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# DIVERSITY OF THE GENUS *Sargassum* (Fucales: Sargassaceae) IN THO CHU ARCHIPELAGO, KIEN GIANG PROVINCE

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**ABSTRACT**

Our study investigated 12 study sites in four main islands of Tho Chu archipelago in 2019. Six *Sargassum* species were recorded for the flora of Tho Chu Archipelago, viz.*Sargassum aquifolium* (Turner) C.Agardh, *Sargassum feldmannii* Pham-Hoang Ho, *Sargassum ilicifolium* (Turner) C.Agardh, *Sargassum mcclurei* Setchell, *Sargassum oligocystum* Montagne, *Sargassum polycystum* C.Agardh, among which three species, namely *Sargassum oligocystum* Montagne, *Sargassum feldmannii* Pham-Hoang Ho and *Sargassum mcclurei* Setchell were newly recorded for Vietnam. There was a significant difference in species composition between Tho Chu, Hon Xanh, Hon Tu and Hon Cao islands; among them, Hon Xanh island differed from the other three islands by 28%, Hon Tu island and Tho Chu island were mostly similarity in flora composition with the similarity index of 85.7%. The morphology of some *Sargassum* species varied by ecological characteristics, especially for *Sargassum aquifolium* (Turner) C. Agardh and *Sargassum oligocystum* Montagne.

**Keywords:** *Sargassum*, biodiversity, seaweed, Tho Chu island, Thailand bay.

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## INTRODUCTION

Tho Chu archipelago located in Vietnam is about 160 km northeast of Ha Tien town and about 154 southwest of Ca Mau cape. The waters around the main island (9º18'10"N and 103º12'42"E), also called Tho Chu island, have high economic potential (Nguyen, 2017).

There is a little information on the biodiversity of Tho Chu area. Recent biodiversity data of Tho Chu archipelago come from the project "Overall biodiversity of coral reef ecosystems and coastal areas in Vietnam's waters for sustainable development". This project has supplied information on marine organism groups in Tho Chu, including seaweeds (Do & Do 2013; Do 2017). The seaweed composition of Tho Chu archipelago published by Do (2017) included 57 species belonging to 26 families, and 4 phyla; including, 6 *Rhodomelaceae* and 5 *Dictyotaceae* species. The others families had only 1 to 4 species. Although these studies did not list specific species, based on the number of species reported, it is likely that the number of *Sargassum* species in Tho Chu archipelago was underestimated.

*Sargassum* J. Agardh belongs to the Sargassaceae family and is a highly diverse and widely distributed seaweed genus in the tropics (Yoshida, 1989). Currently, there are 358 *Sargassum* species, belonging to 3 sub-genera (Algaebase 2020). *Sargassum* species commonly accounted for a high proportion among brown algae. as recognized by Pham (1969, 1985) only 5 *Sargassum* species were present in the waters of Phu Quoc and Ha Tien, including ***Sargassum echinocarpum*** (currently known as *Sargassum aquifolium*), *Sargassum cinereum*, *Sargassum polycystum*, *Sargassum siliquosum*, and *Sargassum swartzii*.

This study aimed to supplement data for understanding seaweed biodiversity in the Tho Chu archipelago by focusing on the *Sargassum* genus, a genus of seaweed of a high economic potential and important biological and ecological roles in Vietnam.

## MATERIALS AND METHODS

### Study sites and data gathering methods

The study was conducted in 2019 with 2 field trips in March 2019 and July 2019 at 4 main islands of Tho Chu archipelago, Kien Giang province including Tho Chu island, Hon Xanh island, Hon Tu island and Hon Cao island. Study sites were selected by a quick survey of topography and ecological conditions of the 4 islands. The study identified 6 representative sites for Tho Chu Island, and 2 representative sites each for Hon Xanh island, Hon Tu island and Hon Cao island (Figure 1).

At each study site, we identified 3 transects perpendicular to the shoreline, each has a length of 100 m. In order to maximize specimen collection for each different distribution area, we surveyed two more parallel routes 20 m and 60 m away from the shoreline. Samples were collected by Scuba diving and Snorkelling, survey images were recorded by OLYMPUS camera (Japan), co-ordinates of sampling sites were identified by GPS Garmin 76CSX.

### Taxonomy research of *Sargassum*

Based on the collected samples, samples in suitable conditions were classisfied based on characteristics such as holdfast, main axis, secondary axis, leaves, vesicles, receptacle,… according to taxonomic documents by Pham (1969, 1985), Nguyen et al., (1993), Nguyen (1997, 2007), Nguyen (2014) and AlgaeBase (2020). Images of reproductive organs produced by BX41 optical microscope (Olympus, Japan) were used to classify specimens ofmorphologically similar species.

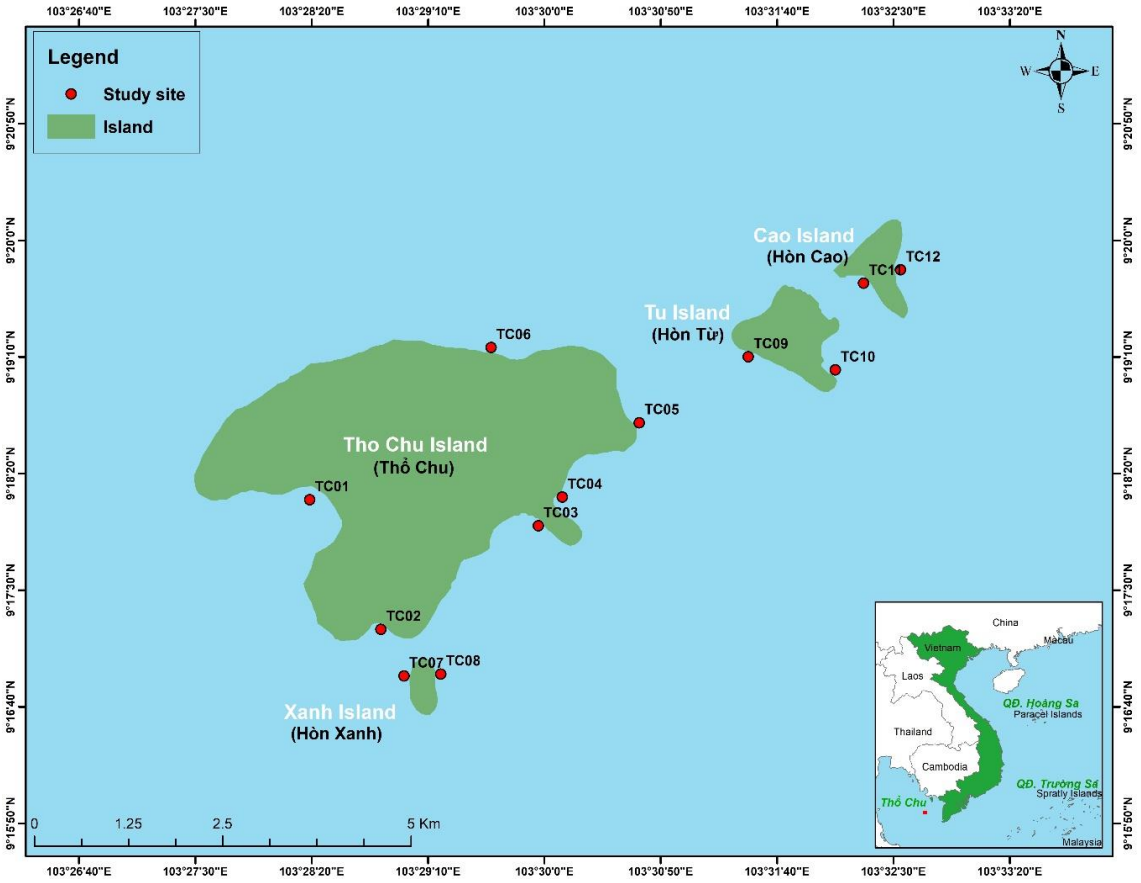


*Figure 1.* Map of study sites

## RESULTS

### Species diversity and distribution of *Sargassum*

6 *Sargassum* species belonging to 5 sections have been identified in Tho Chu archipelago as follows:

| No | Section | Scientific name |
|---|---|---|
| 1 | *Acanthocarpicae* | *Sargassum feldmannii* Pham-Hoang Ho |
| 2 | | *Sargassum oligocystum* Montagne |
| 3 | *Binderianae* | *Sargassum aquifolium* (Turner) C.Agardh |
| 4 | *Ilicifoliae* | *Sargassum ilicifolium* (Turner) C.Agardh |
| 5 | *Ilicifolium* | *Sargassum mcclurei* Setchell |
| 6 | *Polycystae* | *Sargassum polycystum* C.Agardh |

*Sargassum* was present in all 4 islands, recorded at 9 out of 12 study sites. In Tho Chu island recorded the highest number of species was recorded (4 species), followed by Hon Xanh and Hon Tu (3 species). In Hon Cao, only 2 species were recorded.

Among 6 survey sites on Tho Chu, the biggest of the four islands, four sites contained *Sargassum* species. The eastern side of the island was more diverse *Sargassum* than other sides, the four species recorded in Tho Chu island were *S.*

*aquifolium, S. feldmannii, S. oligocystum, S. polycystum*. In Hon Cao island, *S. oligocystum* and *S. feldmannii* were recorded in the southwest. In the northeastern part of Hon Tu island, specimens of *S. aquifolium, S. feldmannii*, and *S. oligocystum* were collected. In Hon Xanh, *S. mcclurei*. *S. ilicifolium* and *S. oligocystum* were found in the western side of the island.

Among 6 species *Sargassum* recorded in Tho Chu archipelago, there were 3 new records for Tho Chu and the West Sea region (*S. oligocystum, S. feldmannii* and *S. mcclurei)*.

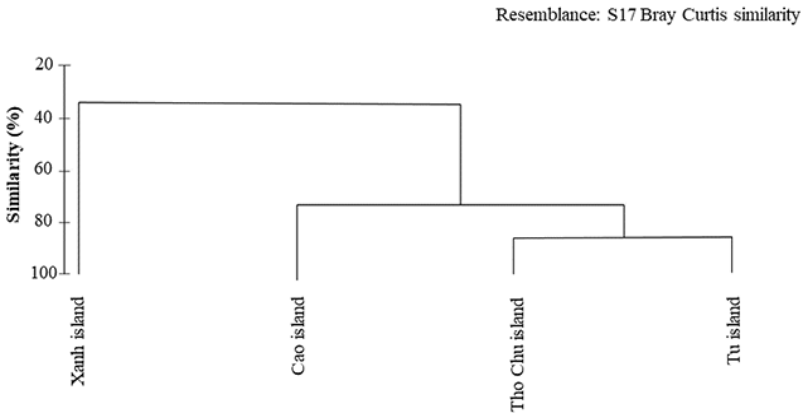


*Figure 2.* Cluster analysis distribution of *Sargassum* among islands

Cluster analysis on the distribution of *Sargassum* among the islands in Tho Chu archipelago showed that *Sargassum* species composition of Hon Xanh island differed from other three islands with a similarity of only 28.5%; Among Hon Cao, Tho Chu island and Hon Tu, Tho Chu and Hon Tu islands have high species similarity with a similarity rate of 85.7%, Hon Cao Island also has similar species composition with these two islands (66.7%).

**Morphological and ecological characteristics**

***Sargassum aquifolium* (Turner) C. Agardh**

*S. aquifolium* was collected in Tho Chu and Hon Tu island at the depth of 1–3 m. Thallus up to 50 cm long, attached to rock or dead coral; Main axis cylindrical; Leaves thick and coarse, margins serrate often with two rows of serrations in exposed habitats. Receptacles racemosely arranged, triquetrous, bearing spines; Vesicle with a short stem and bearing spines. *S. aquifolium* distributeed in areas with weak waves, or deep water often has soft leaves, leaf margin with few spines. In contrast, specimens distributed in the tidal area normally have hard leaves, margin with sharp spines, thallus size around 30–40 cm (Figure 3).


*Figure 3. S. aquifolium* (Tho Chu island, March 2019)

***Sargassum feldmannii* Pham-Hoang Ho**

This commonly found species in Tho Chu archipelago formed populations in threeout of four surveyed islands including Tho Chu island, Hon Tu, and Hon Cao. Main axis slightly compressed; leaves coarse, large size and thick; vesicle scattered. Receptacle triquetrous bearing numerous spines. Thallus 35 cm high or more, bearing 2–3 main branches (Figure 4).


*Figure 4. S. feldmannii* (Tho Chu island, March 2019)

***Sargassum ilicifolium* (Turner) C. Agardh**

*Figure 5. S. ilicifolium* (Xanh island, March 2019)

Found in Hon Xanh island in areas with strong wave actions, distribution range from middle tide to a depth of 4 meters. Main axis cylindrical; leaves small, hard and margin with numerous spines. Vesicles very variable in shape, obovoid or spherical, short stem. Receptacle triquetrous. Thallus size variable with ecology characteristics and depth (Figure 5).

***Sargassum mcclurei* Setchell**

Found in Hon Xanh island, habitat similar to that of *S. ilicifolium*. Base attached to rock or dead coral, distribution range from middle tide to subtidal. Thallus up to 60 cm long (Figure 6).


*Figure 6. S. mcclurei* (Xanh island, March 2019)

***Sargassum oligocystum* Montagne**

*S. oligocystum* forming populations in all four islands. This species grows in middle intertidal areas, with slight to moderate waves action. Specimens were collected at the depth of 1–2.5 meters. Thallus with 2 or 3 main branches, up to 50 cm long or more. Vesicle in leaves. Morphology of thallus may vary between distribution area with different wave regimes and deep levels (Figure 7).


*Figure 7. S. oligocystum* (Cao island, March 2019)

***Sargassum polycystum* C. Agardh**

*S. polycystum* grows in the middle tide areas with moderate wave action; thallus bearing numerous small vesicles, vesicle with spines; rhizoid holdfast; main axis cylindrical and warty. Found in Tho Chu island (Figure 8).


*Figure 8. S. polycystum* (Tho Chu island, March 2019)

## DISCUSSION

The genus *Sargassum* in Vietnam comprised two subgenus *Bactrophycus* J. Agardh and *Sargassum* J. Agardh, and nearly 70 species belonging to 8 sections (Matio 2011, Nguyen 2014). Among the six species recorded in Tho Chu archipelago, *S. aquifolium*, *S. oligocystum*, *S. polycystum* and *S. ilicifolium* are species with wide distribution, having been recorded in the North, Central and Southern sea region of Vietnam. Three-quarters of widely distributed species has been recorded in the West Sea of Vietnam (Pham, 1969; Nguyen, 1993; Nguyen, 2013). These species were also found in neighbouring countries with adjacent sea areas such as the Philippines, Malaysia and Thailand (Phang, 2016). Among the species with wide distribution found in Tho Chu island, *S. oligocystum* is also a new record for the West Sea of Vietnam. Due to ít wide distribution in Southeast Asia, we assume that *S. oligocystum* may also be distributed in other islands in the West Sea of Vietnam.

Results of this study provided important insights into the species diversity of genus *Sargassum* in the west coast region of Vietnam, which will be useful for more comprehensive research on the distribution of *Sargassum* in Vietnam as well as other countries in Southeast Asia, especially countries sharing the Gulf of Thailand such as Malaysia, Thailand and Cambodia. In the Gulf of Thailand area, 32 *Sargassum* species were found in Malaysia (Phang, 2016). while in Thailand only 8 species have been published (Noiraksar, 2008; Kantachumpoo, 2015). Cambodia has not reported any species, while Vietnam has about 70 species (Nguyen, 2013). Other countries in Southeast Asia also have a relatively small number of *Sargassum* species, such as Indonesia with only 8 species and the Philippines with 46 species (Trono, 1992; Phang, 2016).

Islands in the Tho Chu archipelago are heavily influenced by the northeastern and southwestern monsoon winds. At the peak of the two monsoon seasons, the coast is strongly influenced by the waves, highly impacting the

distribution and species composition in this area. The species composition of the Tho Chu archipelago was different from the other islands, partly supporting the viewpoint on the impacts of natural conditions on the distribution of organisms in general and seaweeds in particular (Chiang, 1992; Mineur, 2015). Studies on the ecology, growth characteristics and morphological changes of some typical species in the West Sea area should also be considered to enhance the the scientific database for *Sargassum* in the West Sea of Vietnam.

## CONCLUSIONS

6 species of the genus *Sargassum, Sargassum aquifolium*, *S. feldmannii*, *S. ilicifolium*, *S. mcclurei*, *S. oligocystum* and *S. polycystum*, were recorded in Tho Chu archipelago.

The three species *S. feldmannii*, *S. mcclurei* and *S. oligocystum* were recorded for the first time in the West Sea of Vietnam.

Distribution characteristics of *Sargassum* in Tho Chu archipelago were different among the islands, the species composition of Hon Xanh differed from the other three islands (similarity rate of 28.5%), Tho Chu island and Tu islands have high species composition similarity (similarity rate ofs 85.7%).

Algae morphology in Tho Chu archipelago varied with ecological conditions, especially *S. ilicifolium*, *S. mcclurei*, and *S. polycystum*.

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