

Short Communication

First estimates of primate density and abundance in Siberut National Park, Mentawai Islands, Indonesia

MARCEL C. QUINTEN, FIFIN NOPIANSYAH and J. KEITH HODGES

Abstract In 2011 we carried out the first systematic survey to determine the density and abundance of endemic forest primates in Siberut National Park, in the Mentawai Islands of West Sumatra, Indonesia. Distance sampling was employed to survey 18 transects located systematically throughout the Park, yielding a total survey effort of 192 km and 285 observations of primates for data analysis. From density estimates for the four resident primate species, the Siberut langur *Presbytis siberu*, the pig-tailed snub-nosed langur *Simias concolor*, Kloss's gibbon *Hylobates klossii* and the Siberut macaque *Macaca siberu*, we extrapolated a total population of c. 51,000 primates within the Park. We conclude that Siberut National Park is of major significance for the continued survival of Siberut's endemic primates, and provide recommendations to help ensure that it will continue to function as a refuge for primates.

Keywords *Hylobates klossii*, line-transect survey, *Macaca siberu*, Mentawai Islands, population density, *Presbytis siberu*, Siberut National Park, *Simias concolor*

The Mentawai Island primates are a unique community of sympatrically occurring, endemic species of the c. 6,000 km² (BPS, 2011) Mentawai Archipelago in West Sumatra, Indonesia. On the four main islands (Siberut, Sipora, North Pagai and South Pagai) six species (Roos et al., 2014) coexist: the Siberut macaque *Macaca siberu*, the Pagai Island macaque *Macaca pagensis*, the Siberut langur *Presbytis siberu*, the Pagai langur *Presbytis potenziani*, the pig-tailed snub-nosed langur *Simias concolor*, and Kloss's gibbon *Hylobates klossii*. Threatened mainly by anthropogenic hunting and habitat loss (commercial logging, agriculture), all six species are considered to be in decline (Whittaker, 2006). They are categorized as Vulnerable (*M. siberu*), Endangered (*P. siberu* (as *P. potenziani siberu*) and *H. klossii*) or Critically Endangered (*P. potenziani* (as *P. potenziani potenziani*), *M. pagensis* and *S. concolor*) on

the IUCN Red List (IUCN, 2014). The pig-tailed langur is among the 25 most threatened primates (Mittermeier et al., 2012).

Regardless of their conservation status, there is a dearth of reliable information on the size of the region's primate population, which is essential for effective management and conservation planning. The few publications that have presented population estimates for the Mentawai Islands are typically species-specific (e.g. Tilson, 1977; Whittaker, 2005) and/or base their estimates on geographically restricted data (e.g. Waltert et al., 2008; Quinten et al., 2010). Significantly, there is a lack of data from the archipelago's only protected area, Siberut National Park, located on the largest and northernmost of the four islands. Formally declared in 1993, the Park covers >40% of Siberut (Fig. 1) and comprises predominantly evergreen primary lowland rainforest (>80%; M. Quinten, unpubl. data). Unlike many of Indonesia's protected areas, Siberut National Park was designed to contain human settlements. It is subdivided into three land-use zones (sanctuary, traditional use and park village) and there are at least 5,000 inhabitants in the park village zone (PHPA, 1995), which is the least restricted. As with many government-established parks and reserves, protection and enforcement within the Park are hampered by staff members' lack of knowledge and training in wildlife ecology and conservation management, and by insufficient funding. Thus, despite its >20-year history and its potential importance as a refuge for primates, no systematic surveys have been carried out within the Park boundaries and consequently no data on primate density and abundance are available.

Following on from surveys of primates in the north of the island, outside the National Park (Waltert et al., 2008; Quinten et al., 2010), the Siberut Conservation Programme established a collaboration with the Siberut National Park Authority, Green Siberut Association, and UNESCO to carry out surveys within the Park. Our aims were to provide the first systematic and reliable estimates of primate density and abundance in the Park, extend the existing dataset on primate population sizes in the Mentawai Islands, and provide training in primate survey methodology and data analysis for staff of the National Park Authority and affiliated organizations in the region.

We organized a 3-day workshop (11–14 May 2011), during which participants received in-depth training in theoretical (e.g. survey design, general methodology) and

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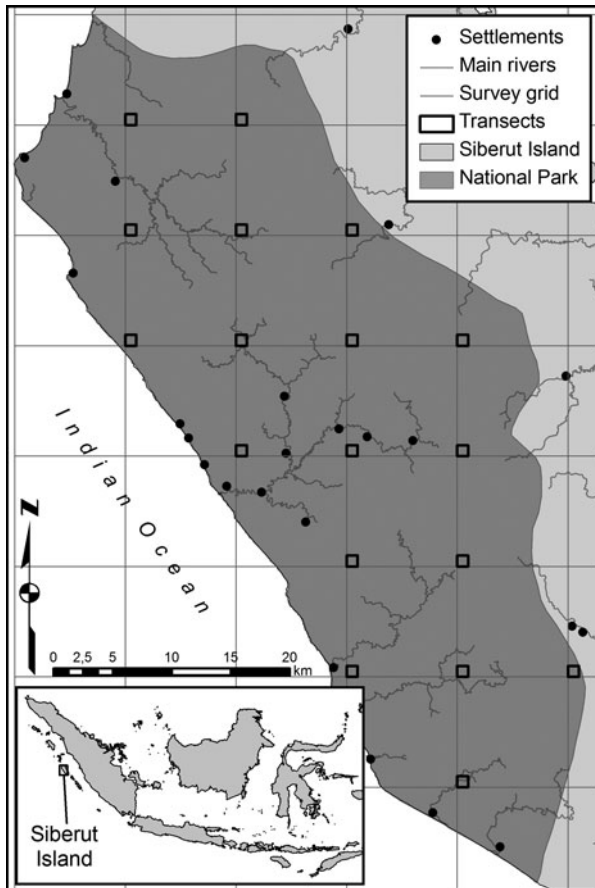


FIG. 1 Locations of 18 closed-circuit transects, within a systematic-random sampling grid, used to survey the four endemic primate species in Siberut National Park in the Mentawai Islands, Indonesia. The rectangle on the inset indicates the location of the main map in Indonesia.

practical (e.g. equipment handling, transect cutting) aspects of primate population surveys. We then assigned successful participants to one of seven teams and sent them to the field to conduct distance sampling surveys (Buckland et al., 2001, 2010) of primates at two or three of a total of 18 closed-circuit transects (length per transect 3,700 m), located according to a random vector grid (Fig. 1). The survey design represented the best possible solution taking into account logistical difficulties (no roads, remoteness, difficult terrain) and available resources (time, manpower, budget).

All teams conducted daily survey walks during times of peak primate activity (c. 07.00–11.00 and 14.30–18.00), and recorded standard survey data (cf. Quinten et al., 2010). Using a laser range finder, perpendicular distances were measured from the transect line to the centre of all countable individuals of each primate cluster; when primates were detected acoustically the perpendicular distance to the estimated location was measured. All teams returned to mainland Sumatra in June 2011 to attend a workshop, where we analysed all data using *DISTANCE* v. 6.0 (Thomas et al., 2009). For this purpose we pooled individual surveys and

primate observations by transect, and analysed each species separately using both visual and acoustic observations. We truncated the data to estimate the detection function $g(x)$ and the cluster (group) size (Table 1); we determined cluster size using the size bias regression method, regressing $\ln(\text{cluster size})$ against the estimated $g(x)$.

By surveying all 18 transects 1–4 times we achieved a total survey effort of 192 km, yielding 285 detection events for the four primate species on Siberut (Table 1): *S. concolor* (52), *M. siberu* (79), *P. siberu* (95) and *H. klossii* (59). *Presbytis siberu* was the most abundant primate, and based on a density of c. 10.44 individuals per km² (c. 4.4 clusters per km²) we estimate the total population in the Park to be 17,400 individuals. We modelled a density of 8.5 individuals per km² (c. 2.4 clusters per km²) and a total population of c. 14,100 individuals for Siberut's other colobine, *S. concolor*. The estimated densities of *H. klossii* and *M. siberu* were 6.29 and 5.55 individuals per km² (c. 2.36 and c. 1.75 clusters per km²), respectively, yielding population estimates of c. 10,500 gibbons and 9,250 macaques (Table 1). Collectively, this indicates a population of c. 51,000 primates within the Park. However, as our survey transects were located almost exclusively in primate habitat (e.g. primary and swamp forest), leaving non-suitable habitat underrepresented (c. 8–13% of the Park area, including bare land and agricultural areas; M. Quinten, unpubl. data), this number may represent a slight overestimation.

Given that no other systematic survey of primates has been conducted in Siberut National Park we cannot compare our results with earlier information, or comment on population changes over time. A comparison with the only available population estimates for the whole island (Whittaker, 2006, largely based on WWF, 1980; Table 1), however, suggests that a substantial proportion of the populations of all four primate species occurs within the Park, emphasizing its conservation importance for the region's primates. It also indicates that *P. siberu* and *S. concolor* are considerably more abundant on Siberut than Whittaker (2006) suggested (our estimates for the Park are c. 1.4–3 times higher than those of Whittaker for the entire island).

Given the Park's comparatively high abundance of primates, and considering that (1) the Park covers almost half of Siberut Island, (2) the areas outside the Park are largely production and conversion forest, and (3) there is little remaining forest (and thus primate habitat) on the three southern Mentawai Islands, we conclude that Siberut National Park represents the most important habitat for primates in the Mentawai region. To successfully fulfil its function as a refuge, the Park administration will need to address two main challenges. Firstly, encroachment associated with human population growth (cf. PHPA, 1995) continues to have a negative impact on primate populations in the Park, principally in terms of habitat loss and hunting (Quinten et al., 2014). Secondly, inadequate funding and

TABLE 1 Species-specific survey results for the primates inhabiting Siberut National Park, Indonesia (Fig. 1), and previous estimates for Siberut Island as a whole (Whittaker, 2005), with the analysis parameters, mean encounter rate, size and density of primate clusters, detection probability, mean density estimate for individuals, and estimated population.

	Pig-tailed langur <i>Simias concolor</i>	Siberut macaque <i>Macaca siberu</i>	Mentawai langur <i>Presbytis siberu</i>	Kloss's gibbon <i>Hylobates klossii</i>
Analysis parameters*				
<i>c</i> (m)	50	62	60	56
<i>w</i> (m)	115	94	100	93
<i>n_t</i>	52	79	95	59
<i>n_a</i>	48	43	77	49
<i>n_{visual/acoustic}</i>	45/3	32/11	62/15	41/8
Analysis results				
Mean encounter rate for clusters, km ⁻¹ (95% CI)	0.25 (0.17–0.38)	0.22 (0.13–0.39)	0.40 (0.28–0.57)	0.26 (0.17–0.39)
Mean cluster size (95% CI)	3.0 (2.4–3.8)	3.2 (2.2–4.6)	2.4 (2.0–2.8)	2.7 (2.1–3.4)
Mean cluster density, km ⁻² (95% CI)	2.8 (1.3–4.6)	1.8 (1.0–3.2)	4.4 (2.9–6.8)	2.4 (1.5–3.8)
Detection probability (95% CI)	0.38 (0.28–0.51)	0.68 (0.52–0.89)	0.46 (0.34–0.61)	0.58 (0.45–0.74)
Mean density, individuals km ⁻² (95% CI, CV)	8.5 (5.0–14.5, 27.2)	5.6 (2.8–11.1, 35.2)	10.4 (6.6–16.5, 23.1)	6.3 (3.7–10.6, 26.5)
Estimated population size (range), Siberut National Park	14,112 (8,252–24,133)	9,248 (4,639–18,438)	17,384 (11,014–27,439)	10,484 (6,206–17,713)
Results of Whittaker (2005)				
Estimated population size (range), Siberut Island	10,750 (6,000–15,500)	23,500 (17,000–30,000)	5,550 (1,600–9,500)	19,500 (18,000–21,000)

**c*, truncation distance for cluster size estimation; *w*, truncation distance for density estimation; *n_t*, total number of observed clusters; *n_a*, number of clusters used for data analysis after truncation; *n_{visual/acoustic}*, ratio of visual versus acoustic observations

levels of training in wildlife management, together with a fragile relationship between the Park authorities and some of its resident communities, compromise the effectiveness of the Park in achieving its conservation objectives.

We advise the Indonesian Ministry of Forestry to increase funding for the Park, to ensure adequate human resources to support the enforcement of its statutes on a local level and to improve staff training in conservation management. Greater emphasis needs to be placed on outreach activities to foster closer interaction and cooperation between Park management and the resident communities, raising local awareness of the value of Siberut's rainforest habitat and the importance of a sustainable approach to resource utilization. Finally, we recommend that further research be carried out, specifically (1) studies to examine the socio-economic needs of the Park's inhabitants, and assess their impact on the land, (2) time-series land-cover assessments to determine rates of deforestation/habitat loss, and (3) long-term monitoring of population trends in the Park (with surveys every 4–5 years); ideally this would be complemented by surveys outside the Park in Siberut's production forest/timber concessions.

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References

BPS (BADAN PUSAT STATISTIK) (2011) *Kepulauan Mentawai in Figures 2011*. Badan Pusat Statistik Kabupaten Kepulauan Mentawai, Tuapejat, Sumatra, Indonesia.

BUCKLAND, S.T., ANDERSON, D.R., BURNHAM, K.P., LAAKE, J.L., BORCHERS, D.L. & THOMAS, L. (2001) *Introduction to Distance Sampling: Estimating Abundance of Biological Populations*. Oxford University Press, Oxford, UK.

BUCKLAND, S.T., PLUMPTRE, A.J., THOMAS, L. & REXSTAD, E.A. (2010) Design and analysis of line transect surveys for primates. *International Journal of Primatology*, 31, 833–847.

IUCN (2014) *IUCN Red List of Threatened Species v. 2014.2*. <http://www.iucnredlist.org> [accessed 11 August 2014].

MITTERMEIER, R.A., SCHWITZER, C., RYLANDS, A.B., TAYLOR, L.A., CHIOZZA, F., WILLIAMSON, E.A. et al. (eds) (2012) *Primates in Peril: The World's 25 Most Endangered Primates 2012–2014*. IUCN/SSC Primate Specialist Group, International Primatological Society, Conservation International & Bristol Conservation and Science Foundation, Bristol, UK.

PHPA (1995) *Siberut National Park Integrated Conservation and Development Management Plan (1995–2020). Volume I: Current Conditions and Evaluation*. Chemonics International in association with PT. Indeco Duta Utama and PT. Nadya Karsa Amerta, for Ditjen Perlindungan Hutan dan Pelestarian Alam, Departemen Kehutanan, Jakarta, Indonesia.

QUINTEN, M.C., STIRLING, F., SCHWARZE, S., DINATA, Y. & HODGES, J.K. (2014) Knowledge, attitudes and practices of local people on Siberut Island (West-Sumatra, Indonesia) towards primate hunting and conservation. *Journal of Threatened Taxa*, 6, 6389–6398.

QUINTEN, M.C., WALTERT, M., SYAMSURI, F. & HODGES, J.K. (2010) Peat swamp forest supports high primate densities on Siberut Island, Sumatra, Indonesia. *Oryx*, 44, 147–151.

ROOS, C., BOONRATANA, R., SUPRIATNA, J., FELLOWES, J.R., GROVES, C.P., NASH, S.D. et al. (2014) An updated taxonomy and conservation status review of Asian primates. *Asian Primates Journal*, 4, 2–38.

THOMAS, L., LAAKE, J.L., REXSTAD, E., STRINDBERG, S., MARQUES, F. F.C., BUCKLAND, S.T. et al. (2009) *Distance 6.0*. Release 2. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK. <http://www.ruwpa.st-and.ac.uk/distance/> [accessed 17 August 2009].

TILSON, R.L. (1977) Social organization of Simakobu monkeys (*Nasalis concolor*) in Siberut Island, Indonesia. *Journal of Mammalogy*, 58, 202–212.

WALTERT, M., ABEGG, C., ZIEGLER, T., HADI, S., PRIATA, D. & HODGES, J.K. (2008) Abundance and community structure of Mentawai primates in the Peleonan forest, north Siberut, Indonesia. *Oryx*, 42, 375–379.

WHITTAKER, D.J. (2005) New population estimates for the endemic Kloss's gibbon (*Hylobates klossii*) on the Mentawai Islands, Indonesia. *Oryx*, 39, 458–461.

WHITTAKER, D.J. (2006) A conservation action plan for the Mentawai primates. *Primate Conservation*, 20, 95–105.

WWF (1980) *Saving Siberut: A Conservation Master Plan*. WWF Indonesia Programme, Bogor, Indonesia.

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