Territorial-like defensive behavior of floral resources by *Heliconius ethilla narcaea* Godart over *H. sara apseudes* (Hübner) (Lepidoptera, Nymphalidae, Heliconiinae)

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ABSTRACT. The use of nectar and pollen of a bromeliad by two heliconiine butterflies, *Heliconius ethilla narcaea* Godart, 1819 and *H. sara apseudes* (Hübner, [1813]) (Lepidoptera, Nymphalidae, Heliconiinae), is herein reported. Observations were made during a pollination study of *Aechmea gracilis* Lindman (Bromeliaceae, Bromelioidea) in a second-growth forest of the village Vila Dois Rios, Ilha Grande, Rio de Janeiro State, southeastern Brazil. Field observations showed that *H. ethilla* can be more aggressive than *H. sara* in exploiting *A. gracilis* floral resources. Temporal differences in the use of these resources were also observed: *H. sara* remained comparatively less time on flowers than *H. ethilla*.
KEY WORDS. Lepidoptera, *Heliconius*, pollination, *Aechmea gracilis*, competition, home range.

Butterfly population structure and dynamics are frequently changing within and between years in response to the distribution and abundance of food resources for larvae and adults (EHRLICH 1984). In heliconiine butterflies, for which the larval foodplants, *Passiflora* spp. (Passifloraceae), are relatively continuous and abundant, population structure and dynamics seem to be influenced by the distribution and abundance of adult feeding resources – nectar and pollen (GILBERT 1972; EHRLICH & GILBERT 1973; SAALFELD & ARAÚJO 1981; GILBERT 1984; ROMANOWSKY *et al.* 1985; MURAWSKI & GILBERT 1986; MURAWSKI 1987).

Members of the genus *Heliconius* Kluk, 1802 have been extensively characterized by maintaining and patrolling specific home ranges over periods of days or weeks. GILBERT (1975) suggested that within their territories there can be a high degree of specificity for particular sites or plants. Nevertheless, an in-depth investigation on the specificity for certain adult nutritional resources as a learned behavior and as an adaptation to minimize the effort in locating suitable flowers has not been performed to date (SWIHART & SWIHART 1970; see also references in BROWN 1981). Territory patrol and aggressive interactions between residents and conspecific

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intruders of four heliconiine butterflies, including two species of *Heliconius*, were described in some detail by BENSON *et al.* (1989), and MURAWSKI (1987) observed similar interactions when floral resources became scarce.

The purpose of this note is to report a territorial-like defensive behavior of two heliconiine butterflies, *H. ethilla narcaea* Godart, 1819 and *H. sara apseudes* (Hübner, [1813]) (Nymphalidae, Heliconiinae), for ephemeral floral resources of a bromeliad.

When closely related species are found exploiting the same resources (*e.g.* water, food and mating sites) in a given area, it is normally expected that interspecific competition will result in the exclusion of one by the other (i.e., competitive exclusion). However, competing species may avoid such direct interaction and naturally coexist by displaying different growth and mortality rates (Mathieu Joron, *in litt.*), or by utilizing the same habitat and resources when they are less competitive (SCHOENER 1974; SCHLYTER & ANDERBRANT 1993). Studies on pollination ecology are good examples to illustrate how different pollinator species can exploit the same resource by being active at different hours of the day in response to the presence of other pollinator organisms or to oscillations of some abiotic factors such as temperature, radiation, relative humidity, barometric pressure and wind speed (FAEGRI & PIJL 1979 *apud* VITALI-VEIGA & MACHADO 2000).

In May 1996, during a study on pollination ecology of the bromeliad *Aechmea gracilis* Lindman carried out by one of us (CFDR) at Ilha Grande, in southeastern Brazil, individuals of *H. ethilla* and *H. sara* were seen competing aggressively for the same feeding resources. The interactions between these two heliconiine species were observed in four occasions, in three different days and suggested exclusion of *H. sara* by *H. ethilla*. Aggressive defense of nectar and pollen sources has been reported previously in other *Heliconius* species (DEVRIES 1987; MURAWSKI 1987). Moreover, some species may distinctly be more aggressive than others when flowers are limited, visiting and defending a single or a few flowering plants within their home range over weeks or months (EHRLICH & GILBERT 1973; DEVRIES 1987). This may be the case of flower use on *A. gracilis*, a plant having only one short flowering period (30-40 days) each year (ALMEIDA *et al.* 1998). The restricted flowering period of this bromeliad may contribute to a limitation of floral resources for its pollinators.

Observations reported here were made in a second-growth forest located 90 m a.s.l. of the village Vila Dois Rios at Ilha Grande (23°11'S and 44°12'W, Angra dos Reis county), an island of about 19,000 ha approximately 150 km south of the city of Rio de Janeiro. Most of Ilha Grande is covered by Atlantic rainforest, and few scattered fragments of primary forest can still be found (ARAÚJO & OLIVEIRA 1988).

During the pollination study, observations were made in hourly intervals from 06:00 to 18:00 on two different inflorescences and at different sites within the forest for three days. Within each hourly interval, flower visitors were recorded in two 15 min-periods, totaling 30 minutes of observation per hour. The number of visits and time spent by each individual of *H. ethilla* (a frequent visitor of flowers of *A. gracilis*; see figure 1) on feeding was recorded using a chronometer. Some behavioral features of *H. ethilla* when exploiting flower resources of the bromeliad

Figs 1-2. Floral resources exploitation of *Aechmea gracilis* Lindman (Bromeliaceae, Bromelioideae) by two heliconiine butterflies. (1) *Heliconius ethilla narcaea*; (2) *Heliconius sara apseudes*.

were also observed, including movements around the plant and a series of interactions with the congeneric *H. sara*, which represents another syntopic *A. gracilis* flower visitor recorded (Fig. 2).

Field observations showed that *H. ethilla* utilizes flowers of *A. gracilis* as a potential source of nectar and pollen (Fig. 1), remaining on the flower for a considerable portion of time (mean = 56.0 ± 54.0 seconds; range 10 to 207 seconds; n = 11 visits). During each visit *H. ethilla* usually inserted its proboscis almost completely inside the flower corolla (Fig. 1), remaining over the flower apparently sucking nectar while moving its wings slowly, opening and closing them, until leaving the flower. In an occasion (19 May 1996), two individuals of *H. ethilla* remained simultaneously exploiting different flowers of the same inflorescence, collecting nectar and pollen with no apparent interference from either part. For five times, after the period spent on a single flower, *H. ethilla* moved to a perch above the inflorescence, remaining there for some minutes. In general, the perch was a tree branch in a sun spot. The height of the perch varied between two and six meters above the inflorescence of *A. gracilis* (mean = 4.1 m ± 1.5; n = 5). After some time spent apparently basking on the perch (4-8 minutes), in two occasions the butterfly flew down again to a flower of the same inflorescence and repeated the behavior described previously - a learned sequence known as trap-line behavior (EHRLICH & GILBERT 1973). The earliest visit of *H. ethilla* to an *A. gracilis* flower was recorded at 7:37 h. After this time the number of visits usually increased until 10:30 h. The last observed visit of *H. ethilla* occurred at 11:09 h.

In four occasions during the study period was excluded of *H. sara* from *A. gracilis* flowers by *H. ethilla*. In all of these occasions individuals of *H. sara*, after approaching and landing on an *A. gracilis* inflorescence, were promptly excluded from it by an individual of *H. ethilla* which was nearby. In one of these occasions the individual of *H. ethilla* which excluded *H. sara* came from a perch in a sun spot. Two successful visits of *H. sara* to *A. gracilis* flowers without exclusion by *H. ethilla* are recorded, but in these occasions no *H. ethilla* was seen in the surrounding area. In these occasions each individual of *H. sara* remained comparatively less time on the flower (10 and 15 seconds, respectively). This behavior is suggestive of a dominance of *H. ethilla* over *H. sara* in the *A. gracilis* flower resource exploitation. The last observed visit of *H. sara* to *A. gracilis* was recorded at 11:24h. After this time no visit to *A. gracilis* flowers occurred by either of these *Heliconius* species. In no occasion *H. sara* was observed using a perch.

It is widely recognized that most heliconiine butterflies are able to collect nectar and pollen from several plants, and hence are able to supplement the usual *Psiguria* sp. (Cucurbitaceae), *Gurania* sp. (Cucurbitaceae) and *Lantana camara* Linnaeus (Verbenaceae) flower resources with many other species (DEVRIES 1987; RAMOS & FREITAS 1999). Nevertheless, bromeliads have rarely been visited by these feeding generalist butterflies (ROMANOWSKY *et al.* 1985; VARASSIN & SAZIMA 2000).

Behavioral and preference changes according to adult food availability and seasonality have been shown to be a remarkable feature of some *Heliconius* species (EHRLICH & GILBERT 1973; BROWN 1981; RAMOS & FREITAS 1999). A long term population study of *Heliconius* butterflies at the study site in Vila Dois Rios will be

conducted in order to confirm whether nectar and pollen exploitation patterns can be established among years as already recognized for other heliconiine species (BOGGS *et al.* 1981; MURAWSKI & GILBERT 1986; RAMOS & FREITAS 1999).

Although the data on *H. ethilla* and *H. sara* reveal that these butterflies can exploit the same nectar and pollen sources in different way, the observation of two males of *H. ethilla* on a single inflorescence of *A. gracilis*, without interfering with each other, suggests that the defensive behavior of this heliconiine butterfly for certain resources, as mentioned in other studies (TURNER 1971; BENSON *et al.* 1989), is indeed a plastic feature and more likely performed when resources are not abundant (MURAWSKI 1987).

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