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Impact of Singareni Coal Mines in Sustaining and Enhancing the Herpetofaunal Assemblage in the Eastern Ghats of Lankapally Reserve Forest of Sathupally Forest Range in Khammam District, Telangana State

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Abstract:

Mining has an effect on biodiversity and the environment throughout the life of a project, both directly and indirectly. These impacts from mining can result from any activity that involves land/forest clearance or direct discharges to water bodies or the air. Despite the significant potential for negative impacts on biodiversity/wildlife from mining operations, there are many opportunities for a mining company to enhance wildlife conservation within their areas of operations. In general, the mining companies, under their regulatory requirements, focus less on protecting and enhancing the environment/biodiversity/wildlife. However, Singareni Collieries Company Limited (SCCL) has been continuously adopting new and scientific approaches to managing biodiversity/wildlife as part of its commitment to establishing and maintaining the ecological balance, especially in Sathupally, where two opencast mines were established in 2005 and 2018 by diverting the forest lands of around 1400 hectares in Lankapally Reserve Forest under the CAMPA scheme. The over-burden (OB) plantations and conservation zones developed by SCCL, the CAMPA plantations developed in the Degraded Forest Lands (DFL) within 5kms from the mine boundaries by the Sathupally Forest Range with SCCL funds are now the new home range for the impacted herpetofauna population due to mining operations.

Keywords: *Coal Mines, Reptiles, Plantations, Restoration, diversity*

INTRODUCTION:

The Singareni Collieries Company Limited (SCCL) is a Government coal mining company jointly owned by the Government of Telangana and the Government of India on a 51:49 equity basis. Coal reserves stretch across 350 Km of the Pranahita – Godavari Valley of Telangana State with a proven geological reserve aggregating to a whopping 8791 million tonnes. SCCL is currently operating 20 Opencast and 24 Underground mines in 6 districts of Telangana with a manpower of around 43,895. In Khammam district, there are two opencast coal mines named Jalagam Vengala Rao (JVR I&II – 1156.72 hectares) and Kistaram (KTR – 285.44 hectares) were established since 2005 and 2018 in Sathupally forest range by diverting a total of 1442.16 hectares from the Lankapally Reserve Forest under the CAMPA Scheme. Anthropogenic pressure has contributed to numerous damage and destruction to animals in the wild, and even more in local wildlife populations i.e., small wildlife species found in rural and urban habitat mosaics (Sainsbury et al., 2021). The intensity of this impact depends on many factors, concerning both eco-ethological traits of different taxa (Lebboroni, and Corti 2006). Coal mining may result in significant changes to soil, microclimate, landscape, and water. These changes highly impact the local flora and fauna (Sainsbury et al., 2021; Nichols & Bamford 1985; Nichols & Grant 2007). The fragmentation of ecological habitats due to mining can have significant impact on the local biodiversity, especially the herpetofauna species (Queheillalt and Morrison, 2006). Disruption of the natural linkages can create significant, sometimes irreversible, changes in the dynamics and the genetic integrity of those populations. Clearing of forests for mine operations and other developmental works being conducted for years may pressurize these creatures (Pearson et al., 2005). This results in the isolation of local populations and threatens to the point of eradication or extinction of the species found in the local area (Vijayakumar et

al., 2001). Hence, the rehabilitation objectives should focus on minimizing these impacts of the mining operation on herpetofauna. Under the CAMPA Funds to the Forest Department, JVR OC I&II, a total of 329.61 Ha of Plantation has been raised with about 370000 plants. Under the CAMPA Funds Kistaram OC to the Forest Department, a total of 69 Ha of Plantation has been raised with 76000 plants so far in the Degraded Forest Lands (DFL) in Sathupally Forest Division. Before commencing the coal mining in the Lankapally Reserve Forest, a preliminary study was conducted under the Environment Impact Assessment (EIA) to document the flora and fauna presence of the total area diverted to both the mines. This EIA report shows only the list of the fauna including the herpetofauna from the area and no quantification was done. Other than the EIA report, there is no scientific monitoring study or documentation conducted previously from the Lankapally Reserve Forest, including the diverted area to the mine operations in the Sathupally Forest Range. Since 2021, SCCL is being into scientific monitoring of the wildlife and its movements in its plantations and conservation zones developed in the mines and in the mine boundaries, adjacent to the forest areas. The present study addresses a detailed report on the diversity and distribution of herpetofauna, to showcase how the conservative measures initiated by SCCL through OB plantations, conservation zones in its mines and CAMPA plantations developed within the 5 km radius from the JVR and KTR mines in Sathupally by the forest department are into sustaining and enhancing its population. It is a 2 yearlong study lasting from 2021 to 2023.

MATERIALS AND METHODS:

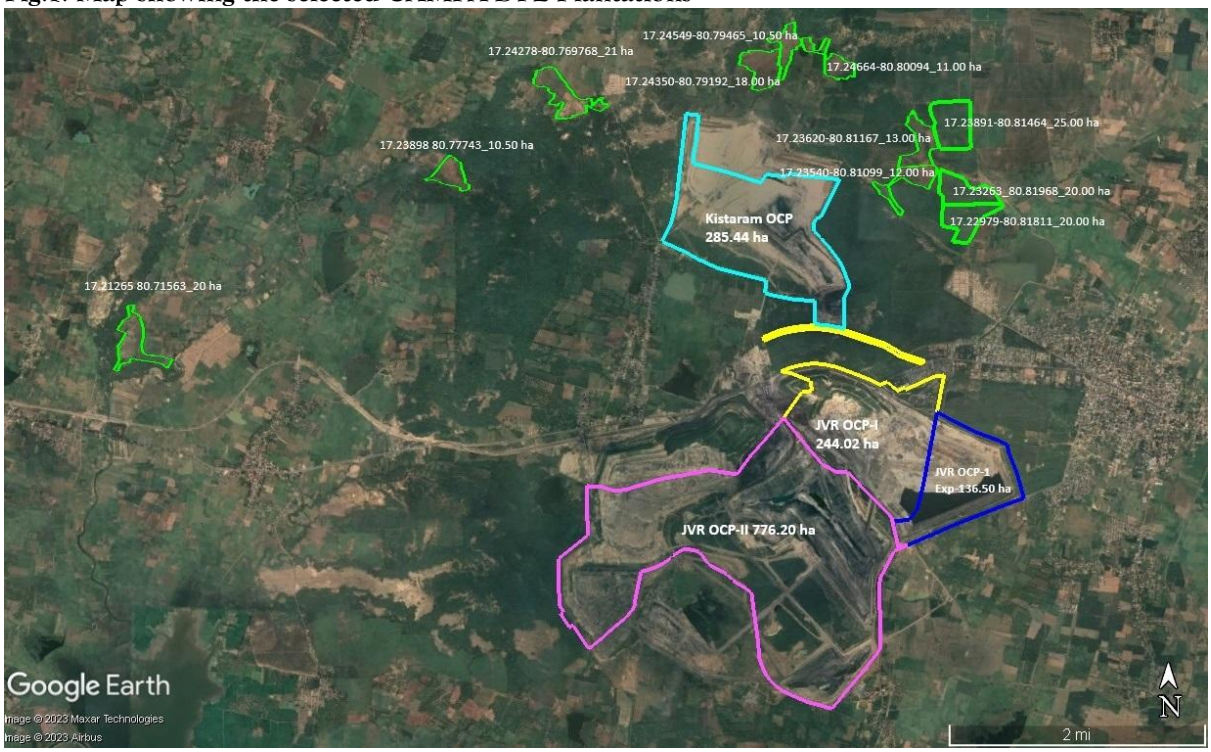
The study was carried out in the selected CAMPA DFL plantations raised in the Lankapally Reserve Forest area within the 5 kms of radius from the mine boundaries (Table 1 and Fig 1). Also, a through literature review was conducted on the secondary information available with the forest department and the company.

Tabe.1: List of selected CAMPA DFL plantations in Lankapally Reserve Forest of Sathupally Forest Range in Khammam District

Plantation No	Year of Raising	Name of the Project	Beat	Geo- reference (central point)		Planting Area in Ha.	No. of plants planted	Species
				Lat (^{0}N)	Long (^{0}E)			
P1	2022-23	JVROCP (776.20 Ha)	Jagannadhapuram	17.236202	80.81167	13.00	14443	Misc
P2	2022-23	JVROCP (776.20 Ha)	Jagannadhapuram	17.235404	80.81099	12.00	13332	Misc
P3	2022-23	JVROCP (776.20 Ha)	Kistaram	17.24278	80.76977	21.00	23331	Misc
P4	2021-22	JVROCP (776.20 Ha)	Jagannadhapuram	17.24350	80.79192	18.00	19998	Misc
P5	2021-22	JVROCP (776.20 Ha)	Jagannadhapuram	17.24549	80.79465	10.50	11666	Misc
P6	2021-22	JVROCP (776.20 Ha)	Jagannadhapuram	17.24664	80.80094	11.50	12777	Misc
P7	2021-22	JVROCP (776.20 Ha)	Kistaram	17.23898	80.77743	10.50	11666	Misc

P8	2020-21	JVROCP (776.20 Ha)	Kakarlapally	17.23891	80.81464	25.00	27775	Misc
P9	2020-21	JVROCP (776.20 Ha)	Kakarlapally	17.22979	80.81811	20.00	22220	Misc
P10	2020-21	JVROCP (776.20 Ha)	Jagannadhapuram	17.23263	80.81968	20.00	22220	Misc
P11	2020-21	Kistaram (285.44 Ha)	Lankapally	17.21265	80.71563	20.00	22220	Misc

Fig.1. Map showing the selected CAMPA-DFL Plantations



Random surveys were conducted in almost all beats of the study area to document the amphibian and reptile species. The streams and marshy areas near the plantations were specially surveyed for amphibians. The calls during the nighttime helped to locate and document the amphibian species. Diurnal forms were collected between dawn and mid-day. Night observations were made wherever possible. The species were identified by referring to the standard field guides and systematic references (; Daniel, 2002; Daniels, 2005; Daniel and Sekar, 1989; Tikader et al., 1992).

Quadrat sampling method was used for estimating abundance and diversity indices. Plots of 8 x 8m size were laid at random, ensuring adequate representations of all habitat types and altitudes. These plots were thoroughly searched by a team of three people (wildlife expert, forest beat officer and forest watcher) (Heyer, et al., 1984). Adequate time was spent on each plot to search the area completely. Amphibians and reptiles in the plot were identified in the field itself as far as possible. The study area was covered three seasons viz. the summer (February-May), the rainy (June-August) and post rainy (September - January). The diversity indices were calculated using the computer program SPDIVERS of STATECOL (Ludwig and Reynolds, 1988).

RESULTS AND DISCUSSION:

A total of 29 species of herpetofauna belonging to 26 genera and 12 families were recorded during the period of study (Tables 2 and 3). Of these, 23 species belonging to 2 orders, 21 genera and 10 families were reptiles and 6 species belonging to 5 genera and 2 families were amphibians. Highest number of species were recorded from P1 plantation in Jagannathapuram beat (20), followed by P10 in Jagannathapuram (16) and P11 in Lankapally (16) beats, P3 in Jagannathapuram (15), P2 in Jagannathapuram (14) and P6 in Jagannathapuram (14) beat, P4 in Jagannathapuram (12) and P7 in Kistaram beats, P5 in Jagannathapuram (11) and 10 in P8 and P9 in Kakarlapally plantations. (Tables 2.1 and 3.1)

Table.2: List of Reptiles (Squamates and testudines) recorded from the CAMPA Plantations

S.No.	Species	Scientific Name	Family	IUCN Status
1	Indian Rock Python	Python molurus (Linnaeus, 1758)	Pythonidae	NT
2	Indian Chameleon	Chamaeleo zeylanicus (Laurenti, 1768)	Chamaeleonidae	LC
3	Common Sand Boa	Eryx conicus (Schneider, 1801)	Boidae	NT
4	Red Sand Boa	Eryx johnii (Russell, 1801)	Boidae	NT
5	Indian Rat Snake	Ptyas mucosa (Linnaeus, 1758)	Colubridae	LC
6	Indian Cobra	Naja naja (Linnaeus, 1758)	Elapidae	LC
7	Olive Keelback	Atretium schistosum (Daudin, 1803)	Colubridae	LC
8	Checkered Keelback	Fowlea piscator (Schneider, 1799)	Colubridae	LC
9	Russell's Viper	Daboia russelii (Shaw & Nodder, 1797)	Viperidae	LC
10	Common Indian Krait	Bungarus caeruleus (Schneider, 1801)	Elapidae	LC
11	Striped Keelback	Amphiesma stolatum (Linnaeus, 1758)	Colubridae	LC
12	Common Vine Snake	Ahaetulla nasuta (Lacépède, 1789)	Colubridae	LC
13	Common Trinket Snake	Coelognathus helena (Daudin, 1803)	Colubridae	LC
14	Common Bronze Back	Dendrelaphis tristis (Daudin, 1803)	Colubridae	LC
15	Common Wolf Snake	Lycodon aulicus (Linnaeus, 1758)	Colubridae	LC
16	Russel's Kukri	Oligodon taeniolatus (Jerdon, 1853)	Colubridae	LC
17	Common Indian Monitor Lizard	Varanus bengalensis (Daudin, 1802)	Varanidae	LC
18	Common Keeled Skink	Eutropis carinata (Schneider, 1801)	Scincidae	LC
19	Bronze grass Skink	Eutropis macularia (Blyth, 1853)	Scincidae	LC
20	Indian Garden Lizard	Calotes versicolor (Daudin, 1802)	Agamidae	LC
21	Flat-headed fan throated lizard	Sitana ponticeriana	Agamidae	LC
22	South Indian Rock Agama	Psammophilus dorsalis (Gray, 1831)	Agamidae	LC

23	Indian Star Tortoise	Geochelone elegans (Schoepff, 1795)	Testudinidae	VU

*LC- Least Concern, NT- Near Threatened, VU- Vulnerable

Table.2.1: Plantations-wise occurrence of reptiles

S.No.	Scientific Name	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
1	Python molurus (Linnaeus, 1758)	+	+				+	+			+	+
2	Chamaeleo zeylanicus (Laurenti, 1768)	+				+		+			+	+
3	Eryx conicus (Schneider, 1801)	+	+			+		+				
4	Eryx johnii (Russell, 1801)										+	+
5	Ptyas mucosa (Linnaeus, 1758)	+	+	+	+	+	+	+	+	+	+	+
6	Naja naja (Linnaeus, 1758)	+	+	+	+		+	+				
7	Atretium schistosum (Daudin, 1803)	+	+	+	+						+	
8	Fowlea piscator (Schneider, 1799)	+	+	+	+	+	+		+	+	+	+
9	Daboia russelii (Shaw & Nodder, 1797)	+	+	+	+	+	+	+	+	+	+	+
10	Bungarus caeruleus (Schneider, 1801)	+		+					+	+	+	+
11	Amphiesma stolatum (Linnaeus, 1758)	+	+	+	+	+	+	+	+	+		
12	Ahaetulla nasuta (Lacépède, 1789)		+		+		+					
13	Coelognathus helena (Daudin, 1803)										+	+
14	Dendrelaphis tristis (Daudin, 1803)										+	+
15	Lycodon aulicus (Linnaeus, 1758)										+	+
16	Oligodon taeniolatus (Jerdon, 1853)	+					+			+	+	+
17	Varanus bengalensis (Daudin, 1802)	+		+	+							+
18	Eutropis carinata (Schneider, 1801)			+		+	+		+			
19	Eutropis macularia (Blyth, 1853)	+		+			+					
20	Calotes versicolor (Daudin, 1802)	+		+			+					
21	Sitana ponticeriana	+	+				+					
22	Psammophilus dorsalis (Gray, 1831)	+	+		+	+		+				
23	Geochelone elegans (Schoepff, 1795)	+	+	+	+	+		+	+	+		

* P1- Jagannadhapuram; P2- Jagannadhapuram; P3- Kistaram; P4- Jagannadhapuram; P5- Jagannadhapuram; P6- Jagannadhapuram; P7- Kistaram; P8- Kakarlapally; P9- Kakarlapally; P10- Jagannadhapuram; P11- Lankapally

Table.3: List of Anuran Amphibians recorded from the CAMPA Plantations

S.No.	Species	Scientific Name	Family	IUCN Status
1	Indian Common Toad	Duttaphrynus melanostictus (Schneider, 1799)	Bufonidae	LC
2	Granular Cricket Frog	Minervarya agricola (Jerdon, 1853)	Dicroglossidae	LC
3	Indian Skipper Frog	Euphlyctis cyanophlyctis (Schneider, 1799)	Dicroglossidae	LC
4	Green Pond Frog	Euphlyctis hexadactylus (Lesson, 1834)	Dicroglossidae	LC
5	Burrowing Frog	Sphaerotheca maskeyi (Schleich and Anders, 1998)	Dicroglossidae	LC
6	Indian Bull Frog	Hoplobatrachus tigerinus (Daudin, 1802)	Dicroglossidae	LC

*LC- Least Concern

Table.3.1: Plantations-wise distribution of amphibians

S.No.	Scientific Name	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
1	Duttaphrynus melanostictus (Schneider, 1799)	1	1	1	1	1	1	1	1	1	1	1
2	Minervarya agricola (Jerdon, 1853)										1	1
3	Euphlyctis cyanophlyctis (Schneider, 1799)	1	1	1			1	1	1	1		
4	Euphlyctis hexadactylus (Lesson, 1834)					1				1		
5	Sphaerotheca maskeyi (Schleich and Anders, 1998)										1	1
6	Hoplobatrachus tigerinus (Daudin, 1802)	1	1	1		1		1	1	1		

* P1- Jagannadhapuram; P2- Jagannadhapuram; P3- Kistaram; P4- Jagannadhapuram; P5- Jagannadhapuram; P6- Jagannadhapuram; P7- Kistaram; P8- Kakarlapally; P9- Kakarlapally; P10- Jagannadhapuram; P11- Lankapally

Highest diversity (H') of reptiles (Table 4) was observed in P1 plantation in Jagannathapuram beat (2.78), followed by P6 in Jagannathapuram (2.56) and lowest from P9 in Kakarlapally beat (2.04). Similarly, richness index (R1) was also highest in P1 plantation in Jagannathapuram (5.22) and lowest in P8 in Kakarlapally beat (2.34).

Table.4: Diversity indices of reptiles in the selected CAMPA plantations

Plantation No	Beat	Richness Index		Diversity Index		Hill's Number		Evenness Index	
		R1	R2	λ	H'	N1	N2	E1	E2
P1	Jagannadhapuram	5.22	3.24	0.05	2.78	16.12	20.04	0.93	0.81
P2	Jagannadhapuram	3.38	2.20	0.05	2.53	12.55	18.55	0.99	0.97
P3	Kistaram	4.16	2.79	0.04	2.63	13.82	23.33	0.97	0.92
P4	Jagannadhapuram	3.00	2.08	0.08	2.26	9.54	12.63	0.94	0.87
P5	Jagannadhapuram	2.91	2.13	0.06	2.29	9.85	17.25	0.99	0.98
P6	Jagannadhapuram	3.46	2.13	0.06	2.56	12.89	16.80	0.97	0.92
P7	Kistaram	2.76	1.96	0.07	2.27	9.69	14.67	0.99	0.97
P8	Kakarlapally	2.34	1.79	0.09	2.04	7.71	11.74	0.98	0.96
P9	Kakarlapally	3.19	2.67	0.03	2.04	7.72	40.00	0.98	0.96
P10	Jagannadhapuram	4.17	3.21	0.02	2.44	11.48	48.75	0.98	0.96
P11	Lankapally	3.42	2.40	0.05	2.46	11.66	20.80	0.99	0.97

The diversity (H') of amphibians showed that highest in P9 – Kakarlapally plantation (1.67) and lowest in P4 – Jagannadhapuram (0.69). Similarly, the richness index (R1) also varied in different locations and highest in P9 – Kakarlapally plantation (1.95) and lowest in P4 – Jagannadhapuram (0.72) (Table 5).

Table.5: Diversity indices of amphibians in the selected CAMPA plantations

Plantation No	Beat	Richness Index		Diversity Index		Hill's Number		Evenness Index	
		R1	R2	λ	H'	N1	N2	E1	E2
P1	Jagannadhapuram	1.03	1.13	0.21	1.08	2.94	4.8	0.98	0.98
P2	Jagannadhapuram	1.12	1.22	0.23	1.01	2.75	4.38	0.92	0.92
P3	Kistaram	1.24	1.34	0.17	1.05	2.87	6	0.96	0.96
P4	Jagannadhapuram	0.72	1	0.27	0.69	2	3.75	1	1
P5	Jagannadhapuram	1.12	1.22	0.23	1.01	2.75	4.38	0.92	0.92
P6	Jagannadhapuram	0.56	0.82	0.4	0.64	1.89	2.5	0.92	0.94
P7	Kistaram	1.03	1.13	0.21	1.08	2.94	4.8	0.98	0.98
P8	Kakarlapally	1.44	1.5	0.13	1.04	2.83	7.5	0.95	0.94
P9	Kakarlapally	1.95	1.66	0.13	1.67	5.32	7.64	0.93	0.89
P10	Jagannadhapuram	1.67	1.63	0.11	1.33	3.78	8.75	0.96	0.94
P11	Lankapally	1.54	1.51	0.13	1.35	3.86	8	0.98	0.97

Our results show that the richness and distribution of the herpetofauna, in general, followed similar trends at different plantations. Of the recorded species, only three were observed from all the plantations namely Indian Rat Snake Ptyas mucosa (Linnaeus, 1758), Russell's Viper Daboia russelii (Shaw & Nodder, 1797) and Indian Common Toad Duttaphrynus melanostictus (Schneider, 1799). It is noteworthy that these species are human commensally in nature everywhere. Common Trinket Snake Coelognathus helena (Daudin, 1803), Common Bronze Back Dendrelaphis tristis (Daudin, 1803), Common Wolf Snake Lycodon aulicus (Linnaeus, 1758), Granular Cricket Frog Minervarya agricola (Jerdon, 1853), Green Pond Frog Euphlyctis hexadactylus (Lesson, 1834) and Burrowing Frog Sphaerotheca maskeyi (Schleich and Anders, 1998) were recorded only in two plantations.

The differences in species richness reported from a plantation and that of our records from the same beat probably reflect our sampling effect. Greater sampling efforts allowed searching more micro-habitats in the plantation areas. The reason for the significantly greater species diversity and higher species richness in P1- Jagannadhapuram plantation is that the plantation is very adjacent to mine boundaries, where the felling of forests was conducted in a phased manner and also the plantation raised by the department with the SCCL funds is growing up well and stared developing linkage to the Lankapally reserve forest. Other than the Jagannadhapuram plantations, the rest of the plantations has road networks, which is a major disturbing factor for the herpetofauna movements from the mine operational areas. Accidental killings of reptiles and amphibians along the roads were also observed during the study period.

CONCLUSION:

Though there are many studies that show that opencast mining exerts pressure on herpetofauna, this study shows SCCL's commitment towards sustaining and enhancing the herpetofauna through a scientific approach in support with the forest department. Since, this study was carried out for inventory purpose, it could not estimate complete species occurrence and populations. Hence, a detailed study will be continued by SCCL to understand the assemblage of herpetofauna in more detail including their habitat preferences from the Lankapally Reserve Forest. And this study will help SCCL in its restoration and rehabilitation process in an eco-friendly and responsible mining process.

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