ABUNDANCE AND HABITAT ASSOCIATION OF A TROPICAL NEST PREDATOR CORVID

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Abstract- We report on abundance and habitat association of a common but relatively understudied tropical nest predator corvid, Green Magpies (Cissa chinensis) in two forest types in Sakaerat Biosphere Reserve in north-eastern Thailand. We conducted bird surveys using transect line counts between May and October 2015. The result showed that abundance and density of the bird was higher in dry evergreen forest (encounter rate = 1.07 birds/km; detection probability = 0.48; density = 11.1 birds/km2) than in old planted forest (encounter rate = 0.81 birds/km; detection probability = 0.50; and density = 8 birds/km2). This difference can be a result of availability of more food and nesting sites in dry evergreen than in old planted forest. With high number of threatened species in the region and limited knowledge of the ecology of many Asian birds, knowing the abundance and distribution of the main nest predators adds to our understanding of the impact of nest predation on nesting behaviour and reproductive strategies of tropical birds. This may assist managers in developing long term conservation strategies on threatened species and habitats.

Keywords- Green Magpie, Cissa chinensis, Sakaerat Biosphere Reserve, nest predation.

I. INTRODUCTION

Habitats inSakaerat Biosphere Reserve (SBR)in north-eastern Thailandwere significantly disturbed from urban development and expansion of agriculture area for several years prior to its establishment in 1967. One major impact of this disturbance is habitat fragmentation and edge effect which changed the physical and biotic conditions in the reserve. These affected bird communities as fragmentation result in changes in species composition of predators in fragmented habitats (Bélisle 2005). Smaller fragmented habitats with a large proportion of edge lose large predators which might control populations of smaller predators. As number of small predators increase, rate of predation on nest contents increases. This results in population reduction or local extinction of birds (Robinson &Sherry 2012). Nest predators reduce nest survival and nest success for tropical birds (Korfanta et al. 2012) and they are a major cause of nest failure in fragmented and small forest patches (Lahti 2001; Newmark & Stanley 2011).

Studies previously conducted in Thailand on nest predation in moist and dry evergreen forests have shown that nest predators accounted for more than 75% of predation events (Pierce and Pobprasert 2013)resulting in very low nest success. Studies on nesting success in SBR have found very low nest success of approximately 2 %. The main cause of this low nest success was a result of nest failure due to nest predation by the Green Magpies (Cissa chinensis), Pig-tailed Macaques (Macaca nemistrina) and snakes (e. g., Boiga spp) which were responsible for 18 %, 53 %, and 18 % respectively of total predation events. Other unidentified predators were responsible for 11 % (Khamcha, unpubl. data). The same trend of nest predation has also been reported for Khao Yai National Park (KYNP) where nest success was found to be approximately 16 %.But similar to SBR, the same three major nest predators were the cause of nest failure; with the Green Magpies, Pig-tailed Macaque and Snakes responsible for 9 %, 43.7 %, and 21.8 % respectively of the total nest predation events in the park. Others predators were found to be responsible for 25 % (Pierce & Pobprasert, 2013; Pierce & Pobprasert, 2007).

Although the studies in SBR have highlighted the level of nest predation, but little attention has been given to abundance and distribution of nest predators in the reserve. In addition, these studies have tended to concentrate on nest predation in the dry evergreen forest leaving out other habitats that the nest predators may also occur (Khamcha, unpubl. data). Moreover, we need an understanding of the abundance and habitat associations of the nest predators to assist us in developing conservation and management strategies, as well as to provide baseline information that may lend more insight into the effects of nest predation on the reproduction success of birds in SBR. Currently, conservation and management of habitats in SBR for birds are hampered by lack of basic ecological information about these nest predators.

Despite the Green Magpiesbeing one such birdspecies that is well known to predate on nest contents of other birds in SBR, no studies have been conducted to provide information ontheir abundance and distribution in the reserve.Coupled with poor knowledge of the ecology of many Asian birds (Sodhi & Brook 2006), the Green Magpies remain relatively understudied and very little is known about their ecological aspects throughout their biogeographic

distribution (Madge 1993; BirdLife International 2012). In this paper, we report on the abundance and distribution of Green Magpiesin SBR. This is a first step in determining factors affecting Green Magpies population and thereby their potential impact on other birds as a nest predator in the reserve.

II. METHODS

Study site

The study was conducted in SBR, north-eastern Thailand. SBR lies between latitude 14° 26′ to 14° 32′ N and longitude 101° 51′ to 101° 57′ E; has an altitudinal range of between 250 – 762 meters above mean sea level, and receives 1260 mm of rain annually. SERS covers an area of approximately 80 km^2 (Trisurat et al., 2006), and is a Biosphere Reserve of Thailand since 1976 under Man and Biosphere Program (MAB) of the United Nations Education, Scientific and Cultural Organization (UNESCO). SBR is a small and highly fragmented forest that is composed of a distinctive heterogeneity of vegetation that comprises three major habitats of dry-evergreen forest (DEF), dry-dipterocarp forest (DDF) and old planted forest (OPF), and other small patches of grassland and bamboo (Trisurat 2010).

Bird surveys

We conducted bird surveys in the three major habitats of DEF, DDF and OPF in order to determine the Green Magpie's abundance and population densities in these habitats. We recorded all birds seen or heard using line transect sampling. A total of twenty-three transect lines were laid out, ten in DEF, seven in both DDF and OPF. Starting from a random point, we laid transects systematically at a distance of 500 m apart in the habitats under study. Each transect line was 500 m long and was started and stopped short of the forest road networks and boundaries by 100 m to avoid edge effect. All surveys were conducted during morning from 06:00 to 08:30 hrs as morning hours have the highest bird activity in this area (Gale unpubl. data). Green Magpie detections were recorded as directly seen or heard by moving steadily along the transect lines at an average speed of 38 m/minute. Given that accuracy in distance measurement is the basis of line transect sampling and an important key factor in producing reliable abundance estimates (Bibby et al., 2000), perpendicular and radial distances from the transect line to individual birds or centre of group were measured using a Bushnell Scout 1000 ARC Laser Rangefinder. All radial angles from transects to the bird were measured using a campus. Each transect was surveyed once every two weeks starting from 11thMay to 25thOctober 2015.

Data analysis

Green Magpie abundance and density was estimated using program Distance version 6.2. For all categories, the half-normal key detection function with a cosine adjustment was applied in order to determine the best fit model to the observed data. We first estimated density based on data pooled across habitat types, and then estimated habitat specific densities. For this paper, we used detection probability and encounter rate (i.e., frequency of occurrence) as a means to assess the distribution of the Green Magpies within each of the vegetation types under study. By using both a measures of abundance and frequency of occurrence, we were able to assess the importance of a habitat for the Green Magpies, based on both its occurrence and abundance within that habitat.

III. RESULTS AND DISCUSSION

Estimates of abundance and distribution

A total of 11 surveys were conducted representing a total effort of 93.5 km transect walk; 55 km in DEF and 38.5 km in OPF respectively. 91 detections were made in 17 transects in the study sites; 59 in DEF and 32 in OPF.No detections were made in the DDF. A greater proportion of records were detections by sound/songs (59 out of 91) than by sightings. Most detections varied from 1 to 2 individuals with the majority of the observations being those of single individuals (mean group size = 1.1 birds; Table 1). Pair or group observations were mostly recorded at the peak of the breeding season between May and June. This is because the Green Magpies live as solitary individuals most of the times and pair or seen in groups often during breeding season. This may explain why most of the observations were single birds. However, the Green Magpies were recorded at all layers in the forestsalthough there appeared to be some preference for the dense understorey canopy (4 – 10 m). Most of the time the bird was observed in the company of other birds like White-crested Laughingthrushes (Garrulax leucolophus) and Greater Racket-tailed Drongo (Dicrurus paradiseus).

Estimate of encounter rate and population density showed a higher encounter rate and density of Green Magpies in DEF than OPF, but a higher detection probability in OPF than DEF. In theory, the recommended number of detections for analysis using Distance is 60 sightings per species (Buckland et al. 2001). This number sometimes is difficult to achieve for most tropical forest bird species, even if more intensive surveys are carried out. In our survey data, habitat specific detections were less than 60 in both DEF and OPF (i.e., 59 detections in DEF and 32 detections in OPF). Small number of detections are likely to result in biased estimates of abundance and density. The high detection probability in the OPF when compared to the DEF may be due to a biased estimation as a result of a small number of detections made in the OPF; or it may have resulted from the openness and less clustering of the vegetation in OPF

which made detection of the birds easier than in DEF.Moreover, the effective sampling width (ESW) was higher in OPF compared to DEF indicating that detections were made at longer distances from the transect line than in DEF (Table 1). Overall, the population density estimate was 10.0 birds/km^2 for the whole SBR when data was pooled across habitats,which agrees well with preliminary population density estimate for the same species in moist evergreen forest in KYNP which was reported to be 10.1 birds/km^2 (Gale, unpubl. data).

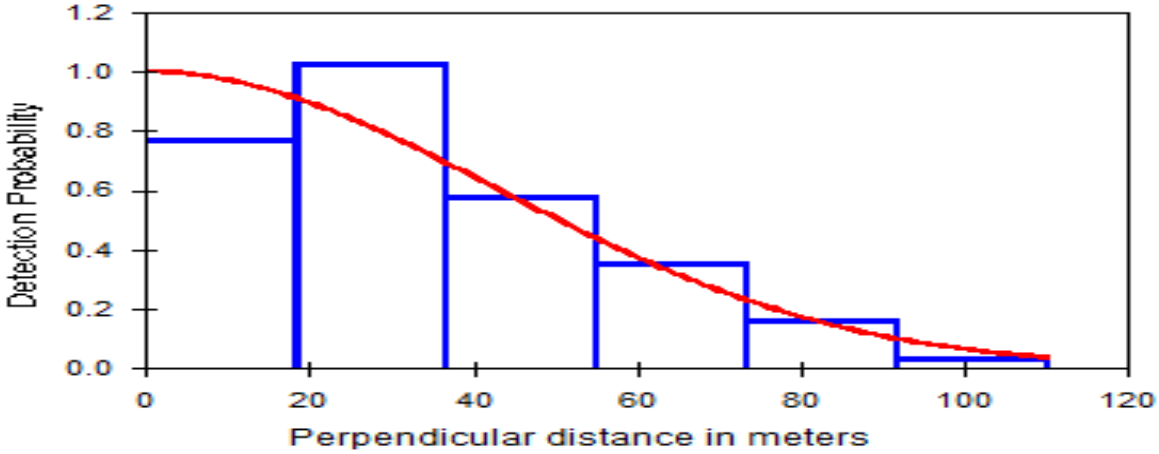


Figure 1: Distribution of detections and fitted probability detection function for Green Magpies at SERS. The half-normal detection function with a cosine adjustment gave the best fit.

Table 1: Parameters of Green Magpie probability detection functions for pooled data across habitats, DEF and OPF. In the table, p refers to the probability of detecting a bird at any given point from the transect line to the furthest sighting in the analysis (denoted by W). ESW refers to the 'Effective Sampling Width' (estimated as p x W). ER refers to 'Encounter Rate' (estimated as n/L,where n = number of observed birds and L = total length of transect lines in kilometres). Upper and lower 95% CI's, and CV's were estimated for density of animals.

Name (Birds/km)	*p*	ESW (m) (Birds/group)	ER	Mean cluster size (Birds/km^2)		Animal Density		
	Estimate	95 % CI	CV					
Pooled data	0.48	52.3		0.97	1.1	10.0	7.87 - 12.61	11.83
DEF only	0.48	53.0		1.07	1.1	11.1	8.27 - 14.85	14.44
OPF only	0.50	54.9		0.81	1.1	8.0	5.19 - 12.42	21.61

The vegetation in DEF is more diverse, clustered, and with dense understory trees compared to the OPF. Green Magpies prefers habitats with dense understorey vegetation, most likely because of higher food availability but also as an anti-predator strategy to reduce predation risk, especially during breeding. Although OPF has less dense understorey vegetation, but the undergrowth primary succession in these forests has proved to provide the Green Magpies with sub-optimal habitats. This is in contrast to the DDF which is too open for the Green Magpies to inhabit. In this study we did not detectthe bird in the DDF. However, on a number of occasions we observed thebird making foraging attempts on insects in the edge between the DEF and DDF.

Abundance and density estimation of animals using distance sampling depends largely on the behaviour of the target animal and survey specific factors like time of survey, weatherand bird activity among others. For cryptic, shy and dense understorey dwelling birds, larger groups are easier to detect and group size may be accurately estimated close to the transect line, and group sizes are poorly estimated at larger distances (Sukumal 2010). This may lead to underestimation of both group size and perpendicular distance from the observer to the centre of a group. Some birds during surveys moved away from the line before being detected or were missed as a consequence of their cryptic and shy behaviour and/or in response to the observer (Fig.1). In addition, the Green Magpie has a green body colour which made it well camouflaged or blended with the surrounding vegetation making it difficult to detect by sight closer to the line. This could be the reason why most of our detections were sound rather than sighting.

Accuracy of abundance estimates

In using distance sampling technique, four critical assumptions were met in order to make abundance estimates accurate indicators of actual densities of Green Magpies in the study sites. According to

Rosenstock et al. (2002), these assumptions are that (1) all transects are randomly placed; (2)animals on the line are detected; (3) animals are detected prior to evasive movement triggered by the observer; and (4) distances are accurately measured.All transect lines were placed systematically in the habitats under study starting from a random point picked from the grids of the map of the study area. All of the transect lines passed through the interior of the forests for most of their lengths. Most of the birds on the lines were detected, although it is possible that some were missed when transects passed through thick and tangled vegetation which might have obscured long distance visibility from the observer. Somebirds that were originally on the line at greater distances from the observer may have moved away before they were detected and some were not detected until they flushed out and flew away in mixed groups with other birds like White-crested Laughingthrush and Greater Racket-tailed Drongo. This only occurred at distances of less than 20m from the line (Figure 1). In such instances, the original locations of the birds before they were disturbed were accurately determined.The requirement that perpendicular distance of the animal from the line be precisely measured was met by use of a laser rangefinder, with a ranging accuracy of one metreand a maximum range of 594 -1000 metres. It was not hard to get accurate distance readings since all detections were observed or heard at distances not more than 120 m. Challenges arose when the birds were sighted inside leaf coverage oftrees or entangled vegetation as it was hard to get an accurate distance readingas these substrates may cause the laser beam to bounce back or scatter such that the rangefinder could not estimate the distance. In such instances use of nearbyhabitat features, such as a branch where the bird was perched on to was necessary in order estimate the distance.When a bird was observed at an angle to the transect line, both the radial distance and angle from the transect line to the bird were measured and used to calculate the perpendicular distance. Consequently, the distance estimates to the birds were not always exact, thereby contributing to inaccuracy in the detection probability function and the abundance estimates. In such cases pooling in of individual distances to distance bands and truncation of detection distances far from the transectlines for analysis helped to improve the fit of the model.Generally, all the assumptions of distance sampling technique were fairly met during our data collection surveys.

The coefficient of variation (CV) measures the precision of abundance estimates as calculated by Distance. In our study, CV for pooled data across habitats, DEF and OPFwere 11.83 %, 14.44 % and 21.61 % respectively (Table 1). The CV for DEF was below the 20% which is recommended for estimates of abundance (Corn & Conroy, 1998).The CV for OPF was slightly above this recommended level. However, the precision of the abundance estimates weregenerally fair and high enough to explain the difference in Green Magpies abundance between the forest typesunder study.

We are not sure as to how representative the results of our study are for the species as a whole across its known geographical distribution range as our results are based on a sample from one location. Repeated surveys to collect more data in other forests where Green Magpies are known to inhabit will eventually give more insights into abundance and habitat association by the bird. Currently no quantitative data exist regarding patterns of habitat use and associations by Green Magpies in other fragmented forests, and consequently, no comparisons can be made. Across habitat and landscapes some bird species appear physiologically tolerant to both micro-climate and micro-habitat changes (Martin 2001). If this was true for the bird of our study, then distribution of the bird in the OPF where undergrowth secondary succession is allowed to establish itself as a management strategy, may be a consequence of the bird's tolerance and trying to occupy habitats with sub-optimal characteristics of the adjacent DEF where most of the detections were made. In addition, the bird has been found to have more nests, foraging successes and higher biomass of its potential foodin the DEF than OPF (Salema, unpubl. data) indicating that DEF is the optimal habitat forthe Green Magpie, hence the higher abundance and density in this forest.

CONCLUSIONS

By conducting this study we have provided information and a starting point that can help to reliably assess the levels of nest predation by the Green Magpiesand their impact on reproduction success of other birds in the habitats that they occur. However, similar studies onthe other major nest predators are also needed in order to fully evaluate the impact of nest predation on the bird community at SERS. With high number of threatened species in the region and limited knowledge of the ecology of many Asian birds (Sodhi & Brook 2006), knowing the abundance and habitat associations of the main nest predators adds to our understanding of the impact of nest predation on nesting behaviour and reproductive strategies of tropical birds. This may assist managers in developing long term conservation plans and strategies on threatened species and habitats.

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