monkeys towards a tortoise. The capuchins do, however, steal and eat the tortoises' eggs.

The incident shows that capuchin monkeys will spontaneously throw a stone hard enough to cause a potential competitor or threatening animal to move away. It also provides a new case of a capuchin using a stick to strike another animal in an aggressive/defensive context. Once again, we are reminded that capuchins use objects effectively and creatively to achieve a goal.

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TWO CASE STUDIES USING PLAYBACKS TO CENSUS NEOTROPICAL PRIMATES: *CALLICEBUS DISCOLOR* AND *ALOUATTA PALLIATA AEQUATORIALIS.*

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A solid understanding of wild population status is needed to monitor biodiversity for conservation (Milner-Gulland & Rowcliffe, 2007), but as time and money are seriously limited in conservation projects, investigators should try to get accurate results whilst minimizing costs. The minimum number of observations required for accurate census results are often difficult to obtain (Marsden, 1999): species may behave cryptically and so are less audible and visible to those conducting surveys, or habitats can be densely vegetated with low visibility, increasing the effort required to achieve minimum number of observations. In order to increase detection in these circumstances, playbacks of conspecific calls have been used for a variety of Neotropical primate species. Playbacks have been used to determine the presence of primates (e.g. *Ateles fusciceps* Peck et al., 2011) and to estimate primate density using a combination of playbacks and distance sampling (e.g. *Callicebus discolor* Dacier et al., 2011), or strip transects (e.g. *Saguinus oedipus* Savage et al., 2010). Here we focus on the use of playbacks to estimate population densities, though some of the content will be of interest for those using playbacks to survey primate presence. We review the requirements to conduct playbacks censuses with Neotropical primates and present assessments of the utility of this method for two Ecuadorian species: red titi monkeys (*Callicebus discolor*) and Ecuadorian mantled howler monkeys (*Alouatta palliata aequatorialis*). We review the utility of playbacks for Ecuadorian mantled howler monkeys and compare the cost and time for three different census methods for red titi monkeys; line transects, passive point transects; and playback point transects.

Using playbacks in combination with distance sampling methods is relatively common in birds (e.g. Alba-Zúñiga et al., 2009), but has been slow to be adopted in primates. Distance sampling is the most widely used method to determine abundance and density of animal populations (Buckland et al., 2001), and is a popular method for sampling primates (Buckland et al., 2010). Censusing primates using distance sampling has been reviewed by Buckland et al. (2010) so will not be repeated here. Instead, we discuss the pre-census checks before using playbacks to determine which if any method, can be used to census a particular species.

Any survey using playbacks needs at least one recording (and ideally multiple recordings) of a spontaneous call by a local group. The ease of recording this call will depend on both species and population density, but could require a few days of pre-census fieldwork and therefore increase the total project cost. However, these recordings need be made only once and can be used for multiple surveys in the area. Even once calls have been recorded, it should be verified that the species responds to playbacks of a conspecific's call before conducting a widespread survey (Figure 1). Some species, such as the buffy headed capuchin (*Cebus xanthosternos*), have been reported not to respond to playbacks (Martins Kierulff et al. 2004). In species with a diverse call repertoire, it is also necessary to determine which call types conspecifics will respond to with vocalizations. For example, individuals may always respond to contact calls, but less frequently respond to predator alarm calls.

The accuracy of distance sampling depends on several assumptions, the first being that animals on the line or point are always detected. Thus to combine playbacks with distance sampling, it is imperative to demonstrate that a species always responds when located at the playback location. This information may already be present in the published literature for some species, reducing pre-census demands. Otherwise, confirming the responses of the species to playbacks will of course raise the cost of the initial survey, but need not be repeated if the census is repeated in future years nor for new surveys with the same species in new areas. The assumption of certain detection is also true for strip transects, though the area of certain detection is expanded to a strip within a certain distance of the census line (Buckland et al., 2001). Determining the probability of response to playbacks of conspecifics is therefore a key factor when using playbacks to estimate density.

A second assumption of distance sampling is that animals are detected at their initial location. It must therefore be checked whether the species is repelled or attracted by conspecific calls (Figure 1). Buckland et al. (2001) caution readers about combining playbacks with distance sampling methods, as species may be attracted to, or repelled by the playback, biasing estimates upwards or downwards respectively. If a species responds to a playback by calling before moving, this movement will not be a problem for estimating density, but movement before calling is a problem. Spatial responses to conspecific calls may be available for some well-studied species. For example, Whitehead (1987) showed that mantled howler monkeys (*A. palliata*) had a high response rate to a "withdrawing" bark sequence, and also responded to this sequence before moving. Although distance sampling requires that individuals do not move in response to playbacks, other methods can still be used. For example, Savage et al., (2010) found that cotton-top tamarins (*Saguinus oedipus*) are attracted to playbacks of conspecific calls from 150-200m, and so used strip transects and lured individuals to the census line with playbacks.

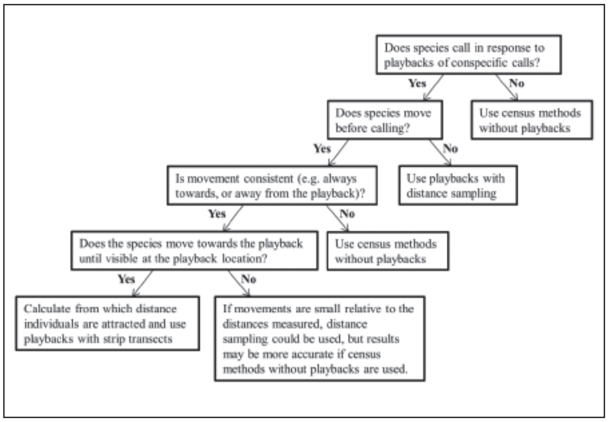

Figure 1. Flowchart showing information needed about a species response to playback before using playbacks to aid detection for density estimations.

In addition to the above, the survey design must have random and replicated census locations so density results are accurate and can be extrapolated (non-random locations may not represent the wider landscape). When designing a playback study, the impact of repeated playbacks on resident groups should be considered. Repeated playbacks at the same location may displace groups as they respond to what appears to be an aggressive intruder. Sampling a greater number of points spread over a large area will increase the accuracy of the density estimate and minimize potential stress to the sampled population.

Callicebus discolor

C. discolor is small cryptic primate that lives in small sized groups of adults and their offspring. The adults produce loud and regular calls, which are audible for about 500m, and occur in the early morning (Dacier et al., 2011). Groups do not chorus every morning (Papworth, 2012). Dacier et al, (2011) have previously shown that the responses of *C. discolor* to playback point transects does not violate the assumptions of distance sampling, and can also provide accurate estimates. Thus here we compare the cost and time for three different census methods for this species in Yasuní National Park, Ecuador (S 0°41, W 76°24); line transects, passive point transects, and playback point transects.

Derby (2008) performed a census of 10 monkey species using line transects. Data were collected two to three days per month over 11 months, between 0600 and 1400 hours. Eighty kilometers of transect were walked, and just 13 *C. discolor* were observed. Unpublished data collected in 2010 by ASR and SP was used to determine the efficiency of passive point censuses of loud calls. Spontaneous calls of *C. discolor* between 0700 and 0730 were recorded. Seventeen calls were heard during seven days of sampling at each of six different points, thus a total of 21 hours of observation. A playback point transect census was also conducted in 2010 (Papworth, 2012) following the methods of Dacier et al., (2011). The playback was recorded from a group living within the sampled area and consisted of four repeats of a two minute duet call with each repeat separated by two minutes of silence. The census sampled 68 points spaced 250-400 m apart over 14 days and recorded 60 responses to the playback.

For each method, the time (in both days and hours) which would be required to reach the minimum number of observations was calculated. The relative cost of equipment used for each method was calculated using current (March 2013) market prices (Table 1). In this case, perhaps because of the cryptic behaviour of *C. discolor*, a census using call playbacks is the fastest way to achieve the minimum sample size (Table 1), and could also be the cheapest if multiple surveys are conducted, reducing equipment costs per survey. Using a point transect with observations of spontaneous calls was predicted to take the most time, so is not considered further. Although the comparative cost of line transects and playback point transects depend on accommodation costs at a particular site and how many surveys the equipment will be used for, the minimum number of observations would be achieved far faster using playback point transects. As no method achieved the minimum sample size for an accurate density estimate it is not possible to compare the precision of each method. However, Dacier et al. (2011) found playback point transects of *Callicebus* gave accurate density estimates, and as this method offers faster detection of this cryptic genus, it is a viable alternative to traditional line transects.

Alouatta palliata aequatorialis

A. palliata aequatorialis is a larger cryptic primate which also lives in small groups of adults and offspring, though these groups are less spatially cohesive and can be very large (up to 21 individuals, SP, unpublished data). Adults produce loud calls, which can be audible for up to 1 km, and can occur at any time of day (SP, unpublished data). Although playbacks of conspecific calls can illicit responses in various *Alouatta* species (e.g. *A. palliata*, Whitehead, 1987; *A. pigra* Kitchen, 2006), we wanted to assess whether these responses violated the assumptions of distance sampling methods. Six groups of Ecuadorian mantled howler monkeys were located in Cerro Blanco Protected Forest (S 2°10, W 80°04) and the loud calls of individuals in these groups were recorded and used to create playback stimuli. Playback stimuli were two minutes long and played at 100dB, which was audible up to 200-300m (depending on habitat type). Recorded calls were only played to groups located more than 1km from where the call was originally recorded, to ensure individuals did not hear playbacks of their own calls or the calls of neighboring groups. Six playback trials were conducted.

In two trials, the groups were silent and did not respond. In another two trials, the monkeys silently fled from the playback, even though they had not been moving before. One of these groups then called continuously for 2 hours and continued calling during the night. In just two trials, *A. palliata aequatorialis* called without moving, but the response was not immediate (a delay of more than 12 minutes for both playbacks). Thus calling responses consistent with the assumptions of distance sampling were recorded to just two of the six trials, and the fleeing responses suggested a possible negative impact of playbacks. Furthermore, for the two trials were the groups did respond, these responses were not immediate. Immediate responses to playbacks are important as they ensure that individuals are not counted twice if they call, move and then call again. Overall, after six playbacks, there was no evidence to suggest that the playback method would work to assess the density of howler monkeys. The silent flight of two groups suggested the activity had a negative impact on howler monkey groups, thus trials were halted.

For *A. palliata aequatorialis* therefore, playback point censuses do not seem an effective method. As mentioned above, the lack of response to the playback may be due to the type of call used. Whitehead (1987) showed that mantled howler monkeys responses to playbacks differed

Table 1. Time needed for each method and equipment costs. The number of days and hours needed is obtained by calculating the time that each study would have to gain the minimum observations recommended by Buckland et al. (2001). These costs may be lower if different brands are used. Accommodation costs are not displayed, as these vary from site to site, but for this species, if accommodation is more than USD40 per night, then the high equipment costs for the playback method will be compensated by the reduced accommodation costs.

Method	Minimum observations	Days needed	Hours needed	Equipment needed	Approximate equipment cost (USD)
Line Transect	60*	63	504	Handheld GPS Sighting compass	200
Passive point transect	75	262	131	Handheld GPS Sighting compass	200
Playback point transect	75	14	95	Handheld GPS Sighting compass Microphone Sound recorder Speaker Sound player	2,113

with call type. In our trials, three of the playbacks used "howl" calls and three used "bark" calls, but no pattern in response was observed to these different types. Alternately, information about the caller may have been encoded in the call, and individuals may respond differently to more or less dominant individuals (Hopkins, 2013). Although it is possible that different playback stimuli or a greater understanding of *A. palliata aequatorialis* behaviour at Cerro Blanco Protected Forest could elicit responses to playbacks which are consistent with the assumptions of distance sampling, we did not continue trials as the negative response to playback was so strong.

A number of *Callicebus* species have been shown to respond to playbacks of conspecific calls (e.g. *C. coimbrai*, Ferrari et al., 2010; *C. nigrifrons*, Cäsar et al., 2012), and it may be that genus specific behavioural responses to conspecific calls make playback point censuses particularly appropriate for this genus. In contrast, the responses of *A. palliata aequatorialis* violated the assumptions of distance sampling, thus passive sampling methods which rely on spontaneously given calls (cue counting, see Buckland et al., 2010) may be more appropriate for *Alouatta* if these responses are typical of the genus. When contrasting playbacks responses of just two species, it is difficult to draw conclusions about which species or genus characteristics are associated with successful or unsuccessful use of playbacks. One hypothesis is that these differences are related to the different grouping patterns and roles of calls in these species. For example, loud calls in *Callicebus* are thought to function in mate or territory defense, and groups of *Callicebus* hold relatively stable territories (Dacier et al. 2011). Therefore loud calls by novel groups within or close to a territory may frequently elicit vocal responses. In contrast, the grouping and social behaviors of *Alouatta* is more varied, with single and multi-male groups, overlapping territories and intragroup dominance hierarchies (Whitehead, 1987; Kitchen, 2006; Hopkins, 2013), thus responses to playbacks simulating the presence of an unknown individual may also be more varied.

In other Neotropical species, investigating behavioral responses to playbacks is necessary before the suitability of playbacks to assess population density can be determined. Playbacks have been used to determine the presence of a variety of Neotropical species (e.g. *Saguinus* spp. Urbani, 2006; *Cacajao melanocephalus*, Bezerra et al. 2010; *Ateles fusciceps*, Peck et al., 2011), thus for these species the first hurdle of demonstrating responses to playbacks have been demonstrated, and it only remains to be investigated whether the behavioral responses to conspecific calls are consistent with the assumptions of density estimation methods.

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REPORT OF A BLACK SPIDER MONKEY (*ATELES CHAMEK*) SWIMMING IN A LARGE RIVER IN CENTRAL-WESTERN BRAZIL

André Valle Nunes

Rivers are considered to influence the current patterns of ecological and genetic variation of Amazonian species and communities (Gascon *et al.*, 2000). Rivers are impenetrable barriers to the dispersal of several vertebrate species, and, in some cases, they interrupt the expansion of species from their origin centers and gene flow between populations of sister species from opposite margins (Sick, 1967; Hershkovitz, 1977; Ayres and Clutton-Brock, 1992; Gascon *et al.*, 2000). Hence, rivers drive, inter and intraspecific differentiation patterns in the distribution of Amazonian primates (Ayres and Clutton-Brock, 1992).

There are few records of New World primate species swimming (Parnell and Buchanan-Smith, 2001). Some platyrrhines, such as *Cebus*, *Cacajao*, *Aotus*, and *Saimiri*, can inhabit or use swamps and seasonally flooded areas, but they do not swim between habitat patches (Socoloske and Kymberley, 2010; Bezerra *et al.*, 2010). The only reports of swimming refer to large primates, such as *Alouatta palliata*, *Cacajao melanocephulus*, as well as large species of Old World cercopithecoids: *Macaca radiata* (bonnet macaque), *Nasalis larvatus* (proboscis monkeys), *Papio anubis* (olive baboon), *Macaca fuscata* (japanese macaques), *Pan troglodytes* (chimpazee), and *Pongo pygmaeus* (bornean orangutan) (Wata, 1981; Yeager, 1991; Forthman, 2000; Agormoorthy *et al.*, 2000; Gonzalez-Socoloske and Snarr, 2010; Bezerra *et al.*, 2010; Bender and Bender, 2013). Among the largest platyrrhines are the atelids, such as the black spider monkey (*Ateles chamek*), which may weight up to 10 kg and has two common characteristics of the subfamily Atelinae: immigration and movement through semibrachiation (Chapman and Chapman, 1989; Chapman and Chapman, 1990; Campbell *et al.* 2005). *Ateles chamek* occurs in lowlands from northeastern Peru, northern and central Bolivia in the Noel Kempf Mercado National Park, and western Brazil in the state of Mato Grosso on the left margins of the rivers Teles Pires and Tapajós (Wallace *et al.*, 1996; Iwanaga and Ferrari, 2002). There are reports of black spider monkeys using the ground to socialize, collect food, and cross open areas (Di Fiore, 2002; Campbell *et al.*, 2005). However, there is no information on swimming. Therefore, we report a rare case of swimming by a female *A. chamek* in an Amazonian River.

On November 28th, 2012, in the municipality of Comodoro (13°47'54"S, 60°27'53"W), in the Amazon of Mato Grosso, we observed a female *A. chamek* crossing the Guaporé River by swimming. Approximately at 16:30 h, the female began moving on the ground of the river's beach, which is located within the Noel Kempff Mercado National Park in the municipality of Santa Cruz, Bolivia (Fig. 1). Next, the specimen began to swim towards the opposite margin, located in the state of Mato Grosso, Brazil. The swimming activity lasted ca. 15 min, and the specimen crossed 38 meters from one margin to the other. The specimen had the body completely submerged, leaving only the

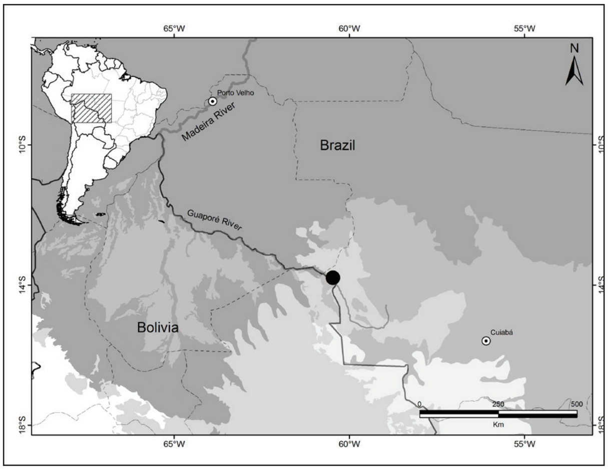

Figure 1. Location of the swimming of black spider monkey (*Ateles chamek*) in Guaporé River, border between Bolivia and Brazil in South America. Tropical and subtropical moist forests; Tropical and subtropical savannas; Floodplains; Tropical and subtropical dry forests; Moutain grasslands. Habitat types follow Olson *et al.* (2001).