The classic episode of biological invasion: *Cochliomyia macellaria* (Fabricius, 1775) versus *Chrysomya megacephala* (Fabricius, 1794) (Diptera: Calliphoridae) – evaluation of the biotic potential

LEANDRO S. BARBOSA¹, MÁRCIA S. COURI¹, VALÉRIA M.A. COELHO² and FERNANDA AVELINO-CAPISTRANO¹³

¹Departamento de Entomologia, Laboratório de Diptera, Museu Nacional/UFRJ, Quinta da Boa Vista, 20940-040 Rio de Janeiro, RJ, Brasil
²Departamento de Microbiologia e Parasitologia, Laboratório de Estudos de Dipteros, Universidade Federal do Estado do Rio de Janeiro/UNIRIO, Rua Frei Caneca, 94, 20211-040 Rio de Janeiro, RJ, Brasil
³Departamento de Zoologia, Laboratório de Entomologia, Universidade Federal do Rio de Janeiro/UFRJ, Avenida Carlos Chagas Filho, 373, Edifício do Centro de Ciências da Saúde, Bloco A, 21941-902 Rio de Janeiro, RJ, Brasil

Manuscript received on June 15, 2015; accepted for publication on August 12, 2015

ABSTRACT

The classic episode of biological invasion: *Cochliomyia macellaria* (Fabricius, 1775) versus *Chrysomya megacephala* (Fabricius, 1794) (Diptera: Calliphoridae) – evaluation of the biotic potential. The biotic of the native fly *Cochliomyia macellaria* and the exotic *Chrysomya megacephala* was compared, through the reproductive capacity and longevity. The experiment took place in a climatized chamber, with four repetitions of 15 grouped couples of each species. The posture, egg mass weight, and death of individuals were observed daily. *C. macellaria* showed an average of longevity of 27.72 days while in *C. megacephala* the average was 41.96 days. The egg mass weight average per repetition was 0.58 g and 1.22 g, respectively. These results give a better understanding about the population dynamics of these species in nature.

Key words: breed capacity, longevity, competition, caliphorids.

INTRODUCTION

Introduced species may cause negatively impact on native species in different ways, as predation, competition, biological pollution, introduction of new parasites or pathogens, among others. Alien species are recognized by the Convention on Biological Diversity as the second most important cause of global biodiversity loss, behind the habitat destruction (Jenkins 1999).

*Cochliomyia macellaria* (Fabricius, 1775) is a native species, which distribution ranges from Nearctic to Neotropical regions. Its maggots are necrophagous and the adults, feed on carcasses, decaying material and also on nectar flowers (Cunha-e-Silva and Milward-de-Azevedo 1994).

*Chrysomya megacephala* (Fabricius, 1794) is native from New Guinea. During its invasion process it received different names based on its trophic niche, as dry-salt-fish-pest in East Asia, because of its capacity of breeding on dry salt fish (Esser 1990); “latrine-flies” due to its frequency in
areas with humans feces; Indian Bazaar Bluebottle (Prins 1979), for its frequency in street popular markets and “Debulliaes” and “Iaesidebull”, palauans names that means graveyard-flies (Olsen and Sidebotton 1990). Introduced in the New World during the past 40 years (Wells 1991). *C. megacephala* was collected for the first time in Brazil in 1975, originated probably from southern Africa, later becoming established in North America (Baumgartner and Greenberg 1984).

After the introduction of the exotic *C. megacephala* in Brazil, *C. macellaria*, usually very common in urban and rural areas, has become rare in these environments (Baumgartner and Greenberg 1885, Guimarães et al. 1978, 1979, Marinho et al. 2003, 2006). Several studies suggested that the decline was due to the competition during the larval stages (Aguiar-Coelho and Milward-de-Azevedo 1996, Faria et al. 1999, Andrade et al. 2002). Although there are no studies comparing the biotic potential of these species, this understanding could bring more information about the competitive advantages of this exotic species.

*Chrysomya* Robineau-Desvoidy, 1830, species are very important from epidemiological aspect, being recognized as a great pathogen carrier (Greenberg 1988, Lawson and Gemmel 1990), what could be explained by its high synanthropy level, favoring human contamination (Ferreira 1978, 1979, 1983, Linhares 1981).

The objective of this study was to compare the biotic potential of *C. macellaria* with *C. megacephala*, under controlled conditions, to better understand the impact of this invasive species on the native populations of *C. macellaria*.

**MATERIALS AND METHODS**

Specimens of *C. macellaria* and *C. megacephala* were collected respectively in a rural area of Paracambi and in an urban area, both Rio de Janeiro (RJ, Brazil). A Van Someren-Rydon trap using as bait sardine with 48 hours decomposition (30°C), was used to collect the material. In the Laboratório de Estudos de Dipteros of Universidade Federal do Estado do Rio de Janeiro (UNIRIO) the species were identified using the taxonomic key of Mello (2003). The colonies of *C. megacephala* and *C. macellaria* were maintained, as described in Barbosa et al. 2004, 2008.

The experiment was conducted in climate controlled chamber (Quim) set at 30°C during the day and 28°C during the night, 60 ± 10% relative humidity and 14 hours of light and 10 hours of dark. The light phase was initiated at 6:00 am. After the emergence of the adults, 60 couples of each species were selected and equally distributed in four cages, allowing the observation in four repetitions.

A solution of water and honey (1:1), water, and bovine meat were offered to adults daily. Meat cut into small cubes of approximately 2cm³ was used as substrate of egg posture for females.

The colonies were examined twice a day, in the morning, at 09:00, when the mortality of the adults was observed, and in the afternoon, at 16:00, when the postures of eggs were weighed in semi-analytical balance Gehaka BG200.

The laying period, oviposition peak and adults longevity were analyzed. The program GraphPad Instat version 2 was used, as well as the t-test, to evaluate the statistical significance of the results, considering the level of significance less than or equal to 5%.

**RESULTS**

The average mass of eggs for *C. macellaria* and *C. megacephala* produced per cage was respectively 0.58 g and 1.22 g. The average production per female/day was 0.0014 g and 0.0026 g, respectively (Table I). Extremely significant difference was observed (P< 0.0002).

The beginning of the oviposition occurred in the sixth day after emergence for both species. The
oviposition peak happened on the 15th day for the native species and in the 10th day for the exotic one. The native females made intermittent ovipositions until the 60th day after the emergence and the exotic until the 59th day (Figure 1a, b).

The minimum and maximum longevities observed in C. macellaria and C. megacephala were respectively 3 and 62 days and 8 and 90 days (Table II). C. macellaria lived, in average, 27.72 days, while C. megacephala lived 41.96 days. The difference found between treatments was extremely significant (P< 0.0001).

The longevity curve among males and females was similar for C. macellaria, while for C. megacephala, the male’s longevity curve did not end so abruptly as in female (Figure 2a, b).

**DISCUSSION**

The results of the present analysis exhibited that the exotic fly competitive advantages goes beyond

---

**Table I**

<table>
<thead>
<tr>
<th>Average/day/female</th>
<th>Average/cage</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. macellaria</td>
<td>C. megacephala</td>
</tr>
<tr>
<td>Mean</td>
<td>0.001349 g</td>
</tr>
<tr>
<td>SD</td>
<td>0.00042 g</td>
</tr>
</tbody>
</table>

*a* Averages followed by the same letter do not differ significantly by the T test (5%).

**Table II**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Averages* (Day)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. macellaria</td>
<td>Total 27.72</td>
<td>± 14.17</td>
</tr>
<tr>
<td></td>
<td>Male 26.77</td>
<td>± 14.38</td>
</tr>
<tr>
<td></td>
<td>Female 28.67</td>
<td>± 14.01</td>
</tr>
<tr>
<td>C. megacephala</td>
<td>Total 41.96</td>
<td>± 15.61</td>
</tr>
<tr>
<td></td>
<td>Male 45.17</td>
<td>± 18.59</td>
</tr>
<tr>
<td></td>
<td>Female 38.75</td>
<td>± 11.18</td>
</tr>
</tbody>
</table>

*a* Averages followed by the same letter do not differ significantly by the T test (5%).

---

**Figure 1**

- **a**: Oviposition rhythm of Cochliomyia macellaria.
- **b**: Oviposition rhythm of Chrysomya megacephala.
the immature stage, corroborating with studies like Cunha-e-Silva and Milward-de-Azevedo (1996) and Barbosa et al. (2004) that analyzed which species independently using different methodologies.

Adults average life span of the exotic species is 34% bigger and the egg production is almost 100% bigger than the native species. Von Zuben et al. (1996) suggested that how bigger is life span, bigger the number of cicles and postures. Our results showed that the number of postures was about 29% bigger in the exotic species, although the period of time was the same in both species. Considering the egg size of both species *C. macellaria*: 1.31mm (Mendonça et al. 2014) and *C. megacephala*: 1.29mm (Sanit et al. 2013), we conclude that the egg mass production of the exotic flies was almost twice the native one. This fact could be explained by reproductive stress phenomena, where copulated females live less than virgins ones. Reproductive stress is observed in other species of *Chrysomya*, as *C. albiceps* (Wiedemann) in Queiroz and Milward-de-Azevedo 1991 and *C. megacephala* in Barbosa et al. (2004), but in *C. macellaria* the life span was similar between male and female (Figure 2a, b).

A longer life span increase the probability of finding new substrates to breading and posturing, that are ephemeral and discrete (So and Dudgeon 1989). This suggests in a higher capacity of dispersion and colonization (Roff 1977) and offspring survival (Ives 1991).

Reis et al. (1999) studying the competition between *Chrysomya putoria* (Wiedemann) and *C. macellaria* in immature stage, suggested that extinction hypothesis has low probability. Although it is important to take in consideration that it is not the only one species that impact *C. macellaria* (Aguir-Coelho and Milward-de-Azevedo 1996, Andrade et al. 2002), and that competitive advantage goes beyond the immature stage at least to *C. megacephala*.

ACKNOWLEDGMENTS

LSB is grateful to Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), for the master fellowship; MSC is grateful to Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPQ, process n° 301301/2007-7) and Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ, process n° E-26/171.281/2006) for the financial support to her project and VMAC is grateful to UNIRIO by institutional and financial support.

REFERENCES

AGUIAR-COELHO VM AND MILWARD-DE-AZEVEDO EMV. 1996. Associação entre larvas de Cochliomyia macellaria (Fabricius) e Chrysomya albiceps

![Figure 2 - a: Longevity curve of males and females of Cochliomyia macellaria. b: Longevity curve of males and females of Chrysomya megacephala.](image)
(Wiedemann), Chrysomya megacephala (Fabricius) e Cochliomyia macellaria (Fabricius) (Calliphoridae, Diptera) sob condições de laboratório. Rev Bras Entomol 41: 35-40.


PRINS AJ. 1979. Discovery of the oriental latrine fly Chrysomya megacephala (Fabricius) along the southwestern coast of South Africa. Annls S Afr Mus 78: 39-47.


