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RESEARCH ARTICLE

Reefs and Scleractinian Community to Open Islands the South China Sea of Vietnam.

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Abstract

Studied reefs and coral community of open islands South China Sea of South Vietnam. Differences in the structure and composition of reef communities depending on the morphology of coastal slopes. Shows a rich diversity of corals, more than 200 species and their high degree of similarity with a wealth of hermatypic Scleractinia on other reefs of Vietnam and in general with the reefs of the South-Western Pacific.

Introduction:-

The island Katuik and Ngũ Phung are on the shelf Southeast of Viet Nam in 70-100 km from the coast. The topography of the island is hilly, hilly-with heights of 10-40 m. South-south-west coast of gently sloping and sandy. The destruction of the primary geological landforms by denudation and abrasion led to the formation of the northern and northeastern coast of the form of rocky ridges underwater slope, characterized by the alternation of bedrock ridges and ravines. The underwater slopes are formed as regular reefs with pronounced morphological zoning and low settlements nonstructural coral communities comparable to those coral formations of the Indo-Pacific.

Vietnamese reef-building corals form various reef structures along the seashore and around the islands. They are small adjacent reefs edging the seashore, barrier reefs separated from the mainland (the island of Re and Jiang Bo reef) and atolls (Spratly Islands) in the open part of the South China Sea (Ken, 1991; Yet, 1997; Latypov, 2013). Among the Vietnamese reefs, there is common reefs "true reef framework", and coral settlements "coral gardens" (Vo, Hodgson, 1997; Latypov, 2011).Different calcareous structures formed on the reefs may formed by coral settlements, usually called "coral layers", coral communities or specialized settlements. Such formations usually characterize early stages of reef development, and do not have geomorphic and vertical bionomic zoning (Pichon, 1981; Loya, 1986; Latypov, 1995).All Vietnamese reefs have distinct bionomic and indifferent apparent morphostructural zoning. Peculiarity of geomorphic and climatic conditions includes factors distinctly defining division of Vietnamese adjacent reefs into two types. The first type includes reefs with sharply defined reef zones (lagoon, reef flat etc.) with well-formed carbonate framework, so-called structural reefs (Wainwright, 1965)common for the tropical zone of the World Ocean. The second type of reefs characterized by feebly marked morphostructural zoning up to the absence of some zones. Calcareous deposits on such reefs represented by thin beds of coral settlements that almost do not change substrate profile. They are structureless or crust (Latypov, 1995) reefs. Vietnamese structural reefs are mainly formed in the closed sand bays and on the organogenic foundation of Holocene reefs (Latypov, 1982), amorphous reefs, mostly on the headlands and in the open bays, primarily on the stony and rocky substrates (Latypov, 1986, 2012; Latypov and Selin, 2011). Reefs of Katuik islands as and some other islands in southern Vietnam have been described previously (Latypov and Selin, 2011) therefore consider reefs Islands Ngũ Phung.

Material and methods:-

Distribution of corals was studied using SCUBA and method frameworks and transects (Loya and Slobodkin, 1971). Line transects were laid out a complete profile with the northern and southern sides. From the north-eastern and eastern sides laid three 200-meter transects at depths from littoral to 6 and 42 m (Figure:1). On transects ater compiling a profile and establishing boundaries physiographic zones calculated the degree of substrate coating corals (Maragos and Jokiel, 1976), the number of massive, branchy and incrusting form colonies. Led zonal sampling Scleractinian, Alcyonarian, *Millepora* and *Heliopora*. Only collected about 500 copies of corals; of these, 222 Scleractinian species defined belonging to 62 genera. Similarity of coral communities was determined by Jaccard (Jaccard, 1902).

Results:-

Morphology and zoning

Morphological profiles and constructions of various parties' islands of reef zonation vary (Figure; 2). On the southern, south-western and north-western sides developed strip adjacent reefs with conventional zones for them: lagoon, reef-flat, reef-front slope of reef and by slope platform (Battistini et al., 1975). Shallow lagoon with sandy bottom and fragments of dead coral distributed many algae, among which the rare Alcyonarian and Scleractinian in the form of small spots of monospecific settlements *Seriatopora histrix.*

Reef-flat-frame old reef with many shallow channels perpendicular to the shore is covered with dense settlements *Acropora*, *Porites* (branching), *Millepora, and Montipora.* Distributed channels individual colonies of corals and small bioherms, calcareous algae, frequent sand glades with numerous fragments of dead coral and an organic detritus.

Reef-front presented reefed monolith with numerous shallow alcoves and cavities with frequent colonies, Scleractinian, curtain of *Halimeda* and other algae. Reef slope developed numerous colonies Scleractinian, whip, grouped in the form of bioherms and longitudinally elongated like hill polyspecific settlements of corals.

By slope platform covered with a layer of fragments of dead coral, small isolated bioherms and scleractinian colonies; meet rare accumulations of sea grass.

In the East of the island, coral settlement, submitted by fragmented colonies, sometimes are grouped on 5-7 copies that do not change the bottom profile of the bedrock areas gradually sink as the distance from the shore. coral settlement alternated with strips of macrophytes *Padina, Dictyota* and *Zonaria*. At a depth 36- 40 m, indigenous outputs alternate with sandy sediments of fine an organic detritus. Here distributed quite numerous lamellar scleractinian colonies and a variety of algae.

The northern section of the bottom profile, defined by the peculiarities of geological structure of typical asymmetrical Ngũ Phung Island, alternating parallel ridges and hollows, aimed to shore slope slopes steeper than marine exposure (Figure: 2B). Coral settlements are numerous. They are presented as separate colonies, groups and small bioherms. They cover the low substrate crust spotted almost without changing his profile.

Bionomical feature.

South side Reefs.

Sandy Beach slopes gently to the sea lagoon, where 20-30 m for invasive calving aggregation transects appear separate clumps of algae *Ulva reticulata, Padina australis* and isolated colony whip scleractinian *Seriatopora, Montipora, Acropora, Porites,* and *Goniastrea*. With 50 m of transect number of algae and corals increases. Rare settlements *S. hstrix* (up to 2x2 m) and colony *Acropora palifera*. Are dominated by algae. Get widespread *U. reticulata, Dictiota dichotoma, Padina australis* often found flowering *Halophyla ovalis, Thallassia hemprichii,* calcareous algae *Halimeda opuntia*. Width zone - 80-120 m, depth up to 2 m. Total collected 19 species of scleractinian and one species hydroid *Millepora*. Qualitative (27 species) and quantitatively dominated by phytobenthos.

Reef-flat consists of dead and living corals, calcareous algae, form an organic detritus and rubble of corals. Advanced system for transversal and longitudinal channels, the latter can reach 2-3 m wide and 15-20 m in length. High degree of covering up to 50% of the corals provide a monospecific settlement *Acropora microphthalma, A.*

nasuta, Porites cylindrica, Montipora hispida, M. foliosa, hydroids *Millepora platyphylla*, and *M. dichotoma*, calcareous algae *H. opuntia*. At channels distributed colony and bioherms from *Acropora, Porites* (massive and branching forms) *Seriatopora, Stylophora, Psammocora, Hydnophora, Montipora, Cyphastrea*, and *Pachyseris* quite frequent Faviidae and Fungiidae. Only on the reef-flat collected 26 species of coral. Zone width 120-200 m. In a normal ebb are drained only single protruding parts of the reef.

Reef-front-a narrow strip of old reef, cemented algae limestone with numerous cavities. The coverage of living corals for less than 20%. Here developed individual isolated colonies massive, massively-poppy and incrusting forms *Psammocora, Pocillopora, Stylophora, Acropora, Goniastrea*, and *Porites*. Niches and caverns distributed dense curtains algae, among which stands out the *H*. opuntia numerous sea urchins *Diadema setosum*.

The slope of the reef at the top of the developed system of canals and the spurs with a high degree of substrate coating corals (60-80%), a rich diversity of species and life forms. set in the upper part of the slope is widespread bioherms (Figure: 3), densely overgrown with scleractinian, alcyonarian and calcareous algae cortical like hill polyspecific settlement. the most frequent here scleractinian *Pocillopora, Acropora, Montipora, Porites, Goniastrea, Diploastrea, Platygyra, Fungia, Herpolita, Pachyseris, Lobophyllia, Hydnophora* and hydroid *Millepora* is just 56 species. Of macrophytes most developed *Halimeda, Dictyota, Pocockiella* - in the channels sandy glades – *Halophyla*. Zone width 50-250 m, depths from 1 to 8 m the. Lower part of the slope more depressed. It weakly sloped stretch of bottom is coated with a layer of fragments of dead coral (cylindrical) and organic detritus with a minor admixture of medium sand. Large bioherms densely overgrown with scleractinian, alcyonarian and single gorgonarian. Between bioherms - large separate massive and massively-branching colonies of *Porites, Diploastrea, Hydrophora, Acropora,* and *Leptoria*. With 590 on 645 m of transects - invasive calving aggregation facies *A.palifera*, in which bioherms almost in contact with large colonies of *Porites murrayensis, Leptoria phrygia*, and *A. palifera* . As we move away from shore at a depth of 10-12 m bioherms and individual colonies are becoming rare, sharply reduced the diversity of corals in the area. A total of 54 species of coral collected. From algae encrusting predominate. Coralinacea meet *Halimeda* and *Dyctiota*.

On the for reef platform, entirely covered with a dense layer of fragments of dead coral with an organic detritus and a significant amount of sand, there are scattered colonies *A. palifera, Pocillopora verrucosa, Porites cylindrica, Goniastrea retiformis, Favia speciosa, F. favus, Galaxea fascicularis, Pectinia paeonia*, and *P. lactuca* - just 17 species, and small patches of grass *H. ovalis, T. hemprichii*.

Reefs of the northwest have a similar structure, among scleractinian in the zone of the spurs and channels dominate the plate from a group *Acropora cytherea.*

On the eastern side of the island of corals do not form buildings with express zonality. Here they settled individual or grouped colonies among the many algae. In the coastal part of hard substrate completely covered with algae *Dyctiota, Sargassum, Padina*, and *Turbinaria*, among which the isolated colony *Acropora digitifera, Pocillopora verrucosa*, and *Cyphastrea serailia*. At a depth of 4-6 m (100-200 m from the coastline) algae coverage is reduced, increasing the number and diversity of scleractinian. Is dominated by massive and massively-encrusting form - from 14 to 59 colonies on 10 m^2, sometimes they are grouped under 5 - 7, often 2-3 colonies. Coverage of the substrate corals are extremely uneven and varies from 4 to 64%, in most cases, are within 20-36%. The most common species of *Acropora, Montipora, Porites, Favia, Favites, Platygyra, Galaxea, Lobophyllia, Goniastrea, Hydnophora, Pachyseris, Merulina, Micedium*, and *Echinophyllia*. Just in the zone collected 61 species corals and 18 species of macrophytes. Zone traced at 300 m, noted striping overgrowth of algae in width of 10-20 m.

At a depth of 42 meters on a sandy weakly silty platform with fine, an organic detritus settled quite numerous corals and algae isolated colony scleractinian. Basically flat forms colonies predominate here *Turbinaria, Pachyseris, Micedium, Fchinophyllia, Leptastrea.* Meet *Montipora, Cycloseris, Diaseris,Fungia, Porites, Goniopora, Favia, Plesiastrea* and isolated *Stylocoeniella, Pocillopora*, and *Acropora* — total 41 species. Macrophytes are many and varied (14 species). On the hilly heights (1-1.5 m) they presented thickets of brown algae *Zonaria* sp. Zone traced eastward at 200 m.

On the north side of the island of coral built cover low-spotted rind indigenous rock ridge. Colony, ground scleractinian, milleporas, helioporas and alcyonarian are grouped into numerous specialized polyspecific settlements (Pichon, 1981). It is widely developed bioherms, frequent congestions of *Fungia* quite densely settled, and individual colonies, scleractinian to 5-7 colonies/m^2. Settlements of corals start from underwear modal horizon littoral, presented rare massive cortical and single branched colonies *Acropora robusla, Pocillopora verrucosa, Montipora hispida, Porites lichen, Balanophyllia gemmifera, Dendrophyllia gracilis*, and *M. platyphylla*- total 16 species. Algae of *Caulerpa, Dyctiota* settle in niches.

With a depth of 2-3 m coral settlement become numerous. Dominate up to 200 m for invasive calving aggregation transects *P. verrucosa, M. platyphylla, M. dichotoma, A.cytherea*, and *Heliopora coerulea*, providing 32-76% coverage of the substrate. On ridges, rising to tidal zones, coral coverage can reach 100% of the expense *B. gemmifera, D. gracilis*, and *M. platyphylla*. Scleractinian of the remaining the largest participation in the formation of coral settlements take *Acropora (cytherea, robusta, formosa) Montipora, Seriatopora, Porites, Diploastrea, Favites, Fungia, Pachyseris, Lobophyllia, Symphyllia, Astreopora, Platygyra*, and *Echinophyllia.* Between corals are common algae *Caulerpa, Padina, Spatoglossum, Asparagopsis*, and *Galaxaura* with a clear predominance of *Caulerpa* and *Galaxaura*. Only in the zone collected 71 species of coral is the maximum number for communities on the Islands Ngũ Phung.

Such distribution of settlements of corals and algae can be traced to a depth of 12-15 m at a distance of 300-400 m from the shore. On some sections of predominant proportion changes *Pocillopora, Millepora* and *Heliopora* in seaward side is dominated by *Millepora*. The number of coral decline, decreasing their taxonomic diversity, algae occupy a large area. In the hollows between ridges (depth 15-18 m), sand deposits are observed with fragments of dead coral and an organic detritus. Coral settlement extended to ledges of solid substratum, as individual colonies. There are the most common *Pocillopora, Montipora, Astreopora, Leptoseris, Pachyseris, Goniopora, Caulastrea, Hydnophora, Leptastrea, Lobophyllia, Echinophyllia*, and *Turbinaria* - a total 62 species. An algae are numerous enough *Caulerpa, Padina, Spatoglossum,*and *Amphizoa*.

Discussion:-

The speciation and distribution of scleractinian in different parts of the coast Islands Thu reveals quite a high degree of similarity (Figure: 4). Despite differences in morphology, zonation, dominant species and life forms, north and east sides have 56.84% of common species; eastern and southern-71.72%. More than a quarter of the species composition of corals (28.14%) common to buildings on all sides of the island. There are, however, particularly in the distribution of corals. Therefore, just on the southern side of developed settlements monospecific *Stylophora, Acropora*, and *Porites*, were occupying large areas. Settlements of *Heliopora*, numerous on the north side, rare on the south and almost absent on the east side, as well as *Millepora*, which are widely settled in the north and the south.

Coral composition varies considerably for different zones. If the number of common species between the sides of the reef has changed less than 1.5 times between zones is different at 3.4 times. Most of the first corals are in coastal areas, with not more than 25% of the total species from other areas. It is interesting to note that, despite comparable wealth of species in different locations of coral east side settlements (31 and 51 species), they have only 19.5% of the total species. Depth 36 m, separates these coral settlement, specifies the conditions that make such different their species compositions. Similar to species diversity (44-65) coral settlements north and south sides at depths of 6-18 m depths are characterized by a high degree of similarities-from 42 to 51% of common species.The coral community examined island have from 67 to 82% of common species with established throughout the Southwest Pacific.

Fringing reefs island Ngũ Phung on morphology, the degree of development of coral structures, qualitative and quantitative composition of corals are comparable to other reefs of South Vietnam and Indo-Pacific (Latypov, 1982, 1987, 2011; Dai, 1993; Vo and Hodgson , 1997). From 222 installed on Ngũ Phung island 80 species - 83% is common with the rest of the Vietnamese reefs. Along with developed reef, with a clear physiographic zonation, with east and north around the island built the middle stage of development, different predominant development of massive forms of corals and wordless zoning.

The same features of a structure of similar zoning with each zone communities of algae and corals, wide development bioherms with domination *Acropora palifera, Porites cylindrica, Millepora dichotoma*, and *Heliopora*

coerulea author observed on the western side of Coëtivy Island (Latypov, 2009). A similar feature other Seychelles reefs result Taylor (Taylor, 1968), Rosen (Rosen, 1971), ~~Pillai, etc~~. (Pillai et al., 1973).

Summing up,it should be noted that the reef with moderate or weak anthropogenic load, and even more so in places where environmental measures taken remain satisfactory or even optimum conditions for existence of reef communities. These reefs are characterized by a high degree of substrate coverage live corals, rich in species for both hermatypic corals and related fauna, including fish. Example serve as reefs of Che, Honnaj, Honden in Khanh Hoa province and under the protection of the State, as well as reefs, the Spratly archipelago Bat′longvi (Veron, 1995; Vo et al., 1997; Yet and Ken, 1997; Latypov, 2008) and, as evidenced by the results of the study of Con Dao Islands, ecosystem which is not subject to any explicit human impacts, including mariculture farms.

Explanation and legends of figure

Figure: 1. Island NgũPhung and location of transects(white lines)

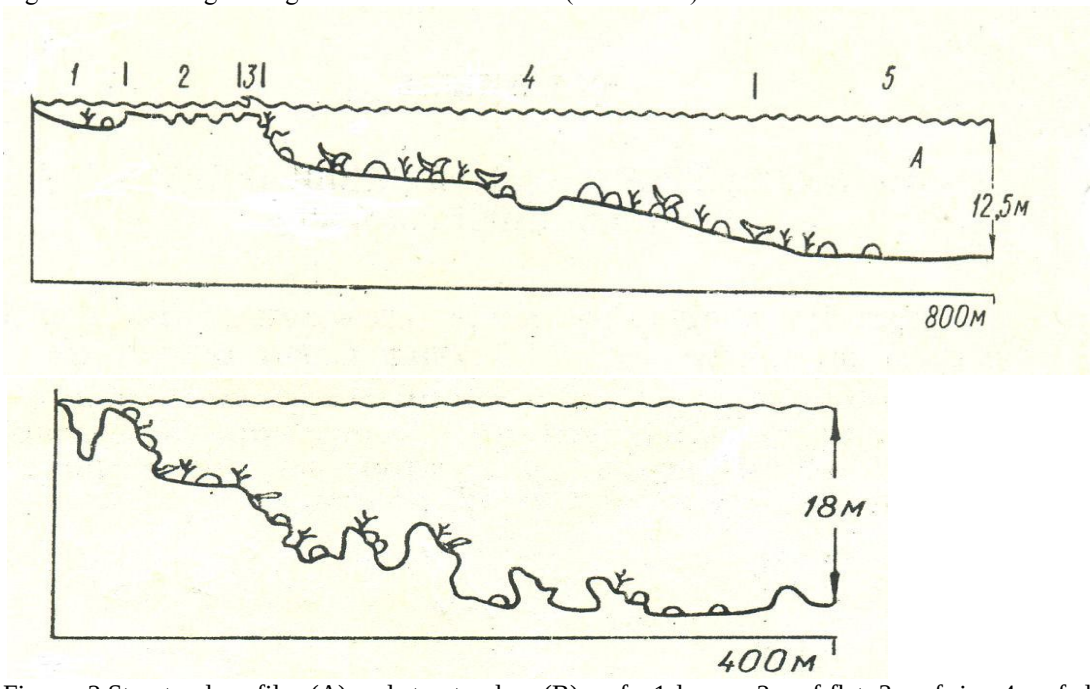

Figure: 2.Structural profiles (A) and structureless (B) reefs, 1-lagoon 2-reef flat, 3-reef rim, 4-reef slope, 5-pre reef platform

Figure: 3.The appearance of bioherms, depth 6 m

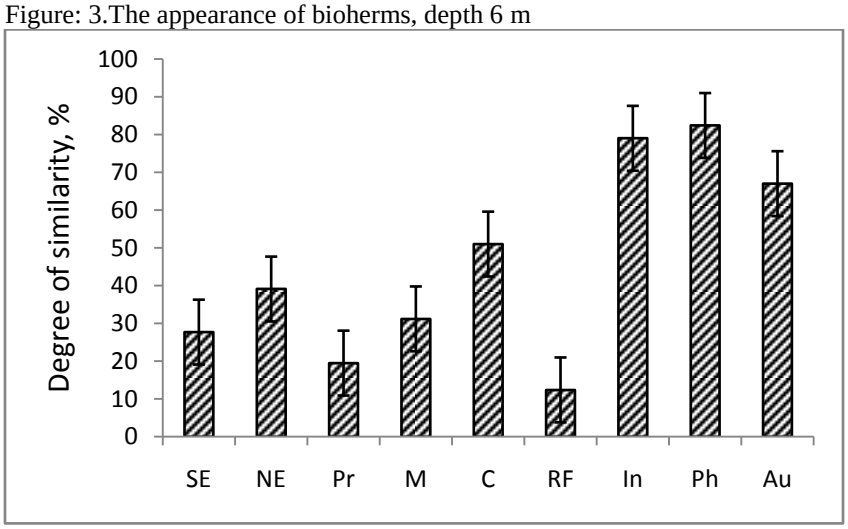

Figure: 4.Similarity chart various coral reef communities. SE-South-East, NE-North-East, Pr-different sides of the island, M- Macrophytes, C- corals, RF-Reef flat and reef front; the similarity of complex corals NgũPhung and In-Indonesia, Ph-the Philippines, Au-Australia

References:-

1. Battistini, R., Bourrouilh, F., Chevalier, J. P., and al., (1975):Element de terminologierecifaleindopacifuque. Tethys. Marseille., 7:111 p.
2. Dai, C.E. (1993): Patterns of Coral Distribution and Benthic Space Partitioning on the Fringing Reefs of Southern Taiwan. Marine Ecology, 14: 185-204.
3. Jaccard, P. (1902):Dois de distribution flovaledans la zone alpine//Bull. Soc. Vaudoise Sci. Nat., 38: 69-130.
4. Ken,L.V.(1991):Stony corals and the coral reefs of Catba islands, Marine Environment and Resources,Sci.Tech.Publ.House.Hanoi, 144-151.
5. Latypov, Yu.Ya.(1982): Species composition and distribution of scleractinians in reefs of the Khanh Hoa province (South Vietnam). Biol.Morya, 6: 5-12.
6. Latypov, Yu.Ya.(1986): Coral communities of the Namsu islands (Gulf of Thailand). Mar.Ecol.Progr.Ser., 29: 261-270.
7. Latypov, Yu.Ya. (1987): Species composition and distribution of Scleractinian in Islands Socotra.Biol.moray.,4:35-41.
8. Latypov, Yu.Ya.(1995): Community structure of scleractinian reefs in the baitylong archipelago (south china sea). Asian Mar.Biol., 12:27-37.

9. Latypov, Yu.Ya. (2008):Species Composition and Structure of Coral Community of a Platform Reef at Bach Long Vi Island in the South China Sea. Russian J. Mar. Biol., 34(4): 249–253.
10. Latypov, Yu.Ya. (2009):Species Composition and Distribution of Scleractinians on the Reefs of the Seychelles Islands.Russian J. Mar. Biol., 35(6): 454–462.
11. Latypov, Yu.Ya.(2011): Scleractinian corals and reefs of Vietnam as a part of the pacific reef ecosystem, Open J.Mar.Sci., 1: 50-68.
12. Latypov, Yu.Ya.(2012).Encrusting protected reef Hon Nai in Cam Ranh bay in the South china sea. Natural Science.,4: 14-21.
13. Latypov, Yu.Ya.(2013):Barrier and platform reefs of the Vietnamese coast of the South China Sea. Int. J. Mar. Sci., 3(4): 23–32.
14. Latypov, Yu.Ya.andSelin,N.I. (2011): Current status of coral reefs of islands in the Gulf of Siam and southern Vietnam. Rus. J.Mar.Biol., 37: 246-253.
15. Loya, Y. (1976): Effects of water turbidity and sedimentation on the community structure of Puertorican corals, Bull.Mar.Sci., 26: 450-466.
16. Loya, Y. and Slobodkin, L. (1971): The coral reefs of Eilat (Gulf of Eilat).Symp.zool. Soc. Lond., 28: pp. 117-140.
17. Maragos, J. E. andJokiel, P. L. (1976): Reef corals of Canton Atoll: 2-lockal distribution.An environmental survey of Canton Atoll lagoon. Naval Undersea Res., NCV. 395: pp. 1-192.
18. Pichon, M. (1981): Dynamic aspects of coral reef benthic structures and zonation. Proc. Fourth Intern. Coral Reef Symp., 1: pp. 581-594.
19. Pillai,C.S.G., Vine, P. J.and Scheer, G. (1973): BerichtiibereineKorallensammlung von den Seychellen. Zool. Jb. Syst., 100: 451—465.
20. Rosen, B.R. (1971): Principal features of reef coral ecology in shallow water environments of Mahe, Seychelles. Symp. Zool. Soc. London., 28: pp. 163-183.
21. Taylor, J.D. (1968): Coral reef and associated invertebrate communities (mainlvmollusran) around Mahe, Seychelles. Phil. Trans. Roy. Soc. London., 254: pp. 129- 206.
22. Veron J.E.N.(1995): Corals in space and time: the biogeography and evolution of the Scleractinia.Townsville: Austral. Inst. Mar. Sci., 321 p.
23. Vo, S.T. and Hodgson, G. (1997): Coral reefs of Vietnam: Recruitment limitation and physical forcing. Paper presented, Int.Coral Reef Symp., 1: 477-482.
24. Vo, S.T., Yet, N.H.and Alino P.M.(1997): Coral and coral reefs in the north of Spratly Archipelago – the results of RP-VN JOMSRE-SCS 1996. Proc. Sci. Conf. RP‑VN JOMSRE-SCS 96. Hanoi, 22–23 April. 1997., pp. 87–101.
25. Wainwright,S.A.(1965): Reef communities visited by the Israel south red expedition, Bull.Sea Fish.Res. Stn.Israel.,38: 40-53.
26. Yet, N.H. (1997); ThánmPhánLoàiHôCúngVàCáuTrúc Ran San HôàoThuyênChài (QuânàoTruòng Sa), Tai NguyênVàMôi Truong Biên, Hanoi.,4: pp. 299-313.
27. Yet, N.H. and Ken, L.V. (1997): Characteristics of scleractinian communities in the Son Tra Island (ThuaThien-Hue Province). Tai NguyênVàMôi Truong Biên.Hanoi., 4: pp. 314–327.