

Preliminary taxonomic survey and molecular documentation of jellyfish species (Cnidaria: Scyphozoa and Cubozoa) in Malaysia

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Mohammed Rizman-Idid¹, Abu Bakar Farrah-Azwa², Ving Ching Chong²

¹*Institute of Ocean and Earth Sciences, University of Malaya, Malaysia*

²*Institute of Biological Sciences, University of Malaya, Malaysia*

Scientific enquiries into jellyfish blooms and associated problems in Malaysia are often deterred by the lack of taxonomical and ecological studies. To date, only two scyphozoan jellyfish species have been documented from field surveys in Malaysian waters, whereas other four Malaysian scyphozoan and two cubozoan jellyfish species have been mentioned in toxicological studies, all of which their species identity were not verified. Thus, this study aimed to document and to resolve the identification of jellyfish in Malaysia using morphology and molecular DNA sequencing of COI, 16S and ITS1 regions. Jellyfish specimens were collected from 2008 to 2010 in the Straits of Malacca, South-China Sea and the Sulu-Sulawesi Sea. Ten scyphozoan and two cubozoan species were recorded, which included eight species from the order Rhizostomeae (Rhizostomatidae, Lobonematidae, Mastigiidae, Catostylidae and Cepheidae), two species from Semaestomeae (Pelagiidae and Cyaneidae) and two species from class Cubozoa; one from order Carybdeida (family Carukiidae) and another from order Chirodropida (family Chiropsalmidae). The COI phylogenetic tree of Cubozoa and Scyphozoa species from the Atlantic and Pacific region showed distinct clustering of six Malaysian jellyfish species. However, most of the deeper divergences and relationships between the families were unresolved, which were also observed in the 16S and ITS1 phylogenetic trees. The Malaysian edible species *Lobonemoides robustus*, *Rhopilema hispidum* and *Rhopilema esculentum* were proven to belong to Rhizostomeae, whereas other scyphozoans showed phylogenetic affinities to Semaestomeae and Kolpophorae. *Chrysaora* and *Cyanea* appeared non-monophyletic, however their paraphyly was not confirmed. Although this study has provided much needed baseline information on the barcoding of Malaysian jellyfish species, there is still a general lack of jellyfish sequences in GenBank to facilitate better species confirmation.

Mohammed Rizman-Idid

Institute of Ocean and Earth Sciences, University of Malaya
Malaysia
rizman@um.edu.my

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(accepted in *Zoological Studies*)

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Ving Ching Chong²**

¹*Institute of Ocean and Earth Sciences, University of Malaya, Malaysia*

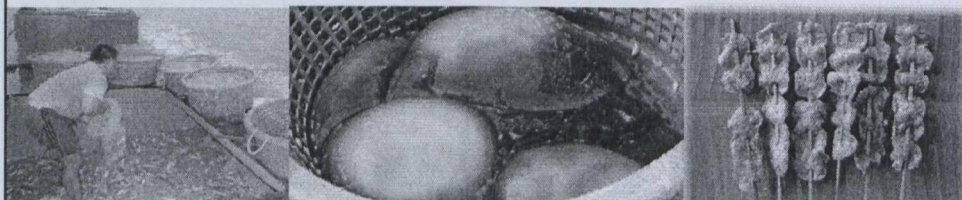
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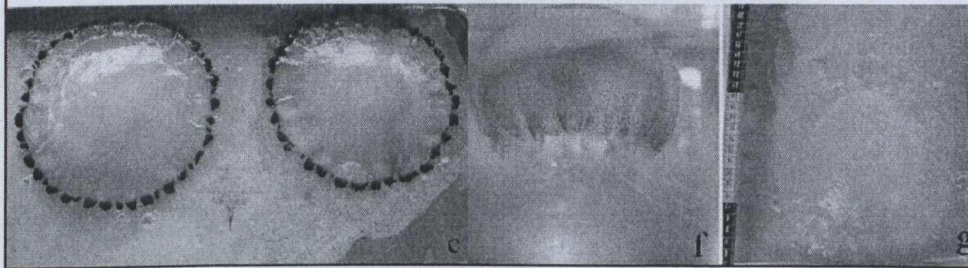
Jellyfish Studies in Malaysia

- ▶ Very few records of jellyfish in Malaysia (Straits of Malacca and South China Sea).
- ▶ Jellyfish species have been overlooked in the country's marine biodiversity checklists and surveys and the inability to identify them.
- ▶ Almost nothing is known about the diversity, biology and ecology of jellyfish in Malaysia. Even edible jellyfish were poorly documented (Daud, 1998 & Rumpet, 1991).



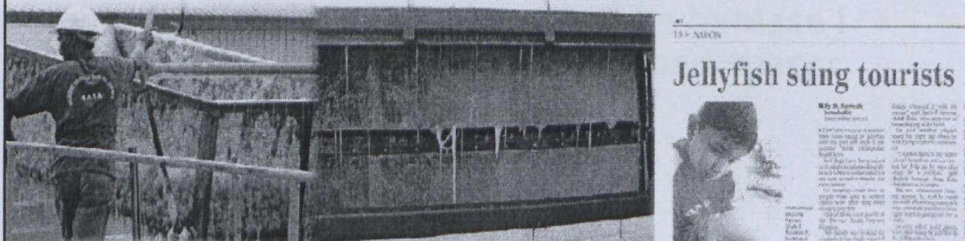
Jellyfish Studies in Malaysia

- ▶ Inability to identify species.
- ▶ Morphological variations among and within species.
- ▶ Their seasonal presence, which is often unpredictable and highly variable in numbers, confounds jellyfish research.



Major Concerns about Jellyfish in Malaysia

- ▶ Large blooms of jellyfish occur seasonally, blocking power station systems and clogging fishing nets.
- ▶ Biofouling of fish cage nets by hydrozoans in mangroves has been observed, with the possibility that jellyfish abundance is increasing.
- ▶ Sporadic cases of human mortality from jellyfish stings, resulting in closure of tourist beaches.



Unverified Jellyfish Identifications

- ▶ Some edible jellyfish were documented as *Rhopilema esculenta* (Rumpet, 1991) and *Lobonema smithi* (Daud, 1998).
- ▶ Toxicological studies (Othman and Burnett 1990; Tan et al. 1993; Azila and Othman 1993):
 - Scyphozoan – *Catostylus mosaicus*, *Lychnorhiza lucerna*, *Chrysaora quinquecirrha* and *Chrysaora hysoscella*
 - Cubozoan – *Carybdea rastoni* and *Chironex fleckeri*
- ▶ Unfortunately, the species identifications of all these studies remain doubtful without satisfactory taxonomic scrutiny and verification.

Objectives

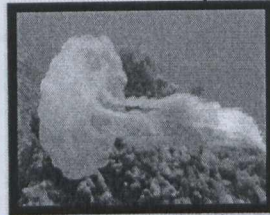
- ▶ This preliminary study aims to document and identify the jellyfish species in Malaysian waters based on their morphological characteristics and molecular DNA sequences.
- ▶ Molecular identification of species using phylogenetic approaches was based on DNA sequences of partial cytochrome oxidase I (COI), 16S and internal transcribed spacer (ITS1) regions.

MATERIALS AND METHODS

- Sampling off the coast of Malaysia (13 sites - Straits of Malacca, South China Sea, Sulu-Sulawesi Sea) from June 2008 to October 2010.
- Morphological identification mostly based on Kramp(1961).
- Molecular genetic markers = COI (DNA barcoding), 16S, ITS.



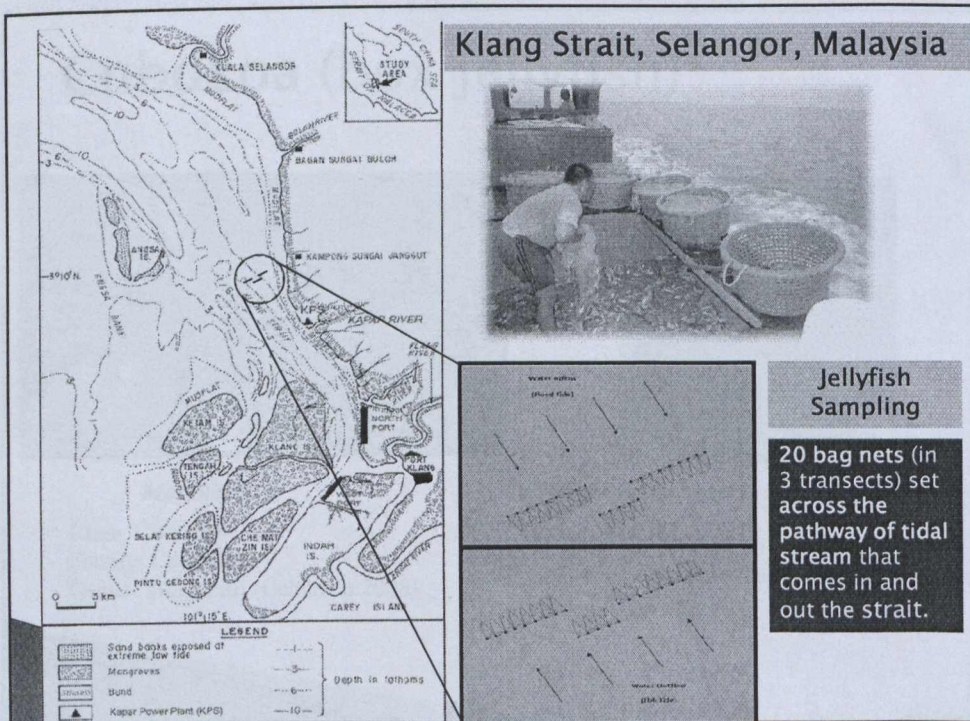
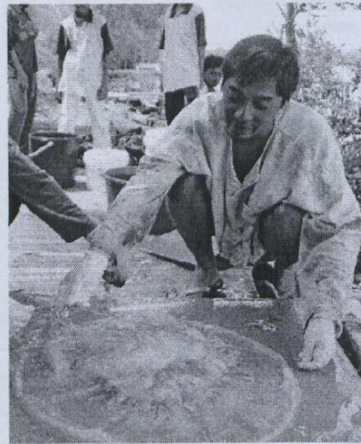
Mastigia sp



Chrysaora chinensis

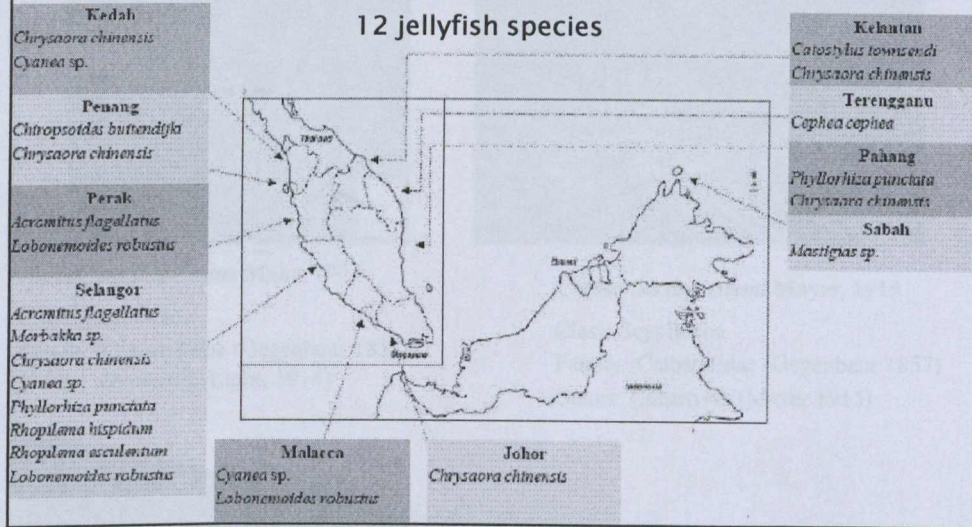


Cephea cephea

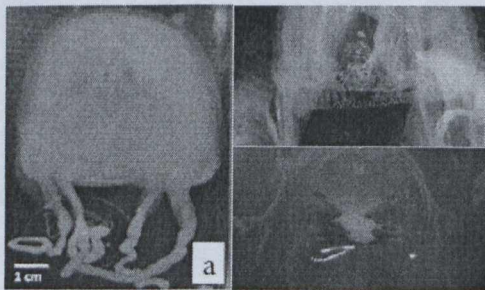


RESULTS

8 species from the order Rhizostomeae (Rhizostomatidae, Lobonematidae, Mastigiidae, Catostylidae and Cepheidae), 2 species from Semaestomeae (Pelagiidae and Cyaneidae) and two species from class Cubozoa; 1 from order Carybdeida (family Carukiidae), 1 order Chirodropida (family Chiropsalmidae).

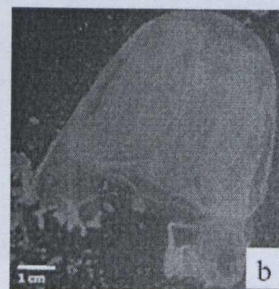


Cubozoa (box jellyfish)



***Morbakka* sp.**

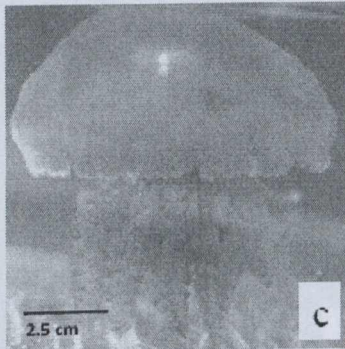
Class: Cubozoa
 Family: Carukiidae
 Genus: *Morbakka* (Gershwin 2008)



***Chiropsoides buitendijki* van der Horst, 1907**

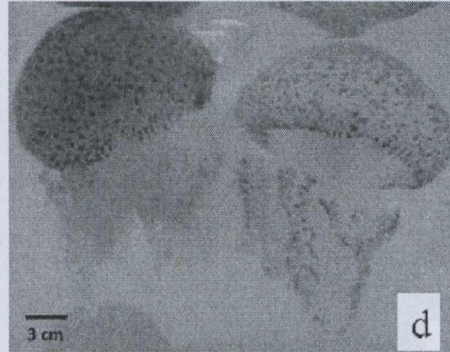
Class: Cubozoa (Werner 1975)
 Family: Chiropsoidae (Haeckel 1882)
 Genus: *Chiropsoides*

Scyphozoa



Acromitus flagellatus Maas, 1903

Class: Scyphozoa
 Family: *Catostylidae* (Gegenbaur 1857)
 Genus: *Acromitus* (Light, 1914)



Catostylus townsendi Mayer, 1915

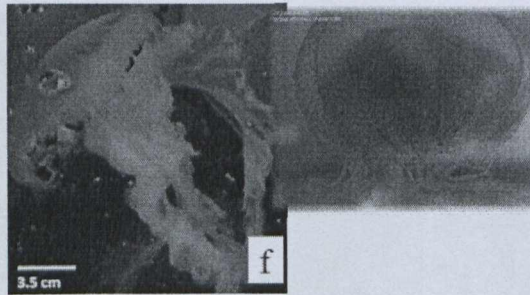
Class: Scyphozoa
 Family: *Catostylidae* (Gegenbaur 1857)
 Genus: *Catostylus* (Mayer 1915)

Scyphozoa



Cephea cephea Forskåll, 1775

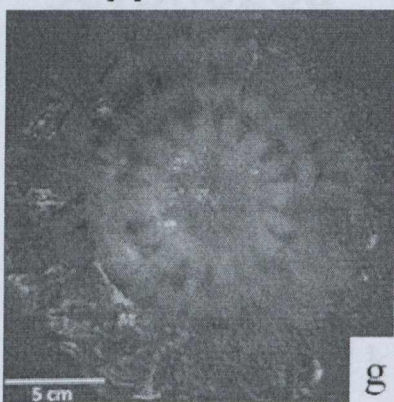
Class: Scyphozoa
 Family: *Cepheidae* (L. Agassiz 1862)
 Genus: *Cephea* (Péron and Lesueur 1809)



Chrysaora chinensis Linne, 1766

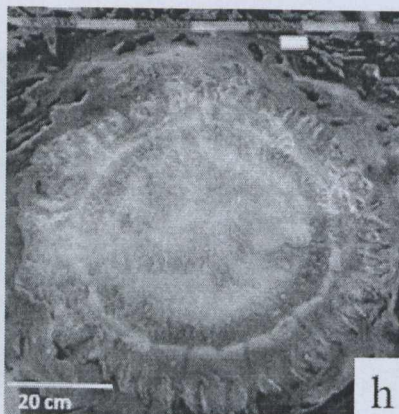
Class: Scyphozoa
 Family: *Pelagiidae* (Gegenbaur 1856)
 Genus: *Chrysaora* (Linne 1766)

Scyphozoa



Cyanea sp. Linne, 1758

Class: Scyphozoa
 Family: *Cyaneidae*
 Genus: *Cyanea* (Péron and Lesueur, 1809)

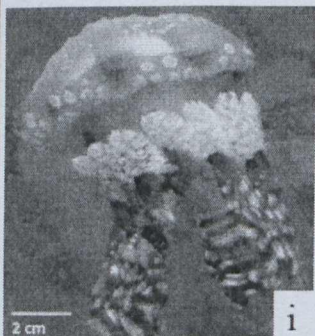


Lobonemoides robustus Stiasny, 1920

Class: Scyphozoa
 Family: *Lobonematidae*
 Genus: *Lobonemoides* (Light 1914)

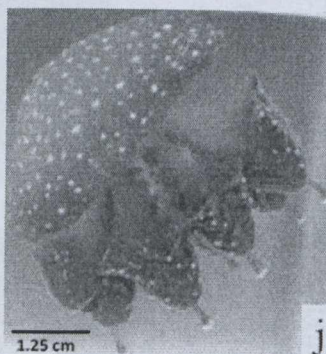
(Edible jellyfish)

Scyphozoa



Mastigias sp. Lesson, 1830

Class: Scyphozoa
 Family: *Mastigiidae* (Stiasny 1921)
 Genus: *Mastigias* (L. Agassiz 1862)

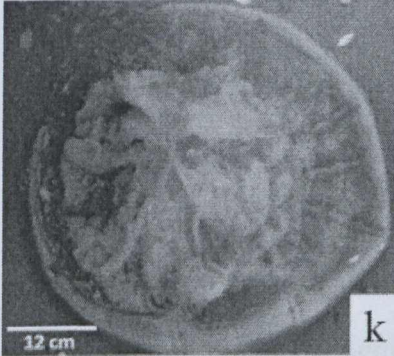


Phyllorhiza punctata von Lendenfeld, 1884

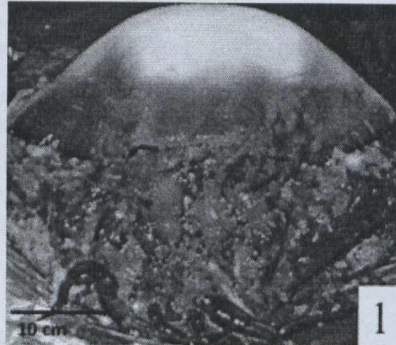
Class: Scyphozoa
 Family: *Mastigiidae* (Stiasny 1921)
 Genus: *Phyllorhiza* (L. Agassiz 1862)



Scyphozoa



***Rhopilema hispidum* Vanhöffen, 1888**
 Class: Scyphozoa
 Family: Rhizostomatidae (Claus 1883)
 Genus: *Rhizostoma* (Macri 1778)
 (Edible jellyfish)



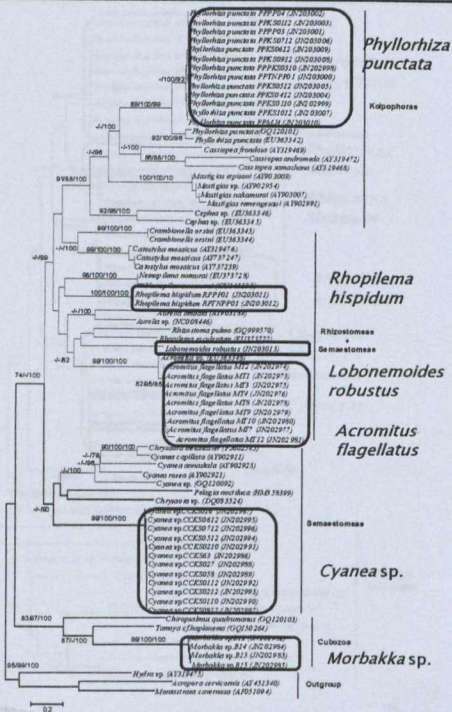
***Rhopilema esculentum* Kishinouye, 1891**
 Class: Scyphozoa
 Family: Rhizostomatidae (Cuvier 1799)
 Genus: *Rhopilema* (Haeckel 1880)
 (Edible jellyfish)

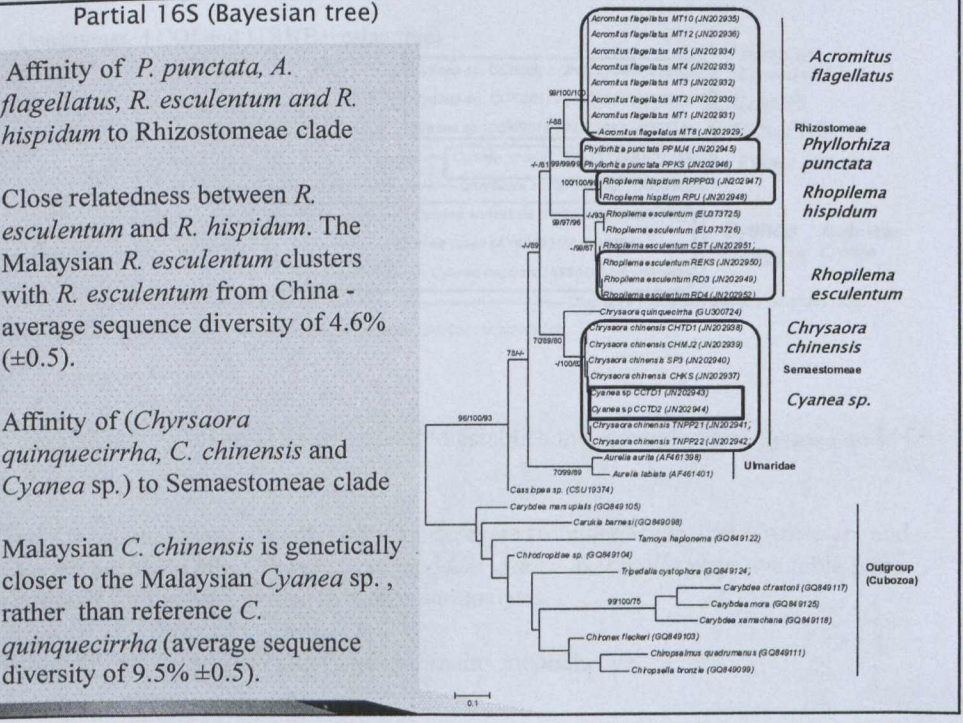
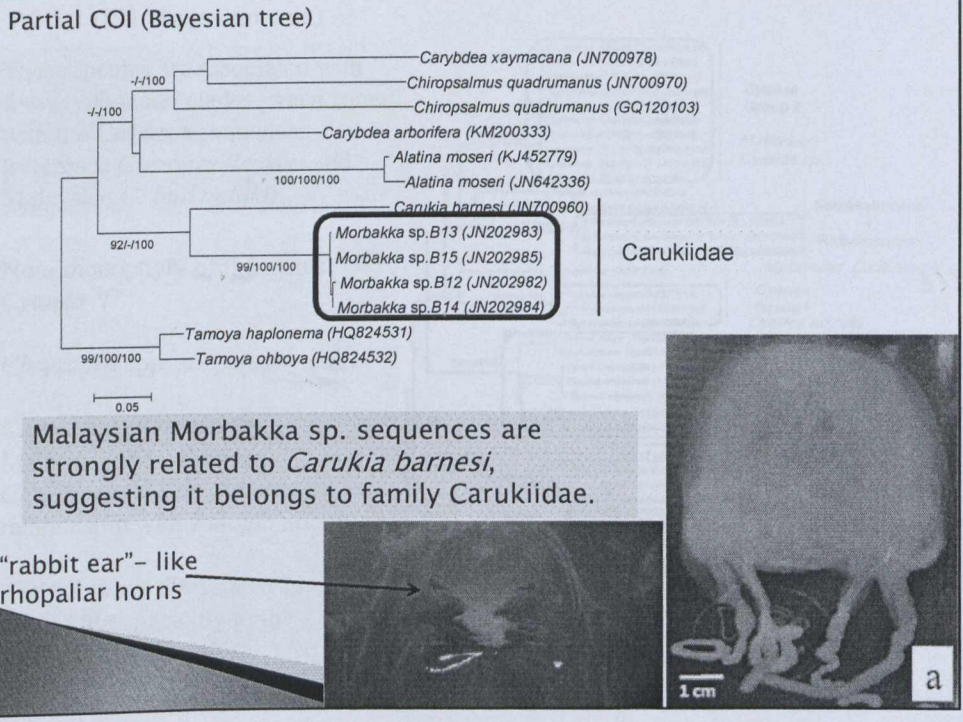
Partial COI (Bayesian tree)

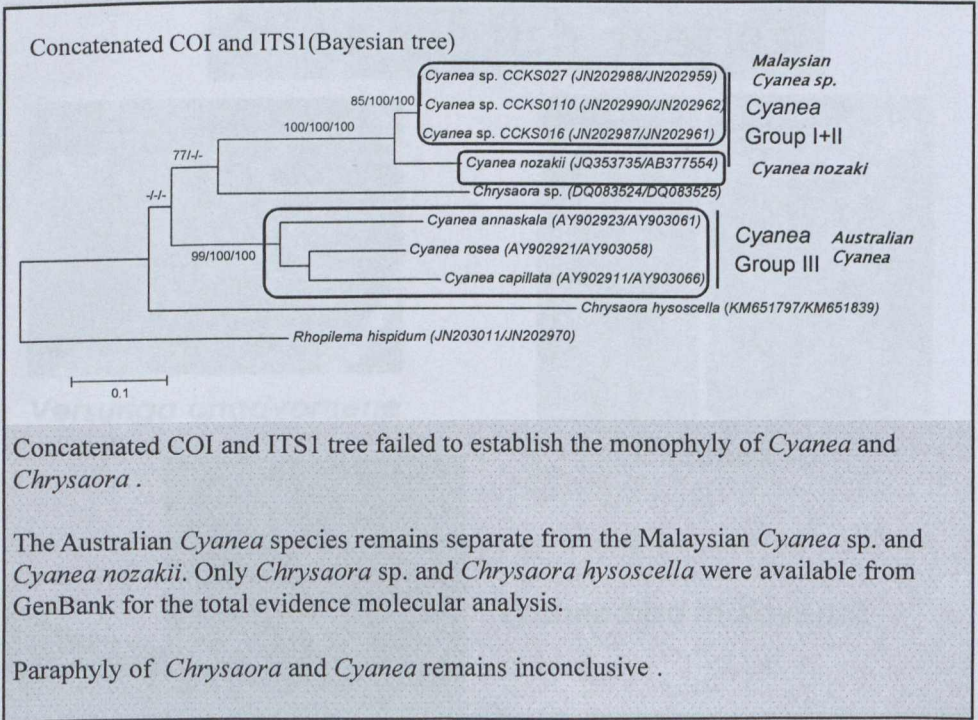
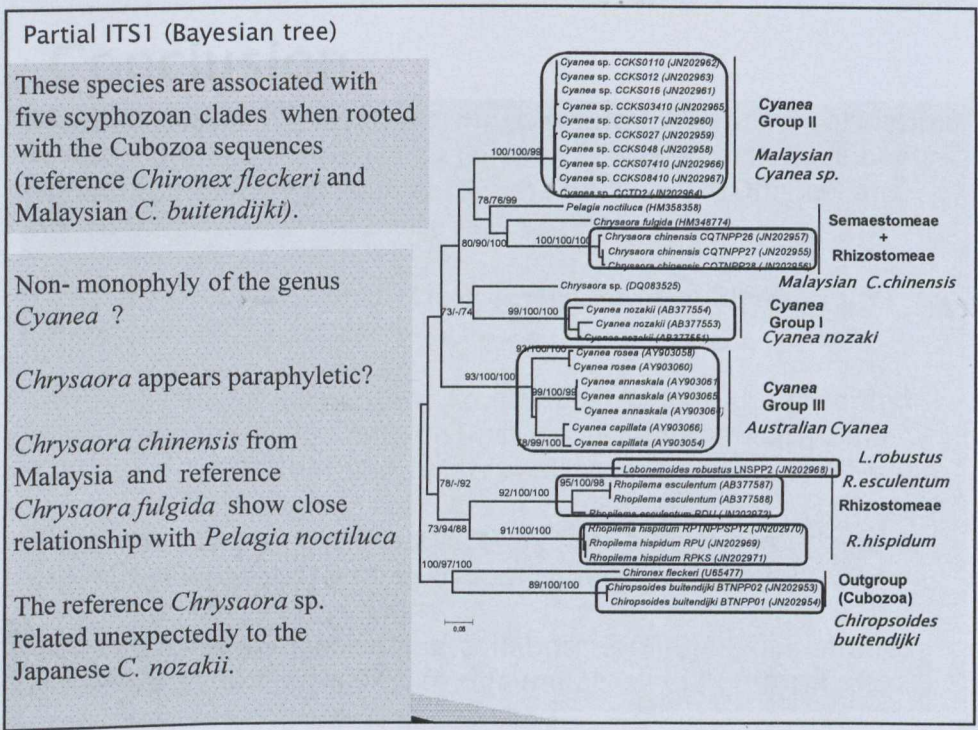
The success of PCR and DNA sequencing varied among the species and the targeted region used.

The COI – six Malaysian jellyfish species are monophyletic and show affinity to four major clades.

Strong support at species nodes, but unresolved at deeper branches.







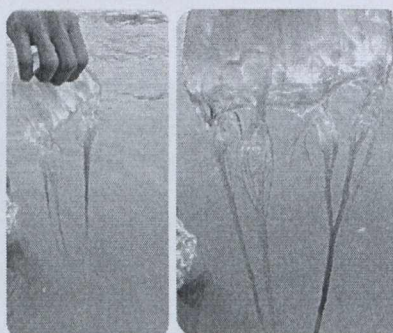
Conclusion

- This study has provided the much needed baseline information on the diversity of Malaysian jellyfish species which have been substantiated by partial cytochrome oxidase I (COI), 16S and internal transcribed spacer (ITS1) sequences.
- A total of 12 putative species of jellyfish were identified, which encompassed 12 genera.
- Although the present study could not conclude the paraphyly of *Cyanea*, the genetically distinct Malaysian *Cyanea* sp. may indicate the possibility of a new or cryptic species.
- Many jellyfish species are therefore yet to be recorded and described while awaiting taxonomic identification.
- Concerted global action and collaboration in jellyfish studies, including global initiatives to document jellyfish information.

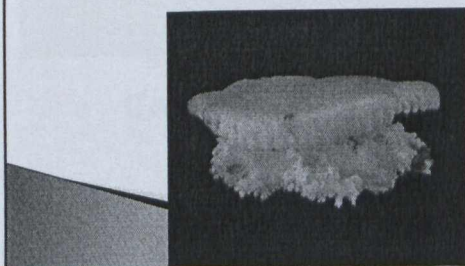
Other jellyfish species



Versuriga anadyomene



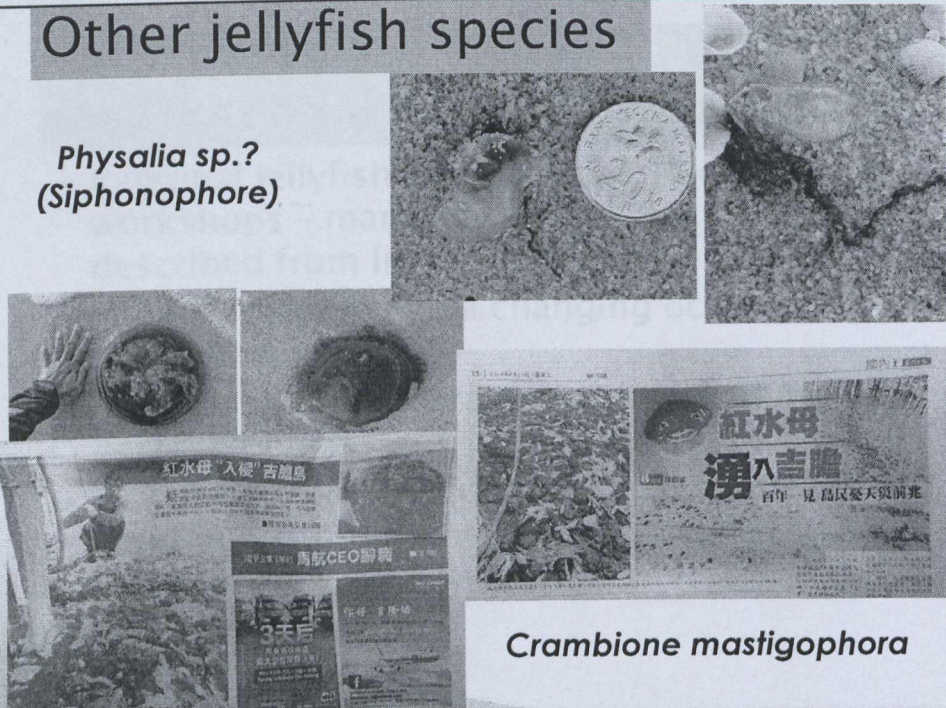
Chironex sp.



Lychnorhiza malayensis

Other jellyfish species

Physalia sp.?
(Siphonophore)



Crambione mastigophora

Other jellyfish species

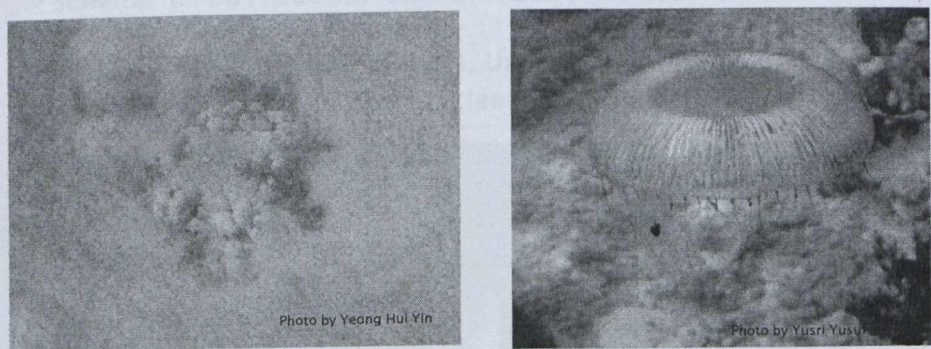


Photo by Yeong Hui Yin

Photo by Yusri Yusri

Cassiopea sp.

Aequorea sp.
(Hydrozoa)

Future Studies (For Potential Collaborations)

- ▶ Regional Jellyfish Systematics & Taxonomy workshops – many species are yet to be described from Indo-Pacific/ SEA.
- ▶ Jellyfish response to a changing ocean environment.
- ▶ Jellyfish culture – obtaining & maintaining jellyfish polyps
- ▶ Biochemistry/ Biotechnology – bioactive compounds of marine fungi associated with jellyfish.

Acknowledgement

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