

Taxonomy and Systematic / Taxonomia e Sistemática

Checklist and new records of Notonectidae (Hemiptera: Heteroptera: Nepomorpha) from Goiás, Brazil

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EntomoBrasilis 10 (1): 44-50 (2017)

Abstract. The Brazilian savannah, called *Cerrado*, has the richest flora among the world's savannahs, and the State of Goiás comprises part of this biome. We present here a checklist for Goiás based on literature and specimens collected, with 18 species of Notonectidae, including new distribution records of *Martarega membranacea* White, 1879, and first records of *Buenoa konta* Nieser & Pelli, 1994; *Buenoa pseudomutabilis* Barbosa, Ribeiro & Nessimian, 2010; *Buenoa tarsalis* Truxal, 1953; *Martarega bentoi* Truxal, 1949 and *Martarega brasiliensis* Truxal, 1949 in the State. This checklist highlights a gap in the knowledge of Notonectidae and a great necessity of works with diversity of backswimmers in Goiás.

Keywords: *Buenoa*; Central-West region; Cerrado; *Martarega*; Neotropical.

Lista de espécies e registros novos de Notonectidae (Hemiptera: Heteroptera: Nepomorpha) do Estado de Goiás, Brasil

Resumo. A savanna brasileira, chamada de Cerrado, possui a maior riqueza de flora dentre as savannas mundiais, e o Estado de Goiás encontra-se dentro dos limites deste bioma. Apresentamos aqui uma lista de espécies para Goiás baseada em literatura e espécimes coletados, com 18 espécies de Notonectidae, incluindo registros novos de distribuição de *Martarega membranacea* White, 1879, e o primeiro registro no Estado de *Buenoa konta* Nieser & Pelli, 1994; *Buenoa pseudomutabilis* Barbosa, Ribeiro & Nessimian, 2010; *Buenoa tarsalis* Truxal, 1953; *Martarega bentoi* Truxal, 1949 e *Martarega brasiliensis* Truxal, 1949. Esta lista destaca uma lacuna no conhecimento de Notonectidae e a grande necessidade de desenvolvimento de artigos com foco na diversidade de Notonectidae em Goiás.

Palavras-chave: *Buenoa*; Cerrado; *Martarega*; Neotropical; região Centro-Oeste.

The State of Goiás comprises part of the 2 million km² of Brazilian savannah, called *Cerrado*, that covers Central Brazil (RATTER *et al.* 1997). This biome has the richest flora among the world's savannahs (> 7.000 species) (KLINK & MACHADO 2005). With high levels of endemism, the *Cerrado* is considered one of the hotspots of biodiversity conservation in the world due to anthropogenic pressure to which it is submitted with the advance of agriculture and livestock (MYERS *et al.* 2000). Much of its biodiversity remains unknown and this scenario is worse when it comes to aquatic insects (CONTADOR *et al.* 2012), when taking into account the Linnaean deficit (WHITTAKER *et al.* 2005; BINI *et al.* 2006) – the lack of taxonomic knowledge of these species – along with Wallacean deficit (WHITTAKER *et al.* 2005) – characterized by a lack of knowledge of the geographical distribution of these species.

Members of Notonectidae are commonly known as backswimmers. This family is the second largest of Nepomorpha, with 11 genera and about 400 species (POLHEMUS & POLHEMUS 2008). In Brazil four genera are found, *Buenoa* Kirkaldy,

1904, *Martarega* White, 1879, *Notonecta* Linnaeus, 1758 and *Enitharoides* Brooks, 1953, with 55 species (MOREIRA *et al.* 2011; BARBOSA & NESSIMIAN 2013a, b; BARBOSA & RODRIGUES, 2013; BARBOSA *et al.* 2012, 2015).

Buenoa and *Martarega* are the largest and most common genera, and hemelytra polymorphism is highly frequent in both. Brachyptery occurs more often in *Martarega*, which in general are found in perennial waters (BARBOSA & RODRIGUES 2013), inhabit eddies of rivers where there is slight current, swim constantly at or near the surface (TRUXAL 1979) and tend to be gregarious forming large schools in deep sheltered eddies (MENKE & TRUXAL 1966). Macropterous individuals are most frequently found in *Buenoa*, which occurs generally in lentic and temporary waters (BARBOSA & RODRIGUES 2013); in *Notonecta*, that such as *Buenoa*, live in static water waiting for free-moving prey to come near (TRUXAL 1979); and *Enitharoides*, which are commonly found in lotic waters.

Edited by:

William Costa Rodrigues

Article History:

Received: 20.xi.2016

Accepted: 19.iii.2017

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🚫 No ORCID record

Funding agencies:

➡ CNPq; CAPES; FAPERJ

The Central-West Region of Brazil lacks recent studies about Notonectidae species, with only a checklist for the State of Mato Grosso do Sul (FLORIANO *et al.* 2013). The main work about this family in this region, mainly from Goiás [The State of Tocantins was part of the territory of State of Goiás until 1988. The records for the municipality of Peixe and vicinity found in TRUXAL (1957) are within the limits of the current State of Tocantins (BARBOSA & NESSIMIAN 2013)], was made by TRUXAL (1957) with new records of three genera and 14 species. In order to aid to fill this gap in the State of Goiás, we present here a checklist of species of Notonectidae occurring in this State, new distributional records of *Martarega membranacea* White, 1879, and first records of *Buenoa konta* Nieser & Pelli, 1994, *Buenoa pseudomutabilis* Barbosa, Ribeiro & Nessimian, 2010, *Buenoa tarsalis* Truxal, 1953, *Martarega bentoii* Truxal, 1949 and *Martarega brasiliensis* White, 1879.

MATERIAL AND METHODS

Samplings were taken in nine municipalities of the State of Goiás: Alto Paraíso de Goiás, Bonfinópolis, Caiapônia, Caldazinha, Cristalina, Jataí, Leopoldo de Bulhões, São João da Aliança, and Silvânia. Specimens were deposited in Coleção Zoológica (ZUFG), Universidade Federal de Goiás, and Coleção Entomológica José Alfredo Pinheiro Dutra (DZRJ), Universidade Federal do Rio de Janeiro.

The specimens were preserved in 80% ethyl alcohol. In quotations of label data, a comma separates different information and a semicolon separates information of different specimens. An exclamation mark (!) indicates new records of a species. Collectors and collection institutions are cited in parentheses. The letter "m" refers to male specimens and the letter "f" to females. The full citation of individual specimens collected at the same locality on different dates is not cited. Maps were made with QGIS® 2.14.2.

RESULTS

In total, were recorded for the state of Goiás 18 species of Notonectidae (12 of *Buenoa*, 5 of *Martarega* and 1 of *Notonecta*), with 13 records found in literature and five species corresponding to new records.

Buenoa Kirkaldy, 1904

Buenoa amnigenus (White, 1879)

Distribution in Brazil. North (AM, PA, TO), Northeast (CE, RN, PB, PE), and Central-West regions (MT, GO, MS) (WHITE 1879; TRUXAL 1953, 1957; NIESER 1975; HECKMAN 1998; BARBOSA & NESSIMIAN 2013; BARBOSA & RODRIGUES 2013; FLORIANO *et al.* 2013).

Occurrence in Goiás (Figure 2). "24 km east of Formoso; 124 km south of Peixe" (This locality probably is in the border between Goiás and Tocantins) (TRUXAL 1957).

Buenoa fittkaui Nieser, 1970

Distribution in Brazil. Central-West Region (GO) (NIESER 1970).

Occurrence in Goiás (Figure 2). "Goiás, near Formosa, Lagoa Feia" (NIESER 1970).

Buenoa konta Nieser & Pelli, 1994

Distribution in Brazil. North (PA) and Southeast regions (MG, RJ) (NIESER & PELLI 1994; NIESER & MELO 1997; MELO & NIESER 2004; RIBEIRO *et al.* 2010; BARBOSA & NESSIMIAN 2013b; BARBOSA & RODRIGUES 2013).

Material examined (Figure 2). Brasil, Estado de Goiás!, Leopoldo de Bulhões (16° 34' 40.92" S, 48° 56' 0.84" W), 20.VI.2012 (K. Dias- Silva): 1 f brachypterous (ZUFG 5177); de Caldazinha (16° 43' 39.66" S, 48° 52' 42.51" W), 17.VIII.2012: 1 m and 1 f brachypterous (ZUFG 5161).

- Amazon Forest
- Cerrado
- Pantanal
- Caatinga
- Atlantic Forest
- Pampa
- State of Goiás

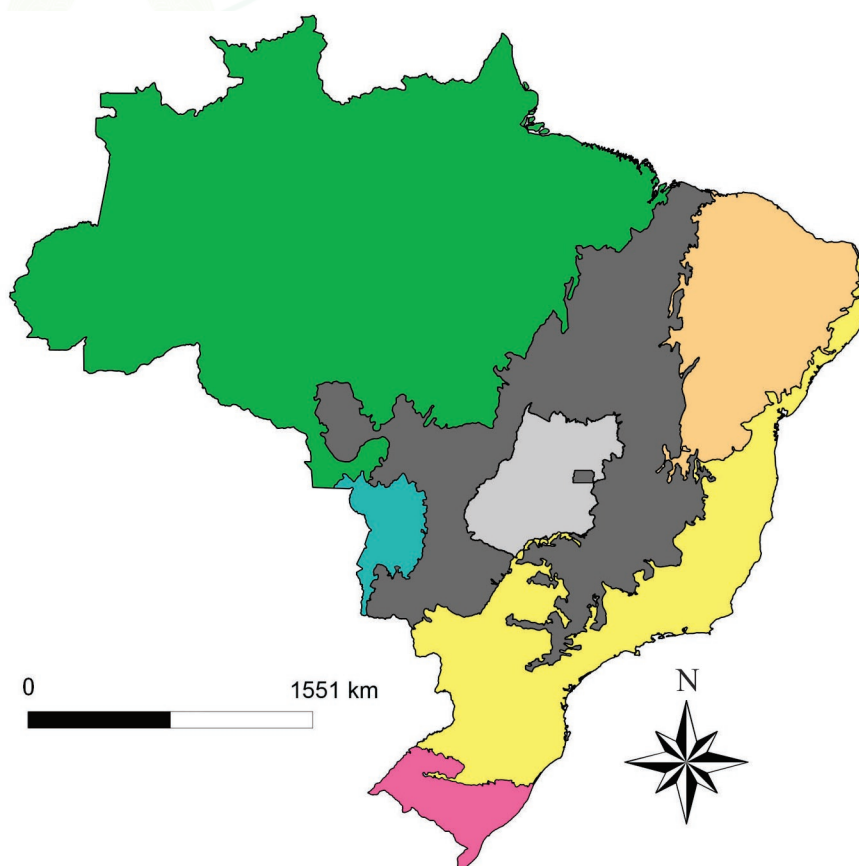


Figure 1. Biomes of Brazil indicating the location of State of Goiás.

Buenoa machrisi Truxal, 1957

Distribution in Brazil. Central-West Region (GO) (TRUXAL 1957).

Occurrence in Goiás (Figure 2). “Veadeiros (In 1963 the municipality of Veadeiros was renamed to Alto Paraíso de Goiás (IBGE 2016), Goiás, Brazil” (TRUXAL 1957).

Material examined. Brasil, Estado de Goiás, Alto Paraíso de Goiás, ponte sobre o córrego Rodoviarinha (14°10'4.20" S, 47°40'15.90" W), 26.III.2013 (D.M. Takiya & A.P.M. Santos): 1 m macropterous (DZRJ 3743); Cachoeira das Loquinhos, Poço do Sol (14°8'40.20" S, 47°28'58.20" W), 23.III.2013 (A.P.M. Santos & D.M. Takiya): 4 m and 1 f macropterous (DZRJ 3744); São João da Aliança, Cachoeira do Macaco, acima da Catedral, encontro de afluentes de água branca e do Rio do Macaco (14° 8' 39.10" S, 47° 20' 33.60" W), 22.III.2013: 1 m macropterous (DZRJ 3747).

Buenoa mutabilis Truxal, 1953

Distribution in Brazil. Northeast (PI), Central-West (GO) and Southeast regions (MG) (Truxal 1957; Nieser and Melo 1997; Vianna and Melo 2003; Melo and Nieser 2004; TAKIYA *et al.* 2016).

Occurrence in Goiás (Figure 2). “20 km north of São João da Aliança” (Truxal 1957).

Buenoa pallens (Champion, 1901)

Distribution in Brazil. North (RR), Central-West (GO) and Southeast regions (MG) (TRUXAL 1953, 1957).

Occurrence in Goiás (Figure 2). “34 km south of Amaro Leite” (TRUXAL 1957).

Buenoa paranensis Jaczewski, 1928

Distribution in Brazil. North (TO), Central-West (GO), Southeast (MG), and South regions (PR) (JACZEWSKI 1928; TRUXAL 1957; NIESER & MELO 1997; MELO & NIESER 2004; SOUZA *et al.* 2006).

Occurrence in Goiás (Figure 3). “20 km north of São João da Aliança; 24 km east of Formoso; 34 km. south of Amaro Leite, 124 km. south of Peixe” (TRUXAL 1957).

Buenoa platycnemis (Fieber, 1851)

Distribution in Brazil. North (AM, PA, TO), Northeast (MA), Central-West (MT, GO), and Southeast regions (RJ) (TRUXAL 1953, 1957; NIESER 1970; RIBEIRO *et al.* 1998; RIBEIRO *et al.* 2010; BARBOSA & NESSIMIAN 2013b).

Occurrence in Goiás (Figure 3). “24 km. east of Formoso” (TRUXAL 1957).

Buenoa pseudomutabilis Barbosa, Ribeiro & Nessimian, 2010

Distribution in Brazil. Northeast (PI), and Southeast regions (RJ) (BARBOSA *et al.* 2010a; TAKIYA *et al.* 2016).

Material examined (Figure 3). Brasil, Estado de Goiás!, Leopoldo de Bulhões (16° 35' 20" S, 48° 56' 52" W), 14.VI.2012 (K. Dias-Silva): 4 m and 1 f (ZUFG 5193), 1 m (ZUFG 5194) macropterous; (16°34'41" S, 48°56'01" W), 20.VI.2012: 4 m (ZUFG 5191), 1 m (ZUFG 5204) macropterous; (16°37'49" S, 48°48'24" W), 18.VII.2012: 2 m and 1 f macropterous (ZUFG 5153); (16°32'12" S, 48°49'48" W), 24.VII.2012: 1 m macropterous (ZUFG 5122), 3m macropterous (ZUFG 5172), 1 m and 1 f macropterous (ZUFG 5189); (16° 40' 51" S, 48° 55' 45" W): 1 m and 2 f macropterous (ZUFG 5209); Bonfinópolis (16°36'13" S, 48°57'36" W), 12.VI.2012: 2 m and 5 f macropterous (ZUFG 5201); Caldazinha (16°40'16" S, 48°50'55" W), 12.VII.2012: 4 m and 4 f (ZUFG 5175), 1 m (ZUFG 5200) macropterous; (16°44'32" S, 48°53'01" W), 03.VIII.2012: 2 m macropterous (ZUFG 5155); (16°42'53" S, 48°55'13" W), 16.VIII.2012: 2 m

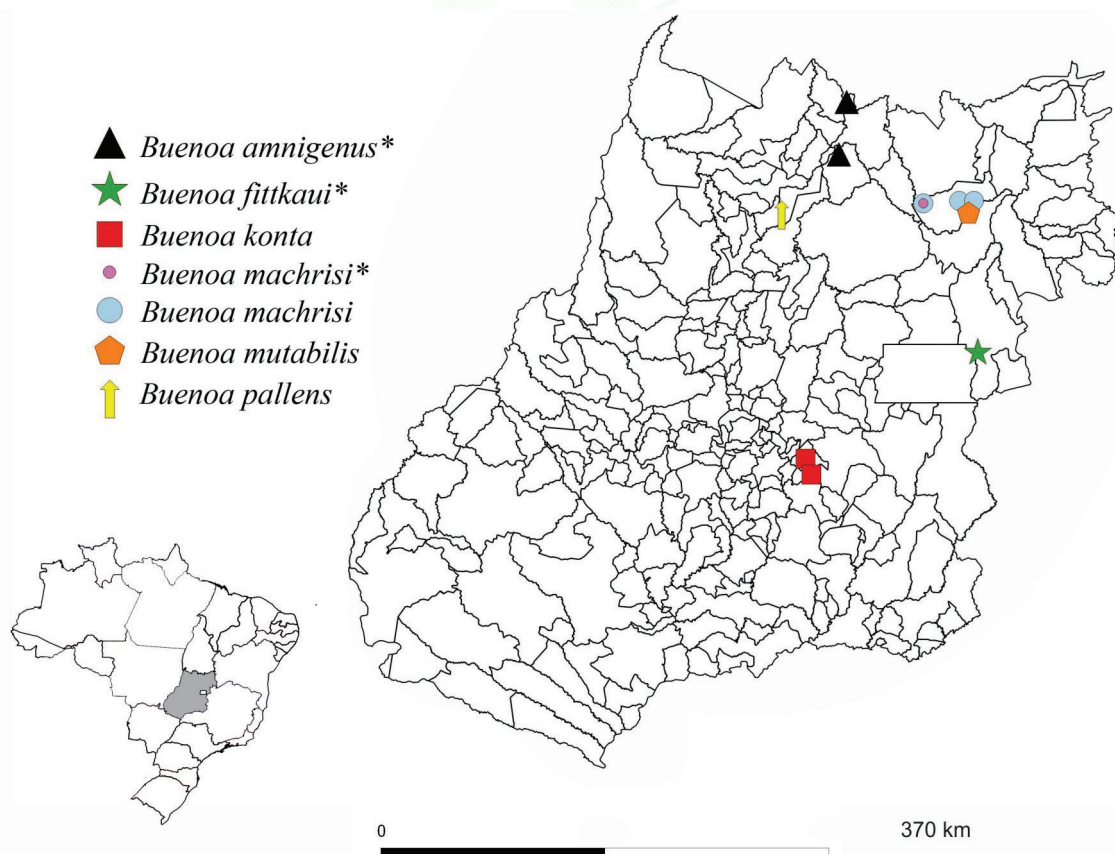


Figure 2. Distributional records of Notonectidae species in municipalities of the State of Goiás (*= known records) – *Buenoa amnigenus*, *B. fittkaii*, *B. konta*, *B. machrisi*, *B. mutabilis* and *B. pallens*.

and 1 f macropterous (ZUFG 5176); (16°43'40" S, 48°52'43" W), 17.VIII.2012: 2 m and 1 f macropterous (ZUFG 5203); Silvânia (16°32'59" S, 48°48'21" W), 05.VII.2012: 1 f macropterous (ZUFG 5182).

Buenoa tarsalis Truxal, 1953

Distribution in Brazil. North (AM, PA), Northeast (PI, CE, RN, PB, PE) and Southeast regions (MG, RJ) (TRUXAL 1953; NIESER 1970; NIESER & MELO 1997; MELO & NIESER 2004; RIBEIRO *et al.* 2010; BARBOSA & NESSIMIAN 2013b; TAKIYA *et al.* 2016).

Material examined (Figure 3). Brasil, Estado de Goiás!, Alto Paraíso de Goiás, Morada do Sol, estrada da propriedade (14°12'16.4" S, 47°50'33" W, 792 m), 25.X.2013 (B.M. Camisão, C.C. Gonçalves & D.M. Takiya): 1 m (DZRJ 3912); 26.X.2013: 1 m and 1 f (DZRJ 3911); Vale das Pedras, Rio São Miguel, praia abaixo das piscinas (14°11'31.8" S, 47°48'20.6" W, 818 m), 25.X.2013 (D.M. Takiya): 5 and 2 f macropterous (DZRJ 3913); (D. Takiya, C. Gonçalves & B. Camisão): 2 m macropterous (DZRJ 3937); Município de Caldazinha (16°40'16" S, 48°50'55" W), 12.VII.2012 (K. Dias-Silva): 1 m macropterous (ZUFG 5198).

Buenoa tibialis Truxal, 1957

Distribution in Brazil. North (PA) and Central-West Region (GO) (TRUXAL 1957; BARBOSA & NESSIMIAN 2013b).

Occurrence in Goiás (Figure 3). "24 km. east of Formoso, Goiás, Brazil" (TRUXAL 1957).

Buenoa triangularis Truxal, 1957

Distribution in Brazil. Central-West Region (GO) (TRUXAL 1957).

Occurrence in Goiás (Figure 3). "Veadeiros (In 1963 the municipality of Veadeiros was renamed to Alto Paraíso de Goiás (IBGE 2016), Goiás, Brazil" (TRUXAL, 1957).

Martarega White, 1879

Martarega bento Truxal, 1949

Distribution in Brazil. Northeast (PI, CE, PE, BA), Central-West (MT) and Southeast (MG, RJ) regions (TRUXAL 1949; BARBOSA & RODRIGUES 2013; BARBOSA & GIEHL 2014; CORDEIRO & MOREIRA 2015; MOREIRA *et al.* 2016; TAKIYA *et al.* 2016).

Material examined (Figure 4). Brasil, Estado de Goiás!, Caiapônia, rio (17°02'12.5" S, 52°06'41.6" W, 602 m), 15.II.2012 (A.P.M. Santos & E. Raimundi): 2 m brachypterous; Jataí, riacho (17°37'43.9" S, 52°20'50.4" W), 25.II.2012 (E. Raimundi): 2 m brachypterous (DZRJ 3614); Alto Paraíso de Goiás, Cachoeira São Bento (14°9'39.50" S, 47°35'39.00" W), 21.III.2013 (A.P.M. Santos & D.M. Takiya): 3 m and 1 f brachypterous (DZRJ 3745); São João da Aliança, Cachoeira do Macaco, acima da Catedral, encontro de afluente de água branca e do Rio do Macaco, (14°8'39.10" S, 47°20'33.60" W), 22.III.2013: 4 m and 5 f brachypterous (DZRJ 3746); Cristalina, córrego de 1º ordem na estrada de chão no caminho para a pedra Chapéu de Sol (16°43'48.80" S, 47°34'8.60" W), 19.III.2013: 4 m and 3 f brachypterous (DZRJ 3748); Cachoeira do Arrojado (16°47'37.10" S, 47°31'26.80" W), 19.III.2013: 4 m and 10 f brachypterous (DZRJ 3749); Leopoldo de Bulhões (16°35'20" S, 48°56'52" W), 14.VI.2012 (K. Dias-Silva): 3 m and 3 f brachypterous (ZUFG 5149), 1 f brachypterous (ZUFG 5163), 1 m and 2 f (ZUFG 5196), 2 m and 1 f (ZUFG 5199), 3 m and 8 f (ZUFG 5210) brachypterous; (16°37'49" S, 48°48'24" W), 18.VII.2012: 1 m and 1 f brachypterous (ZUFG 5159); (16°34'41" S, 48°56'01" W), 20.VI.2012: 1 f brachypterous, 1 f macropterous (ZUFG 5168), 1 m and 2 f brachypterous, 1 m macropterous (ZUFG 5178); (16°32'12" S, 48°49'48" W), 24.VII.2012: 1 f (ZUFG 5151), 3 m (ZUFG 5152), 1 f (ZUFG 5160), 1 m (ZUFG 5165), 4 m and 6 f (ZUFG 5169), 1 m and 2 f (ZUFG 5179), 3 m and 7 f (ZUFG 5180), 8 m and 18 f (ZUFG 5181), 1 m and 6 f (ZUFG 5183), 2 m and 1 f (ZUFG 5185), 1 f (ZUFG 5186), 1 f (ZUFG 5192), 3 m and 2 f (ZUFG 5195), 1 m and 1 f (ZUFG 5202), 13 m and 8 f (ZUFG 5208) brachypterous, 4 m and 3 f brachypterous (ZUFG 5173); 6 m and 7 f brachypterous (ZUFG 5174); (16°40'51" S, 48°55'45"

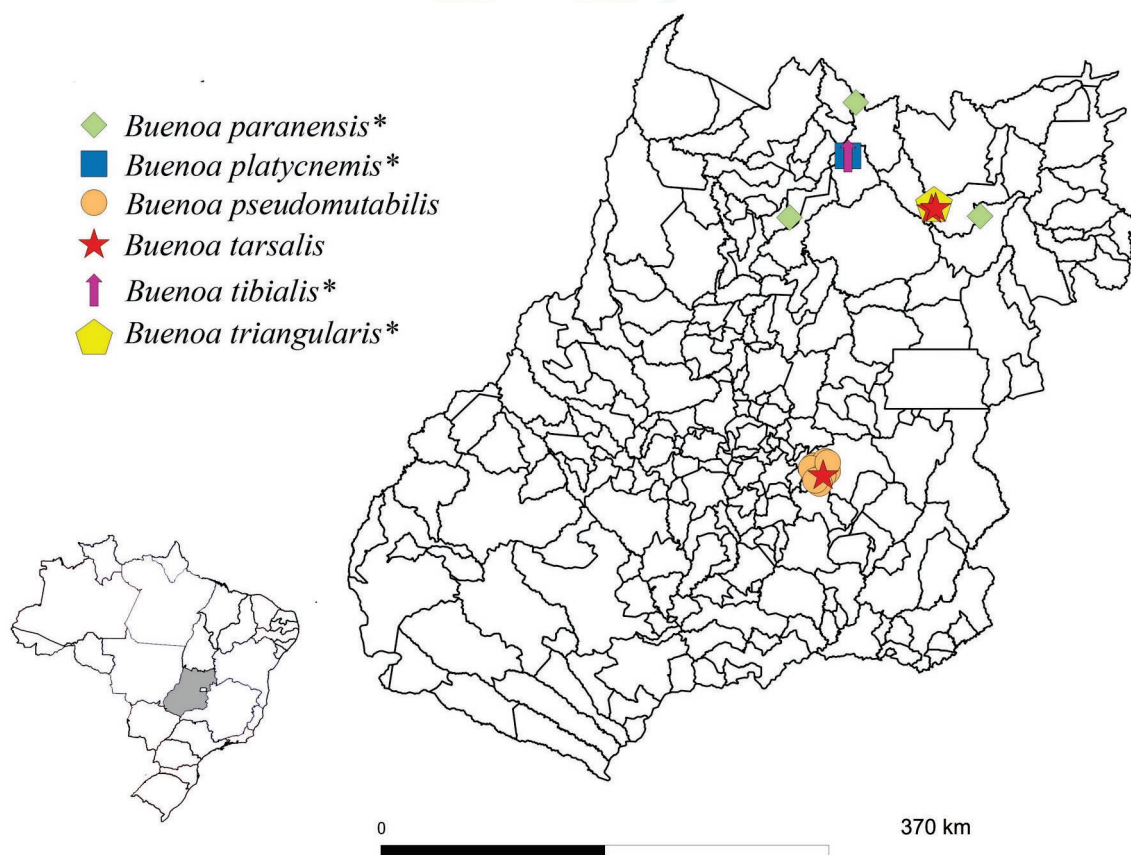


Figure 3. Distributional records of Notonectidae species in municipalities of the State of Goiás (* = known records) - *B. paranensis*, *B. platycnemis*, *B. pseudomutabilis*, *B. tarsalis*, *B. tibialis* and *B. triangularis*.

W): 2 f brachypterous (ZUFG 5209), 357 m and 115 f (ZUFG 5211); (16°33'39" S, 48°49'05" W) 12.VIII.2012: 1 m macropterous (5171); Bonfinópolis (16°36'13" S, 48°57'36" W), 12.VI.2012: 2 m and 3 f brachypterous (ZUFG 5156), 6 m brachypterous (ZUFG 5157), 1 m and 3 f brachypterous (ZUFG 5158), 34 m and 8 f (ZUFG 5207); (16°35'04" S, 48°58'45" W), 26.VII.2012: 1 m brachypterous (ZUFG 5190); Caldazinha (16°40'16" S, 48°50'55" W), 12.VII.2012: 1 f brachypterous (ZUFG 5197); (16°42'53" S, 48°55'13" W), 16.VIII.2012: 34 m and 18 f (5150), 1 f (ZUFG 5162), 1 f (ZUFG 5167), 1m (ZUFG 5170), 28 m and 5 f (ZUFG 5184), 1 m and 2 f (ZUFG 5187) brachypterous; (16°43'40" S, 48°52'43" W), 17.VIII.2012: 3 f brachypterous (ZUFG 5166).

Martarega brasiliensis Truxal, 1949

Distribution in Brazil. North (PA, RR), Northeast (CE, PE), Central-West (MT, MS) and Southeast (RJ, SP) regions (TRUXAL 1949; NIESER 1970; BARBOSA *et al.* 2010b; RIBEIRO *et al.* 2010; BARBOSA *et al.* 2012; BARBOSA & RODRIGUES, 2013; CASTANHOLE *et al.* 2013; FLORIANO *et al.* 2013; BARBOSA & GIEHL 2014; PEREIRA *et al.* 2015a, b).

Material examined (Figure 4). Brasil, Estado de Goiás!, Caldazinha, (16°42'53" S, 48°55'13" W), 16.VIII.2012 (K. Dias-Silva): 1 f brachypterous (ZUFG 5150).

Martarega membranacea White, 1879

Distribution in Brazil. North (AM, RO, PA, TO), Northeast (PI), Central-West (GO, MS) and Southeast regions (MG, RJ, SP) (WHITE 1879; TRUXAL 1949, 1957; NIESER 1970; MELO & NIESER 2004; PEREIRA & MELO 2007; BARBOSA *et al.* 2010b; RIBEIRO *et al.* 2010; BARBOSA *et al.* 2012; BARBOSA & RODRIGUES 2013; CASTANHOLE *et al.* 2013; FLORIANO *et al.* 2013; PEREIRA *et al.* 2015a; TAKIYA *et al.* 2016).

Occurrence in Goiás (Figure 4). "Goiás, near Formosa, Lagoa Feia" (NIESER 1970).

Material examined. Brasil, Estado de Goiás, Caldazinha (16°44'32" S, 48°53'01" W), 03.VIII.2012 (K. Dias-Silva): 2 m and 1 f (ZUFG 5154); (16°42'53" S, 48°55' 13" W), 16.VIII.2012 (K. Dias-Silva): 1 m brachypterous (5150), 1 m brachypterous (ZUFG 5184); (16°43'40" S, 48°52'43" W), 17.VIII.2012: 1 f brachypterous (ZUFG 5166); Silvânia (16°32'59" S, 48°48'21" W), 05.VII.2012: 1 m and 1 f brachypterous (ZUFG 5164).

Martarega nessimiani Barbosa & Rodrigues, 2013

Distribution in Brazil. North (PA), Central-West (GO) and Southeast regions (MG) (BARBOSA & RODRIGUES 2013).

Occurrence in Goiás (Figure 4). Jataí (BARBOSA & RODRIGUES 2013).

Martarega uruguayensis (Berg, 1883)

Distribution in Brazil. All regions (TO, PE, GO, MS, MG, SP, RJ, PR, SC) (JACZEWSKI 1928; TRUXAL 1949, 1957; NIESER & MELO 1997; VIANNA & MELO 2003; MELO & NIESER 2004; PELLI *et al.* 2006; SOUZA *et al.* 2006; BARBOSA *et al.* 2010b; RIBEIRO *et al.* 2010; FLORIANO *et al.* 2013;).

Occurrence in Goiás (Figure 4). "20 km north of São João da Aliança; 24 km east of Formoso" (TRUXAL 1957).

Notonecta Linnaeus, 1758

Notonecta disturbata Hungerford, 1926

Distribution in Brazil. All regions (PA, TO, PI, MT, GO, MG, RJ, SP, RS) (HUNGERFORD 1933; TRUXAL 1957; NIESER 1970; BACHMANN 1971; RIBEIRO *et al.* 1998; MELO & NIESER 2004; RIBEIRO *et al.* 2010; BARBOSA & NESSIMIAN 2013a; TAKIYA *et al.* 2016).

Occurrence in Goiás (Figure 4). "Anápolis" (TRUXAL 1957).

DISCUSSION

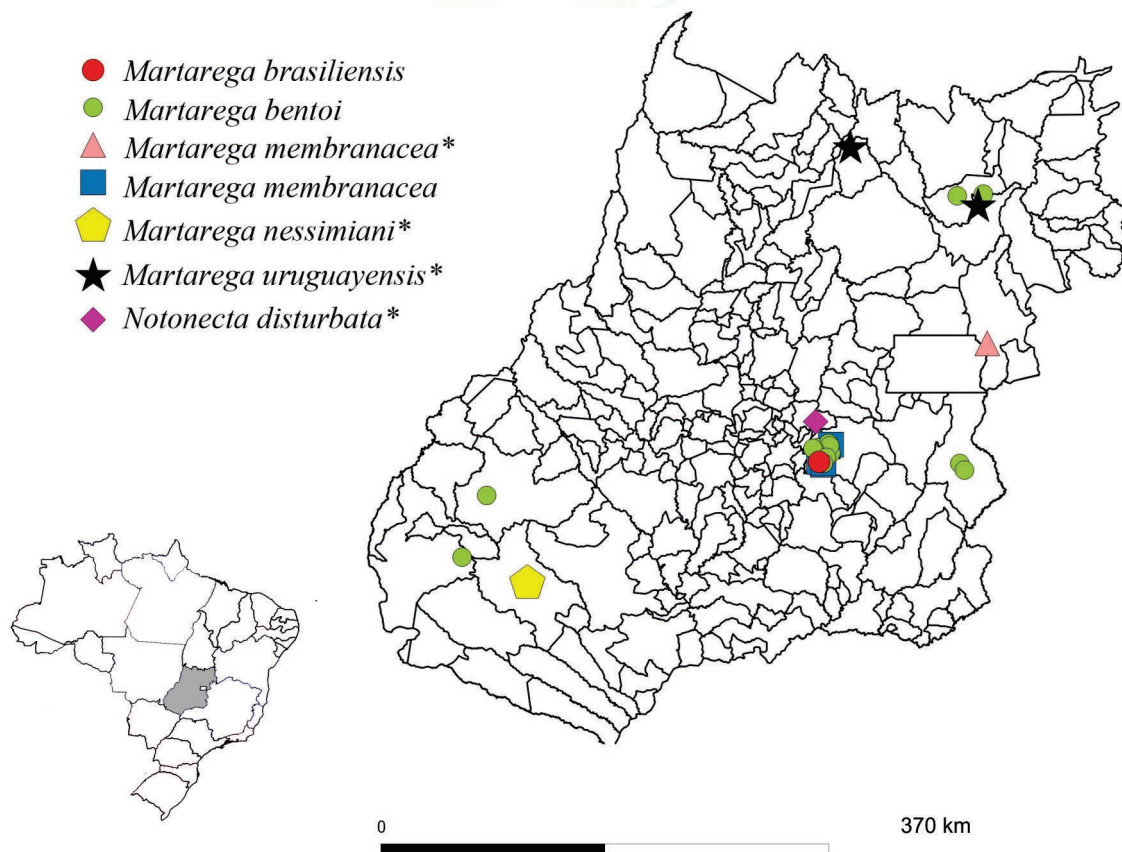


Figure 4. Distributional records of Notonectidae species in municipalities of the State of Goiás (*= known records) - *Martarega brasiliensis*, *M. bentoi*, *M. membranacea*, *M. nessimiani*, *M. uruguayensis* and *Notonecta disturbata*.

The genus *Buenoa* is restricted to the Western Hemisphere and is widely distributed on South America, with 31 known species in Brazil (BARBOSA & NESSIMIAN 2013b). The genus *Martarega* has the same pattern of distribution of *Buenoa*, with 15 known species in Brazil (BARBOSA *et al.* 2012, 2015; BARBOSA & RODRIGUES 2013). *Notonecta* is a cosmopolitan genus, with eight species recorded in the country (MOREIRA *et al.* 2011; BARBOSA & NESSIMIAN 2013a). This work increased to 18 the number of Notonectidae species found in Goiás, representing 33% of total species known in Brazil. With the maps was possible to realize the great area in the State lacking any record of this family. Records of literature and those herein cited are restricted to 16 of 246 municipalities of the state. This checklist highlights a gap in the knowledge of Notonectidae and a great necessity of works with diversity of backswimmers in Goiás, and in Brazil.

ACKNOWLEDGEMENTS

We are grateful to the project “Cerrado Waterbodies”, to collectors cited above and to Adriano Melo who provided part of the specimens in this study. This work was sponsored by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). We are also grateful to the CNPq and *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)/Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ)* for postdoctoral fellowships awarded for the authors.

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Suggestion citation:

Barbosa, J.F. & K. Dias da Silva, 2017. Checklist and new records of Notonectidae (Hemiptera: Heteroptera: Nepomorpha) from Goiás, Brazil. *EntomoBrasilis*, 10 (1): 44-50.

Available on: [doi:10.12741/ebrasilis.v10i1.667](https://doi.org/10.12741/ebrasilis.v10i1.667)

