

Sponge's biodiversity in the limestone islands in Vietnam sea

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Abstract

In 2017, 2018 and 2020, sponge samples were collected at 41 points in the waters surrounding Vietnam's coastal limestone islands (Bai Tu Long, Ha Long bay, Cat Ba and Ba Lua archipelago). Research results have identified 54 species belonging to 33 genera, 24 families of Demosponge class distributed in this area. Ha Long bay area has the highest number of species (53 species), followed by Cat Ba (46 species), Bai Tu Long 19 species; Ba Lua archipelago (Kien Giang) has the least number of species (3 species). Sponges are concentrated in coral reefs with the highest number of species (48 species) and the lowest in the mud and sand bottom (4 species). Biomass of sponges varies from 0.2–1.5 kg/m². There are 11 sites with high biomass, which have the potential to become Vietnam's medicinal drug area.

Keywords: Sponges, limestone island, species, biomass.

INTRODUCTION

Sponges are a group of primitive multicellular organisms with a fairly simple body structure that can be found in most marine waters, but mainly in the ocean [1]. There are currently an estimated 9,000 species in the world [2]. Sponges grow by filtering seawater, so it has the ability to purify seawater through its living activities [1]. In the process of that nutrition, sponges also acquire some toxic substances, excreted by some types of animals and plants (corals living on the reef,...). Through complex biological processes, these substances are absorbed and used as “chemical stores” for their different purposes (against predators, animals and inhibiting other organisms in competing for food sources and living spaces) [2].

Currently, sponges attract the attention in the field of searching for drug sources of natural origin, which has obtained good results in finding anti-cancer compounds and some other diseases [3, 4]. Some places, such as New

Zealand, have cultivated several types of sponges that are valuable for commercial purposes as well as for the study of extracts of bioactive substances [5]. In Vietnam, research on sponge biodiversity is still very limited, especially only a few publications in Ha Long bay [6, 7,] Nha Trang [8, 9], Con Co [10], Phu Quy [11]. But scientists have also found many new substances that have anti-cancer properties in sponges of Vietnam sea [12, 13].

In order to contribute to the full understanding of the biodiversity of sponge, the search for substances containing anticancer, and bioactive substances, a detailed description of the biodiversity of the sponge species distributed in the limestone islands in Vietnam sea is presented below.

RESEARCH METHOD

Sampling time and place

The research is conducted in 4 main areas with 41 sampling points (table 1) in 12/2017, 8/2018 and 1/2020.

Table 1. Location and time of sponge sampling in 2017, 2018, 2020

No.	Location	Coordinate	Time of sampling	
			2017	2018
1	Vung Ha 1	20°49'42"N - 107°10'63"E	7/12/2017	25/8/2018
2	Vung Ha 2	20°50'54"N - 107°09'27"E	7/12/2017	25/8/2018
3	Ho Ang Ca Hong*	20°52'46"N - 107°12'12"E	7/12/2017	21/8/2018
4	Cong Do 2	20°52'58"N - 107°12'31"E	7/12/2017	21/8/2018
5	Dau Be 1	20°45'8.13"N - 107°8'6.79"E	8/12/2017	22/8/2018
6	Dau Be 2*	20°44'49.01"N - 107°8'20.9"E	8/12/2017	22/8/2018
7	Hang Trai	20°47'59.66"N - 107°7'0.3"E	9/12/2017	23/8/2018
8	Dau Go1	20°54'33"N - 107°00'57"E	10/12/2017	24/8/2018
9	Dau Go 2	20°53'58"N - 107°01'21"E	10/12/2017	24/8/2018
10	Hon Bu Nau 1	20°50'58"N - 107°05'10"E	11/12/2017	25/8/2018
11	Hon Bu Nau 2	20°51'07"N - 107°05'14"E	11/12/2017	25/8/2018
12	Ang Me Cung 1	20°50'04" N - 107°05'07"E	-	25/8/2018
13	Ang Me Cung	20°50'07"N - 107°05'09"E	-	25/8/2018
14	Hon Da Den*	21°03'22"N - 107°27'32"E	12/12/2017	28/8/2018
15	Hon Da Den	21°03'22"N - 107°27'28"E		28/8/2018
16	Hon Cuon Buon	21°09'03"N - 107°28'31"E	13/12/2017	28/8/2018
17	Hon Cuon Buon 2	21°10'01"N - 107°38'38"E		28/8/2018
18	Hon Hang Te 1	21°58'49"N - 107°28'01"E	14/12/2017	27/8/2018
19	Hon Hang Te 2*	21°58'47"N - 107°28"E		27/8/2018
20	Hon Tong Hoi	21°00'47"N - 107°26'09"E	14/12/2017	28/8/2018
21	Hon Cat Chuong To	21°00'43"N - 107°24'15"E	14/12/2017	28/8/2018
22	Van Boi 1	20°46'12.11"N - 107°4'46.2"E	16/12/2017	30/8/2018
23	Van Boi 2	20°46'10.51"N - 107°4'33.43"E	16/12/2017	30/8/2018
24	Ang Trong Boi	20°46'18"N - 107°04'43"E		31/8/2018
25	Cat Dua 1	20°44'0.71"N - 107°4'51.98"E	16/12/2017	2/9/2018

26	Cat Dua 2	20°44'11.37"N - 107°4'18.96"E	16/12/2017	2/9/2018
27	Hon Gio Cung 1*	20°47'44.23"N - 107°5'25.70"E	17/12/2017	1/9/2018
28	Hon Gio Cung 2	20°47'26.52"N - 107°5'43.37"E	17/12/2017	1/9/2018
29	Ang Sang 1	20°48'0.88"N - 107°8'48.37"E	18/12/2017	31/8/2018
30	Ang Sang 2	20°48'3.10"N - 107°5'57.22"E	19/12/2017	31/8/2018
31	Ang Tham	20°43'12"N - 107°03'36"E		2/9/2018
32	Ang Vem	20°45'02"N - 107°03'00"E		2/9/2018
33	Hon Tre 1	9°57'09"N - 104°50'31"E	13/1/2018	
34	Hon Tre 2	9°56'55"N - 104°50'07"E	14/1/2018	
35	Hon Tre 3	9°57'14"N - 104°49'05"E	14/1/2018	
36	Hon Re Nho	10°09'02"N - 104°35'17"E	15/1/2018	1/8/2018
37	Hon Da Lua	10°10'05"N - 104°34'44"E	16/1/2018	29/7/2018
38	Hon Hang Tuyen 1	10°10'57"N - 104°35'27"E	17/1/2018	30/7/2018
39	Hon Hang Tuyen 2	10°10'47"N - 104°35'38"E	18/1/2018	31/7/2018
40	Hon Re Lon 1	10°09'21"N - 104°34'50"E		2/8/2018
41	Hon Re Lon 2	10°09'23"N - 104°34'48"E		2/8/2018

Note: *: Additional sample collection location in January 2020.

Sampling methods and documents

The sponge specimen was collected in the intertidal zone in a cross-section perpendicular to the shoreline from the high-tide zone through the mid-tide zone to the low-tide zone. Qualitative samples and quantitative samples were collected in standard plots 40 × 40 cm according to the method of Gunjanova, et al., (1972) [15]; Do Cong Thung (2014) [16]. In the sub-tidal zone, the sample was collected according to the method of English et al., (1997) [17], Do Cong Thung (2014) [16] applied to hard bottom areas and coral reefs. On the reef and adjacent areas, besides direct observation and sampling on the reef surface (thanks to SCUBA diving equipment), quantitative samples were also collected on the bottom using a specialized nylon mesh frame with the size of 1 m × 1 m. The obtained sample is fixed in a cold chamber and then transferred to the laboratory for analysis.

Sample analysis

Morphological and structural methods were used to classify sponge according to the authors Boury-Esnault, N., and Rutzler, K., (1997) [14]; and Hooper (2002) [2]. The classification criteria include: (i) Morphology: Shape, color, surface structure and distribution of the opening of the aquiferous system; (ii) Structure of the skeleton and associated structures (spicules, fibers); (iii) Ecology: Such as depth, habitat, bottom matter, salinity, symbiotic species,... The classification system is based on the document *Systema Porifera* (editors Hooper

& Van Soest, 2002) and is compared with WORMS.

RESEARCH RESULTS

Composition of sponges

A total of 136 sponge samples were collected at 41 points around limestone islands in the Vietnamese waters. Sample analysis results have identified 54 species, 36 genera and 24 families (table 2). In which, there is 1 new species of sponges for science with freshwater origin (*Spongilla* sp.) distributed in Ca Hong lake (Bai Tu Long). Analysis of the composition structure of sponge showed an average of 1.5 species/order; 2.25 species/family. Clionidae family has the highest number of species (10 species), followed by family Chalinidae (8 species); 5 families have 3 species/family, including families Mycalidae, Tethyidae, Halichondriidae, Suberitidae, Callyspongiidae. There are 4 families with 2 species/family, including Petrosiidae, Dysideidae, Irciniidae, Dictyonellidae. There are also 12 families (accounting for 50% of the number of sponge family) with only 1 species/family, including Phloeodictyidae, Niphatidae, Spongiidae, Thoosidae, Spongillidae, Chondrosiidae, Thorectidae, Microcionidae, Biemnidae, Desmacididae, Axinellidae, Agelasidae. With the above poor species composition structure, only a small change of the environment can lose a genus or a family of the Sponge Calcite (Demospongiae) in limestone islands in our

country. Therefore, it is necessary to have appropriate measures to develop and protect sponge species that contribute to the creation of marine drugs in Vietnam.

Table 2. List of sponges in limestone islands (2017, 2018, 2020)

No.	Scientific names	Location					
		1	2	3	4	5	6
	Order Haplosclerida						
	1. Fam. Phloeodictyidae						
1	<i>Siphonodictyon mucosum</i> Bergquist, 1965	-	+	+	-	-	+
	2. Fam. Callyspongiidae						
2	<i>Callyspongia (Callyspongia) roosevelti</i> van Soest, Kaiser & Van Syoc, 2011	-	+	+	-	-	-
3	<i>Callyspongia (Cladochalina) subarmigera</i> (Ridley, 1884)	+	+	+	-	-	-
4	<i>Callyspongia</i> sp.	-	+	+	-	-	-
	3. Fam. Spongillidae						
5	<i>Spongilla</i> sp.						+
	4. Fam. Chalinidae						
6	<i>Haliclona (Haliclona) oculata</i> (Linnaeus, 1759)	+	+	+	-	-	-
7	<i>Haliclona (Gellius) varia</i> (Bowerbank, 1875)	+	+	+	+	+	+
8	<i>Haliclona (Reniera) clathrate</i> (Dendy, 1895)	-	+	+	-	-	-
9	<i>Haliclona (Soestella) xena</i> De Weerd, 1986	-	+	+	-	-	-
10	<i>Haliclona (Haliclona) simulans</i> (Johnston, 1842)	-	+	+	-	-	-
11	<i>Haliclona (Gellius) cymaeformis</i> (Esper, 1806)	-	+	-	-	-	+
12	<i>Cladocroce burapha</i> Putschakarn, de Weerd, Sonchaeng & van Soest, 2004	-	+	-	+	-	+
13	<i>Cladocroce</i> sp.	-	+	-	-	-	+
	5. Fam. Petrosiidae						
14	<i>Xestospongia testudinaria</i> (Lamarck, 1815)	+	+	+	-	-	-
15	<i>Petrosia (Petrosia) nigricans</i> Lindgren, 1897		+	+	+	-	-
	6. Fam. Niphatidae						
16	<i>Gelliodes fibulata</i> (Carter, 1881)	+	+	+	+	-	-
	Order Clionaida						
	7. Fam. Clionaidae						
17	<i>Sphaciospongia tentorioides</i> (Dendy, 1905)	-	+	+	+	-	+
18	<i>S. decumbens</i> Ridley, 1884	-	+	+	-	-	+
19	<i>S. solida</i> Ridley and Dendy, 1886	-	+	+	-	-	+
20	<i>Cliona celata</i> Grant, 1826	-	+	+	-	-	+
21	<i>Cliona orientalis</i> Thiele, 1900	-	+	+	-	-	+
22	<i>Cliona aurivilli</i> (Lindgren, 1897)	-	+	+	-	-	+
23	<i>Cliona</i> sp.	-	+	+	-	-	+
24	<i>Cliothosa hancocki</i> (Topsent, 1888)	-	+	+	-	-	+
25	<i>C. aurivilli</i> (Lindgren, 1897)	-	+	+	-	-	+
26	<i>Pioneer carpenteri</i> (Hancock, 1826)	-	+	+	-	-	+
	Order Chondrillida						
	8. Fam. Chondrillidae						
27	<i>Chondrilla australiensis</i> Carter, 1873	+	+	+	-	-	+
	Order Chondrosida						
	9. Fam. Chondrosiidae						
28	<i>Chondrosia reniformis</i> Nardo, 1847	-	+	-	-	-	-
	Order Dictyoceratida						
	10. Fam. Dysideidae						
29	<i>Dysidea fragilis</i> (Montagu, 1814)	+	+	+	-	-	-
30	<i>Dysidea cinerea</i> Keller, 1889	+	+	+	-	-	-
	11. Fam. Irciniidae						
31	<i>Ircinia echinata</i> (Keller, 1889)	+	+	+	-	-	-
32	<i>Psammocinia</i> sp.		+	+	-	-	-
	12. Fam. Spongiidae						
33	<i>Spongia (Spongia) officinalis</i> Linnaeus, 1759	-	+	+	-	-	-

	13. Fam. Thorectidae						
34	<i>Dactylospongia</i> sp	-	+	+	+	-	+
	Order Suberitida						
	14. Fam. Suberitidae						
35	<i>Suberites carnosus</i> (Johnston, 1842)	-	+	+	-	-	+
36	<i>Suberites diversicolor</i> Becking & Lim, 2009	-	+	+	-	-	+
37	<i>Protosuberites</i> sp.	-	+	+	-	-	+
	15. Fam. Halichondriidae						
38	<i>Amorphinopsis excavans</i> Carter, 1887	-	+	+	-	-	-
39	<i>Hymeniacidon</i> sp.	-	+	-	+	-	+
40	<i>Topsentia dura</i> (Lindgren, 1897)	+	+	+	-	-	+
	Order Poecilosclerida						
	16. Fam. Mycalidae						
41	<i>Mycale (Aegogropila) plumose</i> sensu Hoshino, 1981	+	+	+	-	-	+
42	<i>Mycale (Zygomycale) parishii</i> (Bowerbank, 1875)	-	+	-	-	-	+
43	<i>Mycale</i> sp.	-	+	+	+	-	+
	17. Fam. Microcionidae						
44	<i>Clathria</i> sp.		+	+	-	-	-
	18. Fam. Desmacididae						
45	<i>Desmacidon fruticosum</i> (Montagu, 1814)	-	+	-	+	-	-
	Order Halichondrida						
	19. Fam. Axinellidae						
46	<i>Axinella dissimilis</i> (Bowerbank, 1866)	-	+	+	-	-	-
	20. Fam. Tethyidae						
47	<i>Tethya seychellensis</i> Wright, 1881	+	+	+	-	-	+
48	<i>Tethya aurantium</i> (Pallas, 1766)	+	+	+	-	-	+
49	<i>Tethya</i> sp.	+	+	+	-	-	-
	Order Tetractinellida						
	21. Fam. Thoosidae						
50	<i>Neamphius huxleyi</i> (Sollas, 1888)	+	+	+	-		-
	Order Bubarida						
	22. Fam. Dictyonellidae						
51	<i>Acanthella hispida</i> Pulitzer-Finali, 1982	+	+	+	+	+	-
52	<i>Acanthella cavernosa</i> Dendy, 1922	+	+	+	-	+	-
	Order Biemnida						
	23. Fam. Biemnidae						
53	<i>Biemna megalosigma</i> Hentschel, 1912	-	+	+	-	-	-
	Order Agelasida						
	24. Fam. Agelasidae						
54	<i>Agelas axifera</i> Hentschel, 1911	-	+	+	-	-	-
	Total species	17	53	46	13	3	29

Notes: 1. Bai Tu Long; 2. Ha Long; 3. Cat Ba; 4. Long Chau; 5. Ba Lua islands (Kien Giang); 6. Saltwater lake; -: (No); +: (Yes).

Distribution of sponge species

Space distribution of species number

In limestone islands, especially in the Northeast of Vietnam, sponges are distributed throughout the coral reefs and cliffs of the islands. However, there are dominant species and different concentration densities in different regions. Sample analysis results show that there are 53/54 sponge species in the Ha Long bay area, followed by Cat Ba 46/54 species, Bai Tu Long 17/54 species, Ba

Lua archipelago (Kien Giang) with the least number of species (3/54 species) (table 3). In particular, we have identified 28 species of sponge living in saltwater lakes in Bai Tu Long, Ha Long, Cat Ba area. Among these, four species were not found in the waters outside the saltwater lake, including *Suberites carnosus*, *Suberites diversicolor*, *Protosuberites* sp., *Spogilla* sp. This is a testament to the fact that saltwater lakes form new species for water bodies.

Previous research results of sponge in some coastal islands from the North to the South Central Coast show that 20 sponge species belonging to 19 families were collected in the North Central islands such as Hon Me (Thanh Hoa), Stone Reefs (Quang Binh), Vinh Moc and Con Co (Quang Tri) (2016). Research results in 2017 in the Central coast (Hue to Quang Nam) also identified only 20 species of 14 genera, 13 families of sponge, they are distributed mainly in the Hai Van - Son Cha (Thua Thien-Hue) and Cu Lao Cham (Quang Nam). In 2014, the study by PharmaMar (Spanish Pharmaceutical Group) and Institute of Marine Resources and Environment identified 100 species of sponge belonging to 40 families in Nha Trang bay islands [6]. Thus, it can be seen that the waters of Bai Tu Long,

Ha Long, Cat Ba and Nha Trang bay are two areas with a high level of biodiversity in terms of the number of sponge species of Vietnam.

Research results in 2018, 2019 and 2020 have also identified a number of points with high concentrations of sponge species. It is forecasted that if studying more closely, it is possible to build marine medicinal grounds from sponge in the Vietnam sea:

Bai Tu Long area: from Da Den coordinates (21°03'22"N - 107°27'30"E) to Lach Xuoi Chanh (lotus village) coordinates (21°55'59"N - 107°26'24"E). This is a large medicinal field with distribution of species *Ircinia echinata* (family Ircinidae), *Xestospongia testudinaria* (Petrosiidae); *Dysidea cinerea*, *D. fragilis* (family Dyseidae), *Haliclona (Gellius) varia* (family Chalinidae),...

Table 3. Distribution of sponges on different types of substrates

No.	Bottom type, substrate	Sponge name
1	Sand bed: 9 species	<i>Cliona celata</i> , <i>Cliona orientalis</i> , <i>Cliona aurivilli</i> , <i>Ircinia echinata</i> , <i>Mycale (Aegogropila) plumosa</i> , <i>Mycale</i> sp., <i>Tethya seychellensis</i> , <i>Tethya aurantium</i> , <i>Tethya</i> sp., <i>Haliclona (Gellius) varia</i> .
2	Sand + gravel + rock: 36 species	<i>Cliona celata</i> , <i>C. aurivilli</i> , <i>Cliothosa hancocki</i> , <i>Cliothosa aurivilli</i> , <i>Pioneer carpenteri</i> , <i>Dysidea fragilis</i> , <i>D. cinerea</i> , <i>Gelliodes fibulata</i> , <i>Ircinia echinata</i> , <i>Mycale (Aegogropila) plumosa</i> , <i>M. (Zygomycale) parishii</i> , <i>Axinella dissimilis</i> , <i>Sphaciospongia tentorioides</i> , <i>Tethya seychellensis</i> , <i>T. aurantium</i> , <i>Xestospongia testudinaria</i> , <i>Petrosia (Petrosia) nigricans</i> , <i>Haliclona oculata</i> , <i>H. (Gellius) varia</i> , <i>H. (Reniera) clathrata</i> , <i>H. (Soestella) xena</i> , <i>H. (Haliclona) simulans</i> , <i>H. (Gellius) cymaeformis</i> , <i>Cladocroce burapha</i> , <i>Spongia (Spongia) officinalis</i> , <i>Neamphius huxleyi</i> , <i>Chondrosia reniformis</i> , <i>Clathria</i> sp., <i>Callyspongia roosevelti</i> , <i>C. (Cladochalina) subarmigera</i> , <i>Acanthella hispida</i> , <i>Acanthella cavernosa</i> , <i>Biemna megalosigma</i> , <i>Desmacidon fruticosum</i> , <i>Agelas axifera</i> , <i>Topsentia dura</i> . <i>Siphonodictyon mucosum</i> , <i>Amorphinopsis excavans</i> , <i>Hymeniacidon</i> sp, <i>Chondrilla australiensis</i> , <i>Cliona celata</i> , <i>C. Aurivilli</i> , <i>Cliona</i> sp., <i>Cliothosa hancocki</i> , <i>Cliothosa aurivilli</i> , <i>Pioneer carpenteri</i> , <i>Dysidea fragilis</i> , <i>D. cinerea</i> , <i>Gelliodes fibulata</i> , <i>Ircinia echinata</i> , <i>Psammocinia</i> sp., <i>Mycale (Aegogropila) plumosa</i> , <i>M. (Zygomycale) parishii</i> , <i>Mycale</i> sp. <i>Axinella dissimilis</i> , <i>Sphaciospongia tentorioides</i> , <i>S. decumbens</i> , <i>S. solida</i> , <i>Tethya seychellensis</i> , <i>T. aurantium</i> , <i>Tethya</i> sp., <i>Xestospongia testudinaria</i> , <i>Petrosia (Petrosia) nigricans</i> , <i>Haliclona oculata</i> , <i>H. (Gellius) varia</i> , <i>H. (Reniera) clathrata</i> , <i>H. (Soestella) xena</i> , <i>H. (Haliclona) simulans</i> , <i>H. cymaeformis</i> , <i>Cladocroce</i> sp., <i>Spongia (Spongia) officinalis</i> , <i>Neamphius huxleyi</i> , <i>Chondrosia reniformis</i> , <i>Clathria</i> sp., <i>Callyspongia roosevelti</i> , <i>C. (Cladochalina) subarmigera</i> , <i>Callyspongia</i> sp., <i>Acanthella hispida</i> , <i>Acanthella cavernosa</i> , <i>Biemna megalosigma</i> , <i>Desmacidon fruticosum</i> , <i>Agelas axifera</i> <i>Dactylospongia</i> sp., <i>Topsentia dura</i>
3	Coral reefs: 48 species	<i>Tethya seychellensis</i> , <i>Tethya aurantium</i> , <i>Tethya</i> sp., <i>Haliclona (Gellius) varia</i>
4	Mud + sand: 4 species	<i>Cliona celata</i> , <i>Cliona orientalis</i> , <i>Cliona aurivilli</i> , <i>Cliona</i> sp.
5	Clinging on the crust: 5 species	<i>Cliothosa hancocki</i>
6	Aquaculture rafts, concrete: 10 species	<i>Cliona celata</i> , <i>Cliona orientalis</i> , <i>Cliona aurivilli</i> , <i>Cliothosa hancocki</i> , <i>Haliclona oculata</i> , <i>H. (Gellius) varia</i> , <i>H. (Reniera) clathrata</i> , <i>H. (Soestella) xena</i> , <i>H. (Haliclona) simulans</i> , <i>H.cymaeformis</i>

Ha Long bay: Most of the islands in Ha Long bay have sponge distribution. The two areas, Cong Do and Hang Trai - Dau Be, are the center of almost 20 species of sponge found in the Northeast island. The dominant species are *Dysidea cinerea*, *D. fragilis*, *Mycale plumose*, *Biemma megalosigma*, *Ircinia echinata*,...

Cat Ba islands: Sponge species are mainly concentrated from Hon Van Boi - Van Ha to Ba Trai Dao. Typical species include *Haliclona (Gellius) varia*, *Dysidea cinerea*, *D. fragilis*, *Tethya aurantium*, *Haliclona simulans*,...

Ba Lua archipelago (Kien Giang) have only 3 species: *Acanthella hispida*, *Acanthella cavernosa*, *Haliclona (Gellius) varia*.

Distribution on different types of substrates

Sponge is distributed over 6 types of bottom matter: Sand bottom, sand + gravel + rock, coral reef, mud + sand, clinging to organisms and other substrates. The analysis results showed that the highest number of sponge belongs to the coral reef bottom (48

species); the sand - gravel - rock bottom has 36 species, followed by the aquaculture raft, the concrete substrates (10 species), sand bed 9 species, the crust 5 species, mud and sand 4 species (table 3).

Biomass

Results of biomass sampling in some key areas showed that sponge is often distributed quite concentratedly in areas around limestone islands. The average volume of organisms is quite high, ranging from 0.2–1.5 kg/m² (table 4).

Based on the biological value, 11 points with high biomass were identified. The order from low to high is as follows: Ho Ang Ca Hong, Vung Ha, Hon Ri Nho (0.5 kg/m²); Da Lua (0.6 kg/m²); Hon Hang Te (0.7 kg/m²); Hon Gio Cung (0.8 kg/m²); Cat Chuong To (0.9 kg/m²); Hang Trai (1.0 kg/m²); Dau Be, Van Boi (1.1 kg/m²) and the highest in the water around Da Den island cluster (1.5 kg/m²). These 11 points can be seen as potential areas to become marine drug areas of our country (figure 1).



Figure 1. Diagram of areas with high biomass (> 1 kg fresh/m²)

Table 4. Sponge biomass in some areas of Vietnam's limestone islands

No.	Locations	Bn (kg/m ²)	No.	Locations	Bn (kg/m ²)
1	Hon Da Den	1.5	12	Cong Do	0.2
2	Hon Hang Te	0.7	13	Dau Go	0.2
3	Cat Chuong To	0.9	14	Hon Bu Nau	0.3
4	Ho Ang Cá Hong	0.5	15	Ang Me Cung	0.2
5	Vung Ha	0.5	16	Hon Cuon Buom	0.2
6	Hang Trai	1.0	17	Hon Tong Hoi	0.4
7	Dau Be	1.1	18	Long Chau	0.4
8	Van Boi	1.1	19	Ang Trong Boi	0.3
9	Hon Gio Cung	0.8	20	Cat Dua	0.2
10	Hon Re Nho	0.5	21	Anh Sang	0.2
11	Hon Da Lua	0.6	22	Ang Tham	0.3

Note: Bn - Biomass of average 10 samples studied.

CONCLUSION

The study has identified 54 species, 36 genera and 24 families distributed in the waters around the limestone islands of Vietnam. In which, there is 1 new species of sponge for science with freshwater origin (*Spongilla* sp.) distributed in Ca Hong lake (Bai Tu Long). Clionaidae family has the highest number of species (10 species), followed by Chalinidae (8 species). There are 12 families with only 1 species/family.

Ha Long Bay area has the highest number of species (53 species), followed by Cat Ba (46 species), Bai Tu Long 19 species; Ba Lua Archipelago (Kien Giang) has the least number of species (3 species). The highest number of sponge is distributed in coral reefs (48 species) and the lowest on mud + sand bottom (4 species).

The high concentration areas of sponge include Da Den, Lach Xuoi Chanh, Cong Do and Hang Trai - Dau Be, Hon Van Boi - Van Ha to Ba Trai Dao.

Biomass of sponge varies from 0.2–1.5 kg/m². There are 11 sites with high quality organisms, which are likely to become marine medicinal grounds of Vietnam.

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