Darwin Final Report: ZSL Berbak Carbon Initiative.
Technical Report: A baseline survey of Gibbons *(Hylobates agilis).*

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Abstract

We explore the use of auditory survey techniques for vocalising arboreal primates in the context of biodiversity monitoring for the ZSL Berbak Carbon Intiative project in Sumatra's Jambi province. Historically tropical peat-swamp forest (TPSF) received less research attention than tropical forests on mineral soils. Yet in the context of the strong focus of Indonesia's REDD+ programme upon carbon-rich peatland, and from the perspective of biodiversity conservation, the urgency to answer questions regarding the broader biological value of un-surveyed, carbon-rich peatlands has never been greater.

Our goals were: 1. To provide the first population density estimate for gibbons (*Hylobates agilis unko)* for this pilot REDD+ demonstration site, and 2. To inform the development of research techniques for biodiversity monitoring specific to peat swamp forests. Since our focal species is renowned for its vocalisation, we employed an auditory survey technique, conducting triangulation surveys at four sites in Berbak. At each site, three pairs of observers were positioned at three listening posts situated at least 300m apart. Observation teams recorded the time, bearing and estimated distance of gibbon vocalisations from their listening post. Weather conditions were also noted as these can have a significant effect on triangulation data.

A total of four surveys were conducted, each lasting between two and four days. We estimated the mean gibbon group density to be between 1.1 and 2.3 groups per km2.

1. Methods

a) Field Site: ZSL Berbak Carbon Initiative (BCI)

The BCI study site is an area of predominantly peat swamp forest in eastern Sumatra. Berbak's forests are managed under legislation specific to different land classifications including:
1. Berbak National Park under the control of central government in Jakarta;
2. Hutan lindung (protection forest) under the control of the Jambi provincial government;
3. Hutan tahura, also managed by the provincial government;
4. Hutan produksi (production forest) managed by Indonesian timber concessions.

BCI is a pilot REDD+ project co-managed by the Zoological Society of London (ZSL) and the Government of Indonesia, and funded for three years by the UK government's Darwin initiative.

b) Field Methods

Various methods exist to determine population statistics for forest biodiversity, but for vocal arboreal primates, auditory detection methods are favoured by researchers (Brockelman and Ali, 1987). Some researchers have used single point counts from the top of mountain ridges in order to determine angle and distance of gibbon groups (Nijman and Menken, 2005). However, Cheyne et al. (2007) suggested that at least three listening posts should be used, in a triangular formation with posts at least 300m apart and with 2 observers at each listening post, in order to increase the sampling area and the probability of detecting all groups present in the area, especially in peat swamp forests where the topography does not allow for hill-top monitoring.

Deploying field teams is expensive for conservation NGOs, particularly when surveying remote and difficult-to-access locations. Whilst surveys longer than the present study have been published in literature, Buckley et al. (2006) found that 3-day sample periods are sufficient to make density estimates. As such our minimum planned listening survey was 3 days, although in the analysis one day's data had to be discounted from survey 1 since the field team were not correctly placed to triangulate.

At each site, the field teams arrived at their respective listening posts in time to start listening for calls at 04.00. Observers remained at their posts until 09.00, or until half an hour after the last gibbon group stopped calling. The time, bearing and estimated distance to each of the gibbon groups was recorded by observers along with the prevailing weather conditions.

A significant challenge at this site is the overlap between the optimum time for recording gibbon calls, and the hunting preferences of the Sumatran tiger (*Panthera tigris sumatrae).* Berbak is a site of global importance for tiger conservation hence ZSL's activities in the area but, due to escalating destruction of tiger habitat, incidences of human-tiger conflict are on the increase and represent potentially dangerous conditions for field researchers. As a result, a compromise was reached whereby field teams established listening points at or near to the forest edge, to avoid walking through tiger habitat during the period when they are highly active. This was thought to be an acceptable compromise between field safety and optimum survey coverage of the study site. Also, in the analysis we were able to account for the potential bias by reducing the effective listening area to account for the fact that a proportion of the area was outside gibbon habitat. However this cannot compensate for the inability to sample in more intact primary forest.

3. Analysis

In order to determine the number of gibbon groups at the site, we plotted the estimated position of each gibbon group recorded by each listening point using bespoke scripts in conjunction with the *Raster* and *Calibrate* packages within the R programming environment (R Development Core Team, 2012; Figure 1). We considered the plotted positions along with the time at which calls were recorded at each listening point in order to account for any group movement during the listening period. Following Brockelman and Ali (1987) any estimated gibbon locations mapped more than 500m apart were considered to be different groups. We only included groups that were identified by two or more of the listening posts on the same survey day.

We calculated density estimates of gibbons by using D=n/E (Brockelman and Srikosamatara 1993). The size of the sampling area was calculated based upon the assumption that gibbons can be heard up to 1km away in the forest at Berbak. We calculated the area of land with no potential habitat (treeless swamp bush) using the area tool in ArcGIS and deducted this from the original estimate of the listening area. As a base layer we used a landcover classification map created from a 2008 SPOT image (Satellite Pour L'Observation de la Terre).

4. Results and Discussion

Gibbon groups called frequently and for long durations, with calls being recorded constantly from individual groups for periods of over 2.5 hours. The group density across the four sites varied from 1.1 to 2.3 groups/km2, mean=1.7km2. The listening area for the survey sites ranged from 1.2km2 to 2.7km2. These results are summarised in Table 1 below.

Our density estimates are lower than the 2.1-2.9 groups/km2 recorded by Nijman and Menken (2005) in moist mineral soil forests of East Kalimantan. In the mixed peat-swamp forest of Sebangau, Central Kalimantan, Cheyne et al. (2007) recorded gibbons (*Hylobates albibarbis*) at a density of 2.59km^2.

At each of our sites, calls identified by one listening point only were excluded from the analysis. This may have placed a downward bias on the estimate of gibbon density for Berbak. However, this is a standard technique to allow our results to be comparable with those of other

triangulation studies, so we must assume that there is a similar downward bias on the results of all similar gibbon studies.

In questioning this low density estimate, it should be noted crucially that these surveys were conducted in edge habitat, which included swamp bush and secondary forest in addition to primary peat swamp forest. As such density here may be expected to be lower than in the intact interior of the park. We may be able to test this hypothesis in the future if human-tiger conflict severity falls.

Finally, with just four survey sites it is not possible to make assertions about the relationship between habitat type and gibbon density. However, ongoing work at the site should both verify the initial baseline estimates we have made and enable further analysis of the relationship between habitat type, carbon density and gibbon density.

Figure 1. Example of call triangulation. Axes in UTM coordinates.

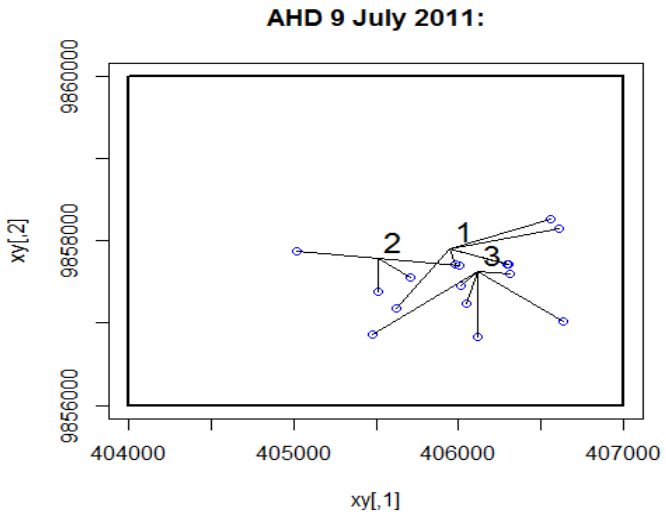

Table 1. Gibbon survey analysis

#	Site Name	Coordinates of LP1 UTM 48S	Dates of Survey	Notes	Mean Estimated Number of Groups	Listening Area km²	Estimated Density Groups/ km²
1	Air Hitam Dalam A	0405951 - 9857913	20-22 March 2011 (2 days, as one day discounted)	Secondary forest	3	2	1.5
2	Air Hitam Dalam B	0405947 - 9857910	6-9 July 2011 (4 days)	Secondary forest, adjacent to primary	3	2.7	1.1
3	Sungai Sawah	0409155 - 9862372	9-12 September 2011 (4 days	Edge of primary forest and swamp bush	3	1.6	1.9
4	Simpang Kayu Aro	0406545 - 9858502	13-16 September 2011 (4 days)	Mosaic: edge of primary forest, swamp bush, secondary	2.75	1.2	2.3
						Mean	***1.7***

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(Brockelman and Srikosamatara 1984; Brockelman and Srikosamatara 1993; Buckley et al. 2006; Cheyne et al. 2007)

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