The Company Canids Confront:
Resource Partitioning in Sympatric Carnivores in an Arid Ecosystem

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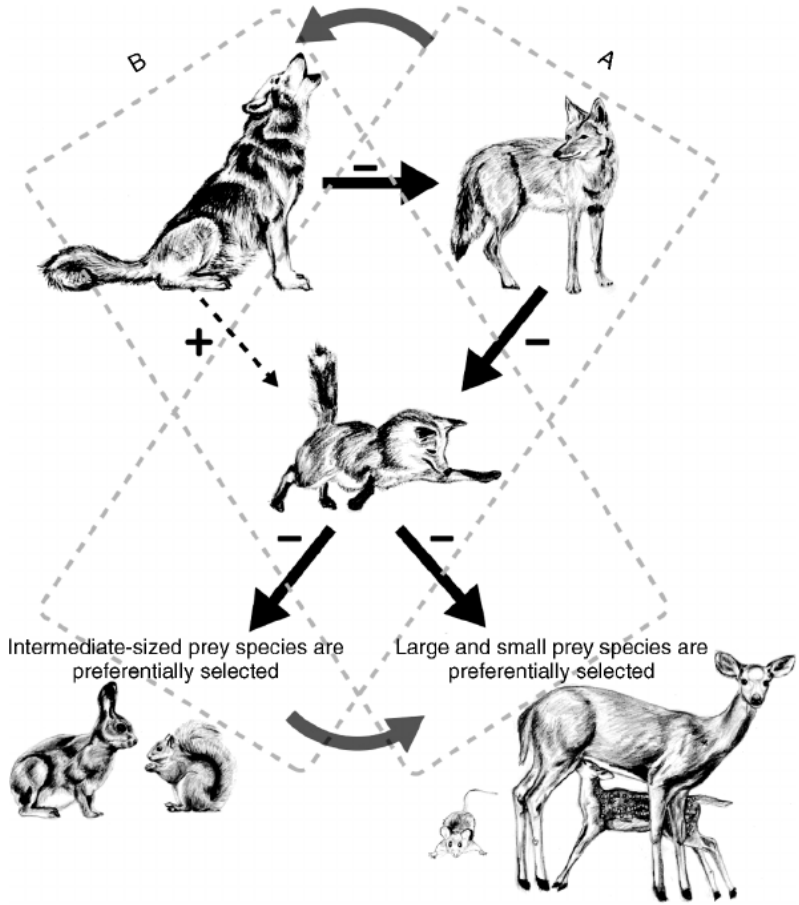
Outline

- A County for Carnivores
  - An Introduction
- (Little) Ark in the Desert
  - Wildlife in the Banni
- Game of Thorns
  - Study Design and Methods
- Eat, Stay, Move
  - Resource Partitioning Results

A County for Carnivores

- Predators important for ecosystem function
- Multiple predators in a landscape
- Size-mediated interactions



[Levi & Wilmers, 2012]

Carnivore Interactions

- Lethal interactions
  - Intra-guild predation
  - Intra-guild competitive killing
- Sub-lethal interactions
  - “Landscape of fear”

Species-scapes

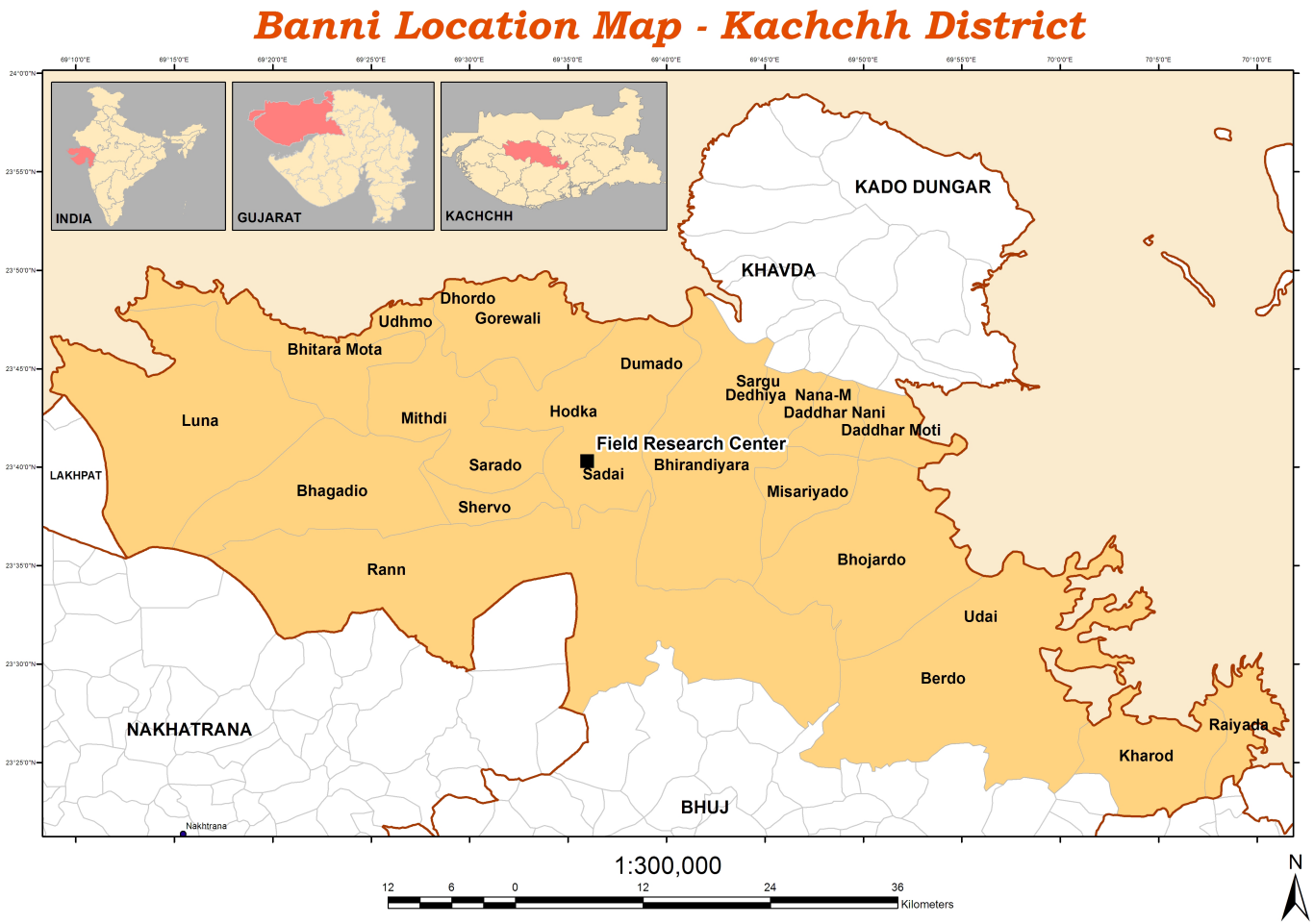
"... a spatial plane of species interactions that combines with resources and habitat structure to drive species distributions"

[Fisher et al., 2012]

Objective

Identify how sympatric carnivores partition resources:
space, time, habitat, and diet

Ark in the Desert



http://bannigrassland.klink.co.in/images/Banni%20Location_2.jpg

Habitats

Image source: Pankaj Joshi

Carnivores in the Banni

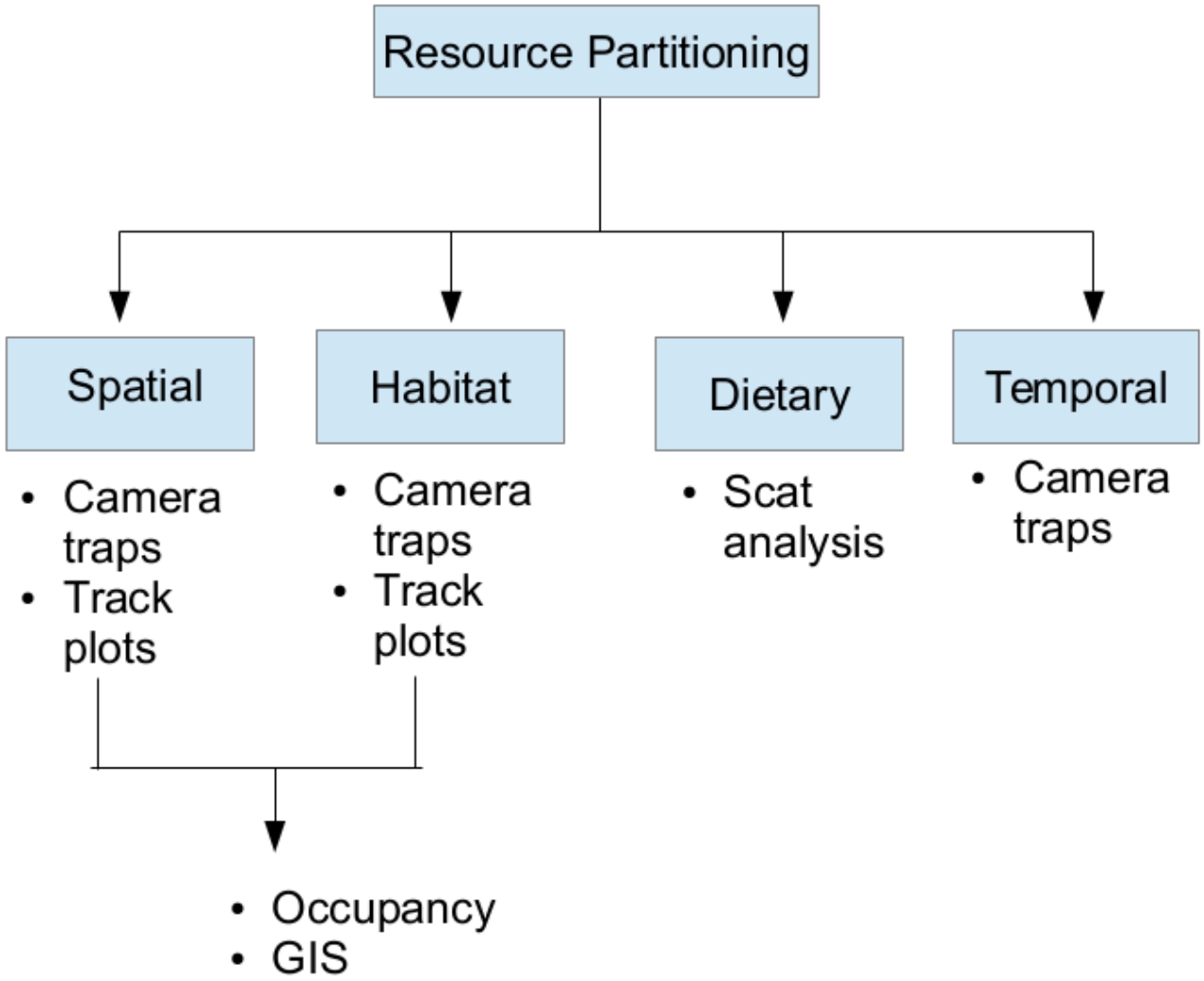
Indian fox image: Abi Vanak

Other Carnivores

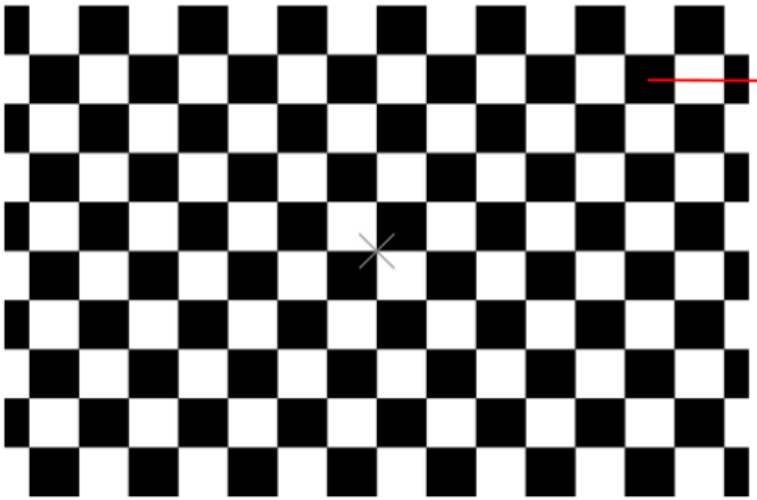
- Indian wolf - *very rare*
- Jungle cat, caracal, desert cat
- Striped hyena

Desert cat in Banni

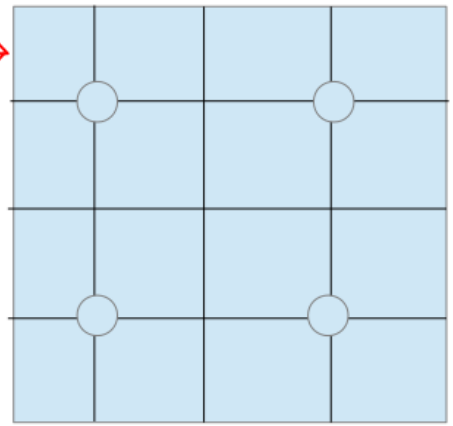
A Game of Thorns



Methodology: Grids

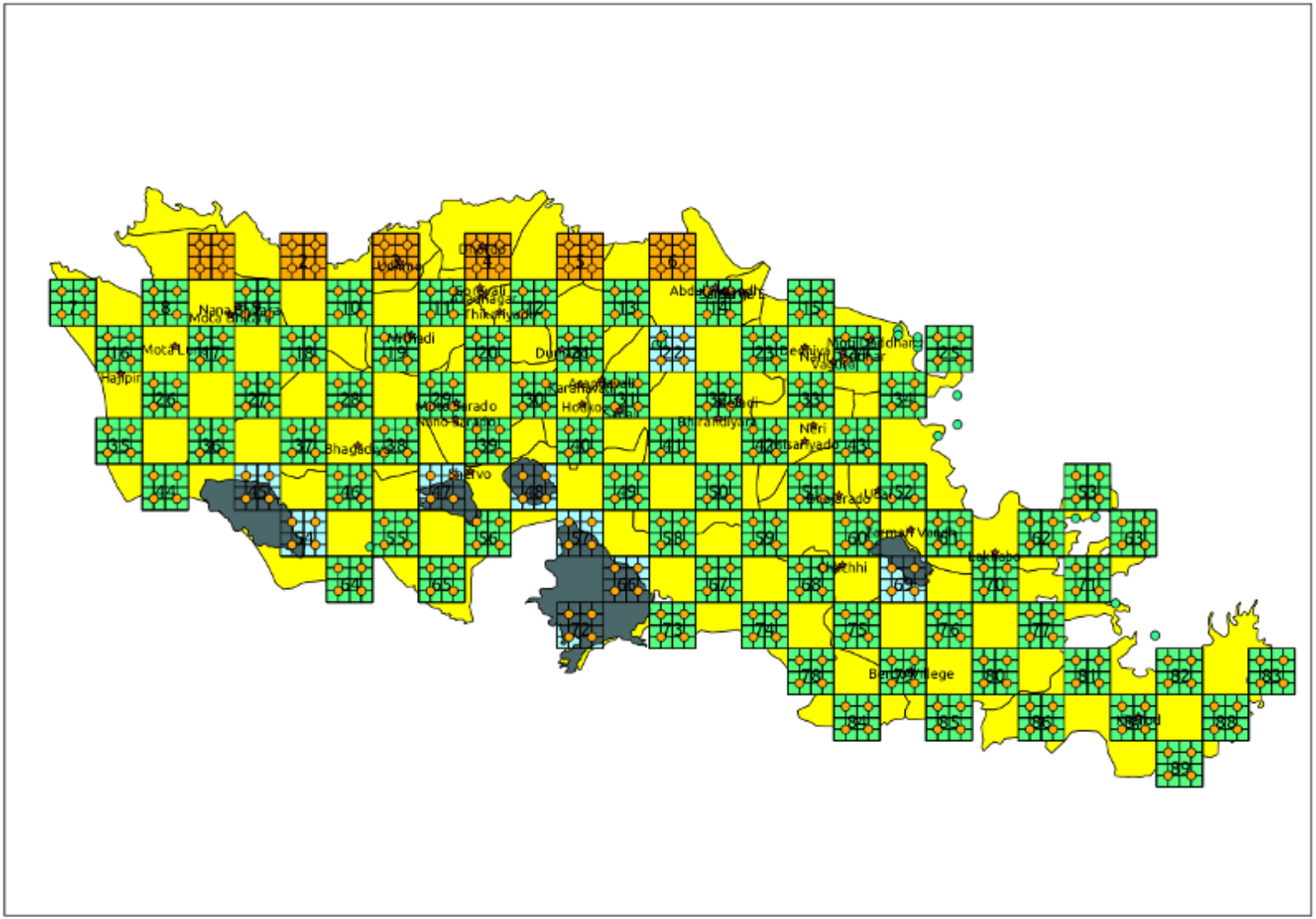


2500 sq.km. - 156 cells

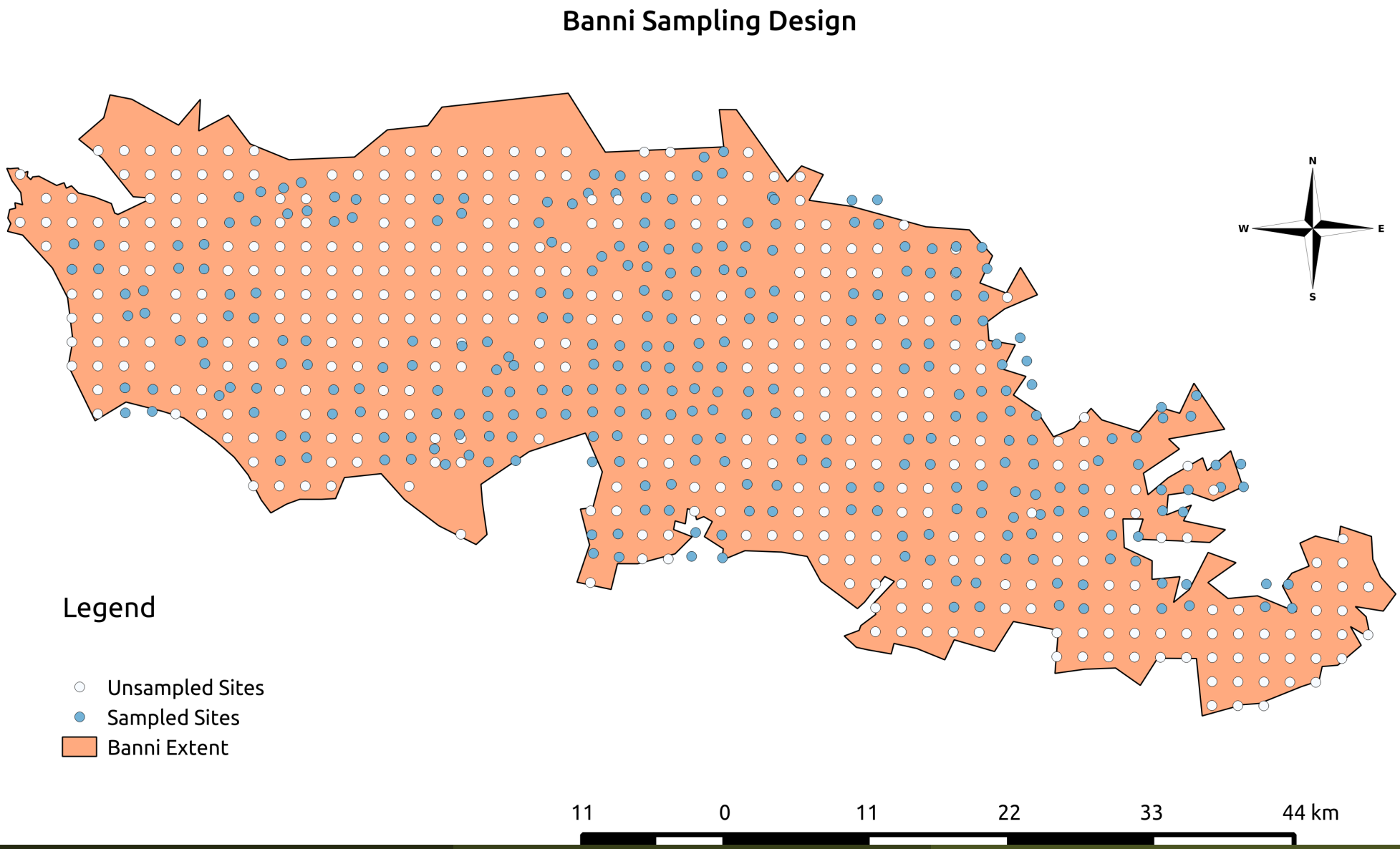


16 sq.km. - 4 camera traps

Methodology: Sampling



Methodology: Sampling



Data Collection: Effort

Photo : Pankaj Joshi

- Camera trapping: All canids
  74 grids * 4 camera traps * 4 days
  $\approx$ 300 cameras * 4 nights $\rightarrow$ 1200 camera trap nights
- $\approx$ 6500 videos - 30 seconds each

Data collection: Effort

- Photographic capture-recapture: Dogs
  - 17/50 villages in Banni - stratified random sampling
  - based on village size (no. of households)

Data collection: Covariates measured

- On ground:
  - Vertical density
  - Ground cover
  - Vegetation type
  - Presence of other canid species
  - Food availability - burrow count, indirect signs of prey
  - Anthropogenic influences - dung pat count, lopping

Data collection: Covariates measured

- Remotely-sensed/GIS:
  - Proximity to human habitation
  - Proximity to road
  - Proximity to water source
  - Vegetation type

Analysis: Camera Trap Videos

Desert fox in Banni

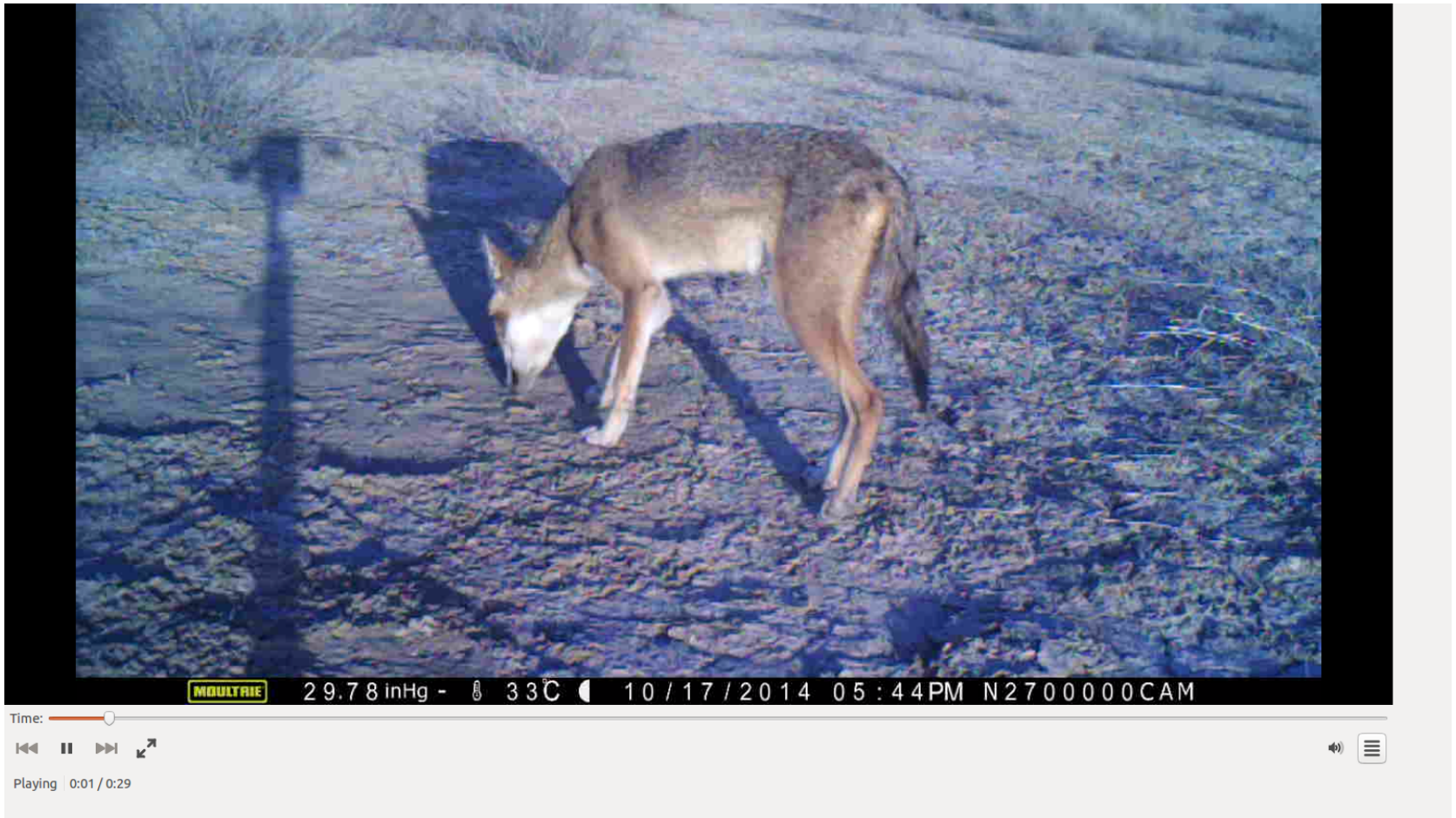
Analysis: Camera Trap Videos

Indian fox in Banni

Analysis: Camera Trap Videos

Dog in Banni

Analysis: Camera Trap Videos

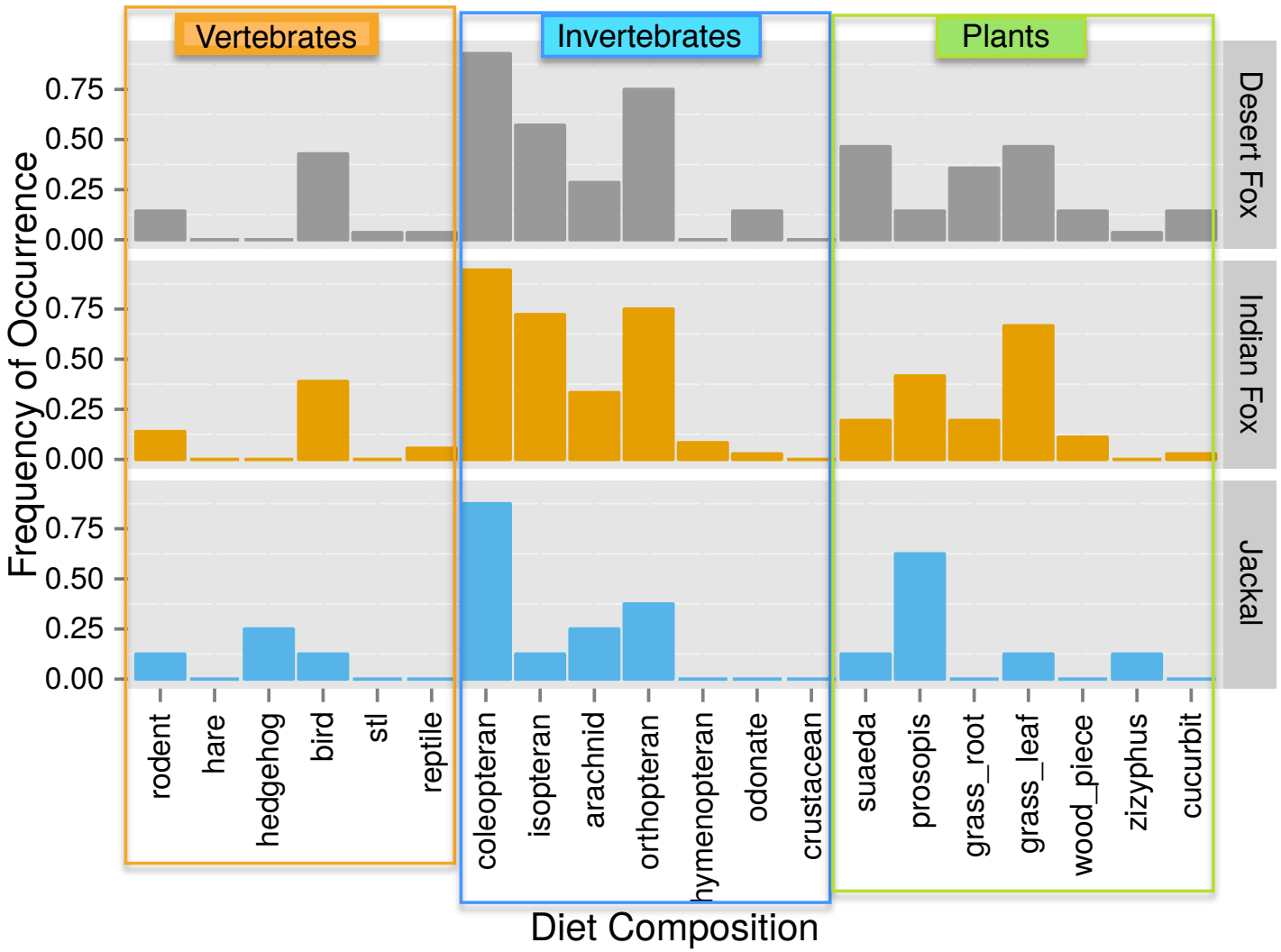


Golden jackal in Banni

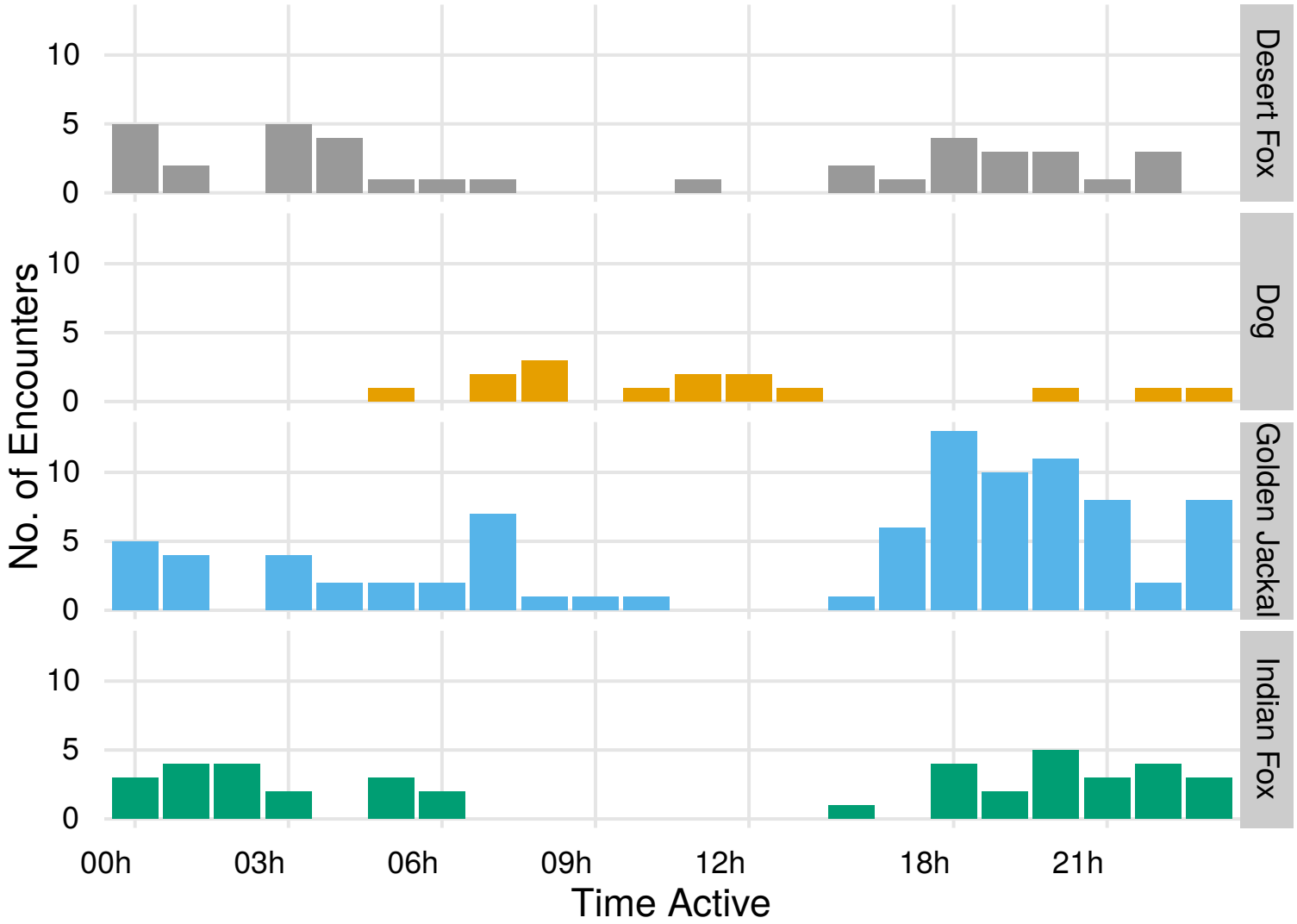
Eat, Stay, Move

Some Results

Very little dietary partitioning



Wild canids crepuscular + nocturnal

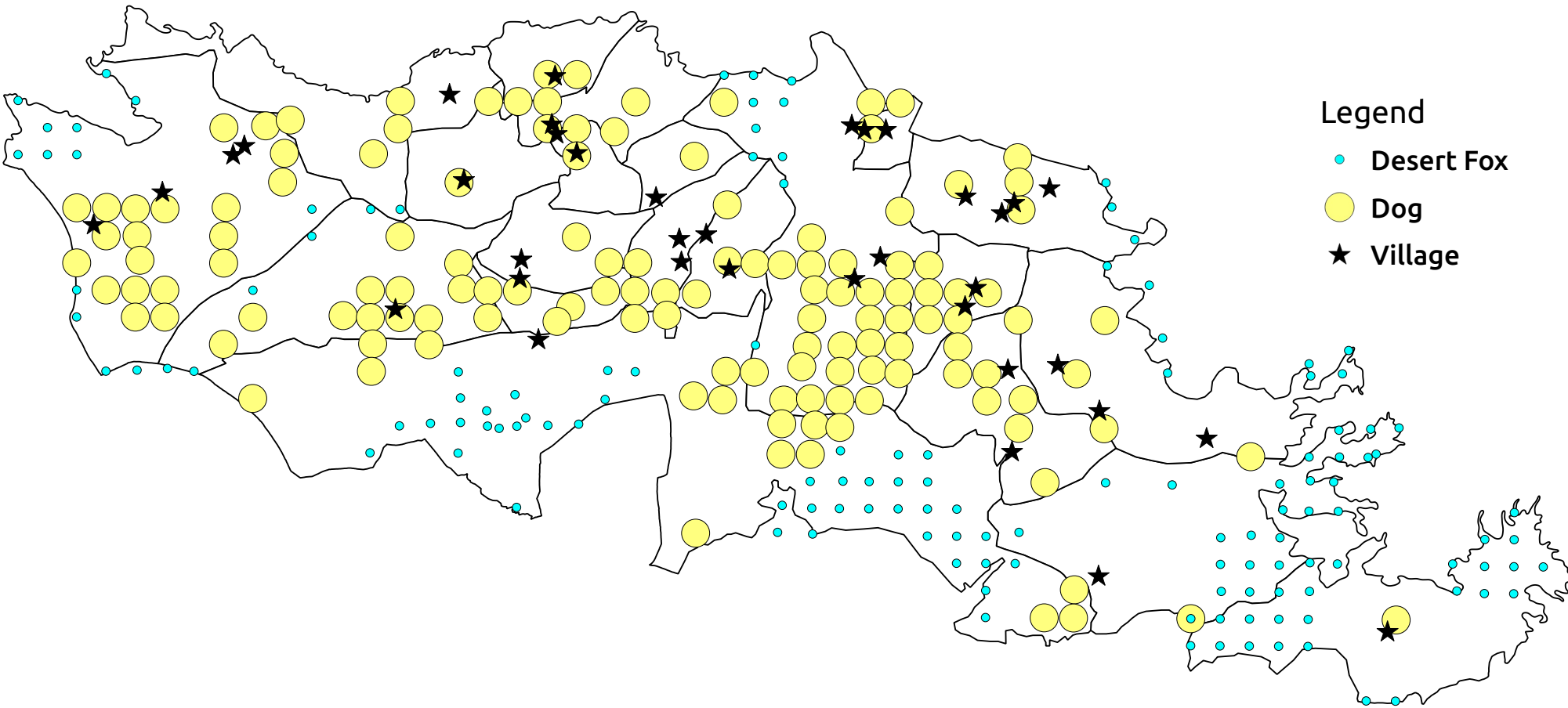


Naïve occupancy

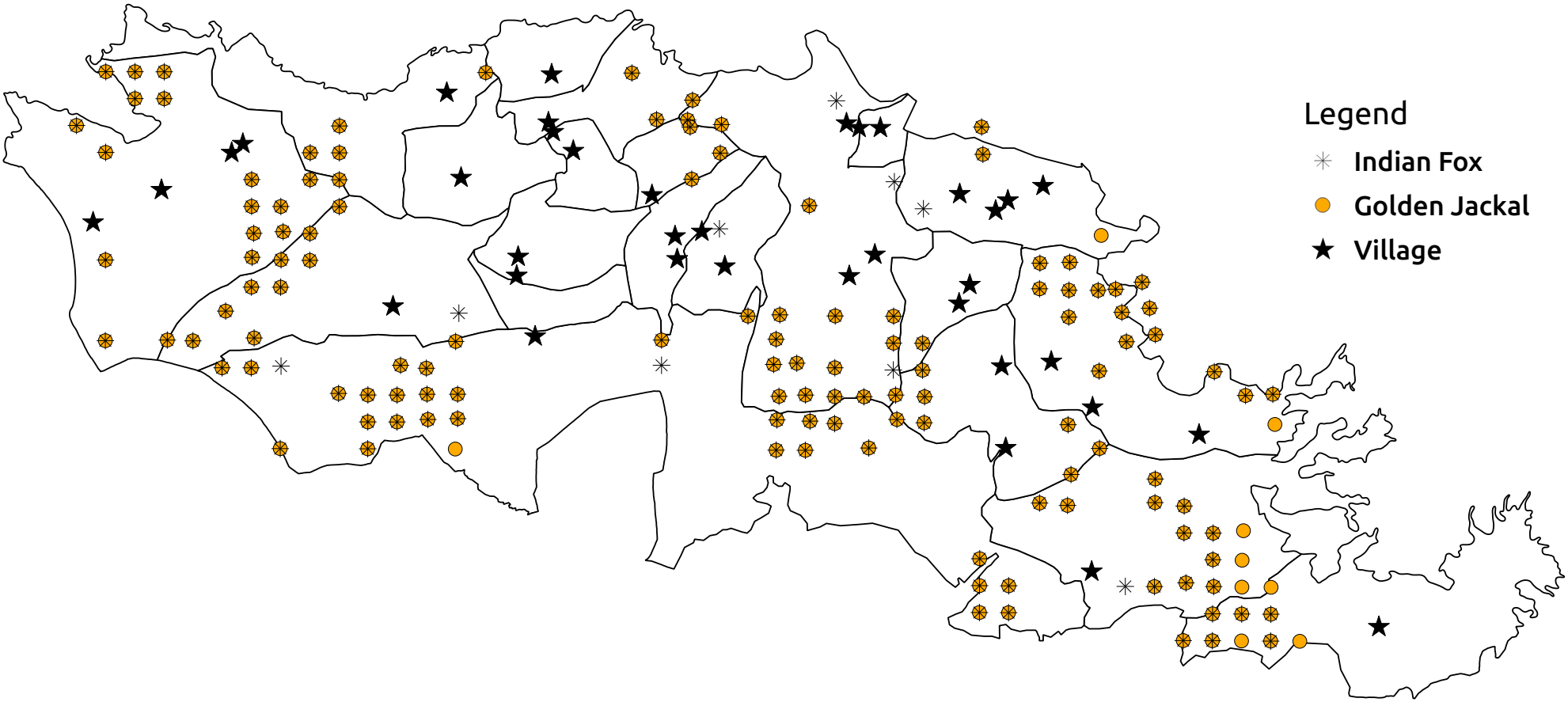
From camera trap data:

Species	**Sites Present**	**Total Sites**	**%**
Indian Fox	61	675	9
Golden Jackal	392	675	58
Desert Fox	81	675	12
Dog	74	675	11

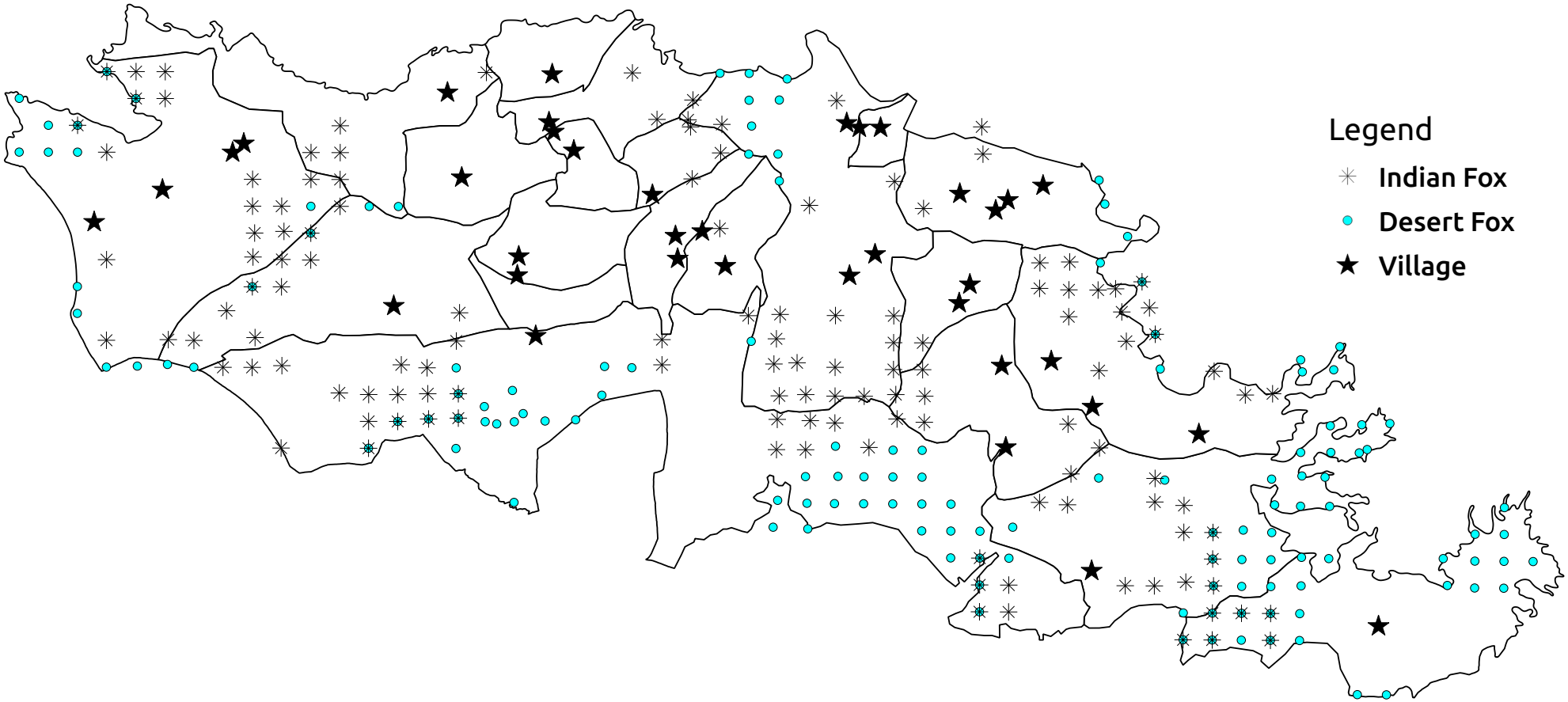
DF & Dog - Complete separation



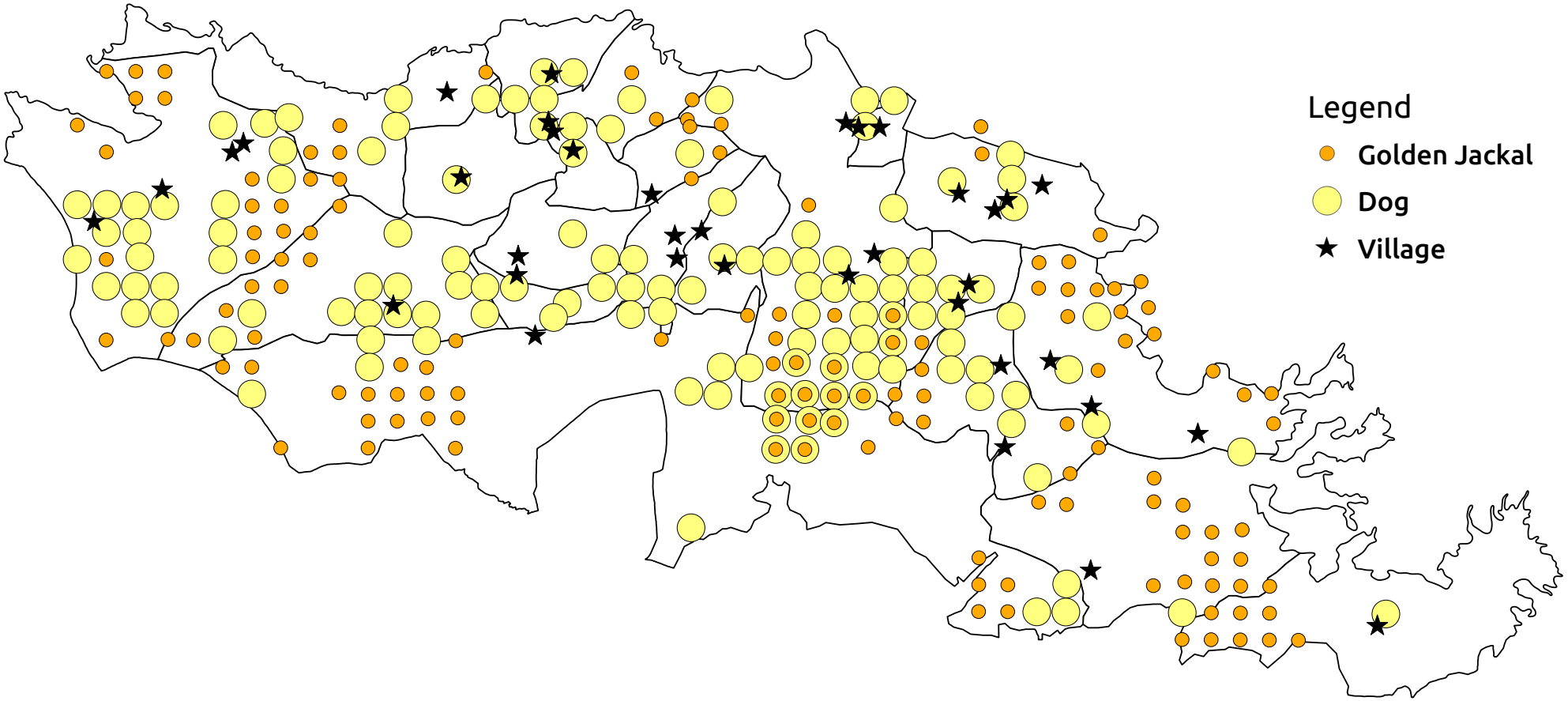
IF & GJ - Complete overlap



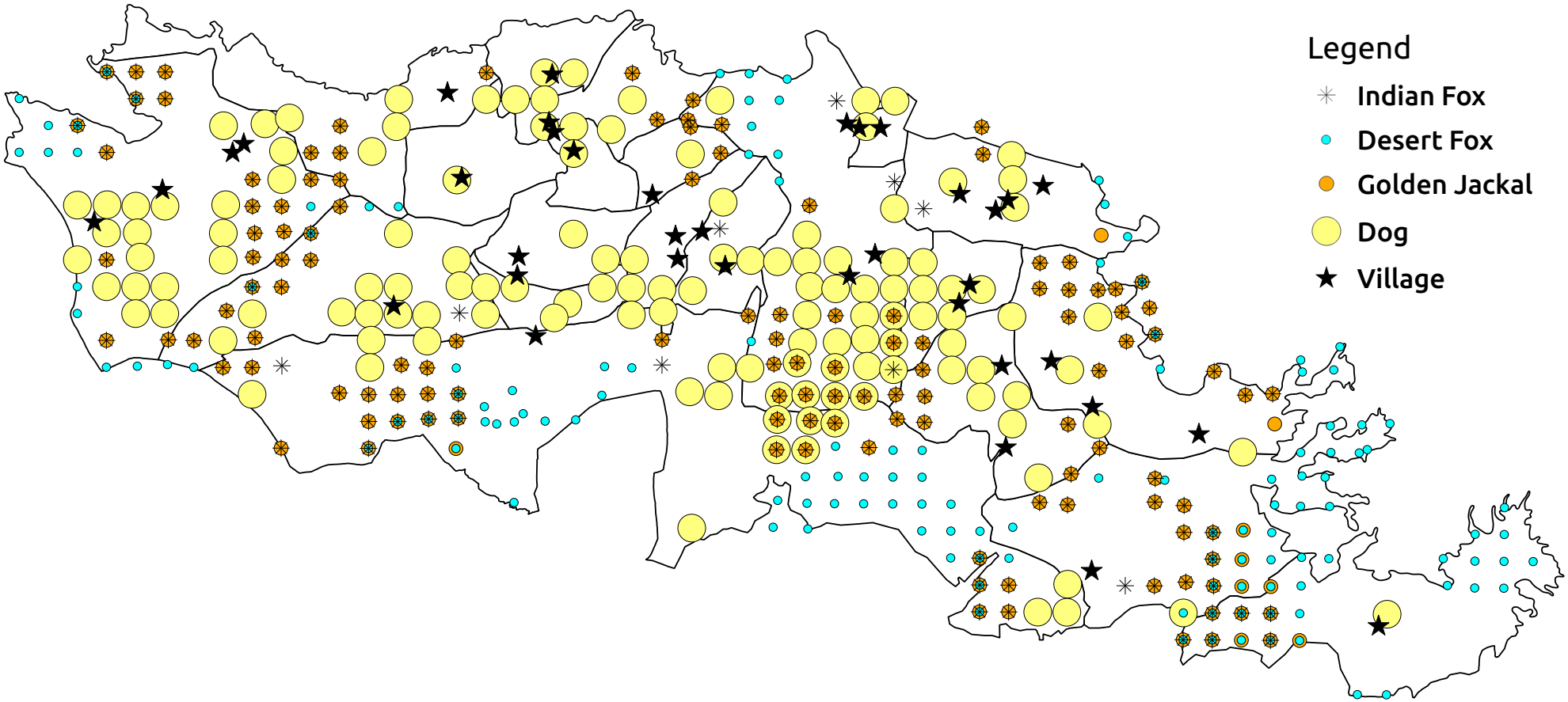
IF & DF - Near complete separation



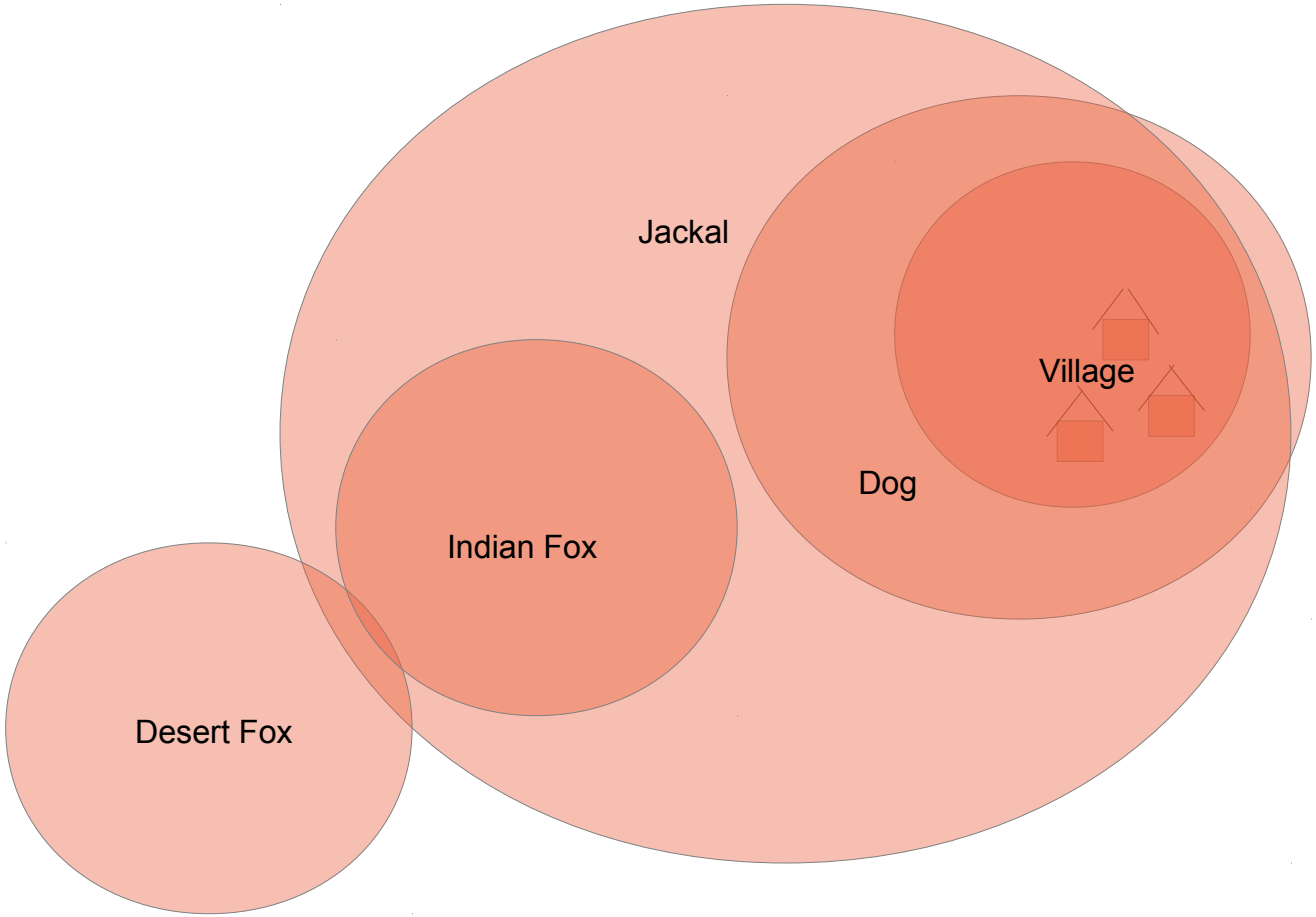
GJ & Dog - Some overlap



Spatial partitioning: All canids



Spatial partitioning: Conceptual diagram



Species interactions: Occupancy analysis

From β values estimated from best model:

Species	IF	DF	Jackal	Dog
IF		-ve	+ve	-ve
DF	0		-ve	-ve
Jackal	0	0		+ve
Dog	0	0	-ve	

Conclusions

- Very little dietary partitioning
  - Especially among foxes
  - Minor differences in plant matter

Conclusions

- Wild canids primarily crepuscular + nocturnal
  - Dogs diurnal
  - No canids active - 2 to 4 PM

Conclusions

- Desert fox - spatial partitioning with other canids
- Dog - spatial partitioning with other canids
- Indian fox & golden jackal - spatial overlap

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References

- Aiyadurai, A. and Y.V. Jhala. (2006) Foraging and habitat use by Golden Jackal (*Canis aureus*) in the Bhal Region, Gujarat, India. J. Bombay Nat. Hist.Soc., 103(1): 5-12.
- Donadio, E. & Buskirk, S.W. (2006) Diet, Morphology, and Interspecific killing in Carnivora. American Naturalist. Vol.167, No.4.
- Fisher, J.T., Anholt, B., Bradbury, S., Wheatley, M., & Volpe, J.P. (2012) Spatial segregation of sympatric marten and fishers: the influence of landscapes and species-scapes. Ecography, 35: 001-009.
- Gese, E.M., Stotts, T.E., & Grothe, S. (1996) Interactions between coyotes and red foxes in Yellowstone National Park, Wyoming. J. Mammalogy. 77(2):377-382.
- Gompper, M.E. & Vanak, A. T. (2008). Subsidized predators, landscapes of fear, and disarticulated carnivore communities. Animal Conservation 11: 13-14.
- Hersteinsson, P. & Macdonald, D.W. (1992) Interspecific competition and the geographical distribution of red and Arctic foxes *Vulpes vulpes* and *Alopex lagopus*. Oikos, 64:505-515.
- Jhala, Y. V. & Moehlman, P.D. (2004) 6.2. Golden Jackal *Canis aureus* Linnaeus, 1758. In: Sillero-Zubiri, C., Hoffmann, M., & Macdonald, D. W. (eds): Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan. IUCN-SSC Canid Specia list Group.
- Kamler, J. F., Stenkewitz, U., Klare, U., Jacobsen, N.F., & Macdonald, D.W. 2012. Resource partitioning among cape foxes, bat-eared foxes, and black-backed jackals in South Africa. Journal of Wildlife Management 76:1241-1253.
- Kamler, J. F., Stenkewitz, U., & Macdonald, D.W. 2013. Lethal and sublethal effects of black-backed jackals on cape foxes and bat-eared foxes. Journal of Mammalogy 94:295- 306.

References

- Roemer, G.W., Gompper, M.E., & van Valkenburgh, B. (2009) The ecological role of the mammalian mesocarnivore. BioScience, Vol.59, No.2.
- Sarmento, P.B., et al. (2010) "Habitat selection and abundance of common genets Genetta genetta using camera capture-mark-recapture data." European Journal of Wildlife Research 56.1: 59-66.
- Scheinin, S., Yom-tov, Y., Motro, U., & Geffen,E. (2005) Behavioural responses of red foxes to an increase in the presence of golden jackals: a field experiment. Animal Behavior, 71: 577-584.
- Sillero-Zubiri, C., Hoffman, M., & Macdonald, D.W. (2004) (Technical Editors) Canids: Foxes, Wolves, Jackals, and Dogs. Gen. Tech. Rep. Status Survey and Conservation Action Plan, IUCN/SSC Canid Specialist Group.
- Smith, D.W., Peterson, R.O., & Houston, D.B. (2003) Yellowstone after wolves. BioScience. 53(4):330-340.
- Levi, Taal, & Wilmers, Christopher. Wolves-coyotes-foxes: a cascade among carnivores. Ecology 93.4 (2012): 921-929.
- Vanak, A.T., Irfan-Ullah, M. & Peterson, T. (2008). Gap analysis of Indian fox conservation using ecological niche modeling. Journal of the Bombay Natural History Society 105: 49-54.

References

- Vanak, A.T. & Gompper, M.E. (2009). Dogs emph(Canis familiaris) as carnivores: Their role and function in intraguild competition. Mammal Review 39: 265-283 - Included in 2012 Mammal Review Virtual Issue.
- Vanak, A. T., Thaker, M & Gompper, M. E. (2009). Experimental examination of behavioural interactions between free-ranging wild and domestic canids. Behavioural Ecology and Sociobiology 64:279-287.
- Vanak, A.T. & Gompper, M.E. (2009). Dietary niche separation between sympatric free-ranging domestic dogs and Indian foxes in central India. Journal of Mammalogy 90:1058-1065.
- Vanak, A.T. & Gompper, M.E. (2010). Interference competition at the landscape level: the effect of free-ranging dogs on a native mesocarnivore. Journal of Applied Ecology 47: 1225:1232.
- Vanak, A. T., Fortin, D., Thaker, M., Owen, C, Lehmann, M, Greatwood, S. & Slotow, R. (2013). Moving to stay in place: behavioural mechanisms of co-existence in an African large carnivore guild. Ecology.
- Voigt, D.R. & Earle, B.D. (1983) Avoidance of coyotes by red fox families. J. Wildlife Mgmt. Vol. 47, No. 3, pp. 852-857.
- Zielinski, W.J. & Kucera, T.E., technical editors. (1995) American marten, fisher, lynx, and wolverine: survey methods for their detection. Gen. Tech. Rep. PSW-GTR-157. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture: 163 p.

“Kutch nahi dekha, to kuch nahi dekha!” - *The Gujarat Tourism Slogan*

THANK YOU!