RESEARCH NOTE

PATH COEFFICIENT ANALYSIS OF CORRELATION BETWEEN BREEDING CYCLES OF THE COMMON MYNA *ACRIDOTHERES TRISTIS* (PASSERIFORMES: STURNIDAE) AND ITS PHTHIRAPTERAN ECTOPARASITES

Roshani Srivastava, **Sandeep Kumar**, **Nidhi Gupta**, **Suneel Kumar Singh** and **Arun Kumar Saxena**

Department of Zoology, Government Raza Postgraduate College, Rampur (Uttar Pradesh) 244 901, India

Louse population fluctuates seasonally. Several factors have been held responsible for the summer buildup of population of avian lice (Marshall A.G. 1981: The Ecology of Ectoparasitic Insects. Academic Press, London, 445 pp). It has been suspected that the breeding time of two haematophagous louse species (*Ricinus picturatus* and *Menacanthus* sp.) might be controlled by the reproductive hormones of the host bird, the orange crowned warbler (*Vermivora cellata*) (Foster M.S. 1969: Ecology 50: 315–323). Furthermore, testosterone implants gave rise to an increase in number of two haematophagous lice (*Machaerilaemus malleus* and *Myrsidea rustica*) on barn swallows (*Hirudo rustica)* (Saino N., Moller A.P., Bolzern A.M. 1995: Behav. Ecol. 6: 397–404).

The present studies were undertaken to record the degree of synchronisation between the breeding cycles of a semi-domestic passerine bird, the common myna *Acridotheres tristis* (L.) and its phthirapteran ectoparasites. Out of four phthirapteran species known to occur on Indian common myna, three species (*Menacanthus eurysternus* Burmeister, 1838, *Brueelia* sp. and *Sturnidoecus bannoo* Ansari, 1955) were taken into consideration in the present studies.

Ten infested birds (both sexes) were weighed and deloused by lethal fumigation (Marshall 1981, op. cit.) every month during May 2000 to April 2001. The entire louse load was transferred to 70% ethanol and separated species-wise and sex-wise under stereozoom trinocular microscope. Total number of adult females of each species was specifically recorded. Feathers of the bird were plucked carefully from each region of body and placed in a glass jar. The bird was dissected in physiological saline to take out the gonads. The latter were cleaned, gently pressed between the folds of paper and weighed. Each feather was examined individually under the stereozoom trinocular microscope to record the number of fresh (unhatched) eggs of each louse species. Total number of live eggs of each louse species recorded from any bird was divided by total number of adult females of that species (subsequently averaged) to obtain the "egg index" in particular month.

To derive the idea about the degree of synchronisation between breeding cycles of the host bird and its lice, an analysis of correlation between mean monthly live egg indices and mean monthly gonadal weights (in mg/100g of body weight) was taken into consideration (Fig. 1). The degree of correlation between live egg indices and mean monthly temperature as well as mean monthly photoperiod (averaged value of daily light hours) was also recorded. However, the values of Pearson's coefficient of correlation (Table 1) give absolute measure of the extent of relationship between two variables (first and second), ignoring the effect of other variables (third, fourth …) that may affect the first (dependent) variable.

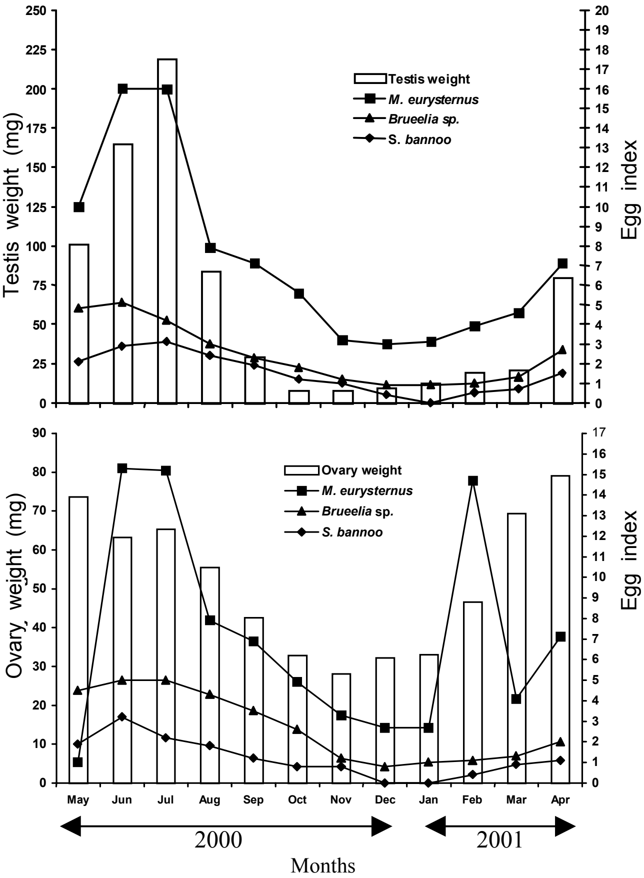

Fig. 1. Mean monthly egg index of three phthirapteran species infesting the common myna, *Acridotheres tristis*, along with host's mean monthly gonadal weight (in mg/100g body weight.

Hence, path coefficient analysis was employed to obtain a clearer picture of the results. In path coefficient analysis, the correlation coefficient between the first (dependent) and second (independent) variable is decomposed into a linear combination of direct effect of independent variable (under consideration) and its indirect effect through other independent variables (third, fourth …) with which the first is correlated (Kaliaperumal V.G., Sundaraj N. 1993: Path coefficient analysis in medicine. In: B.L. Verma, G.D. Shukla and R.N. Srivastava (Eds.), Bio-statistics: Perspective in Health Care Research and Practice. C.B.S. Publishers and Distributors, Delhi, India, 204 pp). The results of path coefficient analysis are given in Table 2.

Address for correspondence: A.K. Saxena, Department of Zoology, Government Raza Postgraduate College, Rampur (Uttar Pradesh) 244 901, India. Phone: ++91 595 234 0849; E-mail: akscsir@rediffmail.com

Table 1. Values of r (Pearson's coefficient of correlation) between the egg indices (mean number of live eggs/ mean number of adult females) of three phthirapteran species infesting common myna (*Acridotheres tristis*) and three potential controlling factors (host gonadal weight, temperature and photoperiod) taken into consideration.

Species	Male birds			Female birds		
	Egg index-testicular weight	Egg index-temperature	Egg index-photoperiod	Egg index-ovarian weight	Egg index-temperature	Egg index-photoperiod
Menacanthus eurysternus	+0.9596	+0.8132	+0.8876	+0.2739	+0.3401	+0.4721
Brueelia sp.	+0.8727	+0.8900	+0.9262	+0.4978	+0.9144	+0.9034
Sturnidoecus bannoo	+0.8729	+0.9244	+0.9009	+0.6004	+0.8973	+0.9036

Table 2. Path analysis matrix of direct and indirect effects (direct effects shown on main diagonals through bold type and indirect effects indicated through ordinary type) of three factors (host gonadal weight, temperature and photoperiod) on the egg indices of three phthirapteran species occurring on common myna (*Acridotheres tristis*).

Species	Male birds			Female birds		
	Egg index-testicular weight	Egg index-temperature	Egg index-photoperiod	Egg index-ovarian weight	Egg index-temperature	Egg index-photoperiod
Menacanthus eurysternus	**+0.8324**	+0.2522	–0.1250	**–0.6994**	–0.8120	+1.7853
	+0.5992	**+0.3500**	–0.1363	–0.4547	**–1.2490**	+2.0438
	+0.7089	+0.3254	**–0.1467**	–0.5676	–1.1603	**+2.2000**
Brueelia sp.	**+0.4184**	+0.3124	+0.1419	**–0.6784**	+0.0227	+1.1535
	+0.0312	**+0.4340**	+0.1548	–0.4411	**+0.0349**	+1.3206
	+0.3563	+0.4032	**+0.1666**	–0.5505	+0.0325	**+1.4215**
Sturnidoecus bannoo	**+0.6365**	+0.6980	–0.4616	**–0.3388**	+0.1079	+0.8313
	+0.4582	**+0.9697**	–0.5035	–0.2203	**+0.1660**	+0.9516
	+0.5421	+0.9009	**–0.5420**	–0.2749	+0.1542	**+1.0243**

Illustration: For *M. eurysternus* (on male birds) value of r between egg index and host testicular weight is +0.9596 (as shown in Table 1). Table 2 (path analysis) indicates that out of 0.9596, +0.8324 is the direct effect of host testicular weight and remaining values are the indirect effects of temperature and photoperiods (0.8324 + 0.2522 – 0.1250 = 0.9596).

Correlation matrix (Table 1) clearly shows that on male birds all the three factors (testicular weight, temperature and photoperiod) had significant positive correlation with live egg index of the three louse species (r = 0.81 to 0.92). On female birds, all the three factors were found significantly correlated with egg index in the non-haematophagous species (*S. bannoo*) but not in the haematophagous species (*M. eurysternus).* Path coefficient analysis (Table 2) suggests that in (haematophagous) *M. eurysternus*, on male birds, direct effect of testicular weight (0.8324) was higher than that of temperature and photoperiod (0.350 and 0.1467, respectively), while on female birds, direct effect of photoperiod (2.20) considerably exceeded the effect of ovarian weight (–0.6994) and temperature (–1.249). In (non-haematophagous) *Brueelia* sp. on male birds, direct effects of testicular weight and temperature were modest (0.4184 and 0.4340) but on female birds, direct effect of photoperiod (1.4215) was much higher than that of ovarian weight and temperature (–0.6784 and 0.0349). In *S. bannoo* on male birds, direct effect of temperature on egg index (0.9697) was higher than that of testicular weight (0.6365) and photoperiod (–0.5420) but on female birds direct effect of photoperiod was quite high (1.0243) in contrast to that of ovarian weight and temperature (–0.3388 and 0.1660, respectively).

The breeding time of two haematophagous amblycerans (*Ricinus picturatus* and *Menacanthus* sp.) reportedly coincided with the breeding period of host bird (orange crowned warbler) (Foster 1969, op. cit.). Since then, the biology of haematophagous versus non-haematophagous species needed further investigation. The path coefficient analysis suggests that in the haematophagous *M. eurysternus*, effect of host testicular weight on egg index can be quite high but the ovarian weight appears to have negligible effect. However, it is quite unlikely that gonadal hormones would influence the reproductive potentials of lice on male birds and not on females. Furthermore, direct effect of testicular weight on live egg index of the non-haematophagous *S. bannoo* was also fairly high. It is difficult to explain how the testicular hormone of the host could influence the reproductive rate of a non-haematophagous species. Thus, the probability that host gonadal cycle and breeding period of lice are synchronized is quite low, as far as this host-parasite model is concerned.

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