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Conservation Status of the Indian Peafowl *Pavo cristatus* (Aves: Galliformes: Phasianidae) in Bangalore University Campus, Bengaluru, Karnataka, India

The Indian Peafowl, Pavo cristatus was abundant in Bangalore University Campus (BUC) during 1970-80. However, the peafowl population declined alarmingly in the BUC region after 1990. The present paper deals with the abundance, sex ratio of peafowls and their conservation methods in the Biodiversity Park (Bio-Park) of BUC, which had been established in 2006. A total of 117 peafowls was recorded in the BUC region in which the females outnumbered the males. The increased abundance of the peafowl population in the campus could be mainly due to the availability of suitable roosting, foraging and nesting sites. The peafowls have used 18 species of plants and trees for perching and roosting in BUC. The peafowl population increased in the BUC region due to habitat rejuvenation and protection, availability of food sources and breeding/nesting sites. The results of the present investigation constitute the baseline data for the further understanding of the ecological community of national bird in the protected habitats as hotspots for biodiversity of urban ecosystem. Conservation of microhabitats through the proper restoration of ponds, streams and water check-dams including vegetation in the BUC is responsible for the existence of peafowl population.

Key words: Abundance, Indian Peafowls, Conservation methods, Nesting trees.

Introduction

The Indian Peafowl *Pavo cristatus* Linnaeus, 1758 (Galliformes: Phasianidae) is one of the most common species around human habitations in India (Ali and Ripley, 1983). It is seen in open forests, secondary growth, wooded and cultivated regions, parks and gardens, and agricultural fields (Ali and Ripley, 1987). The peafowl is omnivorous ground-dwelling, and indigenous to the Indian subcontinent. This resident fowl is widely distributed across the Indian subcontinent, Bangladesh, Sri Lanka, and Myanmar (Ali and Ripley, 1987). It is a very commonly abundant resident bird in the urban landscapes of Bengaluru region, Karnataka, India (Rajashekar, 2011; Rajashekara and Venkatesha, 2015, 2017a). They often form large social groups and can recognize themselves with the individuals in a social group with social alarm calls (Pollard and Blumstein, 2011). They produce anti-predatory calls in response to aerial and terrestrial predators (Kannan and James, 1998). The peafowl breeds throughout the year (Ali and Ripley, 1987; Rasmussen and Anderton, 2005; Grimmett and Inskipp, 2007; Ali, 2012).

Ali (2012) has described the detailed morphology of peafowls. The peafowl male adult is larger, usually of 92–122 cm in length without a train, which constitutes the elongated upper tail coverts and weighs about 4–6 kg. The female is 86cm long and weighs about 2.75–4.00 kg. The male has a metallic bronze-green train of about 200 elongated tail feathers (Tikader, 1983). A female head nape is rufous brown, and the rest of the upper parts is brown. Juveniles of both sexes look like females (Ali and Ripley, 1987). The lifespan of peafowl is 15-25 years (Ali, 2012).

Focus on the population density, sex ratio, abundance and feeding activities; the habitat impact on survival and distribution; and prioritizing the conservation methods to maintain the Indian Peafowl population in educational campus of the urban Bengaluru city, India.

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Birds are widely known as biological indicators of environments (Gill, 1994) and are used as a tool for conservation and environmental impact assessment of any local habitat. This Phasianidae species too is a valuable indicator of environmental quality and assessment of its status can provide essential clues for the management of ecosystems (Fuller and Garson, 2000).

The peafowl plays a dynamic role from the biological point of view as an omnivorous species (Kannan and James, 1998; Rajeshkumar and Balasubramanian, 2011; Ali, 2012). It is a potential natural control agent that feeds on insect pests of crops and contributes to maintaining a healthy and sustainable ecosystem. Hence, the peafowls provide a valuable ecological unit with functioning services in agriculture.

Bangalore City is well-known as 'Udhyana Nagara' (Garden City) for its residential/urban parks and roads lined with large canopy flowering trees (Ramaswamy and Razi, 1973). The city landscapes serve as urban refuges for urban wildlife and reservoirs for several species of flora and fauna.

Pavo cristatus was abundant in Bangalore University Campus (BUC) during 1970-80, but it declined after 1990. It is still a common bird in BUC. The present study about *P. cristatus* in BUC was conducted to ascertain its sex ratio, abundance, population density, behaviour, feeding activities, habitat impact, and conservation status.

Material and Methods

Study area

Bangalore University Campus ($12^{\circ} 55'25.48''$ – $12^{\circ} 58'36.20''$ N and $77^{\circ} 29'32.72''$ – $77^{\circ} 31'30.93''$ E,

elevation 875-900 m asl) is located 14 km from Bengaluru City Railway Station in South Bengaluru. This campus is spread over an area of about 445.15 ha comprising undulating terrain and barren land with vegetation patches of non-deciduous trees, weeds, shrubs, scrubs, herbs, bamboo bushes, and ornamental plants. The campus also has check dams and ponds (Rajashekara and Venkatesha, 2017a, b). The Biodiversity Park (Bio-Park) of 242.80 ha of land, established in 2006 in the campus, forms one of the biodiversity hotspots of Bengaluru Metropolitan Region (BMR) (Ramaswamy and Razi, 1973; International Year of Planet Earth, 2008).

Surveys and sampling methods

Survey of peafowls was conducted to estimate population density during January-June 2017 using a point count method at different spots/plots of BUC as followed by Gurjar *et al.* (2013) and Sukumal *et al.* (2015). The point counts were conducted twice a day, in the morning and evening hours, for 10 minutes each simultaneously by different groups of observers at different sites. The exercise was done once a week.

Activities of peafowls were recorded following Takahashi *et al.* (2008) and Gurjar *et al.* (2013). Sampling was done along the 16 prefixed transects by walking at a uniform pace of about 1-1.5 km/h at 6.00-10.00 h and 14.00-18.00 h. To identify the female and male birds, we used differences in unchanging physical characteristics such as the colour of wings, shoulder, or throat feathers (Somes and Burger, 1993; Grimmett and Inskipp, 2007; Ali, 2012), and the shape of the fleshy white skin on the face (Takahashi *et al.*, 2008).

Field observations were also made on the nests, nesting and roosting sites, feeding habitats, and food

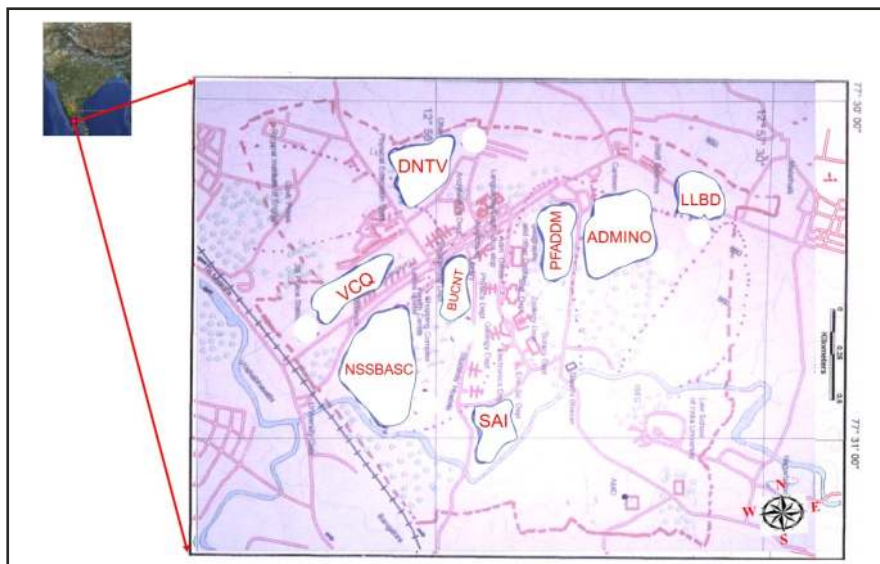


Fig. 1: Map showing the distribution of Indian Peafowls in Bangalore University Campus (study site in India is seen outset). NSSBASC - National Service Scheme Bhavana and Ambedkar Study Center; VCO - Vice Chancellor Quarters; BUCNT - Bangalore University Canteen; DNTV - Danavathrivana; SAI - Sports Authority of India; ADMINO - Administrative Office; LLBD - Department of Law (LLBD); PFADDM - Performing Arts-Dance, Drama and Music

sources of peafowls in BUC. Observations were made on natural predation of birds and their eggs. Call notes of female and male birds were used to locate them during observations. The mean number of birds in each site was assessed and used for further statistical analysis.

The population density (D) was calculated using the total number of birds (N) in a particular area (A) and was expressed as $D=N/A$ (Burnham *et al.*, 1981). Data on the occurrence, sex ratio, population density, and abundance of peafowls at different study sites were analyzed using the Chi-square test with PAST version 1.60 software (Hammer *et al.*, 2001).

Results and Discussion

A total of 117 peafowls were recorded from eight sites of BUC during the study period (Fig. 1 and Table 1). Similar population studies have been conducted at

several places in India (Yasmin, 1995; Dodia, 2001; Subramanian and John, 2001; Ajay, 2010; Hari Krishnan *et al.*, 2010; Rajeshkumar and Balasubramanian, 2011; Gurjar *et al.*, 2013; Jain and Rana, 2013; Mitaal, 2015; Ranjith and Jose, 2016). The findings of our study indicate that BUC campus has a higher number of peafowls than in any other urban areas of the Bengaluru region. This campus/ premises are best suitable for their existence with the availability of sufficient food and water resources, nesting, perching and roosting environs.

More numbers of males and females were found at National Service Scheme Bhavana and Ambedkar Study Center (NSSBASC) in BUC (Table 2) which could be due to the presence of an artificial feeding point (Fig. 2a). The sex ratio of peafowls varied at different sites of the BUC region. The peafowls were

Table 1: Description of study sites for surveys of *Pavo cristatus* in the Bangalore University Campus, India (January - June 2017).

| S.No. | Study sites with their acronyms | Details of sites (habitat) | Area (ha.) |
|-------|---|---|------------|
| 1 | National Service Scheme Bhavana and Ambedkar Study Center (NSSBASC) | Dense vegetation, grasses, fruit trees, water source (pond) | 4.583 |
| 2 | Vice Chancellor Quarters (VCQ) | Thin vegetation, high anthropogenic activities, surrounds hostels and staff quarters | 3.750 |
| 3 | Bangalore University Canteen (BUCNT) | Dense vegetation and high anthropogenic activities | 5.416 |
| 4 | Danavathrivana (DNTV) | Afforestation (medicinal plants and fruit producing plants) maintained by Karnataka Forest Department | 4.168 |
| 5 | Sports Authority of India (SAI) | Covers dense vegetation and passage of polluted Vrushabhavathi River | 1.660 |
| 6 | Administrative Office (ADMINO) | Thorny vegetation, some patches of bamboo bushes and eucalyptus plantation | 5.830 |
| 7 | Department of Law (LLBD) | Bushy vegetation, high anthropogenic activity, and wastes dumped from construction sites | 2.083 |
| 8 | Performing Arts-Dance, Drama and Music (PFADDM) | Sparse vegetation, vehicle disturbances, and human movements | 0.833 |

Table 2: Abundance, population density, and sex ratio of *Pavo cristatus* in different sites of Bangalore University Campus, India (January-June 2017).

| Sites | Mean no. of adults | | Nestlings | Total | % Abundance ^a | Population density index ^b | Sex ratio (Male: Female) ^c | Anthropogenic activities |
|---|--------------------|-----------|-----------|------------|--------------------------|---------------------------------------|---------------------------------------|--------------------------|
| | Males | Females | | | | | | |
| National Service Scheme Bhavana and Ambedkar Study Center (NSSBASC) | 15 | 26 | 5 | 46 | 39.32 | 8.58 | 37:63 | Moderate |
| Vice Chancellor Quarters (VCQ) | 3 | 5 | 0 | 8 | 6.84 | 1.82 | 38:62 | High |
| Bangalore University Canteen (BUCNT) | 3 | 4 | 0 | 7 | 5.98 | 1.10 | 43:57 | Low |
| Danavathrivana (DNTV) | 10 | 12 | 5 | 27 | 23.08 | 5.54 | 45:55 | Absent |
| Sports Authority of India (SAI) | 3 | 4 | 0 | 7 | 5.98 | 3.60 | 43:57 | Absent |
| Administrative Office (ADMINO) | 3 | 6 | 2 | 11 | 9.40 | 1.61 | 33:67 | Absent |
| Department of Law (LLBD) | 3 | 4 | 2 | 9 | 7.69 | 3.69 | 43:57 | High |
| Performing Arts-Dance, Drama and Music (PFADDM) | 2 | 0 | 0 | 2 | 1.71 | 2.05 | 01:00 | High |
| Total | 42 | 61 | 14 | 117 | 100.00 | - | 41:59 | - |

^a Abundance of peafowls in different sites was significantly different ($\chi^2=32.35$, $df=15$, $\chi^2_{15}(0.05) = 25$);

^b Population density of peafowls was not significantly different ($\chi^2=5.4501$, $df=15$, $P>0.05$);

^c Sex ratio of peafowls was not significantly different ($\chi^2=3.682$, $df=15$, $P>0.05$).



Fig. 2: Habitat association of *Pavo cristatus* in Bangalore University Campus, India.

a - Artificial feeding of grains; b - Food (rat carcass) remains after consumption by Indian Peafowl; c - Eggs laid in simple ground nest surrounded by grasses; d - Artificial water source

found feeding on both plant and animal sources (Fig. 2b) in the BUC (Table 3). The peahens constructed simple nests using long grasses for laying eggs (Fig. 2c). The peafowls used 18 species of trees for roosting in BUC (Table 4). The probable reason for such high mobility could be due to the dry vegetation, and low levels of food availability, forcing peafowls to move a lot to forage, and meet out their food requirements. Also, Indian Peafowl uses undergrowth thickets of shrub and bushes during mid-day to avoid the heat of the sun (Ali and Ripley, 1987). Indian peafowls favoured *Acacia* spp. as for roosting because they are sexy, they afford a multi-directional view, they generally grow close to water and in bushy undergrowth, and their first branch is at a maximum preferred height above ground (Rajeshkumar and Balasubramanian, 2011). All these factors help peafowls to escape from predators. Indian peafowls roosted at a height ranging from 07-22 m, favouring a range between 10-13 m as reported by earlier (Rajeshkumar and Balasubramanian, 2011).

Based on our observations, we suggest some measures for the conservation and welfare of the population of peafowls in BUC:

- Whenever there is a scarcity of natural food and water sources at different sites in BUC, peafowls may be provided with grains (wheat/pulses) and water artificially (Fig. 2d).
- Forest fire, cutting of trees, firewood collection, and dumping of garbage, plastic wastes, and waste materials from construction sites must be strictly avoided in the BUC.
- Grazing of cattle, goats, and sheep should be avoided during the period of peafowl breeding for the conservation of grasses that are used for nesting (Rajashekara and Venkatesha, 2017a, 2017b).

Our preliminary conversation with local stakeholders indicates that people and our institution are willing to support such a restoration initiative in this area. Along with researchers, forest managers and local

Table 3: List of food sources (plants and animals) consumed by *Pavo cristatus* in different sites of Bangalore University Campus, India (January-une 2017).

| | Family | Scientific name | Common name | Part consumed |
|-----------------------|--------------------------|--------------------------------|----------------|------------------------|
| Plant sources | | | | |
| 1 | Anacardiaceae | <i>Mangifera indica</i> | Mango | Fruits |
| 2 | Fabaceae | <i>Tamarindus indica</i> | Tamarind | Fruits |
| 3 | | <i>Artocarpus integrifolia</i> | Jackfruit | Fruits, seeds, flowers |
| 4 | Moraceae | <i>Ficus bengalensis</i> | Banyan Tree | Fruits, leaves |
| 5 | | <i>Ficus glomerata</i> | Ficus | Fruits |
| 6 | | <i>Ficus religiosa</i> | Ficus | Fruits |
| 7 | Muntingiaceae | <i>Muntingia calabura</i> | Chinese Cherry | Fruits |
| 8 | Rutaceae | <i>Murraya koenige</i> | Curry Leaf | Fruits |
| 9 | Euphorbiaceae | <i>Phyllanthus emblica</i> | Gooseberry | Fruits, flowers |
| 10 | Santalaceae | <i>Santalum album</i> | Sandal Wood | Fruits |
| 11 | Fabaceae | <i>Cassia accidentalae</i> | Cashewnut | Flowers |
| Animal sources | | | | |
| 12 | Formicidae: Ants | | | |
| 13 | Termitidae: Termites | | | |
| 14 | Orthoptera: Grasshoppers | | | |
| 15 | Araneae: Spiders | | | |
| 16 | Coleoptera: Beetles | | | |
| 17 | Diplopoda: Millipedes | | | |
| 18 | Oligochaeta: Earthworms | | | |

Table 4: Perching plants of *Pavo cristatus* in different sites of Bangalore University Campus, India (January June 2017).

| | Common name | Scientific name |
|----|-------------------------|--------------------------------------|
| 1 | Bamboo | <i>Bambusa sp.</i> L. |
| 2 | Neem | <i>Azadirachta indica</i> A. Juss |
| 3 | Jamun | <i>Syzgium cumini</i> (L.) Skeels. |
| 5 | Tamarind | <i>Tamarindus indica</i> L. |
| 6 | Teak | <i>Tectona grandis</i> L.f. |
| 7 | Indian Sandalwood | <i>Santalum album</i> L. |
| 8 | Champak | <i>Michelia champaca</i> L. |
| 9 | Earleaf Acacia | <i>Acacia leucophloea</i> Willd. |
| 10 | Mango | <i>Mangifera indica</i> L. |
| 11 | Banyan | <i>Ficus bengalensis</i> L. |
| 12 | Jack Fruit | <i>Artocarpus integrifolia</i> L. |
| 13 | Rosewood | <i>Dalbergia sisso</i> L. |
| 14 | Custard Apple | <i>Annona sqomosa</i> L. |
| 15 | Curry Leaves | <i>Murraya koenigi</i> (L.) Sprengel |
| 16 | Eucalyptus | <i>Eucalyptus globulus</i> Lab. |
| 17 | Coconut | <i>Cocos nucifera</i> Linn. |
| 18 | Indian Beech or Karanja | <i>Pongamia pinnata</i> (L.) Pierre |

institutions as well as local community participation, this will emerge as one of the successful, action-oriented and policy-driven projects in this campus. Moreover, such initiatives bring confidence among local stakeholders regarding conservation. At the time of unprecedented habitat destruction, such interventions will contribute not only towards reduced emissions from deforestation and forest degradation but also enhance carbon stocks in degraded forests.

This premises surveyed for the avian communities and other wildlife monitoring should be made sporadically; encroachment for developing infrastructure should be improved by adopting vertical multistoried instead of several horizontal buildings; ancient trees standing in these green patches should be identified and conserved; should be afforested with nectar-yielding flower plants and fruit-yielding local tree species (Rajashekara and

Venkatesha, 2017a, 2017b). The important efforts should be made to understand the habitat and population status of the species through long term monitoring research and *in situ* conservation projects.

बंगलौर विश्वविद्यालय परिसर, बंगलूरू, कर्नाटक, भारत में भारतीय पीफाउल पावो क्रिस्टेटस (एवीस : गैलिफॉर्मीस : फेजिएनिडा) का संरक्षण स्तर

एस. राजशेकरा, एन. आनन्दा, एस.अमूल्या, एम. भाग्यश्री, नजमा खानम, व्हाई प्रथिभा, शाहिस्ता इमराज, आर.एस. सौम्याश्री, वी.हमसा रेखा, डी.एस. विजयालक्ष्मी और एम.जी. वेंकटेशा

सारांश

इंडियन पीफाउल, *पावो क्रिस्टेटस* बंगलौर विश्वविद्यालय परिसर में 1970-80 के दौरान प्रचुर मात्रा में थी। तथापि, 1990 के बाद बंगलौर विश्वविद्यालय परिसर क्षेत्र में पीफाउल आबादी गंभीर रूप से घटी है। इस शोधपत्र में बंगलौर विश्वविद्यालय परिसर के जैवविविधता पार्क (जैव पार्क), जिसे 2006 में स्थापित किया गया था, में पीफाउल की प्रचुरता, लिगानुपात और इनकी संरक्षण विधियों पर विचार किया गया है। बंगलौर विश्वविद्यालय परिसर क्षेत्र में कुल 117 पीफाउल अभिलिखित किए गए, जिसमें मादाए नरों से संख्या में अधिक थी। परिसर में पीफाउल आबादी की वर्धित प्रचुरता मुख्यतः उपयुक्त बसेरा, चारा और नीडन स्थलों की उपलब्धता के कारण हो सकती है। पीफाउलों ने बंगलौर विश्वविद्यालय परिसर में बैठने और बसेरे के लिए पादपों और वृक्षों को 18 प्रजातियों का उपयोग किया। आवास पुनरुज्जीवन और संरक्षण, खाद्य संसाधनों और प्रजनन/नीडन स्थलों की उपलब्धता के कारण बंगलौर विश्वविद्यालय परिसर क्षेत्र में पीफाउल आबादी बढ़ी। वर्तमान अन्वेषण के परिणाम शहरी पारितंत्र की जैवविविधता के लिए हाटस्पॉटों के रूप में संरक्षित आवासों में राष्ट्रीय पक्षी के पारिस्थितिकीय समुदाय को ज्यादा समझने के लिए आधाररेखा आँकड़ों का निर्माण करते हैं। बंगलौर विश्वविद्यालय परिसर में

वनस्पति सहित तालाबों, सरिताओं और जल बांधों के उचित पुनरूद्धार के जरिए सूक्ष्म आवासों के संरक्षण पीफाउल आबादी के अस्तित्व के लिए उत्तरदायी हैं।

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