Practicality of detecting scansorial birds using camera traps in central Japan

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Although camera-trapping is one of the most non-invasive and efficient survey tools for studying wildlife distribution and ecology, it does not seem to be widely established as a survey tool for bird species. We examined the practicality of using camera traps in detecting scansorial birds in central Japan. We chose 221 camera-trapping sites on two mountains in central Japan, during two spring–autumn periods. The sensor cameras were placed at 2–3 m above the ground and facing tree trunks. We recorded all six possible species of scansorial birds with the exception of one species which is a winter visitor. Four of these species were endangered and/or semi-endangered species in the regions. Our results suggest that tree trunk camera-trapping has potential for detecting scansorial birds and providing new information on the ecology of such species.

INTRODUCTION

Camera-trapping ranks among the most non-invasive and efficient techniques for passively surveying animals and, in turn, determining their population density, habitat use and activity patterns (e.g. Burton *et al.* 2015, Rovero & Zimmermann 2016). Camera-trapping has traditionally been used primarily for mammal studies. Bird species, when captured, have been regarded as mere by-products of this method. In recent years, however, some research has suggested that camera-trapping can be a useful approach for surveying large ground-dwelling birds, including pheasants and members of the Cracidae family (O'Brien & Kinnaird 2008, Dinata *et al.* 2008, Li *et al.* 2010, Liang *et al.* 2019). In addition, Seki (2010) captured images of a forest-dwelling community of various bird species by positioning a camera towards an artificial bathing area. While several studies have acknowledged the effectiveness of camera-trapping, it is not widely established as a survey tool for ornithological studies and the improving of camera-trapping methods has potential for expanding its use for the study of bird species.

Earlier, we reported that camera traps directed towards tree trunks can assess the distribution of arboreal small mammals (Suzuki & Ando 2019a,2019b) and their ecology (Suzuki & Ando 2017,2019c). Given the success of that study, we hypothesised that the technique would also aid with the detection of scansorial birds such as woodpeckers (Suzuki & Ando 2009). To assess the efficacy of camera traps in detecting scansorial birds, we sought to inventory scansorial birds by conducting extensive tree trunk camera-trapping in two mountainous areas in central Japan.

METHODS

We performed tree trunk camera-trapping in the mixed conifer–broadleaved forests of Mount Daibosatsu and the Tanzawa Mountains, both on Honshu Island, Japan, for two years from 2 June to 20 November 2007, and from 11 April to 14 November 2008. In Mount Daibosatsu, we set cameras along three rivers and four forest roads (35.666–35.716°N 138.816–138.850°E, altitude 1,350–1,600 m). In the Tanzawa Mountains, we chose two areas: a mountainous area around Fudakake (35.433–35.450°N 139.183–138.216°E, 560–850 m) and Hadano Togawa Park (35.400°N 139.166°E, 300–400 m) at the base of the Tanzawa Mountains. We did not perform surveys during the winter due to heavy snow cover in both areas. Mount Daibosatsu is mostly covered by natural forest dominated by Nikko fir *Abies homolepis* and broad-leaved trees, such as Japanese beech *Fagus crenata* and oak *Quercus crispula*. Tanzawa Mountains mainly feature Japanese cedar *Cryptomeria japonica*, Japanese fir *Abies firma*, Japanese beech and Konara oak *Quercus serrata*. In our previous work, we have detailed the vegetation of both mountainous areas (Suzuki & Ando 2019a).

We placed cameras equipped with an infra-red motion sensor and a flash with visible spectrum (Field-Note IIa, Marifu Co., Ltd., Iwakuni, Japan) at 221 sites for 8–60 days (mean = 34.3, SD = 11.0), for a total of 7,577 camera days. We spent 5 to 10 minutes placing each camera, and 10 to 20 cameras were placed per day. We changed all camera batteries and film every two weeks. This took 2 to 3 minutes per site. In some cameras, the film ran out before the end of the two-week period. We placed each camera site at distances greater than 50 m from each other and directed cameras horizontally towards tree trunks at 2–3 m above the ground. Distances between the cameras and trunks ranged from 35 to 320 cm. We did not use any bait. Shutter speed from detection by the sensor to triggering was 0.6 seconds, and the minimum latency time to the next shot was 2 minutes. We identified bird species captured in pictures with reference to Takano (1985) and Takada & Kanouchi (2004). We reported earlier results of using this method in the Tanzawa Mountains (Suzuki & Ando 2009).

RESULTS

By using tree trunk camera-trapping, we documented six species of scansorial birds in 23 detections during the two-year study period (see Plates 1–5 and Table 1). Of the six species, White-backed Woodpecker *Dendrocopos leucotos* and Japanese Pygmy Woodpecker

Plates 1–5 were all taken by camera-traps on Honshu Island, Japan, in 2007–2008. See Suzuki & Ando (2009) for an image of White-backed Woodpecker.

Plate 1. Japanese Pygmy Woodpecker *Dendrocopos kizuki.*

Plate 2. Great Spotted Woodpecker *Dendrocopos major*.

Plate 3. Japanese Green Woodpecker *Picus awokera*.

Plate 4. Eurasian Treecreeper *Certhia familiaris*.

Plate 5. Eurasian Nuthatch *Sitta europaea*.

D. kizuki appeared only in the Tanzawa Mountains, whereas Eurasian Treecreeper *Certhia familiaris* and Eurasian Nuthatch *Sitta europaea* appeared only on Mount Daibosatsu. The remaining two species—Great Spotted Woodpecker *D. major* and Japanese Green Woodpecker *Picus awokera*—appeared in both areas. In all detection events, birds were pictured on tree trunks.

We detected all species except White-backed Woodpeckers at several camera sites, and we did not detect the same species more than once at the same site on the same day. However, the detection rate for each species was low (Table 1). Although we detected Eurasian Nuthatches most frequently, their detection rate was only 0.09 detection/100 camera days. Similarly, although Great Spotted Woodpeckers appeared at the most camera sites, their rate at detection sites was only 2.3 detection/100 camera sites.

Other identifiable species that we detected were Great Tit *Parus minor* (0.07 detection/100 camera days), Varied Tit *P. varius* (0.15), Eurasian Jay *Garrulus glandarius* (0.04), Brown-headed Thrush *Turdus chrysolaus* (0.04) and Collared Scops Owl *Otus lempiji* (0.01). Nearly all unidentifiable birds appeared in flight or on tree branches, although we detected one Eurasian Jay on a tree trunk. In addition, although we captured images of 10 other birds, we could not identify the species due to blurry or partial images. We have already reported details of the White-backed Woodpecker and Collared Scops Owl in an earlier study (Suzuki & Ando 2009).

DISCUSSION

We succeeded in using tree trunk camera-trapping to detect nearly all scansorial birds that inhabit the studied areas. In an earlier study, Franzreb & Hanula (1995) observed the behaviours of woodpeckers in the United States by directing camera-trapping towards their nesting cavities. By extension, we have demonstrated that tree trunk camera-trapping is useful for detecting scansorial birds, even if researchers are unaware of their nesting places. We did not detect Eurasian Wryneck *Jynx torquilla*, most likely because we did not perform surveys during the winter when these migratory birds occur in central Japan. Determining whether researchers can use tree trunk camera-trapping to detect this and other migratory species will require surveys in the winter or the expansion of surveys into

Table 1. Summary of results of tree trunk camera-trapping.

Species	Number of detections	Detection rate (number of detections/100 camera days)	Number of detection sites	Rate of detection site (number of detection sites/100 camera sites)
White-backed Woodpecker *Dendrocopos leucotos*	1	0.01	1	0.5
Great Spotted Woodpecker *Dendrocopos major*	5	0.07	5	2.3
Japanese Pygmy Woodpecker *Dendrocopos kizuki*	2	0.03	2	0.9
Japanese Green Woodpecker *Picus awokera*	2	0.03	2	0.9
Eurasian Treecreeper *Certhia familiaris*	6	0.08	4	1.8
Eurasian Nuthatch *Sitta europaea*	7	0.09	4	1.8

northern Japan where Eurasian Wrynecks migrate in the summer (Hino 1985).

In particular, camera-trapping allowed us to detect rare or poorly surveyed birds in Japan, including White-backed Woodpeckers, Japanese Green Woodpeckers, Eurasian Treecreepers and Eurasian Nuthatches, all of which are considered as endangered or semi-endangered species in many Japanese prefectures, including in our study areas (Association of Wildlife Research and Envision Conservation Office 2017). White-backed Woodpeckers are especially rare in the Tanzawa Mountains, where there are thought to be fewer than 10 pairs as a result of decreasing large beech *Fagus crenata* forests which form their breeding habitat (Kato *et al.* 2006). The Kanagawa-Branch of Wild Bird Society of Japan collected 47,830 bird observations by society members throughout the Kanagawa Prefecture from 2001 to 2005, but White-backed Woodpecker was only represented in one observation (Wild Bird Society of Japan Kanagawa-Branch 2007). By comparison, observations of other woodpeckers were much more numerous (Japanese Pygmy Woodpeckers, 900 observations; Great Spotted Woodpeckers, >100 observations; and Japanese Green Woodpeckers, >500 observations). Although it is not possible to compare our survey effort to that of the Wild Bird Society, our information suggests that camera-trapping may help to understand ecology and distribution of scansorial birds in decline.

Call playback is the standard method for detecting woodpecker species (Imbeau & Desrochers 2002, Kumar & Singh 2010). Detection rates of our camera-trapping effort were low for all woodpecker species (Table 1) compared to what is typically observed for playback; for example, Three-toed Woodpecker *Picoides tridactylus* was detected at 15 to 44 % of study sites (Imbeau & Desrochers 2002). Additional studies are necessary to clarify whether improved camera placement can increase the detection rates of targeted species and how the method compares to playback. With small arboreal mammals, researchers can increase detection rates by directing camera traps towards trees preferred by the targeted species (Suzuki & Ando 2019a). Likewise, the detection rate of woodpeckers could be increased by directing cameras towards dead trees, which woodpeckers often excavate for nesting and feeding (Smith 1997, Gutzat & Dirnann 2018). In addition, we placed cameras at 2 to 3 m above the ground because this study was designed for detecting flying squirrels mainly landing on trees at this height (Suzuki *et al.* 2012). Scansorial birds tend to occur at greater heights in trees (Nilsson 1984, Li & Martine 1991). Placing cameras higher up tree trunks could therefore increase the detection rates of such species.

In contrast, there are some advantages in camera-trapping. Camera-trapping at non-baited sites minimises confounding effects on behaviour compared to playback, which evokes a territorial response. It can also be effective in documenting behaviour. Although we used film cameras in this study, digital camera traps that can record moving images could record more detailed behaviours. In addition, camera-trapping can collect data over a longer period with less effort than playback surveys. Camera-trapping requires about 5 to 10 minutes for placement per site and observations were made during eight days or more. Also, because battery changes took 2 to 3 minutes per site, camera-trapping can run for 16 days or more by spending a total of just 7 to 13 minutes working time. Additionally, advances in mass storage and battery life mean that the interval between camera checks can now be longer than the two weeks reported in our survey and is not seasonally limited. In contrast, the playback surveys are restricted mainly to the breeding season (Fall 1981). For example, Kumar & Singh (2010) surveyed woodpecker distributions using playback and spent 100 to 110 minutes per site. In addition, Vergara & Schlatter (2004) repeated a minimum of 15 minutes playback method every 100 m throughout their survey area.

Our results suggest that tree trunk camera-trapping has potential for detecting scansorial birds and providing useful knowledge on habitat use, in spite of its limitations. In general, woodpeckers play key roles as cavity excavators for other cavity-nesting birds as well as mammals (Daily *et al.* 1993, Martin & Eadie 1999, Robles & Martin 2013), and therefore the diversity and abundance of woodpecker species in an area is an important indicator of the diversity of forest-dwelling birds and mammals therein (Mikusiński *et al.* 2001, Drever *et al.* 2008). Accordingly, the conservation of woodpeckers frequently appears in conservation management plans (Ligon *et al.* 1986, Kelly *et al.* 2019), and the distribution and ecology of woodpeckers has been actively assessed for decades (Hoyt 1957, Garabedian *et al.* 2018). However, in areas of Asia, especially in the Oriental region where there is high woodpecker diversity (Winkler *et al.* 1995), knowledge of the ecology of scansorial birds is especially poor, and it has been suggested that there is a need to develop monitoring protocols for woodpeckers (Kumar & Singh 2010). Therefore, tree trunk camera-trapping may be useful to advance research on woodpeckers and other scansorial birds.

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