

## **BRAZILIAN SPONDYLIDAE: A BRIEF DISCUSSION ABOUT VARIATION OF SHELL ORNAMENTATION IN THE NORTHEASTERN SPECIES**

Spondylidae do Brasil: uma breve discussão sobre variação na ornamentação da concha em espécies do Nordeste

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### **ABSTRACT**

The Spondylidae is a bivalve family that includes big and notable members of the corals fauna, rarely occurring in estuarine areas. For the Brazilian coast, four species of the genus *Spondylus* have been reported. The absence of a well-researched and agreed-upon taxonomic list for bivalves often causes the most basic problems, like difficulty to determine the valid name for a taxon. A great variability within the same species, diagnoses based on the shell's characteristics make its identification problematic. This study aims to do a brief discussion about identification and taxonomic problems of the family, as well as to show the variations of shell ornamentation in *Spondylus* species that occur in Northeast Brazil. To this end, a short review of the literature was carried out, and the Spondylidae shells deposited in the Prof. Henry Ramos Matthews Malacological Collection" (CMPHRM – Serie B), at the Universidade Federal do Ceará, were inspected. The family has a wide area yet to be explored and it is necessary to make a comprehensive review of this group. The Brazilian shells observed, as expected, showed a large variation on ornamentation.

**Keywords:** *Spondylus*, shell ornamentation, taxonomy.

### **RESUMO**

Spondylidae é uma família de bivalves, que inclui grandes e notáveis membros da fauna de corais, raramente ocorrendo em área estuarina. Para a costa brasileira são registradas quatro espécies do gênero *Spondylus*. A ausência de pesquisas mais aprofundadas e concordância nas listas taxonômicas de bivalves muitas vezes faz com que haja problemas básicos, como a dificuldade em determinar um nome válido para um táxon. A grande variabilidade dentro da mesma espécie, os diagnósticos com base em características da concha tornam a identificação problemática. Este trabalho tem como objetivo fazer uma breve discussão sobre identificação e problemas taxonômicos da família, bem como apresentar a variação de ornamentação das conchas de espécies de *Spondylus* que ocorrem no Brasil. Para a realização do trabalho foi realizado uma breve revisão bibliográfica e conchas de Spondylidae do Nordeste do Brasil, depositadas na "Coleção Malacológica Prof. Henry Ramos Matthews" (CMPHRM - Serie B), da Universidade Federal do Ceará, foram observadas. A família tem uma vasta área ainda a ser explorada, sendo necessário fazer grande revisão no grupo. Com relação à variação das conchas brasileiras observadas estas apresentaram, como esperado, grande variação na ornamentação.

**Palavras-chaves:** *Spondylus*, ornamentação da concha, taxonomia.

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## THE FAMILY SPONDYLIDAE

Commonly known as the “thorny oyster” is characterized inequivalve, triangular cardinal valve, resilifer containing a narrow alivincular resilium, isodont, monomyarian and foot reduced. It has sensory tentacles and eyes in board of the mantle, integrated with the nervous ganglia. These structures are called visual perception organs (Viana & Rocha-Barreira, 2007). Composed only by genus *Spondylus*, the family has 76 living species, found in warm, semi-deep waters of different oceans of the world. For Brazil, Rios (2009) pointed out four species: *Spondylus americanus* Hermann, 1781; *Spondylus erinaceus* Reeve, 1856; *Spondylus ictericus* Reeve, 1856 and *Spondylus gussonii* O.G. Costa, 1829. The species *S. erinaceus* is singled out as synonymy of *S. tenuis* Schreibers, 1793 (Huber, 2010).

*Spondylus* was highly valued by Andean and Mesoamerican societies, having played a significant role in elite and ritual activity. Those people consuming the flesh, using shell for decorative ornamentation, or fine jewelry, currency and in ceremonial offerings. In archaeological context, two species are most important, namely *Spondylus limbatus* G.B. Sowerby II, 1847 and *Spondylus crassisquama* Lamarck, 1819 (Glowacki, 2005). Nowadays, the ‘thorny oysters’ have economic importance, mainly like *objects d’art*.

Spondylidae are closely related to family Pectinidae sharing the complex eyes around the mantle and a well-developed nervous system. Indeed, *Spondylus* was included in Pectinidae before (e.g., Jackson, 1890; Daking, 1928). A molecular phylogenetic study, based on amino-acid sequences of mitochondrial cytochrome c oxidase subunit I (COI), *Spondylus* appears very close to Pectinidae, but not into the group (Matsumoto & Hayami, 2000). Although, despite the efforts reported in mainly in Lamprell (1987, 1992 and 2006), and Lamprell & Kilburn (1995), Lamprell & Willan (2000) and Lamprell & Dekker, 2001), mostly with species from the Mediterranean and Australia –members of this family have a lack of information about their morphology, taxonomy and systematics.

## PROBLEMS IN THE IDENTIFICATION OF BRAZILIAN SPECIES

Considering existing data in the literature for Brazilian species (e.g., Abbott, 1954; Lamprell, 2006; Rios, 1994, 2009), intercessions in their

description have been noticed which make identification uncertain mainly between *S. americanus* and *S. ictericus*.

Common features such as shell size, ornamentation, color have been resorted to (see Table I) but doubts were raised as to their usefulness in species identification probably because of their inaccurate geographic distribution. Thus, to make this process more efficient it is necessary to count on more detailed studies from the both points of view: the internal anatomy and molecular structure.

In short, we can inquire as to (i) how to discern between *Spondylus* species that occur off the Brazilian coast, (ii) are they really the species mentioned in the literature (e.g., Rios, 2009) and (iii) are they, in fact, the same species that occur in the Caribbean?

Original descriptions mostly based on the shells, are often simple and incomplete, sometimes without details of type locality, what may be found to be a cause for confusion. In general, taxonomic uncertainty in Bivalvia are the result of incompletely investigated backlog of several names in the literature and a renewed discovery phase through focused field collecting (Bouchet *et al.*; 2002; Bieler *et al.*, 2013).

For the Spondylidae group, species live in a wide range of ocean environments (from shallow intertidal to great depths, often found cemented beneath rocks and its taxonomy is deemed to be historically confused. Thereby, the research with this group it is very expensive and not attractive.

Similar to Spondylidae, the Ostreidae (Mollusca: Bivalvia) are well known for their high intra-specific variation, which also makes identification problematic. The genus *Crassostrea* (Ostreidae) was reviewed and the researchers point out the differences in almost all morpho-anatomical structures amongst these species (Amaral & Simone, 2014). For *Spondylus* it is evident the lack of such studies for species that occur along the Brazilian coast (Viana & Rocha-Barreira, 2007), with the exception of *S. americanus* (Simone *et al.*, 2015).

Comparison studies of Brazilian and Caribbean species have pointed out the latter area as a hotspot of diversity and thus it has been considered as center of speciation, producing and exporting species. Otherwise, it can also accumulate a biodiversity feedback produced in peripheral habitats (Bowen *et al.*, 2013), from which the Brazilian coast, as a peripheral area, would benefit.

However, such similarities between Caribbean and Brazilian fauna still require attention due to large taxonomic instability present in Mollusca on

account of oceanographic barriers that might generate such consequences as divergence and speciation. The freshwater outflow from the Orinoco and Amazon rivers in northern South America, for example, sets apart the Caribbean and Brazilian habitats, a fact which was established about 11 million years ago (Floeter *et al.*, 2008; Shephard *et al.*, 2010). Research with other molluscs showed species that were early considered the same in the above-mentioned ecosystems but in fact proved to be different ones (Simone, 1998). In order to set up the actual geographic range for *Spondylus*, it is necessary to define the species around the world.

### SPECIES VARIATION: THE NORTHEASTERN BRAZILIAN SHELLS

Spondylidae shells have a wide variation range of shape, color and ornamentation that have been pinpointed in the literature (*e.g.*, Lamprell, 2006; Finet & Lamprell, 2008), that in large shells being the outcome of a combination of environmental (substrate, water depth) and genetic influences (hybridism) causing a taxonomic frustration and therefore in Systematics. The group also raises a few questions as to what characterizes them and distinguishes species from one another, usually a difficult task even under close observation (Lamprell, 2006).

Spondylidae shells from northeastern Brazil (Ceará and Piauí States), deposited in the "Malacological Collection Prof. Henry Ramos Matthews" (CMPHRM - Serie B), at Universidade Federal do Ceará, were analyzed according to descriptions by Lamprell (2006) and Rios (2009). Morphometric shell measurements for individual length and height were also undertaken with a caliper ( $\pm 0.1$  mm accuracy). From 45 shells, two species were identified: 33 of *Spondylus cf. americanus* and 12 *Spondylus tenuis* (Figure 1) with the following results: average of 43,3 mm length and 40 mm height for the first species and 51,9 mm length and 45,1 mm height for the second one. As expected, the large variation in ornamentation, as well as the sizes found for both species, caused doubts in the species identification.

Therefore, the present research work emphasizes the need for revision of this group, aligned to update the occurrence, observation of shells variations, morphology and internal anatomy, habitat and genetic influence. Were these specimens' morphotypes? Is it possible to better differentiate the species from internal anatomy? What is the phylogenetic relationship between species and among outgroups?

It is clear that family Spondylidae has a wide area yet to be explored by taxonomists, phylogeneticists and other researchers. Studies such as that by Finet & Lamprell (2008), reviewing Spondylidae specimens deposited in the Muséum d'Histoire Naturelle (Geneva), make up but an important contribution and just one step in a long way to understand this family.

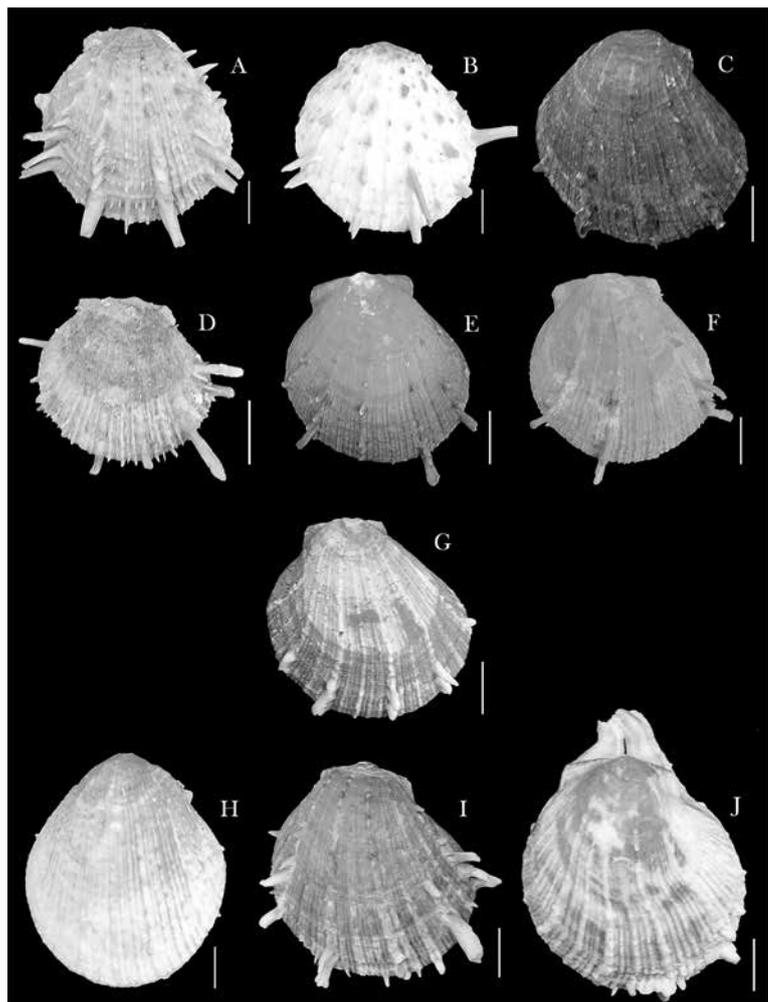


Figure 1 - Shell ornamentations of *Spondylus* from Northeast Brazil. A-F: forms of shell ornamentation of *Spondylus cf. americanus*; G-J: forms of shell ornamentation of *Spondylustenuis*. Scale bars: 20 mm.

Table I – Features described on literature for *Spondylus* that occurs in Brazilian coast (Rios, 1994, 2009; Lamprell, 2006).  
Legend: (?) no information available.

Species / Features	<i>Spondylus americanus</i> Hermann, 1781	<i>Spondylustenuis</i> Schreibers, 1793	<i>Spondylus ictericus</i> Reeve, 1856	<i>Spondylus gussoni</i> Costa, 1829
Shell height	to 150 mm +	to 70 mm	to 70 mm	to 20 mm
Shell length	120 to 180 mm	?	May reach 120 mm	?
Ornamentation	6 principal radial ridges with strong; Variable spines, (spatulate, usually long, spinose and depressed towards the margin); Interstices are wide with 5 or 6 weaker radial ribs which bear smaller sharp spines.	5 principal radial ridges; Irregular, erect, flattened spines; Interstices with fine radial striae.	4 - 9 principal radial ridges; Numerous hollow spines of various, sometimes spatulate with branched ends; Interstices with weaker radial ribs usually with remote, upright, blunt spines.	Approximately 34 radial ribs intercalating to 58 moderately strong, imbricated, nodulose ribs at the ventral margin.
Color	Extremely variable, white with red umbonally and red orange or purple usually in concentric bands. Sometimes pink, mauve, lavender, yellow, or any combination of these colours.	Orange, red umbonally, ribs yellow or orange, spines slightly darker in colour.	Yellow to red or deep purple, often bright red umbonally.	White
Internal color	Internally white with strongly crenulated margin, some colour usually occurs umbonally.	Internally white with an orange crenulated margin.	Internally blue-white with margins similar to the external color.	White
Habitat	In 10 to at least 140 metres	To at least 45 metres	5 to 50 meters	Deep water
Type locality	American seas	Caribe (Guadaloupe)	Bermuda (North America)	Mediterranean
Distribution	Bermuda, Puerto Rico, Caribbean and south eastern United States, W. Indies, Brazil (Pará to Rio Grande do Norte)	Atlantic: West Indies, British Virgin Islands to Northeast Brazil.	Atlantic: Bermuda, Florida to Brazil (Fernando de Noronha, Abrolhos Is.; Pará to Santa Catarina).	Azores, Mediterranean, Antilles, Italy (Sicily), Senegal, Cabo Verde, Yucatan Strait, Dominican Republic, Nevis, St. Lucia; St. Vincent & the Grenadines: Grenada; Barbados, Brazil (off Ceará, Canopus Bank, 240m)

**Material examined of *Spondylus cf. americanus***  
 - CMPHRM 4114B (XII.2003; Ceará; three specimens);  
 CMPHRM 4115B (XII.2013-I.2014; Itarema, Ceará/  
 Parnaíba, Piauí; six shells); CMPHRM 4116B  
 (XII.2013-I.2014; Itarema, Ceará/Paranaíba, Piauí; 14  
 shells); CMPHRM 4118B (25.V.2008; Fortaleza, Ceará;  
 four shells); CMPHRM 4119B (03.V.2008; Redonda,  
 Icapuí, Ceará; one shell); CMPHRM 4120B (25.IV.2008;  
 Redonda, Icapuí, Ceará; one shell); CMPHRM 4123B  
 (25.IV.2008; Redonda, Icapuí, Ceará; one shell).

**Material examined of *Spondylus tenuis*** -  
 CMPHRM 4117B (XII.2013-I.2014; Itarema, Ceará/  
 Paranaíba, Piauí; eight shells); CMPHRM 4121B  
 (25.V.2008; Fortaleza, Ceará; three shells); CMPHRM  
 4122B (25.IV.2008; Redonda, Icapuí, Ceará; one shell).

**Acknowledgements** - To CAPES (Coordenação de  
 Aperfeiçoamento de Pessoal de Nível Superior) for  
 providing a doctoral grant to author V.P. Rocha. To  
 the LIMCE team for helping with laboratory work.

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