AI-BASED SOLUTIONS FOR WILDLIFE SECURITY

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Collaborations

WILDLIFE CONSERVATION SOCIETY

WWF

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AI for Earth

Deployed AI-based Application: Protection Assistant for Wildlife Security(PAWS)

WCS

WWF

Panthera

Uganda

Indonesia

Malaysia

Field study in Indonesia

Wildlife Protection

Wildlife

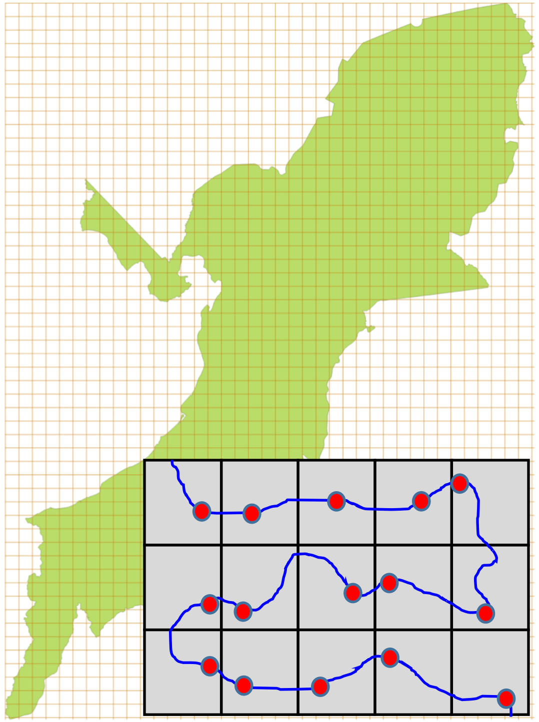
Snares for poaching

Rangers patrolling

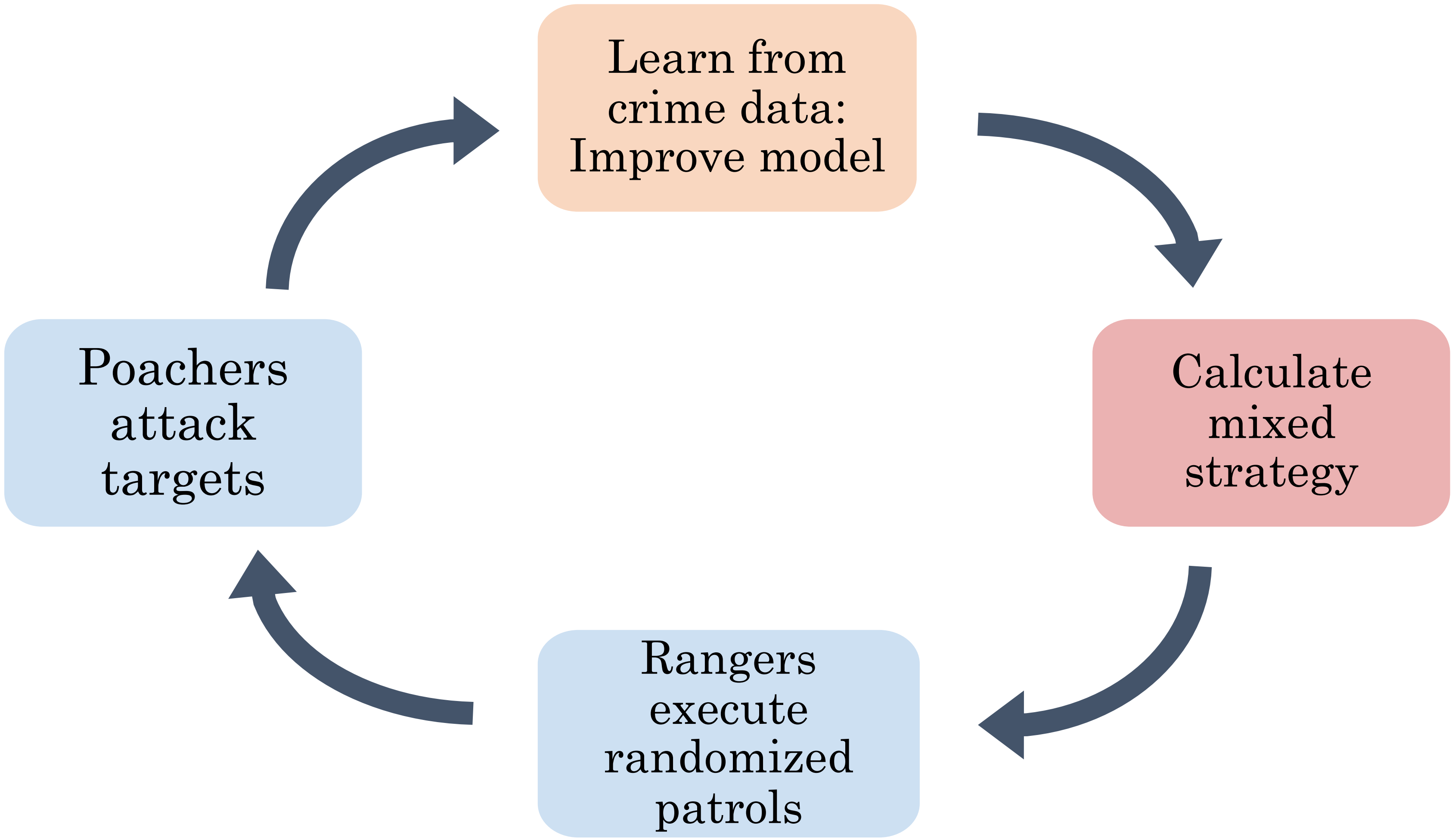
Wildlife Protection: Security Game Model

- Forest area
  - Divided into a grid, cell ~ target
  - Target values: e.g. animal density
- Rangers
  - Conduct patrols
- Poachers
  - Set trapping tools (e.g. snare)

Queen Elizabeth National Park (QENP)



PAWS: Repeated Security Game Model



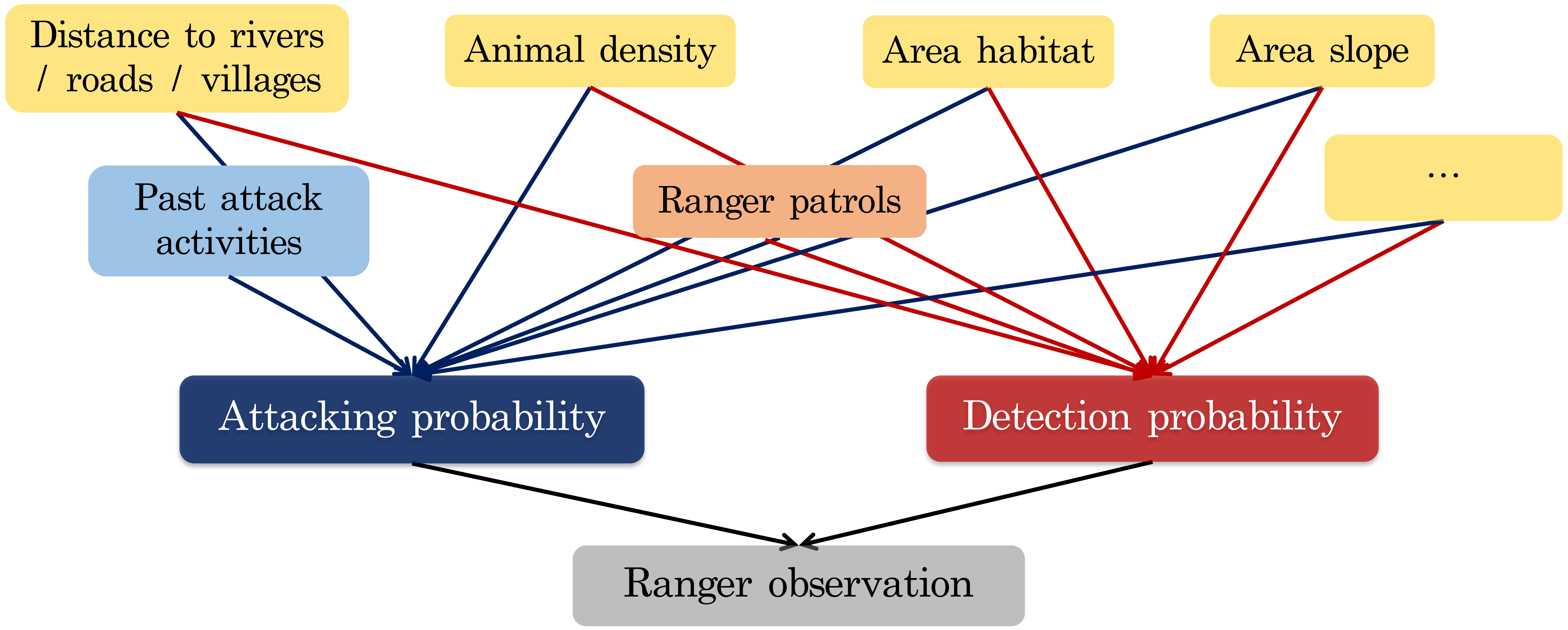
Poacher Behavioral Modeling and Learning: Research Question

How to Model Human Poacher Behavior in Real World?

CHALLENGE

- Take into account domain features
- Handle complex temporal dependence of behavior
- Cope with imperfect observations of poaching

CAPTURE Model



Model Evaluation

- Behavioral models
  - CAPTURE model
  - Machine learning models: Support Vector Machine (SVM), Logistic regression
- Real-world patrol/poaching data
  - Queen Elizabeth National Park (QENP): ~2500 km^2
  - 12-year patrols
  - ~125000 observations
  - 6 types of illegal activities

Real-world Data of 12 Years

Ranger patrols

Poaching activities

Domain features

Model Comparison

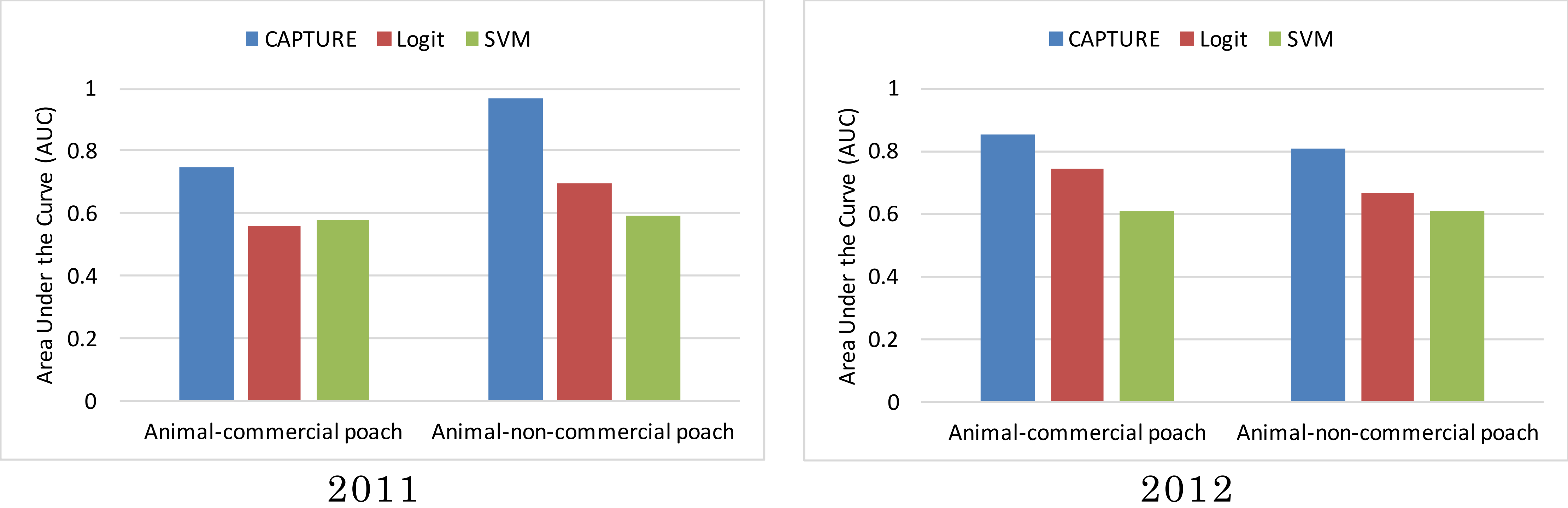
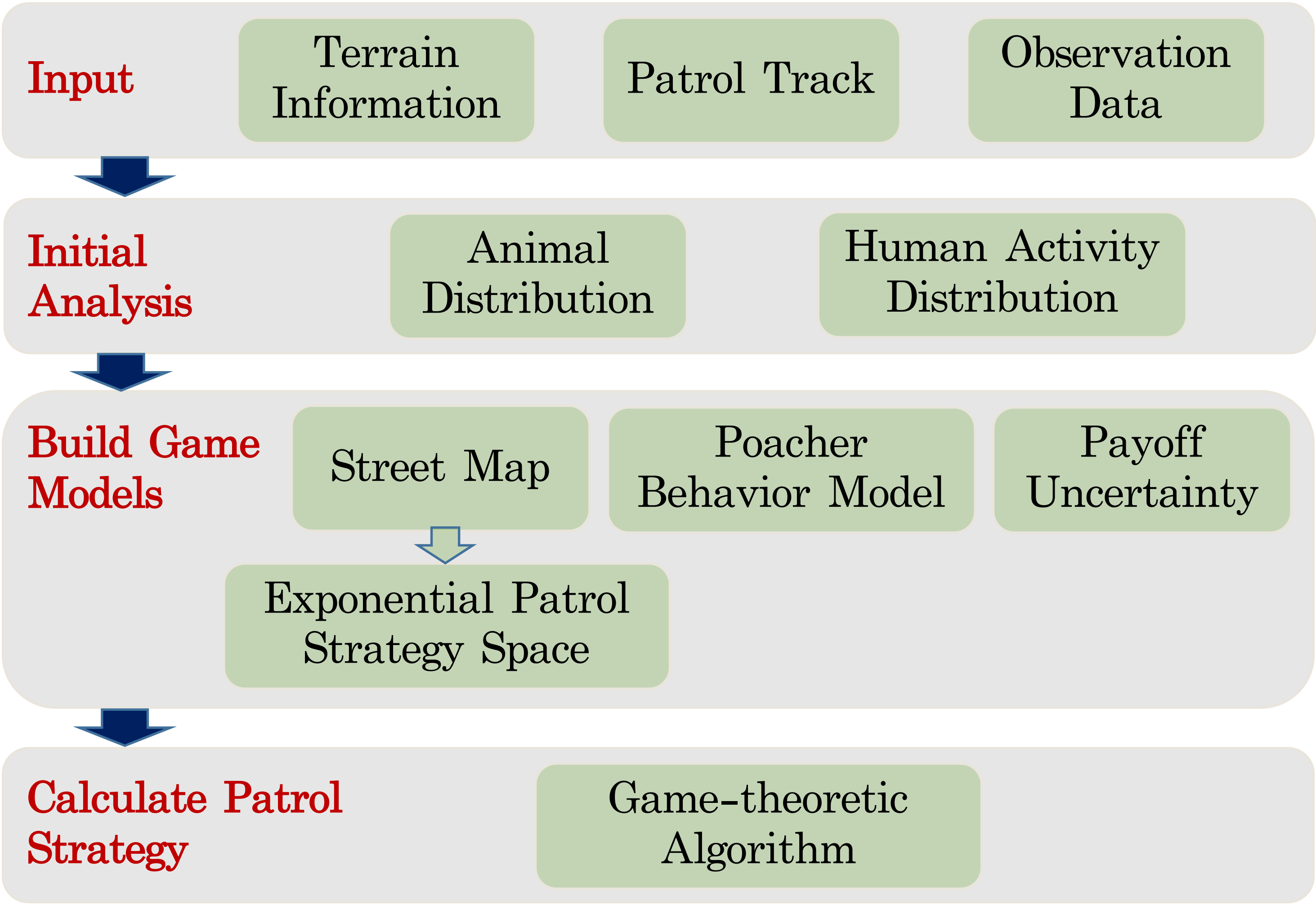


Figure 1: AUC for predicting poaching in dry season

Patrol Planning Overview



PAWS Tested in Malaysia: Build Street Map

PAWS Tested in Malaysia

- Challenges
  - Poacher behavior model
  - Animal density uncertainty
  - Ranger exponential action space
- Tested in Malaysia

Patrol Types	All PAWS Patrol	Explorative PAWS Patrol	Previous Patrol
Total Distance (km)	130.11	20.1	624.75
Avg# Human Signs per km	0.86	1.09	0.57
Avg# Animal Signs per km	0.41	0.44	0.18

Tiger sign (Nov 14)

Human sign (Jul 15)

Human sign (Aug 15)

Human sign (Aug 15)

Latest Results (USC CAIS)

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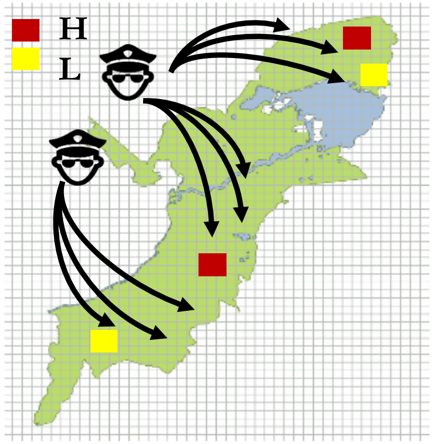
- Poacher behavior modeling:
  - Imperfect crime observation-aware ensemble model [2016]
- Patrol planning:
  - Integrating real-time “SPOT” information [2018]
  - Drone used to inform rangers [2019]

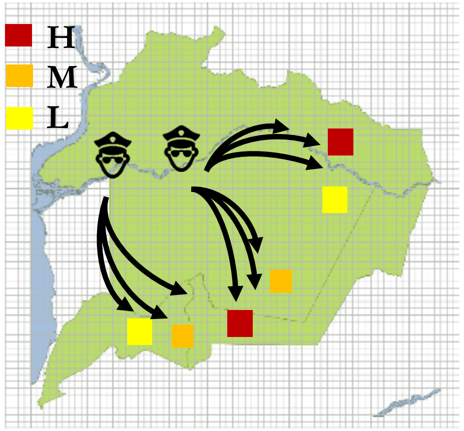
PAWS Real-world Deployment in Uganda: Two Hot Spots Predicted

Historical Base Hit Rate	PAWS Hit Rate
Average: 0.73	3

PAWS Predicted High vs Low Risk Areas:
2 National Parks, 24 areas each, 6 months [2017]

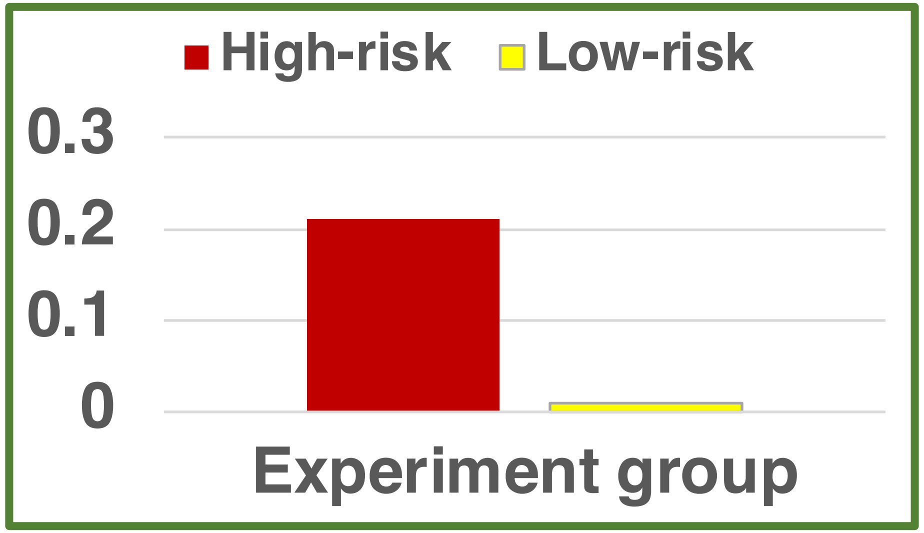


Queen Elizabeth National Park

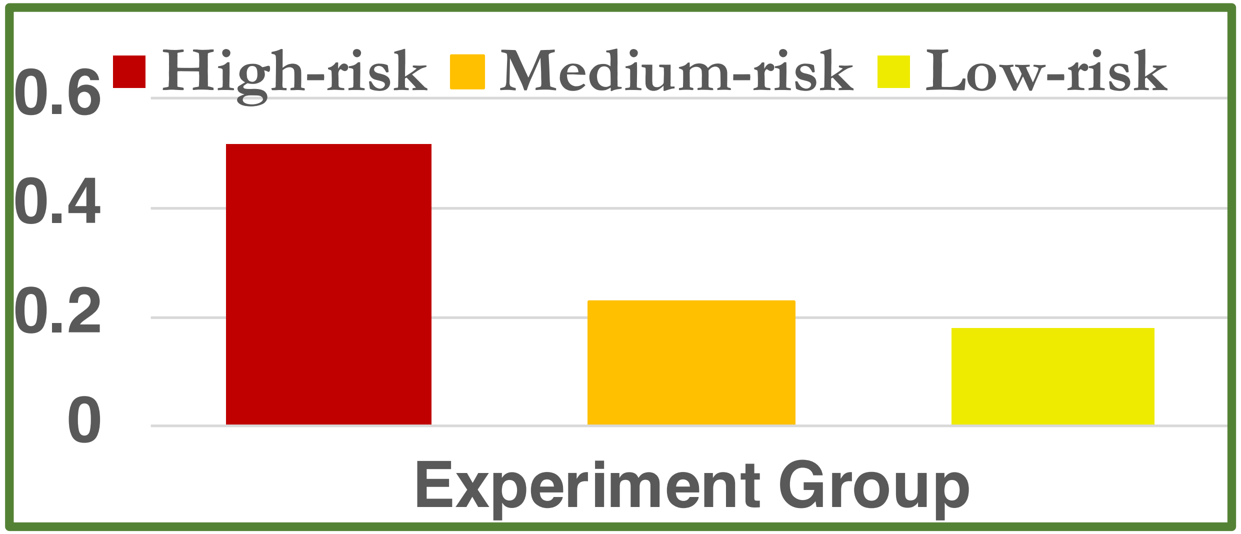


Murchison Falls National Park

Snares per patrolled sq. KM



Snares per patrolled sq. KM



PAWS Real-world Deployment in Cambodia: Srepok Wildlife Sanctuary (2018-2019)

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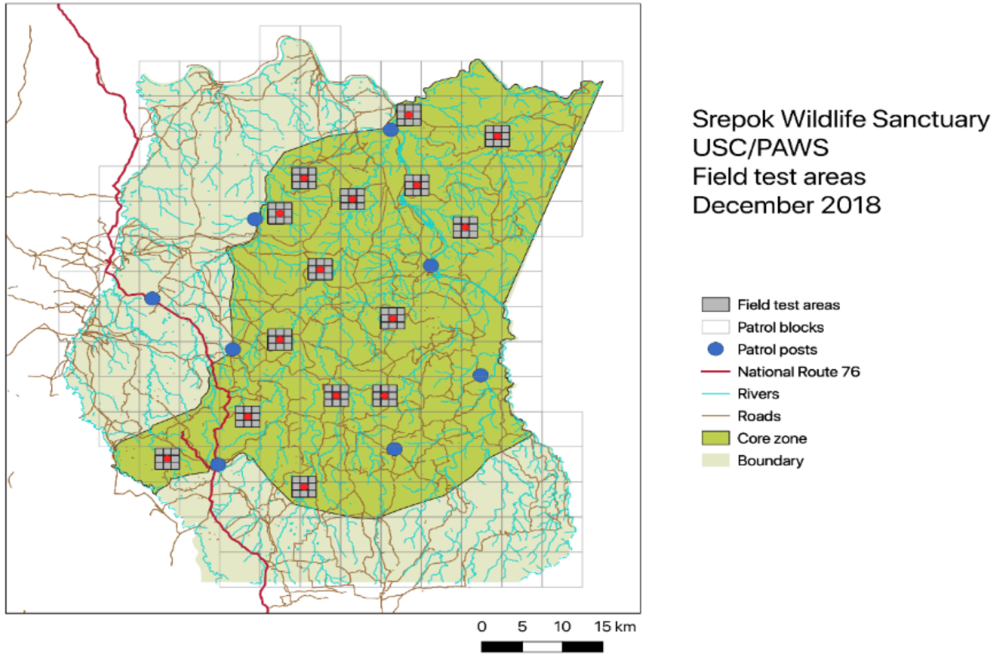
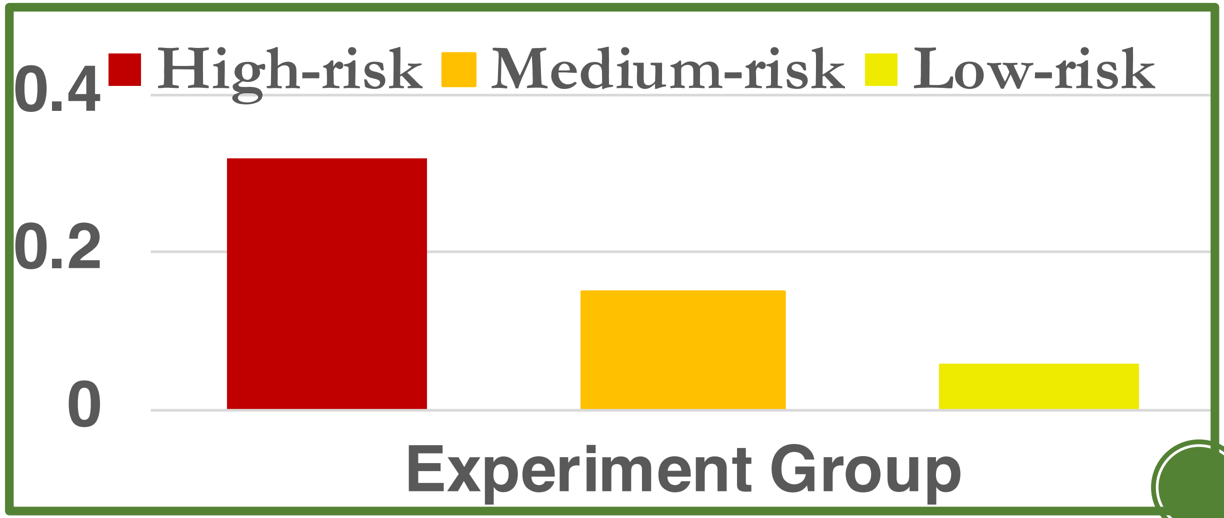


- *521 snares/month PAWS tests*

vs

- *101 snares/month 2018*

Snares per patrolled sq. KM



Green Security Games: Around the Globe with SMART Partnership [2019]

SMART

WWF

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WCS

AI for Earth

Protect Wildlife
600
National Parks
Around the Globe

Also: Protect Forests, Fisheries…

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