

Learning and Planning Under Uncertainty for Wildlife Conservation



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AI-Assisted Decision-Making for Conservation | October 20, 2022



Srepok Wildlife Sanctuary

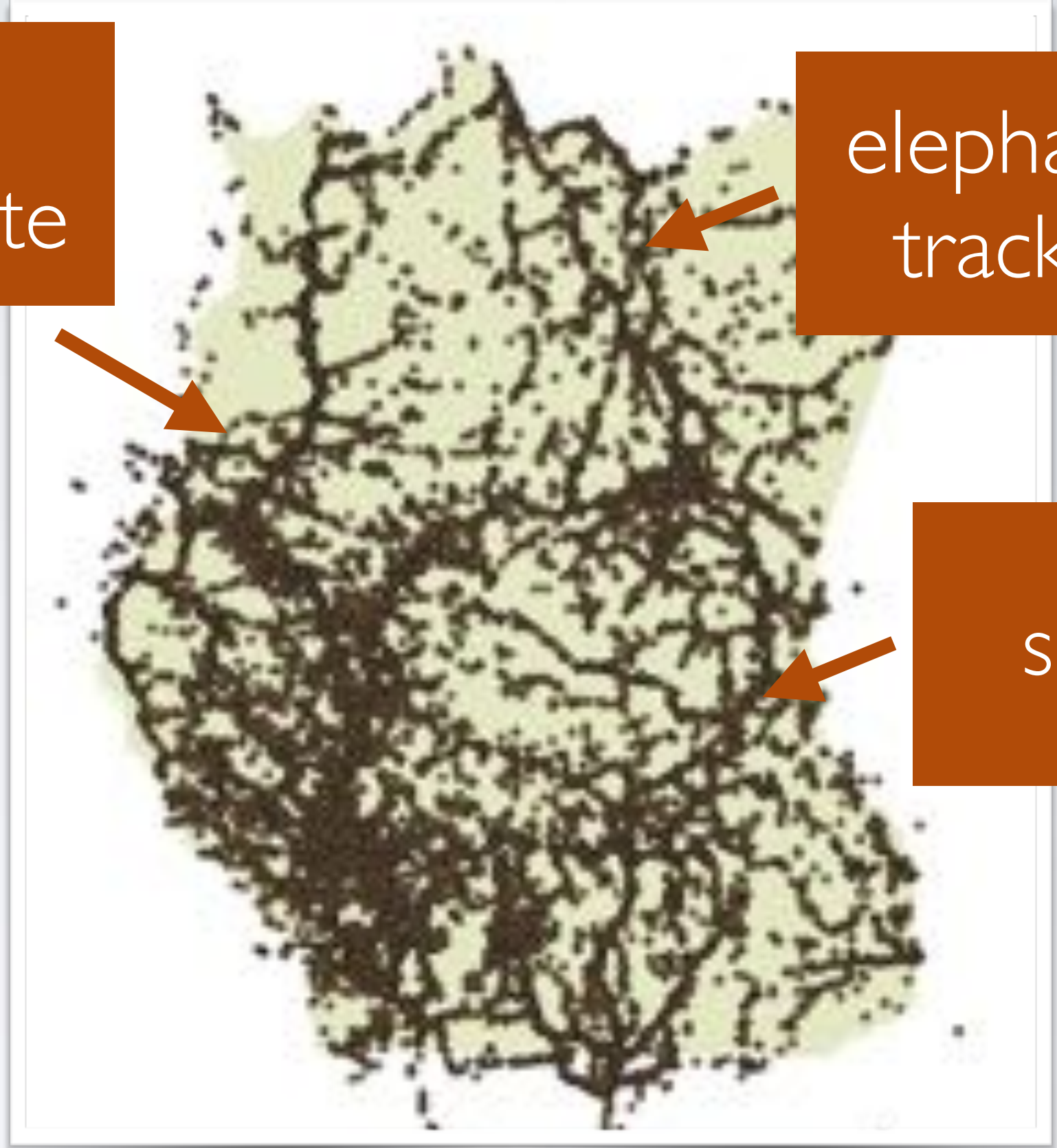
Cambodia



illegal
campsite

elephant
tracks

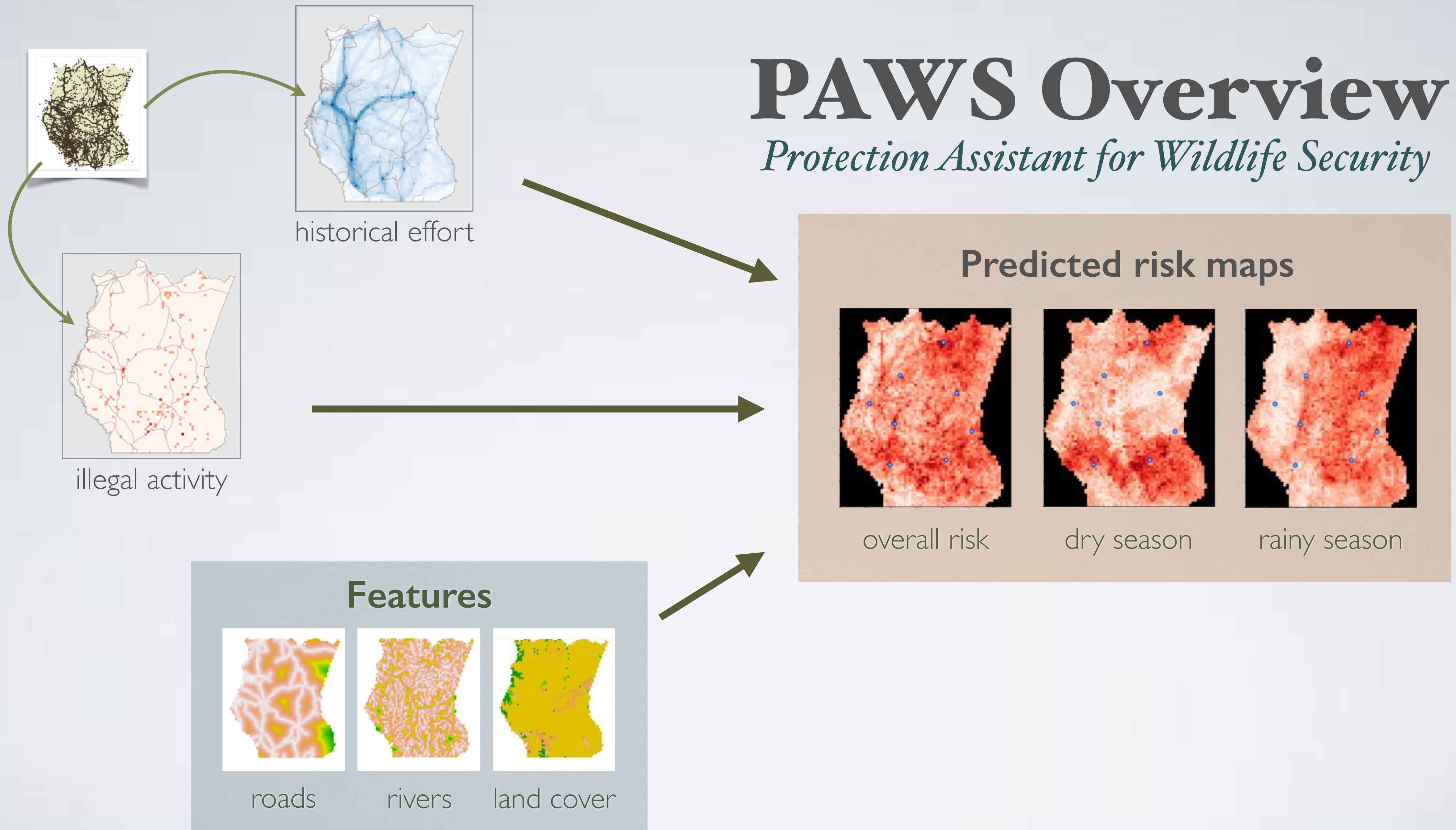
snare

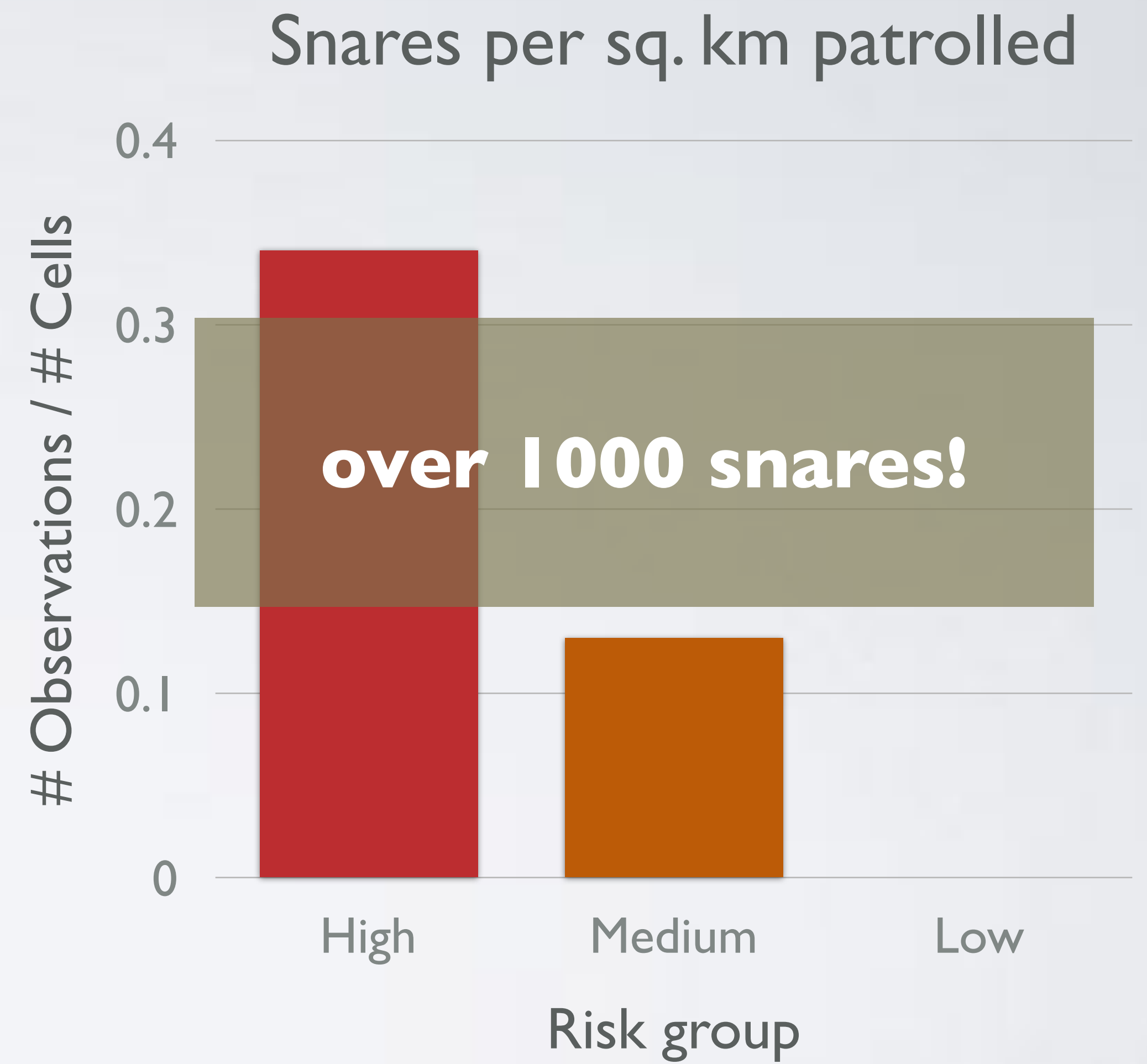
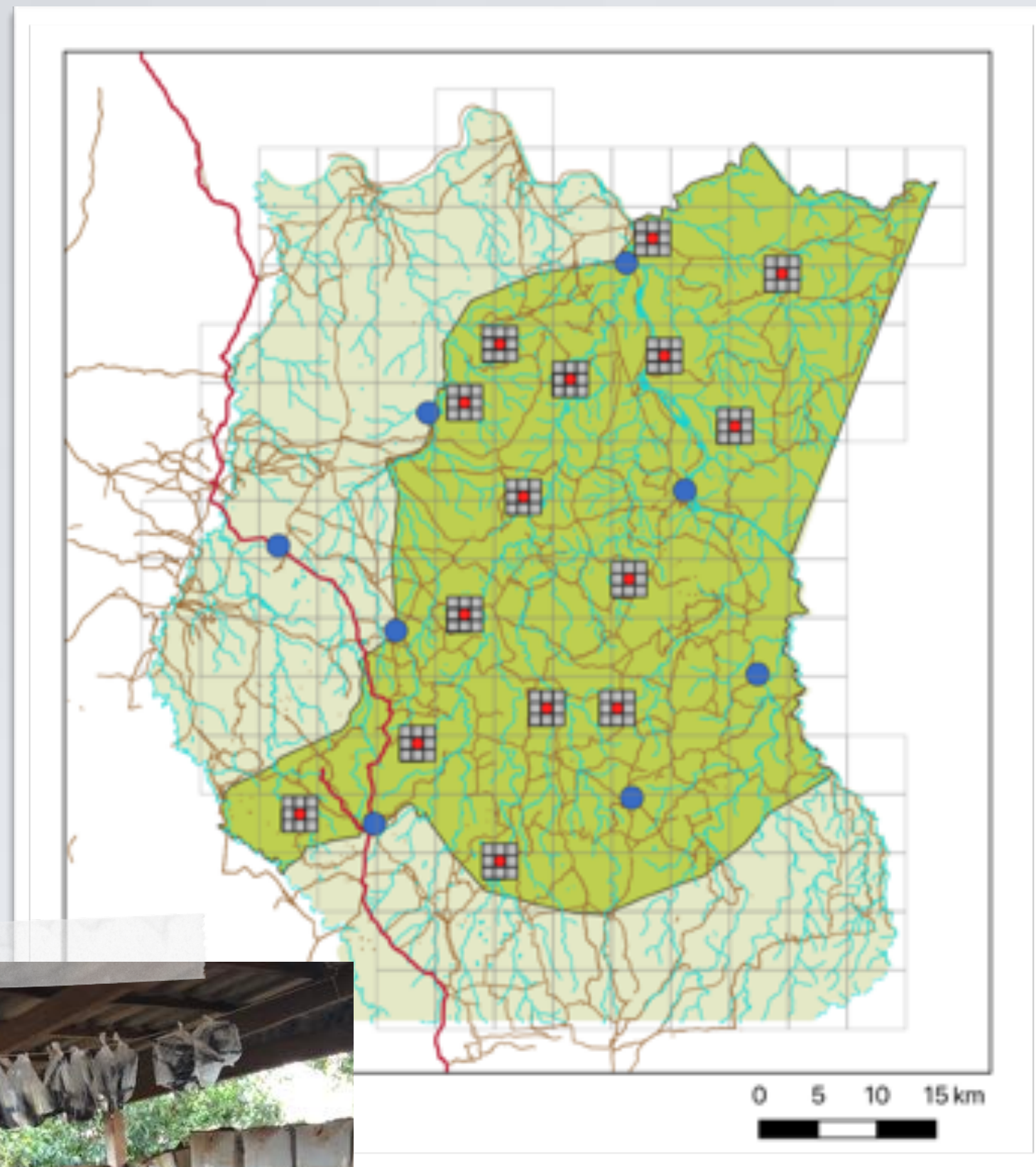


43,269 patrol observations
recorded 2013 – 2018

PAWS Overview

Protection Assistant for Wildlife Security

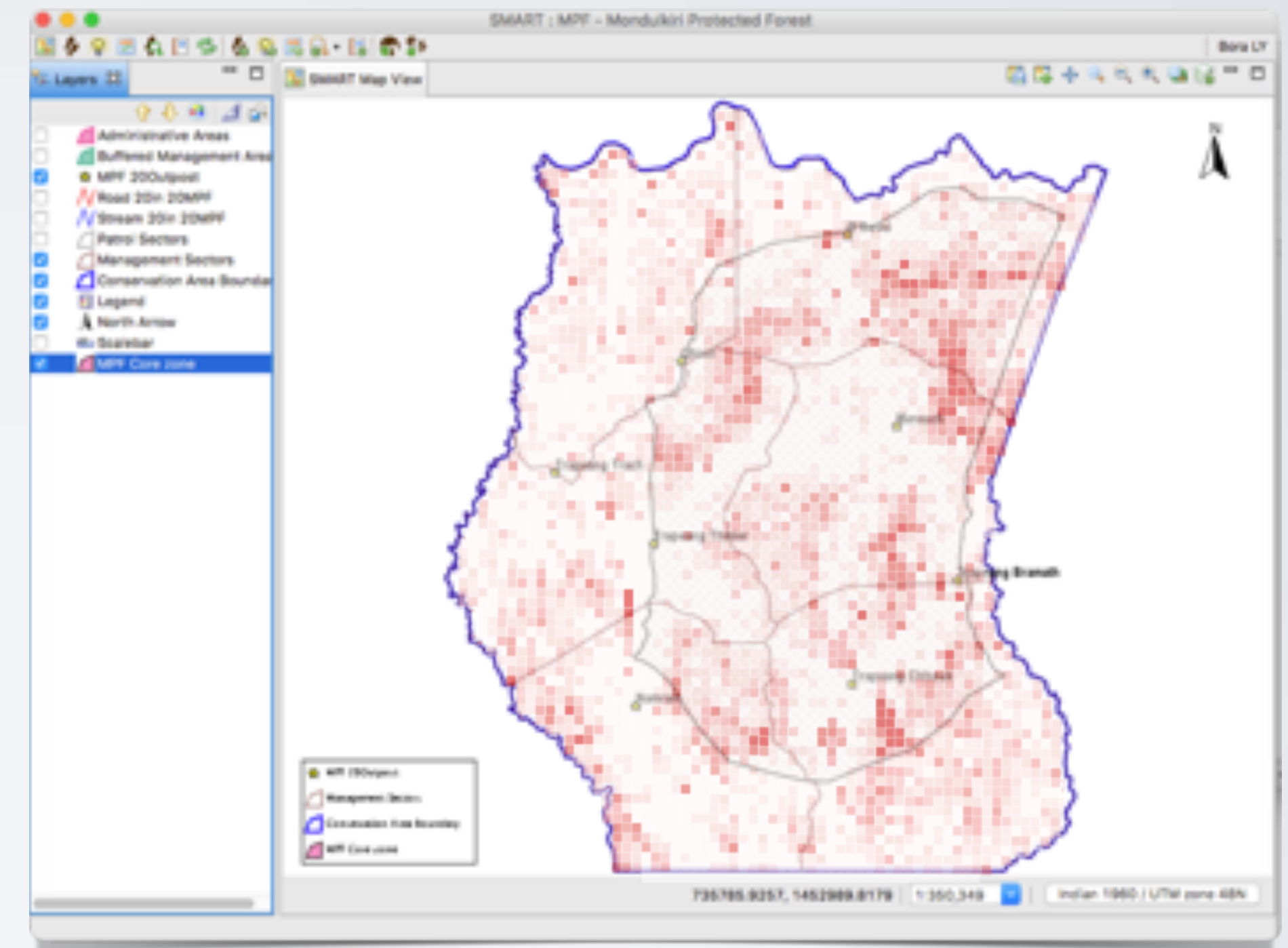
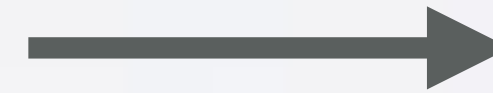
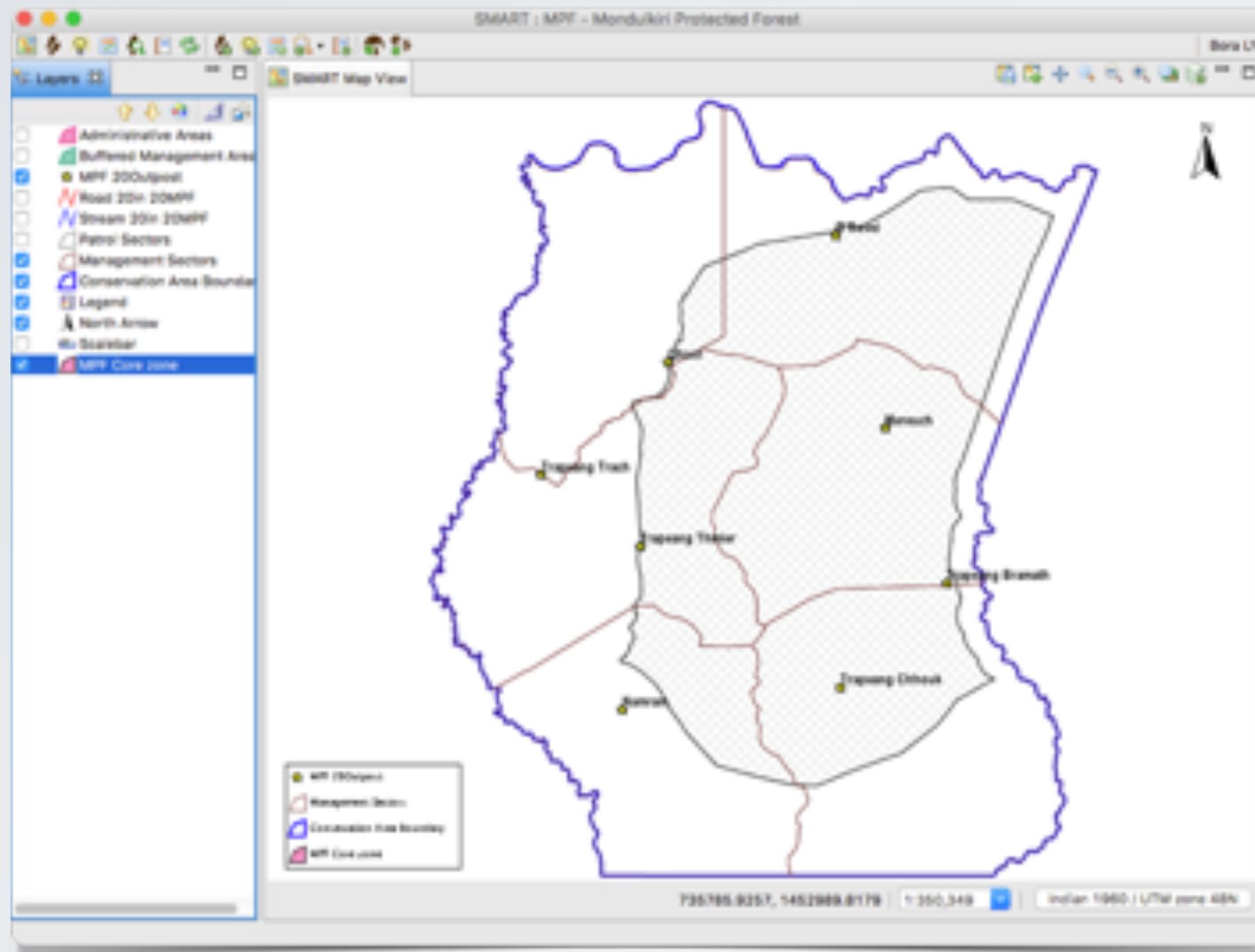


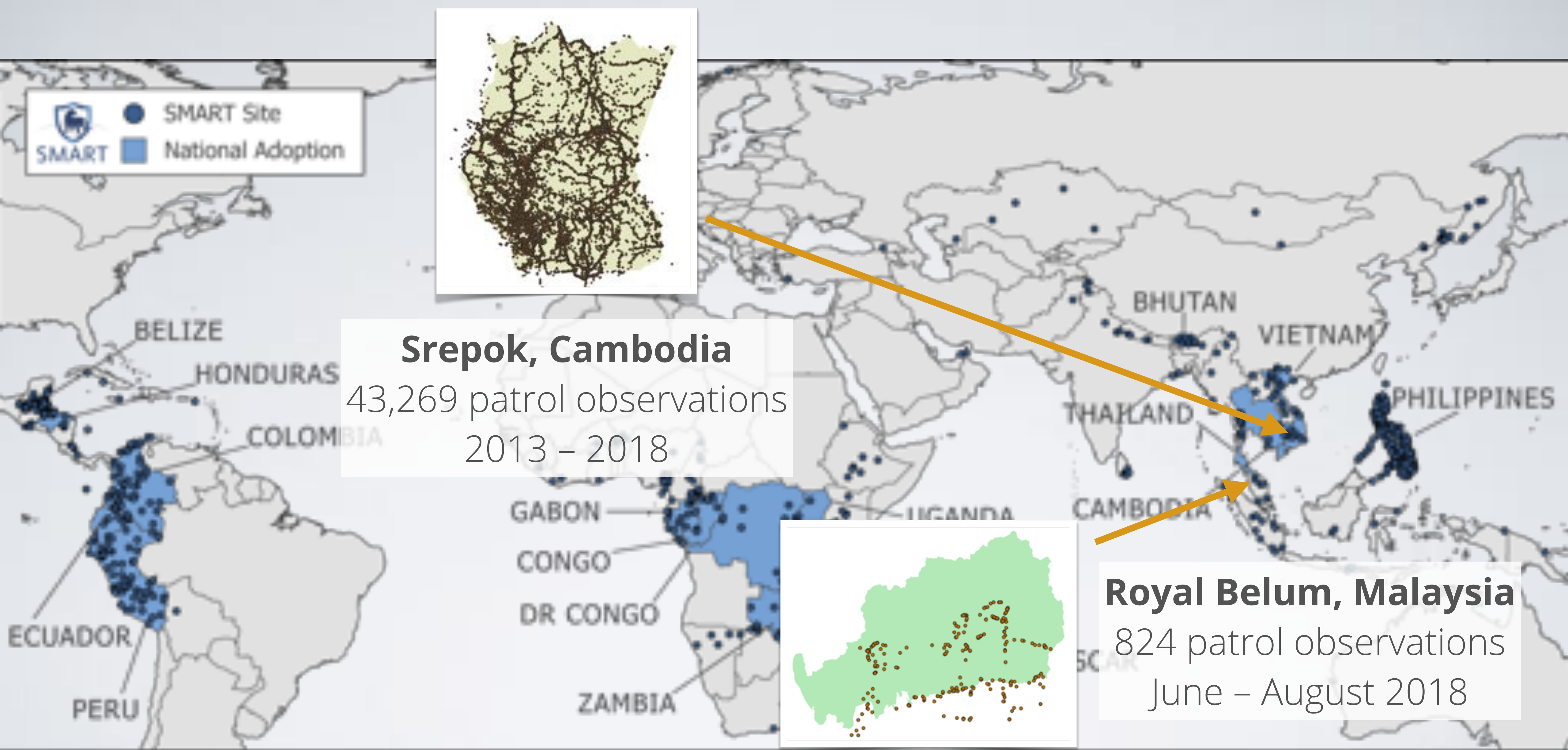




"I am super excited with the results. Let's get this going on other countries too this year."

—Rohit Singh, WWF Zero Poaching Lead





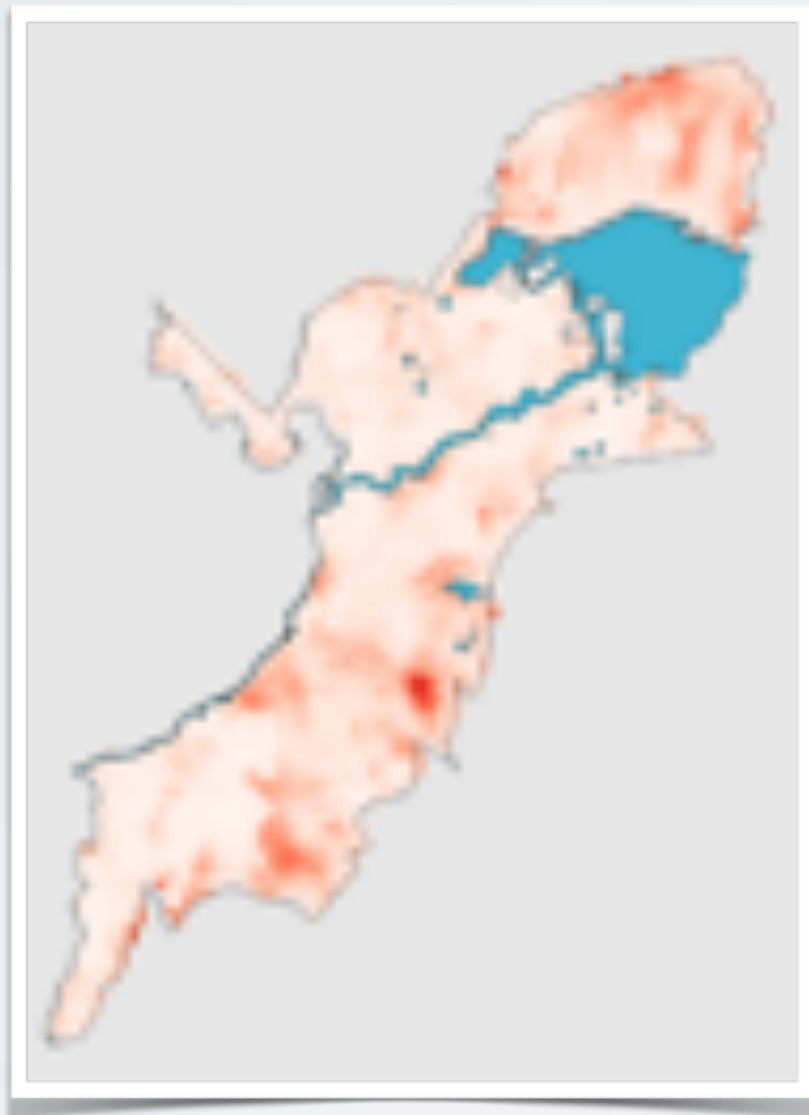
Srepok, Cambodia
43,269 patrol observations
2013 – 2018

Royal Belum, Malaysia
824 patrol observations
June – August 2018

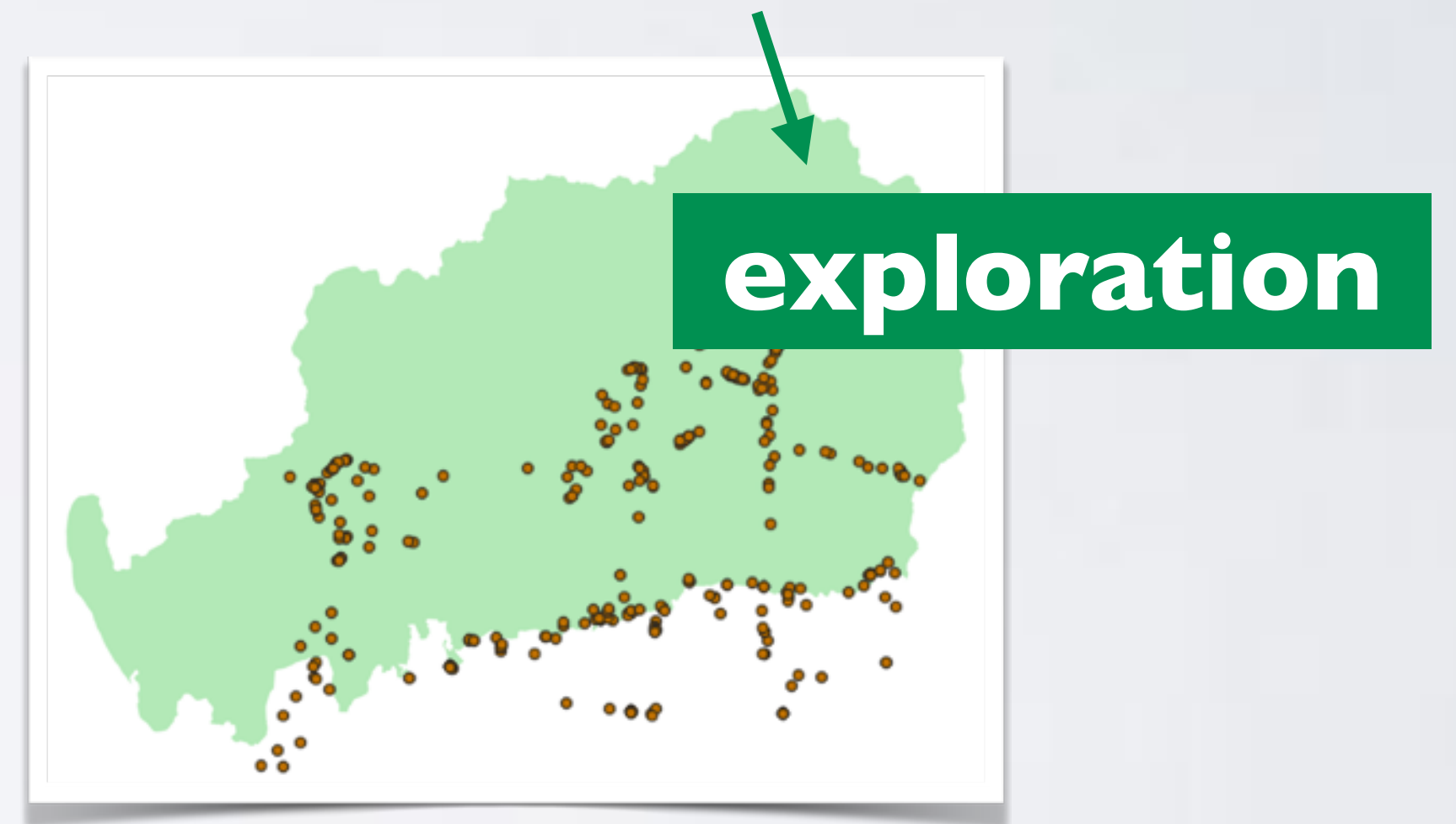
Deployment to 1000+ protected areas

The Dual Mandate **exploitation**

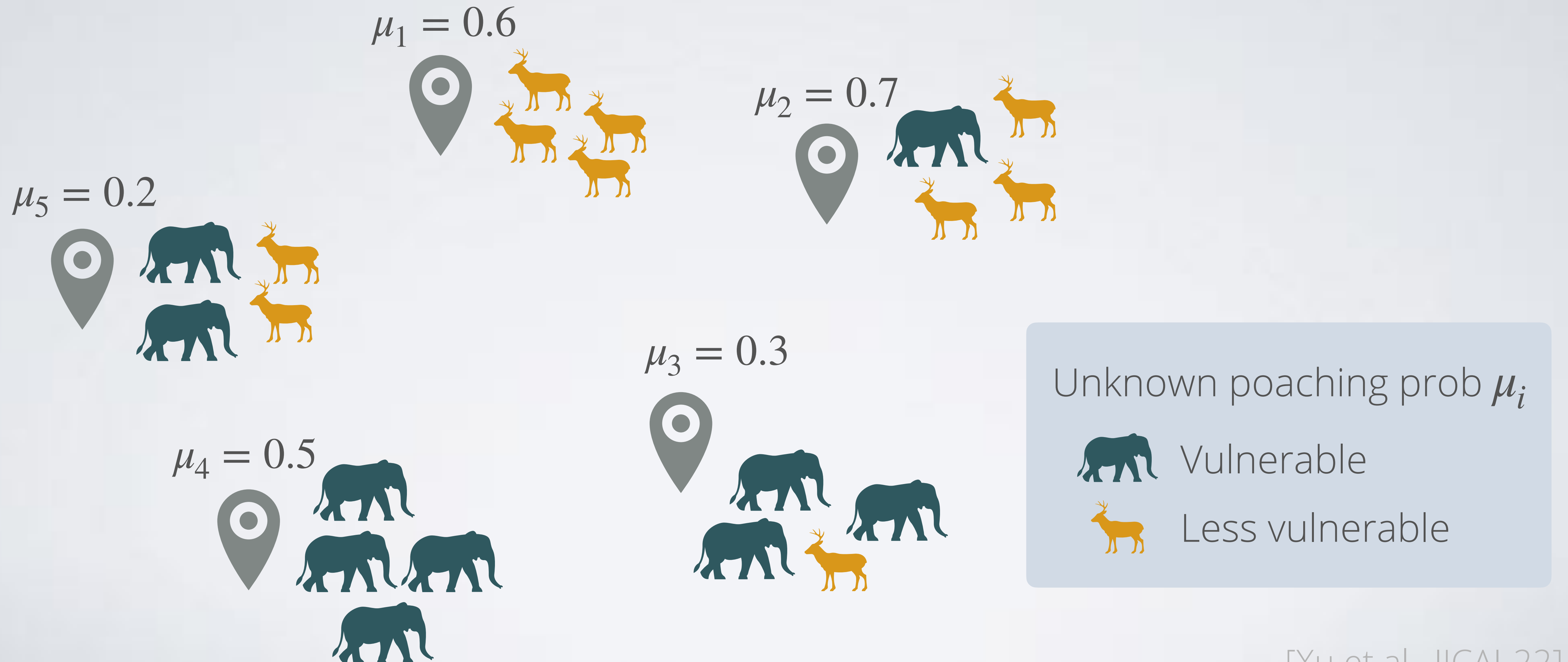
Data-rich parks: build predictive models to plan patrols



Data-scarce parks: conduct patrols to detect illegal activity **and** improve the predictive model



Species prioritization



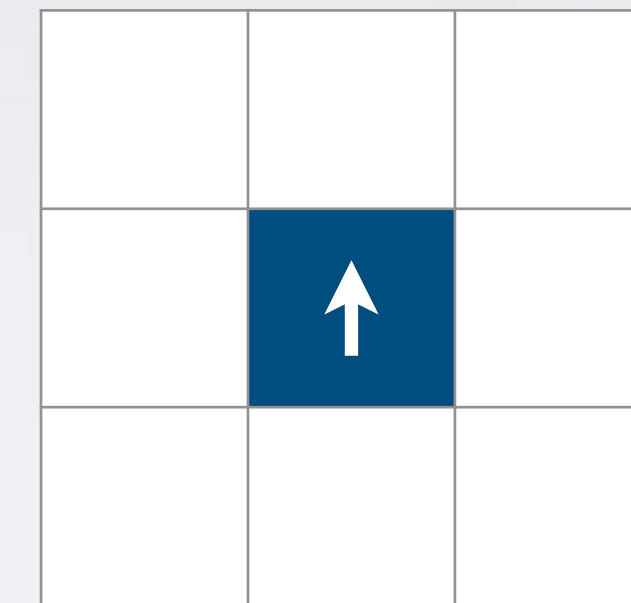
How do adversaries respond to our patrols?



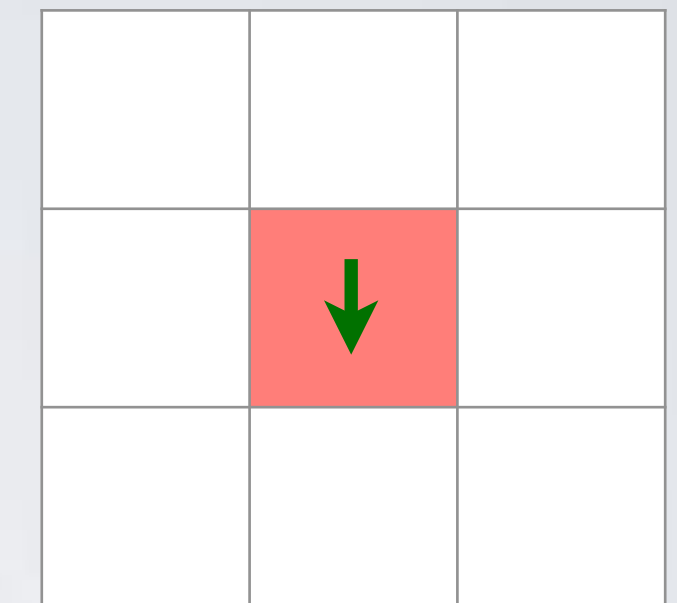
Deterrence is key



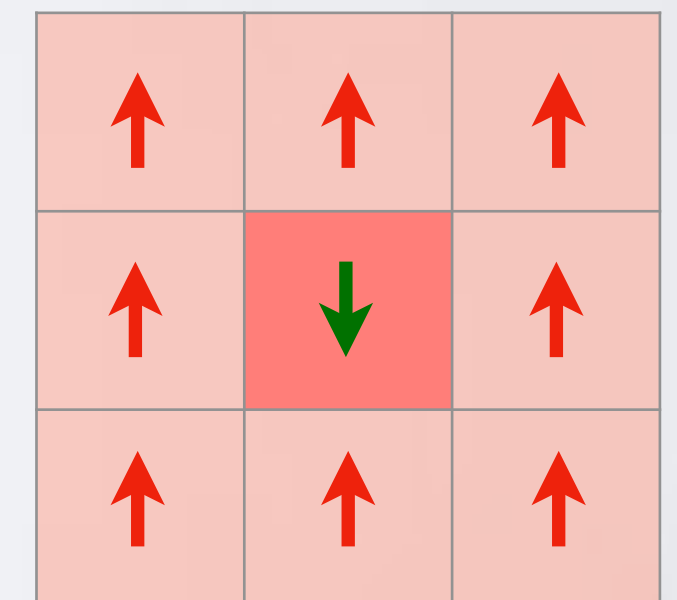
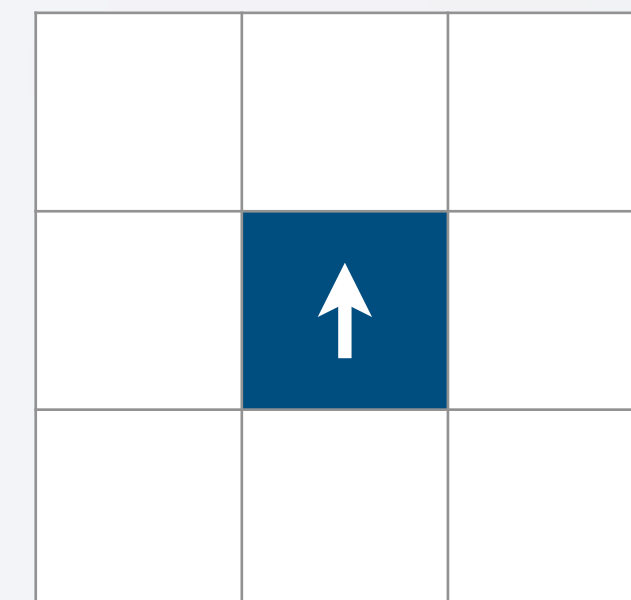
past patrol effort



illegal activity



deterrence

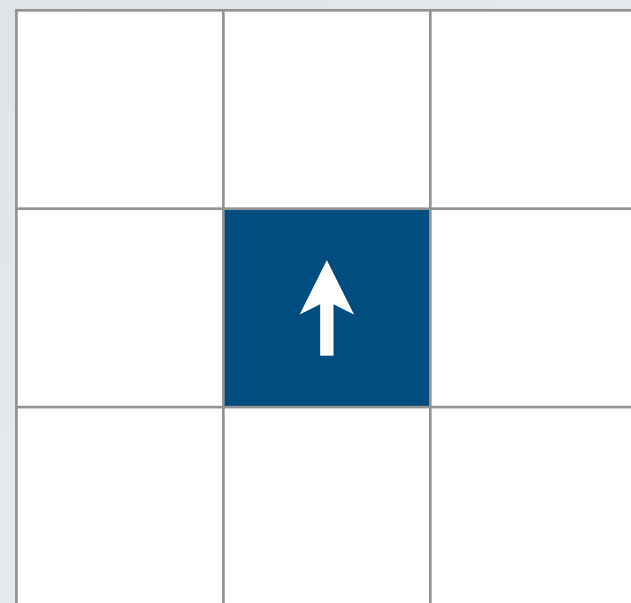


displacement

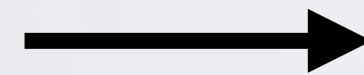
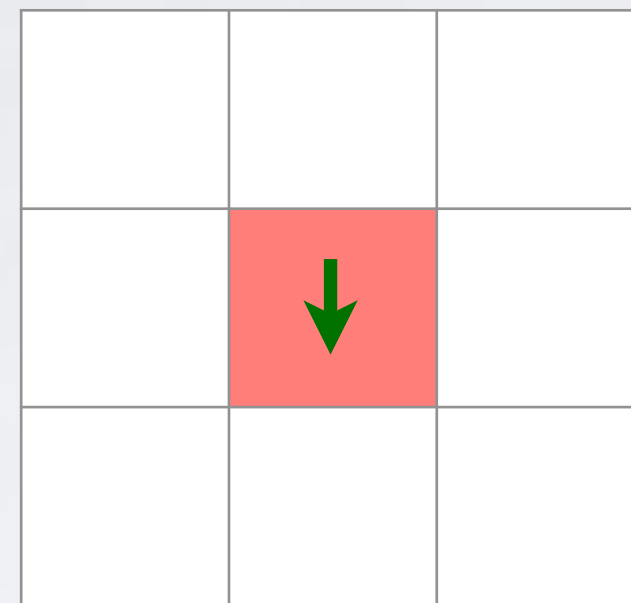
[Xu et al., UAI-21]

Robust planning

past patrol effort



illegal activity

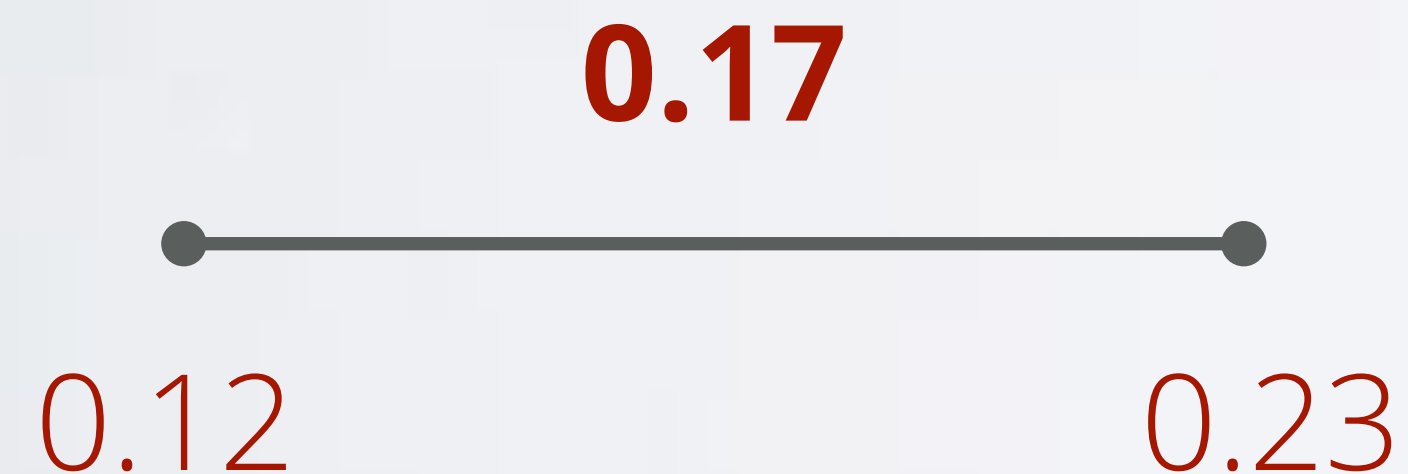


deterrence!

└ sequential decision-making

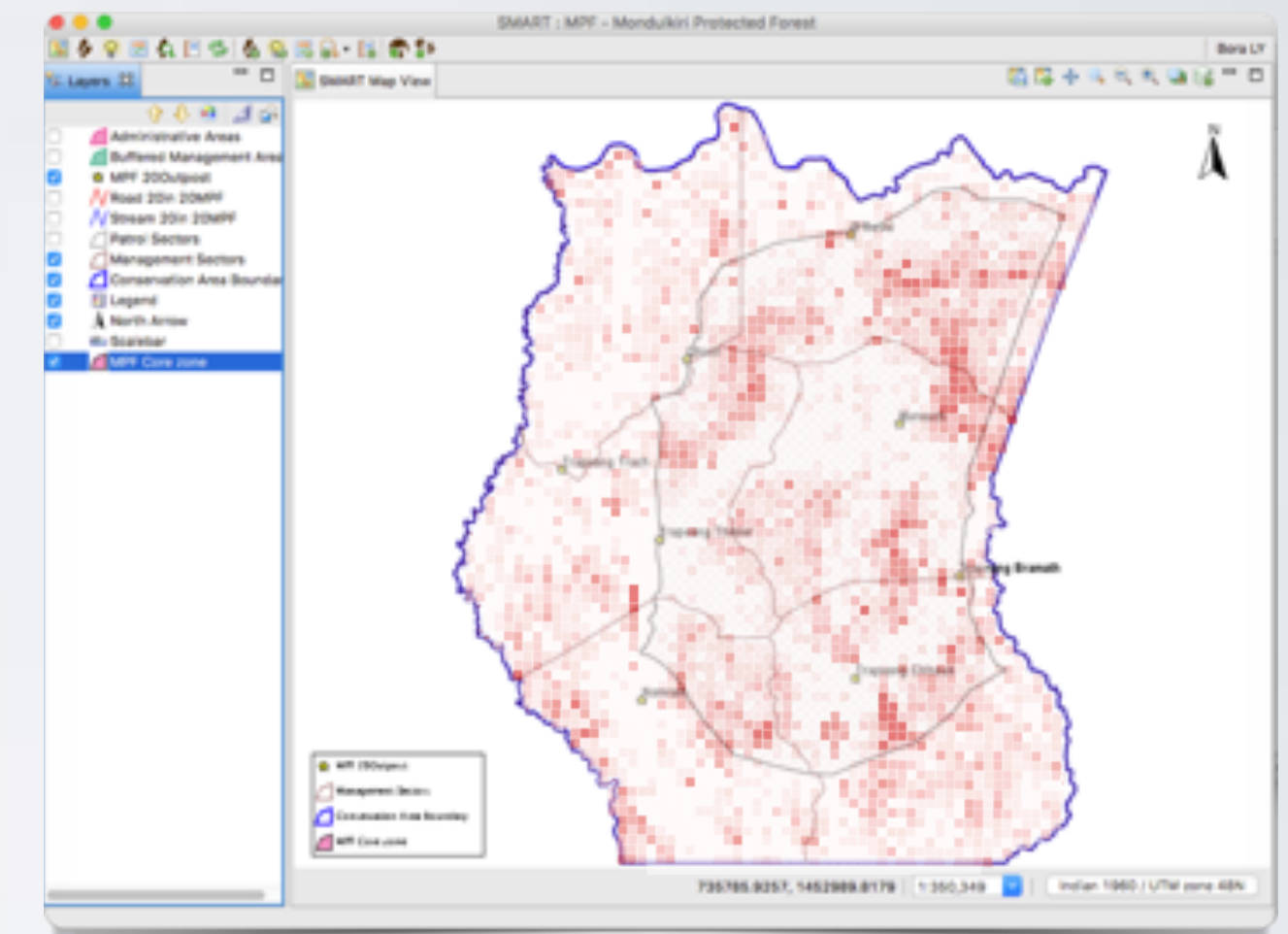
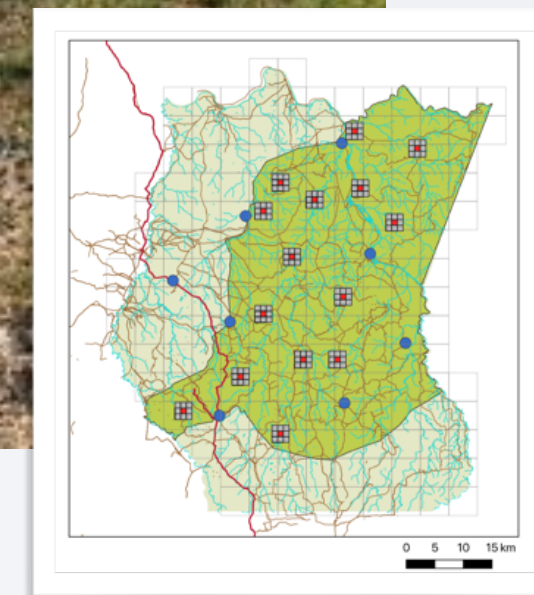
uncertainty?

└ robust patrol planning



PAWS Overview

Protection Assistant for Wildlife Security



Collaboration with
conservation NGOs

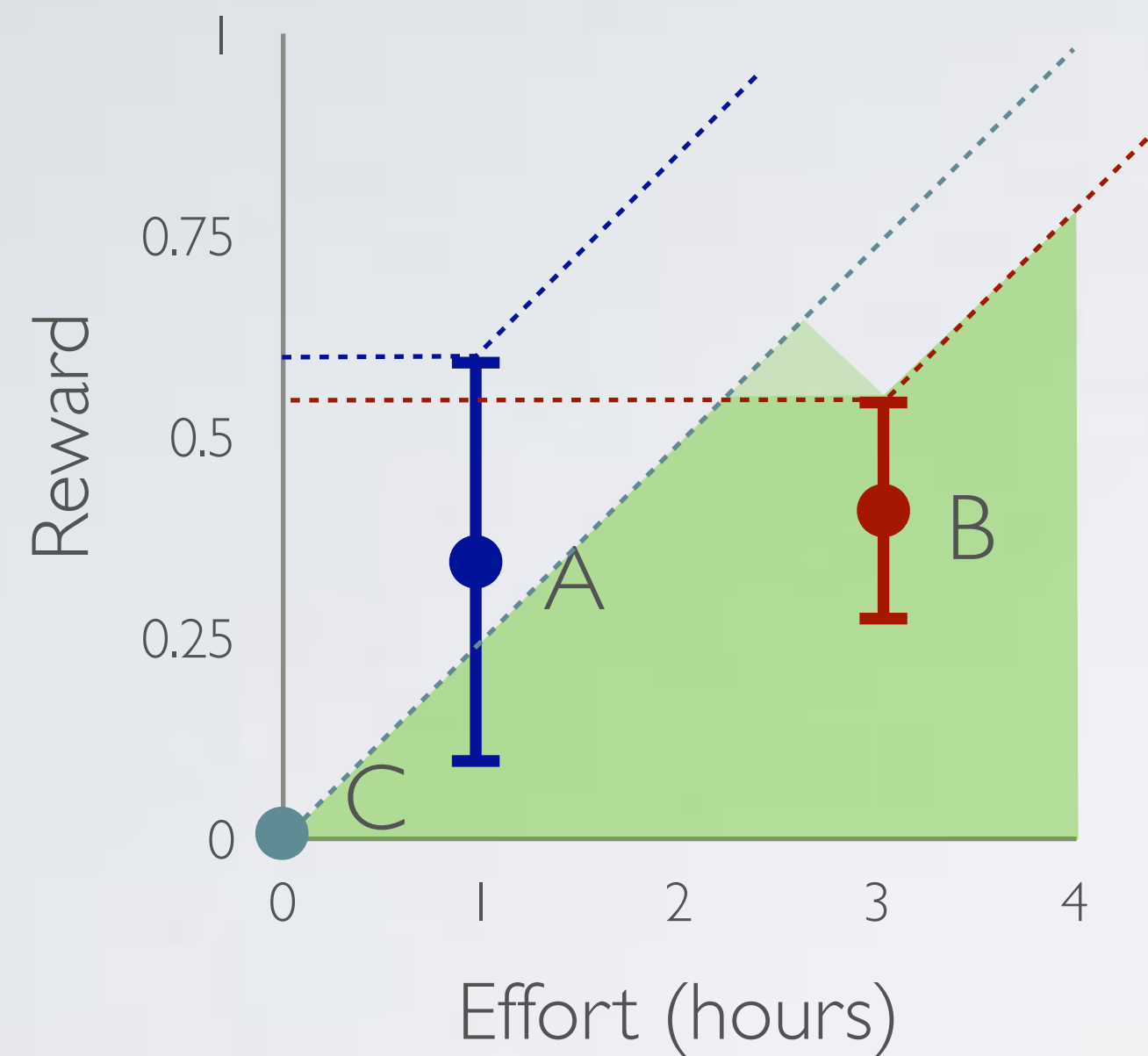


Field tests in Cambodia
and Uganda

[Xu et al., ICDE-20]

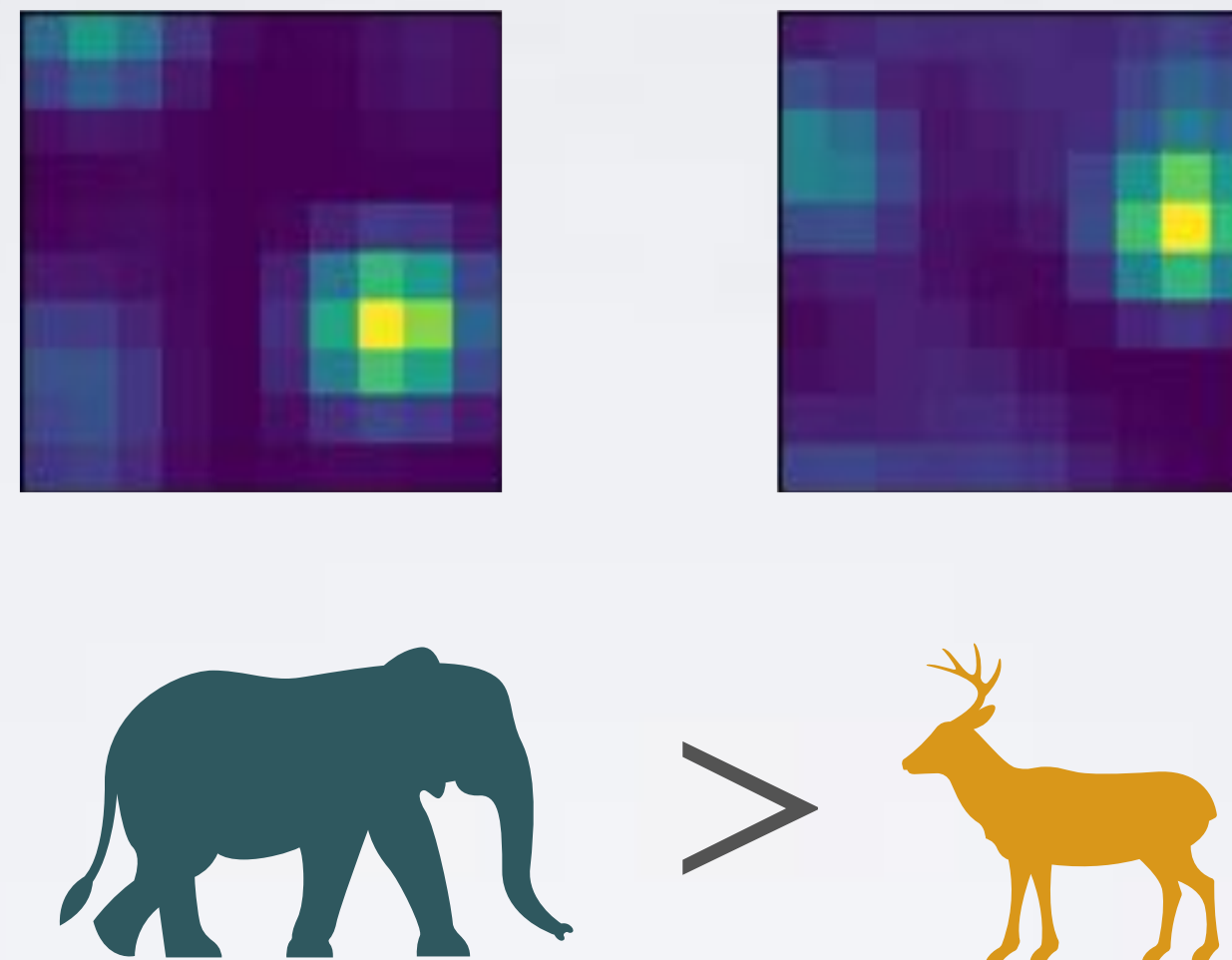
Global deployment

New AI Methodology



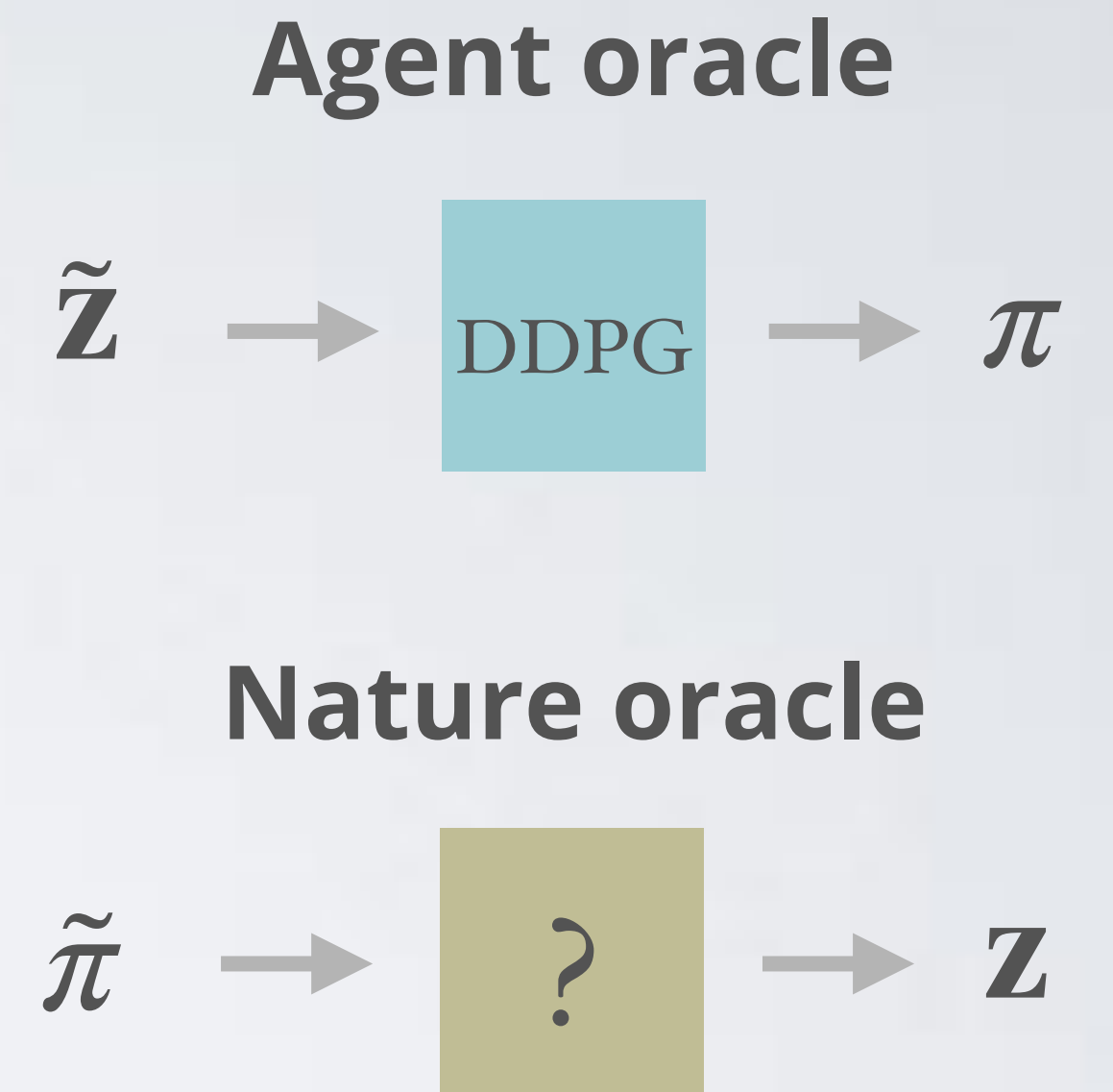
Multi-armed bandits
to explore/exploit

[Xu et al., AAAI-21]



Ranked prioritization
with online allocation

[Xu et al., IJCAI-22]



Robust sequential
decision-making

[Xu et al., UAI-21]

AI for Conservation



Thanks to my collaborators and
our conservation partners

Milind Tambe, Andrew Perrault, Fei Fang,
Andy Plumptre, Andrew Davies, Luke Miratrix,
Kai Wang, Elizabeth Bondi, Arpita Biswas,
Diana Acosta-Navas, Jackson Killian, Rachel Guo



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Computational challenges

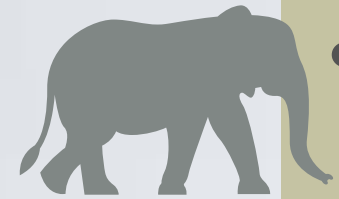
Deploying AI in the real world

AI has much to learn from conservation
and other real-world challenges!

Lessons Learned

Project design + scoping

- Begin with simple computational approaches
- Incremental deployment before ambitious project design



Deployment

- Real-world deployment is necessary for effective technology transfer
- Large-scale deployment requires quality engineering
- Evaluate with self-contained experiments

Marrying research + practice

- Integrate domain expertise into algorithm design
- Consider real-world constraints as research challenges, not limitations
- Limited data inspire research directions to close the gap

