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Lipeurus caponis (Phthiraptera: insecta)

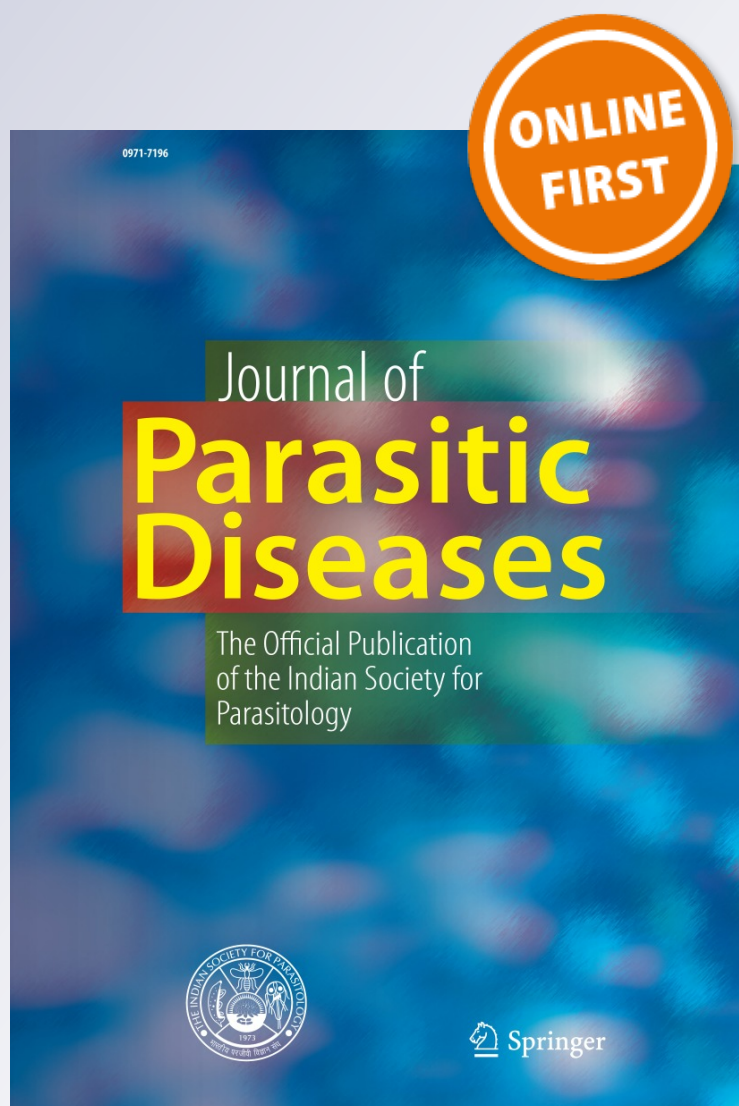
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In vitro bionomics of an ischnoceran louse, *Lipeurus caponis* (Phthiraptera: insecta)

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Abstract Poultry wing louse, *Lipeurus caponis* was reared in vitro condition (35 ± 1 °C, 75–82 % RH) to record the incubation period of the eggs, duration of nymphal instars, adult longevity and the egg rate. The data obtained through in vitro studies was utilized to construct the life table and to determine the intrinsic rate of natural increase. The value of r_m of *L. caponis* appeared to 0.046. At this rate, the population of lice is supposed to double after 16.1 days, indicating it to be a moderate breeder.

Keywords Phthiraptera · Ischnocera · Intrinsic rate · Generation time

Introduction

A survey of literature indicates that the reproductive potentials of phthirapteran ectoparasites exhibit considerable variation. Some species appear to be fast breeder than the others. Moreover, the population growth rate of the parasites depend upon its reproductive potential and the length of the generation. It may be noted that the value of the intrinsic rate of natural increase (rate of increase per head in a population which has attained a stable age distribution; denoted by r_m) of any organism provides vital clues regarding its rate of population growth. Few phthirapterists have tried to compute the intrinsic rate of natural increase of selected avian lice on the basis of data obtained through in vitro experimentations (Saxena et al. 2007, Saxena et al. 2009; Gupta et al. 2007; Arya et al. 2009; Singh et al. 2012). The intrinsic rate of natural increase of

two mammalian ischnoceran has also been determined (Murray and Gordon 1969; Rust 1974). The values of r_m of the species studied by aforesaid workers varied considerably. A look on literature indicated that r_m of poultry louse, *Lipeurus caponis* has yet not been recorded. The present studies deal with the intrinsic rate of natural increase of *L. caponis* infesting domestic fowl (*Gallus gallus domesticus*) on the basis of data derived through in vitro experimentation (Table 1).

Materials and methods

Lice were picked up manually with the help of fine brush from infested fowls. Furthermore, feathers bearing fresh eggs of *L. caponis* were gently cut from the host body and incubated in culture vials (at 35 ± 1 °C, 75–82 % RH) to record the incubation period. Freshly emerged nymphal instars were further reared on the host feather diet, to determine the duration of three nymphal instars. Likewise, the colonies of apparently freshly moulted healthier adult *L. caponis* were reared in vitro condition (in batches) to determine the adult longevity. Culture vials were examined daily. In vitro culture technique adopted by Singh et al. (2012) was followed during present investigation.

The construction of the life table and computation of value of r_m ($\sum e^{-r_m x} l_x m_x = 1$), net reproductive rate ($R_0 = \sum l_x m_x$), the innate capacity of increase ($r_c = \log_e R_0 / T_c$), the precise generation time ($T = \log_e R_0 / r_m$), the finite rate of increase ($\lambda = e^{r_m}$) and the doubling time of population ($DT = \log_2 / \log \lambda$) were based on the method adopted by Evans and Smith (1952) and also followed by Saxena et al. (2007, 2009), Gupta et al. (2007), Arya et al. (2009) and Singh et al. (2012).

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Table 1 In vitro bionomics of *L. Caponis* reared at 35 ± 1 °C, 75–82 % RH, at feather diet

Adult lifespan (male)	12.0 ± 2.10 days (range = 9–20 days; n = 90)
Adult lifespan (female)	15.0 ± 1.7 days (range = 12–24 days; n = 90)
Egg produced during life span (egg laid/female during life span)	6.97
Egg rate/female/day	0.77
Incubation period	6.0 ± 0.69 days (variance = 0.48 days; range = 5–7 days; n = 60)
Duration of I nymphal instar	5.6 ± 1.39 days (variance = 1.95 days; range = 4–9 days; n = 50)
Duration of II nymphal instar	5.9 ± 1.7 days (variance = 2.89 days; range = 4–9 days; n = 33)
Duration of III nymphal instar	5.6 ± 1.6 days (variance = 2.59 days; range = 4–9 days; n = 29)
Net reproductive rate	3.908 female eggs/female
Gross reproductive rate	12.531 female eggs/female
Mean length of generation	29.64 days
Precise generation time	31.70

Results

The incubation period of eggs of *L. Caponis* was 6.0 ± 0.69 days (variance = 0.48 days; range = 5–7 days; n = 60). The duration of first instar nymphs was 5.6 ± 1.39 days (variance = 1.95 days; range = 4–9 days; n = 50). Mean duration of second instar nymphs remained 5.9 ± 1.7 days (variance = 2.89 days; range = 4–9 days; n = 33). Likewise, the average duration of the third instar nymph appeared to be 5.6 ± 1.6 days (variance = 2.59 days; range = 4–9 days; n = 29). The average lifespan of adult males was 12.0 ± 2.10 days (range = 9–20 days; n = 90). The lifespan of adult females was comparatively longer than that of males (15.0 ± 1.7 days; range = 12–24 days; n = 90). The longest survival of any louse was found to be 24 days. The overall results indicate that an adult female, *L. caponis* laid an average 6.97 eggs during the life span at a rate 0.77 eggs/female/day.

The aforesaid data obtained through in vitro experiments on *L. caponis* (i.e., the incubation period of the eggs, duration of three nymphal instars, pre-oviposition period, age specific mortality/survivorship and the fecundity), was utilized to construct the life table. The gross reproductive rate appeared to be 12.53 female eggs/female. The net reproductive rate (Ro) was determined as 3.9 female eggs/female (indicating that a female would be replaced by approximately four live daughter eggs, i.e., four fold increase per generation). The value of mean length of generation ($T_c = \sum l_x m_x / R_0$) appeared to be 29.64 days. The value of precise generation time was determined as 31.70 days.

The intrinsic rate of natural increase was computed by using the trial values of r_m , to find out the value which satisfies the equation $\sum e^{-r_m x} l_x m_x = 1$. At value of $r_m = 0.046$, the summation of $e^{-r_m x} l_x m_x$ for each age in which $m_x > 0$, proved to be 1.007, a reasonably good

approximation to the formula. Using this value of r_m (0.046), the precise corrected generation time ($T = \log_e R_0 / r_m$) was found to be 31.70 days. Thus, under the provided in vitro conditions (at 35 ± 1 °C, 75–82 %, RH) the population of *L. caponis* is supposed to double ($DT = \log 2 / \log e$) after every 16.1 days.

Discussion

A look on literature indicates that the intrinsic rate of natural increase of nine ischnoceran species e.g. *Goniocotes gallinae* (infesting the domestic fowl, *Gallus gallus domesticus*), *Brueelia amandavae* (occurring on Red avadavat, *Amandava amandava*), *Brueelia cyclothorax* (parasitizing house sparrow, *Passer domesticus*), *Sturnidoecus bannoo* (parasitizing common Myna, *Acridotheres tristis*), *Neopsittaconirmus elbeli* (infesting Indian parakeet, *Psittacula eupatria*), *Columbicola columbae* (occurring on domestic pigeon, *Columba livia*), *Anaticola crassicornis* (parasitizing Mallard duck, *Anas platyrhynchos*), *Brueelia plocea* (infesting common baya, *Ploceus philippinus*) and *Columbicola bacillus* (occurring on ring dove, *Streptopelia decaocto*) have been recorded, so far (Saxena et al. 2007, 2009; Gupta et al. 2007, Arya et al. 2009 and Singh et al. 2012). The values of intrinsic rate of natural increase of the aforesaid species have been recorded as 0.07, 0.031, 0.032, 0.049, 0.050, 0.053, 0.074, 0.045 and 0.054. Likewise, the doubling time 10.63, 23.45, 21.35, 14.21, 13.93, 14.2, 9.0, 15.41 and 12.95 days of the aforesaid species also exhibited considerable variations. During present study, the value of r_m of poultry wing louse *L. Caponis* was found to be 0.046 and its doubling time was determined as 16.1 days.

According to Singh et al. (2012), the fast breeding species may build their population at faster rate (than moderate and slow breeders) and may cause extensive

damage to feathers of the host, while slow breeders may exhibit low prevalence and intensity of infestation and thus causing minimal effect on host plumage. *L. caponis* appears to be a moderate breeder and exhibits intermediate condition in their respect.

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References

- Arya G, Ahmad A, Bansal N, Rashmi A, Saxena AK (2009) Population expansion of the common baya louse, *Brueelia plocea* (Lakshminarayana, 1968) (Phthiraptera: ischnocera). *Rev Iero-Latinoam Parasitol* 68(2):192–195
- Evans FC, Smith FE (1952) The intrinsic rate of natural increase of the human louse, *Pediculus humanus*. *L. The Amer Nat* 86(830):299–310
- Gupta N, Kumar S, Saxena AK (2007) Intrinsic rate of natural increase of *Brueelia amandavae* (Ischnocera, Phthiraptera) infesting Indian Red Avadavat. *Biologia* 62(4):458–461
- Murray MD, Gordon G (1969) Ecology of lice on sheep VII: population dynamics of *Damalinia ovis* (Schrank). *Aust J Zool* 17:179–186
- Rust RW (1974) The population dynamics and host utilization of *Geomydoecus oregonus* a parasite of *Thomomys bottae*. *Oecologia* 15:287–304
- Saxena AK, Kumar S, Gupta N, Singh R (2007) Intrinsic rate of natural increase of poultry fluff louse *Goniocotes gallinae* (De Geer 1778) (Ischnocera, Phthiraptera, Insecta). *Zool Sci* 24:327–330
- Saxena AK, Gupta N, Kumar S, Khan V, Arya G, Saxena S (2009) Intrinsic rate of natural increase of five Ischnoceran lice (Phthiraptera: insecta). *Entomol News* 120(4):385–391
- Singh P, Arya G, Ahmad A, Saxena AK (2012) In vitro biology of *Columbicola bacillus* (Phthiraptera: ischnocera). *J Appl and Nat Sci* 4(2):234–236