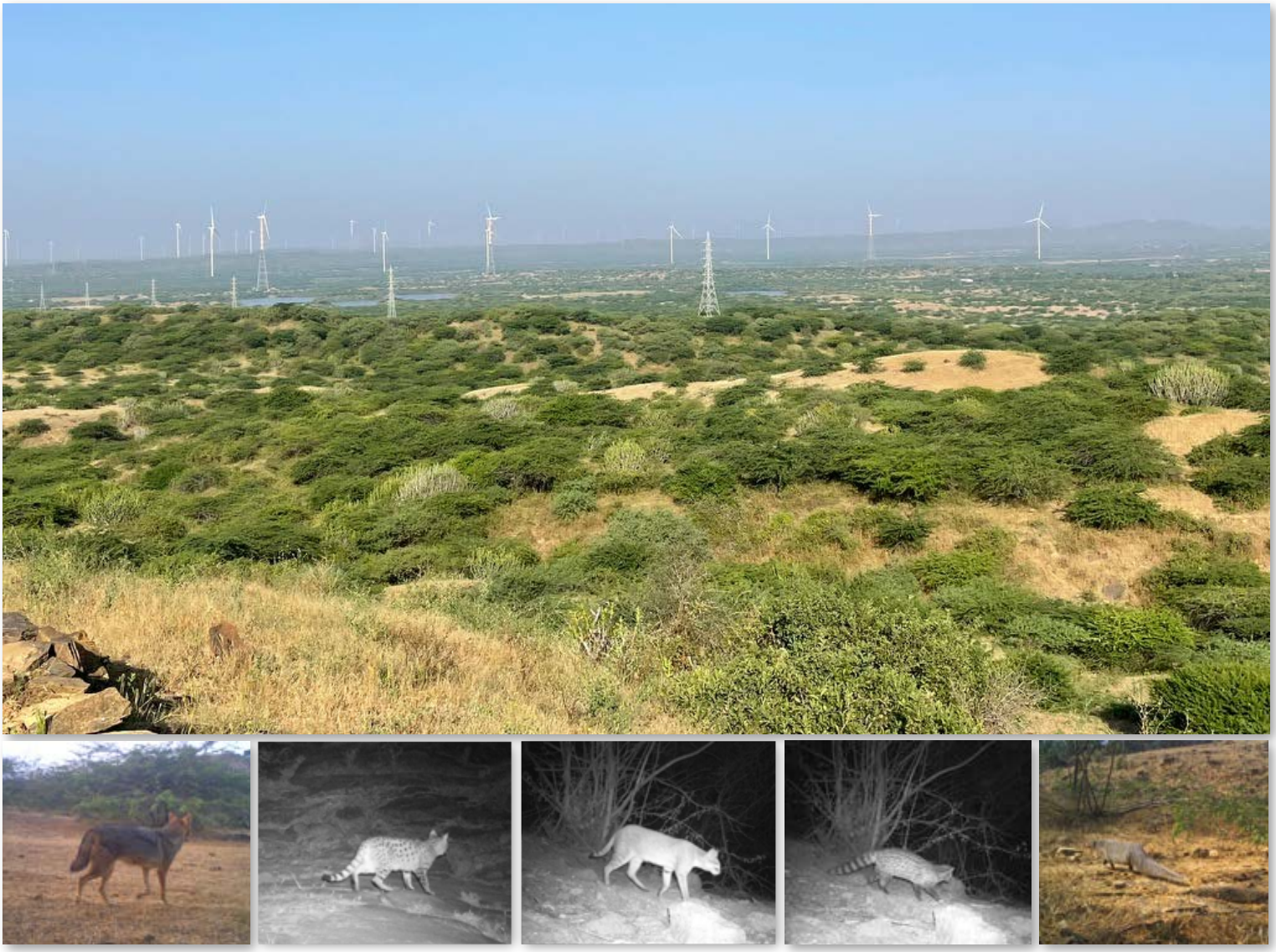
Technical Report No. PR–280

Mechanisms of coexistence in a species-rich carnivore assemblage from a human-dominated landscape in Kachchh, Gujarat, India



Shomita Mukherjee and Nandini R.

2024

SACON
भारतीय वन्यजीव संस्थान
Wildlife Institute of India
IISER TIRUPATI
PANTHERA
CHADVA RAKHAL
MAHARAO PRAGMULJI NATURE CONSERVATION TRUST

Mechanisms of coexistence in a species-rich carnivore assemblage from a human-dominated landscape in Kachchh, Gujarat, India

Technical Report No. PR-280

Funding Agency

PANTHERA

Investigators

Dr. Shomita Mukherjee
Dr. Nandini R.

November 2024

SACON
भारतीय वन्यजीव संस्थान
Wildlife Institute of India
IISER TIRUPATI
PANTHERA
CHADVA RAKHAL
MAHARAO PRAGMULJI NATURE CONSERVATION TRUST

Funded by:
PANTHERA, New York

Recommended citation: Mukherjee, S. and Nandini, R. (2024). Mechanisms of coexistence in a species-rich carnivore assemblage from a human-dominated landscape in Kachchh, Gujarat, India. Technical Report No. PR-280. Sálim Ali Centre for Ornithology and Natural History, (South India Centre of the Wildlife Institute of India, MoEF&CC), Coimbatore. 54 pp.

Front cover image: Raghav N Gopal and WII-SACON–IISER-Tirupati–Panthera Small Cat Project

Back cover image: Jehan Bhujwala

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

We thank PANTHERA, New York for funding this project and the Ministry of Environment, Forest and Climate Change, Government of India, for providing permissions to receive the grant. We thank Shri Virendra Tiwari, Director Wildlife Institute of India and Sálim Ali Centre for Ornithology and Natural History for his support throughout the duration of the project. We thank the Gujarat Forest Department for permission to conduct our work in Reserve Forests surrounding Chadva Rakhal. Our sincere thanks to the Maharao Pragmulji Nature Conservation Trust (MPNCT), Bhuj, Gujarat for support with logistics and permission to work in Chadva Rakhal.

We thank Mr. Jehan Bhujwala, Trustee, MPNCT and Ms. Katie Bhujwala for their immense support and hospitality throughout the fieldwork. Jehan helped link us with locals and village headmen for discussions and interactions. We are very grateful to the locals who supported our work and agreed to let us place our camera traps in their crop fields. Mr. Raghav N. Gopal volunteered on the project for fieldwork, and we thank him for his hard work and professionalism. We thank Mr. Deval Kadam for collecting scat from Chadva Rakhal. We thank Ms. Kavitha Unni, who worked hard in the laboratory at IISER Tirupati and provided data on molecular scat assignments and diets of cats. We are grateful to Mr. Hussain Bafan and Mr. Sultan Bafan who helped with fieldwork. We wish to thank all the staff at the Bhuj House for their great hospitality during our field visits and to Raghav throughout his fieldwork, especially Mr. Mukesh Desai who helped us on innumerable occasions. We are very grateful for that. We thank Dr. Shomen Mukherjee and Mr. Devvratsinh Mori for interactions and discussions in the field. We sincerely thank Dr. Ayan Sadhu, Dr. Sushma H.S. and Dr. Rajah Jayapal for discussions regarding statistical analysis of data. We thank Ms. Angie Appel for meticulously reviewing the draft of our report.

We thank all SACON faculty and staff for their support throughout the project's execution. The Library and the Administration and Finance Divisions provided vital support throughout the project's duration. We thank IISER-Tirupati for its overall support during this collaborative venture. We are especially grateful to all members of Dr. Nandini's laboratory at IISER-Tirupati for their help and support during laboratory analysis.

Among the most crucial outcomes of the project was our interactions with local people, school Principals, teachers and students. We are grateful to all the villagers from Samatra and Godpar villages, who agreed to meet us, the school Principals who helped organise the talks and the students who attended the talks with great interest and interacted with us. Ms. Siddhi Damle, SACON, helped us during our fieldwork while she was conducting her Master's dissertation. We thank her sincerely for taking time out and joining us during our interactions with local people and for presenting the rich carnivore diversity of Chadva Rakhal to school students.

SUMMARY

Savannah landscapes are known to be structurally complex and biodiverse. The Kachchh landscape in Gujarat, western India, is a semi-arid, human-dominated savannah landscape, with a large proportion identified as wasteland. Studies have revealed a spectacular carnivore diversity in this landscape despite the anthropogenic pressures. Fourteen species of carnivores, including domesticated dogs and cats have been reported from here. We selected a 130 km^2 area within this landscape located 25 km west of Bhuj town that included 50 km^2 of partly privately owned pastoral land, Chadva Rakhal (CR) as our study site. The pastureland is surrounded by villages of diverse communities and livelihoods, with a prominent *Maldhari* community of pastoralists who use CR to graze their livestock. Our goal was to understand how carnivores co-exist with each other and with humans and livestock in this landscape and initiate interactions with local residents for biodiversity conservation.

From November 2023 to April 2024, we deployed camera traps in 67 locations (1x1 km grid cells) in our study area, to document site-use intensity in carnivore species using single species single season occupancy models. Our site covariates included grass cover, natural vegetation, *Prosopis juliflora*, as proportions in 10m radius plots, anthropogenic pressure measured from camera trap images and Terrain Ruggedness Index (TRI) from satellite imageries of the landscape. Anthropogenic pressure and the proximity of cameras to a waterbody were used as observation covariates. The temporal overlap of activity patterns of species was estimated using camera trap images and kernel density analysis. We collected scat in CR and assigned these to cat species using molecular tools and felid-specific mitochondrial markers and analysed for diets using existing keys for mammals and invertebrates. We held informal interactions with local people in two villages located at the boundary of CR, to discuss our findings and conservation issues in the landscape and presented our findings to school students in the two villages.

Our total effort of 1,434 camera trap days yielded records of 14 carnivores. We selected species with naïve occupancies greater than 0.20 for further analysis. These were Afro-Asiatic Wildcat *Felis lybica*, Jungle Cat *F. chaus*, Golden Jackal *Canis aureus*, Domestic Dog *C. familiaris*, Small Indian Civet *Viverricula indica* and Indian Grey Mongoose *Urva edwardsii*. The Afro-Asiatic Wildcat had a naïve occupancy of 0.28 but the highest estimate among study species for site-use intensity (ψ) at 0.59 (SE: 0.102) with a detection probability (p) of 0.13 (SE = 0.043). This was followed by the Golden Jackal (naïve occupancy = 0.57; ψ = 0.49, SE = 0.074; p = 0.23 SE = 0.074), Small Indian Civet (naïve occupancy = 0.31; ψ = 0.49, SE = 0.145; p = 0.23, SE = 0.074), Domestic Dog (naïve occupancy = 0.43; ψ = 0.48, SE = 0.13; p = 0.33, SE = 0.08), Indian Grey Mongoose (naïve occupancy = 0.27; ψ = 0.41, SE = 0.177; p = 0.22, SE = 0.074) and Jungle Cat (naïve occupancy = 0.25; ψ = 0.29, SE = 0.106; p = 0.39, SE = 0.094). The Jungle Cat showed a negative association with grass cover, indicating avoidance of very open areas, while the Afro-Asiatic Wildcat had a positive

association with grass cover. Site-use intensity measured as grid cell wise occupancy probabilities for the two cats showed a strong negative correlation (Pearson's r = -0.97). The Golden Jackal was positively associated with grass cover, TRI and anthropogenic pressure and negatively with *P. juliflora* and natural vegetation, while the Domestic Dog showed a positive association with *P. juliflora* and anthropogenic pressure. The Small Indian Civet was negatively associated with terrain, and the Indian Grey Mongoose was positively associated with *P. juliflora* and anthropogenic pressures but negatively with grass cover and TRI. Site-use intensity of the Indian Grey Mongoose was positively correlated with Jungle Cat (Pearson's r = 0.90) and negatively with Afro-Asiatic Wildcat (Pearson's r = -0.86). Other carnivores recorded in the study area were Caracal *Caracal caracal*, Rusty-spotted Cat *Prionailurus rubiginosus*, Leopard *Panthera pardus*, Striped Hyaena *Hyaena hyaena,* Indian Desert Fox *Vulpes vulpes pusilla*, Bengal Fox *V. bengalensis*, Honey Badger *Mellivora capensis* and Domestic Cat *Felis catus*. Jungle Cat and Afro-Asiatic Wildcat were crepuscular and nocturnal and showed high overlap in their diel activity patterns ($\hat{\Delta}_1$ = 0.86). Both also showed high overlap in activity with Golden Jackal and Small Indian Civet ($\hat{\Delta}_1 \geq 0.70$), but low overlap ($\hat{\Delta}_1 \leq 0.70$) with Indian Grey Mongoose which was diurnal. Golden Jackal and Domestic Dog had moderate overlap ($\hat{\Delta}_1$ = 0.55) and Indian grey Mongoose and Small Indian Civet had low overlap ($\hat{\Delta}_1$ = 0.37) in their activity patterns. Sixty-nine scat samples were assigned to cat species using molecular tools (Jungle Cat = 11, Rusty-spotted Cat = 15 and Afro-Asiatic Wildcat = 43). Diet of the cats was dominated by small mammal prey, especially rodents that occurred in more than 80% of their scat. The next most important prey taxa of cats were invertebrates, which occurred in more than 50% of scat of all three cats. Our results show that varied habitat associations and diel activity patterns facilitated coexistence among carnivores. Nocturnal species like the cats and Small Indian Civet segregated over space, while all three were segregated over time with Indian Grey Mongoose and Domestic Dog. The Golden Jackal had low spatial overlap with the cats and a moderate spatio-temporal overlap with Domestic Dog.

Our interactions with local residents and school children revealed curiosity among them regarding carnivores, and an interest to conserve them and the pastureland. We see this as a step forward towards conserving the multi-use landscape for biodiversity while safeguarding livelihoods and cultures. We strongly recommend a revision of land policies, especially those regarding the identification of land as wasteland. We also recommend devising action and management plans for the landscape that include research and monitoring of biodiversity by involving local people, regular dialogues with them, course corrections in actions and the introduction of health measures for humans, livestock and wild species.