



## Mate recognition in *Acanthagrion truncatum* (Odonata: Coenagrionidae)

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**ABSTRACT.** Sexual and species recognition, along with sexual color dimorphism, play an important role in the reproduction of many animal species. In this article, it was investigated if males of the dimorphic Neotropical damselfly *Acanthagrion truncatum* are able to recognize mates and differentiate them between co-specific males and hetero-specific females of sympatric species. The results showed misguided mating attempts from males towards other males and *Homeoura chelifera* females. They also seem able to recognize *A. lancea* and *Telebasis carmesina* females as hetero-specifics. This study support the hypothesis that male-male interactions are misdirected sexual behavior and that sympatric morphologically similarspecies may represent visual interference for mate searching males.

**Keywords:** damselfly, reproductive behavior, Zygoptera, cerrado.

## Reconhecimento sexual em *Acanthagrion truncatum* (Odonata: Coenagrionidae)

**RESUMO.** O reconhecimento sexual e específico, juntamente com o dimorfismo sexual na coloração, desempenham um papel importante na reprodução de muitas espécies de animais. Neste artigo, foi investigado se os machos da libélula neotropical *Acanthagrion truncatum*, que apresenta dimorfismo, são capazes de reconhecer parceiros sexuais e diferenciá-los entre machos e fêmeas co-específicos, bem como fêmeas hetero-específicas de espécies simpátricas. Os resultados mostraram que há ocorrência de tentativas equivocadas de acasalamento de machos com outros machos e fêmeas *Homeoura chelifera*. Eles também parecem capazes de reconhecer fêmeas de *A. lancea* e *Telebasis carmesina* como hetero-específicas. Este estudo suporta a hipótese de que interações entre machos são comportamentos sexuais equivocados e que espécies simpátricas morfologicamente semelhantes podem representar interferências visuais em sua procura por parceiros.

**Palavras-chave:** donzelinha, comportamento reprodutivo, Zygoptera, cerrado.

### Introduction

Sexual color dimorphism (SCD) is common among animals, resulted from male-male and male-female interactions to signal the individual sexual identity (ANDERSSON, 1994). Such dimorphism is considered to be influenced by means of sexual selection and male-male competition (DARWIN, 1871; ANDERSSON, 1994), resulting in a crucial part of animal reproduction: mate recognition.

Coenagrionidae damselflies often exhibit SCD, usually with bright colored males and cryptic females (CORBET, 1999). Most of them are not territorial, with a few exceptions (e.g. GUILLERMO-FERREIRA; DEL-CLARO 2012) and do not present courtship behavior. Male-male interactions are considered to be a mate recognition mistake, because males interact with other males as if they were females in an attempt to mate with them. The presence of sympatric coenagrionids may also result in intense interference visual signals that may pose another problem for mate-searching males (MILLER; FINCKE, 1999).

Thus, in this paper, it was investigated if males of the coenagrionid *Acanthagrion truncatum* Selys, 1876 are able to discriminate between co-specific males and females and hetero-specific females.

### Material and methods

#### Study species

*Acanthagrion* is a neotropical genus, widespread in Brazil, where 22 of the 41 described species can be found. They are common in still waters and ponds, perching on aquatic vegetation. *Acanthagrion truncatum* males present blue-black body coloration, while females are yellowish-green-black.

#### Field study

Fieldwork was performed in a pond in the Ecological Reserve of the Clube de Caça e Pesca Itororó de Uberlândia, Uberlândia – Southeastern Brazil (18°57'S; 48°12'12W, see REU; DEL-CLARO, 2005). In the field, four live individuals of each tested category (according to species and sex,

see below) were tethered to a line and presented to seven individual *A. truncatum* males at the pond, they were allowed to 'fly' in front of the males and perch. This method is widely used with Odonata (FINCKE, 1994; MILLER; FINCKE, 1999; GUILLERMO-FERREIRA; BISPO, 2012). The male response was recorded according to three categories: (1) approach; (2) hover; and (3) grab tandem<sup>-1</sup>; assuming that, these categories show a progressive scale of more intense sexual response. Males that did not respond (N = 31, 22% of tested males) were excluded from the analysis. The following co-specific males and females, and sympatric Coenagrionidae hetero-specific females were presented: *Acanthagrion lancea* Selys, 1876, *Homeoura chelifera* Selys, 1876 and *Telebasis carmesina* Calvert, 1909. Data were analyzed with Chi-square tests with Yates correction using the program Statistica 9® (STATSOFT, 2009).

## Results

The results (Table 1) showed that there is no difference between male response to male and female co-specifics (Chi-square = 2.403; df = 5; p = 0.3). The results also showed that males discriminate between co-specific females and the ones of *A. lancea* (Chi-square = 15.013; df = 5; p = 0.005) and *T. carmesina* (Chi-square = 15.252; df = 5; p = 0.0004). Males also discriminated between co-specific males and females of *A. lancea* (Chi-square = 10.05; df = 5; p = 0.02) and *T. carmesina* (Chi-square = 11.817; df = 5; p = 0.009). On the other hand, the males did not discriminate between *H. chelifera* females and co-specific females (Chi-square = 0.722; df = 5; p = 0.69) and males (Chi-square = 0.58; df = 5; p = 0.94).

**Table 1.** *Acanthagrion truncatum* male (N = 109) responses (approach, hover and grab) to individuals presented to them (co-specific male and female, and hetero-specific females)

Tested species and sex	Approach	Hover	Grab	N males responses
<i>Acanthagrion truncatum</i> female	10	10	6	26
<i>Acanthagrion lancea</i> female	14	0	6	20
<i>Homeoura chelifera</i> female	9	9	3	21
<i>Telebasis carmesina</i> female	17	0	4	21
<i>Acanthagrion truncatum</i> male	7	13	1	21

## Discussion

The field data showed that *A. truncatum* males are able to recognize the females of the congeneric *A. lancea* and the ones of *T. carmesina* as being different from their mates. However, *A. truncatum* males confounded *H. chelifera* females as being co-specific. The females of the latter species are blue and probably resemble *A. truncatum* males, which are also blue.

Miller and Fincke (2004) indicated that hetero-specific females may often be effective signal distracters for males, generating costs in sterile interactions. Additionally, these authors show how recognition among sympatric species may be under the influence of factors such as time of the day and the color morphism of each species. Hence, the results presented here may indicate that the level of hetero-specificity in interactions and the level of distraction imposed by sympatric species depend on the color of their females, rather than their phylogenetic proximity.

The results also showed that males might have difficulties in distinguishing between co-specific males and females, behaving similarly in response to both. Gorb (1998) found that *Coenagrion puella* Linnaeus, 1758 males can distinguish males from females visually by morphological structures and coloration pattern. However, other studies have shown the difficulties males have to identify females. When searching for mates, males may take other males for females and try to mate with them (STOKS; DE BRUYN, 1998; VAN GOSSUM et al., 2005). The results presented here support the theory that male-male interactions in coenagrionids are misdirected mating attempts.

Several studies have shown possible causes and explanations for the failure in mate recognition in Coenagrionidae. Johnson (1964), for example, stated that male-male interactions in coenagrionids are a type of basal territorialism in odonates. However, this is very unlikely since most coenagrionids are non territorial and not site attached (CORBET, 1999). Miller and Fincke (1999), on the other hand, proposed the 'learned mate recognition' theory, which suggests that males must have a number of successful interactions with receptive co-specific females to learn how to recognize mates. Sexual recognition failure also occurs in other Odonata (e.g. Calopterygidae, KUITUNEN et al. 2012; Libellulidae, CORBET, 1999; BICK; BICK 1981; SCHULTZ; SWITZER, 2001; Aeshnidae, HACET, 2010). Recently, evidences have suggested that learned mate recognition can be a common system in this group (KUITUNEN et al. 2012), playing an important role in premating reproductive isolation.

## Conclusion

In conclusion, we suggest that hetero-specific and male-male interactions in *A. truncatum* are driven by recognition failure during male mate recognition learning process.

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## References

- ANDERSSON, M. **Sexual selection**. Princeton: Princeton University Press, 1994.
- BICK, G. H.; BICK, J. C. Heterospecific pairing among Odonata. **Odonatologica**, v. 10, n. 4, p. 259-270, 1981.
- CORBET, P. S. **Dragonflies behaviour and ecology of Odonata**. Essex: Harley Books, 1999.
- DARWIN, C. **The descent of man and selection in relation to sex**. London: John Murray, 1871.
- FINCKE, O. M. Female colour polymorphism in damselflies: failure to reject the null hypothesis. **Animal Behaviour**, v. 47, n. 6, p. 1249-1266, 1994.
- GORB, S. N. Visual cues in mate recognition by males of the damselfly, *Coenagrion puella* (L.) (Odonata: Coenagrionidae). **Journal of Insect Behavior**, v. 11, n. 1, p. 173-192, 1998.
- GUILLERMO-FERREIRA, R.; BISPO, P. C. Male and female interactions during courtship of the neotropical damselfly *Mnesarete pudica* (Odonata: Calopterygidae). **Acta Ethologica**, v. 15, n. 2, p. 173-178, 2012.
- GUILLERMO-FERREIRA, R.; DEL-CLARO, K. Territoriality and male-biased sexual size dimorphism in *Argia reclusa* (Odonata: Zygoptera). **Acta Ethologica**, v. 15, n. 1, p. 101-105, 2012.
- HACET, N. An anomalous connection in the genus *Aeshna* Fabricius 1775 (Odonata: Aeshnidae) with an additional record of *Aeshna cyanea* (Müller, 1764) from Turkish thrace. **Acta Entomologica Serbica**, v. 15, n. 1, p. 1-6, 2010.
- JOHNSON, C. Mating expectancies and sex ratio in the damselfly *Enallagma praevarum* (Odonata: Coenagrionidae). **Southwestern Naturalist**, v. 9, n. 4, p. 297-304, 1964.
- KUITUNEN, K.; HAUKILEHTO, E.; RAATIKAINEN, K. J.; HAKKARAINEN, H.; MIETTINEN, M.; HÖGMANDER, H.; KOTIAHO, J. S. Do allopatric male *Calopteryx virgo* damselflies learn species recognition? **Ecology and Evolution**, v. 2, n. 3, p. 615-621, 2012.
- MILLER, M. N.; FINCKE, O. M. Cues for mate recognition and the effect of prior experience on mate recognition in *Enallagma* damselflies. **Journal of Insect Behavior**, v. 12, n. 6, p. 801-814, 1999.
- MILLER, M. N.; FINCKE, O. M. Mistakes in sexual recognition among sympatric Zygoptera vary with time of day and color morphism (Odonata: Coenagrionidae). **International Journal of Odonatology**, v. 7, n. 3, p. 471-491, 2004.
- REU, W. F.; DEL-CLARO, K. Natural history and biology of *Chlamisus minax* Lacordaire (Chrysomelidae: Chlamisinae). **Neotropical Entomology**, v. 34, n. 3, p. 357-362, 2005.
- SCHULTZ, J. K.; SWITZER, P. V. Pursuit of heterospecific targets by territorial amberwing dragonflies (*Perithemis tenera* Say): a case of mistaken identity. **Journal of Insect Behavior**, v. 14, n. 5, p. 607-620, 2001.
- STATSOFT, INC. **Statistica** (Data Analysis Software System) version 9, 2009. Available from: <http://www.statsoft.com>. Access on: Feb. 2, 2012.
- STOKS, R.; DE BRUYN, L. Unusual reproductive associations of *Ischnura elegans*. **Notulae Odonatologica**, v. 5, n. 1, p. 3-7, 1998.
- VAN GOSSUM, H.; DE BRUYN, L.; STOKS, R. Reversible switches between male-male and male-female mating behaviour by male damselflies. **Biology Letters**, v. 1, n. 3, p. 268-270, 2005.

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