

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

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M.Sc. Thesis Defense

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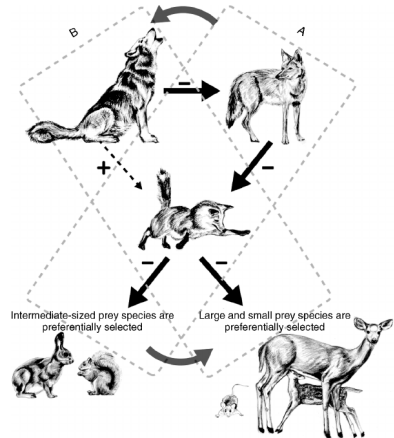
Co-guide: *Dr. Vishweshha Guttal* (CES, IISc)

# Outline

- Introduction
- Goal
- Prior Research
- Study Area
- Study Taxa
- Methodology
- Analysis
- Results
- Conclusions

# Introduction

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



[Levi & Wilmers, 2012]

# Introduction: Carnivore interactions

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



# Introduction: Species-scapes

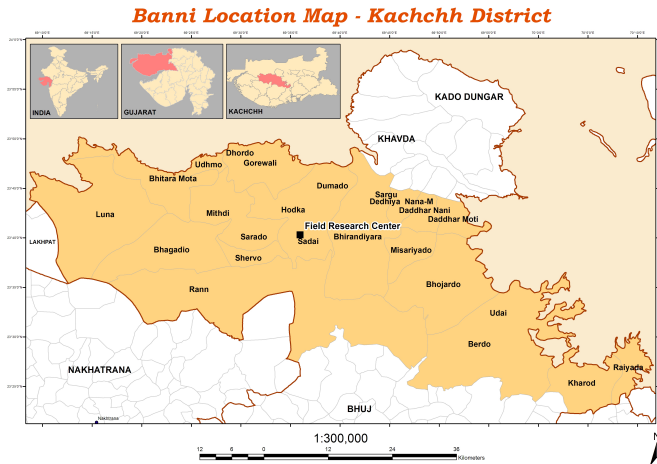
*“... a spatial plane of species interactions that combines with resources and habitat structure to drive species distributions”*

[Fisher et al., 2012]

# Goal

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

# Study Area



[http://bannigrassland.klink.co.in/images/Banni%20Location\\_2.jpg](http://bannigrassland.klink.co.in/images/Banni%20Location_2.jpg)

# Habitats



Image source: Pankaj Joshi

# Taxa



Indian fox image: Abi Vanak

# Other meso- and large carnivores present

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

# Prior Research

- Bat-eared fox, cape fox, & black-backed jackals: South Africa

[Kamler et al., 2013]

- Indian fox & domestic dog: India

[Vanak & Gompper, 2009a; Vanak & Gompper, 2009b; Vanak & Gompper, 2010]

- Domestic dog & golden jackal: India

[Jhala & Aiyadurai, 2006]

- Wolf - Coyote - Red/Swift fox: Canada, North America

[Voigt & Earle, 1983; Gese et al., 1996; Smith et al., 2003]

- Red & Arctic fox: Canada, North America, Eurasia

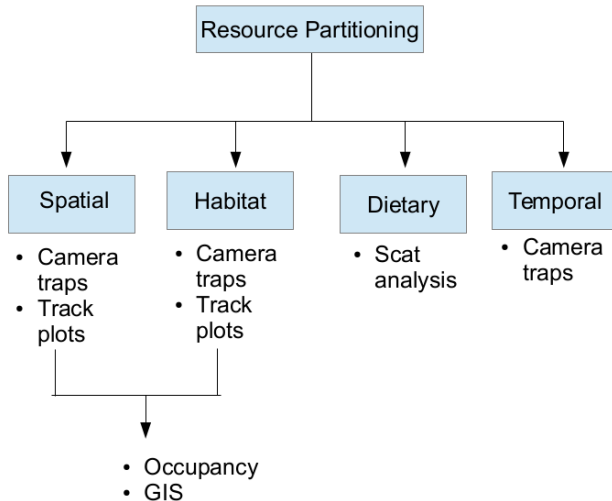
[Hersteinsson & Macdonald, 1992]

# Research Gaps

- Mostly 2-3 species at a time
- Significant dietary niche separation
- Human-subsidized carnivores - rarely considered
- Species-scapes ignored



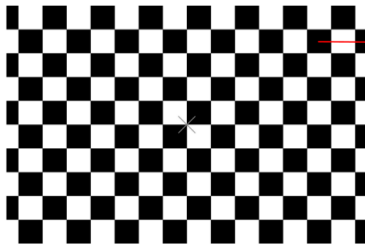
# Methodology: Overview



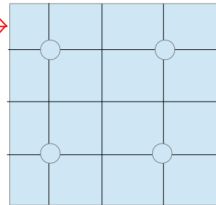
# Methodology: Design

- Grid-based sampling approach: Occupancy framework
  - Nested design
  - Single season, multiple species
- Imperfect detection:
  - Spatial replicates → track plots
  - Temporal replicates → camera traps

# Methodology: Grids



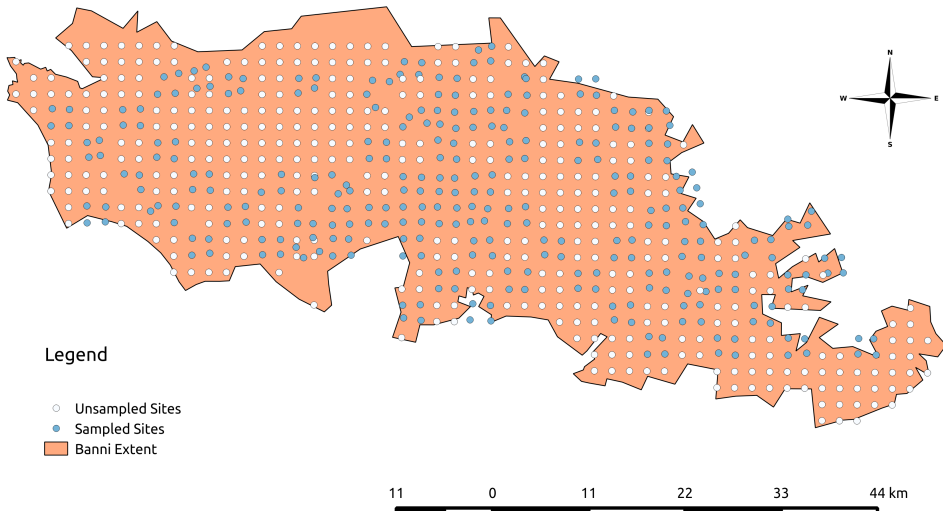
2500 sq.km. - 156 cells



16 sq.km. - 4 camera traps

# Methodology: Sampling

Banni Sampling Design



# Data Collection: Effort

- 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



# Scat collection

- Desert fox & Indian fox - only at active den sites
- Golden jackal - recorded defecating in front of camera

# Analysis: Camera Trap Videos



Desert fox in Banni

# Analysis: Camera Trap Videos



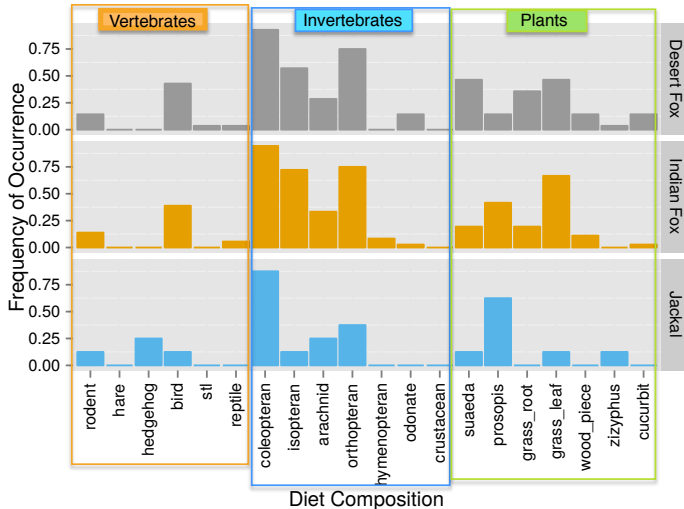
Desert fox in Banni

# Analysis: Occupancy

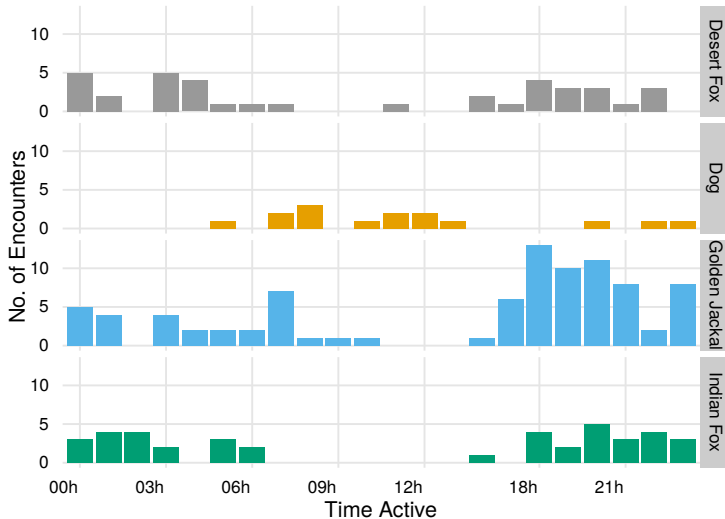
- Assumption: Occupancy of larger canids not affected by smaller ones
- Model selection: Best model from multiple models for each species
- R package: *unmarked*
- Species maps: QGIS

# Results

# Very little dietary partitioning



# Wild canids crepuscular + nocturnal



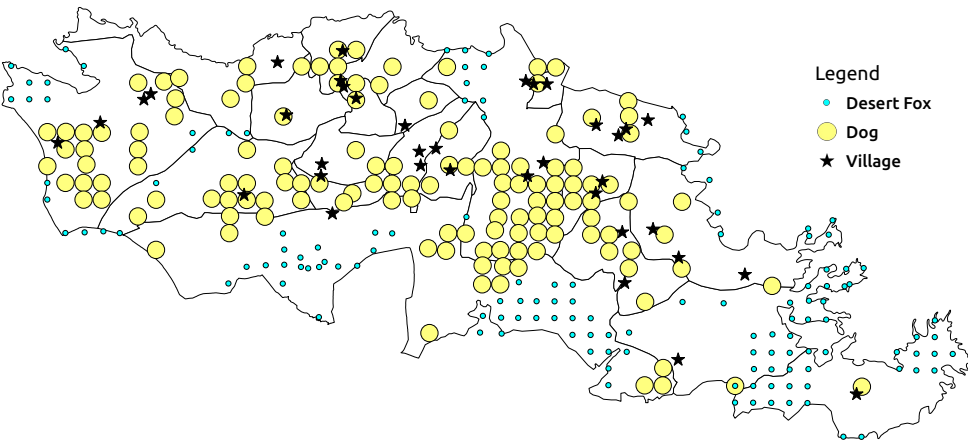
# Naïve occupancy

From camera trap data:

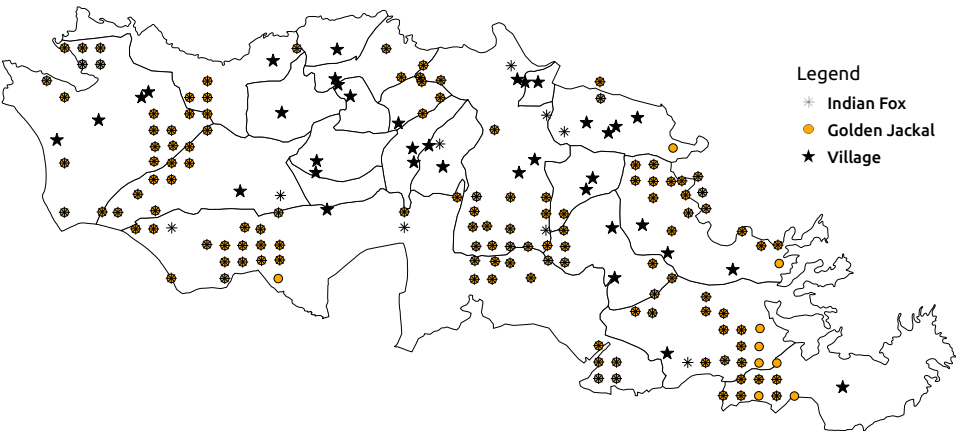
<b>Species</b>	<b>Sites Present</b>	<b>Total Sites</b>	<b>%</b>
Indian Fox	61	675	9
Golden Jackal	392	675	58
Desert Fox	81	675	12
Dog	74	675	11



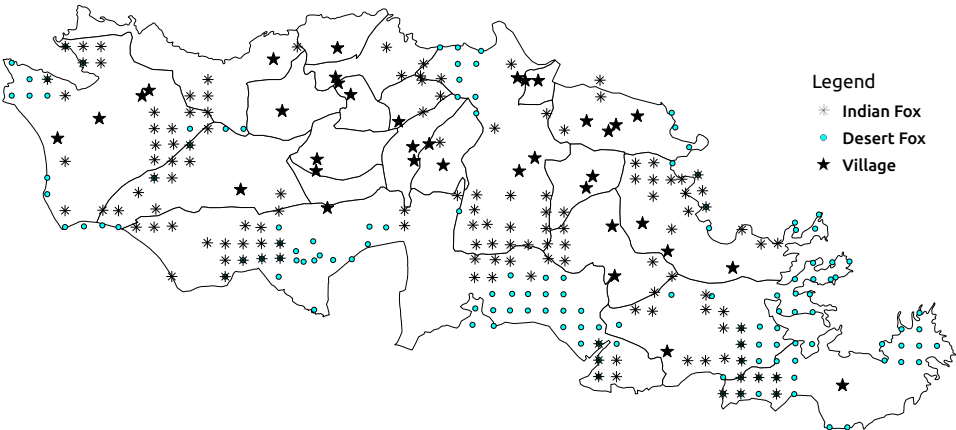
# DF & Dog - Complete separation



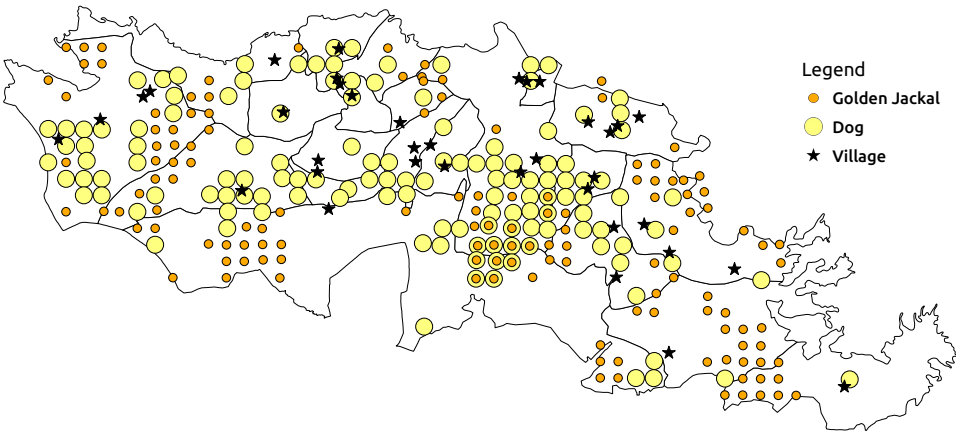
# IF & GJ - Complete overlap



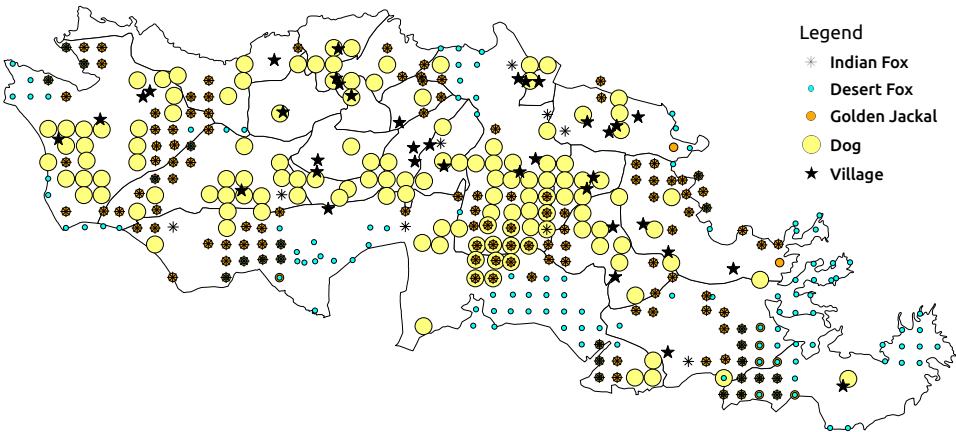
# IF & DF - Near complete separation



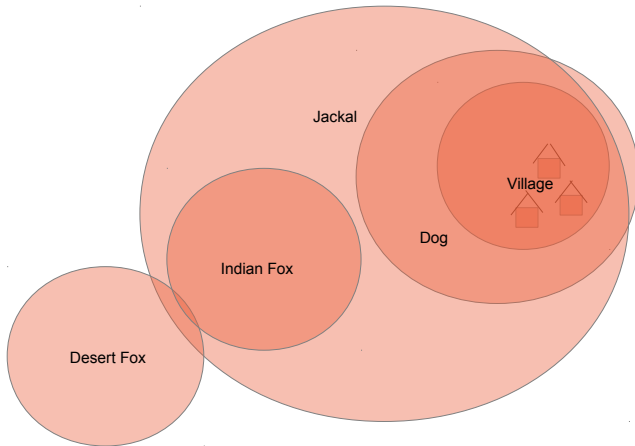
# GJ & Dog - Near complete separation



# Spatial partitioning: All canids



# Spatial partitioning: Conceptual diagram



# Species interactions: Occupancy analysis

From  $\beta$  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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“Kutch nahi dekha, to kuch nahi dekha!” - *The Gujarat Tourism Slogan*

THANK YOU!