

EVOLUTIONARY TREND IN TWO SYMPATRIC SPECIES OF *GONIOCOTES*  
(PHTHIRAPTERA : ISCHNOCEROPHTHIRINA) WITH REMARKS ON  
HOST PHYLOGENY

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ABSTRACT

The evolutionary trend in two sympatric species, viz., *Goniocotes mayuri* and *G. parviceps* parasitic on *Pavo cristatus* and *P. muticus*, is discussed in this paper. Based on the parasite data, host phylogeny is also discussed.

INTRODUCTION

Sympatricity among two species of *Goniocotes* found on the Indian Peafowl (*Pavo cristatus* Linne) and the Green Peafowl (*P. muticus* Linne) was recently discovered by the authors (Lakshminarayana and Emerson, 1971). One of the species of the sympatric pair, *G. parviceps* (Piaget), has been known for more than ninety years and was first described from material collected off the Indian Peafowl in the Amsterdam and Rotterdam zoological gardens. In addition to records from museum skins or zoological garden birds, it has been found on the type host in India and Nepal and off *P. muticus imperator* from Thailand. The other member of the sympatric pair, *G. mayuri*\* Lakshminarayana and Emerson, has been found only on *P. cristatus* in India, Nepal and the Yorks

Zoo, and so far has not been encountered on *P. muticus*. Several collections of Chewing-lice from the latter host from Thailand have been examined, but *G. mayuri* was not found. While describing *G. mayuri* the present authors gave diagnostic characters of *G. parviceps* also, and casually remarked that the former with a symmetrical male genitalia is phylogenetically older to the latter with asymmetrical genitalia. The present paper is to elucidate further our observations on the trend in evolution in these two sympatric species and the light they throw on the phylogeny of their hosts.

The diagnostic characters of the two species are presented in a comparative way (Table I) before discussing the evolutionary trend (see also fig. 1, A—E). We stated elsewhere (Lakshminarayana and Emerson,

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\* *ri* in *mayuri* should be pronounced as *re* in congregation.

1971) that while the males are easily separable, the females are separable with difficulty. Therefore, the males are more useful in discussing the evolutionary trend.

pair always shows antennal variation. This suggests that the fine long seta might be playing a significant role probably sensory, in discriminating the female of its own species, which is other-

TABLE 1. Diagnostic characters of *Goniocotes mayuri* and *parviceps*

Character	<i>mayuri</i>	<i>parviceps</i>
	<i>Male</i>	<i>Male</i>
1. Temporal margin	Constricted	Not constricted
2. Marginal temporal carina	Narrow, weakly sclerotized	Wide, heavily sclerotized
3. Marginal temporal setae	Slender	Robust, nearly spinous
4. Form of seta on first antennal appendage	Small and lanceolate	Long and fine
5. Shape of the lateral prothoracic margin	Nearly rectangular	"Winged"
6. Shape of abdominal tergite I	Sharply projecting over thorax anterolaterally	Normal
7. Setae on tergite VIII	Four	Two
8. Setae on terminal abdominal tergite	Six	Eight
9. Genitalia	Symmetrical	Asymmetrical
	<i>Female</i>	<i>Female</i>
1. Size	Large	Slightly smaller
2. Setae on terminal abdominal tergite	Four long and short setae	Six long and four short setae
3. Shape of internal vulval chamber	Prominent, circular-shaped	Not prominent and discernible

The trend in evolution, based on the males, can be summarized as follows :

The weakly sclerotized marginal temporal carina in *G. mayuri* (fig. 1A, m.c.) is heavily sclerotized in *G. parviceps*. The slender temporal seta in *G. mayuri* are robust and spiniform in *G. parviceps*. The lanceolate seta on the first antennal appendage of *G. mayuri* is modified into a fine and long seta in *G. parviceps* (figs. 1B and D). Sikora and Eichler, 1941, according to Clay, (1949) found that within the 'Ischnocera' antennae play a dominant part in mating and that one member of the sympatric

wise alike to its counterpart in the sympatric pair. The nearly rectangular prothorax in *G. mayuri* is modified into a "winged" form in *G. parviceps*. Likewise, the first abdominal tergite which is strongly projecting into prothorax anterolaterally in *G. mayuri*, became normal in *G. parviceps*. The most significant evolutionary change is perceptible in the male genitalia in that the symmetrical genitalia in *G. mayuri* (fig. 1C) has undergone a change into an asymmetrical one in *G. parviceps* (fig. 1E) and can be easily derived from the symmetrical one in *G. mayuri*, (and not the reverse). hence phylogenetically *G.*

*parviceps* is assumed as younger to *G. mayuri*. This change has obvious advantage in preventing interbreeding between *G. parviceps* and *mayuri* populations. Mayr (1969) stressed the importance of genitalia in the evolution and evaluation of sympatric species.

#### REMARKS ON HOST PHYLOGENY

It was shown (*vide supra*) that *G. mayuri* is phylogenetically older than *G. parviceps*.

While *G. mayuri* is now known only from the Indian peafowl (*Pavo cristatus*), *G. parviceps* is known from the Indian Peafowl and the Green Peafowl (*P. muticus*) also.

Delacour (1951) and Ripley (1961) recorded the distribution of *P. cristatus* in India as south of the Indus River and east to longitude 90°E., and in Nepal and Ceylon from sea level to nearly 1550 meters in the scrub jungle, sal forest, and semicultivated areas.

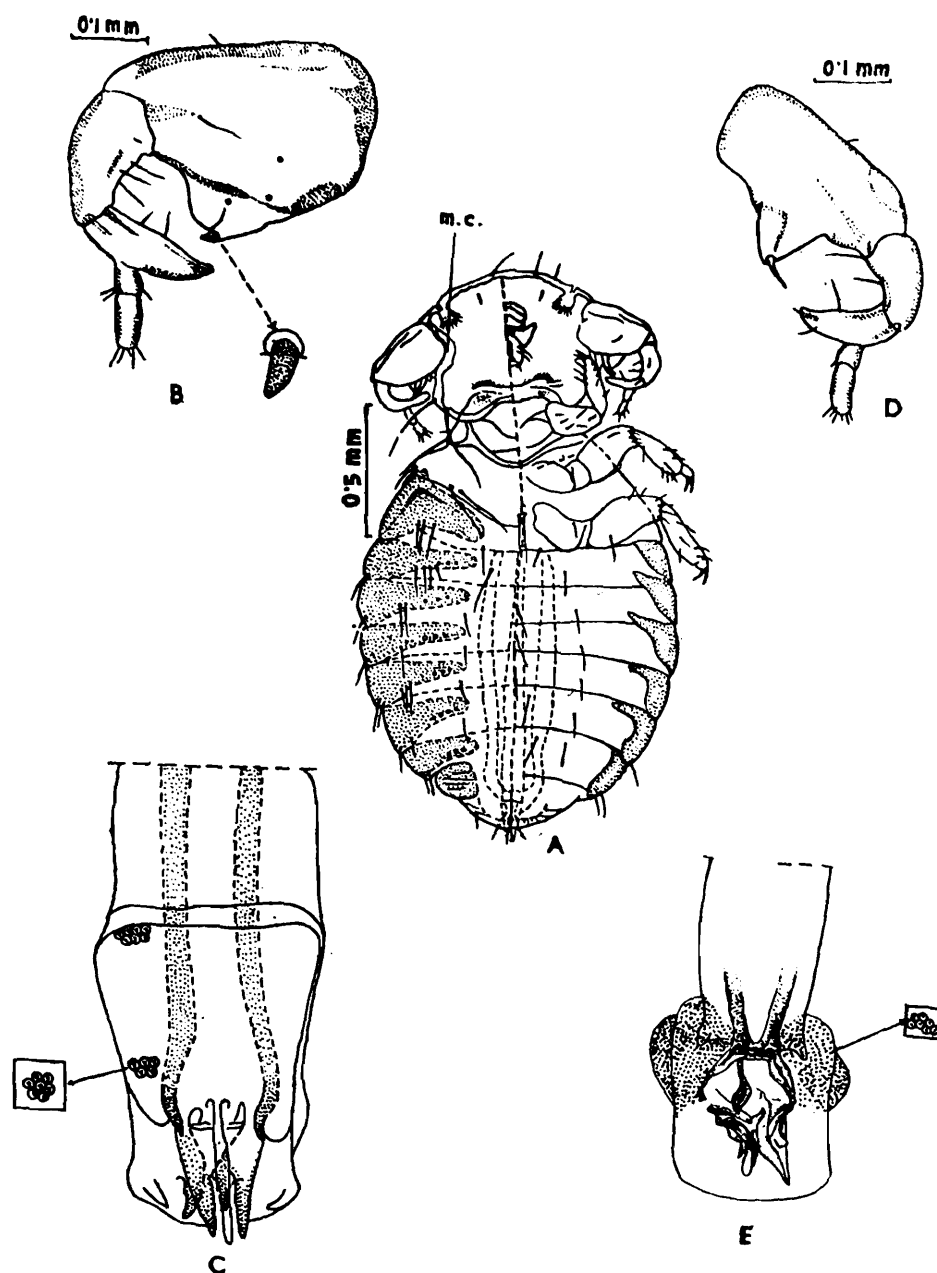


Fig. 1. *Goniocotes mayuri* ; A. Male ; B, Male antenna ; C. Male genitalia ; *G. parviceps* ; D. Male antenna ; E. Male genitalia.

The Green Peafowl, *Pavo muticus*, has three subspecies, viz., *spicifer*, *imperator* and *muticus*. Of these *spicifer* occurs along the south-eastern border of Assam, in the hittagong and Lushai Hills where it is now scarce, and it formerly occurred in Manipur and North Cachar. It also occurs in western Burma, probably as far east as the Irrawaddy River. The subspecies *imperator* inhabits the whole

forests and semi-cultivated fields, while *Pavo muticus* is found in evergreen and moist deciduous forests and long grass. Also, it does not ascend mountain slopes above 1250 meters, although it is numerous just below that altitude (Delacour, 1951).

It is well known that the rise of the Himalaya and Pleistocene glaciation brought

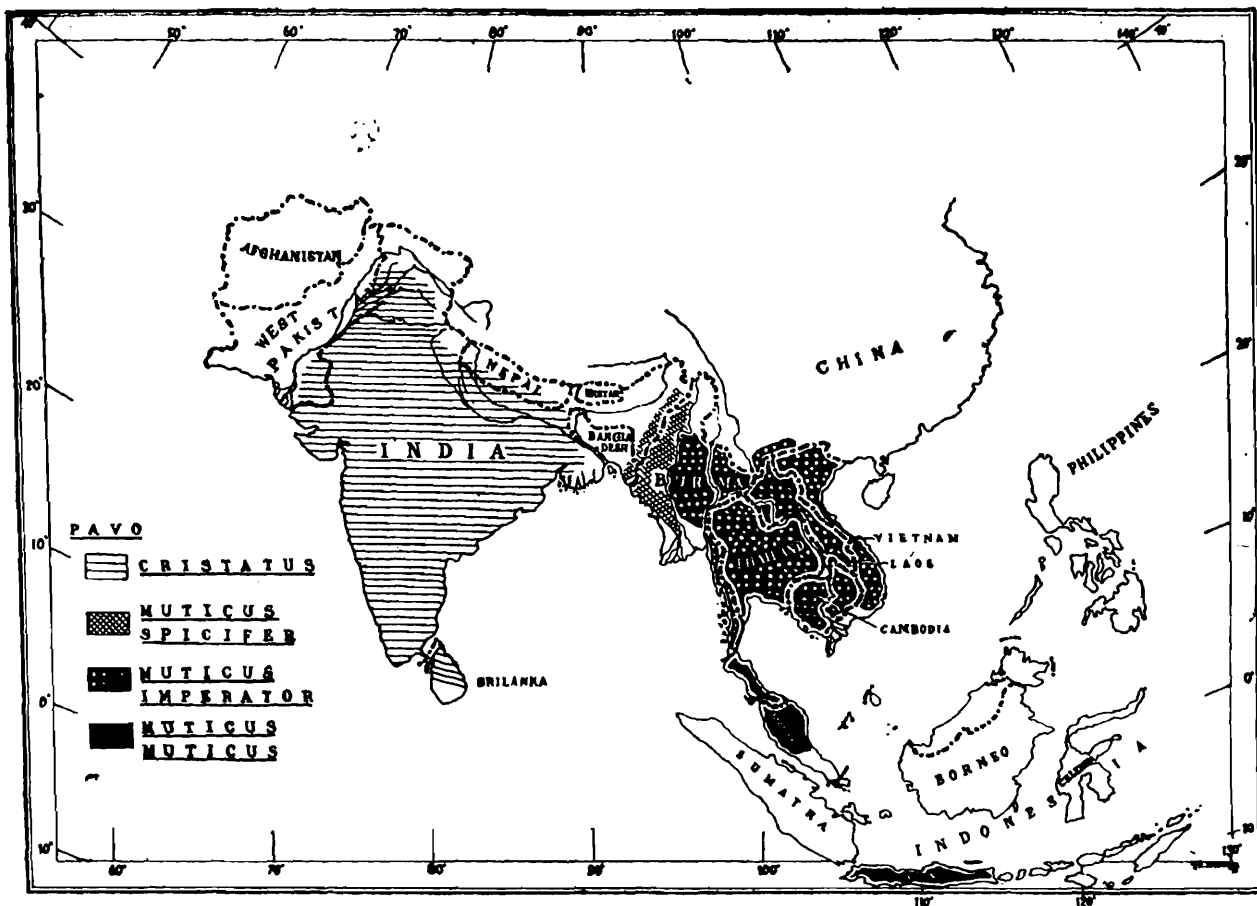


Fig. 2. Distribution of the Peafowls (modified after Delacour, 1951).

“Indo-China”, the extreme south of Yunnan, Thailand south to Kra, and eastern Burma as far west as the Salween-Irrawaddy divide. The subspecies *muticus* is found in Java and the Malay peninsula probably north to the Isthmus of Kra ; it has not been found in Sumatra and Borneo (Delacour, 1951) (Fig. 2.).

*Pavo cristatus* lives in scrub jungles, sal

remarkable changes in the physiography of India and affected the faunal and floral components of both Palaearctic and Oriental regions. It is easy to conjecture that the open country species, *Pavo cristatus*, might have undergone mutation into *Pavo muticus* in the Indo-Chinese subregion consequent to the development of a thick forest background, since mutations in *Pavo* are well known. According to Delacour (op. cit.) *P. cristatus*

has frequent mutations (albinos and black-winged *nigripennis*), and *P. muticus* even speciated to subspecies level. Further, the green mutation in the ancestral *P. cristatus* might have found to be of greater protective value in thick green forest back-ground from the great cats, as the predatory animals like the leopards and tigers are said to be their enemies (Sumati, 1971). It was also possible that *P. muticus* might have lost continuity with the *P. cristatus* populations for considerable period of the geological history.

Among Mallophaga *s.l.*, it is well known that the feather structure on which these avian parasitic forms feed, affect the head structure of the latter (Clay, 1949 and 1951). The colouration in *Pavo* is mainly iridescent and therefore, the structure and arrangement of the barbs and barbules are responsible for the colour. Chandler (1916) attributes the changeable metallic lilacs, fiery reds, blues, greens and purples in Galliformes, to the highly refrangent simple rod like barbules. This author further adds that in the peafowls, the highly iridescent blue, green, and bronze colours are the result of barbules which are totally metamorphosed in both base and pennulum; the green in the peafowl chiefly produced by barbules which are conspicuously ringed or cross-ringed in both base and pennulum. Sumati (1971) on the other hand, mentions that the barbules in the blue peafowl are twisted at the base so that they lie with their flat faces up and covered by three layers of Keratin (0.4  $\mu$  thick) which like the soap bubble reflects the blue colour due to interference of the light; alternatively, she records that the distribution of highly refractive melanin granules with higher refractive index than Keratin gives the iridescence (possibly by Tyndall effect\*). It is assumed that when *P. cristatus* transformed into *P. muticus*, *G. mayuri* populations from the ancestral *P. cristatus* also passed on to

the mutating form *P. muticus*, whose feather structure was undergoing certain modifications. The altered feather structure, i.e., the development and rearrangements of barbules (for the colour change from blue to green) might have necessitated the weakly sclerotized head of *G. mayuri* modified into a heavily sclerotized head as in *G. parviceps*, followed by other structural modifications including the asymmetry of the genitalia. Intertbreeding between the unmodified *G. mayuri* populations and the incipient species *G. parviceps*, perhaps has been prevented by the male genital asymmetry.

When *P. cristatus* and *P. muticus* populations are re-united due to changed geo-ecological conditions, natural interbreeding might have occurred wherever possible. In this connection, it may be recalled that Delacour (op. cit.) stated that the two species of peafowls freely interbreed and produce fertile offsprings (which also incidentally indicates the chromosomal compatibility and that they are closely related and the hypothesis that *muticus* is possibly a mutant species of *cristatus*). During these chance matings, it was possible for some members of the newly evolved *G. parviceps* gaining access to *P. cristatus* and *G. mayuri* populations also to *P. muticus*, a second or subsequent times. *G. parviceps* could get established easily on *P. cristatus* as it is a stronger form, while *G. mayuri* transferred for the second time could not get established on *P. muticus*, since the feather structure has already undergone radical change, and the feeding on it might have posed a problem to the newly acquired *G. mayuri* populations. The original *mayuri* populations did not face this problem, because they were evolving into *parviceps* synchronously with that of the *muticus* host. Thus, either due to physical handicap or in conjunction with the interspecific competition with the stronger and more adapted *G. parviceps*, the newer populations of *G. mayuri* could not get established

a second or subsequent times on *P. muticus*, and eliminated. The asymmetrical genitalia, coupled with the fine long antennal seta in *G. parviceps* might have helped in recognizing its female and thus interbreeding with *G. mayuri* populations might have been prevented either on *P. cristatus* or *P. muticus* (when *mayuri* populations were transferred in subsequent times) (see also Lakshminarayana, 1977).

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#### REFERENCES

- CHANDLER, A. C. 1916. A study of the structure of feathers, with reference to their taxonomic significance. *Univ. Calif. publ. Zool.*, 13 (11) : 243-446. pls. 13-37, 7 text figs.
- CLAY, T. 1949. Some problems in the Evolution of a Group of Ectoparasites.— *Evolution*, 3 (4) : 279-299, II figs.
- CLAY, T. 1950. A preliminary Survey of the Distribution of the Mallophaga on the Class Aves.— *J. Bombay nat. Hist. Soc.*, 49 : 430-433, 3 figs., 2 pls.
- DELACOUR, J. 1951. *The Pheasants of the World*.— (Country Life Ltd.), London ; Charles Scribner & Sons). New York, 247 pp. + 32 pls, 21 maps and figs.
- LAKSHMINARAYANA, K. V. and EMERSON, K. C. 1971. Mallophaga Indica—IV. Notes on *Pavo cristatus* with description of a new species.— *Oriental Ins.* : 95-102, 9 figs.
- LAKSHMINARAYANA, K. V. 1977. Factors involved in the host specificity in Mallophaga sens. lat., (Phthiraptera : Insecta) infesting birds.— In T. N. Ananthakrishnan Ed. *Insects and host specificity* (The Macmillan Co. of India Ltd., Delhi : 101-107.
- MAYR, E. 1969. *Principles of Systematic Zoology*. (Tata McGraw-Hill publishing Co., Ltd., Bombay : X + 428 pp., II-2 figs.
- RIPLEY, II, S. D. 1962. *A Synopsis of the Birds of India and Pakistan together with those of Nepal, Sikkim, Bhutan and Ceylon*.— (Bombay Nat. Hist. Soc. Publ.), Bombay : 702 pp., 1 histogram, 4 maps.
- SIKORA, H. and EICHLER, W. 1941. Ueber Kopulationseigentlichkeiten der Mallophagen (Beobachtungen ueber biologische Eigentumlichkeiten der Mallophagen, III.) *Z. Morph. Okol. Tiere.*, 38 (I) : 80-84, 3 figs.
- SUMATI, K. S. 1971. Peafowls.— *Science To-day*, 6 (2) : 55-56, 1 fig.