Short Communication

Orang-utan nest surveys: the devil is in the details

Andrew J. Marshall and Erik Meijaard

Abstract Nest surveys are widely employed to assess the population density of orang-utans (*Pongo* spp.) and evaluate alternative management scenarios relevant to the protection of these threatened great apes. However, this method is less accurate and prone to much greater error than is generally acknowledged. Here we highlight the limitations of orang-utan nest surveys, discuss the risks of ignoring these limitations, and note conditions under which standard nest survey methods are appropriate.

Keywords Nest survey, orang-utan, *Pongo*, population estimate.

Great ape conservationists widely acknowledge that accurate population estimates are vitally important to assess a species' vulnerability to extinction, to monitor population status, and to inform decisions about how best to allocate limited conservation funds (Kühl et al., 2008). Nevertheless, early figures underestimated orang-utan (*Pongo* spp.) population sizes by as much as three orders of magnitude (Schaller, 1961; MacKinnon, 1971). More recently, in recognition of the fact that the rareness and cryptic nature of orang-utans makes direct surveys generally infeasible and inaccurate, systematic counts along transects of the resting platforms, or nests, that orang-utans build have been widely used as proxies for population density (van Schaik et al., 1995; Buij et al., 2003; Ancrenaz et al., 2004b; Marshall et al., 2006). The results of these orang-utan nest surveys have formed the basis of conservation assessments and management recommendations (Marshall et al., 2006; Wich et al., 2008).

Despite the widespread use and apparent simplicity of orang-utan nest surveys, seemingly esoteric details in methods bedevil attempts to estimate orang-utan abundance reliably by counting nests along transects. In the conversion of nest density to orang-utan population density nest decay rate is a crucial parameter, inversely proportional to population density (van Schaik et al., 1995; Buckland et al., 2001; Laing et al., 2003). Unfortunately, nest decay rates are highly variable at several spatial and temporal scales, with nests decaying in as few as 85 days or lasting for over 800 days (Ancrenaz et al., 2004a; Mathewson et al., 2008). Some of this variation may be explicable; simple bivariate comparisons suggest that orang-utan nests last longer in areas (on Sumatra) with low soil pH (Buij et al., 2003), at higher altitudes (Johnson et al., 2005), in peat swamps (Johnson et al., 2005), in trees with higher wood density (Mathewson et al., 2008), and perhaps during dry seasons (Mathewson et al., 2008). But a substantial proportion of variation in nest decay rates is not readily explicable (Mathewson et al., 2008). For example, nest decay rates at a site in East Kalimantan are inexplicably more than twice as slow as at other sites in Borneo (Mathewson et al., 2008). Similarly, our preliminary analyses indicate that nests decay very rapidly in *Acacia* plantations, complicating our attempts to understand the unusually high nest densities that we have observed in this seemingly marginal orang-utan habitat. Perhaps the large amount of observed variation in nest decay rates results from differences in nest-building behaviour among orang-utan populations or taxa, differences in the activity of decomposers, or some heretofore unidentified parameter. At present, we simply do not know. Similar uncertainty plagues estimates of nest and dung decay rates used to estimate great ape and elephant population densities in Africa (Nchanji & Plumptre, 2001; Walsh & White, 2005).

Our lack of understanding of the factors underlying variation in nest decay rates is unsettling, and is not widely acknowledged by our fellow orang-utan conservation practitioners (Molyneaux, 2007; Mathewson et al., 2008). In 2007 alone we know of at least seven orang-utan surveys that were conducted without determining local nest decay rates. It is understandable that survey teams are tempted to use shortcuts, as gathering accurate data on site-specific nest decay rates takes a minimum of 6 months (Mathewson et al., 2008). Frequently employed shortcuts are based on the assumption that nest decay rates in a particular location are stable over time or that it is appropriate to measure nest decay at one location and extrapolate the estimate obtained across a much larger (and often highly heterogeneous) area. However, neither of these assumptions appears to be true, and succumbing to the temptation to use such shortcuts is unwise and potentially damaging to conservation efforts. At best, these practices will result in imprecise orang-utan density estimates with wide confidence intervals, hampering our ability to identify or monitor priority populations. At worst, ignoring uncertainty in nest decay rates may result in inaccurate estimates that are worse than useless,

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Received 14 September 2008. Revision requested 13 November 2008. Accepted 15 December 2008.

wasting limited funds or diverting investments to sites or particular strategies that do not maximize conservation benefits. Until we have a better understanding of the factors determining nest decay rates, continued, uncritical application of nest transects as a rapid orang-utan survey technique is inadvisable.

Compared to most researchers who have surveyed orang-utans, our colleagues that work in Africa generally have been more cognizant of factors that may affect estimates of forest vertebrate abundance. They have documented substantial variation in nest and dung decay rates across both temporal and spatial scales (Plumptre & Harris, 1995; Tutin et al., 1995; Plumptre & Reynolds, 1996; Nchanji & Plumptre, 2001; Walsh & White, 2005). This variation and potential violations of other key assumptions (Buckland et al., 2001) have received direct consideration and nuanced discussion in several publications reporting empirical and modelling work from Africa (Plumptre & Reynolds 1997; Plumptre, 2000; Walsh & White, 2005; Morgan et al., 2006; Devos et al. 2008). Although some orang-utan surveyors have also focused on such methodological aspects (Ancrenaz et al., 2004a,b; Mathewson et al., 2008), in general those of us charged with assessing the size and status of wild orang-utan populations would benefit from incorporation of recommendations that have emerged from similar survey work in Africa.

While we stress that use of non site- and period-specific nest decay rates is unwise, we recognize the need for rapid survey techniques that identify key orang-utan populations, provide a reasonable estimate of their size, and identify populations that are in danger of local extirpation. Alternative survey methods promise to reduce some of the sources of error that plague traditional nest surveys. For example, marked nest methods eliminate the need to estimate decay rate by basing density estimates on counts of new nests produced during a defined period (Hashimoto, 1995; Plumptre & Reynolds, 1996; Devos et al., 2008). Although this method circumvents some of the limitations of more traditional methods, it nevertheless requires substantial sampling effort to achieve an accurate population estimate (S.N. Spehar et al., unpubl. data). Potential alternatives to line transects may include genetic surveys (Goossens et al., 2005) or systematic surveys of local people (Rijksen & Meijaard, 1999). Thus, we are currently exploring ways to use structured interview surveys in villages across Borneo to provide estimates of relative orang-utan density and to identify populations at particular risk from hunting or imminent land conversion.

We do not mean to imply that orang-utan nest surveys should be abandoned completely; they are valuable in a limited set of circumstances. Specifically, they may be useful as a means of assessing or monitoring population size in well-delineated areas where site- and period-specific nest decay rates are available or, preferably, where nest decay can be monitored concurrently (Johnson et al., 2005; Walsh & White, 2005; Kühl et al., 2008). In such cases care should be taken explicitly to include sampling error of nest decay rates into overall confidence limits surrounding estimates of orang-utan population density. This can be done using the delta method (Buckland et al., 1993) or via statistical resampling techniques. Although nest surveys do retain utility in these specific contexts we feel that the recent pervasive application of this technique in the absence of appropriate nest decay rates is not the most accurate or cost effective way of assessing orang-utan population status. Given the urgency of the threats to wild orang-utan populations (Wich et al., 2008; Marshall et al., 2009), the need for new methods is acute. We urge our orang-utan survey colleagues to join us and some of our colleagues working in Africa in acknowledging the limitations of nest surveys, and to help us seek additional methods to assess orang-utan population sizes and trends.

Acknowledgements

We thank an anonymous reviewer for comments that substantially improved this manuscript.

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Biographical sketches

Andrew J. Marshall has carried out research in Indonesia since 1996, with a focus on the evolutionary ecology, phenology and conservation of tropical forests and vertebrates (particularly Bornean primates). Along with collaborators from Universitas Tanjungpura, Pontianak, Andy runs a long-term field project on the population ecology of gibbons and langurs in Gunung Palung National Park, West Kalimantan, and contributes to orang-utan conservation and research projects across Borneo. Erik Meijaard is manager for the Nature Conservancy's Indonesian forest programme, and also conservation strategy advisor to the Orang-utan Conservation Services Program. He has worked in Indonesia since 1992 and specializes in the science of effective conservation, as well as more fundamental studies on mammal evolution, biogeography, ecology and taxonomy. Erik's other research focuses on new survey approaches using citizen science, the economics of land use and carbon sequestration, and improving conservation science in developing countries.