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Species composition and distribution of Sponges in some islands in Vietnam sea

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ABSTRACT

Research results from 2003 to present, in same Vietnamese islands, have identified 205 Sponges species belonging to 85 genera and 56 families, 22 orders of 3 classes, including Dermospongia class (203 species), two classes Calcarea and Homoscleromorpha has only 1 species in each class. Among these, there are 3 species new to science: Cladocroce pansinii Bertolino & Calcinai, 2023, Cladocroce lamellata Bertolino and Calcinai, 2023 and Spongilla marconii. The diversity of Sponges is quite high, reaching 2.4 species/genus, 3.66 species/family and 9.32 species/order. Orders with the highest number of species include Haplosclerida (55 species), followed by Poecilosclerida (29 species), Dictyoceratida (21 species), and Halichondrida (20 species). The South Central islands have the highest number of species (121 species), followed by the North Central islands (65 species), the Northeastern islands of Vietnam (57 species), Spratly Islands (37 species) and Phu Quoc (15 species). Species *Cinachyrella australiensis, Dysidea fragilis, Dysidea cinerea* can live at a water depth of 134 m. The biomass of Sponges varies from 0.14–2.5 kg/m^2.

Keywords: Island, Vietnam, Sponges, class, species, genus, family, order, diversity, biomass, depth.

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INTRODUCTION

Sponges are a group of organisms with a primitive multicellular structure and a fairly simple body structure. They can live in fresh water, but the majority of species live in the sea [1]. It is estimated that there are about 9,000 species in the world [2], of which 1,500 species are in the East Vietnam Sea [3]. From Sponges, compounds that fight cancer and some other diseases have been found [4, 5].

Before 2000, in Vietnam, Sponges biodiversity research was mainly conducted by foreign authors. From 2000 up to now, research on the biodiversity of Sponges has been paid attention and published by Vietnamese scientists for different sea areas such as Nha Trang [6], Ha Long Bay [7, 8], marine limestone islands of Vietnam [9], Con Co [10], etc. Scientists have also found many new substances with anti-cancer properties in the Sponges Sea of Vietnam [11, 12].

From 2003 to present, scientists from the Institute of Marine Resources and Environment, Institute of Marine Biochemistry, Institute of Natural Compounds Chemistry under the Vietnam Academy of Science and Technology, combined with scientists from the University of Marche Polytechnic University (Italy), Pharma Mar (Spain) organized the collection of samples of sea sponges on typical islands in the Vietnamese Sea to determine their ability to contain medicinal ability. The article will present the species composition, distribution and biomass of 205 Sponges species identified in the study area.

MATERIALS AND METHODS

Materials

Samples were collected from 2003–2021 at locations: islands in the Northeast coast of Vietnam (Ha Long, Cat Ba, Bai Tu Long); North Central islands (Hon Me, Con Co); islands and peninsulas from Hue to Binh Thuan (Hai Van - Son Cha, Cu Lao Cham, Ly Son, Van Phong Bay, Ca Na Bay and Phu Quy Island, Spratly Islands and Phu Quoc (Figure 1). The number of samples collected was 1,500, stored at the Institute of Marine Resources and Environment.

Methods

Sponges samples were collected in the tidal zone in a cross-section perpendicular to the shoreline from high tide area through mid-tidal area to low tide area. Quantitative samples (collected in standard cells 40 × 40 cm) according to the method of Gunjanova (1972); Do Cong Thung (2014) [13, 14]. In the subtidal area, samples were collected according to the method of English et al., (1994) [15], Do Cong Thung (2014) [14] applied to hard bottom areas and coral reefs. Quantitative samples are collected on the bottom using a specialized nylon mesh frame measuring 1 m × 1 m. The sample is fixed in a cold chamber then transferred to the laboratory for analysis.

Morphological and structural methods are used to classify Sponges according to authors Boury-Esnault, N., and Rutzler, K., (1997) [16] and Hooper (2000) [2]. Classification criteria include: (i) morphology: Shape, color, surface structure and distribution of the openings of the water system (Acquiferos system); (ii) Structure of the skeleton and accompanying structures (spicules and fibers); (iii) Ecology: such as depth, habitat, substrate, salinity, symbiotic species, etc. The classification system is based on the document Systema Porifera (editors Hooper & Van Soest, 2002) [2] and compared with WORMS.

RESULTS AND DISCUSSION

Sponges species composition

The results of analyzing about 1,500 samples have identified 205 species, 85 genera, 56 families, 22 orders belonging to 3 classes. Among them, there are 3 species of Sponges new to science: *Cladocroce pansinii* Bertolino & Calcinai, 2023; *Cladocroce lamellata* Bertolino & Calcinai, 2023 and *Spongilla marconii* species. Of the 205 species of Sponges, up to 203 species belong to the class Dermospongia,

two classes Calcarea and Homoscleromorpha each class has only 1 species. The diversity of Sponges species is also quite high, reaching 2.4 species/genus, 3.66 species/family and 9.32 species/order (Table 2). The detailed diversity level for each level is as follows:

Genus level: the number of Sponges species is unevenly distributed, focusing on 8 typical genera with a high number of species, fluctuating from 5–14 species/ genus, including: Haliclona (14 species), Agelas (9 species), Axinella (8 species), Mycale (8 species), Acanthella (7 species), Callyspongia (7 species), Clathria (6 species), Dysidea (5 species), Ircinia (5 species), Hexadella (5 species). The 17 genera have a number of species from 3–4 species/genus and up to 58 genera, accounting for 68.2% of the genera, with only 1–2 species/genus (Table 1). Thus, the loss of just 1–2 species can lead to the disappearance of the corresponding genus, which proves the unsustainability of the Sponges species structure in the Vietnamese islands.

Figure 1. Diagram of sampling islands

In terms of family level: Among the 56 families, there are 6 families with a large number of species: Chalinidae (18 species), followed by the Petrosiidae family (14 species); two families Axinellidae and Niphatidae (10 species/family); Agelasidae (9 species), Clionaidae (9 species); 8 families with 6 species to 8 species/family, including the families Dysideidae (6 species),

Irciniidae (6 species), Microcionidae (6 species), Ianthellidae (6 species), Tetillidae (6 species), Halichondriidae (7 species), Callyspongiidae (7 species), Dictyonellidae (8 species). Among the remaining 42 families, there are 36 families, accounting for 64.2% of the families with 1–3 species (families). With the poor species composition structure as above, just a small impact of the environment can cause the loss of a genus or a family of Sponges in the waters of the islands in our country. Therefore, it is necessary to have appropriate measures to develop and protect Sponges species that contribute to creating marine medicinal resources in Vietnam.

Table 1. Sponge species composition in the waters of Vietnamese islands

No.	Names
	CLASS DEMOSPONGIAE
I	Order: Agelasida
	1. Family Agelasidae
1	*Agelas axifera* Hentschel, 1911[1,2,3,4]
2	*Agelas conifera* (Schmidt, 1870)[3]
3	*Agelas cervicornis* (Schmidt, 1870)[3]
4	*Agelas oroides* (Schmidt, 1864)[2,3]
5	*Agelas sceptrum* (Lamarck, 1815)[3]
6	*Agelas cerebrum* Assmann, van Soest & Köck, 2001[3]
7	*Agelas clathrodes* (Schmidt, 1870)[3]
8	*Agelas ceylonica* (Dendy, 1905)[2]
9	Agelas sp.[3]
II	Astrophorida
	2. Ancorinidae
10	*Asteropus arenosus* van Soest & Beglinger, 2008[3]
11	*Dercitus (Stoeba) latex* (Moraes & Muricy, 2007)[3]
	3. Calthropellidae
12	*Calthropella (Calthropella) pathologica* (Schmidt, 1868)[3]
	4. Thoosidae
13	*Neamphius huxleyi* (Sollas, 1888)[3]
14	Neamphius sp.[3]
III	Chondrosida
	5. Chondrosiidae
15	*Chondrosia reniformis* Nardo, 1847 [1,3]
IV	Chondrillida
	6. Chondrillidae
16	*Chondrilla australiensis* Carter, 1873[2]
17	*Chondrilla mixta* Schulze, 1877[2]
V	Dictyoceratida
	7. Dysideidae
18	*Dysidea fragilis* (Montagu, 1818)[1,3,4,5]
19	*Dysidea cinerea* Keller, 1889[1,2,3,4,5]
20	*Dysidea variabilis* (Duchassaing & Michelotti, 1864)[1,2,3]
21	*Dysidea avara* (Schmidt, 1862)[2]
22	*Lamellodysidea herbacea* (Keller, 1889)[5]
23	Dysidea sp.[3]
	8. Spongiidae
24	*Hippospongia fistulosa* Lendenfeld, 1889[2,3]
25	*Hippospongia gossypina* (Duchassaing & Michelotti, 1864)[3]
26	*Spongia officinalis* Linnaeus, 1759[1,3,5]
27	*Spongia (Spongia) ceylonensis* Dendy, 1905[2]
28	Spongia sp.[3,5]
	9. Irciniidae
29	*Psammocinia beresfordae* Cook & Bergquist, 1996[1,3]
30	*Ircinia variabilis* (Schmidt, 1862)[3]
31	*Ircinia echinata* (Keller, 1889)[1,2,5]
32	*Ircinia ramosa* (Keller, 1889)[2]
33	*Ircinia mutans* (Wilson, 1925)[4]
34	Ircinia sp.[3,5]
	10. Thorectidae
35	*Smenospongia cerebriformis (*Duchassaing & Michelotti, 1864)[2,3]
36	*Phyllospongia foliascens* (Pallas, 1766) [5]
37	*Hyrtios erectus* (Keller, 1889)[2,4]
38	Dactylospongia sp.[1]
VI	Dendroceratida
	11. Dictyodendrillidae
39	*Igernella vansoesti* Uriz & Maldonado, 1996 [3]
VII	Suberitida
	12. Suberitidae
40	*Aaptos suberitoides* (Brøndsted, 1934)[3]
41	*Terpios cruciatus* (Dendy, 1905)[2]
42	*Suberites carnosus* (Johnston, 1842)[1]
43	*Suberites diversicolor* Becking & Lim, 2009[1]
44	Protosuberites sp.[1]
	13. Halichondriidae
45	*Amorphinopsis fenestrata* (Ridley, 1884)[3]
46	*Amorphinopsis excavans* Carter, 1887[1]
47	*Hymeniacidon perlevis* (Montagu, 1818)[1,2]
48	*Ciocalypta stalagmites* Hentschel, 1912[2]

49	*Halichondria (Halichondria) panacea* (Pallas, 1766)[2]
50	*Halichondria dura* Lindgren, 1897[1]
51	*Halichondria (Halichondria) carotenoidea* Alvarez & Hooper, 2011[4]
VIII	Clionaida
	14. Clionaidae
52	*Cliothosa hancocki* (Topsent, 1888)[1,3]
53	*Cliothosa aurivilli*(Lindgren, 1897)[1]
54	*Cliona celata* Grant, 1826[1,3]
55	*Cliona orientalis* Thiele, 1900[1,5]
56	*Cliona aurivilli* (Lindgren, 1897)[1]
57	Cliona sp.[5]
58	*Spheciospongia tentorioides* (Dendy, 1905)[1]
59	*Spheciospongia solida* (Ridley & Dendy, 1886)[1]
60	*Spheciospongia vagabunda* (Ridley, 1884)[5]
	15. Spirastrellidae
61	*Spirastrella cunctatrix* Schmidt, 1868[2]
62	*Spirastrella decumbens* Ridley, 1884[1]
IX	Tethyida
	16. Hemiasterellidae
63	*Paratimea globastrella* Van Soest, Kaiser & Van Syoc, 2011[3]
	17. Tethyidae
64	*Tethya aurantium* (Pallas, 1766)[1,2,3]
65	*Tethya seychellensis* Wright, 1881[1]
66	Tethya sp.[1]
X	Halichondrida (Bubarida ?)
	18. Dictyonellidae
67	*Acanthella cavernosa* Dendy, 1922[1,2,3]
68	*Acanthella hispida* Pulitzer-Finali, 1982[1,3,5]
69	*Acanthella acuta* Schmidt, 1862[3,4]
70	*Acanthella klethra* Pulitzer-Finali, 1982 [1,2,3]
71	*Acanthella ramosa* Kumar, 1925[3]
72	*Acanthella calyx* Dendy, 1922[5]
73	Acanthella sp.[3]
74	*Dictyonella chlorophyllacea* Alvarez & Hooper, 2010[3]
	19. Axinellidae
75	*Axinella damicornis* (Esper, 1794)[3]
76	*Axinella dissimilis* (Bowerbank, 1866)[1,2,3]
77	*Axinella pyramidata* Stephens, 1916 [3]
78	*Axinella aruensis* (Hentschel, 1912)[3]
79	*Axinella massalis* Burton, 1959[3]
80	*Axinella infundibuliformis* (Linnaeus, 1759)[3]
81	*Axinella polypoides* Schmidt, 1862[2]
82	Axinella sp.[3]
83	*Dragmacidon reticulatum* (Ridley & Dendy, 1886)[2]
84	*Ptilocaulis walpersii* (Duchassaing & Michelotti, 1864)[2]
	20. Halichondriidae
85	*Halichondria (Halichondria) panicea* (Pallas, 1766)[3]
86	*Halichondria (Halichondria) carotenoidea* Alvarez & Hooper, 2011[3]
XI	Haplosclerida
	21. Callyspongiidae
87	*Callyspongia eschrichtii* Duchassaing & Michelotti, 1864[3]
88	*Callyspongia (Euplacella) biru* De Voogd, 2004[3]
89	*Callyspongia (Cladochalina) subarmigera* (Ridley, 1884)[1,2,3,4,5]
90	*Callyspongia (Callyspongia) barodensis* Burton, 1959[3]
91	*Callyspongia (Cladochalina) diffusa* (Ridley, 1884)[2]
92	*Callyspongia roosevelti* van Soest, Kaiser & Van Syoc, 2011[1]
93	Callyspongia sp[1,3]
	22. Niphatidae
94	*Gelliodes spinosella* Thiele, 1899[3,4]
95	*Gellioides fibulata* (Carter, 1881)[1,2,3,5]
96	Gelliodes sp.[3]
97	*Niphates erecta* Duchassaing & Michelotti, 1864[2]
98	*Nyphates olemda* Laubenfels, 1954[5]
99	Niphates sp.[5]
100	*Amphimedon complanata* (Duchassaing, 1850)[3]
101	*Amphimedon trindanea* (Ristau, 1978)[2]
102	Amphimedon sp.[3]
103	*Cribrochalina dura* (Wilson, 1902)[5]
	23. Phloeodictyidae
104	*Oceanapia isodictyiformis* (Carter, 1882)[3]
105	*Oceanapia amboinensis* Topsent, 1897[2]
106	*Oceanapia ramsayi* (Lendenfeld, 1888)[2,5]
107	Calyx sp.[5]
	24. Chalinidae
108	*Haliclona (Soestella) mucosa* (Griessinger, 1971)[3]
109	*Haliclona (Soestella) xena* De Weerdt, 1986[1,2,3]
110	*Haliclona (Halichoclona) vansoesti* de Weerdt, de Kluijver & Gomez, 1999[2,3]
111	*Haliclona (Gellius) varia* (Bowerbank, 1875)[1,2,3]
112	*Haliclona (Reniera) cinerea* (Grant, 1826)[3]
113	*Haliclona (Gellius) cymaeformis* (Esper, 1794)[1,2,3]
114	*Haliclona (Reniera) tubifera* (George & Wilson, 1919)[2,3]
115	*Haliclona (Rhizoniera) viscosa* (Topsent, 1888)[3,4]

116	*Haliclona (Haliclona) oculata* (Linnaeus, 1759)[1,3,5]
117	*Haliclona simulans* (Johnston, 1842)[1,3]
118	*Haliclona (Gellius) fibulata* (Schmidt, 1862)[1,2]
119	*Haliclona baeri* (Wilson, 1925)[2]
120	*Haliclona (Reniera) clathrata* (Dendy, 1895)[1]
121	*Gellius varius* (Bowerbank, 1875)[1,2,5]
122	Haliclona sp.[3]
123	*Cladocroce burapha* Putchakarn, de Weerdt, Sonchaeng & van Soest, 2004[1]
124	*Cladocroce pansinii* Bertolino & Calcinai, 2023[1]
125	*Cladocroce lamellata* Bertolino & Calcinai, 2023[1]
	25. Phloeodictyidae
126	*Siphonodictyon mucosum* Bergquist, 1965[1,3]
	26. Petrosiidae
127	*Acanthostrongylophora ingens* (Thiele, 1899)[3]
128	*Xestospongia bocatorensis* Díaz, Thacker, Rützler & Piantoni, 2007[3]
129	*Xestospongia muta* (Schmidt, 1870)[2,3,4,5]
130	Xestospongia sp.[3]
131	*Xestosponea testudinaria* (Lamark, 1815)[1,2,3,4,5]
132	*Neopetrosia carbonaria* (Lamarck, 1814)[2]
133	*Neopetrosia chaliniformis* (Thiele, 1899)[2]
134	*Petrosia (Petrosia) nigricans* Lindgren, 1897[1,5]
135	*P. elastica* (Keller, 1891)[5]
136	Petrosia sp.[5]
137	*Petrosia ficiformis* (Poiret, 1789)[5]
138	*Neopetrosia seriata* (Hentschel, 1912)[5]
139	*Neopetrosia similis* (Ridley & Dendy, 1886)[5]
	27. Calcifibrospongiidae
140	*Calcifibrospongia actinostromarioides* Hartman, 1979[2]
XII	Poecilosclerida
	28. Esperiopsidae
141	*Amphilectus fucorum* (Esper, 1794)[3]
	29. Microcionidae
142	*Clathria (Thalysias) raraechelae*[3]
143	*Clathria (Thalysias) jolicoeuri* (Topsent, 1892)[3]
144	*Clathria (Clathria) barleei* (Bowerbank, 1866)[3]
145	*Clathria (Thalysias) reinwardti* Vosmaer, 1880)[1,2,3,4]
146	*Clathria (Thalysias) basiarenacea* (Boury-Esnault, 1973)[3]
147	*Rhaphidophlus seriatus* Thiele, 1899[3]
	30. Coelosphaeridae
148	*Forcepia (Forcepia) vansoesti* Lim, de Voogd & Tan, 2012[3]
	31. Raspailiidae
149	*Cyamon argon* Dickinson, 1945[3]
150	Cyamon sp.[3]
	32. Hamacanthidae
151	*Hamacantha (Hamacantha) carteri* Topsent, 1904[3]
	33. Merliidae
152	*Merlia normani* Kirkpatrick, 1908[3]
	34. Mycalidae
153	*Mycale (Aegogropila) plumosa* sensu Hoshino, 1981[1,3,5]
154	*Mycale (Carmia) micracanthoxea* Buizer & van Soest, 1977[3]
155	*Mycale (Mycale) laevis* (Carter, 1882)[1,2,3]
156	*Mycale rotalis* (Bowerbank, 1874)[3]
157	*Mycale (Aegogropila) contarenii* (Lieberkühn, 1859)[2]
158	*Mycale* (*Zygomycale*) *parishii* (Bowerbank, 1875)[1,3]
159	*Mycale philippinensis* (Dendy, 1896)[5]
160	Mycale sp.[1,3]
	35. Hymedesmiidae
161	*Phorbas fictitius* (Bowerbank, 1866)[3]
162	*Phorbas tenacior* (Topsent, 1925)[3]
163	Phobas sp.[3]
	36. Myxillidae
164	*Myxilla (Burtonanchora) pistillaris* Topsent, 1916[2]
	37. Esperiopsidae
165	Ulosa sp.[3]
	38.Acarnidae
166	*Acarnus innominatus* Gray, 1867[2]
	39. Crambeidae
167	*Monanchora unguiculata* (Dendy, 1922)[2]
	40. Desmacididae
168	*Desmacidon fruticosum*(Montagu, 1814)[1,2]
169	*Desmapsamma anchorata* (Carter, 1882)[1]
XIII	Axinellida
	38. Raspailiidae
170	*Trikentrion muricatum* (Pallas, 1766)[3]
XIV	Verongida
	39. Aplysinidae
171	*Aplysina aerophoba* Nardo, 1833[3]
172	*Aplysina cavernicola* (Vacelet, 1959)[3]
173	Aplysina sp.[3]
	40. Ianthellidae
174	*Hexadella crypta* Reveillaud, Allewaert, Pérez, Vacelet, Banaigs & Vanreusel, 2012[3]
175	*Hexadella topsenti* Reveillaud, Allewaert, Pérez, Vacelet, Banaigs & Vanreusel, 2012[3]
176	*Hexadella pruvoti* Topsent, 1896[3]
177	*Hexadella racovitzai* Topsent, 1896 [3]

178	Hexadella sp.[3]
179	*Ianthella basta* (Pallas, 1766)[3]
	41. Pseudoceratinidae
180	*Pseudoceratina purpurea* (Carter, 1880)[2]
XV	Biemnida
	42. Biemnidae
181	*Biemna liposphaera* (Hentschel, 1912)[1,2,3]
182	*Biemna variantia* (Bowerbank, 1858)[3,4]
183	*Biemna fortis* Topsent, 1897[5]
XVI	Order Tetractinellida
	43. Ancorinidae
184	*Rhabdastrella reticulata* (Carter, 1883)[2,3]
185	*Rhabdastrella providentiae* (Dendy, 1916)[3]
186	*Rhabdastrella distincta* (Thiele, 1900)[2]
187	*Rhabdastrella globostellata* (Carter, 1883)[2]
188	*Asteropus arenosus* van Soest & Beglinger, 2008[3]
	44. Tetillidae
189	*Cinachyrella alloclada* (Uliczka, 1929)[3]
190	*Cinachyrella australiensis* (Carter, 1886)[2,3]
191	*Cinachyrella anomala* (Dendy, 1905)[2]
192	*Tetilla dactyloidea* (Carter, 1869)[3]
193	*Tetilla ternatensis* (Kieschnick, 1896)[2]
194	*Paratetilla bacca* (Selenka, 1867)[2,5]
	45. Geodiidae
195	*Geodia cydonium* (Linnaeus, 1767)[2]
196	*Geodia macandrewii* Bowerbank, 1858[3]
	46. Thoosidae
197	*Neamphius huxleyi* (Sollas, 1888)[1]
	47. Corallistidae
198	*Corallistes masoni* (Bowerbank, 1869)[3]
XVII	Merliida
	48. Hamacanthidae
199	*Hamacantha (Hamacanth) carteri* Topsent, 1904[3]
XVIII	Scopalinida
	49. Scopalinidae
200	*Stylissa carteri* (Dendy, 1889)[2,5]
201	*Stylissa flabelliformis* (Hentschel, 1912)[5]
XIX	Chondrillida
	50. Chondrillidae
202	*Chondrilla australiensis* Carter,1873[1,5]
XX	Spongillida
	51. Spongillidae
203	*Spongilla manconii* Barbara Calcinai and Bertolino, 2020[1]
	CLASS HOMOSCLEROMORPHA
XXI	Homosclerophorida
	52. Plakinidae
204	*Plakortis communis* Muricy, 2011[2]
	CLASS CALCAREA
XXII	Leucosolenida
	53. Family Sycettidae
205	*Sycon ciliatum* (Fabricius, 1780)[3]

Notes: 1: Northeast Islands; 2: Islands from Thanh Hoa to Quang Tri; 3: From Hai Van - Son Cha (Thua Thien-Hue) to Phu Quy (Binh Thuan); 4: Phu Quoc; 5: Truong Sa Islands.

At the order level: among the 22 Sponges orders distributed on the islands, there are an average of 9.32 species/order. Orders with the highest number of species include: Haplosclerida has the highest number of species (55 species), followed by Poecilosclerida (29 species), Dictyoceratida (21 species), and Halichondrida (20 species). The remaining 4 orders have a number of species greater than the average value, including: Tetractinellida (14 species), Suberitida (12 species), Clionaida (11 species), Verongida (10 species). The remaining fourteen orders have a smaller number of species than the average value, especially 10 orders accounting for 45.4% of the orders, with only 1 to 2 species/order (Chondrosida, Chondrillida, Dendroceratida, Axinellida, Merliida, Scopalinida, Chondrillida, Spongillida, Homosclerophorida, Leucosolenida). The results of this study show that Sponges distribution is uneven among orders and that Haplosclerida has the most diverse species.

Sponges distribution in Vietnam sea islands

Geografical distribution

Based on geographical location, temporarily divide the distribution of Sponges into 5 regions. Among these 5 regions, the South Central islands have the highest number of species with 121 species, followed by the North Central region (65 species), the Northeastern islands of Vietnam (57 species), and Truong Sa Islands (37 species). species) and Phu Quoc (15 species) (Table 1).

Detailed species distribution of the 16 areas studied shows that Nha Trang Bay (Khanh Hoa) has the highest number of species (100 species), followed by Con Co (Quang Tri) with 54 species, Ha Long Bay (53 species). Cat Ba (46 species),

Truong Sa Islands (37 species), Hon Me (Thanh Hoa) and Hai Van - Son Cha (Thua Thien-Hue) (24 species), Van Phong (Khanh Hoa) (13 species), Ninh Thuan - Binh Thuan (12 species), Phu Yen (9 species). In the remaining areas of Cu Lao Cham, Ly Son, and Quy Nhon, the number of Sponges species is very low, ranging from 4–7 species/location (Figure 2).

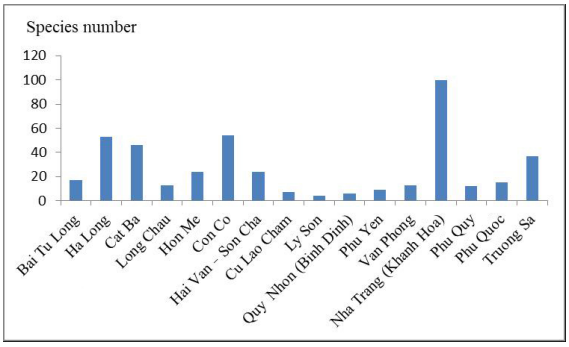

Figure 2. Number of Sponges species in the study areas

The analysis results also found 8 species widely distributed in 80–100% of sampling regions. These include: *Agelas axifera, Dysidea fragilis, Dysidea cinerea, Callyspongia (Cladochalina) subarmigera, Gellioides fibulata, Xestospongia muta, Xestosponea testudinaria, Clathria (Thalysias) reinwardti*. There are about 14 species with an occurrence frequency of 60% to < 80%, including species: *Spongia officinalis, Ircinia echinata, Tethya aurantium, Acanthella cavernosa, Acanthella hispida, Axinella dissimilis, Haliclona (Soestella) xena, Haliclona (Halichoclona) vansoesti, Haliclona (Gellius) varia, Haliclona (Gellius) cymaeformis, Haliclona (Haliclona) oculata, Gellius varius, Mycale (Aegogropila) plumosa, Biemna liposphaera*. The remaining 183 species have low encounter frequencies, less than 60% of locations. In particular, 12 species only distributed in the Truong Sa Islands: *Lamellodysidea herbacea, Phyllospongia foliascens, Spheciospongia vagabunda, Acanthella calyx, Nyphates olemda, Cribrochalina dura, Petrosia elastica, Petrosia ficiformis, Neopetrosia seriata, Neopetrosia similis, Biemna fortis, Stylissa flabelliformis*. Three new species have also been found for the world in Ha Long Bay - Cat Ba and are also endemic to the sea and islands of Northeast Vietnam (*Cladocroce pansinii, Cladocroce lamellata, Spongilla marconii*).

Distribution on different types of substrate

Analysis results show that Sponges is distributed on 6 types of bottom: sandy bottom, sand + gravel + boulders, coral reefs, mud + sand, biological organisms and other substrates. Analysis results show that the vast majority of Sponges species are distributed on the coral reef bottom and the lowest is the sandy bottom. For example, when studying the distribution of Sponges in the Northeast islands, it was found that there are 48 species found on coral reefs, sand - gravel - rock bottom with 36 species, followed by seafood rafts, concrete stands (10 species); Sand bottom (9 species); on the biological crust (5 species), on the sandy mud bottom there are only 4 species. Similarly, research on the distribution of Sponges from Hai Van - Son Cha to Phu Quy (Binh Thuan) shows that the muddy bottom has 1 species distributed. There are 04 species on muddy sandy bottom. Meanwhile, at the bottom of coral reefs, sponge species are distributed with the largest number of species (120 species). Next is on the bedrock reef bottom with a distribution of 99 species, on dead coral reefs there are 98 species. In sand + rock substrate (52 species), sand - live coral has 37 species, dead coral debris + sand has 23 species. Thus, it can be seen that the lowest among the substrates with the appearance of sponges are mud, sand - mud and fine sand, from 1–10 species.

Distribution by depth

Research from 2003 up to now has determined that Sea sponges are concentratedly distributed on rocky reefs, island slopes and coastal coral reefs in Vietnam. They are concentratedly distributed on the bottom at a water depth of 20 m. However, research results show that in the deep sea area (Bistros Reef Area) to a depth of nearly 134 m, there are still sponges distributed. In this area, 10 Sponges samples were collected, including 3 species:

Cinachyrella australiensis, Dysidea fragilis, Dysidea cinerea.

Biodiversity is distributed in some typical islands

Sea sponges play an important role in the structure of coral ecosystems, through their ability to increase the cohesion of coral debris to form stronger reefs. It is also an important food source for other creatures. But their most important role is to create highly biologically active substances, which are an important source of medicinal resources in the sea. Therefore, the biomass research of Sponges contributes to the construction of medicinal yards in Vietnam's sea. The research results of Sponges biomass over the past 10 years, although not complete, still contributes to the understanding of Vietnam's coastal Sponges resources.

Results of biological sampling in some key areas show that Sponges is often quite concentrated in areas around Vietnamese islands. The average amount of organisms is quite high, varying from 0.14–2.5 kg/m^2 (Table 2). Based on the biological quantity, 14 points with high biological quantity have been identified. arranged in order from low to high as follows: Ang Ca Hong Lake, Vung Ha, Small Root Island (0.5 kg/m^2); Fire Rock (0.6 kg/m^2); Hon Hang Te (0.7 kg/m^2); Hon Gio Cung (0.8 kg/m^2); Large kidney (0.9 kg/m^2); Hang Trai (1.0 kg/m^2); Dau Be, Van Boi (1.1 kg/m^2), Da Den island cluster (1.5 kg/m^2), Hai Van - Son Cha (1.9 kg/m^2) and the highest Con Co (2.5 kg/m^2). It can be seen that these 14 points are areas with the potential to become marine medicinal yards around our country's islands.

Table 2. Sponges biodiversity in some Vietnamese islands

No.	Locations	Biomass (kg/m^2)	No.	Locations	Biomass (kg/m^2)
1	Hon Da Den	1.5	14	Hon Bu Lau	0.3
2	Hon Hang Te	0.7	15	Ang Me Cung	0.2
3	Cat Chuong To	0.9	16	Hon Cuon Buom	0.2
4	Ho Ang Ca Hong	0.5	17	Hon Tong Hoi	0.4
5	Vung Ha	0.5	18	Long Chau	0.4
6	Hang Trai	1.0	19	Ang Trong Boi	0.3
7	Dau Be	1.1	20	Cat Dua	0.2
8	Van Boi	1.1	21	Ang Sang	0.2
9	Hon Gio Cung	0.8	22	Ang Tham	0.3
10	Hon Re Nho	0.5	23	Hon Me	1.8
11	Hon Da Lua	0.6	24	Con Co	2.5
12	Cong Do	0.2	25	Hai Van - Son Cha	1.9
13	Dau Go	0.2	26	Phu Quy*	0.14
			27	Phu Quoc*	0.68

Note: Phu Quy* (Hieu, N. V., (2022)).

CONCLUSION

205 species, 85 genera, 56 families, 22 orders have been identified in 3 classes: class Dermospongia (203 species), two classes Calcarea and Homoscleromorpha each with only 1 species. Among them are 3 species new to science: *Cladocroce pansinii, Cladocroce lamellata and Spongilla marconii*.

The diversity is reaching 2.4 species/genus, 3.66 species/family and 9.32 species/order. Orders with the highest number of species include Haplosclerida (55 species), followed by Poecilosclerida (29 species), Dictyoceratida (21 species), and Halichondrida (20 species).

Among these 5 research zones, the South Central islands have the highest number of species with 121 species, followed by the North Central region (65 species), the Northeastern islands of Vietnam (57 species), Spratly Echipelago (37 species) and Phu Quoc (15 species).

Discovery of 3 species of Sponges as *Cinachyrella australiensis, Dysidea fragilis, Dysidea cinerea* distributed to a depth of 134 m, it is a new contribution to the distribution of Sponges in Vietnam

Biomass varies from 0.14–2.5 kg/m^2. Based on biodiversity, 14 points with high biodiversity have been identified, typically Hon Da Den (1.5 kg/m^2), Hai Van - Son Cha (1.9 kg/m^2) and Cao Den (1.5 kg/m^2) at Con Co (2.5 kg/m^2).

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