

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



Shomita Mukherjee and Nandini R.

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भारतीय वन्यजीव संस्थान
Wildlife Institute of India



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Dr. Shomita Mukherjee
Dr. Nandini R.

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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 km² area within this landscape located 25 km west of Bhuj town that included 50 km² 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.

