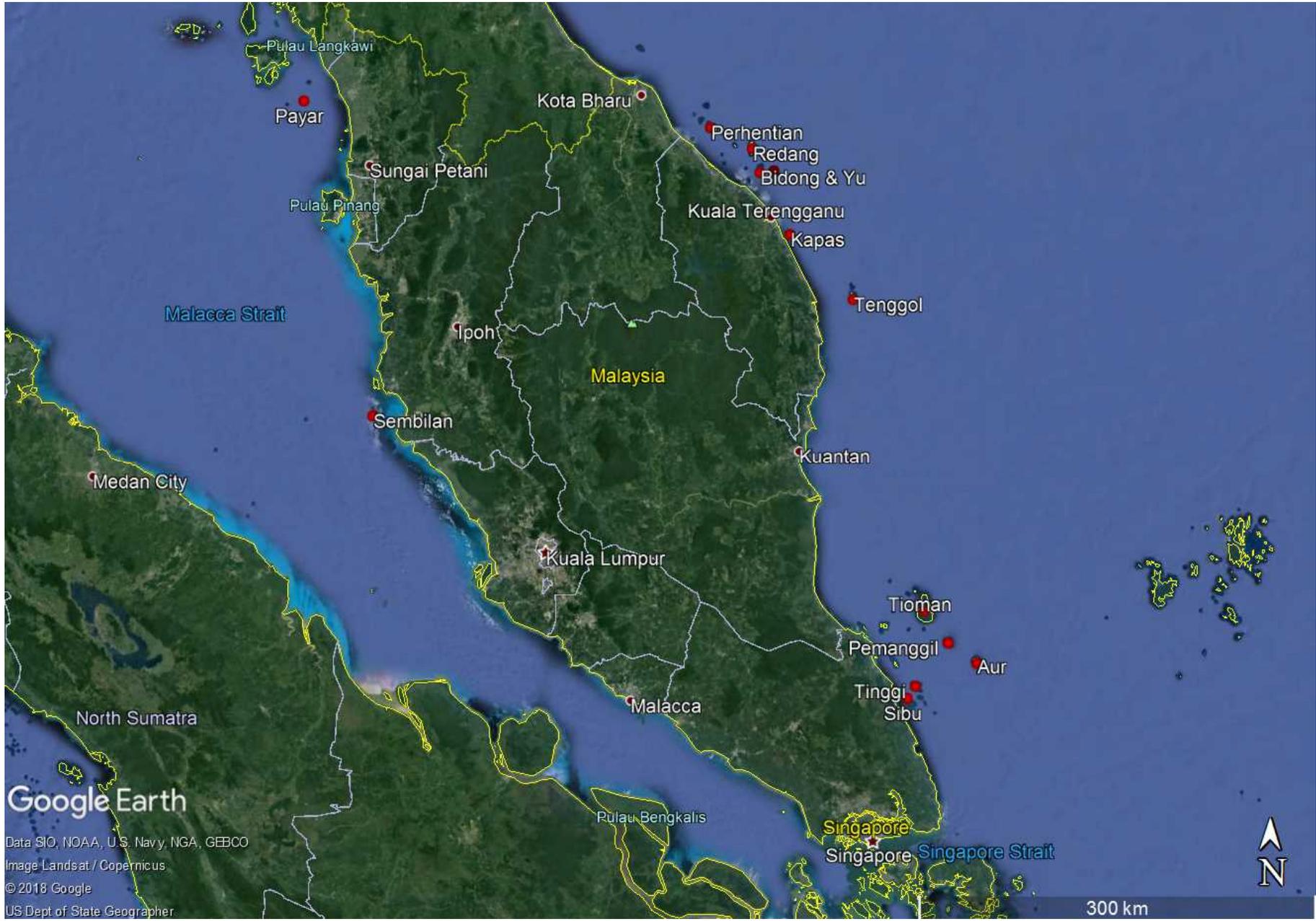
Sarawak

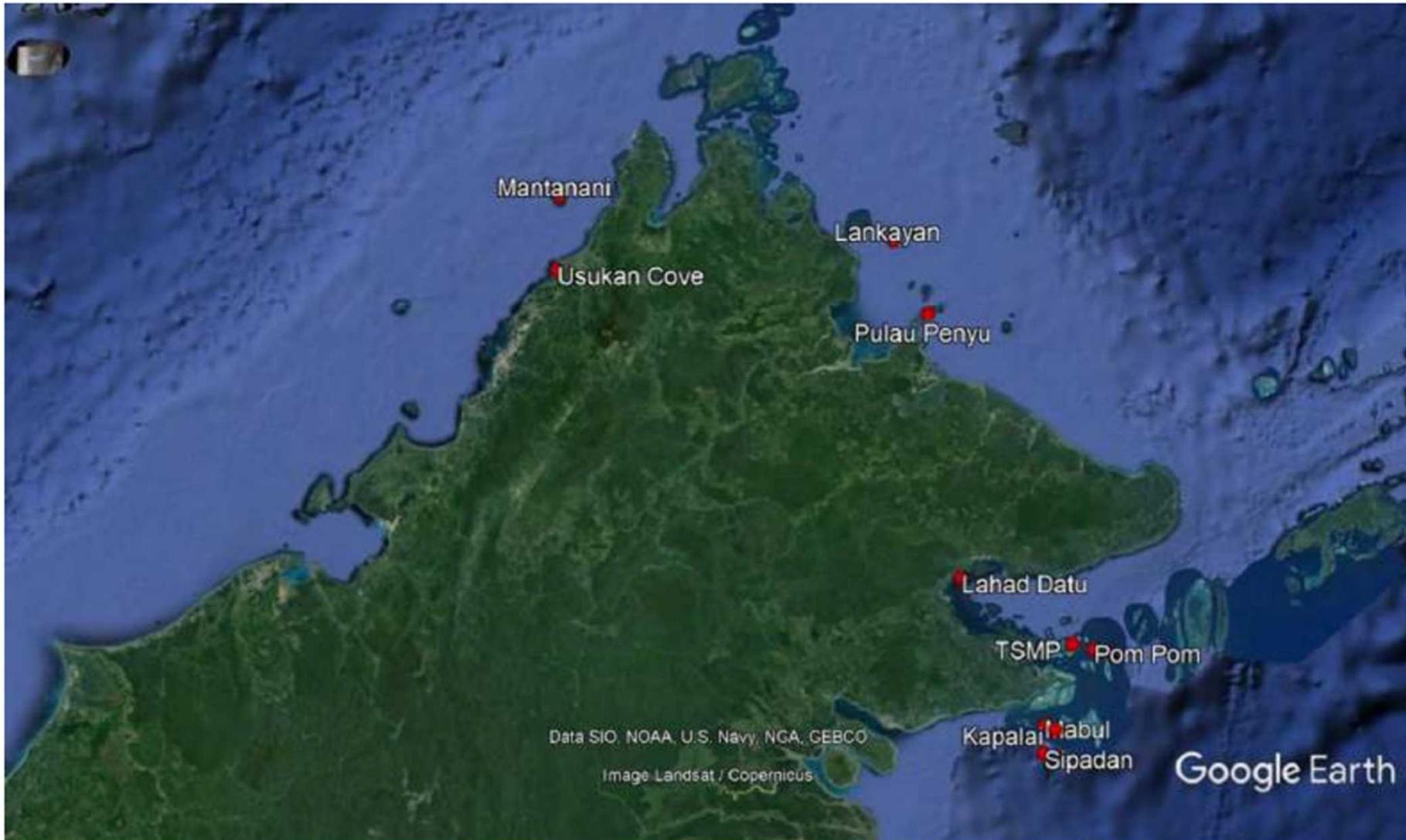
- 1) Pulau Talang Satang National Park
– 1999 turtle conservation
- 2) Miri-Sibuti Marine Park – 2007 coral reef
- 3) Luconia Shoals Marine National Park
– 2018 (> 10,000 km²)

Peninsular Malaysia

- 1) Kedah Marine Parks – 1989 (Pulau Payar)
- 2) Terengganu Marine Parks – 1994 (Pulau Redang)
- 3) Pahang Marine Parks – 1994 (Pulau Tioman)
- 4) Johor Marine Parks – 1994 (Pulau Tinggi)
- 5) Federal Territory Marine Parks – 1994 (Pulau Labuan)

MONITORING AND CONSERVATION

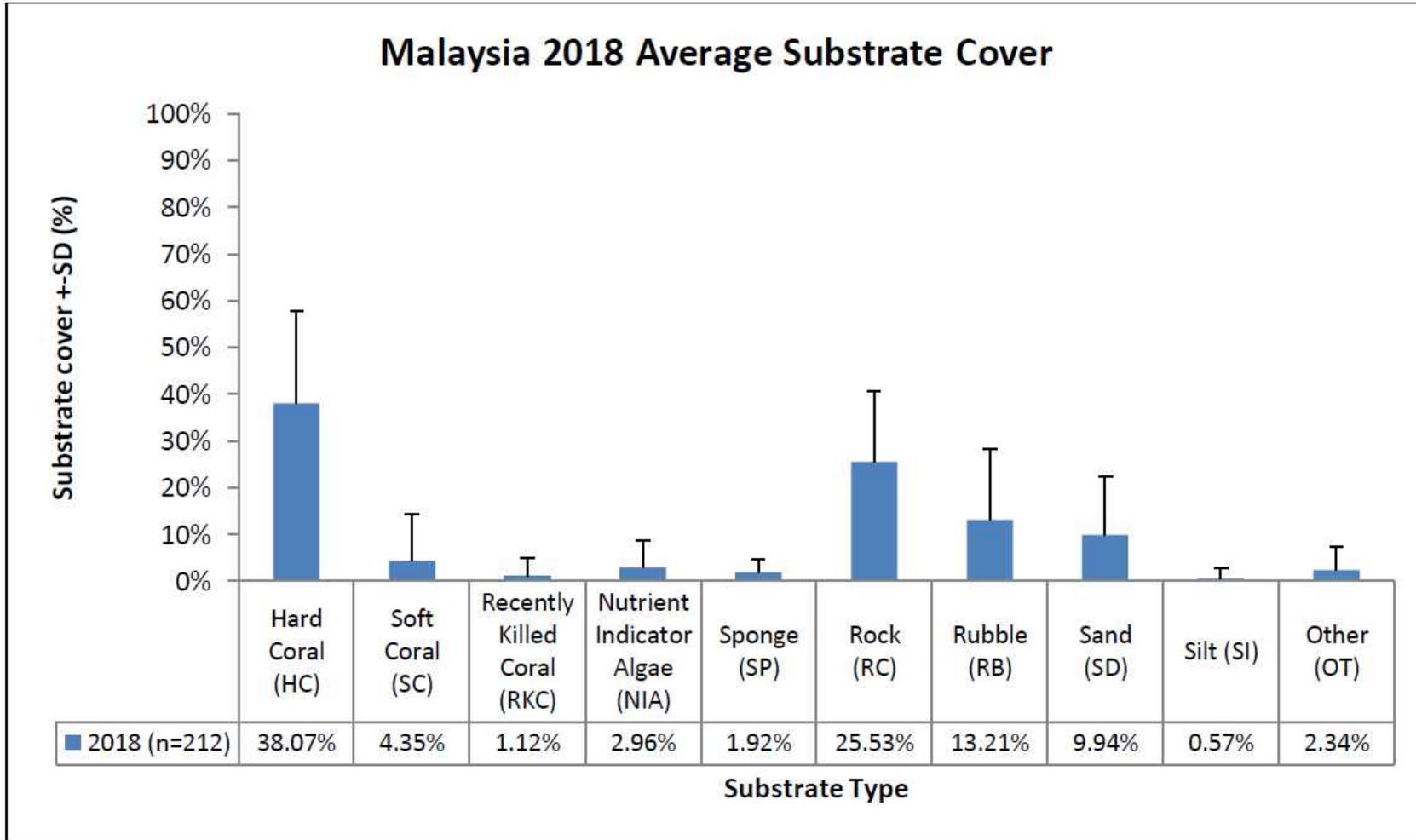




Map 2: Surveyed islands in Sabah
(Note: TSMP= Tun Sakaran Marine Park)

MONITORING AND CONSERVATION





ISSUES

- Extent of reef area is not known
- Need more observation areas in Sarawak
- Priority areas to be determined and observed in finer scale
- Monitoring format/styles
- Data quality and management

Seagrass Meadows



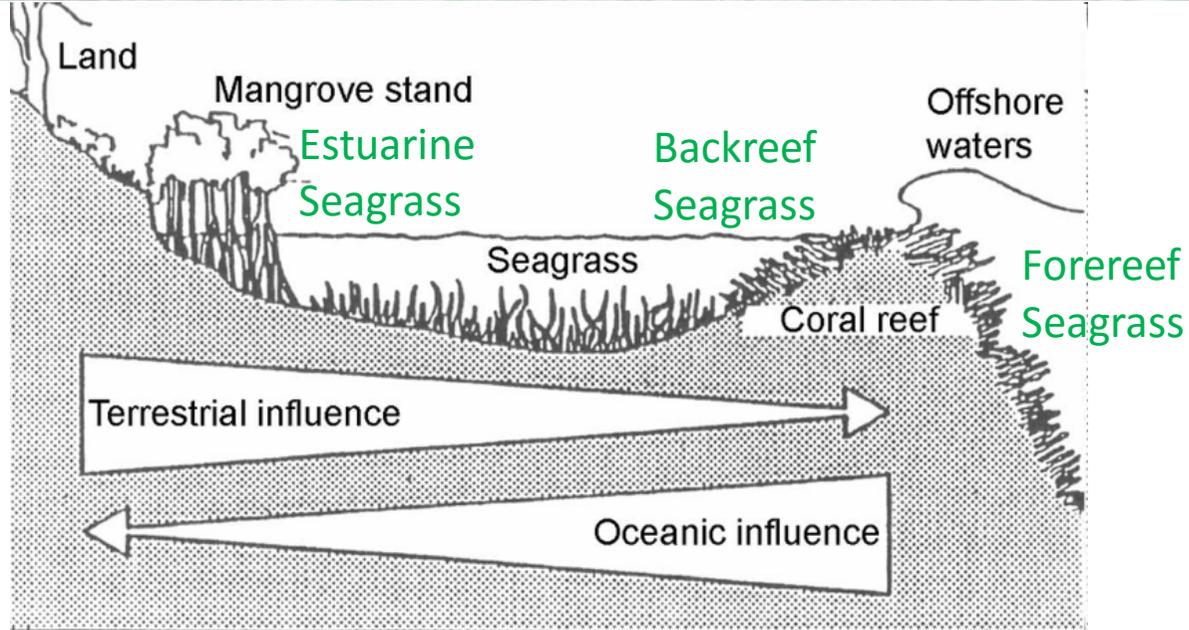


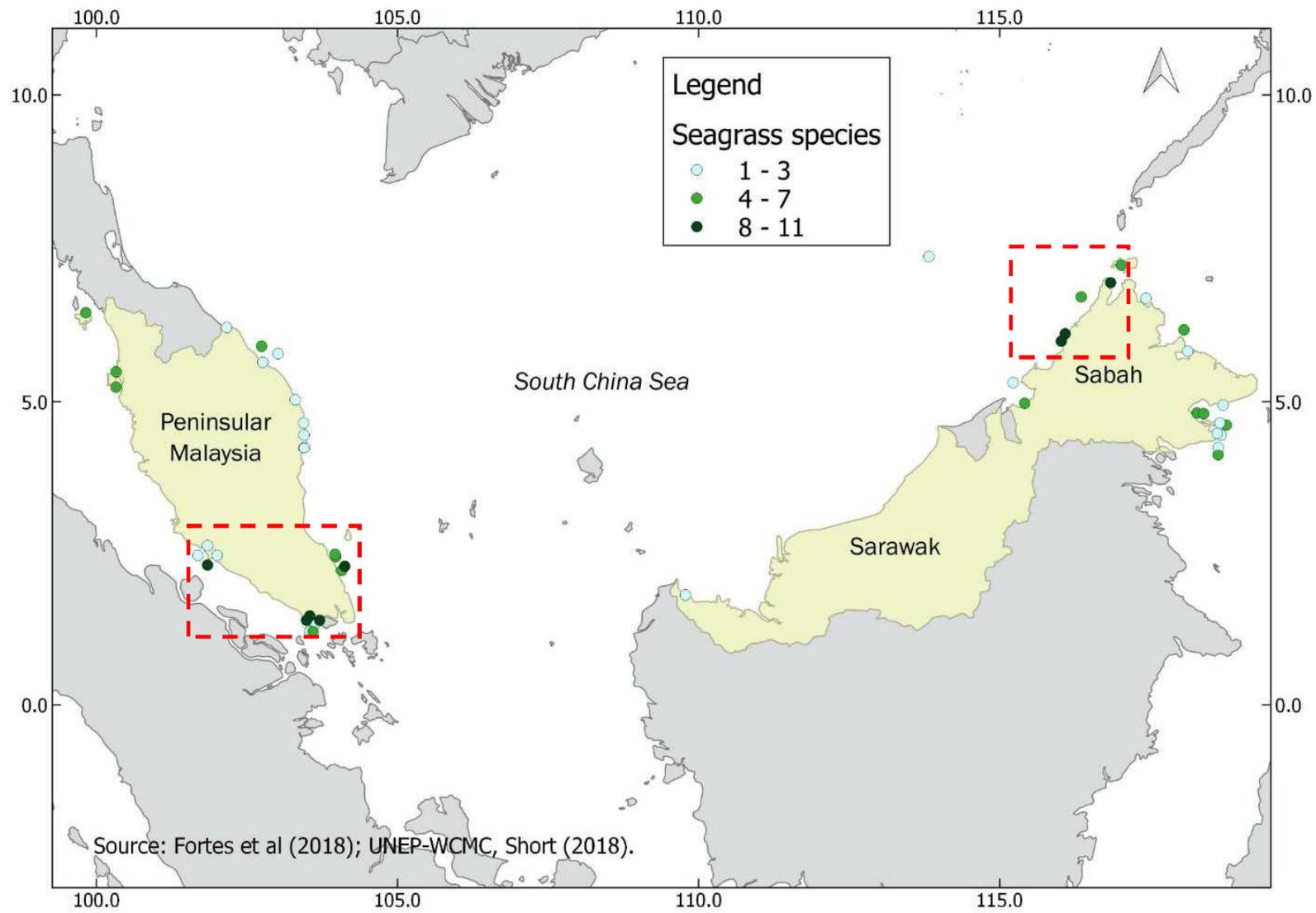
Malaysia

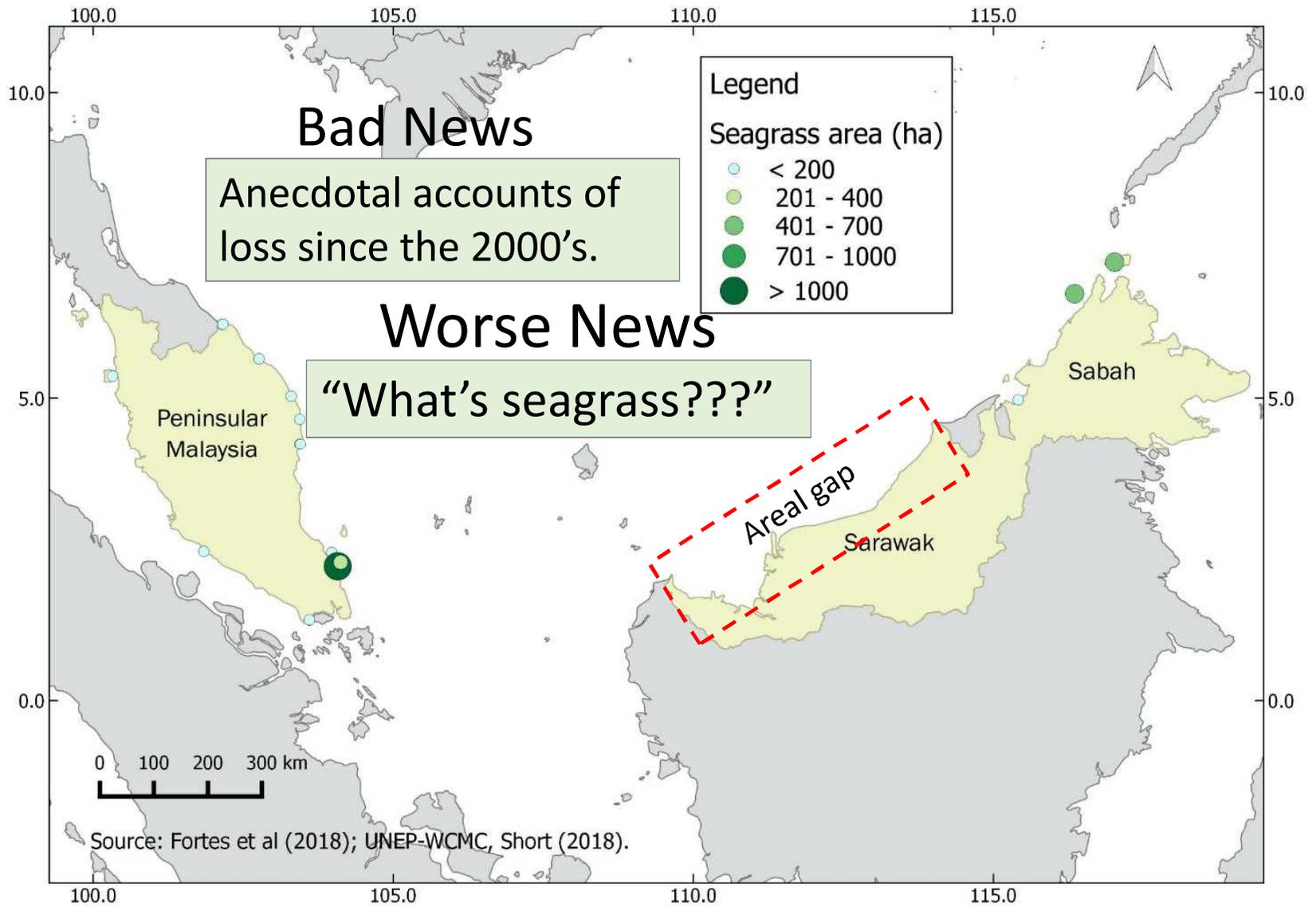
3 families

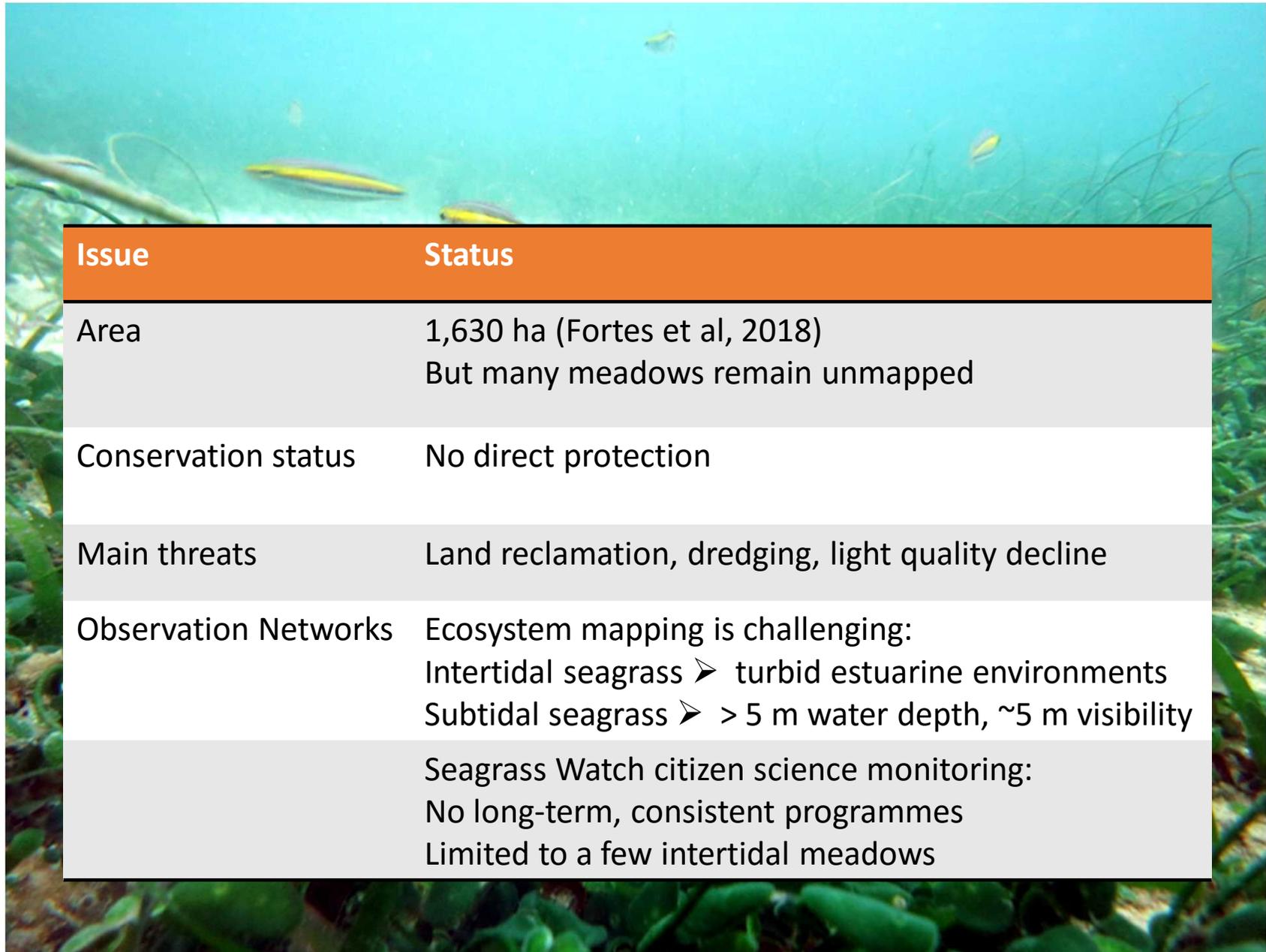
8 genera

16 species









| Issue | Status |
|----------------------|--|
| Area | 1,630 ha (Fortes et al, 2018) But many meadows remain unmapped |
| Conservation status | No direct protection |
| Main threats | Land reclamation, dredging, light quality decline |
| Observation Networks | Ecosystem mapping is challenging: Intertidal seagrass ➤ turbid estuarine environments Subtidal seagrass ➤ > 5 m water depth, ~5 m visibility Seagrass Watch citizen science monitoring: No long-term, consistent programmes Limited to a few intertidal meadows |

Seaweeds



SEAWEED RESOURCES OF MALAYSIA

Algae Research Group, University of Malaya
Phang Siew-Moi, Lim Phaik-Eem, Yeong Hui-Yin



Siew-Moi Phang*, Hui-Yin Yeong and Phaik-Eem Lim

The seaweed resources of Malaysia

Botanica Marina (2019) 62(3):265-273

Taxonomy of Southeast Asian Seaweeds III; Phang, Song & Lim (eds), 2019; 172-203

Checklist of Malaysian Marine Algae - 2019

Phang SM, Yeong HY, Lim PE

Abstract: The marine algal checklist of 2006 has been updated based on publications of new species, new records and taxonomic revisions. The 2019 checklist has an increase of 17 families, 32 genera, and 75 species, including seven new species. The present tally stands at 459 taxa in 72 families; with 35 species in 12 families of Cyanophyta; 113 species in 16 families of Chlorophyta; 95 species in 8 families of Ochrophyta; and 216 species in 36 families of Rhodophyta.

Research Areas:

- ❖ Inventory & Diversity Studies
- ❖ Molecular Taxonomy, Phylogenetics, Genetic Diversity – focus on commercially important species
- ❖ Mass cultivation & Micropropagation of Commercial Seaweeds
- ❖ Utilisation of Seaweeds – nutraceuticals, cosmeceuticals, pharmaceuticals, fertilizer, biofuel
- ❖ Seaweeds & Climate Change – halocarbon emissions from tropical seaweeds.

INVENTORY & DIVERSITY STUDIES

1. Discovering New Species

12 new species described since 1995



Mesospora elongata Poong, Lim & Phang 2013



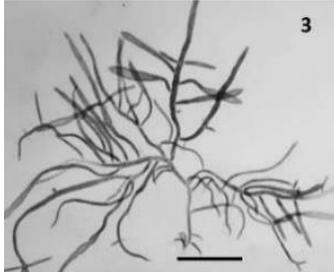
Kappaphycus malesianus Tan, Lim & Phang (2013)



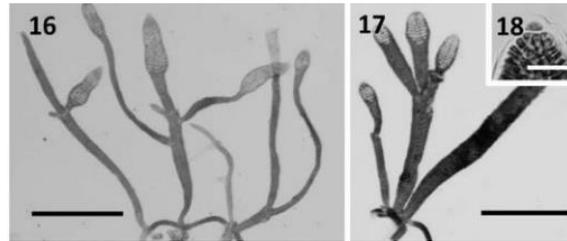
Sargassum stolonifolium
Phang & Yoshida 1995



Halymenia malaysiana P.-L. Tan, P.-E. Lim, S.-M. Lin S.-M. Phang 2015



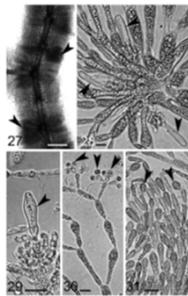
Pterocliadiella phangiae Jelveh, Lim & Maggs (2013)



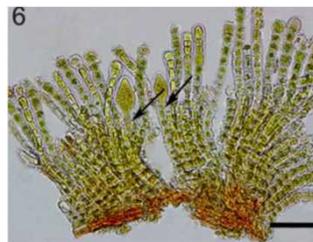
Pterocliadiella megasporangia Jelveh, Lim & Phang (2013)



Halymenia johorensis P.-L. Tan, P.-E. Lim, S.-M. Lin S.-M. Phang 2017



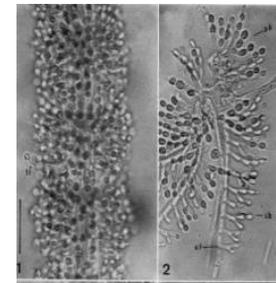
Batrachospermum phangii
T Johnson, PE Lim, ML Vis 2014



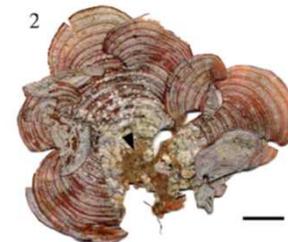
Mesospora indopacifica
Poong, Lim, Phang 2017



Mesospora lombokensis
Poong, Lim, Phang 2017



Batrachospermum tapirense
Kumano & Phang 1987



Padina sulcata Ni-Ni-Win, S.G.A. Draisma & H. Kawai

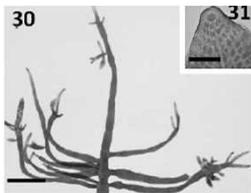
Molecular Taxonomy, Phylogenetics, Genetic Diversity – focus on commercially important species

Diversity of Gelidiales

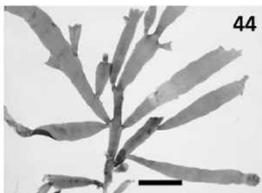
- ❖ Species of Gelidiales are important sources of agar; little known.
- ❖ 8 species of Gelidiales previously reported from Malaysia (Silva et al., 1996; Phang et al, 2008).
- ❖ New records include *Pterocliadiella beachii* and *Pterocliadiella bartlettii*
- ❖ New species: *Pterocliadiella phangiae* Jelveh, Lim & Maggs (2013)
- ❖ *Pterocliadiella megasporangia* Jelveh, Lim & Phang (2013)

Two new species and two new records of *Pterocliadiella* (Gelidiales) from Malaysia based on analyses of *rbcL* and *cox1* gene sequences

JELVEH SOHRABIPOUR^{1,4}, PHAIK-EEM LIM^{1,2*}, CHRISTINE A. MAGGS³ AND SIEW-MOI PHANG^{1,2}
Phycologia (2013) Volume 52 (6), 517–537



Pterocliadiella bartlettii (Taylor) Santelices



Pterocliadiella beachiae Freshwater

Kappaphycus

Phylogenetic relationship of Kappaphycus Doty and Eucheuma J. Agardh (Solieriaceae, Rhodophyta) in Malaysia

J Appl Phycol (2014) 26:1273–1285
 DOI 10.1007/s10811-013-0155-8

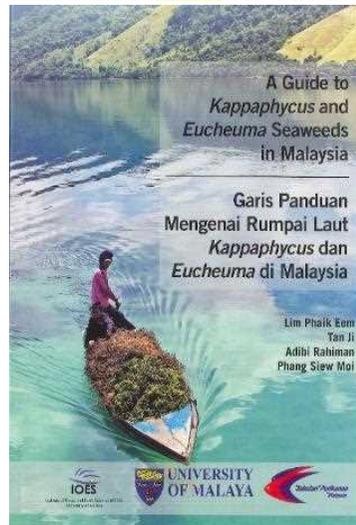
Ji Tan, Phaik-Eem Lim & Siew-Moi Phang

Journal of Applied Phycology
 ISSN 0921-4971
 Volume 25
 Number 1
J Appl Phycol (2013) 25:13–29
 DOI 10.1007/s10811-012-9683-1



Kappaphycus malesianus sp. nov.: a new species of *Kappaphycus* (Gigartinales, Rhodophyta) from Southeast Asia

Ji Tan · Phaik Eem Lim · Siew Moi Phang · Adibi Rahiman · Aluh Nikmatullah · H. Sunarpi · Anicia Q. Hurtado



OPEN ACCESS freely available online

PLOS ONE

Assessment of Four Molecular Markers as Potential DNA Barcodes for Red Algae *Kappaphycus* Doty and *Eucheuma* J. Agardh (Solieriaceae, Rhodophyta)

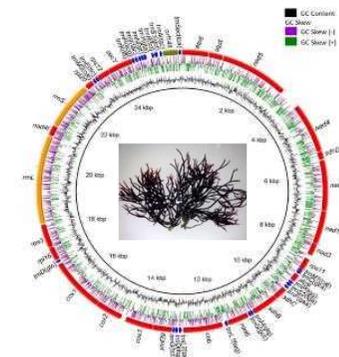
Ji Tan^{1,2}, Phaik-Eem Lim^{1,2*}, Siew-Moi Phang^{1,2}, Dang Diem Hong³, H. Sunarpi⁴, Anicia Q. Hurtado⁵

Genomes & Phylogenetics of *Gracilaria*

J Appl Phycol
 DOI 10.1007/s10811-017-1100-z

Complete mitochondrial genome of *Gracilaria changii* (Rhodophyta: Gracilariaceae)

Song SL, Yong HS, Lim PE, Phang SM



Complete mitochondrial genome of *G. changii* (mitogenome size: 25729 bp)



Marine Mammals

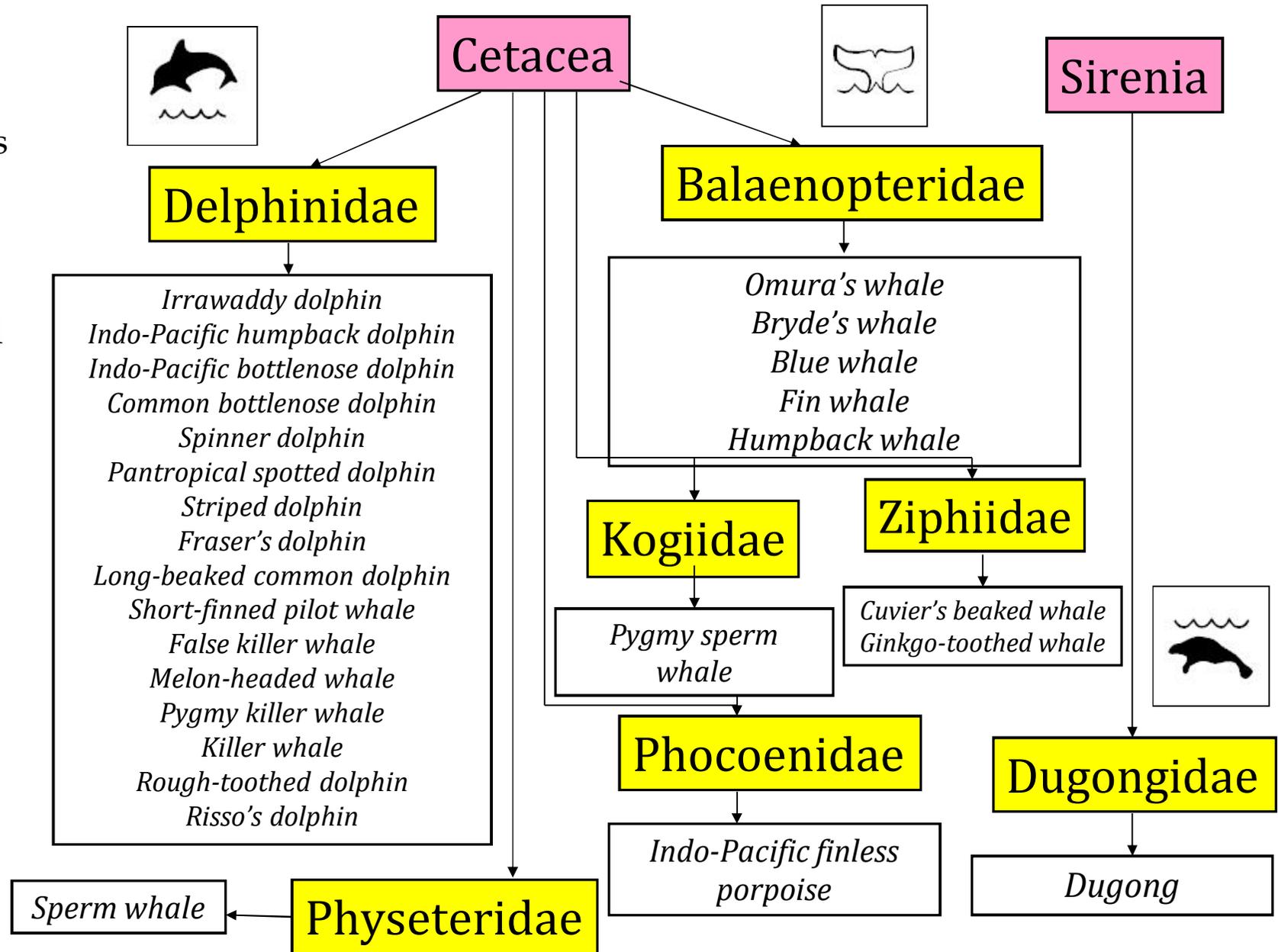
Marine mammal species diversity in Malaysia



26 species of cetaceans
1 species of sirenian

= **27** known species
from live sighting and
stranding records

Ref: Ponnampalam, L. S. 2012.
Opportunistic observations on
the distribution of cetaceans
in the Malaysian South China,
Sulu and Sulawesi Seas and
an updated checklist of
marine mammals in Malaysia.
The Raffles Bulletin of
Zoology 60(1): 221 - 231



Marine mammals are protected under Malaysian laws

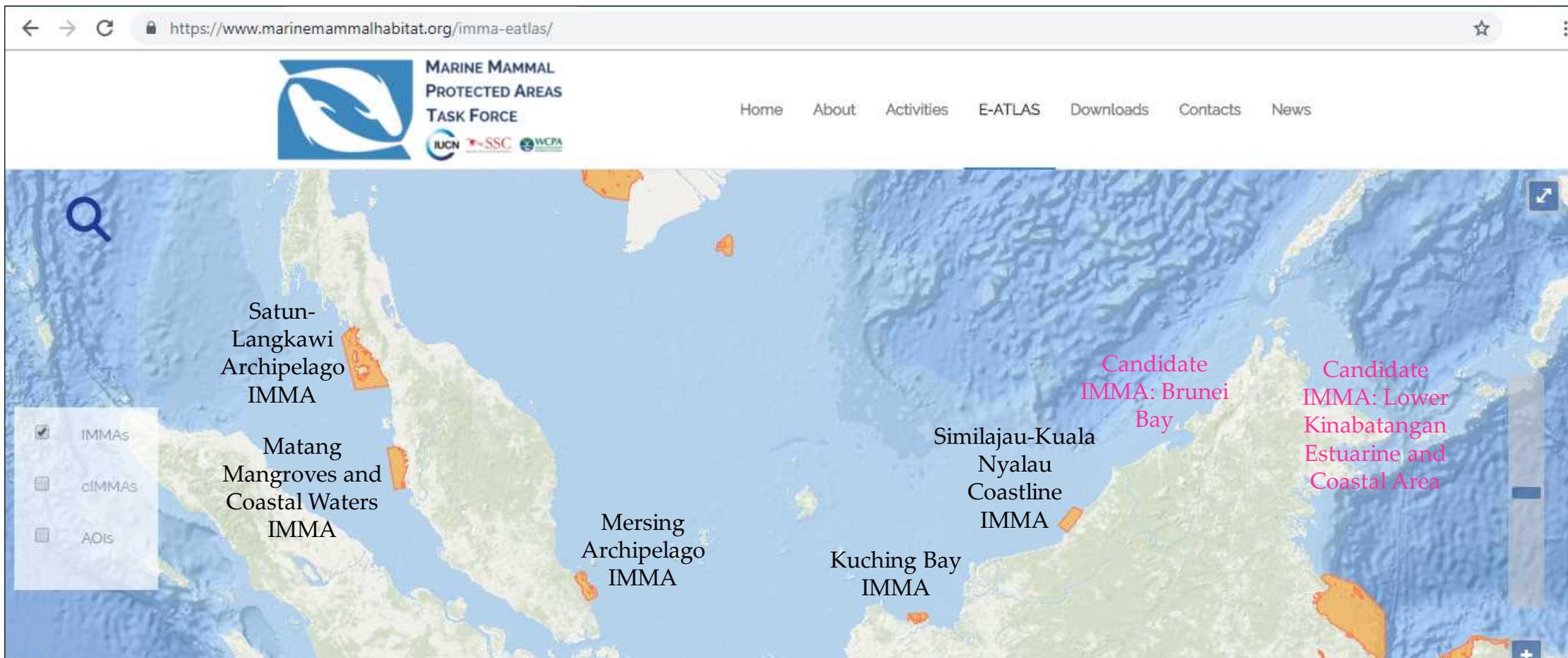


- Fisheries Act 1985 (Part VI, Aquatic Animals)
- Fisheries (Control of Endangered Species) Regulations 1999

All marine mammal species in Malaysia are listed as 'marine endangered species'

- Wild Life Protection Ordinance 1998 (Sarawak)
- Wildlife Conservation Enactment 1997 (Sabah)
- Convention on International Trade of Endangered Species (CITES)

Malaysia recognized with 5 IUCN Important Marine Mammal Areas (IMMA)





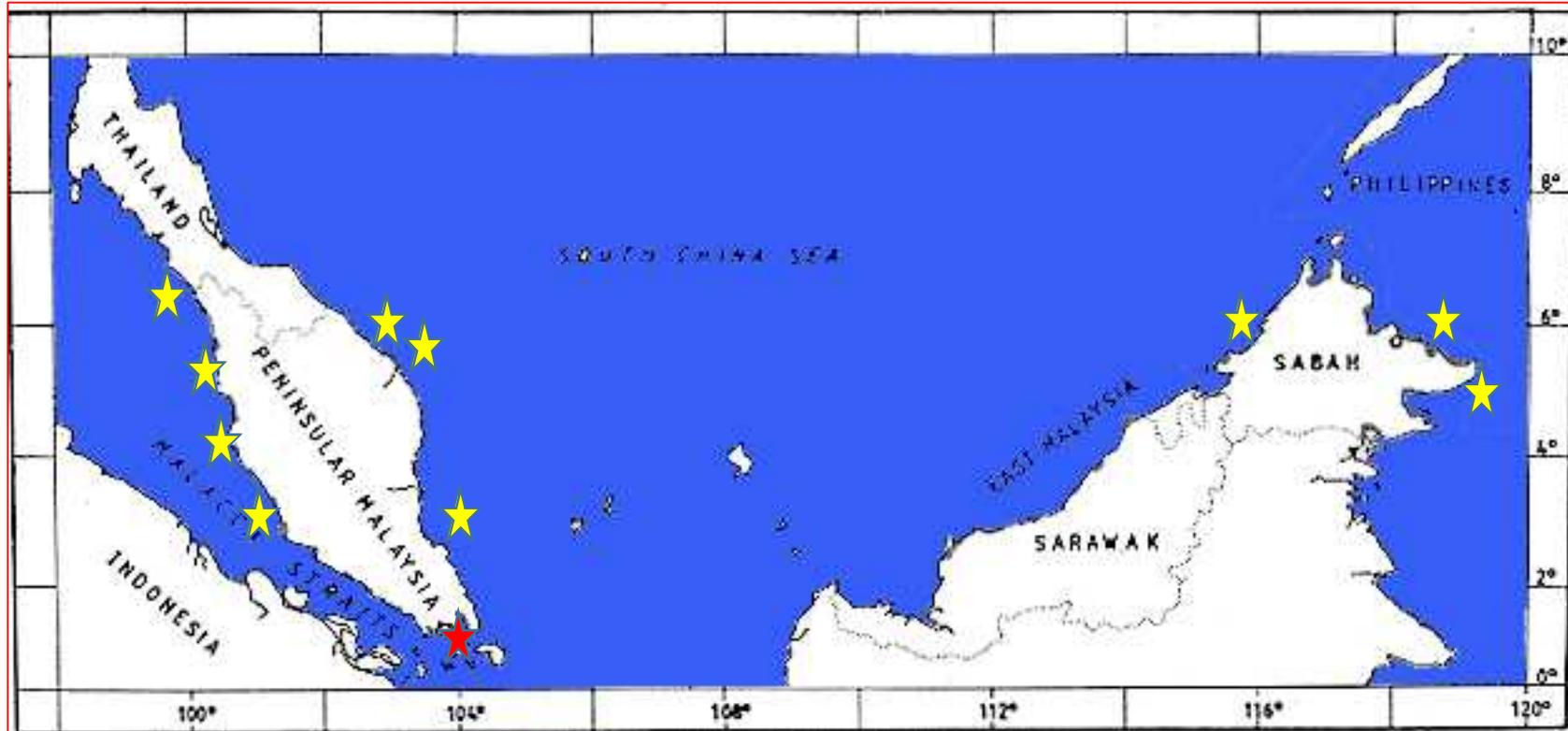
Seahorses

Malaysian Seahorses

- 12 species of seahorses (1 dwarf & 4 pygmy)
- Widespread in Malaysian waters.
- Found in all marine habitats nationwide

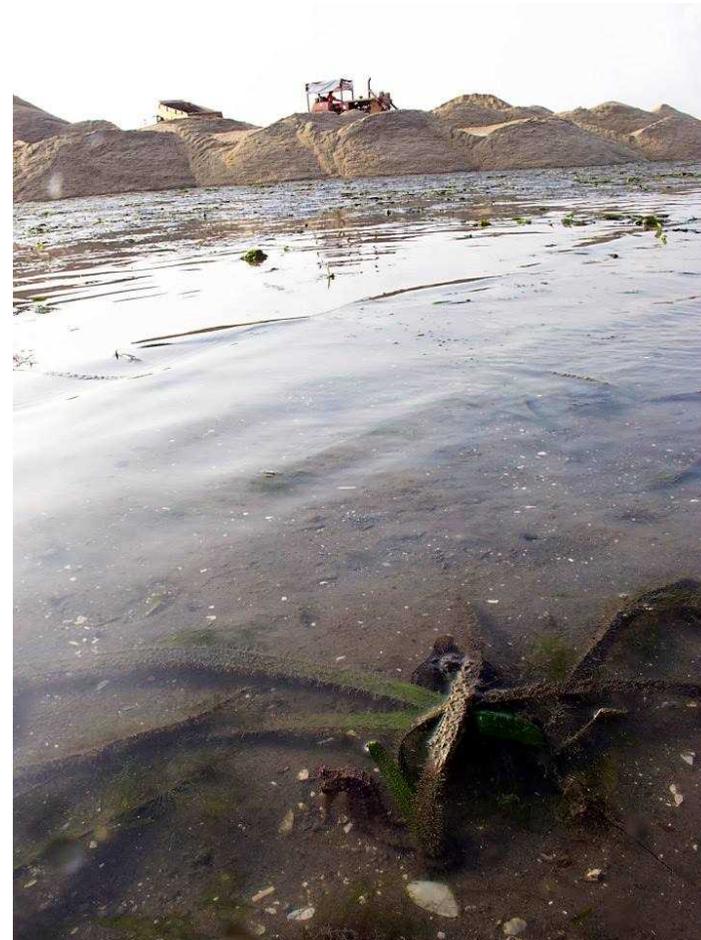
Photo from Teng JS

Seahorse hotspots



Current Threats Affecting Seahorses in Malaysia

- Habitat Degradation & Destruction
- Overfishing
- Traditional Medicine and Curio Trade
- Illegal Aquaculture Release
- No legal protection.
(Lim *et al.* 2011)





Moving forward

- Significant interest in seahorse aquaculture nationwide.
- Citizen science initiatives
- Seahorses in Malaysian local cultures, traditional medicine & trade
- Special area of conservation for seahorses

Summary

STATE OF ECOSYSTEM OBSERVATIONS

| Ecosystem | Location | Species Diversity | Area size | Related organisms (SW, MM, SH) |
|------------------|----------|-------------------|-----------|--------------------------------|
| Mangrove forests | High | High | High | MM, SH |
| Coral reefs | Medium | Medium | Medium | SW, SH |
| Seagrass meadows | Low | High | Low | SW, MM, SH |

WHAT NEXT?

- Location - diversity surveys e.g. Sarawak
- Area size observations
- Location/Diversity of MPAs
- Connectivity – current flow
- Monsoon effects
- Climate change effects
- Deep sea areas (shelf edge)

How inappropriate to call
this Planet **Earth** when it is quite
clearly **Ocean**.

- Arthur C Clarke -

Thank you

Johnston Atoll

Acknowledgements

Mangrove forests: Dr A. Aldrie Amir

Coral reefs: Reef Check Malaysia

Seagrass meadows: Dr Jillian Ooi Lean Sim

Seaweed: Prof Phang Siew Moi, Dr Yeong Hui Yin and Prof Lim Phaik Eem

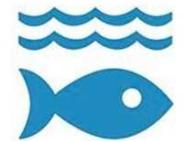
Marine mammals: Dr Louisa Ponnampalam & Mr Fairul Izmal Jamal Hisne

Seahorses: Dr Adam Lim

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image © 2013 TerraMetrics

© 2013 Cnes/Spot Image



**I SUPPORT
GOAL 14
LIFE BELOW
WATER**



MSMS

Malaysian Society of Marine Sciences
Persatuan Sains Lautan Malaysia

15°44'06.91" N 162°22'09.20" W elev -5615 m eye alt 8730.70 km

Google earth

List of Marine Fishes reported from Malaysia

n = 1423

| | | | | | | | |
|----------|----------------------------------|--|--|------------------------------------|---|--------------------------------------|--|
| Sort by: | <input type="radio"/> Family | <input checked="" type="radio"/> Species | <input type="radio"/> Occurrence | <input type="radio"/> Phylogenetic | <input type="checkbox"/> Extended checklist | <input type="checkbox"/> Show photos | |
| Filter: | <input type="radio"/> All fishes | <input type="radio"/> Freshwater | <input checked="" type="radio"/> Saltwater | <input type="radio"/> Introduced | <input type="radio"/> Endemic | <input type="radio"/> Threatened | |
| | <input type="radio"/> Dangerous | <input type="radio"/> Reef-associated | <input type="radio"/> Pelagic | <input type="radio"/> Deep-water | <input type="radio"/> Game fishes | <input type="radio"/> Commercial | |

[Table 1](#): 1356 species currently present in the country/island (endemic, native, introduced, reintroduced);

[Table 2](#): 61 species possibly present in the country/island (stray, questionable);

[Table 3](#): 6 species demonstrated to be absent in the country/island (extirpated, not established, misidentification, error).

[Table 4](#): 1423 species reported from the country/island altogether.

Table 1: 1356 species currently present in the country/island.

Roles of Mangroves

Ecosystem Functions and Services



**Provisioning:
Goods and Products**

**Regulating:
Natural Processes**

**Supporting:
Natural processes that maintain
other ecosystem services**

**Cultural:
Non-material benefits**

Forest resources
Fisheries
Genetic resources
Bio-chemicals & Medicine
Blue carbon
Coastal protection
Water regulation
Bio-filtration
Nutrient cycling
Soil stabilization
Primary production
Oxygen production
Provision of habitat
Aesthetic
Education
Recreation
Heritage and Spiritual

IMPORTANCE

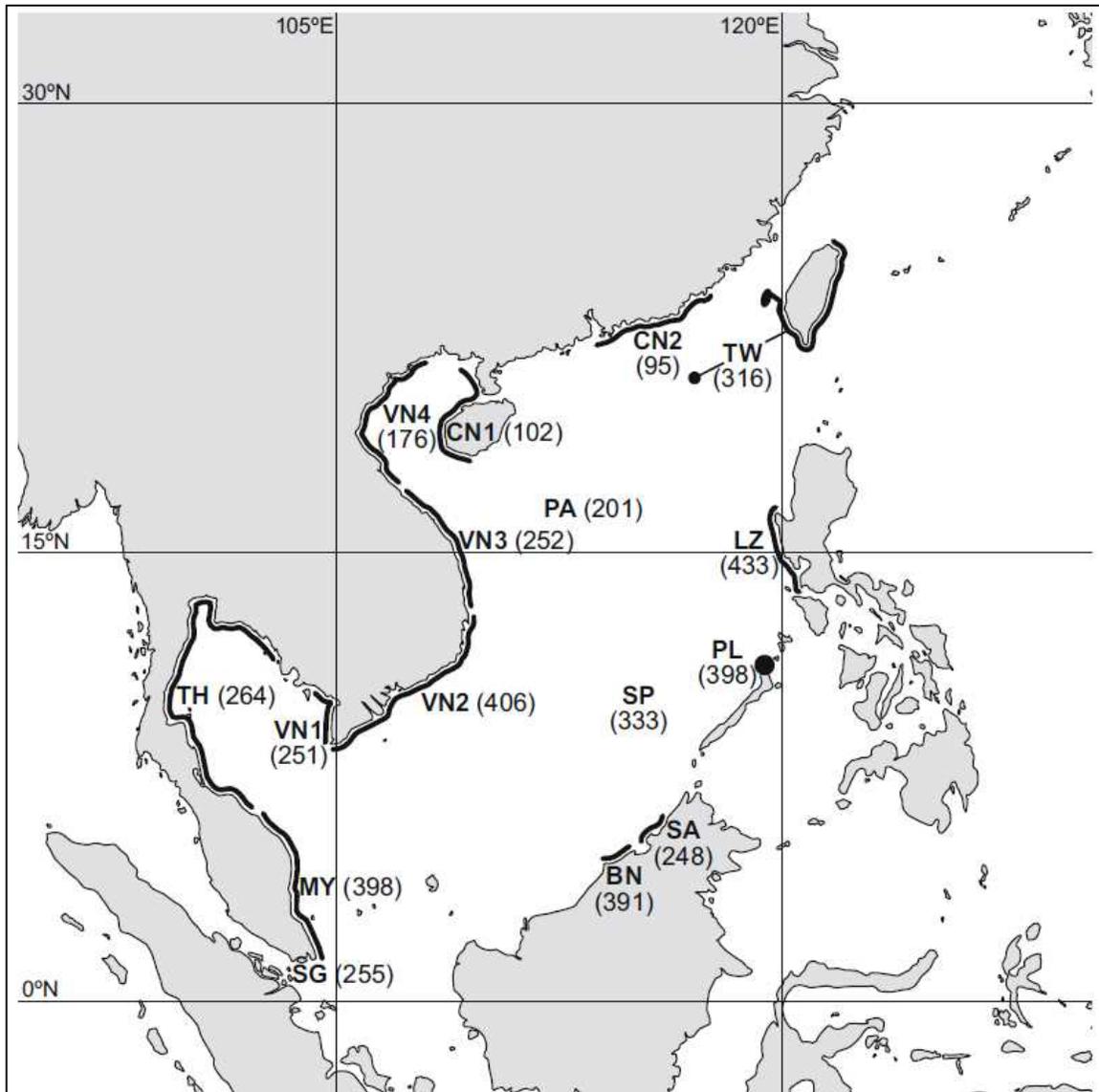


Fig. 1 South China Sea reef areas examined in this study, indicating the respective species richness of stony corals

Diversity of hard corals
(Scleractinia) in
South China Sea

Huang et al (2015)

Fortes, Ooi, Tan, Prathep, Bujang, Yaakub (2018). *Botanica Marina*.

Table 2: Seagrass species distribution in Southeast Asia by country/territory.+

| Family and species | BN | ID | CM | MM | MY | PH | SG | TH | VN | AN+ |
|--|----|----|----|----|----|----|----|----|----|-----|
| Family Hydrocharitaceae | | | | | | | | | | |
| <i>Enhalus acoroides</i> (L. f.) Royle | | • | • | • | • | • | • | • | • | • |
| <i>Thalassia hemprichii</i> (Ehrenb.) Aschers. in Petermann | • | • | • | • | • | • | • | • | • | • |
| <i>Halophila beccarii</i> Aschers. | • | • | • | • | • | • | • | • | • | • |
| <i>Halophila decipiens</i> Ostenfeld | | • | • | • | • | • | • | • | • | • |
| <i>Halophila gaudichaudii</i> J. Kuo | | | | | • | • | | | | |
| <i>Halophila major</i> (Zoll.) Miq. | | • | | • | • | • | | • | • | |
| <i>Halophila minor</i> (Zoll.) den Hartog | | • | • | • | • | • | • | • | • | |
| <i>Halophila ovalis</i> (R. Br.) Hook. f. | • | • | • | • | • | • | • | • | • | • |
| <i>Halophila ovata</i> Gaudich. and in Freycinet | | | | | | • | | | | • |
| <i>Halophila spinulosa</i> (R. Br.) Aschers. | • | • | | • | • | • | • | | | |
| <i>Halophila sulawesii</i> J. Kuo | | • | | | | | | | | |
| <i>Halophila</i> sp. 1 | | | | | | • | | | | |
| <i>Halophila</i> sp. 2 (<i>Halophila tricostata</i> Greenway) | | | | | • | • | | | | |
| Family Cymodoceaceae | | | | | | | | | | |
| <i>Cymodocea rotundata</i> Ehrenb. et Hempr. ex Aschers. | • | • | • | • | • | • | • | • | • | • |
| <i>Cymodocea serrulata</i> (R. Br.) Aschers. et Magnus | | • | • | • | • | • | • | • | • | • |
| <i>Halodule pinifolia</i> (Miki) den Hartog | • | • | • | • | • | • | • | • | • | • |
| <i>Halodule uninervis</i> (Forssk.) Aschers. | | • | • | • | • | • | • | • | • | • |
| <i>Syringodium isoetifolium</i> (Aschers.) Dandy | | • | • | • | • | • | • | • | • | • |
| <i>Thalassodendron ciliatum</i> (Forssk.) den Hartog | | • | | | • | • | | | • | |
| Family Ruppiaceae | | | | | | | | | | |
| <i>Ruppia maritima</i> L. | | • | • | | • | • | | • | | |
| Family Zosteraceae | | | | | | | | | | |
| <i>Zostera japonica</i> Aschers. et Graebn. | | | | | | | | | • | |
| Total no. of species | 7 | 16 | 12 | 13 | 16 | 19 | 12 | 13 | 14 | 9 |

LC but decreasing

Vulnerable

Calling attention to Seagrass Functions



Juvenile fish dominate fish populations in lagoonal seagrass

(Aziz Arshad *et al*, 2006)

6x more juvenile fish in forereef seagrass than coral reefs
(Nina Ho, *MSc thesis*, 2018)



Seagrass as important **capture fisheries** and **gleaning grounds**

(Japar Sidik Bujang *et al*, 2006)

Forereef seagrass dominated by **food fish**, as opposed to aquaria fish in coral reefs

(Nina Ho, *MSc thesis*, 2018)



Dugongs are strategic grazers in seagrass meadows – they have favorite feeding areas **even in low density meadows**

(Heng Wei Khang *et al*, GEF DSCP Project MY4 Final Report, 2019)

PRODUCTION & UTILISATION OF TROPICAL SEAWEEDS

Off-shore Cultivation



Tissue & Protoplast Culture



Production of clonal planting materials from *Gracilaria changii* and *Kappaphycus alvarezii* through tissue culture and culture of *G. changii* explants in airlift photobioreactors

Hui-Yin Yeong · Siew-Moi Phang · C. R. K. Reddy · Norzulaani Khalid

J Appl Phycol (2014) 26:729–746

Bioremediation with Seaweeds



Iranian Journal of Fisheries Sciences

13(3)621-639

2014

Bioremediation efficiency and biochemical composition of *Ulva reticulata* Forsskal (Chlorophyta) cultivated in shrimp (*Penaeus monodon*) hatchery effluent

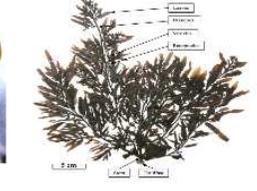
Rabiei, R.^{1,2,3,*}; Phang, S. M.^{1,2}; Yeong, H. Y.²; Lim, P. E.^{1,2}; Ajdari, D.⁴; Zarshenas, G.⁴; Sohrabipour, J.^{1,2,3}

Climate Change & Tropical Seaweeds

J Appl Phycol (2013) 25:1377–1386
DOI 10.1007/s10811-013-9990-x

Volatile halocarbon emissions by three tropical brown seaweeds under different irradiances

Fiona Seh-Lin Keng · Siew-Moi Phang · Noorsaadah Abd Rahman · Emma C. Leedham · Claire Hughes · Andrew D. Robinson · Neil R. P. Harris · John A. Pyle · William T. Sturges



Int. J. Environ. Sci. Technol.
DOI 10.1007/s13762-017-1455-3

ORIGINAL PAPER

Evaluation of tropical seaweeds as feedstock for bioethanol production

M. J. Hessami¹ · S.-M. Phang^{1,2} · A. Salleh¹ · R. Rabiei³



Biofuel

OUTPUTS

THE UNIVERSITY OF MALAYA COLLECTIONS OF ALGAE

UNIVERSITY OF MALAYA ALGAE CULTURE COLLECTION (UMACC)

CATALOGUE OF STRAINS



The only Microalgae Culture Collection in Malaysia

Phang SM & Chu WL. 2004
The University of Malaya Algae Culture
Collection (UMACC) and potential
applications of a unique *Chlorella* from
the collection. Jap. J. Phycol. 52: 221-224

UNIVERSITY OF MALAYA SEAWEEDS AND SEAGRASSES HERBARIUM



The largest collection of seaweeds and seagrasses in Malaysia

Phang SM . 2000
Seagrasses of
Malaysia, University
of Malaya Botanical
Monographs No. 2,
60p.

Phang SM, Yeong HY,
Lim PE (2019) The
seaweed resources of
Malaysia. Botanica
Marina 62(3): 265-
273.

>250 ALGAE STRAINS

- tropical strains with valuable biochemicals
- polar strains for environmental stress research
- database of potential products & processes

25,000 SPECIMENS

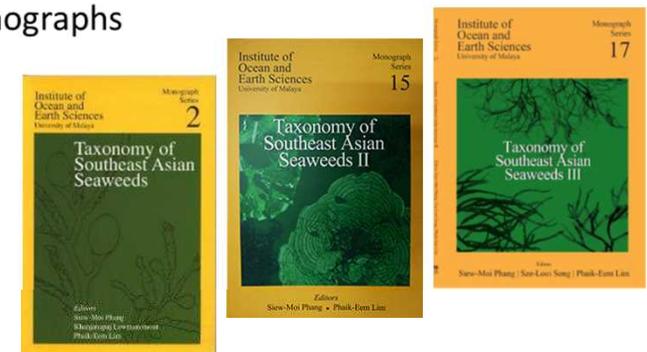
- represent Malaysian & regional flora
- living collection for biotechnological exploitation & fundamental studies
- basis for crop improvement in mariculture

SEASTax- Southeast Asian Seaweed Taxonomy Consortium

- Established after the First Taxonomy of Seaweeds Workshop, University of Malaya, Kuala Lumpur, 2007
- Members from Thailand, Indonesia, Vietnam, Singapore, Japan, Korea, Hong Kong and Malaysia.
- Senior taxonomists to mentor young taxonomists to ensure continuity of expertise

Goals of the SEASTax

- To train and nurture a new generation of seaweed taxonomists
- To ensure accurate documentation of the rich and valuable seaweed resources
- To facilitate sustainable management of the seaweed resources
- To facilitate sustainable development of seaweed resources
- To communicate the seaweed diversity and their identification through illustrated monographs



Marine mammal research and conservation priorities in Malaysia

Research Priorities

- Population assessments, distribution, ecological and habitat studies
- Social structure, behavioural studies in relation to human activities
- Fisheries-related mortality (incl. direct takes)
- Fisheries-linked ecological studies
- Genetic assessments of taxonomy, population structure and genetic diversity
- Impacts of oil, gas and minerals exploration
- Tourism impacts
- Social science studies
- Prevalence of diseases / Pathological studies
- Conservation economics (e.g. valuation, Willingness To Pay, etc.)

Conservation priorities

- Enforcement of existing regulations (trade, MPAs, fisheries management)
- Expanding on MPAs - gazette IMMAs as MMPAs
- National marine mammal management plans drafted and operationalised
- Application of research results (real-world scenario)
- Building local capacity (research, veterinary, communications, management, enforcement, stakeholder involvements)
- Increase awareness levels at governmental level, local communities, general public
- Necessitating MMO requirements in O&G explorative activities
- Regional transboundary collaboration

Malaysian Seahorses

- *Hippocampus kuda*
- *Hippicampus trimaculatus*
- *Hippocampus spinosissimus*
- *Hippocampus comes*
- *Hippocampus barbouri*
- *Hippocampus keloggi*
- *Hippocampus histrix*
- *Hippocampus mohnikei*
- *Hippocampus bargibanti*
- *Hippocampus denise*
- *Hippocampus pontiohi*
- *Hippocampus satomiae*

Photo from Teng JS

Malaysia's Marine Biodiversity: Inventory and Current Status (2011)

Kamarruddin Ibrahim, Che Abdul Rahim Mohamed, Mohammad
Rozaimi Jamaludin, Kee Alfian Abd Adzis, Fitra Aizura Zulkifli,
Lee Jen Nie (Eds)

Department of Marine Park Malaysia
and EKOMAR, UKM



The Status of Hard Coral Diversity in Sabah

¹Zarinah Waheed, ¹Ridzwan Abdul Rahman &
²Affendi Johari Ariff

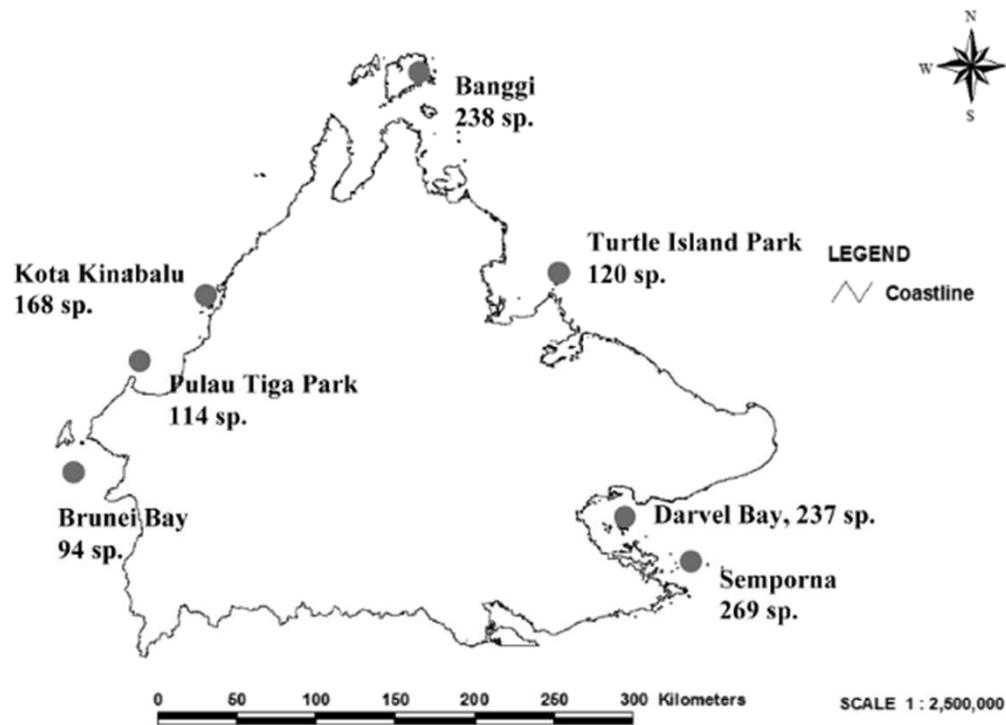


FIGURE 3: Hard Coral Species Distribution in Sabah

Sabah has a total of 471 species of hard corals (including 4 families of non-scleractinian corals)



TABLE 3: New Coral Species Collected from Darvel Bay During Ekspedisi Galaxea '98 (Ditlev, 2003)

| Family | Species |
|-------------|--------------------------------|
| Acroporidae | <i>Enigmopora darveliensis</i> |
| Acroporidae | <i>Acropora ridzwani</i> |
| Fungiidae | <i>Lithophyllon ranjiti</i> |
| Pectinidae | <i>Pectinia crassa</i> |
| Pectinidae | <i>Mycedium spina</i> |
| Euphyllidae | <i>Plerogyra multilobata</i> |
| Euphyllidae | <i>Plerogyra diabolotus</i> |
| Euphyllidae | <i>Plerogyra cauliformis</i> |

Current Knowledge on Scleractinian Coral Diversity of Peninsular Malaysia

*Affendi Yang Amri & Faedzul Rahman Rosman

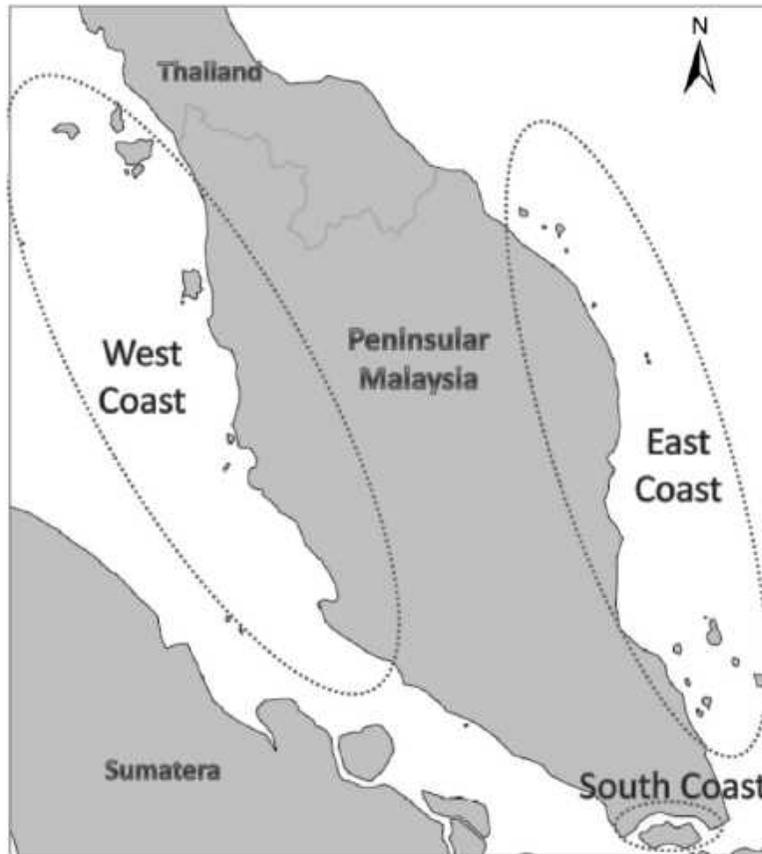


FIGURE 1: Map of Peninsular Malaysia Showing the Three Areas: the West Coast, the East Coast and the South Coast

Total number of Scleractinian coral species in Peninsular Malaysia is 480 species

There are 245 species in its South Coast, 63 species in its West Coast and 431 species in its East Coast



Chondrichthyan Biodiversity in Malaysia and Brunei Darussalam

¹Ahmad Ali, ²Albert Chuan Gambang &
³Annie Lim Pek Khiok

Chondrichthyan biodiversity in the waters of Malaysia and Brunei Darussalam is among the richest in this region with at least 140 species

Malaysia has **7 out of 8 orders of sharks** recorded throughout the world. They are Hexanchiformes, Squaliformes, Squatiniformes, Heterodontiformes, Orectolobiformes, Lamniformes and Carcharhiniformes. The one that is yet to be recorded is Pristiophoriformes (saw sharks).

Surveys conducted between 1999 and 2004 found **two new species of swell shark** namely *Cephaloscyllium sarawakensis* and *C. circlupullum*

Sharks, rays and chimaeras, collectively known as Chondrichthyes or cartilaginous fishes



Marine Mammals in Borneo

¹Saifullah A. Jaaman & ^{1,2}James Bali

TABLE 1: Checklist of All Confirmed Marine Mammal Species Found in East Malaysia (EM), Brunei (Br), Kalimantan, Indonesia (KI), and Expected to Occur (E) (*As Strays)

| No. | Species (Common Name) | Sighting | Stranding / Skeletal Remain | By-catch | Hunting (Sabah) | SOUTH CHINA SEA | | | SULU SEA | CELEBES SEA | KALIMANTAN (Indonesia) | EXPECTED | Recorded in 1997-2002 |
|-----|--|----------|-----------------------------|----------|-----------------|-----------------|--------|---------|----------|-------------|------------------------|-------------|-----------------------|
| | | | | | | Sabah | Brunei | Sarawak | Sabah | Sabah | | * as strays | Boat (B) Aerial (A) |
| 1 | <i>Megaptera novaeangliae</i> (Humpback Whale) | | | | | | | | | | | E* | |
| 2 | <i>Balaenoptera acutorostrata</i> (Minke Whale) | | | | | | | | | | | E* | |
| 3 | <i>Balaenoptera edeni</i> (Bryde's Whale) | X | X | | | C | C | C | C | C | | | B |
| 4 | <i>Balaenoptera borealis</i> (Sei Whale) | | | | | | | | | | | E* | |
| 5 | <i>Balaenoptera physalus</i> (Fin Whale) | X | | | | C | | | | | | | |
| 6 | <i>Balaenoptera musculus</i> (Blue Whale) | | | | | | | | | | | E* | |
| 7 | <i>Physeter macrocephalus</i> (Sperm Whale) | X | X | | | C | | C | | C | | | |
| 8 | <i>Kogia breviceps</i> (Pygmy Sperm Whale) | | X | | | | | C | | | | | |
| 9 | <i>Kogia sima</i> (Dwarf Sperm Whale) | | | | | | | | | | | E | |
| 10 | <i>Ziphius cavirostris</i> (Cuvier's Beaked Whale) | | X | | | C | | | | | | | |
| 11 | <i>Mesoplodon ginkgodens</i> (Ginko-Toothed Beaked Whale) | | | | | | | | | | | E | |
| 12 | <i>Mesoplodon densirostris</i> (Blainville's Beaked Whale) | | | | | | | | | | | E | |
| 13 | <i>Stereo bredanensis</i> (Rough-Toothed Dolphin) | | X | | | | C | C | | | | | |
| 14 | <i>Sousa chinensis</i> (Indo-Pacific Humpbacked Dolphin) | X | X | X | | | C | C | C | C | | | BA |
| 15 | <i>Tursiops truncatus</i> (Common Bottlenose Dolphin) | X | X | X | X | C | | C | C | C | | | B |
| 16 | <i>Tursiops aduncus</i> (Indo-Pacific Bottlenose Dolphin) | X | X | X | X | C | C | C | C | C | | | B |
| 17 | <i>Stenella attenuata</i> (Pantropical Spotted Dolphin) | X | X | X | X | C | C | C | C | C | | | B |
| 18 | <i>Stenella longirostris</i> (Spinner Dolphin) | X | | X | X | C | C | C | C | C | | | B |
| 19 | <i>Sterella coeruleoalba</i> (Stippled Dolphin) | | | | | | | | | | | E | |
| 20 | <i>Delphinus sp.</i> (Common Dolphin) | | X | | | | | | | C | | | |
| 21 | <i>Lagenodelphis hosei</i> (Fraser's Dolphin) | X | X | | | C | | C | C | C | | | B |
| 22 | <i>Grampus griseus</i> (Risso's Dolphin) | | X | | | | C | C | C | C | | | |
| 23 | <i>Peponocephala electra</i> (Melon-Headed Whale) | X | X | | | C | | C | | | | | |
| 24 | <i>Feresa attenuata</i> (Pygmy Killer Whale) | X | | | | | | C | | | | | |
| 25 | <i>Pseudorca crassidens</i> (False Killer Whale) | X | X | | | C | C | C | | C | | | B |
| 26 | <i>Orcinus orca</i> (Killer Whale) | X | X | | | C | | C | | | | | |
| 27 | <i>Globicephala macrorhynchus</i> (Short-Finned Pilot Whale) | X | X | | | | | C | C | C | | | B |
| 28 | <i>Orcaella brevirostris</i> (Irawaddy Dolphin) | X | X | X | X | | C | C | C | C | | | B |
| 29 | <i>Neophocaena phocaenoides</i> (Finless Porpoise) | X | X | X | X | | C | C | C | C | | | B |
| 30 | <i>Dugong dugon</i> (Dugong) | X | X | X | X | C | C | C | C | C | | | A |

TABLE 1: Checklist of All Confirmed Marine Mammal Species Found in East Malaysia (EM), Brunei (Br), Kalimantan, Indonesia (KI), and Expected to Occur (E) (*As Strays)

| No. | Species (Common Name) | Sighting | Stranding / Skeletal Remain | By- catch | Hunting (Sabah) | SOUTH CHINA SEA | | | SULU SEA | CELEBES SEA | KALIMANTAN (Indonesia) | EXPECTED * as strays | Recorded in 1997- 2002 Boat (B) Aerial (A) |
|-----|--|----------|--------------------------------|--------------|--------------------|-----------------|--------|---------|-------------|----------------|---------------------------|-----------------------------|--|
| | | | | | | Sabah | Brunei | Sarawak | Sabah | Sabah | | | |
| 1 | <i>Megaptera novaeangliae</i> (Humpback Whale) | | | | | | | | | | | E* | |
| 2 | <i>Balaenoptera acutorostrata</i> (Minke Whale) | | | | | | | | | | | E* | |
| 3 | <i>Balaenoptera edeni</i> (Bryde's Whale) ← | X | X | | | C | C | C | C | C | | | B |
| 4 | <i>Balaenoptera borealis</i> (Sei Whale) | | | | | | | | | | | E* | |
| 5 | <i>Balaenoptera physalus</i> (Fin Whale) | X | | | | C | | | | | | E* | |
| 6 | <i>Balaenoptera musculus</i> (Blue Whale) | | | | | | | | | | | E* | |
| 7 | <i>Physeter macrocephalus</i> (Sperm Whale) ← | X | X | | | C | | C | | C | | | |
| 8 | <i>Kogia breviceps</i> (Pygmy Sperm Whale) | | X | | | | | | | C | | | |
| 9 | <i>Kogia sima</i> (Dwarf Sperm Whale) | | | | | | | | | | | E | |
| 10 | <i>Ziphius cavirostris</i> (Cuvier's Beaked Whale) | | X | | | C | | | | | | | |
| 11 | <i>Mesoplodon ginkgodens</i> (Ginkgo-Toothed Beaked Whale) | | | | | | | | | | | E | |
| 12 | <i>Mesoplodon densirostris</i> (Blainville's Beaked Whale) | | | | | | | | | | | E | |
| 13 | <i>Stereo bredanensis</i> (Rough-Toothed Dolphin) | | X | | | | C | C | | | | | |
| 14 | <i>Sousa chinensis</i> (Indo-Pacific Humpbacked Dolphin) | X | X | X | | | C | C | C | C | | | BA |
| 15 | <i>Tursiops truncatus</i> (Common Bottlenose Dolphin) | X | X | X | X | C | C | C | C | C | | | B |
| 16 | <i>Tursiops aduncus</i> (Indo-Pacific Bottlenose Dolphin) | X | X | X | X | C | C | C | C | C | | | B |
| 17 | <i>Stenella attenuata</i> (Pantropical Spotted Dolphin) | X | X | X | X | C | C | C | C | C | | | B |
| 18 | <i>Stenella longirostris</i> (Spinner Dolphin) | X | | X | X | C | C | C | | C | | | B |
| 19 | <i>Stenella coeruleoalba</i> (Striped Dolphin) | | | | | | | | | | | E | |
| 20 | <i>Delphinus sp.</i> (Common Dolphin) | | X | | | | | | | C | | | |
| 21 | <i>Lagenodelphis hosei</i> (Fraser's Dolphin) | X | X | | | C | | C | C | C | | | B |
| 22 | <i>Grampus griseus</i> (Risso's Dolphin) | | X | | | | C | C | | | | | |
| 23 | <i>Peponocephala electra</i> (Melon-Headed Whale) | X | X | | | C | | C | | | | | |
| 24 | <i>Feresa attenuata</i> (Pygmy Killer Whale) ← | X | | | | | | C | | | | | |
| 25 | <i>Pseudorca crassidens</i> (False Killer Whale) ← | X | X | | | C | | C | | C | | | B |
| 26 | <i>Orcinus orca</i> (Killer Whale) ← | X | X | | | C | | C | | | | | |
| 27 | <i>Globicephala macrorhynchus</i> (Short-Finned Pilot Whale) | X | X | | | | | C | | C | | | B |
| 28 | <i>Orcaella brevirostris</i> (Irrawaddy Dolphin) | X | X | X | X | | C | C | C | C | | | B |
| 29 | <i>Neophocaena phocaenoides</i> (Finless Porpoise) | X | X | X | X | | C | C | C | C | | | B |
| 30 | <i>Dugong dugon</i> (Dugong) | X | X | X | X | C | C | C | C | C | | | A |

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Table 3. Checklist of marine mammal species known to occur/have occurred in Malaysian waters based on sighting and stranding records. Two-letter abbreviations at the end of each species name denote species codes in Figs. 2 and 3. LS = live sighting record; ST = stranding record.

| Species | Peninsular Malaysia | | Sarawak | | Sabah | | Reference(s) |
|--|---------------------|----|---------|----|-------|----|---|
| | LS | ST | LS | ST | LS | ST | |
| Family Dugongidae | | | | | | | |
| Dugong (<i>Dugong dugon</i>) - Dd | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 1, 16, 21, 23, 25, 27, 28, 29 |
| Family Balaenopteridae | | | | | | | |
| Omura's whale (<i>Balaenoptera omurai</i>) - Bo | | ✓ | | | | | 29 |
| Bryde's whale (<i>Balaenoptera edeni</i>) - Be | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 9, 6, 16, 24, 27, 28, 29 |
| Blue whale (<i>Balaenoptera musculus</i>) - Bm | | | | | | ✓ | 28 |
| Fin whale (<i>Balaenoptera physalus</i>) - Bp | | | | | ✓ | | 18 |
| Humpback whale (<i>Megaptera novaeangliae</i>) - Mn | | | ✓ | | | | 25 |
| Family Ziphiidae | | | | | | | |
| Curvier's beaked whale (<i>Ziphius cavirostris</i>) - Zc | | | | | | ✓ | 20 |
| Ginkgo-toothed whale (<i>Mesoplodon ginkgodens</i>) - Mg | | ✓ | | | | | 13 |
| Family Physeteridae | | | | | | | |
| Sperm whale (<i>Physeter macrocephalus</i>) - Pm | | | | ✓ | ✓ | ✓ | 16, 18, 24 |
| Family Kogiidae | | | | | | | |
| Pygmy sperm whale (<i>Kogia breviceps</i>) - Kb | | ✓ | | ✓ | | | 6, 28 |
| Family Delphinidae | | | | | | | |
| Indo-Pacific humpback dolphin (<i>Sousa chinensis</i>) - Sch | ✓ | ✓ | ✓ | ✓ | ✓ | | 4, 5, 8, 9, 16, 17, 22, 25, 26, 27, 28, 29 |
| Irrawaddy dolphin (<i>Orcaella brevirostris</i>) - Ob | ✓ | ✓ | ✓ | ✓ | ✓ | | 1, 2, 3, 4, 7, 11, 16, 17, 22, 24, 25, 26, 27, 28, 29 |
| Indo-Pacific bottlenose dolphin (<i>Tursiops aduncus</i>) - Ta | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 20, 22, 24, 25, 27, 28, 29 |
| Common bottlenose dolphin (<i>Tursiops truncatus</i>) - Tt | | | | | | ✓ | 24 |
| Long-beaked common dolphin (<i>Delphinus capensis</i>) - Dc | ✓ | ✓ | | | | | 3, 12, 27, 29 |
| Spinner dolphin (<i>Stenella longirostris</i>) - Sl | ✓ | | ✓ | | ✓ | ✓ | 18, 22, 24, 25, 29 |
| Pantropical spotted dolphin (<i>Stenella attenuata</i>) - Sa | | ✓ | ✓ | | ✓ | | 18, 20, 24, 27, 29 |
| Striped dolphin (<i>Stenella coeruleoalba</i>) - Sc | | ✓ | | | | | 27 |
| Fraser's dolphins (<i>Lagenodelphis hosei</i>) - Lh | | | ✓ | ✓ | | | 5, 24 |
| False killer whale (<i>Pseudorca crassidens</i>) - Pc | ✓ | ✓ | | | ✓ | ✓ | 18, 22, 24, 27, 29 |
| Pygmy killer whale (<i>Feresa attenuata</i>) - Fa | | ✓ | ✓ | | ✓ | | 18, 28, 29 |
| Melon-headed whale (<i>Peponocephala electra</i>) - Pe | | ✓ | ✓ | | ✓ | | 18, 24 |
| Rough-toothed dolphin (<i>Steno bredanensis</i>) - Sb | | | | ✓ | ✓ | | 24, 27 |
| Killer whale (<i>Orcinus orca</i>) - Oo | | | | ✓ | ✓ | | 4, 24 |
| Risso's dolphin (<i>Grampus griseus</i>) - Gg | | | | ✓ | | | 16, 24 |
| Short-finned pilot whale (<i>Globicephala macrorhynchus</i>) - Gm | | ✓ | | | ✓ | ✓ | 2, 3, 24 |
| Family Phocoenidae | | | | | | | |
| Indo-Pacific finless porpoise (<i>Neophocaena phocaenoides</i>) - Np | ✓ | ✓ | ✓ | ✓ | ✓ | | 1, 2, 3, 14, 15, 16, 20, 22, 24, 25, 26, 27, 28, 29 |

References: (1) Bank, 1931; (2) Chasen, 1940; (3) Gibson-Hill, 1949; (4) Gibson-Hill, 1950; (5) Fraser, 1956; (6) Harrison & Jamuh, 1958; (7) Lewin, 1958; (8) Harrison, 1960; (9) Mörzner-Bruyns, 1971; (10) Berry et al., 1973; (11) Ratnam, 1982; (12) Abdul, 1986; (13) Mead, 1989; (14) Duckworth, 1995; (15) Durville & Taylor, 1996; (16) Beasley & Jefferson, 1997; (17) Dolar et al., 1997; (18) De Boer, 2000; (19) Jaaman et al., 2000; (20) Jaaman et al., 2001; (21) Jaaman & Lah-Angyi, 2003; (22) Nadarajah, 2000; (23) Mansor et al., 2000; (24) Jaaman, 2004; (25) Bali et al., 2008; (26) Minton et al., 2011; (27) Confirmed third party report; (28) Newspaper report; (29) Recent survey by LSP.

Table 3. Checklist of marine mammal species known to occur/have occurred in Malaysian waters based on sighting and stranding records. Two-letter abbreviations at the end of each species name denote species codes in Figs. 2 and 3. LS = live sighting record; ST = stranding record.

| Species | Peninsular Malaysia | | Sarawak | | Sabah | | Reference(s) |
|--|---------------------|----|---------|----|-------|----|---|
| | LS | ST | LS | ST | LS | ST | |
| Family Dugongidae | | | | | | | |
| Dugong (<i>Dugong dugon</i>) - Dd | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 1, 16, 21, 23, 25, 27, 28, 29 |
| Family Balaenopteridae | | | | | | | |
| Omura's whale (<i>Balaenoptera omurai</i>) - Bo | | ✓ | | | | | 29 |
| Bryde's whale (<i>Balaenoptera edeni</i>) - Be | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 9, 6, 16, 24, 27, 28, 29 |
| Blue whale (<i>Balaenoptera musculus</i>) - Bm | | | | | | ✓ | 28 |
| Fin whale (<i>Balaenoptera physalus</i>) - Bp | | | | | ✓ | | 18 |
| Humpback whale (<i>Megaptera novaeangliae</i>) - Mn | | | ✓ | | | | 25 |
| Family Ziphiidae | | | | | | | |
| Cuvier's beaked whale (<i>Ziphius cavirostris</i>) - Zc | | | | | | ✓ | 20 |
| Ginkgo-toothed whale (<i>Mesoplodon ginkgodens</i>) - Mg | | ✓ | | | | | 13 |
| Family Physeteridae | | | | | | | |
| Sperm whale (<i>Physeter macrocephalus</i>) - Pm | | | | ✓ | ✓ | ✓ | 16, 18, 24 |
| Family Kogiidae | | | | | | | |
| Pygmy sperm whale (<i>Kogia breviceps</i>) - Kb | | ✓ | | ✓ | | | 6, 28 |
| Family Delphinidae | | | | | | | |
| Indo-Pacific humpback dolphin (<i>Sousa chinensis</i>) - Sch | ✓ | ✓ | ✓ | ✓ | ✓ | | 4, 5, 8, 9, 16, 17, 22, 25, 26, 27, 28, 29 |
| Irrawaddy dolphin (<i>Orcaella brevirostris</i>) - Ob | ✓ | ✓ | ✓ | ✓ | ✓ | | 1, 2, 3, 4, 7, 11, 16, 17, 22, 24, 25, 26, 27, 28, 29 |
| Indo-Pacific bottlenose dolphin (<i>Tursiops aduncus</i>) - Ta | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 20, 22, 24, 25, 27, 28, 29 |
| Common bottlenose dolphin (<i>Tursiops truncatus</i>) - Tt | | | | | ✓ | | 24 |
| Long-beaked common dolphin (<i>Delphinus capensis</i>) - Dc | ✓ | ✓ | | | | | 3, 12, 27, 29 |
| Spinner dolphin (<i>Stenella longirostris</i>) - Sl | ✓ | | ✓ | | ✓ | ✓ | 18, 22, 24, 25, 29 |
| Pantropical spotted dolphin (<i>Stenella attenuata</i>) - Sa | | ✓ | ✓ | | ✓ | | 18, 20, 24, 27, 29 |
| Striped dolphin (<i>Stenella coeruleoalba</i>) - Sc | | ✓ | | | | | 27 |
| Fraser's dolphins (<i>Lagenodelphis hosei</i>) - Lh | | | ✓ | ✓ | | | 5, 24 |
| False killer whale (<i>Pseudorca crassidens</i>) - Pc | ✓ | ✓ | | | ✓ | ✓ | 18, 22, 24, 27, 29 |
| Pygmy killer whale (<i>Feresa attenuata</i>) - Fa | | ✓ | ✓ | | ✓ | | 18, 28, 29 |
| Melon-headed whale (<i>Peponocephala electra</i>) - Pe | | ✓ | ✓ | | ✓ | | 18, 24 |
| Rough-toothed dolphin (<i>Steno bredanensis</i>) - Sb | | | | ✓ | ✓ | | 24, 27 |
| Killer whale (<i>Orcinus orca</i>) - Oo | | | | ✓ | ✓ | | 4, 24 |
| Risso's dolphin (<i>Grampus griseus</i>) - Gg | | | | ✓ | | | 16, 24 |
| Short-finned pilot whale (<i>Globicephala macrorhynchus</i>) - Gm | | ✓ | | | ✓ | ✓ | 2, 3, 24 |
| Family Phocoenidae | | | | | | | |
| Indo-Pacific finless porpoise (<i>Neophocaena phocaenoides</i>) - Np | ✓ | ✓ | ✓ | ✓ | ✓ | | 1, 2, 3, 14, 15, 16, 20, 22, 24, 25, 26, 27, 28, 29 |

References: (1) Bank, 1931; (2) Chasen, 1940; (3) Gibson-Hill, 1949; (4) Gibson-Hill, 1950; (5) Fraser, 1956; (6) Harrison & Jamuh, 1958; (7) Lewin, 1958; (8) Harrison, 1960; (9) Mörzer-Bruyns, 1971; (10) Berry et al., 1973; (11) Ratnam, 1982; (12) Abdul, 1986; (13) Mead, 1989; (14) Duckworth, 1995; (15) Durville & Taylor, 1996; (16) Beasley & Jefferson, 1997; (17) Dolar et al., 1997; (18) De Boer, 2000; (19) Jaaman et al., 2000; (20) Jaaman et al., 2001; (21) Jaaman & Lah-Anyi, 2003; (22) Nadarajah, 2000; (23) Mansor et al., 2000; (24) Jaaman, 2004; (25) Bali et al., 2008; (26) Minton et al., 2011; (27) Confirmed third party report; (28) Newspaper report; (29) Recent survey by LSP.

Seagrasses – Diversity, Values and Why they are Declining

¹Japar Sidik Bujang & ¹Muta Harah Zakaria

TABLE 2: Seagrass Communities in Different Areas in Peninsular Malaysia and East Malaysia

| Region | Peninsular Malaysia | | | | | | | | | | | East Malaysia | | | | | |
|---|---------------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|-----------|----------|----------|----------|
| Family/Species/Site | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| Hydrocharitaceae | | | | | | | | | | | | | | | | | |
| <i>Enhalus acoroides</i> (L.f.) Royle | + | + | | | | + | | | | | + | | | + | + | | + |
| <i>Thalassia hemprichii</i> (Ehrenb.) Aschers. | + | + | + | | | | | | | | | | | + | + | | + |
| <i>Halophila beccarii</i> Aschers. | | | | | | | + | + | | | | | + | | | | + |
| <i>Halophila decipiens</i> Ostenfeld | + | | | | | | | | | + | + | | | + | | + | |
| <i>Halophila minor</i> (Zoll.) den Hartog | | + | | | | | | | + | + | + | | | + | | + | |
| <i>Halophila ovalis</i> (R. Br.) Hook. f. | + | + | + | + | + | + | | | + | | + | + | | + | + | + | + |
| <i>Halophila spinulosa</i> Aschers. | | + | | + | | | | | | | | | | + | | | |
| Cymodoceaceae | | | | | | | | | | | | | | | | | |
| <i>Cymodocea rotundata</i> Ehrenb. & Hempr. ex Aschers. | | + | + | + | | | | | | | | | | + | + | | + |
| <i>Cymodocea serrulata</i> (R. Br.) Aschers. & Magnus | + | + | + | | + | + | | | | | | | | + | + | | |
| <i>Halodule pinifolia</i> (Miki) den Hartog | + | + | | | + | | + | + | + | + | + | + | + | + | + | + | + |
| <i>Halodule uninervis</i> (Forssk.) Aschers. | + | + | + | + | + | + | | | | | | | | + | + | | |
| <i>Syringodium isoetifolium</i> (Aschers.) Dandy | + | + | + | + | | | | | | | | | | | | | |
| Total | 8 | 10 | 6 | 5 | 4 | 4 | 2 | 2 | 3 | 3 | 5 | 2 | 2 | 10 | 7 | 4 | 6 |

Note: Ruppia maritima, Thalassodendron ciliatum and Halophila sp. are not included as they are rare in occurrence

- | | | |
|---------------------|---------------------------|-----------------------------------|
| 1 Tehuk Kemang | 2 Tanjung Adang-Merambong | 3 Pulau Tinggi |
| 5 P. Tengah | 6 P. Sibul | 7 Telaga Simpul |
| 9 Merchang | 10 P. Redang | 11 P. Perhentian |
| 13 Pengkalan Nangka | 14 Pulau Gaya | 15 Sepangar Bay |
| 17 Punang-Sari | | 16 P. Selingan, P. Bakungan Kecil |

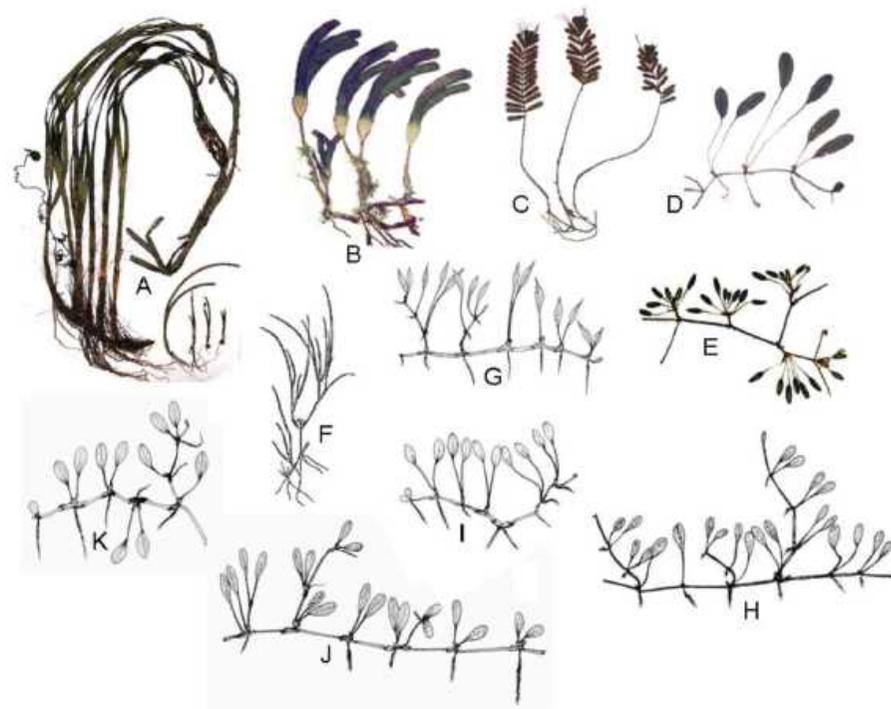


PLATE 3: Selected Seagrasses of Malaysia. (A) *Enhalus acoroides*, (B) *Thalassodendron ciliatum*, (C) *Halophila spinulosa*, (D) *Halophila ovalis*, (E) *Halophila beccarii* (F) *Ruppia maritima* and Unidentified Seagrasses (G) *Halophila* from P. Jambongan, Sabah, (H) *Halophila* from P. Selingan, (I) *Halophila* from P. Gaya, Sabah, (J) *Halophila* from Teluk Kerambunai, Sabah and (K) *Halophila* from P. Perhentian, Terengganu (please refer page 79)

TABLE 1. Estimated Seagrass Areas in Peninsular Malaysia and Sarawak

| State and Location | Area (ha) |
|---|-----------|
| Kelantan | |
| Pengkalan Nangka lagoon | 40.0 |
| Kampung Baru Nelayan-Kampung Sungai Tanjung | 27.0 |
| Pantai Baru Lagoon | 20.0 |
| Terengganu | |
| Sungai Kemaman | 17.0 |
| Chukai, Kemaman | 3.3 |
| Telaga Simpul | 28.0 |
| Sungai Paka lagoon | 4.7 |
| Sungai Paka shoal | 43.0 |
| River bank of Sungai Paka | 1.5 |
| Merchang | 3.0 |
| Gong Batu | 5.0 |
| Negeri Sembilan | |
| Teluk Kemang | 11.0 |
| Johore | |
| Tanjung Adang Laut shoal | 40.0 |
| Tanjung Adang Darat shoal | 42.0 |
| Merambong shoal | 30.0 |
| Sarawak | |
| Punang-Sari | 240.0 |
| Total estimated area | 555.5 |

A Preliminary Checklist of Marine Decapod Crustaceans of Malaysia

Zaidi Che Cob, Azman Abd Rahim, Wan Lotfi Wan Muda,
Abdullah Samat & Mazlan Abd. Ghaffar



TABLE 1: Number of Species of Decapoda Crustaceans Recorded from Malaysian Waters

| Taxon | World* | Malaysia** | % |
|--|--------|------------|-------|
| Order Decapoda Latreille, 1802 | 14,335 | 525 | 3.66 |
| Suborder Dendrobranchiata Bate, 1888 | 540 | 92 | 17.04 |
| Suborder Pleocyemata Burkenroad, 1963 | 13,795 | 433 | 3.14 |
| Infraorder Stenopodidea Bate, 1888 | 69 | 1 | 1.45 |
| Infraorder Caridea Dana, 1852 | 3,268 | 79 | 2.42 |
| Infraorder Astacidea Latreille, 1802 | 653 | - | - |
| Infraorder Glypheidea Winkler, 1883 | 2 | - | - |
| Infraorder Axiidea de Saint Laurent, 1979 | 423 | 1 | 0.24 |
| Infraorder Gebiidea de Saint Laurent, 1979 | 192 | 6 | 3.13 |
| Infraorder Achelata Scholtz & Richter, 1995 | 140 | 13 | 9.29 |
| Infraorder Polychelida Scholtz & Richter, 1995 | 38 | - | - |
| Infraorder Anomura MacLeay, 1838 | 2,451 | 46 | 1.88 |
| Infraorder Brachyura Linnaeus, 1758 | 6,559 | 287 | 4.38 |
| Section Dromiacea De Haan, 1833 | 240 | 2 | 0.83 |
| Section Raninoida De Haan, 1839 | 39 | - | - |
| Section Cyclodorippoida Ortmann, 1892 | 89 | - | - |
| Section Eubrachyura de Saint Laurent, 1980 | 6,191 | 285 | 4.60 |
| Subsection Heterotremata Guinot, 1977 | 5,066 | 164 | 3.24 |
| Subsection Thoracotremata Guinot, 1977 | 1,125 | 121 | 10.76 |

*From de Grave et al. (2009), marine, brackish & freshwater species.

**Marine & brackish water species only.

The Decapoda (literally meaning “ten footed”) are an order of crustaceans of the class Malacostraca, which include many familiar and economically important species such as crayfish, crabs, lobsters, prawns and shrimp



A Brief Review of Marine Shelled Mollusca Diversity in Malaysia: Current State and the Future

*Nur Leena Wong Wai Sin & Aziz Arshad

After collecting scientific writings and compilations of marine shelled mollusca data in Malaysia, **a total of 581 species** have been recorded (~~384 species from class Gastropoda and 197 species from class Bivalvia~~).

The number of species from these available documents seems far too small than the total number of described marine shelled molluscs. Based on essentially non-overlapping regional checklists by Bouchet (2006), **52,525 species** of marine molluscs were documented.



Sea Cucumbers and Sea Stars on the Reefs and Islands of Malaysia

*¹Sim Yee Kwang & ²Kee Alfian Abd Adzis

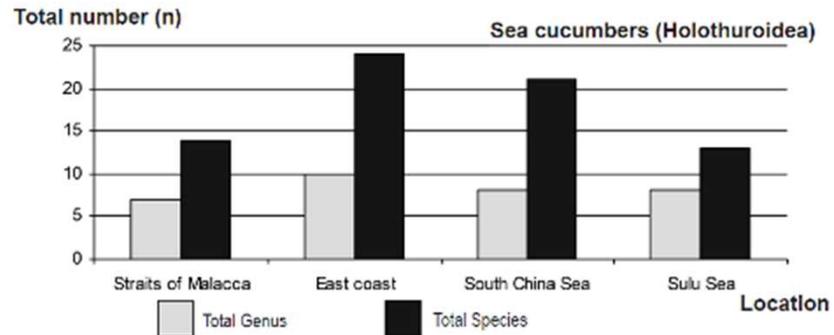
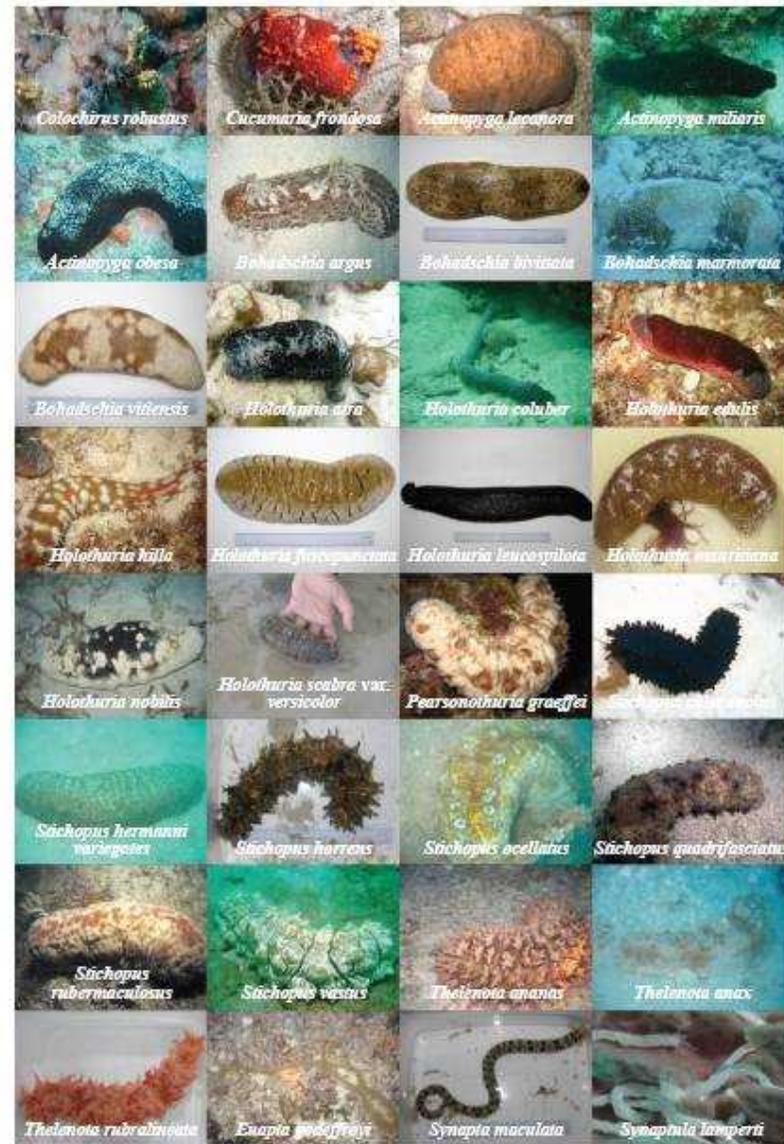


FIGURE 6: The Total Number of Sea Cucumbers (Holothuroidea) (Genera and Species) Collected from Malaysian Coastal Waters from 2004-2009

Four families (Cucumariidae, Holothuriidae, Stichopodidae, and Synaptidae), 11 genera, and 33 species of sea cucumber. Only 2.36% (33 out of 1,400 species worldwide) of sea cucumbers



Sea Cucumbers and Sea Stars on the Reefs and Islands of Malaysia

*¹Sim Yee Kwang & ²Kee Alfian Abd Adzis

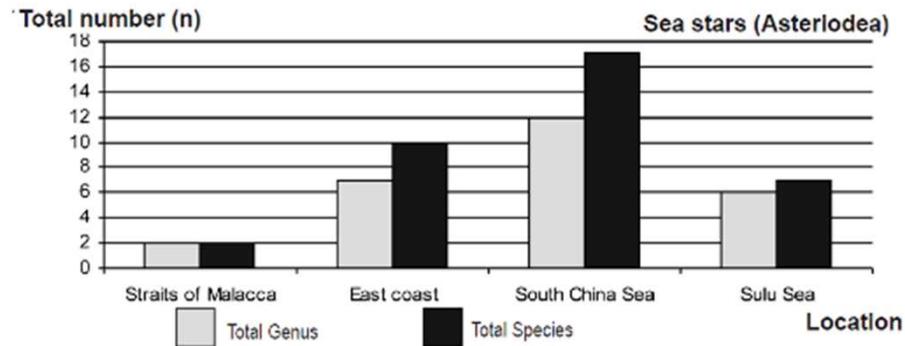


FIGURE 7: The Total Number of Sea Stars (Asteriodes) (Genera and Species) Collected from the Malaysian Coastal Waters from 2004-2009

Six families (Acanthasteridae, Asteropseidae, Echinasteridae, Mithrodiidae, Ophidiasteridae, and Oreasteridae), 13 genera, and 19 species of sea star only 1.06% (19 out of 1,800 species worldwide) of sea stars

