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SPECIES COMPOSITION AND KEY TO SPECIES OF SUBCLASS PTERIOMORPHIA IN THE MANGROVE FOREST ECOSYSTEM OF XUAN THUY NATIONAL PARK, GIAO THUY DISTRICT, NAM DINH PROVINCE

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Abstract

The Pteriomorphia is a subclass of Bivalvia, phylum Mollusca that lives in saltwater. The species in this subclass have a soft body, with a protective and supportive limestone shell. The species belonging to the subclass Pteriomorphia quite varied in morphology and ecological characteristics. Many species with high nutrition are used as valuable foods. Analysis results of the collected samples in the mangrove ecosystem of Xuan Thuy National Park, Nam Dinh province have identified 20 species belonging to 10 genera; (Anadara, Estellacar, Crassostrea, Saccostrea, Anomia, Placuna, Brachidontes, Xenostrobus, Perna, and Isognomon), 7 families (Arcidae, Noetiidae, Ostreidae, Anomiidae, Placunidae, Mytilidae, Isognomonidae) and 5 orders (Arcida, Mytilida, Ostreida, Pectinida and Pteriida). Some food valuable species in the subclass Pteriomorphia in the study area such as: Antique ark, Blood cockle, Half-crenated ark, Nodular ark, Olive ark, Green-shell mussel, Estuarine oyster, Japanese oyster,...that local people exploit and cultivate. The results indicated that the key to 20 species of the subclass Pteriomorphia based on the morphological characteristics of the shell.

Keywords: Bivalvia; Pteriomorphia; Key to species; Xuan Thuy National park

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1. Introduction

The Pteriomorphia is a subclass of Bivalvia, phylum Mollusca that lives in saltwater. The species in this subclass have a soft body, with a protective and supportive limestone shell. This subclass has lamellibranch gills, and is epibenthic. Some attach to the substrate using a byssus or calcium. The foot is reduced. The mantle edges are not fused, the gills are usually large and useful in feeding. This subclass includes many common species of cockles, scallops and oysters [1, 2].

The species belonging to the subclass Pteriomorphia quite varied in morphology and ecological characteristics. Many species with high nutritional content are used as valuable foods such as blood cockles, estuarine oysters,...exploited and cultivated in many places with high economic value. The shells of these species are not only used for handicrafts but also used for many other things such as oyster farming media, environmental cleaning materials, food supplement for livestock,... [3].

Mangrove ecosystem of Xuan Thuy National Park, Giao Thuy district, Nam Dinh province, with a total area of more than 7,000 ha, is considered a typical mangrove ecosystem of the northern estuary of Vietnam. This is a favorable habitat for biomes to live and develop, including the bivalve mollusk group of Pteromorphia class. Determining species composition and identification of bivalve mollusks belonging to this subclass in the National Park is essential to help managers and local people easily identify, manage, exploit and use of molluscs resources [4, 5].

2. Materials and Methods

Sampling method: Samples were collected at 8 different points in the habitats in the mangrove ecosystem and the tidal flats near the mangrove forest. In mangroves, samples were collected on mangrove trees, on substrates, on mud surfaces in tidal flats.

Sample processing and analyzing methods: The collected samples are washed, labeled, photographed and analyzed to identify (describe morphological characteristics, determine species names).

Method for setting of the identification key: Identification key is specific characteristics to all individuals of a population, relatively stable, can be observed directly without the use of special tools. These features are shape, size, color of shell, features of umbone, hinge teeth, hinge, ligament, adductor muscle scar, radial ribs, or concentric lines on the outer shell,... Determination of the opposite morphological features of species and groups of species is the key to identify dichotomous types to order, to family and to species [6].

3. Results and discussion

3.1. List of species belonging to subclass Pteriomorphia in the study area

Analysis results of the samples obtained and reference to previous research documents have identified 20 species of Bivalve mollusks belonging to the subclass Pteriomorphia in the mangrove forest of Xuan Thuy National Park, belonging to 10 genera (Anadara, Estellacar, Crassostrea, Saccostrea, Anomia, Placuna, Brachidontes, Xenostrobus, Perna, and Isognomon), 7 families (Arcidae, Noetiidae, Ostreidae, Anomiidae, Placunidae, Mytilidae, Isognomonidae) and 5 orders (Arcida, Mytilida, Ostreida, Pectinida and Pteriida). A list of species composition identified is shown in Table 1.

Table 1. List of species composition of Subclass Pteriomorphia in Xuan Thuy National Park

No	Scientific names	Vietnamese names	In mangrove forest	On tidal flats
Order- ARCIDA				
Family - Arcidae		**Sò**		
1	*Anadara antiquata* (Linnaeus, 1758)	Sò quéo		x
2	*Anadara granosa* (Linnaeus, 1758)	Sò huyết		x
3	*Anadara subcrenata* (Lienschke, 1869)	Sò lông		x
4	*Anadara nodifera* (Martens, 1860)	Sò nứa		x
Family - Noetiidae				
5	*Estellacar olivacea* (Reeve, 1844)	Sò mít		x
Order - MYTILIDA				
Family - Mytilidae		**Vẹm**		
6	*Brachidontes curvatus,* Dunker, 1857	Quéo		x
7	*Brachidontes emarginatus* (Reeve, 1858)	Quéo	x	x
8	*Brachidontes senhousei* (Benson, 1842)	Quéo	x	x
9	*Xenostrobus atrata* (Lischke, 1871)	Dòm đen	x	x
10	*Perna viridis* (Linnaeus, 1758)	Vẹm vỏ xanh		x
Order - OSTREIDA				
Family - Ostreidae		**Hàu**		
11	*Crassostrea ariakensis* (Fujita, 1913)	Hàu cửa sông	x	x
12	*Crassostrea gigas* (Thunberg, 1793)	Hàu Nhật Bản, Hàu ống	x	x
13	*Saccostrea cucullata* (Born, 1778)	Hàu lá	x	x

14	*Saccostrea glomerata* (Gould, 1850)	Hàu đá, hầu tròn	x	x
15	*Saccostrea mordax* (Gould, 1850)	Hàu mắt tròn	x	x
16	*Saccostrea pestigris* (Hanley, 1846)	Hàu móng lợn	x	x
Order - PECTINIDA				
Family - Anomiidae		**Điệp cánh**		
17	*Anomia aenigmatica* (Holten, 1803)	Điệp lá	x	
18	*Anomia cyteum* (Gray, 1850)		x	
Family - Placunidae				
19	*Placuna placenta* (Linnaeus, 1758)	Điệp tròn		x
Order - PTERIIDA				
Family - Isognomonidae				
20	*Isognomon ephippium* (Linnaeus, 1758)	Trai búa	x	
Total			**13**	**18**

In the mangrove ecosystem of Xuan Thuy National Park, there are significant differences in the number of species, number of genera and families in different orders. The order Ostreida has 6 species, the order Mytilida has 5 species and the order Arcida has 5 species, the order Pectinida has 3 species, at least the order Pterida has only 1 species.

Among families, family Ostreidae accounts for a large number with 7 species, family Mytilidae has 5 species, family Arcidae has 4 species, family Anomiidae has 2 species, family Noetiidae, Placunidae and Isognomonidae have 1 species.

Among the species of the subclass Pteriomorphia, there are 13 common species found in mangrove areas, 18 species commonly found outside and beside the mangroves.

Some species in the Pteriomorphia subclass in the study area have food value such as: Antique ark, Blood cockle, Half-crenated ark, Nodular ark, Olive ark, Green-shell mussel, Estuarine oyster, Japanese oyster, etc. Local people exploit and cultivate the species for food.

3.2. The key to families and species of the subclass Pteriomorphia in the study area

The bivalve mollusks species of the subclass Pteriomorphia can be determined based on the morphological characteristics of the shell, the size and color of the shell, radial ribs of the shell, fold lines are complex properties in the shell. The ribs, concentric grooves are located parallel to the shell margin. The shell margins can be smooth, wavy or serrated.

The following key identifies a number of species maintained by the subclass Pteriomorphia, as well as a number of taxa that are family Arcidae, Noetiidae, Mytilidae, Ostreidae, Anomiidae,… It is possible that, when using this key for wild collected Pteriomorphia, species not included here will either wrong key properly or will key to another species. Identifications should always be checked against the original description of the species in question to verify determination.

The key to family of the subclass Pteriomorphia

1a. There is only an adductor muscle scar on each valve 2

1b. There are 2 (sometimes 3) muscle scar on each valve 5

2a. Interior of shell partly nacreous, with a non-nacreous border developed at least ventrally..... **Isognomonidae**

{*Isognomon ephippium* (Linnaeus, 1758)}

2b. Interior of the shell, if nacreous, without a non-nacreous border 3

3a. Ligament only external, hinge without teeth..... **Ostreidae**

3b. Ligament mainly internal 4

4a. The two valves are thin and unequal, in which a very thin valve is attached to the substrate, with a hole in the middle ..... **Anomiidae**

4b. Two valves are flat, round, nearly equal valves ..... **Placunidae**

..... {*Placuna placenta* (Linnaeus, 1758)}

5a. Anterior and posterior adductor scars are very unequal, the anterior one always small ..... **Mytilidae**

5b. Anterior and posterior adductor scars are not very unequal 6

6a. External ligament, usually with a V-shaped groove. Hinge elongated, nearly straight, with many small transverse teeth. Two subequal adductor muscle scars. ..... **Arcidae**

6b. External ligament, with oblique grooves and transverse striations. Hinge elongate, straightish, with numerous small transverse teeth. Two subequal adductor muscle scars with a ridge or a shelf along 1 or both scars. ..... **Noetiidae**

..... {*Estellacar olivacea* (Reeve, 1844)}

Key to species of the family Arcidae

1a. The ventral margin of the shell with strong crenulations corresponding with the external ribs. The shell is slightly inequivalve, left valve overlapping right valve, there are about 28 radial ribs at each valve (from 26 to 30) ..... *Anadara subcrenata* (Lienschke, 1869)

1b. The ventral margin of the shell with strong crenulations corresponding with the external ribs. The shell is equivalve, valves exactly meeting on margins 2

2a. Many small granulates on ribs in both valves, there are about 40 radial ribs in each valve (from 35 to 44) ..... *Anadara antiquata* (Linnaeus, 1758)

2b. Many bigger granulates on ribs in both valves 3

3a. Shell slightly longer than high, with strongly protruding umbones; about 18 radial ribs (15 to 20) at each valve ..... *Anadara granosa* (Linnaeus, 1758)

3b. Shell markedly longer than high, with moderately protruding umbones; about 21 radial ribs (19 to 23) at each valve ..... *Anadara nodifera* (Martens, 1860)

Fig 1: Isognomon ephippium

Fig 2: Placuna placenta

Fig 3: Estellacar olivacea

Fig 4: Anadara antiquata

Fig 5: Anadara granosa

Fig 6: Anadara subcrenata

Fig 7: Anadara nodifera

Fig 8: Xenostrobus atrata

Fig 9: Brachidontes senhousei

Fig 10: Perna viridis

Fig 11: Brachidontes emarginatus

Fig 12: Brachidontes curvatus

Plate 1: Some species of families Isognomonidae, Placunidae, Noetiidae, Arcidae, Mytilidae

Key to species of the family Mytilidae

1a. Hinge line with a few small teeth under the umbones (1 tooth in right valve, and 2 in the left); anterior adductor scar absent. ..... *Perna viridis* (Linnaeus, 1758)

1b. Hinge line without teeth, or with small crenulations under the umbones and behind the ligament; anterior adductor scar present. 2

2a. Hinge line is smooth, without small serrations. The dorsal margin creating an inverted V-shape. The anterior margin of the shell does not extend beyond the umbones, the posterior margin is rounded. ..... *Xenostrobus atrata* (Lischke, 1871)

2b. Hinge line with many small serrations, the shell is relatively short. 3

3a. Outer surface with radial ribs are fuzzy, unclear in the middle, small anterior margin. ..... *Brachidontes senhousei* (Benson, 1842)

3b. Outer surface with dense radial riblets. 4

4a. Umbones is located at the end of the anterior, the posterior dorsal margin is high in the middle ..... *Brachidontes curvatus* Dunker, 1857

4b. Umbones is not at the end of anterior, nearly 2.5 times longer than the height. ..... *Brachidontes emarginatus* (Reeve, 1858)

Key to species of the family Ostreidae

1a. Valve margins strongly plicate; chomata present all around the internal shell margins 2

1b. Chomata is completely absent 5

2a. Chomata forming 1 row of distant ridgelets in right valve, and corresponding pits in left valve; interior of valves with a crescent-shaped series of small disjunct pallial imprints between the posterior adductor scar and the antero dorsal margin; fingerprint shell structures absent ..... *Saccostrea cucullata* (Born, 1778)

2b. Chomata restricted to the dorsal half of the internal shell margins 3

3a. Valve margins smooth, the shell is less curled, only forming 3-5 edges that protrude out the edge of the shell .... *Saccostrea pestigris* (Hanley, 1846)

3b. Deep curled shell edge 4

4a. Shells oval or nearly round .... *Saccostrea glomerata* (Gould, 1850)

4b. The shell is triangular or long D-shaped ..... *Saccostrea mordax* (Gould, 1850)

5a. Shell large sized, attaining 20 cm in height; posterior adductor scar pale-coloured (white, grey or tinged with pale purple)..... ..... *Crassostrea gigas* (Thunberg, 1793)

5b. Shell medium sized, almost round shape or tongue shape, not exceeding 15cm in high; posterior adductor scar deep purple brown .... *Crassostrea ariakensis* (Fujita, 1913)

Key to species of the family Anomiidae

1. Shell oval as long as a finger or leaf-shaped, more than 2 times wider than its height, and umbones lower than the height .... *Anomia aenigmatica* (Holten, 1803)

2. Shell near-round shaped, umbones on dorsal margine of shell ..... *Anomia cyteum* (Gray, 1850)

Fig 13: Crassostrea ariakensis

Fig 14: Crassostrea gigas

Fig 15: Saccostrea cucullate

Fig 16: Saccostrea glomerata

Fig 17: Saccostrea pestigris

Fig 18: Saccostrea mordax

Fig 19: Anomia aenigmatica

Fig 20: Anomia cyteum

Plate 2: Some species of families Ostreidae, Anomiidae

4. Conclusion

The research results of the collected samples belonging to the Pteriomorphia subclass in the mangrove ecosystem of Xuan Thuy National Park, Nam Dinh province have identified 20 species belonging to 10 genera including Anadara, Estellacar, Crassostrea, Saccostrea, Anomia, Placuna, Brachidontes, Xenostrobus, Perna, and Isognomon, 7 families (Arcidae, Noetiidae, Ostreidae, Anomiidae, Placunidae, Mytilidae, Isognomonidae) and 5 orders including Arcida, Mytilida, Ostreida, Pectinida and Pteriida. Some food valuable species for local people

exploitation and cultivation in the subclass Pteriomorphia in the study area are: *Anadara antiquata* (Antique ark), *Anadara granosa* (blood cockle), *Anadara subcrenata* (Half-crenated ark), *Anadara nodifera* (Nodular ark), *Estellacar olivacea* (Olive ark), *Perna viridis* (Green-shell mussel), *Crassostrea ariakensis* (Estuarine oyster), *Crassostrea gigas* (Japanese oyster),... The morphological characteristics of the shell is the key to determine above 20 species in the study area.

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