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DEFINING THE PRESENT RANGE OF THE ORANGE-NECKED PARTRIDGE (*ARBOROPHILA DAVIDI*) IN VIETNAM

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ABSTRACT

The Orange-necked Partridge, *Arborophila davidi*, is limited to small fragmented patches in southern Vietnam and a small adjacent area in Cambodia. It was first discovered at Bu Kroai, Binh Phuoc Province, Vietnam, but not observed again by scientists until three sightings in 1991 on a small isolated hill at c.150–200 m near Dak Lua substation, Cat Tien National Park (Dong Nai and Lam Dong provinces), followed by further sightings during surveys elsewhere in the park in 1997. The lack of historical data on the distribution of this species limits our ability to understand its relationships with other *Arborophila* species and the potential impacts on this species of human changes to forest ecosystems in the region. From 1997 to 2012, we completed 375 line transects and 220 point counts in forest patches surrounding Bu Kroai in order to identify the present distribution of Orange-necked Partridge. We found the species in seven sites comprising a total area of about 2,300 km^2, mostly at elevations of 80–400 m. Most of these sites were inside protected areas.

Key words: Galliformes, species range, habitat type

INTRODUCTION

The Orange-necked Partridge *Arborophila davidi* occurs in southern Vietnam and a small area of adjacent eastern Cambodia (ROBSON, 2011; BIRDLIFE INTERNATIONAL, 2013) and is classified as a restricted-range species (STATTERSFIELD *ET AL.,* 1998). It was discovered at Bu Kroai, Binh Phuoc Province, southern Vietnam (DELACOUR *ET AL.*, 1927), but was not seen again by ornithologists until 1991 when it was rediscovered in Cat Tien National Park (Dong Nai Province sector), southern Vietnam (EAMES *ET AL.*, 1992), with sporadic sightings thereafter (ATKINS & TENTIJ, 1999; ROBSON *ET AL.,* 1993). The range was later extended to a small area in Cambodia where it was found in 2002 (DAVIDSON *ET AL.,* 2002).

After its rediscovery, the species was classified as Critically Endangered (1994–1999), but later downlisted to Endangered (2000–2008), and (since 2009) downlisted again to Near Threatened after it was recorded at several sites and found to be relatively tolerant of forest degradation. Its population is not thought to be decreasing rapidly, though it has a small population and range (BIRDLIFE INTERNATIONAL, 2013). Despite this increasing knowledge,

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data on its natural history, distribution and abundance are still sparse. Historically, it appears to have always been restricted to a small area. Since our surveys commenced in 1997, the species has been found at more sites, although its distribution remains patchy. This current fragmented distribution could be due either to specific habitat preferences or to habitat loss. Habitat loss in southern Vietnam has been severe in recent decades, particularly owing to logging, but also from deforestation due to herbicide spraying in the 1960s, during the conflict in the area, and the subsequent rapid expansion of settlements and cultivated land (particularly for cashew, cassava, and rubber). This paper aims to 1) review the current distributional knowledge of the Orange-necked Partridge by summarising a series of surveys undertaken during 1997–2012, and 2) use the currently known distribution to provide a baseline for future surveys of the species.

METHODS

Defining Survey Areas

The survey was conducted over 19 sites in southern Vietnam where we expected appropriate forest cover to remain, and where we estimated there to be a good level of protection from human impacts (Table 1). We then included five more sites based on the available literature (nos. 2, 21, 22, 23 and 24 in Table 1). The species is found in tropical seasonal forest and bamboo forest. (forest types are more precisely defined below). Although, in terms of macro-habitat selection, there are many forested sites within the natural range, the likelihood of finding the species in any given site is low if suitable habitat types are absent. Finally, we highlighted 11 sites where future surveys should be carried out to complete our knowledge of the current distribution of the species (Table 2). We excluded forested sites in the Mekong delta and in central Vietnam, as they were distant from the species type locality (DELACOUR *ET AL.*, 1927, DELACOUR & JABOUILLE, 1931) and probably never held habitat suitable for the species. We also excluded the area where the species was first described (DELACOUR *ET AL.*, 1927) (represented as a star in Figure 1) as, after a visit in 2004, it was found to be included in an artificial lake following the construction of the Thac Mo hydroelectric dam.

The surveyed sites included different proportions of various habitat types: dry deciduous dipterocarp forest, bamboo forest (in which generally ≥ 90% of stems belonge to bamboo species), tropical seasonal forest, tropical deciduous forest (following CORLETT, 2009), grassland, wetland, and agricultural land. However, the species was not detected in the last three habitats. We distinguished between tropical seasonal forest and tropical deciduous forest primarily on the predominance of bamboo clumps among the broadleaved trees in the latter category, which accords with the mixed deciduous forest of some authors.

We surveyed areas with the highest conservation status, such as national parks and nature reserves, and ones with lower conservation status such as cultural and historical sites and state forest enterprises. In southern Vietnam, these sites encompass most of the extant forest (from land use maps (FOREST INVENTORY AND PLANNING INSTITUTE, 2010). We estimate this to be about 95% of all remaining forested areas within the region covered. The total area, elevation, and the years of survey of the 19 sites are summarised in Table 1.

Table 1. Surveyed sites for the Orange-necked Partridge in Vietnam. Individual sites represent national parks, nature reserves, cultural and historical sites, forest enterprises, and undesignated government-owned forests that contain potential suitable forest habitats. The conservation protection level is highest in national parks and decreases sequentially for the following five categories as national parks officially get more funding than other categories; therefore they often have better protected condition on the ground.

No.[a]	Name of site	Protected status[b]	Total area[c] (km^2)	Elevation (m)	Survey years	ONP detected[d]
1	Bu Gia Map National Park [1,2]	Protected	260	200–750	2004, 2007	Yes
2	Bu Dop, Dak Ở Protective Forest [2]	Unprotected	342	150–550	2006	Yes
3	Bu Dang (Tho Son + Dong Nai)	Unprotected	140	200–600	2012	Yes
	Protective Forest [1,2]	Unprotected	140	200–600	2012	Yes
4	Nghia Trung State Forest Enterprise [1]	Unprotected	195	200–600	2003, 2004	Yes
5	Vinh Cuu Nature Reserve (Dong Nai Culture Nature Reserve) [1]	Protected	538	50 –200	2006, 2008	Yes
6	Cat Tien National Park [1]	Protected	715	900–659	1997–2012	Yes
7	Da Teh Special-use Forest [1,3]	Unprotected	305	100–600	2001–2002	Yes
8	Tan Phu proposed Nature Reserve [1]	Protected	140	70–220	2005–2006, 2010	Yes
9	Loc Bac State Forest Enterprise [1]	Unprotected	346	400–700	2003	No
10	Bao Lam State Forest Enterprise [1]	Unprotected	237	800–1,000	2003	No
11	Binh Chau – Phuoc Buu Nature Reserve [1]	Protected	113	10–150	1997–1999	No
12	Can Gio Biosphere Reserve [1]	Protected	757	0.7–1.2	1997, 2011, 2012	No
13	Tram Chim National Park [1]	Protected	73	0.4–2.3	1997, 2001	No
14	Duong Minh Chau Cultural & Historical Site [1]	Unprotected	50	–10	2007	No
15	Mount Ba Den Cultural & Historical Site [1]	Unprotected	20	50–986	2005–2007	No
16	Lo Go – Xa Mat National Park [1]	Protected	183	5–10	2005–2007	No
17	Chang Riec Cultural & Historical Site [1]	Unprotected	115	5–10	2007	No
18	Yok Don National Park [1]	Protected	1,120	200–480	2006, 2011	No
19	Bi Doup Nui Ba National Park [1]	Protected	560	1,400–2,300	2008	No
20	Nui Chua National Park [1]	Protected	290	0–1,200	2003–2011	No
21	Ta Dung Nature Reserve [4]	Protected	189	800–1,980	2001	No
22	Dak Mang Proposed Nature Reserve [5]	Unprotected	300	350–750	2004	No
23	Chu Yang Sin national Park [6]	Protected	593	850–2,440	2010	No
24	Lam VienCultural & Historical Site [7]	Protected	280	900–1,600	2009	No

[a] Number corresponding to Figure 1.

[b] Protected means that there is some level of forest protection, whereas unprotected means the forest can be used or converted to other habitats.

[c] Total area of the site, i.e., always likely to be larger than the actual area of each site actually occupied by the Orange-necked Partridge.

[d] "Yes" indicates the species was detected in the area, "No" indicates the species was not detected in the area

References: [1] This work; [2] Le Manh Hung *et al.*, 2006; [3] Nguyen Xuan Dang *et al.*, 2004; [4] Lê Trọng Trải, 2001; [5] Tordoff *et al.*, 2004; [6] BirdLife International, 2010); [7] Mahood *et al.*, 2009

Table 2. Summary of additional forest sites that might contain extant populations of the Orange-necked Partridge in southern Vietnam. The individual sites represent national parks, nature reserves, cultural and historical sites, protective forests, and state forest enterprises that contain potential suitable forest habitats. The conservation protection level is highest in national parks and decreases sequentially for the five categories.

No[a].	Name of site	Protected status[b]	Total area (km^2)	Elevation (m)	Predicted potential for ONHP[c]
25	Loc Ninh, Ta Thiet Protective Forest	Unprotected	163	80–400	1
26	Tan Lap, Suoi Nhung, Dong Xoai Protective Forest	Unprotected	340	100–400	1
27	Thong Nhat State Forest Enterprise	Unprotected	200	150–500	1
28	Quang Truc Special Forest Enterprise	Unprotected	155	400–650	1
29	Dak Nong Special-use Forest	Unprotected	162	150–600	1
30	Da Huoai & Madagui State Forest Enterprise	Unprotected	295	100–600	1
31	Mount Dai Binh Nature Reserve	Protected	50	170–1,300	3
32	Nui Ong Nature Reserve	Protected	255	50–1,400	2
33	Ta Kou Nature Reserve	Protected	119	0–580	2
34	Kalon – Song Mao Nature Reserve	Protected	200	20–1,200	2
35	Phuoc Binh National Park	Protected	198	200–1,900	3
36	Dak Mai Protective Forest	Unprotected	296	150–550	1
37	Thọ Sơn Protective Forest	Unprotected	277	–600	1

[a] Number corresponding to Figure 1.
[b] Protected means that there is some level of forest protection, whereas unprotected means the forest can be used or converted to other habitats.
[c] Predicted potential occupancy of ONHP based on remaining forest and suitable elevation(1 high potential; 2 moderate potential; 3 low potential).

Surveys

The surveys were conducted from 1997 to 2012, between January and May, in the dry season which is also the breeding season, when the species is easiest to detect. Each site was surveyed at least once for a minimum of 10 days. Data on the presence of the species were collected using line transects along available trails passing through different habitat types or point counts located in different habitats. Surveys were carried out within a period ranging from 05h00 and 11h30 and from 15h00 to 18h00; birds were detected either visually or by call. When a bird was detected, we recorded the GPS location. Playback was used to stimulate a response in order to increase detection of the species since it responds very well to playback.

Sites where birds were not detected during our first visit were surveyed multiple times. Owing to these multiple surveys, we are confident that the species was not present in habitat patches where we did not detect it.

RESULTS

The 19 sites surveyed covered a total area of about 6,200 km^2 (Figure 1, Table 1). We found the Orange-necked Partridge at seven sites, and the species was detected in a previous survey at an eighth site (Bu Dop, Dak Ơ Protective Forest, Le Manh Hung *et al*. 2006), with a total area of about 2,300 km^2 across three provinces: Binh Phuoc, Dong Nai, and Lam

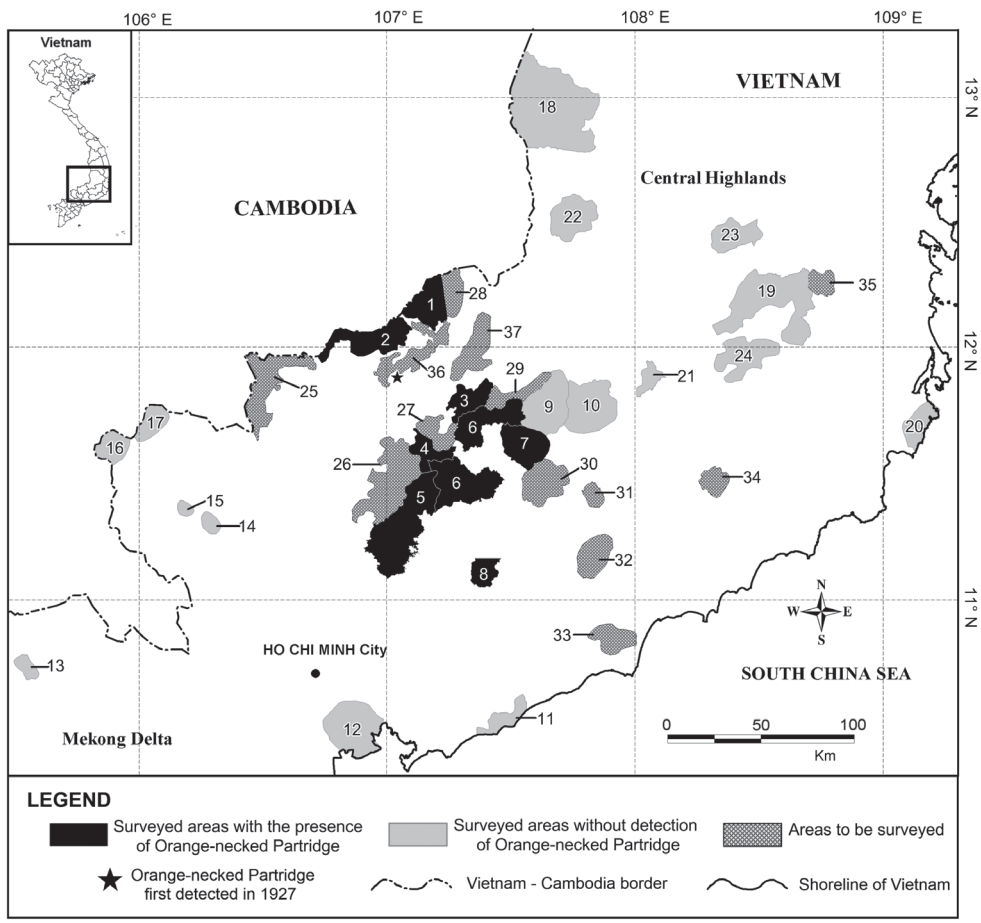

Figure 1. The current distribution of the Orange-necked Partridge in Vietnam. Individual sites shown represent national parks, nature reserves, cultural and historical sites, state forest enterprises, and undesignated government-owned forests that contain potentially suitable forest habitats. Site numbers correspond to Tables 1 and 2.

Dong. Within those seven sites, we had 169 detections of individuals or groups of Orange-necked Partridges in three habitats during our surveys. The species was predominantly found at elevations ranging between 85 and 400 m (up to 607 m) with 41% of the detections located between 85 and 200 m, 47% between 200 and 400 m and 11% between 400 and 607 m. We only detected the Orange-necked Partridge in three habitat types, namely tropical deciduous forest, tropical seasonal forest and bamboo forest. Therefore we define "suitable habitat" as mainly composed of tropical deciduous forest (70% of the detected locations) with lower proportions of detections in tropical seasonal forest (18%), and bamboo forest (12%).

DISCUSSION

In our extensive surveys between 1997 and 2012, the Orange-necked Partridge was detected at seven sites covering a total of 2,300 km^2 of protected areas, encompassed within a cumulative total area of all sites surveyed of 6,200 km^2, in the transitional region between the highlands of central Vietnam and the lowlands of the Mekong Delta.

Within its limited global distribution, this species also appears to be confined to rolling hill slopes covered by tropical deciduous forest and tropical seasonal forest. These may include bamboo patches below 500 m (LE MANH HUNG *ET AL.*, 2006). In some areas, such as in the southern part of Cat Tien National Park and Tan Phu Forest Enterprise (Dong Nai Province), the species was detected in rolling isolated hilltops at 120–320 m but was absent from the surrounding relatively flat lowland terrain showing the same habitat type. The same situation was found in the western half of Vinh Cuu Nature Reserve where we only detected the Orange-necked Partridge in the north-eastern hilly part, while much of the reserve consists of flat lowlands lying below 90 m where the species was not detected. Within the Tan Phu area (site 8), 140 km^2 in total, the species was only detected, and was locally common, in small hilly areas estimated to be about 20 km^2. At the moment, however, it is not clear whether elevation or slope is the key factor affecting the species' distribution. Slope has been shown to separate similar species in the pheasant genus *Lophura* (SUKUMAL & SAVINI, 2009). A similar segregation based on topography might exist among the Orange-necked Partridge and other *Arborophila* species, such as the Scaly-breasted Partridge *A. chloropus*. Based on its specific habitat preferences, therefore, the actual area of habitat occupied by Orange-necked Partridge could be very much smaller than the 2,300 km^2 of protected area in which we found it: possibly as little as 200 km^2 in total.

The prevalence of detections of the species in tropical deciduous forest could be a byproduct of the prevalence of this habitat over the other two (tropical seasonal forest and bamboo forest). However, the proportions of each forest type in the study areas were not defined. Moreover, due to its intermediate composition, tropical deciduous forest might be seen as merely occupying an intermediate position along a gradient of previous forest disturbance, with tropical seasonal forest being the least disturbed and bamboo forest being the most heavily disturbed.

The species may also survive in degraded or regenerating habitat, as it was recorded in some state forest enterprises such as Nghia Trung, Bu Dang, and Da Teh where the forests had been severely logged. We can hypothesize that it is only relatively safe from the impacts of human activity (i.e., hunting and deforestation for agricultural use) in the two national parks in which we found it, Bu Gia Map and Cat Tien National Parks. National parks receive

more official funding than other categories such as nature reserves, historical sites, state forest enterprises, etc. Sites designated as national parks normally have the highest level of protection on the ground compared to the other protected area designations.

For 64 years, from the time of its discovery by DELACOUR *ET AL*. (1927) until its rediscovery in 1991, the Orange-necked Partridge was known only from the type locality. It seems likely, therefore, that it was either never widespread or that human impacts on its habitat and population were already significant at the time of its discovery. The much larger body of historical information on closely related species occupying similar types of forest in the region suggests that the former explanation is most likely. The limited distributional range of Orange-necked Partridge might be due to its limitation to hilly terrain (with exclusion from the extreme lowlands by Scaly-breasted Partridge) and its replacement at higher elevations by the larger Bar-backed Partridge *Arborophila brunneopectus*. High elevation in the north of the distributional range determined through this work might act as a natural barrier preventing its dispersal further northward.

Based on the presence of extant forest, suitable elevations, and their proximity to the areas where the species is currently found, we identified an additional 13 sites that should be surveyed for the Orange-necked Partridge (Figure 1, Table 2). Of these sites, we suggest eight might have a high probability of containing populations, and which therefore should be given the highest priority for future surveys. Of the remaining five sites, only three were classified as having a moderate chance of supporting populations and the final two sites have low chances of holding populations of the species. Moreover, we suggest additional surveys sites 21, 22 and 24 (Table 1) as past surveys conducted in those areas were done for general conservation census of the entire bird community and not specifically for the presence of Orange-necked Partridge. Therefore we cannot exclude the possibility that the species might still be present.

A rapidly decreasing time window remains to survey the 13 sites identified as survey priorities, because most habitats within the historical range have low protection and are shrinking drastically due to the rapid expansion of agricultural land, human settlements and high hunting pressure. However, threats to the species occur not only in non-protected areas and low-level protected conditions, but also in national parks where the species continues to face illegal hunting and habitat loss. Recently, hydroelectric plants have become another major cause of habitat loss, especially when they are built inside or near parks, as they result in habitat degradation and increases the opportunities for people to illegally penetrate deep into protected habitat. Due to these reasons, two hydroelectric plants named Dong Nai 6 and Dong Nai 6A planned to be built in the north sector of Cat Tien National Park were cancelled as, besides destroying part of the protected area forest, they would have badly affected the wetland found within it and altered the flow of the Dong Nai River at its edge.

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REFERENCES

ATKINS, R. A. AND M. TENTIJ. 1999. The Orange-necked Partridge and five other Galliformes in two protected areas in southern Vietnam. *Annual Review of the World Pheasant Association 1998/99*: 49–52.

BIRDLIFE INTERNATIONAL. 2010. The biodiversity of Chu Yang Sin National Park, Dak Lak Province, Vietnam. Compiled and edited by R. Hughes, BirdLife International in Indochina. Hanoi, Vietnam.

BIRDLIFE INTERNATIONAL. 2013. Species factsheet: *Arborophila davidi*. Downloaded from http://www.birdlife.org on 03/06/2013.

CORLETT, R. 2009. *The Ecology of Tropical East Asia*. Oxford University Press, Oxford, U.K.

DAVIDSON, P., J. WALSTON, AND C. POOLE. 2002. Endangered partridge discovered in Cambodia. World Birdwatch 24: 4.

DELACOUR J., P. JABOUILLE, AND W. P. LOWE. 1927. New birds from Indo-China. *Bull. Brit. Orn. Club* 47: 151–170.

DELACOUR, J., AND P. JABOUILLE. 1931. Les oiseaux de l'Indochine Francaise, 1–4. *Paris: Exposition Coloniale Internationale*.

EAMES, J. C., C. R. ROBSON, N. CU AND T. LA. 1992. Forest bird surveys in Vietnam *1991*. ICBP Study Report 51.

FOREST INVENTORY AND PLANNING INSTITUTE. 2010. Land use map of Viet Nam.

LA MANH HUNG, NGUYEN MANH HA, TRAN THIEU DU, TRAN DUC AI, VUONG DUY LAP AND VU THANH PHONH. 2006. The Status and Distribution of Orange-necked Partridge *Arborophila davidi* in Binh Phuoc Province, Vietnam. Unpublished report to the BP Conservation Programme.

LÊ TRỌNG TRÀI. 2001. *Chuyên Đề Tài Nguyên Động Vật Khu Bảo Tồn Thiên Nhiên Tà ĐùngTỉnh Đắc Lắc*. Viện Điều tra quy hoạch rừng Trung tâm Tài nguyên và Môi trường Lâm nghiệp. Báo cáo tháng 10, 2001. Hà Nội.

MAHOOD, S. P., LE TRONG TRAI, TRAN VAN HUNG AND LE ANH HUNG. 2009. Identification, planning and management of forests of high conservation value: final consultancy report. Hanoi, Vietnam: BirdLife International Vietnam Programme, Ha Noi, Vietnam.

NGUYEN XUAN DANG, DO HUU THU, AND T. OSBORN, (eds.). 2004. A Biological and Socioeconomic Assessment of Da Teh State Forest Enterprise, Lam Dong Province, Vietnam. WWF Cat Tien National Park Conservation Project, Hanoi.

ROBSON, C. R., J. C. EAMES, NGUYEN CU AND TRUONG VAN LA. 1993. Birds recorded during the third BirdLife/ Forest Birds Working Group expedition in Viet Nam. *Forktail* 9: 89–119.

ROBSON, C. R. 2011. *Birds of South-East Asia*. New Holland. London.

STATTERSFIELD, A. J., M. J. CROSBY, A. J. LONG, AND D. C. WEGE. 1998. *Endemic bird areas of the world: priorities for biodiversity conservation*. BirdLife International, Cambridge, U.K..

SUKUMAL, N. AND T. SAVINI. 2009. Altitudinal differences in habitat use by Siamese fireback (*Lophura diardi*) and Silver pheasant (*Lophura nycthemera*) in Khao Yai National Park, Thailand. *International Journal of Galliformes Conservation* 1: 18–22.

TORDOFF, A. W., TRAN QUOC BAO, NGUYEN DUC TU AND LE MANH HUNG. 2004. *Sourcebook of existing and proposed protected areas in Vietnam. Second edition*. BirdLife International in Indochina and Ministry of Agriculture and Rural Development, Hanoi.