

DIVERSITY OF ECHINODERMS (ECHINODERMATA) IN THE NORTH EASTERN ISLANDS, VIETNAM

Do Cong Thung^{1,*}, Dao Minh Dong²

¹*Institute of Marine Environment and Resources, VAST, Vietnam*

²*Bach Long Vi Marine Protected Area Management Board, Hai Phong, Vietnam*

*E-mail: thungdocong@gmail.com

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Abstract. 41 species have been identified, belonging to 29 genera, 18 families, 10 orders and 5 classes of Echinoderms in Northeast islands, from Mong Cai (Quang Ninh) to Do Son (Hai Phong). Compared to previous publications, 15 species were first identified in the Tonkin Gulf. The diversity of species numbers shows that Oreasteridae and Holothuriidae have the highest number of species (5 species/family), similarly the genus *Holothuri* has the highest species number (5 species). Ha Long Bay - Cat Ba has 33 species; Co To - Thanh Lan has 24 species and Bai Tu Long has 25 species. Echinoderms live in three habitats: Sand, coral, reef. The highest number of species is living in the sandy bottom and coral reefs, 39% and the lowest number only about 10% in coral reefs and reef. Van Boi, Van Ha, Da Den, Bac Van, Hong Van have high density of Echinoderms, potentially becoming marine medicine yards.

Keywords: Echinoderms, Northeast islands, first discovered, diverse, habitat, medicinal field.

INTRODUCTION

In the Northeast of marine areas, from Mong Cai (Quang Ninh) to Do Son (Hai Phong), the coast is nearly 300 km long, occupying about half of the total area of the western Gulf of Tonkin. The shoreline, with many bays, is covered by more than 2,000 limestone islands. The most notable islands are the cluster islands: From Co To - Tran islands, Bai Tu Long island, Ha Long - Cat Ba - Long Chau and Bach Long Vi. Because of the heterogeneous topography including the sea, islands and estuarine areas, there are abundant creatures in the Northeast of Vietnam. Up to date, more than 2,000 species of animals have been identified in the waters surrounding the Northeast islands, and more than 2800 species of animals and plants live in the forests on the island. The number of species is sorted from high to low as follows: Ha Long - Cat Ba

(4,900 species), Bach Long Vi (945 species), Ha Mai (756 species), Thanh Lan - Co To (680 species), Ba Mun (561 species), Dao island (485 species). 2,000 marine species not only create the largest catch of the Tonkin Gulf but also are a rich source of marine medicine. Preliminary assessments have identified about 200 species of Echinoderms distributed in the Tonkin Gulf, among which 19 species are capable of containing important medicinal herbs. There are even species that not only contain medicinal plants but also thrive, creating large biomass capable of becoming the large marine medicine fields of our country. This paper will present the diversity of Echinoderms in Northeast islands in order to contribute to the sustainable exploitation and conservation of these important animal resources.

RESEARCH METHODOLOGY

In years 2014, 2015 and 2018, specimens were collected in four main areas from Co To to Cat Ba. In Co To - Thanh Lan, samples were collected at the large Co To, small Co To, Thanh Lan, Bac Van, Nam Cap and Van Chay. Bai Tu Long area included Da Den, Hang Ngoi, Tra Lap, Tra Gioi, Cua Nua, Cua Xuoi Chanh (Ban Sen), Cam Pha bay. Ha Long bay area consisted of Yen Ngua, Hang Trai and Dau Be. Samples in the Cat Ba area were collected in Van Boi, Van Ha, Tung Ngon (fig. 1). In addition to the four main areas, they also collected specimens for their distribution in Ha Mai, Thuong Mai, Van Canh, Ngoc Vung, Bach Long Vi and Con Co islands.

Method of sampling is based on the procedure of Marine Resources and Environment survey in 2014 of the Institute of Marine Resources and Environment [1]. The basic principle is to collect samples in both

tidal and subtidal areas using the method of diving sampling with the help of scuba diving equipment. A 100 m long transect line is placed parallel to the shore at two different depths of 3 m and 10 m. At each sampling station, there are 3 sampling points, with a square of 1 m². All collected samples should be classified into groups of organisms on board, labeled and stored with formalin 10%, then transferred to 98% alcohol.

Identification of species by morphological and structural method was conducted by Zhang Feng Kinh et al., (1964) [2], Clark, A. M., (1971) [3], Coleman, N., (2007) [4], Zulfigar et al., (2008) [5]. According to these authors, species identification characteristics are based on morphology, color, location of mouth, anus, water hole, skeletal structure, tubular bodies, self-destroying organs, water exchange systems and bait.

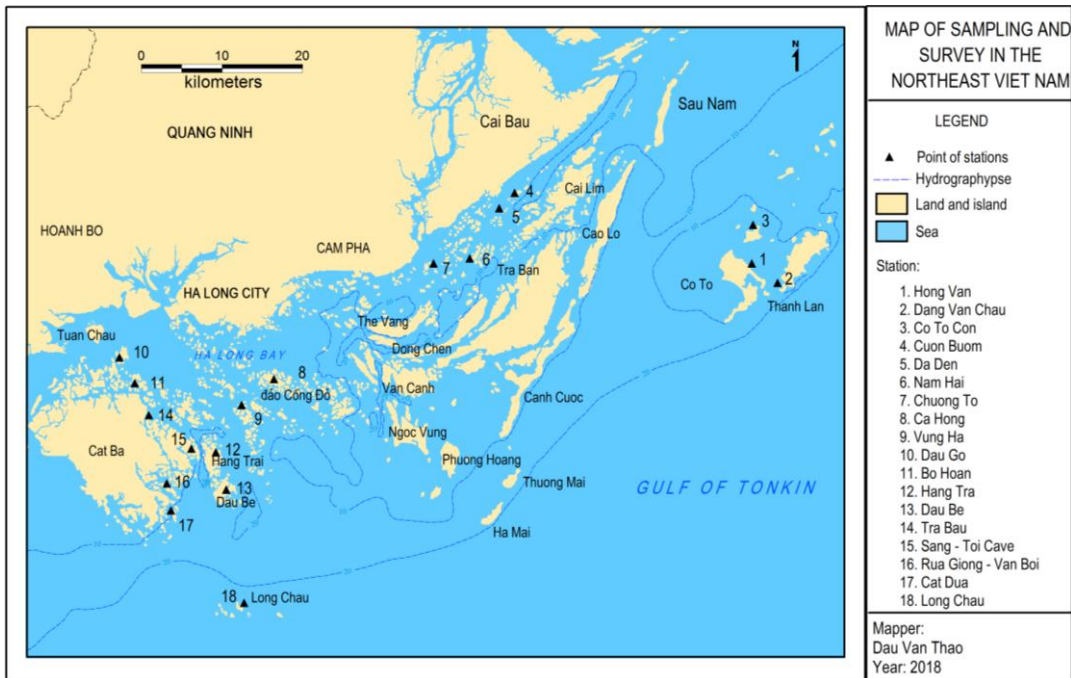


Fig. 1. Sampling location

RESULTS AND DISCUSSION

Diversity of species composition in the waters around the islands of Northeast Vietnam. In the sea of Vietnam, there are about 350 species belonging to 58 families, 5

classes (Crinoidea, Holothuroidea, Asteroidea, Sea urchins and Ophiuroidea). Most species are found in some families such as Astropectinidae, Holothuriidae, Cucumariidae, Amphiuridae. Common species are *Holothuria vagabunda*,

Diadema setosum, Sea Star (*Astropecten monacanthus*, *A. Polycanthus*, *A. velitaris*), *Ophiactis savygni*,...

In the waters around the islands of Northeast Vietnam, 41 species belonging to 29 genus, 18 families, 10 orders and 5 classes of Echinoderms have been identified. Compared with previous publications, 15 species were first identified in the Tonkin Gulf (table 1). Considering the diversity of species numbers, Oreasteridae and Holothuriidae have the highest number of species (5 species/family); followed by two families of Ophiotrichidae, Ophiactidae, each with 4 species; the Astropectenidae and the Stichopodidae each

have three species. The remaining 12 families have only 1–2 species/family. The number of species is too small for a family to show the high vulnerability of the Echinoderms in the sea. Likewise, when evaluating the diversity of species for genus, only one genus of Holothurians (Holothuria) has five species; two sea stars (*Anthenea*, *Astropecten*) have 3 species/genus; the remaining 25 genus have only 1–2 species/genus. Sea cucumbers and starfish dominate the number of species and are of high medicinal and economic values, showing a high economic potential for these echinoderms.

Table 1. The species composition and distribution of Echinoderms in the Northeast islands of Vietnam

No	Scientific name	Location of distribution			F
		A	B	C	
	Class Crinoidea				
	Order Articulata				
	1. Fam. Antedonidae				
1	<i>Eumetra aphrodite</i> A. H. Clark, 1912			s	+
	Class Asteroidea				
	Order Valvatida				
	2. Fam. Oreasteridae				
2	<i>Anthenea pentagonula</i> (Lamarck, 1816)	c			
3	<i>Anthenea sibogae</i> Doderlein, 1915	c		c	+
4	<i>Anthenea tuberculosa</i> Gray, 1947		c		+
5	<i>Pentaceraster gracilis</i> (Lutken, 1871)	s, c			+
6	<i>Protoreaster nodusus</i> (Linnaeus, 1758)	s, c			
	3. Fam. Goniasteridae				
7	<i>Stellaster equestris</i> (Retzius, 1805)	c			+
	4. Fam. Archasteridae				
8	<i>Archaster typicus</i> Müller & Troschel, 1840	s		s	
	Order: Paxillosida				
	5. Fam. Astropectinidae				
9	<i>Astropecten monacanthus</i> Sladen, 1883		s	s	
10	<i>Astropecten polyacanthus</i> Müller & Troschel, 1842		s	s	
11	<i>Astropecten velitaris</i> Von Martens, 1865			s	
	Class Holothuroidea				
	Order Dendrochirotida				
	6. Fam. Cucumariidae				
12	<i>Cercodemus anceps</i> Selenka, 1867	c	c	c	+
13	<i>Colochirus quadrangularis</i> Troschel, 1846	c	c	c	
	Order Synallactida				
	7. Fam. Stichopodidae				
14	<i>Stichopus chloronotus</i> Brandt, 1835	c	c		
15	<i>Stichopus horrens</i> Selenka, 1867			c	
16	<i>Thelenota</i> sp			c	+

	Order Holothuriida				
	8. Fam. Holothuriidae				
17	<i>Holothuria (Martensiothuria) leucospilota</i> (Brandt, 1835)	s, c, r	s, c, r	s, c, r	
18	<i>Holothuria atra</i> Jaeger, 1833	s, c, r		s, c, r	
19	<i>Holothuria (Metriatyla) scabra</i> Jaeger, 1833			s, c, r	
20	<i>Holothuria martensii</i> Semper, 1868			s, c, r	
21	<i>Holothuria (Theelothuria) squamifera</i> Semper, 1868			s, c, r	
	Order Apodida				
	9. Fam. Synaptidae				
22	<i>Synaptula lamperti</i> Heding, 1928	c	c	c	+
	Class Sea urchinsea				
	Order Aulodonta				
	10. Fam. Diadematidae				
23	<i>Diadema setosum</i> (Leske, 1778)	c, r	c, r	c, r	
24	<i>Echinothrix calamaris</i> (Pallas, 1774)		c, r		
	Order Camarodonta				
	11. Fam. Temnopleuridae				
25	<i>Temnopleurus toreumaticus</i> (Leske, 1178)			c	
	12. Fam. Strongylocentrotidae				
26	<i>Strongylocentrotus droebachiensis</i> (O.F. Müller, 1776)		c, r	c, r	+
27	<i>Strongylocentrotus intermedius</i> (A. Agassiz, 1863)		c, r		+
	Class Ophiuroidea				
	Order Ophiacanthida				
	13. Fam. Ophiacanthidae				
28	<i>Ophiocamax rugosa</i> Koehler, 1904	s, c	s, c	s, c	
	14. Fam. Ophiomyxidae				
29	<i>Ophiomyxa australis</i> (Lutken, 1869)	s, c	s, c	s, c	
30	<i>Ophiomyxa neglecta</i> (Koehler, 1904)	s, c	s, c	s, c	
	Order Amphilepidida				
	15. Fam. Ophiotrichidae				
31	<i>Macrophiothrix longipeda</i> (Lamarck, 1816)	s, c	s, c	s, c	
32	<i>Ophiotrix (Placophiotrix) striolata</i> Grube, 1868	s, c	s, c	s, c	
33	<i>Ophiomaza cacaotica</i> Lyman, 1871	s, c	s, c	s, c	
34	<i>Ophionereis dubiasinensis</i> Duncan, 1879	s, c	s, c	s, c	
	16. Fam. Ophiolepididae				
35	<i>Ophioplocus imbricatus</i> (Müller & Troschel, 1842)			s, c	
36	<i>Ophioplocus japonicus</i> H. L. Clack, 1911		s, c	s, c	
	17. Fam. Ophiactidae				
37	<i>Ophiactis affinis</i> Duncan, 1879		s, c	s, c	
38	<i>Ophiactis modesta</i> Brock, 1888	s, c	s, c	s, c	
39	<i>Ophiactis savignyi</i> (Miiller et Troschel, 1842)	s, c	s, c	s, c	
40	<i>Ophiopholis mirabilis</i> (Duncan, 1879)	s, c	s, c	s, c	
	18. Fam. Amphiuridae				
41	<i>Amphiolus (Amphichilus) impressus</i> (Ljungman, 1867)	s, c	s, c	s, c	
Total species		24	25	33	10

Notes: A: Co To - Thanh Lan; B: Bai Tu Long; C: Ha Long - Cat Ba; F: The new species for Tonkin Gulf; c: Distributed in coral reefs; s: Distributed on the sand bottom; r: Distributed in reefs.

Distribution of the Echinoderms in the waters around the islands of Northeast Vietnam. The number of species in each region is different. The number of species distributed highly in Ha Long - Cat Ba (33

species) and Co To - Thanh Lan and Bai Tu Long ranged from 24 to 25 species/region (table 1).

The distribution of Da Gai can be divided into five focus areas: Co To - Thanh Lan; Bai

Tu Long; Ha Long bay; Cat Ba archipelago; offshore islands.

Co To - Thanh Lan area: A habitat of large species of Cucumariidae, typical species: *Cercodemas anceps*, *Colochirus quadrangularis*; the holothurians family, species *Holothuria (Martensiothuria) leucospilota*; Sea Star (Oreasteridae) *Pentaceraster gracilis*.

Bai Tu Long sea area: From Hon Da Den (21°03'22"-107°27'30") to Lach Xuoi Chanh (Ban Sen) (21°55'59"-107°26'24"); mainly distributed species of the family Oreasteridae, species: *Anthenea pentagonula*, *Anthenea tuberculosa*, *Anthenea sibogae*; Cucumariidae species *Colochirus quadrangularis*.

Ha Long bay: Mainly concentrated in Cong Do and Hang Trai - Dau Be areas. Dominant species are Holothuridae (*Holothuria leucospilota*, *Holothuria atra*, *Holothuria (Metriatyla) scabra*). In addition, species of sea stars, sea cucumbers can be found,...

The Cat Ba Sea: The skin species live from Van Boi, Van Ha to Ba Trai Dao. Van Boi - Van Ha is the living center of the Sea Stars (Astropectinidae and Ophidiasteridae), typical species include *Archaster typicus*, *Astropecten monacanthus*, *Astropecten polyacanthus*; species *Stichopus chlorophyllum* (Stichopodidae) and 2 Holothurians species as *Holothuria leucospilota*, *Holothuria atra*.

Offshore islands: Including more Southern islands such as Bach Long Vi, Con Co. Species of sea cucumber as *Holothuria leucospilota*, *Holothuria atra*, *Holothuria (Metriatyla) scabra* and species of Sea Stars and Sea urchinsea are usually distributed here.

Echinoderms are distributed in three main habitats: sand, rock, and reef (table 1). Depending on the distribution in one or more habitats, they are divided into five major distributions (fig. 2).

Species distributed only on sandy bottoms: There are 5 species, accounting for 12% of total species, occupying themselves on or in the surface of sandy bottom, including *Eumetra Aphrodite* (Crinoidea); 3 species of *Astropecten (Astropecten monacanthus, A. polyacanthus, A. velitaris)* and 1 species of *Archaster typicus*.

The number of species associated with reefs is 11 species - 27%. They consist of four species of Sea Stars (*Anthenea pentagonula, A. sibogae, A. tuberculosa, Stellaster equestris*) and six species of holothurian (*Stichopus chloronotus, Cercodemas anceps, Colochirus quadrangularis, Stichopus horrens, Thelenota sp, Synaptula lamperti*).

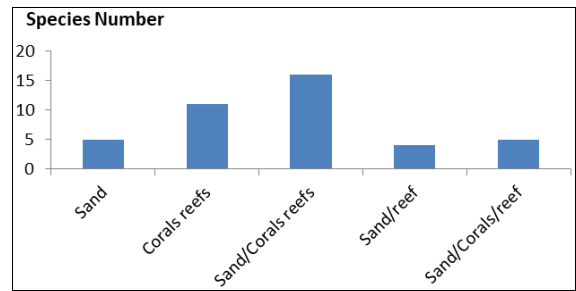


Fig. 2. The distribution of Echinoderms in the habitat types

Species that live on sandy or coral reefs include 16 species - 39%, up to 14 species of Ophiuroidea, including Ophiacanthidae and Amphiuroidae, each with one species; Ophiomyxidae family and Ophiolepididae family with two species; 4 species/family of Ophiotrichidae, Ophiactidae. The class Asteroidea has two species (*Pentaceraster gracilis, Protoreaster nodus*).

Number of species on coral reefs and reef: 4 species of Sea urchinsea, *Diadema setosum, Echinothrix calamaris, Strongylocentrotus droebachiensis, Strongylocentrotus intermedius*.

Species distributed in all three habitats (coral reef, reefs and sandy bottoms): Include 5 species - 12% of the Holothurian, which are *Holothuria (Martensiothuria) leucospilota, Holothuria atra, Holothuria (Metriatyla) scabra, Holothuria martensii, Holothuria (Theleothuria) squamifera*.

From the above analysis, it can be seen that Ha Long - Cat Ba is the place that is favorable for the growth of the Echinoderms. The concentrated distribution of sea cucumbers and starfish on coral reefs, sandy tidal flats is indicative of the potential for the formation of economic areas, source of medicinal herbs.

Some features of biomass and some valuable medicine yards. The biomass of the Echinoderm group is relatively high, accounting for 29% of the total benthic organisms in the Tonkin Gulf, 39% of the Thuan Hai - Minh Hai waters, 51% in Van Phong Bay, Nha Trang. The research results on this group are not much, but have identified some typical communities in the Tonkin Gulf, where the dominant role belongs to the Echinoderm group. This has been confirmed by detailed studies of 11 benthic communities distributed in the Tonkin Gulf. It was found

that community number 2 was located at depths of 60–80 m in the southern part of the bay. Ophiuroidea species are the dominant group in this community. Even at a depth of 100–160 m, located on the outer edge of the continental shelf, the Echinoderm group (Crinoidea, Ophiuroidea) still plays a dominant role in the community. Dozen tons of sea cucumbers were exploited by Co To people every month to serve the food needs of tourists. According to the results of recent studies, the substances that can be extracted from sea cucumbers are resistant to cancer cells [6].

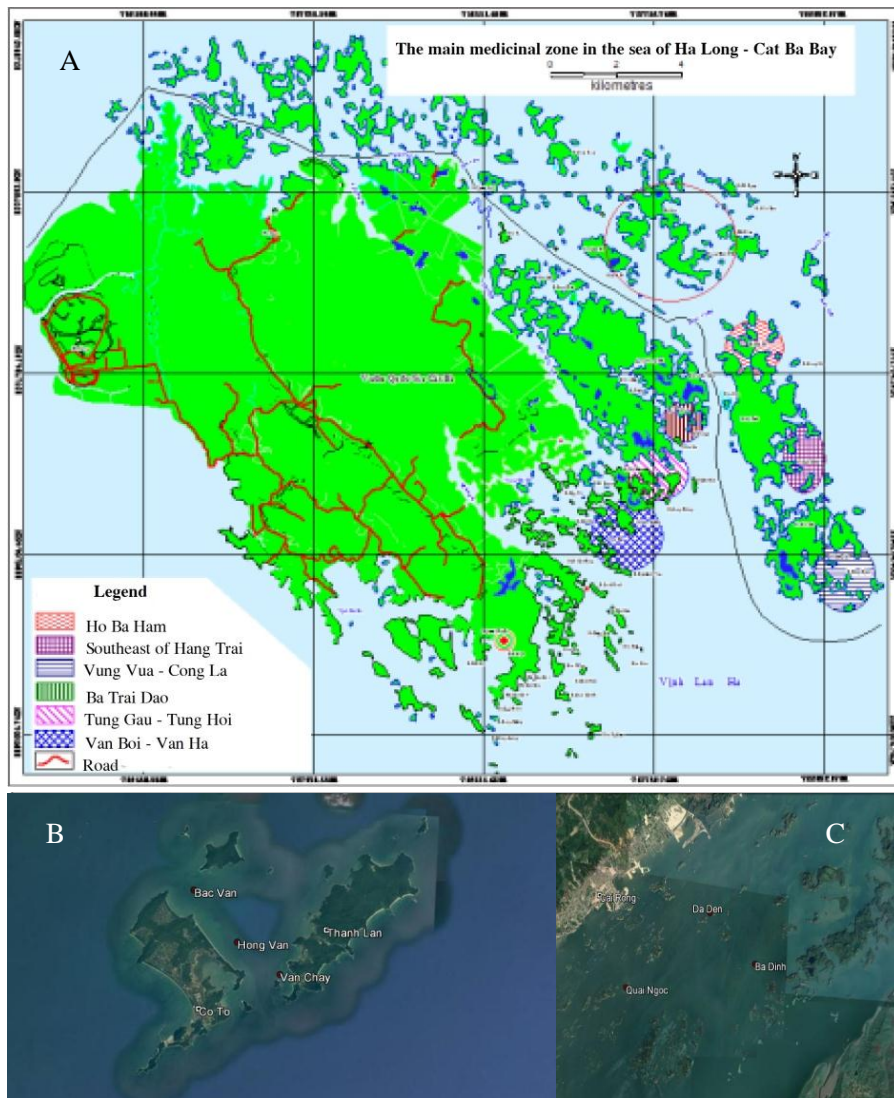


Fig. 3. Diagram of distribution of medicinal herbs in the Northeast of Vietnam, A: Ha Long - Cat Ba; B: Bai Tu Long; C: Co To - Thanh Lan

Many tons of Echinoderms can be exploited, ensuring the need to carry out the extraction of essential substances. Interestingly, there are species that not only contain medicinal herbs, but also thrive, creating large biomass capable of becoming major marine medicinal grounds such as Sea Stars, Holothurians, Sea urchins in Ha Long - Cat Ba (fig. 3A). Van Boi - Van Ha area (Cat Ba island) is also known as starfish medicinal grounds and has an area of about 5 hectares, in which there is the concentration of shallow starfish (*Astropecten polyacanthus*, *A. monacanthus*) with high density (20 individuals/m²) on average reaching 0.3 kg/m² (in March). With this volume, it is possible to estimate temporal stock of 15 tonnes of starfish and a catching capacity of 7.5 tonnes per year. Ground of Sea Star *Anthenea pentagonula* and Cucumber *Holothuria scabra* is identified in Da Den, Ba Dinh and Quai Ngoc (Bai Tu Long bay) (fig. 3B). Ground of Sea Cucumber and Sea Urchins is in Co To (fig. 3C). In addition, Black Holothurian as *Holothuria Martensii* and Sea urchins *Diadema setosum*. Soft Coral, Sea Urchins, Sea Cucumbers are distributed in the area from Bai Hong Van to Khe Trau of the Co To island. Local people exploit from 20 to 50 kg Black *Holothuria vagabunda*, bring on sale, average about 30 kg/day, 900–1,000 kg of sea cucumber per month. Black Holothurian usually lives on coral reefs and tides are fed into sandy beaches. On each section of 50 m long, 3 m wide we obtained from 20 to 30 such Sea Cucumber. Approximately in 5–10 m² a Sea Cucumber is found. In addition to Sea Cucumber, there is also the concentration of the Sea Urchins (*Diadema setosum*). The density of Sea Urchin is high on the coral reefs in Hong Van, even reaches 5–10 individuals per m² at some places. This density allows us to exploit a large number of samples.

CONCLUSION AND RECOMMENDATION

Conclusion. In the waters around the islands of Northeast Vietnam 41 species belonging to 29 genus, 18 families, 10 orders and 5 classes of Echinoderms have been identified. Compared to previous publications, 10 species were first identified in the Tonkin Gulf.

They are distributed in Ha Long - Cat Ba with 33 species and Co To - Thanh Lan with 24 species and Bai Tu Long Bay with 25 species.

Echinoderms live in three habitats: Sand, coral, reef. The highest number of species lives on sandy bottoms and coral reefs with 16 species, accounting for 39% and the lowest number is on coral reef and reef with 4 species, accounting for 10%.

The high concentration areas such as Van Boi, Van Ha, Da Den, Bac Van and Hong Van are likely to become marine medicine yards.

Recommendation. Poverty of the species richness of the families is an indicator of vulnerability of the Echinoderms in Northeast islands in Vietnam. Consequently, there is a need for conservation and sustainable exploitation.

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REFERENCES

- [1] Do Cong Thung, 2014. Zoobenthic survey procedures. Process of investigation and survey of marine resources and environment. *Publishing House for Science and Technology*. Pp. 211–240.
- [2] Zhang Feng Kinh et al., 1964. Echinoderms of China. *Science Publishing House*, 142 p.
- [3] Clark, A. M., 1971. Monograph of shallow-water Indo-West Pacific echinoderms. *Trust. Br. Mus.(Nat. Hist.), Publ.*, **690**, 1–238.
- [4] Coleman, N., 2007. Sea Stars: Echinoderms of the Asia/Indo-Pacific. *Springwood Qld*. 136 p.
- [5] Zulfigar, Y., Sim, Y. K., Tan, S. H., and Shirayama, Y., 2008. Field Guide to the Echinoderms (Sea Cucumbers and Sea Stars) of Malaysia. Kyoto University Press, 103 p.
- [6] Van Minh, C., Dang, N. H., Cuong, N. X., Van Kiem, P., and Huong, H. T., 2007.

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Bioactive constituents from marine organisms inhabiting in Vietnamese sea.

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