

**RUSSIAN CONTRIBUTIONS TO STUDIES OF VIETNAMESE BIVALVE
MOLLUSCS. PART 1.
HISTORICAL AND BIBLIOGRAPHICAL REVIEW
WITH EMPHASIS ON FAUNAL STUDIES**

Konstantin A. Lutaenko

*The Institute Museum, Institute of Marine Biology, Far East Branch of the Russian
Academy of Sciences, Vladivostok 690041, Russia*

ABSTRACT

A review of the Russian literature containing information on Vietnamese bivalve mollusks is presented. The history of research, main expeditions and collections obtained in coastal waters of Vietnam since 1960s are briefly described; maps of sampling stations of Russian research vessels are included. The paper emphasizes faunal studies, although information on ecological, genetic and developmental biology studies is also provided. A total of 40 papers on different aspects of malacology or containing bivalve molluscan names were published during last 30 years.

**MORE THAN A CENTURY OF
MOLLUSCAN STUDIES**

The bivalve molluscan fauna of the South China Sea - the biggest sea in the World Ocean - is still insufficiently studied. The most comprehensive monograph by Tchang *et al.* (1960) is outdated and is written in the Chinese language, which makes difficult its use as a taxonomic guide. A number of Chinese papers published in the 1950-1990s contain records of species from the South China Sea (a brief review see in Scott, 1994, and bibliographies in Bernard *et al.*, 1993, Zhuang, 1992, and Xu, 1997) and share some species in common with Vietnamese fauna. The Vietnamese national literature is scarce, and published textbooks are dealing with selected species (Nguyen Chinh, 1996).

Bivalve mollusks of Indo-China and Vietnam itself were studied by French malacologists in the second half of the 19th century and until World War II. They pub-

lished several key papers, which are still a major source of faunal information (Crosse & Fischer, 1889; 1890; Dautzenberg & Fischer, 1905; Fischer, 1891, etc.). Many taxonomic revisions of the French authors (E. Lamy, E. Fischer-Piette and others) based on collections of the Muséum National d'Histoire Naturelle in Paris contain Vietnamese records.

The next stage of Vietnamese malacology began with two Soviet-Vietnamese expeditions undertaken by the Pacific Research Institute of Fisheries and Oceanography (Vladivostok) in 1960 and 1961 in accordance with intergovernmental agreement. The first expedition headed by Dr. N.A. Zarenkov worked for around a year using the R/V *Orlik* (Zarenkov *et al.*, 1963), and all collections of bottom animals were deposited in the Department of Zoology of Moscow State University, but I saw a number of molluscan specimens in the Zoological Institute, Russian Academy of Sciences (until 1991 - USSR Academy of Sciences; hereafter ZISP; St.-Petersburg). The expedition of 1961 was carried out in Tonkin (Beibu) Gulf with participation of staff members of the ZISP Prof. E.F. Gurjanova and Dr. N.L. Tzvetkova who published later detailed descriptions of the bottom fauna and communities, including species lists as well as data on the distribution and abundance of common species of bivalves (Gurjanova, 1972; Gurjanova & Chang Hiu Phuong, 1972a,b; Tzvetkova, 1972). The second (1961) expedition sampled the entire area

of Tonkin Gulf and collected zoological materials from 105 stations in the depth range from 18 to 157 m (R/V *Pelamida*), and in the western part of the bay from 5 to 30 m (51 stations; R/V *VD-12*) (Figs. 1-2; see also: Gurjanova, 1962). All molluscan collections of this expedition are stored in the ZISP and they were subsequently treated in the 1960s-1990s by several Russian malacologists including study of cephalopods (Khromov, 1988).

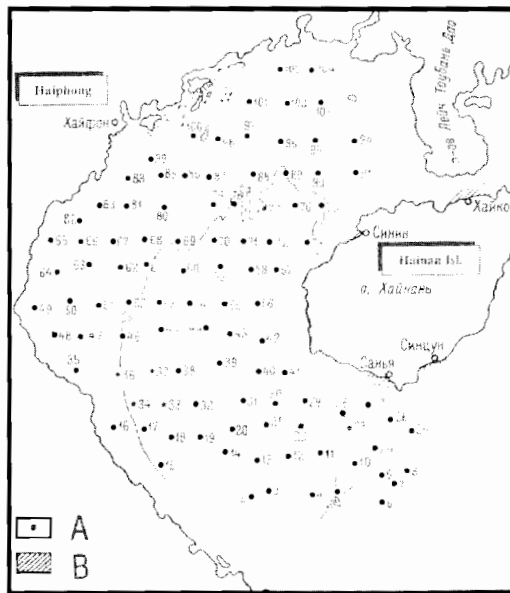


Fig. 1. Sampling station of the R/V *Pelamida* in Tonkin Gulf (1961). The map was originally reproduced in Gurjanova (1972). A - subtidal stations, B - intertidal areas studied.

The Soviet-Vietnamese joint studies of the biology of coastal waters were renewed in the 1980s owing to collaboration of the Institute of Marine Biology, Far East Branch of the USSR Academy of Sciences (hereafter - IMB; Vladivostok) and the Institute of Marine Research, National Research Centre of Vietnam (now Institute of Oceanography) (Zhirmunsky & Le Trong Phan, 1988). These studies were conducted using large research vessels *Kallisto* (1981), *Berill* (1981,

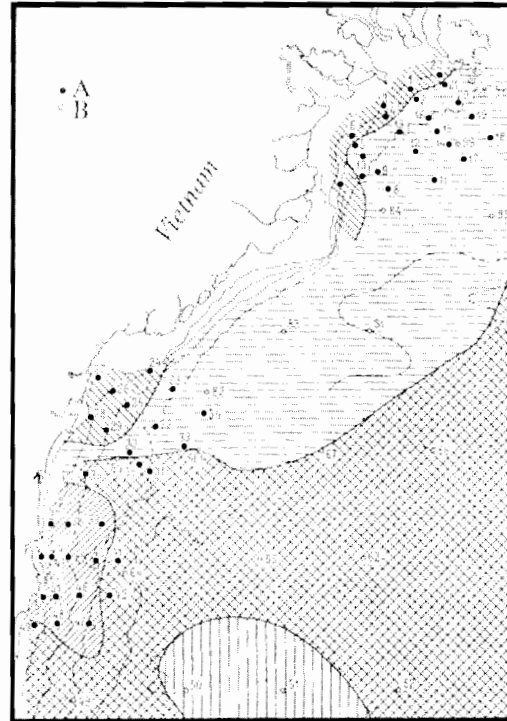


Fig. 2. Sampling stations of the R/V *VD-12* and *Pelamida* in the western part of Tonkin Gulf (1961). Shading areas show distribution of different bottom communities. The map was originally reproduced in Tzvetkova (1972). A - stations of *VD-12*, B - stations of *Pelamida*.

1984), *Academik Aleksandr Nesmeyanov* (1984, 1986, 1987) and *Professor Bogorov* mainly in southern Vietnam, the Gulf of Siam (Gulf of Thailand) and partly in Tonkin Bay. Several coastal expeditions were also made before 1989. In these studies, special attention was paid to bivalve mollusks as an abundant and commercially important group of intertidal and subtidal animals, primarily to their biology, ecology and reproduction (Malakhov *et al.*, 1985; Zhirmunsky & Le Trong Phan, 1988).

Molluscan collections were made in the central part of Vietnamese coast during 1988-1991 by the Soviet-Vietnamese Tropical Centre (Gogolev, 1994) but the location of these samples is unknown to us. Most likely, they were deposited in some institu-

tions or museums in Moscow.

Below is a brief review of different aspects of molluscan research by Russian malacologists and related scientists with emphasis on faunal and biogeographical studies. In the second part of this paper, precise list of species recorded in Russian works are presented.

FAUNAL, BIOGEOGRAPHICAL AND TAXONOMIC STUDIES

The most important Russian contribution to studies of the benthic fauna of Vietnam was Gurjanova's (1972) paper dealing with the fauna of Tonkin Gulf and its ecological and biogeographical features. She (Fig. 3) compiled a list of species found in this area by II Soviet-Vietnamese expedition (1961), the



Fig. 3. Professor Eupraxie F. Gurjanova 1902-1981. Reproduced from the frontispiece of the jubilee issue of *Issledovanya Fauny Morei* (Explorations of the Fauna of the Seas, 1972, vol.10) dedicated to E.F. Gurjanova.

Soviet-Chinese expedition to the western coast of Hainan Island (1959) and those mentioned in two previous lists by Serène (1937) and Dawydoff (1952). Her list included 104 bivalve species (among them 18 identified to the genus level). All species were identified by Russian malacologist O.A. Scarlato who performed also in the 1960s a faunal and taxonomic revision of the Chinese Tellinoidea (Donacidae, Psammobiidae, Scrobiculariidae and Tellinidae), based on Chinese and Russian collections mainly from the Yellow Sea and Hainan Island (Scarlato, 1965). A detailed description of the Hainan expedition and a map of sampling areas are given by Gurjanova (1959). Examination of catalogue cards of the ZISP reveals that Scarlato studied part of the Vietnamese materials.

Gurjanova (1972) showed that the fauna of Tonkin Gulf situated in the tropical zone bears typical tropical features, but it is impoverished due to "subtropical" conditions, i.e., pronounced seasonality and winter cooling of the water masses down to bottom. These "negative features" of the Tonkin Gulf fauna were illustrated by the example of bivalve mollusks (Gurjanova, 1972, pp. 85-86, 89), and can be summarized as follows:

1. *Absence of some common tropical faunal elements in Tonkin Gulf fauna.*

Mytilus smaragdinus (= *Perna viridis*) (Mytilidae) was not found in expedition samples, while it is commercially important and abundant species in the Gulf of Thailand and southern Vietnam. Typical Indo-West Pacific bivalves of the family Tridacnidae - three species of the genus *Tridacna* - were found only on the southern coast of Hainan Island, but not on the Vietnamese coast, and the genus *Hippopus* is completely absent even in Hainan fauna. Because of weak development of coral reefs, a few species of coral borers were found, and impoverished composition of the genera *Chama* (Chamidae), *Spondylus* (Spondylidae) and *Ostreidae* was

established (for instance, among ostreids only five species occur on the Vietnamese coast, while in Hainan Island there are 17 species). Gurjanova (1972) also noted rare occurrence of *Chlamys* and *Pecten* (Pectinidae) on the Vietnamese side of the gulf.

2. Difference between the fauna of southern Vietnam and Tonkin Gulf

About 170 species of Bivalvia were recorded for southern Vietnam based on different sources and 101 species - for Tonkin Gulf (Gurjanova, 1972, p. 89; but the list on pp. 78-80 includes 104 species). The same regularity was established for gastropods. Gurjanova (1972) explained the impoverished character of Tonkin Gulf fauna by the strong variability of hydrological factors and water mass dynamics, complicated and unstable circulation system with strong tidal currents.

Six types of distributional ranges of bottom fauna species inhabiting Tonkin Gulf were recognized taking into account bivalve species also (Gurjanova, 1972; all species names here are given in original spelling):

Type 1 distribution

Pan-Indo-Pacific species widely distributed from the eastern coast of Africa eastward to islands of the central part of the Pacific Ocean, northward to southern Japan and southward to Australia (*Paphia lirata*, *Ostrea echinata*, *Ostrea mordax*, *Modiolus watsoni*, *Arca tortuosa*, *Amussium pleuronectes*, *Clausinella thiara*, *Placuna placenta*, *Meretrix meretrix*, *Malleus albus*).

Type 2 distribution

Eastern elements, or Philippine-Malayan West-Pacific species distributed in the western tropical Pacific Ocean; the center of their development - shallow waters of the Malayan Archipelago and Philippine Islands (*Pedalion isognomum*, *Venerupis philippinarum*, *Clausinella calophyla*,

Modiola philippinarum, *Beguinia semiorbiculata*).

Type 3 distribution

Western Atlantic-Indian elements, or species distributed in the Indian or Indian and Atlantic Oceans and spreading eastward to Indo-China and Malayan Archipelago (*Donax faba*, *Donax cuneatus*).

Type 4 distribution

Sino-Japanese elements, or species distributed in southern Japan and along the continental coast of China, southward spreading to the eastern shelf of Indo-China (*Clausinella isabellina*, *Asaphis dichotoma*, *Aloidis erythron*, *Sanguinolaria castanea*, *Sanguinolaria inflata*, *Abrina magna*, *Tellinides chinensis*, *Arca subcrenata*, *Isocardia vulgaris*, *Dosinia gibba*, *Cyclina sinensis*, *Amussium japonicus*, *Ostrea rivularis*, *Gomphina aequilatera*).

Type 5 distribution

Atlantic-Mediterranean elements are recognized based on polychaete fauna with reference to possible existence of such ranges in mollusks.

Type 6 distribution

Sino-Vietnamese elements, or species distributed in the north-western part of the South China Sea (southern China - Hainan Island and Guangdong Province) and Tonkin Gulf: the only possible endemic species of Vietnam is known - *Isocardia vulgaris*.

Based on the analysis of distributional ranges of bottom fauna species, Gurjanova (1972), in her biogeographical scheme, placed Tonkin Gulf into the "Hainan Province of the Sino-Japanese Subregion of the West-Pacific Region of the Indo-West Pacific Superregion".

The study of the Vietnamese and Chinese molluscan collections of the ZISP was continued by I.P. Zorina [1928-1995], who published three papers dealing with the ecol-

Table 1.
Biogeographical groups.

	Number of species	% of the species
1. Indo-West Pacific species in the broadest sense	20	14.3
2. Indo-West Pacific species (without Oceania)	29	20.7
3. Indo-West Pacific species with disjunct distributional ranges	8	5.7
4. West-Indian - Western Pacific species	16	11.5
5. West Pacific (including Oceania) species	3	2.2
6. Japanese-Malayan species	15	10.7
7. Philippine-Malayan species	10	7.1
8. Chinese-Australian species	14	10
9. Chinese-Japanese species	19	13.5
10. Conventional endemics of Tonkin Gulf	6	4.3

Table 2.

A.			
Tropical species proper		161 species	45.9 %
Tropical-subtropical species		190 species	54.1 %
B.			
Circumtropical species		7 species	2.2 %
Widely distributed Indo-West-Pacific species		143 species	40.8 %
Species distributed in the eastern part of the Indo-Pacific and penetrating as far westward as Bengal Bay		144 species	41.0 %
Species distributed in China and Japan		42 species	11.8 %
Possible endemics of Tonkin Gulf		15 species	4.2 %

Table 3.

Pattern of distribution	Number of species	Temperature tolerance	Temperatures of optimum
1. Species distributed northward to Sagami Bay in Honshu with extreme points in New Zealand, Tasmania or South Africa	168 (88.4 %)	5° to 29°C	22° to 25°C
2. Species with distributional ranges of the above type but with Yellow Sea included	16 (8.4 %)	5° to 29°C	22° to 25°C
3. Species distributed northward to low-boreal (temperate) waters	6 (3.2 %)	-1-0° to 20°C	15-20° to 17-22°C

ogy, distribution and taxonomy of Tonkin Gulf bivalve fauna (Zorina, 1975; 1978a;b). In total, she identified 351 species belonging to 150 genera and 49 families (Zorina, 1978a), but complete species list has never been published except for the enumeration of 140 species from 7 selected families (Zorina, 1975). However, Zorina prepared a card catalogue of the studied collection (see second part of this paper). Based on mentioned 140 species of the families Donacidae, Veneridae, Mactridae, Psammobiidae, Tellinidae, Solecurtidae and Semelidae, Zorina (1975) subdivided Tonkin Gulf fauna into 10 biogeographical groups (Table 1).

Separate analysis of the fauna of the intertidal zone (74 species) and subtidal zone (66 species) showed that species compositions of both zones are close to each other in biogeographical characteristics, however, some differences between these bathymetric areas are found. Among subtidal inhabitants, species widely distributed in the Indo-Pacific in its eastern part or in the western Pacific Ocean are predominant (61%), while only 49% of the intertidal fauna has such distributional ranges. Among intertidal species, the share of mollusks whose distribution is limited by coasts of China and Japan is higher (16%) as compared to subtidal fauna (10%). Zorina (1975) stated that there is no sharp difference in biogeographical composition of the intertidal and subtidal faunas because of absence of purely intertidal genera and a significant role of planktonic larvae in the dispersal of bivalve mollusks. Biogeographical processing of the entire fauna of Tonkin Gulf and Hainan Island led to the conclusion about predominance of tropical species (132, or 94%), i.e., distributional ranges of these species lie exclusively in tropical waters. Seven species (5.3%) reach to southern Japan and the Yellow Sea, and, thus, can be regarded as tropical-subtropical, and one species (0.7%) - *Mactra quadrangularis* (= *M. veneriformis*) penetrates also into the low-boreal (temperate) area of the Sea of Japan in its north-

western part. It was found that 73 species (or 52.1%) of the Tonkin Gulf bivalve fauna are known from the Indian Ocean.

Comparison of the Tonkin Gulf fauna with those of the Philippine Islands and Japan showed that the former one is 2.5 times poorer than Philippine fauna, but, at least, 1.3 times richer than Japanese fauna. There is a great difference between intertidal faunas of the continental and island (Hainan) coasts of Tonkin Gulf: Hainan Island fauna is two times richer in species. So, Zorina (1975) confirmed the conclusion of Gurjanova (1972) about the impoverished character of Tonkin Gulf fauna caused by the specific hydrological regime (low winter temperatures and high freshening). Nguyen Van Chung and Dao Tan Ho (1995) established that the number of zoobenthic species found in Tonkin Gulf is about 20% of the total Vietnamese fauna, and the diversity of species increases from north to south.

It should be noted that the biogeographical analysis performed on the basis of 351 species identified by Zorina (1978a) yielded different figures (Table 2), especially concerning to the share of typical tropical species (45.9%), which is much lower as compared to the results of consideration of seven selected families (94%).

Zorina (1978a) also subdivided tropical-subtropical species inhabiting Tonkin Gulf into the three groups and calculated (based on the method of Golikov and Scarlato, 1973; Scarlato, 1977) tolerance temperatures and optimum temperatures for these species (Table 3).

As for areas situated south of Tonkin Gulf, the faunal information in Russian literature is scarce. Malakhov et al. (1985) mentioned that about 150 species of bivalves were identified in collections taken by the expedition aboard the R/V *Berill* in 1984, but this list was not published. However, in a couple of papers dealing with hydrobiological descriptions of coral reefs and soft bottom communities, biofouling communities and in some papers describing the ecology of individual

species of mollusks, there are records of bivalve species which we extracted in order to compile a total list presented in the second part of this paper.

Gogolev (1994) undertook an attempt to discuss molluscan faunal properties of the central Vietnamese coast. In his list, only 14 species of bivalves are presented. He stated that central region is similar in species diversity (as exemplified mostly by gastropods) to southern region known as the most rich in terms of the number of species. This is explained by the good development of coral reefs and by the similarity of hydrological conditions.

Gogolev (1994) found three species of the genus *Tridacna* (*T. squamosa*, *T. crocea* and *T. maxima*) in the Nhatrang area, but was unable to record species of *Hippopus* despite special search, while the latter species were registered for Annam by Serène (1937). This might be related to decreasing coral reefs areas (Gogolev, 1994).

Evseev and Lutaenko (1998) analysed the anadarine (Arcidae) fauna of Vietnam based on the above-mentioned collections from Tonkin Gulf (ZISP) and southern Vietnam (now stored in the Institute Museum, IMB, hereafter MIMB, and the Zoological Museum of Far East State University - ZMFU, both at Vladivostok). A total of 20 species were found in Vietnamese fauna. The list of Vietnamese anadarines bears close resemblance to that of southern China except for three species (*Anadara broughtoni*; *Anadara inaequalis*, and *Anadara indica*), but they were found previously in the Chinese coast of Tonkin Gulf (Cai & Zhang, 1988). Some differences in the anadarine faunas of central/southern and northern Vietnam are evident - at least, five species were not found in southern Vietnam, and the similarity of the Gulf of Thailand and Tonkin Gulf anadarines is 50 % of combined list. So, there seems to be an opposite trend in the distribution of species of this subfamily along the Vietnamese coast: in moving from north to south, species diversity gradually or sharply

decreases, which may be explained by the insufficient material studied. In general, the fauna of Vietnamese anadarines can be regarded as being typical Indo-Pacific and there are no endemic species in Vietnam (Evseev and Lutaenko, 1998).

Russian authors also contributed to the taxonomy of Vietnamese bivalves apart from faunal studies proper. At least, Scarlato (1965) described one species of tellinoids (Semelidae) of the genus *Abrina*. Zorina (1978b) described nine new species of the genera *Phacoides*, *Pillucina*, *Codakia* (Lucinidae), *Pitar* (Veneridae), *Diplodonta* (Ungulinidae), *Raeta* (Mactridae), *Moerella* (Tellinidae) and *Gari* (Psammobiidae). Subsequent workers rarely cite these species and they are needed in revision based on the type materials whose photographs we give here (Appendix of the second part of this paper). One species of the genus *Anadara* (Arcidae) - *A. kafanovi* - was described by Lutaenko (1993) from Tonkin Gulf, its holotype is stored in ZMFU and was illustrated in Darkina & Lutaenko (1996).

ECOLOGICAL, GENETIC AND DEVELOPMENTAL BIOLOGY STUDIES

Autecological studies of some bivalve species belonging to the families Arcidae, Mytilidae, Tridacnidae and Teredinidae were carried out during expedition works of the IMB in 1980s by several workers. Special attention was paid to biology and ecology of a commercially important mytilid, the green mussel *Perna viridis*. Evseev (1989) described its shell morphology and compared two other species of the genus, *Perna indica* and *Perna canaliculus*, illustrating with original drawings of internal and external shell surface and structure of the anterior part of the shell. Malakhov and Blinov (1988) and Blinov et al. (1989) studied settlements of *P. viridis* in the Phukhanh Province on natural and artificial substrata including biomass and population density, size

and sex structure, and size-weight ratio during ontogenesis. The high density reaching 2000 specimens per square m and biomass of 80 kg per square m was found in Thuytrieu Lagoon, and this area was proposed for experimental cultivation of this species. Evseev and Tran Dinh Nam (1989) investigated in detail the morphology and ecology of another mytilid, *Lithophaga nasuta*, in the Gulf of Thailand, and described the encapsulation of postlarval stage, the process of boring into living corals, the orientation of boreholes, and the size-frequency distribution of mollusks. Selin (1989) undertook a study on the distribution, population structure and growth rates of the common ark shell, *Arca ventricosa* (Arcidae), in the subtidal zone of Trong Island (Namzu Islands, Gulf of Thailand). In this area, *A. ventricosa* inhabits massive coral forms, commonly of the genus *Porites*, with highest population density of 36 specimens per square m. Selin and Latypov (1990) studied distribution and growth of *Tridacna crocea* (Tridacnidae) on the reefs adjacent to Kondao Islands. The tridacnid occurs mainly near colonies of massive corals (*Porites*, *Lobophyllia*, etc.), with maximum depth limit of 8 m; the mean population density and biomass were 1-5 individuals per square m and 307-1745 g per square m, with maximum values of about 70 individuals per m and 17 kg per m. Local differences in growth rates and shell form were established, and it was suggested that *T. crocea* plays an important role in the formation of communities and in the processes of bioerosion and sedimentation on coral reefs of Vietnam.

Yakovlev (1989) demonstrated some peculiarities of the morphology and ecology of an undescribed wood-boring bivalve belonging to the genus *Zachisia* (Teredinidae), which was considered earlier to be monotypical. The species was discovered in the roots of sea-grasses in 1982 near Nha Trang City. Although a description of morphology of the bivalve was provided, no species name was

given.

A few genetic studies of bivalve mollusks have been carried out in Vietnam by Soviet researchers. Kartavtsev and Pham Thi My (1989) analysed variability and differentiation of populations of *P. viridis* in coastal waters of Phukhanh Province, and Manchenko (1989) studied intraspecific allozymic variations for 27 invertebrate species including two pteriids, *Pinctada margaritifera* and *Pinctada nigra*.

Researches in developmental biology have been devoted to various embryological aspects of bivalve mollusks from southern Vietnam. In January-February 1986 in four areas (Nha Trang, Kondao, Phuquok-Anthoi, and Thotu (Tho Chu) Islands) Kasyanov *et al.* (1989) investigated reproductive state of 50 species of bivalve molluscs belonging to 17 families and discussed various patterns of reproductive biology. Naidenko (1989) studied induction of spawning and larval development (up to the veliger and veliconcha stages) of *Tridacna squamosa* (Tridacnidae) and *Limaria fragilis* (Limidae). Kryuchkova (1989) described the structure of veliconcha stages of 10 genera from 10 families. The material was collected in Nha Trang Bay and was illustrated with original drawings of larvae; she presented data on the morphology of larva of *Neilonella coix* (Malletiidae), which was described for the first time, paying special attention to hinge structure. Kulikova (1989) presented data on the qualitative and quantitative distribution of bivalve larvae in January-March 1986 (8th cruise of R/V *Akademik Aleksandr Nesmeyanov*) in the areas of Nha Trang, Kondao, Phuquok, Anthoi and Tho Chu Islands. This information included density of larvae, their species or generic composition (but mostly identified to family level), and vertical distribution. Yakovlev (1989) described the reproduction of a new species of *Zachisia* with extreme sexual dimorphism, which involves the participation of dwarf males.

Very general data on the reproduction and

distribution of larvae of bivalves are given in a brief preliminary report by Malakhov *et al.* (1985).

The use of biogeochemical methods in study of age and growth of *Pinna fumata* (Pinnidae), *Pecten plica* and *Amusium pleuronectes* (Pectinidae) was demonstrated by Dorofeeva *et al.* (1987) and Pozdnyakova & Silina (1989), who investigated variations in magnesium, strontium and sodium concentrations in the upper calcitic layer of the shell and in the ligament structures.

The hydrobiological investigations were carried out by the IMB in four directions:

(1) Biofouling communities on anthropogenic substrates; (2) descriptive studies of the structure and composition of intertidal communities and (3) those of soft bottom areas; (4) macrobenthic communities of coral reefs. Zvyagintsev and Mikhailov (1988), Zvyagintsev (1989), Mikhailov *et al.* (1990), Zevina *et al.* (1992) and Zvyagintsev *et al.* (1993) gave an account of biofouling communities of ships, piers, buoys and supporting pillars of oil platforms in different areas of Vietnam including Gulf of Thailand, Kondao Islands, Ho Chi Minh and Nha Trang areas, Danang and Haiphong. Selin (1991) showed the role of bivalve mollusks in the formation of fouling communities of oil platforms deployed in South China Sea along Vietnam; distribution and composition of some bivalves in pioneer settlements of reef-building corals on piles of oil platforms were also described by Latypov (1991). Gulbin *et al.* (1987; 1988) and Nguyen Van Chung *et al.* (1988) presented the results of the hydrobiological survey of 1980-1982 in the intertidal zone of southern Vietnam and identified three bionomic types: rocky and stony shores, dead coral reefs, and sandy beaches and muddy flats.

In subtidal environments, a macrobenthic hydrobiological survey was conducted in 1981-1983 using SCUBA in Nha Phu Lagoon which lead to distinguishing four communities in soft bottom (Lukin *et al.*, 1988); some communities were dominated by the bi-

valves "*Tellina stamella*" [*T. staurella*] (Tellinidae) and *Chione sp.* (Veneridae). Latypov (1993; 1999; 2000) undertook a survey of the macrobenthic communities of coral reefs in Kondao Islands, Tho Chu Island and An Thoi Archipelago.

Because bivalve mollusks play a significant role in both soft bottom and coral reef communities, all studies mentioned earlier always contain important ecological and sometimes faunal information on the species composition, spatial distribution and densities/biomasses, which can be used in further researches.

In summary, it should be stressed that, in many aspects for the first time, Russian marine biologists and malacologists in the 1960s-1990s revealed the biogeographical structure of the bottom fauna of Vietnamese coastal waters, including the molluscan one, and showed its complex zoogeographical nature, differences between northern and southern regions and implemented their ecological/environmental explanations. Gurjanova (1972) and Zorina (1975) classified the distributional ranges of species inhabiting Vietnamese coastal waters and considered the relationships of Vietnamese fauna with other tropical faunas. In general studies, mollusks necessarily served as an important object for faunal treatments. A total of more than 360 bivalve species became known from Vietnam (see the second part of this paper). In addition, Russian authors described eleven new species from

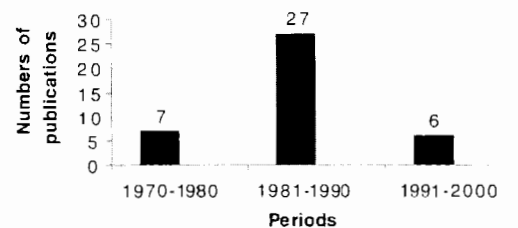


Fig. 4. Dynamics of publications of Russian authors related to different aspects of malacological researches in Vietnam or contained bivalve molluscan names.

northern Vietnam. Biology, ecology and reproduction of some, often abundant and edible species, have been studied in southern Vietnam, and their role in bottom communities was elucidated. Although a majority of these researches were ceased in 1990s due to political and economical changes in Russia (see dynamics of publications in Fig. 4), it is believed that Russian contribution to Vietnamese malacology formed a basis for future progress in this field.

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BIBLIOGRAPHY & REFERENCES

- Bernard, F.R., Y.Y. Cai & B. Morton. 1993. Catalogue of the Living Marine Bivalve Molluscs of China. Hong Kong University Press, Hong Kong, 146 pp.
- Blinov, S.V., V.V. Malakhov, N.I. Selin & Yu.M. Yakovlev. 1989. Biology of the commercial mollusc *Perna viridis* in the coastal waters of southern Vietnam. Pages 19-24. In: V.L. Kasyanov & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of Southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Crosse, H. & Fischer, P. 1889. Note sur la faune conchyliologique marine de l'Annam. - Journal de Conchyliologie 37: 281-296.
- Crosse, H. & Fischer, P. 1890. Mollusques marins de la Baie d'Halong (Tonkin). - Journal de Conchyliologie 38:14-19.
- Darkina, S.M. & K.A. Lutaenko. 1996. Catalogue of the collection of bivalve mollusks in the Zoological Museum, Far East State University, Vladivostok. - The Korean Journal of Malacology 12 (1): 53-83.
- Dautzenberg, P. & Fischer, H. 1905. Liste des mollusques recoltés par M. le Capitaine de Fregate Blais au Tonkin, et description d'especes nouvelles. - Journal de Conchyliologie 53: 85-234.
- Dawydoff, C.M. 1952. Contribution a l'etude des invertébrés de la faune marine benthique de l'Indochine. - Bulletin Biologique de la France et de la Belgique Supplement 37:1-158.
- Dorofeeva, L.A., L.A. Pozdnyakova & A.V. Silina. 1987. Dependence of growth rate and calcium-magnesium ration in *Pinna fumata* shells on environmental temperature. - Bulletin' Moskovskogo Obshchestva Ispytateley Prirody, Otdel Biologicheskii [Bulletin of Moscow Society of Naturalists, Series Biological] 62 (6): 109-115. [In Russian with English abstract]
- Evseev, G.A. 1989. On the green mussel *Perna viridis* (L.). Pages 6-11. In: V.L. Kasyanov & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of Southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Evseev, G.A. & Tran Dinh Nam. 1989. Morphology and ecology of the coral-boring bivalve mollusc *Lithophaga nasuta* (Bivalvia: Mytilidae). Pages 25-38. In: A.V. Zhirmunsky & Le Trong Phan (eds.). Bi-

- ology of the Coastal Waters of Vietnam. Benthic Invertebrates of southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts].
- Evseev, G.A. & K.A. Lutaenko. 1998. Bivalves of the subfamily Anadarinae (Arcidae) from Vietnam. - *Malacological Review Supplement* 7:1-37.
- Fischer, P. 1891. Catalogue et distribution géographique des mollusques terrestres, fluviatiles et marins d'une partie de l'Indo-Chine (Siam, Laos, Cambodge, Cochinchine, Annam, Tonkin). - *Bulletin de la Société d'Histoire Naturelle d'Autun* 4: 87-276.
- Gogolev, A.Yu. 1994. Studies of marine molluscs of Vietnam. Pages 140-149. In: D.S. Pavlov & Yu.N. Sbirin (eds.). *Hydrobionts of Southern Vietnam*. Nauka Publishing House, Moscow. [In Russian with English abstract]
- Golikov, A.N. & O.A. Scarlato. 1973. Method for indirectly defining optimum temperatures of inhabitancy for marine cold-blooded animals. - *Marine Biology* 20:1-5.
- Gulbin, V.V., K.L. Vinogradova & Nguyen Van Chung. 1987. Quantitative distribution of macrobenthos in the intertidal zone of islands of south Vietnam. - *Biologiya Morya* [Marine Biology, Vladivostok] 3: 59-65. [In Russian with English abstract]
- Gulbin, V.V., Kussakin, O.G. & Nguyen Van Chung. 1988. Soviet-Vietnamese hydrobiological investigations of the intertidal zone of southern Vietnam. Pages 100-105. In: V.I. Ilyichev (ed.). *Pacific Annual*. Far East Branch, USSR Academy of Sciences, Vladivostok. [In Russian, title translated]
- Gurjanova (as Guryanova), E.F. 1959. A study of the intertidal zone of Chinese seas. - *Bulletin of the Academy of Sciences of the USSR, Biological Series* 5: 741-759. [In Russian with extended English abstract]
- Gurjanova, E.F. 1962. II Vietnamese research and reconnaissance expedition. - *Vestnik AN SSSR* [Herald of the USSR Academy of Sciences] 2: 95-96. [In Russian, title translated]
- Gurjanova, E.F. 1972. Fauna of the Tonking (sic!) Gulf and its environmental conditions. - *Explorations of the Fauna of the Seas (Leningrad)* 10 (18): 22-146. [In Russian]
- Gurjanova, E.F. & Chang Hiu Phong. 1972a. Bottom communities of the Tonking (sic!) Gulf. - *Explorations of the Fauna of the Seas (Leningrad)* 10 (18): 147-168. [In Russian]
- Gurjanova, E.F. & Chang Hiu Phong. 1972b. Intertidal zone of the Tonking (sic!) Gulf. - *Explorations of the Fauna of the Seas (Leningrad)* 10 (18): 179-197. [In Russian]
- Kartavtsev, Yu.F. & Pham Thi My. 1989. Population genetic studies of the green mussel *Perna viridis* from the coastal waters of Phukhanh Province. Pages 25-33. In: V.L. Kasyanov & Le Trong Phan (eds.). *Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of Southern Vietnam*. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Kasyanov, V.L., V.A. Kulikova & T.Kh. Naidenko. 1989. Reproductive state of bivalve molluscs and echinoderms of the coastal waters of southern Vietnam in winter months. Pages 52-57. In: V.L. Kasyanov & Le Trong Phan (eds.). *Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of Southern Vietnam*. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Khromov, D.N. 1988. Cuttlefishes of the family Sepiidae (Cephalopoda) in the collection of Zoological Institute, USSR Academy of Sciences. - *Proceedings of the Zoological Institute, USSR Academy of Sciences* 187: 174-195. [In Russian with English abstract]
- Kryuchkova, G.A. 1989. Morphology of larvae of common bivalves in Nhatrang Bay

- of the South China Sea. Pages 68-82. In: V.L. Kasyanov & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of Southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Kulikova, V.A. 1989. Distribution of pelagic larvae of molluscs in the coastal waters of southern Vietnam. Pages 83-87. In: V.L. Kasyanov & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of Southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Latypov, Yu.Ya. 1991. Pioneer settlements of reef-building corals on piles of oil platforms in the South China Sea. - *Biologiya Morya* [Marine Biology, Vladivostok] 3: 93-99. [In Russian with English abstract]
- Latypov, Yu.Ya. 1993. Benthic communities of the coral reefs of the Kondao Islands (the South China Sea). - *Biologiya Morya* [Marine Biology, Vladivostok] 5-6: 40-53. [In Russian with English abstract]
- Latypov, Yu.Ya. 1999. Benthic communities of coral reefs of Tho Chu Island (Gulf of Thailand, South China Sea). - *Biologiya Morya* [Marine Biology, Vladivostok] 25 (3): 201-208. [In Russian with English abstract]
- Latypov, Yu.Ya. 2000. Communities of macrobenthos on the reefs of the An Thoi Archipelago, the South China Sea. - *Biologiya Morya* [Marine Biology, Vladivostok] 26 (1): 22-30. [In Russian with English abstract]
- Lukin, V.I., V.I. Fadeev, S.A. Rostomov, & Nguyen Van Chung. 1988. Soft bottom communities of the Nha Phu Lagoon (South China Sea). Pages 87-110. In: A.V. Zhirmunsky & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam: Hydrobiological Study of Intertidal and Sublittoral Zones of Southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Lutaenko, K.A. 1993. A new species of the genus *Anadara* (Bivalvia, Arcidae) from the South China Sea. - *Zoologichesky Zhurnal* [Zoological Journal] 72 (11): 140-143. [In Russian with English abstract]
- Malakhov, V.V. & S.V. Blinov. 1988. Perspectives of the cultivation of bivalve mollusk *Perna viridis* in the Socialist Republic of Vietnam. Pages 97-100. In: G.B. Zevina (ed.). Biology of the Ocean. Nauka Publishing House, Moscow. [In Russian, title translated]
- Malakhov, V.V., Yu.M. Yakovlev & S.V. Blinov. 1985. Studies of the biology of commercial bivalve molluscs during IX cruise of the R/V "Berill" in the coastal waters of south Vietnam. - *Biologiya Morya* [Marine Biology, Vladivostok] 3: 71-74. [In Russian with English abstract]
- Manchenko, G.P. 1989. Intraspecific genetic variation in marine invertebrates from coastal waters of southern Vietnam. Pages 34-51. In: V.L. Kasyanov & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of Southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Mikhailov, R.S., A.Yu. Zvyagintsev & I.A. Kashin. 1990. Fouling communities of vessels of limited region of sailing near the coast of Vietnam. Pages 110-116. In: V.S. Levin & G.A. Evseev (eds.). Systematics and Chorology of Marine Organisms. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian, title translated]
- Naidenko, T.Kh. 1989. Induction of spawning and larval development in some molluscs and echinoderms of the coastal waters of southern Vietnam. Pages 62-67. In: V.L. Kasyanov & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of South-

- ern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Nguyen Chinh. 1996. Some Economical Mollusc Species in Vietnamese Seas. Science and Technology Publ. House, Hanoi, 1996. 131 pp. [In Vietnamese, title translated]
- Nguyen Van Chung, O.G. Kussakin & V.V. Gulbin. 1988. Intertidal survey in Phu Khanh Province. Pages 81-86. In: A.V. Zhirmunsky & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam: Hydrobiological Study of Intertidal and Sublittoral Zones of Southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Nguyen Van Chung & Dao Tan Ho. 1995. Zoobenthos fauna in the sea waters of Vietnam. - Collection of Marine Research Works (Nhatrang) 6: 91-100.
- Pozdnyakova, L.A. & A.V. Silina. 1989. Biogeochemical methods in the study of linear growth in the scallops *Pecten plicata* and *Amusium pleuronectes*. Pages 90-98. In: V.L. Kasyanov & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of Southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Scarlato, O.A. 1965. Bivalve mollusks of the superfamily Tellinacea of Chinese seas. - *Studia Marina Sinica* 8: 27-114. [In Chinese with extended Russian abstract; title translated]
- Scarlato, O.A. 1977. Bivalve molluscs and temperature as an agent determining their geographical distribution. - *Malacologia* 16 (1): 247-250.
- Scott, P.H. 1994. Bivalve molluscs from the southeastern waters of Hong Kong. Pages 55-100. In: B. Morton (ed.). The Malacofauna of Hong Kong and Southern China III. Proceedings of the Third International Workshop on the Malacofauna of Hong Kong and Southern China, Hong Kong, 13 April - 1 May, 1992. Hong Kong University Press, Hong Kong.
- Selin, N.I. 1989. Distribution, population structure and growth rate of the bivalve mollusc *Area ventricosa* in the sublittoral zone of islands in Siam Bay (South China Sea). Pages 39-44. In: A.V. Zhirmunsky & Le Trong Phan (eds.). Biology of the Coastal Waters of Vietnam. Benthic Invertebrates of southern Vietnam. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts].
- Selin, N.I. 1991. The role of molluscs in the formation of fouling community on supports of oil platforms in the South China Sea. - *Biologiya Morya* [Marine Biology, Vladivostok] 4: 90-94. [In Russian with English abstract]
- Selin, N.I. & Yu.Ya. Latypov. 1990. Distribution and growth of the bivalve mollusc *Tridacna crocea* in the off-shore waters of the Kondao Islands, South China Sea. - *Biologiya Morya* [Marine Biology, Vladivostok] 6: 31-36. [In Russian with English abstract]
- Serène, R. 1937. Inventaire des invertèbrés marins de l'Indochine (1re liste). - Institut Océanographique de l'Indochine, Note 30:1-83. [In French]
- Tchang, S., C.Y. Tsi, K.M. Li, S.T. Ma, Z. Wang, H.M. Hwang & Q.Q. Zhuang. 1960. Bivalves of Nanhai (South China Sea). Science Press, Peking (Beijing), 272 pp. [In Chinese, title translated]
- Tzvetkova, N.L. 1972. A brief hydrobiological characteristic of the three shallow fishing regions in the western part of the Tonking (sic!) Gulf. - *Explorations of the Fauna of the Seas (Leningrad)* 10 (18): 169-178. [In Russian]
- Xu, F. 1997. Bivalve Mollusca of China Seas. Science Press, Beijing, 333 pp. [in Chinese]
- Yakovlev, Yu.M. 1989. A new species of wood-boring mollusc from the South China Sea and peculiarities of its reproduction. Pages

- 103-109. In: V.L. Kasyanov & Le Trong Phan (eds.). *Biology of the Coastal Waters of Vietnam. Ontogenesis of Marine Animals of Southern Vietnam*. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Zarenkov, N.A., Wu Wang Lieu & Nguyen Tin Kan. 1963. A general characteristic of quantitative distribution of plankton and benthos in the Tonkin Bay and the adjoining parts of the South-Chinese Sea. - *Doklady Akademii Nauk SSSR* [Reports of the USSR Academy of Sciences] 148(6): 1389-1391. [In Russian]
- Zevina, G.B., A.Yu. Zvyagintsev & S.E. Negashev. 1992. Cirripeds of the Coast of Vietnam and their Role in Fouling. Institute of Marine Biology, Far East Branch of the USSR Academy of Sciences, Vladivostok, 143 pp. [In Russian, title translated]
- Zhirmunsky, A.V. & Le Trong Phan. 1988. Joint Soviet-Vietnamese research in marine biology during 1980-1986. Pages 5-9. In: A.V. Zhirmunsky & Le Trong Phan (eds.). *Biology of the Coastal Waters of Vietnam: Hydrobiological Study of Intertidal and Sublittoral Zones of Southern Vietnam*. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Zhuang, Q. 1992. Research on marine bivalves in the People's Republic of China. - *American Malacological Bulletin* 9 (2): 207-215.
- Zorina, I.P. 1975. The fauna of Bivalvia of the Tonking (sic!) Gulf. - *Zoologicheskyy Zhurnal* [Zoological Journal, Moscow] 54 (3): 455-458. [In Russian with English abstract]
- Zorina, I.P. 1978a. Some peculiarities of ecology of bivalve mollusks of Tonkin Gulf. Pages 65-66. In: L.Ya. Borkin (ed.). *Morphology, Systematics and Evolution of Animals*. Zoological Institute, USSR Academy of Sciences, Leningrad. [In Russian, title translated]
- Zorina, I.P. 1978b. New species of bivalve mollusks (Bivalvia) of Tonkin Gulf (South China Sea). - *Proceedings of the Zoological Institute, USSR Academy of Sciences* 61:193-203. [In Russian, title translated]
- Zvyagintsev, A.Yu. 1989. Fouling and corrosion deterioration of supporting pillars of oil platforms in the South China Sea. - *Biologiya Morya* [Marine Biology, Vladivostok] 6: 46-50. [In Russian with English abstract]
- Zvyagintsev, A.Yu. & S.R. Mikhailov. 1988. Fouling of ships, piers and buoys in the southern Vietnam. Pages 137-147. A.V. Zhirmunsky & Le Trong Phan (eds.). *Biology of the Coastal Waters of Vietnam: Hydrobiological Study of Intertidal and Sublittoral Zones of Southern Vietnam*. Far East Branch of the USSR Academy of Sciences, Vladivostok. [In Russian with English and Vietnamese abstracts]
- Zvyagintsev, A.Yu., I.A. Kashin & Do Kong Thung. 1993. Fouling of hydrotechnical structures along the coast of Vietnam. - *Biologiya Morya* [Marine Biology, Vladivostok] 5-6: 54-63. [In Russian with English abstract]