NESTING HABITS AND COLONIAL PRODUCTIVITY OF *POLISTES CANADENSIS CANADENSIS* (L.) (HYMENOPTERA- VESPIDAE) IN A CAATINGA AREA, BAHIA STATE- BRAZIL

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ABSTRACT: The paper aims at increasing the knowledge on the ecology of *Polistes canadensis canadensis* colonies in a Caatinga region. We studied some aspects of *Pc. canadensis* nesting habitats and colonial productivity. In the environmental conditions studied, this species nests on several types of substrata, particularly on thorny plants and in caves. The colony productivity and the cell reoccupation rate varies from one colony to another. In some colonies, we found cells with one, two and, more rarely, three reoccupations, this is up to four individuals produced in one cell only. The rate of the first reoccupation was 2.88-34.78%, with an average rate of 15.96%. The number of adults produced by the colonies of *Pc. canadensis* varied from 10 to 576 individuals. Productivity, given by the relationship between the number of born adults and the number of cell existing in the nest, varied from 31.25 to 123.19% and presented an average of 88.50%.

INTRODUCTION

Among social wasps, the genus *Polistes* presents the largest geographic distribution. Its members are cosmopolitan and occur in almost all terrestrial environments. In some locations, their colonies are more numerous than the total number of colonies of all the other combined genera. This fact provides the possibility of biologically comparing species from different regions.

The *Polistes* life cycle relates to one of the most important generalizations concerning the social biology of wasps. The genus has been considered a "Key genus", stressing the importance of the group towards the understand of the evolution of wasp social behavior and their colonial productivity has been used as an index of colonial population dynamics for social wasps.

The social wasp *polistes canadensis canadensis* presents several characteristics that qualify it as a predator agent in integrated pest management. It is relatively little aggressive, which enables one to transfer its nests easily. It is abundant and, in particular, actively predates on several agricultural pests.

Several studies have been carried out in State of Bahia on the ecological aspects of *Pc. canadensis*: phenology, nesting habits, and range of action; however, all of them were carried out in the same location and under the same ecological conditions. Therefore, studies on this wasp under other environmental conditions are necessary.

The variability of ecological conditions and climate found in the tropical regions of South America allows major changes to occur among social insects and enables a single wasp species to present a variety of nesting habits.

Colonial productivity is fundamental for the maintenance, and above all, for the evolution of social wasp species and responds to genetic selective and/or social pressure. The colonial productivity of wasps depends on various factors, among which we can distinguish: the reproductive capacity of each colony, the ratio of success of new colonies, and environmental conditions.

This study aims at increasing the knowledge on the nesting habits and productivity of *Pc. canadensis* colonies in a Caatinga region, thus...
contributing to the understanding of a potentially useful species.

MATERIALS AND METHODS

The study was carried out in the municipality of Itatim—State of Bahia (12°42'S; 39°41'W Gr). This municipality has an altitude of 240 m above sea level, presents a semi-arid climate and a landscape that is typical of Caatinga regions. It is 100% inserted in the drought polygon area and is considered to have a high risk of drought incidence¹.

The field data and observations used in this study were collected/carried out from April 1996 to February 1997.

Nesting habits. In order to locate nests, we took monthly field trips into Itatim’s Caatinga. We then carefully inspected the vegetation (Caatinga), human construction, and the many caves existing in the location. The nests found were then marked and data were collected regarding the data that the nest was found, number of adults present, nesting substratum, height in relation to the ground, color, and dimensions, the latter being calculated by the maximum measurements of length and width¹⁰.

The active nests were not collected, but we only captured a few adults for later identification. Due to the size of certain colonies, the counting of the number of adults was carried out by means of photography.

Colonial productivity. During the field trips, we found many abandoned nests, most of which were semi-destroyed and presented predation signs. Among the abandoned nests, those found in good condition were collected for productivity analysis by counting the number of meconios¹⁵.

RESULTS AND DISCUSSION

Nesting habits. The nest colors always varied among various shades of grey that were lighter in the younger nests and darker in the older ones. The type of material used in nest construction as well as its seasonality must influence the nest color; however, we were not able to correlate these features. In Cruz das Almas (State of Bahia), at the same time that fruits of the nut (Terminalia catappa) were ripening, the nests of Polistes canadensis canadensis acquired a reddish color because the wasps use these dark red fruits, as a feeding resource and their fibers for nest construction/enlargement (Marques & Santos not published).

The nests of P. c. canadensis are classified as stelocritus ginnodomo⁷. The nest shapes varied a lot, from triangular, diamond-shaped, rectangular and sub-circular to other indefinite shapes. The stalk was always eccentric and there was always only one stalk; a peculiarity was found in one of the stalks in the nests fixed to mandacaru (Cereus jamacaru) plants. Due to nest or plant growth, the nests touched the plant thorns many times which then covered with a substance that was similar to that of the stalks. This gave the nest a multi-stalked appearance and greater stability.

Another peculiarity in the nests of P. c. canadensis found in the Caatinga was the position of the combs and cells. Nests with horizontal combs and vertical cells are the ones most commonly found in this species; however, when the nest was constructed on mandacaru plants, they invariably presented a different shape, with vertical combs and cells slightly inclining downwards.

More than 250 active nests of P. c. canadensis were found. The number of adults coexisting in the nest varied from 1 to 63 individuals, the latter in a nest with dimensions of 18.5×13.0 cm, which are greater values than those found for this species by¹⁰ Marques et al.

In the municipality of Itatim, P. c. canadensis nests on several types of substrata, particularly on thorny plants such as the mandacaru and in caves (Table 1). Once again,
Table 1: Nesting habit of *Polistes canadensis* in the Caatinga in State of Bahia-Ba, April 1996 to February 1997

<table>
<thead>
<tr>
<th>Substratum</th>
<th>Number of nests found</th>
<th>Height in relation to the ground (m)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
<td></td>
</tr>
<tr>
<td>Palma d’ouro (Opuntia sp)</td>
<td>19</td>
<td>0.30</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>Mandacaru (Cereus jamacaru)</td>
<td>145</td>
<td>1.05</td>
<td>3.20</td>
<td></td>
</tr>
<tr>
<td>Sisal (Agave sisalana)</td>
<td>06</td>
<td>0.40</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>Licurioba (Siagrus coronata)</td>
<td>06</td>
<td>0.65</td>
<td>1.05</td>
<td></td>
</tr>
<tr>
<td>Licurizeiro (Siagrus vagans)</td>
<td>06</td>
<td>1.65</td>
<td>2.25</td>
<td></td>
</tr>
<tr>
<td>Caves</td>
<td>63</td>
<td>0.15</td>
<td>7.80</td>
<td></td>
</tr>
<tr>
<td>Human Constructions</td>
<td>41</td>
<td>2.10</td>
<td>2.55</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>286</td>
<td>0.15</td>
<td>7.80</td>
<td></td>
</tr>
</tbody>
</table>

Our data differ from those found in the municipality of Cruz das Almas, where these wasps nest exclusively on human constructions\(^9\).

Differences in relation to studies carried out in Cruz das Almas are probably due to variation in environmental conditions. Although the municipality of Itatim presents a landscape that has been rather influenced by man, it still keeps its natural vegetation characteristics while Cruz das Almas presents a typically agricultural and pastoral landscape thus decreasing the number of possible niches for nesting. Another important factor is the difference in climate. Rain is constant in Cruz das Almas and this factor probably leads the wasps for “choosing” more protected sites such as human construction. On the other hand, rain is absent most of the time in Itatim where there may be dry periods lasting over three years. In these conditions, birds, lizards and other predators would be the main harmful agents to the colonies. In this type of environment, caves and thorny shrubs would provide the necessary shelter. We observed two birds that had been stabbed by mandacaru thorns very close to nests of *Polistes c. canadensis*.

Santos (not published) observed rows of *Polistes c. canadensis* in thorny shrubs near the sisal and mandacaru in other Caatinga in the municipalities of Cansancão and Valente in State of Bahia.

**Colonial productivity.** The productivity results for *Posistse canadensis* are shown in Table 2.

Cell reoccupation rate varied from one colony to another. In some colonies, we found cells with one, two and, more rarely, three reoccupations, that is, up to four individuals produced in one cell only. The rate of the first reoccupation was 2.88-34.78%, with an average rate of 15.96%.

The cell reoccupation data of *P. c. canadensis* were equivalent to those found for *P. versicolor* in State of Sao Paulo\(^7\) and superior to those found for *P. biglumis* and *P. snelleni* in Japan\(^8\).

High cell reoccupation rate indicates a
moderating agent of the colony growth that prevents the nests from reaching big proportions, for this would make colonial control by the dominant queen difficult. Another possibility is that the high reoccupation rates are already reflections of dominance by different queens in the several sub-areas of the nest. This type of internal division of the nest is especially important if we take into account that queens of *Polistes canadensis* are not very capable of exerting dominance in the nest and present a rather primitive dominance relation in which aggressive behavior is fundamental for dominance maintenance.

During the counting of meconios, we observed that the reoccupied cells were not spread on the nest, but rather seemed to be grouped in some points. In addition, reoccupied, as well as empty cells, were simultaneously found in all analyzed nests.

In order to test the supposition that the reoccupied cells are grouped in certain points of the nest, we analyzed the spatial distribution pattern of used and reused cells. To that end we used the contiguous quadrants technique. In a nest of *P. c. canadensis*, we marked a transection of 2 cells in width and 35 in length. This transection was subdivided in 35 contiguous quadrants of 35 cells (Figure 1). We then counted the number of meconios in each quadrant and analyzed the distribution pattern.

The analysis showed that, in the studied nest, reoccupied cells follow an aggregate distribution.
Table-2: Productivity analysis of colonies of *Polistes canadensis canadensis* in Itatim-Ba. (Itatim-Ba, April 1996 to February 1997)

<table>
<thead>
<tr>
<th>Colony</th>
<th>Dimension of the Nest (cm)</th>
<th>Cell Number in the Nest</th>
<th>Cells with One Adult Born</th>
<th>Cells with Two Adults Born</th>
<th>Cells with Three Adults Born</th>
<th>Cells with Four Adults Born</th>
<th>Total of Adults Born</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>4.2×3.1</td>
<td>29</td>
<td>18 (62.07)</td>
<td></td>
<td></td>
<td></td>
<td>18 (62.07)</td>
</tr>
<tr>
<td>02</td>
<td>7.1×6.2</td>
<td>71</td>
<td>50 (70.42)</td>
<td>05 (7.04)</td>
<td></td>
<td></td>
<td>60 (84.51)</td>
</tr>
<tr>
<td>03</td>
<td>7.0×5.0</td>
<td>78</td>
<td>38 (48.72)</td>
<td>04 (5.13)</td>
<td></td>
<td></td>
<td>46 (58.97)</td>
</tr>
<tr>
<td>04</td>
<td>16.5×8.0</td>
<td>312</td>
<td>111 (35.57)</td>
<td>09 (2.88)</td>
<td></td>
<td></td>
<td>119 (38.14)</td>
</tr>
<tr>
<td>05</td>
<td>8.5×7.0</td>
<td>102</td>
<td>68 (66.67)</td>
<td>22 (21.57)</td>
<td>02 (1.96)</td>
<td></td>
<td>118 (115.69)</td>
</tr>
<tr>
<td>06</td>
<td>3.5×3.0</td>
<td>32</td>
<td>10 (31.25)</td>
<td></td>
<td></td>
<td></td>
<td>10 (31.25)</td>
</tr>
<tr>
<td>07</td>
<td>7.0×6.2</td>
<td>81</td>
<td>51 (62.96)</td>
<td>17 (20.99)</td>
<td></td>
<td></td>
<td>85 (104.94)</td>
</tr>
<tr>
<td>08</td>
<td>7.0×4.5</td>
<td>68</td>
<td>48 (70.59)</td>
<td>02 (2.94)</td>
<td></td>
<td></td>
<td>52 (76.47)</td>
</tr>
<tr>
<td>09</td>
<td>6.5×5.0</td>
<td>69</td>
<td>34 (49.28)</td>
<td>24 (34.78)</td>
<td>01 (1.45)</td>
<td></td>
<td>85 (123.19)</td>
</tr>
<tr>
<td>10</td>
<td>18.7×13.5</td>
<td>477</td>
<td>304 (63.73)</td>
<td>97 (20.34)</td>
<td>22 (4.61)</td>
<td>03 (0.63)</td>
<td>576 (120.75)</td>
</tr>
<tr>
<td>11</td>
<td>20.5×11.0</td>
<td>436</td>
<td>234 (53.67)</td>
<td>70 (16.09)</td>
<td>17 (3.90)</td>
<td>01 (0.23)</td>
<td>429 (98.39)</td>
</tr>
<tr>
<td>12</td>
<td>19.5×11.5</td>
<td>455</td>
<td>261 (57.36)</td>
<td>44 (9.67)</td>
<td>03 (0.66)</td>
<td></td>
<td>358 (78.68)</td>
</tr>
<tr>
<td>Means</td>
<td></td>
<td>184.17</td>
<td>102.25 (55.52)</td>
<td>29.40 (15.96)</td>
<td>09 (4.89)</td>
<td>02 (1.08)</td>
<td>163 (50)</td>
</tr>
</tbody>
</table>
(Figure 2). The presence of reoccupation sites is probably an indication that different queens were dominating different areas in the nest.

The productivity of *Polistes simillimus* and *P. versicolor* was studied, and discussed the precarious balance between colonial productivity, nest size and queen dominance. To these authors, this trinomial originates queen territorial domains in the nest, which would bring about a type of selective pressure towards the abandonment of monogyny.

The number of adults produced by the colonies of *P. c. canadensis* varied from 10 to 576 individuals. Productivity given by the relation between the number of born adults and the number of cells existing in the nest varied from 31.25 to 123.19% and presented an average of 88.50%.

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