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ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

LIFE CYCLE AND LIFE TABLE OF BLOWFLY *SARCONESIA CHLOROGASTER* (WIEDEMANN, 1830) (DIPTERA, CALLIPHORIDAE) UNDER LABORATORY CONDITIONS AT CUSCO, PERÚ

CICLO BIOLÓGICO Y TABLA DE VIDA DE *SARCONESIA CHLOROGASTER* (WIEDEMANN, 1830) (DIPTERA, CALLIPHORIDAE) EN CONDICIONES DE LABORATORIO EN CUSCO, PERÚ

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ABSTRACT

The life cycle and the life table of blowfly *Sarconesia chlorogaster* (Wiedemann, 1830) (Diptera, Calliphoridae), known as a species of forensic importance, was studied. The rearing was carried out under uncontrolled laboratory conditions, with 13±3 C and 50±4 % of relative humidity on average. The life table was prepared taking the development stages as the age structure. The life cycle lasts 55 days: Egg: 2 days, Larva I: 2 days, Larva II: 2 days, Larva III: 26.67 days and Pupa: 21.67 days. The survival curve shows a gradual decrease in mortality in the first stages of development, but it is pronounced between the last two stages.

Keywords: Cusco – forensic entomology – life table – *Sarconesia*

RESUMEN

Se estudió el ciclo biológico y tabla de vida de *Sarconesia chlorogaster* (Wiedemann, 1830) (Diptera, Calliphoridae), conocida como una especie de importancia forense. La cría se realizó en condiciones de laboratorio no controladas, a 13±3° C y a una Humedad Relativa de 50±4 %. La tabla de vida se elaboró tomando como estructura de edades los estados de desarrollo. El ciclo de vida dura 55 días: Huevo: 2 días, Larva I: 2 días, Larva II: 2 días, Larva III: 26,67 días y Pupa: 21,67 días. La curva de sobrevivencia muestra un decrecimiento gradual en los primeros días de desarrollo pero es más pronunciada entre los dos últimos estadíos.

Palabras clave: Cusco – entomología forense – *Sarconesia* – tabla de sobrevivencia

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INTRODUCTION

Sarconesia chlorogaster (Wiedemann, 1830) blowfly is known as one of the most important species in the forensic insect fauna (Moura *et al*., 1997; Mulieri *et al.*, 2006; Mariluis et al., 2008; Battán-Horenstein *et al*., 2016, Castillo *et al.*, 2017). The bionomy of this species has been studied in Brazil (Queiroz *et al*., 1985), and about synantropy and diversity of Calliphoridae (Blacio *et al.*, 2020).

The specimens has been collected in several locations between the Premontane and Alpine formations, with an upper elevational range of 4000 m and is considered to be a mostly xerophytic species in Peru (Baumgartner & Greenberg, 1985). The morphology of the developmental stages has been studied (Greenberg & Szyska, 1984). Studies on fauna of forensic importance in Peru have been carried out mainly for the coastal region (Valleys of the Chancay and Rímac rivers) (Dale, 1985) and Lambayeque (Medina-Achín *et al*., 2018). An undergraduate thesis has been developed on fauna of forensic importance in pig carcasses at Cusco (Cusihuallpa & Méndez, 2013).

Given the importance of insects associated with cadavers, various studies have been carried out, life cycle (Bonatto, 1996), immature stages (Greenberg & Szyska, 1984; Queiroz *et al*., 1985; Bonatto & Carvalho, 1996; Florez & Wolff, 2009), diversity (Mariluis *et al*.,1990; Mulieri *et al*., 2006; Battán-Horenstein *et al*., 2016), synanthropy (Moura & Bonatto, 1999), cadaveric succession (Vairo *et al*., 2015; Medina-Achín *et al*., 2018; Lecheta & Moura, 2019) and other aspects (Moura & Bonatto,1999; Labud *et al*., 2003; Mulieri *et al.*, 2006; Wells *et al*., 2015; Lecheta *et al*., 2017), including observations about the age of forensically useful stages (Lecheta & Moura, 2019).

The effect of temperature on development time was studied for *S. chlorogaster*, concluding that its life cycle varied with temperature (Lecheta *et al.*, 2015).

Several species of Calliphoridae have been studied and their life cycle and life tables have been elaborated (Gabre *et al.*, 2005; Rueda *et al.*, 2010; Pruna *et al.*, 2019). However, despite its importance, there are no local studies on the biology of *S. chlorogaster*.

The objectives of this study are: a) to determine the life cycle duration of *S. chlorogaster* under uncontrolled laboratory conditions, b) to develop a life table for *S. chlorogaster*.

MATERIAL AND METHODS

Necrotrappers were used to collect adults: a) each trap was a plastic bottle, b) the upper part of each bottle was cut and inverted, leaving the conical shape of the end directed towards the inside of the container, c) each bottle was baited with a piece of liver. The traps were installed in the APV "Pro Housing Associations" Santa María (Cerro Picol, Cusco), Peru, with the following data: 13°31'26.62" S and 71°54'00.54" W, 3374 masl. The collected adults were taken to the Entomology laboratory of the Faculty of Sciences (UNSAAC), Cuzco, Peru, and placed in 250 g plastic containers that contained liver. Each container had a gauze lid to promote air exchange.

Three plastic cups with 250 g capacity were used, in each one the number of initial eggs was recorded, as well as the number of larvae and pupae. Laboratory conditions were not controlled, registering between 13±3° C and 50±4 % relative humidity on average. The duration of each stage of development was recorded on a worksheet. Measures were taken with a micrometric lens mounted in a stereo microscope. Measures were taken between the head apex and the posterior spiracular plate. The samples were: egg (thirteen samples), Larva stage I (ten samples), Larva stage II (ten samples), Larva stage III (ten samples) and pupa (seven samples). For each growth stage the mean and standard deviation were measured.

The life table was elaborated taking each stage of development using the following age groups: egg, Larva I (LI), Larva II (LII), Larva III (LIII) and pupa. The components of the life table were: x=pivotal age, nx = number of individuals, lx = number surviving at the beginning of age class, dx = number dying during the age interval, qx =

mortality index, Lx = number of individuals alive between age x and x+1, Tx = Total number of individuals x age units beyond the age x, ex = life expectation. For the elaboration of the life table, Southwood (1966) has was followed with some modifications (Mariluis *et al*., 2008). The initial number of eggs is the average of the three plastic cups employed, and the number of survivors has been followed up to the pupal stage.

Ethical aspects

The authors have followed the ethical laws of the country.

RESULTS

The measures for the stages of development of *S. chlorogaster* and the standard deviation are observed in Table 1.

Table 1. Measurements, in mm, of the development stages of *Sarconesia chlorogaster*: average and standard deviation (SD). L= larvae*.

	Egg	LI	LII	LIII	Pupa
Average	1,32	3,42	8,264	15,013	11,537
SD	0,07	0,120	0,403	0,481	1,164

*measures were taken with mature stage

The duration of the stages of development, in days, are shown in figure 1.

The life table shows the biological parameters of *S. chlorogaster* (Table 2).

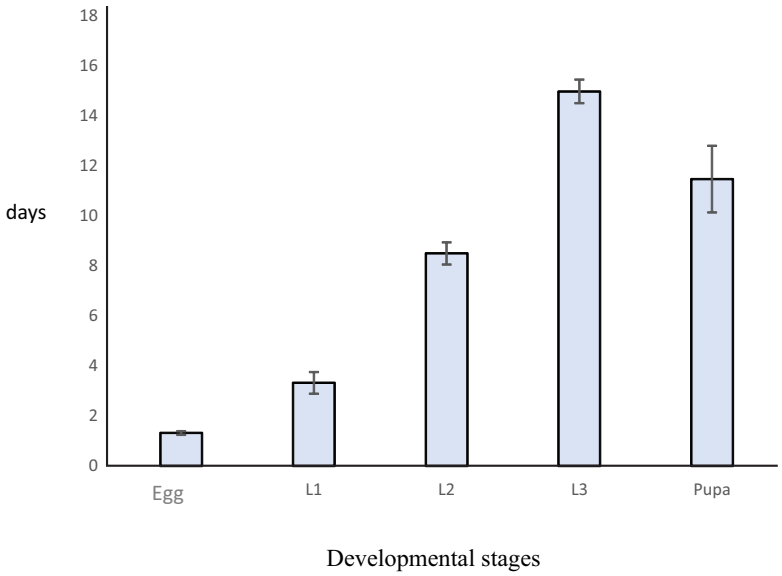

Figure 1. Duration, in days, of the developmental stages of *Sarconesia chlorogaster* (egg: 1.32±0.07; Larva I: 3.32±0.43; Larva II: 8.49±0.44; Larva III: 14.96±0.47; pupa: 11.46±1.33).

Table 2. Life table of *Sarconesia chlorogaster* under laboratory conditions. Cusco. 2019.*

x	nx	lx	dx	qx	Lx	Tx	Ex
0-Egg	196	1	5	0,03	193,5	560	2,86
Egg-Larva I	191	0,97	40	0,21	171	366,5	1,92
Larva I-Larva II	151	0,77	40	0,26	131	195,5	1,29
Larva II-Larva III	111	0,57	102	0,92	60	64,5	0,58
Pupa	9	0.05	9	1	4,5		0

* x=pivotal age, nx = number of individuals, lx = number surviving at the beginning of age class, dx = number dying during the age interval, qx = mortality index, Lx = number of individuals alive between age x and x+1, Tx = Total number of individuals x age units beyond the age x, ex = expectation of life

The survival curve shows that there is a gradual mortality as the life cycle progresses (Fig. 2).

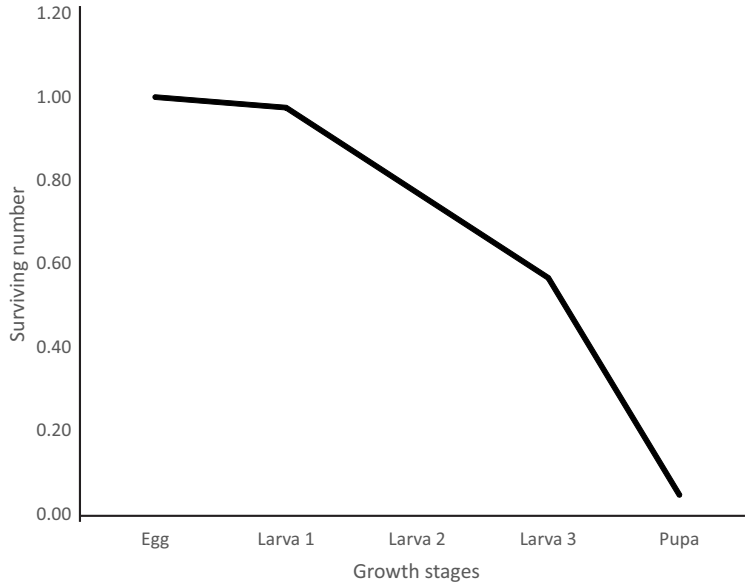

Figure 2. Survival curve of *Sarconesia chlorogaster* under laboratory conditions. Cusco, Perú.

DISCUSSION

The duration of the life cycle, taking into account the stages of development coincide quite well with that reported for this species in Peru (Greenberg & Szyska, 1984), even though, for this study, the breeding was carried out at 1,000 masl and some conditions were modified manually, such as the humidity that was added in the brood chambers. It was demonstrated, with *S. chlorogaster*, that the development time is influenced by the temperature (Lecheta *et al.*, 2015). In the case of *Lucilia sericata* (Meigen, 1826) there was a negative relation between life cycle and the temperature (Pruna *et al.*, 2019). Additionally, management in the laboratory of a colony of *L. sericata* was similar to *S. chlologaster* (Rueda *et al.*, 2010). It´s possible to assume that temperature has an important influence in the life cycle, but this aspect is only noticeable under controlled conditions.

The life table shows a higher life expectancy for the first stages of development (Table 2) and a rapidly decreasing survival curve from LIII to pupa (Fig. 2). It is possible to assume errors in the management of the last stages of development, but, taking into account the rearing conditions, it can also be assumed that, having grown up in plastic cups with limited capacity, (250 g capacity), the

environment has resulted too small to offer adequate conditions for survival. Duration of egg and the duration of the age-stages were similar to *Chrysomya megacephala* (Fabricius, 1794), but, study with *C. megacephala* were made under controlled conditions and taken into account several aspects that were no considered with *S. chlorogaster*(Gabre et al., 2005).

In conclusion, the life cycle of *S. chlorogaster* under uncontrolled laboratory conditions lasted 55 days: Egg - 2 days, LI -2 days, LII -2 days, LII - 26.67 and pupa-21.67 days at temperatures of 13±3 C and 50±1 % RH. The survival curve shows a gradual decrease in mortality in the first stages of development, but it is pronounced between the last two stages.

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