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Density of the Indian Peafowl *Pavo cristatus* and Red Junglefowl *Gallus gallus* (Galliformes) in Similipal Tiger Reserve, Odisha, India

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Abstract
We used line transect method to estimate the density of the Indian Peafowl *Pavo cristatus* and Red Junglefowl *Gallus gallus* in the Similipal Tiger Reserve, Odisha, India during May and November 2016. Each forest beat was taken as sampling unit. Transect lines of 2km distance laid in the intensive study area. Each transect was covered three times (total 738km) during pre-monsoon (May) and post-monsoon (November) of 2016. Transects were walked early in the morning in the first two hours after the sunrise when usually birds are most active. Totally 75 transect lines were covered in a random sampling method.

1. Introduction

Development of reliable methods for estimating abundance is a prerequisite for assessing a species conservation status (Conroy & Caroll 2001). Galliformes are useful indicators of environmental quality and the assessment of their status is essential for management purposes (Fuller & Garson 2000). Providing an understanding of the abundance and distribution of bird species is fundamental to successful conservation management (Conroy & Noon 1996). Few data exist for the majority of Galliformes, which constitute one of the most threatened bird families in the world. Monitoring the population status of wild animal forms an important component of conservation effort and effective wildlife management. It provides information on the status of wildlife population and can help evaluating effective conservation actions, thereby allows for adaptive management (Williams *et al*. 2002).

Large or medium-sized ground dwelling birds such as the Red Junglefowl *Gallus gallus* play an important functional role in ecosystems, including dispersing seeds and controlling insect pests (Arshad *et al.* 2000) and serving as prey for large or small carnivores (Borah *et al* 2009, Hayward *et al.* 2012). Furthermore, the Red Jungle fowl is very sensitive to forest fires as its ground nesting period coincides with forest fire in the tropical forests of India (Javed & Rahmani 2000). Therefore, monitoring the population of Red Junglefowl is crucial for conservation and forest management through conserving its habitat. Despite its wide distribution in India, very few studies have been conducted on the Red Junglefowl and these mainly relate to abundance and conservation status (Ferrnandes *et al*. 2009; Subhani *et al.* 2010; Harihar & Fernandes 2011) and habitat use (Javed & Rahmani 2000).

The Indian Peafowl *Pavo cristatus* also Known as the Blue Peafowl is the national bird of India and comes under Schedule-1 of the Indian wildlife Protection Act, 1972. This bird is listed as Least Concern (LC) by the International Union for Conservation of Nature (IUCN). The Indian Peafowl is terrestrial bird and a resident breeder across the Indian subcontinent and is found mainly on the ground

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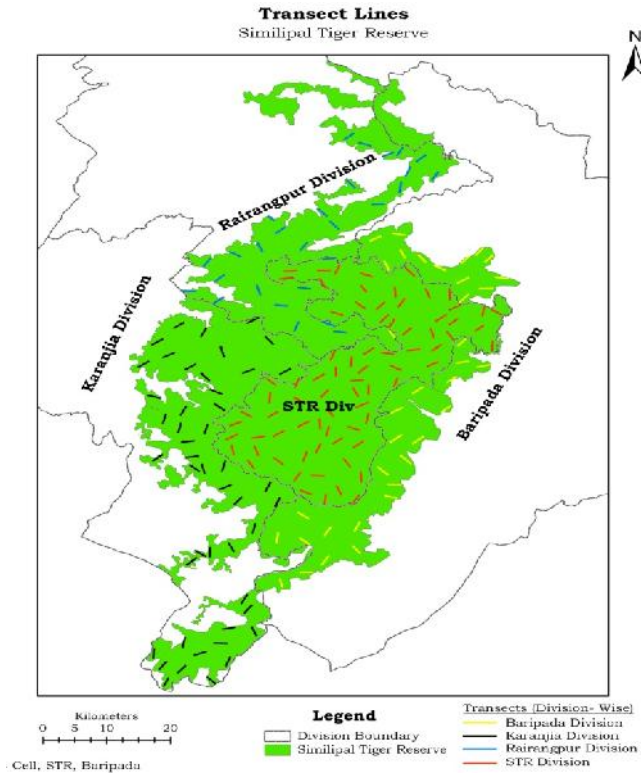

Fig.1. Map showing the study area and line transect in Similipal Tiger Reserve.

Fig. 2. Red Junglefowl captured during camera trap exercise.

Fig. 3. Peafowl captured during the camera trap exercise.

in dry and semi-desert areas and forests. It roosts in trees or other high places at night. Peafowls are omnivorous and eat seeds, fruit, insects, small rodents and reptiles (such as snakes and lizards). Male Indian Peafowls show characteristics such as colorful tail feathers or train during breeding season. Its train makes the male peafowl one of the largest flying birds in the world. Their loud calls make them easy to detect and in forest often indicate the presence of a predator such as a tiger.

2. Materials and Methods

2.1. Study area

Similipal Tiger Reserve (Fig. 1) located in the Mayurbhanj District of Odisha and spreads over 2,750 km^2 of the Chotanagpur plateau. The park is surrounded by high plateaus and hills, the highest peak being the twin peaks of Khairiburu and Meghashani (1,515 m above sea level). At least 12 rivers cut across the plain area, all of which drain into the Bay of Bengal. An astounding 1,078 species of plants including 94 species of orchids find their home in the tiger reserve. It hosts 55 species of mammals, 304 species of birds, 60 species of reptiles, 21 species of frogs, 60 species of fishes and 164 species of butterflies that have been recorded from the park. The core area comprises of ranges with an area of 1,194.75 km^2 (Nayak *et al* 2014). The core area comprises of ranges with an area of 1,194.75 km^2. The landscape of Similipal encompasses numerous rolling hills covered with tropical semi-evergreen forest, tropical moist deciduous forest, dry deciduous hill forest, highland forest and Savannah. The climate of Similipal is tropical. Three distinct seasons are experienced inside the Similipal during the year. The annual rainfall ranges from 1,200 to 2,000 mm. The temperature varies from 5 to 40°C. The southern and western portions are cooler whereas north-eastern portion is warmer.

2.2. Methods

Field sampling was carried out during May and November in 2016 in an area of 1,194.75 km^2 within the tiger reserve. Data were collected by

field staff of the tiger reserve. We used a Distance Sampling line transect method to estimate population of the Indian Peafowl (Anderson *et al.* 1979; Burnham *et al.* 1980; Buckland *et al.*1993). Within forest areas a beat was considered as the sampling unit and transects of 2km length were studied in each beat.

Since beats are spread out the entire protected area, this transect lay out design allows for sampling across all habitat types within the protected area (Jhala *et al.* 2009). A total of 75 permanently marked transects were studied in 75 beats of seven ranges of Similipal Tiger Reserve. Sighting angles of Indian Peafowl and Red Junglefowl (Figs. 2−3) were recorded using a hand-held compass.

2.3. Data analysis

Line Transects data were analysed using DISTANCE 6.0 software (Thomas *et al.* 2009). This software enables the computation of detection probability for the sighting records obtained during the field transect surveys (Buckland 1985; Buckland *et al.* 1993, Karanth & Nichols 2002). Four key functions (uniform, half-normal, hazard rate and negative exponential, all with cosine series adjustment) were considered for the analysis. Key function selection was evaluated using Akaike's Information Criteria (AIC) and Chi-squared statistics were used to assess the goodness of fit of each function (Burnham *et al.* 1980; Buckland *et al.* 1993).The distribution of data was first examined by assigning very small cut-off points to the distance intervals during the curve fitting to detect evidences of evasive movements by fowls. After choosing convenient cutoff points for the distance intervals, the best key function with the appropriate adjustment term was selected using the criterion of the lowest AIC.

3. Results

During the surveys, pre-monsoon (May 2016) density of the Indian Peafowl was estimated 4.55±0.69 km^2 and during the post-monsoon (November 2016) 3.43±0.73 km^2 (Figs. 4−5). Similarly during the surveys, pre-monsoon (May 2016) density of the Red Junglefowl was estimated 5.62±1.59 km^2 and during the post-monsoon (November 2016) 4.33±1.88 km^2 (Figs. 6−7).

Distance sampling methodology has been used to estimate the density of Grey Junglefowl in many protected areas in India (Ramesh *et al.* 2011; Selvan & Sridharan 2012; Narasimmarajan *et al.* 2012). The variation of results of density in different studies could be influenced by many factors such as season, annual variations and differences by observers.

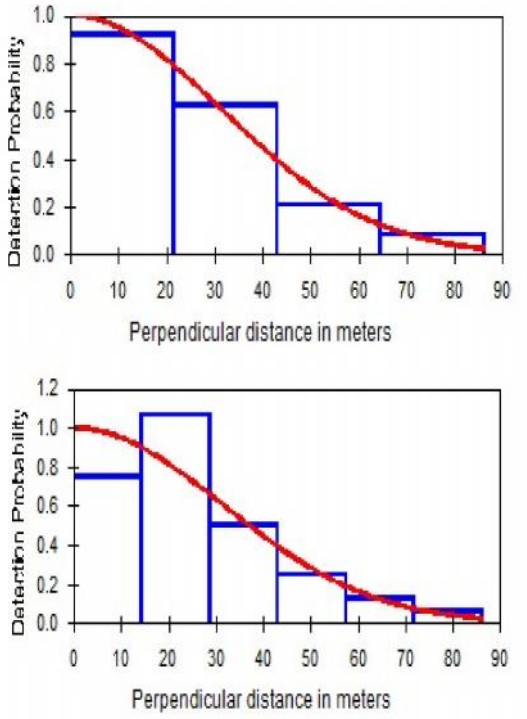

Fig. 4. Detection probability of overall Indian Peafowl during May 2016.

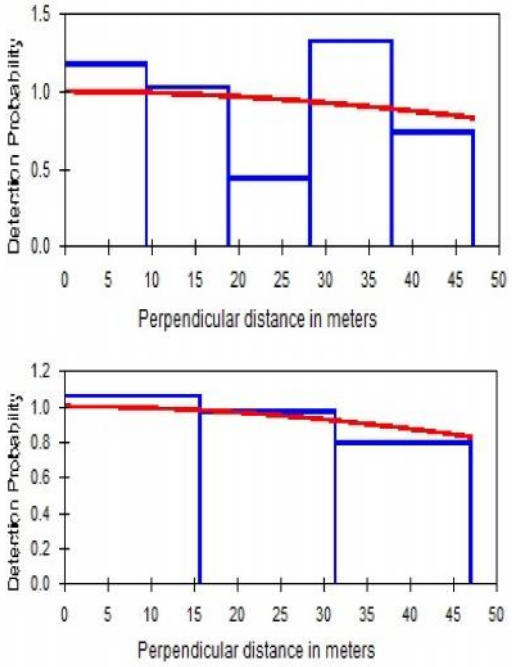

Fig. 5. Detection probability of overall Indian Peafowl during November 2016.

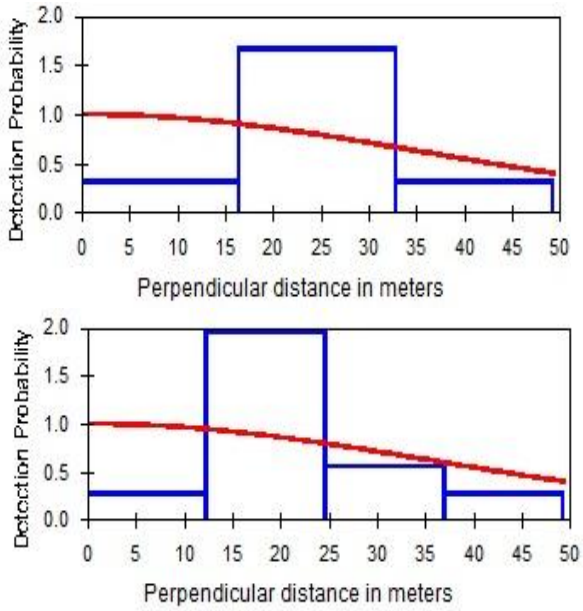

Fig. 6. Detection probability of overall Red Junglefowl during May 2016.

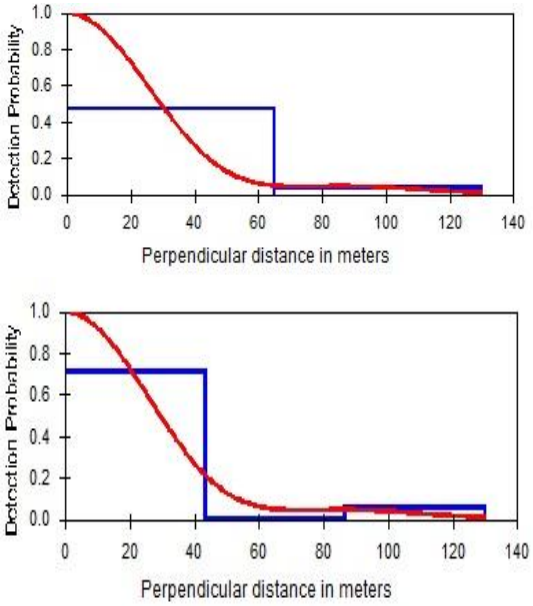

Fig. 7. Detection probability of overall Red Junglefowl during November 2016.

The distance sampling technique based on line transect sighting of Red Junglefowl provided a statistically robust estimate in the population estimation. By adopting this technique, comparable density estimates of the Red Junglefowl can be generated from protected areas across the country which can serve as critical base lines data for future monitoring.

4. Discussion

The line transect method was found to be more convenient as most of the birds were detected close to the line making the detection and counting easier. Previous research has also suggested that line transects produce more accurate densities of bird species than point counts densities (Jarvinen 1978; Verner 1985; Raman 2003). The line transect method was previously used for estimating abundance of the Indian Peafowl in Gir National Park (Trivedi 1993; Sankar *et al.* 2004). After fifty-five magnificent years being named the National Bird of India, the mesmerizing Indian Peafowl faces negligence regarding field surveys and scientific research in the Indian subcontinent. Peafowls are facing various threats that are resulting in population decline. It is imperative to understand the changes in habitat and population status of these birds on a constant basis. Although our results for both the Red Junglefowl and Peafowl population density in the Similipal Tiger Reserve are important, we still need a better understanding of ecological dynamics of both of these fowl species. To fulfill this gap and to provide specific forest management recommendations to local institutions, we suggest that future research should focus on long-term population monitoring of both Red Junglefowl and Peafowl to know population /demographic parameters such as population trend and survival.

Conservation

Due to the maintaining and increasing populations, the Indian Peafowl has a conservation rating of least concern by the International Union for Conservation of Nature (IUCN). However, poaching of Indian Peafowl for their meat and feathers, in addition to accidental poisoning through feeding on seeds are known threats to the wild birds (Alexander 1983). Adult birds can usually escape from the ground predators by flying into trees. Large animals such as tigers, leopards and dholes can sometimes ambush them and in some areas such as the Gir forest, Indian Peafowls are fairly common prey for such formidable predators (Parasharya *et al.* 1999). Chicks are somewhat more prone to predation than adult birds. Adults living near human habitations are also sometimes hunted by domestic dogs. The veracity about peacocks is loss and destruction

of habitats due to the urban sprawl that result in shrinking of natural habitats. Export, import and internal trade of the peacock have been banned under the Wildlife Protection Act. Another problem in detecting violators is that most peacocks are killed outside protected areas, hence several poaching cases go unnoticed or unreported cause for concern is that most of the peacocks, according to wildlife experts, are killed during the mating season. Wildlife experts opine that it is easy to kill a male peacock during the mating season, when it dances in an open area and therefore it is easily targeted. We can well imagine how threatened the peacock would be when male birds are killed just before mating.

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