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Congo Peafowl use both primary and regenerating forest in Salonga National Park, Democratic Republic of Congo

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The Congo Peafowl *Afropavo congensis* is a little-known species endemic to the Democratic Republic of Congo. A central question in assessing its conservation status is the degree to which it uses secondary forest. Here, we measure relative use of two contiguous forest blocks in Salonga National Park, one patch of primary forest and another of secondary forest that has been regenerating for over 30 years. We searched for Congo Peafowl using systematic surveys along a transect grid, and exhaustive searching of smaller subsections of habitat for secondary signs of peafowl presence (feathers and droppings). Detections of secondary signs of peafowl presence were significantly more frequent in secondary than in primary forest, and 19 of the 31 sightings of birds were in secondary forest. Microhabitats used by the birds differed between forest types, with those in secondary forest being closer to the nearest watercourse, having fewer large trees, and lower plant species richness. In addition, fewer taxonomic groups were found in peafowl droppings collected in secondary forest. Overall, our results demonstrate that old regenerating forest is heavily used by Congo Peafowl at least in this area. Secondary habitats must therefore be considered when planning for the conservation of this species, particularly where regenerating forest fragments might connect larger blocks of habitat.

Introduction

The Congo Peafowl *Afropavo congensis* is an enigmatic species, most closely related to the Asian peafowls (*Pavo*), yet morphologically quite distinct from them (Verheyen 1956, de Boer and van Bocxstaele 1981, Kimball et al. 1997, 1999, Dyke et al. 2003, Kriegs et al. 2007, Eo et al. 2009). It is also geographically isolated from all other Phasianinae occurring in Asia. Despite its great ornithological interest as the only member of this subfamily native to Africa, the Congo Peafowl, described to science by James Chapin in 1936, has remained a little-known and mysterious bird (Urban et al. 1986, Hart and Upoki 1997). Consequently, there have been repeated calls for ecological studies of the species in its natural habitat (Lippens and Wille 1976, Collar and Stuart 1985, Dupain et al. 1996, Hart and Upoki 1997). Currently listed as globally Vulnerable in the IUCN Red List (BirdLife International 2009), the Congo Peafowl is endemic to the Democratic Republic of Congo (DRC). It is assumed to have a small population with an estimated extent of occurrence of c. 700 000 km^2. Recent surveys have revealed that large areas within the limits of its occurrence are apparently unoccupied, suggesting that the population is severely fragmented and exists as a series of small subpopulations (Hart and Upoki 1997, Standards and Petitions Working Group 2006, BirdLife International 2009).

Despite its immense interest from a biogeographical and conservation perspective, a lack of information on distribution severely hampers the development of a coherent conservation programme for this species most fundamentally because the locations of the most important populations are unknown. For example, the western part of its geographic range has not been surveyed in recent times, though there is evidence it occurs between the Lukenie and Sankuru Rivers (Thompson 1996). Furthermore, information on the habitats used by Congo Peafowl in areas where it is known to occur remains sketchy. Without comprehensive information on both distribution and habitat use, it is difficult to ensure that viable populations are being safeguarded within existing protected areas, and to move from information-gathering to promoting conservation action for the species (Fuller and Garson 2000, Fuller et al. 2003).

To address some of these gaps in our knowledge of the Congo Peafowl, we report new data on habitat use in Salonga National Park, a site at which this species occurs in comparatively high densities across a gradient from primary to secondary forest (Mulotwa et al. 2006). A critical question is the degree to which secondary habitats, particularly regenerating tropical forest, are used (Dunn 2004, Vitz and Rodewald 2006). Hart and Upoki (1997) report some observations of Congo Peafowl from secondary forest, but the extent to which the species can tolerate regenerating forest is currently unknown. Our principal aims were therefore: (1) to determine the relative frequency of use of primary and secondary forest, and (2) to identify whether microhabitats used by the birds in the two habitat types differ. Such microhabitat-scale studies have important applications in conservation biology, where the aim is to assess the consequences of different types of land management, or scale-up to maintain or maximise the conservation value of a given region.

Here, we take the approach of describing habitat use by comparing the frequency of detection and variation in key habitat characteristics in two areas differing in gross habitat structure and degree of forest openness. We describe the characteristics of Congo Peafowl microhabitats in areas of primary forest and old secondary forest that has been regenerating for at least 34 years.

Materials and methods

Fieldwork took place in Salonga National Park (SNP), Democratic Republic of Congo (1º00′–3º20′ S, 20º00′–22º30′ E). Africa's largest tropical rainforest reserve, SNP lies in the central Congo River basin, in an isolated region accessed primarily by water or air. The estimated total area of the park is about 3 656 000 ha, in two blocks separated by a gap about 40–45 km wide. The northern block is c. 1 700 000 ha, and the southern block is c. 1 900 000 ha. Altitude varies between 350 m and 700 m, rising gradually from west to east. Our study area was located close to Lokofa (01º42′ S, 20º35′ E) in the southern block of the SNP, at an altitude of c. 360 m above sea level). Fieldwork was carried out between June 2004 and November 2005. Temperatures are stable throughout the year in the study area, with typical diurnal variation taking temperatures from about 20 ºC at night to 30 ºC during the day. Morning cloud and afternoon storms are typical. Most of the annual rainfall of 2 000 mm occurs within two periods, between September and November, and from March to May, usually peaking in October and November. Periods of lower precipitation are June to August and December to February with minima in June and July as well as in January and February (Evrard 1968).

The study plot comprised two contiguous square blocks of forest: 2 km^2 of undisturbed primary forest (UPF) and 2 km^2 of old-growth secondary forest (OSF; c. 34 years' regeneration). Six parallel transects 4 km in length and 200 m apart were established across the boundary between the two forest types, such that half the length of each transect fell within UPF and half within OSF. At intervals of 200 m along each transect, a numbered stick was planted as a signpost, thus creating a grid of 100 squares of 200 m × 200 m, with 50 squares each in UPF and OSF. A similar grid-based design has been used previously for studying equatorial forest Galliformes in Uganda (see Sande et al. 2001).

To generate Congo Peafowl sightings within the grid, two transect lines were selected randomly each month, and walked by one of us (MM) at a velocity of approximately 1 km h^{-1}. The direction and distance to every Congo Peafowl seen along the transect line was noted. Any droppings and feathers seen during the transect walks were collected and their locations noted. In total, 140 km of transect was walked in each habitat type, and data collection was carried out in the morning and afternoon, and approximately equally across the wet and dry seasons (Table 1). To supplement the transect data, some of the grid squares were chosen at random each month and searched thoroughly for droppings and feathers. This resulted in 27 searches in the UPF (108 ha, taking 81 h) and 35 in the OSF (140 ha, taking 105 h). Effort was approximately equally allocated across seasons with 29 and 33 searches occurring in the wet and dry seasons, respectively. The observer (MM) is highly experienced in identifying Congo Peafowl droppings and feathers in the field, and took care to avoid confusion with those of other Galliformes that also occur in SNP (in particular, Crested Guineafowl *Guttera pucherani*).

We established a 10 m × 10 m quadrat around the location of each individual sighted or droppings/feathers collected, and recorded forest type (UPF or OSF), litter cover (%), canopy cover (%), forest understorey (open or closed), distance to the nearest watercourse (DNWC), the height and diameter at breast height (DBH) for the two biggest trees (height1, height2, DBH1, DBH2), the species richness of dominant plants and the taxonomic richness of food items found in droppings. The variables were chosen as they are seasonally stable, easy to measure, and representative of the habitat characteristics that describe the immediate environment of a bird's location. Faecal analysis involving the identification of fragments surviving digestion was used to determine food items eaten throughout the year and across microhabitats in each forest type. Prior to analysis faecal samples were sieved through a 212 µm mesh. Organic material retained by the sieve was examined under a binocular microscope to assess the species composition of animal and vegetal items following Browne and Aebischer (2003) and Libois and Laudelot (2004). Richness was measured as the total number of groups identified to the lowest practicable taxonomic level from animal or vegetal items in the droppings. Microphotographs of animal and vegetal items were taken to aid identification and act as reference material. Comparison with standard published texts (Hulstaert 1966, Stanek 1978, Hubert 1979, Roth 1980, Scholtz and Holm 1985, Pihan 1986, Lejoly et al. 1988, Tailfer 1989) assisted identification of material.

For our purpose, it was neither necessary nor desirable to calculate absolute measures of density for describing relative habitat use. Hence, we compare the frequency of detecting Congo Peafowl or their secondary signs in primary and old secondary forest and in open and closed understorey forest using the chi-square (χ^2) test both in the case of line transect data and exhaustive grid-searching data. These tests accounted for the fact that the number of samples obtained differed between sites. Microhabitat characteristics were compared between habitats using the Mann-Whitney test.

Results

We detected Congo Peafowl, either through sighting or collecting feathers or droppings, on 256 occasions: 79 in the undisturbed forest and 177 in the old secondary forest. Forest with an open understorey generated 208 of the 256 detections, while the remaining 48 were in forest with a closed understorey. Congo Peafowl were physically sighted on 31 occasions, all of which were during transect surveys (Table 2). This equated to one sighting per 9.03 km of transect walked, a low return on effort for the transect surveys. Although the majority of sightings (19) were in the OSF, the frequency of sightings did not differ significantly between the two habitats (χ^2 = 1.6, df = 1, p = 0.21), perhaps partly reflecting the relatively small number of visual detections leading to low statistical power. Secondary signs were detected at a greater frequency in OSF than in UPF for both droppings (χ^2 = 12.4, df = 1, $p < 0.001$) and feathers (χ^2 = 30.3, df = 1, $p < 0.001$).

A comparison between locations with open and closed understoreys (Table 3) shows that secondary signs were found at greater frequency in open than in closed forest for droppings (transect surveys: χ^2 = 47.1, df = 1, $p < 0.001$, searching: χ^2 = 38.9, df = 1, $p < 0.001$) and feathers, though the latter was only significant for transect data (χ^2 = 26.6, df = 1, $p < 0.001$).

Locations where birds were seen or secondary signs were found differed in many of the measured microhabitat variables according to habitat type. Sites in OSF were closer to the nearest watercourse, the girths and heights of the largest trees were smaller, plant species richness was lower, and fewer taxonomic groups were found in the droppings (Table 4). These locations (where birds were seen or secondary signs found) also differed in many of the measured microhabitat variables according to forest openness. Sites with a closed understorey were further from the nearest watercourse, had lower leaf litter and canopy coverage, the girths and heights of the largest trees were larger, plant species richness was higher, and more taxonomic groups were found in the droppings (Table 5).

Discussion

Our results demonstrate for the first time that regenerating old secondary forest habitats are heavily used by Congo Peafowl. Although we did detect birds via visual observation and by locating secondary signs in undisturbed primary forest, both methods resulted in a greater frequency of detection in regenerating secondary forest. The fact that both methods agree is important, because visual detections are more likely to be biased by such factors as habitat openness than the detections of secondary signs of peafowl presence. Although Hart and Upoki (1997) relate several accounts of Congo Peafowl using secondary forest, this species has been reported to occur largely only in primary forest by several authors (Verheyen 1963, Collar and Stuart 1985, Urban et al. 1986, del Hoyo et al. 1994, Dupain et al. 1996). Our data show that, at least in our study area, use of old regenerating forest was relatively intense, although it must be noted that the secondary forest has been undisturbed for more than 30 years, and is in close proximity to primary forest. Human access is not permitted in the national park, and our observations suggest that levels of hunting and human disturbance are currently very low in this study area. However, because of illegal poaching and

Table 1: Search effort during transect surveys (half of each transect line was in undisturbed primary forest, while the other half traversed secondary forest) at Salonga National Park

Transect line	Transect length (km)	Dry season		Wet season		Total distance (km)
		Number of visits	Distance walked (km)	Number of visits	Distance walked (km)	
1	4	8	32	4	16	48
2	4	4	16	8	32	48
3	4	6	24	6	24	48
4	4	4	16	8	32	40
5	4	4	16	6	24	48
6	4	8	32	4	16	48

Table 2: Number of detections of birds and secondary signs of Congo Peafowl activity in primary forest and secondary forest at Salonga National Park

Habitat	Droppings		Feathers		Individuals	
	Transect	Searching	Transect	Searching	Transect	Searching
Undisturbed primary forest	35	18	12	2	12	0
Old-growth secondary forest	72	24	48	14	19	0
Total	107	42	60	16	31	0

Table 3: Number of detections of birds and secondary signs of Congo Peafowl activity in forest with open and closed understorey at Salonga National Park

Habitat	Droppings		Feathers		Individuals	
	Transect	Searching	Transect	Searching	Transect	Searching
Open understorey	88	41	48	10	21	0
Closed understorey	19	1	12	6	10	0
Total	107	42	60	16	31	0

encroachment, Salonga National Park still remains on the UNESCO List of World Heritage in Danger, to which it was added in 1999 (UNESCO 1999). The very low rate of visual detection compared to secondary signs underlines the value of using signs of peafowl presence to maximise the amount of data that can be generated from fieldwork time on this species.

The intense use of regenerating forest that we document here could be associated with the rich food source from the abundant fruiting of secondary forest plants. Leaf litter was thicker in the OSF than in the UPF, which could also play an important role in attracting birds to the OSF. Leaf litter invertebrates comprise the majority of animal items in the diet of the Congo Peafowl (MM unpublished data) and the deeper leaf litter in the OSF could be associated with increased abundance and diversity of suitable invertebrate prey items, as has been found in other systems (Chouteau 2007). The species richness of dominant plant species was higher in OSF, which could have produced the greater abundance and diversity of fruits in that habitat. Most of the vegetal items in the diet of the Congo Peafowl, as assessed by faecal analysis, were from secondary forest plant species (MM unpublished data). In fact, most of the fruiting plants observed during the study were characteristic of the OSF and appeared suitable as food for Congo Peafowl.

In this study, detections of Congo Peafowl or its secondary signs occurred mainly at locations less than 3 km from a watercourse, although detections were never made in swampy areas. This corresponds with general statements in the literature that the species generally occurs in reasonably close proximity to water points but not in swampy forest or places liable to flooding (Collar and Stuart 1985, Urban et al. 1986, Dupain et al. 1996). Furthermore, detections of Congo Peafowl were greater in forest with open understorey and a dense canopy. Whilst the primary components of the habitat underlying its use appeared to be dense canopy and deep leaf litter cover, more detailed studies comparing habitat variables at peafowl locations with a set of random locations will be required to investigate habitat selection in more detail.

Besides being a relatively old regenerating forest, the secondary forest studied here was in close proximity to a primary forest. It is still vital to establish whether birds are resident and breeding in secondary forest, or whether undisturbed forest was acting as a source for many of the birds seen in regenerating forest. In addition, the amount of time that a secondary forest has been allowed to regenerate might be important in determining its suitability for Congo Peafowl, as lags between revegetation and provision of usable habitat are typical for many restoration projects (Vesk et al. 2008). Surveys in other regenerating forests are required to establish whether the use of this habitat is widespread across the geographic range of the Congo Peafowl. If this is found to be the case, it suggests that patches of secondary or regenerating forest connecting primary forest might increase

Table 4: Comparison of microhabitat and taxonomic richness of items in faecal material between undisturbed primary forest and old secondary forest in the Salonga National Park. DBH = diameter at breast height

Variable	Undisturbed primary forest (median value)	Old secondary forest (median value)	Mann-Whitney *U*
Distance to nearest watercourse (m)	3000	804	2603.5***
Litter cover (%)	70	80	4528^{ns}
Canopy cover (%)	60	80	4700.5^{ns}
Tree DBH1 (cm)	44.6	31.2	1643.5**
Tree height1 (m)	20	15	695^{ns}
Tree DBH2 (cm)	27.1	23.3	1939**
Tree height2 (m)	15	18	1030.5^{ns}
Species richness of dominant plants	2	2	1966.5***
Taxonomic richness of food	4	3	1971.5*

* $p < 0.001$, ** $p < 0.01$, *** $p < 0.05$, ^{ns} = not significant

Table 5: Comparison of microhabitat and taxonomic richness of items in faecal material between forest with an open understorey and forest with a closed understorey in the Salonga National Park. DBH = diameter at breast height

Variable	Open forest (median value)	Closed forest (median value)	Mann-Whitney *U*
Distance to nearest watercourse (m)	1004	3400	2603.5^{ns}
Litter cover (%)	80	62.5	2248.5***
Canopy cover (%)	80	62.5	2671.5**
Tree DBH1 (cm)	36.3	49.5	1113*
Tree height1 (m)	15	27.5	1074**
Tree DBH2 (cm)	26.8	20.4	547*
Tree height2 (m)	18	10	334***
Species richness	3	6	1168.5***
Taxonomic richness of food	2	2.5	1194^{ns}

* $p < 0.001$, ** $p < 0.01$, *** $p < 0.05$, ^{ns} = not significant

connectivity at a landscape scale by allowing movement of Congo Peafowl between forest blocks; besides, they may also support breeding populations. As such, secondary forests might be an important component of conservation strategies for this rare species that is sparsely distributed across a large geographic range.

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References

BirdLife International. 2009. Species factsheet: *Afropavo congensis*. Available at http://www.birdlife.org [accessed 6 February 2009].

Browne SJ, Aebischer NJ. 2003. Habitat use, foraging ecology and diet of Turtle Dove *Streptopelia turtur* in Britain. *Ibis* 145: 1–9.

Chouteau P. 2007. The impact of burning on the microhabitat used by two species of Couas in the western dry forest of Madagascar. *Ostrich* 78: 43–49.

Collar NJ, Stuart SN. 1985. *Threatened birds of Africa and related islands: the ICPB/IUCN Red Data Book, Part 1* (3rd edn). Cambridge: International Council for Bird Preservation; Gland and Cambridge: International Union for Conservation of Nature and Natural Resources.

de Boer LEM, van Bocxstaele R. 1981. Somatic chromosomes of the Congo peafowl *Afropavo congensis* and their bearing on the species' affinities. *Condor* 83: 204–208.

del Hoyo J, Elliot A, Sargatal J (eds). 1994. *Handbook of the birds of the world, vol. 2: New World vultures to guineafowl*. Barcelona: Lynx Edicions.

Dunn RR. 2004. Recovery of faunal communities during tropical forest regeneration. *Conservation Biology* 18: 302–309.

Dupain J, van Krunkelsven E, van Elsacker L. 1996. Recent observations on the Congo peacock *Afropavo congensis* in the Equateur Province, Zaire. *Ostrich* 67: 94–95.

Dyke GJ, Gulas BE, Crowe TM. 2003. Suprageneric relationships of galliform birds (Aves, Galliformes): a cladistic analysis of morphological characters. *Zoological Journal of the Linnean Society* 137: 227–244.

Eo, SH, Bininda-Emonds ORP, Carroll JP. 2009. A phylogenetic supertree of the fowls (Galloanserae, Aves). *Zoologica Scripta* 38: 465–481.

Evrard C. 1968. *Recherches écologiques sur le peuplement forestier des sols hydromorphes de la cuvette centrale Congolaise*. Publications de l'Institut National pour l'Etude Agronomique du Congo, Série Scientifique 110. Bruxelles: INEAC.

Fuller RA, Garson PJ (eds). 2000. *Pheasants: status survey and conservation action plan 2000–2004*. Gland and Cambridge: IUCN; Reading: World Pheasant Association.

Fuller RA, McGowan PJK, Carroll JP, Dekker RWRJ, Garson PJ. 2003. What does IUCN species action planning contribute to the conservation process? *Biological Conservation* 112: 343–349.

Hart JA, Upoki A. 1997. Distribution and conservation status of Congo Peafowl *Afropavo congensis* in eastern Zaire. *Bird Conservation International* 7: 295–316.

Hubert M. 1979. *Les araignées*. Paris: Société nouvelle des éditions Boubée.

Hulstaert GMSC. 1966. *Notes de botanique Mongo*. *Académie royale des sciences d'outre-mer, classe des sciences naturelles et médicales, nouvelle série* 15-3. Bruxelles: Académie royale des sciences d'outre-mer.

Kimball RT, Braun EL, Ligon JD. 1997. Resolution of the phylogenetic position of the Congo peafowl, *Afropavo congensis*: a biogeographic and evolutionary enigma. *Proceedings of the Royal Society of London Series B–Biological Sciences* 264: 1517–1523.

Kimball RT, Braun EL, Zwartjes PW, Crowe TM, Ligon JD. 1999. A molecular phylogeny of the pheasants and partridges suggests that these lineages are not monophyletic. *Molecular Phylogenetics and Evolution* 11: 38–54.

Kriegs JO, Matzke A, Churakov G, Kuritzin A, Mayr G, Brosius J, Schmitz J. 2007. Waves of genomic hitchhikers shed light on the evolution of gamebirds (Aves: Galliformes). *BMC Evolutionary Biology* 7: 1–11.

Lejoly J, Lisowski S, Ndjele M. 1988. *Catalogue des plantes vasculaires des sous-régions de Kisangani et de la Tshopo (Haut-Zaïre)*. Bruxelles: Travaux du Laboratoire de Botanique Systématique et de Phytosociologie de l'Université Libre de Bruxelles.

Libois R, Laudelout A. 2004. Food niche segregation between the Malachite Kingfisher, *Alcedo cristata* and the Pied Kingfisher, *Ceryle rudis*, at the Lake Nokoué, Bénin. *Ostrich* 15: 32–38.

Lippens L, Wille H. 1976. *Les Oiseaux du Zaire*. Tielt, Belgium: Lannoo.

Mulotwa M, Louette M, Dudu A, Upoki A. 2006. The Congo Peafowl *Afropavo congensis* in Salonga National Park (Democratic Republic of Congo). *Malimbus* 28: 52–53.

Pihan JC. 1986. *Les Insectes*. Paris: Masson et Réalisations editoriales pédagogiques.

Roth M. 1980. *Initiation à la morphologie, la systématique et l'écologie des Insectes*. Technical Document No. 23. Paris: Office de la recherche scientifique et technique outre-mer.

Sande E, Dranzoa C, Wegge P. 2001. Population density of the Nahan's Francolin *Francolinus nahani* in Budongo Forest Reserve, Uganda. *Ostrich* Suppl. 15: 33–37.

Scholtz HC, Holm E. 1985. *Insects of southern Africa*. Durban: Butterworth.

Standards and Petitions Working Group. 2006. *Guidelines for using the IUCN Red List categories and criteria*. Version 6.2. Gland and Cambridge: IUCN.

Stanek VJ. 1978. *Encyclopédie illustrée des insectes*. Paris: Gründ.

Tailfer Y. 1989. *La forêt dense d'Afrique centrale*. *Identification pratique des principaux arbres*. Tome I and II. Paris: Agence de Coopération Culturelle et Technique.

Thompson JAM. 1996. New information about the presence of the Congo Peafowl. *WPA News* 50: 3–8.

UNESCO (United Nations Educational, Scientific and Cultural Organization). 1999. *Convention concerning the protection of the world cultural and natural heritage: World Heritage Committee, 23rd session, Marrakesh, Morocco*. Paris: UNESCO.

Urban E, Fry CH, Keith S. 1986. *The birds of Africa*, vol. 2. London: Academic Press.

Verheyen R. 1956. Contribution à l'anatomie et à la systématique des Galliformes. *Bulletin de l'Institut royal des Sciences naturelles de Belgique: Biologie* 32: 1–24.

Verheyen WN. 1963. Sur quelques données concernant le dimorphisme sexuel, la distribution géographique d'*Afropavo congensis* Chapin, ainsi qu'un essai de bibliographie générale. *Bulletin de la Société royale de zoologie d'Anvers* 26: 7–15.

Vesk PA, Nolan R, Thomson JR, Dorrough JW, MacNally R. 2008. Time lags in provision of habitat resources through revegetation. *Biological Conservation* 141: 174–186.

Vitz AC, Rodewald AD. 2006. Can regenerating clearcuts benefit mature-forest songbirds? An examination of post-breeding ecology. *Biological Conservation* 127: 477–486.

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