Neotropical Entomology

ISSN: 1519-566X

journal homepage: www.scielo.br/ne

ECOLOGY, BEHAVIOR AND BIONOMICS

The Endangered Butterfly *Charonias theano* (Boisduval) (Lepidoptera: Pieridae): Current Status, Threats and its Rediscovery in the State of São Paulo, Southeastern Brazil

AVL Freitas[1], LA Kaminski[1], CA Iserhard[1], EP Barbosa[1], OJ Marini Filho[2]

[1] Depto de Biologia Animal & Museu de Zoologia, Instituto de Biologia, Univ Estadual de Campinas, Campinas, SP, Brasil
[2]Centro de Pesquisa e Conservação do Cerrado e Caatinga – CECAT, Instituto Chico Mendes de Conservação da Biodiversidade, Brasília, DF, Brasil

Keywords
Aporiina, Atlantic Forest, endangered species, Pierini, Serra do Japi

Correspondence
André V L Freitas, Depto de Biologia Animal & Museu de Zoologia, Instituto de Biologia, Univ Estadual de Campinas, CP6109, 13083-970, Campinas, SP, Brasil; baku@unicamp.br

Edited by Kleber Del Claro – UFU

Received 26 May 2011 and accepted 03 August 2011

Abstract

The pierid *Charonias theano* (Boisduval), an endangered butterfly species, has been rarely observed in nature, and has not been recorded in the state of São Paulo in the last 50 years despite numerous efforts to locate extant colonies. Based on museum specimens and personal information, *C. theano* was known from 26 sites in southeastern and southern Brazil. Recently, an apparently viable population was recorded in a new locality, at Serra do Japi, Jundiaí, São Paulo, with several individuals observed during two weeks in April, 2011. The existence of this population at Serra do Japi is an important finding, since this site represents one of the few large forested protected areas where the species could potentially persist not only in the state of São Paulo, but within its entire historical distribution.

Introduction

In the last Brazilian red list of endangered fauna (Machado *et al* 2008), 55 species of butterflies were categorized as threatened, with most of them (51 species) inhabiting the Atlantic Forest biome (see also Lewinsohn *et al* 2005). Three possible reasons for this pattern are: 1) the high endemism of this region, 2) the high degree of conversion of most natural habitats in Atlantic Forest (Brown & Brown 1992, Dean 1996), and 3) the considerable amount of accumulated knowledge of butterflies in this biome (Brown & Freitas 2000a,b). In fact, the majority of the published butterfly inventories in Brazil come from the Atlantic Forest region, including some of the most complete species lists for the country (Brown & Freitas 2000a,b, Santos *et al* 2008, Francini *et al* 2011).

One of these well surveyed Atlantic Forest sites is "Serra do Japi", a large remnant of montane forest in the state of São Paulo in southeastern Brazil. The area was intensively sampled from 1987 to 1991, resulting in a list of 652 species (Brown 1992). However, even considering the high species richness, only three endangered butterflies have been recorded in the area so far, namely *Tithorea harmonia caissara* Zikán (Nymphalidae), *Xenandra heliodes dibapha* (Stichel) (Riodinidae) and *Olafia roscius iphimedia* (Plötz) (Hesperiidae).

The pierid *Charonias theano* (Boisduval) (Fig 1b-c) is an endangered butterfly species known from southeastern and southern Brazil (Casagrande & Mielke 2008). Although widespread in the past, *C. theano* is apparently losing habitats due to anthropic disturbance (Casagrande & Mielke 2008), and very few individuals have been observed in recent years.

From 1988 to 2007, the first author together with K. S. Brown Jr. and other researchers intensively surveyed several forested areas in the Atlantic Forest. These surveys resulted in the location of several endangered butterfly colonies (see Francini *et al* 2005, Freitas &

Fig 1 Habitat and adults of *Charonias theano* in Serra do Japi, Jundiai, São Paulo, Brazil. a) General view of the habitat where the first male was observed on April 2011; b) Adult male feeding on *Eupatorium gaudichaudianum* (Asteraceae); c) Museum specimen of an adult male showing the wing pattern (dorsal left, ventral right).

Brown 2005, Freitas *et al* 2009, Freitas 2010), and also in the recognition and description of several new species (Francini *et al* 2004, Freitas 2004, 2007, Freitas *et al* 2010, 2011). From 1999 to 2007, during the research project "Borboletas do Estado de São Paulo" (Biota-Fapesp Research Program) many different habitats were intensively sampled in this state, aiming to produce lists of species in poorly known areas and to search for endangered and long unseen butterfly species, including *C. theano*. Despite all these efforts, the species remained unrecorded until the present observation in April 2011 in the Serra do Japi.

This paper reports these new observations of *C. theano* in the Serra do Japi and includes a description of the natural history and behavior of adults, and a discussion about the current status of this species in Brazil.

Material and Methods

Study site

The "Reserva Municipal Biológica da Serra do Japi" is an area of semi-deciduous mesophytic forest in the municipalities of Jundiaí and Cabreúva, in the state of São Paulo in Southeastern Brazil. The area includes nearly 28,000 ha of a mosaic of primary and, mainly, secondary forests in diverse stages of succession, in altitudes that varies from 700 m to 1,300 m a.s.l. A complete and detailed description of the area can be found in Morellato (1992).

The entire area of Serra do Japi was intensively sampled in the last 25 years (see Brown & Freitas 1999, 2000b for general sampling methods), including surveys in March and April when butterfly richness in the area peaks (Brown 1992).

Data from museum specimens of *C. theano* were obtained from nine collections. The acronyms for the collections are: **BMNH -** British Museum (Natural History), London, England; **CEIOC -** Coleção Entomológica do Instituto Oswaldo Cruz, Rio de Janeiro, Rio de Janeiro, Brazil; **CGCM -** Carlos Guilherme Costa Mielke Collection, Curitiba, Paraná, Brazil; **DZUP -** Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil; **FLMNH -** McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA (contains the former Allyn Museum of Entomology collection); **MNHN -** Muséum National d´Histoire Naturelle, Paris, France; **MNRJ -** Museu Nacional da Universidade Federal do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil; **MZSP -** Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil; **USNM -** National Museum of Natural History, Smithsonian Institution, Washington, DC, USA. Additional data of sightings of the species in the field were provided by Carlos GC Mielke.

Observations of *C. theano* at Serra do Japi were made from April 10-27, 2011, in four places near the Research Station (centered on 23°13'S 46°55'W). Behavioral observations were made with the aid of binoculars, and photographs were taken with a Canon EOS 20D © digital camera. All three areas where *C. theano* was present were visited from 09:00h to 16:00h by AVLF, LAK, EPB and OJM-F to record notes on behavior and natural history of adults.

Results

Natural history and adult behavior of Charonias theano *at Serra do Japi*

From 10 to 27 April 2011, approximately 11 adults of *C.*

theano (10 males and one female) were observed in four places near the Research Station at Serra do Japi. The first sighting was on April 10, when a single male was observed flying high (about four to five meters high at approximately 10:00h, apparently patrolling an area with flowers of *Bidens segetum* (Asteraceae) (exact locality in Fig 1a). This same area was intensively searched in the following six days with no additional individuals observed.

On April 15, five additional individuals (four males and one female) were observed feeding on flowers of *Eupatorium gaudichaudianum* (Asteraceae) (Fig. 1b) at the edge of an unpaved road about 1 km NE of the first sighting. All individuals were observed on a single plant, despite the fact that other flowering *E. gaudichaudianum* bushes were present nearby. Adults fed on the flowers until 15:30h, when they dispersed after the plant was shaded. The same area was visited on April 16 at 09:15h, and three males were observed flying and patrolling the area near the flowers in a typical territorial behavior. On the same day, five additional males were observed patrolling two adjacent areas close to the Research Station high in the canopy. These observations were facilitated by the topography of the terrain that provided a vantage point. Activity was observed from 09:30h to 12:00h, after which all males disappeared. On April 20, a single male was observed on the same flowers. No individuals were observed on April 27, in any of the previous observation sites of the study area.

Males were territorial, and were observed chasing other conspecific males for short periods. Aerial interactions were also observed with several other butterflies present in the area, including *Enantia clarissa* (Weymer) (Pieridae: Dismorphiinae), *Philaethria wernickei* (Röber) (Nymphalidae: Heliconiini), species of *Actinote* Hübner (Nymphalidae: Acraeini), and even a large *Battus polystictus polystictus* (Butler) (Papilionidae: Troidini). In flight, males resemble *Methona themisto* (Hübner) (Nymphalidae: Ithomiini). During territorial behavior, males were not observed perching, but instead patrolled continuously, with males flying and continuously chasing other butterflies.

Territorial behavior occurred mainly during the morning, from 09:00h to 12:30h, after which all territorial activity stopped and males disappeared from the supposed territories. Some males were observed later during the afternoon, however, feeding on flowers.

Feeding behavior was observed starting in the late morning (after 10:30h) and adults (six males and the only observed female) were observed visiting Asteraceae as nectar sources (*E. gaudichaudianum* and *B. segetum*). Additionally, one male was observed briefly visiting yellow flowers of *Senna* sp. (Fabaceae), and another male was observed puddling on wet soil.

No courtship behavior was observed during the period of study, and no females were observed attempting to lay eggs.

Discussion

Natural history

The record of *C. theano* in Serra do Japi is quite surprising, given that this area has previously been intensively surveyed for butterflies. In particular, the region near the Research Station has been visited in the last six years every April for butterfly surveys. These recent visits resulted in 31 new records of species to the previous list of Serra do Japi (AVL Freitas *et al unpublished data*), but *C. theano* was never observed in the region until 2011. It is interesting to note that *C. theano* was relatively common and conspicuous in the area from April 10-16, 2011, and was easily observed on flowers or patrolling territories every day during this period. Given that of Serra do Japi is isolated from the network of large forested areas of the region, it is less likely that the presence of *C. theano* in the area is a result of a recent colonization by individuals from neighboring populations. Accordingly, the lack of observation of *C. theano* at Serra do Japi in previous years could be due to: 1) the species being present in very low densities; 2) the species being absent from the study area, with populations having recently expanded to the study area from other less accessible areas in the Serra do Japi, or 3) a combination of both.

If *C. theano* does present strong fluctuations in numbers throughout the years, these could be related with host plant availability (possibly a mistletoe, Braby & Nishida 2010), or because *C. theano* is a poor competitor compared with other species using Loranthaceae/Viscaceae as host plants in the study area, including several butterflies which are abundant in Serra do Japi, such as the Pieridae *Pereute antodyca* (Boisduval), *Pereute swainsoni* (Gray), *Archonias brassolis tereas* (Godart), *Catasticta bythis* (Hübner), *Melete lycimnia paulista* Fruhstorfer, *Hesperocharis anguitea* (Godart) and several Lycaenidae and Riodinidae (Brown 1992, LA Kaminski *et al unpublished data*).

Based on museum specimens, previous records of *C. theano* suggest there is no diapause or dormancy in this species (Table 1). According to these records, there may be a population peak around April as most of the multiple-individual samples come from this month (26 out of 55 individuals with month information available).

The territoriality observed in males of *C. theano* is a trait also observed in *Charonias eurytele* (Hewitson) (Pieridae) (DeVries 1987, Salazar 2004, Braby & Nishida 2010), but the general behavior of both species is very different. In *C. eurytele*, males were observed perching and patrolling territories in small light gaps about 3 m above

Table 1 Data for *Charonias theano* from nine Museum collections (see text for codes), and field observations. An asterisk (*) indicates areas where most of the original habitats were converted to urban or agrarian systems, having low chances to still host healthy populations of *C. theano*; (+) indicates sites where *C. theano* has been searched by different researchers (see text for details) and not observed in the last 30 years; (boldface) indicates sites where the species has been recorded recently (last 30 years).

Code	Sex	Date	State	Municipality	Site	Altitude (m)
MZSP	1 male	X.1942	Paraná	Londrina*+	Heimtal[1]	580-840
MZSP	1 male	X.1944	Paraná	Londrina*+	Heimtal[1]	580-840
MZSP	1 male	IV.1915	Paraná	-----	-----	-----
MZSP	1 male	-----	São Paulo	-----	-----	-----
MZSP	1 male	1932	São Paulo	-----	-----	-----
MZSP	1 male	IV.1916	São Paulo	Campina do Monte Alegre*	Engenheiro Hermillo*	600
MZSP	1 male	-----	São Paulo	-----	-----	
MZSP	1 male	28.IV.1928	São Paulo	São Paulo*+	Ipiranga*+	800
MZSP	1 female	-----	São Paulo	-----	-----	-----
DZUP	2 males	IV.1952	Paraná	Cândido de Abreu*	-----	540-600
DZUP	2 males	IV.1959	Paraná	Ponta Grosa*+	-----	970-1,000
DZUP	1 male	22.IV.1951	Paraná	Guarapuava*+	-----	1,000-1,300
DZUP	1 male	10.IX.1961	São Paulo	São Paulo/Mairiporã+	Serra da Cantareira+	700-1,200
DZUP	1 male	VI.1935	São Paulo	Avaré*	-----	760-800
DZUP	1 male	25.VII.1971	Minas Gerais	**Cambuquira**	-----	950-1,300
DZUP	1 male	06.I.1973	Minas Gerais	**Cambuquira**	-----	950-1,300
DZUP	2 males	15-16.III.1981	Minas Gerais	**Cambuquira**	-----	950-1,300
DZUP	1 male	25.V.1967	Minas Gerais	Poços de Caldas+	-----	1,100-1,200
DZUP	1 female	25.V.1967	Minas Gerais	Poços de Caldas+	-----	1,100-1,200
DZUP	1 male	29.VII.1964	Minas Gerais	**Conceição dos Ouros**	-----	860-900
DZUP	1 male	26.V.1967	Minas Gerais	**Conceição dos Ouros**	-----	860-900
DZUP	1 male	19.IV.1968	Minas Gerais	**Conceição dos Ouros**	-----	860-900
FLMNH	2 males	-----	Paraná	Castro*+	-----	980-1,000
FLMNH	1 female	-----	Paraná	Castro*+	-----	980-1,000
FLMNH	1 male	1937	São Paulo	São Paulo*+	-----	800-900
FLMNH	1 male	19.I.1968	Minas Gerais	**Conceição dos Ouros**	-----	860-900
FLMNH	1 male	-----	Rio de Janeiro	Mendes	-----	440-500
MNRJ	2 males	24.IV.1926	São Paulo	Araras*+	Loreto*+	670
MNRJ	1 male	-----	São Paulo	Araras*+	Loreto*+	670
MNRJ	1 female	-----	São Paulo	Araras*+	Loreto*+	670
MNRJ	3 males	2.V.1926	São Paulo	Amparo*	-----	670-700
MNRJ	1 female	-----	São Paulo	Amparo*	-----	670-700
MNRJ	2 males	-----	São Paulo	-----	-----	-----
MNRJ	2 females	-----	São Paulo	-----	-----	-----
MNRJ	1 male	1933	Minas Gerais	Caxambu	-----	890-1,000
MNHN	1 male	-----	-----	-----	-----	-----
MNHN	1 male	II.1900	São Paulo	-----	Rio Paranapanema	-----
MNHN	1 male	1911	São Paulo	-----	-----	-----

Continue

Table 1 Continuation.

Code	Sex	Date	State	Municipality	Site	Altitude (m)
MNHN	1 female	1918	-----	-----	"Bresil Meridional"	-----
MNHN	1 female	1911	São Paulo	-----	-----	-----
MNHN	1 male	1911	Espírito Santo	Santa Leopoldina+	-----	16-800
BMNH	4 males	IV.1898	Paraná	Castro*+	-----	980-1,000
BMNH	2 females	IV.1898	Paraná	Castro*+	-----	980-1,000
BMNH	1 male	IV-V.1910	Paraná	Castro*+	-----	980-1,000
BMNH	1 female	IV-V.1910	Paraná	Castro*+	-----	980-1,000
BMNH	2 males	-----	São Paulo	-----	-----	-----
BMNH	1 male	-----	São Paulo	Casa Branca*	-----	680-700
BMNH	1 male	II.1882	São Paulo	Casa Branca*	-----	680-700
BMNH	1 male	1901	São Paulo	Bauru	-----	520-600
BMNH	1 male	-----	Minas Gerais	-----	-----	-----
BMNH	1 female	-----	Minas Gerais	-----	-----	-----
BMNH	1 male	28.II.1917	Minas Gerais	Passa Quatro	-----	970-2,000
BMNH	2 males	1897	Minas Gerais	-----	-----	-----
BMNH	4 females	1897	Minas Gerais	-----	-----	-----
BMNH	2 males	1879	Rio de Janeiro	-----	-----	-----
BMNH	3 males	-----	-----	-----	-----	-----
BMNH	1 male	-----	-----	-----	-----	-----
BMNH	1 female	-----	-----	Ipanema[1]	-----	-----
BMNH	1 male	IV.1898	-----	-----	Valley River Juahy[1]	-----
BMNH	1 female	1929	Ecuador[2]	-----	-----	-----
USNM	2 males	-----	-----	-----	-----	-----
USNM	1 female	-----	Paraná	Castro*+	-----	980-1,000
USNM	2 males	-----	Paraná	Castro*+	-----	980-1,000
USNM	1 male	-----	São Paulo	Mogi Guaçu*	-----	600-650
USNM	5 males	-----	São Paulo	-----	-----	-----
CEIOC	2 males	II.1940	Minas Gerais	Caxambu	-----	890-1,000
CEIOC	1 male	11.III.1916	Minas Gerais	Passa Quatro	Fazenda dos Campos	1,600
CEIOC	1 male	26.II.1914	Espírito Santo	Alegre*	Fazenda Jerusalem*[3]	250-1,300
CEIOC	1 female	26.II.1914	Espírito Santo	Alegre*	Fazenda Jerusalem*[3]	250-1,300
CEIOC	1 female	23.V.1915	Espírito Santo	Alegre*	Fazenda Jerusalem*[3]	250-1,300
CEIOC	1 male	23.III.1923	-----	-----	-----	-----
CGCM	1 male	IV.1938	Santa Catarina	Joinville+	-----	0-300
CGCM	1 male	-----	São Paulo	Presidente Prudente*	-----	450-480
C.G.C. Mielke	4 males	30.IV.1989	Minas Gerais	**Pouso Alegre**	-----	800-1,300
C.G.C. Mielke	1 female	3.VII.1989	Minas Gerais	**Pouso Alegre**	-----	800-1,300
C.G.C. Mielke	1 male	14.IV.1995	Minas Gerais	**Conceição dos Ouros**	**Rio Sapucaí**	800
C.G.C. Mielke	1 male	17.XII.1997	Minas Gerais	**Conceição dos Ouros**	**Rio Sapucaí**	800
C.G.C. Mielke	1 male	15.I.2003	Minas Gerais	**Conceição dos Ouros**	**Rio Sapucaí**	800
Present study	> 10 seen	10-16.IV.2011	São Paulo	**Jundiaí**	**Serra do Japi**	1,000-1,200

[1]Unknown localities; [2]Probably wrong data; [3]Exact locality unknown, probably nearby the municipality of Alegre, Espírito Santo.

ground, flying slowly in the understory. In *C. theano*, males were observed flying continuously in open areas or above the canopy, with a flight not as slow as that described for *C. eurytele*. In both species, territorial behavior was observed mainly in the morning, as also reported in the closely related genus *Archonias* Hübner (DeVries 1987, Brown 1992, Braby & Nishida 2010).

Conservation of C. theano

Based on the museum records and field observations, *C. theano* has been recorded at 26 localities in six states in south and southeastern Brazil (Table 1, Fig 2) (Zikán & Zikán 1968, Ebert 1969, Casagrande *et al* 1998, Casagrande & Mielke 2008): Santa Catarina, Paraná, São Paulo, Minas Gerais, Rio de Janeiro and Espírito Santo. In all localities, the species was found associated with semi-deciduous forests of mid- to high altitudes in the interior (500-1,100 m) (Table 1).

The records from Joinville (coastal Santa Catarina), and Mendes (Rio de Janeiro) are noteworthy, since these are the only two localities of dense lowland rainforest from where the species has been reported. The presence of *C. theano* in the state of Rio de Janeiro, previously considered dubious (see discussion in Monteiro *et al* 2010), is now confirmed (see Table 1). In Espírito Santo, the species was never recorded despite more than 30 years of inventories in the montane region of Santa Teresa and Santa Leopoldina, where the butterfly was presumably recorded in the beginning of the last century (Table 1), but it was already listed as expected for the region by Brown & Freitas (2000a). The record from Ecuador is considered an error.

Most of the sites where *C. theano* has been recorded in the past are now severely converted by human activities, and the majority has little forest remaining (Table 1). For example, in the municipalities of Ponta Grossa, Guarapuava, Londrina and Castro (all in the state of Parana), four sites where the species was frequently collected in the first half of the 20th century (see Table 1), it has not been recorded in the last 50 years despite many field expeditions to the forest remnants at these four localities (Table 1, Fig 2) (Dolibaina *et al* 2011, OHH Mielke, *pers. comm.*).

In Minas Gerais the species has not been recorded from Poços de Caldas recently (KS Brown and AVL Freitas, *pers. obs.*), a region where it was recorded by Ebert (1969), although the region still presents large forested areas that could still host the species in the region (as

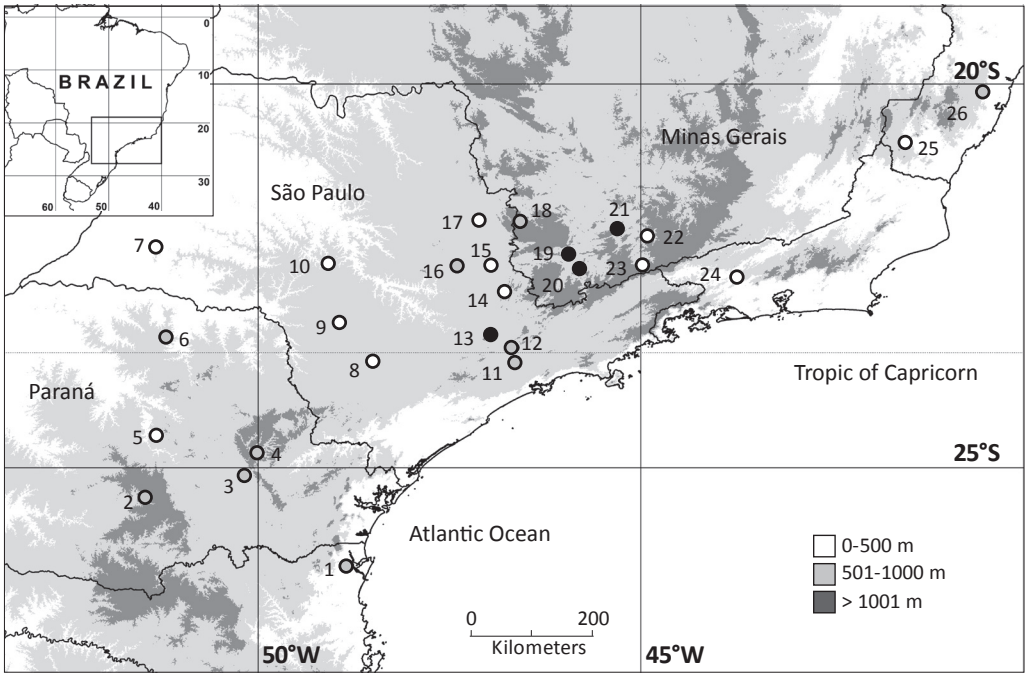

Fig 2 Map showing the 26 known localities for *Charonias theano* in Southern and Southeastern Brazil (all uncertain and wrong localities are not shown, see Table 1 for further details); 1) Joinville, SC; 2) Guarapuava, PR; 3) Ponta Grossa, PR; 4) Castro, PR; 5) Cândido de Abreu, PR; 6) Londrina, PR; 7) Presidente Prudente, SP; 8) Campina do Monte Alegre, SP; 9) Avaré, SP; 10) Bauru, SP; 11) São Paulo (Ipiranga), SP; 12) Mairiporã (Serra da Cantareira), SP; 13) Jundiaí (Serra do Japi), SP; 14) Amparo, SP; 15) Mogi Guaçu, SP; 16) Araras (Loreto), SP; 17) Casa Branca, SP; 18) Poços de Caldas, MG; 19) Pouso Alegre, MG; 20) Conceição dos Ouros, MG; 21) Cambuquira, MG; 22) Caxambu, MG; 23) Passa Quatro, MG; 24) Mendes, RJ; 25) Alegre, ES; 26) Santa Leopoldina, ES. Abbreviations for states: ES = Espírito Santo; MG = Minas Gerais; PR = Paraná; RJ = Rio de Janeiro; SC = Santa Catarina; SP = São Paulo. Open circles = sites where the species was present in the past and not seen recently; gray circles = sites where the species was recorded in the past, searched in the last 30 years and not recorded; solid circles = sites where the species was recorded in the last 30 years.

well as the region of Passa Quatro, where the species was recorded by Zikán & Zikán 1968), but recent records from three close sites (Table 1, Fig 2) suggests that there is still suitable habitats in a region nearby the border of São Paulo State.

In Santa Catarina, the species has not been recorded in more than 50 years of intensive sampling in Joinville and neighboring areas (H Miers, CGC Mielke and OHH Mielke, *pers. com.*). In addition, there are no recent records of *C. theano* from Rio de Janeiro and from Espírito Santo. In the state of São Paulo, of the 11 known localities for *C. theano*, only the "Serra da Cantareira" still has large forested areas where the species could still persist. Nevertheless, *C. theano* has not been recorded at this locality despite more than 100h of inventories in March and April in the region from 1989 to 2003 (AVL Freitas *pers. obs.*).

Based on the present evidence, the status of *C. theano* deserves special attention. There are four localities where the species has been observed in the last 30 years (one in São Paulo and three in Minas Gerais, Fig 2), and most known populations have apparently gone extinct or are in decline. The few confirmed populations are small and show extreme fluctuations in number of mature individuals among years, making the species hard to detect. These characteristics are more than enough to validate the status of the species as endangered (Casagrande & Mielke 2008; see also Francini *et al* 2005 for a similar but more critical example).

In view of the present scenario, the discovery of an apparently viable population of *C. theano* in Serra do Japi is an important finding, since the entire area, with more than 28,000 ha, is the largest portion of habitat where the species could still persist in the state of São Paulo (almost twice as large as Serra da Cantareira, and with much less anthropogenic pressures in surrounding areas). Important priorities for future research and conservation of this species include: 1) discovery of the host plants, 2) description of immature stages, including their predators and parasitoids, 3) population studies to evaluate the actual size of each demographic unit (this would be feasible in Serra do Japi) and how these fluctuate from one year to another, and 4) location of other populations of *C. theano* (Freitas & Marini Filho 2011). Such information would provide essential insights into the factors contributing to make this species so sensitive, rare and localized in comparison with its close relatives.

Acknowledgments

Authors thank Marcelo Monge for the identification of the plants used as nectar sources by adults of *C. theano* and Keith Willmott and Paulo Oliveira for critical reading of the manuscript. The following people helped with information from the Museums: Diego Dolibaina and Olaf Mielke (DZUP), Blanca Huertas (BMNH), Bob Robbins and Brian Harris (USNM), Alexandre Soares (MNRJ), Marcio Felix (CEIOC), Marcelo Duarte (MZSP), Keith Willmott (FLMNH), Jacques Pierre and Rose Nguyen (MNHN), and Carlos Mielke (CGCM). LAK was supported by FAPESP (10/51340-8), and EPB thanks CAPES for a fellowship. AVLF thanks FAPESP (grant 04/05269-9), and the Brazilian Research Council – CNPq (fellowship 300282/2008-7). This publication is part of the RedeLep "Rede Nacional de Pesquisa e Conservação de Lepidópteros" SISBIOTA-Brasil/CNPq (563332/2010-7), and BIOTA-FAPESP Program (11/50225-3). This paper is dedicated to Dr. Keith S. Brown Jr., an enthusiastic scientist that worked with butterfly ecology and conservation, and who greatly inspired the authors to work with butterfly conservation.

References

Braby MF, Nishida K (2010) The immature stages, larval food plants and biology of Neotropical mistletoe butterflies (Lepidoptera: Pieridae). II. The *Catasticta* group (Pierini: Aporiina). J Nat Hist 44: 1831-1928.

Brown Jr KS (1992) Borboletas da Serra do Japi: diversidade, habitats, recursos alimentares e variação temporal, p.142-187. In Morellato LPC (ed) História natural da Serra do Japi: ecologia e preservação de uma área florestal no sudeste do Brasil. Campinas, Editora da Unicamp, 321p.

Brown Jr KS, Brown GG (1992) Habitat alteration and species loss in Brazilian forests, p. 119-142. In Whitmore TC, Sayer JA (eds) Tropical deforestation and species extinction. London, Chapman & Hall, xiii + 153p.

Brown Jr KS, Freitas AVL (2000a) Diversidade de Lepidoptera em Santa Teresa, Espírito Santo. Bol Mus Biol Mello Leitão, NS, 11/12: 71-116.

Brown Jr KS, Freitas AVL (2000b) Atlantic Forest butterflies: indicators for landscape conservation. Biotropica 32: 934-956.

Casagrande MM, Brown Jr KS, Mielke OHH (1998) Borboletas (Lepidoptera) ameaçadas de extinção em Minas Gerais, Brasil. Rev Bras Zool 15: 241-259.

Casagrande MM, Mielke OHH (2008) Lepidoptera: Capítulo 46 - *Charonias theano theano* (Boisduval, 1836). In Machado ABM, Drummond GM, Paglia AP (orgs) Livro vermelho da fauna ameaçada de extinção. Vol I. 1 ed. Brasília: Biodiversidade 19, v. I, p. 438-439.

Dean W (1996) A ferro e fogo. A história e a devastação da Mata Atlântica brasileira. São Paulo, Companhia das Letras, 484p.

DeVries PJ (1987) The butterflies of Costa Rica and their natural history, Vol I: Papilionidae, Pieridae, Nymphalidae. Princeton, Princeton University Press, 327p.

Dolibaina DR, Mielke OHH, Casagrande MM (2011) Borboletas (Papilionoidea e Hesperioidea) de Guarapuava e arredores, Paraná, Brasil: um inventário com base em 63 anos de registros. Biota Neotrop 11: 1-14.

Ebert H (1969) On the frequency of butterflies in eastern Brazil, with a list of the butterfly fauna of Poços de Caldas, Minas Gerais. J Lepid Soc 23: 1-48.

Francini RB, Duarte M, Mielke OHH, Caldas A, Freitas AVL (2011) Butterflies (Lepidoptera, Papilionoidea and Hesperioidea) of the "Baixada Santista" region, coastal São Paulo, Southeastern Brazil. Rev Bras Entomol 55: 55-68.

Francini RB, Freitas AVL, Brown Jr KS (2005) Rediscovery of *Actinote zikani* (D'Almeida) (Nymphalidae, Heliconiinae, Acraeini): Natural history, population biology and conservation of an endangered butterfly in SE Brazil. J Lepid Soc 59: 134-142.

Francini RB, Freitas AVL, Penz CM (2004) Two new species of *Actinote* (Lepidoptera, Nymphalidae) from Southeastern Brazil. Zootaxa 719: 1-10.

Freitas AVL (2004) A new species of *Yphthimoides* (Nymphalidae, Satyrinae) from southeastern Brazil. J Lepid Soc 58: 7-12.

Freitas AVL (2007) A new species of *Moneuptychia* Forster (Lepidoptera: Satyrinae: Euptychiina) from the highlands of Southeastern Brazil. Neotrop Entomol 36: 919-925.

Freitas AVL (2010) Impactos potenciais das mudanças propostas no Código Florestal Brasileiro sobre as borboletas. Biota Neotrop 10: 53-57.

Freitas AVL, Brown Jr KS (2005) Immature stages of *Napeogenes sulphurina* Bates, 1862 (Lepidoptera, Nymphalidae, Ithomiinae) from Northeastern Brazil. J Lepid Soc 59: 35-37.

Freitas AVL, Emery EO, Mielke OHH (2010) A new species of *Moneuptychia* Forster (Lepidoptera: Satyrinae: Euptychiina) from Central Brazil. Neotrop Entomol 39: 83-90.

Freitas AVL, Francini RB, Souza TS (2009) Immature stages and natural history of the threatened butterfly *Actinote quadra* (Nymphalidae: Heliconiinae: Acraeini). Trop Lepid Res 19: 82-88.

Freitas AVL, Marini Filho OJ (2011) Plano de Ação Nacional para Conservação dos Lepidópteros. ICMBio, Brasília, 124p.

Freitas AVL, Mielke OHH, Moser A, Silva-Brandão KL, Iserhard CA (2011) A new genus and species of Euptychiina (Lepidoptera: Nymphalidae, Satyrinae) from south Brazil. Neotrop Entomol 40: 231-237.

Lewinsohn TM, Freitas AVL, Prado PI (2005) Conservation of terrestrial invertebrates and their habitats in Brazil. Conserv Biol 19: 640-645.

Machado ABM, Drummond GM, Paglia AP (2008) Livro vermelho da fauna brasileira ameaçada de extinção. MMA, Brasília, 1420p.

Monteiro RF, Freitas AVL, Costa Filho MAF, Nascimento MS, Alves TG, Brown Jr KS, Mielke OHH, Casagrande MM, Duarte M (2010) Borboletas da Mata Atlântica do estado do Rio de Janeiro: Pieridae (Lepidoptera). Arq Mus Nac Rio Janeiro 67: 283-289.

Morellato LPC (1992) História natural da Serra do Japi: ecologia e preservação de uma área florestal no Sudeste do Brasil. Campinas, Editora da Unicamp, 321p.

Salazar JA (2004) Género *Charonias* Röber, 1908, p.82-83. In Le Crom JF, Llorente-Bousquets J, Constantino LM, Salazar JA (eds) Mariposas de Colombia. Vol. 2, Pieridae. Bogotá, CARLEC Ltda, 133p.

Santos EC, Mielke OHH, Casagrande MM (2008) Inventários de borboletas no Brasil: estado da arte e modelo de áreas prioritárias para pesquisa com vistas à conservação. Nat Conserv 6: 68-90.

Zikán JF, Zikán W (1968) Inseto-fauna do Itatiaia e da Mantiqueira. III. Lepidoptera. Pesq Agropec Bras 3: 45-109.