



# Mitigating human-wildlife conflict

Dr Samuel Penny  
September 2025

**BRISTOL  
ZOOLOGICAL  
SOCIETY**  
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# Mitigating human-wildlife conflict

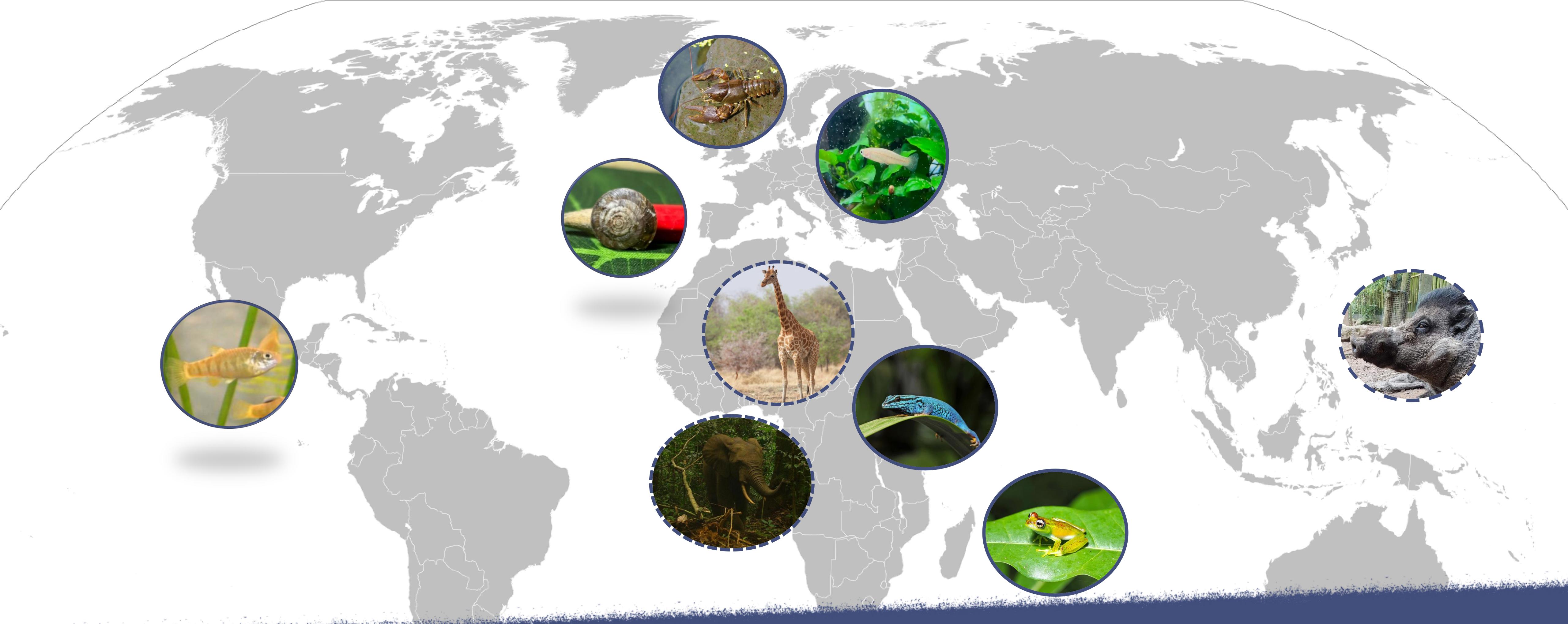
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## About me

- Conservation Manager & Lecturer at BZS
- Wildlife ecologist with a focus on applied conservation in tropical ecosystems
  - Biomonitoring and spatial ecology
  - Human-wildlife co-existence & anti-poaching
  - Integrating technology and conservation
- Contact me on [spenny@bzsociey.org.uk](mailto:spenny@bzsociey.org.uk)





# Conservation at BZS

BZS has ongoing projects within 9 countries

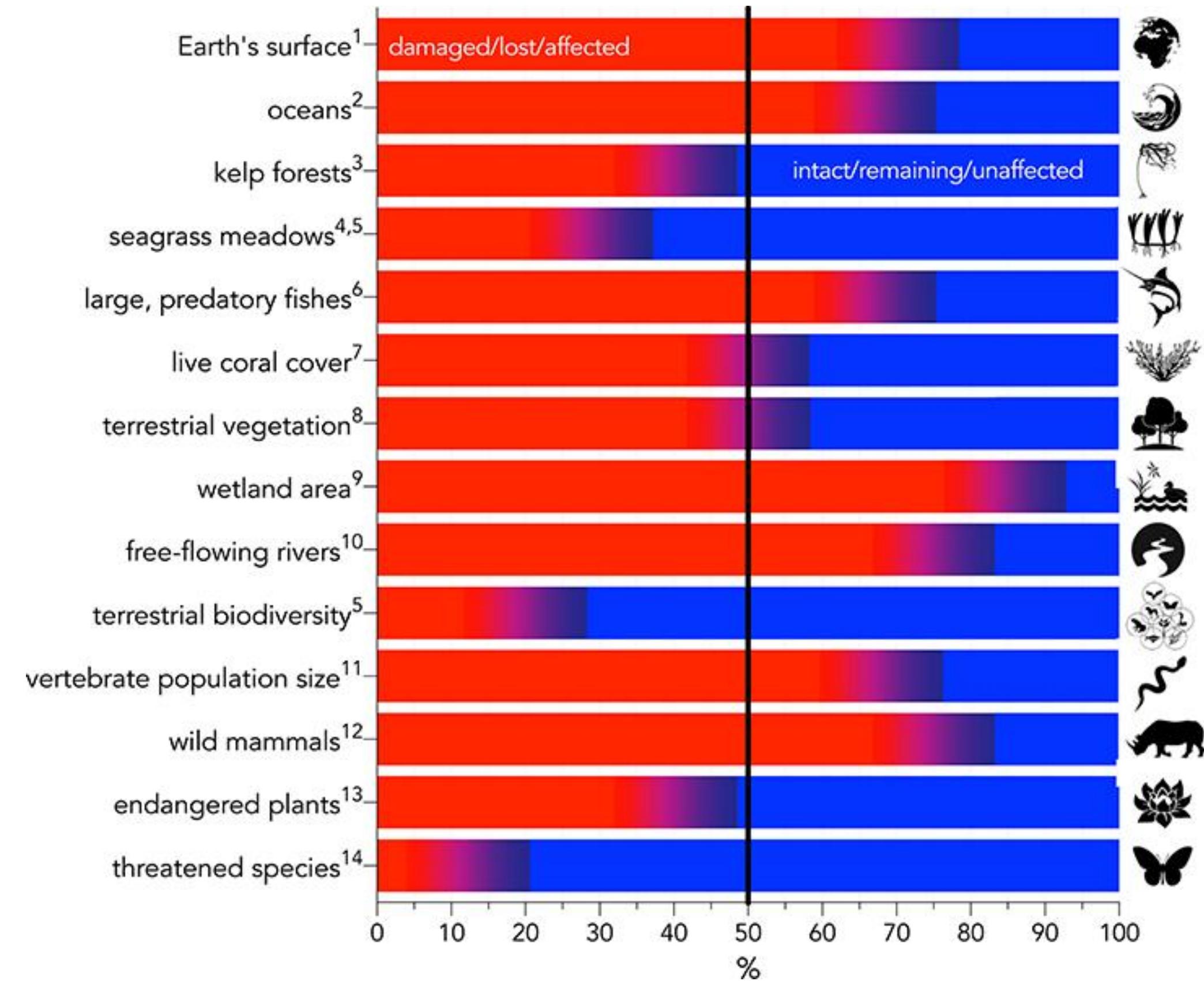
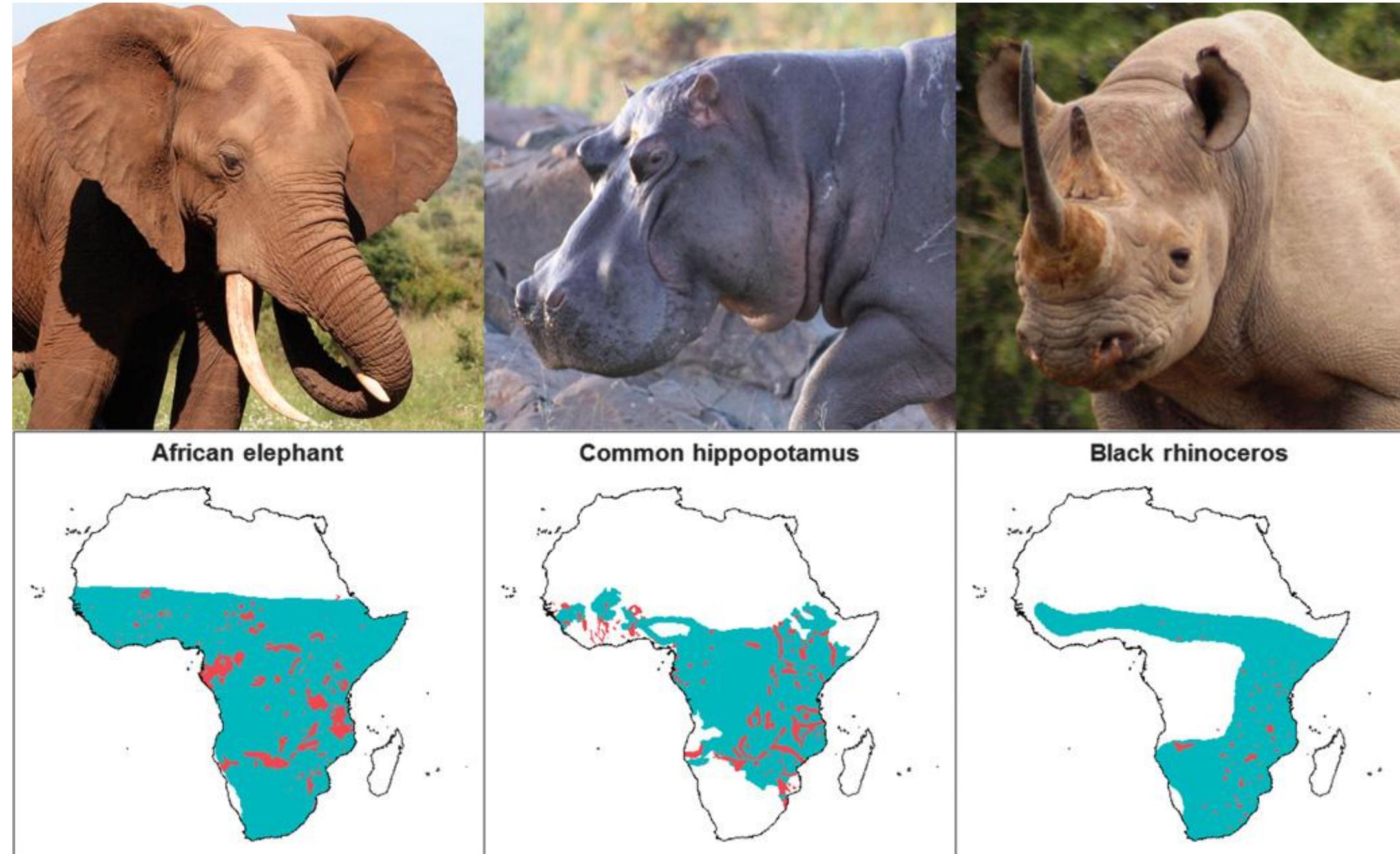
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# Mitigating human-wildlife conflict

1. Context of the problem
2. Wildlife conflict case studies
  - Kordofan giraffe
  - White rhino
  - African forest elephant
  - Visayan warty pig
3. Technological fix?



## The sixth mass extinction?

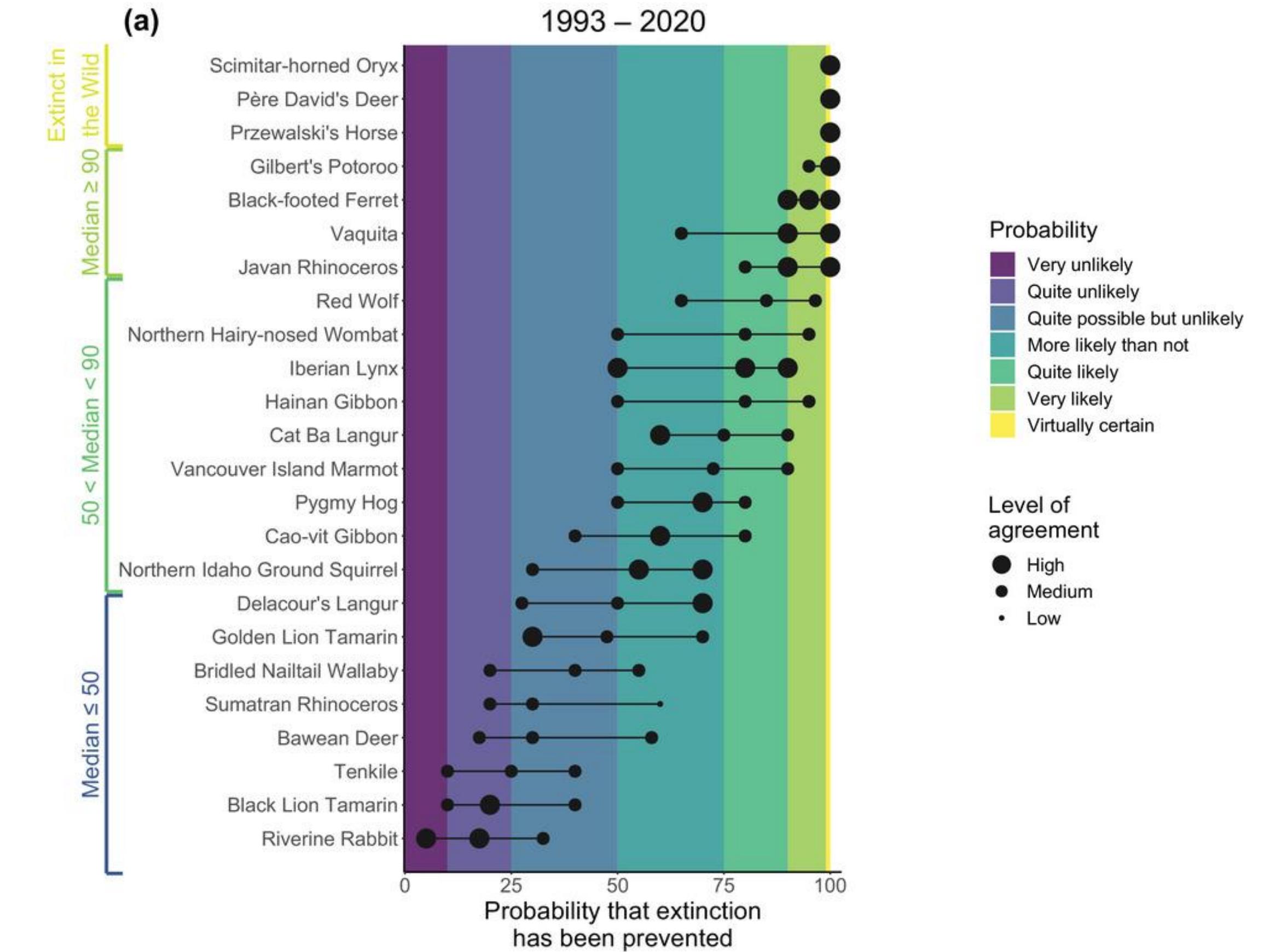


Ripple, et al. 2015. Collapse of the world's largest herbivores. *Science advances*, 1(4), p.e1400103.

Bradshaw, et al., 2021. Underestimating the challenges of avoiding a ghastly future. *Frontiers in Conservation Science*, 1, p.9.

## Conservation works!

- Extinction rates would be much higher without conservation actions!
- Needs to be scaled up to avert further biodiversity loss, trophic collapse and loss of ecosystem functions/services.
- However, funding gap of over \$500 billion by 2030 (Nature Conservancy, 2020).



Bolam et al., 2021. How many bird and mammal extinctions has recent conservation action prevented? *Conservation Letters*, 14(1), p.e12762.

## Human-wildlife conflict

Human-wildlife conflict occurs when **animals pose a direct and recurring threat** to the livelihood or safety of people, leading to the **persecution of that species** and conflict about what should be done.

Human-wildlife coexistence?

Human-wildlife interactions?

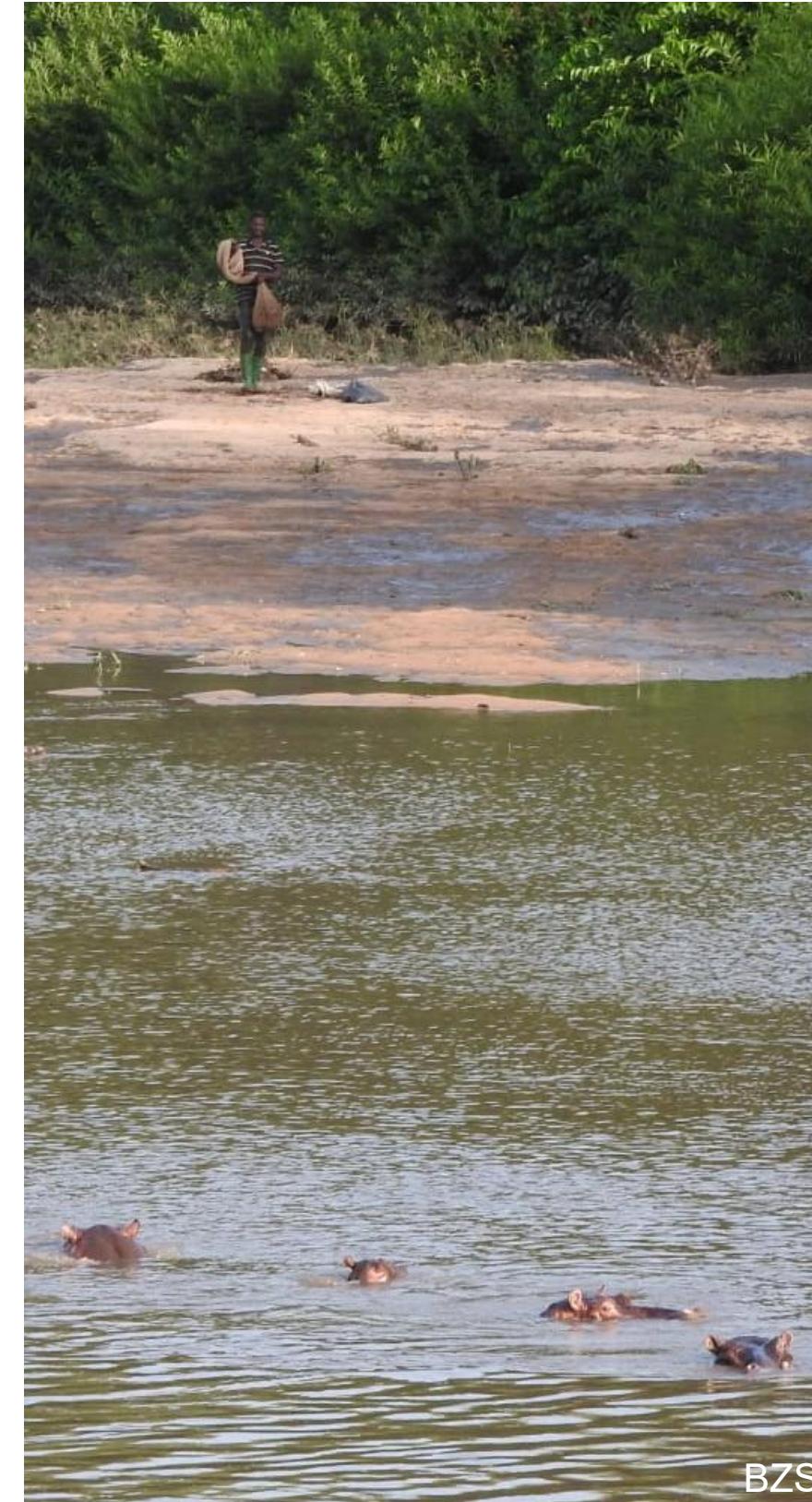
Human-wildlife impacts?



Elephant crop foraging near Monte Alén, Equatorial Guinea.

## Scale of the problem

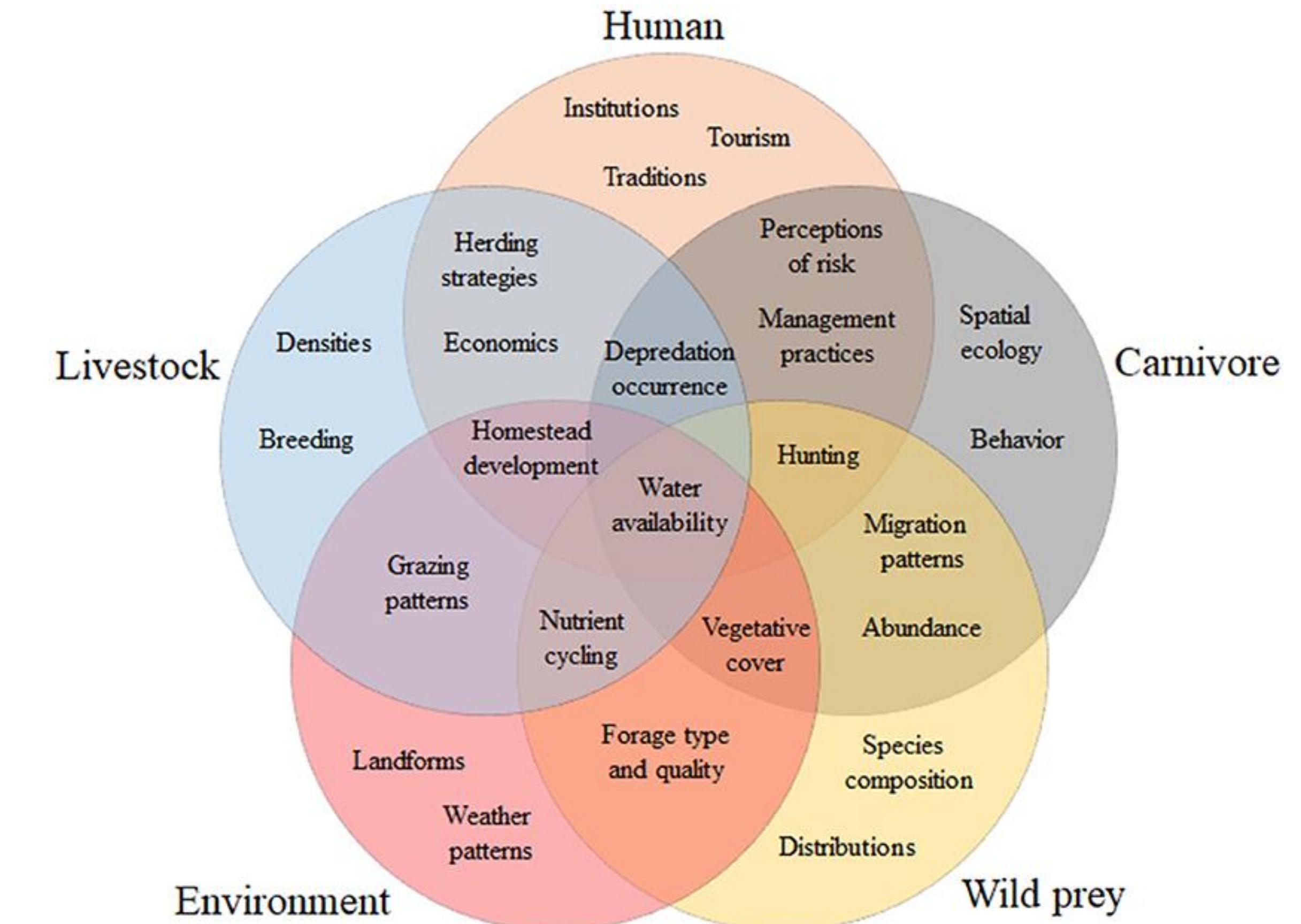
- Livestock production accounts for 26% of the earth's terrestrial surface (Foley et al. 2011)
- Over 250 species of terrestrial vertebrates recorded in conflicts with humans (Torres et al. 2018).
- Need to reduce or mitigate negative impacts of human-wildlife interactions (ecological, social, economic)



Agricultural damage, depredation, competition, disease transmission, injury

## Conservation conflicts

- Parties with strongly held opinions **clash over conservation objectives** or assert interests at the expense of another
- Often intractable or ‘wicked’ problems that lack clear solutions embedded in complex systems involving **interacting ecological, economic, and socio-political elements**



Beck et al. (2019). A model for human-lion (*Panthera leo*) conflict composed of five distinct and overlapping dimensions.

# Conservation conflict in Cameroon

- Pastoralists drive cattle into In Bénoué National Park where they compete for browse with wildlife
- Investigated **use of drones** to detect giraffe but not feasible with current technology
- Reliant on camera traps and rangers for data
- Giraffe predicted to go extinct without further intervention



Poverty, climate change & desertification

Local communities  
'Resource access'

Government bodies  
'Legal requirements & budget constraints'

Conservation groups  
'Protect wildlife'

Biodiversity crisis & extinction

## Legislation



BZS

## Compensation



KWS

## Community awareness & education



BZS

## Livelihood diversification



BZS

- Enforcement or protection
- Often effective at reducing impacts
- Can increase conflict if perceived unfairness, disenfranchisement

- Effective in short-term
- Expensive and can lead to dependency
- Doesn't solve ecological impacts or conflict

- Co-existence through behavioural change
- Can take generations
- May not change underlying causes

- Alternatives to conflict
- Requires targeted management
- Must be sustainable

## Lethal control



## Translocations



## Physical barriers



## Deterrents



- Traditional in some areas
- Often tightly controlled
- Can exacerbate conflict

- Removes nuisance animals
- Technical and expensive
- Does not occur for conservation goals

- Fencing & barriers
- Requires discrete areas
- Migration and injury issues

- Disrupts an animal's behaviour
- Difficult to assess
- Habituation a problem

## Wildlife deterrents

- Disrupt an animal's behaviour that would otherwise negatively influence a human goal
- Evoke **avoidance behaviours** by exploiting defensive or anti-predator behavioural response
- Must be tailored towards a species' susceptibility to a stimulus



Methods to curtail or modify animal movement vary widely, but frequently employ olfactory, visual and auditory stimuli, or increasingly novel technologies

# Finding a solution

**Conservation Evidence**  
in numbers

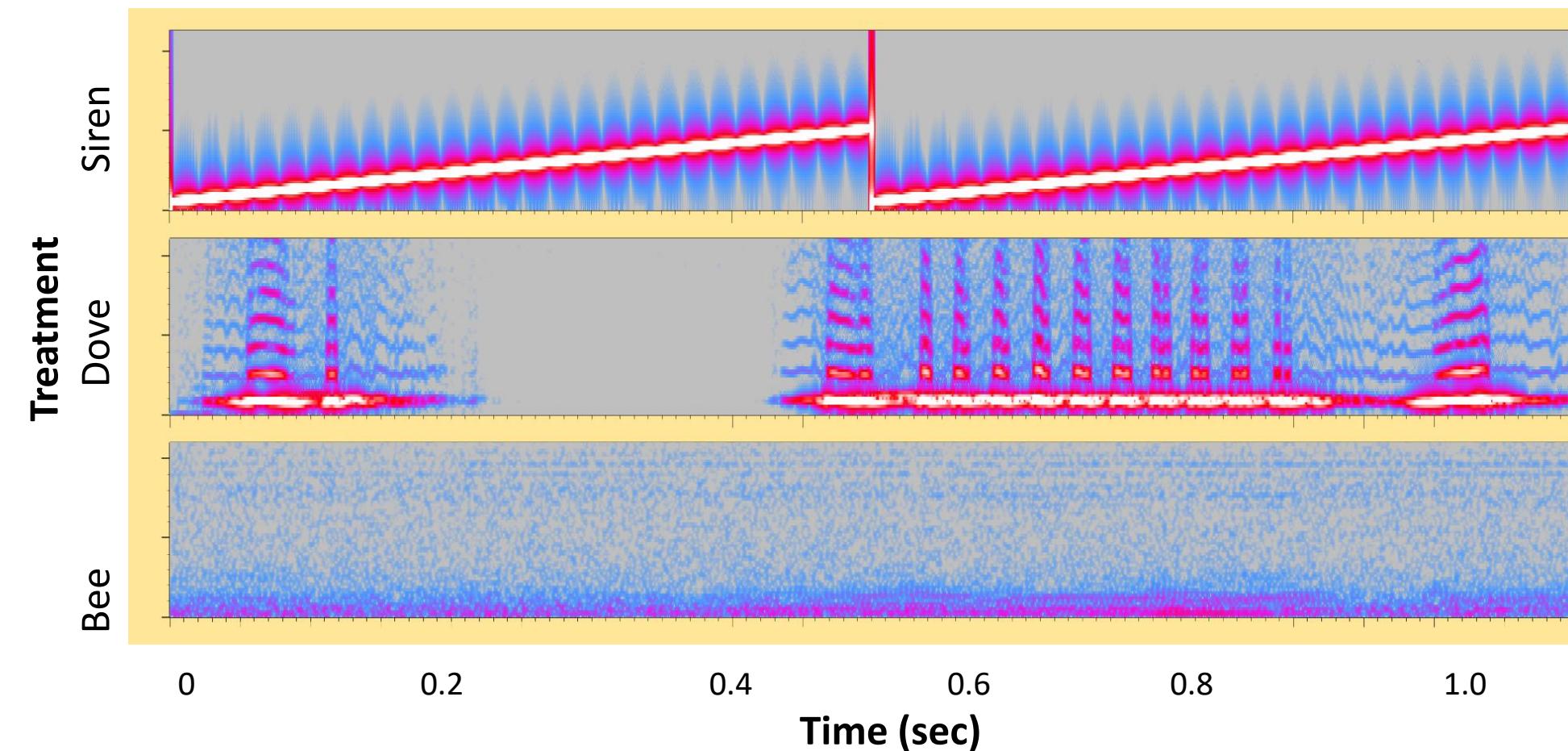
Over 600,000 scientific papers scanned

conservationevidence.com

Use flags to reduce predation of livestock by mammals to reduce human-wildlife conflict	Likely to be beneficial	5	
Use guardian animals (e.g. dogs, llamas, donkeys) bonded to livestock to deter predators to reduce human-wildlife conflict	Beneficial	12	
Install electric fencing to protect crops from mammals to reduce human-wildlife conflict	Beneficial	11	
Deter predation of livestock by using shock/electronic dog-training collars to reduce human-wildlife conflict	Beneficial	5	
Use lights and sound to deter predation of livestock by mammals to reduce human-wildlife conflict	Likely to be beneficial	3	
Scare birds from fish farms	Likely to be ineffective or harmful	16	

## Mechanism

- Aversive or threatening stimuli can elicit fear or anxiety in a target subject, **increasing real or perceived risk** to a point where the costs of utilising a resource or area exceed its benefits
- Strength of a behavioural response /perceived risk, depends on animal's life history and motivational state



## Deterrents and rhinoceros

- Pursuit of rhinos can move them away from fence lines during high risk periods such as during full moons



Penny et al. 2019. Using drones and sirens to elicit avoidance behaviour in white rhinoceros as an anti-poaching tactic. *Proceedings of the Royal Society B*, 286

## Herdin rhinos with drones

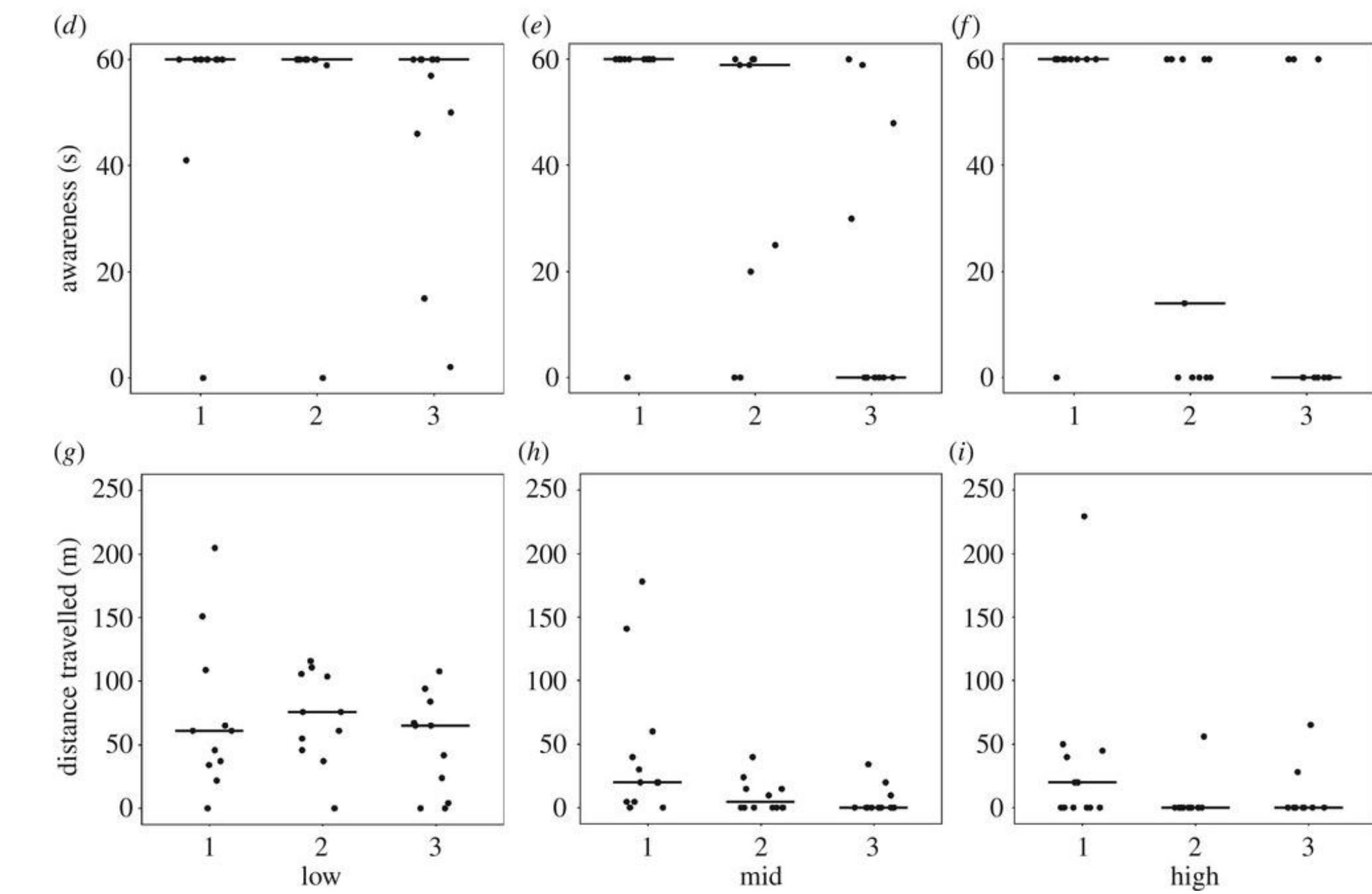
- Drones were superior at manipulating rhino movement than the siren owing to its longer transmission range and capability of pursuit
- Due to their additional surveillance functions, poachers are likely to be incentivised to avoid areas where they operate



Penny et al. 2019. Using drones and sirens to elicit avoidance behaviour in white rhinoceros as an anti-poaching tactic. *Proceedings of the Royal Society B*, 286

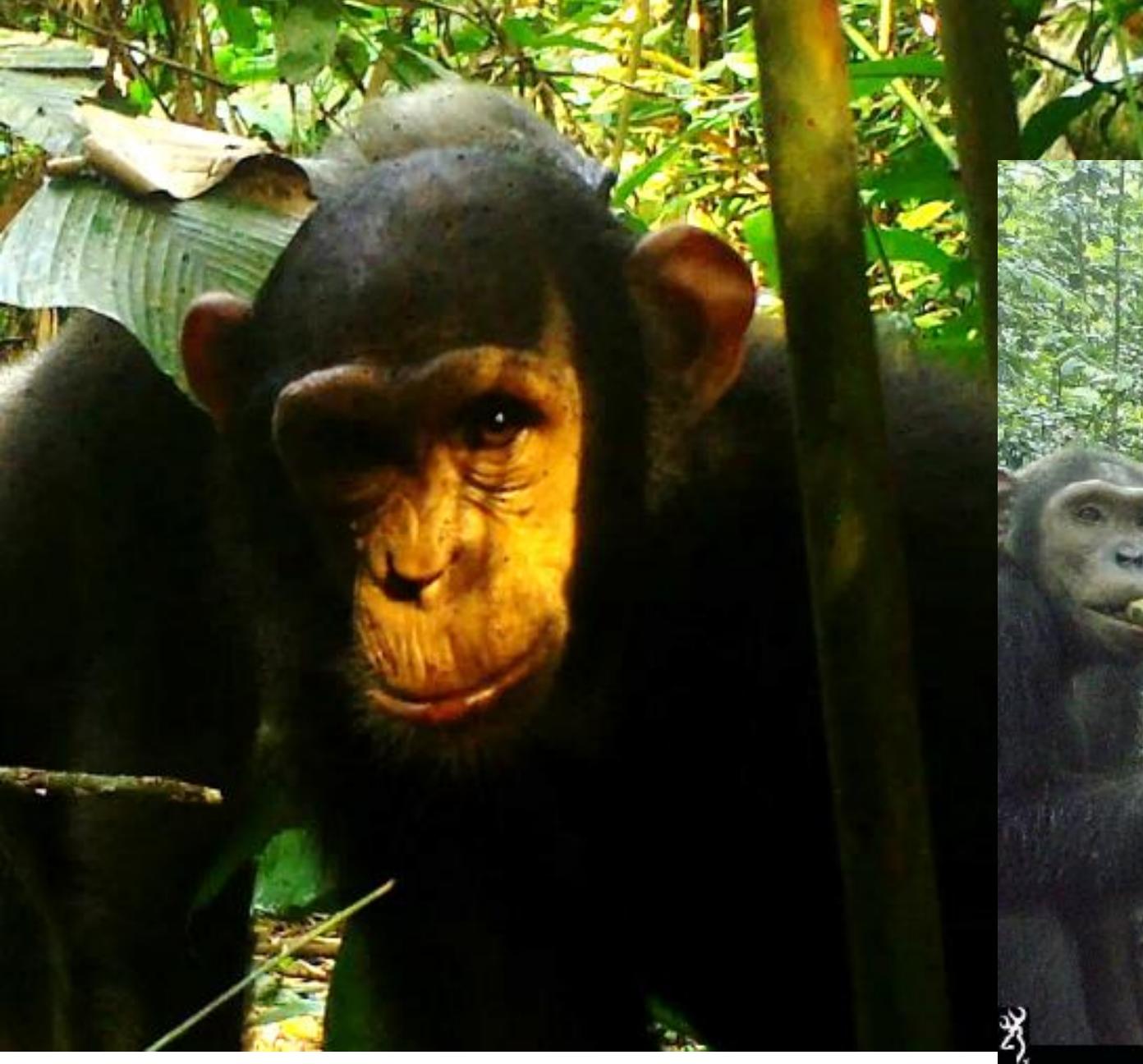
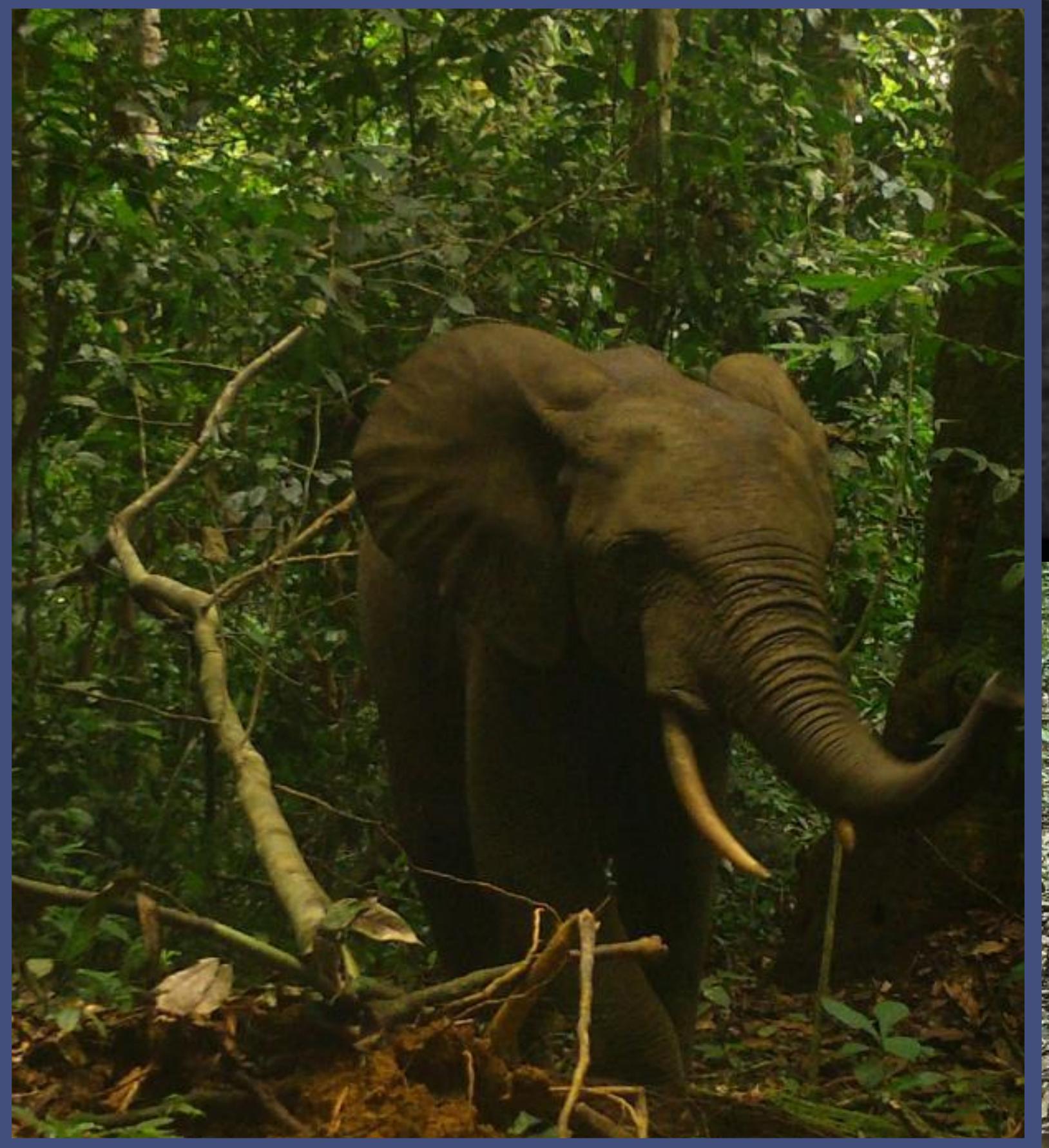
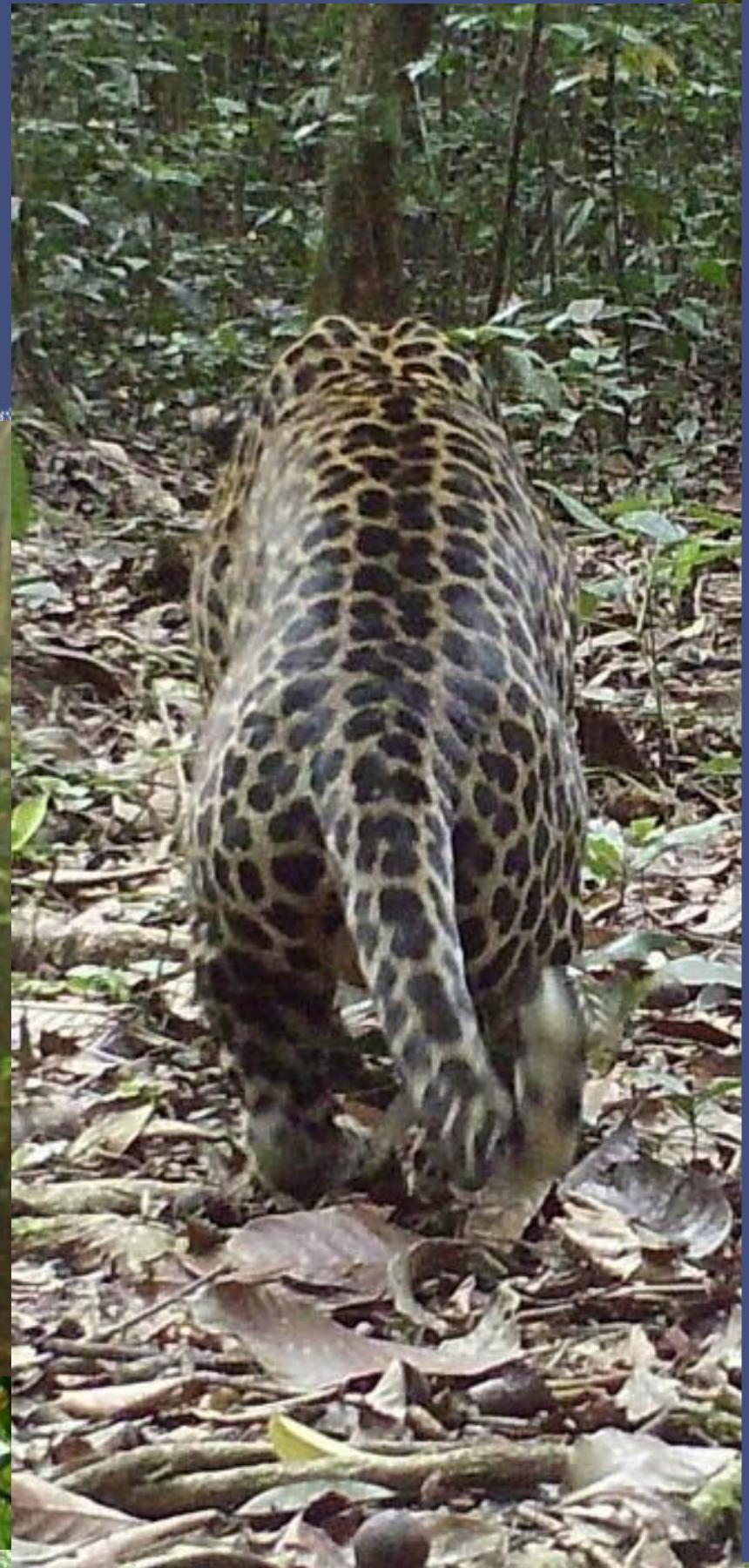
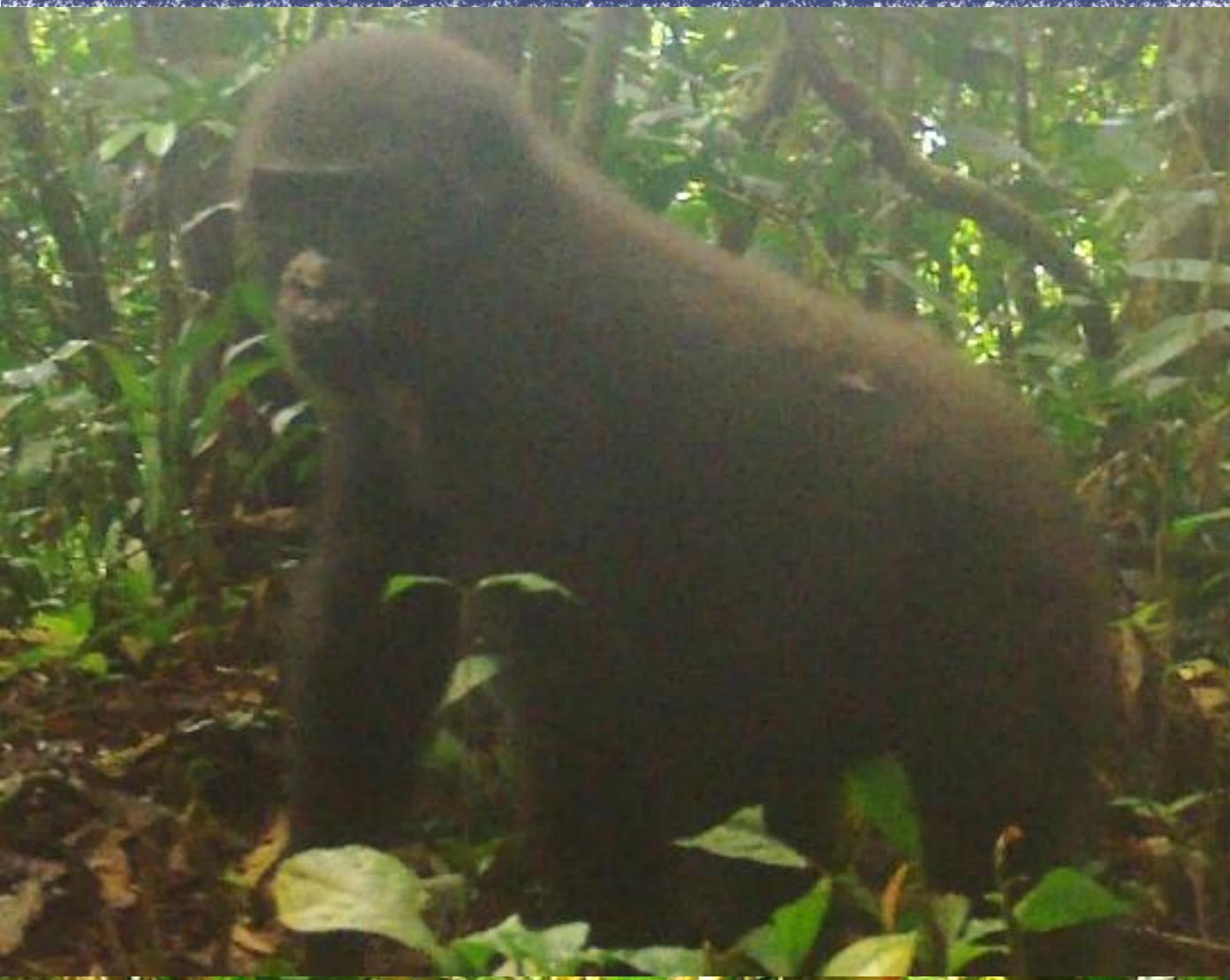
## Habituation

- Repeated stimulation can diminish a behavioural response through **habituation** or **sensory fatigue**; key for understanding long-term effectiveness
- Response decreases in frequency and/or magnitude until it reaches an asymptotic level
- Difficult but not impossible to assess in the field!



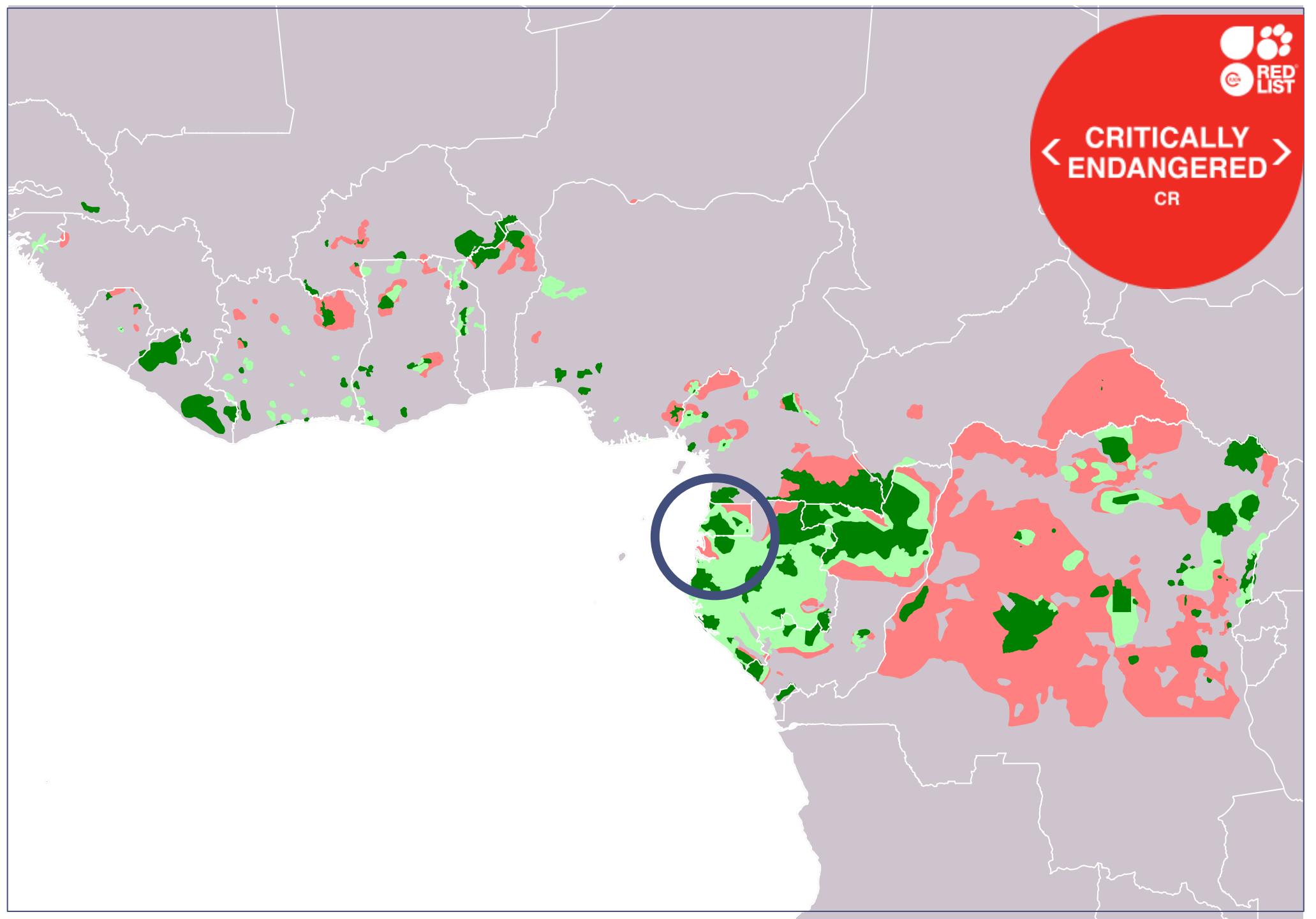
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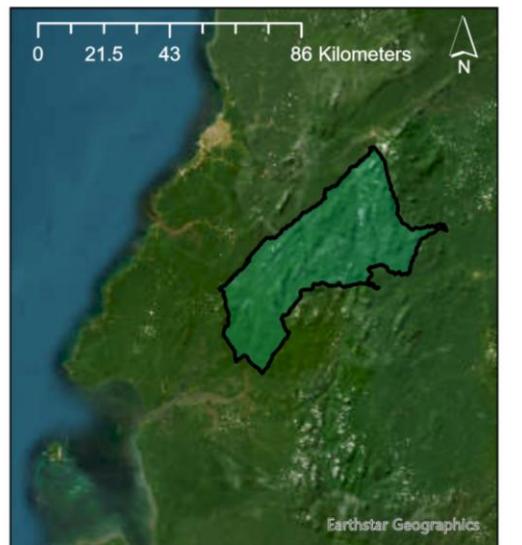


# Mitigating human-elephant conflict in Equatorial Guinea

- BZS is working to conserve African forest elephant (*Loxodonta cyclotis*)
- Global population has fallen by more than 86% over a period of 31 years (IUCN Redlist 2021).
- Persistent unmonitored killing of elephants
- Slower reproductive rate than savannah elephants



Possibly extant (light green), extant (dark green), extinct (red).



## The problem

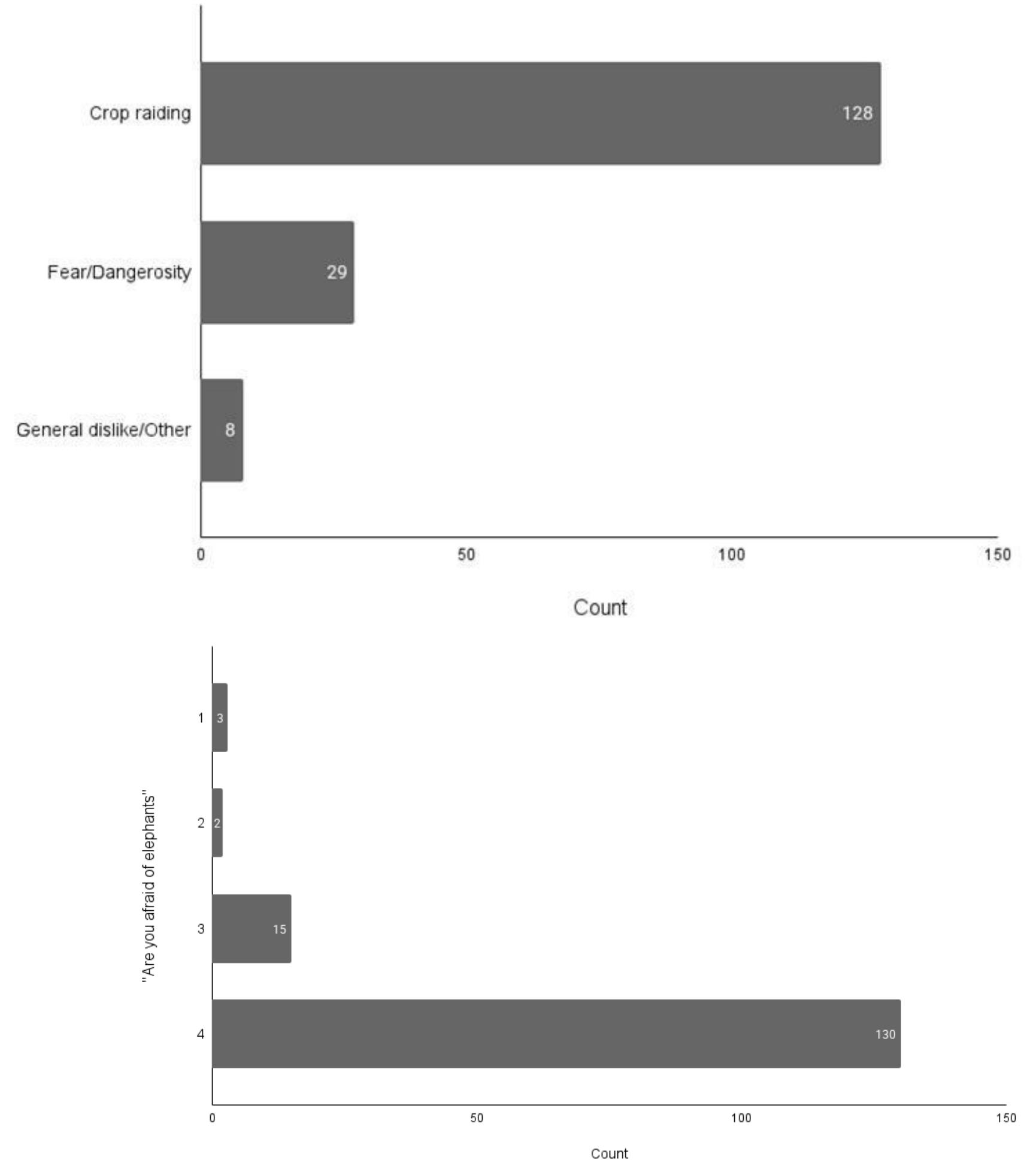
- Animosity due to crop-foraging. Raiding said to be almost daily (2020 BZS survey of farmers).
- Lack of government capacity for protection & monitoring of PAs
- Semi-structured interviews showed negative perceptions (fear and ranking) towards elephants (BZS, 2024).



Many crops are desirable to elephants (pineapple, yucca, plantain)

# Perceptions of elephants around Monte Alén

abusive takes sometimes abuses people food destroys lot eats everything abusive leaves already disturbs comparison farms village kill time ones forest waste enters hate even size eating finds nothing afraid little go one scary know go



## Early warning system



## Smelly elephant repellent



- Locally-made bells hung on fences warn people of elephants
- Chased away (shouting, banging on saucepans)

- Fermented mixture of chilli, garlic, gingers, dung
- Hung in empty bottles on fence

## Motion-sensor light/sound



## Simple wire fence

- Bamboo and wire fence with no adverse stimuli
- Low cost & maintenance

## Preliminary trials

- To assess whether the methods are effective:
  - Farmer logbooks
  - Verification of all elephant crop-foraging events
  - Camera traps
  - Monitoring crop phenology
- **Limited number of elephant incursions** – other species potentially more present (including chimpanzees)
- Only ~30 elephant incursions in two years – need to improve local perceptions of elephants

## Rapid response units

- Chase elephants off farm plots
- Habituation less likely as physically chased
- Issues
  - Requires teams on standby
  - Occurs overnight but not reported until morning



## Beehive fence & chilli bricks

- Economic hardship & lack of opportunities – honey a source of income to farmers
- Less chance of habituation as stimuli reliant on pain and subsequent avoidance
- Difficult to get bees to stay put!



## Technological solutions?

- GPS collars fitted; alerts sent to response teams (Mozambique wildlife alliance, 2024).
- AI-assisted cameras; alerts; flashing lights (m-Twiga Project, 2025).
- But much harder and more expensive to locate and dart an elephant in tropical forest!
- Drones could provide real-time monitoring and/or deter crop foraging



Real-time monitoring is increasingly accessible.

# Mitigating pig conflict in the Philippines

- BZS is working to conserve Visayan warty pig (*Sus cebifrons*)
- BZS community surveys revealed most common reasons for **killing pigs** were for food and **to protect crops** from foraging (162 interviews and 32 focus groups)
- 821 traps and snares removed from NPPNP between 2022 and 2025 by anti-poaching patrols!



# Mitigating pig conflict in Philippines

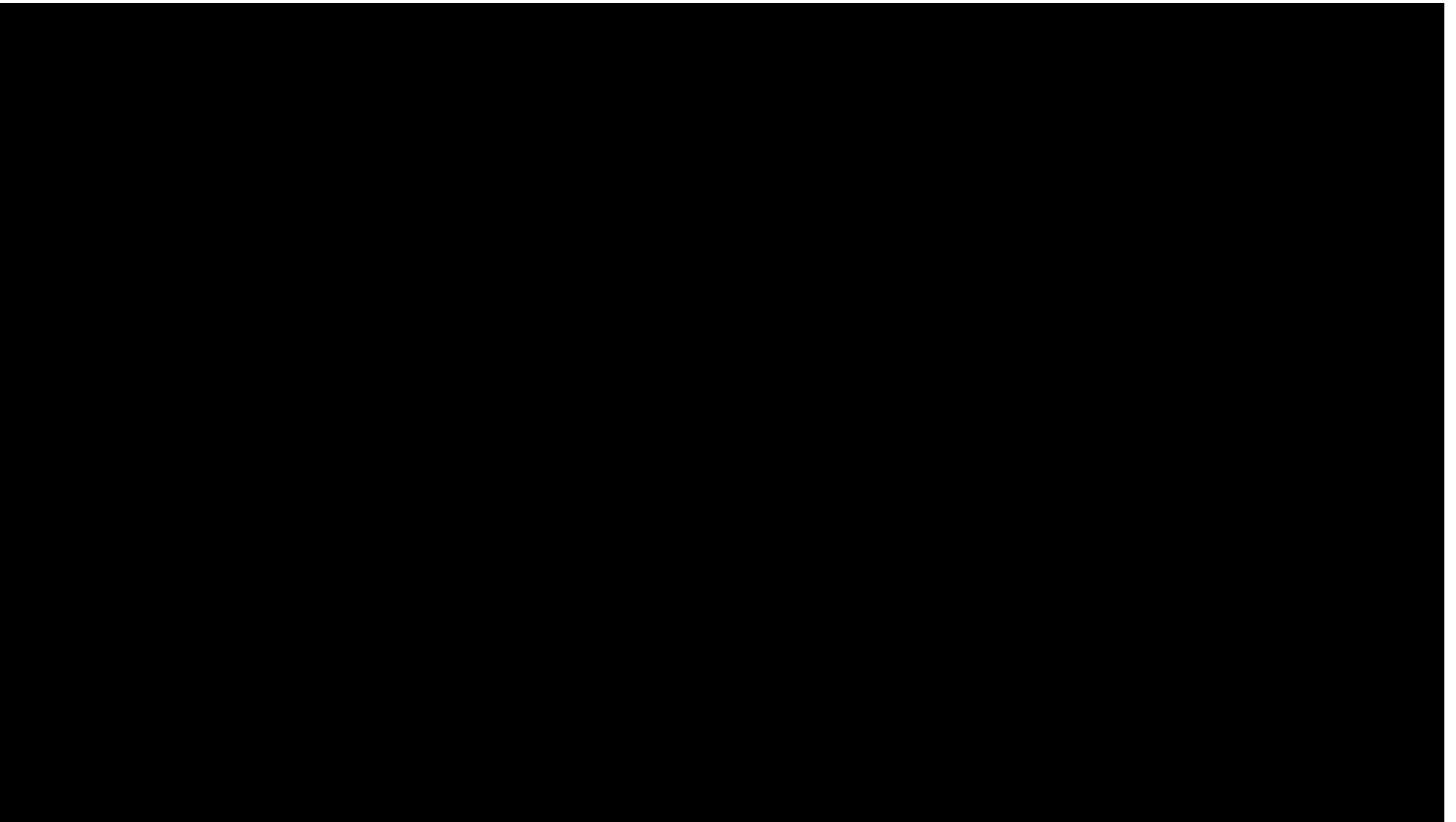
## Existing approach

- Anti-poaching patrols and biodiversity monitoring (camera trapping and transects)
- Livelihood diversification (vegetable and shrimp farming; basket making)
- Wildlife campaign (community events e.g. basketball)



## Pig deterrents?

- Evidence of effective mitigations against crop foraging pigs is scarce or focuses on culling!
- Anecdotal evidence suggest chilli or the colour blue...
- Pilots of deterrents, crop monitoring and interviews, employing similar monitoring to Equatorial Guinea.
- Build on education campaign to encourage tolerance, particularly if warty pigs are not frequent crop foragers!
- Highlight relevant crop protection methods or promote crops less susceptible to pig foraging



## Summary

- Human-wildlife impacts affect crops but also livestock and property, cause human injury, disease transmission etc.
- Monitoring success is often tricky, and habituation remains an issue.
- Impacts can potentially be reduced via technical solutions, but cost, logistics and complexity hinder applicability and long-term sustainability
- Perceptions often matter as much as reality!
- **Working with people is key** if underlying causes are to be solved!



# ANY QUESTIONS?

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