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Clearing Width and Movements of Understory Rainforest Birds[1]

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ABSTRACT

We assessed the capacity of three species of disturbance-sensitive understory birds to traverse a highway (50–75 m width) and large farm clearing (250 m width), by radio-tracking translocated individuals in central Amazonia, Brazil. Most individuals translocated across the highway (eight of nine birds) or moved within continuous forest (five of seven birds) returned to their home ranges, whereas none of five birds moved across the large clearing returned. Our results suggest that large clearings (>250 m width) can significantly reduce the movements of some understory rainforest birds.

RESUMEN

Avaliamos a capacidade de três espécies de pássaros de sub-bosque, sensíveis à perturbações, para atravessar uma estrada pavimentada (50–75 m de largura) e uma grande área desmatada de uma fazenda (250 m de largura) ambas na Amazônia central brasileira. Para tal, os indivíduos destas espécies foram rastreados através do uso de rádio transmissor. A maioria dos indivíduos que se translocaram através da estrada (eight de nine pássaros) ou que se moveram dentro da floresta contínua (five de seven pássaros) retornaram para suas respectivas áreas de vida, ao passo que nenhum dos cinco pássaros que se moveram através da área desmatada da fazenda regressaram. Nossos resultados sugerem então que grandes áreas desmatadas (>250 m) podem significantemente reduzir os movimentos de alguns pássaros de sub-bosque que habitam a floresta tropical úmida.

Key words: Amazon birds; bird movements; bird translocations; rainforest fragmentation; roads; understory birds.

Understory Rainforest Birds Are Highly Sensitive To Habitat Disturbance. Many species decline or disappear from forest fragments (Stouffer & Bierregaard 1995, Stratford & Stouffer 1999, Beier *et al.* 2002), logged rainforest (Thiollay 1992, Aleixo 1999), fire-disturbed forest (Barlow *et al.* 2002), and forest edges bordering agricultural fields (Restrepo & Gomez 1998) and road clearings (Laurance 2004). One possible explanation for bird declines in modified landscapes is that some species may be reluctant to move across forest clearings or may have limited dispersal ability (Terborgh 1974, Stouffer & Bierregaard 1995, Sekercioglu *et al.* 2002).

In most tropical regions, forest habitat is being cleared and isolated by the rapid proliferation of small and large clearings, but the extent to which this affects the movement and dispersal of wildlife is still unknown. Recent studies on the effects of narrow road clearings (30–40 m width) on understory birds in central Amazonia revealed that local movements of many species were significantly inhibited (Laurance *et al.* 2004). Species that respond negatively to small clearings include members of mixed-species flocks (Develey & Stouffer 2001, Laurance *et al.* 2004), army ant-followers, terrestrial species, and solitary insectivores (Laurance *et al.* 2004). Two distinctive but interrelated mechanisms were identified as contributing to the inhibition of bird movements: avoidance of edge habitat and a reluctance to traverse forest clearings (Laurance *et al.* 2004).

Are understory birds actually unable to cross small clearings, or do reduced movements across roads (Develey & Stouffer 2001, Laurance *et al.* 2004) simply reflect an alignment of individual home ranges with road edges coupled with a general reluctance to traverse open areas? To address this question we undertook experimental translocations of key bird species across small and larger forest clearings in central Amazonia. Translocation studies have certain advantages over passive observations of wildlife movements because they can control and replicate many factors, such as the distance between capture and release sites, the timing of the experiment, landscape composition and configuration, and the motivation of the translocated species (which almost invariably have an intense desire to return to their original territory; Bélisle *et al.* 2001). However, the degree to which these translocated movements reflect actual bird movements is still unknown.

Bird translocations were undertaken at three study sites surrounded by primary rainforest 50–80 km north of Manaus, Brazil (Fig. 1). These included (1) a highway clearing of 50–75 m width, (2) a farm clearing of 250 m width, and (3) a continuous-rainforest site. The highway-clearing site was situated along the BR-174, a major highway that connects Manaus to Caracas, Venezuela. This site was situated inside a forest reserve (controlled by the National Institute for Amazonian Research [INPA]) and is one of the few remaining sites north of Manaus where undisturbed rainforest still borders the highway clearing. The farm-clearing site bordered the BR-174 highway, and was selected because it supported a large, well-maintained cattle pasture (250 m × 2500 m in area), without forest regrowth. The pasture clearing

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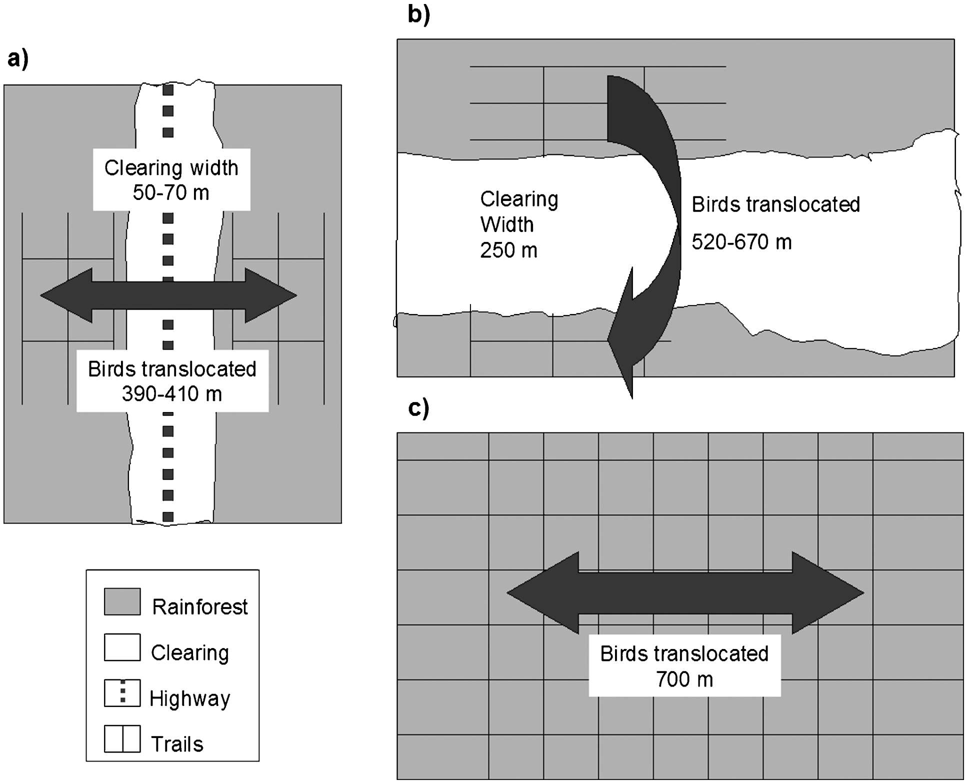

FIGURE 1. Bird-translocation sites in central Amazonia: (a) the narrow highway clearing, (b) the larger farm clearing, and (c) the control site. Arrows indicate direction of translocations.

was much longer (2500 m) than it was wide, so that translocated birds attempting to return to their territories would not simply circumvent the clearing (Desrochers & Hannon 1997). The control site was in a large block (>100,000 ha) of continuous primary rainforest at the Biological Dynamics of Forest Fragments Project (Lovejoy *et al.* 1986, Laurance *et al.* 2002), at a site (the camp Km 41 vicinity) that contained a 100-ha network of forest trails.

We selected three bird species as representatives of three different understory guilds whose movements appear to be significantly disrupted by small road clearings (Laurance *et al.* 2004). All three species are nonmigratory, relatively common in mist-net captures, and maintain home ranges of about 5–15 ha per pair (Terborgh *et al.* 1990, Stouffer & Bierregaard 1995, Develey & Stouffer 2001). The cinereous antshrike, *Thamnomanes caesius*, (mean ± SD weight = 17.5 ± 1.1 g) is a sentinel and core member of understory mixed-species flocks. The scale-backed antbird, *Hylophylax poecilinota*, (16.8 ± 1.2 g) is an understory species that is mainly solitary, whereas the rufous-capped antthrush, *Formicarius colma*, (46 ± 2.8 g) is a solitary terrestrial species.

We captured birds in mist nets (12 × 2 m, 36-mm mesh size) using playback of bird vocalizations. Resident birds were targeted because they would be highly motivated to return to their home range. Only male birds were used in the study because their response to playback generally indicates that they are territorial and not transitory. Male plumage is also a good indicator of adulthood whereas females and subadults are often difficult to distinguish on the basis of plumage alone. Playback was not undertaken at sites if previously translocated and released birds were still in the area.

To facilitate our movements at the highway and farm clearings, we cut trail grids (*ca.* 200–250 m × 150–200 m) into the forest on opposite sides of the clearings (Fig. 1). Each grid consisted of three evenly spaced trails parallel to the clearing intersected by two evenly spaced trails that were perpendicular to the clearing. We banded and weighed captured birds, and fitted radio transmitters (Holohil Systems, Ontario, Canada) to their lower back. Birds at the highway and farm sites were captured and translocated to the opposite side of the clearing (Fig. 1), whereas those at the control site were translocated a comparable distance (700 m) within continuous forest (Fig. 1). Translocation distances varied somewhat within treatments because birds were captured in different places along the grids. Initially, we left translocated birds undisturbed for a few hours, then tracked their movements at frequent (1–3 h) intervals until they had either returned to their original territories or had disappeared from the study area.

We translocated 21 individual birds: 9 across the highway, 5 across the farm clearing, and 7 at the control site (sample sizes were limited by a large number of malfunctioning transmitters and the low density of forest birds in central Amazonian forests; Stouffer & Bierregaard 1995). Nine individuals (three of each study species) were translocated across the highway clearing, with birds being moved 390–420 m from their original capture point (Fig. 1). At least eight of these birds returned to their home ranges (the ninth lost its radio). However, the three species responded differently to translocation: *Thamnomanes* returned very quickly to their respective territories (usually within 3–5 h), whereas *Hylophylax* and *Formicarius* individuals flew to the road verge and moved up and down the forest edge but did not cross during the first day. However, all individuals (with the possible exception of one *Formicarius* that lost its radio) had returned to their original territories within 2 d. Because at least eight of the nine translocated birds traversed the highway clearing we did not undertake control translocations for equivalent distances for this part of the experiment.

Five birds (three *Hylophylax* and two *Formicarius*) were translocated across the large clearing, being moved for distances of 520–670 m from their original capture point (Fig. 1). Unfortunately, *Thamnomanes* were not captured at this site due to the low density of mixed species flocks. No translocated birds returned to their original territories during a period of 5–10 d. Within 2–4 d of translocation, birds had left the release site, both release and capture sites were surveyed for a further 3–6 d but no individuals could be detected anywhere in the study area. In addition to searching for radio transmitters, we undertook taped playback in the birds' original territories to determine if the birds had returned without their radios.

We translocated seven birds (five *Hylophylax,* two *Formicarius*) at the control site, with all individuals being moved 700 m from their original capture point. Because of malfunctioning transmitters, most (four of five) *Hylophylax* were fitted with legbands only. At least five of the seven birds returned to their original capture site: both *Formicarius* (returning within 1 d) and three *Hylophylax* (two returning within 1 d and one within 4 d). The fate of the other two *Hylophylax* is unknown, but because both were merely banded, rather than carrying transmitters, they might have returned to their home range and avoided recapture. Although we assumed, conservatively, that only five of seven birds returned to their respective territories in intact forest, this proportion was still significantly higher than that returning across the large clearing (zero of five birds; $P = 0.028$; Fisher's exact test). Thus, in this experiment, a 250 m wide clearing significantly inhibited the homing movements of territorial birds, relative to individuals in intact forest.

Our results suggest that larger (>250 m wide) forest clearings significantly inhibit the movements of these fragmentation-sensitive understory birds in central Amazonia. A smaller highway clearing (50–75 m wide), however, did not inhibit movements enough to prevent homing. These results help us to interpret the findings of earlier studies of bird responses to road clearings (Develey & Stouffer 2001, Laurance *et al.* 2004) and forest fragmentation (Stouffer & Bierregaard 1995, Borges & Stouffer 1999). We suggest that narrow road clearings inhibit the daily or regular movement patterns of some understory forest birds, but do not constitute a major barrier to dispersal movements or gene flow. However, the decline and disappearance of birds from recently isolated forest remnants, and the recolonization of fragments by several species when secondary forest regenerated in the surrounding matrix (Stouffer & Bierregaard 1995), suggests that large clearings significantly inhibit dispersal of some understory bird species.

Translocation experiments are currently being advocated as a technique to provide specific predictions of a species' response to habitat fragmentation (Bélisle *et al.* 2001). It is uncertain, however, whether the responses of translocated adult males to forest clearings also reflect other kinds of movements by the species, such as dispersal, which is usually undertaken by juveniles or subadults (Lidicker 1975). Nevertheless, there is little doubt that translocated birds, which have been experimentally separated from their established territory and mate, have an extremely strong motivation to return to their original territory. That such movements are significantly inhibited by a moderately wide (250 m wide) clearing suggests that populations of these species may become isolated (Brown & Kodric-Brown 1977), and therefore highly vulnerable to local extinction, in fragmented forests. Habitat fragmentation is likely to increase in the Brazilian Amazon over the next decade from government-sponsored infrastructure programs (Laurance *et al.* 2001). Understanding the implications of these landscape changes is crucial for reducing their impacts on forest-dependent wildlife.

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