SISTEMÁTICA E ECOLOGIA DE ESPÉCIES DE *Omalonyx* (MOLLUSCA, GASTROPODA, SUCCINEIDAE) NO ESTADO DO RIO GRANDE DO SUL

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DISSERTAÇÃO DE MESTRADO
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Às famílias Oliveira, Arruda e Araújo
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RESUMO

Apresenta-se a revalidação da espécie *Omalonyx convexa* (Martens, 1868), sua distribuição no Estado do Rio Grande do Sul, bem como sua ecologia. Os espécimes de *O. convexa* apresentaram uma variação na coloração do tegumento de branco leitoso ao cinza escuro, próximo ao preto, passando pelo alaranjado, bege e acinzentado. A concha apresentou-se encoberta pelo manto em diferentes graus, porém, em nenhum dos espécimes, exibiu-se completamente ocultada. Os animais foram encontrados em ambientes de águas lênticas e em terrenos alagados, em macrófitas das espécies *Eicchornia crassipes*, *Salvinia auriculata, Pistia stratiotis,* em vegetações adjacentes a margens de banhados e sob substratos artificiais como lonas, papelões e isopores. Propõe-se, para a espécie-tipo do gênero *O. unguis* (d´Orbigny, 1835), um neótipo, uma vez que esta não apresenta material nominotípico designado. Em relação à cavidade palial da família Succineidae, observa-se o ureter primário iniciando-se no rim, próximo ao pericárdio, e correndo transversalmente até o reto. O ureter secundário percorre uma pequena distância junto ao reto. Em seguida, este margeia a borda do manto, passa pelo pneumostômio e segue adiante até a região anterior da cavidade palial. O ureter secundário, então, se dobra em um ângulo de 180^{o} e passa a ser denominado ureter terciário. Este se encaminha na direção do pneumostômio e se abre imediatamente em posição anterior ao orifício respiratório, no lado direito deste, pelo poro excretor, o que permite classificá-los entre os Heterurethra. Examinou-se o valor da concha de *Omalonyx* na diagnose das espécies do gênero. Foram medidas 218 conchas, oriundas de 13 populações, e pertencentes a três espécies de *Omalonyx.* Duas Análises Canônicas Discriminantes foram realizadas: a primeira considerou a população de cada localidade como um grupo distinto; na segunda, o agrupamento foi realizado por espécie. O grupo de populações resultou bastante heterogêneo e apenas 54,1% dos grupos resultaram como classificados corretamente. A segunda análise apresentou um percentual de 94,0% de correção, com resultados bastante significativos, demonstrando que as medidas de conchas podem auxiliar na determinação das espécies deste gênero. Foram investigados e discutidos os caracteres do sistema reprodutório, a morfologia dos tentáculos e a posição do poro genital no holótipo de *Omalonyx (Neohyalimax) brasiliensis* (Simroth, 1896) e de *Omalonyx* s.s. Propõe-se a sinonimização de *Neohyalimax* com *Omalonyx,* tornando-se o primeiro, um sinônimo júnior. *Omalonyx brasiliensis* (Simroth, 1896) permanece uma espécie válida, com base unicamente no holótipo.

ABSTRACT

SYSTEMATICS AND ECOLOGY OF *Omalonyx* (MOLLUSCA, GASTROPODA, SUCCINEIDAE) FROM THE RIO GRANDE DO SUL STATE

The revalidation of the species *Omalonyx convexa* (Martens, 1868), its distribution in the Rio Grande do Sul state, as well as its ecology are presented in this work. The specimens of *O. convexa* presented a variation of the tegument coloring which comprehended from milky white to dark gray, almost black, passing through orange, beige and gray. The shell presented itself covered by the mantle in different proportions, however, it was not completely covered on any of the specimens. The animals were found in lentic water environments and flooded terrains, on macrophytes of the species *Eicchornia crassipes*, *Salvinia auriculata, Pistia stratiotis,* in vegetations adjacent to swamp banks and under artificial objects such as canvases, cardboards and styrofoam. A neotype is proposed for the type-species of the genus *O. unguis* (d´Orbigny, 1835), once it does not present any designated nominotypical material. Regarding the pallial cavity of the family Succineidae, it is observed that the primary ureter initiates at the kidney, near the pericardium, and runs transversely until the rectum. The secondary ureter follows a short distance along the rectum, and then it borders the edge of the mantle passing by the pneumostome, and proceeds to the anterior region of the pallial cavity. Next, the secondary ureter folds with an 180^{o} angle and becomes determined as the tertiary ureter, which follows on the direction of the pneumostome and opens in a position immediately anterior to the respiratory orifice, on its right side, by the excretory pore, which allows their classification among the Heterurethra. The value of the *Omalonyx* shell in the species diagnosis of the genus was examined. For this purpose, 218 shells from 13 different populations were measured, belonging to three species of *Omalonyx.* Two Canonical Discriminant Analysis were made: the first considered the population of each locality as a distinct group; for the second, the grouping was made by species. The population groups resulted as highly heterogeneous and only 54.1% of the groups were correctly classified. The second analysis presented a correction percentage of 94%, with highly significant results, demonstrating that shell measurements can aid in the species determination of this genus. The characters of the reproductive system, the morphology of the tentacles and the position of the genital pore in the holotype of *Omalonyx (Neohyalimax) brasiliensis* (Simroth, 1896) and *Omalonyx* s.s. were investigated and discussed. The synonymization of *Neohyalimax* with *Omalonyx* is proposed, the former becoming a junior synonym. *Omalonyx brasiliensis* (Simroth, 1896) remains a valid species, based solely on the holotype.

APRESENTAÇÃO

A família Succineidae Beck, 1837 é cosmopolita, compreende caracóis e lesmas terrestres e, devido a características de seus representantes, tem gerado grande controvérsia, em sua classificação, com base na disposição do ureter na cavidade palial. Patterson (1971) foi o único autor a fazer um estudo mais amplo da família, todavia utilizou poucas espécies de cada gênero. O gênero *Omalonyx* d´Orbigny, 1837 apresenta distribuição neotropical e, possivelmente devido ao seu tipo de habitat e ocorrência restrita, ainda pouco se sabe sobre esse grupo. O conhecimento das espécies desse gênero baseia-se quase sempre apenas na descrição original, utilizando-se principalmente características da morfologia externa dos animais e o local de ocorrência. O trabalho mais recente sobre *Omalonyx* é de Tillier (1981) que estudou a morfologia do sistema reprodutório de alguns representantes deste gênero. Todavia, este trabalho insiste na investigação do valor da concha na diagnose específica e distribuição geográfica das espécies. Devido a incertezas na classificação e aos poucos estudos realizados com as espécies desse gênero, propôs-se o estudo dos *Omalonyx* do Estado do Rio Grande do Sul, com base no exame de espécimes coletados, exame de exemplares depositados em diversas coleções científicas, estudo de material tipo e levantamento e análise de toda a literatura disponível. Os resultados deste estudo foram compilados em quatro artigos e uma nota científica, apresentados aqui sob a forma de capítulos:

Capítulo I: ARRUDA, J. O. & THOMÉ, J. W. Revalidation of *Omalonyx convexa* and designation of a neotype for *Omalonyx unguis* (Mollusca, Gastropoda, Succineidae), a ser submetido à **Journal of Molluscan Studies**.

Capítulo II: ARRUDA, J. O. & THOMÉ, J. W. Synonymization of *Neohyalimax* with recharacterization of *Omalonyx brasiliensis* (Mollusca, Gastropoda, Succineidae), a ser submetido à **Zootaxa**.

Capítulo III: ARRUDA, J. O., GIL, G. M. & THOMÉ, J. W. The value of the Shell in the specific diagnosis of *Omalonyx* (Mollusca, Gastropoda, Succineidae), a ser submetido à **Zootaxa**.

Capítulo IV: ARRUDA, J. O. & THOMÉ, J. W. Recaracterization of the pallial cavity of Succineidae (Mollusca, Gastropoda), a ser submetido à **Zootaxa**.

Capítulo V: ARRUDA, J. O. & THOMÉ, J. W. Ocurrence and ecological

observations about *Omalonyx convexa* (Mollusca, Gastropoda, Succineidae), a ser submetido à **Zootaxa**.

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TILLIER, S. South American and Juan Fernández succineid slugs (Pulmonata). **Journal of Molluscan Studies,** 47: 125-146, 1981.

CAPÍTULO I

REVALIDATION OF *Omalonyx convexa* AND DESIGNATION Of A NEOTYPE FOR *Omalonyx unguis* (MOLLUSCA, GASTROPODA, SUCCINEIDAE)

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SHORT RUNNING HEAD: REVALIDATION AND DESIGNATION Of A NEOTYPE FOR *Omalonyx*

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Abstract

Omalonyx convexa has been cited for Brazil, Argentina and Uruguay. However, it was considered as a synonymous of *O. unguis*. *Omalonyx* specimens from Paraguay, Argentina and Brazil were studied, and specialized bibliography was consulted. It was concluded that *O. unguis* and *O. convexa* are two different species, revalidating the latter. The animals from the Rio Grande do Sul state (Brazil), Chapadmalal, Jujuy and a few specimens of Rio Santiago (Argentina) were considered as *O. convexa*. Specimens from Formosa, Chaco, Barca Grande, Partido de Tigre and a few individuals from Rio Santiago (Argentina), as well as Asunción (Paraguay) belong to the species *O. unguis*. Being that *Omalonyx unguis*, the type-species of the genus, does not possess designated nominotypical material, the lot MLP-11878, from Formosa, is proposed as the neotype.

Keywords: *Omalonyx convexa, Omalonyx unguis,* revalidation, neotype, reproductive system.

Introduction

Omalonyx convexa was described by Martens (1868), using specimens from Porto Alegre (Rio Grande do Sul state, Brazil), under the name *Succinea (Pellicula) convexa.* The author described the external morphology of the shell and mentioned their measurements. Martens (1868) declared that this species could be related to the European *Succinea,* due to the type of habitat in which it lives. In that same year, Heynemann characterized the jaw and radulae of this species, however, under the name of *Pellicula convexa* Martens. The number of teeth for lines and rows were indicated for

the radulae and the number of cusps on each tooth. This author commented that the shape of jaw and radulae demonstrated their similarity to *Succinea.* [According to article 50.6 of the International Code of Zoological Nomenclature (ICZN), the name should the attributed to Heynemann (1868, p. 112) being that the name proposed by Martens was published by the same periodical in the same year, but on page 183. Yet, according to article 24.2 of the ICZN, Doering (1876, p. 304) can be considered as the first revisor, who gave preference to Martens as author of the name, accepting Heynemann's intention].

Omalonyx convexa has been mentioned for Brazil, Argentina and Uruguay (Doering, 1876; Morretes, 1949; Salgado & Coelho, 2003; Scarabino, 2003). However, in the study of Tillier (1981), *O. convexa* was considered a synonymous of *O. unguis.* In that study, Tillier justified the synonymization only with the fact that it had already been proposed by Doering (1876), based on the radulae and jaw descriptions by Heynemann (1868) – which would be equal in both species – and for being biogeographically acceptable!

To verify if *Omalonyx convexa* is a synonym of *O. unguis,* specimens of *Omalonyx* from southern Brazil, Paraguay and Argentina had their reproductive systems investigated.

Material

The reproductive systems of the MNHN specimens, unnumbered, were examined, which were also studied by Tillier (1981): The reproductive systems of the MNHN specimens, unnumbered, were examined, which were also studied by Tillier (1981): ARGENTINA, **Buenos Aires**: Rio Santiago, 2 *spec.*, M. I. Hylton Scott leg,

Alba Coll. 11.43; ARGENTINA, **Buenos Aires**: Ezeiza, "*Homalonyx gallardoi*" *ex auctore,* 2 *spec.*, 1971, Camagni Coll.; ARGENTINA, Tucumán: ciudad de Tucumán, topotypes of "*Homalonyx weyrauchi*", 2 *spec.* The other studied lots were: BRAZIL, **Rio Grande do Sul**: Porto Alegre, **Lectotype ZMB-13734a, Paralectotypes ZMB-13734b (damaged shells) and 19 paralectotypes ZMB-13734c** *Succinea convexa* (v. Mts.)*,* 2 *spec.* PARAGUAY, **Central**: Asunción, *Hom unguis* d´Orb*,* 1 *spec.*, canje F. H. Schade. (MACN 19968). ARGENTINA, **Jujuy**: Termas del Palmar, *Homalonyx convexa*?, 1 *spec.*, V.1947, M. Biraben col. (MACN 27246). ARGENTINA, **Formosa**: Villafañe, *Omalonyx* sp., (Arroyo Bellaco, Estância La Marcela, 26°14.17´S 59°07.08´W) 2 *spec.*, 30.10.2004, C. Ituarte leg. (MLP 11878). ARGENTINA, **Formosa**: *Omalonyx* sp., 1 *spec.* (MLP 4567-1). ARGENTINA, **Chaco**: Resistencia, *Homalonyx,* 1 *spec.*, 1935, dou. J. B. Daguerre. (MACN 22931). ARGENTINA, **Chaco**: Resistência, *Omalonyx unguis* d´Orb*,* 1 *spec.*, 28.X.1961, P. Vanzolini leg. J. L. Leme det. (MZUSP 14748). ARGENTINA, **Buenos Aires**: Rio Santiago, *Homalonyx,* 1 *spec.*, 1919. (MACN 10208). ARGENTINA, **Buenos Aires**: Rio Santiago, *Homalonyx,* 2 *spec.*, 12-13.XI.1919, M. Doello-Jurado col. (MACN 10268). ARGENTINA, **Buenos Aires**: Rio Santiago, *Omalonyx* sp., 2 *spec.* (MLP 31321). ARGENTINA, **Buenos Aires**: Rio Santiago, *Homalonyx* sp.*,* 2 *spec.*, Dád. A Radice leg. (MACN 14472). ARGENTINA, **Buenos Aires**: Arroio Barca Grande, *Homalonyx* sp., 2 *spec.*, Mayo 1923. (MACN 13996). ARGENTINA, **Buenos Aires**: Partido de Tigre, *Omalonyx* sp., 4 *spec.* (lote 734 da coleção do Laboratório de Malacologia da UFMG). ARGENTINA, **Buenos Aires**: Chapadmalal, *Homalonyx gallardoi* H. Scott, 2 *spec.*, II.1951, Ibarra Grasso leg, M. I. H. S det. (MACN 27242). BRAZIL, **Rio Grande do Sul**: São Borja, *Omalonyx convexa* (Martens, 1868)*,* (28°39´50,6´´S 55°59´03.2´´W) 7 *spec.*, A. Paladini, E. Moysés, J. Arruda leg., J. Arruda det. (MCP 8828). BRAZIL, **Rio Grande**

do Sul: Santa Maria, *Omalonyx convexa,* 3 *spec.*, J. Arruda leg. and det. (MCP 8829). BRAZIL, **Rio Grande do Sul**: Santa Maria, *Omalonyx convexa,* (Cidade dos Meninos, 29°41´15.3´´S 53°43´10.5´´W) 3 *spec.*, 8.V.2005, F. Engler, J. Arruda, P. Bergonci leg. J. Arruda det. (MCP 8831). BRAZIL, **Rio Grande do Sul**: Torres, *Omalonyx convexa,* (rio Mampituba, 29°15´26.8´´ S 49°51´09.1´´W) 2 *spec.*, 26.III.2006, E. da Silva, J. Arruda, J. Picanço, L. Araújo leg. J. Arruda det. (MCP 8832). BRAZIL, **Rio Grande do Sul**: Cachoeira do Sul, *Omalonyx convexa,* (estrada BR 290 km 255, 30°14´55.7´´S 52°46´33.8´´W)1 *spec.*, 9.X.2005, F. Engler, J. Arruda, P. Bergonci leg., J. Arruda det. (MCP 8840). BRAZIL, **Rio Grande do Sul**: Novo Hamburgo, *Omalonyx convexa,* (Bairro Lomba Grande, 29°43´11.0´´S 51°06´03.0´´W) 1 *spec.*, 23.X.2005, C. Vilanova, J. Arruda leg., J. Arruda det. (MCP 8848). BRAZIL, **Rio Grande do Sul**: Porto Alegre, *Omalonyx convexa,* (Ilha das Flores) 3 *spec.*, 29.IV.2006, A. Paladini, J. Arruda leg. J. Arruda det. (MCP 8837). BRAZIL, **Rio Grande do Sul**: Porto Alegre, *Omalonyx convexa,* (Ilha das Flores, 29°59´20.9´´S 51°15´56.0´´W) 4 *spec.*, 13.IV.2006, E. Moysés, . J. Arruda leg., J. Arruda det. (MCP 8842). BRAZIL, **Rio Grande do Sul**: Porto Alegre, *Omalonyx convexa,* (Parque Farroupilha) 1 *spec.*, 01.X.2005, L. Araújo, J. Arruda leg., J. Arruda det. (MCP 8849). BRAZIL, **Rio Grande do Sul**: Cachoeirinha, *Omalonyx convexa,* 1 *spec.*, 29.IV.2006, A. Paladini, J. Arruda leg. J. Arruda det. (MCP 8839). BRAZIL, **Rio Grande do Sul**: Camaquã, *Omalonyx convexa,* (30°54´00.7´´S 51°47´57.5´´W) 5 *spec.*, E. Moysés, F. Engler, J. Arruda leg., J. Arruda det. (MCP 8841). BRAZIL, **Rio Grande do Sul**: Pelotas, *Omalonyx convexa,* (Estrada Pelotas – Rio Grande) 8 *spec.*, 18.III.2006, A. Paladini, J. Arruda leg. J. Arruda det. (MCP 8836).

Institution abbreviations: MACN, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" e Instituto Nacional de Investigacion de las Ciências Naturales; MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio

Grande do Sul (Brazil); MLP, Museo de La Plata (Argentina); MNHN, Muséum national d´Histoire naturalle (Paris); MZUSP, Museu de Zoologia da Universidade de São Paulo (Brazil); UFMG, Universidade Federal de Minas Gerais (Brazil); ZMB, Museum für Naturkunde der Humboldt Universität zu Berlin.

Results

The specimens from the Rio Grande do Sul state, the MNHN lots studied by Tillier, the Argentinian specimens from Chapadmalal, Jujuy and the lot MACN-14472 from Rio Santiago presented an internal anatomy equal to the paralectotypes of *Omalonyx convexa* (Martens, 1868) (Fig. 1).

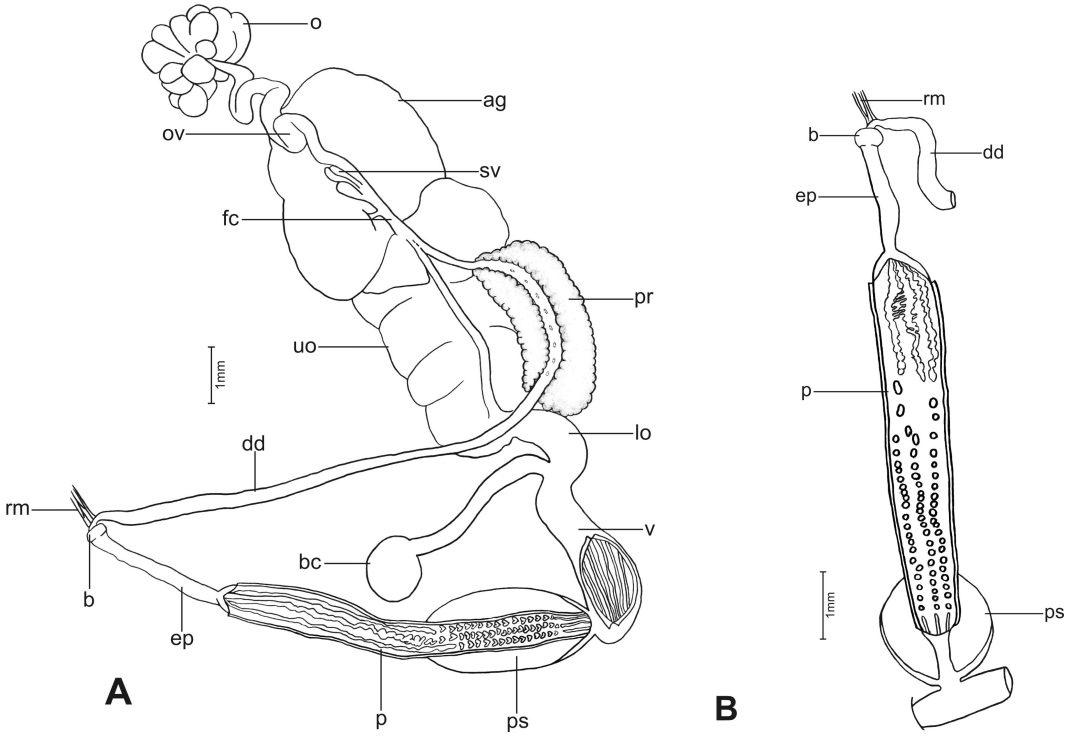

Figure 1A: Reproductive system of *Omalonyx convexa* (MCP-8832) and B: Evertophallus (MCP-8828) showing other configuration of the inner papillaries' shape. Abbreviations: ag, albumen gland; b, bulb; bc, *bursa copulatrix;* dd, defferent duct; ep, epiphallus; fc, fertilization complex; lo, lower oviduct; o, ovariotestis; ov, ovispermoduct; p, evertophallus; pr, prostate; ps, phallus sheath; rm, retractor muscle; sv, seminal vesicles; uo, upper oviduct; v, vagina.

For the characterization of this species, morphometric measurements were made on the reproductive systems of 39 collected specimens. The epiphallus presented a smooth external surface, which represents approximately half the length of the evertophallus.

The retractor muscle of the evertophallus (rm) adheres to the "epiphallus-defferent duct" junction either on the narrowing of the defferent duct, near the "epiphallus-defferent duct" junction or on the "epiphallus-defferent duct" junction.

The thick phallus sheath covers approximately the entire distal half of the evertophallus. It gradually becomes a thin membrane, which covers the proximal region of the evertophallus and the epiphallus.

The half of the proximal region of the evertophallus generally presented itself a little wider than the remaining of the evertophallus. The internal face of the evertophallus presents sculpturings, and this character is considered important for specific determination. In *O. convexa*, longitudinal folds were observed in the wider proximal region and papillaries in the distal region. The folds presented themselves with three different morphologies: smooth, rippled or with a wrinkled and anastomosed aspect. The papillaries are commonly cordiform, aligned and homogeneously distant between themselves throughout the distal region of the evertophallus. In the distal extremity there are short and smooth longitudinal folds. Within the studied populations, only São Borja presented discoid instead of cordiform papillas.

The vagina is approximately half the length of the evertophallus, with smooth longitudinal folds on its internal face.

The length of the *bursa copulatrix* duct corresponds to, approximately, 1.5 times the length of the vagina. The *bursa copulatrix* presented itself either ovoid or, mainly, in

spherical shape. In the animals which present spherical shapes, the *bursa copulatrix* corresponds to a third of its duct. When ovoid, the length was generally 1.5 times the width.

The prostate is prolonged in adult individuals of *O. convexa*. An average of 2.85 to 1 was observed for the length/width proportion.

The oviduct can be divided in upper and lower portions. The upper oviduct is inflated and saclike, with thin walls and smooth internal face. The lower oviduct is a prolonging of the vagina, initiating right after the beginning of the *bursa copulatrix* duct. It is generally half the length of the upper oviduct and its internal face presents the same sculpturings of the vagina.

The ovulispermoduct was ordinarily thick, convolute and pigmented. The ovariotestis presented itself either hemispherical or, predominantly, discoid.

The remaining lots, from Rio Santiago, Formosa, Chaco, Barca Grande, Partido de Tigre and Paraguay presented an analogous internal anatomy among themselves and distinct from what was shown for the previous group. The anatomy of the reproductive system concurs with the characteristics proposed by Arruda *et al.* (2006) to *O. unguis* (d´Orbigny, 1835). For this species, the characterization is added with a upper oviduct approximately the size of the vagina, with a thin wall, saclike projections and smooth internal face. The lower oviduct is long, approximately three times the size of the vagina, convolute, presents a thick wall and has longitudinal folds in the internal face.

Discussion and Conclusion

Tillier (1981) proposed the distribution of the species *O. unguis* for southern Brazil, based on the synonymity between *O. convexa* and *O. unguis*. The author

justified this synonymization by claiming that it had been previously proposed by Doering (1876). However, Doering (1876) synonymized the animal described by him in 1873, from Rosário (Argentina), as *O. unguis.* This author affirmed that the animals from Santa Fé, a little further to the north from Rosário, would be typical specimens of *O. unguis* and maintained the species *O. convexa* as valid for the Rosário specimens. Doering (1876) commented that the shell and the animal of the species *O. convexa* are much more convex than *O. unguis,* the body coloring in *O. convexa*, despite enabling many analogies, is much darker and the animal itself is relatively smaller than *O. unguis.*

The species *Omalonyx unguis*, type-species of the genus *Omalonyx,* has generated uncertainties and mainly doubts in its characterization, for not presenting designated nominotypical material. Tillier (1981), in the attempt of resolving the problem, designated a lectotype and paralectotypes for the species *O. unguis* based on shells collected by d´Orbigny in Paraguay. It is believed that the author chose the material from that source because of the ample description of d´Orbigny (1837). However, in the previous description made by d´Orbigny (1835), the species *H. (C.) unguis* is mentioned, based on material from Férussac's collection, for Paraguay and Bolivia. Yet, Tillier (1981) declared that none of the shells from Férussac's collection are found at the Muséum National d´Histoire Naturelle or at the British Museum (Natural History). Therefore, there are no more syntypes of the species d´Orbigny (1835) and, consequently, the election of lectotypes contradicts ICZN.

For the characterization and illustration of the internal anatomy of *O. unguis,* Tillier (1981) was mainly based on specimens from Argentina (Rio Santiago, Ezeiza, Tucumán), despite having designated a lectotype from Paraguay. The studied specimen

from Asunción, Paraguay, presented an anatomy of the reproductive system different from what was presented by Tillier (1981) for the species *O. unguis.*

Based on what was exposed above, the proposition of a neotype for *Omalonyx unguis* is justified. To elect the examined lot from Paraguay as the neotype would be the most prudent, since d´Orbigny (1835) mentioned this country as a local of occurrence for the species. However, this lot is composed by only two individuals, one of them very young, measuring only 7.2 mm in length and the other, measuring approximately 11 mm, which had its internal anatomy damaged. Besides, the lot does not present precise data concerning place of collection of specimens.

The proposed neotype is an adult specimen from the lot MLP-11878 from Formosa, Argentina. It came accompanied by 13 specimens of lot MLP-11878b (paraneotypes). The selection of this neotype, geographically dislocated slightly to the south, according to the proposal of d´Orbigny (1835), is justified by the fact that the animals from this lot present an anatomy of the reproductive system equal to the specimens from Asunción, by the fact that the Formosa department has borders with Paraguay and by the detailing of the collection data presented on lot MLP-11878.

Based on the discussion above, the synonymization of *O. unguis* of Tillier (1981) *non O. unguis* (d´Orbigny, 1835) under *O. convexa* is proposed. The lot MLP-11878 is proposed as a neotype for *Omalonyx unguis* (d´Orbigny, 1835) and the anatomy of its reproductive system is represented in Arruda *et al.* (2006).

The following differential diagnosis is proposed: a) *O. convexa:* discoid ovariotestis, lower oviduct approximately half the size of the upper oviduct, proximal region wider than posterior region of evertophallus, with longitudinal folds on the proximal half of its internal face and cordiform papillaries on the other half; b) *O. unguis:* spherical ovariotestis, lower oviduct approximately three times the size of the

upper oviduct, epiphallus presenting a serpent-like fold on its outer surface and discoid papillaries on the internal face of the evertophallus.

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CAPÍTULO II

Synonymization of *Neohyalimax* with recharacterization of *Omalonyx brasiliensis* (Mollusca, Gastropoda, Succineidae)

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Abstract

Omalonyx brasiliensis was originally described as *Neohyalimax brasiliensis* by Simroth (1896). Patterson (1971) proposed the species as a subgenus of *Omalonyx* based on the characters of the reproductive system, and brought attention to some details of the original description. Based on the examination and discussion of these characters and the holotype, a synonymization of *Neohyalimax* with *Omalonyx* is proposed, making the former a junior synonym. *Omalonyx brasiliensis* (Simroth, 1896) remains a valid species, based solely on the holotype.

Keywords: *Neohyalimax, Omalonyx brasiliensis,* reproductive system.

Introduction

The genus *Omalonyx* d´Orbigny, 1837 includes terrestrial slugs which are very peculiar concerning external shape. They present a reduced, flat and fingernail-like shell. *Omalonyx* is commonly presented with two subgenera: *Omalonyx* s.s. and *Neohyalimax* Simroth, 1896 (Patterson, 1971). The subgenus *Neohyalimax* is monotypical, detaining the species *Omalonyx (N.) brasiliensis* described by Simroth (1896) as *Neohyalimax brasiliensis*, from a unique specimen from the Rio Grande do Sul state (Brazil). Patterson (1971), when revising the family, considered this species as a subgenus of *Omalonyx.* This author discoursed about the similarities of *Omalonyx*

felina (Guppy, 1872) [= *O. matheroni* according to Tillier (1981)] and *Neohyalimax brasiliensis* and brought attention to two details in the general description of *Neohyalimax brasiliensis:* the number of seminal vesicles and tentacles. Barker (2001) also highlighted the position of the reproductive pore in *Neohyalimax.* These characters and the anatomy of the reproductive system were investigated in this study.

Material

The following lots were examined: *Neohyalimax brasiliensis* Srth., 1 *spec.* (ZMB 45.913); BRAZIL, **Rio Grande do** Sul: Pelotas, *Omalonyx convexa,* (Estrada Pelotas – Rio Grande, 31°45´53.1´´S 52°22´48.2´´W) 48 *spec.,* A. Paladini, J. Arruda leg., J. Arruda det. (MCP 8836). BRAZIL, **Rio Grande do** Sul: Cachoeirinha, 34 *spec.*, 29.IV.2006, A. Paladini, J. Arruda leg., J. Arruda det. (MCP 8839).

Institution abbreviations: MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (Brazil) and ZMB, Museum für Naturkunde der Humboldt Universität zu Berlin.

Results and Discussion

Simroth (1896) mentioned that *Neohyalimax brasiliensis* is found at the Berlin Museum (Museum für Naturkunde der Humboldt Universität zu Berlin). Indeed there is a lot (ZMB-45.913) with this description, however, there is no monotypical indication on the label. Being that there is no other known specimen for this species, it is believed that the mentioned lot is the holotype. An opportunity to study the specimen was made viable, its morphoanatomy was studied and some considerations were made, confronted with observations presented by Patterson (1971) and Barker (2001).

Patterson (*op. cit.*) declared that there are similarities between *Omalonyx felina* (Guppy, 1872) [= *O. matheroni* according to Tillier (1981)] and *Neohyalimax brasiliensis* concerning the general shape of the body, the pigmentation of the mantle and the pattern of the reproductive system. Being that the reproductive system of *Neohyalimax brasiliensis* is similar to *Omalonyx* s.s. and different from *Hyalimax,* which resembles *Succinea* Draparnaud, 1801, Patterson proposed *Neohyalimax* as a subgenus of *Omalonyx.* However, this author brought attention to two details of the original description of *Neohyalimax brasiliensis:* first, that it has one seminal vesicle

(observing two vesicles in *O. felina*); second, that *Neohyalimax* has only one pair of tentacles, while *Omalonyx* s.s. has two. In a thorough examination of the individual, the presence of two vesicles and one fecundation pouch was verified. This observation contradicts Simroth (1896) and concurs with the observation of Patterson (1971) for *Omalonyx* s.s.

Simroth (1896) observed in *Neohyalimax* only one pair of tentacles, the ommatophores. Patterson (*op. cit.*) affirmed that the *Omalonyx* s.s. present two pairs of tentacles. In *O. brasiliensis,* it was not possible to visualize the second pair of tentacles indeed. However, preserved individuals of *Omalonyx* s.s. were examinated and, in the same lot, there are specimens in which the presence of the second pair of tentacles cannot be observed and, in other specimens, these tentacles were very evident. It is believed that, during the preservation process, the second pair of tentacles, smaller than the ommatophores, contracted themselves and can be confused with the rugosity of the tegument near the animal's mouth. A histological examination should confirm this hypothesis.

Simroth (1896) did not mention the presence of an epiphallus in *Neohyalimax.* However, when examining the type-specimen, the presence of this structure is verified, which is slightly narrower than the evertophallus and is a character present in all *Omalonyx* s.s.

Barker (2001) brought attention to the placement of the genital aperture in *Omalonyx (Neohyalimax)*, commenting that it is immediately adjacent to the right tentacle. When examining *O. brasiliensis* it was verified that there is no difference regarding the position of the genital pore in relation to the other *Omalonyx* s.s.

One of the most unique characteristics in *O. brasiliensis* is the presence of a flat shell, covered by the mantle. This character, according to Simroth (1896), would approximate the species to the genus *Hyalimax.* In the description of *O. felina,* Guppy (1872) affirmed that the shell presented itself covered by the mantle and that, occasionally, was retracted, exposing its central region. Gibbons (1879), taking Guppy (*op. cit.*) into consideration, affirmed to have repeatedly observed living specimens of *Omalonyx* and never noticed more than a limited portion of the shell border covered by the mantle. In observations of live specimens of the genus *Omalonyx* from the Rio Grande do Sul and Minas Gerais states (Brazil), it was verified that there are different levels of shell coverage by the mantle. However, despite having noticed animals with highly covered shells, no specimen presented a shell completely covered by the mantle.

Based on the examination of the type-specimen of *Omalonyx brasiliensis*, a redescription of the reproductive system is made (Fig. 1) for a better anatomical knowledge of the existent structures. The analyzed specimen was already dissected and the reproductive system is separated in two parts: one showing the vagina (previously dissected and exposing its internal face papillaries), the *bursa copulatrix* duct and its gland and the lower oviduct; the other part is composed by the upper oviduct, prostate, albumen gland, fertilization complex, ovulispermoduct, ovariotestis, defferent duct, epiphallus and evertophallus.

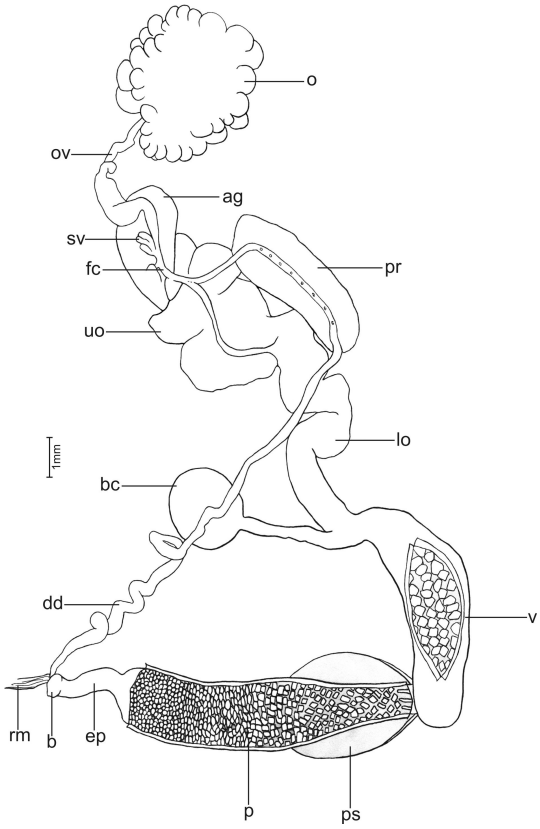

Figure 1: Reconstruction of the reproductive system of *Omalonyx brasiliensis* (ZMB-45.913).

Abbreviations: ag, albumen gland; b, bulb; bc, *bursa copulatrix;* dd, defferent duct; ep, epiphallus; fc, fertilization complex; lo, lower oviduct; o, ovariotestis; ov, ovispermoduct; p, evertophallus; pr, prostate; ps, evertophallus sheath; rm, retractor muscle; sv, seminal vesicles; uo, upper oviduct; v, vagina.

The epiphallus corresponds to approximately one fourth of the evertophallus, it has a bulb and its outer face is smooth. The evertophallus has a thick and wide wall, and the internal face is covered by aligned diamond shaped papillaries. In the proximal extremity, the papillaries were smaller and discoid. In the distal extremity there are small longitudinal folds, present in all *Omalonyx.* The evertophallus sheath, thick and muscular, covers practically its entire distal half. The other half of the evertophallus and the epiphallus are covered by a thin and transparent sheath. The retractor muscle of the evertophallus inserts itself on the junction of the defferent duct with the epiphallus.

The prostate is long and the defferent duct, immerse in it, has small orifices during its trajectory in the gland.

The vagina corresponds to approximately half of the evertophallus. It has a thick wall and its internal face papillaries are aligned and diamond shaped. These papillaries are analogous to the evertophallus', but more robust. The *bursa copulatrix* is spherical, with a diameter corresponding to approximately half the length of its duct. The *bursa copulatrix* gland is slim and corresponds to about two thirds of the vagina.

The lower oviduct is long, thick, convolute and it has rippled longitudinal folds in its internal face. The upper oviduct, approximately half the lower oviduct, is very inflated and convolute.

The albumen gland is small and corresponds to about one third of the prostate. It resembles a bean, with long and slightly inclined shape. The ovulispermoduct is lightly convolute and more inflated in its distal portion. The ovariotestis is spherical and large.

These characteristics of the reproductive system of *O. brasiliensis* resemble the ones exposed by Tillier (1981) for *O. matheroni,* with the exception of the internal face of the vagina. According to this author, in *O. matheroni* the vagina has irregular longitudinal folds, inconsistent in number or shape. But *O. brasiliensis* presents papillaries instead of folds, analogous to the ones in their evertophallus.

Conclusion

Considering the discussion presented about the number of seminal vesicles, the number of tentacles and the position of the genital aperture, as well as the observations about the reproductive system, a synonymization of *Neohyalimax* with *Omalonyx* is proposed, the former becoming the junior synonym. *Omalonyx brasiliensis* (Simroth, 1896) remains a valid species, based only on the holotype.

Acknowledgments

We are grateful to Matthias Glaubrecht (ZMB) for loaning material; to Guacira Gil for her criticisms and suggestions; to Luiz Augusto F. Araújo for the translation from Portuguese to English; to Centro Nacional de Desenvolvimento Científico e Tecnológico for the financial support (CNPq 131716/2005-0 for JOA, 500032/2003-3 for JWT).

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CAPITULO III

The value of the shell in the specific diagnosis of *Omalonyx* (Mollusca, Gastropoda, Succineidae)

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Abstract

The value of the shell in the specific determination of the genus *Omalonyx* was tested in this work. For this purpose, 218 shells were measured, originating from 13 populations and pertaining to three species of *Omalonyx.* Two Canonical Discriminant Analysis (CDA) were made, being that the first analysis considered the population of each locality as a distinct group, and, in the second, the grouping was made by species. The population group resulted as being widely heterogeneous and only 54.1% of the groups were correctly classified. In the second analysis, the classification of the specimens according to species presented a correction percentage of 94.0% with very significant results, demonstrating that shell measurements can assist in the species determination of the genus *Omalonyx.*

Key words: Shell, *Omalonyx,* Canonical Discriminant Analysis

Introduction

The pre-Linnean gastropod systematics were generally focused on the shape, sculpture and coloring of the shell (Bieler, 1992). The majority of succineid descriptions were made based on the analysis of the shell and, rarely, based on the external morphology (Döring, 1873; d´Orbigny, 1837; Pfeiffer, 1849; 1854; Martens, 1868; Guppy, 1878; Simroth, 1896; Ancey, 1899; Smith, 1905; Pilsbry, 1926; Marshall,

1927). The secular prevalence of the conchological studies in classification was justified by the accessibility to character observations. However, intraspecific variations and exposure to different environments generated small morphological alterations on the shell, leading to wrong diagnosis.

The compared anatomy and histological investigations reached their first peak in the late of the 19th century (Bieler, 1992). Comparative studies were published based on morphological and/or anatomical characters of the shell, jaw, radula, pallial complex, nervous system, reproductive and digestive systems (Hylton Scott & Lapuente, 1968; Hylton Scott, 1971; Patterson, 1971; Tillier, 1981; Haszprunar, 1988; Bieler, 1992; Ponder & Lindberg, 1997). However, the taxonomic classification of most Succineidae species is still based on shell characters, which, due to their small diversity and considerably convergence, suggests only a fragmented or doubtful aid concerning systematic analysis (Patterson, 1971).

Tillier (1981) mentioned that, in succineid slugs, the shell alone does not allow an exact specific determination. This author commented that, prior to himself, no other author had the opportunity to make anatomical comparisons among the species of the genus *Omalonyx*. Therefore, the determinations depended much more on the origin localities of the animals than on its characters.

In order to test the hypothesis of the shell being a good character for specific diagnosis, 218 shell measurements were made on three different species of the genus *Omalonyx*.

Material and Methods

The examined lots were: PERU, **Loreto**: *Omalonyx matheroni,* 5 shells, J. Arruda det. (MLP 6867-1). PERU, **San Martín**: Tarapoto, *Omalonyx matheroni* (Potiez & Michaud) (Rosanaico) 6 shells, 06.VIII.2005, H. P. Salas leg., J. Arruda det. (MCP 8850). ARGENTINA, **Formosa**: Villafañe, *Omalonyx unguis*, (Arroyo Bellaco, Estância La Marcela, 26º14.17´S 59º07.08´W) 6 shells, 30.10.2004, C. Ituarte leg., J. Arruda det. (MLP 11878). ARGENTINA, **Buenos Aires**: Chapadmalal, *Omalonyx gallardoi* Hylton Scott & Lapuente, 1968 (= *O. convexa*), 6 shells, II.1951, Ibarra Grasso leg. (MLP 9604). ARGENTINA, **Buenos Aires**: Navarro, *Omalonyx gallardoi* Hylton Scott & Lapuente, 1968 (= *O. convexa*), 3 shells, 06.X.1966, Gallardo, J. leg. leg. (MLP 9606). ARGENTINA, **Buenos Aires**: La Pipinas, *Omalonyx convexa,* (Ruta

provincial 36 km 10, camino a Pipinas) 6 shells, 18.XII.1998, Blanco Marcela leg., J. Arruda det. (MLP 11767). BRAZIL, **Rio Grande do Sul**: São Borja, *Omalonyx convexa* (Martens, 1868), (28°39´50,6´´S 55°59´03.2´´W) 23 shells, 02.II.2006, A. Paladini, E. Moysés, J. Arruda leg., J. Arruda det. (MCP 8828). BRAZIL, **Rio Grande do Sul**: Santa Maria, *Omalonyx convexa,* (Cidade dos Meninos, 29°41´15.3´´S 53°43´10.5´´W) 34 shells, 8.V.2005, F. Engler, J. Arruda, P. Bergonci leg. J. Arruda det. (MCP 8831). BRAZIL, **Rio Grande do Sul**: Torres, *Omalonyx convexa,* (rio Mampituba, 29°15´26.8´´S 49°51´09.1´´W) 8 shells, 26.III.2006, E. da Silva, J. Arruda, J. Picanço, L. Araújo leg. J. Arruda det. (MCP 8832). BRAZIL, **Rio Grande do Sul**: Estrela, *Omalonyx convexa,* (29°29´45.0´´S 51°54´51.3´´W) 19 shells, 17.II.2006, J. Arruda leg. and det. (MCP 8844). BRAZIL, **Rio Grande do Sul**: Porto Alegre, *Omalonyx convexa,* (Ilha das Flores) 37 shells, 29.IV.2006, A. Paladini, J. Arruda leg. J. Arruda det. (MCP 8837). BRAZIL, **Rio Grande do Sul**: Camaquã, *Omalonyx convexa,* (30°54´00.7´´S 51°47´57.5´´W) 29 shells, 19.I.2006, E. Moysés, F. Engler, J. Arruda leg., J. Arruda det. (MCP 8841). BRAZIL, **Rio Grande do Sul**: Pelotas, *Omalonyx convexa,* (Estrada Pelotas – Rio Grande) 36 shells, 18.III.2006, A. Paladini, J. Arruda leg. J. Arruda det. (MCP 8836). From these, the internal anatomy of the reproductive system of specimens from all localities was studied, except for Navarro.

Total length (tl), width (w) and height (h) measurements were made on the shells, as well as total aperture length (ta). Posteriorly, a canonical discriminant analysis was made, using the SPSS statistical package, version 11.5. This analysis withdrawals the influence of size on shape discrimination (Albrecht, 1980; Reis *et al.,* 1990; Peres-Neto, 1995).

Institution abbreviations: MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (Brazil); MLP, Museo de La Plata (Argentina).

Results and Discussion

The averages and standard deviations of the 13 investigated populations are found on TABLE I. For analysis purposes, two types of population groupings were made: in the first, the population of each locality was considered as a distinct group and, in the second analysis, the grouping was made by species, independently of the locality where the animals were collected.

Table I: Averages (**μ**) and standard deviation (**δ**) of the metric variables measured on 218 shells of 13 populations of the genus *Omalonyx*.

Localities	Variables							
	Total Length		Total Width		Aperture Length		Height	
	μ	**δ**	**μ**	**δ**	**μ**	**δ**	**μ**	**δ**
Santa Maria	10,84	1,02	6,24	0,61	9,74	0,90	3,55	0,50
Estrela	8,55	1,11	4,69	0,49	7,61	1,03	2,62	0,46
Torres	9,58	0,87	5,45	0,42	8,71	0,79	2,73	0,26
Ilha Flores	8,81	1,73	5,12	0,90	7,82	1,66	2,57	0,56
Camaquã	10,03	1,52	5,87	0,77	9,13	1,35	2,63	0,57
Pelotas	8,81	0,96	5,09	0,43	8,01	0,92	2,33	0,27
São Borja	8,45	1,25	4,57	0,61	7,67	1,11	2,30	0,64
Camino Pipinas	7,11	0,72	4,23	0,49	6,29	0,72	2,33	0,49
Formosa	10,10	0,77	6,32	0,54	9,41	0,85	2,10	0,17
Loreto	12,82	1,23	7,33	1,00	12,14	1,12	2,62	0,22
Tarapoto	10,32	0,65	6,19	0,44	9,83	0,75	1,92	0,27
Navarro	8,50	0,40	5,13	0,32	7,37	0,23	2,73	0,49
Chapadmalal	8,77	1,36	5,28	0,63	7,85	1,19	2,70	0,48

In the first analysis–which considered the 13 populations as distinct groups–the results pointed the first two discriminant functions (F1 and F2) as being highly explanatory (Tab. II), with the variance percentage reaching 92.4% (F1= 65.1% and F2= 27.3%), demonstrating the quality of these two discriminant functions. To evaluate if the canonical discriminant functions contributed significantly to the separation of the groups, Wilks' Lamba test was used. The Function 3, despite resulting as highly significant (Tab. III), contains only 6.4% of the variance. The independent variables showed low correlation with the discriminant Function 1 (Tab. IV). Nonetheless, it can be verified that the width and length of the shell aperture are the variables which allow the distinction of four population groupings: a) Loreto population (Peru); b) Tarapoto population (Peru); c) Formosa population (Argentina); d) other populations. In Function 2, the variables which best discriminated the groups were shell width and height, distinguishing the *Omalonyx* population from Santa Maria. For Function 3, aperture length, total height and length of the shell were highly significant. Function 4 did not result as significant.

Table II: Eigenvalues, variance percentage and canonical correlation of canonical functions, resultant of discriminant analysis, considering groupings of individuals according to locality of origin.

Functions	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	2,986	65,1	65,1	0,866
2	1,253	27,3	92,4	0,746
3	0,293	6,4	98,8	0,476
4	0,055	1,2	100,0	0,229

Table III: Result of Wilks' Lambda test and respective significance, when considering groupings of individuals according to locality of origin.

Test of Functions	Wilks' Lambda	Chi-Square	Degrees of Freedom	Significance
1 through 4	0,082	522,449	48	0,000
2 through 4	0,325	234,153	33	0,000
3 through 4	0,733	64,838	20	0,000
4	0,948	11,231	9	0,260

Table IV: Correlation between the discriminant variables and canonical discriminant functions considering 13 populations of *Omalonyx*. * indicates high correlation. The Function 4 was subtracted for not presenting significance in the determination of the groups.

Variables	FUNCTIONS		
	1	2	3
Total Width	0,381	0,774*	0,452
Aperture Length	0,338	0,542	0,725*
Height	-0,196	0,671	0,704*
Total Length	0.267	0,561	0,697*

When plotting the first two functions (Fig. 1), the formation of four population groups can be observed, mainly by the centroids, when considering Function 1. The centroids of the Loreto (Peru), Tarapoto (Peru) and Formosa (Peru) populations are separated from the others, indicating that in these populations the animals have wider shells with larger aperture length than the other analyzed populations. For the centroids of the fourth group, formed by 10 populations, there is a great variability in relation to Function 1. The greatest differences are found between the centroids of the Camino de Pipinas (Argentina) and Camaquã (Brazil) populations. Still in this group, in relation to Function 2, the amplest differences are between the populations of São Borja (smaller shell width and height) and Santa Maria (larger shell height and width), both originating from cities of the Rio Grande do Sul state, Brazil.

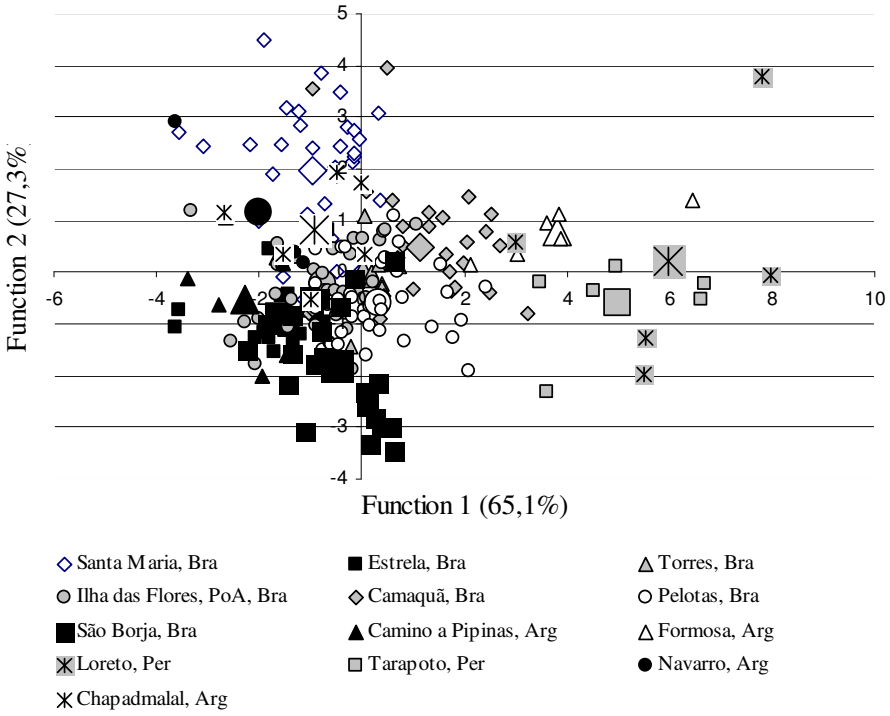

Figure 1: Chart of the first and second canonical discriminant functions of the shells of *Omalonyx* populations from Santa Maria, Ilha das Flores, São Borja, Estrela, Camaquã, Torres and Pelotas in Brasil; Formosa, Camino de Pipinas, Navarro, Chapadmalal in Argentina and Loreto and Tarapoto in Peru. The centroids of each population are represented by the correspondent symbol, in greater size. The variance percentage correspondent to each function is between brackets.

The population group, originating from 10 different localities, resulted highly heterogeneous, demonstrating that the initially used criterion (classification by population) did not prove itself effective. An evidence is the fact that only 54.1% of the proposed groups were correctly classified. TABLE V presents the percentage of success in the classification, for each population.

Table V: Correction percentage of specimen groupings, made, *a priori*, using the localities of origin of the populations as a criterion.

Localities	%
Santa Maria, RS, BR	73,5
Estrela, RS, BR	57,9
Torres, RS, BR	37,5
Ilha das Flores, RS, BR	29,7
Camaquã, RS, BR	51,7
Pelotas, RS, BR	44,4
São Borja, RS, BR	65,2
Camino de Pipinas, ARG	83,3
Formosa, ARG	66,7
Loreto, PERU	80,0
Tarapoto, PERU	83,3
Navarro, ARG	66,7
Chapadmalal, ARG	33,3

In the second canonical discriminant analysis, the three species contained in the sample, described based on the anatomic study of the reproductive system, were: *Omalonyx matheroni* (Potiez & Michaud, 1835), *O. unguis* (d´Orbigny, 1835) and *O. convexa* (Martens, 1868). The obtained results (Tab. VI) were highly significant (Tab. VII) demonstrating that the shell measurements are characters which can aid in the determination of species of the genus *Omalonyx*. The correlation between each of the shell measurements and the discriminant functions (Tab. VIII) indicates that the variables of total width, aperture length and total length of shell are the variables which most strongly distinguish the specimens, in Function 1, which contains 95.2% of the variability, while the shell height variable is responsible for the distinction of the group in Function 2, which contains only 4.8% of variability (Fig. 2).

Table VI: Eigenvalues, variance percentage and canonical correlation of the canonical functions, resultant of discriminant analysis, considering groupings of individuals according to species.

Functions	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.209	95.2	95.2	0.740
2	0.061	4.8	100.0	0.239

Table VII: Result of Wilks' Lambda test and respective significance, when considering groupings of individuals according to species.

Test of Functions	Wilks' Lambda	Chi-Square	Degrees of Freedom	Significance
1 through 2	0,427	181,788	8	0,000
2	0,943	12,609	3	0,006

Table VIII: Correlation between the discriminant variables and canonical discriminant functions considering three species of *Omalonyx.* * greatest absolute correlation between each variable and any discriminant function.

Variables	FUNCTIONS	
	1	2
Total Width	0,377*	-0,009
Aperture Length	0,367*	0,313
Total Length	0,289*	0,279
Height	-0.186	0,248*

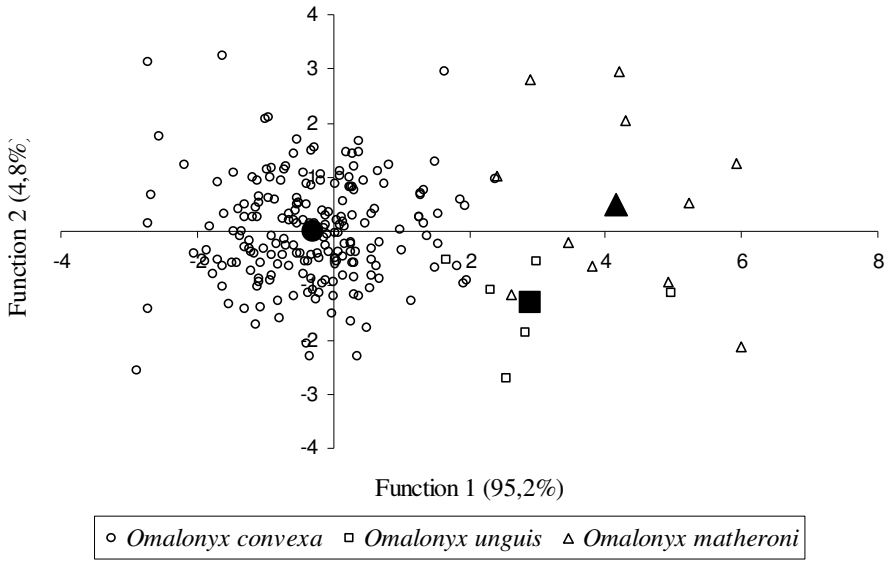

Figure 2: Chart of the two first canonical discriminant functions of *Omalonyx convexa* (Martens, 1868), *Omalonyx unguis* (d´Orbigny, 1835) and *Omalonyx matheroni* (Potiez & Michaud, 1835) shells. The centroids of each population are represented by the correspondent symbol, in greater size and striped. The variance percentage correspondent to each function is between brackets.

The classification of the specimens according to species presented a correction percentage of 94.0% (Tab. IX), proving that, in this genus, the shell measurements can be used in the confirmation of the species diagnosis with satisfactory results. It is

important to point out that the characters of the reproductive system should be taken into consideration in the diagnosis of species from this genus.

Table IX: Correction percentage of specimen groupings, made, *a priori*, using the three examined *Omalonyx* species as a criterion.

Species	%
Omalonyx convexa	95,0
Omalonyx unguis	83,3
Omalonyx matheroni	81,8

Therefore, the group formed by the Loreto and Tarapoto populations corresponds to the species *Omalonyx matheroni* (Potiez & Michaud, 1835), which has a characteristic–in the reproductive system–hemispheric ovariotestis, a lower oviduct approximately three times the size of the upper oviduct, thin post-prostate defferent duct and elliptic papillaries on the internal face of the evertophallus. Concerning the shell measurements, the ta/tl proportion varied from 0.93 to 0.96, the w/tl proportion varied from 0.53 to 0.64 and the w/ta proportion varied from 0.55 to 0.68.

The specimens from Formosa belong to the species *O. unguis* (d´Orbigny, 1835) and have a characteristic spherical ovariotestis, a lower oviduct approximately three times the size of the upper oviduct, thick post-prostate defferent duct, epiphallus presenting a serpent-like fold on its outer surface and discoid papillaries on the internal face of the evertophallus. Concerning the shell measurements, the ta/tl proportion varied from 0.92 to 0.96, w/tl proportion varied from 0.62 to 0.64 and w/ta proportion varied from 0.66 to 0.68.

The last group is formed by specimens of *O. convexa* (Martens, 1868), which present discoid ovariotestis, a lower oviduct of approximately half the size of the upper oviduct, thick post-prostate defferent duct, proximal region wider than posterior region of evertophallus, longitudinal folds on the proximal half of the internal face and, on the other half, cordiform papillaries. Concerning the shell measurements, the ta/tl proportion varied from 0.89 to 0.91, w/tl proportion varied from 0.56 to 0.61 and w/ta proportion varied from 0.62 to 0.68.

Statistical analysis made from shell measurements proved to be an important tool in the differentiation of the investigated species. However, due to the great inter-population variability verified for *Omalonyx* shells, the investigation of other less variable structures, such as the reproductive system, is recommended for the species of this genus, giving greater robustness and security in the diagnose.

Acknowledgments

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CAPITULO IV

Recharacterization of the pallial cavity of Succineidae (Mollusca, Gastropoda)

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Abstract

The pallial cavity in the Succineidae family is characterized as Heterurethra. There, the primary ureter initiates at the kidney, near the pericardium, and runs transversely until the rectum. The secondary ureter travels a short distance along with the rectum. Then, it borders the mantle edge, passes the pneumostome and follows to the anterior region of the pallial cavity. The secondary ureter, then, folds in an 180^{o} angle and becomes the tertiary ureter. It follows on the direction of the pneumostome and opens immediately before the respiratory orifice, on its right side, by the excretory pore.

Keywords: Pallial cavity, Heterurethra, Succineidae

Introduction

In Succineidae Beck, 1837, the pallial cavity and its structures were widely commented. The first author to identify and classify the pallial cavity of snails was Pilsbry (1900). This author characterized the mollusks in three groups denominated Orthurethra, Heterurethra and Sigmurethra. Pilsbry (*op. cit.*) reported that the pallial cavity was different in succineids and, therefore, named them Heterurethra. However, he did not mention the characteristics for the group.

Baker (1926) commented about his observations of the pallial cavity of *Omalonyx felina* (Guppy, 1872). According to this author, the lung resembles the shape of a crescent moon and the kidney has a lanceolate shape and bends over the visceral

mass. The primary ureter presents a thin and wide wall which covers half of the ventral surface of the kidney and involves its outer edge. The secondary ureter is a narrower continuation of the primary ureter and follows the posterior border of the lung, after making a slight turn over the intestine. The anal, respiratory and kidney's pores open separately, which the author considered as a peculiarity of the genus *Omalonyx* d´Orbigny, 1837.

Quick (1933) summarized the general characteristics of the British *Succinea* Draparnaud, 1801. Among these are: a comparatively short lung, a kidney which extends from the pericardium to the rectum, with the ureter passing its frontal edge and then folding forwards, on the side of the rectum. The author commented that in *Succinea elegans* Risso, 1826 (sic.), *S. pfeifferi* Rossmässler, 1835 and *S. putris* (Linnaeus, 1758), the ureter opens on the respiratory orifice by a lateral branch, where a blind caecum continues for a small distance beyond the respiratory aperture.

Posteriorly, Baker (1955) defined the Heterurethra by the presence of an aulacopod foot, short lung and transversal kidney which extends from the pericardium to the rectum. According to the author, the primary ureter begins on or very close the pericardium and runs transversely to the rectum. The secondary ureter travels a short distance along the rectum, to the urinary chamber at the pneumostome. Baker (*op. cit.*) included the family Aillyidae Baker, 1930 and left the inclusion of Athoracophoridae Fischer, 1883 within the Heterurethra unresolved. For the genus *Omalonyx,* the author brought attention to the position of the kidney, which presents itself longitudinally in relation to the body.

Lanzieri (1965) reported that in *S. meridionalis,* the primary ureter initiates close to the pericardium and runs transversely over the kidney in the direction of the rectum. When it reaches the rectum, the ureter bends on a straight angle and follows the end of the digestive system laterally. The secondary ureter continues its course, passes dorsally over the pneumostome and opens anteriorly to the pulmonary orifice.

The Succineidae are commonly classified as Heterurethra (Solem, 1959; Lanzieri, 1965; Patterson, 1971; Salgado & Coelho, 2003). However, some authors consider them as Sigmurethra (Tillier, 1981; Hubricht, 1985). The Sigmurethra, according to Pilsbry (1900), have a primary ureter that follows to the posterior region of the mantle cavity and, from there, a canal or closed tube opens until the last fold of the intestine. Then, it follows to the anterior region of the mantle edge. Morphologically, the continuation of the ureter, being the secondary ureter, is simply a narrow strip of the

aerating surface of the lung, differentiated by a slight ridge that forms a canal or, in more advanced forms, a tube.

Considering the different morphologies presented for the pallial cavity of Succineidae and consequent controversy about its classification, a recharacterization of this cavity, for succineids, and comments about its relation to the family Athoracophoridae will be presented.

Material and Methods

The examined lots were: COSTA RICA, **Cartago**: Turrialba, *Succinea* sp., (CATIE) 2 *spec.*, 12.VII.1988, J. W. Thomé leg., J. Arruda det. (MRCN 31907). PERU, **San Martín**: Tarapoto, *Omalonyx matheroni* (Potiez & Michaud) (Rosanaico) 6 *spec.*, 06.VIII.2005, H. P. Salas leg., J. Arruda det. (MCP 8850). ARGENTINA, **Formosa**: Villafañe, *Omalonyx* sp., (Arroyo Bellaco, Estância La Marcela, 26°14.17´S 59°07.08´W) 6 *spec.*, 30.10.2004, C. Ituarte leg. (MLP 11878). BRAZIL, **Rio Grande do Sul**: Santa Maria, *Omalonyx convexa,* (Cidade dos Meninos, 29°41´15.3´´S 53°43´10.5´´W) 3 *spec.*, 8.V.2005, F. Engler, J. Arruda, P. Bergonci leg. J. Arruda det. (MCP 8831). BRAZIL, **Rio Grande do Sul**: Vacaria, *Succinea* sp., 2 *spec.*, 15.VI. 83, C. J. Becker leg., J. Arruda det. (MRCN 7559). BRAZIL, **Rio Grande do Sul**: Porto Alegre, *Omalonyx convexa,* (Ilha das Flores, 29°59´20.9´´S 51°15´56.0´´W) 4 *spec.*, 13.IV.2006, E. Moysés, J. Arruda leg., J. Arruda det. (MCP 8842). BRAZIL, **Rio Grande do Sul**: Pelotas, *Omalonyx convexa,* (Estrada Pelotas – Rio Grande) 8 *spec.*, 18.III.2006, A. Paladini, J. Arruda leg. J. Arruda det. (MCP 8836). GERMANY: Baden Würtenberg, *Succinea putris* (Linnaeus, 1758), (Under Entringen) 4 *spec.*, 18-19.V.1986, M. C. Mansur leg. (MRCN 32827).

Institution abbreviations: MRCN, Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul (Brazil); MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (Brazil); MLP, Museo de La Plata (Argentina).

Results

The genera *Succinea* and *Omalonyx* present a long kidney, which extends from the pericardium to the rectum. The primary ureter begins along the pericardium and

prolongs itself over the anterior surface of the kidney until passing the rectum, where it makes a 90° curve in *Succinea* and a slightly greater curve in *Omalonyx.* The secondary ureter initiates from this point and, in *Omalonyx,* is also near the origin of the retractor muscles. In this genus, the secondary ureter borders the mantle edge, passes under the pneumostome and follows to the anterior region of the pallial cavity. Then, the ureter folds in 180° and becomes denominated as tertiary ureter. It follows on the direction of the pneumostome and opens immediately anterior to the respiratory orifice, on its right side, through the excretory pore (Fig. 1A). In *Succinea,* the secondary ureter passes over the pneumostome, along the mantle edge, and follows until the anterior region of the pallial cavity. The tertiary ureter initiates after an 180° curve of the secondary ureter and runs in direction to the pneumostome, opening through the excretory pore located immediately anterior and on the right side of the respiratory orifice (Fig. 1B).

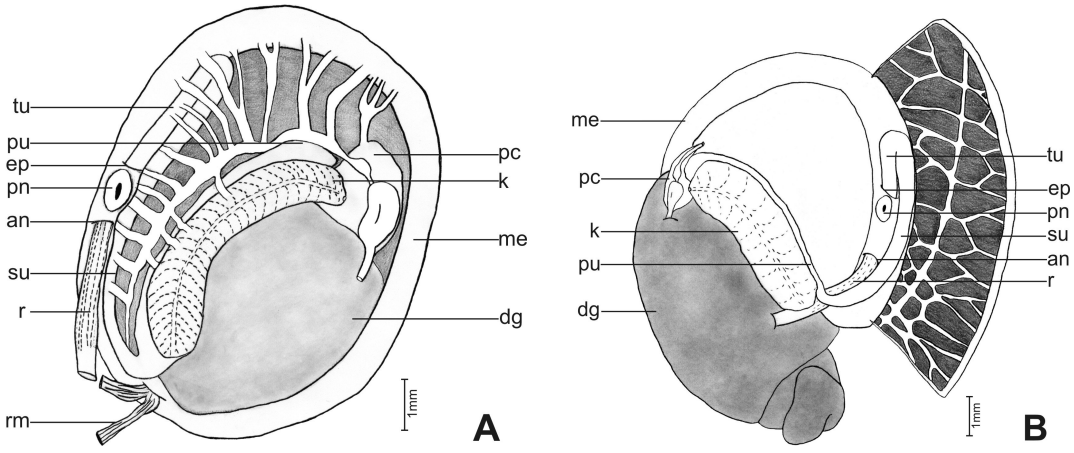

Figure 1: Pallial cavity A) Inner dorsal view of the cavity of *Omalonyx convexa* (Martens, 1868) (MCP 8836) and B) Cavity with mantle struck to the right side of the animal's body of *Succinea* sp. (MRCN 31907). Abbreviations: an, anus; dg, digestive gland; ep, excretory pore; k, kidney; me, mantle edge; pc, pericardium; pn, pneumostome; pu, primary ureter; r, rectum; rm, retractor muscle; su, secondary ureter; tu, tertiary ureter.

The rectum, which initiates when the primary ureter makes a curve and becomes the secondary ureter, presents longitudinal folds which are smooth on its internal face. It opens at the anal orifice, located posteriorly and to the left side of the pneumostome.

The anal, excretory and respiratory orifices are located on the right lateral of the animals' body. The first two are presented externally covered by the mantle edge. The

pneumostome can be visualized due to a constriction of the mantle edge at the height of this orifice.

Discussion and Conclusion

The positions of the structures in the pallial cavity in *Succinea* and *Omalonyx* are in accordance with the references of Baker (1926; 1955) and Lanzieri (1965) for Heterurethra, barring some considerations. In *Omalonyx,* a different trajectory of the secondary ureter was observed, which extends under the pneumostome until the anterior region of the pallial cavity. The tertiary ureter begins when the secondary ureter makes an 180^{o} degree curve and follows in direction to the pneumostome. Baker (1955) described for *Omalonyx felina* a secondary ureter that runs a course along the rectum and extends beyond it, by a short distance, until the pneumostome. This author did not mention the extension of the secondary ureter to the anterior region of the pallial cavity or made reference to a tertiary ureter.

Lanzieri (1965) disagreed with Quick (1933) when reporting that in *S. meridionalis,* the secondary ureter, close to the mantle edge, passed in front of the pneumostome and opened anteriorly to the pulmonary orifice. Quick (*op. cit.*) mentioned that the ureter opens at the respiratory orifice by one of its branches, while a blind caecum continues for a short distance beyond the pneumostome. In the examined *Succinea*, the presence of a blind caecum was not observed, the trajectory of the secondary ureter was slightly distinct from what was exposed by Lanzieri (*op. cit.*) and the tertiary ureter opens at an excretory orifice immediately anterior to the pneumostome, and not at the pneumostome. It was verified that the secondary ureter passes over the pneumostome, between the mantle edge and the mantle, and not under the pneumostome, according to what was mentioned by Lanzieri (*op. cit.*).

Baker (1955), while disserting about Heterurethra, indicated his doubt about the inclusion of the family Athoracophoridae in this group with a question mark. However, the author exposed the similarities of this family in relation to the Succineidae. Baker (*op. cit.*) brought attention to the intriguing similarity between the lung lobes of Athoracophoridae and the lung veins of *Omalonyx.* The author also correlated the separation of the anal pore, excretory pore and pneumostome in *Athoracophorus* Gould, 1852*,* with his previous observations (Baker, 1926) in *Omalonyx*.

Burton (1981) made a polished and detailed work about the pallial cavity of Athoracophoridae. The author reported about the size, disposition and function of the structures, exposed the differences between the two subfamilies Athoracophorinae and Aneitinae and discussed about the advantages and disadvantages of their adaptations. The ureter, in both subfamilies, is long and has many loops. In Athoracophorinae the ureter begins on the left side of the kidney, a tubule connects the ureter to the intestine and the anal, excretory and pneumostome orifices are separated among themselves. In Aneitinae, the ureter, which originates to the right side of the kidney, shows three loops, runs a distance dorsally to the lung, then makes a curve and loops to the excretory pore. In this subfamily, the tubule connecting the ureter to the intestine is not observed and the excretory pore, the pneumostome and the anus are located very near to each other, at the top of the right side of the mantle.

According to what was exposed above, it can be inferred that the position of the heart in relation to the kidney in Succineidae and Athoracophoridae is similar, being one on the side of the other. In Aneitinae, the trajectory of the ureter which advances passed the excretory pore and loops back to open itself at the pneumostome is similar to the one presented in *Omalonyx*. Barker (2001) commented that the disposition between the excretory pore, pneumostome and anal pore in Aneitinae is similar to the one found in succineid slugs.

Despite these presented similarities, Pilsbry (1900), when classifying the mollusks by the pallial cavity, did not consider Athoracophoridae as belonging to Heterurethra. Posteriorly, this author (1948) commented about the suborder Elasmognatha Mörch, 1865, which grouped the families Succineidae and Athoracophoridae based on the jaw morphology. Pilsbry (*op. cit.*) criticized this proposal, justifying the immense difference between the pallial cavities of the families and proposed the withdrawal of the athoracophorids. Therefore, Elasmognatha would present itself as an equivalent to Heterurethra. However, Burch and Patterson (1968) affirmed that Succineidae and Athoracophoridae are related through tentacle retraction, characters of the body surface, pallial cavity and male genitalia. These authors concluded that, due to these similarities, the families should be together in Heterurethra. Wade *et al.* (2001, 2006), through molecular phylogeny studies, agreed to the monophyly of Heterurethra, formed by succineids and athoracophorids.

The pallial cavity of the Succineidae, despite extensively commented on literature, is scarcely detailed concerning the trajectory of the ureter. Baker (1955)

suggested that the ancestors of the Sigmurethra mollusks, probably had Heterurethra lungs. However, a rigorous definition of what is a Heterurethra pallial cavity and how its structures are presented, as accomplished in this investigation, are indispensable conditions in order to make comparisons to other groups and therefore infer about their evolution and adaptations.

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CAPITULO V

Occurrence and ecological observations about *Omalonyx convexa* (Mollusca, Gastropoda, Succineidae)

The mollusks of the family Succineidae have as a pattern a well demarcated lateral groove (aulacopods) and poorly defined tubercles on the dorsal surface of the body. The life strategy of the family is incorrectly generalized as amphibian. Many species occur in swamps, marshlands, lake banks and on emerging vegetation of fresh water systems, while others live on the ground and on trees (Barker, 2001).

Omalonyx d´Orbigny, 1837 includes terrestrial slugs which are very peculiar concerning their external shape. They have a reduced, flat and fingernail-like shell. The body presents a pattern of yellow coloring with two black longitudinal stripes and blackish stains throughout the entire body, including the mantle (Barker, 2001). The former covers the visceral mass and the edge of the shell. It is the most amphibian genus of the family and its representatives are necessarily close to fresh water environments. According to Patterson (1971), they occur in the Caribbean Islands, in Central America and are amply distributed throughout South America.

Hylton Scott and Lapuente (1968) brought attention to the scarcity of succineid representatives deposited in museum collections, mainly for the genus *Omalonyx.* Intending to broaden the knowledge about this group of mollusks, the ecology of *Omalonyx convexa* (Martens, 1868) was studied, for specimens from the Rio Grande do Sul state, Brazil.

Observations and collections of mollusks were made between October of 2005 and May of 2006. They were found in the municipalities of Cachoeira do Sul, Cachoeirinha, Camaquã, Estrela, Novo Hamburgo, Pelotas, Porto Alegre, Santa Maria, São Borja and Torres (Fig.1). The collected animals were killed according to a technique adapted from Thomé (1975) and preserved in 70 GL^{o} alcohol. They are deposited at the Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, under the lots: BRAZIL, **Rio Grande do Sul**: São Borja, *Omalonyx convexa* (Martens, 1868), ($28^{o}39´50,6´´S$ $55^{o}59´03.2´´W$) 7 *spec.*, A. Paladini, E. Moysés, J. Arruda leg., J. Arruda det. (MCP 8828). BRAZIL, **Rio Grande do Sul**: Santa Maria, *Omalonyx convexa,* 3 *spec.*, J. Arruda leg. and det. (MCP 8829). BRAZIL, **Rio Grande do Sul**: Santa Maria, *Omalonyx convexa,* (Cidade dos Meninos,

29°41´15.3´´S 53°43´10.5´´W) 3 *spec.*, 8.V.2005, F. Engler, J. Arruda, P. Bergonci leg. J. Arruda det. (MCP 8831). BRAZIL, **Rio Grande do Sul**: Torres, *Omalonyx convexa,* (rio Mampituba, 29°15´26.8´´ S 49°51´09.1´´W) 2 *spec.*, 26.III.2006, E. da Silva, J. Arruda, J. Picanço, L. Araújo leg. J. Arruda det. (MCP 8832). BRAZIL, **Rio Grande do Sul**: Cachoeira do Sul, *Omalonyx convexa,* (estrada BR 290 km 255, 30°14´55.7´´S 52°46´33.8´´W)1 *spec.*, 9.X.2005, F. Engler, J. Arruda, P. Bergonci leg., J. Arruda det. (MCP 8840). BRAZIL, **Rio Grande do Sul**: Estrela, *Omalonyx convexa,* (29°29´45.0´´S 51°54´51.3´´W) 2 *spec.*, 17.II.2006, J. Arruda leg. and det. (MCP 8844). BRAZIL, **Rio Grande do Sul**: Novo Hamburgo, *Omalonyx convexa,* (Bairro Lomba Grande, 29°43´11.0´´S 51°06´03.0´´W) 1 *spec.*, 23.X.2005, C. Vilanova, J. Arruda leg., J. Arruda det. (MCP 8848). BRAZIL, **Rio Grande do Sul**: Porto Alegre, *Omalonyx convexa,* (Ilha das Flores) 3 *spec.*, 29.IV.2006, A. Paladini, J. Arruda leg., J. Arruda det. (MCP 8837). **Rio Grande do Sul**: Porto Alegre, *Omalonyx convexa,* (Ilha das Flores, 29°59´20.9´´S 51°15´56.0´´W) 4 *spec.*, 13.IV.2006, E. Moysés, J. Arruda leg., J. Arruda det. (MCP 8842). BRAZIL, **Rio Grande do Sul**: Porto Alegre, *Omalonyx convexa,* (Parque Farroupilha) 1 *spec.*, 01.X.2005, L. Araújo, J. Arruda leg., J. Arruda det. (MCP 8849). BRAZIL, **Rio Grande do Sul**: Cachoeirinha, *Omalonyx convexa,* 1 *spec.*, 29.IV.2006, A. Paladini, J. Arruda leg. J. Arruda det. (MCP 8839). BRAZIL, **Rio Grande do Sul**: Camaquã, *Omalonyx convexa,* (30°54´00.7´´S 51°47´57.5´´W) 5 *spec.*, E. Moysés, F. Engler, J. Arruda leg., J. Arruda det. (MCP 8841). BRAZIL, **Rio Grande do Sul**: Pelotas, *Omalonyx convexa,* (Estrada Pelotas – Rio Grande) 8 *spec.*, 18.III.2006, A. Paladini, J. Arruda leg. J. Arruda det. (MCP 8836).

There are also records of this species for the municipalities of Gravataí, Viamão and Taquara, in lots of the Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul collection: BRAZIL, **Rio Grande do Sul**: Porto Alegre, (banhado do dique do rio Gravataí), 1 *spec.,* T. de Lema leg. (MRCN 1524). BRAZIL, **Rio Grande do Sul**: Viamão, (Chácara N. Sra. Das Graças) 1 *spec.* (MRCN 2506). BRAZIL, **Rio Grande do Sul**: Taquara, 1 *spec.*, J. C. Gonzáles leg. (MRCN 2610). BRAZIL, **Rio Grande do Sul**: Sapiranga, (Estr. Sapiranga – Taquara, RS240) 1 *spec.*, L. Ely leg. (MRCN 2877).

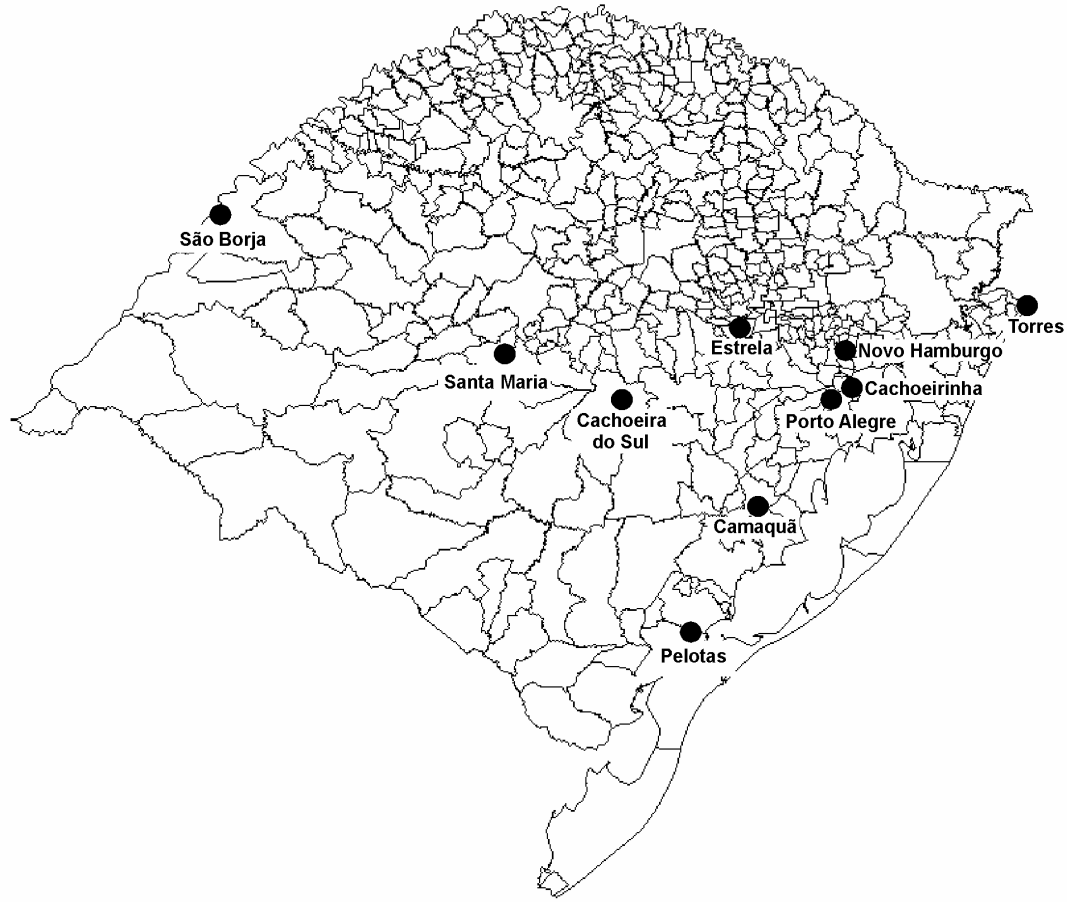

Fig.1. Map from Rio Grande do Sul state (Brazil) showing the municipalities where was found *Omalonyx convexa* (Martens, 1868).

The specimens of *O. convexa,* observed *in vivo* in their habitat presented an ample variation of their body coloring. The color of the tegument varied between milky white, dark gray practically black, orange, beige and gray, the latter two being the most commonly observed. The shell presented itself covered by the mantle in different extents, however, it was not completely covered on any of the specimens. Animals with up to four centimeters in length were observed.

The animals were found in lentic water environments, such as draining ditches for rice plantations, flooded terrains, dikes and lakes. They were spotted mainly on macrophytes *Eicchornia crassipes*, *Salvinia auriculata* and *Pistia stratiotis*. However, they were also found on the trunk (dry portion) of a semi-submersed tree in a temporary flooded site; in vegetations adjacent to the banks of flooded sites, dikes and flooded grazing fields; on water covered grass; among the leaves of a "gravatá" *Eryngium* sp.;

under artificial substrates such as canvases, cardboards, plastic bottles, tetra-pak boxes and styrofoam. This species did not present itself as restricted to natural or fresh water environments, being also found in waters where the city sewers are dumped without treatment. The luminous intensity of the day and the temperature are factors which influence the behavior of these animals.

In the early morning and in the end of the afternoon, when the temperature is more pleasant, the animals were observed on the stem and on the adaxial region of the macrophytes leaves, on grasses in flooded areas and under adjacent vegetation on the banks of dikes and lakes. In this last case, they presented themselves as camouflaged to the environment, making visualization very difficult. During the hottest hours of the day, they were found on flowers, roots, abaxial regions and close to the base of macrophyte flowers.

At the *ilha da Pintada* (Pintada island), municipality of Porto Alegre, the nematode *Leucochloridium* sp. was detected on the ommatophores of 10% of the sighted *O. convexa* specimens. This vermin presented metacercariae striped with white, beige and brown colors. The specific determination of the nematode was not possible because adult individuals, crucial to the diagnosis, were not found.

d´Orbigny (1837) mentioned the presence of *Omalonyx unguis* (d´Orbigny, 1835) close to aquatic environments, on stems of aquatic plants. Martens (1868) reported, in the description of *O. convexa,* that it was found in the proximities of macrophytes and that, therefore, were similar to the European *Succinea* Draparnaud, 1801. Döring (1873) commented about finding these slugs on moist soil, covered by small weeds, on the banks of lagoons, in small isles of grass or floating on estuaries. However, Parodiz (1963), affirmed that the animals of this genus are not found out of the water, like *Succinea,* which can inhabit moist areas. This author commented that these animals are always submersed among the macrophytes or scraping the bottom. Hermann and Dundee (1967) reported, for Ecuador, the occurrence of *O. unguis* on the *Hymenachne donacifolia* (Raddi) (sic.) grass, on floating wooden logs covered by algae and, with smaller frequency, swimming in the water. Hermann and Dundee (*op. cit.*) indicated, in Antigua, the presence of *Omalonyx* specimens on a pile of moist bushes, beside a small water reservoir.

In this study, *O. convexa* was observed in fresh water environments as well as in adjacent areas. This behavior by the animals contradicts Parodiz (1963) and concurs

with the observations presented by Martens (1868), Döring (1873) and Hermann and Dundee (1967).

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CONCLUSÕES GERAIS

A família Succineidae apresenta a cavidade palial caracterizada por um ureter primário que se inicia no rim, próximo ao pericárdio, e corre transversalmente até o reto. A partir de então, passa a se chamar ureter secundário e percorre uma pequena distância junto ao reto. Em seguida, este margeia a borda do manto, passa pelo pneumostômio e segue adiante até a região anterior da cavidade palial. O ureter secundário, então, se dobra em um ângulo de 180^{o} e passa a ser denominado ureter terciário. Este se encaminha na direção do pneumostômio e se abre imediatamente anterior ao orifício respiratório, no lado direito deste, pelo poro excretor. Isto permite manter a família classificada como Heterurethra.

As espécies do gênero *Omalonyx* que ocorrem no Estado do Rio Grande do Sul são *O. brasiliensis* (Simroth, 1896) e *O. convexa* (Martens, 1868).

A espécie *Omalonyx brasiliensis* foi originalmente descrita como *Neohyalimax brasiliensis* por Simroth (1896), para o Rio Grande do Sul. Patterson (1971) manteve a espécie considerando *Neohyalimax* subgênero. Recentemente Salgado; Coelho (2003) mencionaram a espécie como do gênero *Neohyalimax.* Patterson (*op. cit.*) chamou a atenção para alguns detalhes da descrição original de Simroth, que não se enquadravam nas demais espécies de *Omalonyx* s.s. Com base no estudo e discussão desses caracteres e exame do holótipo, propõe-se a sinonimização de *Neohyalimax* com *Omalonyx,* tornando-se o primeiro, um sinônimo júnior. *Omalonyx brasiliensis* (Simroth, 1896) permanece uma espécie válida com base unicamente no holótipo, pois, apesar de dois anos de intensas coletas no Estado do Rio Grande do Sul, esta não mais foi encontrada.

Os exemplares de *O. convexa* exibiram, *in vivo,* uma grande variação na coloração no tegumento. Foram observados animais com cores variando de branco leitoso ao cinza escuro, próximo ao preto, passando pelo alaranjado, bege e acinzentado. A concha apresentou-se encoberta pelo manto em diferentes graus, porém, nunca completamente ocultada.

O gênero *Omalonyx* é considerado o mais anfíbio dos sucineídeos, habitando ambientes de águas lênticas como pântanos, brejos, margens de lagos, além de solo úmido e sobre vegetação emergente de sistemas de água doce. Exemplares de *O. convexa* foram encontrados nas macrófitas *Eicchornia crassipes*, *Salvinia auriculata* e *Pistia stratiotis.* Os substratos artificiais que abrigaram representantes dessa espécie foram lonas, papelões, garrafas "pet", caixas "tetra-pak" e isopor.

Os animais, no início da manhã e final da tarde, quando a temperatura era mais amena, foram avistados sobre o caule e na região adaxial das folhas de macrófitas, sobre gramíneas em áreas alagadiças e sob vegetação adjacente a margem de açudes e lagos. Nas horas mais quentes do dia, encontravam-se nas flores, raízes, região abaxial e perto da base das folhas de macrófitas.

Tillier (1981) sinonimizou a espécie *Omalonyx convexa* sob *O. unguis* (d´Orbigny, 1835) e propôs um lectótipo baseado em uma concha procedente do Paraguai. Contudo, o autor caracterizou a anatomia da espécie fundamentada no estudo de exemplares argentinos. No presente estudo concluiu-se que *O. convexa* e *O. unguis* são duas espécies distintas. Os espécimes procedentes do Estado do Rio Grande do Sul, os lotes estudados por Tillier (1981), os espécimes argentinos oriundos de Chapadmalal, Jujuy e Rio Santiago (lote MACN-14472) exibiram anatomia interna igual ao dos paralectótipos de *Omalonyx convexa* (Martens, 1868). Os demais lotes provenientes de Rio Santiago, Formosa, Chaco, Barca Grande, Partido de Tigre (Argentina) e Asunción (Paraguai) apresentaram anatomia interna análoga entre si e com característicos iguais aos propostos por Arruda *et al.* (2006) para a espécie *O. unguis*.

A espécie *Omalonyx unguis*, espécie-tipo do gênero *Omalonyx,* não possui material nominotípico designado. Propõe-se um neótipo para a espécie, com base em um espécime adulto do lote MLP-11878, procedente de Formosa, Argentina.

Na análise canônica discriminante de medidas das conchas de *Omalonyx,* que considerou a população de cada localidade como um grupo distinto, resultou bastante heterogêneo e apenas 54,1% dos grupos foram classificados corretamente. A segunda análise, que agrupou as conchas por espécies, apresentou um percentual de 94,0% de correção, com resultados bastante significativos e demonstrando que as medidas de conchas podem auxiliar na confirmação da determinação das espécies do gênero *Omalonyx.* Devido a grande variabilidade interpopulacional verificada nas conchas de *Omalonyx*, estruturas menos variáveis, como o sistema reprodutório, devem ser investigadas nas espécies desse gênero, fornecendo maior robustez e segurança na diagnose.

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- *Littorina bifasciata* Adams, 1952: 67 (no locality; types lost; neotype here designated BMNH 2356). Reeve, 1990: 56 (in part).
- *Littorina nigra*-Peterson, 1964: 43; pl. 12, fig. 3 (not Sowerby, 1832).

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- ANSELL, A.D. & TREVAILLION, A. 1970. Brood protection in the stenoglossan gastropod *Bullia melanoides* (Deshayes). *Journal of Natural History*, **4**: 369-374.
- DUNCAN, C.J. 1975. Reproduction. In: *Pulmonates* (V. Fretter & J.F. Peake, eds), **1**: 309-365. Academic Press, London.
- ELLIS, A.E. 1926. *British snails*. Clarendon Press, Oxford.
- NISBET, R.H. 1973. The role of the buccal mass in the trochid. *Proceedings of the Malacological Society of London*, **40**: 435-468.
- RUNNEGAR, B. & POJETA, J. 1985. Origin and diversification of the Mollusca. In: *The Mollusca*, **10**: *Evolution* (E.R. Trueman & M.R. Clarke, eds), 1-57. Academic Press, London.
- THORSON, G. 1958. Parallel level bottom communities, their temperature adaptation, and their "balance" between predators and food animals. In: *Perspectives in marine biology* (A.A. Buzzati-Traverso, ed.), 67-86. University of California Press, Berkeley.

Journal titles are printed in italics and cited in full with the volume number in. Repeat authors' names and journal titles in multiple entries and avoid *ibid.*

RESEARCH NOTES

Short manuscripts (no longer than six double-spaced typed pages) that require rapid publication can be submitted as Research Notes. They are normally methodological notes or on subjects of exceptional interest.

These should be written *Nature* style. There should be no headings and no abstract; acknowledgements should be brief. The title should be in bold lower-case type, the authors' names in lower-case and the address in italics.

References in the text should be cited only by a superscript number, and listed at the end of the paper in the order they appear in the text. References are abbreviated, i.e. titles of papers omitted, names of journals abbreviated in standard form of (see *World List of Scientific Periodicals*).

For example:

- 1. STASEK, C.R. 1967. *Occ. Pap. Calif. Acad. Sci*., **61**: 1-44.
- 2. MORTON, B. 1981. *Sarsia*, **66**: 241-256.

ILLUSTRATIONS

All illustrations should be referred to in the text as 'Figures' (or, if in parentheses, as 'Fig.' or 'Figs') and numbered in a single series with Arabic numerals. (Note that figures in another work are referred to as 'fig.' or 'figs'.)

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Illustrations must each carry a scale bar and not magnifications in the figure captions.

Lettering should be in Helvetica bold (or similar sans-serif) font, with final printing size no more than 3 mm. Each component of a composite figure should be given a capital letter; labels and abbreviations should be in lower-case letters.

Captions for figures should be grouped together in sequence and placed at the end of the paper. The caption format for composite figures should be, for example:

- **Figure 1.**: *Littorina littorea*. **A.** Pallial oviduct. **B.** Penis. Abbreviations: a, albumen gland; b, bursa; sg, sperm groove. Scale bars: **A** = 2.0 mm; **B** = 1.0 mm.

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1) *General.* All papers must be in English. Authors whose native language is not English are encouraged to have their manuscripts read by a native English-speaking colleague before submission. Nomenclature must be in agreement with the *International Code of Zoological Nomenclature* (4th edition 1999), which came into force on 1 January 2000. Author(s) of species name must be provided when the scientific name of any animal species is first mentioned (the year of publication needs not be given; if you give it, then provide a full reference of this in the reference list). Authors of plant species name need not be given. Metric systems should be used. If possible, use the common font New Times Roman and use as little formatting as possible (use only **bold** and *italics* where necessary and indenti paragraphs except the first). Special symbols (e.g. male or female sign) should be avoided because they are likely to be altered when files are read on different machines (Mac versus PC with different language systems). You can code them as m# and f#, which can be replaced during page setting. The style of each author is generally respected but they must follow the following general guidelines.

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4) The **abstract** should be concise and informative. Any new names or new combinations proposed in the paper should be mentioned. Abstracts in other languages may also be included in addition to English abstract. The abstract should be followed by a list of **key words**. Abstract and key works are not needed in short correspondence.

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A) **Journal paper**:
Smith, A. (1999) Title of the paper. *Title of the journal in full*, volume number, page range.

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Smith, A. & Smith, B. (2000) Title of the Chapter. *In*: Smith, A, Smith, B. & Smith, C. (Eds), *Title of Book*. Publisher name and location, pp. x–y.

C) **Book**:
Smith, A., Smith, B. & Smith, C. (2001) *Title of Book*. Publisher name and location, xyz pp.

C) **Internet resources**
Author (2002) *Title of website, database or other resources*, Publisher name and location (if indicated), number of pages (if known). Available from: http://xxx.xxx.xxx/ (Date of access).

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