Habitat preference of Indian peafowl (*Pavo cristatus*) in selected areas of Palakkad district, Kerala, India

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The Indian peafowl (*Pavo cristatus*), a species of national importance, remains unstudied in major habitats of Kerala as well as the country as a whole. In Kerala, peafowl population is on the increase; they are now becoming an unconventional pest among the farmer community and an indicator species of change in climatic conditions. It has been estimated that peafowl show preference towards some habitats. Identification of their habitat preference by vegetation analysis will be effective in reducing the conflicts between man and bird with proper intervention.

Keywords: Habitat preference, peafowl, population analysis, vegetation analysis.

PEAFOWL include two Asiatic species, namely Blue (Indian) peafowl (*Pavo cristatus*) and Green peafowl (*Pavo muticus*), and an African species, viz. Congo peafowl (*Afropavo congensis*).

Indian peafowl – declared as the National Bird of India in 1963 due to its 'flagship' value – is the largest among pheasants[1]. Peacocks (term used to denote male birds) have large body size and plumage which is stunningly coloured with a long and heavy train of feathers. This brilliantly coloured train – which visibly seems to be a burden for the bird and is likely to attract predators, has perplexed the scientific community. The 'handicap hypothesis' of Zahavi[2], explains that this long train of feathers is the criterion for sexual selection by females[3]. Indian peafowl are mainly seen in the tropical forests of the country[4]. They are known to occupy scrub jungles and forest fringes, preferably in moist, dry deciduous and in semiarid zones[1]. Regions close to agricultural fields, stream sides[5], good vegetation and human habitation in semi-wild conditions are also preferred[6]. This preference of peafowl for crop fields has given them a pest status. Selection of scrubs and open areas is for 'dust bathing' and 'lekking', phenomena by which the males engage in display to attract females[7]; sexual selection is based on the choice of the females defending on these displays[8].

Even though there is a healthy population of peafowl in different parts of the country, very few studies have been done on their population, ecology and the threats they face[1,9], especially in Palakkad, Kerala. So the status of the peafowl population of this area is not well known.

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Vegetation analysis was done during May and June 2015. Quadrate method was used as it is one of the most preferred methods in plant analysis. Line transects were laid across the study area using a rope. Quadrates of size 20 × 20 m were marked on both sides of the line transect after every 100 m.

Plants with girth at breast height (GBH) above 15 cm were considered as trees. The clump of plants with the sum of GBH above 15 cm was also considered as trees. These two categories contribute to the overall tree canopy. Plants with GBH less than 15 cm which do not contribute to the overall tree canopy were considered as shrubs.

GBH was measured only for the trees. In case of shrubs each of the quadrates was again divided into four sub quadrates of size 10 × 10 m for further analysis.

Importance value index (IVI) was calculated for all tree species. This is the sum of relative frequency, relative abundance and relative density, and is an index representing the importance of each species in the habitat.

Family importance value (FIV) was calculated for each family. This is the sum of family relative density, family relative diversity and family relative dominance and is an index representing the importance of each family in a habitat.

Bird sampling was done using several methods based on the species, habitat and terrain type. Selection of a particular method is based on the usefulness, efficiency and the study goals[10]. For analysing population density of the peafowl line transect method was used. This is because the method has been in use since 1930s (ref. 11) and is more practical, efficient, inexpensive and is applicable for round-the-year observations. Predetermined distance was walked along the line transect laid through the study area at a fixed speed and the birds were recorded. Recording was done as the activity observation number, that is, an observation number denoted an observation for 5 min using a field diary and stopwatch. Activity of a bird during an observation was noted. An hour consisted of 12 observation numbers. Activities were grouped under walk, feed, preen, display, run, stand, fly, sit and call.

Walk: Slow pace unless disturbed.
Feed: Forage mostly by picking from ground or from vegetation.
Fly: Mostly for roosting and to change the site of feeding, usually covering short distances.
Preen: Slightly opening the beaks and running it through the feathers, mostly during rest.
Sit: Preferably on trees of 10–15 m height or under heavy thickets during midday[12].
Call: Loud call like 'he – on' followed by short calls, repeated 5–7 times, mostly by males.
Display: Semicircular movements by males displaying and vibrating train feathers.

Table 1. Girth at breast height analysis at Chittur, Kerala

Scientific name	∑GBH	BA	P	N	F%	A	D	RF	RA	RD	IVI
Azadirachta indica	2.32	0.13	3	4	50.00	1.33	0.67	0.5	2.26	0.04	2.8
Eucalyptus citriodora	10.71	0.64	1	16	16.67	16.00	2.67	0.17	27.08	0.18	27.40
Morinda pubsecens	2.37	0.04	4	11	66.67	2.75	1.83	0.67	4.65	0.12	5.44
Butea monosperma	0.72	0.04	1	1	16.67	1.00	0.17	0.17	1.69	0.01	1.87
Samanea saman	9.86	0.87	1	9	16.67	9.00	1.50	0.17	15.23	0.10	15.50
Bridelia retusa	2.91	0.14	1	6	16.67	6.00	1.00	0.17	10.16	0.07	10.40
Tamarindus indica	1.10	0.10	1	1	16.67	1.00	0.17	0.17	1.69	0.01	1.87
Tectona grandis	21.33	0.96	2	42	33.33	21.00	7.00	0.33	35.55	0.50	36.40
Mangifera indica	0.48	0.02	1	1	16.67	1.00	0.17	0.17	1.69	0.01	1.87

BA, Basal area; P, No of plots species occurred; N, No. of individuals of the species; F%, Frequency percentage; A, Abundance; D, Density; RF, Relative frequency; RA, Relative abundance; RD, Relative density; IVI, Importance value index.

Table 2. Girth at breast height analysis at Chulanur, Kerala

Scientific name	∑GBH	BA	P	N	F%	D	A	RF	RA	RD	IVI
Acacia auriculiformis	3.00	0.14	3	6	60	1.20	2.00	0.60	2.32	0.03	2.95
Azadirachta indica	0.30	0.007	1	1	20	0.20	1.00	0.20	1.16	0.004	1.36
Bambusa bambos	15.38	2.58	3	116	60	23.20	38.70	0.60	44.83	0.50	45.93
Anacardium occidentale	0.16	0.002	1	1	20	0.20	1.00	0.20	1.16	0.004	1.36
Cassia siamea	4.30	0.16	3	10	60	2.00	3.33	0.60	3.86	0.04	4.50
Xylia xylocarpa	7.53	0.17	4	29	80	5.80	7.25	0.80	8.4	0.11	9.31
Eucalyptus citriodora	2.45	0.12	2	4	40	0.80	2.00	0.40	2.32	0.02	2.74
Ficus religiosa	0.20	0.003	1	1	20	0.20	1.00	0.20	1.16	0.004	1.36
Dalbergia latifolia	0.18	0.003	1	1	20	0.20	1.00	0.20	1.16	0.004	1.36
Leucaena leucocephala	9.45	0.47	4	17	80	3.40	4.25	0.80	4.92	0.07	5.79
Morinda pubsecens	0.99	0.02	3	4	60	0.80	1.33	0.60	1.54	0.02	2.16
Bombax ceiba	1.48	0.06	3	3	60	0.60	1.00	0.60	1.16	0.01	1.77
Syzygium cumini	0.20	0.003	1	1	20	0.20	1.00	0.20	1.16	0.004	1.36
Careya arborea	0.17	0.002	1	1	20	0.20	1.00	0.20	1.16	0.004	1.36
Pterocarpus marsupium	1.29	0.07	2	2	40	0.40	1.00	0.40	1.16	0.01	1.57
Tamarindus indica	0.92	0.02	1	4	20	0.80	4.00	0.20	4.63	0.02	4.85
Pongamia pinnata	5.89	0.11	2	27	40	5.40	13.50	0.40	15.64	0.12	16.16
Terminalia paniculata	4.15	0.26	3	6	60	1.20	2.00	0.60	2.32	0.03	2.95

Recording was done in those hours when the activity of the birds was high, during dawn and dusk[13]. It varied according to conditions in different sites, but mostly it was scheduled between 6.30 and 9.30 am as well as 4.30 and 6.30 pm.

The software, Estimator 700 was used for plotting the species accumulation curves of the sites[14].

In Chittur, the trees observed belong to nine genera and eight families (Table 1). Among them, *Tectona grandis* is more dominant and important, with high IVI (36.40). The species has more number of individuals (42) and relative abundance (35.55). However, its frequency of occurrence is less than *Morinda pubsecens* (66.67) and *Azadirachta indica* (50), due to its presence only in two plots, whereas the other two are present in four and three plots respectively. Next is *Eukalyptus citriodora* with IVI of 27.40 and 16 individuals with an abundance of 27.08, but its frequency of occurrence is restricted only to one plot. *Samanea saman* holds more basal area in comparison with the number of individuals[9].

In Chulanur, the trees observed belong to 18 genera and 10 families (Table 2). Among them, *Bambusa bambos* dominates with more number of individuals (116). It is an important species, with high IVI of 45.93. This is followed by *Pongamia pinnata* with IVI of 16.16 and 27 individuals, but occurring only in 2 plots. In the case of *Xylia xylocarpa*, 29 individuals are present, but they are spread across 4 plots which decreases their abundance. *X. xylocarpa* and *Leucaena leucocephala* which are found in four plots hold more frequency percentage (80).

In Pullode, the trees observed belong to 15 genera and 11 families (Table 3). Among them, more number of individuals (83) and high IVI (50.80) is found for *Musa* sp. This is followed by *L. leucocephala* with IVI of 9.85; only 8 individuals are present, but all exist in a single plot, thus increasing their abundance. *T. grandis* is found in four plots and holds more frequency percentage (66.67).

Family analysis of vegetation from Chittur shows that Lamiaceae holds more relative density (46.15), relative dominance (32.66%) and high FIV (89.92), whereas

Table 3. Girth at breast height analysis at Pullode, Kerala

Scientific name	∑GBH	BA	N	P	F%	D	A	RF	RA	RD	IVI
Areca catechu	1.37	0.03	6	2	33.33	1.00	3.00	0.33	3.61	0.04	3.98
Azadirachta indica	0.75	0.009	5	2	33.33	0.83	2.50	0.33	3.00	0.03	3.36
Cocos neucifera	2.79	0.10	6	2	33.33	1.00	3.00	0.33	3.61	0.04	3.98
Gliricidia sepium	0.61	0.01	3	1	16.67	0.50	3.00	0.17	3.61	0.02	3.80
Acacia sp.	0.42	0.007	2	1	16.67	0.33	2.00	0.17	2.40	0.01	2.58
Dalbergia latifolia	1.60	0.10	2	1	16.67	0.33	2.00	0.17	2.40	0.01	2.58
Mangifera indica	2.63	0.19	3	3	50.00	0.50	1.00	0.50	1.30	0.02	1.82
Morinda pubsecens	1.93	0.04	8	3	50.00	1.33	2.67	0.50	3.20	0.05	3.75
Musa sp.	26.92	0.70	83	2	33.33	13.83	41.50	0.33	49.90	0.52	50.80
Bombax ceiba	0.32	0.008	1	1	16.67	0.17	1.00	0.17	1.20	0.006	1.38
Strychnos nuxvomica	0.52	0.02	1	1	16.67	0.17	1.00	0.17	1.20	0.006	1.38
Syzygium cumini	0.64	0.009	4	1	16.67	0.67	4.00	0.17	4.82	0.03	5.02
Tectona grandis	11.58	0.54	26	4	66.67	4.33	6.50	0.67	7.80	0.16	8.63
Terminalia paniculata	1.25	0.07	2	1	16.67	0.33	2.00	0.17	2.40	0.01	2.58
Leucaena leucocephala	1.73	0.03	8	1	16.67	1.33	8.00	0.17	9.63	0.05	9.85

Fabaceae holds more relative diversity of species (22.22%).

At Chulanur, Poaceae holds more relative density (49.57%), relative dominance (61.38%), and FIV (116.51), but less diversity. Fabaceae also holds more relative diversity than other families (44.40%).

At Pullode, Musaceae holds more relative density (51.88%), relative dominance (37.57%) and high FIV (96.12), but less diversity. Fabaceae holds more diversity (26.67%).

Figure 1 *a–c* shows the species accumulation curves at Chittur, Chulanur and Pullode respectively.

Figure 2 shows girth class distribution at the three sites. In Chittur, girth class 40–60 holds more number of individuals but the girth class 20–40 holds more species diversity. In Chulanur, the number of individuals belonging to girth class less than 20 is dominant in number, but girth class 20–40 holds more species diversity. In Pullode, girth class 20–40 holds more number of individuals as well as species diversity.

Shrub analysis at Chittur shows that the family Arecaceae holds more number of individuals (47), abundance (7.83) and density (1.96), but holds less frequency percentage, whereas *M. pubsecens* has more frequency (58.33), and is found in more number of plots.

At Chulanur, the family Fabaceae holds more number of individuals (44), abundance (3.17), density (1.10) and diversity (35%), but *X. xylocarpa* is found in more number of plots, while *A. auriculiformis* holds more abundance.

At Pullode, *A. auriculiformis* holds more individuals (9) and density (0.38). It also shows high frequency along with *T. grandis* and *M. pubsecens* (16.67).

Average of the overall population analysed during May (Figure 3) shows that in Pullode the male : female ratio is nearly 1 : 2, but in Chittur it is exactly 1 : 2 and in Chulanur it is close to 1 : 2. Number of sub adults and young ones is more in Pullode than in the other two sites, which indicates an increasing population. Standard deviation is more in females in all cases. This shows that the number of females varies each time. Indian peafowl are found to be polygynous and hold 2–3 breeding peahens in the harem[15]. Size of the harem also varies according to the local conditions. Studies have reported that due to small breeding territory, peafowl do not defend their harem in some cases[16].

Average of the overall population analysed during June (Figure 4) shows that in Pullode the male : female ratio is above 1 : 3, which shows an increase in population in comparison with that of May. In Chulanur, there is a small progress in the sex ratio and in the number of sub adults. In Chittur, there is a small decrease in the sex ratio, and increase in the number of sub adults and young ones. As in the case of May, standard deviation is high for the females with regard to other categories.

Activity observations during May (Figure 5) show that in Chittur, activity time of males, females, sub adults and young ones is consumed by walk, followed by feed, except males which preen between walk and feed.

Observations from Chulanur show that males consume most of the activity time for stand and preen; their activities are restricted in walk, run and fly. Females consume most of the activity time for walk, followed by feed, stand, run, preen and fly. Most of the activity time of sub adults is consumed by walk, followed by feed, stand, run and preen.

Observations from Pullode show that males, females, sub adults and young ones consume most of their activity time for walk followed by feed. Males also concentrate on display.

Activity observed in June (Figure 6) shows that in Chittur, males consume most of their activity time for walk, run and display, followed by stand, feed, preen and call. In case of females, sub adults and young ones, it is walk followed by feed.

Observations from Chulanur show that males consume most of the activity time for walk followed by preen; while for females and sub adults, it is walk and feed.

Observations from Pullode show that males consume more activity time for walk followed by preen. Feed and display also consume a major share of their activity time.

Stand structure analysis is one of the simplest and common methods for analysis of vegetation of a particular area. Results of stand structure analysis vary depending upon the topography, climatic conditions and rate of anthropogenic interaction.

In the present study, vegetation analysis shows that Pullode is the site where more diverse habitats are found, but number of species is less here than the peafowl sanctuary. This might be due to the presence of paddy, ginger and plantain fields in the study area, where other unwanted species of plants are removed. Mixed plantations cover most of the study site, resulting in increase in the number of individuals of the selected species and decrease in species diversity. Since the plantations are of teak, coconut and areca nut, and shrub growth does not influence tree growth, scrubs were developed between the trees. *Musa* sp. is an important species with high IVI[17], while Musaceae is the important family with high FIV. The borders of the plantations merge with the banks of the local Gayathri river, where land acquisition and clearing

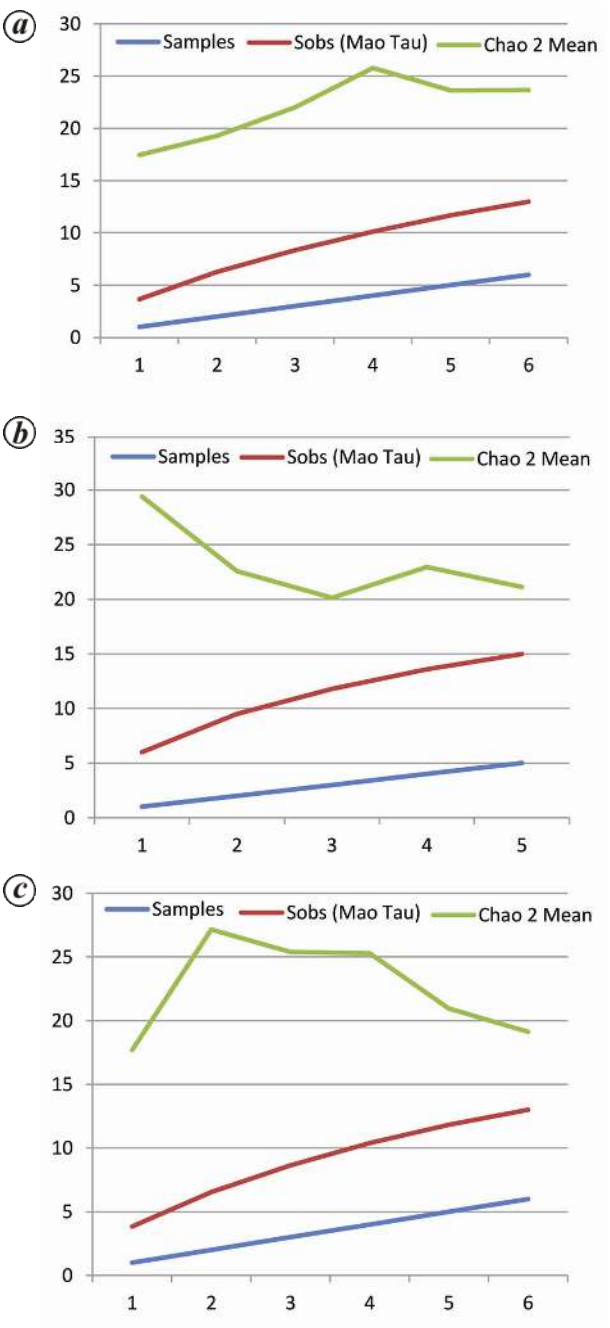

Figure 1. Species accumulation curves at (***a***) Chittur, (***b***) Chulanur and (***c***) Pullode.

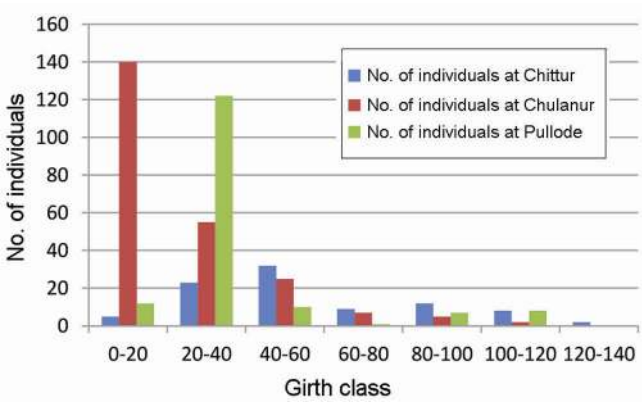

Figure 2. Girth class distribution at the sites.

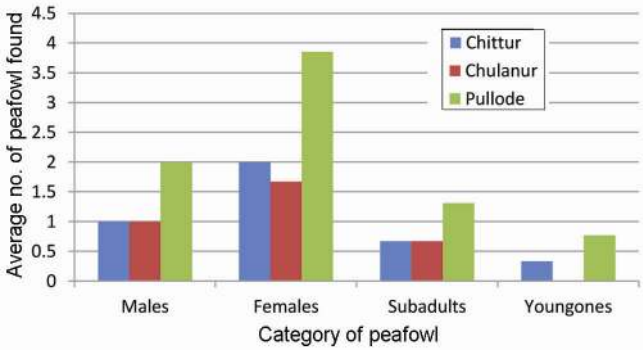

Figure 3. Population analysis in May.

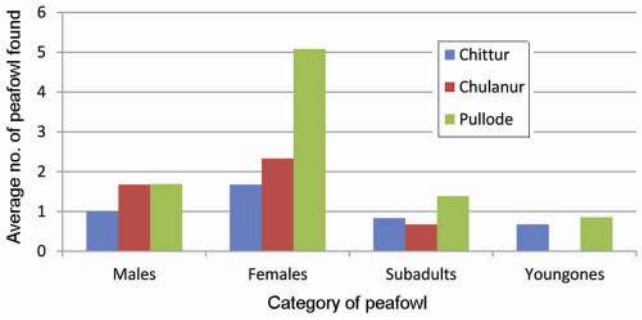

Figure 4. Population analysis in June.

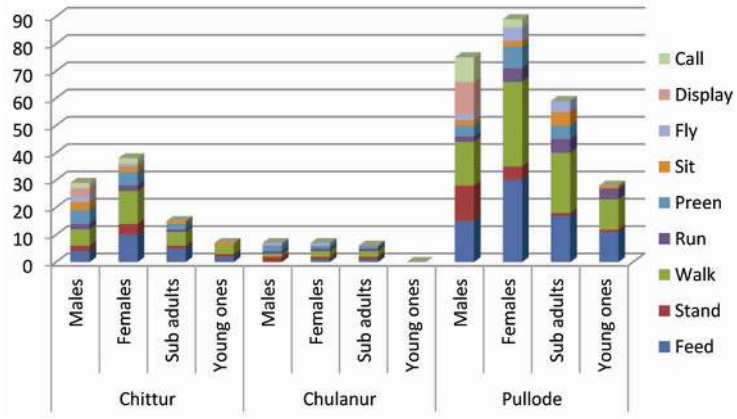

Figure 5. Activity observed in May.

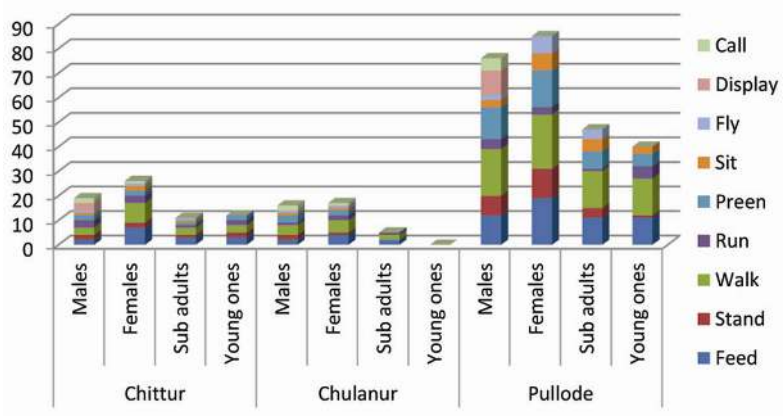

Figure 6. Activity observed in June.

is not permitted; this leads to thick growth of bushes. Open plain fields covered with grass are also present in the study area, which are suitable for foraging, display, dust bath, etc. of the birds.

Chulanur is the protected sanctuary area with no anthropogenic interference. This results in the persistence of all kinds of trees and shrubs in the area increases the species number. *B. bambos* is the important species and Poaceae is the important family. Diversity in the forest types is not seen in the study area located within the boundaries of the sanctuary. Paddy fields are located about 1 km away from the sanctuary area. Plain grasslands are almost absent in the study area.

Chittur college campus is a forest patch where the forested area under the control of the Government merges with private property. Disturbances are seen in the private area. Diversity in vegetation types is less. Since it is confined within the campus premises, species diversity is less but the number of individuals is high compared to the total area. *T. grandis* is the important species and Lamiaceae is the important family. Forested area of the campus merges with the local Sokanashini river, but the abundance of human settlements on the riverbanks reduces the chance of spreading of the shrubs. Also the catchment area of the river in the region is comparatively less.

Vegetation type diversity and the number of peafowl observed are found to be related. They need scrubs to breed, huge trees to roost and fields to forage[18]. Pullode, the site where more diverse vegetation is seen, holds more number of peafowl observations than the other sites. Diversity of habitat results in an increase in the availability of food, both in the form of diverse prey as well as crops. Peafowl abundance is also dependent on the prey density and biomass[1]. With the area located away from direct anthropogenic disturbances, lack of predators and competing species, there is increase in the number of peafowl. Movement towards the crop fields from natural habitat might have resulted in the increase in the number of birds during the study period. At the same time, the study area consists of adequate scrubs and tall trees amidst the plantation and crop fields suitable for their breeding, feeding, resting and roosting. This diminishes their chance to move away from the study area, thus increasing the frequency of encounter during our visits.

In Chulanur Peafowl Sanctuary, a semi-deciduous forest, the peafowl count was estimated to be around 200; which is less than that in Pullode. The sanctuary does not

have any crop fields within its boundaries, but the birds are found at a distance of about 1 km. Thus the birds move away from the sanctuary for food, which decreases the probability of frequency of encounter during our visits, resulting in negligible increase in the observations during May and June. More number of peafowl were observed nearby paddy fields, which validates their affinity towards crop fields.

Peafowl count from Chittur college campus was found to be lower than that of the other two sites. This might be due to the increased human interactions such as increased rate of logging and occasional clearing of bushes. Also, construction work in the college campus might have resulted in a temporary decrease in their frequency. Possibility of movement away from the natural habitat towards the surrounding crop fields as in the case of the Chulanur study site is high here, because paddy fields are present around 1–2 km away from the campus.

In all cases the standard deviation values of females are found to be higher than others. This may be due to the movement of peafowl within the region, especially females which are more in number, and also variations in harem size and the nature of not defending the harem due to small breeding territory.

The study areas of Chulanur, Chittur and Pullode have similar climatic conditions, cultivation trends and human interactions. There are some common issues which should be managed for the conservation of peafowl.

1. Intensive research is needed to determine the habitat requirements of peafowl[19].
2. An educational initiative should be launched with the aim of creating awareness among local people and reduce hunting.
3. The peacock population has come down over the years in many parts of Kerala, mainly due to stray dogs[13,18]. So effective birth control programmes should be carried out to control the dog population.
4. Crop damage by peafowl is a major concern among the farmers. As a result, the peafowl is considered as a pest in this region[20]. To avoid this situation proper compensation is to be provided by the Forest Department to the farmers facing losses due to the birds.

Thus, habitat with more diverse vegetation was found to be preferred by the peafowl. Abundance of feeding ground is important for their number to increase. The birds were seen to move out of their natural habitats preferring crop fields, leading to increase in population at Pullode and decrease at Chulanur and Chittur. Presence of more number of sub adults and young ones at Pullode than in other sites, shows that there is a good chance of increase in bird population in future at Pullode. At Chittur the population may show a decline. Since it is a highly protected sanctuary, Chulanur may show a natural increase in bird population if the seasonal changes are excluded.

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