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Correlates of Mating Success in Indian Peafowl

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The Indian Peafowl (*Pavo cristatus*) is a lek-breeding, dimorphic species, with males having an elaborate tail called the train. Adult males with a completely developed train establish display territories in mid-April, and maintain them until the end of the breeding season in September, when molting of train feathers begins (pers. obs.). A skewed distribution of matings towards a few males has been reported in Indian Peafowl by Rands et al. (1984) and Petrie et al. (1991). While Petrie et al. (1991) attributed variance in mating success to the variance in train morphology, Rands et al. (1984) suggested that male mating success could be a result of the combined effects of male behavior and active female choice based on phenotypic traits. We investigated the relationship between the variance in mating success and behavior, in addition to the variation in train morphology of males.

Methods.—Our study was conducted on a population of around 50 birds at Aligarh fort, situated in the outskirts of the town of Aligarh (27°30'N, 79°40'E) in India. In 1994, there were 23 adult peacocks in the study area that progressively established their display sites from the third week of April onwards. A group of 11 males with adjacent display sites was selected for detailed simultaneous observations. Sample size was restricted to 11 because it would have been difficult to collect data on more males simultaneously. Data on behavior of these peacocks were collected by focal-animal sampling (Altmann 1974) during June and July 1994 (the peak mating period). Behavioral observations were made between 0500 and 0900, with a total of 240 h of observations. Data on the following were collected: total time spent in display (presence or absence of females was recorded at same time); number of calls of different notes (a call "kian kian kian" is considered to have three notes); total number of calls during observation period; and number of successful matings.

Males showed philopatry to their display sites and tended to roost and rest near these sites until molting was completed. Moreover, all of the males did not molt simultaneously, which helped in recognition and allowed collection of molted feathers of different males separately. Lengths of fish-tail feathers were measured (for classification of Peacock train feather types, see Manning 1987). The length of longest fish-tail feather corresponds to the train length.

We tabulated the following independent variables: proportion of observed time spent displaying in females' absence (display rate); number of calls per minute of observation time (call rate); proportion of total calls having more than five notes (CALLS > 5N); and length of longest fish-tail feather. The dependent variable was mating success. Mating success was expressed as the proportion of total copulations (recorded for the 11 males) obtained by a given male. Pearson product-moment correlations were used to evaluate the relation between each of the independent variables and mating success. Partial correlation between mating success and each independent variable was calculated, holding each of the other variables constant, to eliminate the problem of intercorrelations of variables (Snedecor and Cochran 1967).

Results.—The most successful male obtained 10 of the 31 copulations observed. Two males mated five times, one mated four times, one mated three times, one mated twice, and two mated once. Two males obtained no mates.

The statistical analysis of results is in Table 1. Mating success of males was significantly correlated with proportion of total calls having greater than five notes, CALLS > 5N ($r = 0.53$, $n = 11$, $P < 0.05$) and with the length of longest fish-tail feather per male ($r = 0.72$, $n = 11$, $P < 0.01$). Call rate ($r = 0.01$) and display rate ($r = -0.31$) were not significantly correlated with mating success.

Partial correlation analysis involving all of the five variables together revealed that display rate ($r = -0.74$, $P < 0.05$) and length of longest fish-tail feather per male ($r = 0.76$, $P < 0.05$) were significantly correlated to mating success when the other three independent variables were held constant.

Discussion.—Our results suggest that certain behavioral factors also contribute to variance in mating success in addition to train morphology.

The inverse correlation of mating success with display rate suggests that display behavior is important in attracting females. The display rate has been found

TABLE 1. Behavioral and morphological factors affecting mating success of peacocks. Dependent variable is number of mates obtained. Correlations with number of mates obtained based on 11 males in group studied.

Independent variable	$\bar{x} \pm$ SD	Correlation Simple r	Correlation Partial r_p
Display rate[a]	0.054 ± 0.222	−0.31	−0.74
Length of longest fish-tail feather (cm)	153.163 ± 6.999	0.72	0.76
CALLS > 5N[b]	0.538 ± 0.212	0.53	0.56
Call rate[c]	0.236 ± 0.032	0.01	0.55

[a] Proportion of observed time spent by males in displaying in females' absence.
[b] Proportion of total number of calls having notes greater than five.
[c] Number of calls per minute of observation time. r_p is partial correlation with all of the other three variables partialled out.

to determine male mating success in the Sage Grouse (*Centrocercus urophasianus;* Gibson and Bradbury 1985) and for numerous other species.

The positive correlation of mating success with CALLS > 5N suggests that call length might serve as a cue in mate selection. In the Grey Partridge (*Perdix perdix*), Beani and Dessi-Fulgheri (1995) showed that females selected males on the basis of vocal performance. Males producing high rates of "rusty-gate" calls with longer duration were preferred by female partridges. In passerines, song components are used as cues for mate selection by females (Eriksson and Wallin 1986, Searcy and Andersson 1986, Catchpole 1987). Baker et al. (1986, 1987) showed experimentally that larger song repertories were more attractive to females. In pheasants also, calls may be important in mate selection because they can be detected at some distance. However, call length and not the call rate may serve as a cue for mate choice. In Indian Peafowl, the ability to produce mating calls probably develops with the progress of age. This was evident from two facts: the subadult males did not produce mating calls; and two males that had established territories for the first time in 1994 (i.e. were younger than other males) could not produce a single mating call with more than five notes. Loffredo and Borgia (1986) also suggested that, in the Satin Bowerbird (*Ptilinorhynchus violaceus*), the complexity of male courtship vocalizations is correlated with male age, and that such complexity may influence female choice.

The length of longest fish-tail feather, which corresponds to train length (Manning 1987), was correlated with mating success. This supports Petrie et al. (1991), who indicated that aspects of train morphology serve as cues for female choice. Experimental studies on the polygynous Long-tailed Widowbird (*Euplectes progne;* Andersson 1982), the monogamous Barn Swallow (*Hirundo rustica;* Møller 1988), and the promiscuous Queen Whydah (*Vidua regia;* Barnard 1990) also showed that females preferred to mate with males having longer tails.

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Consequences For Captive Zebra Finches of Consuming Tall Fescue Seeds Infected With the Endophytic Fungus *Acremonium coenophialum*

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Tall fescue (*Festuca arundinacea*) plants can be infected with the endophytic fungus *Acremonium coenophialum*. This fungus, which grows subcutaneously in leaves, stems, and seeds, does not undergo sexual reproduction or sporulate, and cannot survive outside the plant (Clay 1988). The fungus is passed from one generation to the next through infected seed. A mutualistic relationship exists between the grass and the fungus. The fungal endophytes produce ergopeptine alkaloids, notably ergovaline (Thompson and Stuedemann 1993), which makes the grass less palatable and more toxic to insect herbivores (Latch et al. 1985, Johnson et al. 1985) and nematodes (Kimmons et al. 1990). Because infected grasses are hardy (Arachevaleta et al. 1989) and resistant to insects, one infected cultivar (Kentucky 31) was widely planted before its infection was discovered. Hence, most of the plants grown on 14 million hectares of tall fescue pastures in the United States are infected (Shelby and Dalrymple 1987, Stuedemann and Hoveland 1988).

Consumption of large amounts of fungus-infected tall fescue (hereafter called infected fescue) can have a deleterious effect on livestock. Cattle grazing infected fescue, especially in hot weather, have exhibited lower food intake, lower daily mass gains, higher rectal temperatures, and a decrease in reproductive rates (Hoveland et al. 1983, Aldrich 1993, Schmidt and Osborn 1993). These problems, however, can largely be avoided by proper management, allowing infected tall fescue cultivars to still be recommended for pastures (Bouton et al. 1993).

Consumption of infected fescue can reduce the reproductive potential of laboratory rats (*Rattus norvegicus*; Zavos et al. 1986, Varney et al. 1987, 1988) and laboratory mice (*Mus musculus*; Zavos et al. 1987, 1988a, b, 1990, Godfrey et al. 1994). Reproductive rates decreased owing to reduced male fertility and because of delayed estruses, increased abortion rates, and poor lactation in females.

Whether avian seed predators that ingest infected fescue seeds suffer any ill effects is unclear. Zavos et al. (1993) reported a 10% reduction in fertility of Japanese Quail (*Coturnix japonica*) fed a diet of 45% infected fescue seed. It also is unknown whether birds find infected fescue seeds less palatable than uninfected ones, or whether they can discriminate between the two. In this study, we compared mass gains, reproductive rates, and mortality rates of Zebra Finches (*Taeniopygia guttata*) fed infected fescue *ad libitum* to those for conspecifics provided similar assess to uninfected fescue seed. Further, we tested whether these birds can discriminate between infected and uninfected seed.

Methods.—Experiments were conducted in 1992 and 1993 and lasted 18 months. Subjects were 20 pairs of Zebra Finches housed in Utah State University's Laboratory Animal Research Facility. Ambient temperatures were maintained between 21° and 23°C. Finch pairs were housed individually in 0.5 × 0.5 × 0.65 m cages that contained several perches and a straw basket that served as a nest. Each cage contained a water bowl and two feeding cups located 0.4 m apart. At the initiation of these experiments, a male and female finch were randomly paired together. If one died during the experimental period, it was replaced with an adult of the same sex.

Each finch pair was randomly assigned to either of two groups: (1) one received *ad libitum* tall fescue seed (K-31 cultivar) infected with *A. coenophialum* (hereafter called fungus finches); and (2) the other group received an *ad libitum* supply of uninfected fescue seed of the same cultivar (control finches). Approximately once every 10 days fungus finches were given for 48 h an *ad libitum* supply of sprouted infected fescue seed; control finches received similar access to sprouted uninfected seed. To supplement this diet, finches had access to Vita Finch Feed for 6 h each day. They also were allowed free access to water, calcium, and nesting material.

Each finch was weighed when the experiment be-