

Draft Environment and Social Impact Assessment

Project Number: 55205-001
29 April 2022

Lao PDR: Monsoon Wind Power Project Part 17: Appendix F (part 3)

Prepared by Impact Energy Asia Development Limited (IEAD) for the Asian Development Bank.

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

Environmental and Social Impact
Assessment

29 April 2022

Project No.: 0598121

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2	2.1	As above	As above	Kamonthip Ma-Oon	29-04-22	Final ESIA Report

APPENDIX F BIODIVERSITY BASELINE SURVEY REPORTS

Annex 1 Summary of key-informant interviews

#	Date	Name	Village	Years in Area	Tel No.	Significant Roosts
1	03/02	Mr. Vongsavanh	Dak Ta Ook Noy	21	020 9344 6180	One, rock crevice, ≈100 bats, outside project area
2	03/02	Mr. Nousak	District authority	7	020 9833 8522	None
3	03/02	Mr. Voonkham	Dak Dom	4	030 9485 852	None
4	06/02	Local farmer	Dak Ta Ook Noy	-	-	None
5	07/02	Mr. Bounyouy Sysouphanh	Dakran	21	-	None
6	12/02	Mr. Sengmaly	Xieng Louang	15	-	None
7	12/02	Mr. Vonemany	Trongmeuang	46	030 4507 160	None
8	14/02	Mr. Bounxang	Trongmeuang	23	-	None
9	25/02	Mr. Sengpha	Dak Chieng A	30	-	None
10	26/02	Mr. Vongkeo	Dak Chieng A	35	030 9887 538	One, rock crevice, ≈100 bats, Houay Vee
11	26/02	Mr. Syphone	Dak Chieng A	27	-	None
12	26/02	Mr. Suonsavanh	Dak Chieng A	29	-	One, rock crevice, ≈100 bats, Houay Vee
13	02/03	Local villager	Dak Chieng A	20	-	None
14	17/03	Local villager	Dak Chieng A	40	030 4528 529	None
15	24/03	Mr. Viengsamone	Trangyeung	22	020 9964 2839	None
16	25/03	Mr. Sengchon	Plao	40	030 9419 834	None
17	14/07	Local villager	Dak Yen	20	-	None
18	14/07	Mr. Cheam	Dak Yen	35	-	None
19	14/07	Local villager	Dak Yen	50	-	None
20	16/07	Mr. Khammina	Dak Yen	49	030 9898 013	None
21	16/07	Mr. Kham Eik	Dak Yen	49	030 9502 092	None
22	21/07	Mr. Vong Son	Xieng Louang	42	-	Dak Kor Cave, with 10,000 bats, 3-4 hrs walk from Dak Nong village, Sanxay District, Attapu Province

Annex 2 Coordinates of sites sampled with live-traps & acoustic devices (SM4s)

Habitats: Ag=Arable agriculture, Ba=Banana grove, Bg=Bamboo grove, Dbf=Disturbed broadleaf evergreen forest, Pa=Pasture, Pbf=Primary broadleaf evergreen forest, Pi=Pine forest, Pl=Plantation. **Bold** font indicates the dominant habitat present.

Survey Zone	Site Code	Sampling Date	Latitude	Longitude	Elevation	Habitats
1.1	LT-01	03/02/2021	15.544430°	107.352090°	1068	Pbf/Bg
	LT-02	04/02/2021	15.543470°	107.348000°	1170	Dbf/Bg/Pi
	LT-03	05/02/2021	15.535080°	107.352120°	977	Dbf
	LT-04	05/02/2021	15.530460°	107.351450°	973	Dbf/Ag
	LT-05	06/02/2021	15.528220°	107.343990°	1127	Dbf/Bg
1.2	LT-06	07/02/2021	15.402300°	107.210960°	1194	Dbf/Ag
	LT-07	08/02/2021	15.388940°	107.224410°	1240	Dbf/Ag
	LT-08	09/02/2021	15.401760°	107.225610°	1328	Dbf/Ba/Pa
	LT-09	10/02/2021	15.405610°	107.219270°	1334	Dbf/Ba/Pa
1.3	LT-10	11/02/2021	15.331880°	107.168460°	1195	Dbf/Pi/Ag
	LT-11	12/02/2021	15.330500°	107.163950°	1215	Dbf/Pdf/Ag
	LT-12	13/02/2021	15.320530°	107.168010°	1226	Dbf/Ag/Pi
	LT-13	14/02/2021	15.320540°	107.167980°	1179	Dbf/Pi
2.1	LT-14	24/02/2021	15.419840°	107.123660°	1289	Dbf
	LT-15	25/02/2021	15.420990°	107.120410°	1307	Dbf/Pi
	LT-16	26/02/2021	15.424840°	107.120150°	1256	Pbf
	LT-17	27/02/2021	15.427420°	107.11940°	1246	Dbf/Pi
	LT-18	28/02/2021	15.436700°	107.117630°	1206	Dbf/Pi
2.2	LT-19	02/03/2021	15.407150°	107.124060°	1176	Dbf
	LT-20	03/03/2021	15.396230°	107.122250°	1180	Pbf/Pi
	LT-21	04/03/2021	15.395430°	107.124820°	1179	Pbf/Pi
	LT-22	05/03/2021	15.400030°	107.125050°	1234	Dbf/Pi
	LT-23	06/03/2021	15.404640°	107.127100°	1214	Dbf/Pi
3.1	LT-24	16/03/2021	15.461700°	107.082100°	1240	Pbf
	LT-25	17/03/2021	15.464010°	107.077600°	1205	Dbf
	LT-26	18/03/2021	15.463290°	107.074470°	1145	Dbf
	LT-27	19/03/2021	15.466280°	107.079330°	1219	Dbf/Pl
	LT-28	20/03/2021	15.468970°	107.075910°	1286	Dbf/Bg
	LT-29	21/03/2021	15.473360°	107.077530°	1335	Pbf/Dbf
	LT-30	22/03/2021	15.477540°	107.073070°	1366	Dbf/Ba/Bg
	LT-31	23/03/2021	15.481690°	107.069520°	1424	Pbf
	LT-32	24/03/2021	15.485490°	107.068850°	1425	Pbf
	LT-33	25/03/2021	15.489150°	107.072460°	1471	Pbf
	LT-34	26/03/2021	15.493310°	107.066790°	1380	Pbf
	LT-35	27/03/2021	15.494320°	107.063990°	1392	Dbf
4.1	LT-36	17/06/2021	15.479660°	107.153680°	1413	Dbf

Survey Zone	Site Code	Sampling Date	Latitude	Longitude	Elevation	Habitats
	LT-37	18/06/2021	15.475060°	107.147430°	1399	Dbf
	LT-38	19/06/2021	15.471040°	107.143890°	1332	Dbf
	LT-39	20/06/2021	15.466940°	107.146690°	1500	Dbf/Bg
	LT-40	21/06/2021	15.468480°	107.143460°	1363	Pbf/Bg
	LT-41	22/06/2021	15.470810°	107.146360°	1236	Dbf
	LT-42	23/06/2021	15.475490°	107.151070°	1526	Pbf
	LT-43	24/06/2021	15.484620°	107.165310°	1361	Pbf
	LT-44	25/06/2021	15.482860°	107.158940°	1338	Pbf
	LT-45	26/06/2021	15.479950°	107.158540°	1415	Pbf
	LT-46	27/06/2021	15.481590°	107.157170°	1352	Pbf
	LT-47	28/06/2021	15.476730°	107.154730°	1449	Pbf
5.1	LT-48	14/07/2021	15.369040°	107.146880°	1233	Dbf/Pl
	LT-49	15/07/2021	15.378010°	107.145200°	1241	Dbf/Pl
	LT-50	16/07/2021	15.347110°	107.147680°	1209	Dbf/Ag
	LT-51	17/07/2021	15.355430°	107.150090°	1243	Dbf/Ag/Pl
	LT-52	18/07/2021	15.360150°	107.147160°	1258	Dbf/Pl
	LT-53	19/07/2021	15.374870°	107.142110°	1202	Dbf/Ag
5.2	LT-54	20/07/2021	15.297760°	107.072620°	1144	Dbf/Pi
	LT-55	21/07/2021	15.295520°	107.083110°	1169	Dbf/Ag
	LT-56	22/07/2021	15.308990°	107.069110°	1156	Pi/Dbf
	LT-57	23/07/2021	15.305780°	107.073400°	1142	Dbf/Pi

Annex 3 Coordinates of additional acoustic sampling sites (AMs +/-or SM4s)

Habitats: Ag=Arable agriculture, Ba=Banana grove, Bg=Bamboo grove, Dbf=Disturbed broadleaf evergreen forest, Pa=Pasture, Pbf=Primary broadleaf evergreen forest, Pi=Pine forest, Pl=Plantation. Bold font indicates the dominant habitat present.

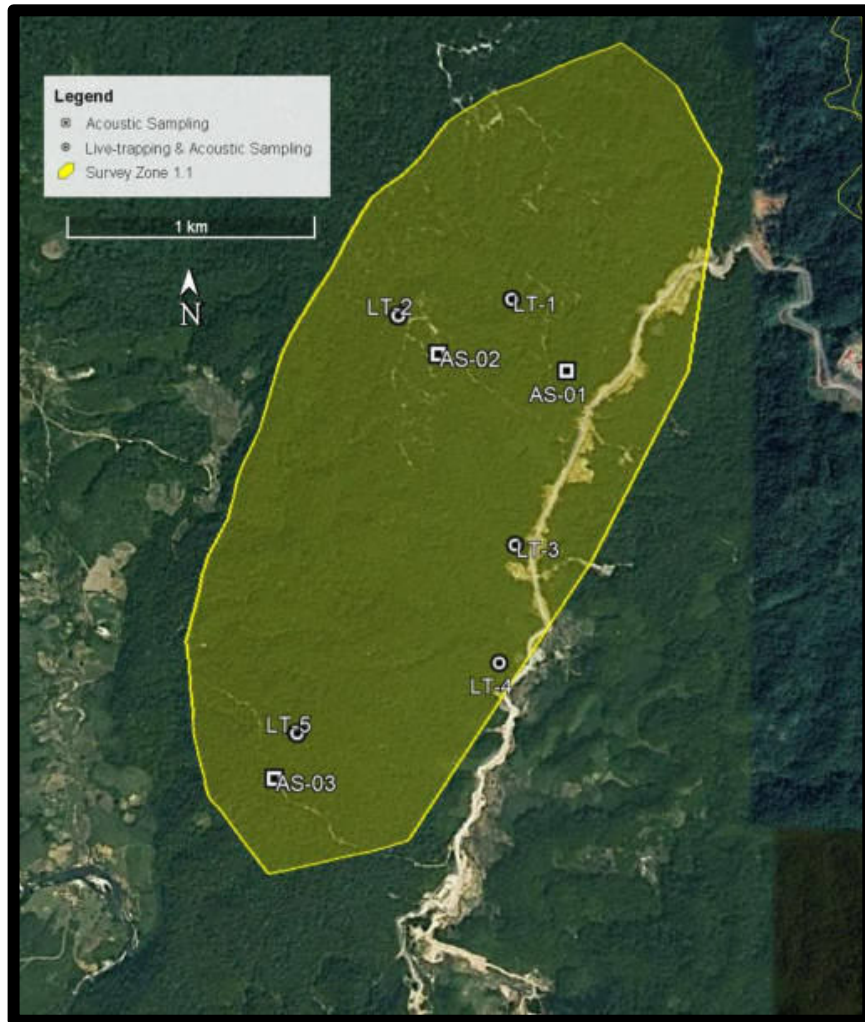
Survey Zone	Site Code	Sampling Start Date	Latitude	Longitude	Elevation	Habitats
1.1	AS-01	03/02/2021	15.541750°	107.354230°	1032	Pbf /Bg
	AS-02	04/02/2021	15.542160°	107.349400°	1105	Dbf /Bg/Pi
	AS-03	06/02/2021	15.526510°	107.343060°	1146	Dbf /Bg
1.2	AS-04	07/02/2021	15.403760°	107.216950°	1254	Dbf /Ag
	AS-05	08/02/2021	15.390700°	107.228460°	1241	Dbf
	AS-06	09/02/2021	15.398760°	107.226010°	1361	Dbf /Pa
	AS-07	10/02/2021	15.407570°	107.216430°	1286	Dbf /Pa
1.3	AS-08	13/02/2021	15.319880°	107.165280°	1194	Dbf /Pi
2.1	AS-09	23/02/2021	15.435300°	107.118930°	1266	Dbf /Pi
	AS-10	23/02/2021	15.432970°	107.117220°	1250	Dbf /Pi
	AS-11	23/02/2021	15.432390°	107.118690°	1300	Dbf /Pi
	AS-12	23/02/2021	15.428850°	107.118790°	1268	Dbf /Pi
	AS-13	23/02/2021	15.426890°	107.120520°	1245	Pbf
	AS-14	23/02/2021	15.422620°	107.116260°	1257	Pbf /Pi
	AS-15	23/02/2021	15.422210°	107.118960°	1280	Pbf /Pi
	AS-16	23/02/2021	15.420580°	107.122430°	1291	Dbf /Ag
	AS-17	23/02/2021	15.417880°	107.120230°	1229	Dbf
	AS-18	23/02/2021	15.417460°	107.123890°	1295	Dbf
	AS-19	23/02/2021	15.418090°	107.121640°	1310	Dbf
	AS-20	23/02/2021	15.418890°	107.122970°	1316	Dbf
	AS-21	24/02/2021	15.418760°	107.124950°	1320	Dbf
	AS-22	25/02/2021	15.421980°	107.121340°	1272	Dbf /Pi
2.2	AS-23	01/03/2021	15.410780°	107.127340°	1200	Dbf
	AS-24	01/03/2021	15.405760°	107.123730°	1232	Dbf /Pi
	AS-25	01/03/2021	15.407200°	107.128300°	1216	Pbf /Pi
	AS-26	01/03/2021	15.403190°	107.12405°	1226	Dbf /Pi
	AS-27	01/03/2021	15.400730°	107.126820°	1221	Pbf
	AS-28	01/03/2021	15.397440°	107.121560°	1188	Pbf /Pi
	AS-29	01/03/2021	15.395110°	107.126890°	1179	Pbf
	AS-30	01/03/2021	15.395320°	107.122420°	1176	Dbf
	AS-31	01/03/2021	15.392240°	107.125670°	1236	Dbf /Pi
	AS-32	01/03/2021	15.391330°	107.125980°	1232	Dbf /Pi
	AS-33	01/03/2021	15.409540°	107.125830°	1200	Dbf
3.1	AS-34	16/03/2021	15.492450°	107.063100°	1363	Dbf
	AS-35	16/03/2021	15.491870°	107.073490°	1409	Dbf
	AS-36	16/03/2021	15.485370°	107.070450°	1426	Pbf

Survey Zone	Site Code	Sampling Start Date	Latitude	Longitude	Elevation	Habitats
	AS-37	16/03/2021	15.485390°	107.072770°	1421	Pbf/Bg
	AS-38	16/03/2021	15.479130°	107.070500°	1422	Dbf
	AS-39	16/03/2021	15.478120°	107.076130°	1357	Dbf/Bg
	AS-40	16/03/2021	15.473460°	107.072240°	1354	Pbf
	AS-41	16/03/2021	15.469460°	107.079120°	1306	Dbf
	AS-42	16/03/2021	15.461030°	107.078600°	1301	Pbf
	AS-43	16/03/2021	15.463950°	107.081940°	1230	Pbf
4.1	AS-44	17/06/2021	15.484140°	107.163220°	1408	Pbf
	AS-45	17/06/2021	15.480690°	107.163220°	1489	Pbf
	AS-46	17/06/2021	15.480160°	107.154750°	1362	Dbf
	AS-47	17/06/2021	15.478460°	107.159610°	1435	Pbf
	AS-48	17/06/2021	15.475720°	107.156420°	1494	Pbf
	AS-49	17/06/2021	15.473810°	107.151790°	1407	Pbf
	AS-50	17/06/2021	15.473680°	107.151630°	1507	Pbf
	AS-51	17/06/2021	15.468030°	107.151300°	1564	Pbf
	AS-52	18/06/2021	15.469660°	107.145430°	1343	Pbf
	AS-53	18/06/2021	15.466310°	107.148240°	1542	Pbf/Bg
	AS-54	20/06/2021	15.468850°	107.146240°	1405	Pbf/Bg
	AS-55	21/06/2021	15.466670°	107.144710°	1435	Pbf
	AS-56	22/06/2021	15.470970°	107.147250°	1276	Pbf
	AS-57	23/06/2021	15.476180°	107.149300°	1490	Pbf
AS-58	26/06/2021	15.479280°	107.156330°	1428	Pbf	
AS-59	28/06/2021	15.478420°	107.154870°	1404	Pbf	
5.1	AS-60	14/07/2021	15.379800°	107.148030°	1188	Dbf
	AS-61	14/07/2021	15.377450°	107.143140°	1247	Dbf/Pl
	AS-62	14/07/2021	15.372950°	107.146390°	1193	Dbf/Pl
	AS-63	14/07/2021	15.370020°	107.141560°	1225	Dbf/Pl
	AS-64	14/07/2021	15.364000°	107.142580°	1205	Pl
	AS-65	14/07/2021	15.364420°	107.149250°	1234	Dbf/Pl
	AS-66	14/07/2021	15.355140°	107.144370°	1212	Dbf/Pl
	AS-67	14/07/2021	15.358540°	107.150450°	1240	Pbf
	AS-68	14/07/2021	15.350460°	107.145960°	1170	Pbf/Ag
	AS-69	14/07/2021	15.350750°	107.150900°	1184	Dbf/Ag
	AS-70	14/07/2021	15.369710°	107.145160°	1244	Dbf/Pl
	AS-71	15/07/2021	15.374920°	107.145000°	1249	Dbf/Pl
	AS-72	16/07/2021	15.349130°	107.149570°	1222	Dbf/Ag
	AS-73	17/07/2021	15.355140°	107.146490°	1243	Dbf/Pl/Ag
	AS-74	18/07/2021	15.357670°	107.145320°	1279	Dbf/Ag
	AS-75	19/07/2021	15.373420°	107.143260°	1245	Dbf/Pl
5.2	AS-76	21/07/2021	15.320370°	107.064240°	1132	Dbf/Pi
	AS-77	21/07/2021	15.317830°	107.068820°	1137	Pbf/Pi
	AS-78	21/07/2021	15.312930°	107.066940°	1144	Dbf/Pi

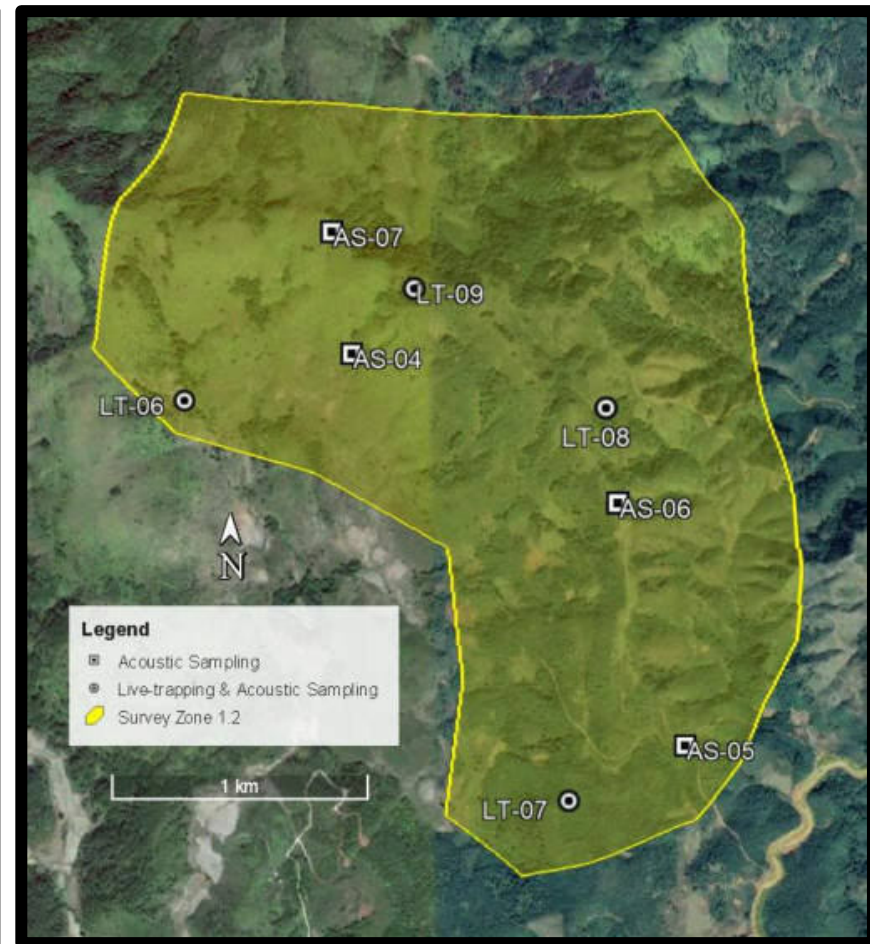
Survey Zone	Site Code	Sampling Start Date	Latitude	Longitude	Elevation	Habitats
	AS-79	20/07/2021	15.311450°	107.071990°	1207	Pi
	AS-80	20/07/2021	15.303990°	107.069160°	1151	Pi/Dbf/Ag
	AS-81	20/07/2021	15.303060°	107.074940°	1133	Pbf/Pi/Pa
	AS-82	20/07/2021	15.292460°	107.072980°	1140	Dbf/Ag
	AS-83	20/07/2021	15.296240°	107.080380°	1128	Dbf/Ag
	AS-84	20/07/2021	15.291580°	107.085040°	1176	Pbf
	AS-85	20/07/2021	15.294000°	107.089830°	1189	Pbf
	AS-86	20/07/2021	15.296760°	107.074320°	1122	Dbf/Ag
	AS-87	21/07/2021	15.293670°	107.085200°	1150	Pbf
	AS-88	22/07/2021	15.309050°	107.071500°	1191	Pi
	AS-89	23/07/2021	15.307350°	107.072430°	1200	Pi
	AS-90	24/07/2021	15.297630°	107.076160°	1128	Pl/Dbf
	AS-91	24/07/2021	15.298050°	107.078180°	1135	Ag
	AS-92	25/07/2021	15.299900°	107.073690°	1164	Pi/Pa
	AS-93	25/07/2021	15.301920°	107.071900°	1176	Pi/Dbf/Ag

Annex 4 Maps of live-trapping and/or acoustic sampling locations

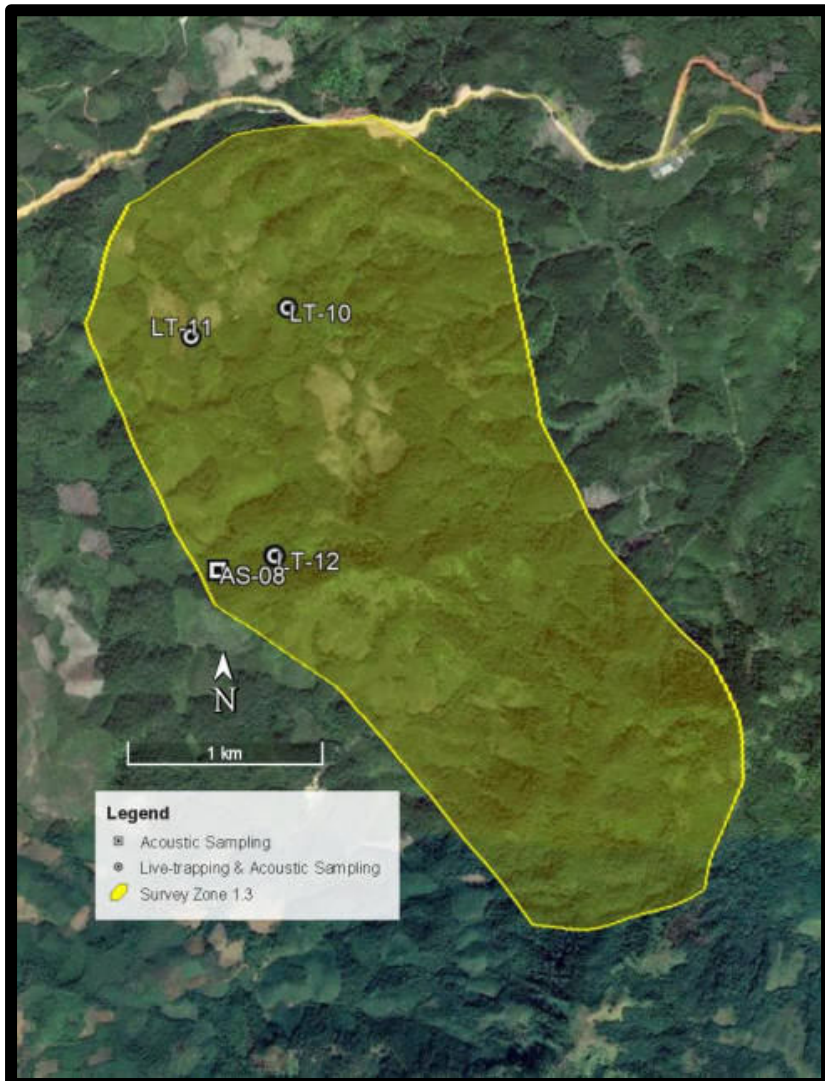
Survey Zone 1.1



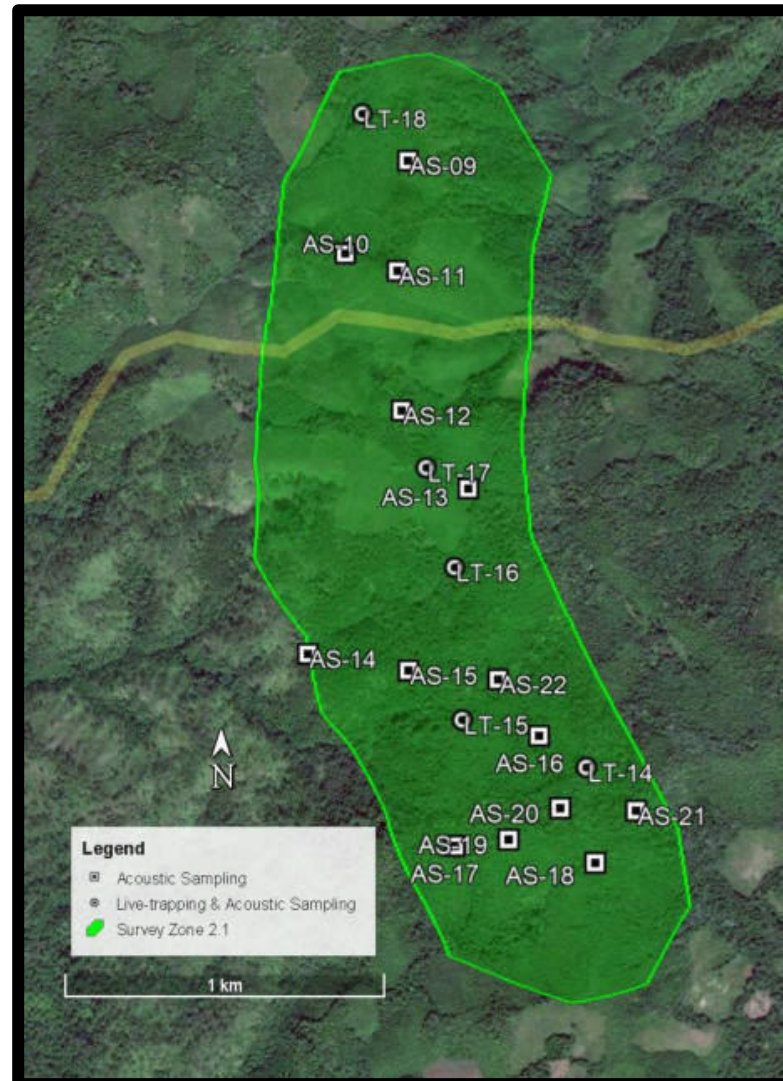
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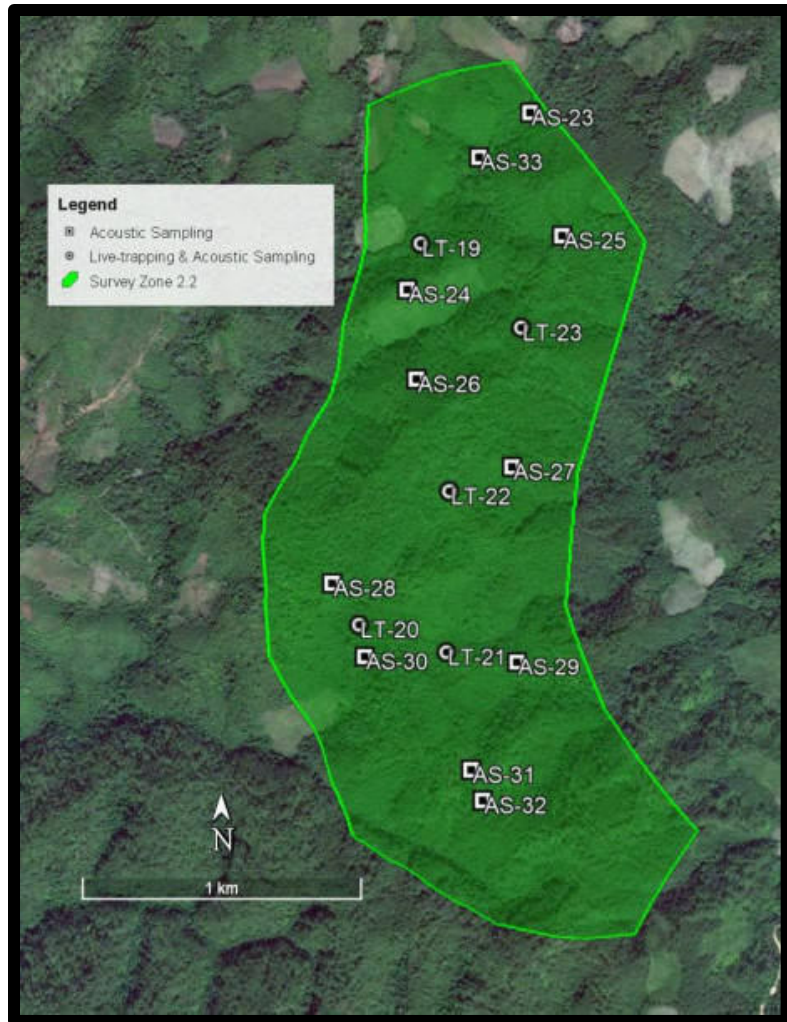
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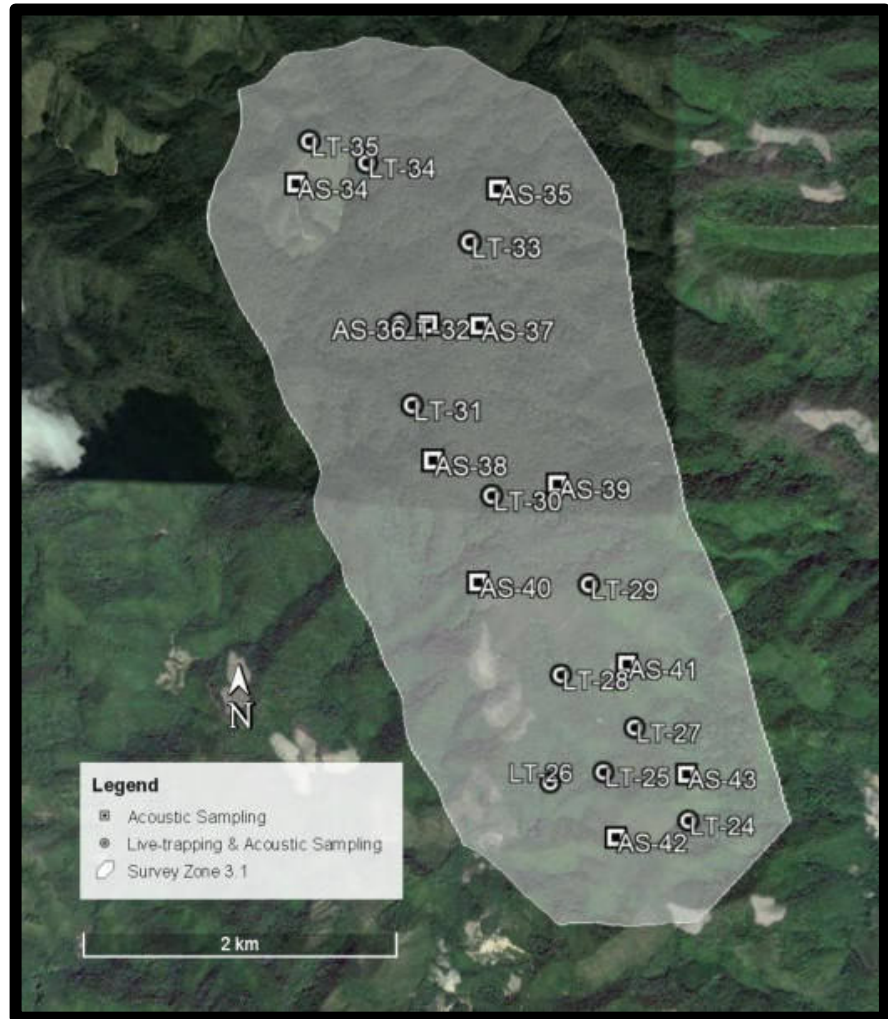
Survey Zone 2.1



Survey Zone 2.2



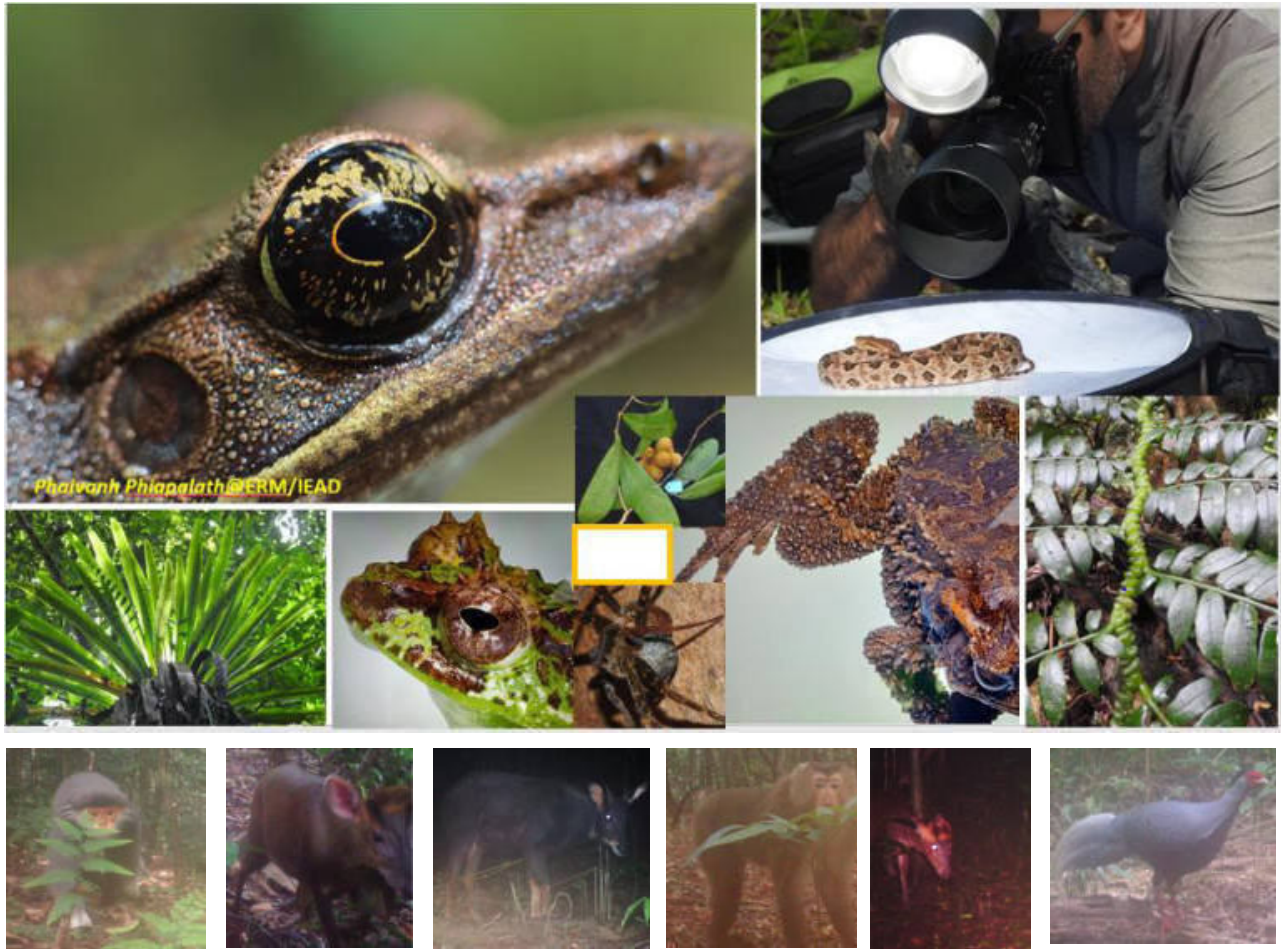
Survey Zone 3.1



MAMMAL, HERPETOFAUNA AND PLANT ASSESSMENT REPORT

MAMMAL, HERPETOFAUNA AND PLANT ASSESSMENT OF THE MONSOON WINDFARM POWER PROJECT

DAK CHEUNG, SEKONG PROVINCE



Consulting Service of ERM for IEAD, Thailand

Final Draft Report

March 2022



Citation: Phiapalath, P., Khotpathoom, T. and Souladeth, P. (2022). Biodiversity Assessment of Monsoon Windfarm Power Project. Environmental Resources Management (ERM), Thailand,



SUMMARY

This report provides the results of mammal, herpetofauna and plant assessment of the Monsoon Windfarm Power Project in Dak Cheung District, Sekong Province. It was conducted from July to December, 2021 for both two survey seasons as the wet season survey from July to August and the dry season survey in December 2021. The survey area was identified in the defined high priority areas of biodiversity (high conservation value) of the project according to the critical habitat screening¹. There are two high priority zones of biodiversity were defined as Zone A (eastern zone - Annamite) and Zone B (northern zone – Phou Koungking and Phou Yai). The eastern zone which is relevant to the proposed Transmission Lines of the project from Dak Cheung to Vietnam and the northern zone is relevant to the wind turbine tower construction.

The Survey blocks (SB) were only Upper Evergreen Forest (UEF), as SB1 and SB2 were located in eastern zone at the elevation from 1,029m to 1,208m a.s.l., and SB3, SB4 and SB5 were located in northern zone at the elevations from 1,205m to 1,615m a.s.l., the area higher than 1,500m were found in SB3 and SB4 and that considered Montane Forest/Montane Evergreen Forest, but still part of the UEF.

The current assessment showed the project area has support some important biodiversity value. It was confirmed that the high conservation value area which was defined by the critical habitat screening further from the rapid ecological assessment in December 2020 (Phiapalath *et al.*, 2021) since a number of globally threatened species were present. There was a total of 653 species (115 fauna, and 538 flora species) in the five survey blocks, of which, 44 mammals, 29 reptiles and 42 amphibians. This figure for the fauna species included some few species from reliable village reports from the interviews such as Python and Cobra that the local villagers used to collect them.

A total of 23 Globally Threatened (GT²) species were confirmed in the field (14 mammals, 6 reptile, 1 amphibian and 2 plant species). These GT species were found in all SBs as at least 6 GT species in SB5 and 9 GT species in SB2 and also SB3.

Plant: A total of 626 records, representing 538 species from 178 families (including non-tree species), of which 250 tree species and 58 families were recorded. The numbers of species count also included some species were found outside the plant plots to generate a full list of plants in the perspective survey area. Non-tree species were just counted but not used for analysis because no detailed measuring was taken.

There were mainly the family of Fagaceae, Lauraceae, Rubiaceae, Theaceae and Symplocaceae as the dominant families of the survey area. Tree species richness was found

¹ Only tree species which met the requirement for abundant analysis were used for this purpose.

² GT = Globally Threatened species of IUCN Redlist, includes CR, EN and VU.

in lower elevation such as SB1 and SB2 as ca. 72 and 68 species per hectare respectively, whereas higher elevation such as SB5, SB3 and SB4 were relatively low species richness: 50, 32 and 28 species, respectively. Only 2 GT species (1 EN and 1 VU) were identified as 1 Endangered species (*Zingiber mellis* in SB3 and 1 Vulnerable species *Pittostorum pauciflorum*) in SB4 and SB5. Interestingly, 10 possible new plant species were recorded and 29 first plant records of Laos in the survey blocks, mainly in the Survey block 2.

The Survey block 1 has 4 first records and 2 possible new species³; the SB2 has 11 first records, 6 possible new species to science and 2 NT species; the SB3 has 11 first records, 1 GT and 1 NT species; the SB4 has 11 first records, 1 GT and 1 NT species; the SB5 has 6 first records, 2 possible new species. But, please note that many of these species were found in more than one survey block.

Mammal: a total of 59 mammal species were reported for their presence but only 44 species (14 GT) were confirmed their presence in the Survey blocks. Majority of the fauna species that were directly confirmed in the field with evidences from the field assessment, both direct observation, evidences of tracks, dropping and feeding sites which were photographed and many of them from camera trapping. A majority of the mammal species were of a low population, except Pangolins in the survey block 2 and Chinese Serow in the survey block 3 and 4.

Species richness was found in SB2, SB3 and SB4, particularly the SB2 has high number of GT species and then SB3. A total of 14 Globally Threatened mammal species were directly, indirectly observed with some of them were caught on camera traps, included Northern buff-cheeked Gibbon (*Nomascus annamensis*, EN), Red-shanked Douc Langur (*Pygathrix nemaeus*, CR), Chinese Pangolin (*Manis Pentadactyla*, VU), Sunda Pangolin (*Manis javanicus*, CR), Stump-tailed Macaque (*Macaca arctoides*, VU), Northern Pig-tailed Macaque (*Macaca leonina*, VU), Sambar (*Rusa unicolor*, VU), Chinese Serow (*Capricornis milneedwardsii*, VU), Sun Bear (*Helarctos malayanus*, VU), Asiatic Black Bear (*Ursus thibetanus*, VU), and Great Hog Badger (*Arctonyx collaris*, VU). Only Bengal Slow Loris (*Nycticebus bengalensis*, EN), was based on reliable village reports as local villagers used to hunt them recently. Some few other GT species were reported with some information but their presences were not confirmed during the surveys including Annamite Striped Rabbit (*Negolagus timminsi*, EN), Indochinese Silvered Leaf Monkey (*Trachypethicus germaini*, EN), Binturong (*Arctictis binturong*, VU) and Pygmy Slow Loris (*Nycticebus pygmaeus*, EN) which were therefore not listed as GT species in the survey area.

Overall, populations of the GT mammal species in the survey area are low except some reasonable populations of Pangolins in the SB2 and Chinese Serow in SB3 & SB4, and

³ Possible new species is the undescribed species which is listed as candidate for new species to science but officially it needs to be published through peer review journals.

probably Douc Langur in SB2 and SB4. Douc Langurs were mostly reported except the survey block 5 but direct sighting of this animal was only twice as in the SB2 (a group of 3-5 animals) and SB4 (a group of 7 animals), also gibbons were active and their songs heard in SB1 and SB2 from few mornings due to raining, also in SB4 during the dry season survey, more GT species were recorded on camera traps.

Herpetology: a total of 71 herpetofauna species, of which 42 amphibian and 29 reptile species were confirmed from the field surveys. There were 2 GT species of herpetofauna confirmed from the field as Red River Krait (*Bungarus slowinskii*, VU) in SB2 and Serrate Frilled Treefrog (*Kurixalus cf gryllus*, VU) in SB4. Interestingly, 4 reptile species were first record of Laos, 2 reptile species were second record of Laos and 3 species have not been described yet, they are possible new species to science.

The target species that were directly confirmed in the field including Northern buff-cheeked Gibbon (*Nomascus annamensis*, EN), Red-shanked Douc Langur (*Pygathrix nemaeus*, CR), Chinese Pangolin (*Manis Pentadactyla*, VU), Sunda Pangolin (*Manis javanicus*, CR), Stump-tailed Macaque (*Macaca arctoides*, VU), Sambar (*Rusa unicolor*, VU), Chinese Serow (*Capricornis milneedwardsii*, VU), Annamite Striped Rabbit (*Negolagus timminsi*, EN), Owston's Civet (*Chrotogale owstoni*, EN), Impressed Tortoise (*Manouria impressa*, VU) and Red River Krait (*Bungarus slowinskii*, VU). Also, other GT species were confirmed but not on the target species as Serrate Frilled Treefrog (*Kurixalus cf gryllus*, VU), Stump-tailed Macaque (*Macaca arctoides*, VU), Northern Pig-tailed Macaque (*Macaca leonina*, VU), Chinese Serow (*Capricornis milneedwardsii*, VU), Sun Bear (*Helarctos malayanus*, VU) and Asiatic Black Bear (*Ursus thibetanus*, VU), Great Hog Badger (*Arctonyx collaris*, VU) and Smooth-coated Otter (*Lutrogale perspicillata*, VU).

In conclusion, apart from GT species there are 48 endemic species were found in the survey blocks, of which 29 first plant records of Laos, 4 first herpetofauna records of Laos, 2 second herpetofauna records of Laos, 10 possible new plant and 3 possible new herpetofauna species were defined for new species to science.

This report can be used as baseline for long-term monitoring in the area which some indicator species would be identified such as gibbon, douc langur and sambar are most sensitive species to disturbance. Therefore, these species are probably candidate for biodiversity monitoring. Since the survey area holds a great number of flora and fauna species which are important for conservation and some research in the future. As more effort of research especially for herpetofauna and plants would provide some more interesting species to discover. Therefore, this report would be useful not only for the project but also for the Government of Laos especially for further research of academia.

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ABBREVIATIONS

a.s.l.	above sea level
BCC	Biodiversity Conservation Corridor
CoZ	Corridor Zone
CR	Critically Endangered
DAFO	District Agriculture and Forestry Office
DBH	Diameter at Breast Height
DoF	Department of Forestry
EN	Endangered
ESS	Ecologically Sensitive Site
ERM	Environmental Resource Management
GoL	Government of Lao
GPS	Global Positioning System
GT	Global Threatened
HCV	High Conservation Value
IBA	Important Bird Area
IBAT	Integrated Biodiversity Assessment Tool
IEAD	Impact Energy Asia Development Limited
IUCN	International Union for Conservation of Nature
IVI	Important Value Index
KBA	Key Biodiversity Area
MAF	Ministry of Agriculture and Forestry
MEF	Montane Evergreen Forest
MDF	Mixed Deciduous Forest
NGO	Non-Government Organisation
NT	Near-Threatened
NTFPs	Non-Timber Forest Products
NPA	National Protected Area
LAO PDR	Lao People's Democratic Republic
LC	Least Concern
MF	Montane Forest
PAFO	Provincial Agriculture and Forestry Office
PA	Protected Area
PF	Protection Forest
SB	Survey Block
UEF	Upper Evergreen Forest
UTM	Universal Transverse Mercator
VU	Vulnerable
WCS	Wildlife Conservation Society
WWF	Worldwide Fund for Nature

CONVENTIONS

IUCN REDLIST (Definitions)

Threatened Species: A taxon is classified under the list of Critically Endangered, Endangered and Vulnerable according to IUCN Category.

Critically Endangered Species (CR): A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria that facing an extremely high risk of extinction in the wild due to smaller global population, habitats, habitat fragmentation and under high threat.

Endangered Species (EN): A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

Vulnerable Species (VU): A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is hence considered to be facing a high risk of extinction in the wild.

Near-Threatened: A taxon is Near - Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least Concern: A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

Lao PDR risk categories relate specifically to the threat to survival of a species in Lao PDR. Elsewhere in its world range, it may be secure, even numerous. The classification system is taken from Duckworth *et al.*, (1999):

At Risk in Lao PDR (ARL): this category is roughly equivalent at a national level to the Globally Threatened categories of IUCN (2001).

Potentially At Risk in Lao PDR (PARL): this category includes species (a) suspected to be At Risk in Lao PDR but where information about threats or species status is insufficient to make a firm categorisation, and (b) species on or close to the borderline of At Risk in Lao PDR.

Conditionally At Risk in Lao PDR (CARL): this category includes species which are not confirmed to be currently extant in Lao PDR, but which if they are, will clearly be At Risk in Lao PDR.

Little Known in Lao PDR (LKL): this category provides for species where the conservation status is difficult to assess with confidence.

NATIONAL CATEGORY (*Aquatic Animal and Wildlife Law (2021)*)

- Prohibited Species (Category I): category list is rare, near extinct, high value and are specially important in the development of economic and social, environment, educational scientific research. The animals of such category as stated above shall be managed, inspected, preserved, and shall be controlled the use.
- Management Species (Category II): beneficial wildlife and aquatics in term of economic social, environment, and livelihoods of multi ethnic people and educational scientific research. The animal of such category has stated above shall be managed, inspected, preserved, protected and shall be controlled the use.
- General Species (Category III): wildlife and aquatics that are able to be generating and reproductive widely in nature that are very important to social economic development, and educational scientific research. The animals of such category as stated above can be used in accordance with the law and shall guarantee the use without any extinction, and not harmful adversely impact the ecological and environmental system.

LOCALITY: Terms of species were used for this assessment

Common (C): a species is seen commonly in the survey area (+++)

Frequent (F): a species is seen frequently in the survey area (++)

Occasional (O): a species is seen occasionally in the survey area (+)

Rare (R) under the status of occurrence: a species is rarely seen in the survey area (dry forest landscape) as only once or twice but it would not be rare in other area.

Key Species: this term is generally used to mention a species of conservation significance; it is often an endangered or critical endangered species according to IUCN or prohibited species according to Lao Law.

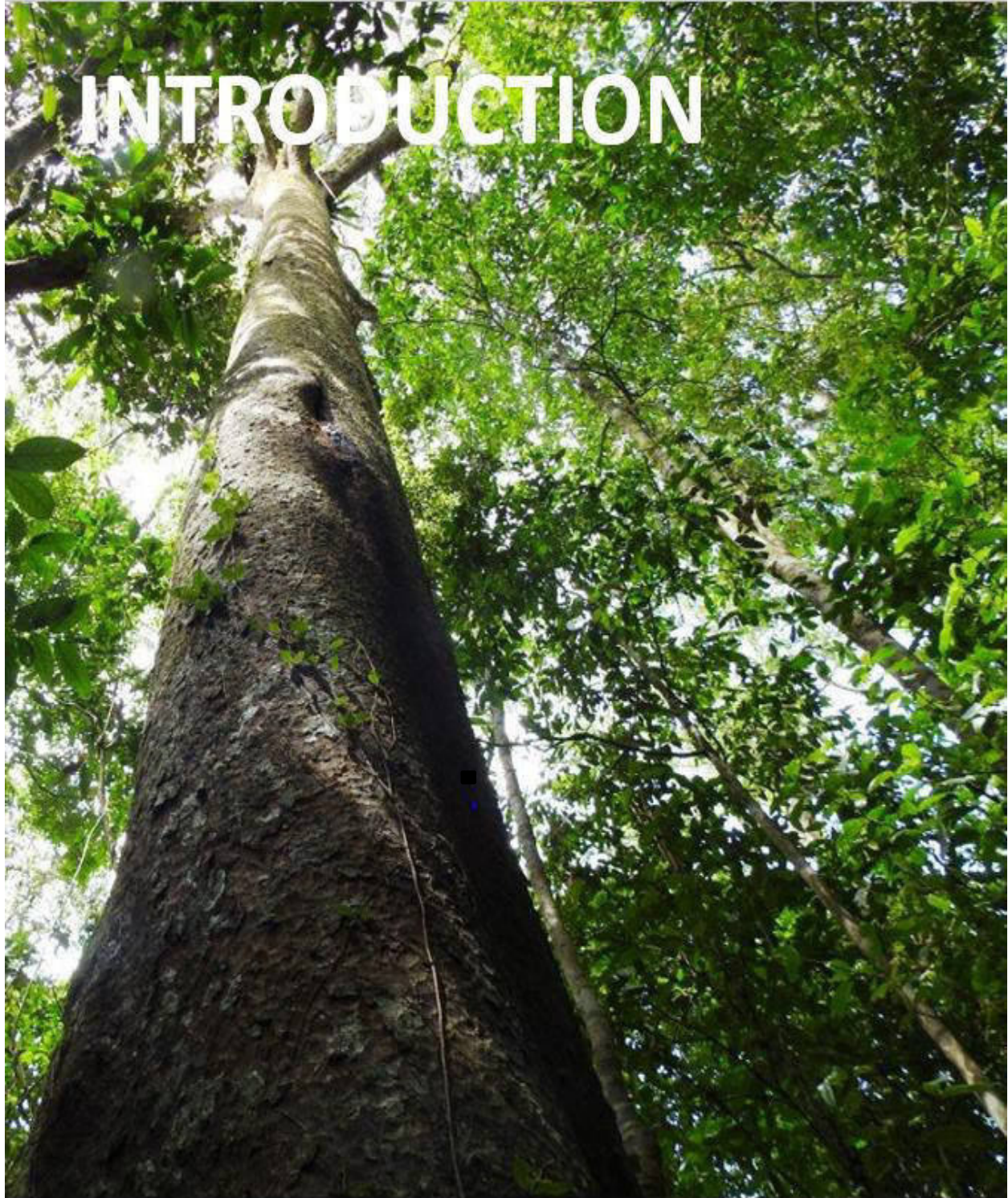
Table of Contents

SUMMARY.....	3
ACKNOWLEDGEMENTS.....	6
ABBREVIATIONS.....	7
CONVENTIONS.....	8
I. INTRODUCTION.....	14
II. BACKGROUND.....	16
2.1 VEGETATION AND FLORA.....	17
2.2 MAMMAL.....	18
2.3 HERPETOLOGY.....	18
III. SCOPE AND PURPOSE OF THE ASSESSMENT.....	20
3.1 SCOPE OF THE ASSESSMENT.....	20
3.2 OBJECTIVE OF THE ASSESSMENT.....	21
3.3 SURVEY PERIOD.....	21
3.4 SURVEY SPECIALIST TEAM AND EXPERTISES.....	22
IV. STUDY AREA AND METHODS.....	25
4.1 SURVEY AREA.....	25
4.2 SURVEY METHODS.....	26
4.2.1 Field Surveys.....	28
4.2.1.1 <i>Field Surveys for Wildlife by survey block</i>	28
4.2.1.2 <i>Survey Techniques for Mammals</i>	28
4.2.1.3 <i>Survey Techniques for Herpetology</i>	32
4.2.1.4 <i>Survey Techniques for Plants and other flora</i>	32
4.2.2 Threat Collection.....	35
4.2.3 Survey effort.....	35
4.3 DATA PREPARATION AND ANALYSIS.....	35
4.3.1 Data Preparation.....	35
4.3.1.1 <i>Species Identification</i>	38
4.3.1.2 <i>Species Records and Listing</i>	38
4.3.2 Analysis.....	39
4.4 MATERIALS AND EQUIPMENT.....	40

5	FINDINGS OF THE ASSESSMENT	41
5.1	HABITATS.....	41
5.1.1	Habitats of Survey block 1 (Southern Annamite)	42
5.1.2	Habitats of Survey block 2 (Southern Annamite)	43
5.1.3	Habitats of Survey block 3 (Phou Koungking - East)	44
5.1.4	Habitats of Survey block 4 (Phou Koungking - West)	44
5.1.5	Habitats of Survey block 5 (Phou Yai)	44
5.2	OVERVALL FINDINGS OF FLORA AND FAUNA SPECIES.....	46
5.3	RESULTS OF THE ASSESSMENT BY TAXON AND SURVEY BLOCK	59
5.3.1	<i>Vegetation and Flora</i>	60
5.3.1.1	<i>Introduction</i>	60
5.3.1.2	<i>Key findings</i>	61
5.3.1.3	<i>Findings by survey block and sampling</i>	65
5.3.1.3.1	<i>Findings by Survey block 1 (Annamite)</i>	65
5.3.1.3.2	<i>Findings by Survey block 2 (Annamite)</i>	68
5.3.1.3.3	<i>Findings by Survey block 3 (Phou Koungking E)</i>	71
5.3.1.3.4	<i>Findings by Survey block 4 (Phou Koungking W)</i>	74
5.3.1.3.5	<i>Findings by Survey block 5 (Phou Yai)</i>	77
5.3.1.4	<i>Plant community</i>	80
5.3.1.5	<i>Globally threatened species accounts</i>	80
5.3.1.6	<i>First record and possible new species by survey block</i>	81
5.3.1.7	<i>Some other interesting plant species in the survey area</i>	82
5.3.1.8	<i>Distribution of important plant species in the survey area</i>	82
5.3.1.9	<i>First record and possible new species accounts</i>	86
5.3.1.10	<i>Recommendations</i>	95
5.3.1.11	<i>Conclusions</i>	95
5.3.2	Mammal	96
5.3.2.1	<i>Introduction</i>	97
5.3.2.2	<i>Key findings</i>	97
5.3.2.3	<i>Findings from camera trapping</i>	99
5.3.2.4	<i>Findings by survey block</i>	103
5.3.2.4.1	<i>Findings by Survey block 1 (Annamite)</i>	103

5.3.2.4.2 Findings by Survey block 2 (Annamite)	103
5.3.2.4.3 Findings by Survey block 3 (Phou Koungking E)	103
5.3.2.4.4 Findings by Survey block 4 (Phou Koungking W)	104
5.3.2.4.5 Findings by Survey block 5 (Phou Yai)	104
5.3.2.5 Overview of mammal community	104
5.3.2.6 Globally threatened species accounts	105
5.3.2.7 First record and possible new species accounts	119
5.3.2.7 Some other selected species accounts	119
5.3.2.8 Seasonal variation and distribution of mammal species in the survey area	120
5.3.2.9 Recommendations	120
5.3.2.10 Conclusions	120
5.3.3 Herpetology	122
5.3.3.1 Introduction	122
5.3.3.2 Key findings	123
5.3.3.3 Findings by survey block	124
5.3.3.3.1 Findings by Survey block 1 (Annamite)	124
5.3.3.3.2 Findings by Survey block 2 (Annamite)	125
5.3.3.3.3 Findings by Survey block 3 (Phou Koungking E)	125
5.3.3.3.4 Findings by Survey block 4 (Phou Koungking W)	125
5.3.3.3.5 Findings by Survey block 5 (Phou Yai)	125
5.3.3.4 Overview of herpetofauna community	126
5.3.3.5 Globally threatened species accounts	127
5.3.3.6 First record and possible new species accounts	131
5.3.3.7 Some other selected species accounts	133
5.3.3.8 Seasonal variation and distribution of herpetology in the survey area	133
5.3.3.9 Recommendations	134
5.3.3.10 Conclusions	134
6. THREATS TO BIODIVERSITY	134
7. CONCLUSIONS	136
REFERENCES	137
ANNEXES	142
Annex 1a-1. Summary of plant plot by Survey Block (SB1 – Annamite) based on DAFOR	143

Annex 1a-2. Summary of tree species list in the Survey Block 1	151
Annex 1b-1. Summary of plant plot by Survey Block (SB2 – Annamite).....	153
Annex 1b-2. Summary of tree species list in the Survey Block 2	161
Annex 1c-1. Summary of plant plot by Survey Block (SB3 – Phou Koungking E)	163
Annex 1c-2. Summary of tree species list in the Survey Block 3	171
Annex 1d-1. Summary of plant plot by Survey Block (SB4 – Phou Koungking W).....	172
Annex 1d-2. Summary of tree species list in the Survey Block 4	180
Annex 1e-1. Summary of plant plot by Survey Block (SB5 – Phou Yai).....	181
Annex 1e-2. Summary of tree species list in the Survey Block 5	189
Annex 2. List of mammal records from the survey area.....	191
Annex 3a. List of herpetofauna (reptile) records from the survey area	193
Annex 3b. List of herpetofauna (amphibian) records from the survey area	194
Annex 4. Photos of some other wildlife species from the survey area	196
Annex 5. Photos of some forest landscape and structures from the survey area.....	199
Annex 6. Waypoints for important (key and GT species) records	202
Annex 7. Some pictures of wildlife from camera trapping	209
Annex 8. Some other incidental records.....	231
Annex 9. Permission of the survey team	234
Annex 10. List of External Experts for Consultations	236



I. INTRODUCTION

This mammal, herpetofauna and plant assessment is to improve knowledge, verify and confirm the presence and absence of survey taxon species especially the key and target

species in the Monsoon Windfarm Power Project, Dak Cheung District. It was conducted for wet season survey in July and August, 2021, and dry season survey in December 2021, focused in the defined high priority areas of biodiversity (High Conservation Value) of the Project. There are two zones of the high priority areas (HCV) were defined from the critical habitat screening further from the rapid ecological assessment in December 2020 (Phiapalath *et al.*, 2021) as Zone A (eastern zone - Annamite) and Zone B (northern zone – Phou Kounkking and Phou Yai). The Zone A is relevant to the proposed Transmission Line (TL) of the project from Dak Cheung to Vietnam and the Zone B is relevant to the wind turbine tower construction (see Fig. 1).

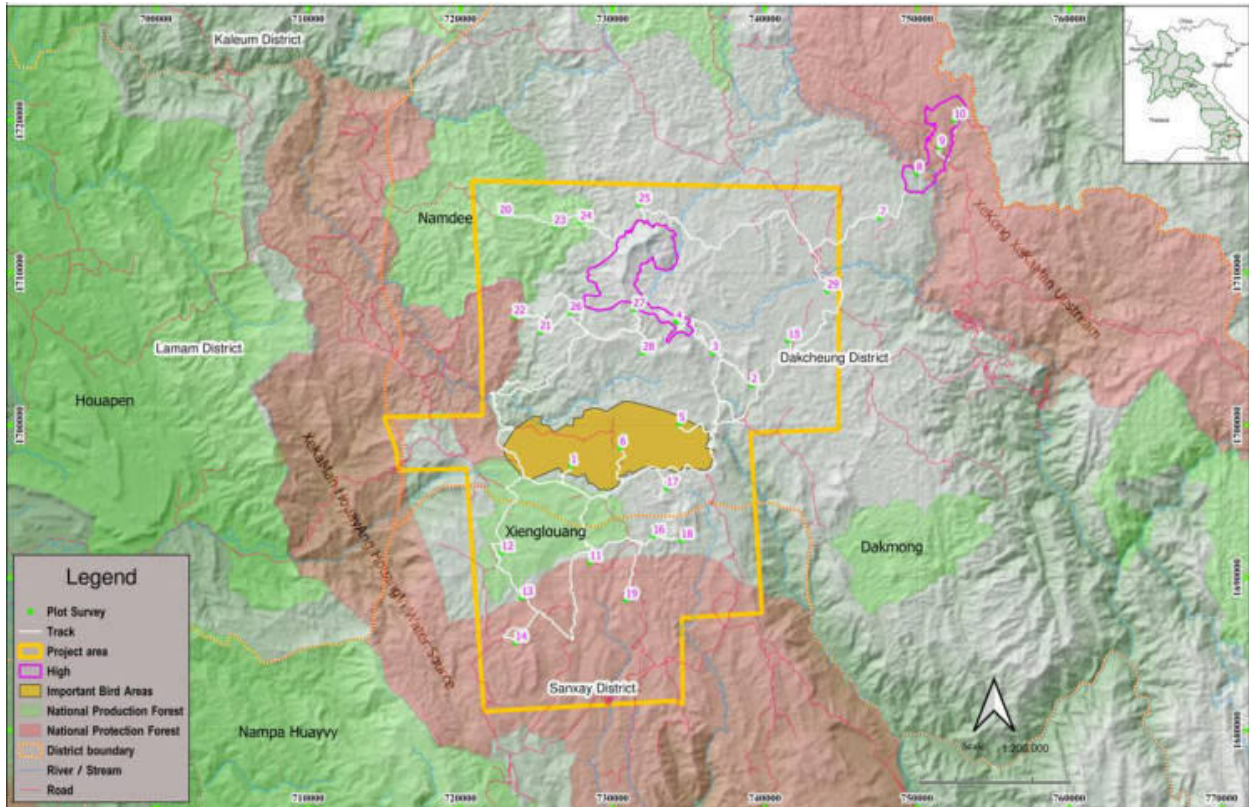
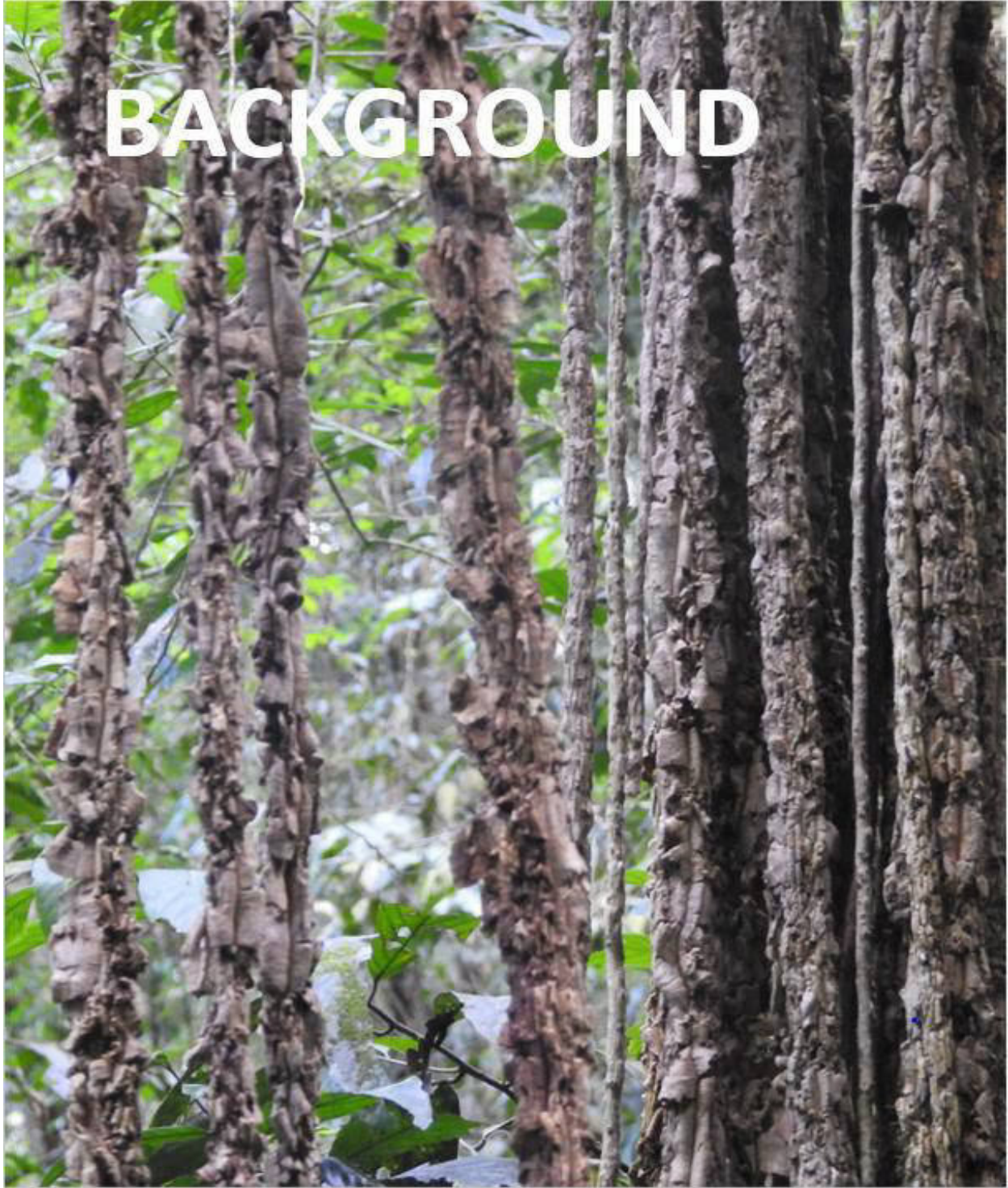


Figure 1. Location of Monsoon Windfarm Power Project in Dak Cheung Plateau

This report presents the approach and findings of the two field survey campaigns for mammals, herpetofauna, and plants, focusing on the potential high priority species identified from the critical habitat screening.



II. BACKGROUND

Sekong Province is the smallest province in Lao PDR, also has the smallest population (113,048 as of 2015) and the lowest population density of any provinces in the country. It was established in 1984 by splitting from Salavan Province. The Sekong Province has the

most diverse ethnic groups in southern Laos as 14 ethnic groups, they are more of animism worship. Dak Cheung District is the upland and the remotest district with about a half of it is plateau, non-plateau is found in the north to the east which are mountainous with high terrains, known part of the Southern Annamite. There are two minority ethnic groups in this district as Tra Lieng and Ka Tou (see Fig. 4). Access to the district was very difficult in the past but it is easier today after the access road was upgraded in recent years. Local villagers rely on hill rice cultivation, cattle raising and crop plantations especially coffee plantation. It is one of coffee producing areas of Lao PDR, but not much well known.

It notes that the project area is not part of any important conservation area, only the western part was defined as Important Bird Area (IBA) but its habitat was degraded as well as loss of many associated species, including Asian Elephant has no longer today. Some part of the district, including the Annamite section and Phou Kounking. Part of the area called Laeng Nam Sekong-Xe Kaman Protection Forest (PF) and some local PFs, but were not recognized by local villagers when it is a protection forest. Meanwhile, the forest stretch along the Lao-Vietnam border is recognised as conservation area "Biodiversity Conservation Corridor (BCC) which was partly overlapping with the Laeng Nam Sekong-Xe Kaman PF.

The Monsoon Windfarm Power Project is located in Dak Cheung Plateau, Dak Cheung District of Sekong Province, the highland of the southern Laos, of altitudes over 1,000m a.s.l., (ranges from 800m-1,600m a.s.l.). The proposed Monsoon Windfarm Power Project has a concession area of ca. 708 km² with its capacity of 600 MW and a 500 Kv Transmission Line of 21.3 km crossing the Annamite mountain range from Dak Cheung to Vietnam. Xe Khaman River is the main river in the project area and relevant to the alignment of the proposed TL.

No comprehensive biodiversity survey has been conducted in the project concession area so especially the high priority area (high conservation value) which was identified during the rapid ecological assessment in December 2020 and showed possibility of some globally threatened and endemic species could occur in the project area. Some specific descriptions by taxon based on reviews and Integrated Biodiversity Assessment Tool (IBAT) database were given as following:

2.1 VEGETATION AND FLORA

Upper Evergreen Forest was defined in the priority areas of biodiversity of the project as the majority of the tree species in the UEF belong to *Hopea pierrei* Hance (Dipterocarpaceae), *Cinnamomum iners* Reinw. ex Blume (Lauraceae), *Dacrydium elatum* (Roxb.) Wall. ex Hook., *Dacrycarpus imbricatus* (Blume) de Laub. (Podocarpaceae) and *Pinus kesiya* Royle ex Gordon (Pinaceae).

With reference to the previous survey in the Biodiversity Conservation Corridor (BCC) for ADB project including the Annamite section of Dak Cheung District (Nanthavong *et al.*, 2019), as well as habitat suitability as well as partly IBAT database/IUCN Redlist/KBA for distribution of globally threatened species in and adjacent to the project concession area would include at least 6 plant species such as Mai Ketsana (*Aquilaria crassna*, CR), Mai ket dam (*Dalbergia oliveri*, EN), Mai khaen hin (*Hopea ferrea*, EN), Mai Khapa lamxay (*Meistera Celsa*, EN), Mai hoa lanoy (*Cycas micholitzii*, VU) and Mai yang den (*Dipterocarpus costatus*,

VU). Yet, the project area has not been surveyed on the ground before and due to habitat uniqueness of high elevation of the Annamite there would be presence of some endemic plant species.

2.2 MAMMAL

A terrestrial wildlife species is important to maintain forest ecosystem and we have quite better knowledge and conservation status of this wildlife group than other groups so it is unlikely that there would be the discovery of mammal species new to science in the last 20 years (IUCN 2013).

Due to habitat fragmentation, land claims for animal ranching, hunting and human pressure this wildlife group is under higher threats today compared to other wildlife groups, except some large mammals that inhabit the sacred forest such as Phou Kounking (Survey Block 3 & 4). Consequently, many of them are at risk of national and regional extinction since the survey area is not defined as legally protected area. The sacred forest⁴ of Phou Kounking made not many people entering the area and that disturbed level in the area is considered low to make some species quite safe to inhabit in the Phou Kounking sacred forest.

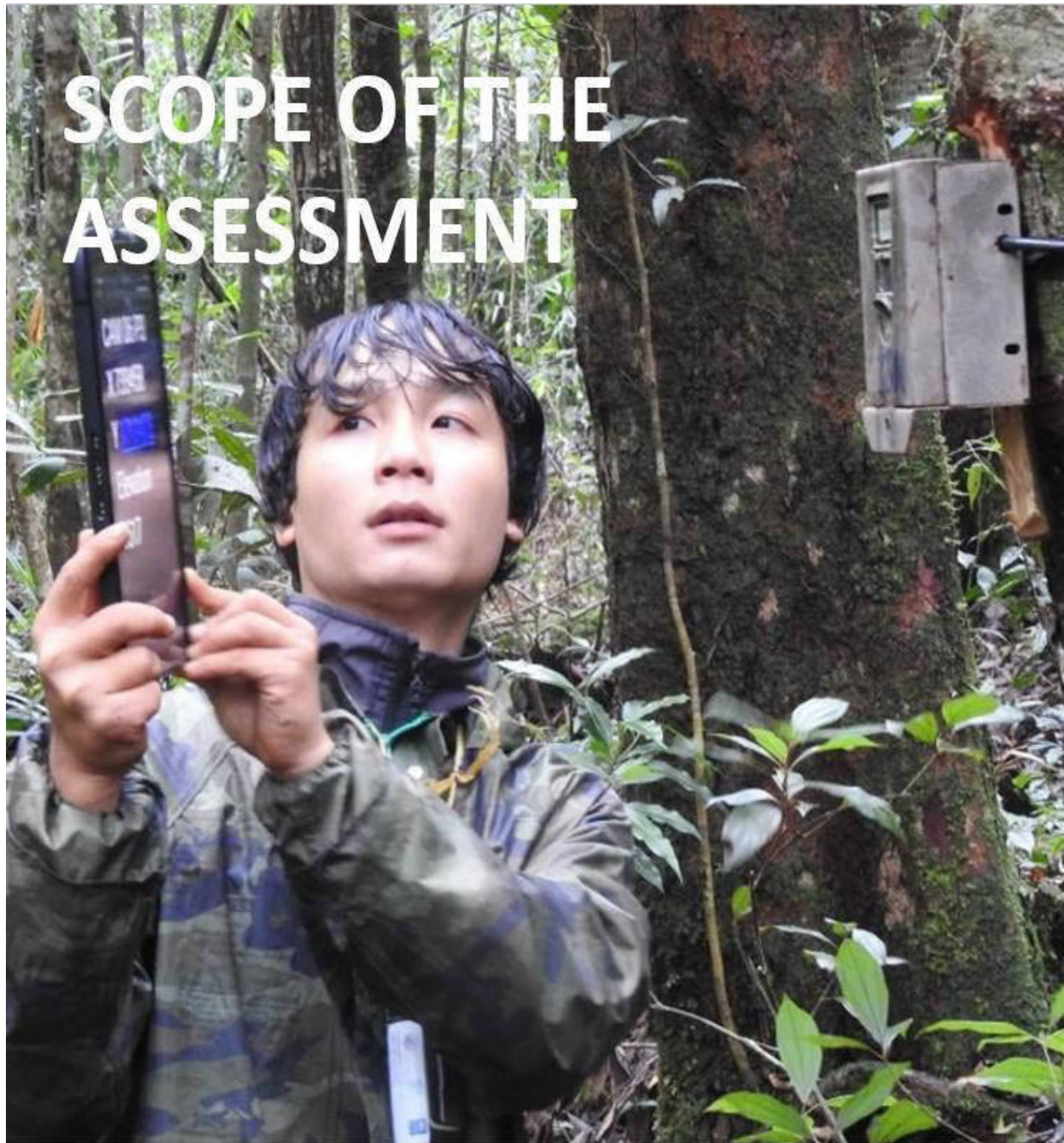
With reference to the IBAT database/IUCN Redlist/KBA for distribution of globally threatened species in and adjacent to the project concession area, including the Annamite Mountain Range where Transmission Lines will run through would include at least 19 species such as Saola (*Pseudoryx nghetinhensis*, CR), Tiger (*Panthera tigris*, EN), Northern buff-cheeked Gibbon (*N. annamensis*, EN), Red-shanked Douc Langur (*Pygathrix nemaeus*, CR), Large antlered Muntjac (*Muntiacus vuquangensis*, CR), Sudan Pangolin (*Manis javanicus*, CR), Indochinese Silvered Leaf Monkey (*Trachypethicus germaini*, EN), Annamite Striped Rabbit (*Negolagus timminsi*, EN), Owston's Civet (*Chrotogale owstoni*, EN), Sambar (*Rusa unicolor*, VU), Chinese Serow (*Capricornis milneedwardsii*, VU), Clouded Leopard (*Neofelis nebulosa*, VU), and Stump-tailed Macaque (*Macaca arctoides*, VU), Smooth-coated Otter (*Lutrogale perspicillata*, VU), Asiatic Black Bear (*Ursus thibetanus*, VU), Binturong (*Arctictis binturong*, VU), Bengal Slow Loris (*Nycticebus bengalensis*, EN), Pygmy Slow Loris (*Nycticebus pygmaeus*, EN) and Great Hog Badger (*Arctonyx collaris*, VU).

2.3 HERPETOLOGY

Small streams in Upper Evergreen Forest of altitude over 1,000m a.s.l. are highly potential to presence of some important and endemic herpetofauna species. The herpetofauna (amphibians and reptiles) are a little-known vertebrate group in Lao PDR, and some numbers of records so far in the country have not been previously known to science (Stuart 2005). There are a few herpetologists who have conducted a herpetofauna inventory in the country and never done in Dak Cheung District. Through the relevant literatures on herpetofauna from Laos revealed that there are less than a hundred species recognized so far (Stuart *et al.*, 2013).

⁴ Sacred forest a spiritual forest where local people believe the place of Ghost (A. Soury, 2007). It is a special religious and important site for culture of local communities living in adjacent areas.

With reference to the IBAT database/IUCN Redlist/KBA for distribution of globally threatened herpetofauna species in and adjacent to the project concession area would include at least 10 reptile species such as Bourret's Box Turtle (*Cuora bourreti*, CR), Three-horned scale Pitviper (*Protobothrops sieversorum*, EN), Yellow eyed Spadefoot Toad *Leptobrachium xanthops* (EN), Black-breasted Leaf Turtle (*Geoemyda spengleri*, EN), Keeled Box Turtle (*Cuora mouhotii*, EN), Impressed Tortoise (*Manouria impressa*, VU), King Cobra (*Ophiophagus Hannah*, VU), Red River Krait (*Bungarus slowinskii*, VU), Indochinese Spitting Cobra (*Naja siamensis*, VU) and Burmese Python (*Python bivittatus*, VU). In addition, there would be some numbers of endemic species in the project area especially in the proposed TL within the Annamite Range.



SCOPE OF THE ASSESSMENT

III. SCOPE AND PURPOSE OF THE ASSESSMENT

3.1 SCOPE OF THE ASSESSMENT

The assessment was conducted through defining 5 survey blocks (1,600 ha each), as a square block covering some sections beyond the high priority areas of biodiversity but not cover

some portions of the defined high priority areas (see Fig. 1). The assessment focused on mammal, herpetofauna and plants as the target species that are highly possible to present in the project area and relevant to the nature of the project and so the target species must be confirmed their presence or absence from the assessment including: Northern buff-cheeked Gibbon (*Nomascus annamensis*, EN), Red-shanked Douc Langur (*Pygathrix nemaeus*, CR), Indochinese Silvered Leaf Monkey (*Trachypethicus germaini*, EN), Large antlered Muntjac (*Muntiacus vuquangensis*, CR), Annamite Striped Rabbit (*Negolagus timminsi*, EN), Owston’s Civet (*Chrotogale owstoni*, EN), Bourret’s Box Turtle (*Cuora bourreti*, CR), Three-horned scale Pitviper (*Protobothrops sieversorum*, EN), Yellow eyed Spadefoot Toad *Leptobrachium xanthops* (EN), Black-breasted Leaf Turtle (*Geoemyda spengleri*, EN), Impressed Tortoise (*Manouria impressa*, VU) and Red River Krait (*Bungarus slowinskii*, VU).

3.2 OBJECTIVE OF THE ASSESSMENT

The main objective of the assignment was to understand the current status of biodiversity, focused on globally threatened species, the “target” species of the project area.

Knowledge gain can be used for planning for prevention and mitigating adverse impacts from planning process to construction and operations of the project development.

3.3 SURVEY PERIOD

The assessment from July 11 to August 3, 2021 for dry season and in December, 2021 for wet season as the detailed schedule below:

- Wet season survey

Date	Activity
11/07/2021	Traveled from VTE to Sekong Province
12/07/2021	Traveled to Dak Cheung, met with DAFO and to SB1 – fieldwork
13/07/2021	SB1 – fieldwork and village interviews – Ban Dak Dom
14/07/2021	SB1 – fieldwork
15/07/2021	SB1 – fieldwork
16/07/2021	SB2 – fieldwork
17/07/2021	SB2 – fieldwork
18/07/2021	SB2 – fieldwork
19/07/2021	SB2, and returned to Dak Cheung and to next fieldwork
20/07/2021	SB5 – fieldwork and village interviews – Ban Prao
21/07/2021	Survey block 5 – fieldwork
23/07/2021	SB5 – fieldwork
24/07/2021	SB5 – fieldwork
25/07/2021	SB3 and SB4 – fieldwork village interviews – Ban Dak Dreun
26/07/2021	SB3 and SB4 – fieldwork by main team in parallel
27/07/2021	SB3 and SB4 – fieldwork by main team in parallel
28/07/2021	SB3 and SB4 – fieldwork by main team in parallel
29/07/2021	Field data checks

30/07/-1/8/2021	Team Wrap up
02/08/2021	Return to Pakse
03/08/2021	Return to VTE

- Dry season survey

Date	Activity
05/12/2021	Travel from VTE to Sekong Province
06/12/2021	Travel to Dak Cheung, and camping at site - fieldwork.
07/12/2021	SB1 – fieldwork
08/12/2021	SB1 – fieldwork
09/12/2021	SB1 – fieldwork
10/12/2021	SB2 – fieldwork
11/12/2021	SB2 – fieldwork
12/12/2021	SB2 – fieldwork
13/12/2021	SB2 – fieldwork, return to Dak Cheung and to then SB5
14/12/2021	SB5 – fieldwork
15/12/2021	SB5 – fieldwork
16/12/2021	SB5 – fieldwork
17/12/2021	SB3 – fieldwork
18/12/2021	SB3 – fieldwork
19/12/2021	SB3 – fieldwork
20/12/2021	SB3 – fieldwork and then to SB4
21/12/2021	SB4 – fieldwork
22/12/2021	SB4 – fieldwork
23/12/2021	SB4 – fieldwork
24/12/2021	SB4 – fieldwork and then return to Dak Cheung
25/12/2021	Team Wrap up
26/12/2021	Return to Pakse
27/12/2021	Return to VTE

3.4 SURVEY SPECIALIST TEAM AND EXPERTISES

The technical team of 5 experts and 8 assistants, including the participants from Provincial and District Offices, and some military and local villagers who joined the surveys, made a total of 17 personnels. The expert team was permitted to conduct the survey for both wet and dry seasons (see Annex 9). A sub-team for mammal, herpetology and botany as each sub-team had one lead specialist with assistants (see Table 1a, 1b and Fig. 2).

Table 1a. List of experts and assistants

<i>Field</i>	<i>Name of Specialist</i>	<i>Degree</i>	<i>Field of expertise</i>	<i>Years of Experience</i>	<i>Tasks</i>
Lead Specialist Team					
<i>Team Leader, Mammal</i>	<i>Phaivanh Phiapalath</i>	<i>PhD</i>	<i>Wildlife surveys & Protected Areas</i>	<i>20+</i>	<i>Team Leader and Mammals</i>
<i>Herpetofauna</i>	<i>Peter Brakels</i>	<i>M.Sc</i>	<i>Reptile</i>	<i>7</i>	<i>Reptile</i>
<i>Herpetofauna – snake</i>	<i>Nathanael Maury</i>	<i>M.Sc</i>	<i>Reptile</i>	<i>10</i>	<i>Herpetology</i>
<i>Botany</i>	<i>Phetlasy Souladeth</i>	<i>PhD</i>	<i>Botany/taxonomy</i>	<i>10</i>	<i>Botany and habitats</i>
<i>Field Team leader, Camera trap</i>	<i>Thananh Khotpathoom</i>	<i>PhD</i>	<i>Wildlife/bird Camera trapping</i>	<i>15</i>	<i>Wildlife inventory, Camera trapping</i>
Assistant Specialist Team					
<i>Plant</i>	<i>Metmany Soukhavong</i>	<i>PhD can.</i>	<i>Plant</i>	<i>7</i>	<i>Botany</i>
<i>Mammal</i>	<i>Duangphachanh Souvansai</i>	<i>M.Sc</i>	<i>Mammal</i>	<i>5</i>	<i>Primate</i>
<i>Herpetofauna</i>	<i>Nina Pou Maury</i>	<i>B.Sc</i>	<i>Reptile</i>	<i>4</i>	<i>Herpetology</i>
<i>GIS</i>	<i>Sounthone Thilavong</i>	<i>B.Sc</i>	<i>GIS and mapping</i>	<i>5</i>	<i>GIS and Mapping</i>
<i>Assistant</i>	<i>Vilasack Chanthabouasone</i>	<i>Diploma</i>	<i>Wildlife inventory</i>	<i>5</i>	<i>Field assistance</i>
<i>Assistant</i>	<i>Nep Thonephakdy</i>	<i>Certifica.</i>	<i>Wildlife inventory</i>	<i>5</i>	<i>Field assistance</i>
Government Assistant Team					
<i>GoL Assistant</i>	<i>Somchit Boulaphone</i>	<i>Diploma</i>	<i>Veterinarian, PAFO</i>	<i>30</i>	<i>Field assistance</i>
<i>GoL Assistant</i>	<i>Thongkham Boudtavong</i>	<i>Diploma</i>	<i>Veterinarian, DAFO</i>	<i>25</i>	<i>Field assistance</i>
<i>Military</i>	<i>Thongkhoun</i>	<i>Certifica.</i>	<i>Patrol</i>		<i>Field assistance</i>
<i>Military</i>	<i>Sengnisone</i>	<i>Certifica.</i>	<i>Patrol</i>		<i>Field assistance</i>
<i>Military</i>	<i>Choy Leuanlaisao</i>	<i>Certifica.</i>	<i>Patrol</i>		<i>Field assistance</i>

In addition, we had the local villagers participated in the survey which varied from survey block to survey block, but on average of 4 persons at a time. Their participations were useful as their knowledge in not only about the site but also wildlife information.

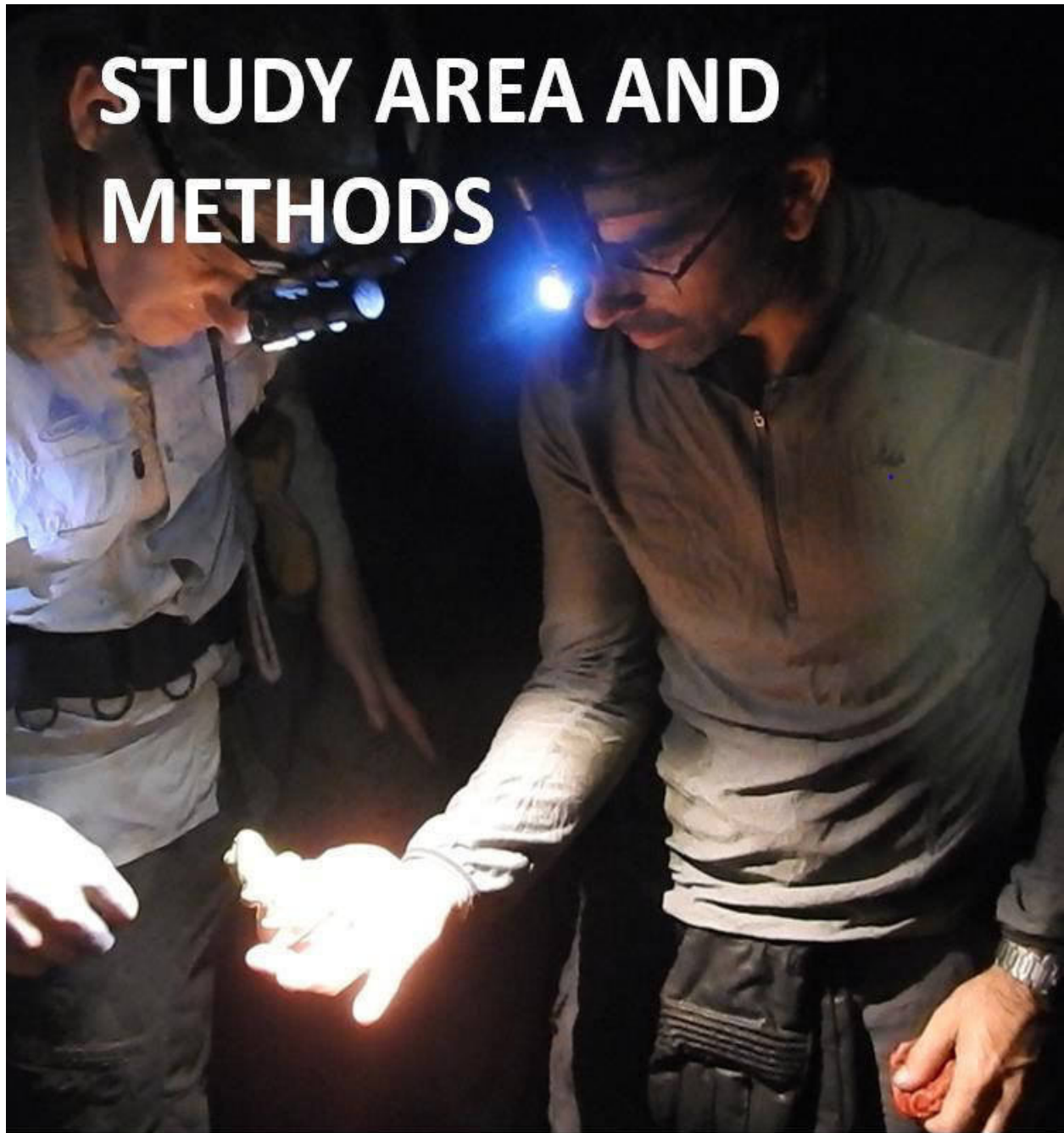
Table 1b. List of village participants in the survey and key informants

No	Names	Name of Villages	Ages	Responsibility
1	Mr. Sengvanphone	Ban Dak Dom	53	Village Chief
2	Mr. Khamson	Ban Dak Dom	58	Village Elderly
3	Mr. Khamvong	Ban Dak Dom	46	Village militia

4	Mr. Chitmany	Ban Dak Dom	39	Village militia
5	Mr. Sengnisone	Ban Dak Dom	32	Solder
6	Mr. Khamvong	Ban Dak Dreun	40	Village Chief
7	Mr. Sonenivong	Ban Dak Dreun	45	Village militia
8	Mr. Deng	Ban Dak Dreun	65	Village Elderly
9	Mr. Sone	Ban Dak Dreun	36	Teacher
10	Mr. Kham	Ban Dak Dreun	37	Villager
11	Mr. Puni	Ban Dak Dreun	26	Villager
12	Mr. Sengchanh	Ban Prao	54	Village Chief
13	Mr. Thongchanh	Ban Prao	65	Village Elderly
14	Mr. Vong	Ban Prao	29	Village Youth
15	Mr. Mith	Ban Prao	18	Village Youth
16	Mr. Vieng	Ban Prao	21	Village Youth
17	Mr. Sydachanh	Ban Dak Ta-ork	38	Village militia
18	Mr. Sonexay	Ban Dak Ta-ork	31	Villager
19	Mr. Bounpheng	Ban Dak Kang	54	Village Chief
20	Mr. Bounhing	Ban Dak Kang	60	Villager - Eldery
21	Mr. Bounhiang	Ban Dak Kang	45	Villager
22	Mr. Chandy	Ban Dak Kang	34	Villager



Figure 2. Expert team with field assistants



IV. STUDY AREA AND METHODS

4.1 SURVEY AREA

Sekong Province is located in southern Laos, it is mountainous area and plateau at above 800m a.s.l. which is considered the Annamite Mountain Range – the southern section of the Annamite. The assessment focused in the high priority areas – of the project site in the northeast section at Ban Prao, northwest section at Ban Dak Dreun and the TL section at Ban

Dak Dom and Dak Ta-ok. This mammal, herpetofauna and plant assessment was undertaken in the priority areas of high biodiversity value of the project site for an area of 3,523 ha, of which first zone on the east of 1,189 ha and the second zone on the north of 2,134 ha. Five survey blocks were defined (16 km² per survey block), of which 2 survey blocks in the Zone A - eastern zone and other 3 survey blocks in the Zone B - northern zone (see Fig. 3).

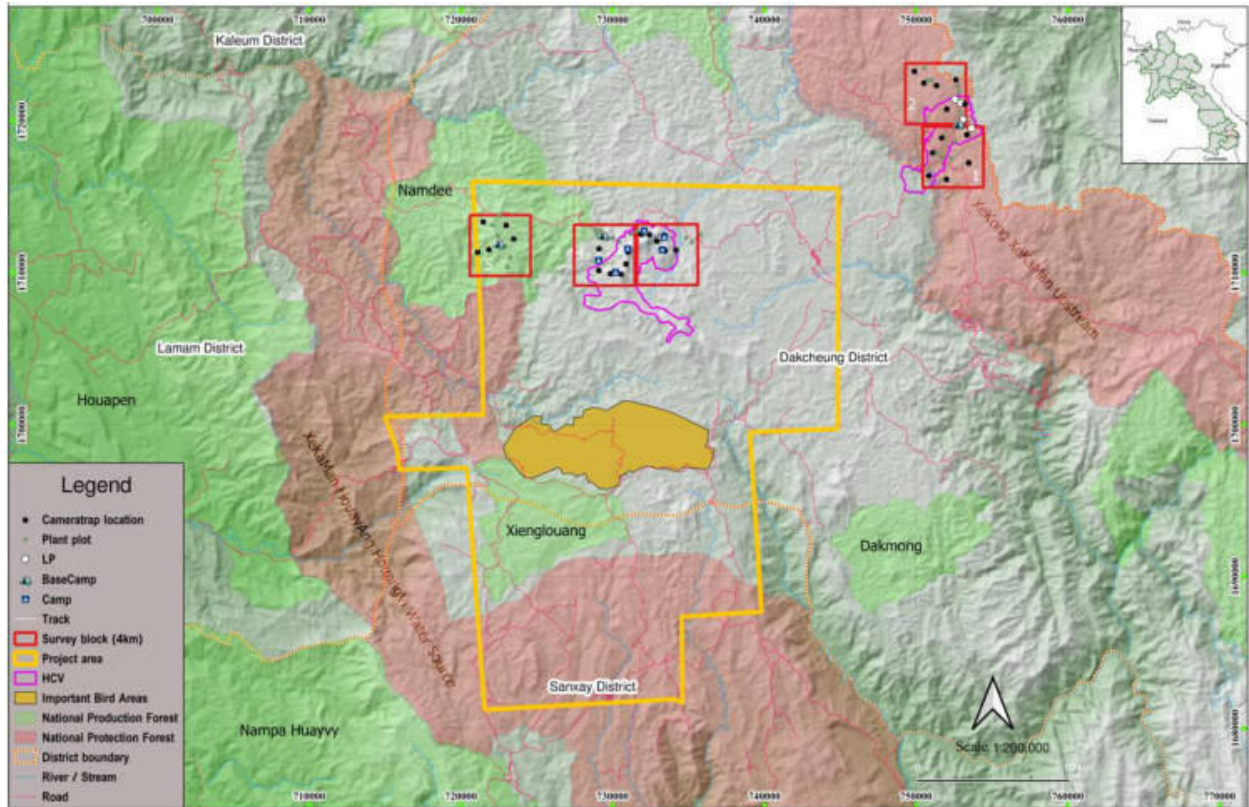


Figure 3. Survey blocks of the assessment in high conservation value areas

4.2 SURVEY METHODS

The mammal, herpetofauna and plant assessment was conducted through village interviews on wildlife information and direct field surveys.

The village interviews were conducted in those villages located relevant to the survey blocks including Ban Dak Dom, Ban Dak Ta-ok, Ban Dak Dreun, Ban Prao and Ban Dak Kang. A majority of local communities in the survey area is Tra Lieng as ethnic uniqueness which can be observed from their typical settlements and cultures. They live and spend most time in forests for collecting forest products and hunting which their knowledge in wildlife is well accepted (see Fig. 4). The knowledge gained from the village interviews was preliminary information of wildlife in the survey area for field verification, focused on globally threatened “target” wildlife species.



Figure 4. Settlement of Tra Lieng, tribal ethnic group of Dak Cheung District

The survey was designed to cover the whole priority area as to confirm where presence or absence of the target species. The field surveys for each survey block were conducted by 3 sub-teams as on mammal, reptiles and plant. Each sub-team defined different habitats of interest for the specific survey which was based on the information given from the village interviews and GIS analysis. The survey was conducted for 3-4 days per survey block for each field campaign (wet season and dry season).

Plant plot surveys were conducted to obtain a list of plant species present in survey block, where density, frequency, presence of threatened species, endemism (first records) of Laos. As plant plots were established for each survey block, a total of 30 plots in 5 survey blocks (6 plots each, 1 plot of 17.85m²).

There were three base camps as Based-Camp 1 (UTM: 752797/1719851, alt: 1,062m a.s.l) for the SB 1 and SB 2 with sub-camps and gibbon listening posts; Based-Camp 2 (UTM: 729390/1712518, alt: 1,298m a.s.l) for SB 3 (UTM: 722525/1711972, alt: 1,404m a.s.l) and SB 4 with 8 sub-camps and gibbon listening posts; and Based-Camp 3 for SB 5 with 1 sub-camp and gibbon listening posts (see Fig. 3 and Fig. 5) as detailed coordinates in Table 2a below:

Table 2a. Coordinates of base-camp and sub-camp (UTM)

No	N	E	Altitude	Name of location	Remarks
1	752797	1719851	1062	Base-Camp 1	
2	753658	1719515	1130	Listening Post 1	Not camping
3	753099	1720108	1045	Listening Post 2	Not camping
4	752926	1721182	1083	Listening Post 3	Not camping
5	752555	1721423	1147	Listening Post 4	Not camping
5	729390	1712518	1298	Base-Camp 2	
6	730994	1711565	1576	Sub-camp/Listening Post 1, SB3	
7	730192	1710031	1456	Sub-camp/Listening Post 2, SB3	
8	729078	1710805	1289	Sub-camp/Listening Post 3, SB3	
9	732071	1712767	1519	Sub-camp/Listening Post 4, SB4	
10	733414	1712349	1474	Sub-camp/Listening Post 5, SB4	
11	733277	1711503	1488	Sub-camp/Listening Post 6, SB4	
12	734131	1709338	1337	Sub-camp, SB4	
13	722515	1711972	1404	Base-Camp 3, SB5	
14	723322	1710817	1229	Sub-Camp 3, SB5	

Detailed descriptions of methodologies on village interviews, field surveys and plant plot survey by each perspective sub-team were provided as following:

4.2.1 Field Surveys

4.2.1.1 Field Surveys for Wildlife by survey block

Further from the village interviews, we obtained where target species would be present and that helped design the survey camps and transects. There were some differences of time efforts and time of observations among sub-teams as the herpetology survey was also conducted at night with night spotting for 4 hours per night from 7.00pm – 10.00pm, 3 nights per survey block.

Geographic coordinates of the survey sites, camps, transects and point counts were recorded. The date and general descriptions of habitats and micro-habitats were recorded for key individuals of wild animals encountered. There were some different techniques used for mammal, reptile and botanic surveys as following:

4.2.1.2 Survey Techniques for Mammals

Surveys for mammals were conducted by survey walk (reconnaissance) with time started from morning at 7.30am to 11.30am and late afternoon from 1.30pm to 5.30pm, but at early at 5.30am for gibbon listening posts. There were a forest walk, specific site and morning listening post (see Fig. 5). The slow-forest walk was used for general mammal survey in the forest to detect animals directly, by calls and other evidences such as footprint, tracks, scratch, dropping and calls/sounds. We walked slowly and quietly in forest, stopped for a few minutes then kept walking crossing various conditions of habitats, including fallows. Any

species' evidences found on ground and tree trunks such as tracks, droppings, scratches, hollows, claw marks, roosting sites, feeding sites etc.

The specific sites were observed along river/stream channels including water body, mineral licks and under fruit trees e.g *figus*. Any important evidences of wildlife found were photographed and collected for specimens, such as droppings so a number of small plastic bags were prepared for this purpose. With any wild animals' evidences found we used a ruler to measure the size of the evidence. Any calls of animal heard were recorded, including any noise detected from animal travel e.g monkey, sounds of fighting etc.

Camera traps (30 units) were installed in all survey blocks (6 units per block) for identifying target ground mammal species. These were set at different heights of camera trap position as from a breast height for targeting a large mammal and lower for a small mammal (see Fig. 5a – 5d). The camera traps were installed in specific locations where supposed to be used by wild animals and deployed for 5 months (see Table 2b and Fig. 3, Fig. 7 & 9).

Table 2b. Location of camera traps (UTM)

Camera trap No.	N	E	Altitude	Remarks
1	751700	1718919	1129	CAM01-Block 1 – Southern Annamite
2	751085	1717937	1120	CAM02-Block 1 – Southern Annamite
3	750847	1716442	1074	CAM03-Block 1 – Southern Annamite
4	752005	1716183	1103	CAM04-Block 1 – Southern Annamite
5	753478	1717282	1096	CAM05-Block 1 – Southern Annamite
6	753351	1719133	1147	CAM06-Block 1 – Southern Annamite
7	749888	1723299	1148	CAM01-Block 2 – Southern Annamite
8	750515	1722523	1236	CAM02-Block 2 – Southern Annamite
9	752624	1722764	1220	CAM03-Block 2 – Southern Annamite
10	753233	1721151	1095	CAM04-Block 2 – Southern Annamite
11	751349	1722368	1248	CAM05-Block 2 – Southern Annamite
12	752030	1720813	1209	CAM06-Block 2 – Southern Annamite
13	731864	1712582	1510	CAM01-Block 3 – Phou Koungking, E
14	732425	1712541	1599	CAM02-Block 3 – Phou Koungking, E
15	733417	1712501	1494	CAM03-Block 3 – Phou Koungking, E
16	732923	1712124	1574	CAM04-Block 3 – Phou Koungking, E
17	733293	1711518	1467	CAM05-Block 3 – Phou Koungking, E
18	733458	1711473	1517	CAM06-Block 3 – Phou Koungking, E
19	734176	1711527	1322	CAM07-Block 3 – Phou Koungking, E
20	731020	1711408	1615	CAM01-Block 4 – Phou Koungking, W
21	730881	1710610	1624	CAM02-Block 4 – Phou Koungking, W
22	730566	1709941	1559	CAM03-Block 4 – Phou Koungking, W
23	729860	1709973	1467	CAM04-Block 4 – Phou Koungking, W
24	729097	1710186	1205	CAM05-Block 4 – Phou Koungking, W
25	729097	1711619	1311	CAM06-Block 4 – Phou Koungking, W

26	722984	1713163	1340	CAM01-Block 5 – Phou Yai, Dak kang
27	723477	1712271	1282	CAM02-Block 5 – Phou Yai, Dak kang
28	721100	1711389	1206	CAM03-Block 5 – Phou Yai, Dak kang
29	721848	1711560	1219	CAM04-Block 5 – Phou Yai, Dak kang
30	721472	1713389	1324	CAM05-Block 5 – Phou Yai, Dak kang

Remarks: 7 camera traps for SB3 due to some species of interest while only 4 camera traps for SB5.

Nonetheless, this was not a systematic or grid system designed for setting up the camera traps due to a small number of camera traps available and the purpose was to assist in identifying additional species. We set up these camera traps for 5 months (Jul-Dec) which supposed to have 4,500 trap days, but some camera traps did not work well. Therefore, 3,233 trap days from 29 cameras were successful and partly successful.

In principle, for 3,233 trap days is possible to capture some species with reasonable distribution. But, the species with very low population would not be captured from camera trapping in short period. It is suggested that the minimum trapping effort on camera traps for 20 ha requires 913 trap-nights (Si *et al.*, 2014) and for the case of our survey area, ca. 500 ha as most potential habitats – the core with intact forest habitats, along the Lao-Vietnam border and the Phou Koungking where the target terrestrial species would be present. If the effort for 2 years with 30 camera traps for these potential habitats can confirm presence or absence of the GT and or rare species in the area.



Figure 5a. Field activities of the assessment



Figure 5b. Field activities of the assessment_sub team to sub-camp



Figure 5c. Field activities of the assessment_camera trap collection



Figure 5d. Field activities of the assessment_field data collection

4.2.1.3 Survey Techniques for Herpetology

The survey for herpetology was conducted in a point count for daytime and for night spotting. The daytime survey usually started from morning at 8.00am to 11.30am and late afternoon from 2.00pm to 5.30pm and night survey from 7pm to 10pm. During day time the designed survey camps survey team searched in various micro-habitats for the amphibian and reptile species. There were various species of frogs and small reptiles including forest frogs, lizard and snakes, in particular. The team searched for the animals under cover on ground, water and trees carefully in each survey block. The main micro-habitats for this taxon that were searched along riverbanks, stream banks, river bushes, bushes around adjacent ponds and wetlands where possible. Where by riverine, any debris, wood or tree that has risen from the water surface were surveyed to detect water monitor, for example. Catching amphibians with barehand in gloves and the main tools used for capturing snake with snake tongs. Collecting some unfamiliar reptile species for detailed identification and photographing in camps with collecting specimen in tissue for DNA analysis.

4.2.1.4 Survey Techniques for Plants and other flora

The plant survey was conducted to obtain if any important and conservation significance plant species in the survey area by listing plant species with their densities and frequencies, threatened species and endemic species, by survey block. A total of 30 plant plots in 5 survey blocks were conducted (see Table 3). On average elevation of 1,312m a.s.l., which ranges from 1,029m a.s.l., of the Survey block 1 to 1,615m a.s.l., of the Survey block 3.

Table 3. Location of plant plots by survey block (Coordinates)

Survey Block	Plant Plot	UTM		Coordinates		Altitude
		X	Y	N	E	
SB1	1	752943	1719617	15°32'29.5"	107°21'29.7"	1,033
	2	752607	1718678	15°31'59.1"	107°21'18.1"	1,029
	3	752318	1717523	15°31'21.6"	107°21'08.0"	1,054
	4	751395	1717920	15°31'34.8"	107°20'37.2"	1,098
	5	751734	1717636	15°31'25.5"	107°20'48.5"	1,067
	6	752607	1719693	15°32'32.1"	107°21'18.5"	1,075
SB2	1	750740	1722688	15°34'10.1"	107°20'17.0"	1,242
	2	750569	1723483	15°34'36.0"	107°20'11.5"	1,224
	3	751025	1722672	15°34'09.5"	107°20'26.5"	1,248
	4	752726	1722359	15°33'58.7"	107°21'23.5"	1,184
	5	752836	1721953	15°33'45.5"	107°21'27.0"	1,166
	6	752943	1720599	15°33'01.4"	107°21'30.1"	1,048
SB3	1	734837	1712290	15°28'37.4"	107°11'19.9"	1,257
	2	735209	1712032	15°28'28.9"	107°11'32.2"	1,350
	3	735792	1712515	15°28'44.4"	107°11'52.0"	1,351
	4	731614	1712736	15°28'53.0"	107°09'31.9"	1,423
	5	731869	1712562	15°28'47.3"	107°09'40.4"	1,510

	6	732041	1712500	15°28'45.2"	107°09'46.2"	1,615
SB4	1	728886	1712825	15°28'56.8"	107°08'00.5"	1,273
	2	728974	1712562	15°28'48.2"	107°08'03.3"	1,241
	3	729218	1712797	15°28'55.8"	107°08'11.6"	1,309
	4	730017	1712249	15°28'37.7"	107°08'38.2"	1,386
	5	730445	1712019	15°28'30.1"	107°08'52.5"	1,386
	6	731205	1712548	15°28'47.0"	107°09'18.1"	1,407
SB5	1	723071	1710374	15°27'38.9"	107°04'44.6"	1,299
	2	723254	1710986	15°27'58.8"	107°04'51.0"	1,270
	3	722916	1711735	15°28'23.2"	107°04'39.9"	1,347
	4	722424	1712428	15°28'45.9"	107°04'23.6"	1,422
	5	722080	1713133	15°29'09.0"	107°04'12.3"	1,446
	6	722534	1713764	15°29'29.4"	107°04'27.7"	1,405

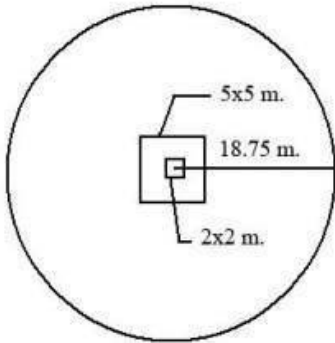
General descriptions of the habitat types by survey block as below:

Survey Block	General description of habitat types	Localities
SB1	Habitat types found in the Survey block 1 were Upper Evergreen Forest and degraded forest as some portions of fallows and agricultural land were found in the central section of the survey block area.	Ban Dak Dom and Ban Dak Ta-ok.
SB2	Habitat types found in the survey block 2 were mainly Upper Evergreen Forest and some degraded forest as some portions of fallows and agricultural land were found in the southwest section of the survey block.	Ban Dak Dom.
SB3	Habitat types found in the survey block 3 were mainly Upper Evergreen Forest (as Montane Evergreen Forest is identified for Phou Koungking) and some degraded forest as some portions of fallows and agricultural land were found in the southern section of the survey block.	Ban Dak Dreun
SB4	Habitat types found in the Survey block 4 were Upper Evergreen Forest (as Montane Evergreen Forest known Phou Koungking) and some degraded forest as some portions of fallows and agricultural land were found in the western section of the survey block.	Ban Prao
SB5	Habitat types found in the Survey block 5 were Upper Evergreen Forest and largely degraded forest – a high portion of fallows and agricultural land were found mainly in the southern section of the Survey block.	Ban Prao and Ban Dak Kang

For each survey block has 6 plant plots (0.1ha each) with a small plot (5x5m) for saplings, and a smallest plot (2mx2m) for herbs and grasses.

Design for Data Collection by Sampling

Plant species and family, number of seedlings, and undergrowth vegetation were recorded as moss, herbs, fern etc. Some important information such as tree species, tree family, its DBH, total height and also specific type of climbers, shrubs, ferns, mosses, herbs and bamboo species, including the number of clumps and its stems per clump. On that account, sampling plant plot consists of 3 types of temporary plots as.



- A circular sample plots with a radius of 17.85 meters (or 0.1 ha): data of trees which are diameter at breast height (DBH) ≥ 10 centimeters were recorded. Other significant information was recorded and measured such as tree species, DBH, total height, timber quality and bamboo species, including number of clumps and stems per clump.
- Square plots of 5x5 meters (25 square meters or 0.0025 ha) were established in the middle of the circular plots. Information of small trees and/or saplings (trees whose DBH < 10 centimeters and whose height > 1.3 meters), tree species, number of trees, and height, as well as NTFP species were recorded from these plots.
- Square plots of 2x2 meters (4 square meters or 0.0004 ha) were established within the larger square plots of 5x5 meters. Data concerning plant species, number of seedlings, and undergrowth vegetation was recorded.

Descriptions of habitat and data of each survey block were collected using DAFOR⁵ form as following:

- Unique ID reference for the survey block
- Plot size used; location with latitude and longitude coordinates.
- Date and time of survey and Name of surveyors
- General description of the vegetation:
 - habitat types, dominant species of higher plants
 - maximum and mean height of vegetation
 - vegetation cover (%) and water cover (%)
 - area of bare ground (%)
 - for forest – approximate age and height of main canopy).
- A condition score of each survey block.
- Presence/absence of Red-listed species or other critical habitat triggers
- Presence/absence of alien invasive species.
- Additional remarks and comments (if necessary)
- Photographs to show the location of the plot and to illustrate the habitat type/key species present.

⁵ DAFOR: D - Dominant, A - Abundant, F - Frequent, O - Occasional, R - Rare.

In addition, during the dry season, additional information to support some important plant species⁶ such as flowers and fruits were collected. As well as obtained their distributions in the survey area beyond the plant plots.

Specimen Collection

Specimens of some important plant species that could not be identified in the field are essentially important which were used for further species identification and reference for publication. The specimens were wrapped using newspapers and kept properly, most tree leaves were kept in good shape. They are kept in suitable room condition in the Herbarium of the Faculty of Forestry, NUoL with numbering (see Fig. 6b).

4.2.2 Threat Collection

All key threats found were recorded and photographed as to understand the current level of threats for particular taxon, ecosystem and the survey area. Type of threats were recorded where any evidences of timber logging e.g stumps, logs, camps, hunting camps, hunters, gunshot, snares, people, cattle in forests etc.

4.2.3 Survey effort

Five survey blocks were defined and each SB of 16km² (4km x 4km), covering the whole part of the high priority area of biodiversity. For the terrestrial survey, a team of 13 personnels⁷ with other 4 assistants, made a total of 17 personnel which were divided into 3-4 sub-teams at a time for each SB, but varied from survey block to survey block. As on average of the survey effort in a total of 595 man-days for both wet and dry season or 119 man-days per survey block. In addition, the survey effort with assistance from camera trapping which was installed for 5 months (14/7-14/12) of 30 camera traps for 4,500 trap nights but effectiveness of 71% of 3,233 trap nights⁸. Therefore, the survey effort is considered cover well enough in the survey area (see Fig. 6a-1 & 6a-2).

4.3 DATA PREPARATION AND ANALYSIS

4.3.1 Data Preparation

All information gained from survey blocks and sampling plots were entered into data sheets for making ease for basic analysis and data entry for any analysis program. For plant, a total of 30 plant plots in 5 survey blocks as 6 plant plots were consolidated for each survey block and present by survey block. Nonetheless, only the tree species with a size of DBH \geq 10 cm were used for the analysis and made in number of the tree species listed in the DAFOR data form. Although some non-tree species were not used for the analysis, they were cumulatively listed for the total species account by plant plot (see Annex 1b).

⁶ *The important plant species are those defined globally threatened species as well as possible new species and first records of Laos.*

⁷ *This figure excludes the botanic team*

⁸ *This figure excludes the camera traps of disfunction and partly function.*

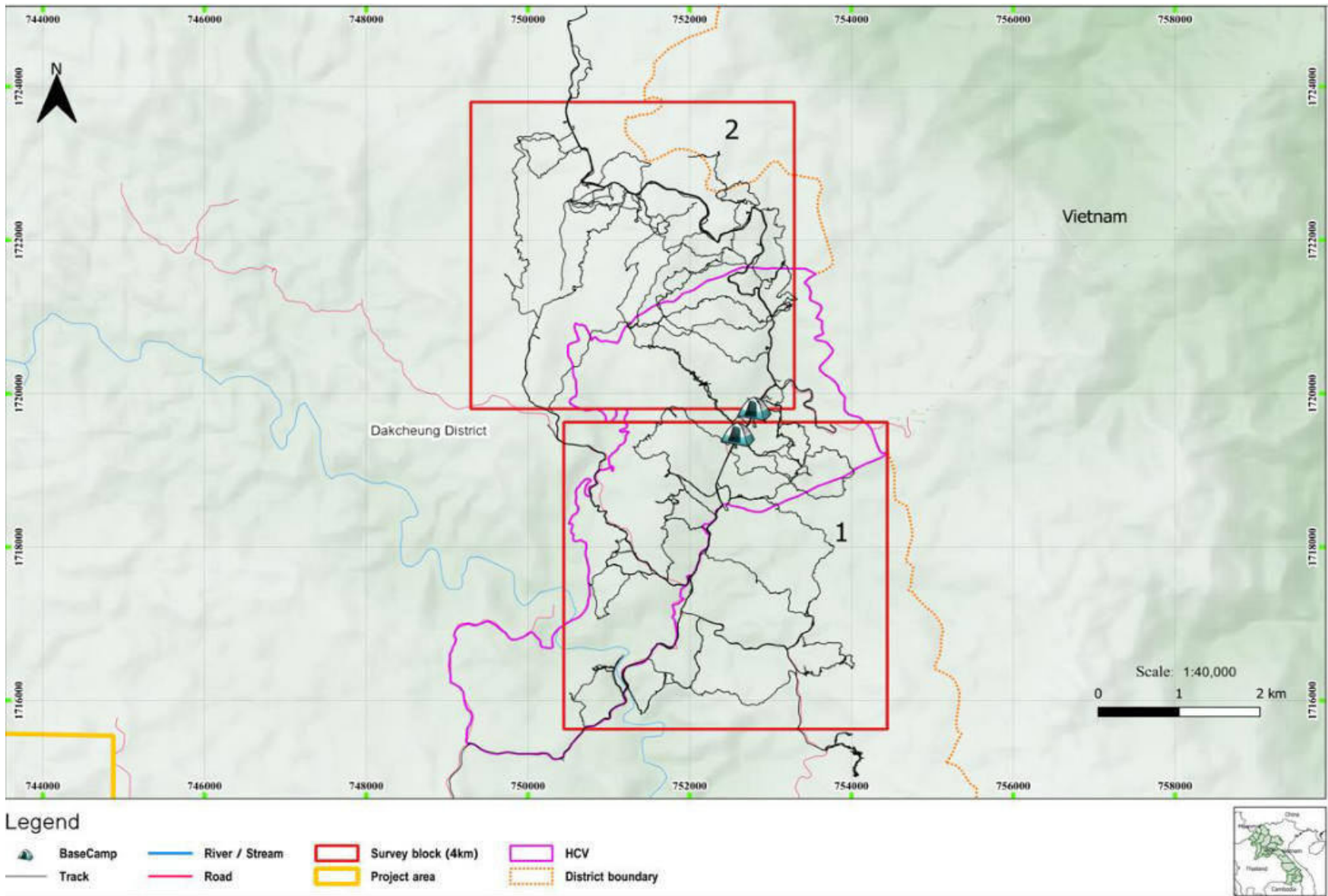


Figure 6a-1. Survey tracks of the survey area for Zone A – Eastern Zone

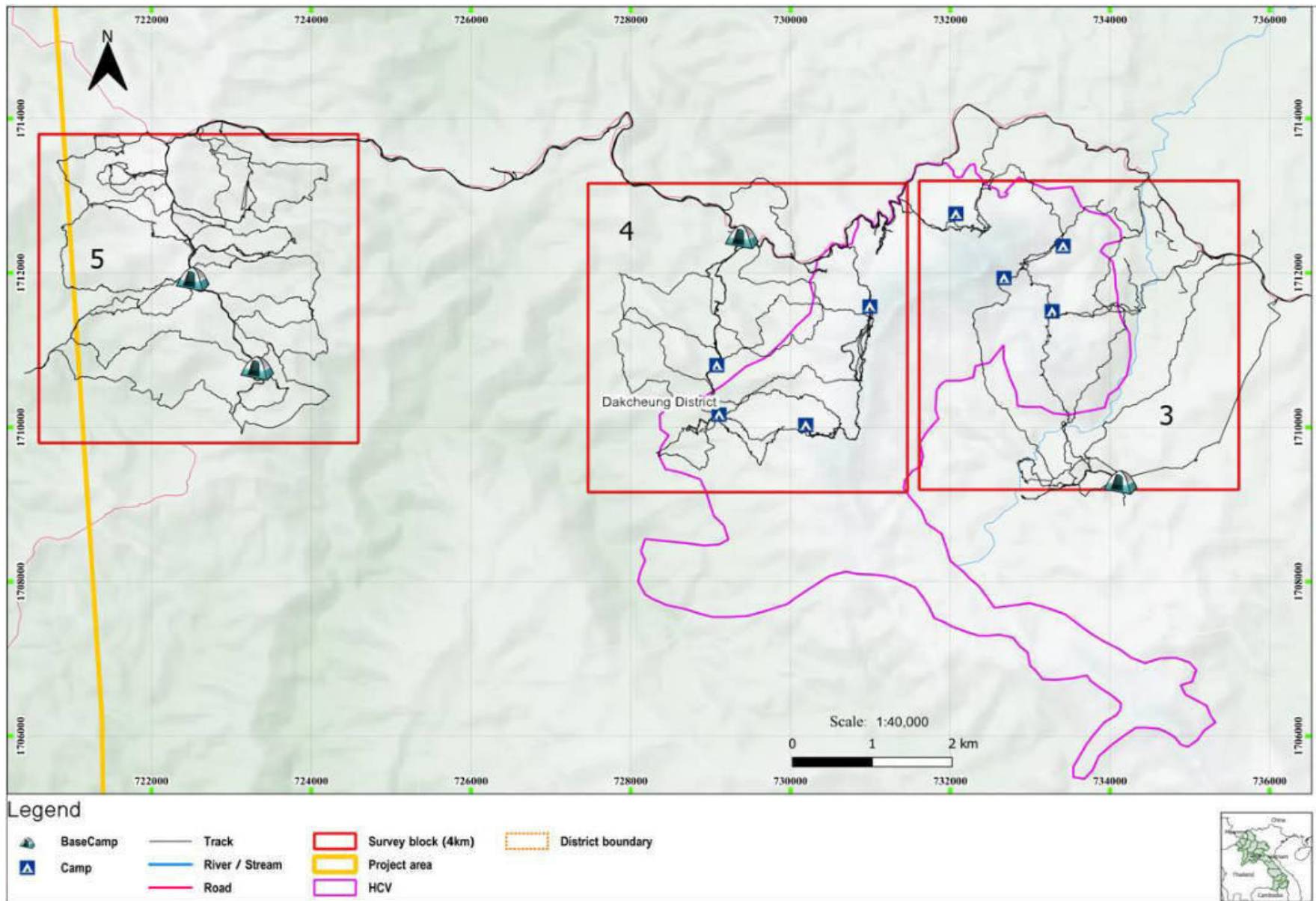


Figure 6a-2. Survey tracks of the survey area for Zone B - Northern Zone

4.3.1.1 Species Identification

Species Identification: in general, all species encountered in the field, any evidences, photos and specimens were identified, using field guides, double checked and discussed with relevant experts when identification of the species were unsure. For flora, the plants were identified using guidebooks. Some species which were not familiar their specimens were collected to compare with specimens available at the herbarium of the National University of Laos (NUoL), Faculty of Forestry. Specimens of plant species were collected, dried in oven, piled in stack and numbered them according to the recording system of the Faculty of Forestry's Herbarium, NUoL which can be revisited for double checking in case of needs for publishing (see Fig. 6b).

For some specimens of uncertainty were checked with international network of experts such as the expert teams of Royal Botanic Garden of Edinburgh, Scotland; Kagoshima University of Japan, Kyusu Open University, Singapore Botanic Garden, Da Lat University of Vietnam, Forest Herbarium of Thailand and Kasetsart University of Thailand (see Annex 10), using photos of the specimens – tree leaf structures for identification.

For first records of plants were checked with external experts and that still some ongoing as some species need some additional supports such as fruits and flowers which were collected and confirmed the same status. For the possible new species to science were checked with external experts of these institutes as some of them were principally confirmed. These possible new species will be officially adopted upon their publications and that will take for 2 years at least.

As well as the herpetofauna, specimens of some herpetofauna species were collected in samples and tissue for DNA analysis and stored at the Faculty of Natural Sciences, NUoL. These specimens - the possible new reptile species are in the process of shipping to North Carolina Museum of Natural Sciences, USA, under the cooperation between NUoL and the North Carolina Museum of Natural Sciences. For first and second records of reptiles were checked with external experts and that still ongoing and in preparation for publication.

It will take time for DNA analysis, as these possible new species will be officially adopted upon their publications and that will take for 2-3 years. Therefore, we prefer them for the time being in the state of possible new species or first records of Laos for the report.

4.3.1.2 Species Records and Listing

The species records were made with GPS coordinates, mainly for important fauna and flora as not only Globally Threatened (GT) species but also Near-Threatened and Endemic species such as first records of Laos, second records of Laos and possible new species (see Annex 3).

The species recorded, including some of them from reliable village reports were listed for the area and arranged by survey block and plant plot. Each species was checked if it is globally threatened, nationally important, first records of Laos/ endemic species or possible new species to science. The GT species were confirmed in the field can be listed in bold **X** (see Table 14b), if only reliable village report can be also listed but not in bold **X**.



Figure 6b. Specimens of plants with numbering at NUoL

The list of fauna species in this report includes some few species from reliable village reports⁹ but the list of GT species did not include those GT species from village reports, the GT species must be confirmed in the field. It is because the GT species are globally concerned if there are with some reasonable populations¹⁰ in the survey area some potential negative impact on the species and their habitats must be described and precautions as prevention and mitigation measures must be in place.

4.3.2 Analysis

The spreadsheet data were used for basic calculations to obtain a list of species presence by Survey block from direct field observations. This was used to obtain frequency of species detection. As the species encountered were rated with an estimate for their current status of low (+), medium (++) and high (+++), also gave if that was found in any evidence, seen or

⁹ Reliable village report is the provisional data from local villagers with their confidences as it was reported from more than one village with more villagers reported the species presence and so it was given a rate of at least medium (M).

¹⁰ The species with a reasonable population for this context is meant that the species with some viable population as frequency of encounters during the survey was not low – at least 3-4 encounters from short field visits.

detected during the surveys for Occasional (O), Frequent (F), Common (C); however, for the village report of confidence was rated of Low (L), Medium (M), High (H).

For the plant species identifications were conducted in association with botanic networks regionally and internationally. For the species status were analyzed using statistic techniques to obtain density, frequency and abundance. The equations below were used to develop a series of indices (Curtis and McIntosh, 1950):

$$\text{Density (D)} = \frac{\text{Total number of individual tree species}}{\text{Total number of sampling plots studied}} \quad (\text{no/ha})$$

$$\text{Relative Density (RD)} = \frac{\text{Total number of individual tree species}}{\text{Total number of individuals of all species}} \times 100$$

$$\text{Percentage Frequency (PF)} = \frac{\text{Total number of sampling plots which species occurred}}{\text{Total number of sampling plots studied}} \times 100$$

$$\text{Relative Frequency (RF)} = \frac{\text{Total number occurrence of tree species}}{\text{Total number occurrence of all species}} \times 100$$

$$\text{Abundance (AB)} = \frac{\text{Total number of individual tree species}}{\text{Total number of sampling plots of occurrence}}$$

For camera trapping, a free and open-source R package camtrapR was used for data analysis using a new toolbox for flexible and efficient management of data generated in camera trap-based wildlife studies. The result of the analysis was shown in abundance and frequency.

4.4 MATERIALS AND EQUIPMENT

Materials and equipment for the survey were binoculars (4 pairs), cameras (4 units) with good shooting lens capacity, GPS (4 units), Camera trap (30 units), battery Alkaline (3A), Field Guides (mammal, bird, reptile and plants), Data Forms (various forms for each sub-team), absolute alcohol for reptiles, torches, snake tongs, poles (15m) for tree leave collection, scoop nets, newspapers for plant specimen collection, plastic bags, gloves, tents, camps etc.

FINDINGS OF THE ASSESSMENT



5 FINDINGS OF THE ASSESSMENT

5.1 HABITATS

The whole survey area was mainly Evergreen Forest with sub-forest type to Upper Evergreen Forest since its elevation above 1,000m a.s.l., and specially for the elevation of

above 1,500m was Montane Forest. The forest habitats of the survey blocks were mainly original forest but some portions of the area were degraded as considered secondary forest and fallows which were found in patterns, including some small coffee plantation in the SB1, and agricultural land – shifting cultivation.

5.1.1 Habitats of Survey block 1 (Southern Annamite)

Habitat types found in the Survey block 1 were Upper Evergreen Forest (UEF) and degraded forest as some portions of fallows and agricultural land were found partly in the central section of the survey block, along the road. The paved road from Dak Cheung town to Lao-Vietnam Checkpoint (Dak Ta-ok¹¹) runs through the north portion of this survey block. The original forest was found on east, northeast and northwest of the Survey block. The most relevant villages in the SB1 were Ban Dak Dom, Dak Ta-ok and 1 military camp. Photos of the forests and forest habitats were taken from the SB1 (see Fig. 7), with examples of forest structures and forest characteristics shown in location numbers from 1.1 to 1.6 accordingly (see Fig. 8a; Annex 5).

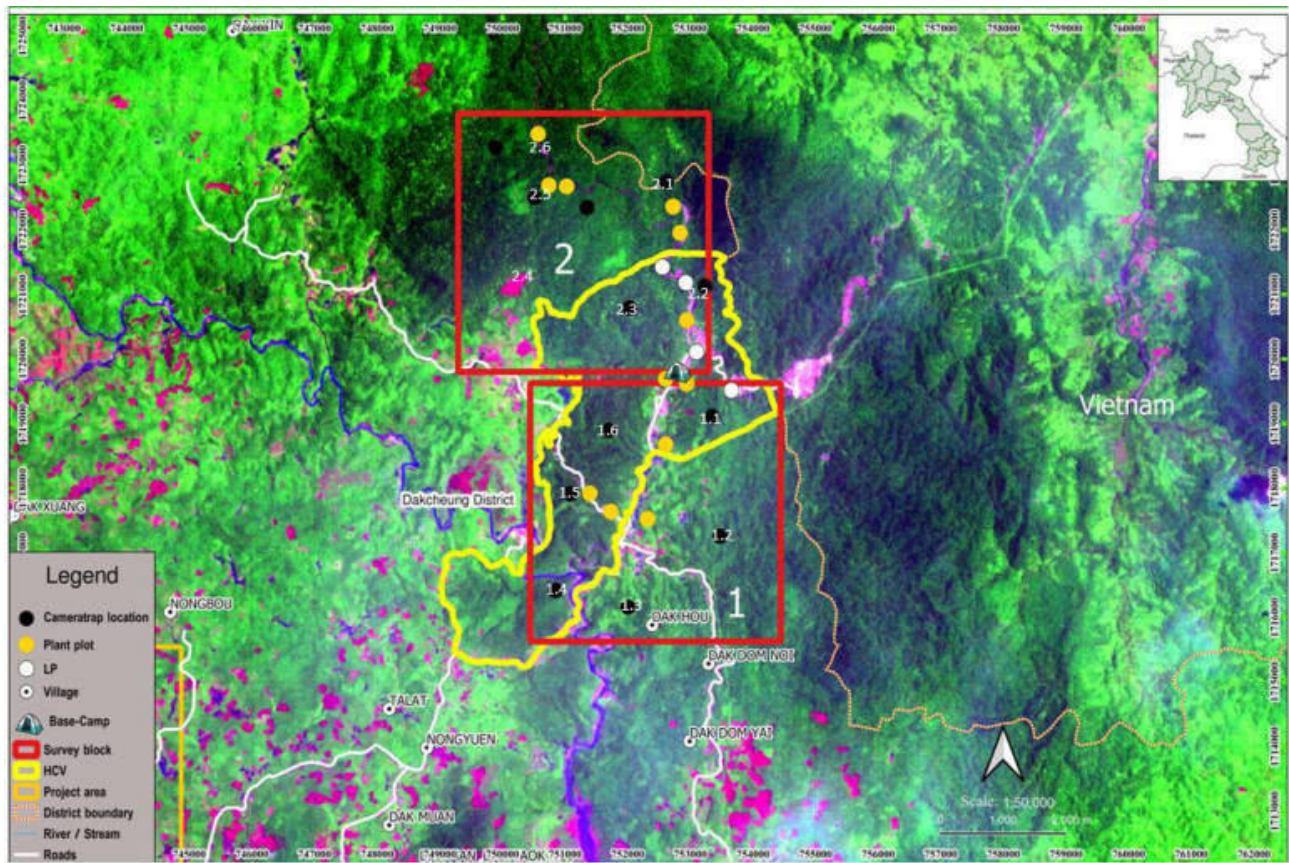


Figure 7. Survey block 1 and 2 with numbers of forest habitat conditions

¹¹ This border checkpoint (Dak Ta-ok) is a local checkpoint but it is under the process for upgrading to an international checkpoint.



Figure 8a. Survey block 1 with examples of forest structures

5.1.2 Habitats of Survey block 2 (Southern Annamite)

Habitat types found in the survey block 2 were mainly Upper Evergreen Forest with some portions of secondary forest and degraded forest as fallows and agricultural land were found in the southwest section of the Survey block (see Fig. 7), with examples of forest structures shown in location numbers from 2.1 to 2.6 accordingly (see Fig. 8b).



Figure 8b. Survey block 2 with examples of forest structures

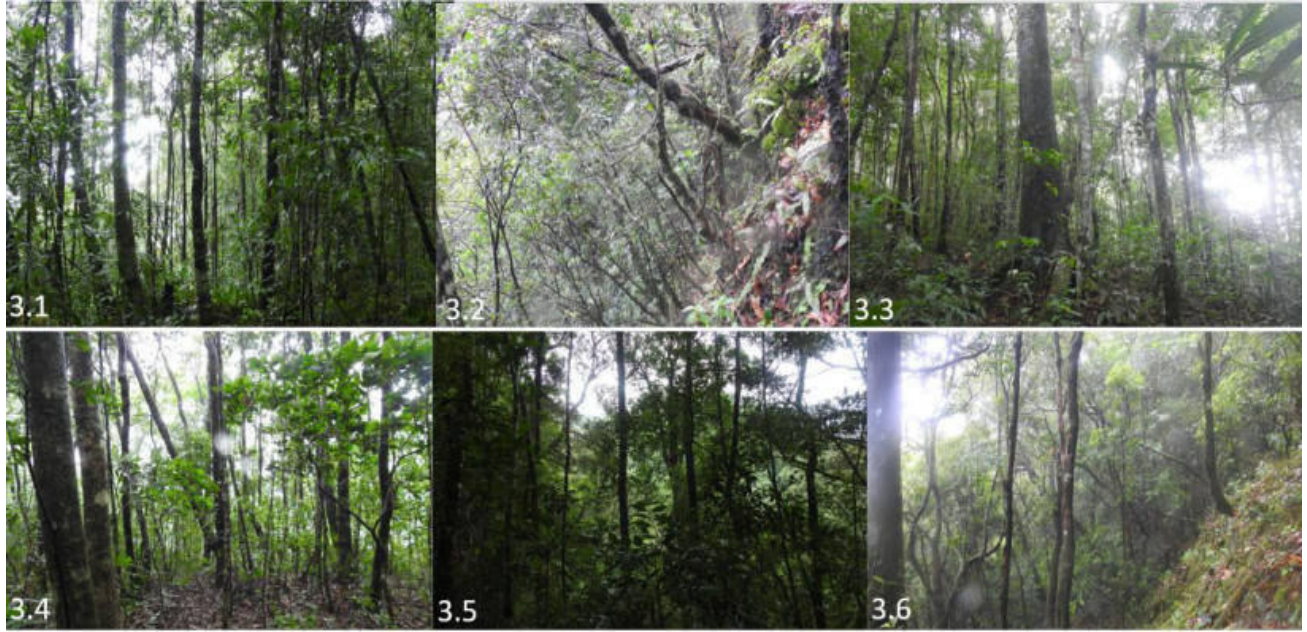


Figure 10a. Survey block 3 with examples of forest structures



Figure 10b. Survey block 4 with examples of forest structures

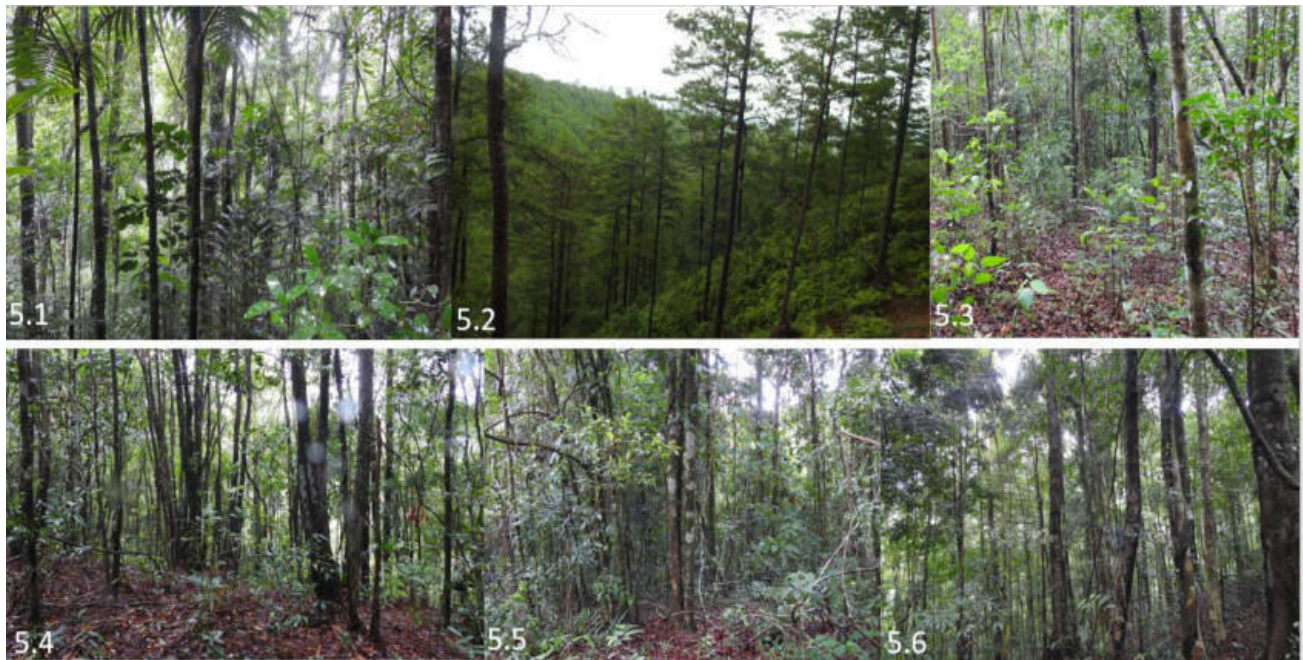


Figure 10c. Survey block 5 with examples of forest structures

5.2 OVERVALL FINDINGS OF FLORA AND FAUNA SPECIES

Wildlife and flora species were recorded in the survey area, made a total of 653 species (115 fauna, and 538 flora species), of which, 44 mammals, 29 reptiles and 42 amphibians. However, only tree species count made a total of 365 species (115 fauna, and 250 tree species), of which, 44 mammals, 29 reptiles and 42 amphibians (see Table 4). Therefore, 250 tree species were recorded for plant analysis, the rest were non-tree species count and some were partly outside the plant plots within the Survey blocks and they were not used for the plant analysis. This figure for the fauna species included some species from reliable village reports such as Python and Cobra that the local villagers used to collect them.

The number of species encounters in the survey area which were divided by different taxa on different categories for species in a total, field confirmed, globally threatened species and the species were photographed (see Annex 2).

A total of 23 Globally Threatened species were confirmed in the field as 14 mammal, 6 reptiles, 1 amphibian and 2 plant species. Other GT species were listed from the village interviews with insufficient provisional information and not confirmed for the GT list such as Elongate Tortoise, Keeled Box Turtle, Asiatic soft-shell turtle, Dhole, Binturong and Pygmy Loris.

Plant: A total of 626 records, representing 538 species from 178 families (including non-tree species), of which 250 tree species and 58 families were recorded. The numbers of species count also included some species were found outside the plant plots to generate a full list of plants in the perspective survey area. Non-tree species were just counted but not used for the analysis.

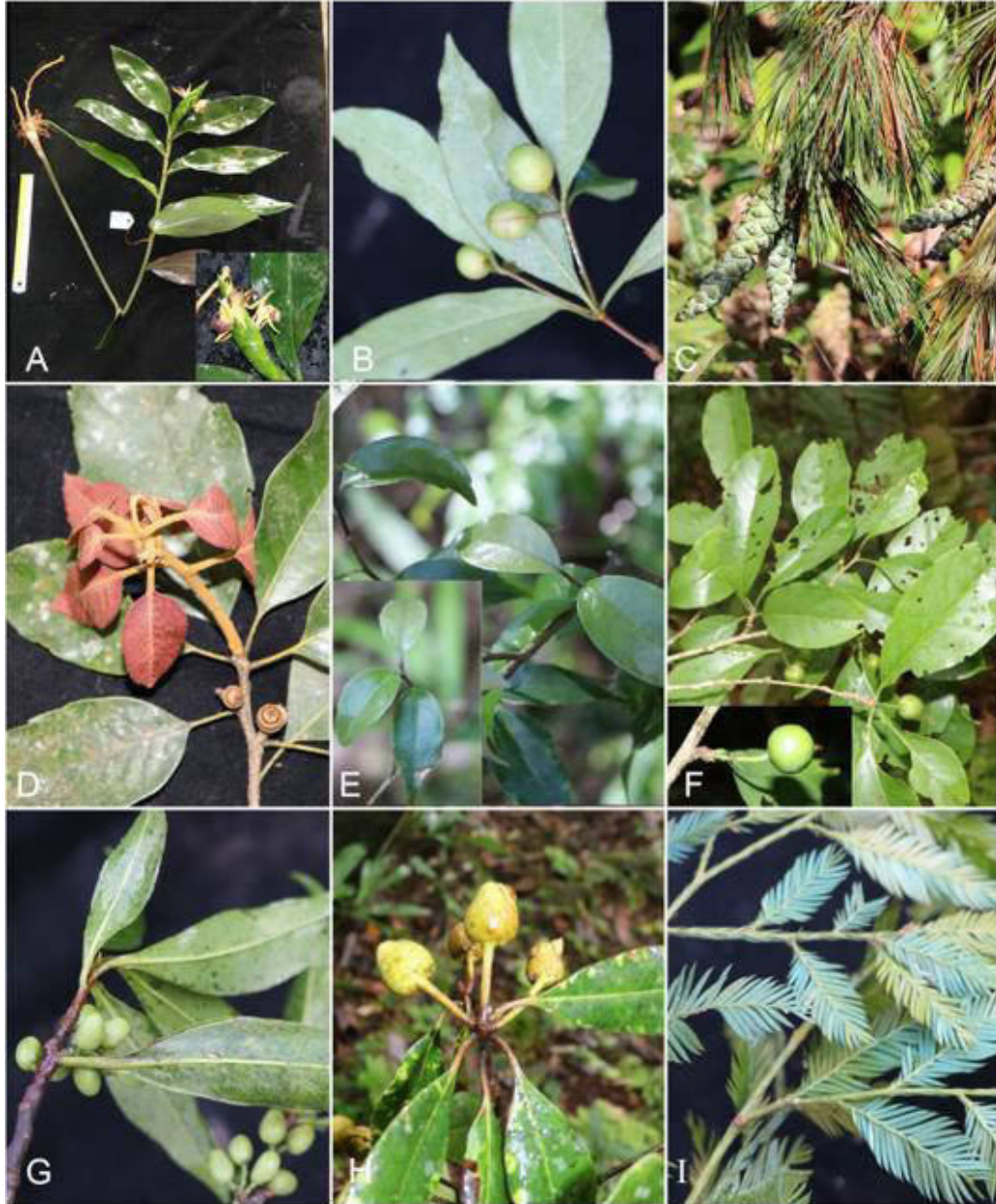
Table 4. Summary of wildlife and tree species by taxon category and survey block

Taxon	Survey Blok 1					Survey Blok 2					Survey Blok 3					Survey Blok 4					Survey Blok 5					Summary				
	Total	Field Confirm.	GT species	Common	Photo	Total	Field Confirm.	GT species	Common	Photo	Total	Field Confirm.	GT species	Common	Photo	Total	Field Confirm.	GT species	Common	Photo	Total	Field Confirm.	GT species	Common	Photo	Total	Field Confirm.	GT species	Common	Photo
Plant (tree)	72	72	0	72	72	68	68	0	68	68	32	32	1	32	32	28	28	1	27	28	50	50	1	49	50	250	250	2	248	250
Bird																														
Mammal	37	26	6	19	16	43	32	8	23	14	40	26	9	17	16	42	28	8	21	16	42	33	6	25	27	59	44	14	33	26
Reptile	10	8	3	5	8	14	11	5	6	7	21	15	3	12	12	17	16	4	12	13	11	11	4	7	8	32	29	6	23	26
Amphibian	13	13	0	13	13	12	12	0	12	12	17	17	0	16	16	16	14	1	13	13	12	12	0	12	13	41	42	1	41	42
Fish																														
Total	132	119	9	109	109	137	123	13	109	101	110	90	13	77	76	103	86	14	73	70	115	106	11	93	98	382	365	23	345	344

Remarks: GT reptile species from the reliable village reports were not included on the GT confirmed list here.

The result showed that the Rubiaceae, Lauraceae and Fagaceae, Annonaceae and Febaceae were the dominant families with 83 species. Tree species richness was found in lower elevation such as SB1 and SB2 as ca. 72 and 68 species per hectare whereas higher elevation such as SB5, SB3 and SB4 were relatively low species richness: 50, 32 and 28 species, respectively. A total of only 2 Globally Threatened species were identified in the survey blocks (see Fig. 11a). Excitingly, 10 possible new species to science were recorded, and 29 first records of Laos were found in the survey blocks, mainly in Survey block 2 (see Table 5c, Fig. 11b and 11c).

Mammal: a total of 59 mammal species were reported for their presence but only 44 species (14 GT) were confirmed their presence in the Survey blocks. The fauna species that were directly confirmed in the field with evidences from the field assessment, both direct observation, evidences of tracks, dropping and feeding sites which were photographed (see Fig. 12a, Annex 6 and 7) and many of them from camera trapping (see Fig. 12b and 12c, and Annex 7). A majority of the GT mammal species were of a low population, except Pangolins in the survey block 2 and Chinese Serow in the survey block 3 and 4. As 13 globally threatened mammal species were directly confirmed in the field: Northern buff-cheeked Gibbon (*Nomascus annamensis*, EN), Red-shanked Douc Langur (*Pygathrix nemaeus*, CR), Chinese Pangolin (*Manis Pentadactyla*, VU), Sunda Pangolin (*Manis javanicus*, CR), Stump-tailed Macaque (*Macaca arctoides*, VU), Northern Pig-tailed Macaque (*Macaca leonina*, VU), Sambar (*Rusa unicolor*, VU), Chinese Serow (*Capricornis milneedwardsii*, VU), Sun Bear (*Helarctos malayanus*, VU) and Asiatic Black Bear (*Ursus thibetanus*, VU), Great Hog Badger (*Arctonyx collaris*, VU) and Smooth-coated Otter (*Lutrogale perspicillata*, VU).



A. EN, and First Record: *Zingiber mellis*; **B.** VU: *Pittosporum pauciflorum*; **C.** NT: *Pinus dalatensis*; **D-E.** Data Deficient (DD): **D.** *Quercus thorelii* and **E.** *Stewartia laotica*; **F-I.** Least Concern species (LC): **F.** *Ilex chapaensis*; **G.** *Symplocos wikstroemiiifolia*; **H.** *Anneslea fragrans*; and **I.** *Dacrycarpus imbricatus*.

Figure 11a. Some globally and near-threatened plant species



Figure 11b. Some first records of plant species of Laos from Dak Cheung



Figure 11c. Some possible new plant species of Laos from Dak Cheung



Figure 12a. Some photos and evidences of important mammal species

Yet, some other GT species were reported but insufficient support information from the field survey to confirm their presence such as Annamite Striped Rabbit (*Negolagus timminsi*, EN), Indochinese Silvered Leaf Monkey (*Trachypethicus germaini*, EN), Binturong (*Arctictis binturong*, VU) and Pygmy Slow Loris (*Nycticebus pygmaeus*, EN). Overall, populations of the mammal species in the survey area are low except some reasonable populations of Pangolins in the SB2 and Chinese Serow in SB3 & SB4. More wildlife species were recorded from camera trapping (see Annex 7), with some photographs including some important bird species (see Fig. 12b and 12c).

Herpetology: a total of 71 herpetofauna species, of which 42 amphibian and 29 reptile species were confirmed from the field surveys. There were 2 GT species of herpetofauna confirmed from the field as Red River Krait (*Bungarus slowinskii*, VU) in SB2 and Serrate Frilled Treefrog (*Kurixalus cf gryllus*, VU) in SB4. Interestingly, 4 reptile species were first record of Laos, 2 reptile species were second record of Laos and 3 species have not been described yet, they are possible new species to science (see Fig. 13a and 13b).



Figure 12b. Some photos of mammal species from camera trapping

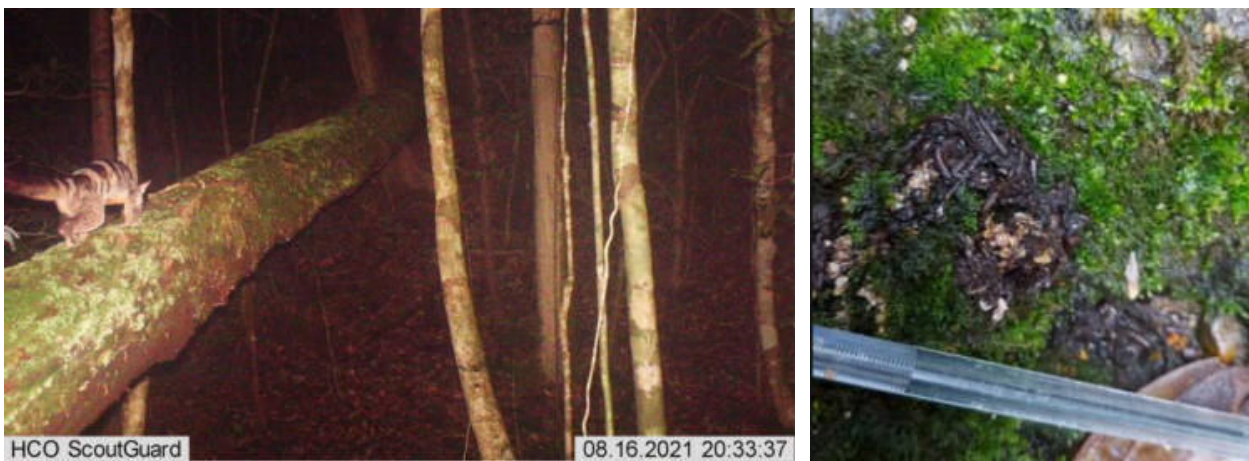


Figure 12c. Owston's Civet (EN) and dropping of Smooth-coated Otter



A. Serrated Frilled Treefrog *Kurixalus cf. gryllus* (VU) – first record in Laos; **B.** Truong Son Bug-eyed Frog *Theioderma truongsongense* – first record in Laos; **C.** Horned Bush frog *Gracixalus supercornutu*; **D.** Green snake *Trimeresurus vogeli*; **E.** Spiny torrent frog *Amolops spinapectoralis* – first record in Laos; **F.** *Limnonectes cf. poilani* – first record in Laos; **G.** Mountain wolf snake *Lycodon ruhstrati*; **H.** Green tree frog *Zhangixalus feae*; **I.** Han's Horned Frog *Ophryophryne hansii*; **J.** Inger's treefrog *Rhacophorus robertingeri*; **K.** *Ophryophryne cf. poilani*; **L.** *Xenophrys cf. maosonensis*

Figure 13a. Some first records of herpetofauna species from Dak Cheung



Carapace of Impressed Tortoise and Chinese Soft-shell Turtle (VU)

Figure 13b. Some photos of turtles from the villages