Designing an Animal Monitoring and Census Program using Line Transects

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Research Design and Transect Layout:

To census the abundance of hunted species we recommend collecting both animal sign and sighting data on straight-line transects placed in a stratified random fashion at sites (Figure 1); and collecting data on a monthly basis. For a village site, a team of two trained local people can collect all data for their village or a nearby village. The transect layout described below is designed to respond to both the scale of animal home ranges and the scale of human hunting forays.

We suggest a transect length of 4 km, a distance likely to cross a minimum of one home range area for most animal species. For example, the mean home range area for white-lipped peccaries (*Tayassu pecari*) in the northern Amazon region is 6,600 ha (Fragoso, 1998). Assuming a simplified circular home range area, the radius of this area would be 4.6 km. A transect length of 4 km would thus cross about half of one home range of at least one herd. Walking this length increases the likelihood of detecting a herd if one inhabits that area. Similarly, collared peccaries have a mean home range area of 1,090 ha in this region (Fragoso, 1999), equivalent to an area with radius of 1.9 km. A 4 km transect would cross the home range of at least one herd of collared peccaries. Three years of tracking 12 resident-adult tapirs in a mixed forest-ranch-farmland habitat in the Atlantic forest region of Brazil revealed a mean home range area of 330 ha (Medici, 2010). From this home range estimate we derive an equivalent radius of 1.0 km; one transect should cross 2 tapir home range areas. Adult agoutis have a mean home range area of 5.7 ha in this ecosystem (Silvius and Fragoso, 2003), for an equivalent circular area with radius of 135 m. One 4 km transect should therefore cross about 13 agouti home ranges.

Transect start points and compass headings should be selected using randomly generated UTM coordinates, a topographical map and a satellite image of the region. Transect location should be stratified by distance so that no transect is closer than 4 km from any other transect at any point. Based on home range sizes, this spacing increased the likelihood that sightings and tracks counted on different lines are of different individuals for almost all of the widest ranging species, reducing the likelihood of double counting individuals between transects. For collared peccaries with a home range radius of 1,025 m, this means that the home range of an animal whose sign was seen at a point on the line would extend outward 512.5 m to either side of the line. Since transect lines are $\geq$ 4 km from any other line than the animal or herd sighted is unlikely to be the same animal or herd seen on another line. This assumption does not hold for the wider ranging white-lipped peccary, since the radius of its circular home range is 4.6 km, a distance less than the

minimum between two different lines. However, many transect lines will be much further apart than 4 km from another line.

No pre-existing trails should be used as transects; there is evidence that regular human use of trails for any activity frightens off animals for up to 3 days after use (pers. comm. G. Urquhart). Teams of local technicians should open each transect by clearing vegetation to a width of about a meter. Transect length should be measured using a tape measure and distances sequentially marked at 50 m intervals with plastic flagging, aluminum tags, or wooden stakes. Transects should be used exclusively by technicians, with other community members agreeing not to use them for any reason, except in an emergency situation. You can detect the presence of others on transects through footprints; when this occurs we recommend holding a meeting with the community to address the problem. In the few cases when this happened during our study the community was responsive to our needs and participated in motivating the person identified from refraining from using our transect as a trail. People can hunt around and across transects using their own trails or while wandering through the area but they cannot walk or spend time on transects themselves.

Exception to the straight-line nature of transects should occur only when impassable barriers such as cliffs are encountered (rivers and creeks can usually be crossed by wading, using temporary bridges or canoes). In these circumstances, extend the transect in the opposite direction from the start point until completing 4 km of line. If this approach brings you within 4 km of another transect, returned to the area of the barrier and continue the transect at a 90 degree angle from the previous bearing until attaining the 4 km length. If this approach is impossible because of further impassable barriers, instead turn left 90 degrees.

Both sighting and sign data should be collected on transects but at different times (see below). A detailed comparison of data collected with both methods is under way and will be presented elsewhere, but preliminary analysis indicates that observation data underestimate the abundance of terrestrial vertebrates and fails to detect them in places where they are readily quantified through sign. This is most marked for species such as tapir (*Tapirus terrestris*) and paca (*Agouti paca*), with the consequence that they are not reported through visual sightings in either hunted or unhunted zones in some studies where they are probably present (e.g. in the greater Manu area by Nuñez-Iturri et al. (2007, 2008), Terborgh et al. (2008), and Endo et al. (2010)). Each transect should be walked once to collect sighting data during the first two weeks of the month (the time period needed for two technicians to walk all 8 transects at their site). One technician (if possible the best hunter in the community) searches for animals, while the other records data and takes measurements. For each animal sighted they should record the meter location on the transect, species, number of individuals, sex, age, behavior, habitat, distance from observer (with tape measure), and

azimuth from trail (with Suunto compass (Figure 2)). The same transects should be walked again once on the last two weeks of the month by the same two technicians. During this period they should watch for and recorded fresh sign data (primarily tracks, but also feces, hair, bones, digging, burrows, eaten fruit or seeds, browsed plants, etc.) within a 1 m wide band of the center line of the transect (Figure 3). Only sign estimated to be less than 3 days in age were included in the database. For each sign encountered technicians noted meter distance on transect, species, estimated number of animals in the group, type of sign, if feeding and habitat. Generally, the collection of data of the same type should be spaced by 1 month on the same transect, and 2 weeks elapsed between the collection of different types of data (e.g., sighting and sign) to maintain independence of collected data.

We place 8 transects at each village or control (unhunted) sites, (Figure 1). At each village or control site, 4 transects should be placed within a 6 km radius of the village center or a simulated center at control areas and 4 more at a 6 to 12 km distance from the center point of villages or simulated center of control areas. The near, 0 to 6 km radius area is a priori classed as a heavily hunted zone based on studies of hunting by indigenous peoples in our region and beyond (Strong, 2005; Strong et al., 2010; Constantino, 2010), while the 6-12 km areas as lightly hunted zones based on previous research of hunting by Makushi Indians in a mixed forest savanna village in neighboring Brazil (Strong, 2005; Strong et al, 2010; Strong and Fragoso, unpubl. data). Actual intensity of hunting at these distances can be measured by kill data collected and mapped for the study village (Read et al., 2010). Hunters from four forest communities travel on average less (5.5 km) than hunters from the savanna-forest edge (9.5 km) and savanna (12.5 km) communities (Read et al. 2010). The center point of control areas should be located about from 24 to 40 km from the center point of the nearest village. Control sites should be described as unhunted by the nearest villagers.

Figure 1. Transect layout around a center point (village center or randomly selected point in a control area).

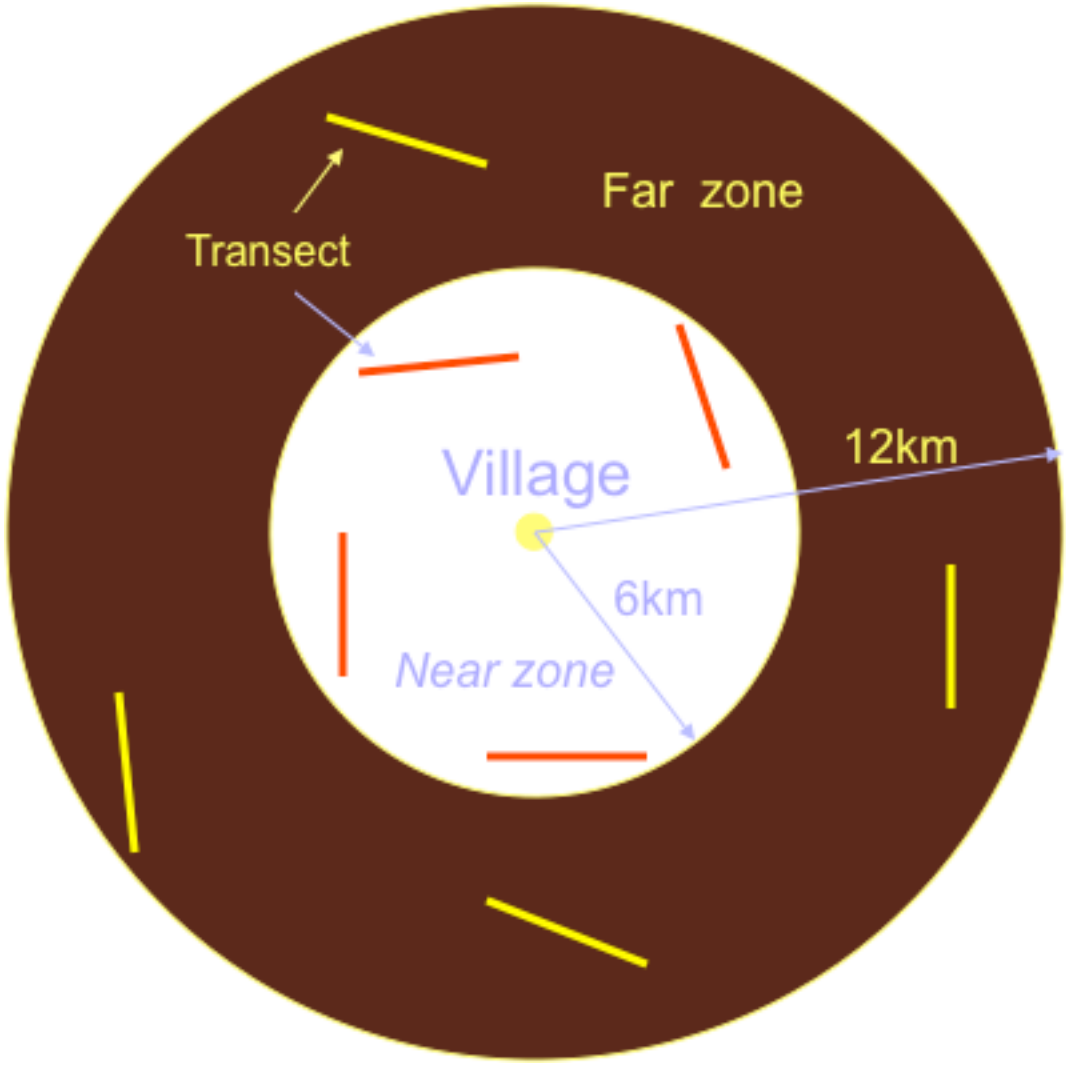


Figure 2: An example of a transect for sighting animals. For each animal sighted you should record the meter location on the transect, species, number of individuals, sex, age, behavior, habitat, distance from observer (with tape measure), and azimuth from trail.

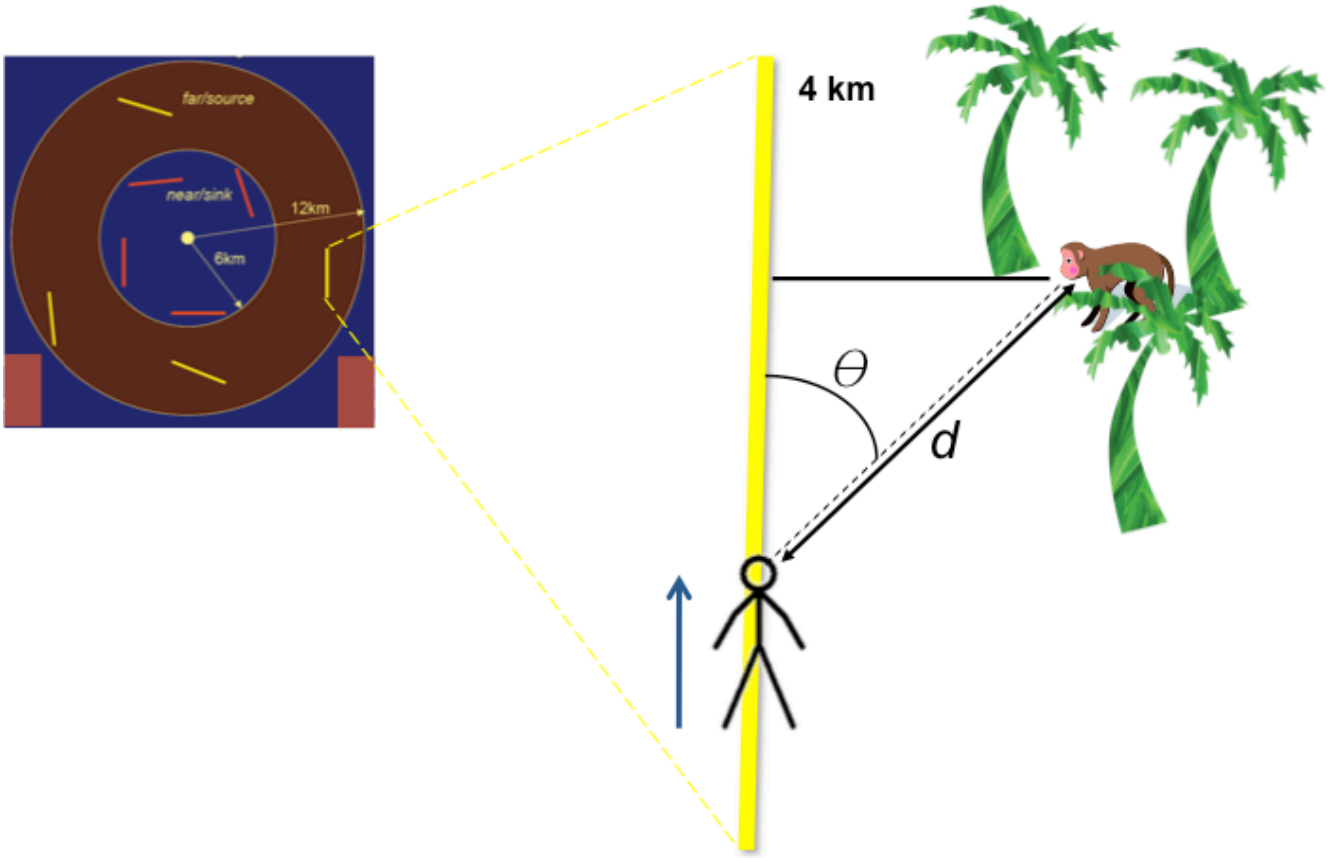
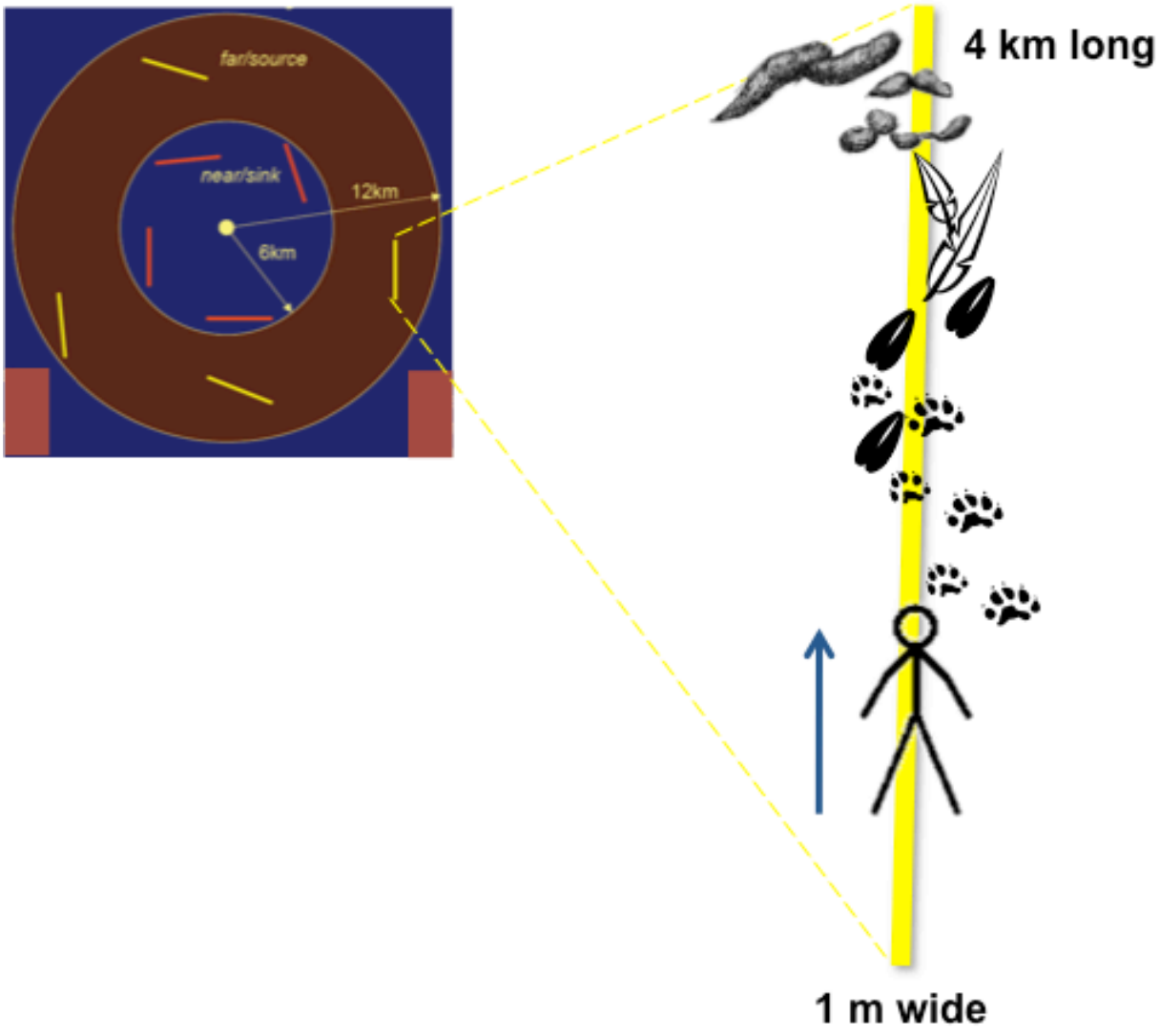


Figure 3. A diagrammatic representation of a transect for recording animal sign. Technicians should watch for and recorded fresh sign data (primarily tracks, but also feces, hair, bones, digging, burrows, eaten fruit or seeds, browsed plants, etc.) within a 1 m wide band of the center line of the transect. Only sign estimated to be less than 3 days in age should be recorded. For each sign encountered technicians noted meter distance on transect, species, estimated number of animals in the group, type of sign, if feeding and habitat.



References

Constantino, P. de A.L., 2010. Disentangling the effects of deforestation and indigenous hunting on wildlife in the Amazon. PhD thesis, University of Florida, Gainesville, USA.

Endo, W., Peres, C.A., Salas, E., Mori, S., Sanchez-Vega, J., Sheppard, G.H., Pacheco V., Yu, D.W., 2010. Game vertebrate densities in hunted and nonhunted forest sites in Manu National Park, Peru. Biotropica 42, 251-261.

Fragoso, J.M.V., 1998. Home range and movement patterns of white-lipped peccary (Tayassu pecari) herds in the northern Brazilian Amazon. Biotropica 30, 458-469.

Fragoso, J.M.V., 1999. Scale perception and resource partitioning by peccaries: behavioral causes and ecological implications. Journal of Mammalogy 80, 993-1003.

Medici, E.M., 2010. Assessing the viability of lowland tapir populations in a fragmented landscape. PhD thesis, University of Kent, United Kingdom.

Nuñez -Iturri, G., Howe, H.F., 2007. Bushmeat and the fate of trees with seeds dispersed by large primates in a lowland rain forest in western Amazonia. Biotropica 39, 348–354.

Nuñez-Iturri, G., Olsson, O., Howe, H.F., 2008. Hunting reduces recruitment of primate-dispersed trees in Amazonian Peru. Biological Conservation 141, 1536–1546.

Read, J.M., Fragoso, J.M.V., Silvius, K.M., Luzar, J.B., Cummings, A.R., Giery, S.T., de Oliveira, L.F., 2010. Space, place, and hunting patterns among Amerindians of the Guyanese Amazon. Journal of Latin American Geography 9, 213-243.

Strong, J., 2005. Tortoise ecology, movements and seed dispersal in Amazonia. MS thesis, SUNY College of Environmental Sciences and Forestry, Syracuse, NY, USA.

Strong, J.N., Fragoso, J.M.V., de Oliveira, L.F., 2010. Padroes de uso e escolha de caça pelos índios Macuxi em Roraima, in: Barbosa, R.I., Melo, V.F. (Eds.), Roraima: Homem, Ambiente e Ecologia. Fundação Estadual do Meio Ambiente, Ciência e Tecnologia, Roraima Brazil, pp. 631-644.

Terborgh, J., Nuñez-Iturri, G., Pitman, N.C.A., Valverde, F.H.C., Alvarez, P., Swamy, V., Pringle, E.G., Paine, C.E.T., 2008. Tree recruitment in an empty forest. Ecology 89, 1757-1768.