

Detering elephant impacts by exploiting their demonstrated fear of the human “super predator”

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Traditional view in predator-prey ecology: direct killing only way predators affect prey numbers



2 zebras

-



1 directly killed by lions

=



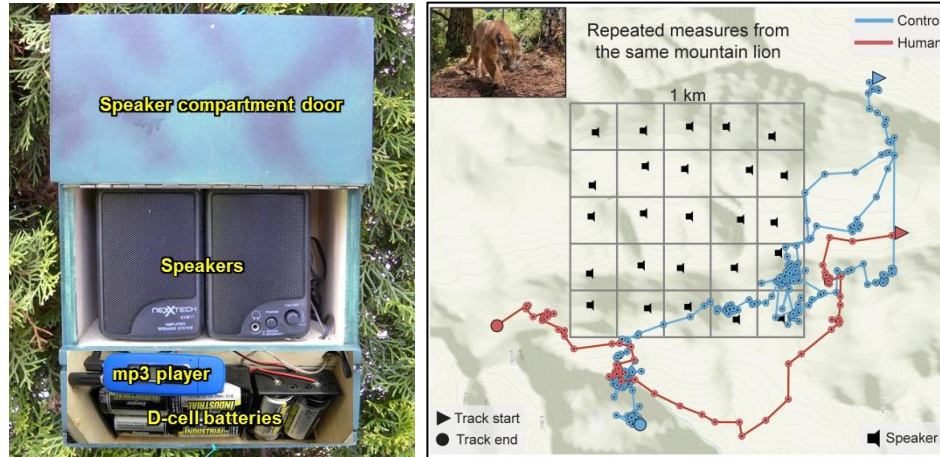
1 zebra

Obviousness of effect of direct killing why impacts of fear (anti-predator behavioural responses)
long remained unexplored in wildlife population and community ecology

Our lab focuses on experimentally testing impacts of fear on wildlife population and community ecology

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Long-term (months), intermittent playbacks over large areas (km²)



Short-term (s), small area (m²) playbacks



Zanette & Clinchy 2020 *Annual Review of Ecology, Evolution, and Systematics*

We conduct manipulative field experiments on free-living wildlife which generally involve 'adding' predators by simulating their presence using audio playbacks

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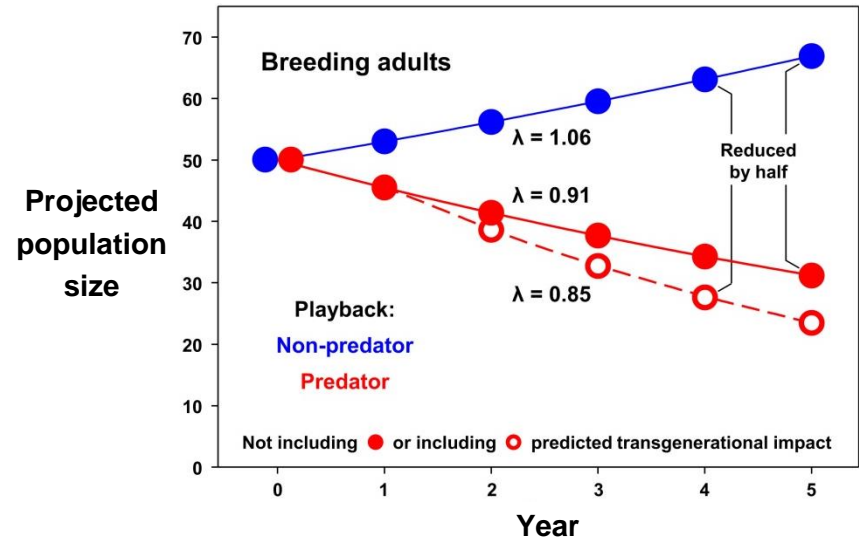
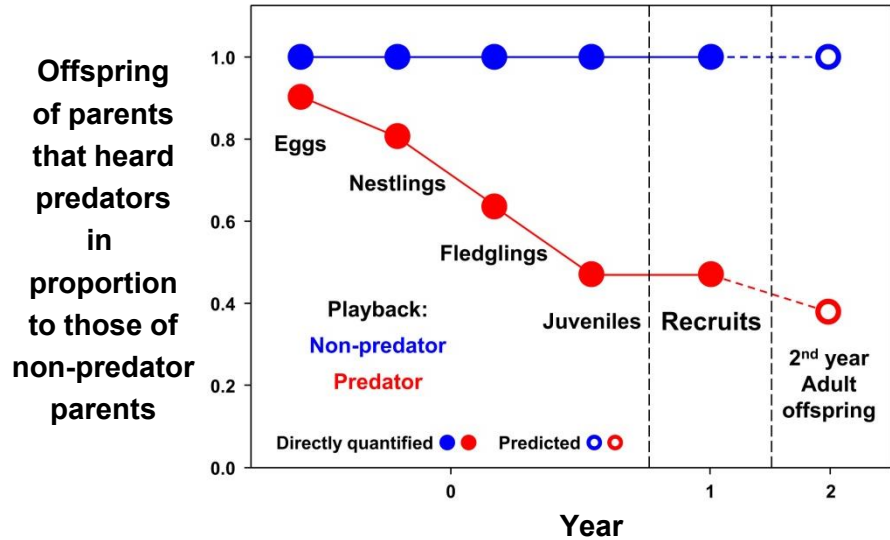
Short-term (s), small area (m²) playbacks



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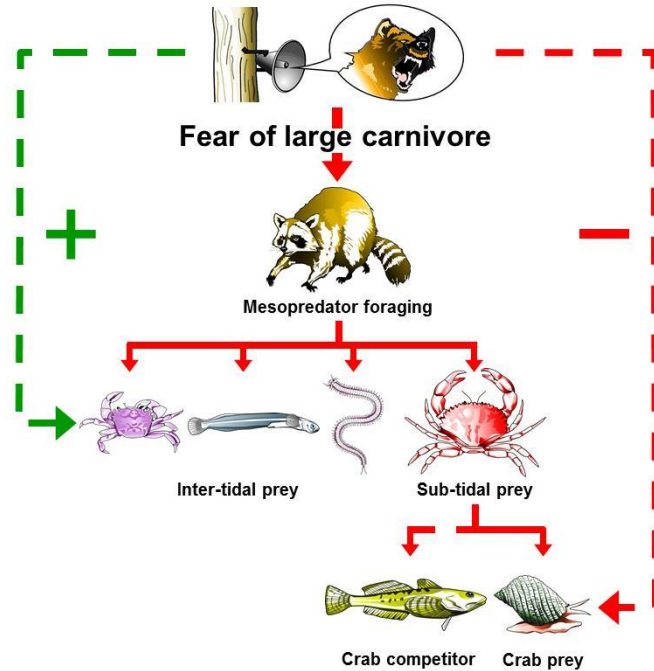
Fear of predators in free-living wildlife reduces population growth over generations



Zanette et al 2011 *Science* ; Allen et al. 2022 *PNAS*

Fear itself can reduce wildlife populations by half in just 5 years, or just 4 years when transgenerational impacts are additionally considered

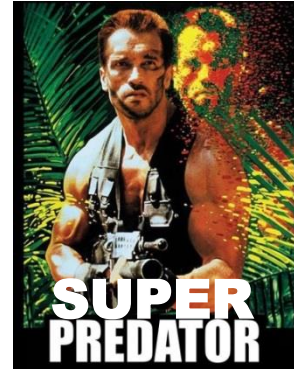
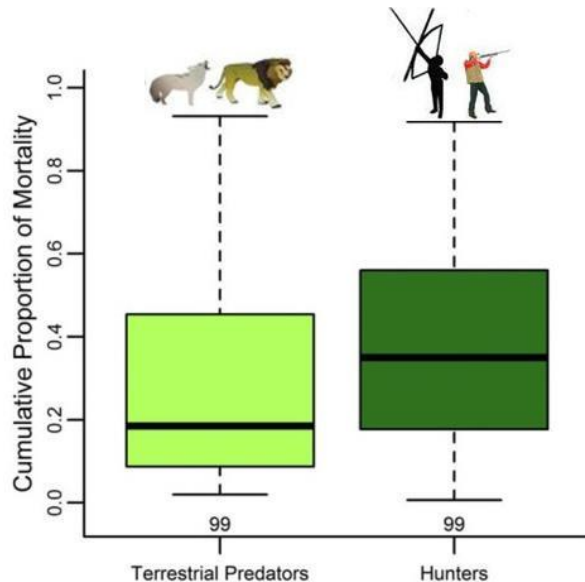
Fear of large carnivores causes a trophic cascade



Suraci et al 2016 *Nature Communications*

Fear of large carnivores reduced mesocarnivore foraging, **benefitting the mesocarnivore's prey**, causing **cascading impacts on a competitor and prey of the mesocarnivore's prey**

Fear of the human “super predator” likely to exceed fear of all other predators given our greater lethality



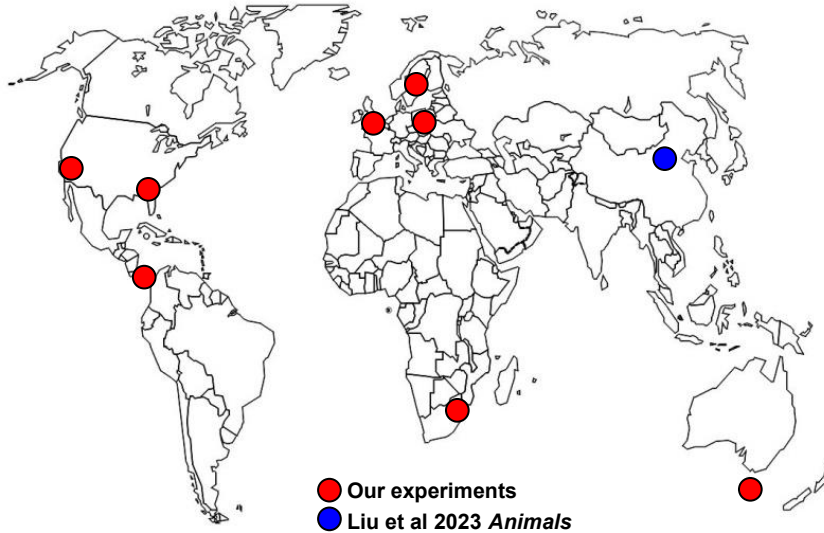
“The unique ecology of human predators”

Darimont et al 2015 *Science* ; Hill et al 2019 *Global Ecol. Biogeogr.*

Recent worldwide analyses show **humans kill medium, large and very large mammalian and avian prey** (dinner-plate size or >) at much higher rates than non-human predators do

How scary are we humans?

Conducting comparable experiments across the globe



Where experiments conducted to date



Automated Behavioural Response system (ABR)

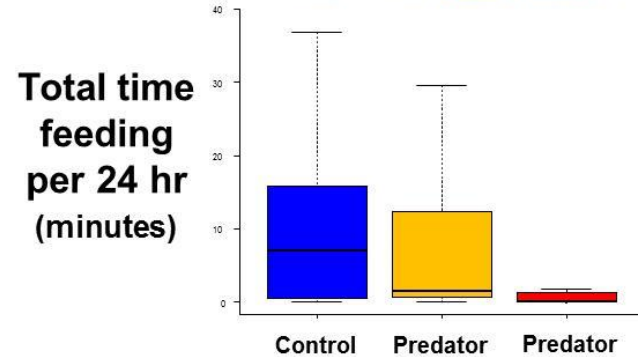
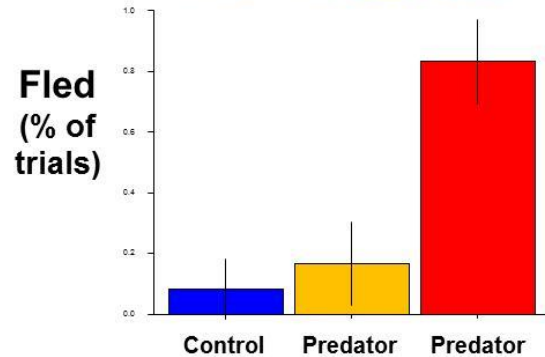
All experiments test reactions to playbacks of humans speaking calmly in locally-used languages, large carnivore vocalizations and non-predator controls

Humans, but not their dogs, displace pumas from their kills: an experimental approach

Short
term
Small
scale



Cougars
Santa Cruz
California, USA



Suraci et al Zanette, Wilmers 2019 *Scientific Reports*

Fear of humans caused cougars to flee from their food caches and spend less total time feeding whereas hearing dogs had no effects; verified fear of humans could cause trophic cascade

Paramount fear of the human “super predator” pervades the planet



Experiments across the globe demonstrate wildlife everywhere fear the human “super predator” far more than the world’s most fearsome large carnivores, such as lions, bears and wolves

Fear of humans CAN cause impacts down the food chain

Carnivore community



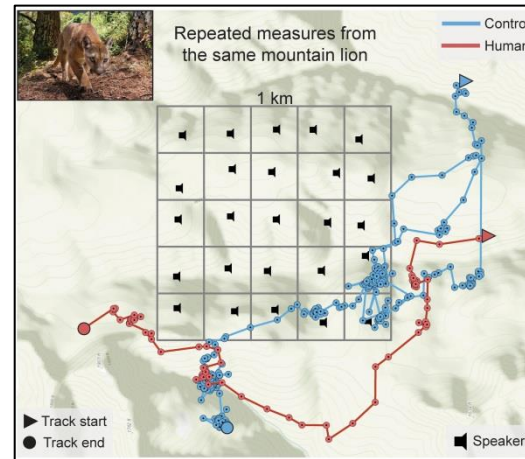
Cougar, bobcat, skunk, opossum

Santa Cruz, CA

Speakers in forest



Experimental sites



5-week-long broadcasts, then reversed; replicated on 2 **grids of 1 km² each**

**Broadcast human or non-predator (frog) vocalizations for 5 weeks at a time,
on two separate 1 km² study grids, each with an array of 25 speakers**

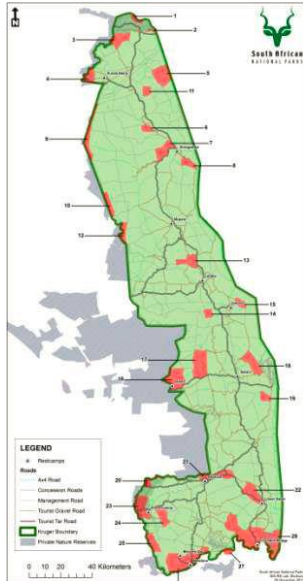
Fear of humans as apex predators has landscape-scale impacts from mountain lions to mice



Suraci et al Zanette, Wilmers 2019 *Ecology Letters*

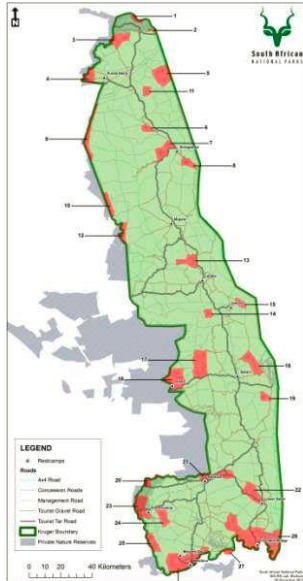
Fear of humans caused avoidance and cautiousness in large carnivores, and elusiveness and reduced foraging in mesocarnivores, with cascading benefits for small mammals

Creating “virtual villages” with human playbacks as “natural” means to create “elephant refugia” in KNP



Adaptive elephant management map

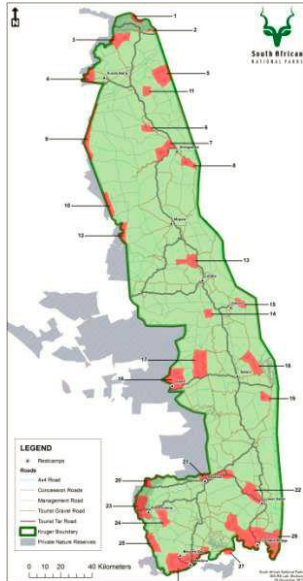
Creating “virtual villages” with human playbacks as “natural” means to create “elephant refugia” in KNP



Deterring elephant space-use and impact in identified areas of concern is one of the highest priority actions advised in the Kruger National Park Elephant Management Plan

Adaptive elephant management map

Creating “virtual villages” with human playbacks as “natural” means to create “elephant refugia” in KNP

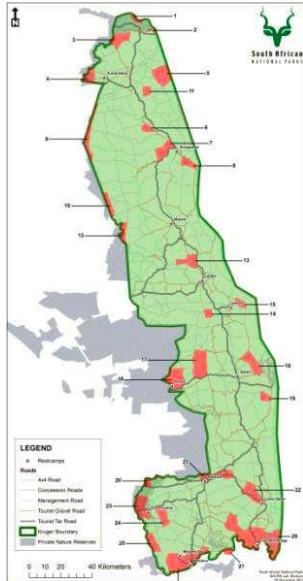


Deterring elephant space-use and impact in identified areas of concern is one of the highest priority actions advised in the Kruger National Park Elephant Management Plan

One process arguably still missing in allowing for the "natural" space use of elephants in KNP is the role humans historically played in both hunting and disturbing (chasing away) elephants

Adaptive elephant management map

Creating “virtual villages” with human playbacks as “natural” means to create “elephant refugia” in KNP



Adaptive elephant management map

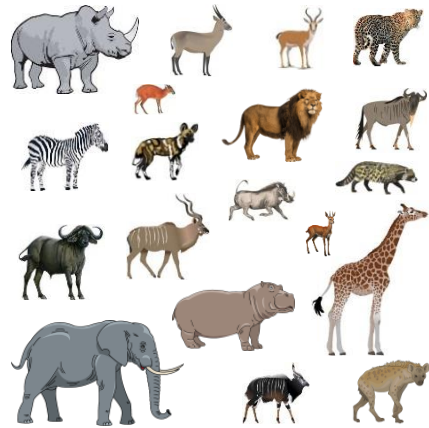
Deterring elephant space-use and impact in identified areas of concern is one of the highest priority actions advised in the Kruger National Park Elephant Management Plan

One process arguably still missing in allowing for the "natural" space use of elephants in KNP is the role humans historically played in both hunting and disturbing (chasing away) elephants

We have a SANParks permit in place (SS1416) and in June will begin a long-term, large-scale experiment broadcasting human playbacks testing the effects on elephant space-use and impacts

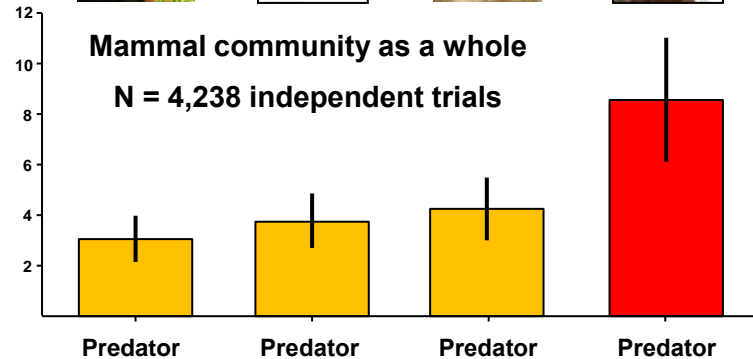
Fear of the human “super predator” pervades the South African savanna

Short
term
Small
scale



Savanna mammal community
Greater **Kruger** National Park

Run
(Odds ratio
relative to
Control [Bird])

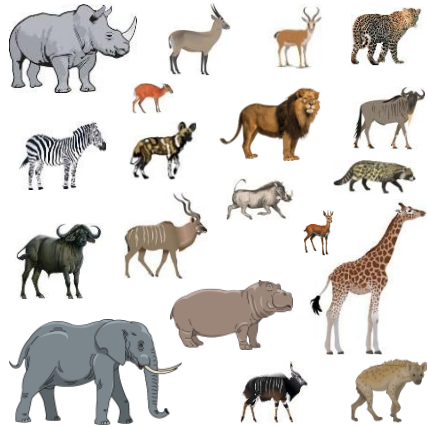


Zanette, **Peel** et al Packer 2023 *Current Biology*

Considering the community as a whole, wildlife were twice as likely to run from humans than lions whereas responses to hunting sounds (dogs barking, gunshots) were similar to lions

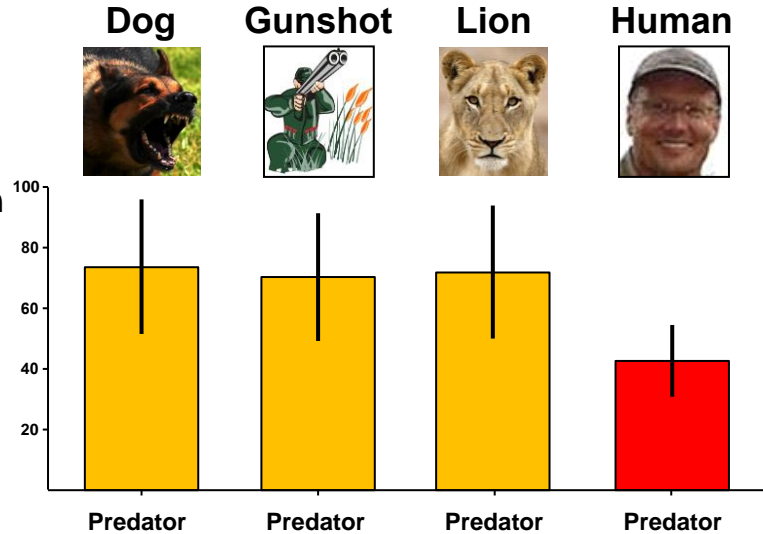
Fear of the human “super predator” pervades the South African savanna

Short
term
Small
scale



Savanna mammal community
Greater Kruger National Park

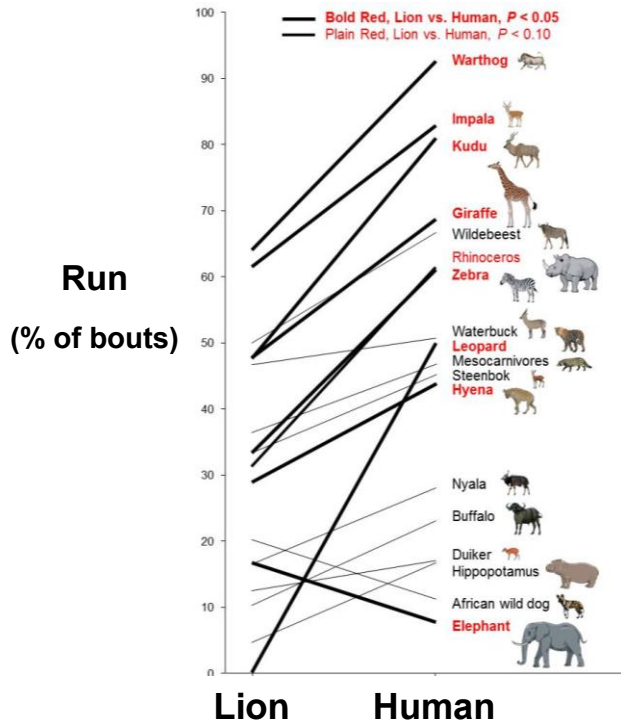
Time to Abandon
Waterhole
(% relative to
Control [Bird])



Zanette, Peel et al Packer 2023 *Current Biology*

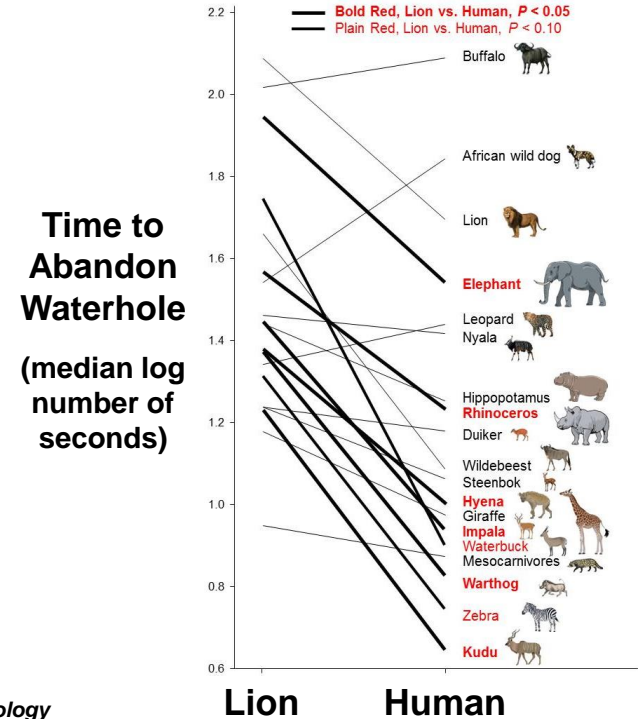
As a whole, wildlife abandoned waterholes (N = 21) during the dry season in 40% faster time to humans than lions, whereas responses to dogs or gunshots were again similar to lions

Fully 95% of species either ran more from humans than lions or abandoned waterholes faster to humans



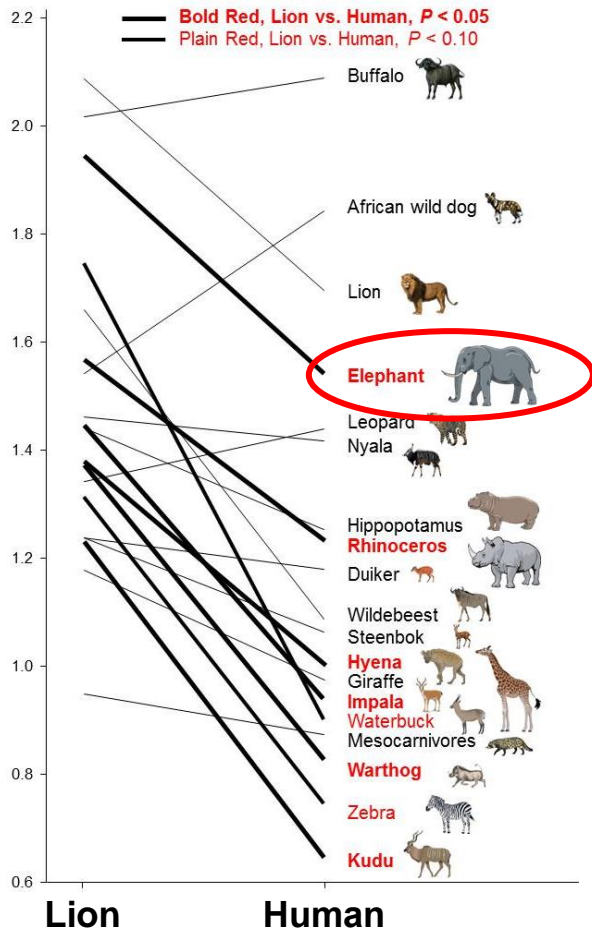
Greater
fear of humans
than lions
was
overwhelmingly
pervasive
throughout
the savanna
mammal
community

Zanette, Peel et al Packer 2023 *Current Biology*



Time to Abandon Waterhole

(median log number of seconds)



Fear of humans deterred elephants from waterholes



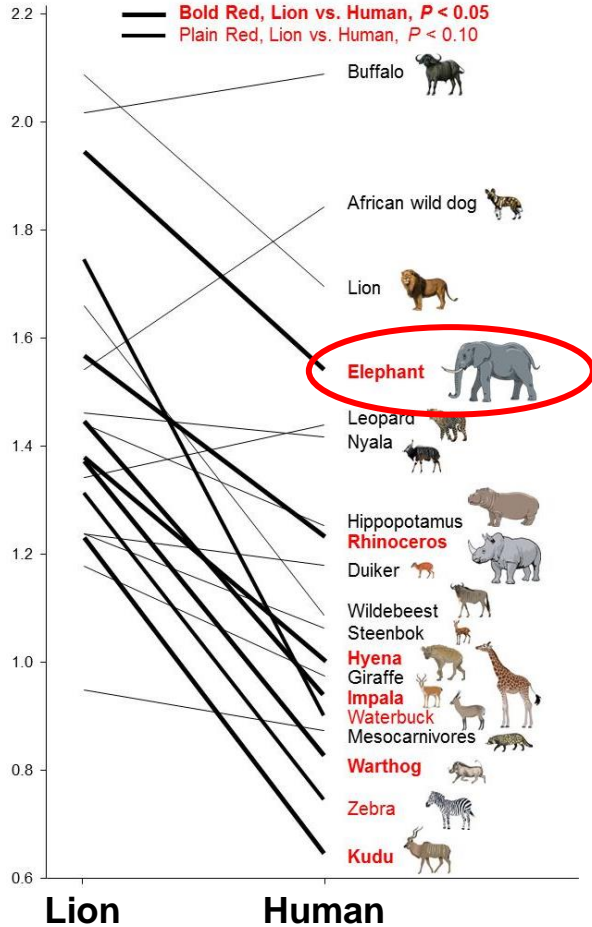
Elephants abandoned waterholes significantly faster to humans than lions

Fear of humans CAN deter elephants in Kruger

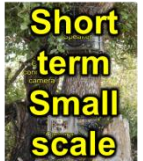


Time to
Abandon
Waterhole

(median log
number of
seconds)

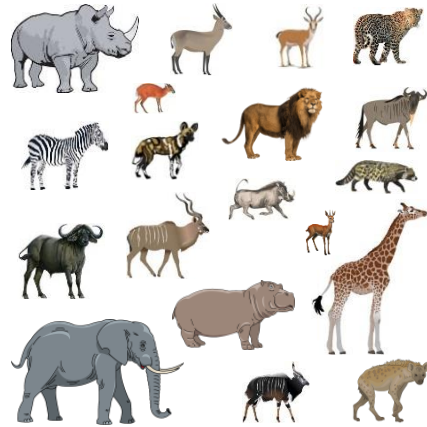


Elephants abandoned waterholes
significantly **faster to humans** than lions




Do wildlife in protected areas know they are protected?

Short
term
Small
scale



Savanna mammal community
Greater Kruger National Park

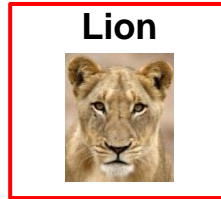
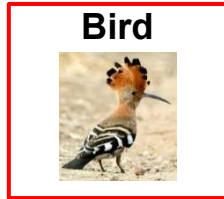


Many tourists 

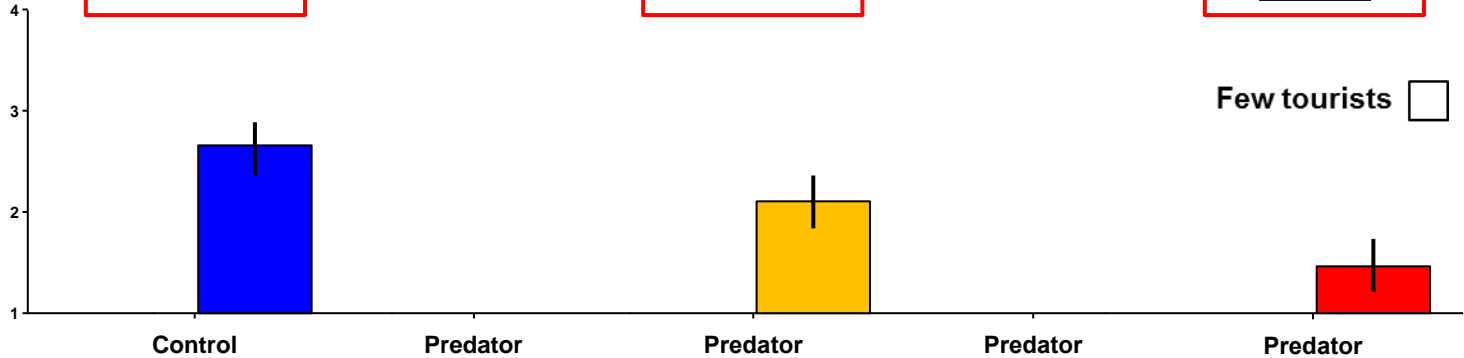
Zanette, Ferreira, Smit, Peel et al *In prep*

Just discussed experiment conducted where few tourists (Klaserie PNR). Conducted comparable experiment in 2023 both where few tourists (Klaserie) and many tourists (Skukuza)

Do wildlife in protected areas know they are protected?



Time to
Abandon
Waterhole
(videos
per
bout)



Zanette, Ferreira, Smit, Peel et al *In prep*

Broadcast control, lion and human playbacks
as in prior experiment

Do wildlife in protected areas know they are protected?



Bird



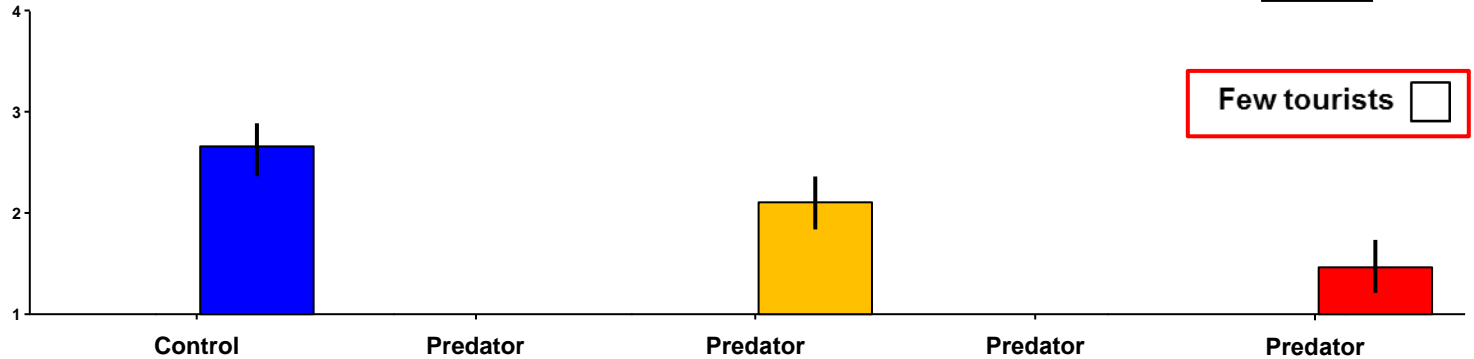
Lion



Human



Time to Abandon Waterhole
(videos per bout)



Zanette, Ferreira, Smit, Peel et al *In prep*

Here showing results from where there are few tourists (Klaserie)
where prior study conducted

Do wildlife in protected areas know they are protected?



Bird



Lion

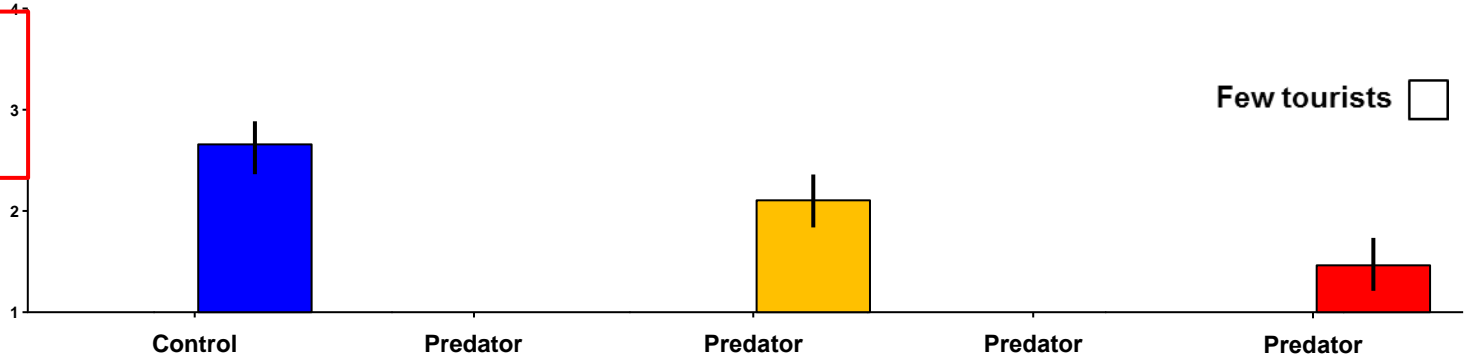


Human



Time to Abandon Waterhole

(videos per bout)



Few tourists

Zanette, Ferreira, Smit, Peel et al *In prep*

Showing time to abandon the waterhole;
shorter times demonstrating scarier treatments

Do wildlife in protected areas know they are protected?



Bird



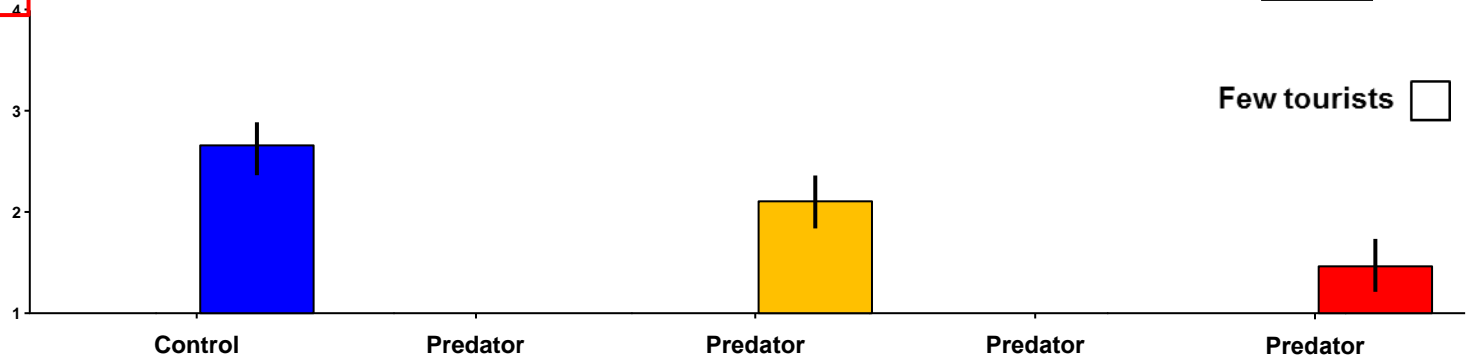
Lion



Human



Time to Abandon Waterhole
(videos per bout)

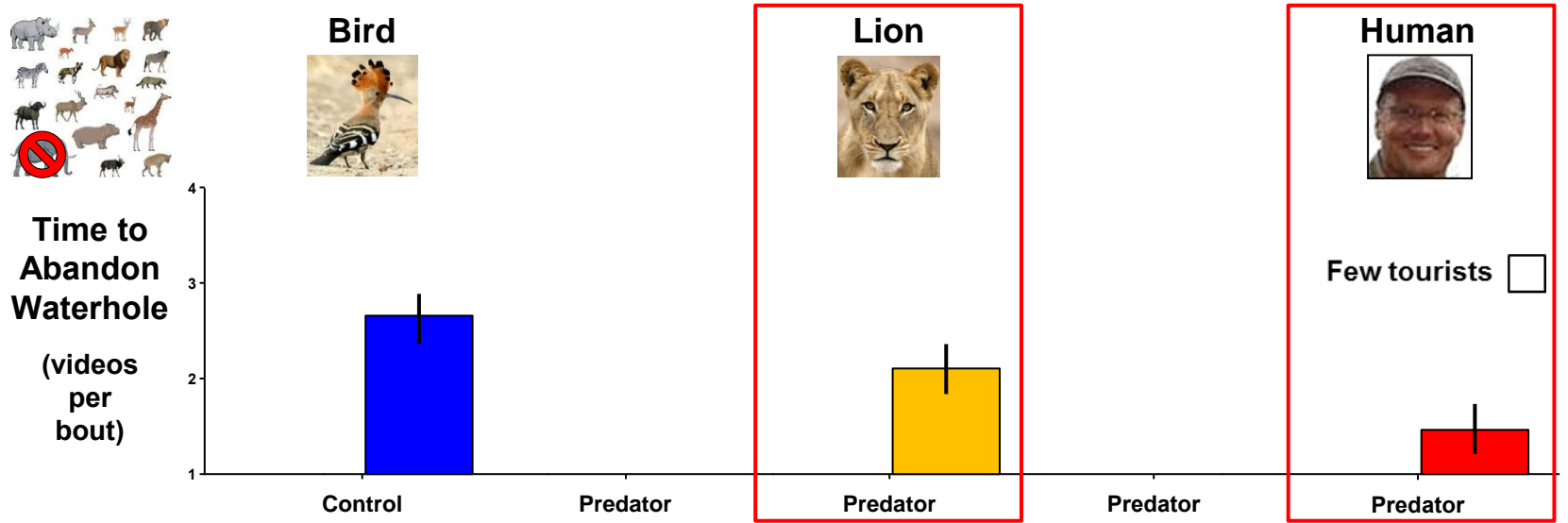


Few tourists

Zanette, Ferreira, Smit, Peel et al *In prep*

Showing results from entire savanna mammal community
MINUS elephants

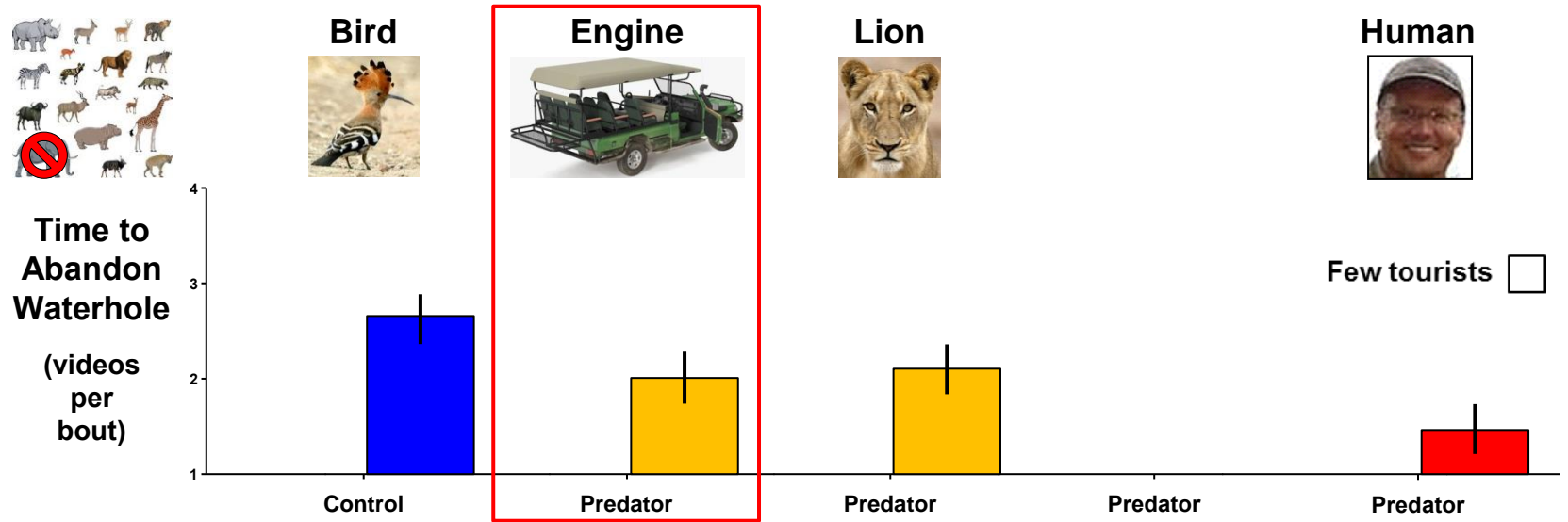
Where few tourists wildlife abandoned waterholes in faster time to humans than lions, as shown before



Zanette, Ferreira, Smit, Peel et al *In prep*

Responses to controls, lions and humans as found previously where few tourists (Klaserie);
demonstrating the consistency of effects across years

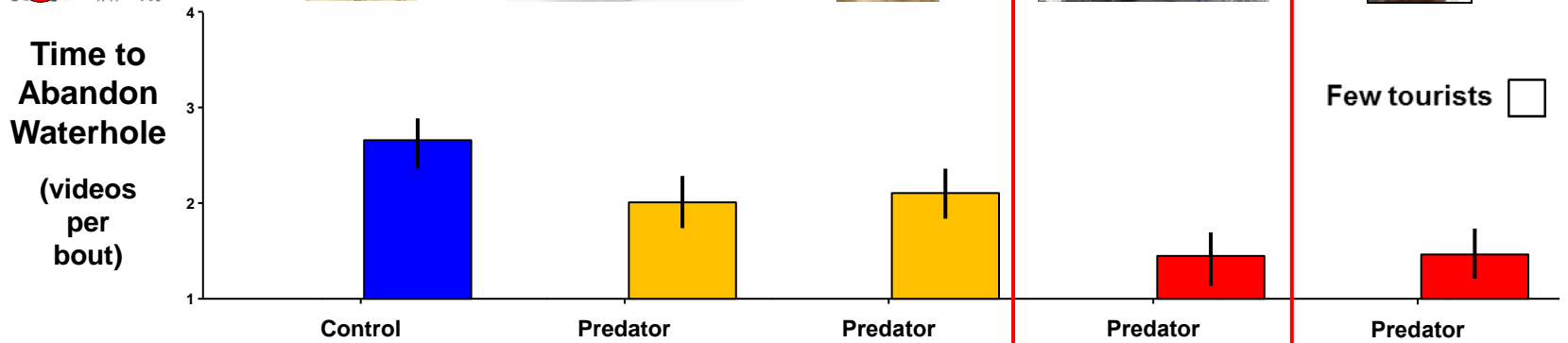
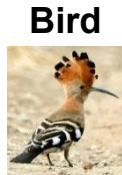
Anthropogenic noises (engines) were as frightening as lions but far less frightening than human voices



Zanette, Ferreira, Smit, Peel et al *In prep*

Responses to engine sounds, simulating tourism, were similar to lions, and far less than to human voices; comparable to the responses to gunshots in prior experiment

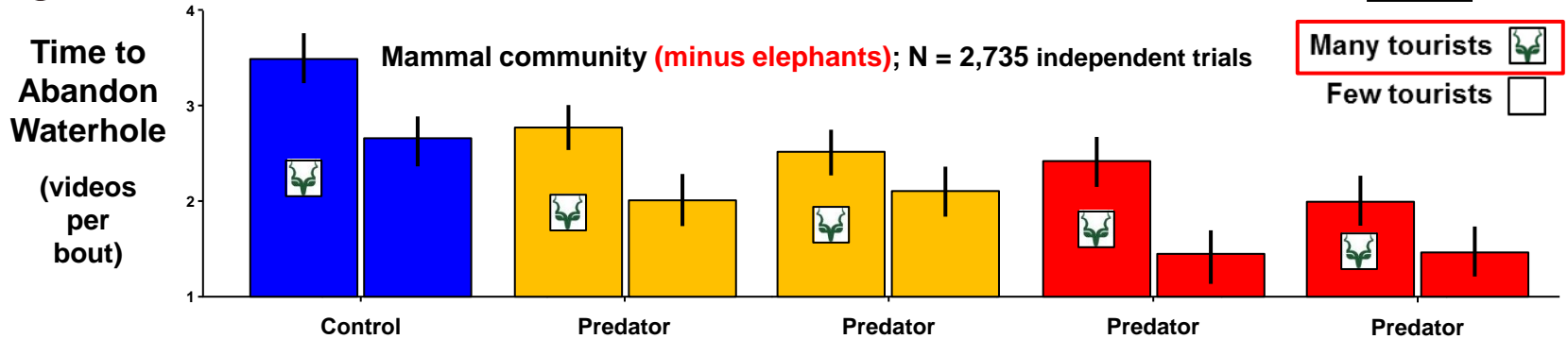
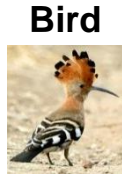
Hearing human “super predator” inspires greatest fear – even voices mixed with anthropogenic noise



Zanette, Ferreira, Smit, Peel et al *In prep*

Responses to hearing human voices mixed with engine sounds were comparable to hearing human voices alone, and far stronger than to hearing lions, or engine sounds alone

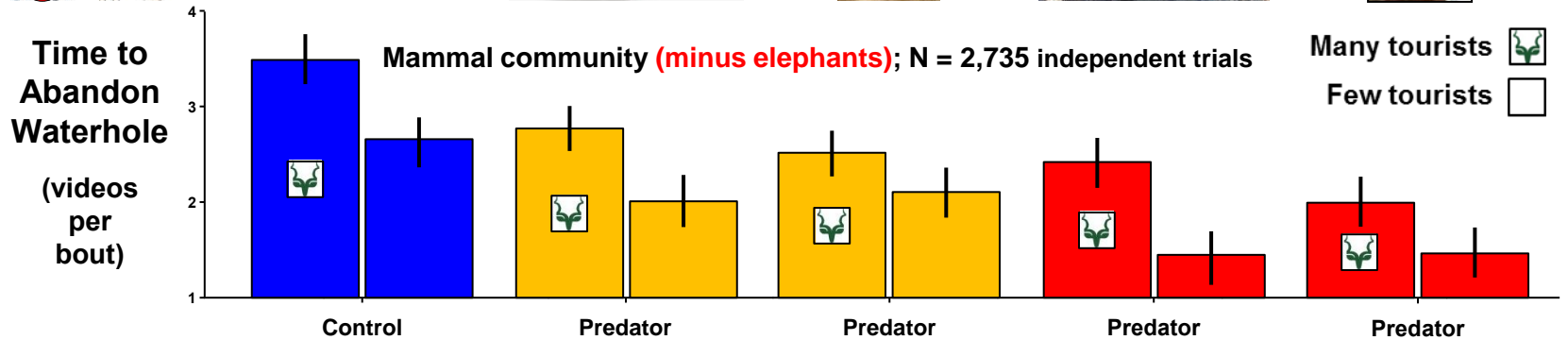
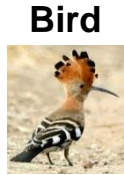
Wildlife were slower to abandon waterholes to any and all treatments where there were many tourists



Zanette, Ferreira, Smit, Peel et al *In prep*

Generalized human disturbance may desensitize animals in heavily touristed areas,
but NO treatment by tourism level (Kruger vs. Klaserie) interactions

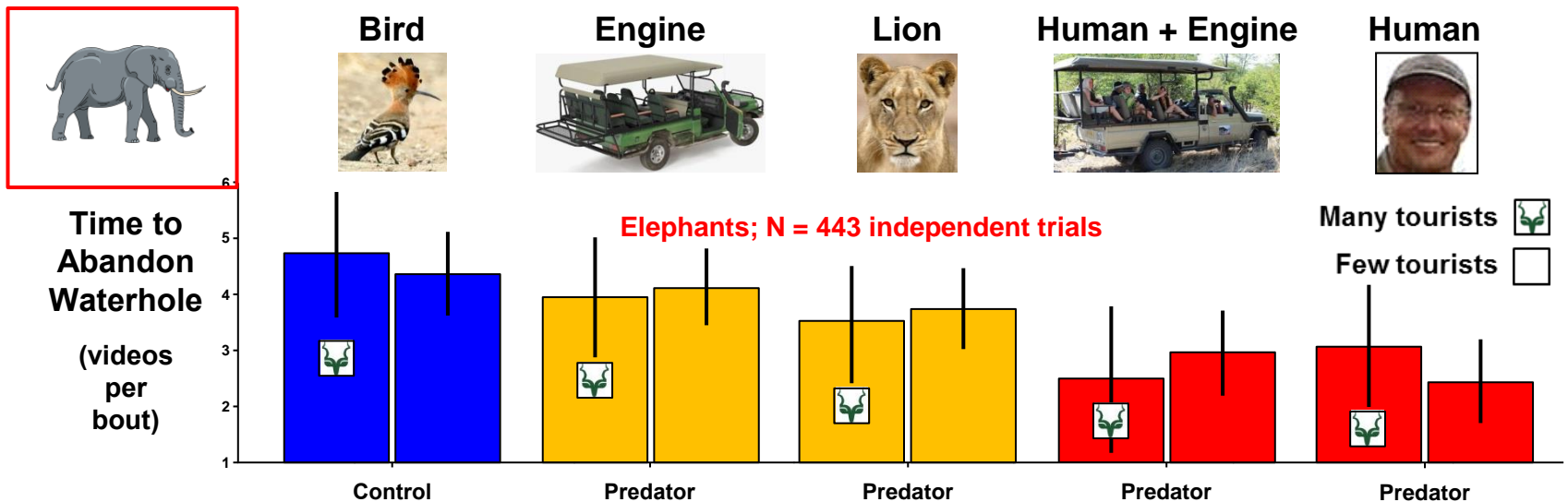
Wildlife in protected areas do NOT know protected – remain most fearful of human “super predator”



Zanette, Ferreira, Smit, Peel et al *In prep*

Generalized human disturbance may desensitize animals in heavily touristed areas,
but **NO treatment by tourism level (Kruger vs. Klaserie) interactions**

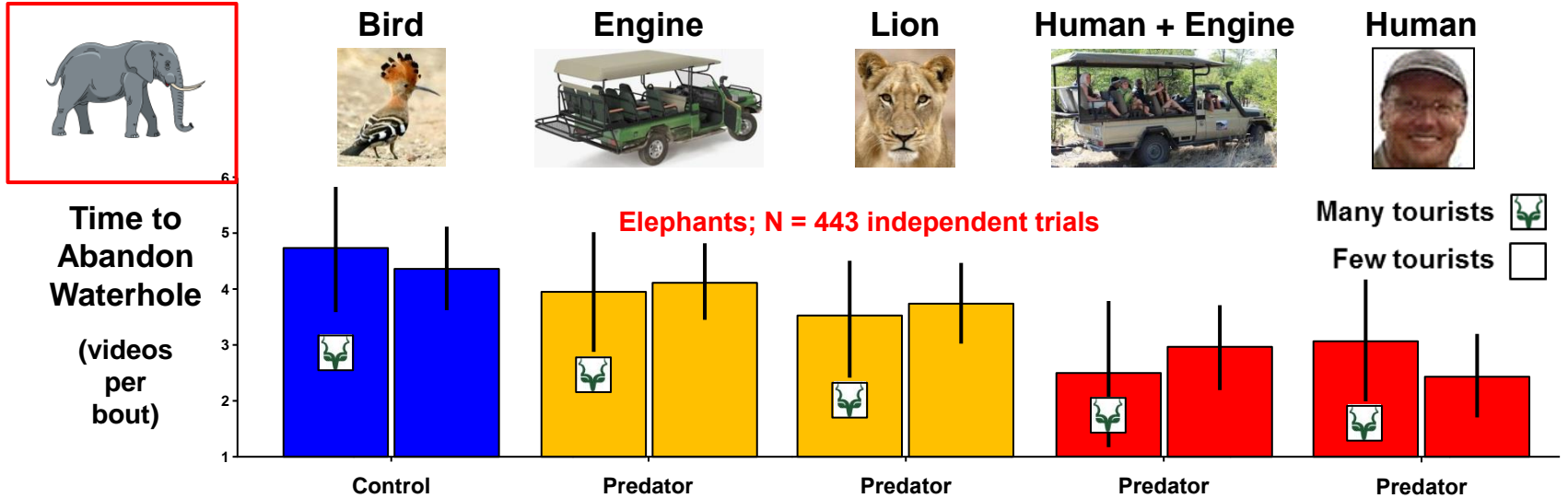
Elephants most fearful of hearing human voices regardless of where



Zanette, Ferreira, Smit, Peel et al *In prep*

Elephants demonstrated same pattern of responses to different treatments **as other wildlife** while demonstrating a **consistent magnitude** of responses **regardless of tourism level**

“Virtual villages” using human playbacks strongest means to create “elephant refugia”

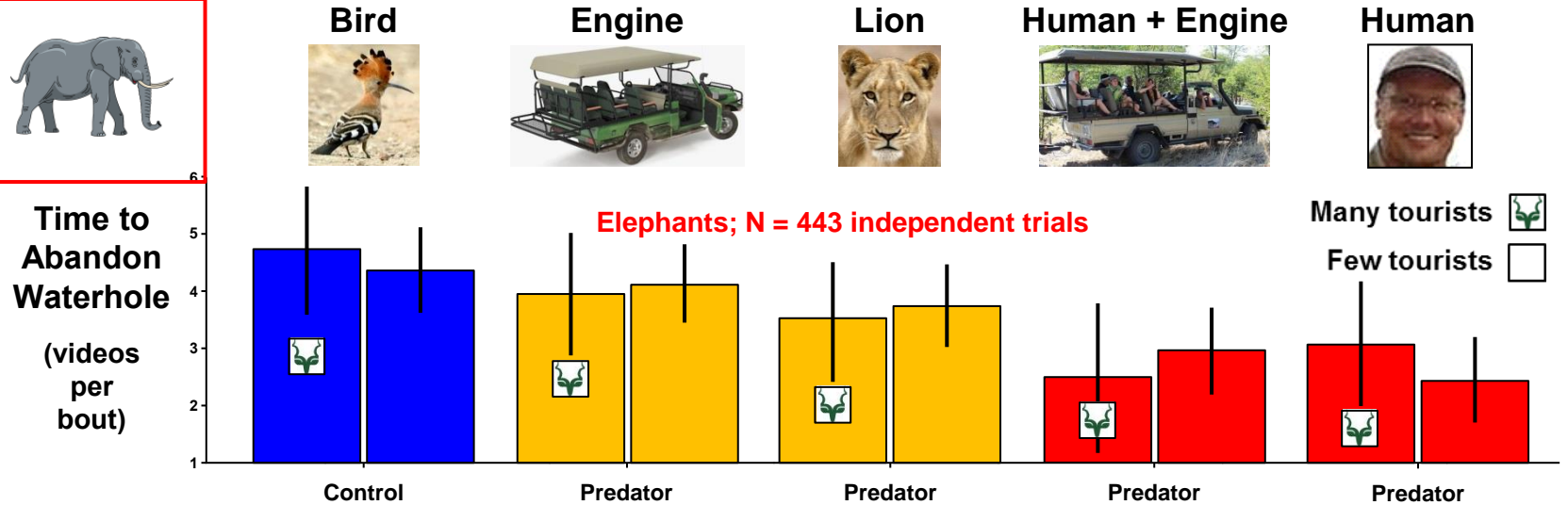
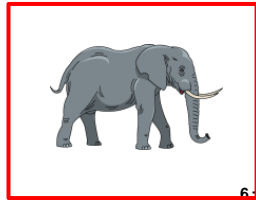


Zanette, Ferreira, Smit, Peel et al *In prep*

Elephants in KNP are **consistently most fearful** of
the **human “super predator”**

“Virtual villages” using human playbacks strongest means to create “elephant refugia”

Short
term
Small
scale

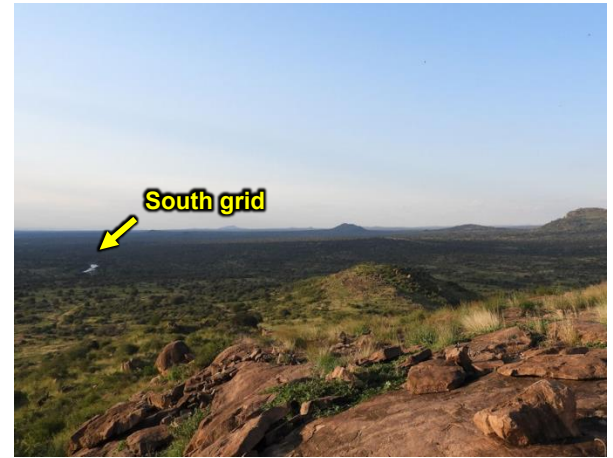
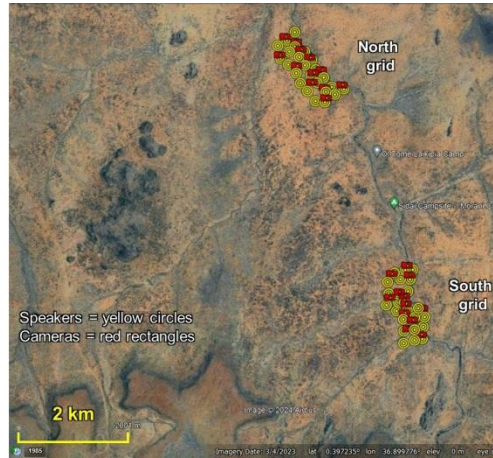


Zanette, Ferreira, Smit, Peel et al *In prep*

Elephants in KNP are **consistently most fearful** of
the **human “super predator”**

Created “virtual villages” using human playbacks to deter elephants: an experimental test in Kenya

Savanna mammal community, Kenya Wildlife Service’s Mpala Research Centre, central Kenya



5-week-long broadcasts, then reversed; replicated on **2 grids of 1 km² each**

Broadcast human or non-predator (bird) vocalizations for 5 weeks at a time, on two separate ~ 1 km² study grids, each with an array of 24 speakers

Creating “virtual villages” using human playbacks to deter elephants: speaker deployment

Solar-powered speakers



Deployed in thorny Acacias



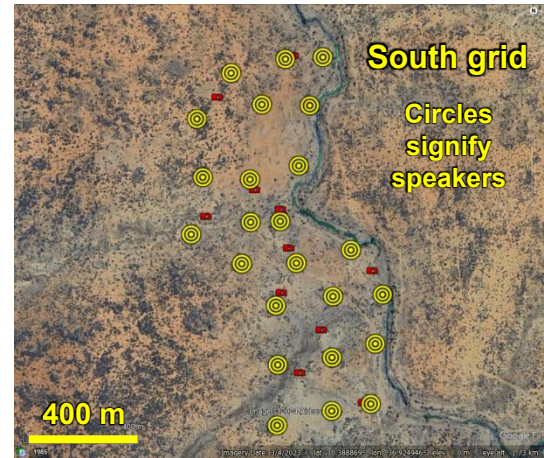
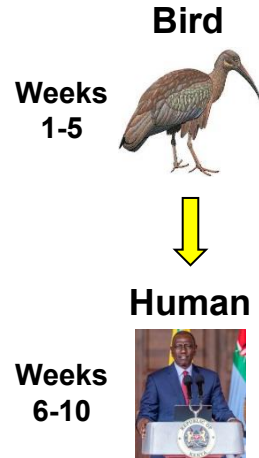
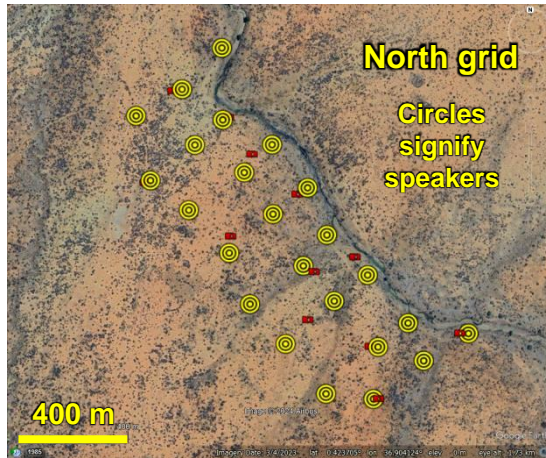
Out of reach of people



Deployed 48 custom-built solar-powered speakers that ran maintenance-free for 10 weeks which positioning successfully prevented from being stolen, or damaged by wildlife

Experimental design ensured spatial and temporal replication

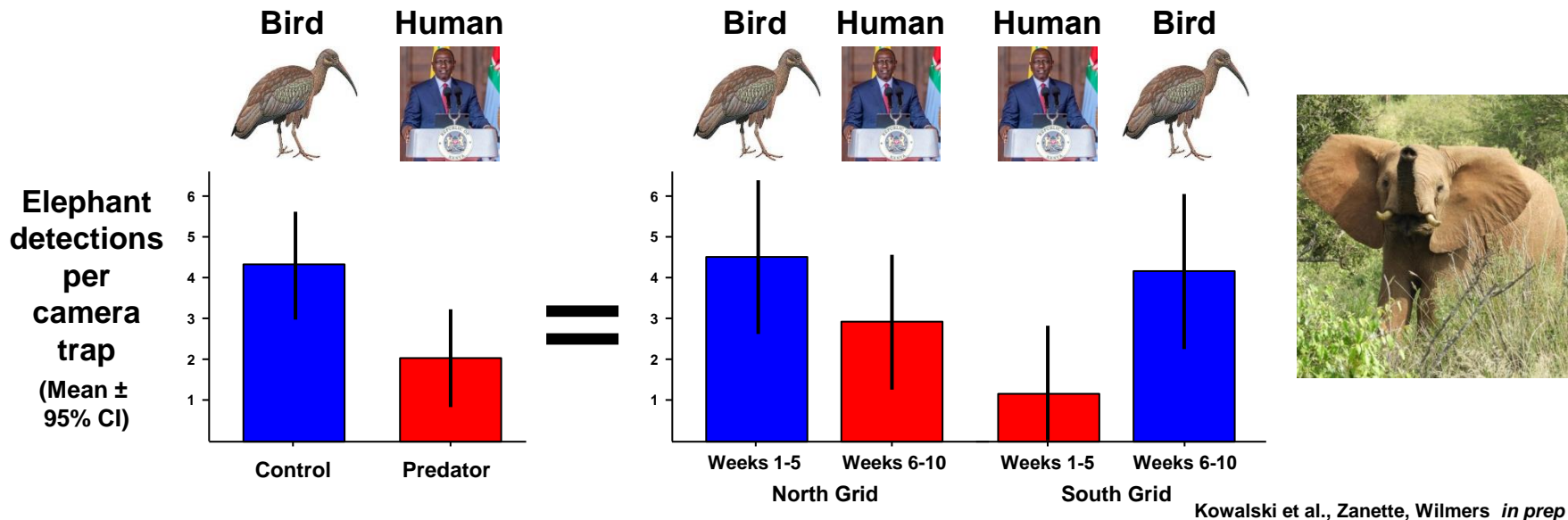
12 camera traps deployed per grid to record elephant detections (defined as > 30 min apart)



3 grid-long transects, walked before and after each treatment period to assay tree and shrub damage

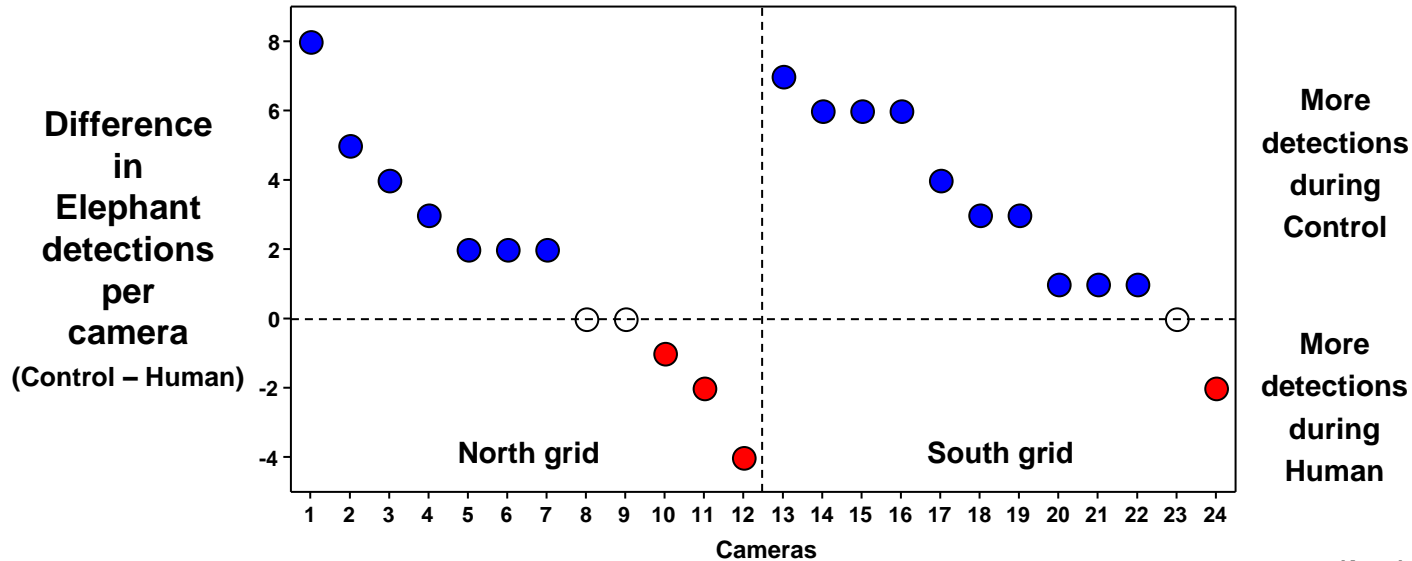
Powerful repeated-measures cross-over design proven effective in prior experiment on mountain lions in California (*Ecology Letters* 2019 22:1578)

Fear of humans REDUCED elephant detections – by more than half (53%)



Elephant detections were reduced during human playback periods on both experimental grids (35% less on N, 72% less on S)

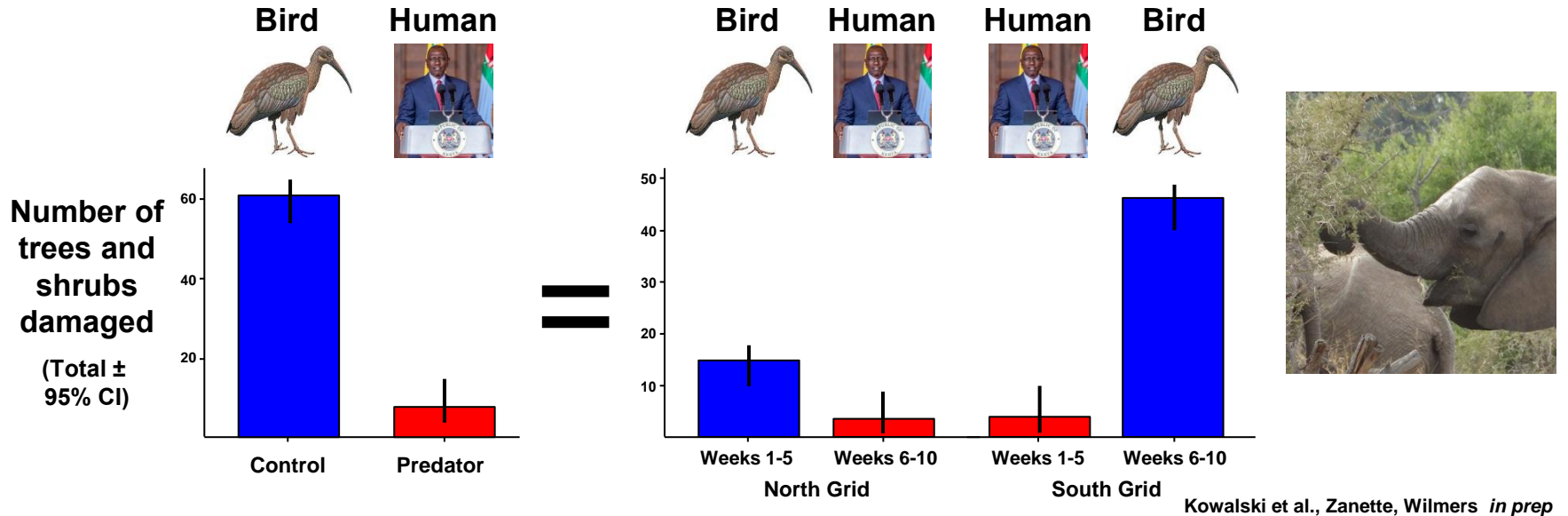
Fear-of-humans-induced reduction in elephant detections blindingly obvious from repeated-measures



Kowalski et al., Zanette, Wilmers *in prep*

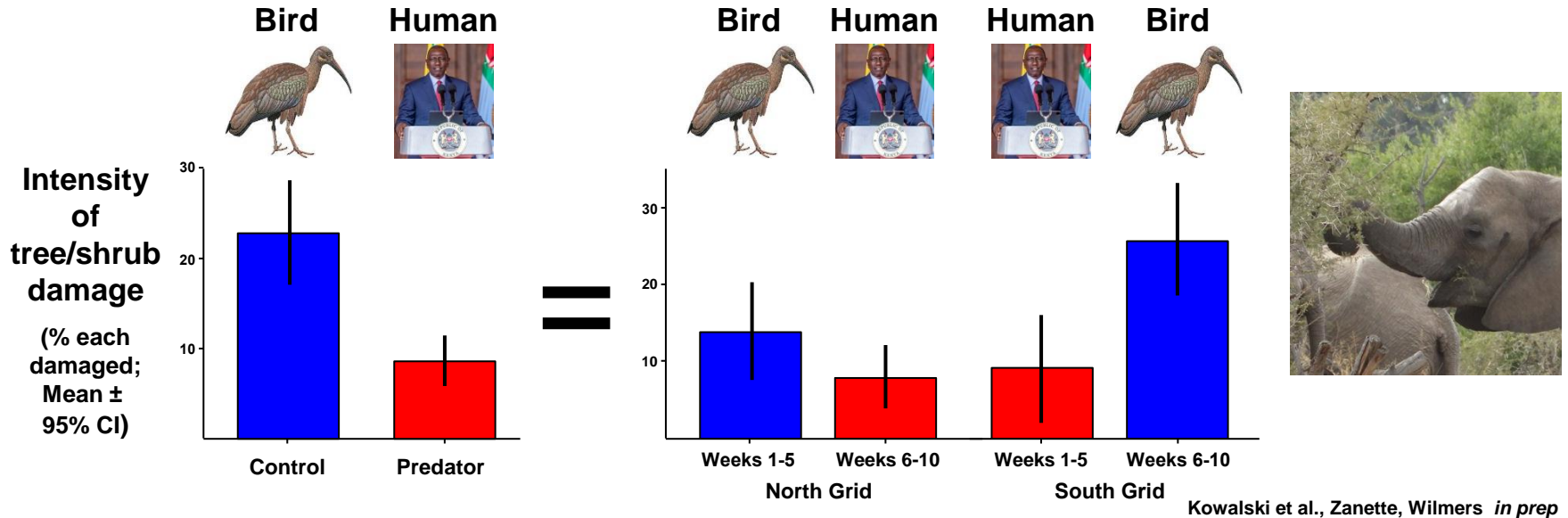
Elephant detections were reduced during human playback periods on both experimental grids (Wilcoxon matched-pairs test, $p = 0.003$)

Fear of humans reduced the number of trees and shrubs damaged by 87%



Number of trees and shrubs damaged was reduced by 3/4s or more during human playback periods on both experimental grids (73% less on N, 92% less on S)

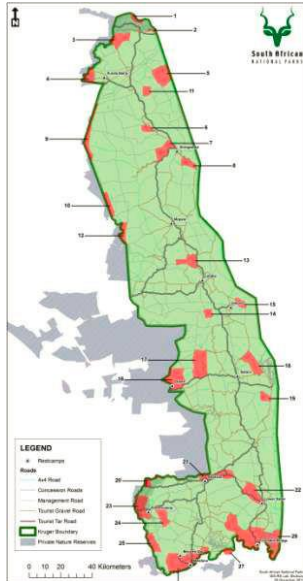
Fear of humans reduced the intensity of tree and shrub damage (% each was damaged) by 62%



Intensity of tree and shrub damage was reduced by 2/5s or more

during human playback periods on both experimental grids (43% less on N, 64% less on S)

Creating “virtual villages” with human playbacks as “natural” means to create “elephant refugia” in KNP



Adaptive elephant management map

Elephants in Kruger consistently fear humans, over time and across locations

Elephants in Kruger can be deterred from waterholes using human playbacks, for at least some time

Results from Kenya demonstrate creating “virtual villages” using human playbacks is both feasible and can deter elephant space-use and impacts

Thanks very much!

