UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL

INSTITUTO DE GEOCIÊNCIAS

PROGRAMA DE PÓS-GRADUAÇÃO EM GEOCIÊNCIAS

O GÊNERO *XESTOLEBERIS* SARS, 1866 (CRUSTACEA-OSTRACODA) NAS PLATAFORMAS NORTE, NORDESTE E LESTE E NO ARQUIPÉLAGO DE SÃO PEDRO E SÃO PAULO, BRASIL

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Orientador – Prof. Dr. João Carlos Coimbra

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RESUMO

Os ostracodes constituem um importante grupo de microcrustáceos que tem despertado o interesse tanto das biociências quanto das geociências. Para tanto, é fundamental o estudo taxonômico destes organismos e o entendimento de sua distribuição e ecologia. Os trabalhos realizados na plataforma continental brasileira muito têm contribuído para o conhecimento do grupo, que é bastante diverso. Porém, a riqueza e complexidade dos ostracodes ressaltam a necessidade de mais estudos também na plataforma. Em ilhas oceânicas brasileiras, as pesquisas com ostracodes ainda é muito recente, com poucos trabalhos publicados. A importância de estudar os ambientes insulares reside no fato de tais áreas colaborarem para o entendimento da diversidade, biogeografia e evolução dos organismos. O presente trabalho visa aumentar o conhecimento do grupo na plataforma continental do Brasil, mais especificamente nas regiões Norte, Nordeste e Leste, e no Arquipélago de São Pedro e São Paulo (ASPSP), através do estudo do gênero *Xestoleberis* Sars. Este gênero é bastante diversificado e amplamente distribuído em todos os oceanos, e, no Brasil, ocorre ao longo de toda a plataforma, além das ilhas oceânicas. Foi registrado um total de oito espécies nas áreas estudadas, sendo duas endêmicas ao ASPSP e seis pertencentes à plataforma. Das espécies encontradas na plataforma continental, quatro são novas, uma foi mantida em nomenclatura aberta e uma já havia sido previamente descrita.

Palavras-chave: Ilhas Oceânicas, Ostracodes, Plataforma Continental, Taxonomia.

ABSTRACT

The ostracods represent an important group of microcrustaceans that has aroused interest in biosciences and geosciences. For this, it is crucial the taxonomic study of these organisms and to understand their distribution and ecology. The works conducted in the Brazilian continental shelf contributed greatly to the knowledge of this group that is quite diverse. However, the great richness and complexity of ostracods highlight the need for more studies also in the platform. In the Brazilian oceanic islands, the searches on these crustaceans are still very recent, with a few numbers of published works. The study of insular habitat collaborates with the understanding of diversity, biogeography and evolution of the organisms. The present work aims to increase the knowledge of the group in the Brazilian continental shelf, specifically in the Northern, Northeastern and Eastern regions, and in the Archipelago of São Pedro and São Paulo (ASPSP), with the study of the genus *Xestoleberis* Sars. This genus is diversified and widely distributed in all oceans and in Brazil occurs along the entire shelf and in oceanic islands. Eight species were recorded in the study areas, two species are endemic to the ASPSP and six belong to the continental shelf. Among the platform species, four are new, one was maintained in open nomenclature and one was already described.

Key-words: Oceanic Islands, Ostracods, Continental Shelf, Taxonomy.

SUMÁRIO

CAPÍTULO 1

INTRODUÇÃO

Os ostracodes são microcrustáceos encontrados em praticamente todos os ambientes aquáticos e com grande amplitude no registro fóssil, do Ordoviciano ao Recente. São constituídos por uma carapaça bivalve quitino-calcítica, responsável pela proteção do corpo formado por 5-7 apêndices, dependendo do grupo. Considerando-se indivíduos adultos, a maioria mede entre 0,4 e 1 mm de comprimento. Seu crescimento se dá através de mudas ou ecdises, caracterizando até oito estágios ontogenéticos. Para cada estágio uma nova carapaça é secretada. A carapaça calcificada dos ostracodes permite excelente potencial de preservação ao organismo, podendo ser encontrado em grande abundância nas rochas sedimentares (Horne *et al*., 2002; Coimbra & Bergue, 2011). Eles são comumente utilizados em estudos paleoecológicos, paleoclimáticos e paleoceanográficos (Bergue, 2006; Bergue & Coimbra, 2008), além de possuírem grande potencial bioestratigráfico em virtude da curta amplitude de algumas espécies (Coimbra & Bergue, 2011).

Os estudos com os ostracodes no Brasil englobam tanto a ostracofauna recente quanto a fóssil, abrangendo vários períodos geológicos, podendo ser marinhos ou continentais. Com a criação de programas federais que apoiam pesquisas em ilhas oceânicas brasileiras (PROARQUIPELAGO e PROTRINDADE) financiados pelo CNPq e pela Marinha do Brasil, foi possível estender ainda mais o leque de estudos enfocando os ostracodes, inclusive tendo já sido publicados alguns trabalhos (*e.g*. Coimbra *et al*., 2009; Antonietto *et al*., 2012; Coimbra & Carreño, 2012; Coimbra *et al*., 2013).

O presente trabalho tem como objetivo contribuir para o conhecimento dos ostracodes marinhos no Brasil através do estudo do gênero *Xestoleberis* Sars, 1866 nas plataformas Norte, Nordeste e Leste bem como no Arquipélago de São Pedro e São Paulo. Os resultados estão apresentados em dois artigos, onde o primeiro corresponde às espécies registradas no Arquipélago de São Pedro e São Paulo (Capítulo 2) e, o segundo, trata das espécies que ocorrem nas regiões Norte, Nordeste e Leste da plataforma continental brasileira (Capítulo 3).

O gênero *Xestoleberis* Sars, 1866

O gênero *Xestoleberis*, pertencente à família Xestoleberididae, é conhecido desde o Cenomaniano até o Recente. É caracterizado por uma carapaça lisa,

dorsalmente arqueada e achatada ventralmente, e em alguns casos pontiaguda anteriormente (Morkhoven, 1962). A maioria das espécies vive em ambiente marinho raso, nos hábitats fóticos das zonas litoral e sublitoral, em substratos arenosos ou em algas. Alguns xestoleberidideos colonizam habitats intersticiais em substratos de areia grossa e algumas espécies estão adaptadas a viver em ambientes profundos. Muitos apresentam padrões de pigmentação na carapaça que permitem ao animal passar despercebido pelos predadores (Bonaduce & Danielopol, 1988).

Uma das características diagnósticas dos xestoleberidideos é uma estrutura chamada de "*Xestoleberis*-spot". Esta marca consiste em uma irregularidade conspícua na superfície interna de ambas as valvas. Segundo Keyser (1988), o *spot* é o local onde um grupo formado por quatro músculos, que envolvem a glândula fiandeira, está conectado à valva. Já Bonaduce & Danielopol (1988) acreditam que esta impressão é uma marca de um ligamento que dá suporte a algumas estruturas oculares laterais. Segundo os autores, a presença do "*Xestoleberis*-spot" em espécies de água profunda sugere que ocorreu a migração de uma zona fótica para uma de maior profundidade; nestas espécies observa-se uma redução ou ausência das lentes que formam os ocelos e o *spot* permanece como uma estrutura relicta do ligamento.

O gênero *Xestoleberis* tem uma distribuição global. No Brasil, já foi registrado em vários estudos, ocorrendo ao longo de toda a plataforma continental, em ilhas oceânicas e talude, bem como no registro fóssil (Coimbra *et al*., 1999; Machado *et al*., 2005; Bergue & Coimbra, 2008; Machado, 2008; Coimbra & Carreño, 2012; Antonietto *et al*., 2013).

ÁREAS DE ESTUDO

Plataforma Continental Brasileira

As margens continentais são o limite entre qualquer continente e oceano, as quais consistem em regiões geológicas com maior variedade de profundidades e com uma extraordinária gama de estruturas morfológicas, podendo ser classificadas como tectonicamente ativas ou passivas. As margens ativas caracterizam-se por grande atividade tectônica e vulcanismo. As margens passivas ou do tipo Atlântico são divididas em plataforma continental, com profundidade de até 200 m e cerca de 0-350 km de distância da costa; talude continental, zona esta de grande declividade, onde a profundidade aumenta significativamente (de 100-200 m para 1500 m), e situa-se entre

350-390 km da costa; e sopé continental, com profundidade variando entre 1500-4500 m e distância de cerca de 390-860 km da costa (Kennett, 1982).

A margem continental brasileira é considerada do tipo Atlântico (ou passiva), apresentando as três feições características desse tipo de margem. É subdividida, segundo Batista Neto & Silva (2004), em dois grandes setores: Equatorial e Leste-Sudeste-Sul. Já Zembruscki *et al*. (1972) e Tessler & Mahiques (2003), com base em características morfológicas, subdividem a margem continental brasileira em três grandes setores: Norte ou Equatorial, Nordeste-Leste e Sul. A divisão da plataforma continental adotada neste trabalho é a de Silveira (1964) e Muehe (1998) que corresponde a cinco grandes regiões (Norte, Nordeste, Leste, Sudeste e Sul). Informações sobre as características sedimentares e oceanográficas podem ser encontradas no Capítulo 3.

Arquipélago de São Pedro e São Paulo (ASPSP)

O ASPSP é o topo de um edifício rochoso submarino que se ergue de uma profundidade de cerca de 4000 m (Campos *et al*., 2009) e encontra-se nas coordenadas 00°55’10’’N e 29°20’33’’O. O Cabo do Calcanhar, no Rio Grande do Norte, é o ponto mais próximo na costa brasileira do arquipélago, distando cerca de 510 milhas náuticas (~1100 km). O ASPSP fica quase na metade do caminho entre o Brasil e a África, em torno de 985 milhas náuticas (~1824 km) da costa de Guiné-Bissau (Almeida, 2006).

O ASPSP é formado por dez ilhas e diversas pontas de rochas, situadas nas proximidades da dorsal meso-oceânica. Os pontos extremos ficam entre as ilhas Erebus e Pillar, cuja distância é de 420 m. As ilhas Belmonte, São Pedro, São Paulo e Cabral envolvem uma pequena enseada, com abertura voltada para NO. Esta enseada tem cerca de 100 m de comprimento por 50 m de largura, com 8 a 15 m de profundidade. O fundo da enseada é constituído por sedimentos provenientes da atividade biogênica e da desagregação das rochas que constituem o arquipélago, é rico em macroalgas e possui no bentos espécies de moluscos e crustáceos, dentre vários outros grupos animais (Almeida, 2006; Amaral *et al*., 2009). O relevo do ASPSP é acidentado e seu ponto culminante (18 m) situa-se na ilha São Pedro; o ponto mais alto da ilha Belmonte tem cerca de 16 m de altitude, onde está localizado o farol, e na ilha São Paulo as maiores elevações atingem 17 m (Campos *et al*., 2009). Seu condicionamento tectônico é especial, visto que se inclui no trecho de falhas transformantes ativas da grande Zona de

Fratura de São Paulo, que atravessa todo o Oceano Atlântico (Almeida, 2006). Ao movimento transcorrente destas falhas são atribuídos os pequenos terremotos que atingem em torno de quatro graus na escala Richter e ocorrem com certa frequência no local (Motoki *et al*., 2009).

O arquipélago está inserido no Sistema Equatorial de Correntes Marinhas, sofrendo influência direta da Corrente Sul Equatorial Superficial, que flui no sentido E-O, e da Corrente Equatorial Submersa, que flui no sentido contrário (O-E), a uma profundidade que varia entre 60 e 100 m. A ação conjunta destas duas correntes marinhas gera um padrão hidrológico de elevada complexidade e com grande influência no ecossistema insular, notadamente o fenômeno de enriquecimento de nutrientes, devido à ressurgência decorrente da interação entre as correntes oceânicas e o relevo submarino (Campos *et al*., 2009).

Em relação às condições meteorológicas, o arquipélago está sob influência da Zona de Convergência Intertropical (ZCIT). A anomalia da temperatura superficial do mar entre os hemisférios afeta significativamente a posição da ZCIT (Stramma & Schott, 1999), cujo ciclo é anual e seu deslocamento ao longo desse período controla o índice pluviométrico, tanto na costa do Nordeste do Brasil quanto no arquipélago. Assim, observou-se que no primeiro semestre, nos meses de janeiro a maio, a ZCIT está sobre o arquipélago, período de maior pluviosidade, onde o valor máximo de precipitação acumulada (370 mm) ocorre no mês de abril. No segundo semestre, a ZCIT está mais ao norte e observa-se menor precipitação sobre a região (Soares *et al*., 2009).

MATERIAL E MÉTODOS

Amostragem na Plataforma Continental Brasileira

Foram analisadas 359 amostras provenientes da plataforma continental brasileira, coletadas por dois programas de pesquisas oceanográficas: Projeto REMAC e Operações GEOMAR. O Projeto REMAC é resultado de uma parceria entre a PETROBRAS e o "*Woods Hole Oceanographic Institute"* e foi realizado em oito tratos, dos quais cinco foram utilizados neste trabalho (4 a 7). A amostragem feita no trato 4 (27/01 a 08/12/73) ocorreu na região Nordeste (Fortaleza-CE/Salvador-BA); os tratos 5 (11/02 a 23/02/73) e 5A (25/02 a 03/03/73) na região Norte e parte da região Nordeste (Cabo Orange-AP/Fortaleza-CE); o trato 6 (08/03 a 21/03/73) realizou coletas nas

regiões Norte e Nordeste (Belém-PA/Recife-PE) e o trato 7 nas regiões Nordeste e Leste (Recife-PE/Cabo Frio-RJ).

As Operações GEOMAR foram divididas em sete tratos e realizadas pela DHN (Diretoria de Hidrografia e Navegação da Marinha do Brasil), sendo as amostras dos tratos I, II e III analisadas neste trabalho. A Operação GEOMAR I ocorreu entre a Ilha de Maracá, no estado do Amapá, e a Foz do Rio Parnaíba, entre os estados do Maranhão e Piauí; a GEOMAR II foi realizada entre a Ilha de Maracá até o Cabo Orange, ambos no estado do Amapá; e a GEOMAR III amostrou a região entre o Cabo Orange e o Município de Salinópolis, no Pará.

As amostras foram fornecidas como sedimentos secos e sua preparação se deu pelos métodos usuais para ostracodes recentes e sub-recentes, seguindo a rotina: (i) lavagem em peneiras com frações de 0,250, 0,177 e 0,074 mm; (ii) secagem em estufa a 80ºC; e (iii) pesagem e triagem da fração retida nas peneiras de 0,250 e 0,177 mm. Maiores detalhes podem ser encontrados em Coimbra *et al*. (1999).

Amostragem no Arquipélago de São Pedro e São Paulo (ASPSP)

O material analisado é proveniente de 22 amostras de sedimentos e algas coletadas na enseada do ASPSP, entre os meses de julho e agosto de 2010. As coletas foram feitas através de mergulho livre em profundidades que variaram de 2 a 11 m. O material foi acondicionado em potes plásticos e fixado em álcool 70%. Para recuperação de ostracodes do substrato alga foi triada a amostra completa. Já para as amostras de sedimento, fracionou-se o conteúdo e 20 ml de cada amostra foi triado. As carapaças (vivos) de ostracodes recuperadas foram fixadas em álcool 70% e as valvas (mortos) acondicionadas em lâminas de células múltiplas. Maiores informações sobre as coletas estão em Coimbra *et al.* (2013).

Triagem e Confecção de Imagens

A triagem do material de estudo foi realizada com o auxílio de um microscópio estereoscópico. As imagens foram obtidas através de Microscopia Eletrônica de Varredura (MEV), no Centro de Microscopia Eletrônica/UFRGS, e Microscopia Óptica (MO), no Laboratório de Microfósseis Calcários/UFRGS.

ESTADO DA ARTE

Os estudos taxonômicos, (paleo)zoogeográficos e ecológicos com ostracodes recentes e sub-recentes da plataforma continental brasileira realizados nas últimas décadas muito têm contribuído para o conhecimento da ostracofauna sulamericana. Um dos trabalhos pioneiros abordando a zoogeografia dos ostracodes da plataforma continental brasileira (do Oiapoque ao Chuí) foi realizado por Pinto *et al*. (1972), onde os autores registraram cerca de 50 gêneros, inspirando muitos outros estudos taxonômicos e zoogeográficos, contribuindo para o conhecimento sobre a diversidade específica e os padrões de distribuição das assembleias de águas quentes e temperadas (*e.g.* Coimbra & Ornellas, 1986, 1987, 1989; Purper & Ornellas, 1987, 1989; Ramos, 1994, 1996, 1998; Ramos *et al.* 1999, 2004, 2009, 2013, 2014; Bergue & Coimbra, 2002; Machado *et al*. 2005; Machado, 2008).

Coimbra & Ornellas (1989), a partir do estudo da subfamília Orionininae, identificaram três associações faunísticas, a primeira correspondente às regiões Nordeste/Leste (águas quentes), a segunda típica da região Sul (águas temperadas) e uma assembleia transicional entre as latitudes 15º01'S e 21º02'S, cujo limite sul foi estendido para 23ºS por Coimbra *et al*. (1995). Segundo aqueles autores e Machado (2008), o padrão de distribuição das assembleias de ostracodes pode estar condicionado, principalmente, pela presença de diferentes massas d'água, as quais controlam a temperatura da água, e, secundariamente, pelo tipo de substrato.

O estudo de ostracodes em ilhas oceânicas brasileiras é bem recente. Coimbra *et al.* (2009) e Coimbra & Carreño (2012) foram os primeiro trabalhos realizados com ostracodes insulares no Brasil, com uma análise da fauna da Ilha da Trindade e do Atol das Rocas. Os autores registraram uma ostracofauna relativamente diversificada, com baixa abundância e sem espécies endêmicas, onde a dispersão das mesmas se deu através dos montes submarinos que ligam ambas as ilhas a plataforma continental. No ASPSP, o primeiro trabalho foi realizado por Antonietto *et al.* (2012), com um levantamento preliminar dos ostracodes, seguido por Coimbra *et al*. (2013), onde foram registradas 14 espécies (a maioria em nomenclatura aberta) e descritos um gênero e uma espécie novos.

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CAPÍTULO 2

MANUSCRITO 1

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Prezada autora Nathalia Carvalho da Luz

Informamos que seu trabalho abaixo relacionado recebeu em parecer favorável dos consultores e editores, sendo aceito para publicação na Iheringia, Série Zoologia.

O manuscrito será encaminhado para editoração e revisão final pela Comissão Editorial, eventualmente pequenas modificações podem ser necessárias durante o processo de editoração.

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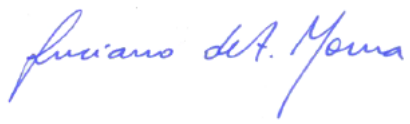
Autoria de: Nathalia Carvalho da Luz & João Carlos Coimbra

Atenciosamente,



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NEW SPECIES OF XESTOLEBERIDIDAE (OSTRACODA, CRUSTACEA) FROM THE ARCHIPELAGO OF SÃO PEDRO AND SÃO PAULO, EQUATORIAL ATLANTIC

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ABSTRACT. Two new species of Xestoleberididae: *Xestoleberis brasilinsularis* sp. nov. and *Xestoleberis machadoae* sp. nov., both endemic to Archipelago of São Pedro and São Paulo, are described. The record of these shallow marine waters species from Brazilian oceanic islands represents an important contribution to the knowledge of the evolutionary history the species inhabit areas.

KEYWORDS. *Xestoleberis*, taxonomy, morphology, Atlantic Ocean.

RESUMO. Duas novas espécies de Xestoleberididae: *Xestoleberis brasilinsularis* sp. nov. e *Xestoleberis machadoae* sp. nov., ambas endêmicas do Arquipélago São Pedro e São Paulo, são descritas. O registro dessas espécies em ilhas oceânicas brasileiras representa uma importante contribuição para o conhecimento da história evolutiva das espécies que habitam estas áreas.

PALAVRAS-CHAVE. *Xestoleberis*, taxonomia, morfologia, Oceano Atlântico.

The oceanic islands are of great scientific interest, mainly their origins and their very special terrestrial and marine ecosystems. The island environments have been used as a model for many scientific fields, such as biogeography, ecology, evolution and conservation. In recent decades, the study of the Brazilian oceanic islands and their flora

and fauna has grown significantly with the financial support of the governmental program known as PROARQUIPÉLAGO. This program is also responsible by the logistical support to the researches performed in the Archipelago of São Pedro and São Paulo, that is a group of very small rocky islets in the Equatorial Atlantic Ocean (CAMPOS *et al.*, 2003; COIMBRA *et al*., 2009; ANTONIETTO *et al*., 2012; COIMBRA & CARREÑO, 2012; COIMBRA *et al.*, 2013).

COIMBRA *et al.* (2013) is an important contribution to the knowledge of the ostracod fauna from the Archipelago of São Pedro and São Paulo. The authors identified and illustrated 14 species, described one new genus and species and leaving the two species of the genus *Xestoleberis* Sars, 1866, herein described, in open nomenclature.

Xestoleberis, a cosmopolitan marine ostracod genus, is the most specious Xestoleberididae and possesses a rich fossil record, being known since the Cretaceous (MORKHOVEN, 1962). This genus prefers shallow marine waters, but some of its species have been recovered from deep sea (DANIELOPOL *et al*., 1996) and marine marginal environments (DIAS-BRITO *et al*., 1988). The present paper describes and illustrates two new species of *Xestoleberis*, both recovered from the cove of the Archipelago of São Pedro and São Paulo, and very likely endemic to this oceanic area.

MATERIAL AND METHODS

The Archipelago of São Pedro and São Paulo (00°55’10’’N/29°20’33’’W) is the top of a submarine morphological elevation whose base is at ~3,800 m water depth. Few rocky islets compose it, being the four largest (Cabral, São Pedro, São Paulo and Belmonte) arranged in a semicircle forming a shallow cove with maximum depth of ~15 m (Fig 1). The Calcanhar Cape, in the State of Rio Grande do Norte, is the nearest Brazilian continental area of the Archipelago of São Pedro and São Paulo (ASPSP), whose distance is 510 nautical miles (~ 1,100 km). On the other hand, the archipelago is around 985 nautical miles (~ 1,824 km) from the coast of Guinea-Bissau, in Africa (ALMEIDA, 2006).

The ASPSP and the Brazilian coast are separated by deep ocean whose depth can reach up to 4000 m, and in its nearest surroundings the top of some seamounts are located only 100 m below the surface (MORAES & MURICY, 2007). According to STRAMMA & ENGLAND (1999), this archipelago is inserted into the system of equatorial

currents, suffering direct influence of the South Equatorial Current, which flows superficially from east to the west, and of the South Equatorial Undercurrent, that flows in the opposite direction, at a depth ranging between 60 and 100 m. The combined action of these two currents results in a pattern of high hydrological complexity and with great influence on the island ecosystem, causing nutrient enrichment of waters due to upwelling resulting from the interaction between ocean currents and submarine topography (CAMPOS *et al*., 2009).

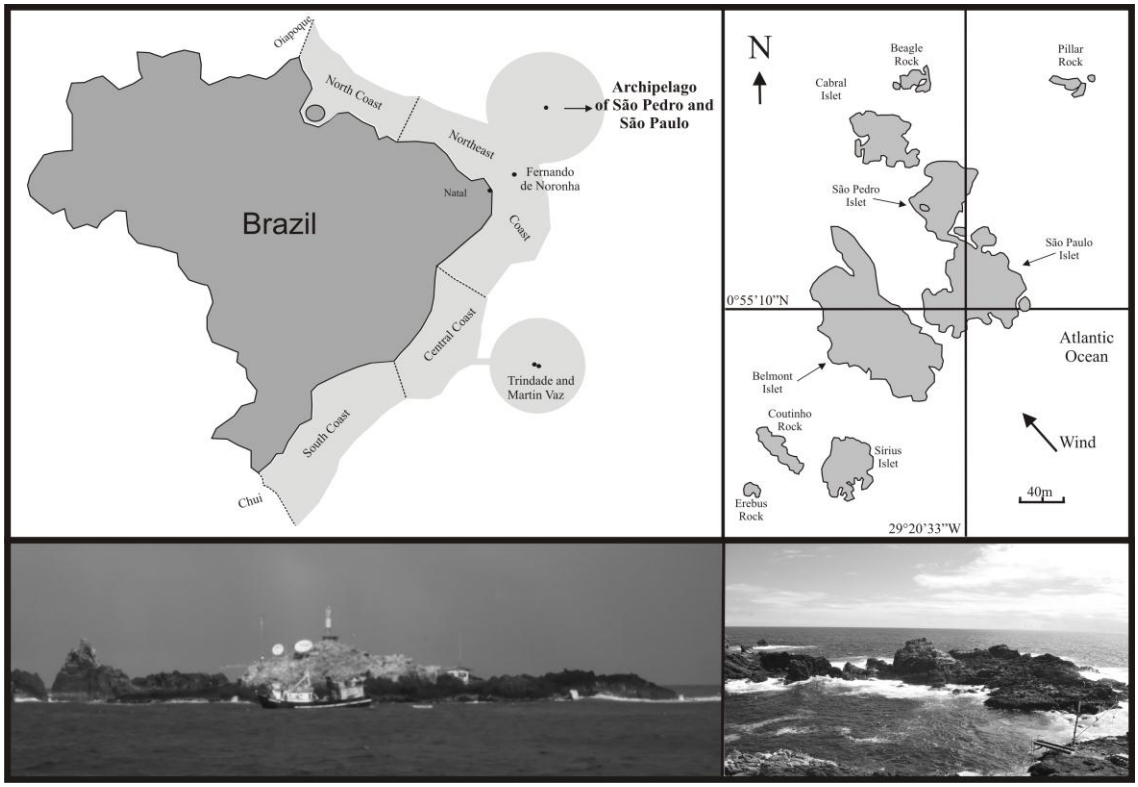

Figure 1. Location map of Archipelago São Pedro and São Paulo (modified from SOARES *et al.*, 2009; MACEDO *et al.*, 2009).

The study material is composed by 22 samples (seven barren for Xestoleberididae), hand collected in three different areas in the cove of the ASPSP by free diving at depths ranging from 2 and 11 m (Fig 2, Tab. I). All material examined was collected by Cláudia Pinto Machado, Fernando Erthal and Sandro Monticelli Petró, with the help of the Brazilian Navy crew, during 15 days in July/August 2010. COIMBRA *et al.* (2013) present more details of field and laboratorial procedures.

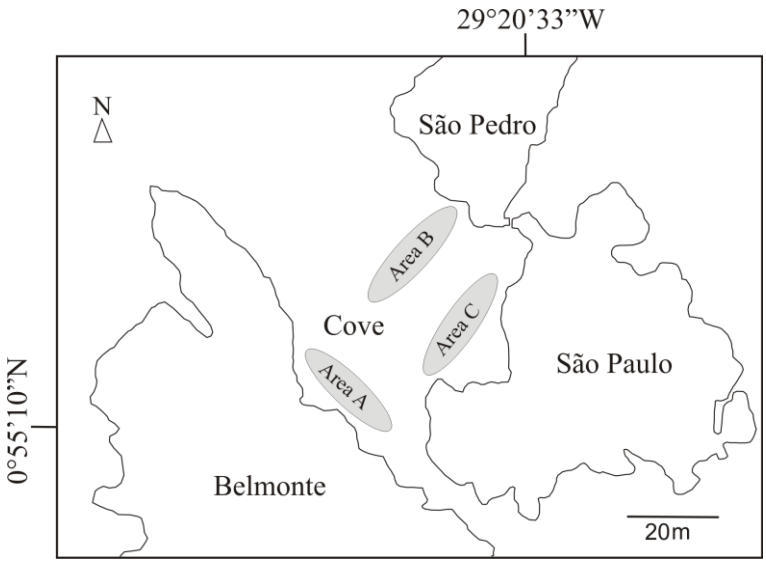

Figure 2. Cove of the Archipelago of São Pedro and São Paulo (modified from COIMBRA *et al.*, 2013).

Table I. Number, location, substrate and depth of the 15 fertile samples for Xestoleberididae, cove of the ASPSP, Equatorial Atlantic.

Sample number	Area of collection in the cove	Substrate (Algae/Sediment)	Depth (~m)
M 1001-N	Area A	Algae (*Caulerpa racemosa*)	2
M 1002-N	Area A	Algae sp. 1	2
M 1003-N	Area A	Sediment	5
M 1004-N	Area A	Sediment	5
M 1005-N	Area A	Sediment	5
M 1010-N	Area A	Sediment	10
M 1012-N	Area B	Sediment	11
M 1014-N	Area B	Sediment	11
M 1017-N	Area A	Algae sp. 1	2
M 1023-N	Area C	Algae (*Caulerpa racemosa*)	4
M 1025-N	Area C	Algae (*Caulerpa racemosa*)	4
M 1030-N	Area C	Algae sp. 2	5
M 1031-N	Area C	Algae (*Caulerpa racemosa*)	5
M 1032-N	Area C	Algae (*Caulerpa racemosa*)	5
M 1036-N	Area C	Algae sp. 2	5

The ostracodes herein examined are held in the collections of the 'Museu de Paleontologia', Universidade Federal do Rio Grande do Sul (UFRGS), Section of Ostracoda. The figured material is identified by the prefix MP-O. All scanning electronic microscopy (= SEM) photographs were taken at the 'Centro de Microscopia Eletronica' at UFRGS. Unfortunately, the LV number MP-O-2466 was broken after SEM analysis. However, only this adult specimen rendered a good photo of the central muscle scars.

Morphological abbreviations: LV, left valve; RV, right valve; c, carapace; v, valve; ♀, female; ♂, male.

TAXONOMY

Family Xestoleberididae Sars, 1928

Genus *Xestoleberis* Sars, 1866

Xestoleberis brasilinsularis sp. nov.

(Figs 3-13)

Xestoleberis toni? WOUTERS. ANTONIETTO *et al.*, 2012:40-41, Figs. 6:9-12; Tab. 8 (non *Xestoleberis toni* WOUTERS, 2003:152, Pl. 9, Figs. 1-8; Pl. 13, Figs. 5a-c).

Xestoleberis sp. 1 COIMBRA *et al*., 2013:297, Figs. 58-61; Tab. 4.

Type material. Holotype, MP-O-2474, ♀, RV, length: 0.42 mm; height: 0.22 mm. Paratypes. MP-O-2475, ♀, LV, length: 0.41 mm; height: 0.22 mm; MP-O-2476, ♀, carapace, width: 0.19 mm; length: 0.40 mm. MP-O-2477, ♂, RV, length: 0.44 mm; height: 0.21 mm.

Etymology. From Brasil and the Latin origin, *insularis* = of an island, because of its record being restricted to an archipelago.

Type locality. Archipelago of São Pedro and São Paulo, Equatorial Atlantic.

Occurrence. See table II.

Diagnosis. Small-sized and relatively thin carapace. Subovate elongate to subrectangular in lateral view; ovate-elongate in dorsal view. Greatest length just below mid-height. Greatest height just posterior mid-length. Anterior margin obliquely rounded, with apex in the lower third. Posterior margin subtruncated. Surface typically

smooth with two types of normal pore canals: sieve-type and lip-type. A very delicate flange, more developed in RV, runs along the anterior and ventral margins.

Table II. Occurrence and abundance of living and dead *Xestoleberis brasilinsularis* sp. nov. recovered at the ASPSP, Equatorial Atlantic.

Sample number	Substrate (Algae/Sediment)	Depth (~m)	Adults	Juveniles
M 1003-N	Sediment	5	6c, 4v	3c, 5v
M 1004-N	Sediment	5	-	6v
M 1005-N	Sediment	5	1c	1v
M 1010-N	Sediment	10	1c, 2v	2v
M 1012-N	Sediment	11	1c, 3v	1v
M 1014-N	Sediment	11	1c, 1v	1v
M 1023-N	Algae (*Caulerpa racemosa*)	4	1v	1v
M 1025-N	Algae (*Caulerpa racemosa*)	4	1v	9v
M 1030-N	Algae sp. 2	5	1v	3v
M 1031-N	Algae (*Caulerpa racemosa*)	5	1v	4v
M 1036-N	Algae sp. 2	5	-	1v

Description. A relatively thin-shelled and small-sized species of *Xestoleberis*. Subovate elongate to subrectangular in lateral view. In dorsal view, ovate-elongate. In ventral view, flattened. LV overlapping RV mainly anteriorly and posteroventrally. Maximum length just below mid-height. Maximum height just posterior mid-length. Maximum width posteriorly. Anterior margin obliquely rounded, with apex in the lower third. Posterior margin subtruncated. Dorsal margin moderately arched. Ventral margin sinuous near the middle, more conspicuously in RV. Surface typically smooth with two types of normal pore canals (*sensu* SATO & KAMIYA, 2007): sieve-type and lip-type. A very delicate flange, more developed in RV, runs along the anterior and ventral margins. In living specimens, some very short marginal bristles overlaps the flange forming a false delicate reticulum when photographed by SEM (see Figs 3, 9). *Xestoleberis*-spot small and almost invisible; around it there is a milky patch. Inner lamella wide at anterior, narrow ventrally and posteriorly. Line of concrescence and inner lamella widely separated anteriorly, forming a large vestibulum. Posterior vestibulum very

small, visible only in large magnification. Selvage subperipheral in both valves, bending outwards in the oral region. Marginal pore canals numerous and short, mostly simple and straight, as typical for the genus. Hinge hemimerodont, with well-developed crenulate terminal teeth in RV; median element smooth. Central muscle scars constituted by four adductors vertically aligned and a frontal U-shaped. Two mandibular scars below in front. Sexual dimorphism present: females more inflated posteriorly, somewhat more height and with a more marked oral concavity. Males more rounded posteriorly.

Remarks. *Xestoleberis brasilinsularis* sp. nov. was identified by ANTONIETTO *et al.* (2012) as *Xestoleberis toni*? WOUTERS, 2003. However, as already briefly discussed by COIMBRA *et al.* (2013), these two taxa are not conspecific. In fact, they have not only different outlines, but also different central muscle scars pattern and *Xestoleberis* spot, that is larger in the species described by WOUTERS (2003) for Cape Verde Islands. The new species does not fit well in any *Xestoleberis* morphological group proposed by BONADUCE & DANIELOPOL (1988) neither by SATO & KAMIYA (2007).

Xestoleberis machadoae **sp. nov.**

(Figs 14-24)

Xestoleberis sp. 1 ANTONIETTO *et al.*, 2012:40-41, Figs. 6:13-20; Tab. 9.
Xestoleberis sp. 2 COIMBRA *et al*., 2013:297, Figs. 62-66; Tab. 4.

Type material. Holotype, MP-O-2478, ♀, RV, length: 0.34 mm; height: 0.19 mm. Paratypes. MP-O-2466, ♂, RV, length: 0,28 mm; height: 0,13 mm; MP-O-2479, ♀, LV, length: 0.33 mm; height: 0.16 mm; MP-O-2480, ♀, carapace, width: 0.21 mm; length: 0.32 mm; MP-O-2481, ♂, RV, length: 0.33 mm; height: 0.16 mm; MP-O-2482, ♂, LV, length: 0.34 mm; height: 0.16 mm; MP-O-2483, ♂, carapace, width:0.19 mm; length: 0.33 mm.

Etymology. This species was named in honor of Cláudia Pinto Machado, a friend of the authors, in recognition of her contribution to the study of Recent Brazilian shallow water marine ostracodes, and for her tireless willingness to collect ostracodes in inhospitable Brazilian oceanic islands.

Type locality. Archipelago of São Pedro and São Paulo, Equatorial Atlantic.

Occurrence. See table III.

Table III. Occurrence and abundance of living and dead *Xestoleberis machadoae* sp. nov. recovered at the ASPSP, Equatorial Atlantic.

Sample number	Substrate (Algae/Sediment)	Depth (~m)	Adults	Juveniles
M 1001-N	Algae (*Caulerpa racemosa*)	2	-	1c
M 1002-N	Algae sp. 1	2	1c	1c
M 1003-N	Sediment	5	15c, 32v	3c, 15v
M 1004-N	Sediment	5	20c, 7v	2c, 1v
M 1005-N	Sediment	5	17c, 11v	3v
M 1010-N	Sediment	10	1c, 1v	1v
M 1012-N	Sediment	11	2c	7c
M 1014-N	Sediment	11	3v	-
M 1017-N	Algae sp. 1	2	-	3v
M 1023-N	Algae (*Caulerpa racemosa*)	4	-	1c, 1v
M 1025-N	Algae (*Caulerpa racemosa*)	4	1v	1c, 1v
M 1030-N	Algae sp. 2	5	2v	-
M 1032-N	Algae (*Caulerpa racemosa*)	5	1v	-

Diagnosis. Carapace very small and relatively thin. Subrectangular elongate in lateral view; in dorsal view, oval in females and subpiriform in males. In ventral view, strongly flattened. Anterior margin obliquely rounded, projected ventrally, with an adjacent small sunken area. Posterior margin almost evenly rounded in RV, more narrowly rounded in LV. Surface predominantly smooth, with three different normal pore canals: sieve-type, simple-type and lip-type. In SEM, there are one very delicate anteroventral submarginal rib and two minor ribs behind it.

Description. A very small and relatively thin-shelled species of *Xestoleberis*. Subrectangular elongate in lateral view. In dorsal view, strongly inflated and ovate. In ventral view, strongly flattened. LV overlapping RV mainly anteriorly and posterodorsally. Maximum length almost ventrally. Maximum height medially. Maximum width near the middle. Anterior margin obliquely rounded, projected ventrally, with a depressed region adjacent to it forming a well-defined small sunken

area. Posterior margin almost evenly rounded in RV, more narrowly rounded in LV. Dorsal margin moderately convex. Ventral margin almost straight, hidden by a lateral inflation more developed in LV. Surface predominantly smooth, with three patterns of normal pore canals (*sensu* SATO & KAMIYA, 2007): sieve-type, simple-type and lip-type. In SEM, there are one very delicate anteroventral submarginal rib and two minor ribs behind it. *Xestoleberis*-spot small and almost invisible. A large vestibulum is present anteriorly. Selvage subperipheral in both valves, bending outwards in the oral region. Marginal pore canals not numerous, simple and straight. Hinge hemimerodont, with delicately crenulate terminal teeth in RV; median element smooth. Central muscle scars constituted by four adductors vertically aligned and a frontal U-shaped. Mandibular scars not visible. Sexual dimorphism present. Males with a more arched dorsal margin and less developed lateral inflation in LV. In dorsal view, subpiriform. Maximum width posteriorly.

Remarks. *Xestoleberis machadoae* sp. nov. has less than 0.4 mm in length, exhibits elongate and dorsally gently convex valves in lateral view, hinge hemimerodont with slightly crenulate terminal teeth in RV and smooth hinge-bar in LV, and *Xestoleberis*-spot poor-developed, features typical of the *Xestoleberis arcturi* Triebel group of BONADUCE & DANIELOPOL (1988). Conversely, this new species does not fit well in any group proposed by SATO & KAMIYA (2007) for Japanese species.

DISCUSSION

The study of Recent and Quaternary ostracodes of the family Xestoleberididae in Brazil showed that the species of the genus *Xestoleberis* already identified are mainly under open nomenclature. Coimbra *et al.* (1992), analyzing the relationship of ostracodes, biofacies of foraminifers and lithofacies in the coralline Bay of Tamandaré (NE Brazil), identified *Xestoleberis* spp. only in the carbonate lithofacies. Coimbra *et al.* (1999) recorded *Xestoleberis* sp. 1 along the entire equatorial shelf, while *Xestoleberis* sp. 2 was identified only in the most western portion of that region. Machado *et al.* (2005), studying very shallow water ostracodes off Cabo Frio town (~22°S), in the State of Rio de Janeiro, identified *Xestoleberis umbonata* Whatley *et al.*, 1998, one of the dominant ostracod species in their material. BERGUE & COIMBRA (2008), in a study of littoral benthic meiofauna of the State of São Paulo, recorded only five specimens of a species of this genus that remained in open nomenclature. Coimbra

et al. (2009) and Coimbra & Carreño (2012), in a preliminary study of ostracodes from the Trindade Island (20º30'S, 29º18'W) and Rocas Atoll (03°52'S, 33°9'W), two oceanic Brazilian islands, recorded *Xestoleberis* sp. in Trindade and *Xestoleberis* spp. in Rocas. Coimbra *et al*. (2013), as already briefly presented in the introduction of this paper, also discussed preliminarily the two taxa herein formally described. In that paper, the authors outlined a first comparison among the ostracod fauna of three Brazilian oceanic islands (ASPSP, Trindade and Rocas) and discussed the dispersal and potential of colonization of isolated oceanic islands by benthic ostracodes. Finally, the first author, examining 377 samples recovered from the north and northeastern Brazilian shelf, found four unidentified species of *Xestoleberis* that will be studied in an ongoing project.

A comparison of all species of *Xestoleberis* above discussed with the two new species of this genus described for the ASPSP, revealed no similarity among *X. brasilinsularis* sp. nov., *X. machadoae* sp. nov. and any of those taxa.

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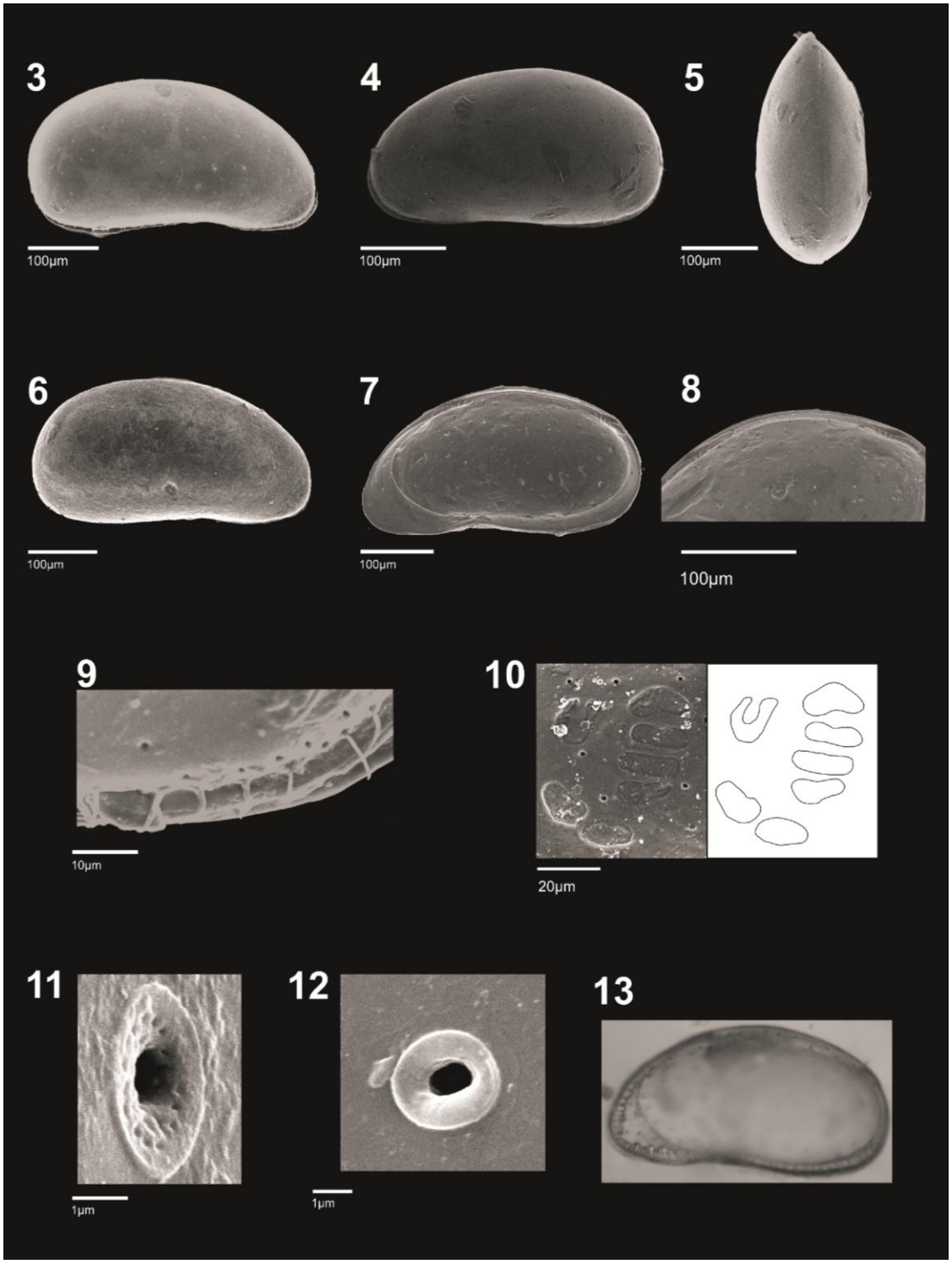

Figure 3-13. *Xestoleberis brasilinsularis*. 3, MP-O-2474, ♀, RV; 4, MP-O-2475, ♀, LV; 5, MP-O-2476, ♀, c, dorsal view; 6, MP-O-2477, ♂, RV; 7, MP-O-2477, ♂, RV, internal view; 8, MP-O-2474, ♀ RV, hinge; 9, MP-O-2476, ♀, c, flange; 10, MP-O-2477, ♂, RV, central muscle scars; 11, MP-O-2474, ♀, c, sieve-type pore; 12, MP-O-2476, ♀, c, lip-type pore; 13, MP-O-2474, ♀, RV, internal view, not in scale.

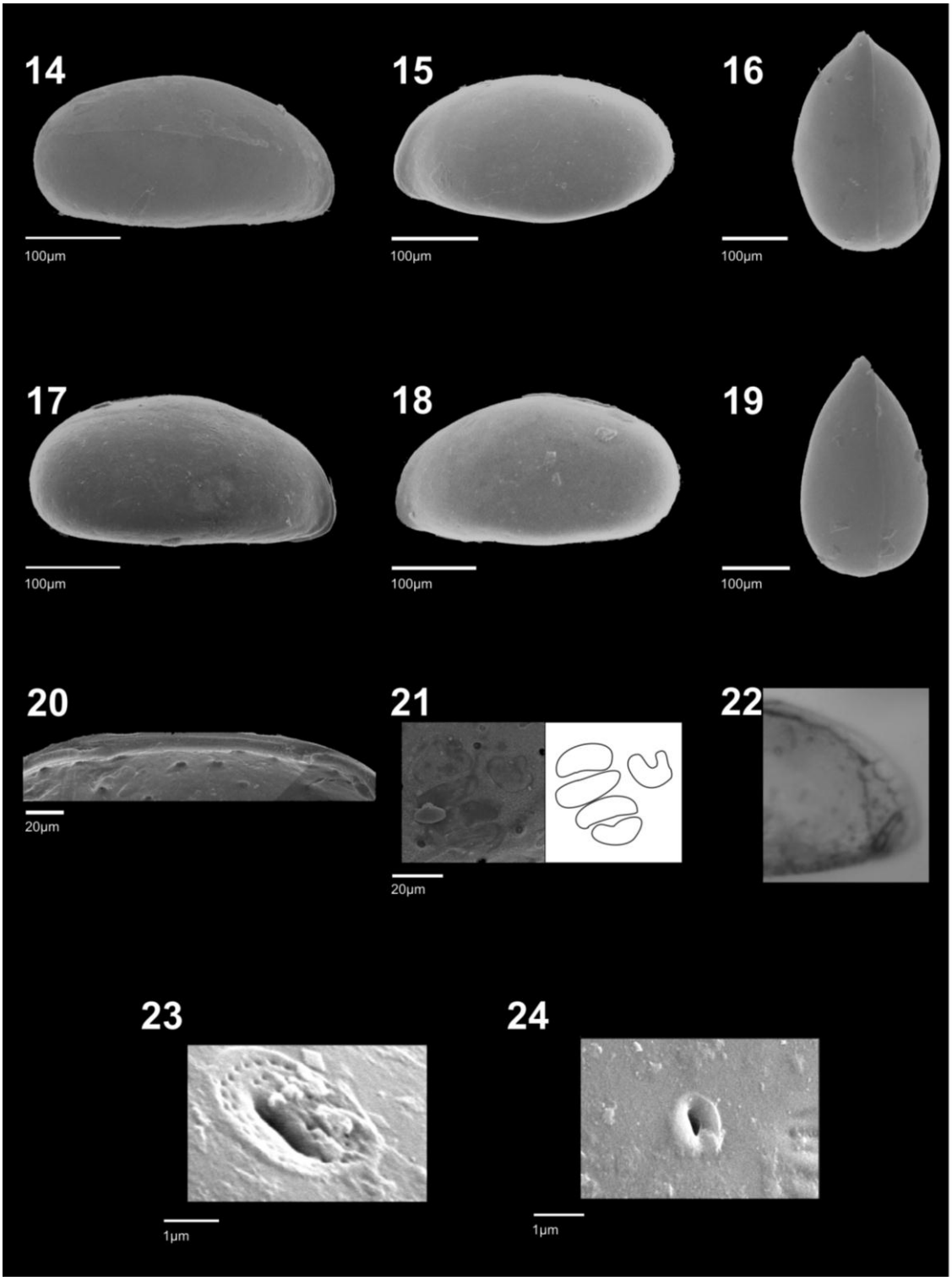

Figure 14-24. *Xestoleberis machadoae*. 14, MP-O-2478, ♀, RV; 15, MP-O-2479, ♀, LV; 16, MP-O-2480, ♀, c, dorsal view; 17, MP-O-2481, ♂, RV; 18, MP-O-2482, ♂, LV; 19, MP-O-2483, ♂, c, dorsal view; 20, MP-O-2481, ♂, RV hinge; 21, MP-O-2466, ♂, RV, central muscle scars; 22, MP-O-2481, ♂, anterior margin, not in scale; 23, MP-O-2478, ♀, RV, sieve-type pore; 24, MP-O-2478, ♀, RV, lip-type pore.

CAPÍTULO 3

MANUSCRITO 2

(Em processo de submissão à revista Zootaxa)

The genus Xestoleberis (Ostracoda: Xestoleberididae) in the Northern, Northeastern and Eastern regions of Brazilian continental shelf

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Abstract. The analysis of 359 samples from three regions of Brazilian continental shelf (Northern, Northeastern and Eastern) resulted in the recognition of six species of the genus *Xestoleberis*. One of these species was already described, *X. umbonata* Whatley *et al.*, four species are new and herein described, *X. inesae* sp. nov., *X. amazonica* sp. nov., *X. subtriangularis* sp. nov. and *X. virilis* sp. nov., and one was maintained at open nomenclature, *Xestoleberis* sp. The species *X. inesae* sp. nov. is widely distributed in the study area, occurring along all regions while *X. amazonica* sp. nov. is restricted to the Northern region. *Xestoleberis subtriangularis* sp. nov., *X. virilis* sp. nov. and *Xestoleberis* sp. occur in the Northeastern and Eastern regions. *Xestoleberis umbonata* Whatley *et al.* was recorded in this study only in the south of the Eastern region, around Cabo Frio town.

Key words: New species, Ostracoda, South Atlantic Ocean, Taxonomy.

Introduction

The Brazilian continental shelf extends to about 8,000 km, from Orange Cape (~4°N) to Chui (~33°S) and comprises different climate zones, resulting in a differentiated input of the hydrographic network. The discharge focuses mainly in two sites of the shelf: in the north, with the Amazon River system, and in the south, with Prata River (Muehe & Garcez 2005). In the northern portion, the continental shelf

reaches a width of 330 km, close to the Amazon River mouth, and in the southeastern/southern reaches 200-220 km (Knoppers *et al*. 2002).

In this context of a great variability of climate zones and continental input in the Brazilian shelf, an abundant and representative assemblage of ostracods is found. These crustaceans have being studied in last decades for taxonomic, zoo and palaeozoogeographical purposes, besides ecologic studies (*e.g*. Pinto *et al.* 1978, Coimbra & Ornellas 1989, Coimbra *et al.* 1992, 1999, Carmo & Sanguinetti 1999, Brandão 2004, Machado *et al*. 2005, Machado 2008, Ramos *et al*. 2014). *Xestoleberis*, a cosmopolitan genus of Xestoleberididae, was recorded from north (Coimbra *et al.* 1999) to south of the Brazilian shelf (Whatley *et al.* 1998, Machado 2005) and in the Brazilian oceanic islands (Coimbra *et al.* 2009, Antonietto *et al.* 2012, Coimbra & Carreño 2012, Coimbra *et al.* 2013). The genus is relatively easy to recognize by its frequently subovate and smooth carapace, but the similarities among species of *Xestoleberis* difficult the identification of singular species, which contributes to keep them in open nomenclature as discussed by Titterton & Whatley (2005).

The present work aims to contribute to the knowledge of the genus *Xestoleberis* along the most part of the Brazilian continental shelf, revealing the number of species, identifying and describing new taxa, as well as discussing their geographical distribution.

Material and Methods

The Brazilian continental shelf is placed on the occidental board of South Atlantic, whose acting system of oceanic currents is represented by the North Brazil Current (or Guianas Current) and Brazil Current. Based on geographic and geomorphological criteria, the continental shelf can be divided into five regions (Silveira 1964, Muehe 1998, Muehe & Garcez 2005). From north to south in continental margin: (1) Northern Region, from Orange Cape (AP) to Parnaiba Delta (PI); (2) Northeastern Region, from Parnaiba Delta (PI) to Belmonte (BA); (3) Eastern Region, from Belmonte (BA) town to Cabo Frio town (RJ); (4) Southeastern Region, from Cabo Frio (RJ) to Santa Marta Cape (SC) and (5) Southern Region, from Santa Marta Cape (SC) to Chui (RS) (Fig. 1).

The study material came from three regions: Northern, Northeastern and Eastern. The Northern region corresponds to the Amazon or Equatorial shelf as defined

by Silveira (1964) and has the wider platform, about 330 km off the Amazon River mouth. The bottom sediments are predominantly terrigenous and it coast is marked by a complex system of deltas and estuaries due to the influence of Amazon River. The Northeastern is characterized by a narrow shelf and carbonate sediments. Plateaus, marginal terraces, seamounts and sandstone reefs are noteworthy features of this region. In the Eastern region predominates carbonate facies and a great number of beach ridges (Martins & Coutinho 1981). In this region is observed the Transitional Zone defined by Coimbra & Ornellas (1989) and redefined by Coimbra *et al.* (1995) localized between the latitudes 15°01'S and 23°S. The three regions herein studied share in common warm waters. On the other hand, below the Transitional Zone the temperature is cold. For more details, see Castro & Miranda (1996) and Silveira *et al*. (2000).

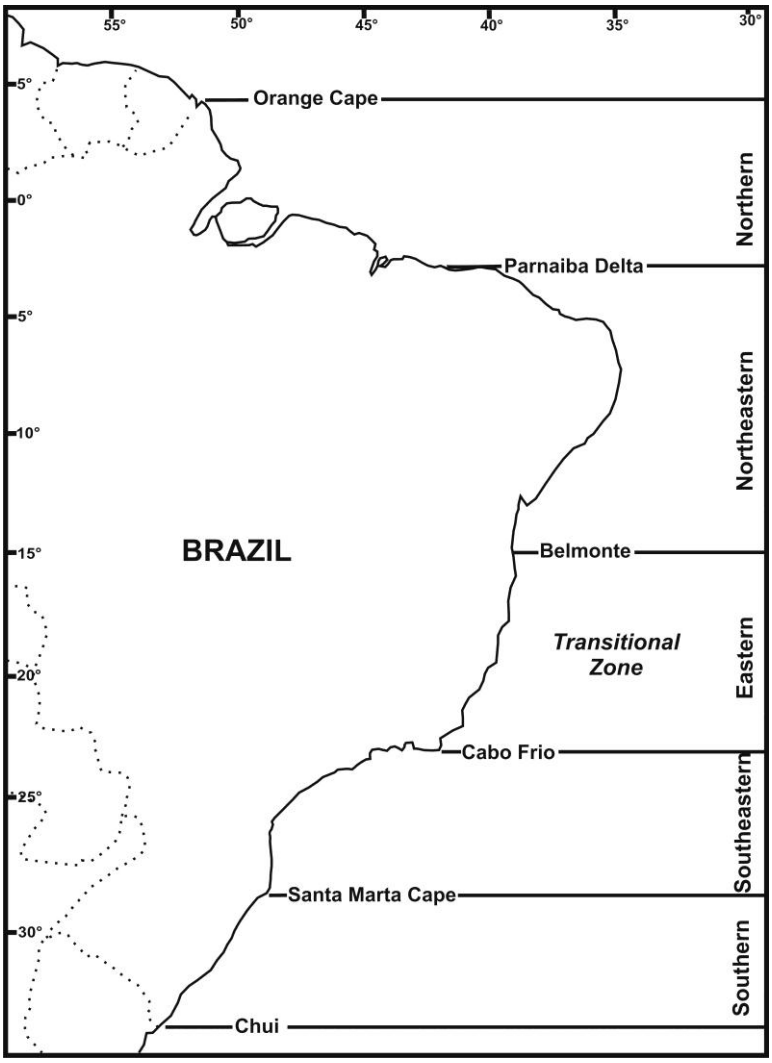

Figure 1. Map of the Brazilian continental shelf and its regions zonation (Modified from Muehe & Garcez 2005).

The 359 samples analyzed in the present study were collected by REMAC (Legs 4 to 7) and GEOMAR (Legs I, II and III) projects. The sampling was made by van Veen and Phillips grabs techniques, with a depth range about 11 to 280 m. The material was provided as dried sediment and each sample had been sieved into three different size fractions: 0.250, 0.177 and 0.074 mm. Only the two first size fractions were picked totally for Ostracoda while the last one was too fine and frequently barren.

The specimens herein examined are held in the collections of the 'Museu de Paleontologia', Universidade Federal do Rio Grande do Sul (UFRGS), Section of Ostracoda. The figured material is identified by the prefix MP-O. The scanning electronic microscopy (= SEM) photographs were taken at the 'Centro de Microscopia Eletronica' at UFRGS.

Morphological abbreviations: LV, left valve; RV, right valve.

Taxonomy

Subclass OSTRACODA Latreille

Order PODOCOPIDA Müller

Superfamily XESTOLEBERIDOIDEA Sars

Family XESTOLEBERIDIDAE Sars

Genus *Xestoleberis* Sars

***Xestoleberis umbonata* Whatley *et al.* 1998**
Fig. 3:13–14

1998 Whatley *et al.*, p. 112, pl. 6, figs. 13–18.
2005 Machado *et al*., p. 252, pl. IV, fig. 13, tabs. 1–2.
2008 Machado, p.126, tab. V.

Material. 115 specimens.

Figured specimens. MP-O-1606 and MP-O-1607.

Occurence and distribution. In the present study, this species occurs in the south of the Eastern region from Brazilian continental Shelf, around Cabo Frio town (Fig. 2). *Xestoleberis umbonata* was first recorded in recent sediments of Argentina by Whatley *et al.* (1998). Ramos (1998) also recorded *X. umbonata* in the Southern region of Brazil

where is quite abundant. According to Machado *et al*. (2005), *X*. *umbonata* is one of the dominant species off Cabo Frio.

***Xestoleberis inesae* sp. nov.**
Fig. 3:1–12

1999 *Xestoleberis* sp. 1 Coimbra *et al.*, pl. 3, fig. 7; tab. 1.
2008 *Xestoleberis* sp. 1 Machado, p. 127, pl. 5, figs. 18–19, tab. VI, VIII.

Type series. Holotype: MP-O-1608, adult female, carapace width: 0.38 mm; RV length 0.54 mm, height 0.36 mm; RV length: 0.57 mm, height 0,36 mm. Paratypes, two adult males (MP-O-1609 and MP-O-1610), one adult female (MP-O-1611) and one juvenile (MP-O-1612).

Type locality. REMAC/Leg 7 – Sample 3820 (16°24.5'S/38°35'W); depth: 51 m; sediment: carbonate gravel and sand.

Etymology. In honor of Maria Inês Feijó Ramos, in recognition of her contribution to the knowledge of Recent and fossil ostracods from Brazil.

Material. 245 specimens.

Dimensions. See table 1.

TABLE 1. Dimensions of *Xestoleberis inesae* sp. nov.

Material	Length (mm)	Height (mm)	Width (mm)
Male			
MP-O-1609 (RV)	0.52	0.31	-
MP-O-1609 (LV)	0.53	0.32	-
MP-O-1610 (carapace)	0.53	-	0.33
Female			
MP-O-1611 (RV)	0.53	0.35	-
Juvenile			
MP-O-1612 (RV)	0.45	0.29	-

Diagnosis. A large-sized species of *Xestoleberis*. Carapace subovate in lateral view with ventral margin almost straight and posterior margin truncated ventrally. LV

overlapping RV in almost all the entire margin. Surface smooth with lip-type pore canals and not well-defined large opaque patches. *Xestoleberis*-spot conspicuous, long and outlined. Hinge antimerodont with robust terminal teeth in RV. Adductors muscle scars with an oblique V-shaped spot in the top. Frontal scar V-shaped.

Description. A large and thick-shelled species of *Xestoleberis*. Subovate in lateral view. In dorsal view subovate. Flattened in ventral view. LV overlapping RV in almost all the entire margin, except anteroventrally, posteroventrally and somewhat at the anterior cardinal angle. Maximum length in the lower third of the height. Maximum height medianly. Maximum width posteriorly. Anterior margin obliquely rounded and protruded. RV posterior margin rounded dorsally and truncated ventrally. LV posterior margin evenly rounded. Dorsal margin convex. Ventral almost straight. Surface typically smooth, with lip-type pore canals (*sensu* Sato & Kamiya 2007) and not well-defined large opaque patches. Eye-spot inconspicuous. *Xestoleberis*-spot conspicuous, long and outlined. Inner lamella separated from line of concrescence anterior and posteriorly, forming two small vestibula. Selvage peripheral in both valves, except mid-ventrally. Straight and spaced marginal pore canals. Hinge antimerodont, with numerous very well-developed teeth in RV and sockets in LV. Median element crenulate. Central muscle scars constituted by four adductors vertically aligned: from the base to the top, the two first adductors scars are subelliptical, the third one somewhat rounded and the last one oblique and V-shaped; a frontal U-shaped and two mandibular scars. Sexual dimorphism present: male less flattened ventrally than female, with dorsal margin more inclined. In dorsal view, female more inflated than male.

Remarks. *Xestoleberis inesae* sp. nov. has a similar outline to *Xestoleberis margaritea* (Brady) described firstly in recent samples of Europe and identified by Bold (1963) in Miocene and Pleistocene of Trinidad. The species differ from each other by papillae in surface of *X. margaritea* not observed in the species herein described, which surface is quite smooth; the posterior margin is more rounded in *X. margaritea*. *Xestoleberis inesae* sp. nov. is also similar to the female of *Xestoleberis virilis* sp. nov., differing by the anterior margin more protruded and dorsal margin more convex in the first one. Besides, the *Xestoleberis*-spot of *X. virilis* sp. nov. is smaller and divided in two parts.

Occurrence and distribution. *Xestoleberis inesae* sp. nov. occurs along the Northern, Northeastern and Eastern regions of Brazilian continental shelf (Fig. 2). This

species is the most abundant species of this genus between Orange Cape and town of Cabo Frio.

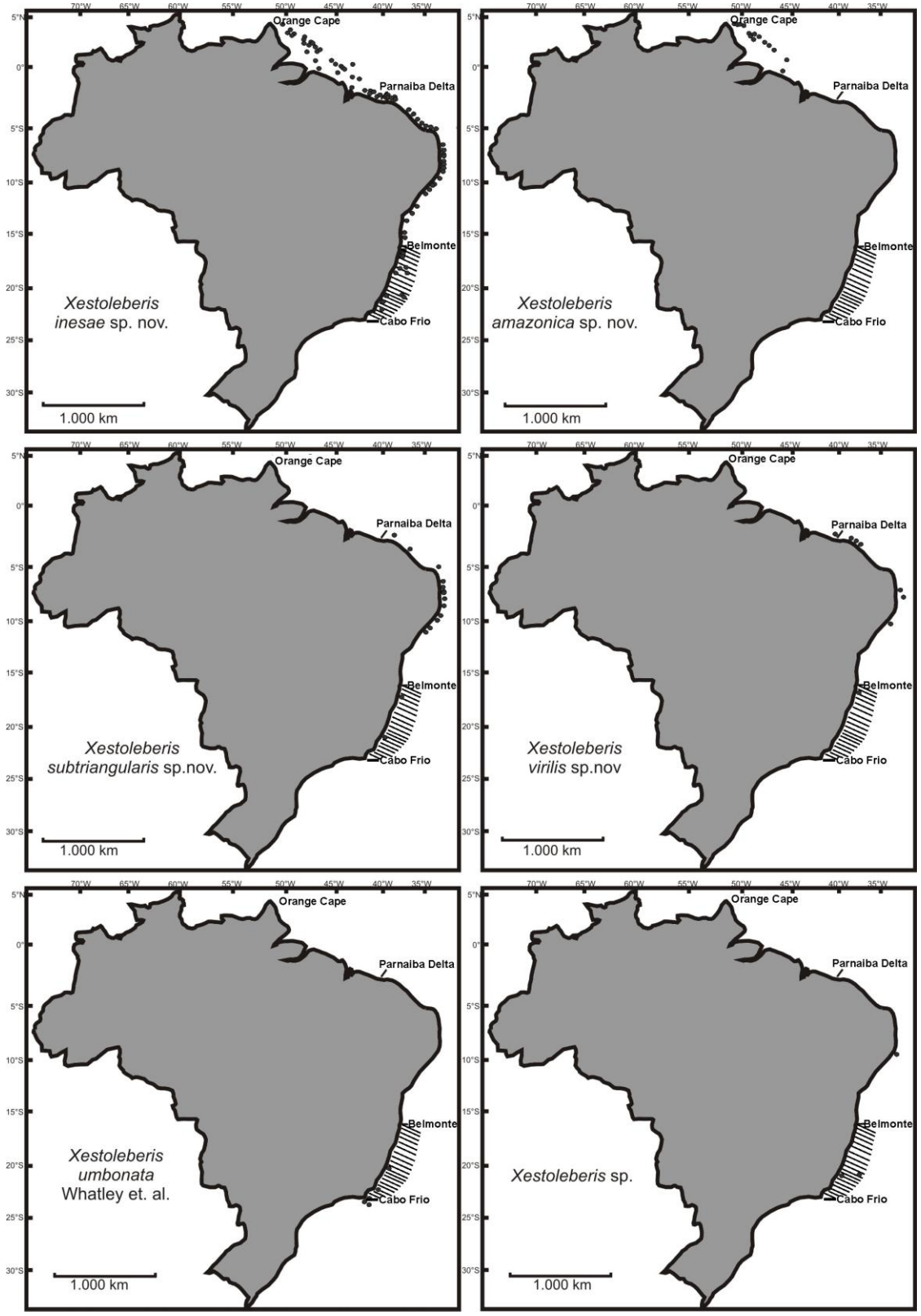

Figure 2. Distribution of *Xestoleberis* species in the Brazilian continental shelf. The hatched area corresponds to the Transitional Zone of Coimbra *et al.* (1995).

***Xestoleberis amazonica* sp. nov.**
Fig. 4:1–14

1999 *Xestoleberis* sp. 2 Coimbra *et al.*, tab. 1.

Type series. Holotype: MP-O-1938, adult female, RV length 0.48 mm, height: 0.32 mm. Paratypes, three adult males (MP-O-1939–MP-O-1941) and two adult females (MP-O-1942 and MP-O-1943).

Type locality. GEOMAR/Leg III – Sample 210 (04°35.5'N/50°21'W); depth: 104 m; sediment: sand and bioclasts.

Etymology. With reference to the restrict distribution of the species to the Amazon region.

Material. 90 specimens.

Dimensions. See table 2.

TABLE 2. Dimensions of *Xestoleberis amazonica* sp. nov.

Material	Length (mm)	Height (mm)	Width (mm)
Male			
MP-O-1939 (RV)	0.45	0.30	-
MP-O-1939 (LV)	0.47	0.32	-
MP-O-1940 (carapace)	0.46	-	0.28
MP-O-1941 (LV)	0.46	0.29	-
Female			
MP-O-1942 (LV)	0.50	0.35	-
MP-O-1943 (carapace)	0.50	-	0.32

Diagnosis. A medium-sized *Xestoleberis* species. Carapace almost drop-shaped in lateral view with sinuous ventral margin. LV overlapping RV, except in ventral margin. Surface smooth with sieve-type, lip-type and simple-type normal pore canals. *Xestoleberis*-spot small, outlined and divided in two parts. Hinge antimerodont with median element crenulate and short. Adductor muscle scars a row of four subelliptical scars and frontal V-shaped.

Description. A medium and thick-shelled species of *Xestoleberis*. Somewhat drop-shaped in lateral view. In dorsal view ovate. Flattened in ventral view. LV overlapping RV, except in ventral margin. Maximum length in the last third of the height. Maximum height medianly. Maximum width just below the middle. Anterior margin obliquely rounded, protruded and pointed ventrally. Posterior margin similar in both valves but slightly more rounded in LV. Dorsal margin arched. Ventral margin slightly convex anteriorly. Surface typically smooth, with three patterns of normal pore canals (*sensu* Sato & Kamiya 2007): sieve-type, lip-type and simple-type. Eye-spot inconspicuous. *Xestoleberis*-spot small, outlined and divided in two parts. Line of concrescence and inner lamella separated anterior and posteriorly, forming a relatively large vestibulum at the anterior end. Selvage peripheral in anterior margin and subperipheral in posterior margin. Marginal pore canals simple, straight and short. Hinge antimerodont, with well-developed teeth in posterior and anterior elements. Both terminal teeth in RV. Median element crenulate and short. Adductors muscle scars a row of four subelliptical scars, the ventral-median more elongate. Frontal muscle scar V-shaped. Sexual dimorphism present: female conspicuously large than male and more rounded in RV. In dorsal view male less tumid at the posterior end.

Remarks. *Xestoleberis amazonica* sp. nov. has a similar shape to *X. rigusa* Müller, described to Antarctica. However, *X. rigusa* is greater and more inflated in dorsal view than *X. amazonica* sp. nov. Both species also differ from each other in the pattern of *Xestoleberis*-spot, which is small and divided in two parts in the species herein described.

Occurrence and distribution. *Xestoleberis amazonica* sp. nov. occurs along the Northern region of the Brazilian continental shelf (Fig. 2). This species was already recorded by Coimbra *et al.* (1999) in open nomenclature. It is restricted to the area between Orange Cape and Parnaiba Delta.

***Xestoleberis subtriangularis* sp. nov.**
Fig. 5:1–11

Type series. Holotype: MP-O-1692, adult female, RV length 0.54 mm, height 0.35 mm. Paratypes, one adult male (MP-O-1693) and four adult females (MP-O-1694–MP-O-1697).

Type locality. REMAC/Leg 7 – Sample 3767 (9°19.5'S/35°03'W); depth: 44 m; sediment: biodetritical sand.

Etymology. With reference to the shape of carapace in lateral view.

Material. 38 specimens.

Dimensions. See table 3.

TABLE 3. Dimensions of *Xestoleberis subtriangularis* sp. nov.

Material	Length (mm)	Height (mm)	Width (mm)
Male			
MP-O-1693 (RV)	0.51	0.32	-
MP-O-1693 (LV)	0.52	0.33	-
Female			
MP-O-1694 (LV)	0.55	0.35	-
MP-O-1695 (carapace)	0.50	-	0.32
MP-O-1696 (RV)	0.50	0.30	-
MP-O-1697 (RV)	0.49	0.30	-

Diagnosis. A medium-sized species of *Xestoleberis*. Carapace extremely tumid, subtriangular in lateral view. LV overlapping RV at the anterior and posterior ends. A very small and inconspicuous, flange more developed in RV, runs along the antero- and posteroventral margins. Eye-spot conspicuous and large, visible in transmitted light. Hinge antimerodont with median element coarsely crenulate. Adductors scars subelliptical and frontal spot somewhat rounded.

Description. A medium and thick-shelled species of *Xestoleberis*. Subtriangular in lateral view; subpiriform and strongly inflated in dorsal view; quite flattened in ventral view. LV overlapping RV at the anterior and posterior ends. Maximum length in the lower third of the height. Maximum height almost in the middle. Maximum width at the posterior third. Anterior margin sloping obliquely anterodorsally and somewhat pointed anteroventrally. Posterior subtruncated in RV and asymmetrically rounded in LV. Dorsal margin strongly arched. Ventral margin slightly convex. A very small and few conspicuous flange, more developed in RV, runs along the antero- and posteroventral margins. Surface typically smooth with two types of normal pore canals (*sensu* Sato &

Kamiya 2007): sieve-type and lip-type. Eye-spot conspicuous and large, visible in transmitted light. *Xestoleberis*-spot long and narrow. Inner lamella relatively wide and with a well-defined anterior vestibulum; posterior vestibulum very narrow. Selvage peripheral, except ventrally. Marginal pore canals sparse, simple and straight. Hinge antimerodont with terminal teeth in RV and well-developed anterior element. Median element coarsely crenulate. Central muscle scars a vertical row of four subelliptical adductors; frontal scar somewhat rounded. Sexual dimorphism present: male less flattened ventrally, a little more triangular in lateral view and less width in dorsal view.

Remarks. *Xestoleberis subtriangularis* sp. nov. differs from all other species herein studied mainly in the subtriangular shape in lateral view and the conspicuous eye-spot. This species is similar to *X. ferax* Klie described to the South-West Africa (Namibia), differing in the posterior end, which is more rounded in the African species. Also, the carapace of *X. subtriangularis* sp. nov. is more tumid and the *Xestoleberis*-spot is longer and not outlined.

Occurrence and distribution. *Xestoleberis subtriangularis* sp. nov. occurs along the Northeastern and Eastern regions of the Brazilian continental shelf (Fig. 2).

***Xestoleberis virilis* sp. nov.**
Fig. 6:1–11

Type series. Holotype: MP-O-1814, adult male, carapace width 0.24 mm; RV length 0.47 mm, height 0.30 mm; LV length 0.48 mm; height 0.31 mm. Paratypes, one adult male (MP-O-1815) and one adult female (MP-O-1816).

Type locality. REMAC/Leg 7 – Sample 3935 (21°02'S/40°36'W); depth: 17 m; sediment: carbonate sand, gravel and some red algae.

Etymology. With reference to the greater number of male specimens.

Material. 15 specimens.

Dimensions. See table 4.

Diagnosis. A medium-sized species of *Xestoleberis*. Carapace subretangular in lateral view. LV overlapping RV in almost entire margin, except antero- and posteroventrally. Posterior margin sloping obliquely posteroventrally. Surface smooth with simple pore canals. *Xestoleberis*-spot conspicuous, outlined and divided in two parts. Hinge antimerodont with median element quite long. Four adductor muscle scars

with dorsal one almost divided in half and ventral scar subovate. Frontal muscle scar U-shaped.

TABLE 4. Dimensions of *Xestoleberis virilis* sp. nov.

Material	Length (mm)	Height (mm)	Width (mm)
Male			
MP-O-1815 (LV)	0.49	0.32	-
Female			
MP-O-1816 (RV)	0.51	0.34	-
MP-O-1816 (carapace)	0.53	0.35	-

Description. A medium and thick-shelled species of *Xestoleberis*. Subretangular in lateral view. Subovate in dorsal view. Flattened in ventral view. LV overlapping RV in almost entire margin, except in antero- and posteroventrally. Maximum length just below mid-height. Maximum height near mid-length. Maximum width medianlly. Anterior margin asymmetrically rounded. Posterior margin sloping obliquely posteroventrally. Dorsal margin arched. Ventral margin slightly sinuous. Surface typically smooth with simple-type pore canals (*sensu* Sato & Kamiya 2007). Eye-spot inconspicuous. *Xestoleberis*-spot conspicuous, outlined and divided in two parts. Line of concrescence separated from inner lamella forming a relatively large vestibulum anteriorly and a narrow one posteroventrally. Selvage peripheral anterior and posteriorly, subperipheral ventrally. Marginal pore canals numerous, simple and straight. Hinge antimerodont with terminal teeth in RV; median element crenulate quite long. Adductors muscle scars a row of four scars, the dorsal almost divided in half, the dorsal-median and ventral median subelliptical, the ventral somewhat rounded and subcordate; frontal muscle scar U-shaped. Sexual dimorphism present: female conspicuous larger than male and more flattened ventrally, with posterior end subtruncated in RV and a little more rounded in LV.

Remarks. This relatively rare species was described mainly based on the carapace of male from which were found much more specimens. The male and female of *Xestoleberis virilis* sp. nov. have important differences in outline what can be also observed in other species of this genus as *X. ramosa* Müller, from South Africa.

Occurrence and distribution. *Xestoleberis virilis* sp. nov. was recorded in the Northeastern and Eastern regions of the Brazilian continental shelf (Fig. 2).

***Xestoleberis* sp.**
Fig. 6:12–14

2008 *Xestoleberis* sp. 2 Machado, p. 128, pl. 5, figs. 20–21, pl. 6, fig. 1, tab. VI.

Figured specimen. MP-O-1898.

Locality. REMAC/Leg 7 – Sample 3791 (12º14'S/37º35'W); depth: 37 m; sediment: biodetritical sand.

Material. 8 specimens.

Dimensions. See table 5.

TABLE 5. Dimensions of *Xestoleberis* sp.

Material	Length (mm)	Height (mm)	Width (mm)
MP-O-1698 (carapace)	RV: 0.46 LV: 0.47	RV: 0.21 LV: 0.24	0.28

Description. A medium and moderately thick-shelled species of *Xestoleberis*. In lateral view, RV subretangular elongate; LV subovate elongate. In dorsal view, subovate and quite inflated. Strongly flattened ventrally. LV overlapping RV along dorsal, anterior and posterior margins. Maximum length almost ventrally. Maximum height in the middle. Maximum width in posterior third. In RV, anterior margin obliquely pronounced and narrowly rounded ventrally; posterior margin obliquely sloping, somewhat pointed ventrally. Dorsal margin somewhat straight and sloping backward; ventral margin almost straight. In LV, anterior margin obliquely pronounced and narrowly rounded; posterior asymmetrically rounded. Dorsal margin convex; ventral margin convex and somewhat sinuous. Surface typically smooth, with lip-type normal pore canals (*sensu* Sato & Kamiya 2007). Eye-spot inconspicuous. *Xestoleberis*-spot conspicuous and long. Hinge hemimerodont, with crenulate terminal teeth in RV and median element smooth. Adductor muscle scars a row of four subelliptical spots. Frontal scar not well-defined.

Remarks. *Xestoleberis* sp. is a very rare species. In the present paper, was recorded only eight specimens, considering adults and two juveniles, what hindered a more detailed morphological and taxonomical study.

Occurrence and distribution. *Xestoleberis* sp. occurs along the Northeastern and Eastern regions of the Brazilian continental shelf (Fig. 2).

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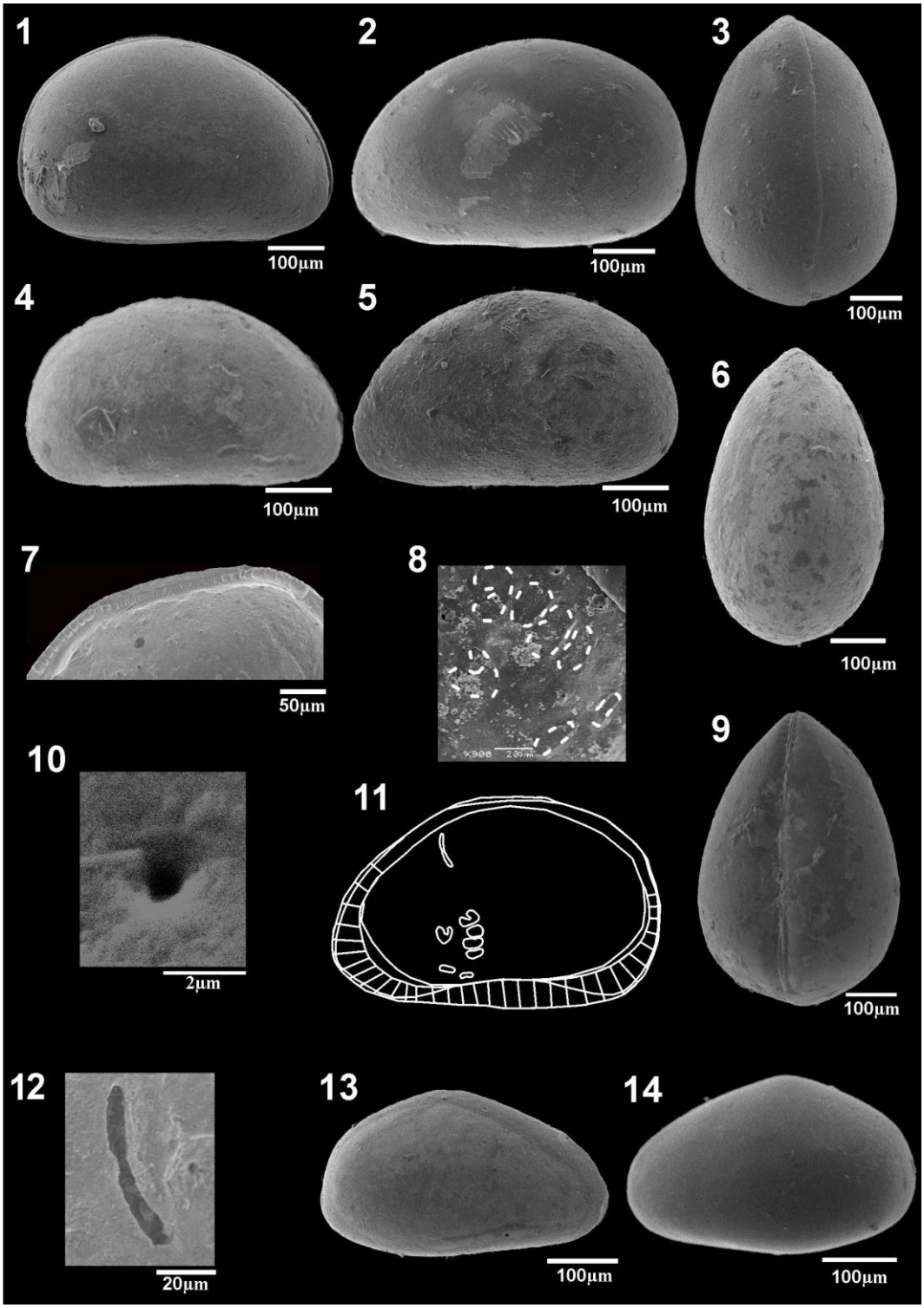

Figure 3. 1–12. *Xestoleberis inesae* sp. nov. 1. Female, RV (MP-O-1608, holotype). 2. Female, LV (MP-O-1608, holotype). 3. Female, dorsal view (MP-O-1608, holotype). 4. Male, RV (MP-O-1609). 5. Male, LV (MP-O-1609). 6. Male, dorsal view (MP-O-1610). 7. Hinge (MP-O-1611). 8. Central and mandibular muscle scars (MP-O-1612). 9. Female, ventral view (MP-O-1608, holotype). 10. Lip-type normal pore canal (MP-O-1608, holotype). 11. Schematic drawing of some RV internal features. 12. *Xestoleberis*-spot (MP-O-1607). 13–14. *Xestoleberis umbonata* Whatley *et al.* 1998. 13. Male, RV (MP-O-1606). 14. Male, LV (MP-O-1607).

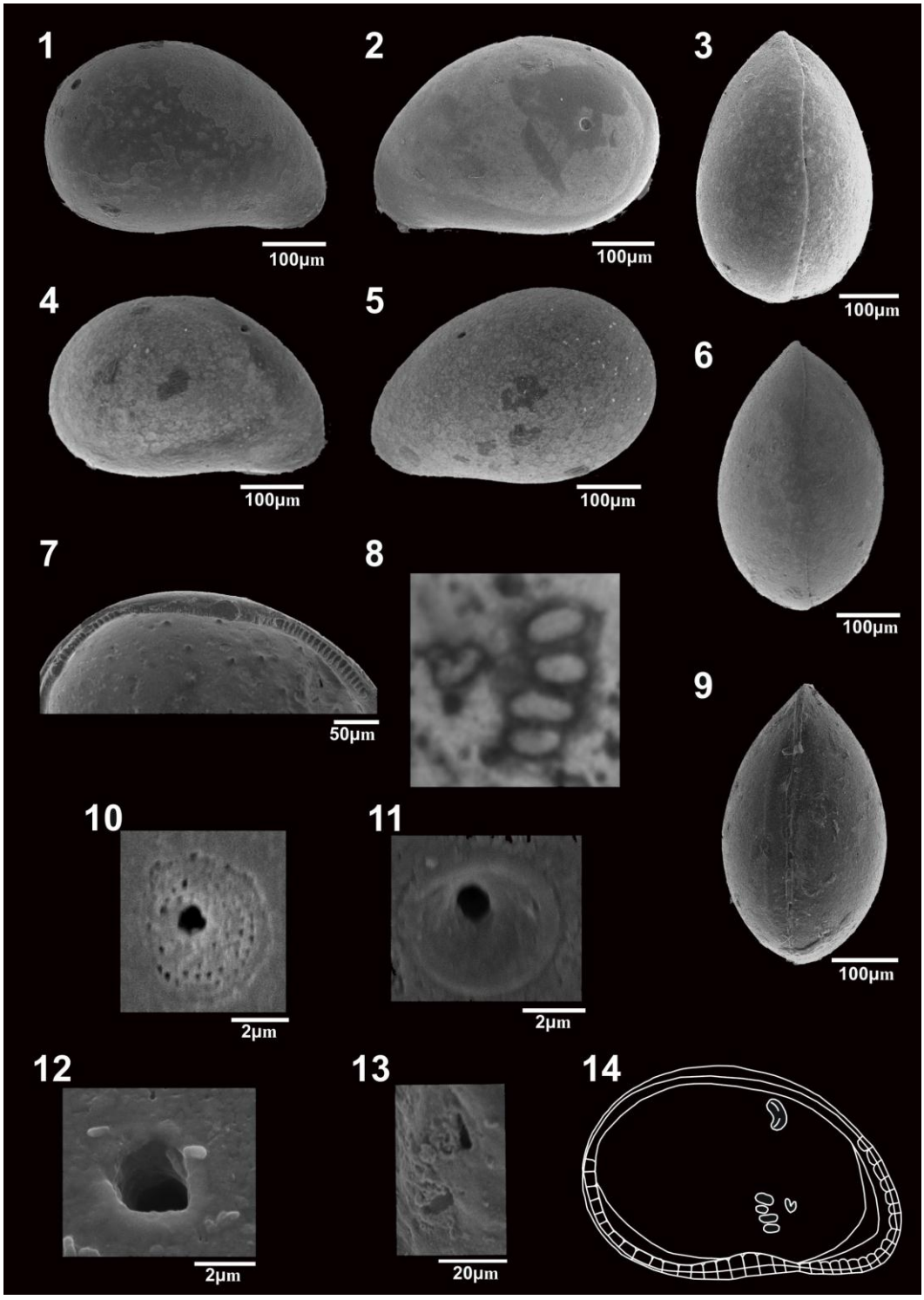

Figure 4. *Xestoleberis amazonica* sp. nov. 1. Female, RV (MP-O-1938, holotype). 2. Female, LV (MP-O-1942). 3. Female, dorsal view (MP-O-1943). 4. Male, RV (MP-O-1939). 5. Male, LV (MP-O-1939). 6. Male, dorsal view (MP-O-1940). 7. Hinge (MP-O-1942). 8. Central muscle scars (MP-O-1942), not in scale. 9. Male, ventral view (MP-O-1940). 10. Sieve-type normal pore canal (MP-O-1941). 11. Lip-type normal pore canal (MP-O-1941). 12. Simple-type normal pore canal (MP-O-1941). 13. *Xestoleberis*-spot (MP-O-1942). 14. Schematic drawing of some LV internal features.

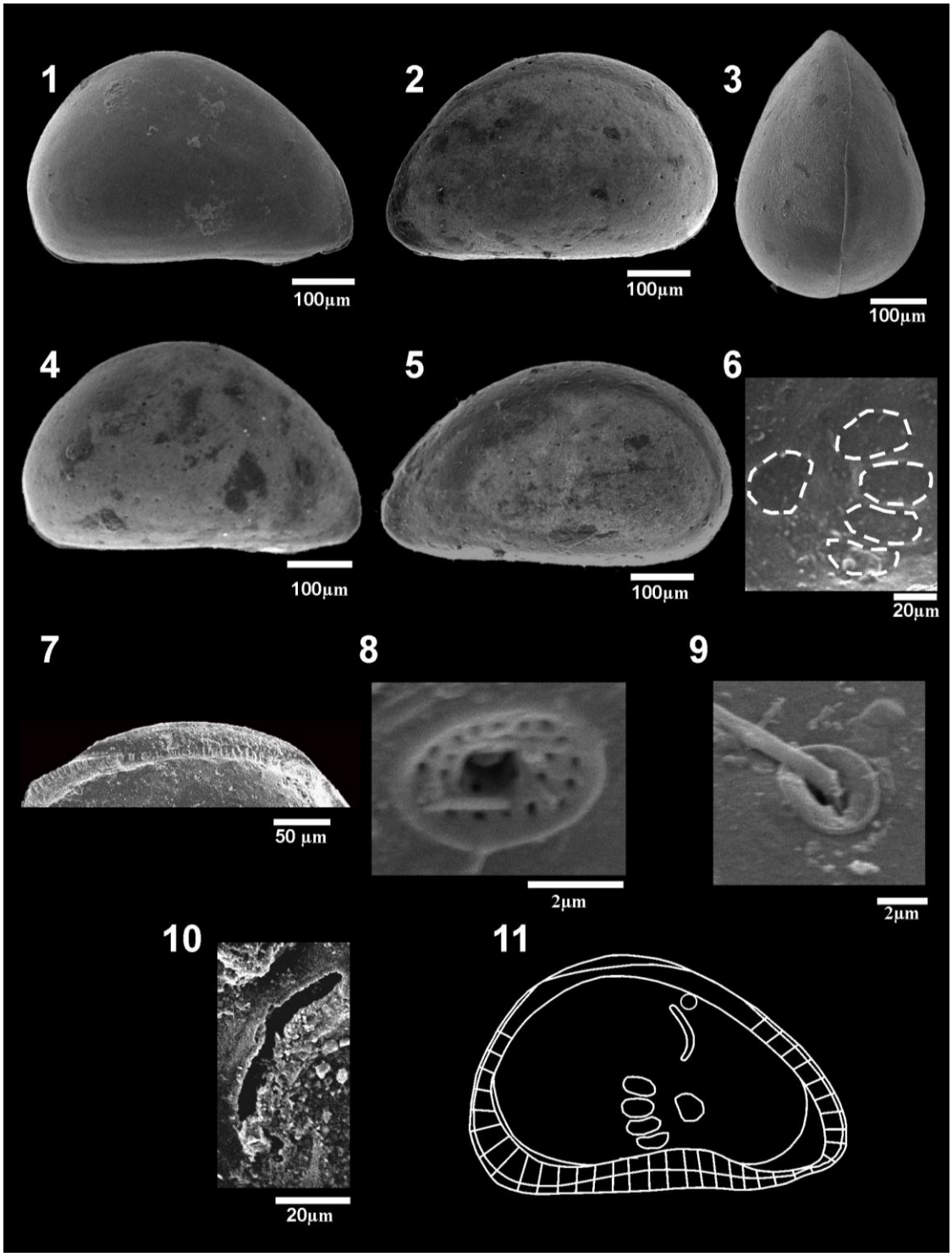

Figure 5. *Xestoleberis subtriangularis* sp. nov. 1. Female, RV (MP-O-1692, holotype). 2. Female, LV (MP-O-1694). 3. Female, dorsal view (MP-O-1695). 4. Male, RV (MP-O-1693). 5. Male, LV (MP-O-1693). 6. Central muscle scars (MP-O-1696). 7. Hinge (MP-O-1697). 8. Sieve-type normal pore canal (MP-O-1692, holotype). 9. Lip-type normal pore canal (MP-O-1692, holotype). 10. *Xestoleberis*-spot (MP-O-1697). 11. Schematic drawing of some LV internal features.

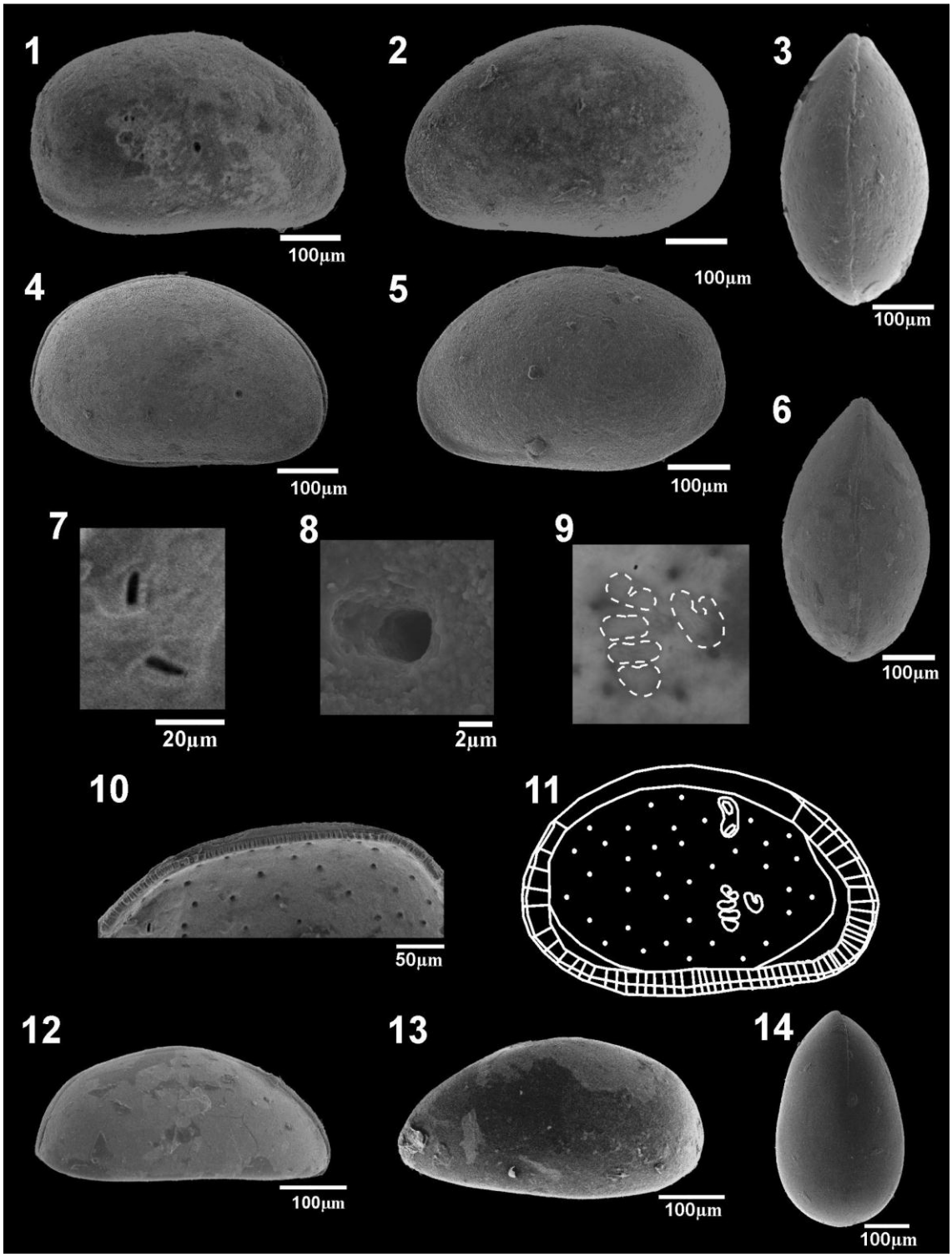

Figure 6. 1–11. *Xestoleberis virilis* sp. nov. 1. Female, RV (MP-O-1816). 2. Female, LV (MP-O-1816). 3. Male, dorsal view (MP-O-1814, holotype). 4. Male, RV (MP-O-1814, holotype). 5. Male, LV (MP-O-1815). 6. Male, ventral view (MP-O-1814, holotype). 7. *Xestoleberis*-spot (MP-O-1816). 8. Simple-type normal pore canal (MP-O-1816). 9. Central muscle scars (MP-O-1815). 10. Hinge (MP-O-1816). 11. Schematic drawing of some LV internal features. 12–14. *Xestoleberis* sp. 12. Carapace, RV (MP-O-1698). 13. Carapace, LV (MP-O-1698). 14. Carapace, dorsal view (MP-O-1698).