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SHORT NOTE

Seasonality and nesting habits of the endemic social wasp *Polistes ridleyi* Kirby, 1890 in the Fernando de Noronha Archipelago, Northeast Brazil

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Abstract
We studied the seasonality and made notes about the nesting habits of the endemic social wasp *Polistes ridleyi* Kirby, 1890 of the Fernando de Noronha Archipelago. We collected 427 adult paper wasp *P. ridleyi* specimens for nine months using *Malaise* interception traps. The highest abundance of wasps was observed in October, November, and December, a fact most likely explained by the lowest precipitation levels on the island. We recorded 38 *P. ridleyi* nests. However, most of them were collected in a single *Cynophalla flexuosa* (L.) plant. This agglomeration may suggest multi-combs behavior, as reported for another species of *Polistes* spp.

Social wasps explore different environments and substrates for nesting, in search of plant substrate, stems, and leaves (Somavilla et al., 2012), agricultural (Milani et al., 2020), and urban (Oliveira et al., 2017) ecosystems, in addition to using anthropic substrates such as metal and concrete (often on human constructions), as already reported for species of *Polistes* Lepeletier, 1836.

Polistes is one of the most diverse, familiar, and widespread genera of social wasps, with 237 described species found in all habitable continents (Richards, 1978; Carpenter, 1996; Silveira et al., 2021; Somavilla et al., 2021). The colonies of the species consist of a single comb without a protective covering and are attached to the substrate by a peduncle (Wenzel, 1998; Somavilla et al., 2012). Despite the genus being one of the most well-documented groups of social wasps regarding behavioral studies, there is no information on the nesting or behavior of the endemic species *Polistes ridleyi* Kirby, 1890 in Fernando de Noronha. The only information about this species was presented by Kirby (1890) in the original description: "The insect stings slightly, but only when much irritated; it plays a very important part in the fertilization of the flowers, especially the Cucurbitaceae."

This study aims to understand better this social wasp species' seasonality and nidification behavior. It presents the results from a research project which performed samplings in Fernando de Noronha Archipelago with passive samplings methods such as flight interception traps (*Malaise*) from June 2019 to February 2020 and active sweeping during a week in June/2019 and February/2020.

The Brazilian oceanic archipelago of Fernando de Noronha (latitude 3°45′S to 3°57′S; longitude 32°19′W to 32°41′W) is of volcanic origin and was never connected to the continent. It has a tropical oceanic climate (Awi) (Dubreuil et al., 2019). The archipelago has a tropical climate with an annual temperature ranging from 23.5 ºC to 31.5 ºC and annual precipitation of 1,400 mm, but with significant

interannual variability. It is characterized by a dry season, with a mean precipitation of 27.2 mm/month (August – January), and a rainy season, with a mean precipitation of 211.7 mm/month (March – July) (see IBAMA, 1990; Rafael et al., 2021). In general, the archipelago of Fernando de Noronha has suffered major ecological disturbances due to several human interventions, and a large part of the native vegetation was devastated. At the same time, exotic plants and animals were introduced to serve as food. However, there are still preserved areas on the island serving as a refuge for fauna and flora (Rafael et al., 2020, 2021; Mahlmann et al., 2022). The native entomofauna was altered or even partially extinct long before being studied or recorded. Today, thirty-eight species of insects (3.39%) were described from local specimens, most likely endemic species (Rafael et al., 2021).

Details about Fernando de Noronha Archipelago, sampling effort, methods, collection period, and the sampled points are available in Rafael et al. (2021) and Mahlmann et al. (2022). The vouchers specimens examined were from the Coleção Zoológica do Maranhão of Universidade Estadual do Maranhão (CZMA), Caxias, Maranhão, Brazil, and the Coleção Zoológica de Invertebrados of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil. The Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) approved the sampling activities under license number 62,821.

We used the software R program (R Core Team 2020) to calculate the Pearson correlation (r) for abundance versus precipitation and temperature. Data referring to temperature (°C) and precipitation (mm) were accessed through the online database of the Instituto Nacional de Meteorologia (INMET, 2022) of the Ministério da Agricultura, Pecuária e Abastecimento.

A total of 427 adult paper wasp *P. ridleyi* specimens (Figure 2A) were collected during nine months using interception traps, having been the only vespid species recorded for the island. The highest abundance of wasps was observed in October, November, and December, most likely explained by the lowest precipitation levels on the island during this period. On the other hand, in January and February, the first months of the rainy season, the number of *Polistes* specimens was reduced (Figure 1).

The present study did not register a correlation between abundance, temperature, and humidity ($r = -0.343$ $p = 0.365$ and $r = -0.520$ $p = 0.150$, respectively). However, there was a negative correlation between abundance and precipitation ($r = -0.678$ $p = 0.044$). As expected in equatorial regions, the highest abundance of individuals was recorded in the dry season, and this is due to the intense foraging activity (Detoni & Prezoto, 2021) and the increase in the foundation of new colonies in this period (Somavilla et al., 2012). Thus, *Malaise* traps, a flight interception method, were efficient for collecting wasps.

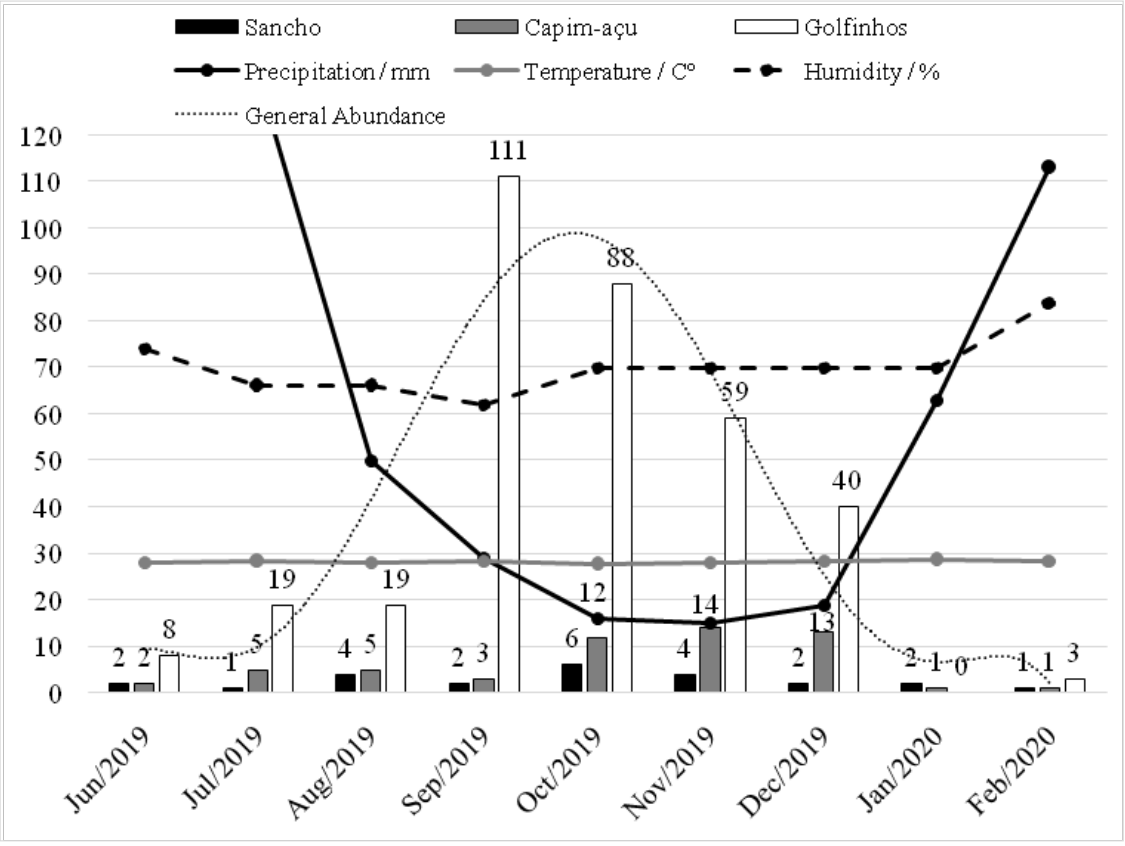

Fig 1. Population fluctuation of *Polistes ridleyi* Kirby, 1890 in the archipelago of Fernando de Noronha over nine months of collection using flight interception traps (*Malaise*).

The rainy season impacts the ability and energy cost of the flight. Raindrops pose a more significant threat to insects, which are considerably smaller than bats and birds (Heinrich, 1975; Poulsen, 1996; Dickerson et al., 2014; Lawson & Rands, 2019). Many insect species have demonstrated behavioral changes by decreasing their activity during the decrease of barometric pressure (rain), to reduce the likelihood of injury or death during rains and heavy winds (Marchand & McNeil, 2000; Pellegrino et al., 2013).

We recorded higher wasp abundance in the area called Golfinhos in comparison with two other areas (Figure 1). The better preservation status and the absence of tourists can explain the higher abundance of wasps in the Golfinhos area. However, we cannot discard the idea that flight interception traps (*Malaise*) were installed close to an agglomeration found colonies, causing the abundance to be high as they are social insects.

We recorded 38 nests of *P. ridleyi* in the archipelago of Fernando de Noronha, most of them curiously built in a single plant *Cynophalla flexuosa* (L.) J. Presl (Capparaceae) (n = 37) and only one nest in *Sapium argutum* (Müll. Arg.) Huber. (Euphorbiaceae) (Figure 2B, C). Twenty-eight nests were active, and only ten were abandoned nests. It was possible to record all levels of colonial development, with nests ranging from a few cell units (about 5-9) with two or three adult individuals and larger nests reaching approximately 130 cells and more than 30 adult individuals.

This agglomeration found in close nests on a single substrate (Figure 2C) may be related to similar nesting strategies already reported for the species *Polistes canadensis* (Linnaeus, 1758) (Jeanne, 1979), in which an initial foundation occurs, and new combs are added around the first comb. The agglomeration may also be linked to the fact that *C. flexuosa* has perennial, broad leaves and trichomes, fundamental characteristics of a natural substrate for the success of social wasp colonies because these characteristics contribute to protection against abiotic and biotic factors, besides contributing to the longevity of colonies (Barbosa et al., 2020).

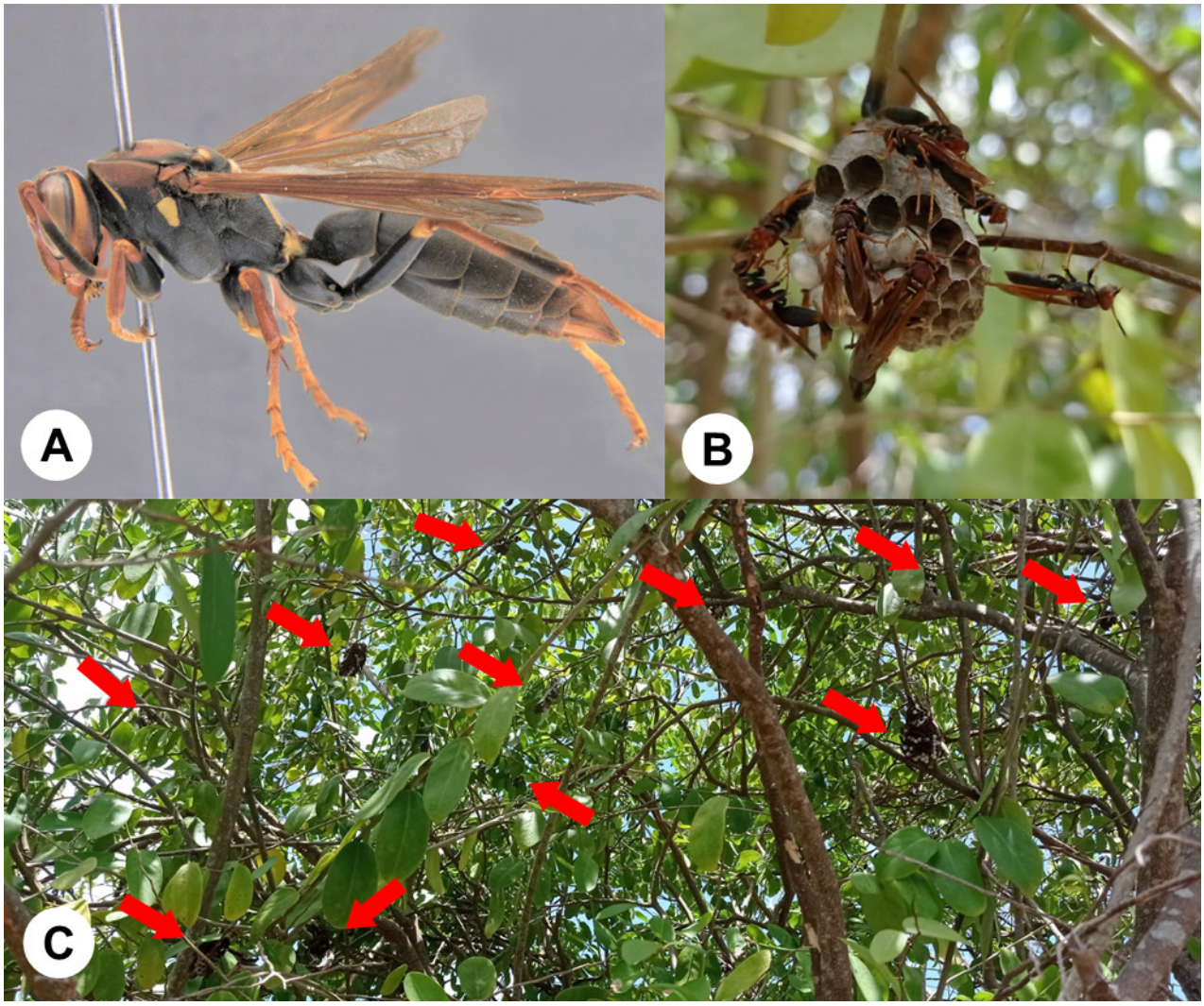

Fig 2. A – *Polistes ridleyi* Kirby, 1890, in lateral view; B – Colony of *P. ridleyi*; C – Red arrows showing nearby colonies on the same tree canopy *Cynophalla flexuosa* (Capparaceae).

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Author's Contribution

A Somavilla – Conceptualization, investigation and data curation;
T Mahlmann – Conceptualization, sampling, investigation and data curation;
BC Barbosa – Conceptualization, investigation and data curation;
F Limeira-de-Oliveira – Sampling, project administration;
JA Rafael – Sampling, project administration, funding acquisition;
All authors – Writing and revising.

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