



Intrinsic rate of natural increase of an ischnoceran louse, *Gonicotes jirufti* (Ansari, 1947) (Phthiraptera: Insecta)

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Abstract: The ischnoceran lice, *Gonicotes jirufti* (Ansari, 1947) infesting the black partridge, *Francolinus francolinus* (Linnaeus, 1766) were reared *in vitro* condition ($35 \pm 1^\circ\text{C}$, 75-82% RH, at feather diet), to record the incubation period, adult longevity and daily egg rate. Obtained data from *in vitro* experimentation were used to construct the life table and was used to determine the intrinsic rate of natural increase (rm). The value of rm of aforesaid species was computed as 0.042. At this rate the doubling time of its population appeared to be 16.50 days. In comparison to the other species studied so far, *G. jirufti* (Ansari, 1947) seems to be a moderate breeder. [Aftab Ahmad. **Intrinsic rate of natural increase of an ischnoceran louse, *Gonicotes jirufti* (Ansari, 1947) (Phthiraptera: Insecta).** *J Am Sci* 2020;16(12):63-67]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). <http://www.jofamericanscience.org>. 5. doi:[10.7537/marsjas161220.05](https://doi.org/10.7537/marsjas161220.05).

Key words: *In vitro*, intrinsic rate, Ischnocera, Lice, Phthiraptera

1. Introduction

The intrinsic rate of natural increase of avian ischnocera e.g., *Brueelia amandava* parasitizing common munia, Indian red avadavat¹, *Brueellia cyclothorax* Burmeister, 1838 from house sparrow, *Passer domesticus* L; *Sternoedocus bannoo* Ansari 1955 from common myna, *Acridothere stritistis* L; *Neopsittaconirmus elbeli* Guimaraes, 1974 parasitizing Indian parakeet, *Psittaculae upatria* L; *Columbicola columbae* Linnaeus, 1758 from rock pigeon, *Columba livia* Gmelian; *Anaticola crassicornis* from Mallard duck, *Anas platyrhynchos* L², *Brueelia plocea* Lakhsminarayana, 1968 from common baya, *Ploceus philippinus*³, *Gonicotes gallinae* De Geer, 1778 parasitizing domestic fowl, *Gallus gallus domesticus*⁴. *Upupicola upupae* Shrank from common hoopae, *Upupa epops*⁵, *Columbicola bacillus* Giebel parasitizing Eurasian collared dove, *Streptopelia decaocta* Frivalsky, 1838⁶, *Lipeurus caponis* Linne parasitizing domestic fowl, *Gallus gallus domesticus*⁷ have been noted on the basis of data obtained through *in vitro* experimentation. Similarly the value of intrinsic rate of natural increase of three mammalian lice (sheep louse, *Bovicola ovis*, rodent louse, *Geomydoecus oregonus*, Goat biting louse, *Bovicola caprae*) have also been indicated by the workers^{8,9,10}.

Since, the values of 'rm' of the species studies so far, varied considerably. Hence, it was found worthwhile to work out the life table statistics of one more ischnoceran louse. In the present paper, an attempt has been made to compute the intrinsic rate of natural increase of *Gonicotes jirufti* (Ansari, 1947)

infesting black partridges, *Francolinus francolinus* (Linnaeus, 1766) on the basis of data obtained through *in vitro* experimentations.

2. Materials and methods

Black partridges, *Francolinus francolinus* (Linnaeus, 1766) were trapped alive during (2016-17) in district Rampur U.P. and subjected to deloused (manually). Few feathers were gently taken out and deloused bird released in the wild. Some feathers bearing fresh eggs were gently cut from the host body and incubated in culture vials (at $35 \pm 1^\circ\text{C}$, 75-82% RH), to record the incubation period. The humidity was maintained in culture vials by placing 50-100 M.L. of saturated solution of salts according to the guidelines of the worker¹¹. Freshly emerged nymphal instars were reared on the host feather diet, to determine the duration of three nymphal instars. Likewise, the colonies of apparently freshly moulted healthier adult lice were reared *in vitro* condition (in batches) to determine the adult longevity. Culture vials were examined daily.

The data obtained from *in vitro* experimentation were used to construct the life table and compute the intrinsic rate of natural increase, rm ($e^{-rm}lxmx=1$; where e =base of natural logarithms; x = age of individuals in days; lx = number of individuals alive at age x as a proportion of one; mx = number of female offspring produced/ female in the age interval x), net reproductive rate ($R_0 = \sum l_x m_x$), the innate capacity of increase ($rc = \log_e R_0 / T_c$), the precise generation time ($T = \log_e R_0 / rm$), the finite rate of

increase (=erm) and the doubling time of population ($DT = \log 2 / \log r$) on the lines suggested by ^{12,13}. Evans and Smith¹², Howe¹³ and also followed by ^(4, 2, 1, 3).

3.Result

The mean incubation period of the eggs appeared to be 5.70 ± 0.95 days (range, 4-8 days, n=118). The average duration of first, second and third instar nymphs ranged from 5.61 ± 0.77 days (range, 4- days, n=106), 5.67 ± 0.88 days (range, 4-7 days, n=93), 5.41 ± 0.82 days (range, 4-7 days, n=46) respectively (Fig. 1). The average adult life span of males and females was found to be (15.52 ± 6.66) days (range, 2-26 days, n=150, 16.64 ± 7.66 days (range, 2-30 days, n=150) (Fig. 2 & 3).

The life table (Table 1) was constructed on the basis of lines suggested by the afore said workers. Studies on population structure of *G. jirufti* (Ansari, 1947) indicated that male, female ratio in natural population is 1:1.35. Thus, maternal frequency ($m_x =$ average number of female egg produced) was determined by multiplying the daily average egg rate by a factor of 0.57. While preparing the survivorship table, it was assumed that all the eggs laid were fertile and the nymphal mortality (larval mortality) would be negligible on the body of host.

The gross reproductive rate of *G. jirufti* (Ansari, 1947) (m_x - average number of daughter eggs expected to be produced by a female living through entire reproductive period) seems to be 13.892 (Table 2). Likewise, the net reproductive rate (R_0) appeared to be 4.606. The mean length of generation ($\sum x l x m_x / R_0$) was determined as 37.09 days. The value of intrinsic rate of natural increase was computed by using trial values of r to find the figure which satisfied the equation $\sum e^{-r x} l x m_x = 1$. In Table 1, put the values $r_m = 0.042$ for each age, the summation of $\sum e^{-r_m x} l x m_x$ proved to be 1.008. By this value of r_m (0.042) the precise corrected generation time ($T = \log_e R_0 / r_m$) appeared to be 36.33. Likewise, at this value of r_m (0.042) the doubling time ($DT = \log_e 2 / \log_e r$) of *G. jirufti* (Ansari, 1947) appeared to be 16.5 days.

4.Discussion

Marshall ¹⁴ has indicated that adequate information for construction of life table is rarely

available. Evans and Smith ¹² constructed the life table of human head louse *Pediculus humanus* after making several assumptions as done in present case also.

A review of literature indicates that the intrinsic rate of natural increase of twelve ischnoceran species have been recorded, so far (1, 4, 2, 3, 5, 6, 7) (Table 2). The value of gross reproductive rate of the species studies by aforesaid workers varied from 4.7-29.2 days (Table 2). The net reproductive rate varies from 2.9-14.4. The values of r_m of the different species varied from 0.031-0.074. Finally, the value of doubling time of different species has been recorded as 9.0 -23.5 days (Table 2). In comparison to earlier studies species, the black partridge louse, *Gonicotes jirufti* (Ansari, 1947) appears to be moderate breeder as its r_m equaled 0.042 and the doubling time remained 15.6 days.

As far as the mammalian lice are concerned, the value of r_m for sheep louse, *B. bovis* has been estimated as 0.053 per day (thus, doubling in 13-14 days) (Murray and Gordon, 1969). The value of r_m for rodent louse, *Geomydoecus oregonus* remained too low (0.006 per day indicating doubling after every 112 days)⁹. The data clearly shows that the reproductive potentials of different phthirapterans exhibit considerable diversity.

Presumably, the fast breeding species may build their population at faster rate (than moderate and slow breeders) and consequently may cause extensive damage to feathers of the host. On the other hand, slow breeders may exhibit low prevalence and intensity of infestation and thus causing minimal effect on host plumage. The moderate breeders like *G. jirufti* (Ansari, 1947) presumably are supposed to exhibit intermediate condition in this regard.

5.Acknowledgements

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Table 1: Life table and intrinsic rate of natural increase of *Gonicotes jirufti*

X	lx	mx	lxmx	Xlxmx	rmx	e-rmx	e-rmxlxmx
0-23	Immature stage of <i>Gonicotes jirufti</i>						
24-25	Pre- oviposition period						
25	1.000	0.000	0.000	0.000	1.050	0.350	0.000
26	1.000	0.000	0.000	0.000	1.092	0.336	0.000
27	0.967	0.000	0.000	0.000	1.134	0.322	0.000
28	0.953	0.315	0.171	4.788	1.176	0.309	0.053
29	0.933	0.414	0.220	6.392	1.218	0.296	0.065

X	lx	mx	lxmx	Xlxmx	rmx	e-rmx	e-rmxlxmx
30	0.920	0.341	0.179	5.358	1.260	0.284	0.051
31	0.900	0.519	0.266	8.246	1.302	0.272	0.072
32	0.873	0.634	0.315	10.093	1.344	0.261	0.082
33	0.840	0.508	0.243	8.026	1.386	0.250	0.061
34	0.820	0.732	0.342	11.628	1.428	0.240	0.082
35	0.753	0.761	0.327	11.438	1.470	0.230	0.075
36	0.727	0.817	0.338	12.175	1.512	0.220	0.075
37	0.680	0.804	0.312	11.529	1.554	0.211	0.066
38	0.640	0.823	0.300	11.408	1.596	0.203	0.061
39	0.593	0.787	0.266	10.374	1.638	0.194	0.052
40	0.547	0.671	0.209	8.360	1.680	0.186	0.039
41	0.500	0.760	0.217	8.881	1.722	0.179	0.039
42	0.467	0.471	0.125	5.267	1.764	0.171	0.021
43	0.440	0.652	0.163	7.026	1.806	0.164	0.027
44	0.380	0.632	0.137	6.019	1.848	0.158	0.022
45	0.340	0.725	0.141	6.327	1.890	0.151	0.021
46	0.313	0.617	0.110	5.069	1.932	0.145	0.016
47	0.280	0.452	0.072	3.393	1.974	0.139	0.010
48	0.247	0.432	0.061	2.918	2.016	0.133	0.008
49	0.207	0.290	0.034	1.676	2.058	0.128	0.004
50	0.180	0.407	0.042	2.090	2.100	0.122	0.005
51	0.147	0.000	0.000	0.000	2.142	0.117	0.000
52	0.100	0.267	0.015	0.790	2.184	0.113	0.002
53	0.047	0.000	0.000	0.000	2.226	0.108	0.000
54	0.013	0.000	0.000	0.000	2.268	0.104	0.000
55	0.000	0.000	0.000	0.000	2.310	0.099	0.000
							1.008

Table 2: Intrinsic rate of natural increase of different ischnoceran lice.

Species	Gross reproductive rate	Net reproductive rate (females egg per female)	Mean length of generation	r	D	References
<i>Brueelia amandava</i> (<i>Amandava amandava</i>)	4.98	3.31	35.4	0.031	23.45	Gupta et al. 2007
<i>Brueelia cyclothorax</i> (<i>Passer domesticus</i>)	4.7	2.9	34.2	0.032	21.35	Saxena et al. 2009
<i>Sturnidoecus bannoo</i> (<i>Acridotheres tristis</i>)	9.3	5.0	33.1	0.049	14.21	Saxena et al. 2009
<i>Neopsittaconirmus elbeli</i> (<i>Psittacula eupatra</i>)	7.9	5.2	33.5	0.050	13.93	Saxena et al. 2009
<i>Columbicola columbae</i> (<i>Columba livia</i>)	9.9	8.0	39.4	0.053	14.2	Saxena et al. 2009
<i>Anaticola crassicornis</i> (<i>Anas platyrhynchos</i>)	29.2	14.4	36.6	0.074	9.01	Saxena et al. 2009
<i>Brueelia plocea</i> (<i>Ploceus philippinus</i>)	7.74	3.74	28.19	0.045	15.41	Arya et al. 2009
<i>Goniocotes gallinae</i> (<i>Gallus g. domesticus</i>)	12.49	8.3	36.9	0.059	11.73	Saxena et al. 2007
<i>Upupicola upupae</i> (<i>Upupa epops</i>)	6.08	3.67	37.15	0.035	19.1	Agarwal et al. 2011
<i>Columbicola bacillus</i> (<i>Streptopelia decaocta</i>)	12.37	6.20	35.93	0.054	12.95	Singh et al 2012
<i>Bovicola caprae</i>	11.62	6.73	35.27	0.055	12.6	Rashmi et al 2010
<i>Lipeurus caponis</i> (<i>Gallus gallus domesticus</i>)	12.53	3.9	29.64	0.046	16.1	Kumar and Hasan 2016
<i>Goniocotes jirufti</i> (<i>Francolinus francolinus</i>)	13.89	4.606	37.09	0.042	16.50	Present study

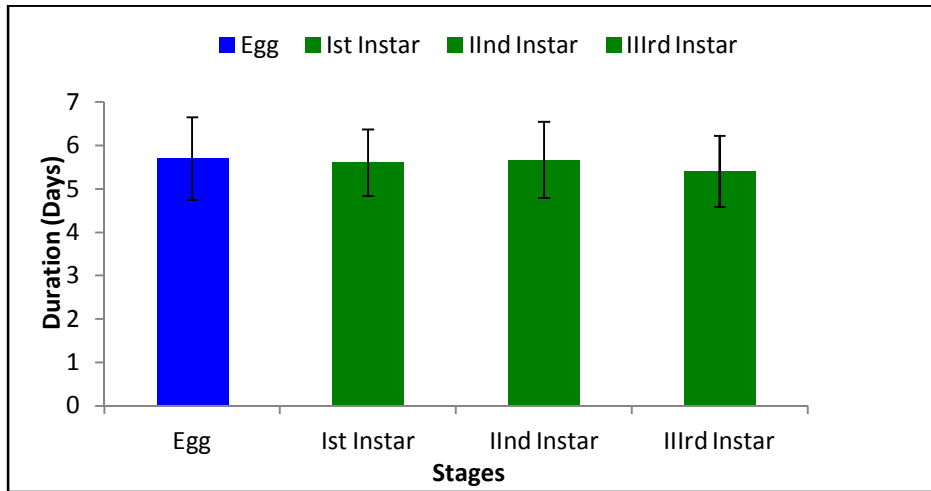


Fig.1: Duration of different life stages of *G. jirufti* (Ansari, 1947).

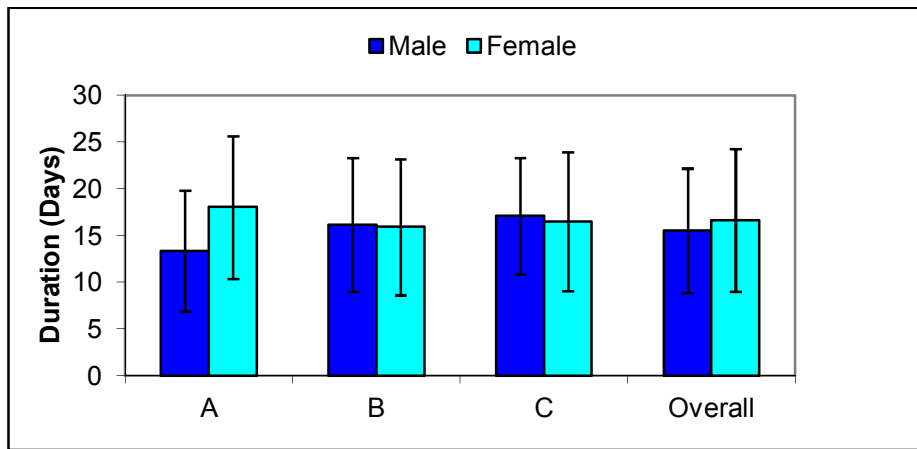


Fig.2: Adult longevity of males and females of *G. jirufti* (Ansari, 1947).

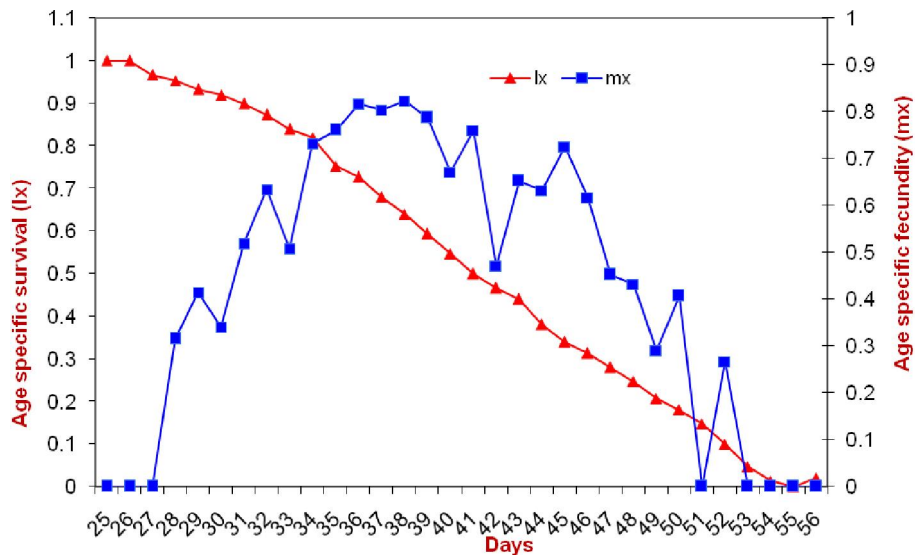


Fig.3: Age specific survival and fecundity of *G. jirufti* (Ansari, 1947) in *in vitro* condition (35+1C, 75-82% RH, at feather diet).

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