Annex 4. Photos of some other wildlife species from the survey area

4a. *Dopasia sokolovi (second record of Laos) from SB3*

4b. Feeding site of Pangolins (Chinese Pangolin)

4c. Claw marks of Bears on tree trunk (Sun Bear) from SB5

4d. Bat sp. from SB3

4e. Gymnure sp. from SB5

4f. Sokolov's Grass Lizard from SB3 (second record of Laos)

Annex 5. Photos of some forest landscape and structures from the survey area

Survey block #1 (Southern Annamite)

Survey block #2 (Southern Annamite)

Survey block #3 (Phou Koungking East)

Survey block #4 (Phou Koungking West)

Survey block #5 (Phou Yai)

Annex 6. Waypoints for important (key and GT species) records

1	Plants: Coordinates of first and second records, Globally Threatened and New Species Candidates									
2				Endemism Species				UTM		Alt
3	Group and Family	Species	GT	First Reccord	Second Reccord	New SP Candidat	Survey block	X	Y	(m a.s.l)
4	Pentaphylacaceae	Adinandra integerrima T.Anderson ex Dyer		x			4/2	728974	1712562	
5	Pentaphylacaceae	Adinandra integerrima T.Anderson ex Dyer		x			4/3	729218	1712797	
6	Pentaphylacaceae	Adinandra integerrima T.Anderson ex Dyer		x			4/4	730017	1712249	
7	Pentaphylacaceae	Adinandra integerrima T.Anderson ex Dyer		x			4/5	730445	1712019	
8	Pentaphylacaceae	Adinandra integerrima T.Anderson ex Dyer		x			4/6	731205	1712548	
9	Lauraceae	Alseodaphne bidoupensis Yahara		x			2/1	750740	1722688	
10	Lauraceae	Alseodaphne bidoupensis Yahara		x			2/3	751025	1722672	
11	Marattiaceae	Angiopteris wangii Ching		x			2/6	752943	1720599	
12	Icacinaceae	Apodytes dimidiata E.Mey. ex Arn.		x			3/1	734837	1712290	
13	Icacinaceae	Apodytes dimidiata E.Mey. ex Arn.		x			3/2	735209	1712032	
14	Icacinaceae	Apodytes dimidiata E.Mey. ex Arn.		x			3/3	735792	1712515	
15	Primulaceae	Ardisia gracilenta C.M.Hu & J.E.Vidal		x			3/2	735209	1712032	
16	Primulaceae	Ardisia gracilenta C.M.Hu & J.E.Vidal		x			3/3	735792	1712515	
17	Primulaceae	Ardisia gracilenta C.M.Hu & J.E.Vidal		x			3/4	731614	1712736	
18	Primulaceae	Ardisia gracilenta C.M.Hu & J.E.Vidal		x			4/2	728974	1712562	
19	Primulaceae	Ardisia gracilenta C.M.Hu & J.E.Vidal		x			4/4	730017	1712249	
20	Primulaceae	Ardisia gracilenta C.M.Hu & J.E.Vidal		x			5/3	722916	1711735	
21	Primulaceae	Ardisia gracilenta C.M.Hu & J.E.Vidal		x			5/5	722080	1713133	
22	Rubiaceae	Argostemma bariense Pierre ex Pit.		x			2/6	752943	1720599	
23	Rubiaceae	Brachytome wallichii Hook.f.		x			4/1	728886	1712825	
24	Rubiaceae	Brachytome wallichii Hook.f.		x			4/2	728974	1712562	
25	Rubiaceae	Brachytome wallichii Hook.f.		x			4/4	730017	1712249	
26	Melastomataceae	Bredia sp. (new genus record for Laos)		x			2/5	723254	1710986	
27	Theaceae	Camellia sp. 1				x	5/1	723071	1710374	
28	Theaceae	Camellia sp. 1				x	5/6	722534	1713764	
29	Rubiaceae	Chassalia curviflora (Wall.) Thwaites		x			3/1	734837	1712290	
30	Daphniphyllaceae	Daphniphyllum beddomei Craib		x			3/1	734837	1712290	
31	Daphniphyllaceae	Daphniphyllum beddomei Craib		x			3/2	735209	1712032	
32	Daphniphyllaceae	Daphniphyllum beddomei Craib		x			3/3	735792	1712515	
33	Daphniphyllaceae	Daphniphyllum beddomei Craib		x			3/4	731614	1712736	
34	Daphniphyllaceae	Daphniphyllum beddomei Craib		x			3/5	731869	1712562	
35	Daphniphyllaceae	Daphniphyllum beddomei Craib		x			3/6	732041	1712500	
36	Elaeocarpaceae	Elaeocarpus dubius DC.		x			1/3	752318	1717523	
37	Elaeocarpaceae	Elaeocarpus dubius DC.		x			1/4	751395	1717920	
38	Elaeocarpaceae	Elaeocarpus dubius DC.		x			2/1	750740	1722688	
39	Elaeocarpaceae	Elaeocarpus dubius DC.		x			2/2	750569	1723483	
40	Elaeocarpaceae	Elaeocarpus dubius DC.		x			2/4	752726	1722359	
41	Elaeocarpaceae	Elaeocarpus limitaneus Hand.-Mazz.		x			2/5	752836	1721953	
42	Gnetaceae	Gnetum gnemon L.		x			3/1	734837	1712290	
43	Euphorbiaceae	Gymnanthes remota (Steenis) Esser		x			4/1	728886	1712825	
44	Euphorbiaceae	Gymnanthes remota (Steenis) Esser		x			4/2	728974	1712562	
45	Euphorbiaceae	Gymnanthes remota (Steenis) Esser		x			4/3	729218	1712797	
46	Euphorbiaceae	Gymnanthes remota (Steenis) Esser		x			4/4	730017	1712249	
47	Euphorbiaceae	Gymnanthes remota (Steenis) Esser		x			4/5	730445	1712019	
48	Euphorbiaceae	Gymnanthes remota (Steenis) Esser		x			4/6	731205	1712548	
49	Araliaceae	Heptapleurum cambodianum (Yahara & Tagane) Lowry & G.M		x			1/4	751395	1717920	
50	Araliaceae	Heptapleurum cambodianum (Yahara & Tagane) Lowry & G.M		x			1/6	752607	1719693	
51	Araliaceae	Heptapleurum cambodianum (Yahara & Tagane) Lowry & G.M		x			3/4	731614	1712736	
52	Araliaceae	Heptapleurum cambodianum (Yahara & Tagane) Lowry & G.M		x			3/5	731869	1712562	
53	Araliaceae	Heptapleurum cambodianum (Yahara & Tagane) Lowry & G.M		x			5/3	722916	1711735	
54	Araliaceae	Heptapleurum cambodianum (Yahara & Tagane) Lowry & G.M		x			5/5	722080	1713133	
55	Araliaceae	Heptapleurum cambodianum (Yahara & Tagane) Lowry & G.M		x			5/6	722534	1713764	
56	Aquifoliaceae	Ilex chapaensis Merr.		x			4/6	731205	1712548	
57	Aquifoliaceae	Ilex chapaensis Merr.		x			5/1	723071	1710374	

58	Aquifoliaceae	Ilex chapaensis Merr.		x			5/2	723254	1710986	
59	Aquifoliaceae	Ilex chapaensis Merr.		x			5/3	722916	1711735	
60	Lauraceae	Lindera bokorensis Yahara & Tagane		x			1/5	751734	1717636	
61	Lauraceae	Lindera bokorensis Yahara & Tagane		x			2/6	752943	1720599	
62	Lauraceae	Lindera bokorensis Yahara & Tagane		x			4/1	728886	1712825	
63	Lauraceae	Lindera bokorensis Yahara & Tagane		x			4/3	729218	1712797	
64	Lauraceae	Lindera bokorensis Yahara & Tagane		x			4/4	730017	1712249	
65	Lauraceae	Lindera bokorensis Yahara & Tagane		x			4/5	730445	1712019	
66	Fagaceae	Lithocarpus elephantum (Hance) A.Camus		x			3/2	735209	1712032	
67	Fagaceae	Lithocarpus elephantum (Hance) A.Camus		x			3/5	731869	1712562	
68	Fagaceae	Lithocarpus elephantum (Hance) A.Camus		x			3/6	732041	1712500	
69	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			1/1	752943	1719617	
70	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			1/6	752607	1719693	
71	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			2/1	750740	1722688	
72	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			2/4	752726	1722359	
73	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			2/6	752943	1720599	
74	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			3/2	735209	1712032	
75	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			3/6	732041	1712500	
76	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			5/1	723071	1710374	
77	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			5/2	723254	1710986	
78	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			5/3	722916	1711735	
79	Fagaceae	Lithocarpus pierrei (Hickel & A.Camus) A.Camus		x			5/6	722534	1713764	
80	Lauraceae	Machilus sp.				x	2/2	750569	1723483	
81	Sapotaceae	Madhuca cochinchinensis (Pierre ex Dubard) H.J.Lam		x			2/5	752836	1721953	
82	Lauraceae	Neolitsea sp.				x	1/5	751734	1717636	
83	Escalloniaceae	Polyosma dolichocarpa Merr.		x			2/4	752726	1722359	
84	Escalloniaceae	Polyosma dolichocarpa Merr.		x			2/6	752943	1720599	
85	Rubiaceae	Psychotria cambodiana Pierre ex Pit.		x			4/1	728886	1712825	
86	Rubiaceae	Psychotria cambodiana Pierre ex Pit.		x			4/2	728974	1712562	
87	Rubiaceae	Psychotria cambodiana Pierre ex Pit.		x			4/3	729218	1712797	
88	Fagaceae	Quercus langbianensis Hickel & A.Camus	NT	x			4/1	728886	1712825	
89	Fagaceae	Quercus langbianensis Hickel & A.Camus	NT	x			4/2	728974	1712562	
90	Fagaceae	Quercus langbianensis Hickel & A.Camus	NT	x			4/3	729218	1712797	
91	Fagaceae	Quercus langbianensis Hickel & A.Camus	NT	x			4/4	730017	1712249	
92	Fagaceae	Quercus langbianensis Hickel & A.Camus	NT	x			4/5	730445	1712019	
93	Fagaceae	Quercus sp.1				x	1/1	752943	1719617	
94	Fagaceae	Quercus sp.1				x	1/2	752607	1718678	
95	Sapotaceae	Sarcosperma kontumense Gagnep. ex Aubrév.		x			2/4	752726	1722359	
96	Symplocaceae	Symplocos wikstroemiifolia Hayata		x			4/1	728886	1712825	
97	Symplocaceae	Symplocos wikstroemiifolia Hayata		x			4/2	728974	1712562	
98	Symplocaceae	Symplocos wikstroemiifolia Hayata		x			4/3	729218	1712797	
99	Symplocaceae	Symplocos wikstroemiifolia Hayata		x			4/4	730017	1712249	
100	Symplocaceae	Symplocos wikstroemiifolia Hayata		x			4/5	730445	1712019	
101	Symplocaceae	Symplocos wikstroemiifolia Hayata		x			4/6	731205	1712548	
102	Symplocaceae	Symplocos wikstroemiifolia Hayata		x			5/1	723071	1710374	
103	Symplocaceae	Symplocos wikstroemiifolia Hayata		x			5/6	722534	1713764	
104	Rubiaceae	Urophyllum sp. 1 (new genus record for Laos)		x			2/1	750740	1722688	

106	Rubiaceae	Urophyllum sp. 3 (new genus record for Laos)		x			2/6	752943	1720599	
107	Ericaceae	Vaccinium sp. 1				x	2/2	750569	1723483	
108	Polygalaceae	Xanthophyllum ellipticum Korth. ex Miq.		x			1/3	752318	1717523	
109	Polygalaceae	Xanthophyllum ellipticum Korth. ex Miq.		x			1/5	751734	1717636	
110	Polygalaceae	Xanthophyllum ellipticum Korth. ex Miq.		x			2/1	750740	1722688	
111	Polygalaceae	Xanthophyllum ellipticum Korth. ex Miq.		x			2/2	750569	1723483	
112	Polygalaceae	Xanthophyllum ellipticum Korth. ex Miq.		x			2/3	751025	1722672	
113	Polygalaceae	Xanthophyllum ellipticum Korth. ex Miq.		x			2/4	752726	1722359	
114	Polygalaceae	Xanthophyllum sp. 1				x	5/1	723071	1710374	
115	Zingiberaceae	Zingiber mellis Škorničk., H.Đ.Trần & Šída f.	EN	x			3/3	735792	1712515	
116	Podocarpaceae	Nageia fleuryi (Hickel) de Laub.	NT				2/3	751025	1722672	
117	Podocarpaceae	Nageia fleuryi (Hickel) de Laub.	NT				5/6	722534	1713764	
118	Pinaceae	Pinus dalatensis Ferré	NT				2/1	750740	1722688	
119	Pittostoraceae	Pittosporum pauciflorum Hook. & Arn.	VU				4/1	728886	1712825	
120	Pittostoraceae	Pittosporum pauciflorum Hook. & Arn.	VU				4/6	731205	1712548	
121	Pittostoraceae	Pittosporum pauciflorum Hook. & Arn.	VU				5/1	723071	1710374	
122	Pittostoraceae	Pittosporum pauciflorum Hook. & Arn.	VU				5/2	723254	1710986	
123	Pittostoraceae	Pittosporum pauciflorum Hook. & Arn.	VU				5/3	722916	1711735	

Mammals: Coordinates of Globally Threatened Species

Group and Family	Common Name	Scientific Name	GT	Endemic Species			Survey block	UTM		Alt
				First Reccord	Second Reccord	New SP Can.		X	Y	(m a.s.l)
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				2	751472	1722999	1,259
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				3	722825	1712721	1,340
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				2	753085	1722328	1,140
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				3	732291	1711333	1,598
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				2	752030	1720813	1,209
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				2	753233	1721151	1,095
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				2	752624	1722764	1,220
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				3	733417	1712501	1,494
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				3	732425	1712541	1,599
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				3	733458	1711473	1,517
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				4	730566	1709941	1,559
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				4	729860	1709973	1,467
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				4	729097	1711619	1,311
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				4	731020	1711408	1,615
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				4	730566	1709941	1,559
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				4	729097	1711619	1,311
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				5	721848	1711560	1,219
Colobinae	Stump-tailed Macaque	*Macaca arctoides*	VU				5	721100	1711389	1,206
Hylobatinae	Buff-cheeked Gibbon	Nomascus annamensis	EN				1	753461	1719462	1,135
Hylobatinae	Buff-cheeked Gibbon	Nomascus annamensis	EN				1	754059	1719265	1,167
Hylobatinae	Buff-cheeked Gibbon	Nomascus annamensis	EN				2	753416	1721669	1,160
Hylobatinae	Buff-cheeked Gibbon	Nomascus annamensis	EN				4	729900	1710465	1,439
Hylobatinae	Buff-cheeked Gibbon	Nomascus annamensis	EN				4	729956	1711647	1,510
Colobinae	Red-shanked Douc Langur	*Pygathrix nemaeus*	CR				2	751402	1722656	1,243
Colobinae	Red-shanked Douc Langur	*Pygathrix nemaeus*	CR				3	732493	1712583	1,623
Colobinae	Red-shanked Douc Langur	*Pygathrix nemaeus*	CR				4	730836	1710015	1,600
Colobinae	Red-shanked Douc Langur	*Pygathrix nemaeus*	CR				4	730837	1710699	1,565
Colobinae	Red-shanked Douc Langur	*Pygathrix nemaeus*	CR				4	730837	1710015	1,600
Colobinae	Red-shanked Douc Langur	*Pygathrix nemaeus*	CR				4	730838	1710700	1,565
Colobinae	Red-shanked Douc Langur	*Pygathrix nemaeus*	CR				4	730085	1710377	1,339
Colobinae	Red-shanked Douc Langur	*Pygathrix nemaeus*	CR				4	730566	1709941	1,559
Manidae	Chinese Pangolin	*Manis pentadactyla*	CR				1	751113	1717914	1,133
Manidae	Chinese Pangolin	*Manis pentadactyla*	CR				1	751078	1717929	1,123
Manidae	Chinese Pangolin	*Manis pentadactyla*	CR				1	751090	1717921	1,129
Manidae	Chinese Pangolin	*Manis pentadactyla*	CR				2	750637	1724419	1,210
Manidae	Chinese Pangolin	*Manis pentadactyla*	CR				2	751037	1723050	1,107
Manidae	Chinese Pangolin	*Manis pentadactyla*	CR				4	729628	1709538	1,357
Manidae	Chinese Pangolin	*Manis pentadactyla*	CR				4	728728	1709978	1,157
Manidae	Sunda Pangolin	*Manis javanica*	CR				2	752546	1722746	1,117
Manidae	Chinese Pangolin	*Manis pentadactyla*	CR				2	753134	1721101	1,081
Manidae	Chinese Pangolin	*Manis pentadactyla*	CR				2	751361	1722498	1,249
Manidae	Sunda Pangolin	*Manis javanica*	CR				2	750623	1723932	1,240
Manidae	Sunda Pangolin	*Manis javanica*	CR				2	752546	1722746	1,117
Manidae	Sunda Pangolin	*Manis javanica*	CR				1	753904	1718763	1,103
Manidae	Sunda Pangolin	*Manis javanica*	CR				1	751740	1717708	1,077
Manidae	Sunda Pangolin	*Manis javanica*	CR				1	751875	1718740	1,096
Manidae	Sunda Pangolin	*Manis javanica*	CR				1	750995	1717133	1,055
Manidae	Sunda Pangolin	*Manis javanica*	CR				1	751718	1717678	1,055
Manidae	Sunda Pangolin	*Manis javanica*	CR				1	751740	1717708	1,055
Manidae	Sunda Pangolin	*Manis javanica*	CR				1	751652	1718019	1,108
Manidae	Sunda Pangolin	*Manis javanica*	CR				2	752645	1720851	1,135
Ursidae	Asiatic Black Bear	*Ursus thibetanus*	VU				2	751402	1722656	1,220
Ursidae	Sun Bear	*Helarctos malayanus*	VU				2	752479	1722669	1,226
Ursidae	Sun Bear	*Helarctos malayanus*	VU				2	751325	1722243	1,248
Ursidae	Sun Bear	*Helarctos malayanus*	VU				4	729339	1710074	1,255
Ursidae	Sun Bear	*Helarctos malayanus*	VU				4	728770	1709947	1,184
Ursidae	Sun Bear	*Helarctos malayanus*	VU				4	728834	1709911	1,212

Ursidae	Sun Bear	*Helarctos malayanus*	VU				4	728838	1709910	1,230
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723129	1712261	1,284
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723266	1712237	1,287
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723382	1712245	1,279
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723520	1712263	1,273
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723520	1712262	1,268
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723564	1712247	1,243
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723564	1712254	1,251
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723643	1712291	1,267
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723642	1712298	1,270
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723665	1712334	1,231
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	721642	1713606	1,323
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723266	1712237	1,287
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723382	1712245	1,279
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723520	1712263	1,273
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723520	1712262	1,268
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723564	1712247	1,243
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723564	1712254	1,251
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723643	1712291	1,267
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723642	1712298	1,270
Ursidae	Sun Bear	*Helarctos malayanus*	VU				5	723665	1712334	1,231
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	732425	1712541	1,599
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	731020	1711408	1,615
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	732923	1712124	1,574
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	729097	1710186	1,205
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	732923	1712124	1,574
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	729934	1710026	1,450
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730190	1710041	1,455
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730197	1710040	1,455
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730303	1709908	1,510
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730303	1709897	1,510
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730672	1711061	1,595
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730967	1711228	1,617
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730969	1711206	1,633
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730975	1711190	1,630
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730977	1711342	1,355
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730977	1711343	1,590
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				5	723011	1713638	1,307
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				2	751570	1720922	1,218
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				2	751361	1720881	1,228
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				2	749913	1722013	1,175
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				2	749758	1721516	1,202
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	734177	1711333	1,314
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	733865	1710656	1,446
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	733556	1710165	1,333
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	733292	1709346	1,377
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	732551	1710388	1,344
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	732681	1711965	1,667
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	732758	1711932	1,671
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	732815	1711948	1,677
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	732819	1711947	1,677
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	732982	1712151	1,536
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	733362	1709377	1,386
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	733910	1709537	1,372
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				3	733342	1709203	1,359
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	729021	1711816	1,220
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	729022	1710187	1,191
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	729002	1710199	1,193
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	728857	1710251	1,223
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	728435	1710597	1,212
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	727902	1710831	1,252
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730788	1710614	1,559
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	730900	1710863	1,604
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	729762	1710465	1,277
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	728837	1709926	1,219

Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	728838	1709926	1,219
Bovidae	Chinese Serow	*Capricornis milneedwardsii*	VU				4	728966	1710048	1,201
Cervidae	Sambar Deer	*Cervus unicolor*	VU				5	721100	1711389	1,206
Cervidae	Sambar Deer	*Cervus unicolor*	VU				1	751361	1722393	1,243
Cervidae	Sambar Deer	*Cervus unicolor*	VU				1	751357	1722333	1,247
Cervidae	Sambar Deer	*Cervus unicolor*	VU				1	751999	1716192	1,015
Cervidae	Sambar Deer	*Cervus unicolor*	VU				2	751357	1722333	1,247
Cervidae	Sambar Deer	*Cervus unicolor*	VU				3	734416	1711606	1,244
Cervidae	Sambar Deer	*Cervus unicolor*	VU				3	734540	1711897	1,234
Cervidae	Sambar Deer	*Cervus unicolor*	VU				1	752165	1716093	1,126
Cervidae	Sambar Deer	*Cervus unicolor*	VU				1	753475	1718680	1,105
Cervidae	Sambar Deer	*Cervus unicolor*	VU				1	751873	1718713	1,081
Cervidae	Sambar Deer	*Cervus unicolor*	VU				2	749864	1722653	1,155
Cervidae	Sambar Deer	*Cervus unicolor*	VU				2	749874	1722628	1,154
Cervidae	Sambar Deer	*Cervus unicolor*	VU				2	749861	1722258	1,157
Cervidae	Sambar Deer	*Cervus unicolor*	VU				2	750719	1722436	1,255
Cervidae	Sambar Deer	*Cervus unicolor*	VU				2	750835	1722538	1,262
Cervidae	Sambar Deer	*Cervus unicolor*	VU				2	750719	1722436	1,233
Cervidae	Sambar Deer	*Cervus unicolor*	VU				2	750835	1722538	1,242
Cervidae	Sambar Deer	*Cervus unicolor*	VU				3	734364	1713062	1,242
Cervidae	Sambar Deer	*Cervus unicolor*	VU				4	729375	1710315	1,276
Cervidae	Sambar Deer	*Cervus unicolor*	VU				4	729543	1710458	1,276
Cervidae	Sambar Deer	*Cervus unicolor*	VU				4	729726	1710575	1,300
Cervidae	Sambar Deer	*Cervus unicolor*	VU				4	729799	1711609	1,314
Cervidae	Sambar Deer	*Cervus unicolor*	VU				4	729630	1710450	1,272
Cervidae	Sambar Deer	*Cervus unicolor*	VU				5	721483	1713559	1,285
Cervidae	Sambar Deer	*Cervus unicolor*	VU				5	721503	1713582	1,297
Mustelidae	Smooth-coated Otter	*Lutrogale perspicillata*	VU				3	732896	1709422	1,341
Mustelidae	Great Hog Badger	*Arctonyx collaris*	VU				5	721472	1713389	1,324
Cercopithecidae	Northern Pig-tailed Macaque	*Macaca leonina*	VU				5	721848	1711560	1,219
Cercopithecidae	Northern Pig-tailed Macaque	*Macaca leonina*	VU				5	721848	1711560	1,219
Viverridae	Owston's Civet	*Chrotogale owstoni*	EN				3	733458	1711473	1,517

Herps: Coordinates of first and second records, Globally Threatened and New Species Candidates

Group and Family	Species	GT	Endemism Species: First Reccord	Endemism Species: Second Reccord	Endemism Species: New SP Candidate	Survey block	Coordinates: N	Coordinates: E	Alt (m a.s.l)
LIZARDS									
Anguidae	Dopasia sokolovi			x		4	15.470230	107.182620	1322
Agamidae	Acanthosaura prasina		x			4	15.469810	107.175920	1520
Scincidae	Pseudocalotes ziegleri			x		3	15.478276	107.154488	1440
Scincidae	Plestiodon quadrilineatus		x			1	15.535272	107.338804	1080
Elaphidae	Bungarus slowinskii	VU				2	15.555660	107.358260	1080
AMPHIBIANS – FROGS									
Ranidae	Amolops spinapectoralis		x			3	15.502398	107.368455	1170
Dicroglossidae	Quasipaa sp.				x		15.478276	107.154488	1440
Dicroglossidae	Limnonectes poilani		x				15.539671	107.353805	1065
Megophryidae	Leptobrachella firthi		x			1	15.544283	107.352045	1080
Megophryidae	Xenophrys cf maosonensis				x	2	15.544283	107.352045	1090
Rhacophoridae	Rhacophorus sp nov				x	2	15.459712	107.285291	1185
Rhacophoridae	Theloderma truongsonensis		x			4	15.478276	107.154488	1455
Rhacophoridae	Kurixalus cf gryllus	VU				4	15.478428	107.152935	1450

Annex 7. Some pictures of wildlife from camera trapping

Cam 1_SB1: Annamite Muntjac

Cam 1_SB1: Small-toothed Ferret Badger

Cam 1_SB1: Silvered Pheasant (female)

Cam 1_SB1: Masked Palm Civet

Cam 2_SB1: East Asian Porcupine

Cam 2_SB1: Annamite Muntjac

Cam 3_SB1: Silvered Pheasant (female)

Cam 3_SB1: Berdmore's berylmys Rat

Cam 5_SB1: Wild Pig

Cam 1_SB2: Wild Pig (?)

Cam 2_SB2: Red Muntjac

Cam 2_SB2: Masked Palm Civet

Cam 2_SB2: Wild Pig (?)

Cam 2_SB2: Annamite Muntjac

Cam 2_SB2: Red Muntjac

Cam 2_SB2: Annamite Muntjac

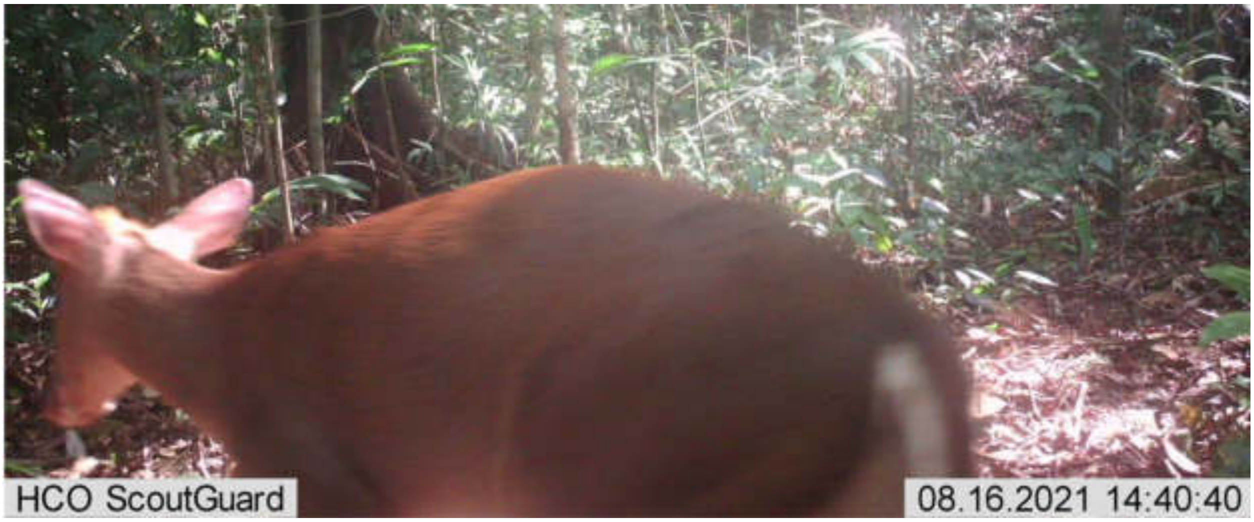
Cam 2_SB2: Large Indian Civet

Cam 2_SB2: Eurasian Wild Pig

Cam 3_SB2: Stump-tailed Macaque (VU)

Cam 3_SB2: Annamite Muntjac

Cam 3_SB2: Black-hood Laughingthrush



Cam 3_SB2: Red Muntjac

Cam 3_SB2: Wild Pig (?)

Cam 3_SB2: Silvered Pheasant (sub-species) – male

Cam 4_SB2: Annamite Muntjac

Cam 4_SB2: Stump-tailed Macaque (VU)

Cam 4_SB2: Wild Pig (?)

Cam 5_SB2: Silvered Pheasant (sub-species) – male

Cam 6_SB2: Wild Pig

Cam 6_SB2: Stump-tailed Macaque (VU)

Cam 2_SB3: Stump-tailed Macaque (VU)

Cam 2_SB3: Annamite Muntjac

Cam 2_SB3: Chinese Serow (VU)

Cam 3_SB3: Crab-eating Mongoose

Cam 3_SB3: Stump-tailed Macaque (VU)

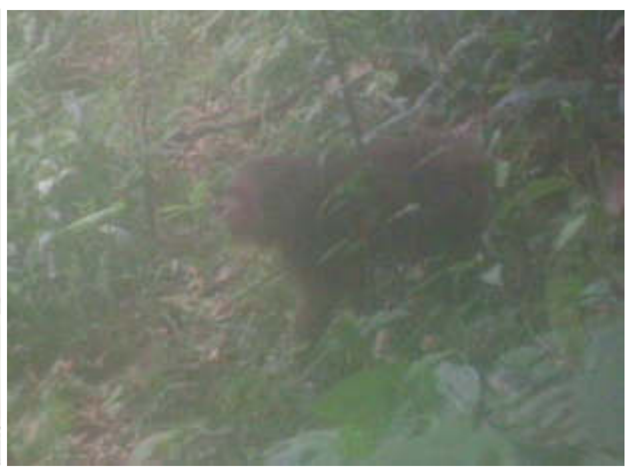
Cam 4_SB3: Chinese Serow (VU)

Cam 5_SB3: Brush-tailed Porcupine

Cam 5_SB3: Silvered Pheasant (male)

Cam 1_SB4: Stump-tailed Macaque (VU) Cam 1_SB4: Crab-eating Mongoose

Cam 1_SB4: Chinese Serow (VU)



Cam 2_SB4: Annamite Muntjac

Cam 2_SB4: Stump-tailed Macaque (VU)

Cam 2_SB4: Red Muntjac

Cam 3_SB4: Annamite Muntjac

Cam 3_SB4: Silvered Pheasant (males and female)

Cam 3_SB4: Red-shanked Douc Langur (CR)


Cam 3_SB4: Red Muntjac


Cam 3_SB4: Stump-tailed Macaque (VU)

Cam 3_SB4: Small Asian Mongoose

Cam 3_SB5: Northern Pig-tailed Macaque (VU)

Cam 4_SB4: Brush-tailed Porcupine

Cam 4_SB4: Annamite Muntjac (female?)

Cam 4_SB4: Stump-tailed Macaque (VU)

Cam 4_SB4: Annamite Muntjac

Cam 4_SB4: Crab-eating Mongoose

Cam 4_SB4: Masked Palm Civet

Cam 5_SB4: Long-tailed Giant Rat

Cam 5_SB4: Chinese Serow (VU)

Cam 5_SB4: Small-toothed Ferret Badger

Cam 5_SB4: Yellow-throated Marten

Cam 5_SB4: Annamite Muntjac

Cam 5_SB4: Eurasian Wild Pig

Cam 6_SB4: Silvered Pheasant (males, sub-species)

Cam 6_SB4: Annamite Muntjac

Cam 1_SB5: Yellow-throated Marten

Cam 1_SB5: Common Treeshrew (?)

Cam 1_SB5: Annamite Muntjac

Cam 1_SB5: Small-toothed Ferret Badger

Cam 1_SB5: Spotted Linsang

Cam 1_SB5: Long-tailed Giant Rat

Cam 1_SB5: Masked Palm Civet

Cam 1_SB4: Pallas’s squirrel

Cam 1_SB5: Variable Squirrel (?)

Cam 2_SB5: Yellow-throated Marten

Cam 2_SB5: Annamite Muntjac (?)

Cam 2_SB5: Northern Pig-tailed Macaque (VU)

Cam 2_SB5: Red Muntjac

Cam 2_SB5: Sambar Deer (VU)

Cam 3_SB5: Black Giant Squirrel

Cam 3_SB5: Annamite Muntjac

Cam 3_SB5: Red Muntjac

Cam 3_SB5: Red Junglefowl

Cam 4_SB5: Annamite Muntjac

Cam 4_SB4: Stump-tailed Macaque (VU)


Cam 5_SB5: Wild Pig


Cam 6_SB5: Great Hog Badger (VU)


Cam 5_SB5: Annamite Muntjac


Cam 5_SB3: Annamite Muntjac


Cam 5_SB3: Crab-eating Mongoose

Cam 6_SB3: Owston's Civet Badger

Cam 6_SB3: Masked Palm Civet

Cam 6_SB3: Small-toothed Ferret

Cam 7_SB3: Annamite Muntjac

Annex 8. Some other incidental records

Fish

Fish: a total of 9 fish species were found by opportunistic in small upstream of SB1 and SB2 with some photographs, but did not listed for this report. Most interesting was the record of important endemic genus which is usually found only in upstream at high elevation such such as the Genus of *Schistura, Annamia, Vamanenia* and *Poropuntius* (see below).

A. *Annamia* sp., **B.** *Vamanenia* sp., **C.** *Schistura sp.*
D. *Channa limbata*

Bird

The bird survey was conducted by the bird team separately from this assignment; however, a total of over 130 bird species were recorded by opportunistic encounters with some photographs during the surveys especially from the dry season as more winter birds visiting the area. Most interesting was the record of Crested Argus *Rheinardia ocellata* (EN) which was detected from its morning song was heard in the block 1 on July 13 and 14, 2021. This bird was present along the border area with Vietnam. During the dry season this bird gave a call every day in SB1 which were heard from the Base-Camp 1 on the east and north. Often, its calls were heard in evening at at 6pm and morning at 7am from December 6 to 13, 2021. The Annamite Mountain Range of Lao and Vietnam is the habitat of this bird, but it is really rare. As large ground bird is vulnerable to be trapped and was extirpated in many places of the Annamite. It would be present in SB2 as well but we did not observe in early morning and evening since we have no sub-camp in this block. Feathure of Crested Argus was found in Ban Dak Ta-ok, it was hunted with snare in 2021 from the SB1 - Lao-Vietnam border (see below).

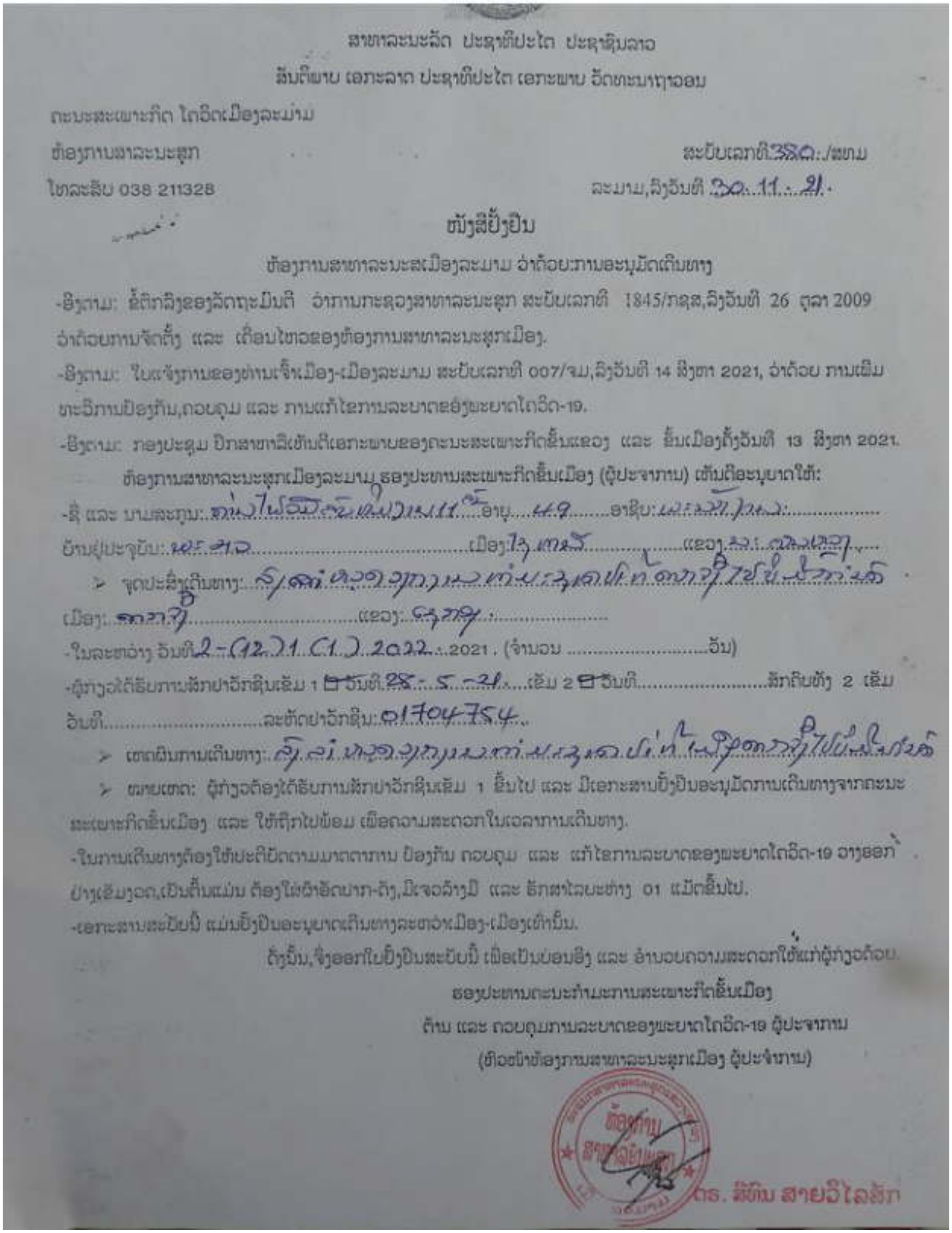
Feather of Crested Argus from Ban Dak Ta-ok noy

Also, feathers of Silvered Pheasant *Lophura nycthemera* and Siamese Fireback *Lophura diardi* and were recorded in SB1 and SB2. Interestingly, several males and females of Silvered Pheasant were caught on camera traps (SB1, SB2, SB3, and SB4). According to the bird photos from the camera traps is a sub-species to Silvered Pheasant. It is rare and first record of Laos.

As well as Wreathed Hornbill *Aceros nipalensis* (VU) as 5 individuals were seen directly in SB1 from flying overhead during the dry season survey on December 8, 2021, just near the Lao-Vietnam border; and Great Hornbill *Buceros bicornis* (VU) as a pair was seen flying overhead in SB2 on December 10, 2021. The Wreathed Hornbill is the first record in the area and not listed in the IBAT for the area. These birds are nationally conservation significance. In addition, other important and endemic birds are Oriential Pied Hornbill *Anthracoceros albirostris*, White-stripped Magpie, Vietnamese Cutia *Cutia legalleni.*

Seasonal variation and distribution of bird species in the survey area is quite different as more species of birds were observed during the dry season since more winder birds visiting the area, and some specific birds were observed such as Wreathed Hornbill (VU) and White-stripped Magpie which were not observed during the wet season survey.

Annex 9. Permission of the survey team



ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ

ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ຄະນະສະເພາະກິດ ໂຄວິດເມືອງລະມາມ

ຫ້ອງການສາທາລະນະສຸກ — ສະບັບເລກທີ 380/ສທມ

ໂທລະສັບ 038 211328 — ລະມາມ,ວັນທີ 30.11.21

ໜັງສືຢັ້ງຢືນ

ຫ້ອງການສາທາລະນະສຸກເມືອງລະມາມ ວ່າດ້ວຍການອະນຸມັດເດີນທາງ

-ອີງຕາມ: ຂໍ້ຕົກລົງຂອງລັດຖະມົນຕີ ວ່າການກະຊວງສາທາລະນະສຸກ ສະບັບເລກທີ 1845/ກຊສ,ລົງວັນທີ 26 ຕຸລາ 2009 ວ່າດ້ວຍການຈັດຕັ້ງ ແລະ ເຄື່ອນໄຫວຂອງຫ້ອງການສາທາລະນະສຸກເມືອງ.

-ອີງຕາມ: ໃບແຈ້ງການຂອງທ່ານເຈົ້າເມືອງ-ເມືອງລະມາມ ສະບັບເລກທີ 007/ຈມ,ລົງວັນທີ 14 ສິງຫາ 2021, ວ່າດ້ວຍ ການເພີ່ມທະວີການປ້ອງກັນ,ຄວບຄຸມ ແລະ ການແກ້ໄຂການລະບາດຂອງພະຍາດໂຄວິດ-19.

-ອີງຕາມ: ກອງປະຊຸມ ປຶກສາຫາລືເຫັນດີເອກະພາບຂອງຄະນະສະເພາະກິດຂັ້ນແຂວງ ແລະ ຂັ້ນເມືອງຄັ້ງວັນທີ 13 ສິງຫາ 2021.

ຫ້ອງການສາທາລະນະສຸກເມືອງລະມາມ ຮອງປະທານສະເພາະກິດຂັ້ນເມືອງ (ຜູ້ປະຈຳການ) ເຫັນດີອະນຸຍາດໃຫ້:

-ຊື່ ແລະ ນາມສະກຸນ: [illegible] ອາຍຸ 49 ອາຊີບ: [illegible]

ບ້ານຢູ່ປະຈຸບັນ: [illegible] ເມືອງ: [illegible] ແຂວງ: [illegible]

> ຈຸດປະສົງເດີນທາງ: [illegible]

ເມືອງ: [illegible] ແຂວງ: [illegible]

-ໃນລະຫວ່າງ ວັນທີ 2-(12) 1 (1) 2022 2021 . (ຈຳນວນ .... ວັນ)

-ຜູ້ກ່ຽວໄດ້ຮັບການສັກຢາວັກຊີນເຂັມ 1 ວັນທີ 28-5-21 ເຂັມ 2 ວັນທີ .... ສັກຄົບທັງ 2 ເຂັມ ວັນທີ .... ລະຫັດຢາວັກຊີນ: 01704754

> ເຫດຜົນການເດີນທາງ: [illegible]

> ໝາຍເຫດ: ຜູ້ກ່ຽວຕ້ອງໄດ້ຮັບການສັກຢາວັກຊີນເຂັມ 1 ຂຶ້ນໄປ ແລະ ມີເອກະສານຢັ້ງຢືນອະນຸມັດການເດີນທາງຈາກຄະນະສະເພາະກິດຂັ້ນເມືອງ ແລະ ໃຫ້ຖືກໄປພ້ອມ ເພື່ອຄວາມສະດວກໃນເວລາການເດີນທາງ.

-ໃນການເດີນທາງຕ້ອງໃຫ້ປະຕິບັດຕາມມາດຕະການ ປ້ອງກັນ ຄວບຄຸມ ແລະ ແກ້ໄຂການລະບາດຂອງພະຍາດໂຄວິດ-19 ວາງອອກ ຢ່າງເຂັ້ມງວດ,ເປັນຕົ້ນແມ່ນ ຕ້ອງໃສ່ຜ້າອັດປາກ-ດັງ,ມີເຈວລ້າງມື ແລະ ຮັກສາໄລຍະຫ່າງ 01 ແມັດຂຶ້ນໄປ.

-ເອກະສານສະບັບນີ້ ແມ່ນຢັ້ງຢືນອະນຸຍາດເດີນທາງລະຫວ່າງເມືອງ-ເມືອງເທົ່ານັ້ນ.

ດັ່ງນັ້ນ,ຈຶ່ງອອກໃບຢັ້ງຢືນສະບັບນີ້ ເພື່ອເປັນບ່ອນອີງ ແລະ ອຳນວຍຄວາມສະດວກໃຫ້ແກ່ຜູ້ກ່ຽວດ້ວຍ.

ຮອງປະທານຄະນະກຳມະການສະເພາະກິດຂັ້ນເມືອງ

ຕ້ານ ແລະ ຄວບຄຸມການລະບາດຂອງພະຍາດໂຄວິດ-19 ຜູ້ປະຈຳການ

(ຫົວໜ້າຫ້ອງການສາທາລະນະສຸກເມືອງ ຜູ້ປະຈຳການ)

ດຣ. ສີທົນ ສາຍວິໄລສັກ

ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ

ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ແຂວງເຊກອງ

ພະແນກກະສິກຳ ແລະ ປ່າໄມ້

ເລກທີ: 2047/ກປຂ.21

ເຊກອງ, ວັນທີ: 30.11.2021

ໃບສະເໜີ

ຮຽນ: ຫົວໜ້າຄະນະສະເພາະກິດ ຄວບຄຸມພະຍາດ COVID-19 ຂັ້ນແຂວງ ທີ່ນັບຖື

ເລື່ອງ: ຂໍສະເໜີທ່ານ ອອກຂໍ້ຕົກລົງແຕ່ງຕັ້ງພະນັກງານລົງເຮັດວຽກຢູ່ພາກສະໜາມທີ່ເມືອງດາກຈຶງ ແຂວງ ເຊກອງ

- ອີງຕາມ: ຄຳສັ່ງແນະນຳ ສະບັບເລກທີ 42/ຈຂ.ຊກ, ລົງວັນທີ 20.8. 2021 ວ່າດ້ວຍສືບຕໍ່ການປ້ອງກັນ ແລະ ຄວບຄຸມຕ້ານ ແລະ ສະກັດກັ້ນການລະບາດຂອງພະຍາດ ໂຄວິດ-19 ທົ່ວແຂວງເຊກອງ.
- ອີງຕາມ: ໜັງສືສະເໜີ ຂອງທີມງານຊ່ຽວຊານ ຈາກມະຫາວິທະຍາໄລແຫ່ງຊາດ ໃນກົງວັນທີ 23 /11/ 2021 ເລື່ອງການລົງສຳຫຼວດຊີວະນາໆພັນຂອງທີມງານ ໃນນາມຊ່ຽວຊານຂອງບໍລິສັດ Impact Energy Asia Developmnt Limited (IEAD) ໃນໂຄງການພະລັງງານລົມ ທີ່ເມືອງດາກຈຶງ, ແຂວງ ເຊກອງ ລະຫວ່າງວັນທີ 28 ພະຈິກ ຫາວັນ ທີ 20 ທັນວາ 2021

ພະແນກກະສິກຳ ແລະ ປ່າໄມ້ແຂວງ ຂໍຖືເປັນກຽດຮຽນສະເໜີມາຍັງ ຄະນະສະເພາະກິດຂັ້ນແຂວງ ເພື່ອຄົ້ນຄວ້າ ແລະ ພິຈາລະນາອະນຸມັດ ໃຫ້ຄະນະທີມງານຊ່ຽວຊານ ໃນການລົງສຳຫຼວດຊີວະນາໆພັນ ໃນນາມຊ່ຽວຊານຂອງບໍລິສັດ Impact Energy Asia Developmnt Limited (IEAD) ໃນໂຄງການພະລັງງານລົມ ທີ່ເມືອງດາກຈຶງ, ແຂວງເຊກອງ ລະຫວ່າງ ວັນທີ 28 ພະຈິກ ຫາ ວັນທີ 20 ທັນວາ 2021 ເຊິ່ງມີລາຍຊື່ດັ່ງລຸ່ມນີ້:

➢ ພາກສ່ວນທີມງານຊ່ຽວຊານຈາກມະຫາວິທະຍາໄລແຫ່ງຊາດ ມີຈຳນວນ 11 ຄົນ :

1. ທ່ານ ປອ ໄພວັນ ເພຍປະລັດ
2. ທ່ານ ປອ ທະນັນ ໂຄດປະທຸມ
3. ທ່ານ ປອ ເພັດລາສີ ສຸລະເດັດ
4. ທ່ານ ປອ ມັດມະນີ ສຸຂະວົງ
5. ທ່ານ ດວງພະຈັນ ສຸວັນໄຊ
6. ທ່ານ ທອງ ວົງພູທອນ
7. ທ່ານ ບົດເຕີ້ ຜູເກວ
8. ທ່ານ ນາທາແນວ ມິວລີ
9. ທ່ານ ສຸນທອນ ພິລາວົງ
10. ທ່ານ ແນບ ທອນພັກດີ
11. ທ່ານ ວິລາສັກ ຈັນທະບົວສອນ

➢ ພາກສ່ວນພະນັກງານວິຊາການຂັ້ນແຂວງ 1 ທ່ານ :

1. ທ່ານ ສົມຈິດ ບຸລະພອນ ຫົວໜ້າໜ່ວຍງານລ້ຽງສັດ,ຂະແໜງລ້ຽງສັດ ແລະ ການປະມົງ

ດັ່ງນັ້ນ ຈຶ່ງຮຽນສະເໜີມາຍັງທ່ານເພື່ອຄົ້ນຄວ້າ ແລະ ພິຈາລະນາຕາມຄວາມສົມຄວນນີ້ດ້ວຍ.

ຫົວໜ້າພະແນກກະສິກຳ ແລະ ປ່າໄມ້

ເລີນສີ ສຸລິຕະ

Annex 10. List of External Experts for Consultations

Name of Expert	Field of expertise	Organization
Dr. Mark Newman	Botany	Royal Botanic Garden Edinburgh, Scotland
Dr. Philip Thomas	Botany	Royal Botanic Garden Edinburgh, Scotland
Dr. Shuichiro Tangane	Botany	Kagoshima University, Japan
Dr. Tetsukazu Yahara	Botany	Kyushu Open University, Japan
Dr. Ngoc Nguyen Van	Botany	Da Lat University, Vietnam
Dr. Somran Suddee	Botany	Forest Herbarium, Thailand
Dr. Chatchai Ngernsaengsaruay	Botany	Kasetsart University, Thailand
Dr. Stuart Lindsay	Botany	Singapore Botanic Garden, Singapore
Dr. Will Duckworth	Wildlife	SCC of IUCN HQ/ Senior Biologist of WCS
Dr. Rob Timmins	Wildlife	Senior Biologist of WCS/Independent Researcher
Dr. Duc Hoang Minh	Wildlife	Southern Institute of Ecology, Ho Chi Minh
Dr. Bryan Stuart	Reptile	North Carolina Museum of Natural Sciences
Dr. Somphouthone Phimmachak	Reptile	National University of Laos, Vientiane

COLLISION RISK MODEL FOR ESTIMATING ANNUAL MORTALITY OF GREY-FACED BUZZARD (BUTASTUR INDICUS)

[Double-click to import picture]

Collision Risk Model for IEAD Monsoon Wind Power Project

Estimating annual mortality of Grey-faced buzzard (*Butastur indicus*)

15th February 2022

Project No.: 0598121

The business of sustainability

Document details	
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Signature Page

15th February 2022

Collision Risk Model for IEAD Monsoon Wind Power Project

Estimating annual mortality of Grey-faced buzzard (*Butastur indicus*)

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Acronyms and Abbreviations

CRH	Collision risk height
CRM	Collision risk model
NatureScot	Scotland's nature agency
PBR	Potential biological removal
RPM	Revolutions per minute
VP	Vantage point
WTG	Wind turbine generator

1. INTRODUCTION

1.1 Purpose and scope

This report follows from the Monsoon Wind Power Project, Sekong and Attapue Provinces, Lao PDR - Collision Risk Approach report and contains the methods and results of Collision Risk Modelling (CRM) and Potential Biological Removal (PBR) calculations, specifically in regards to the Grey-faced buzzard (*Butastur indicus*).

Grey-faced buzzard was chosen as a species of interest for this modelling based on analysis of datasheets and reports from Dr Santi Xayyasith and his bird survey team. During vantage point (VP) surveys it was encountered at 11 VPs of a total 14 and assessed to have been flying at collision risk height (CRH) for a total of 2190 seconds at 8 VPs within areas of proposed wind turbine generator (WTG) arrays.

To assess the potential impact of the Monsoon Wind Power Project on the Grey-faced buzzard population, collision risk modelling to estimate annual mortality as a result of the project was undertaken following the Band onshore model outlined in the Wind farm impacts on birds - Calculating a theoretical collision risk assuming no avoiding action guidance note (NatureScot, 2000) and a potential biological removal calculation originally developed for marine mammals (Wade, 1998) and since adopted for estimating sustainable levels of bird mortality (Dillingham and Fletcher, 2008) was undertaken.

Estimated annual mortality was calculated at each of the 6 individual turbine arrays and aggregated to give a total overall estimated annual mortality for the project.

2. METHODOLOGY AND DATA

2.1 Excel spreadsheet calculations

All calculations were made on an excel spreadsheet and rounded to either 1, 2 or 3 decimal places in this report. As such text in figures may not exactly equate to the detailed spreadsheet numbers, due to rounding.

2.2 Collision Risk Model

To estimate annual mortality, the collision risk model uses the Band two stage calculation. The calculation first assesses the probability of a bird being hit whilst flying through the rotors, and then secondly applies this probability to the annual number of birds transiting the rotors within a windfarm array. Data used in the model includes bird morphological measurements and physical turbine parameters. Where this data is unknown or in a range, in order to provide a conservative estimate, the ‘worst case’ numbers are chosen or a reasonable assumption based on similar data is made.

2.2.1 Bird Data

Grey-faced buzzard are a migratory species and they are assumed to have presence for 5 months of the year between November to March, based on Vantage Point data, a total of 151 days. Available daylight hours during the months the grey-faced buzzard is present within the project site averaged 11.55 per day (Timeanddate.com, 2022). As a diurnal species roosting at night this value was used in the model as the hours per day birds were present and flying. Physically grey-faced buzzards are 41-48cm long with a wingspan of 101-110cm (Ferguson-Lees & Christie, 2001), to obtain ‘worst case’ results 48cm and 110cm were the values used within the model. Very little is known about their flight speed and there is no data available. The 12.5m/s flight speed data of the Harris Hawk (*Parabuteo* *unicinctus*) is used within the model as a proxy (AZ Animals, 2022), this choice is due to similarity of physical size and behaviour of both species. Within the model there is an option to select flapping or gliding flight type, flapping was chosen as a ‘worst case’ and due to observed behaviour of raptors interacting/avoiding wind turbines. Grey-faced buzzard avoidance rates with wind turbines are unknown, NatureScot guidance shows raptor avoidance between 95-99% depending on species, as such 95% avoidance rate was chosen as a worst case and applied to the overall estimated annual mortality. These parameters as used in the model are shown in table 1.

Data from Dr Santi Xayyasith’s VP datasheets is summarised in table 2 and locations in figure 1. Data from VPs 9 and 10 are not used within the model as these VPs are within an area for a High Voltage cable with no turbines and therefore no turbine collision risk. The single below collision risk height flight recorded from VP 14 in June is likely to be either a species mis-identification or an aberrant record of a wandering none (or failed) breeder. As a consequence of this and the flight being below collision risk height it has been excluded from analysis. The remaining VP data was separated according to the relevant array and was used to calculate risk for each individual array where grey-faced buzzard was recorded.

Table 1: Bird data used within CRM

Bird Data	Value
Length (metres)	0.48
Wingspan (metres)	1.1
Flight speed (metres/sec)	12.5*
Days per year bird present (days)	151
Hours per day bird present (hours)	11.55
Avoidance rate (%)	95%

**Proxy value from Harris Hawk*

Table 2: VP Survey Data for Each Array

VP	Array	Total Time Surveyed (hours)	Area Visible from VP (hectare)	Hectare hours (time x area)	Total Flight time observed (seconds)	Flight time observed 0-30m (seconds)	Flight time observed 30-150m (seconds)	Flight time observed >150m (seconds)	Data used in CRM calculations (Yes/No)
1	East Central Array	120	628.5	75420	0	0	0	0	Yes
2	East Central Array	120	628.5	75420	484	0	330	135	Yes
3	East Central Array	120	628.5	75420	90	60	30	0	Yes
4	East Central Array	120	628.5	75420	330	135	195	0	Yes
5	South West Array	120	628.5	75420	390	0	345	45	Yes
6	Ban Dakdonna Array	120	628.5	75420	390	195	195	0	Yes

7	South West Array	120	628.5	75420	150	105	45	0	Yes
8	South West Array	120	628.5	75420	0	0	0	0	Yes
9	HV Line	120	628.5	75420	720	45	615	60	No
10	HV Line	120	628.5	75420	300	0	0	300	No
11	Ban Dakdonna Array	120	628.5	75420	0	0	0	0	Yes
12	Dak Cheung village Array	108	628.5	67878	360	105	255	0	Yes
13	North West Array	108	628.5	67878	585	405	180	0	Yes
14	Southernmost Array	108	628.5	67878	30	30	0	0	No

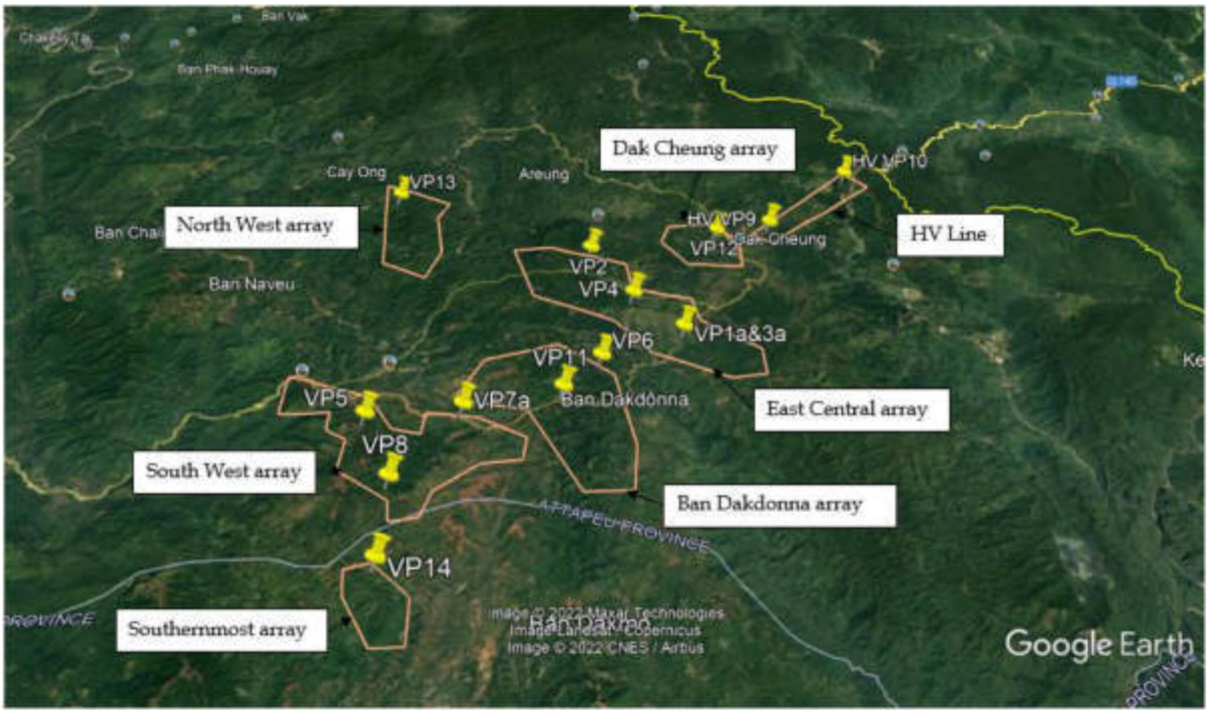

Figure 1: Locations of the arrays and VPs

2.2.2 Turbine and Array Data

Designs for the project show 155 total turbines split between 6 arrays, the largest array has 44 turbines and the smallest array has 7 turbines. A 500m buffer was created around each turbine in each array in order to calculate total array area as shown in table 3. There are two different turbine designs within the project and parameters used within the model for these turbines were taken from the technical specifications for the GW165-4.0MW and GW155-4.5MW (see table 4). Both turbine designs have 95% availability (aka proportion of time running), 110m hub height above ground level, and despite being variable pitch by design for the purposes of the CRM they were both assumed to operate at 10 degrees' blade pitch. A collision risk height correction factor was calculated for both turbines to scale up collected survey data from a survey assumed 30m to 150m collision risk height to fit the design collision risk height (27.5m to 192.5m for the GW165-4.0MW and 32.5m to 187.5m for the GW155-4.5MW). The correction factor is calculated by taking the actual size of the turbine collision risk zone (165m for the GW165-4.0MW and 155m for the GW155-4.5MW) and dividing it by the size of the VP survey assumed collision risk zone (120m).

Table 3: Turbine array data used within CRM

Array	Number of GW165 – 4.0MW	Number of GW155 – 4.5MW	Number of Total Turbines	Array area (Hectares)
Ban Dakdonna Array	34	3	37	1889.72
Dak Cheung village Array	7	0	7	394.15
East Central Array	34	10	44	2108.36
North West Array	17	0	17	782.00
South West Array	34	7	41	2195.21
Southernmost Array	9	0	9	409.99
Total	135	20	155	7779.44

Table 4: Turbine technical specifications used within CRM

Parameter	GW165 – 4.0MW	GW155 – 4.5MW
Total number used in project	135	20
Rotor diameter (metres)	165	155
Rotor blades	3	3
Hub height (metres)	110	110
Minimum tip height above ground level (metres)	27.5	32.5
Maximum tip height above ground level (metres)	192.5	187.5
Maximum blade width (metres)	2.8	4.8
Blade pitch (degrees)	10*	10*
Maximum rated RPM	10.5	9.5
Availability (%)	95%	95%
Collision risk height correction factor**	1.375	1.292

**Assumed value for CRM, turbine specifications show variable pitch*

***VP survey data was collected assuming a collision risk zone between 30m to 150m, this correction factor scales the data up to match actual turbine parameters*

2.2.3 Collision Calculations

2.2.3.1 First Stage – Risk of Collision

The first stage of the CRM calculation uses NatureScot's 'Calculation of collision risk for bird passing through rotor area' spreadsheet (NatureScot, 2000). Inputting turbine and bird parameters yields an upwind, downwind and average collision risk.

Bird length was set as 0.48m and wingspan as 1.1m, with 12.5m/sec flight speed with flapping set as the flight type.

Table 5 shows the parameters used for each turbine design during this first stage of the calculation and the results. Rotation period is defined as time taken for a single rotation and was calculated using turbine maximum rated RPM.

For the GW165-4.0MW turbine average Collision Risk was to 4.02% after 95% wind turbine availability was applied.

For the GW155-4.5MW turbine average Collision Risk was to 5.43% after 95% wind turbine availability was applied.

Table 5: Risk of Collision of a Grey-faced buzzard with a turbine

Parameter	GW165 – 4.0MW	GW155 – 4.5MW
Collision risk factoring in turbine availability (%)	4.02	5.43
Collision risk (%)	4.23	5.72
Number of blades	3	3
Maximum width of blade (m)	2.8	4.8
Pitch (degrees)	10	10
Bird length (m)	0.48	0.48
Bird wingspan (m)	1.1	1.1
Flapping (0) or gliding (1)	Flapping (0)	Flapping (0)
Bird speed (m/sec)	12.5	12.5
Rotor diameter (m)	165	155
Rotation period (sec)	5.71	6.32

2.2.3.2 Second Stage – Number of transits through rotors

To inform the second stage of the modelling the following calculations were made for each set of turbines at each individual array:

Flight risk volume

This is defined as the flight risk volume is equal to the maximum height of the rotor (m) multiplied by the area of the array (ha) multiplied by 10,000.

The maximum height of the rotor is taken from the technical specifications as in table 4. The area of the array was the total area of the array divided by the total number of turbines of both types, multiplied by number of the type being calculated as in table 3 (example below). 10,000 is used to convert hectares to metres so the result of the calculation is expressed as metres^3.

- For example, GW165-4.0MW at Ban Dakdonna array
  - Maximum height: 187.5m
  - Area of the array: 1889.72ha ÷ 37 total turbines × 34 GW165-4.0MW turbines = 1736.5ha
  - Flight risk volume: 3342764749m^3 = 187.5m × (1736.5ha × 10000)

Combined rotor swept volume

The swept volume is equal to the number of wind turbines multiplied πR^2 multiplied by the maximum width of the rotor added to the length of the bird.

The number of the type of wind turbine being calculated in each array is seen in table 3. The radius of each turbine is half the rotor diameter seen in table 4. The maximum width of the blade is seen in table 4 also and the length of the bird is seen in table 1.

- For example, GW165-4.0MW at Ban Dakdonna array
  - Number of GW165-4.0MW turbines in array: 34
  - Radius: 165m ÷ 2 = 82.5m
  - Maximum width of the blade added to length of the bird: 2.8m + 0.48m = 3.28m
  - Combined rotor swept volume: 2384572.497m^3 = 34 × $\pi 82.5^2$ × 3.28

Bird occupancy

Bird occupancy is equal to the number of birds within the array at risk height multiplied by time spent flying in flight risk volume within 1 year.

To calculate the number of birds within the array at risk height from the VP survey data, the total time flight at risk height in hours is divided by the total hectare hours and the result is then multiplied by the total array area in hectares. This gives activity at surveyed risk height across the site. Activity at risk height is then multiplied by collision risk height correction factor for the turbines being calculated (as explained in section 2.2.2 and seen in table 4), giving an adjusted activity at risk height. Adjusted activity at risk height is then multiplied by hours per day that the bird is present on site and days per year the bird is present on site (see table 1) to give bird occupancy.

- For example (see table 6), GW165-4.0MW at Ban Dakdonna array
  - Surveyed activity at risk height: (0.054hours ÷ 150840hectare-hours) × 1889.72hectares = 0.000678599 per hour
  - Adjusted activity at risk height: 0.000678599 × 1.375 = 0.000933074
  - Bird occupancy: 1.627hrs/yr = 0.000933074 × 11.55 × 151

Table 6: Example calculation of bird occupancy at Ban Dakdonna array

VP	Array	Total Time Surveyed (hours)	Area Visible from VP (hectare)	Hectare hours (time x area)	Flight time observed 30-150m (hours)
6	Ban Dakdonna Array	120	628.5	75420	0.054
11	Ban Dakdonna Array	120	628.5	75420	0

Total	**Total**	240	1257	150840	0.054

Bird occupancy of rotor swept volume

The bird occupancy of rotor swept volume is bird occupancy multiplied by combined rotor swept volume divided by flight risk volume.

Bird occupancy, combined rotor swept volume and flight risk volume have all previously been calculated, there is a multiplication of 3600 to convert the result from hours to seconds.

- For example, GW165-4.0MW at Ban Dakdonna array
  - Bird occupancy of rotor swept volume: 4.179 = 1.627hrs/yr × (2384572.497m^3 ÷ 3342764749m^3) × 3600

Bird transit time through rotor

Bird transit time taken is the seconds it takes for a bird to pass through the length of the max rotor width plus bird length.

Using maximum blade width (see table 4), bird length and bird speed (see table 5), it is calculated by adding bird length to blade width and dividing by bird speed.

- For example, GW165-4.0MW at Ban Dakdonna array
  - Bird transit time through rotor: 0.2624sec = (2.8m + 0.48m) ÷ 12.5 m/sec

Number of transits through rotors

The number of transits through the rotors is the number of bird expected to fly through the rotors in a year. It is calculated by taking the bird occupancy of the swept rotor volume and dividing it by the bird transit time.

- For example, GW165-4.0MW at Ban Dakdonna array
  - Number of transits through rotors: 15.926 = 4.179 ÷ 0.2624

2.2.3.3 Estimated annual number of collisions assuming no avoidance

Once the above stage one and two calculations are concluded to calculate collision risk with no avoidance the number of transits through rotors in a year is multiplied by the risk of collision factoring in turbine availability (see section 2.2.3.1 and table 5). For the purposes of the model it is assumed all collisions are fatal.

- For example, GW165-4.0MW at Ban Dakdonna array
  - Annual estimated collision risk with no avoidance: 0.64 = 15.926 × 4.02%

This value is then added to the value obtained for the other turbine design in that array, and summed for all arrays to give an overall estimated annual number of collisions assuming no avoidance. Avoidance rates as deemed suitable can be applied to this number to get an estimated annual mortality, for this CRM 95% has been chosen as a worst case for raptor avoidance.

2.3 Potential Biological Removal

To calculated PBR the Dillingham and Fletcher (2008) calculation was used.

$$PBR = N_{min} \times \frac{R_{max}}{2} \times F_R$$

$$N_{min} = \tilde{N}e^{(Z_p CV_{\tilde{N}})}$$

$$R_{max} = \lambda_{max} - 1$$

$$\lambda_{max} = \frac{(s\alpha - s + \alpha + 1) + \sqrt{(s - s\alpha - \alpha - 1)^2 - 4s\alpha^2}}{2\alpha}$$

This calculation requires input of:

- Estimated population size (individuals) - Ñ
- Recovery factor (0.1-1, where appropriate values may be: 1.0 for 'least concern' species population increasing or stable. 0.5 for 'least concern' species population decreasing. 0.3 for 'near threatened', and 0.1 for all threatened species) - F_r
- Adult survival (0.1-1) - s
- Age at first reproduction (years) - α
- Z_p was set at -0.842 and CV_N was set at 10% following Dillingham and Fletcher (2008) guidance.

For this assessment of Grey-faced buzzard the following values were used for estimated population. 100,000 individuals as estimated (Ferguson-Lees & Christie, 2001), 50,000 individuals as an assumed new potential number due to population decline, and a worst case scenario of 10,000 individuals at which threshold status on the IUCN Red List may change from Least Concern to Near Threatened. These population numbers were selected as little is known about the true Grey-faced buzzard total population size. The population is generally thought to be decreasing in size due to habitat degradation and loss among other threats (BirdLife International, 2022).

Recovery factor was set as 0.5 for the 100,000 and 50,000 populations, and at 0.3 for the 10,000 as a worst case.

Age at first reproduction was assumed to be 3 years as a worst case, based on a generation length of 5.05 years (BirdLife International, 2022), this also matches with the proxy species of Common Buzzard (*Buteo buteo)*.

Adult survival was unknown, for the purposes of the calculation Common Buzzard was chosen as a proxy species with an adult survival of 0.9 (BTO BirdFacts, 2022).

3. RESULTS

3.1 Estimated Annual Mortality of Grey-faced buzzard

Following all the calculations detailed in section 2.2.3 based on parameters and data contained in section 2.2 yields the results shown in table 7. To enable other avoidance rates to be applied table 8 contains estimated annual mortality with 0% avoidance.

The overall estimated annual mortality with 95% avoidance of Grey-faced buzzard for the Monsoon Wind Power Project is 0.335 birds per year. Another way to express this is 1 expected Grey-faced buzzard mortality every 3 years. The lowest mortality is expected in the Southernmost array with 0 as during the VP surveys no Grey-faced buzzard were recorded at risk height in this area. The highest mortality is expected in the East Central Array with 0.116, likely due to it having the highest number of turbines of all the arrays.

After factoring in turbine parameters and total percentage on time, the GW155-4.5MW turbine has a slightly higher risk of collision at 5.43% than the GW165-4.0MW with 4.02% (shown in table 9), this is likely due to wider maximum width of blade at 4.8m for the GW155-4.5MW compared to the 2.8m of the GW165-4.0MW turbine.

Within arrays with both turbines there is slightly more expected annual mortality assigned to the GW155-4.5MW than the GW165-4.0MW, due to the wider maximum blade having a larger percentage risk of collision. Overall the GW165-4.0MW has more estimated annual mortality, this is likely due to there being 135 of these turbines compared to only 20 of the GW155-4.5MW.

Table 7: Estimated Annual Mortality – 95% Avoidance

Array	Total Estimated Annual Mortality 95% Avoidance	Estimated Annual Mortality 95% Avoidance GW165 – 4.0MW	Estimated Annual Mortality 95% Avoidance GW155 – 4.5MW
Ban Dakdonna Array	0.069	0.032	0.037
Dak Cheung village Array	0.018	0.018	-
East Central Array	0.116	0.054	0.062
North West Array	0.030	0.030	-
South West Array	0.102	0.047	0.054
Southernmost Array	0.000	0.000	0.000
Total	**0.335**	**0.181**	**0.154**

Table 8: Estimated Annual Mortality – 0% Avoidance

Array	Total Estimated Annual Mortality 0% Avoidance	Estimated Annual Mortality 0% Avoidance GW165 – 4.0MW	Estimated Annual Mortality 0% Avoidance GW155 – 4.5MW
Ban Dakdonna Array	1.376	0.640	0.736
Dak Cheung village Array	0.352	0.352	-
East Central Array	2.329	1.0827	1.246
North West Array	0.603	0.603	-
South West Array	2.033	0.945	1.088
Southernmost Array	0	0	0
Total	**6.693**	**3.622**	**3.071**

Table 9: Collision Risk Percentage turbine comparison

Collision Risk %	GW165 – 4.0MW	GW155 – 4.5MW
Collision risk factoring in turbine availability (%)	4.02	5.43
Collision risk (%)	4.23	5.72

3.2 Potential Biological Removal of Grey-faced buzzard

The results of the calculations for PBR are shown in table 10. The worst case 10,000 individual population assumption indicates a maximum removal from the global population of 210 Grey-faced buzzard per annum before significant population effects occur. The middle case 50,000 gives a PBR of 1750 per annum. The 100,000 estimate allows for non-natural mortality of 3499 individuals per annum.

Table 10: Potential Biological Removal for different estimated Grey-face buzzard populations

Population Estimate	100,000 individuals	50,000 individuals	10,000 individuals
λmax	1.152	1.152	1.152
Rmax	0.152	0.152	0.152
Nmin	91924.74	45962.37	9192.47
Recovery factor	0.5	0.5	0.3
PBR	**3499**	**1750**	**210**

4. SUMMARY

4.1 Interpreting Estimated Annual Mortality and Potential Biological Removal of Grey-faced buzzard

The results within section 3.1 and 3.2 can be utilised together to show the overall impact the Monsoon Wind Power Project is likely to have on the global population of Grey-faced buzzard. Table 11 shows percentage of PBR estimated to be caused by this project.

In the worst case scenario of 10,000 individuals the project is likely to cause 0.16% of the total annual global non-natural mortalities that could occur before significant negative impacts on the global population occur.

In the middle case 50,000 individuals the project is likely to cause 0.019% of the total annual global non-natural mortalities that could occur before significant negative impacts on the global population occur.

In the 100,000 individuals estimate the project is likely to cause 0.009% of the total annual global non-natural mortalities that could occur before significant negative impacts on the global population occur.

Table 11: Impacts of Estimated Annual Mortality and Potential Biological Removal

Population Estimate	100,000 individuals	50,000 individuals	10,000 individuals
Annual Estimated Mortality – 95% avoidance	0.335	0.335	0.335
PBR	3499	1750	210
Percentage of PBR used by Monsoon Wind Project	0.009%	0.019%	0.16%

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Monsoon Wind Power Project, Sekong and Attapue Provinces, Lao PDR

Collision Risk Approach

11 January 2022

Project No.: 0598121

The business of sustainability

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Monsoon Wind Power Project, Sekong and Attapue Provinces, Lao PDR

Collision Risk Approach

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1. INTRODUCTION

1.1 Purpose and scope of this report

This report outlines the proposed approach to assessing the collision risk to birds, based on a review of the reports and datasheets received from Dr. Santi Xayyasith and his bird survey team. The report identifies the species recorded, their conservation status, level of flight activity, migratory or resident status and occurrence patterns. On the basis of this information, it provides a view on whether further assessment using collision risk modelling would be required.

The report provides information on the survey work undertaken and the methodological approach to survey and assessment.

2. METHODOLOGY AND DATA

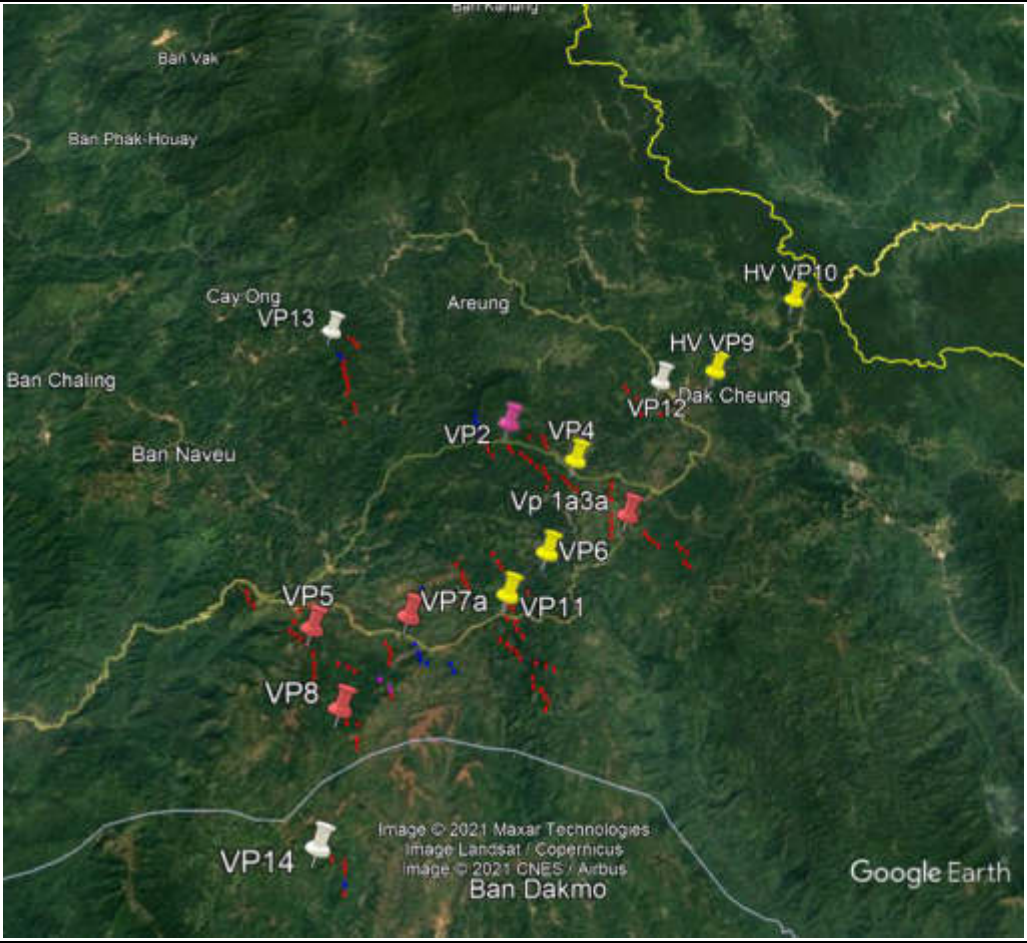
2.1 Vantage Point Surveys

Vantage point (VP) surveys were designed according to good international practice, particularly that produced by NatureScot (formerly Scottish Natural Heritage). Given the large and discontinuous area occupied by the arrays, and uncertainties over specific turbine locations, a sampling rather than complete survey approach was adopted. A total of 14 VP's were selected to provide sampling coverage over the habitats associated with the different array areas, including two VP's dedicated to monitoring the flight activity associated with the proposed high voltage (HV) transmission line at the Lao border (VP's 9 and 10).

Table 2.1 Vantage Point relationship to arrays

Location	Vantage Points
East Central Arrays	1a, 3a, 2, 4
South East Array	5, 7a, 8
Ban Dakdonna Array	6, 11
Dak Cheung village Array	12
North West Array	13
Southernmost array	14
HV transmission line	9 & 10

Figure 2.1 Vantage Point and Array Locations



Vantage point surveys were planned to have 12 hours survey per VP per month from December 2020 to November 2021 inclusive. Despite the challenges of the terrain, remoteness of location, weather and COVID-19 outbreaks, the survey team completed all the visits to all VP's in every month except April and May, when COVID-19 lockdown restrictions prevented surveys. Total survey time at all VP's was 120 hours, with the exception of VP's 12, 13, and 14 which were added a month after surveys started in response to layout changes, and where survey time was 108 hours.

2.1.1 Species Identified

A total of 24 species (excluding three flights to two unspecified species) were recorded. ***Table 2.2*** lists these in alphabetical order. Of the species recorded, all were raptors, with the exception of two heron species (Chinese Pond Heron and Cinnamon Bittern), a wader (Red-wattled Lapwing) and Greater Hornbill.

All but three of the species recorded were IUCN Least Concern (LC), with two Near Threatened (NT) and one Vulnerable (VU) species recorded.

The majority of species were resident (13), although 11 species were migrants. These proved to be broad front migrants, and there are no Important Bird Areas designated for congregatory or migratory species identified within 50km of the project boundary.

Table 2.2 Species recorded during VP surveys

Species common name	Scientific name	IUCN red list status	Resident/Migratory
Besra	*Accipter virgatus*	LC	Altitudinal migrant
Black baza	*Aviceda leuphotes*	LC	Migrant
Black eagle	*Ictinaetus malaiensis*	LC	Resident
Black-winged kite	*Elanus caeruleus*	LC	Resident
Changeable hawk-eagle	*Nisaetus cirrhatus*	LC	Resident
Chinese pond heron	*Aredola bacchus*	LC	Migrant
Cinnamon bittern	*Ixobrychus cinnamomeus*	LC	Migrant
Crested goshawk	*Accipiter trivirgatus*	LC	Resident
Crested serpent eagle	*Spilornis cheela*	LC	Resident
Eastern buzzard	*Buteo japonicas*	LC	Migrant
Eurasian kestrel	*Falco tinnunculus*	LC	Migrant
Eurasian Sparrowhawk	*Accipiter nisus*	LC	Migrant
Great Hornbill	*Buceros bicornis*	VU	Resident
Grey-faced Buzzard	*Butastur indicus*	LC	Migrant
Japanese Sparrowhawk	*Accipiter gularis*	LC	Migrant
Jerdon's Baza	*Aviceda jerdoni*	LC	Resident
Mountain Hawk-Eagle	*Nisaetus nipalensis*	NT	Resident
Northern Goshawk	*Accipiter gentilis*	LC	Migrant
Oriental Hobby	*Falco severus*	LC	Resident
Oriental Honey Buzzard	*Pernis ptilorhynchus*	LC	Resident
Osprey	*Pandion haliaetus*	LC	Migrant
Red-wattled Lapwing	*Vanellus indicus*	LC	Resident
Rufous-bellied Eagle	*Lophotriorchis kienerii*	NT	Resident
Shikra	*Accipiter badius*	LC	Resident

2.1.2 Approach to high value species

Three species with higher IUCN conservation status were identified during the VP surveys. These were the Great Hornbill (VU), the Mountain Hawk-eagle (NT), and the Rufous-bellied Eagle (NT).

The Great Hornbill was observed once from VP10, an area where the high voltage transmission line to Vietnam will be constructed. A total of 15 seconds at collision risk height was recorded. The species is largely sedentary, favouring unlogged evergreen and mixed deciduous woodland. A collision risk model would conclude, on the basis of the observed activity, that no collision would occur. It's presence in an area where HV transmission lines are proposed would indicate a need for additional mitigation, such as flight diverters, to be considered.

Mountain Hawk-eagle was observed for three flights from VP4 and one flight at VP2, both VP's related to the East Central Arrays. Of these four flights, only that at VP2 had flight activity at collision risk height, with a total of 120 seconds recorded. The collision risk modelling would identify the total aerial density based on the coverage of the four VP's sampling the East Central Arrays, divided by the total survey time. This would give an aerial occupancy rate of 4.41925E-07 (i.e. 0.00000041925). Previous experience of collision risk modelling indicates this level of aerial occupancy would not trigger a meaningful collision risk within the lifetime of the wind farm.

Rufous-bellied eagle was also recorded once at VP4 and once at VP2. Of these two flights 30 seconds was spent at collision risk height at VP2, and none at VP4. Likely collision risk is therefore, as with mountain hawk-eagle, likely to be statistically insignificant.

2.2 Approach to least concern species

All other species recorded were least concern. Table 2.3 indicates the total flight time, at all heights, recorded between December 2020 and November 2021 inclusive. The proportion of flights at collision risk height is much smaller.

Table 2.3 Total all flight time in seconds

Species common name	Altitudinal migrant	Migrant	Resident	Time at CRH
Besra	415			270
Black Baza		120		30
Black Eagle			8262	3450
Black-winged kite			600	300
Changeable Hawk-eagle			72	0
Chinese Pond Heron		90		0
Cinamon Bittern		120		0
Crested Goshawk			1506	465
Crested Serpent Eagle			5105	975
Eastern Buzzard		120		120
Eurasian Kestrel		610		90
Eurasian Sparrowhawk		150		15
Great Hornbill (VU)			135	15
Grey-faced Buzzard		3829		2190
Japanese Sparrowhawk		90		45
Jerdon's Baza			915	450
Mountain Hawk-Eagle (NT)			300	120
Northern Goshawk		82		45
Oriental Hobby			924	375
Oriental Honey Buzzard			2310	1110
Osprey		600		375
Red-wattled Lapwing			30	0
Rufous-bellied Eagle (NT)			180	60
Shikra			1288	180

Of the LC species, no flights at collision risk height were recorded for Chinese Pond Heron, Cinnamon Bittern, Changeable Hawk-eagle, and Red-wattled Lapwing. These have therefore been ruled out from further assessment.

Most migrant species spent less than 375 seconds at collision risk height, and this would not generate sufficient time at collision risk height to have a statistical probability of a collision within the lifetime of the wind farm. Grey-faced Buzzard which was commonly encountered at ten of the fourteen VP's from November through till March, was observed for a total of 2190 seconds at collision risk height. Observation time for the five migration months was 600 hours. Over all the arrays that it occurs, the likelihood of collision is still small, as the total density is likely to be less than 0.0000612 hectare/hours. The statistical probability of a collision is therefore likely to be very low. The population is not known, but is assumed to exceed 100,000 individuals (Birdlife International 2021), and it has a large area of occupancy. It is therefore highly unlikely that the wind farm would have any population level effect.

Generally, resident birds, by virtue of being present throughout the year, have a larger number of observations. Most are below a thousand seconds at collision risk height, and therefore unlikely to trigger a likely significant collision risk within the life time of the wind farm, and all are from widespread and common populations. Three species have elevated times at collision risk time, most notably Black Eagle (3450 seconds in 1320 hours of observation), Crested Serpent Eagle (975 seconds in 1416 hours of observation), and Oriental Honey Buzzard (1110 seconds in 960 hours of observation).

Black Eagle is widespread within the wind farm, having been recorded at eleven VP's. Actual aerial occupancy is still relatively low (approximately 0.0000127 hectare/hours), however, over all the arrays there is potential for collisions to result in some local reduction in breeding pairs, but this is unlikely to be significant beyond this local scale, given the wide distribution of the species, and a population believed to be in excess of 10,000 individuals within it's extensive range.

Crested Serpent Eagle is even more widespread, having been observed at twelve VP locations. Activity at collision risk height is lower, and therefore the overall likelihood of collision is lower. Some arrays, most notably the East Central Arrays, have higher levels of activity, and the possibility of local effects cannot be excluded. However it is a widespread and common species over much of its range, with a stable population.

Similarly the Oriental honey buzzard is also widespread, being recorded at ten VP's, and has activity at collision risk height very similar to the Crested Serpent Eagle. Risks to this population are slight, as it has an even bigger global range than the two previous species, and may have a population of 100,000-1,000,000 individuals, although the trend is believed to be declining.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Summary of the Key Findings

Based on a high level of sampling effort over the different geographical arrays within the proposed Monsoon wind farm there is no significant risk to any higher risk species (NT or VU) recorded during the VP surveys.

All migrant species are IUCN LC, and most record levels of flight at collision risk height that are unlikely to result in a collision risk model indicating a risk of collision within the life time of the wind farm. This is primarily due to the low proportion of collision risk flights in comparison to the survey area and hours of observation. The only migrant with relatively high levels of flight at collision risk height is the Grey-faced Buzzard, and as this still amounts to only 2190 seconds over 1188 hours of observation, the risk of collision remains low. This together with the large and widespread population indicates no population level effect is likely.

Resident birds tend to have higher levels of recorded flight activity, but of these, only three came close to activity levels around or greater than 1000 seconds. None of these three species were likely to exceed anything other than local effects, due to the low statistical likelihood of collision, and widespread and common nature of the populations.

3.2 Conclusion

No higher value species (NT, VU) occur at levels likely to trigger collision risk, and aerial occupancy rates are so low that there is little to no value in running a collision risk model.

This is also largely true for LC species, although the possibility of collisions for species such as Black Eagle cannot be ruled out. However any such effects would only ever be significant, if at all, at the local population level and no significant population level effect is anticipated, given the range and population status of the LC species.

There is some evidence of broad front raptor migration, but all species involved are LC, and again the low levels of likely aerial occupancy indicate a collision risk model would be unlikely to indicate sufficient collisions within the lifetime of the wind farm to threaten the status of such populations. No Important Bird Areas for migration are found within 50km of the proposed wind farm and extensive field observations during the important migration months do not indicate the study area is a significant migratory or congregatory area.

No cumulative impact assessment has been performed, however there are no other wind farms in the Lao area and the spatial separation from transboundary wind farms e.g. in Vietnam, would suggest little, if any, likelihood of cumulative effects with other wind farms.

On this basis it is not proposed to undertake further collision risk modelling, although the data to do so is available should it be required.

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