Proposal B - Example

Estimating Population Densities of Longtailed Macaques (*Macaca fascicularis*) on Tinjil Island, Indonesia

INTRODUCTION

In 1987, Tinjil Island, located off the southern coast of West Java, Indonesia [Figure 1], was designated as a natural habitat breeding facility (NHBF) for long-tailed macaques (*Macaca fascicularis*) [Kyes 1993]. Between 1988 and 1990, a total of 475 adult M. fascicularis were released on to Tinjil Island; since then, population surveys have been conducted on a regular basis to monitor population numbers in order to avoid both the over-harvesting of animals for biomedical research or rapid population expansion, which would require both increased harvesting and provisioning of the primate population [Crockett *et al* 1996].

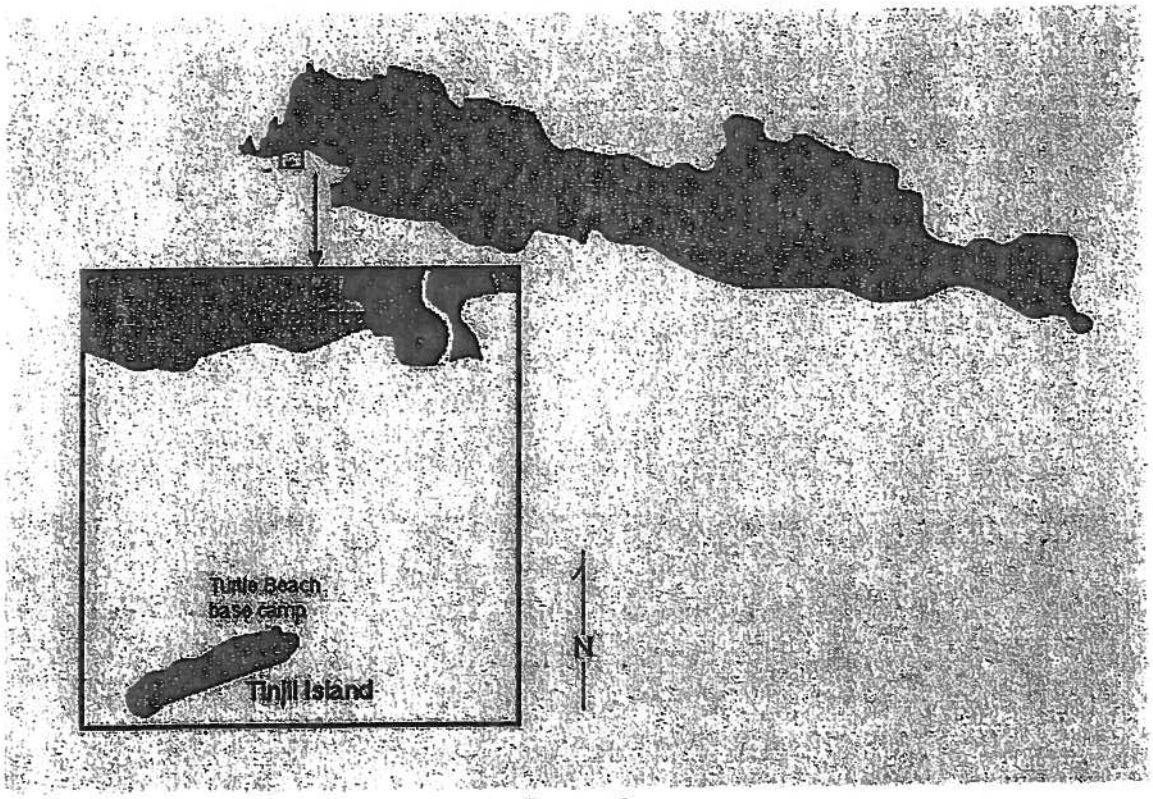

FIGURE 1

There are situations in which a population estimation can be made using more indirect methods (e.g., measuring feces abundance); however, surveys of arboreal primate species are most reliably done through counts of individual animals by observers. More specifically, the most statistically reliable method of data collection on numbers of primate groups in forest habitats is line transect sampling [Techniques for the Study of Primate Population Ecology 1981]. Buckland *et al* (1993) write that very mobile species are better surveyed by the line transect method, and it is

preferable in general because more time is spent actually sampling, while in other methods time is often spent travelling between and locating sample points.

When utilizing this method, an observer walks along a single, straight, randomly selected transect and perpendicular distances (or sighting distances and sighting angles, but this method has been shown to be less reliable) are measured from the transect to each animal detected [Buckland *et al* 1993]. These observed numbers are then totaled and divided by the size of the sample area, giving an estimate of the size of the total population of the larger area represented by the transect.

For this study, we will use a variation on the traditional line transect sampling method, referred to as "synchronous sightings" in an unpublished paper by Janson and Terborgh. It is a method for use in areas with natural boundaries, including islands, but has rarely been used to survey forest primates [Techniques for the Study of Primate Population Ecology 1981]. Multiple observers walk along parallel transects and the data collected is combined to provide a more accurate estimation of the total primate population than can be found using single observer collection.

METHODS

Field Site

The study will be conducted on Tinjil Island, located at approximately 7 0' S, 105 45'W off the south coast of West Java, Indonesia]. The island consists primarily of lowland, secondary tropical rain forest and coastal vegetation. Tinjil is approximately 1 km wide and 6 km in length, with 10 transects having been previously cleared [Figure 2]. Three transects run East -West (ES, CD and SH), while the other 7 run North-South (DS, HW, SA, JK, RK, OS, KO). All transects are marked at 25 m intervals to assist in identifying one's location.

Procedure

Sampling will take place over the entire course of the field study program. Dr. Kyes and I, along with two (or more) additional students, will do observations simultaneously along the ES and CD transects for two days in succession, taking day three off, and beginning the cycle again on day four. The additional observers will assist us in procuring exact

measurements from the transects either by use of a tape measure or a laser range detector; however, in order to avoid observer biases, only Dr. Kyes and I will collect population data. The survey schedule will be repeated six times, with data collection for a total of 26 transect surveys (13 on each trail). Since the first four to six hours of the day are known to be peak hours of primate activity as well as observer concentration (Defler & Pintor, 1985; NRC 1981), all sampling will begin between 0600 - 0700. During the survey, the rate of movement of the observers will be approximately 1.5 km/h with frequent stops to listen for movement and to scan the area. No surveys will be conducted during rainstorms or windstorms, should they occur during the course of the program. These weather conditions would bias our counts; the noise prevents observers from being able to detect animals (e.g., via alarm calls or movement through tree limbs) and also alters the animals' behavior, as monkeys generally become less active and tend to freeze rather than flee as a behavioral response to observers in these conditions (Holt & Cologne, 1987; NRC, 1981; Peres, 1999).

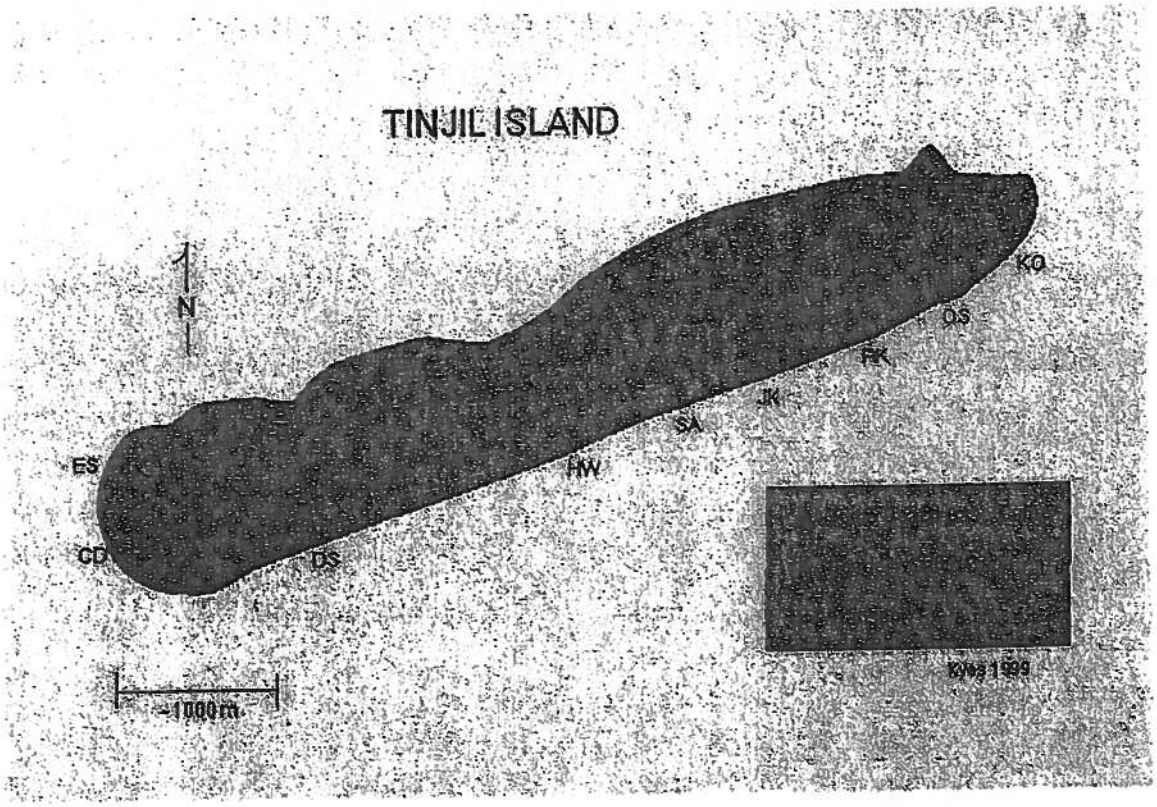

FIGURE 2

The following information will be collected during each of the sampling sessions: time of contact; perpendicular distance from monkey to

observer (using tape measure); location on transect (via location markers placed every 25m along the transect); height from ground; direction from transect (N,S,E,W); mode of detection (visual, vocalizations, tree movement); number of animals in the group; age/sex composition of the group; behavior of the group (resting, fleeing, eating, giving alarm calls, etc); an estimation of how good the count is (e.g., is the group moving? Are they sitting?); and direction of movement (if applicable) [Kyes, R.C., *pers. comm.*]. Only animals that are seen – that is, not simply identified via auditory cues – by the observer(s) will be counted. When a group is encountered, the observers will spend no longer than 10 minutes observing the animals in order to gather pertinent data. To avoid possible overlap of group observations between transects, observers will carry walkie-talkies and will remain in continuous contact (as allowed by the variable distance between the transects and density of foliage). This will also ensure that observers are walking at approximately the same pace along their transects. Observers will not leave the trails at any time, unless this is necessary for measuring the distance from the trail to the estimated center of any observed group. When multiple observers are sampling on one trail, they will be paced out 10-15 m apart. No talking, with the exception of walkie-talkie communication, will be allowed during sampling sessions, to prevent possible disturbance of animals.

Data Analysis

Data will be analyzed using the procedures described in *Techniques for the Study of Primate Population Ecology*. Using the following formula:

$$\frac{\text{Estimated animal population, } N}{\text{Census area, } A} = \frac{\text{Number of animals seen in sample area, } n}{\text{Sample area, } a}$$

When a sample area is based on a transect, the area surveyed is found using $A = lw$ (l = the length of the transect line and $2w$ = the strip width, i.e., the width on each side of the transect line). If we solve for N, we come up with the equation:

$$N = \frac{nA}{2*lw}$$

For the purposes of this study, we will be using a strip width of 50 m (i.e., there will be at least 100 m between the two transects being sampled). This width will not overlap with the strip width of the parallel transect.

There are a few basic assumptions upon which the theory of line transect sampling is dependent. When using the formulas listed above, we are making the following assumptions:

1. Animals directly on the line will never be missed. It is also understood that all of the animals in the sample area will not be detected, and the farther an animal is from the line, the less likely it is to be detected.
2. Animals are fixed at the initial sighting position; they do not move before being detected and none are counted twice.
3. Distances are measured exactly, thus avoiding both measurement errors and rounding errors.
4. Sightings are independent events.

This study will be conducted in such a way as to minimize violations of these assumptions.

To assess survey consistency, a comparison will be made between surveys conducted during the first and second halves of the field study program (as noted in *Techniques...*, Altmann and Altmann [1970] found that surveys show a marked tendency to become more accurate with time). Data from the 2000 survey will be compared to the 2001 data. Additionally, data from parallel and single line transect samples will be compared. Data will be analyzed upon our return to the University of Washington using DISTANCE software.

SUMMARY

Starting approximately 2 July and continuing through 20 July 2001, I, in tandem with Dr. Kyes and/or one or more additional observers, will conduct parallel line transect samples on the East-West transects (ES and CD) on Tinjil Island, Indonesia. During this time period I hope to collect data from 13 separate samples of the E-W transects. This data will then be compared with single line transect samples from the same transects in the hope that the parallel line method will prove to be a more accurate measure of the island's *Macaca fascicularis* population. Also, data from this year's survey will be compared to the 2000 survey with the assumption that the experience gained during IFSP last year will be reflected in the counts obtained.

Parallel line transect sampling is a technique that is not often used (as far as the literature is concerned), but has potential to provide more precise estimations of population density. By doubling the area from which we are recording data, we essentially double our N, which greatly increases

the accuracy – the chance of finding a "real effect", in statistical terms – of a study. While the technique itself may be more accurate, the data collected by a fledgling field observer may not be so reliable (with potential to break one of the fundamental assumptions – No. 3, above – underlying the method). Comparing the data collected in 2000 to that collected in 2001 will help to assess that reliability.

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