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DIPLOME D'ETUDES SUPERIEURES SPECIALISEES PRODUCTIONS ANIMALES EN REGIONS CHAUDES

MEMOIRE DE STAGE

ANNEXES

RECENSER LES NIDS D'ORANGS-OUTANS PAR UNE METHODE AERIENNE - SABAH, MALAYSIA
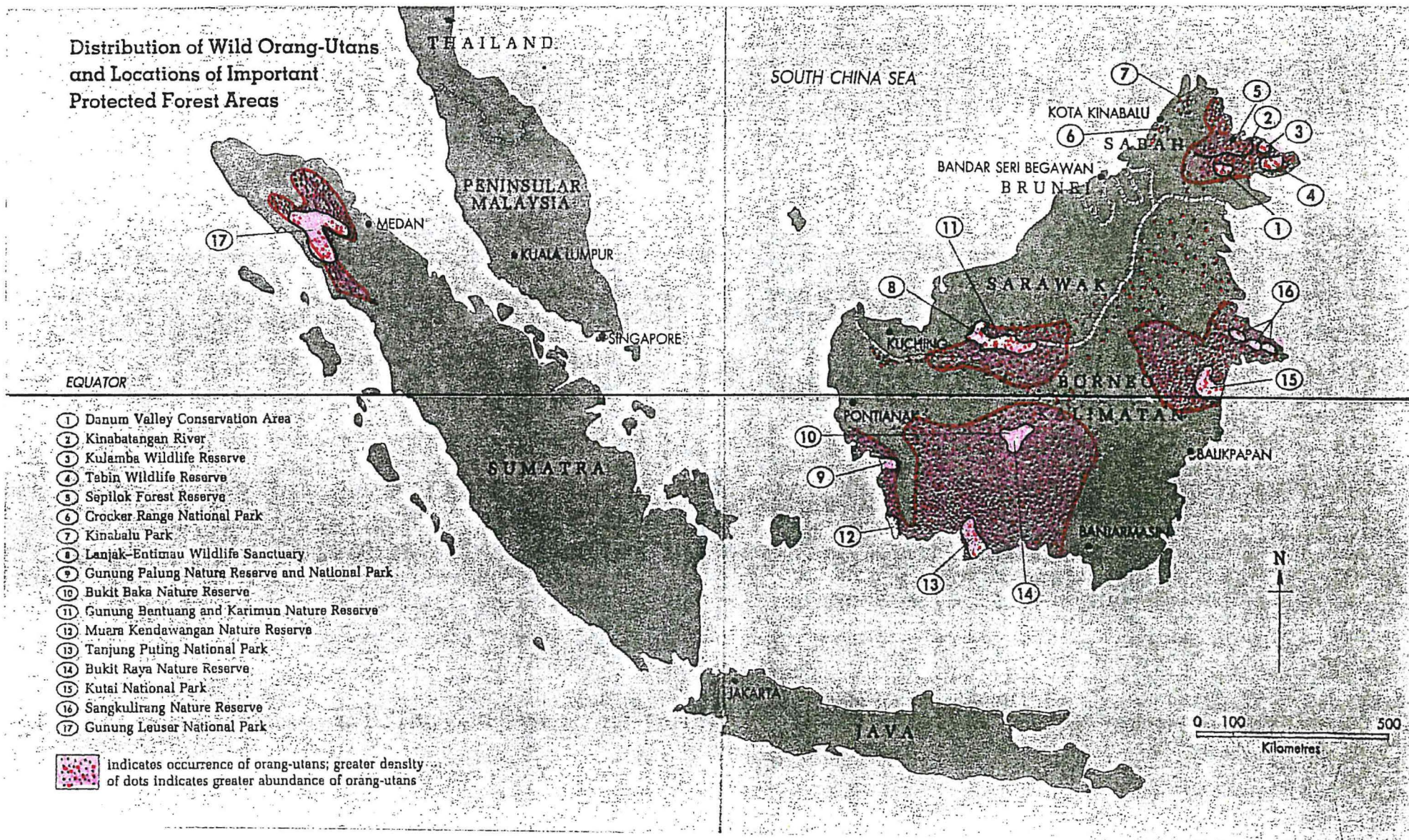
par

Caroline GILBERT

Année universitaire 1998-1999

ANNEXE 1

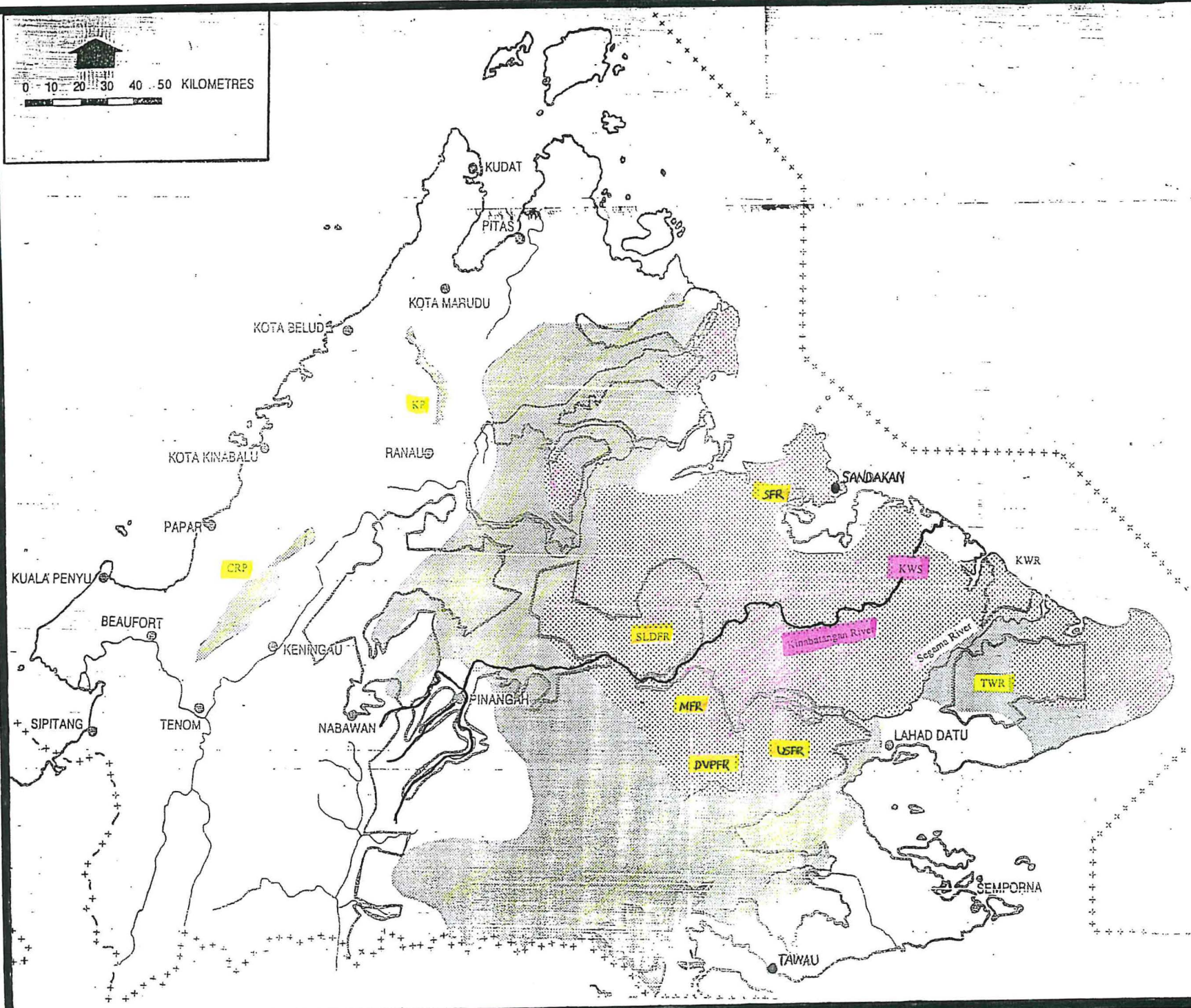## Distribution géographique des orangs-outans et localisation des principales zones protégées

Distribution of Wild Orang-Utans and Locations of Important Protected Forest Areas

1. Danum Valley Conservation Area
2. Kinabatangan River
3. Kulamba Wildlife Reserve
4. Tabin Wildlife Reserve
5. Sepilok Forest Reserve
6. Crocker Range National Park
7. Kinabalu Park
8. Lanjak-Entimau Wildlife Sanctuary
9. Gunung Palung Nature Reserve and National Park
10. Bukit Baka Nature Reserve
11. Gunung Bentuang and Karimun Nature Reserve
12. Muara Kendawangan Nature Reserve
13. Tanjung Puting National Park
14. Bukit Raya Nature Reserve
15. Kutai National Park
16. Sangkulirang Nature Reserve
17. Gunung Leuser National Park

indicates occurrence of orang-utans; greater density of dots indicates greater abundance of orang-utans

ANNEXE 2

Distribution et densités des orangs-outans dans l'état de Sabah (Malaisie) avec localisation des principales zones protégées (issu de Payne, 1988)
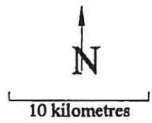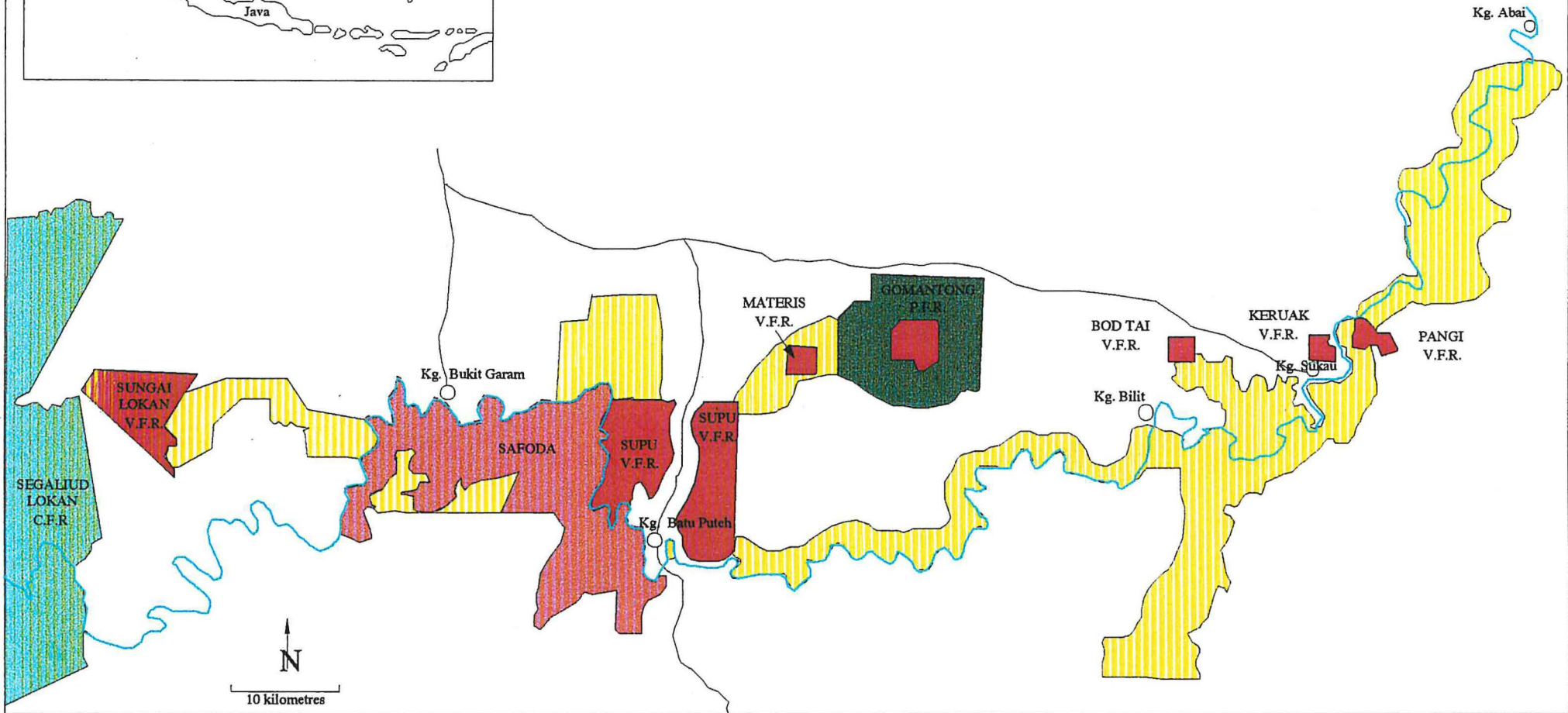
NATURAL
DISTRIBUTION OF
THE ORANG-UTAN

LEGEND

Population density generally high,
0.5 - 5.0 orang-utan/km²

Population density generally low,
< 0.5 orang-utan/km²

CRP	Crocker Range Park
DVPFR	Danum Valley Protection Forest Reserve
KP	Kinabalu Park
KWR	Kulamba Wildlife Reserve
KWS	Kinabatangan Wildlife Sanctuary (in process of establishment)
MFR	Malua Forest Reserve
SFR	Sepilok Forest Reserve
SLDFR	Segaliud-Lokan & Deramakot Forest Reserves
TWR	Tabin Wildlife Reserve
USFR	Ulu Segama Forest Reserve

0 10 20 30 40 50 KILOMETRES

ANNEXE 3

**Localisation du Sanctuaire de faune sauvage de la Kinabatangan
(version 1994, ne pas tenir compte des surfaces)**

THE LOWER KINABATANGAN REGION

MALAYSIA

Peninsular Malaysia

Sabah

SINGAPORE

Sumatra

Kalimantan

Sulawesi

INDONESIA

Java

Kg. Abai

MATERIS V.F.R.

GOMANTONG P.F.R.

BOD TAI V.F.R.

KERUAK V.F.R.

PANGI V.F.R.

SUNGAI LOKAN V.F.R.

Kg. Bukit Garam

SAFODA

SUPU V.F.R.

SUPU V.F.R.

Kg. Sukau

Kg. Bilit

SEGALIUD LOKAN C.F.R.

Kg. Batu Puteh

N

10 kilometres

	Proposed Kinabatangan Wildlife Sanctuary		Commercial Forest Reseve	Kinabatangan River
	Virgin Forest Reserve		Sabah Forestry Development Authority (SAFODA) rattan plantation	Main public roads
	Protection Forest Reserve			○ Main Kampungs (villages)

ANNEXE 4

Les line transects (Burnham *et al.*, 1980; Buckland *et al.*, 1993)

L'échantillonnage des populations animales à partir de transects recouvre un ensemble de méthodes (Eberhardt, 1978). La théorie complète du *line transect* n'a été établie que récemment (Burnham *et al.*, 1980, Buckland *et al.*, 1993).

Plusieurs avantages importants de cette méthode sont à noter : aucune limite de largeur de bande d'observation n'est imposée à l'observateur, aucune condition sur la répartition spatiale des animaux n'est nécessaire et un animal non compté n'introduit pas de sous-estimation systématique de la densité. De plus, peu de conditions sont nécessaires au choix des transects, qui seront de préférence linéaires et non parallèles aux rivières, routes… pouvant influer sur la distribution des animaux. Ceci confère au *line transect* une meilleure efficacité et une réduction des biais négatifs de sous-estimation par rapport au *strip transect*, comptage des animaux dans une bande de largeur fixe.

Principe du line transect (Gaillard *et al.*, 1993)
L'observateur parcourt une ligne de longueur L définie, et les mesures suivantes sont relevées lorsqu'un animal est aperçu : *(cf. figure 1)*
  - la distance radiale de l'observateur à l'animal, r
  - la distance perpendiculaire de l'animal à la ligne de marche, x
  - l'angle entre la ligne de marche et la ligne imaginaire, t
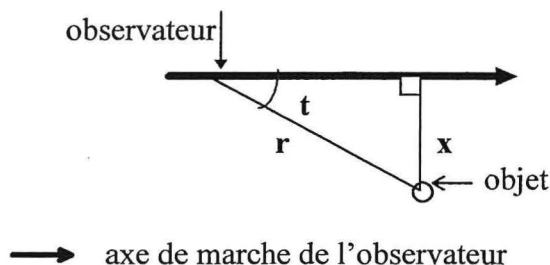
Figure 1 : Principe du line-transect

Les distances perpendiculaires mesurées servent à établir la largeur effective du transect, w, et la densité **D** est donnée par la formule :

$$D = n / (2Lw)$$

n = nombre de contacts
w = moitié de la largeur de la bande effective d'observation (ESW : Effective Strip Width)

Les 5 conditions d'applications du line transect (Gaillard *et al.*, 1993)
- Tout individu se trouvant sur l'axe de marche est détecté (ceci est parfois difficile, voire impossible).
- L'observateur n'influe pas sur la position des animaux et ils sont détectés avant qu'ils ne fuient.
- Les détections sont des événements indépendants.

- Les mesures sont précises (ce biais est difficile à estimer).
- Aucun individu n'est échantillonné plus d'une fois.

La fonction de détection g(x)

C'est la probabilité de détecter un objet qui se trouve à une distance x de la ligne centrale. g(x) est égale à la probabilité (détection / distance x) avec g(0) = 1. Elle est fonction de plusieurs facteurs, incluant les caractéristiques de l'objet, du milieu et l'expérience de l'observateur.

Les hypothèses pour décrire cette courbe sont que tous les animaux se trouvant sur le transect seront toujours détectés, d'où g(0) = 1 et que leur probabilité de détection décroît avec la distance depuis la ligne de marche (Jolly, 1981).

$w = \int g(x)\, dx$ de 0 à la limite de visibilité   *(cf. figure 2)*
dx : dérivée de x
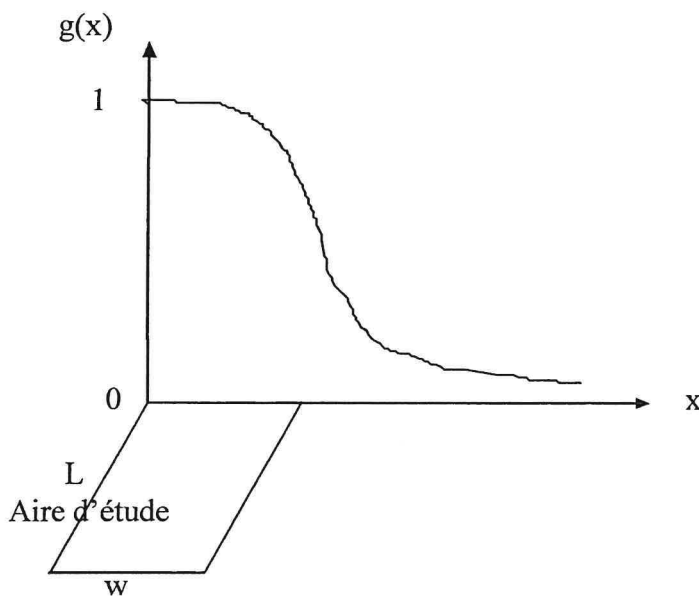
Figure 2 : La courbe de probabilité de détection, g(x)

Analyse statistique

Pour le *line transect*, les modèles d'estimation de la largeur de bande effective (Gaillard *et al.*, 1993; Burnham *et al.*, 1980; Buckland *et al.*, 1993) regroupent ceux utilisant la distance radiale et l'angle de fuite, moins performants, et les distances perpendiculaires. On distingue pour les mesures perpendiculaires les méthodes paramétriques (prendre la moyenne arithmétique des distances perpendiculaires), ad-hoc (rechercher sur l'histogramme la distance à partir de laquelle le nombre d'observations chute brusquement) et non-paramétriques, qui semblent les plus robustes : séries de Fourier, modèle polynomial.

Le logiciel Distance (Buckland *et al.*, 1993) peut-être utilisé pour le calcul de la densité, selon le modèle le plus approprié. La dernière version utilisable, la version 3.5, est téléchargeable via internet.

ANNEXE 5

Site d'étude du projet et principaux layons

Légende
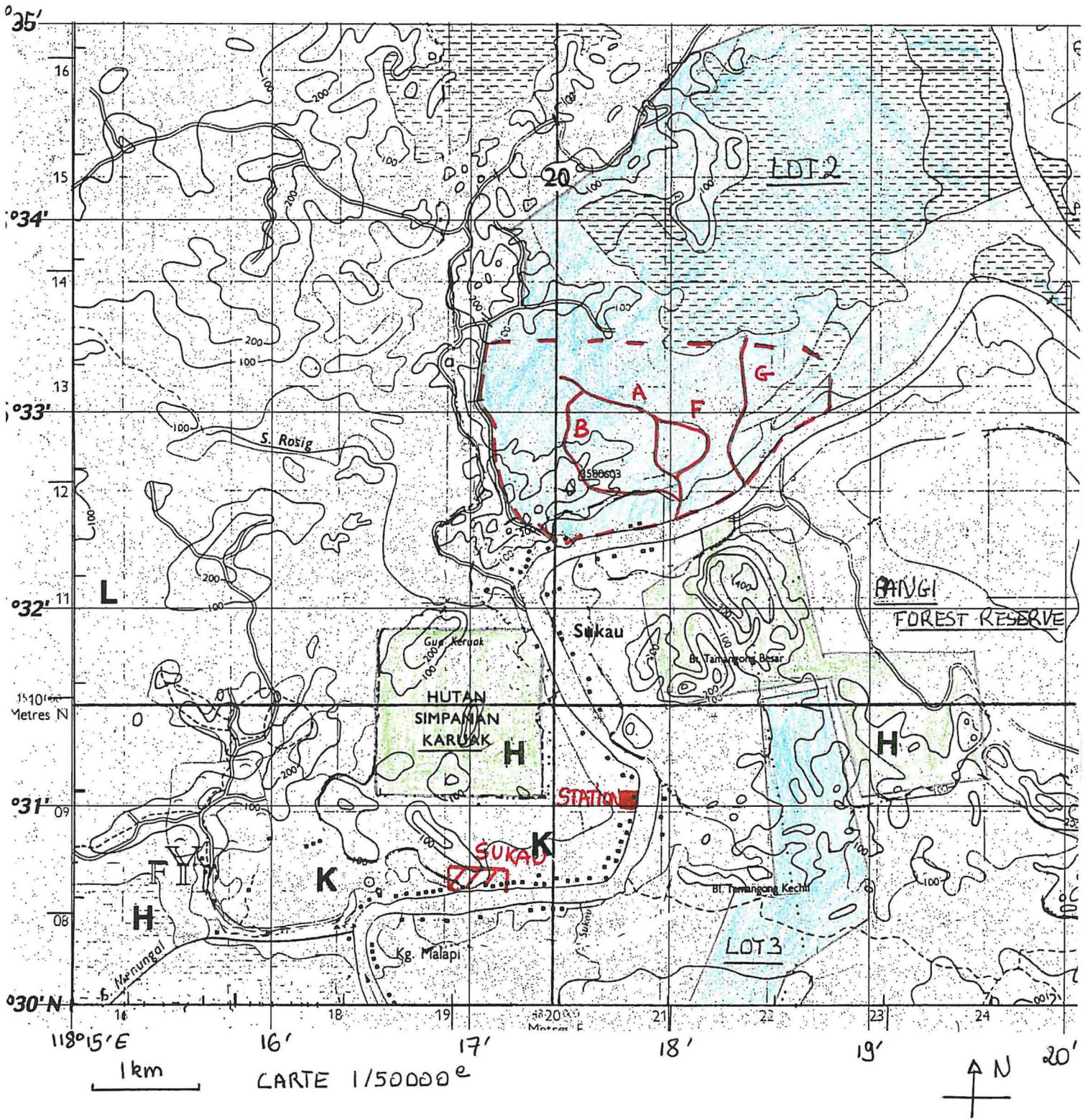
☐ (bleu)	SANCTUAIRE
☐ (vert)	RÉSERVE FORESTIÈRE
——	PRINCIPAUX LAYONS DU SITE D'ETUDE
- - -	LIMITES DU SITE D'ETUDE
▨	VILLAGE

CARTE 1/50000e

1 km

↑ N

Labels on map: LOT 2, PANGI FOREST RESERVE, Sukau, Bt. Tamangong Besar, HUTAN SIMPAMAN KARUAK, Gua Keruak, STATION, SUKAU, Bt. Tamangong Kechil, LOT 3, Kg. Malapi, S. Menungal, S. Rosig, S. Sukau

Coordinates: 118°15'E, 16', 17', 18', 19', 20'
35', 34', 33', 32', 31', 30'N
1540000 Metres N, 1820000 Metres E

Zones: A, B, F, G, H, K, L, F

ANNEXE 6

Feuilles de prises de notes pour comptages terrestres

Transect's Presentation

1 - Opening date of the transect

2 - Nest's counting date

3 - Nest's counting team

4 - Name of the area

5 -Name of the transect

6 - Length :

7 : GPS's points :

Start (Pt 0)	**N**	
	E	
Pt 1	**N**	
	E	
Pt 2	**N**	
	E	
Pt 3	**N**	
	E	
Pt 4	**N**	
	E	
End (Pt 5)	**N**	
	E	

8 - Comments :

JALAN'S DESCRIPTION

Date :

Jalan :

Team :

Meteo	Distance on transect	Forest's Type	Topography	Animal's sign / Human's sign	Comments / hour

				Date :
			1 – Hour	
			2- Nest's number	Team :
			3- Distance on transect	
			4- Forest's Type and canopy height	
			5- Tree's height	
			6- Nest's height (visible from air : L / TL)	Jalan:
			7- Nest's class	
			8- Perpendicular distance (+bear.)	
			9- Tree's diameter	
			10- Tree's name (+comments)	NEST'S COUNTING

ANNEXE 7

Résultats répertoriés pour le second recensement

ANNEXE 7

SECOND RECENSEMENT									
date	équipe	nom du transect	heure	n° du nid	distance sur le transect (m)	visible (l), non visible (tl)	classe du nid	distance perpendiculaire (m)	direction (droite / gauche)
17/08/99	Z,H,B,A	Bawang	7;27	1	-280	l	4	7,5	g
			7;35	2	-180	l	5	10	d
			7;37	3	-160	tl	5	5	d
			7;42	4	-60	tl	5	7	d
			7;58	5	25	tl	5	4,5	g
			8;01	6	55	tl	5	env 120	d
			8;07	7	120	tl	4	24	q
			8;24	8	285	tl	3	11,5	d
			8;24	9	285	tl	3	11	d
			8;24	10	285	tl	5	11	d
			8;25	11	280	tl	5	20	d
			8;28	12	300	l	4	4,2	d
			8;29	13	300	tl	5	7,5	g
			8;30	14	300	tl	3	12,2	g
			8;39	15	320	l	3	3,2	g
			8;40	16	320	l	3	1	d
			8;45	17	340	tl	5	3,1	g
			8;55	18	460	tl	4	4,8	d
			9;00	19	505	tl	5	1	g
			9;03	20	535	tl	3	5,5	d
			9;35	21	660	tl	4	1,7	g
			9;35	22	660	tl	5	5,1	d
			9;41	23	665	l	1	18,7	d
			9;44	24	690	tl	4	1	d
			9;46	25	700	tl	4	5	d
			9;51	26	760	tl	4	12	d
			9;55	27	805	tl	5	1,2	g
			10;04	28	920	l	4	7	d
			10;04	29	920	tl	5	7	d
			10;06	30	935	tl	3	13	g
			10;09	31	960	tl	5	8,5	d
			10;09	32	960	tl	5	env 40	d
			10;09	33	960	l	4	16	d
			10;10	34	960	tl	4	20,6	d
			10;15	35	975	tl	5	1	g
			10;20	36	1030	tl	5	7	g
			10;24	37	1070	l	3	30,5	d
			10;36	38	1140	l	3	9	d
			10;38	39	1150	tl	3	20	d
			10;39	40	1160	tl	4	15,5	d
			10;39	41	1160	tl	4	15,5	d
			10;40	42	1160	tl	5	20	d
			10;46	43	1220	l	3	5,1	d
			10;52	44	1300	tl	5	15	d
			10;56	45	1340	tl	5	16	d
			10;58	46	1360	tl	5	22,7	d
			10;58	47	1360	tl	5	22,7	d
			11;13	48	1520	tl	4	20,5	g
			11;13	49	1520	tl	5	10	d
			11;23	50	1670	tl	5	9,1	g
			11;27	51	1770	l	5	1	g
21/08/99	Z,H,S,A	Lee	6;40	1	60	tl	5	20	g
			6;44	2	125	tl	5	13,8	d
			6;45	3	140	tl	5	3,8	d
			6;54	4	240	tl	4	10,1	g
			6;55	5	245	tl	5	6,7	d

ANNEXE 7

				6;55	6	245	tl	5	6,7	d
				6;56	7	250	l	3	3,8	g
				6;56	8	250	l	2	2,8	d
				6;57	9	250	tl	5	2,8	d
				7;01	10	290	tl	5	11,5	d
				7;05	11	320	tl	5	1,2	g
				7;20	12	440	l	4	16	d
				7;33	13	600	tl	4	4,3	g
				7;34	14	600	tl	5	5,5	d
				7;34	15	600	tl	4	1,3	d
				7;36	16	600	tl	5	9,6	g
				7;37	17	610	tl	5	13	g
				7;39	18	640	tl	5	5,5	d
				7;40	19	650	tl	5	5,4	d
				7;41	20	660	l	2	5,2	d
				7;45	21	700	tl	5	3,3	g
				7;50	22	760	tl	5	13,5	d
				7;51	23	770	tl	5	9,7	g
				8;32	24	1130	l	4	50	g
				8;41	25	1240	tl	5	4,7	d
				8;41	26	1240	tl	5	7,7	d
				8;57	27	1570	l	4	30	g
				9;01	28	1670	tl	3	12,2	g
				9;03	29	1670	tl	5	1	g
				9;03	30	1670	tl	5	2	g
				9;03	31	1670	tl	4	4	d
				9;06	32	1700	tl	5	1	g
				9;06	33	1700	tl	4	2,7	d
				9;06	34	1700	tl	5	6,3	d
19/08/99	Z,B,H,A		S	9;19	1	575	l	5	3,5	d
				9;22	2	550	l	5	12,2	d
				9;24	3	530	tl	5	8,5	d
				9;26	4	500	tl	5	60	g
				9;28	5	485	tl	5	3,6	d
				9;29	6	470	tl	5	12,4	g
				9;30	7	470	tl	3	80	g
				9;33	8	420	tl	4	5,2	d
				9;35	9	410	tl	4	10,6	g
				9;35	10	410	l	5	13	g
				9;35	11	410	l	5	13	g
				9;36	12	410	l	5	13	g
				9;38	13	380	tl	5	5,1	g
				9;38	14	380	tl	5	5,1	g
				9;39	15	375	tl	4	1,5	g
				9;39	16	370	tl	5	5	g
				9;40	17	370	l	4	19,7	d
				9;43	18	330	tl	5	11,3	d
				9;44	19	330	l	5	50	d
				9;45	20	330	tl	5	7	g
				9;45	21	330	tl	5	25	d
				9;45	22	320	tl	4	1	d
				9;46	23	320	tl	5	1	g
				9;46	24	320	tl	4	8	g
				9;47	25	315	tl	4	9,7	g
				9;47	26	305	tl	4	5,8	g
				9;47	27	305	tl	4	16,5	g
				9;48	28	305	l	1	2	d
				9;50	29	305	tl	5	13,7	d
				9;53	30	300	tl	4	4,5	g
				9;53	31	300	tl	2	8,5	g
				9;54	32	300	tl	5	0,5	g
				9;57	33	260	tl	3	13,5	g
				9;57	34	260	l	4	16	d
				9;58	35	250	l	5	1	g
				10;01	36	225	tl	5	5,4	d
				10;02	37	215	tl	3	30	g
				10;04	38	205	tl	4	2	g

				10;05	39	185	I	4	5,3	g
				10;08	40	175	tl	1	5,3	g
				10;09	41	175	tl	3	4	d
				10;09	42	160	I	2	6	g
				10;09	43	160	I	3	5	g
				10;10	44	155	tl	5	15	d
				10;13	45	125	tl	5	23,3	d
				10;13	46	125	tl	5	18,5	d
				10;15	47	115	tl	5	30	g
				10;17	48	75	II	3	16,2	g
				10;18	49	75	I	4	0,1	g
				10;19	50	25	tl	3	6	g
				10;20	51	25	tl	4	5	d
19/08/99	Z,H,B,A	Hassan	10;41	1	0	tl	3	27	d
			10;41	2	20	I	4	7	d
			10;41	3	0	tl	4	4	g
			10;45	4	20	tl	5	4,3	d
			10;55	5	160	tl	5	16	g
			10;59	6	220	tl	4	3,9	g
			11;04	7	290	I	5	1	g
			11;08	8	340	tl	4	13,6	d
			11;19	9	520	tl	5	7	g
			11;22	10	555	tl	3	11,5	g
			11;25	11	600	tl	5	10	g
			11;32	12	605	I	4	11	g
			11;56	13	660	I	4	6,4	d
			12;01	14	760	I	5	1	g
			12;01	15	760	I	5	1	g
			12;02	16	760	I	5	5	g
			12;02	17	760	tl	5	10,4	g
			12;10	18	900	tl	5	12	g
			12;12	19	900	tl	5	2,6	d
			12;13	20	920	tl	5	1	g
			12;14	21	940	tl	5	2	d
			12;15	22	940	tl	4	14,3	d
			12;18	23	990	tl	5	7,6	d
			12;18	24	990	tl	5	5,2	d
			12;18	25	990	tl	5	5,2	d
			12;18	26	990	tl	4	7	d
			12;18	27	990	tl	3	3,1	d
			12;22	28	1000	tl	5	26	d
			12;22	29	1000	tl	5	21	d
			12;22	30	1000	tl	5	26	d
			12;23	31	1010	tl	5	8,5	g
			12;23	32	1010	tl	5	8,7	g
			12;27	33	1040	tl	5	16	g
			12;31	34	1100	tl	4	5,3	g
			12;32	35	1110	tl	5	2,5	g
			12;34	36	1130	tl	5	8	g
			12;34	37	1130	tl	5	8	g
			12;45	38	1340	tl	5	14	g
			12;46	39	1340	tl	5	12,1	d
			12;48	40	1400	tl	4	17,5	g
			13;10	41	1500	tl	5	4	d
			13;10	42	1500	tl	4	16,5	d
			13;12	43	1500	tl	5	16	d
			13;13	44	1510	tl	4	7,6	d
			13;25	45	1700	tl	5	3,5	d
25/08/99	Z,H,B,A	Pangi	7;07	1	280	I	5	14,5	d
			7;08	2	280	I	5	100	d
			7;10	3	300	tl	1	17,3	g
			7;13	4	305	I	5	3	g
			7;53	5	890	tl	3	5,3	d
			7;58	6	980	tl	5	4,4	g
			8;24	7	1030	I	5	1,3	d
			8;24	8	1030	I	3	5,6	g
			8;24	9	1030	I	3	5,4	d

			8;29	10	1060	tl	3	6,9	d
			8;29	11	1060	tl	3	4	d
			8;30	12	1060	tl	5	9,4	d
			8;31	13	1060	tl	5	1	d
			8;44	14	1260	tl	5	4	d
			8;44	15	1260	tl	5	4,9	g
			8;45	16	1270	tl	5	15	d
			8;45	17	1280	tl	3	1	g
			8;47	18	1280	tl	4	8	g
			8;48	19	1280	l	1	14,4	g
			8;50	20	1280	l	1	16,4	g
			9;09	21	1480	tl	3	1	d
			9;16	22	1540	tl	3	23	d
			9;23	23	1630	tl	4	16,4	g
			9;25	24	1640	tl	5	1,6	d
			9;46	25	1760	tl	3	40	g
13/08/99	H,B,A	Caroline	7;00	1	60	tl	3	3	d
			7;01	2	60	l	2	7	g
			7;07	3	140	l	3	10	g
			7;15	4	170	l	2	13,5	g
			7;42	5	390	tl	4	6,5	d
			7;47	6	430	tl	5	5	d
			7;52	7	520	l	3	45	g
			7;56	8	550	tl	3	13,5	g
			8;06	9	670	l	3	4	d
			8;06	10	670	l	3	8,2	g
			8;14	11	690	tl	4	13,5	d
			8;50	12	1080	tl	4	35	g
			9;08	13	1350	tl	4	7	g
			9;13	14	1370	l	3	10,5	d
			9;30	15	1610	l	3	40	d
26/08/99	Z,H,B,A	Morisem 1	11;53	1	125	tl	4	10	g
			11;55	2	125	tl	5	10,8	d
			11;57	3	125	tl	5	20	d
			12;00	4	150	tl	5	10	g
			12;00	5	150	tl	5	10	g
			12;03	6	200	tl	5	9,6	d
27/08/99	Z,H,B,A	Morisem 2	8;05	1	74	l	3	29,5	g
			8;05	2	74	l	4	29,5	g
			8;05	3	74	l	4	29,5	g
			8;05	4	74	l	4	29,5	g
			8;05	5	74	l	5	29,5	g
			8;08	6	74	l	5	29,5	g
			8;08	7	74	l	5	29,5	g
			8;08	8	74	tl	3	6	g
			8;12	9	60	l	5	1,5	d
			8;17	10	90	tl	3	5	g
			8;45	11	680	tl	5	6,6	g
			8;48	12	690	l	4	6,3	d
			9;11	13	882	tl	4	env 100	d
			9;13	14	920	l	4	9,5	g
			9;13	15	920	l	4	9,5	g
			9;13	16	920	l	4	9	g
			9;13	17	920	l	5	8,5	g
			9;13	18	920	l	5	8,5	g
			9;13	19	920	l	5	8,5	g
			9;15	20	920	l	5	env 90	d
			9;24	21	1000	l	4	env 70	g
			9;24	22	1000	l	4	env 70	g
			9;24	23	1000	l	5	env 70	g
			9;41	24	1300	l	5	40	g
			9;45	25	1420	tl	5	4,8	d
			9;53	26	1565	l	5	10,4	g
26/08/99	Z,H,B,A	Temenggong	7;54	1	300	tl	3	1,4	g
			7;56	2	350	tl	4	13	g
			8;00	3	430	tl	5	4,5	d
			8;17	4	600	l	1	6	d

Date		Nom							
			8;26	5	670	l	5	1,8	d
			9;10	6	950	tl	3	8,4	g
			9;14	7	970	tl	4	3,1	g
			9;11	8	970	tl	5	10,4	g
			9;11	9	970	tl	5	10,3	g
			9;27	10	1250	l	3	30	d
11/08/99	Z,H,S,A	Benoit	10;37	1	?	tl	3	env 50	d
			10;42	2	?	tl	4	9	d
			10;45	3	?	l	3	11	g
			10;48	4	?	l	4	25	g
			10;48	5	?	l	4	11	g
			10;48	6	?	tl	4	11	d
			10;52	7	?	tl	5	11,8	d
			10;57	8	?	tl	3	13	g
			10;57	9	?	tl	5	13	g
			11;08	10	?	tl	5	env 100	g
			11;08	11	?	tl	5	env 150	g
			11;08	12	?	tl	5	env 80	d
			11;13	13	?	l	4	env 120	d
			11;15	14	?	tl	3	env 50	d
			11;16	15	?	l	5	env 60	g
			11;16	16	?	l	4	env 60	g
			11;18	17	?	tl	3	25	d
			11;18	18	?	tl	2	3	d
			11;21	19	?	tl	5	25	d
			11;24	20	?	tl	4	24	d
			11;25	21	?	tl	4	21	d
			11;25	22	?	tl	5	21	g
			11;30	23	?	tl	5	15	d
			11;31	24	?	tl	3	32	g
			11;33	25	?	l	3	11	g
			11;37	26	?	l	4	17	g
			11;39	27	?	tl	5	24	d
			11;39	28	?	l	3	24	d
			11;41	29	?	tl	5	26	d
			11;41	30	?	tl	5	26	d
			11;41	31	?	l	4	40	g
			11;45	32	?	l	1	env 200	g
12/08/99	Z,H,B,A	Boy	8;04	1	?	l	5	12	d
			8;07	2	?	l	4	70	g
			8;07	3	?	l	5	env 120	g
			8;08	4	?	tl	4	env 100	g
			8;09	5	?	l	4	env 90	d
			8;10	6	?	tl	4	40	g
			8;11	7	?	tl	5	env 90	d
			8;12	8	?	tl	4	45	g
			8;15	9	?	l	5	10	g
			8;17	10	?	l	5	4	d
			8;17	11	?	l	5	7	d
			8;23	12	?	tl	5	18	d
			8;30	13	?	tl	3	4,1	g
			8;31	14	?	tl	4	24	g
			8;36	15	?	tl	3	20	g
			8;40	16	?	tl	5	16	g
			8;43	17	?	tl	5	8	g
			8;45	18	?	tl	4	env 60	g
			8;45	19	?	tl	5	14	g
			8;47	20	?	l	5	21	d
			8;50	21	?	l	5	env 60	d
			8;51	22	?	tl	5	40	g
			8;56	23	?	l	3	21	d
			8;57	24	?	tl	4	40	d
			9;00	25	?	l	3	27	d
			9;03	26	?	tl	5	27	g
			9;03	27	?	l	4	27	g
			9;03	28	?	l	5	36	g
			9;03	29	?	tl	5	24	g

			9;08	30	?	l	5	env 200	d
			9;08	31	?	l	5	env 100	d
			9;09	32	?	tl	5	env 100	g
			9;11	33	?	tl	5	16	d
			9;13	34	?	l	1	12	g
			9;18	35	?	tl	5	25	d
			9;20	36	?	l	4	11,5	g
			9;20	37	?	l	4	15	g
			9;21	38	?	l	4	35	d
			9;23	39	?	tl	5	14,6	g
			9;25	40	?	tl	5	11	d
			9;25	41	?	tl	3	2	d
			9;29	42	?	tl	3	6	d
			9;29	43	?	tl	5	7	d
			9;29	44	?	l	3	9	d
			9;31	45	?	l	3	env 100	g
			9;31	46	?	tl	5	env 120	g
			9;31	47	?	l	5	env 120	g
			9;32	48	?	tl	3	16,5	g
			9;33	49	?	tl	5	16,5	g
			9;35	50	?	l	5	14	d
			9;36	51	?	l	5	11	d
			9;36	52	?	l	3	11	d
			9;36	53	?	tl	5	11	d
			9;49	54	?	l	4	30	g
			9;52	55	?	l	4	8	d
			9;54	56	?	tl	5	17	d
			9;56	57	?	tl	4	14,5	g
			9;56	58	?	l	5	14	g
			9;58	59	?	tl	5	26	d
			10;04	60	?	tl	4	9	g
			10;25	61	?	tl	3	15	d
			10;26	62	?	tl	3	11,1	d
			10;34	63	?	l	3	10,5	d
			10;36	64	?	tl	5	1	d
			10;36	65	?	tl	3	2	d
11/08/99	Z,B,S,A	Motorob	14;27	1	?	l	4	env 200	g
			14;31	2	?	tl	5	40	d
			14;32	3	?	l	2	40	d
			14;33	4	?	tl	2	env 70	g
			14;34	5	?	tl	5	40	d
			14;34	6	?	tl	5	40	d
			14;37	7	?	l	5	25	d
			14;38	8	?	l	5	env 50	g
			14;40	9	?	l	5	30	g
			14;43	10	?	tl	4	13	g
			14;51	11	?	tl	3	45	g
			14;52	12	?	l	3	2,6	g
			14;54	13	?	tl	5	18	d
			14;54	14	?	tl	5	18	d
			14;58	15	?	tl	4	16	d
			15;07	16	?	l	3	18	g
			15;10	17	?	l	3	17	d
			15;12	18	?	l	3	21,5	d
			15;13	19	?	tl	5	19	d
			15;15	20	?	l	4	21	g
			15;20	21	?	tl	3	18	g
			15;27	22	?	tl	3	25	d
			15;32	23	?	l	5	4	g
			15;34	24	?	l	3	35	d
			15;37	25	?	tl	5	20	g
			15;39	26	?	tl	5	5	d
			15;39	27	?	tl	5	5	d
			15;39	28	?	tl	4	10	d
			15;41	29	?	l	3	25	g
			15;49	30	?	tl	3	4	g
			15;51	31	?	tl	5	4	g

			15;52	32	?	tl	4	5	g
			15;52	33	?	tl	4	7,4	g
			15;53	34	?	tl	3	11	d
			15;55	35	?	l	5	45	d
			15;56	36	?	l	3	35	d
			15;56	37	?	l	5	35	d
			15;58	38	?	l	2	45	d
			16;01	39	?	l	5	1	d
			16;09	40	?	l	2	env 90	d
03/09/99	Z,B,S,A,H	Quenny	8;33	1	20	tl	4	1	d
			8;34	2	20	tl	5	19	g
			8;35	3	30	tl	3	5	g
			8;35	4	30	tl	3	7	g
			8;56	5	450	tl	4	4,5	g
			9;13	6	780	tl	3	30	g
21/08/99	Z,B,S,A,H	Quenny	9;49	7	920	l	4	17	g
			10;19	8	1430	l	3	20	g
			10;23	9	1580	tl	5	13	d
			10;25	10	1590	l	4	9,6	g
			10;34	11	1730	l	4	0,4	g
03/09/95	Z,B,S,A,H	Herman	10;14	1	45	l	2	3,7	d
			10;15	2	65	tl	3	3,3	g
			10;21	3	170	l	4	13,4	d
			10;23	4	220	tl	5	0	?
			10;24	5	230	tl	4	6,2	g
			10;24	6	230	tl	5	3,5	g
			10;24	7	230	tl	5	3,5	g
			10;27	8	295	tl	5	11	d
			10;28	9	310	tl	4	8,5	d
			10;29	10	310	tl	3	10,1	d
			10;31	11	350	tl	3	3,4	g
			10;32	12	350	tl	4	6,8	d
			10;35	13	420	l	3	5,6	d
			10;49	14	680	tl	5	40	g
			10;51	15	730	tl	3	30	g
			10;55	16	840	tl	5	60	d
03/09/199	Z,B,S,A,H	Husfik	6;59	1	200	l	3	1,1	g
			6;59	2	200	l	5	1,1	g
			7;03	3	220	tl	3	6,1	d
			7;13	4	380	tl	3	8	g
			7;13	5	380	tl	5	8	g
			7;13	6	380	tl	2	8	g
			7;15	7	380	tl	5	3,5	g
			7;16	8	380	tl	5	3,8	g
			7;16	9	380	l	4	2,8	d
			7;31	10	400	tl	1	15,3	g
			7;32	11	400	tl	3	15,3	g
			7;32	12	400	l	4	16,8	g
			7;34	13	425	tl	4	7,5	d
			7;36	14	425	tl	5	7,5	d
			7;36	15	425	tl	5	4,3	d
			7;38	16	455	tl	4	8	g
			7;38	17	455	tl	5	16,6	g
			7;47	18	620	tl	4	0	g
			7;48	19	620	tl	5	0	g
			7;49	20	630	tl	4	4,8	d
			7;50	21	630	tl	5	16,4	g
			7;50	22	630	tl	4	21	g
			7;54	23	675	tl	4	5	d
			7;58	24	780	tl	5	1	g
			8;00	25	790	l	4	6,3	d
			8;00	26	790	tl	3	4	d
			8;00	27	790	tl	5	4	d

ANNEXE 8

Caractéristiques de l'hélicoptère

(1 321 mm)

(1 918 mm)

(330 mm)

(9 500 mm)

(457 mm)

(10 160 mm)

(980 mm)

(2 306 mm)

(6 533 mm)

(11 824 mm)

(1 110 mm)

(2 540 mm)

(1 974 mm)

* (3 543 mm)

(343 mm) DROOPED BLADE

(1 816 mm)
DROPPED
BLADE

(1 651 mm)

(305 mm)

(1 829 mm)

(3 264 mm)

(495 mm)
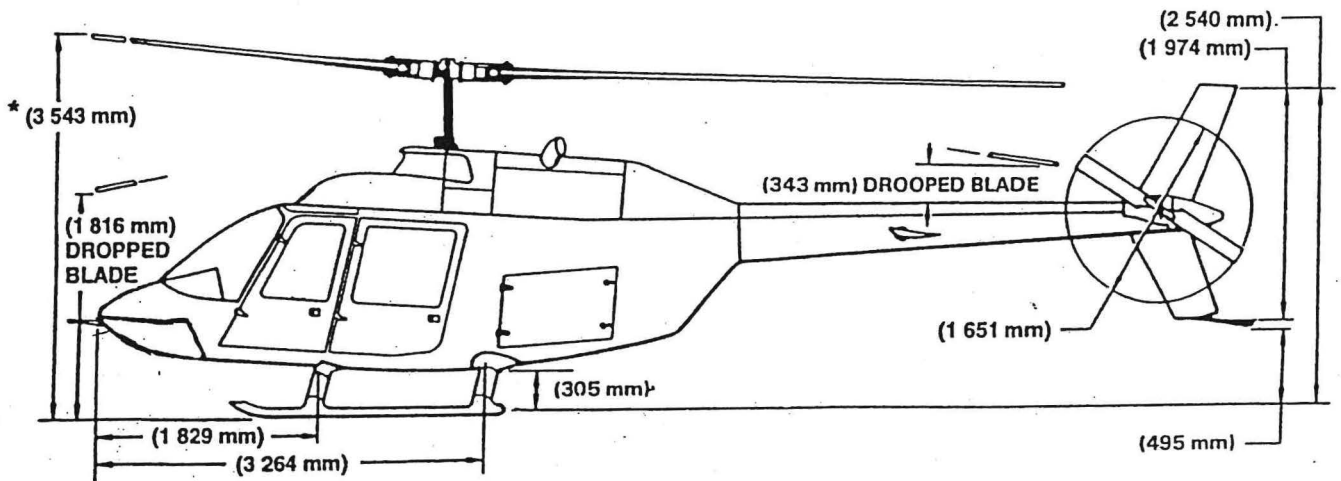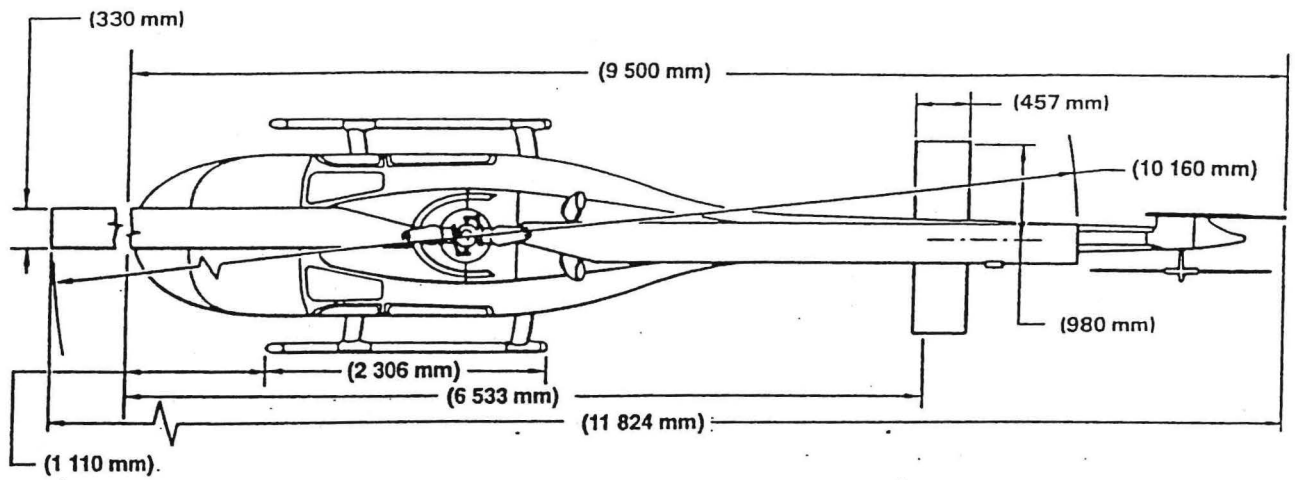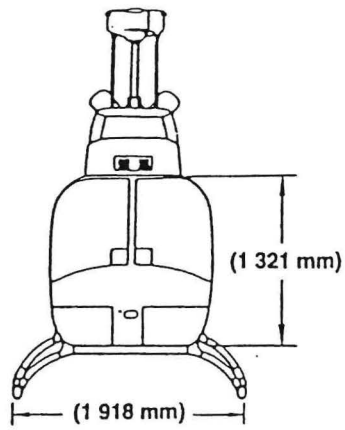
*** MEASUREMENT TAKEN WITH MAIN ROTOR BLADE RAISED
AGAINST THE DYNAMIC FLAP RESTRAINT.**

Principal dimensions — Metric

ANNEXE 9

Feuillets explicatifs destinés aux observateurs

A FEW EXPLANATIONS ABOUT THE HELICOPTER SURVEY

1. WHY COUNTING?

Counting is the first step for the conservation of a species : we need to know how many individuals live in the area surveyed to improve the Kinabatangan Orangutan Conservation Project.

2. WHY COUNTING FROM A HELICOPTER?

1) Censusing by air permits access to difficult areas, like swamps, or mountains, bushes...
2) The time needed to fly over an area is considerably reduced compared to the same survey by the ground.
3) It allows the survey of large areas, which leads to a more accurate census.

3. THE ORIGINALITY OF THE KINABATANGAN ORANGUTAN CONSERVATION PROJECT: CENSUSING ORANGUTAN NESTS BY AIR

1) Dr. J. Payne, WWF Malaysia, conducted in 1985 a pilot survey. He found that it was possible to count nests from a helicopter, but his densities results were approximative.
2) We are going to organize the first study to describe this method, and to validate it by comparison with the ground results, which is a method commonly employed now.

4. WHAT ARE WE GOING TO DO?

a) Material

- We have the money to fly for 7 hours, in 2 flights. The first one will last 4 hours on the 11th of August and the second one 3 hours, on the 12th of August 1999.
- We will rent the helicopter from the Sabah air sdn bhd, and reach the study sites from Sandakan.
- The pilot, M. Surezza NG. Abdullah, and the 2 observers, M. Sampoladon Pilik and M. Sundang Sarim were contacted with the help of the Sabah Wildlife department.

b) Method

- GROUND CENSUS

To census orang utans, it is almost impossible to count them directly by seeing the animals, as they are used to hide at the top of the trees, and often rest quietly. So the methods used by scientists consist in counting the indices of presence of these animals, the nests they make to sleep at night. They usually build a new nest each night, and sometimes during the day, to have a rest.

The nests are quite easily seen from the ground, and the methods to census from the ground need to walk along a line transect (ie a straight line), counting the nests seen and recording the perpendicular distance from the transect. Then the density can be calculated using the following formula:

$$D = n / 2wLrtp$$

D: density of orangutans

n : number of nests counted

w: width of the strip where the nests were seen (calculated by the software DISTANCE which uses the probability of detection of nests. This probability decreases with his distance from the transect surveyed: a nest seen on the line has a probability of 1, the maximum, to be detected, then when the nest is far from the line, its probability to be seen is much inferior.)

L: lenght of the line transect

p : proportion of animals building nests (the infants, still with their mother don't build nest), from previous datas, p = 0,9

r: number of nest built per day. New nests are always built for the night, and sometimes during the day. From previous data, r = 1,7

t: nests decay rate or life span of the nest. It takes time for the nest to disappear, and as we count all the nests without taking care of their age, we have to divide the numbers found by the time a nest can be visible for the observers.

t will be estimated from an intensive study led by the project, which had begun in January. From previous datas, the life span of nests was approximately 145 days!

- AERIAL CENSUS

This formula will be used also for the air results.

-We will fly along straight transects of known lenght, and the two observers will count the nests on both sides of the helicopter, to obtain a number of nests for a given strip of land flown over.

- We will also fly over the ground transects, some flags will be fixed on the ground or in trees to mark the begining of these transects. We counted nests in order to compare the results from the ground and from the air. This was done during june 1999, by our assistants, and the transects will be surveyed again in August.

As we will miss some nests from the air, we will only see in fact the nests which are on the top of the trees. In order to get a better estimation of the total number of nests which are in the aerial transects, we will compare these data with the ground survey, which is more precise.

A video camera will be held by the copilot in order to record the flight.

- We will fly over the whole sanctuary, so we will be able to compare in the end the densities in the different areas.

5. HOW THE AERIAL SURVEY WILL BE CONDUCTED?

- flight pattern

The flight pattern, including all the transects followed and their order to be surveyed will be given to the pilot. GPS points and bearing will provide accurate transects.

-Pilot (M. Surezza NG Abdullah)

The two most important things to respect, thanks to the pilot's skills, are:

1. to maintain a CONSTANT ALTITUDE, even if the topogaphy changes

ALTITUDE = 90 m, ie 70 m from the average canopy.
This is really important, because if the altitude changes, the width of the transects changes also, and this will give inaccurate datas.

2. to maintain a CONSTANT SPEED

SPEED= 60km/h
This will permit for the observers to count the nests. If the speed changes, the detection of the nests will change (low speed, detection increased, fast speed, detection decreased), and we want it CONSTANT.

-Copilot (Marc Ancrenaz)

He will check the GPS points to follow, and record the data of time: beginning and end of a transect, forest types identified, comments or problems.
He will assist the pilot, and inform the observers to begin and to stop to count.
He will also be in charge of the video camera.

-Observers (M. Sampoladon Pilik, M. Sundang Sarim)

They are going to do the most important part of this census. Upon them will depend the results of the census.
The two observers will seat on each side of the helicopter, so both sides can be surveyed.

The width of the strip to be surveyed will be of 150 meters, for each observer.
To visualize this strip, two lines of tape will be fixed on the windows of the helicopter. The first line, which will materialize the interior line, must be alignated with the squid of the helicopter when the observer counts nests. This position must be kept constant during the flight, so that the strip width won't change.
We will fix the tape, and check the strip during a five minute flight on the 10th of August.
All watches must be coordinated before the departure.

The main points are:
1. not to miss a nest. So the attention must be constant during the flight. This is really difficult, but essential. Missing nests will underestimate the numbers of orangutans in the areas.
2. Count the nests which are IN the strip.
The eyes must be placed in order that the marks on the window and the helicopter can coincide. All the nests seen between those marks are counted. If a nest in on a mark, it has to be counted if its center is in the strip, and not counted if its center is outside the strip.

-Recorder (Caroline Gilbert)

A third assistant will seat between the two observers, and each time a nest is spotted, the observer will tell him or tap his leg to record it. Then we'll have the number of nest for each transect.

He will also record the time of the beginning and the ending of each transect. He will have a chronometer to record these data and a tape recorder.

6.CONCLUSION

After having analysed these data, we will calculate the densities of orangutans in each area surveyed.

Then we will know the repartition of orangutans in the Sanctuary, so we will be able to propose advice for the conservation of this endangered ape, by identifying areas to be protected or gazetted first, or to gazet other areas so that the animals can move from areas to areas, without passing through plantations.

- on the ground : point ① and ② confounded
  ③ - ④ "

- in the air : points ① and ③/
  ALWAYS confounded

diagram

window

TEST
measured with
the observer

← h

=> TEST
GROUND

70m = H

W=150m

=> FLIGHT

canopy
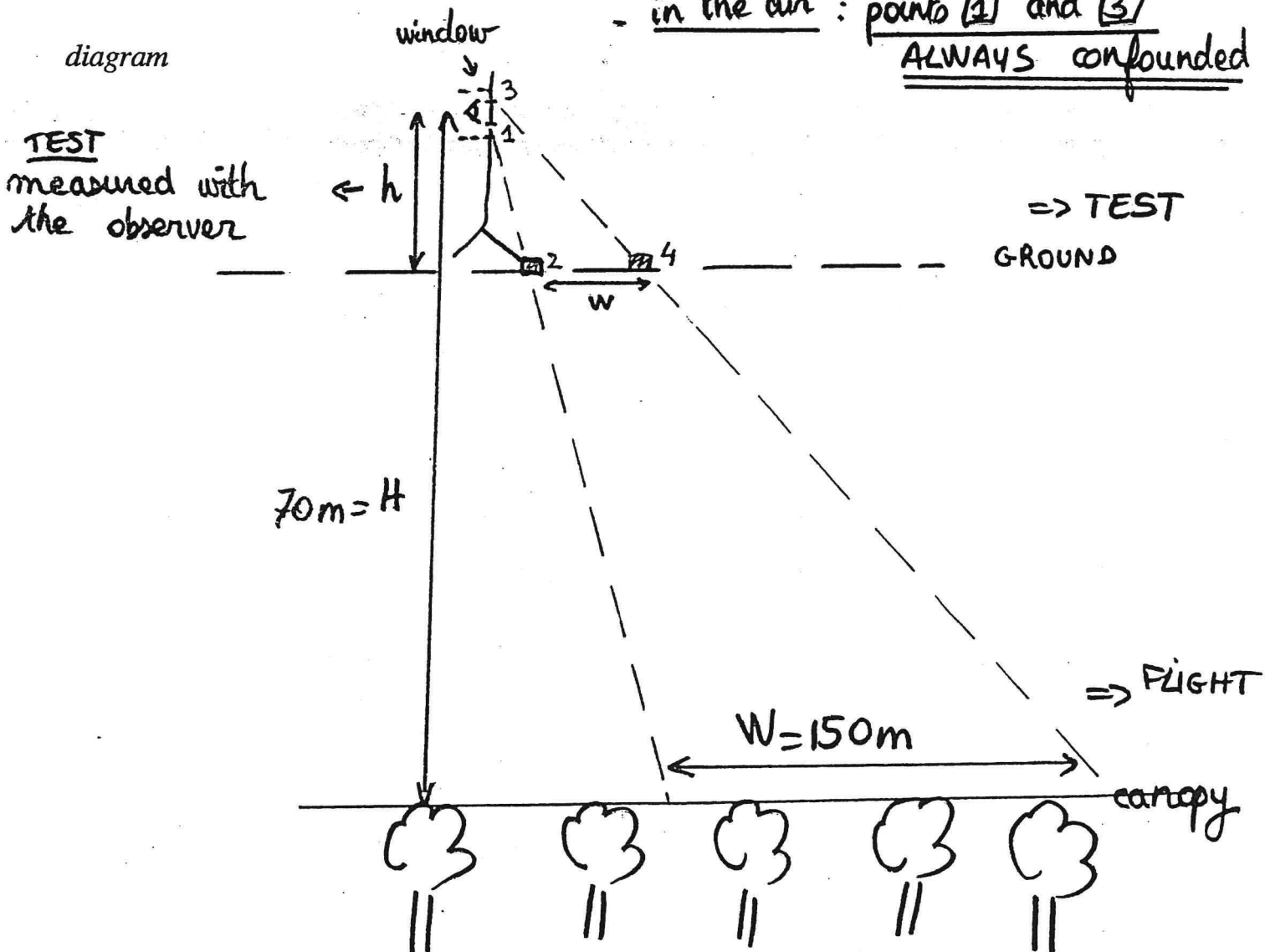
ANNEXE 10

Photographie de l'hélicoptère et de l'équipe

Photographie 1 : l'équipe du recensement

De gauche à droite : Sundang Sarim, Marc Ancrenaz, Caroline Gilbert, Surezza NG Abdullah, Sampoladon Pilik

Photographie 2 : l'hélicoptère

ANNEXE 11

Plans de vol, premier et second vol : points GPS des transects

ANNEXE 11

Plan de vol ; premier vol

lot n°	n° du transect	Tn à Tn+1	GPS départ	05° Nord	118/117°Est	GPS fin	05° Nord	118°/117°Est	direction	distance	tps-60 km/h	tps#60km/h
									degrés	km	min	min
5	1		GPS 1	28' 30.4"	118° 11' 44.4"	GPS 2	28' 30.4"	118° 05' 32.9"	270	11,4	11,5	
5		2>3	GPS 2	28' 30.4"	05' 32.9"	GPS 3	29' 37.0"	05' 32.9"		2		2
5	2		GPS 3	29' 37.0"	05' 32.9"	GPS 4	29' 37.0"	11' 25.7"	90	10,825	11	
5		4>5	GPS 4	29' 37.0"	11' 25.7"	GPS 5	30' 44.4"	10' 00.0"		3,3		3,25
5 à Gom.FR	3		GPS 5	30' 44.4"	10' 00.0"	GPS 6	30' 44.4"	01' 49.0"	270	15,25	15,25	
Gom. FR		6>7	GPS 6	30' 44.4"	01' 49.0"	GPS 7	31' 47.7"	01' 49.0"		2		2
Gom. FR	4		GPS 7	31' 47.7"	01' 49.0"	GPS 8	31' 47.7"	06' 18.1"	90	8,2	8,25	
Gom. FR		8>9	GPS 8	31' 47.7"	06' 18.1"	GPS 9	32' 52.6"	06' 18.1"		2		2
Gom. FR	5		GPS 9	32' 52.6"	06' 18.1"	GPS 10	32' 52.6"	02' 44.4"	270	6,5	6,5	
Gom. à 6		10>11	GPS 10	32' 52.6"	02' 44.4"	GPS 11	25' 27.9"	03' 32.0"		13,65		13,75
6	6		GPS 11	25' 27.9"	03' 32.0"	GPS 12	23' 38.6"	03' 32.0"	180	3,375	3,25	
6		12>13	GPS 12	23' 38.6"	03' 32.0"	GPS 13	23' 38.6"	01' 41.1"		3		3
6 à 7	7		GPS 13	23' 38.6"	01' 41.1"	GPS 14	25' 27.9"	01' 41.1"	360	3,3	3,25	
7		14>15	GPS 14	25' 27.9"	01' 41.1"	GPS 15	26' 00.0"	00' 14.8"		3,2		3,25
7	8		GPS 15	26' 00.0"	00' 14.8"	GPS 16	24' 24.7"	00' 14.8"	180	2,85	3	
7 à Supu FR		16>17	GPS 16	24' 24.7"	00' 14.8"	GPS 17	24' 40.2"	117° 58' 41.1"		3,05		3
Supu FR	9		GPS 17	24' 40.2"	117° 58' 41.1"	GPS 18	29' 32.9"	58' 41.1"	360	9	9	
Supu FR à 8		18>19	GPS 18	29' 32.9"	58' 41.1"	GPS 19	32' 03.3"	55' 19.7"		7,5		7,5
8 à Supu	10		GPS 19	32' 03.3"	55' 19.7"	GPS 20	26' 32.0"	55' 19.7"	180	10,05	10	
Supu FR à Saf.		20>21	GPS 20	26' 32.0"	55' 19.7"	GPS 21	26' 14.8"	54' 50.9"		1		1
Safoda	11		GPS 21	26' 14.8"	54' 50.9"	GPS 22	23' 35.5"	54' 50.9"	180	4,875	4,5	
Safoda		22>23	GPS 22	23' 35.5"	54' 50.9"	GPS 23	25' 56.7"	53' 11.5"		5,3		5,25
Safoda	12		GPS 23	25' 56.7"	53' 11.5"	GPS 24	29' 24.7"	53' 11.5"	360	6,45	6,5	
Safoda		24>25	GPS 24	29' 24.7"	53' 11.5"	GPS 25	29' 34.5"	51' 32.9"		2,95		3
Safoda à 9	13		GPS 25	29' 34.5"	51' 32.9"	GPS 26	27' 11.5"	51' 32.9"	180	4,325	4,5	
9		26>27	GPS 26	27' 11.5"	51' 32.9"	GPS 27	27' 30.4"	49' 55.0"		3		3
9 à Safoda	14		GPS 27	27' 30.4"	49' 55.0"	GPS 28	29' 16.4"	49' 55.0"	360	3,25	3,25	
Safoda		28>29	GPS 28	29' 16.4"	49' 55.0"	GPS 29	28' 18.1"	48' 15.6"		3,5		3,5
Safoda à 9	15		GPS 29	28' 18.1"	48' 15.6"	GPS 30	27' 05.7"	48' 15.6"	180	2,25	2,25	
9 à 10		30>31	GPS 30	27' 05.7"	48' 15.6"	GPS 31	27' 29.6"	47' 19.7"		1,85		2
10	16		GPS 31	27' 29.6"	47' 19.7"	GPS 32	29' 18.1"	44' 53.4"	307	5,6	5,75	
10		32>33	GPS 32	29' 18.1"	44' 53.4"	GPS 33	26' 55.9"	42' 53.4"		5,75		5,75
10 à Lokan FR	17		GPS 33	26' 55.9"	42' 53.4"	GPS 34	26' 55.0"	40' 41.1"	270	3,4	3,5	
Lokan		34>35	GPS 34	26' 55.0"	40' 41.1"	GPS 35	28' 00.0"	39' 49.3"		2,95		3
Lokan FR à 10	18		GPS 35	28' 00.0"	39' 49.3"	GPS 36	28' 00.0"	42' 08.2"	90	4,15	4,25	
10 à Lokan FR		36>37	GPS 36	28' 00.0"	42' 08.2"	GPS 37	29' 04.9"	41' 27.9"		2,35		2,25
Lokan	19		GPS 37	29' 04.9"	41' 27.9"	GPS 38	29' 04.9"	38' 26.3"	270	5,45	5,25	
Total										188,85 km	120,75 min	108,5 min
												229,25 min

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ANNEXE 11

lot n°	n° du transect	Tn à Tn+1	GPS départ	05° Nord	118° Est	GPS fin	05° Nord	118° Est	direction degrés	distance km	tps-60 km/h min	tps#60km/h min
1	1		GPS 1	40' 04.9"	20' 47.7"	GPS 2	40' 04.9"	23' 29.6"	90	4,9	5	
1		GPS2>GPS3	GPS 2	40' 04.9"	23' 29.6"	GPS 3	39' 00"	24' 29.6"		2,7		2,5
1	2		GPS 3	39' 00"	24' 29.6"	GPS 4	39' 00"	19' 49.3"	270	8,5	8,5	
1		4>5	GPS 4	39' 00"	19' 49.3"	GPS 5	37' 51.7"	20' 11.5"		2,125		2
1	3 Motorob		GPS 5	37' 51.7"	20' 11.5"	GPS 6	37' 51.7"	25' 25.5"	90	9,475	9,5	
1		6>7	GPS 6	37' 51.7"	25' 25.5"	GPS 7	36' 44.4"	24' 00.0"		3,25	-	3,5
1	4		GPS 7	36' 44.4"	24' 00.0"	GPS 8	36' 44.4"	19' 42.7"	270	7,775	7,75	
1		8>9	GPS 8	36' 44.4"	19' 42.7"	GPS 9	35' 38.6"	19' 03.3"		2,35		2
1	5		GPS 9	35' 38.6"	19' 03.3"	GPS 10	35' 38.6"	21' 27.9"	90	4,4	4,5	
1		10>11	GPS 10	35' 38.6"	21' 27.9"	GPS 11	37' 56.7"	22' 14.8"		4,425		4,5
1	6 Benoit		GPS 11	37' 56.7"	22' 14.8"	GPS 12	38' 31.2"	22' 14.8"	360	0,75	0,75	
1		12>13	GPS 12	38' 31.2"	22' 14.8"	GPS 13	37' 50.9"	22' 13.1"		0,925		1
1	7 Boy		GPS 13	37' 50.9"	22' 13.1"	GPS 14	37' 16.4"	22' 49.3"	135	1,525	1,5	
1 à 2		14>15	GPS 14	37' 16.4"	22' 49.3"	GPS 15	34' 27.1"	19' 41.9"		7,65		7,5
2	8		GPS 15	34' 27.1"	19' 41.9"	GPS 16	34' 27.1"	17' 50.1"	270	3,45	3,5	
2		16>17	GPS 16	34' 27.1"	17' 50.1"	GPS 17	33' 53.4"	17' 18.1"		1,4		1,5
2	9		GPS 17	33' 53.4"	17' 18.1"	GPS 18	33' 53.4"	19' 55.0"	90	4,85	5	
2		18>19	GPS 18	33' 53.4"	19' 55.0"	GPS 19	33' 20.9"	19' 16.4"		1,575		1,5
2	10 Hassan		GPS 19	33' 20.9"	19' 16.4"	GPS 20	33' 20.9"	17' 11.5"	270	3,875	4	
2		20>21	GPS 20	33' 20.9"	17' 11.5"	GPS 21	32' 56.3"	17' 08.2"		0,75		0,75
2	11 Quenny		GPS 21	32' 56.3"	17' 08.2"	GPS 22	32' 56.3"	18' 39.4"	90	2,8	2,5	
2		22>23	GPS 22	32' 56.3"	18' 39.4"	GPS 23	32' 47.0"	18' 30.0"		0,4		0,5
2	12 Bawang		GPS 23	32' 47.0"	18' 30.0"	GPS 24	32' 47.0"	17' 05.0"	270	2,55	2,5	
2		24>25	GPS 24	32' 47.0"	17' 05.0"	GPS 25	32' 24.6"	17' 39.9"		1,15		1
2	13 Lee		GPS 25	32' 24.6"	17' 39.9"	GPS 26	33' 22.8"	17' 39.9"	360	1,625	1,75	
2		26>27	GPS 26	33' 22.8"	17' 39.9"	GPS 27	32' 28.2"	18' 05.0"		1,75		1,75
2	14 Husfik		GPS 27	32' 28.2"	18' 05.0"	GPS 28	32' 56.6"	18' 05.0"	360	0,9	1	
2 à Pangi FR		28>29	GPS 28	32' 56.6"	18' 05.0"	GPS 29	32' 20.0"	18' 02.0"		1,65		1,75
Pangi FR	15 Pangi		GPS 29	32' 20.0"	18' 02.0"	GPS 30	31' 12.6"	18' 02.0"	180	1,825	2	
Pangi FR		30>31	GPS 30	31' 12.6"	18' 02.0"	GPS 31	31' 28.0"	17' 37.0"		0,725		0,5
Pangi FR	16 Caro		GPS 31	31' 28.0"	17' 37.0"	GPS 32	31' 28.0"	19' 36.2"	90	3,6	3,5	
Pangi FR à 3		32>33	GPS 32	31' 28.0"	19' 36.2"	GPS 33	31' 05.3"	18' 50.7"		1,3		1,5
3	17 Temengong		GPS 33	31' 05.3"	18' 50.7"	GPS 34	30' 19.6"	18' 23.7"	205	2,3	2,5	
3		34>35	GPS 34	30' 19.6"	18' 23.7"	GPS 35	30' 12.3"	18' 14.6"		0,15		0,25
3	18 Morisem		GPS 35	30' 12.3"	18' 14.6"	GPS 36	28' 00.0"	17' 41.1"	190	4,25	4,25	
3		36>37	GPS 36	28' 00.0"	17' 41.1"	GPS 37	27' 48.5"	17' 36.2"		0,375		0,25
3	19		GPS 37	27' 48.5"	17' 36.2"	GPS 38	27' 48.5"	11' 46.0"	270	10,95	11	
3		38>39	GPS 38	27' 48.5"	11' 46.0"	GPS 39	28' 36.2"	13' 11.5"		3,1		3
3	20		GPS 39	28' 36.2"	13' 11.5"	GPS 40	28' 36.2"	14' 12.3"	90	1,85	1,75	
3 à 4		40>41	GPS 40	28' 36.2"	14' 12.3"	GPS 41	28' 36.2"	14' 23.8"		0,3		0,5
4	21		GPS 41	28' 36.2"	14' 23.8"	GPS 42	28' 36.2"	16' 00.0"	90	3	3	
4		42>43	GPS 42	28' 36.2"	16' 00.0"	GPS 43	29' 24.7"	16' 09.9"		1,5		1,5
4	22		GPS 43	29' 24.7"	16' 09.9"	GPS 44	29' 24.7"	13' 54.2"	270	4,15	4,25	
4		44>45	GPS 44	29' 24.7"	13' 54.2"	GPS 45	30' 13.1"	12' 37.0"		2,85		3
4	23		GPS 45	30' 13.1"	12' 37.0"	GPS 46	30' 13.1"	15' 04.9"	90	4,55	4,5	
Total										136,25 km	94,5 min	82,25 min
												176,75 min

ANNEXE 12

Les drapeaux placés

LÉGENDE

SANCTUAIRE   RÉSERVE FORESTIÈRE   ↑ DRAPEAUX

LOT 2

20

HASSAN   S
        LEE
QUENNY   HERMAN
        BAWANG
        HUSFIK
        PANG

PANGI
FOREST RESERVE

Sukau

Bt. Tamangong Besar

HUTAN
SIMPANAN
KARUAK   H

CARO   H

K

Bt. Tamangong Kechil   TEMMENGONG

F
H

K

S. Memungol

Kg. Malapi

MORISEM 1

05°30'N

K

MORISEM 2

20

L

H
LOT 4

S. KINABATANGAN   S. Tamesong   LOT 3

118°15'E   1km   16'   17'   18'   19'   ↑N
CARTE 1/50000e   ⊢—⊣ TRANSECTS
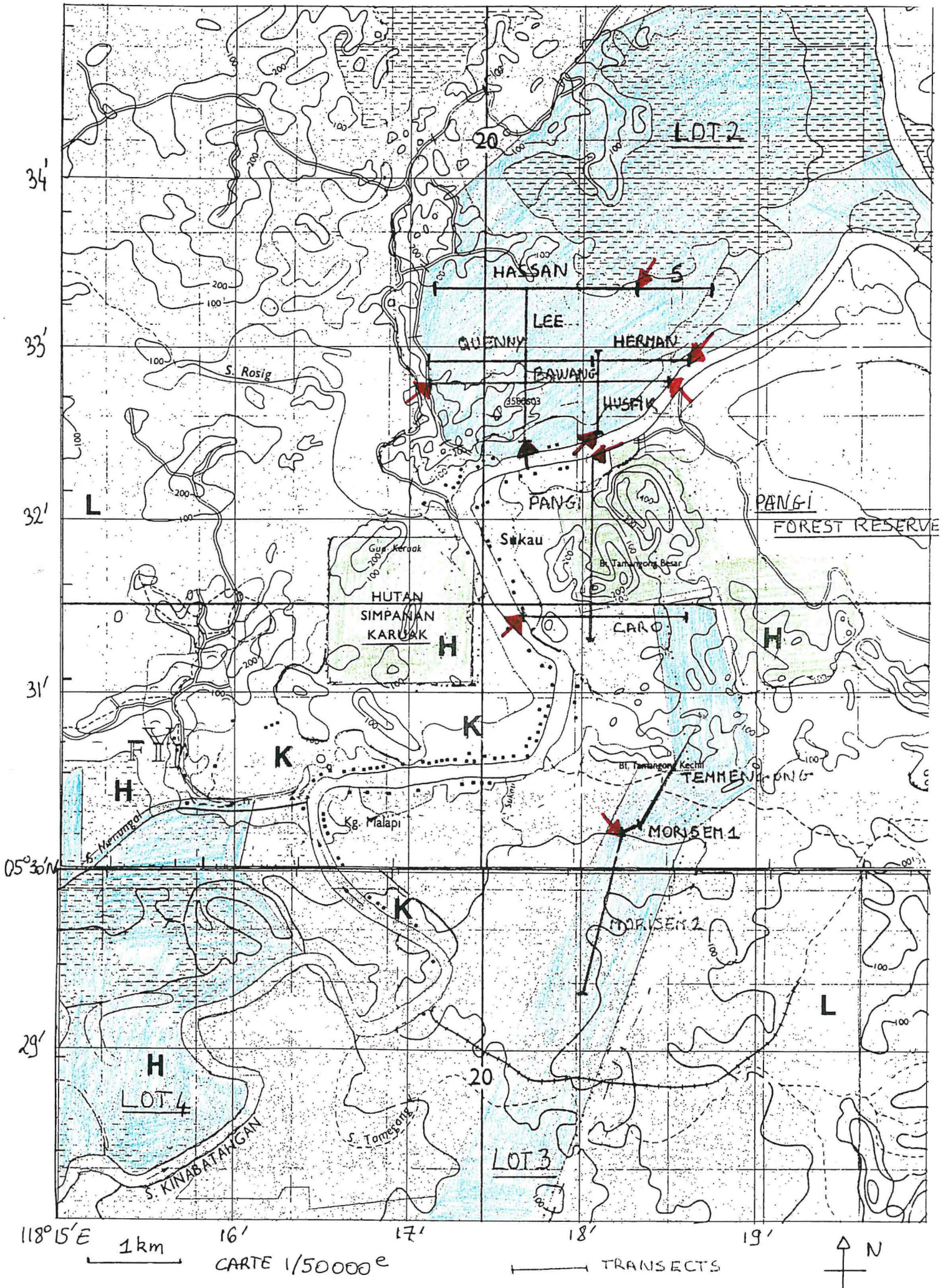
ANNEXE 13

Feuilles de prise de notes vierges

Data Sheet – Recorder

AREA: Date of flight:

Observer on the right:
Observer on the left:

T nb	Start Hour	End Hour	Obs. **LEFT**	Obs. **RIGHT**	Comments:

Data sheet – copilot

Area number: Date of flight:

Observer left: starting hour:
Observer right: ending hour:
                                                Total duration of flight:

Meteorology:
Speed of flight:

T nb	GPS start	GPS end	Start H	End H	Ho	Height Every 2'	Comments	S	L +	L -	H

ANNEXE 14

Rapport préliminaire destiné au Sabah Wildlife Department

PRELIMINARY REPORT ON THE HELICOPTER SURVEY

OF THE KINABATANGAN WILDLIFE SANCTUARY

CONFIDENTIAL

ATTENTION:

SABAH WILDLIFE DEPARTMENT

EXECUTANT:

Kinabatangan Orangutan Conservation Project (HUTAN)

Drs Isabelle lackman-Ancrenaz and Marc Ancrenaz
Mrs Caroline Gilbert
HUTAN
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90734 Sandakan, Sabah, Malaysia
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1. Background and Objectives

As already discussed and agreed with the "Sabah Wildlife Department", an helicopter nest census has been carried out on the "Kinabatangan Wildlife Sanctuary" on August, 11th and 12th, 1999.

The main objective of this helicopter survey was to count nests visible from the air along transects covering the whole KWS. This should allow to determine the size of the current orangutan population living in the KWS.

This preliminary report presents information which have been collected during these flights: number of nests spotted by the observers, habitat types, animals and on-going human activities recorded within the KWS boundaries.

2. Material and Methods

Two flights have been carried out with an helicopter of "Sabah Air", based in sandakan airport:

-August 11th, 1999: 10 am-1pm. Survey of lots 5,6,7,8,9,10 of the KWS as well as Gomantong, Supu and Lokan Forest Reserves and Safoda area.

-August 12th, 1999: 9.45 am-11.40am; 12.30 pm-13.30pm. Survey of lots 1,2,3,4 of the KWS as well as Pangui Forest Reserve.

The team survey involved:
-M. Surezza NG Abdullah (Sabah Air), pilot.
-D. Marc Ancrenaz (Hutan), co-pilot
-M. Sampoladon Pilik (SWD), left observer.
-M. Sundang Sarim (SWD), right observer.
-Ms. Caroline Gilbert, recorder.

Systematic sampling of the KWS using parallel transects has been previously designed in a precise flight pattern (Map 1).

Along these transects, the helicopter speed was kept constant (70km/hour), and the altitude about 200 feet above the forest canopy.

The width of the strip covered by the observers was about 150 meters each. Limits of these strips (one on the left, one on the right) were indicated on the helicopter windows by the mean of tapes.

Each nest spotted by each observer was recorded by the recorder on a specially designed data sheet (Annex 1).

The copilot helped the pilot in carefully implementing the flight pattern, and also recorded information on the different forest types and on-going human activities.

3. General Results

	Nb of transects	Kms	Nb of nests	Nb nests/km
First Flight	19	114.05	750	6.58
Second Flight	23	86.8	883	10.17
TOTAL	42	200.85	1633	8.13

4. Results per transect

Exact GPS positions and flight duration for each transect, as well as other information collected during the flight are given according to the following pattern:

Transect Nb (LOT Number):   duration of flight (min'-sec"), nb of kms

Habitat type: RF: riverine forest
                  SF: swamp forest
                  DLDF: dry lowland dipterocarp forest
                  SILDF: semi inundated lowland dipterocarp forest
(In coma are given the duration of flight over each habitat)

Number of nests: seen by the right observer (R), the left observer (L) and total (T). Number of nests/km

Other Information: if any, with GPS position recorded during the flight. On the map, are reported in green colour the location of human activities within the KWS boundaries.

TRANSECT 1 (LOT 1-LOT 2):   3'18" - 3.85 kms

Habitat:	SF (0'-2'23") - RF (2'23"-3'18")
Number of nest:	Right (R): 8 - Left (L): 7, Total (T): 15 - *3.9 nests/km*
Other information:	-

TRANSECT 2 (LOT 1-LOT 2):   6'41' - 7.79 kms

Habitat: SF (0'-2'13") - RF (2'13"-3'24") - Kinabatangan sg (3'24"-3'34") - RF (3'34"-5'06") - SILDF (5'06"-6'41")
Number of nest: R: 24 - L: 42 - T: 66 - *8.47 nests/km*
Other information: **5'34": Drain, intense on-going logging activities**
GPS: N 05° 39' 00"
E 118° 20' 51.7"
6'26": Drain

TRANSECT 3 (LOT 1-LOT 2):   7'32" - 8.78 kms

Habitat: SILDF (0'-2'27") - Kinab sg (2'27"-2'39") - SILDF (2'39"-4'05") - sungai (4'05") - RF (4'19"-6'05") - SILDF (6'05"-7'32") - Nipah palms
Number of nest: R: 23, L: 34, T: 57 - *6.5 nests/km*
Other information: 1'53": 11 elephants
1'56: 2 storm storks
6'05": drain
6'05"-6'57": intense on-going logging activities: tractors and heavy machinery, camp; roads, lot of logs already felt down
GPS: N 05° 37' 51.7" -
from E 118° 24' 8.2" to E 118° 24'41.1"

| **TRANSECT 4 (LOT 1-LOT 2):** | 6'33" - 7.64 kms |

Habitat: SILDF (0'-4'15") - RF (4'15"-4'39") - Kinab sg (4'39"-4'53") - RF (4'53"-5'11") - SF (5'11"-6'33")

Number of nest: R: 24, L: 38, T: 62 - *8.1 nests/km*

Other information: **1'19": drain**
GPS: N 05° 36' 44.4"
      E 118° 23' 9.9"
3'20": road and on going logging activities
GPS: N 05° 35' 38.6"
      E 118° 19' 18.1"

| **TRANSECT 5 (LOT 1-LOT 2):** | 2'43" - 3.17 kms |

Habitat: RF (0'-15") - Kinab sg (15"-28") - SILDF (28"-2'43")

Number of nest: R: 2, L: 14, T: 16 - *5 nests/km*

Other information: **28": on-going logging activities**
GPS: N 05° 35' 38.6"
      E 118° 19' 18.1"

| **TRANSECT 6 (LOT 1):** | 1'03" - 1.22 km |

Habitat: SILDF

Number of nest: R: 0, L: 7, T: 7 - *5.73 nests/km*

Other information: -

| **TRANSECT 7 (LOT 1):** | 1'09" - 1.34 km |

Habitat: SILDF

Number of nest: R: 6, L: 13, T: 19 - *14.2 nests/km*

Other information: **1'15": on-going logging activities near the river .**
GPS: N 05° 37' 23"
      E 118° 22' 37.8"

| **TRANSECT 8 (LOT 2):** | 3'09" - 3.67 kms |

Habitat: SILDF (0-2'45") - DLDF (2'45"-3'09")

Number of nest: R: 20, L: 27, T: 47 - *12.8 nests/km*

Other information: -

| **TRANSECT 9 (LOT 2):** | 3'53" - 4.43 kms |

Habitat: SILDF (0-2'46") - RF (2'46"-3'53") - Kinab. sg (3'53")

Number of nest: R: 29, L: 23, T: 52 - *11.74 nests/km*

Other information: -

| **TRANSECT 10 (LOT 2):** | 3'02" - 3.53 kms |

Habitat: SILDF

Number of nest: R: 12, L: 32, T: 44 - *12.46 nests/km*

Other information: -

TRANSECT 11 (LOT 2): 2'12" - 2.57 kms

Habitat:	SILDF (0-2'06") - RF (2'06"-2'12") - Kinab. Sg (2'12").
Number of nest:	R: 21, L: 5, T: 26 - *10.1 nests/km*
Other information:	-

TRANSECT 12 (LOT 2): 2' - 2.33 kms

Habitat:	RF (0-51") - SILDF (51"-1'13") - DLDF (1'13"-2'20")
Number of nest:	R: 6, L: 15, T: 21 - *9 nests/km*
Other information:	-

TRANSECT 13 (LOT 2): 1'44" - 2.02 kms

Habitat:	DLDF (0-44") - SILDF (44"-1'44")
Number of nest:	R: 6, L: 15, T: 21 - *10.4 nests/km*
Other information:	-

TRANSECT 14 (LOT 2): 56" - 1.08 km

Habitat:	SILDF (0-50") - SF (50"-56")
Number of nest:	R: 0, L: 5, T: 5 - *4.6 nests/km*
Other information:	-

TRANSECT 15 (Pangui Forest Reserve): 1'26" - 1.67 kms

Habitat:	DLDF (0-1'15") - SILDF (1'15"-1'26")
Number of nest:	R: 9, L: 14, T: 23 - *13.8 nests/km*
Other information:	-

TRANSECT 16 (Pangui Forest Reserve): 2'51" - 3.32 kms

Habitat:	DLDF
Number of nest:	R: 25, L: 17, T: 42 - *12.65 nests/km*
Other information:	-

TRANSECT 17 (LOT 3): 1'10" - 1.36 kms

Habitat:	DLDF
Number of nest:	R: 10, L: 2, T: 12 - *8.8 nests/km*
Other information:	-

TRANSECT 18 (LOT 3): 3'27" - 4.02 kms

Habitat:	RF (0-26") - sungai (26") - DLDF (27"-1'40") - SF (1'40"-2'20") - DLDF (2'20"-3'27")
Number of nest:	R: 23, L: 35, T: 58 - *14.4 nests/km*
Other information:	-

| **TRANSECT 19 (LOT 3):** | 8'25" - 9.82 kms |

Habitat: DLDF (0-3'57") - RF (3'57"-4'30") - DLDF (4'30"-7'54") - RF (7'54"-8'25") - Kinab. sg
Number of nest: R: 64, L: 74, T: 138 - *14.05 nests/km*
Other information: **4'30": forest recently logged**
GPS: N 05° 27' 48.5"
E 118° 14' 47.7"

| **TRANSECT 20 (LOT 3):** | 1'20" - 1.55 km |

Habitat: RF
Number of nest: R: 2, L: 5, T: 7 - *4.5 nests/km*
Other information: -

| **TRANSECT 21 (LOT 4):** | 2'18" - 2.68 kms |

Habitat: RF (0-32") - oxbow lake - RF
Number of nest: R: 23, L: 10, T: 33 - *12.3 nests/km*
Other information: -

| **TRANSECT 22 (LOT 4):** | 3'41" - 4.29 kms |

Habitat: RF (0-2'02") - SILDF (2'02"-3'40")
Number of nest: R: 25, L: 35, T: 70 - *16.3 nests/km*
Other information: -

| **TRANSECT 23 (LOT 4):** | 3'52" - 4.51 kms |

Habitat: SILDF
Number of nest: R: 23, L: 29, T: 52 - *11.5 nets/km*
Other information: -

| **TRANSECT 24 (LOT 5):** | 9'15" - 10.79 kms |

Habitat: SILDF
Number of nest: R: 45, L: 35, T: 80 - *7.4 nests/km*
Other information: -

| **TRANSECT 25 (LOT 5):** | 8'34' - 10 kms |

Habitat: SILDF (0-1') - SF (1'-5') - SILDF (5'-8'34")
Number of nest: R: 64, L: 45, T: 109 - *10.9 nets/km*
Other information: **8'15": drain inside the forest**
GPS: N 05° 29' 37"
E 118° 10' 14.8"

| **TRANSECT 26 (LOT 5 - Gomantong Forest Reserve):** | 12'56" - 15.08 kms |

Habitat: SF (0-5'40") - SILDF (5'40"-7'57") - DLDF (7'57"-12'56")
Number of nest: R: 24, L: 36, T: 60 - *4 nests/km*
Other information: -

TRANSECT 27 (Gomantong Forest Reserve):	6'45" - 7.87 kms

Habitat: DLDF
Number of nest: R: 16, L: 31, T: 47 - *5.9 nests/km*
Other information: -

TRANSECT 28 (Gomantong Forest Reserve):	5'22" - 6.26 kms

Habitat: DLDF
Number of nest: R: 11, L: 21, T: 42 - *6.7 nests/km*
Other information: -

TRANSECT 29 (LOT 6):	2'58" - 3.46 kms

Habitat: RF (0-1'41") - SILDF (1'41"-2'58")
Number of nest: R: 11, L: 14, T: 25 - *7.2 nests/km*
Other information: **24': large road**
                                         GPS: N 05° 25' 13.1"
                                         E 118° 03' 32"

TRANSECT 30 (LOT 6 - LOT 7):	· 1'21" - 1.57 km

Habitat: RF
Number of nest: R: 1, L: 7, T: 8 - *5 nests/km*
Other information: -

TRANSECT 31 (LOT 7):	2'40" - 3.11 km

Habitat: SILDF (0-59') - SF (59"-2') - RF (2'-2'35") - Kinab sg
Number of nest: R: 9, L: 11, T: 20 - *6.4 nests/km*
Other information: -

TRANSECT 32 (Supu Forest Reserve):	6'26" - 7.5 kms

Habitat: RF (0-2'03") - SF (2'03"-6'26")
Number of nest: R:12, L: 17, T: 29 - *3.9 nests/km*
Other information: **2'30": recent logging activities**
                                         GPS: N 05° 26' 14.8"
                                         E 117 58' 41.1"

TRANSECT 33 (LOT 8 - Supu Forest Reserve):	8'46" - 10.23 kms

Habitat: SF (0-1'54") - SILDF (1'54"-2'30") - DLDF (2'30"-6'26") - RF (6'26"-8'46")
Number of nest: R: 37, L: 56, T: 93 - *9 nests/km*
Other information: -

TRANSECT 34 (Safoda):	4'16" - 4.98 kms

Habitat: RF (0-1'36") - SILDF (1'36"-4'16")
Number of nest: R:25, L: 17, T: 42 - *8.4 nests/km*
Other information: massive on-going logging activities.

TRANSECT 35 (Safoda):	4'52" - 5.68 kms

Habitat: DLDF (0-2') - SILDF (2'-4'52")
Number of nest: R:34, L: 38, T: 72 - *12.7 nests/km*
Other information: massive on-going logging activities

TRANSECT 36 (Safoda - LOT 9):	3'42" - 4.32 kms

Habitat: RF (0-1'15") - SILDF (1'15"-3'42")
Number of nest: R:2, L: 17, T: 19 - *4.4 nests/km*
Other information: -

TRANSECT 37 (LOT 9 - Safoda):	2'17" - 2.66 kms

Habitat: SILDF
Number of nest: R: 0, L: 15, T: 15 - *5.6 nests/km*
Other information: -

TRANSECT 38 (Safoda - LOT 9):	1'56" - 2.25 kms

Habitat: RF
Number of nest: R: 4, L: 9, T: 13 - *5.8 nests/km*
Other information: -

TRANSECT 39 (LOT 10):	4'30" - 5.25 kms

Habitat: SILDF (0-2'54") - SF (2'54"-4'30")
Number of nest: R: 5, L: 16, T: 21 - *4 nests/km*
Other information: **2'40": one road crosses the KWS**
                           GPS: N 05° 28' 31.2"
                           E 117° 45' 52.6"

TRANSECT 40 (LOT 10 - Lokan Forest Reserve):	3'12" - 3.73 kms

Habitat: SILDF (0-1'15") - sungai (1'15-1'20") - RF (1'20"-2'02") - DLDF (2'02" - 3'12")
Number of nest: R:0, L: 10, T: 10 - *2.7 nests/km*
Other information: -

TRANSECT 41 (Lokan Forest Reserve - LOT 10):	3'25" - 3.99 kms

Habitat: DLDF (0-48") - SILDF (48"-1'24") - RF (1'24"-1'53") - sungai (1'53"-1'55") - SILDF (1'55"-3'25")
Number of nest: R: 3, L: 12, T: 15 - *3.7 nests/km*
Other information: -

TRANSECT 42 (Lokan Forest Reserve):	4'32" - 5.28 kms

Habitat: SILDF
Number of nest: R: 4, L: 16, T: 20 - *3.4 nests/km*
Other information: **2'25": road inside the LFR**
                           GPS: N 05° 29' 04.9"
                           E 117° 39' 52.6"

5. GENERAL CONCLUSIONS

Nest counting from the air:

Counting orangutan nests from helicopter appears to be a valuable tool to quickly assess the qualitative abundance of orangutans. As already discussed by Payne, the results largely depend on the skills of the observers, and on the type of habitat surveyed. Of course, an unknown proportion of the total number of nests in the forest is not recorded from the air.

We are currently checking from the ground the number of nest in different lots (1-2-3) of the KWS in order to calibrate the results obtained from the air. Then, we will be able using results of the aerial survey to calculate orangutan density for the whole Kinabatangan Wildlife Sanctuary. Final results will be sent to the Sabah Wildlife Department as soon as available.

> According to the rough results, we can say that more nests per km have been spotted in Lots 1,2,3,4 (10.17 nests/km) than in Lots 5 to 10 of the KWS (6.58 nests/km).

> Despite the intense on-going logging activities currently undertaken within Safoda area, a very large number of nests have been spotted in some areas still under forest cover (about 10 nests/km). According to these results, it is very important to keep a corridor of forest wide enough along the Kinabatangan river for at least two main obvious reasons:
> -to secure the future of the orangutan population surviving in Safoda area.
> -to not totally disrupt the current corridor which exists within the KWS and which allows animal movements between the different lots.

Human activities within the boundaries of the Kinabatangan Wildlife Sanctuary

Some human activities are currently on-going within the KWS.

> Logging on a large scale have been mainly spotted in Lot 1 and 2.

These logging activities involve large areas in the lots located close to Abei. A great umber of logs have been spotted on the ground. These activities are not visible from the Kinabatangan river since the access roads are from the plantations surrounding the KWS, and not from the Kinabatangan river.

Other areas have been logged recently (Lot 3, Supu FR), but no on-going logging activity was recorded by the time of the two flights.

> Several large drains and roads have also been recorded inside the limits of the Sanctuary: Lots 1, 2, 5, 6 and 10.

Along these roads or drains, past or on-going logging activities have also been recorded from the helicopter.

The monitoring of the KWS from the air appears to be very useful to quickly monitor the area. Indeed, some places are not easily accessible from the Kinabatangan river and its attributes and thus appear to be difficult to monitor from the ground. During our flight, logging activities have been mainly spotted in areas far away from the Kinabatangan river with easy access from the surrounding plantations

> An helicopter or a small plane can be a very useful input to monitor human activities and their exact location beyond the boundaries of the KWS.

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ANNEXE 15

Photographies aériennes

Photographie 1 :

Commentaires : canopée basse, type « dégradé - », présence d'une route d'exploitation récente en bas à gauche de la photographie

Photographie 2 :
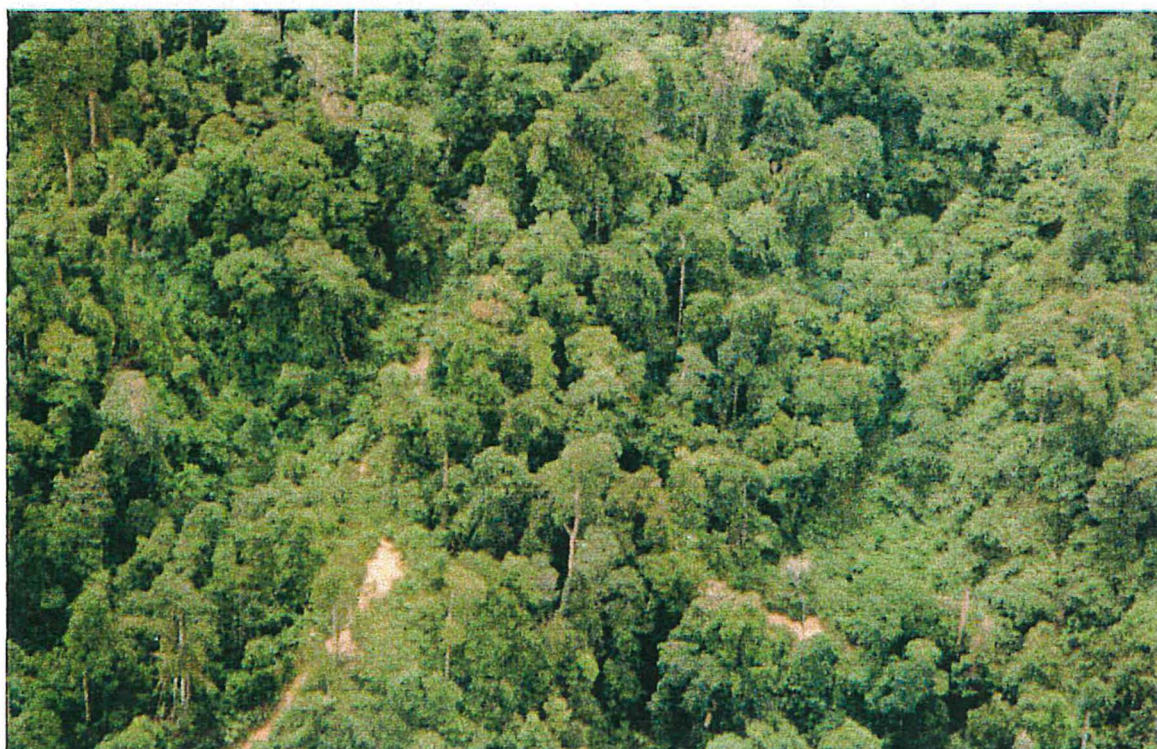
<u>Commentaires</u> : canopée basse, forêt type « dégradé + », présence de plusieurs routes d'exploitation

Photographie 3 :

Commentaires : route d'exploitation forestière récente, de chaque côté, forêt de type « dégradé - »

Photographie 4 :

Commentaires : Vue d'une zone de forêt protégée, entourée des plantations de palmier à huile

ANNEXE 16

Résultats transect par transect

	marécage					dégradé +				
TRANSECT 1										
Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	143	2,78	6	8	14	10	0,194	0	0	0
TRANSECT 2										
Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	120	2,333	7	3	10	84	1,633	18	9	27
	30	0,583	0	2	2					
TRANSECT 3										
Motorob Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	30	0,583	0	2	2	117	2,275	7	4	11
						86	1,672	16	15	31
TRANSECT 4										
Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	60	1,167	1	0	1	60	1,167	10	0	10
						68	1,322	10	9	19
TRANSECT 5										
Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						15	0,292	2	2	4
TRANSECT 6										
Benoit Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						63	1,225	7	0	7
TRANSECT 7										
Boy Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						69	1,342	13	6	19
TRANSECT 8										
Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						189	3,675	27	20	47
TRANSECT 9										
Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						90	1,75	8	16	24
TRANSECT 10										
Hassan Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 11										
Quenry,Herman	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
Lot 2	30	0,583	0	3	3	42	0,817	3	13	16
TRANSECT 12										
Bawang	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
Lot 2										
TRANSECT 13										
Lee Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 14										
Husfik	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
Lot 2										
TRANSECT 15										
Pangi	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
Pangi FR						26	0,506	6	0	6
TRANSECT 16										
Caro	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
Pangi FR						80	1,556	12	7	19
TRANSECT 17										
Temenggong	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
Lot 3						70	1,361	2	10	12
TRANSECT 18										
Morisem	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
Lot 3	60	1,167	5	1	6	90	1,75	18	17	35
						57	1,108	12	5	17
TRANSECT 19										
Lot 3	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						60	1,167	11	9	20
TRANSECT 20										
Lot 3	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 21										
Lot 4	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 22										
Lot 4	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 23										
Lot 4	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						82	1,594	13	4	17
TRANSECT 24										
Lot 5	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						180	3,5	3	11	14
TRANSECT 25										
Lot 5	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	60	1,167	17	18	35	214	4,161	11	18	29
	60	1,167	0	0	0					
TRANSECT 26										

Lot 5 - Gomantong	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	300	5,833	3	4	7					
TRANSECT 27	marécage					dégradé +				
Gomantong	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 28	marécage					dégradé +				
Gomantong	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 29	marécage					dégradé +				
Lot 6	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 30	marécage					dégradé +				
Lot 6	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 31	marécage					dégradé +				
Lot 6	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	60	1,167	2	1	3	60	1,167	3	8	11
TRANSECT 32	marécage					dégradé +				
Pin Supu	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	240	4,667	0	2	2	60	1,167	4	2	6
						26	0,506	6	0	6
TRANSECT 33	marécage					dégradé +				
Lot 8 - Pin Supu	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	90	1,75	6	0	6	60	1,167	4	5	9
						60	1,167	5	7	12
TRANSECT 34	marécage					dégradé +				
Safoda	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	30	0,583	1	0	1	150	2,917	14	13	27
						76	1,478	11	3	14
TRANSECT 35	marécage					dégradé +				
Safoda	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						120	2,333	24	19	43
						112	2,178	9	9	18
TRANSECT 36	marécage					dégradé +				
Safoda - Lot 9	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						120	2,333	10	1	11
TRANSECT 37	marécage					dégradé +				
Safoda - Lot 9	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 38	marécage					dégradé +				
Safoda - Lot 9	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	86	1,672	6	4	10					
TRANSECT 39	marécage					dégradé +				
Lot 10	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	120	2,333	3	0	3	150	2,917	13	5	18
TRANSECT 40	marécage					dégradé +				
Lot 10 - Lokan	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 41	marécage					dégradé +				
Lot 10 - Lokan	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						170	3,305	9	3	12
TRANSECT 42	marécage					dégradé +				
Lokan	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						120	2,333	9	0	9
TOTAL	marécage					dégradé +				
	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	1519	**29,535**	57	48	105	3036	**59,035**	330	250	580

	dégradé -					colline				
TRANSECT 1 Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	27	0,525	1	0	1					
TRANSECT 2 Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	90	1,75	17	10	27					
TRANSECT 3 Motorob Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	120	2,333	2	2	4					
TRANSECT 4 Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	90	1,75	11	13	24					
	18	0,35	4	2	6					
TRANSECT 5 Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 6 Benoit Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 7 Boy Lot 1 - 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 8 Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 9 Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	60	1,167	1	1	2					
	83	1,614	14	12	26					
TRANSECT 10 Hassan Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	182	3,539	32	12	44					
TRANSECT 11 Quenny,Herman Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	60	1,167	2	5	7					
TRANSECT 12 Bawang Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	60	1,167	8	2	10	60	1,167	7	4	11
TRANSECT 13 Lee Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	74	1,439	11	5	16	30	0,583	4	1	5
TRANSECT 14 Husfik Lot 2	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	56	1,089	5	0	5					
TRANSECT 15 Pangi Pangi FR	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
						60	1,167	8	9	17
TRANSECT 16 Caro Pangi FR	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 17 Ternenggong Lot 3	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 18 Morisem Lot 3	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 19 Lot 3	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	445	8,653	63	55	118					
TRANSECT 20 Lot 3	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	80	1,556	5	2	7					
TRANSECT 21 Lot 4	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	138	2,683	10	23	33					
TRANSECT 22 Lot 4	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	221	4,297	35	25	60					
TRANSECT 23 Lot 4	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	150	2,917	16	19	35					
TRANSECT 24 Lot 5	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	375	7,292	32	34	66					
TRANSECT 25 Lot 5	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	60	1,167	9	10	19					
	120	2,333	8	18	26					
TRANSECT 26	dégradé -					colline				

Lot 5 - Gomantong	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	180	3,5	7	10	17	180	3,5	7	0	7
	116	2,256	19	10	29					
TRANSECT 27	dégradé -					colline				
Gomantong	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	165	3,208	21	10	31	240	4,667	10	6	16
TRANSECT 28	dégradé -					colline				
Gomantong	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	322	6,261	41	11	52					
TRANSECT 29	dégradé -					colline				
Lot 6	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	167	3,247	14	11	25					
TRANSECT 30	dégradé -					colline				
Lot 6	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	63	1,225	7	1	8					
TRANSECT 31	dégradé -					colline				
Lot 6	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	40	0,778	6	0	6					
TRANSECT 32	dégradé -					colline				
Pin Supu	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	60	1,167	7	8	15					
TRANSECT 33	dégradé -					colline				
Lot 8 - Pin Supu	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	150	2,917	20	9	29	120	2,333	17	2	19
	46	0,894	5	14	19					
TRANSECT 34	dégradé -					colline				
Safoda	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 35	dégradé -					colline				
Safoda	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	60	1,167	5	6	11					
TRANSECT 36	dégradé -					colline				
Safoda - Lot 9	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	102	1,983	7	1	8					
TRANSECT 37	dégradé -					colline				
Safoda - Lot 9	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	137	2,664	15	0	15					
TRANSECT 38	dégradé -					colline				
Safoda - Lot 9	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	30	0,583	3	0	3					
TRANSECT 39	dégradé -					colline				
Lot 10	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
TRANSECT 40	dégradé -					colline				
Lot 10 - Lokan	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	187	3,636	10	0	10					
TRANSECT 41	dégradé -					colline				
Lot 10 - Lokan	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	30	0,583	3	0	3					
TRANSECT 42	dégradé -					colline				
Lokan	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	150	2,917	7	4	11					
TOTAL	dégradé -					colline				
	sec	km	nb nids G	nb nids D	nb nids tot	sec	km	nb nids G	nb nids D	nb nids tot
	4514	**87,774**	483	345	**828**	690	**13,417**	53	22	**75**

ANNEXE 16

TRANSECT 1	duree totale	km	nb nids tot
Lot 1 - 2			
	180	3,5	15
TRANSECT 2			
Lot 1 - 2			
	324	6,3	66
TRANSECT 3			
Motorob Lot 1 - 2			
	353	6,864	48
TRANSECT 4			57 (48+9)
Lot 1 - 2			
	296	5,755	60
TRANSECT 5			
Lot 1 - 2			
	15	0,292	4
TRANSECT 6			16 (4 +12)
Benoit Lot 1 - 2			
	63	1,225	7
TRANSECT 7			
Boy Lot 1 - 2			
	69	1,342	19
TRANSECT 8			
Lot 2			
	189	3,675	47
TRANSECT 9			
Lot 2			
	233	4,53	52
TRANSECT 10			
Hassan Lot 2			
	182	3,539	44
TRANSECT 11			
Quenny,Herman			
Lot 2	132	2,567	26
TRANSECT 12			
Bawang			
Lot 2	120	2,333	21
TRANSECT 13			
Lee Lot 2			
	104	2,022	21
TRANSECT 14			
Husfik			
Lot 2	56	1,089	5
TRANSECT 15			
Pangi			
Pangi FR	86	1,672	23
TRANSECT 16			
Caro			
Pangi FR	80	1,555	19
TRANSECT 17			42 (19+23)
Temenggong			
Lot 3	70	1,361	12
TRANSECT 18			
Morisem			
Lot 3			
	207	4,025	58
TRANSECT 19			
Lot 3			
	505	9,819	138
TRANSECT 20			
Lot 3			
	80	1,556	7
TRANSECT 21			
Lot 4			
	138	2,683	33
TRANSECT 22			
Lot 4			
	221	4,297	60
TRANSECT 23			

Lot 4			
	232	4,511	52
TRANSECT 24			
Lot 5			
	555	10,791	80
TRANSECT 25			
Lot 5			
	514	9,994	109
TRANSECT 26			
Lot 5 - Gomantong			
	776	15,089	60
TRANSECT 27			
Gomantong			
	405	7,875	47
TRANSECT 28			
Gomantong			
	322	6,261	52
TRANSECT 29			
Lot 6			
	167	3,247	25
TRANSECT 30			
Lot 6			
	63	1,225	8
TRANSECT 31			
Lot 6			
	160	3,111	20
TRANSECT 32			
Pin Supu			
	386	7,505	29
TRANSECT 33			
Lot 8 - Pin Supu			
	526	10,228	94
TRANSECT 34			
Safoda			
	256	4,978	42
TRANSECT 35			
Safoda			
	292	5,678	72
TRANSECT 36			
Safoda - Lot 9			
	222	4,317	19
TRANSECT 37			
Safoda - Lot 9			
	137	2,664	15
TRANSECT 38			
Safoda - Lot 9			
	116	2,256	13
TRANSECT 39			
Lot 10			
	270	5,25	21
TRANSECT 40			
Lot 10 - Lokan			
	187	3,636	10
TRANSECT 41			
Lot 10 - Lokan			
	200	3,889	15
TRANSECT 42			
Lokan			
	270	5,25	20
TOTAL			
	duree totale	km	nb nids tot
	9759	189,756	1588

Pour les transects 3, 5, 16: résultats de l'observateur gauche et droit séparés

	marécage G			marécage D		
	sec	km	nb nids G	sec	km	nb nids D
TRANSECT 3						
TRANSECT 5						
TRANSECT 16						
	dégradé + G			dégradé + D		
	sec	km	nb nids G	sec	km	nb nids D
TRANSECT 3						
TRANSECT 5	117	2,275	12			
TRANSECT 16	30	0,583	3	60	1,167	4
	dégradé - G			dégradé - D		
	sec	km	nb nids G	sec	km	nb nids D
TRANSECT 3	32	0,622	9			
TRANSECT 5						
TRANSECT 16						
	colline G			colline D		
	min	km	nb nids G	min	km	nb nids D
TRANSECT 3						
TRANSECT 5						
TRANSECT 16	60	1,167	10	30	0,583	6

total	sec	km	nids Gauche	nids Droite	nids total
	117	2,275	12		12
	60	1,167		4	4
	60	1,167	10		10
	30	0,583		6	6
	32	0,622	9		9
	30	0,583	3		3
	329	**6,397**	**34**	**10**	**44**

ANNEXE 16

Résultats comptage aérien

TOTAL	marécage				
	sec	km	nb nids G	nb nids D	nb nids tot
	1519	29,535	57	48	105
	dégradé +				
	sec	km	nb nids G	nb nids D	nb nids tot
	3036	59,035	330	250	580
	dégradé -				
	sec	km	nb nids G	nb nids D	nb nids tot
	4514	87,774	483	345	828
	colline				
	sec	km	nb nids G	nb nids D	nb nids tot
	690	13,417	53	22	75
TOTAL	9759	189,761	923	665	1588
transects G,D	329	6,397	34	10	44
TOTAL	10088	196,158	957	675	1632

ANNEXE 17

Division du Sanctuaire en zones pour l'analyse de variance

Lower Kinabatangan Area

Projected Areas of Forest
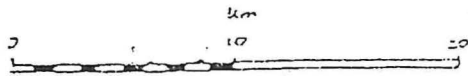
Wildlife Sanctuary (proposed)

Forest Reserve

SAFODA rattan plantation

ZONE 1

ABAI

ZONE 5

ZONE 2

BUTONG

Materis FR

Gomantong FR

Bod Tai FR

Karuak FR

Sungai Lokan FR

ZONE 9

ZONE 7

Supu FR

Pangi FR

RAWOG

LOKAN

LAHAG

ZONE 3

BATU PUTIH

GOMANTONG

ZONE 4

ZONE 8

ZONE 6

ZONE C

ZONE B

ZONE A
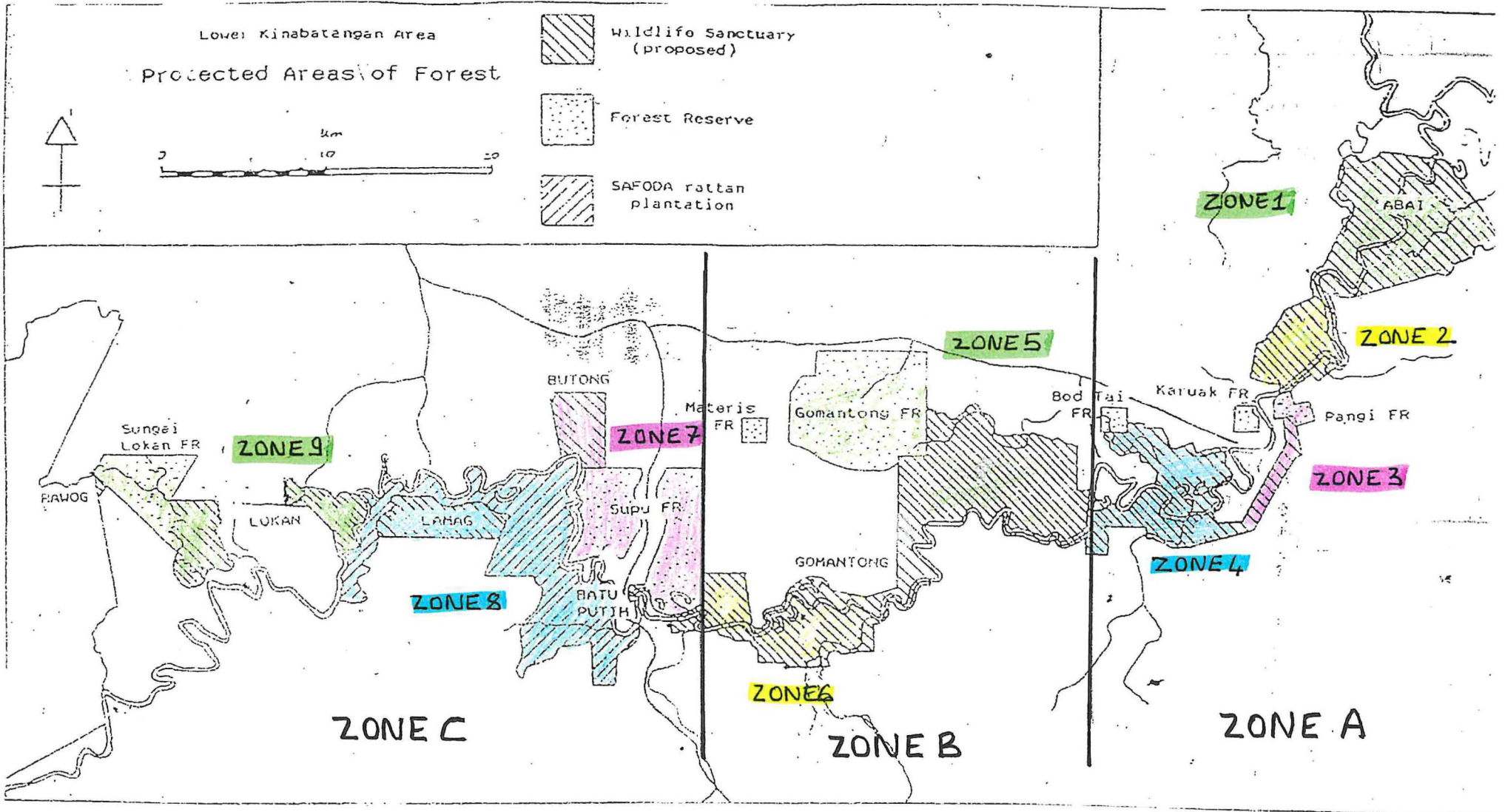
ANNEXE 18

Analyse de variance pour 9 zones

ANNEXE 18

n° transect	Lot n°	nb nids/km	zone
1	1 et 2	3,9	1
2	1 et 2	8,47	1
3 Motorob	1 et 2	6,49	1
4	1 et 2	9,35	1
5	1 et 2	5,04	1
6 Benoit	1 et 2	5,71	1
7 Boy	1 et 2	14,16	1
8	1 et 2	12,79	2
9	1 et 2	11,49	2
10 Hassan	1 et 2	12,45	2
11Quenny	1 et 2	10,13	2
12 Bawang	1 et 2	9	2
13 Lee	1 et 2	10,41	2
14 Husfik	1 et 2	4,61	2
15 Pangi	Pangi FR	13,79	3
16 Caro	Pangi FR	12,63	3
17 Temeng	3	8,79	3
18 Mor 2	3	14,41	3
19	3	14,05	4
20	3	4,51	4
21	4	12,3	4
22	4	13,98	4
23	4	11,52	4
24	5	7,41	5
25	5	10,9	5
26	5	3,98	5
27	Gomantong FR	5,97	5
28	Gomantong FR	8,3	5
29	6	7,21	6
30	6 et 7	5,08	6
31	7	6,42	6
32	Supu FR	3,87	7
33	8 - Supu FR	9,19	7
34	Safoda	8,43	8
35	Safoda	12,67	8
36	Safoda - 9	4,4	8
37	Safoda - 9	5,64	8
38	Safoda - 9	5,77	8
39	10	4	9
40	Lokan FR - 10	2,68	9
41	Lokan FR - 10	3,76	9
42	Lokan FR	3,78	9

zone 1	zone 2	zone 3	zone 4	zone 5	zone 6	zone 7	zone 8	zone 9
3,9	12,79	13,79	14,05	7,41	7,21	3,87	8,43	4
8,47	11,49	12,63	4,51	10,9	5,08	9,19	12,67	2,68
6,49	12,45	8,79	12,3	3,98	6,42		4,4	3,76
9,35	10,13	14,41	13,98	5,97			5,64	3,78
5,04	9		11,52	8,3			5,77	
5,71	10,41							
14,16	4,61							

Analyse de variance pour un facteur

RAPPORT DETAILLE

Groupes	Nombre d'échantillons	Somme	Moyenne	Variance
Colonne 1	7	53,12	7,588571429	11,983314
Colonne 2	7	70,88	10,12571429	7,6888619
Colonne 3	4	49,62	12,405	6,3523667
Colonne 4	5	56,36	11,272	15,47337
Colonne 5	5	36,56	7,312	6,69067
Colonne 6	3	18,71	6,236666667	1,1594333
Colonne 7	2	13,06	6,53	14,1512
Colonne 8	5	36,91	7,382	10,89667
Colonne 9	4	14,22	3,555	0,3521

ANALYSE DE VARIANCE

Source des variations	Somme des carrés	Degré de liberté	Moyenne des carrés	F	Probabilité	Valeur critique pour F
Entre Groupes	256,6190362	8	32,07737952	3,6901481	0,00355156	2,234564533
A l'intérieur des groupes	286,8593638	33	8,692707994			
Total	543,4784	41				

FR : Réserve Forestière

ANNEXE 19

Analyse de variance pour 3 zones

ANNEXE 19

n° transect	Lot n°	nb nids/km	zone 1	zone 2
1	1 et 2	3,9	1	A
2	1 et 2	8,47	1	A
3 Motorob	1 et 2	6,49	1	A
4	1 et 2	9,35	1	A
5	1 et 2	5,04	1	A
6 Benoit	1 et 2	5,71	1	A
7 Boy	1 et 2	14,16	1	A
8	1 et 2	12,79	2	A
9	1 et 2	11,49	2	A
10 Hassan	1 et 2	12,45	2	A
11Quenny	1 et 2	10,13	2	A
12 Bawang	1 et 2	9	2	A
13 Lee	1 et 2	10,41	2	A
14 Husfik	1 et 2	4,61	2	A
15 Pangi	Pangi FR	13,79	3	A
16 Caro	Pangi FR	12,63	3	A
17 Temeng	3	8,79	3	A
18 Mor 2	3	14,41	3	A
19	3	14,05	4	A
20	3	4,51	4	A
21	4	12,3	4	A
22	4	13,98	4	A
23	4	11,52	4	A
24	5	7,41	5	B
25	5	10,9	5	B
26	5	3,98	5	B
27	Gomantong FR	5,97	5	B
28	Gomantong FR	8,3	5	B
29	6	7,21	6	B
30	6 et 7	5,08	6	B
31	7	6,42	6	B
32	Supu FR	3,87	7	C
33	8 - Supu FR	9,19	7	C
34	Safoda	8,43	8	C
35	Safoda	12,67	8	C
36	Safoda - 9	4,4	8	C
37	Safoda - 9	5,64	8	C
38	Safoda - 9	5,77	8	C
39	10	4	9	C
40	Lokan FR - 10	2,68	9	C
41	Lokan FR - 10	3,76	9	C
42	Lokan FR	3,78	9	C

zone A	zone B	zone C
3,9	7,41	3,87
8,47	10,9	9,19
6,49	3,98	8,43
9,35	5,97	12,67
5,04	8,3	4,4
5,71	7,21	5,64
14,16	5,08	5,77
12,79	6,42	4
11,49		2,68
12,45		3,76
10,13		3,78
9		
10,41		
4,61		
13,79		
12,63		
8,79		
14,41		
14,05		
4,51		
12,3		
13,98		
11,52		

Analyse de variance pour un facteur

RAPPORT DETAILLE

Groupes	Nombre d'échantillons	Somme	Moyenne	Variance
zone A	23	229,98	9,999130435	12,3193265
zone B	8	55,27	6,90875	4,46424107
zone C	11	64,19	5,835454545	9,25198727

ANALYSE DE VARIANCE

Source des variations	Somme des carrés	Degré de liberté	Moyenne des carrés	F	Probabilité	Valeur critique pour F
Entre Groupes	148,6836572	2	74,34182858	7,34389545	0,001964205	3,238099566
A l'intérieur des groupes	394,7947428	39	10,12294212			
Total	543,4784	41				

ANNEXE 20

Analyse de variance pour les types d'habitat

analyse de variance (3)

transects;zone	marécage (1) nb nids/km	dégradé + (2) nb nids/km	dégradé - (3) nb nids/km	colline (4) nb nids/km
T 1 Lot 1-2	5,035971223	0	1,904761905	
T 2 Lot 1-2	4,115226337	16,53398653	15,42857143	
T 3 Lot 1-2 Mot	3,430531732	10,64099316	1,714530647	
T 4 Lot 1-2	0,856898029	11,65126557	14,28571429	
T 5 Lot 1-2		13,69863014		
T 6 Lot 1-2 ben		5,714285714		
T 7 lot 1-2 Boy		14,15797317		
T 8 Lot 2		12,78911565		
T 9 Lot 2		13,71428571	10,06832075	
T 10 lot 2 Hass			12,43289065	
T 11 Lot 2 Q,H	5,145797599	19,58384333	5,998286204	
T 12 lot 2 Baw			8,568980291	9,42587832
T13 Lot 2 Lee			11,11883252	8,57632933
T14 Lot 2 Husfik			4,591368228	
T15 Pangi FR Pangi		11,85770751		14,5672665
T 16 Pangi FR Caro		12,21079692		
T 17 Lot 3 Tem		8,817046289		
T 18 Lot 3 Mor	5,141388175	18,19454164		
T19 Lot 3		17,13796058	13,63688894	
T 20 Lot 3			4,498714653	
T 21 Lot 4			12,29966455	
T 22 Lot 4			13,96323016	
T 23 Lot 4		10,66499373	11,99862873	
T 24 Lot 5		4	9,051014811	
T 25 Lot 5	14,99571551	6,969478491	12,85714286	
T 26 Lot 5-Gom	1,200068575		7,991660876	2
T 27 Gom			9,663341646	3,42832655
T 28 Gom			8,305382527	
T 29 Lot 6			7,699414844	
T 30 Lot 6			6,530612245	
T 31 Lot 6	2,570694087	9,42587832	7,712082262	
T 32 Pin Supu	0,428540819	7,172743574	12,85347044	
T 33 Lot 8-pin Supu	3,428571429	8,997429306	12,59511939	8,14402057
T 34 Safoda	1,715265866	9,328782708		
T 35 Safoda		13,52250055	9,42587832	
T 36 Safoda-Lot 9		4,71495928	4,034291478	
T 37 Safoda-Lot 9			5,630630631	
T 38 Safoda-Lot 9	5,980861244		5,145797599	
T 39 Lot 10	1,285897985	6,170723346		
T 40 Lot 10-Lokan			2,750275028	
T 41 Lot 10-Lokan		3,63086233	5,145797599	
T 42 Lokan		3,857693956	3,7709976	

ANNEXE 20

analyse de variance (3)

habitat 1	habitat 2	habitat 3	habitat 4
14,99571551	19,58384333	15,42857143	14,5672665
5,980861244	18,19454164	14,28571429	9,42587832
5,145797599	17,13796058	13,96323016	8,576329331
5,141388175	16,53398653	13,63688894	8,144020574
5,035971223	14,15797317	12,85714286	3,428326548
4,115226337	13,71428571	12,85347044	2
3,430531732	13,69863014	12,59511939	
3,428571429	13,52250055	12,43289065	
2,570694087	12,78911565	12,29966455	
1,715265866	12,21079692	11,99862873	
1,285897985	11,85770751	11,11883252	
1,200068575	11,65126557	10,06832075	
0,856898029	10,66499373	9,663341646	
0,428540819	10,64099316	9,42587832	
	9,42587832	9,051014811	
	9,328782708	8,568980291	
	8,997429306	8,305382527	
	8,817046289	7,991660876	
	7,172743574	7,712082262	
	6,969478491	7,699414844	
	6,170723346	6,530612245	
	5,714285714	5,998286204	
	4,71495928	5,630630631	
	4	5,145797599	
	3,857693956	5,145797599	
	3,63086233	4,591368228	
	0	4,498714653	
		4,034291478	
		3,7709976	
		2,750275028	
		1,904761905	

Analyse de variance pour un facteur

RAPPORT DETAILLE

Groupes	Nombre d'échantillons	Somme	Moyenne	Variance
Colonne 1	14	55,33142861	3,952244901	13,4041463
Colonne 2	27	275,1584775	10,19105472	24,0056522
Colonne 3	32	273,6722941	8,55225919	15,6431943
Colonne 4	6	46,14182127	7,690303545	20,3679485

ANALYSE DE VARIANCE

Source des variations	Somme des carrés	Degré de liberté	Moyenne des carrés	F	Probabilité	Valeur critique pour F
Entre Groupes	365,0941412	3	121,6980471	6,58929236	0,00051695	2,726594062
A l'intérieur des groupes	1385,179626	75	18,46906168			
Total	1750,273767	78				

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ANNEXE 21

Calcul par application de la méthode Jolly 2 (Jolly, 1969)

ANNEXE 21

LOT 1 et 2

	yi nids	zi km²
T 1	15	1,155
T 2	66	2,3379
T 3	57	2,6355
T 4	60	1,9251
T 5	16	0,9519
T 8	47	1,1025
T 9	52	1,3581
T 10	44	1,0605
T 11	26	0,7701
T 12	21	0,6999
Sy1 ; Sz1	404	13,9965

$N1 = 47$

$n1 = 10$

$Z1 = Z lot1 + Z lot 2 = 75,01$ km²

$R1 = 28,86436$

	Colonne 1	Colonne 2
Colonne 1	370,044444	
Colonne 2	10,1054333	0,44834447
variance yi	variance zi	covariance

$Y1 = Z1 \times R1 = 2165,115644$

var $Y1 = 27854$

LOT 3 et 4

	yi nids	zi km²
T 19	138	2,9469
T 20	7	0,4656
T 21	33	0,8049
T 22	60	1,2879
T 23	52	1,3545
Sy2 ; Sz2	290	6,8598

$N2 = 24$

$n2 = 5$

$Z2 = 34,87$ km²

$R2 = 42,275$

	Colonne 1	Colonne 2
Colonne 1	2416,5	
Colonne 2	46,583175	0,90771311

$Y2 = Z2 \times R2 = 1474,1392$

var $Y2 = 9130$

LOT 5 et Gomantong FR

	yi nids	zi km²
T 24	80	3,2376
T 25	109	2,9994
T 26	60	4,5255
T 27	47	2,3625
T 28	52	1,8795
Sy3 ; Sz3	348	15,0045

$N3 = 38$

$n3 = 5$

$Z3 = 107,59$ km²

$R3 = 23,193$

	Colonne 1	Colonne 2
Colonne 1	643,3	
Colonne 2	5,482725	1,01138171

$Y3 = 2495,33$

var $Y3 = 233970$

LOT 6 , 7 , 8 et Pin Supu

	yi nids	zi km²
T 29	25	1,0395
T 30	8	0,4725
T 31	20	0,9345
T 32	29	2,2506
T 33	94	3,0696
Sy4 ; Sz4	176	7,7667

$N4 = 70$

$n4 = 5$

$Z4 = 96,57$ km²

$R4 = 22,66$

	Colonne 1	Colonne 2
Colonne 1	1142,7	
Colonne 2	32,219865	1,15010637

$Y4 = 2188,3583$

var $Y4 = 248417$

ANNEXE 21

LOT 9 et Safoda

	yi nids	zi km²
T 34	42	1,4946
T 35	72	1,7046
T 36	19	1,2951
T 37	15	0,798
T 38	13	0,6756
Sy5 ; Sz5	161	5,9679

$N5 = 59$
$n5 = 59$
$Z5 = 44,35$ km²
$R5 = 26,978$

	Colonne 1	Colonne 2
Colonne 1	629,7	
Colonne 2	9,67443	0,1967119

$Y5 = 1196,47$
var $Y5 = 160000$

LOT 10 et Lokan FR

	yi nids	zi km²
T 40	10	1,1199
T 41	15	1,197
T 42	20	1,5855
Sy6 ; Sz6	45	3,9024

$N6 = 26$
$n6 = 3$
$Z6 = 29,82$ km²
$R6 = 11,53$

	Colonne 1	Colonne 2
Colonne 1	25	
Colonne 2	1,164	0,06227667

$Y6 = 343,825$
var $Y6 = 1280$

ANNEXE 22

Détail des valeurs en nids/km ² pour les types d'habitats

Hill

Transect	Dist air	surf km²D, G	surf km² tot	nb nids G	nids G/km²	nb nids D	nids D/km²	nb nids tot	nids/km²	Transect	Distance m	nb nids	Somme dist	W	surf km²	nb nids/km²
BAWANG	1,167	0,17505	0,3501	7	39,9885747	4	22,8506141	11	31,4195944	BAWANG	1275	15	326,9	22,5448276	0,02874466	521,836143
LEE	0,583	0,08745	0,1749	4	45,7404231	1	11,4351058	5	28,5877644	LEE	600	13	137,9	13,79	0,008274	1571,18685
PANGI	1,167	0,17505	0,3501	8	45,7012282	9	51,4138817	17	48,557555	PANGI	1320	13	149	14,9	0,019668	660,972137
CARO	0,5835	0,087525		10	114,253071		0									
	0,2915	0,043725				6	137,221269									
	0,875	0,13125	0,2625					16	60,952381	CARO	350	2	25	16,6666667	0,00583333	342,857143

Logged +

Transect	Dist air	surf km²D, G	surf km² tot	nb nids G	nids G/km²	nb nids D	nids D/km²	nb nids tot	nids/km²	Transect	Distance m	nb nids	Somme dist	W	surf km²	nb nids/km²
HERMAN	0,817	0,12255	0,2451	3	24,4798042	13	106,079151	16	65,2794778	HERMAN	980	9	109	15,5714286	0,01526	589,777195
PANGI	0,506	0,0759	0,1518	6	79,0513834	0	0	6	39,5256917	PANGI	780	1	34,8	23,2	0,018096	55,2608311
CARO	0,5835	0,087525	0,17505		0	4	45,7012282									
	0,2915	0,043725	0,08745	3	68,6106346		0									
	0,875	0,13125	0,2625					7	26,6666667	CARO	1410	5	76,7	17,0444444	0,02403267	208,050154
MORISEM 2	1,75	0,2625	0,525	18	68,5714286	17	64,7619048	35	66,6666667	MORISEM 2	1710	13	300,6	30,06	0,0514026	252,905495
BOY	1,342	0,2013	0,4026	13	64,5802285	6	29,8062593	19	47,1932439	BOY	1690	25	651,3	28,3173913	0,04785639	522,396263
MOTOROB	1,672	0,2508	0,5016	16	63,7958533	15	59,8086124	31	61,8022329	MOTOROB	890	12	363,5	27,9615385	0,02488577	482,203298
BENOIT	1,225	0,18375	0,3675	7	38,0952381	0	0	7	19,047619	BENOIT	720	12	366,8	34,9333333	0,025152	477,099237

Logged -

Transect	Dist air	surf km²D, G	surf km² tot	nb nids G	nids G/km²	nb nids D	nids D/km²	nb nids tot	nids/km²	Transect	Distance m	nb nids	Somme dist	W	surf km²	nb nids/km²
BAWANG	1,167	0,17505	0,3501	8	45,7012282	2	11,4253071	10	28,5632676	BAWANG	1285	12	154	16,2105263	0,02083053	576,077619
HUSFIK	1,089	0,16335	0,3267	5	30,6091215	0	0	5	15,3045608	HUSFIK	980	15	196,2	14,5333333	0,01424267	1053,17356
LEE	1,439	0,21585	0,4317	11	50,9613157	5	23,1642344	16	37,0627751	LEE	1110	8	99	15,2307692	0,01690615	473,200473
QUENNY	1,167	0,17505	0,3501	2	11,4253071	5	28,5632676	7	19,9942873	QUENNY	720	2	43	21,5	0,01548	129,198966
S	1,75	0,2625	0,525	7	26,6666667	1	3,80952381	8	15,2380952	S	610	28	453,5	18,8958333	0,01152646	2429,1937
HASSAN	1,75	0,2625	0,525	25	95,2380952	11	41,9047619	36	68,5714286	HASSAN	1940	27	421,3	18,7244444	0,03632542	743,281106
TEMENGGONG	1,361	0,20415	0,4083	2	9,7967181	10	48,9835905	12	29,3901543	TEMENGGONG	1730	6	88,9	17,78	0,0307594	195,062322

Swamp

Transect	Dist air	surf km²D, G	surf km² tot	nb nids G	nids G/km²	nb nids D	nids D/km²	nb nids tot	nids/km²	Transect	Distance m	nb nids	Somme dist	W	surf km²	nb nids/km²
QUENNY	0,583	0,08745	0,1749	0	0	3	34,3053173	3	17,1526587	QUENNY	1160	4	83,5	23,8571429	0,02767429	144,538509

ANNEXE 23

Valeurs en nids/km ^{2} pour les types d'habitats

Valeurs nids/km² pour les types d'habitats

	Colline	**type 1**		
Transect	nids G/km²	nids D/km²	nids air/km²	nb nidssol/km²
BAWANG	39,989	22,851	31,420	521,836
LEE	45,740	11,435	28,588	1571,187
PANGI	45,701	51,414	48,558	660,972
CARO	114,253	137,221	60,952	342,857

	Dégradé +	**type 2**		
Transect	nids G/km²	nids D/km²	nids air/km²	nb nidssol/km²
HERMAN	24,480	106,079	65,279	589,777
PANGI	79,051	0,000	39,526	55,261
CARO	68,611	45,701	26,667	208,050
MORISEM 2	68,571	64,762	66,667	252,905
BOY	64,580	29,806	47,193	522,396
MOTOROB	63,796	59,809	61,802	482,203
BENOIT	38,095	0,000	19,048	477,099

	Logged -			
Transect	nids G/km²	nids D/km²	nids air/km²	nb nidssol/km²
BAWANG	45,701	11,425	28,563	576,078
HUSFIK	30,609	0,000	15,305	1053,174
LEE	50,961	23,164	37,063	473,200
QUENNY	11,425	28,563	19,994	129,199
S	26,667	3,810	15,238	2429,194
HASSAN	95,238	41,905	68,571	743,281
TEMENGGONG	9,797	48,984	29,390	195,062

	Swamp			
Transect	nids G/km²	nids D/km²	nids air/km²	nb nidssol/km²
QUENNY	0	34,305	17,153	144,539

Transect	nids D/km²	nids G/km²	nids air/km²	nb nidssol/km²	type habitat
BAWANG	22,851	39,989	31,420	521,836	1
LEE	11,435	45,740	28,588	1571,187	1
PANGI	51,414	45,701	48,558	660,972	1
CARO	137,221	114,253	60,952	342,857	1
HERMAN	106,079	24,480	65,279	589,777	2
PANGI	0,000	79,051	39,526	55,261	2
CARO	45,701	68,611	26,667	208,050	2
MORISEM 2	64,762	68,571	66,667	252,905	2
BOY	29,806	64,580	47,193	522,396	2
MOTOROB	59,809	63,796	61,802	482,203	2
BENOIT	0,000	38,095	19,048	477,099	2
BAWANG	11,425	45,701	28,563	576,078	3
HUSFIK	0,000	30,609	15,305	1053,174	3
LEE	23,164	50,961	37,063	473,200	3
QUENNY	28,563	11,425	19,994	129,199	3
S	3,810	26,667	15,238	2429,194	3
HASSAN	41,905	95,238	68,571	743,281	3
TEMENGGONG	48,984	9,797	29,390	195,062	3
QUENNY	34,305	0,000	17,153	144,539	4

ANNEXE 24

**Détails des données pour les nids « visibles » et « non visibles »**

Corrélation entre les nids estimés "visibles de l'air" au cours du recensement terrestre et les résultats aériens

		km	nids	nids "Visibles"	% nids "V"
BAWANG	colline	1,275	31	7	22,58
LEE	colline	0,6	20	4	20
PANGI	colline	1,32	20	5	25
CARO	colline	0,35	4	1	25
			75	17	22,67
BOY	dégradé +	1,69	65	29	44,62
MOTOROB	dégradé +	0,89	40	19	47,5
BENOIT	dégradé +	0,72	32	10	31,25
HERMAN	dégradé +	0,98	16	3	18,75
PANGI	dégradé +	0,78	5	3	60
CARO	dégradé +	1,41	11	7	63,64
MORISEM 2	dégradé +	1,71	26	21	80,77
			195	92	47,18
HUSFIK	degradé -	0,98	27	5	18,52
S	degradé -	0,61	51	14	27,45
BAWANG	degradé -	1,285	20	5	25
LEE	degradé -	1,11	14	2	14,29
QUENNY	degradé -	0,72	4	3	75
HASSAN	degradé -	1,94	45	7	15,56
TEMENGGONG	degradé -	1,73	10	3	30
			171	39	22,81
QUENNY	marécage	1,16	7	1	14,29

	% nids "V"	nids/km air
colline	22,67	5,59
dégradé +	47,18	9,825
degradé -	22,81	9,433
marécage	14,29	3,555

coefficient de corrélation

	Colonne 1	Colonne 2
Colonne 1	1	
Colonne 2	0,74775588	1
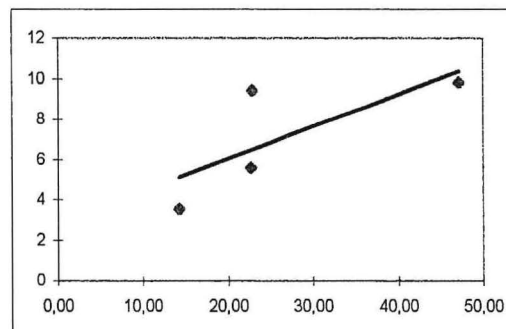
		% nids "V"	nids/km air
colline	BAWANG	22,58	9,426
	LEE	20	8,576
	PANGI	25	14,567
	CARO	25	18,286
degradé +	BOY	44,62	14,158
	MOTOROB	47,5	18,541
	BENOIT	31,25	5,714
	HERMAN	18,75	19,584
	PANGI	60	11,858
	CARO	63,64	8
	MORISEM 2	80,77	20
dégradé -	HUSFIK	18,52	4,591
	S	27,45	4,571
	BAWANG	25	8,569
	LEE	14,29	11,119
	QUENNY	75	5,998
	HASSAN	15,56	20,571
	TEMENGGONG	30	8,817
marécage	QUENNY	14,29	5,146

coefficient de corrélation

	Colonne 1	Colonne 2
Colonne 1	1	
Colonne 2	0,10532437	1

ANNEXE 25

Etude de corrélation pour les transects air - sol < 750 nids/km ^{2}

Corrélation entre nids/km²air et nids/km² sol < 750

	nb nids /km² air	nb nids /km² sol
Bawang	30,00428633	526,3568309
Lee	34,68780971	933,1052409
S	15,23809524	2429,193703
Hassan	68,57142857	743,2811059
Pangi	45,96322942	417,120058
Caro	43,80952381	234,6473585
Morisem 2	66,66666667	252,9054951
Temenggong	29,3040293	195,0623224
Benoit	19,04761905	477,0992366
Boy	47,19324391	522,3962635
Motorob	65,69551557	482,2032981
Q + H	33,76184911	278,3840363
Husfik	15,3609831	1053,173563

en éliminant les transects avec un nombre de nids /km² > 750

	nb nids /km² air	nb nids /km² sol
Bawang	30,00428633	526,3568309
Hassan	68,57142857	743,2811059
Pangi	45,96322942	417,120058
Caro	43,80952381	234,6473585
Morisem 2	66,66666667	252,9054951
Temenggong	29,3040293	195,0623224
Benoit	19,04761905	477,0992366
Boy	47,19324391	522,3962635
Motorob	65,69551557	482,2032981
Q + H	33,76184911	278,3840363

COEFFICIENT DE CORRELATION

	Colonne 1	Colonne 2
Colonne 1	1	
Colonne 2	0,288509153	1

nids/km² air-sol