DISTRIBUTION OF FRESHWATER PRAWNS (CRUSTACEA: DECAPODA) MACROBRACHIUM AMAZONICUM (HELLER, 1862), MACROBRACHIUM BRASILIENSE (HELLER, 1862) AND MACROBRACHIUM JELSKII (MIERS, 1877) IN THE STATE OF RORAIMA, BRAZIL

DISTRIBUIÇÃO DE CAMARÃO DE ÁGUA DOCE (CRUSTACEA: DECAPODA) MACROBRACHIUM AMAZONICUM (HELLER, 1862), MACROBRACHIUM BRASILIENSE (HELLER, 1862) E MACROBRACHIUM JELSKII (MIERS, 1877) NO ESTADO DE RORAIMA, BRASIL

Maria Aparecida Laurindo dos Santos
Francinéia Zanetti da Costa[1]
Patrícia Macedo de Castro[2]
Célio Magalhães[3]

RESUMO: O estado de Roraima apresenta uma grande diversidade de ambientes aquáticos, como lagos, veredas de buritis, alagados, igarapés e rios. Este estudo, portanto, teve como objetivo conhecer a distribuição das espécies M. amazonicum, M. brasiliense e M. jelskii no estado de Roraima, Brasil. Tendo como área de estudo doze municípios de Roraima, o material utilizado neste estudo foram as espécies M. amazonicum, M. brasiliense e M. jelskii depositados na coleção do Museu Integrado de Roraima-MIRR e do Instituto Nacional de Pesquisa da Amazônia-INPA e coletas adicionais. Essas coletas foram realizadas no período diurno e noturno, utilizando puçá, armadilha tipo covo; matapi de garrafa pet; e rede de arrasto pequena e retangular. Foram identificados 896 indivíduos das espécies M. amazonicum, M.brasiliense e M. jelskii, distribuídos nos ecossistemas aquáticos de lavrado e floresta de terra firme e floresta alagada do estado de Roraima. A distribuição e o número de indivíduos identificados das espécies M. amazonicum, M. brasiliense e M. jelskii, corroborou com o objetivo pretendido, promovendo o aumento da distribuição dos camarões de água doce dessas espécies nos ecossistemas aquáticos do estado.

Palavras-chave: Crustacea, Caridea, Amazon Basin, Habitats.

ABSTRACT: The state of Roraima presents a great diversity of aquatic environments, such as lakes, buritis trails, wetlands, streams and rivers. This study, therefore, aimed to know the geographical distribution of the M. amazonicum, M. brasiliense and M. jelskii species in the state of Roraima, Brazil. The study area included twelve municipalities in the state of Roraima. The material used in this study was the M. amazonicum, M. brasiliense and M. jelskii specimens deposited in the collection of the Integrated Museum of Roraima-MIRR and the National Institute of Amazonian Research-INPA. Additional shrimp collections. Methods a Freshwater shrimp were collected during the day and night periods, for hand sampling (puçá); Covo trap; Pet bottle kettle; and a small rectangular trawl. Results 896 individuals of the Pleocyemata suborder of the family Palaemonidae of the genus Macrobrachium were identified, among them the species M. amazonicum, M. brasiliense and M. jelskii. They are distributed in the aquatic ecosystems of plowing and forest in the state of Roraima. The number and geographical distribution of the species M. amazonicum, M. brasiliense and M. jelskii that compose the prawn species of Roraima, corroborated with the proposed study. However, in reference to the intended objective, everything was achieved, promoting the increase of the distribution with respect to freshwater prawns in Roraima.

Keywords: Crustacea, Caridea, Bacia Amazônica, Habitats.

1 https://orcid.org/0000-0002-2118-6153
2 https://orcid.org/0000-0003-2426-8936
3 https://orcid.org/0000-0003-4858-2575

INTRODUCTION

Freshwater prawns are widely distributed in inland waters of South America, and can be divided into two informal groups (Rodríguez 1981). The Caridea infraorder represented by the families Palaemonidae and Euryrhynchidae and the infraorder Dendobranchiata that comprise the prawns the family Sergestidae. Several studies on the taxonomy and geographical distribution of freshwater prawns in the Amazon are available in the carcinogen literature. These studies were reviewed by Melo (2003), Holthuis monographs (1951;1952), with the revision of the subfamilies Euryrhynchinae and Palaemoninae, the works of Holthuis (1966), Magalhães (2002); García-Dávila and Magalhães (2003), Pileggi et al. (2013) and Pimentel and Magalhães (2014), the contributions of Kensley and Walker (1982) and Carvalho et al. (2014).

The state of Roraima presents a great diversity of aquatic environments, such as lakes, buritis trails, wetlands, streams and rivers. Despite the vast hydrographic network that makes up the state, records of freshwater prawns are almost entirely unknown in the carcinological literature and only very recently documented occurrences of some species have been published. Pileggi et al. (2013) published the first documented record of the occurrence of prawns in Roraima, and even then only one batch of one species, M. amazonicum (Heller 1862), registered for Marará, Parana Fachada, basin of the Branco river. Castro and Silva (2013), documented the occurrence of M. brasiliense (Heller 1862), M. nattereri, M. inpa (Kensley and Walker 1862), and three morphospecies of Macrobrachium, in the Perdido igarapé, in the municipality of Mucajaí. Pereira et al (2017) and Santos et al (2018) recorded species occurrences M. brasiliense and M. nattereri in the municipality of Boa Vista e Alto Alegre and Cavalcante and Castro (2014) recorded the occurrence of the species M. jelskii (Miers, 1877) in Tambaqui fish ponds (Colossoma macropomum Cuvier, 1818) in the municipality of Alto Alegre), as well as the preliminary reports presented by Castro- Guterres and Guterres (2008a; 2008b). The richness of the aquatic environments that make up the ecosystems of the state and the forest areas of the state suggests that this fauna should be much more abundant. This study, therefore, aimed to know the geographical distribution of the Macrobrachium amazonicum, Macrobrachium brasiliense and Macrobrachium jelskii species in the state of Roraima, Brazil.

MATERIAL AND METHODS

Study area

The study area included twelve municipalities in the state of Roraima. The state is located in the extreme north of the Amazon, between the coordinates 5º16'N and 1º25'S and 58º55'W and 64º48'W; It has a territorial area of 225,116 km², occupying 2.6% of the Brazilian territory. It borders the Cooperative Republic of Guyana, the Bolivarian Republic of Venezuela and also borders the states of Pará and Amazonas (Ferreira et al., 2007). It is formed by two large landscapes: forest or forest areas (Ferreira et al., 2007), and the open area (approximately 40,000 km²) located in the north-northeast region of the state, known locally as lavrado or savannah (Nascimento, 1998; Barbosa et al., 2007, Ferreira et al., 2007, Carvalho and Carvalho, 2012).

The Roraima hydrographic network is formed by rivers originating from the Parima-Pacaraima complex, whose majority of the rivers are tributaries of Uraricoera and Tacutu, which give rise to the Branco river; This is 581 km long and runs through the state in the northeast-southeast direction. Its main tributaries are, on the right bank, the Cauamé, Mucajaí, Água Boa and Catrimani

rivers; and from the left bank, Quitauau and Anauá, with its tributary the Baruana river (Santos et al., 1985; Freitas 2001; Ferreira et al., 2007).

Material

The material used in this study was the Macrobrachium amazonicum, Macrobrachium brasiliense and Macrobrachium jelskii specimens deposited in the collection of the Integrated Museum of Roraima-MIRR/IACT-RR and the National Institute of Amazonian Research-INPA. The M. brasiliense species originate from scientific expeditions carried out by INPA and MIRR researchers in the municipalities of Normandia, Bonfim, Alto Alegre, Boa Vista, Amajari, Cantá, Caracaraí, Mucajaí and Iracema.

Additional shrimp collections (SISBIO authorization no. 47494-1) were carried out from April 2014 to April 2015, collections were made in rivers, streams and buritis trails in the municipalities of Boa Vista, Alto Alegre, Bonfim and Cantá in river basins and in 1st and 2nd order streams, in the municipalities of Cantá, São Luíz do Anauá, São João da Baliza, Caroebe, Rorainópolis and part of the lower Rio Branco region (Terra Preta and Caicubi), located in the municipality of Caracaraí.

Methods

A Freshwater shrimp were collected during the day and night periods, using a 45 × 45 cm wide and 1 mm mesh size collection for hand sampling (puçá); Covo trap (50 cm long by 25 wide and 25 high); Pet bottle kettle; And a small rectangular trawl, approximately 2 m long by 1 m wide and 5 mm mesh size between nodes. The traps were set up at the bottom of the streams and rivers, where they remained for an interval of four to six hours, baited with commercial cat food and armed more than once a day and at night. The captured shrimp were fixed on the spot in 90% alcohol and labeled, noting in detail the location of the collection, geographical coordinates, date and time of collection, the name (s) of the collector (s) And other relevant ecological information (notes on habitat and microhabitat characteristics).

The specimens were examined with stereomicroscopes from Wild M8, Leica M 125 / IC80HD Leica NF4129. Samples were examined with Wild M8 Leica M 125 / IC80HD Leica NF4129 stereomicroscopes. The identification of the shrimps was made using the dichotomous keys of Holthuis (1951, 1952, 1966). Kensley and Walker (1982), Tiefenbacher (1978), Rodriguez (1980, 1982), Melo (2003) as well as current samples MIRR and INPA collections. Shrimps obtained from the additional collections were deposited in the INPA and MIRR collections.

RESULTS

Shrimp of the suborder Pleocymanta of the family Palaemonidae of the genus Macrobrachium 896 individuals were identified in this study, among which the species M. amazonicum, M.brasiliense and M. jelskii, which are distributed in aquatic ecosystems of Lavrado and forest in the state of Roraima (Tables 1 and 2).

We analyzed 55 individuals of the M.amazonicum species, among males, females, ovigeras and immature females presenting the lowest number of individuals. In submerged litter, pedralde area and macrophyte bank. Specimens from the MIRR and INPA collections were also analyzed. The species M. amazonicum presents morphological variations and the meristic characters are very close to the M. jelskii species, which can sometimes make it difficult to identify the species. M. amazonicum is a specimen known in the Amazon region for its economic potential (Odinetz-Collart 1993).

The species M. brasiliense presented a larger number of individuals with 778 specimens. The M.brasiliense species were captured in streams and Rivers habitats, in forest and plowed areas, in the microhabitat of litter, pedralds, rapids and macrophytes bank. Species from the Inpa and MIRR collection were used. The specimens captured in the additional collection in forest areas showed dark coloration (Figure 1), a fact that may be hypothetically justified as a result of the influence of the habitat where they live.

Figure 1: Shrimp of the species M. brasiliense caught in a forest aquatic ecosystem.

Source: Santos, M.A.L (2014).

MIRR and INPA collection. The specimens were captured in rivers and streams in areas of forests and plows, at night with traps and puçá in the daytime. The collections were performed by means of a trap. The microhabitat of this species were litter, pedral, beach and ravine. The collections performed during the study yielded a small number of males, both at night and daytime, with higher occurrence of females. M. jelskii may be confused with M. amazonicum for their morphological similarities, but the distinguishing characters of that species are the number of teeth and the shape of the rostrum, which is less armed and more spaced than those of M. amazonicum.

Discussion

The distribution patterns that occur in Roraima are similar to those in the northern states and in the countries that are part of the Amazon because of the similarity of habitat and microhabitat. The similarity of the basin and sub-basins of the Rio Branco with the Orinoco, Essequibo, Negro and Amazonas basins favors a peculiarity of aquatic environments, such as: rivers and streams of clear and black water, buritis trails, lakes and floods, in forest ecosystems, dryland forest,

Table 1: Geographical distribution of the species Macrobrachium amazonicum, M. brasiliense and Macrobrachium jelskii in the watersheds and aquatic ecosystems of Lavrado (L), Forest (F) and Flooded forest (Ff) of the state of Roraima.

Species	Hydrographic basin(River)													Ecosystem		
	Anauá	Amajari	Branco	Caroebe	Cauamé	Jatapu	Jauaperi	Jufari	Mucajaí	Quitauau	Tacutu	Trairão	Uraricoera	L	F	F f
M. amazonicum			X			X					X		X	X	X	
M. brasiliense	X	X	X	X	X	X	X	X		X		X	X	X	X	X
M. jelskii			X						X					X	X	

Source: The authors (2019).

M. jelskii species presented the second largest number of individuals in this study, with a total of 60 individuals between collection and additional material from the

and flooded forest in the southern portion near the basin of the Rio Negro. These environments may favor faunal interconnections as well as the diversity of

Tabela 2: Ocorrência das espécies de camarões de água doce em municípios do estado de Roraima (Abreviaturas: AA= Alto Alegre, AMR= Amajari, BFM= Bonfim, BV= Boa Vista, CCI= Caracarai, CNT= Cantá, CRB= Caroebe, IRM= Iracema, MCJ= Mucajaí, NRD= Normandia, PCR= Pacaraima, SJB= São João da Baliza, SLA= São Luiz , RPO= Rorainópolis).

Espécies	Municípios													
	AA	AMR	BV	BFM	CNT	CCR	CRB	IRM	MCJ	NRD	PCR	ROR	SL	SJB
M. amazonicum	X	X	X	X	X	X	X			X				
M. brasiliense	X	X	X	X	X	X	X		X			X	X	X
M. jelskii	X	X	X		X	X			X					

Source: The authors (2019).

freshwater prawns in the region (Magalhães and Pereira, 2003; 2007).

The similarity of the aquatic environments of Roraima with those of the other states of the northern region favors the distribution of Macrobrachium brasiliense, since this species has a wide distribution in the South American watersheds (Melo, 2003) and several new records for the Amazon basin were recently reported by Garcia-Dávila and Magalhães (2003), Valencia and Campos (2010), Pileggi et al. (2013) and Pimentel and Magalhães (2014). M. brasiliense was recorded for the first time in the municipality of Mucajai in Roraima (Castro and Silva, 2013). In this study the geographic distribution is extended to a further eleven municipalities of the state (Table 2), occurring in the Branco, Mucajai, Quitauau, Jufari, Cauamé, Trairão, Anauá, Jauaperi, Jatapú, Caroebe and Amajari basins. M. brasiliense inhabits rivers and small igarapés of 1st and 2nd order in the areas of plowing, forest and flooded forest of the north and south of the state (Figure 2).

Macrobrachium amazonicum has a large distribution in South America (Melo 2003; Vergamini et al., 2011) and also had several new records for the Amazon Basin reported in recent works (Garcia-Dávila and Magalhães, 2003; Valencia and Campos, 2010; Pileggi et al., 2013; Pimentel and Magalhães, 2014). M. amazonicum was first recorded for the state of Roraima in the municipality of Caracaraí, lower Rio Branco by Pileggi et al. (2013). The records made in this research increase the distribution to seven municipalities (Table 2). And for the basins of the Tacutu, Uraricoera, Cauamé, Jufari and Jatapu rivers (Figure 3).

Figure 2: Forest aquatic ecosystem.

Source: Santos, M.A.L (2014).

Macrobrachium jelskii also has a wide distribution in South America (Melo, 2003) and its occurrence in the Amazon Basin was reported by several authors (Holthuis, 1966; Rodriguez, 1980, 1982; Kensley and Walker 1982; Magalhães 2002; Garcia-Dávila and Magalhães 2003; Vieira , 2003; Pileggi et al.,

Figure 3: Jatapu River, Forest Ecosystem.

Source: Santos, M.A.L (2014).

2013; Pimentel and Magalhães, 2014). In the state of Roraima, the species was listed by Cavalcante e Castro (2014) as a fauna associated with tambaqui fish, Colossoma macropomum Couver, 1818 in the municipality of Alto Alegre. The records made in this work, the species has its distribution area expanded to four municipalities (Table 2), with distribution in the Branco and Mucajaí basins. However, it is likely that the species also occurs in other basins in the state, since García-Dávila (1998) reported that M. jelskii and M. amazonicum coexist in the same habitat type.

Conclusion

Although it was possible to state conclusively the number and geographical distribution of the species M. amazonicum, M. brasiliense and M. jelskii that compose the prawn species of Roraima, corroborated with the proposed study. Nevertheless, there is still a gap regarding the real number of species that is distributed in Roraima. However, in reference to the intended objective, everything was achieved, promoting the increase of the distribution with respect to freshwater prawns in Roraima.

ACKNOWLEDGEMENTS

National Institute of Amazonian Research, Graduate Program in Fresh Water Biology and Inner Fishing.

Agreement of Technical-Scientific Cooperation 01280.000370 / 2011 agreement between the parties INPA, UERR and IACTI-RR.

LITERATURE CITED

Barbosa, R.I.; Campos, C.; Fearnside, F.; Pinto P.M. 2007. **The “Lavrados” of Roraima: Biodiversity and Conservation of Brazil Amazonian Savannas. Functional Ecosystems and Communities**, 1(29): 29-41.

Carvalho, F.L.; Magalhães, C.; Mantelatto, F.L. 2014. **Molecular and morphological differentiation between two Miocene-divergent lineages of Amazonian shrimps, with the description of a new species (Decapoda, Palaemonidae, Palaemon)**. Zookeyes, 4(457): 79-108.

Carvalho, T.M.; Carvalho, C.M. 2012. **Interrelation of geomorphology and fauna of Lavrado region in Roraima, Brazil–suggestions for future studies**. Quaternary Science Journal. 61(2):146–155.

Castro, P.M.; Silva, M.R. 2013. **Caranguejos e Camarões (Crustacea: Decapoda) do Igarapé do Perdido, Apiaú, Mucajaí, Roraima**. Boletim do Museu Integrado de Roraima. 7(1): 40-47.

Cavalcante, R. M.; Castro, P. M. 2014. **Verificação das Potencialidades do Camarão de Água Doce Macrobrachium jelskii Miers, 1877 com Cultivo em Viveiro de Tambaqui Colossoma macropomum no Município de Alto Alegre no Estado de Roraima**. Revista Eletrônica Ambiente, Gestão e Desenvolvimento, Universidade

Estadual de Roraima-UERR, Boa Vista, 6: 45-53.

Ferreira, E.; Zuanon, J. Forsber, B.; Goulding, M.; Briglia-Ferreira, S. R. 2007. **Rio Branco: Peixes, Ecologia e Conservação de Roraima**. Amazonas-Amazon Conservation Association (ACA), Instituto Nacional de pesquisas da Amazônia (INPA), Sociedade Civil Mamiruá. 2007. 201p.

Freitas, A. **2001 Estudos Sociais Roraima: Geografia e História**. 5ª Ed. São Paulo: Cor-print Gráfica e Editora Ltda. 2001. 160p.

Garcia-Dávila, C. 1998. **Revisão Taxonômica dos Camarões de água doce (Crustacea: Decapodo: Palaemonidae Sergestidae) da Amazônia Peruana**. Dissertação de Mestrado, Instituto Nacional de Pesquisa da Amazônia-INPA, Manaus, Amazonas. 60p.

Garcia-Dávila, C. 1998. **Revisão Taxonômica dos Camarões de água doce (Crustacea: Decapodo: Palaemonidae Sergestidae) da Amazônia Peruana**. Dissertação de Mestrado, Instituto Nacional de Pesquisa da Amazônia-INPA, Manaus, Amazonas. 60p.

García-Dávila, C.R.; Magalhães, C. 2003. **Revisão taxonômica dos camarões de água doce (Crustacea: Decapoda: Palaemonidae, Sergestidae) da Amazônia Peruana**. Acta Amazonica. 33(4): 663-686.

Holthuis, L.B. 1951. **A general revision of the Palaemonidae (Crustacea, Decapoda, Natantia) of the Americas. I. The subfamilies Euryrhynchynae and Pontoniinae. Occasional Paper.** Allan Hancock Foundation. 11: 1-332.

Holthuis, L.B. 1952. **A General Revision of the Palaemonidae (Crustacea Decapoda Natantia) of the Americas II.The Subfamily Palaemoninae**. Los Angeles. Occasional Paper. Allan Hancoock Foundation. 12: 1-400.

Holthuis, L.B. 1966. **A collection of freshwater prawns (Crustacea, Decapoda, Palaemonidae) from Amazonia, Brasil, collected by Dr. G. Marlier. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique**. 42 (10): 1-11.

Kensley, B.; Walker, I. 1982. **Palaemonid shrimps from the amazon basin, Brazil (Crustacea: Decapoda: Natantia)**. Smithsonian Contributions Zoology. 362: 1-28.

Magalhães, C. 2002. **A rapid assessment of the decapod fauna in the Rio Tahuamanu and Rio Manuripi Basins, with new records of shrimps and crabs for Bolivia (Crustacea, Decapoda, Palaemonidae, Sergestidae, Trichodactylidae)**. Revista Brasileira de Zoologia. 19(4): 1091-1103.

Magalhães, C.; Pereira, G. 2007.**Assessment of the decapod crustacean diversity in the Guayana shield region aiming at conservation decisions**.Biota Neotropica. 7(2): 111-124.

Magalhães, C; Pereira, G. 2003. **Survey of Decapod Crustaceans in the Caura River Basin, Bolívar State, Venezuela: Species Richness, Habitat, Zoogeographical Aspects and Conservation Implications**. In: Chernoff, B.; Machado-Allison, A.; Riseng, K.; Montamboult, J.R. (Ed.). Una Evoluación Rápida de Los EcosistemasAcuáticos de la Cuenca del Rio Cauara, Estado Bolívar, Venezuela. Boletin RAP de EvoluaciónBiologíca 28. Conservation International, Washington, D.C. p. 56-63.

Melo, G.A.S. 2003. **Família Atyidae, Palaemonidae e Sergestidae**. In: Melo, G. A. S. (ed.). Manual de identificação dos Crustacea Decapoda de água doce do Brasil. São Paulo, Editora Loyola. p.289-415.

Nascimento, S.P. 1998. **Ocorrência de Lagartos no Lavrado de Roraima, Brasil (Sauria: Gekkonidae, Teiidae, Iguanidae,**

Polychridae, Tropiduridae, Scincidae e Amphisbaenidae). Boletim Museu Integrado de Roraima, Boa Vista- RR. 4:39-49.

Odinetz-Collart, O. 1993. **Ecologia e Potencial Pesqueiro do Camarão-Canela, Macrobrachium amazonicum na Bacia Amazônica**. In. Ferreira, E.J. G, Santos, G.M., Leão, E.L.M., Oliveira, L.A (Ed.), 1993. Bases cientificas para estratégicas de preservação e desenvolvimento da Amazônia. v.2. Instituto Nacional de pesquisas da Amazônia, Manaus, p. 147-166.

Pereira, J. A; Castro, P. M; Zanetti, F. C; Santos, M. A. L. 2017. **Camarões de água doce (Crustacea: Decapoda) que ocorrem no igarapé Água Boa, municípios de Alto Alegre e Boa Vista, Roraima**. Bol. Mus. Int. de Roraima. ISSN (online).2317-5206. v 11(2). p. 39-44.

Pileggi, L.; Magalhães, C.; Bond-Buckup, G.; Mantelatto, F.L. 2013. **New records and extension of the known distribution of some freshwater shrimps in Brazil**. Revista Mexicana de Biodiversidade, 84:562-574.

Pimentel, F. R. 2003. **Taxonomia dos Camarões de Água Doce (Crustecea Decapoda: Palaemonidae, Euryrhynchidae, Sergestidae) da Amazônia Oriental: Estado do Amapá e Pará**. Dissertação de Mestrado, Universidade Federal do Amazonas-UFAM/ Instituto Nacional de Pesquisas da Amazônia-INPA, Manaus, Amazonas. 89p.

Pimentel, F. R.; Magalhães, C. 2014. **Palaemonidae, Euryrhynchidae and Sergestidae (Crustacea: Decapoda); Records of Native Spercies from the States of Amapá and Pará, Brasil, with Maps of Geographic Distribution**. Journal of Species Lists and Distribution. Check List, 10(6): 1300-1315.

Rodríguez, G. 1980. **Los Crustaceos Decapodos de Venezuela**. Centro de Ecologia, Instituto Venezolano de Investigaciones Cientificas. Caracas. Venezuela.1980. p. 494.

Rodríguez, G. 1982. **Fresh-water shrimps (Crustacea, Decapoda, Natantia) of Orinoco Basin and the Venezuelan Guyana**. Journal of CrustaceanBiology. 2 (3): 378-391.

Santos, M. A. L; Castro, P. M; Magalhães, C. 2018. **Freshwater shrimps (Crustacea, Decapoda, Caridea, Dendrobranchiata) from Roraima, Brazil: species composition, distribution, and new records**. Check List 14 (1): 21–35. https://doi.org/10.15560/14.1.21

Santos, U.M.; Bringel, S.R.B.; Ribeiro, M.N.G.; Silva, M.N.P. 1985. **Rios da bacia Amazônica II. Os afluentes do rio Branco.** Acta Amazonica. 15(1-2): 147-156.

Tiefenbacher, L. 1978. **Zur Systematik und Verbreitung der Euryrhynchinae (Decapoda, Natantia, Palaemonidae)**. Crustaceana, 35(2):177-189.

Valencia, D.M.; Campos, M.R. 2010. **Freshwater Shimps of the Colombian Tributaries of the Amazon and Orinoco Rives (Palaeminidae, Euryrhynchidae, and Sergestidae (Crustacea:Decapoda)**. Caldasia,32(1): 221-234.

Vergamini, F.G.; Pileggi, L.G.; **Mantelatto, F.L. 2011. Genetic variability of Amazon river prawn Macrobrachium amazonicum (Decapoda, Caridea, Palaemonidae)**. Contributions to Zoology, 80(1): 67-83.

Vieira, I.M. 2003. **Diversidade de Crustáceosdas Ressacas da Lagoa dos Índios, Tacacá e APA do Curiaú**. In: Takiyama, L.R.; Silva, A.Q. (Org.).Diagnóstico das ressacas do Estado do Amapá: Bacias do Igarapé da Fortaleza e Rio Curiaú. Macapá-AP, CPAQ/IEPA e DGEO/SEMA.p.53-63.