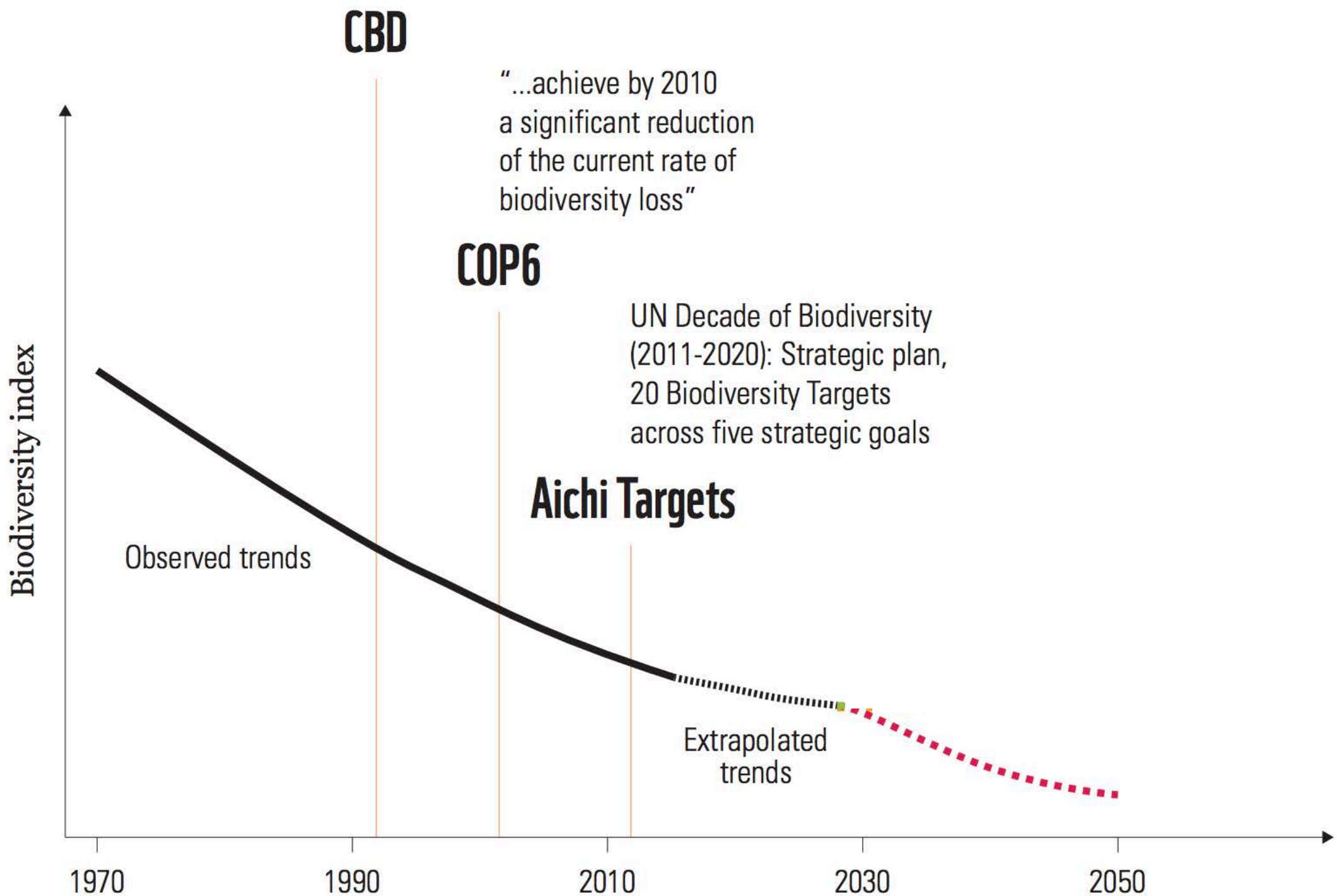
Solutions for nature and people

Bridging the ecological and social dimensions of conservation

Charlotte H. Chang
chchang@nimbios.org

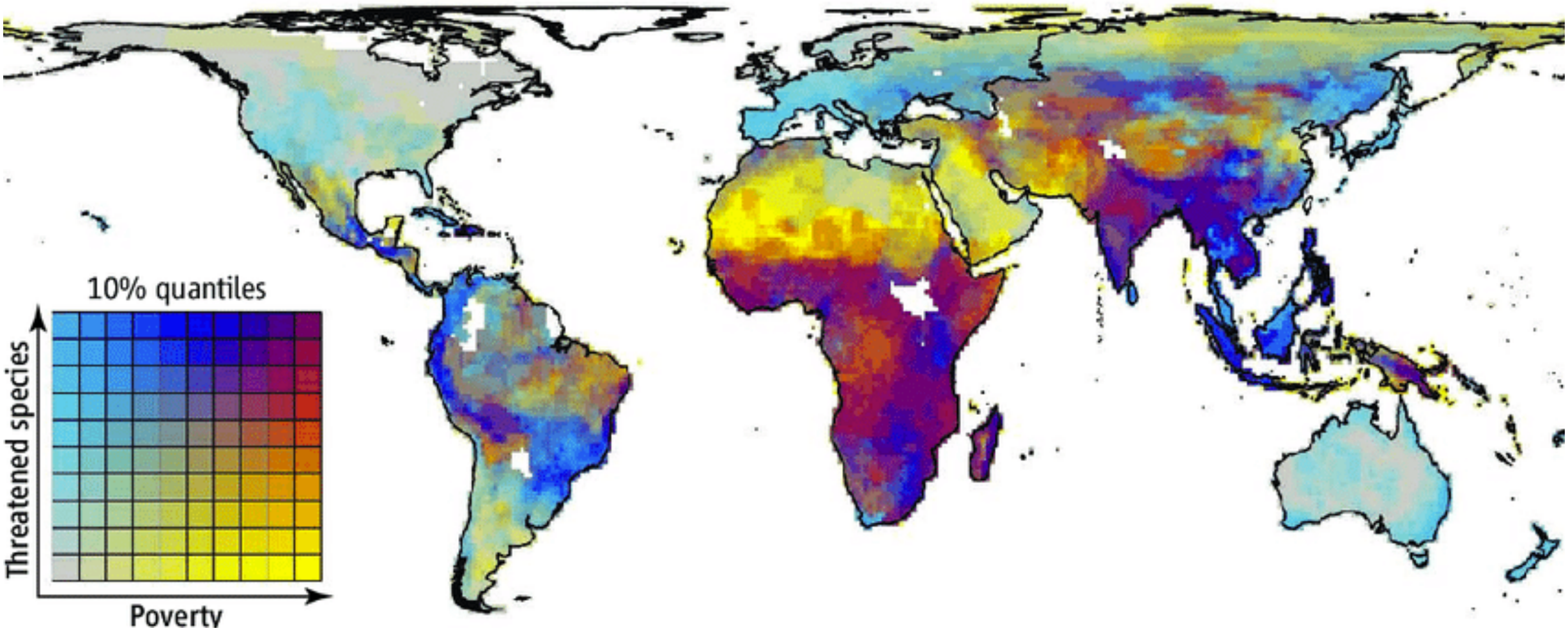
NIMBioS

BIODIVERSITY IN CRISIS



Mace *et al*. 2018, *Nature*; Living Planet Index 2018

CONSERVING BIODIVERSITY IN THE FACE OF POVERTY



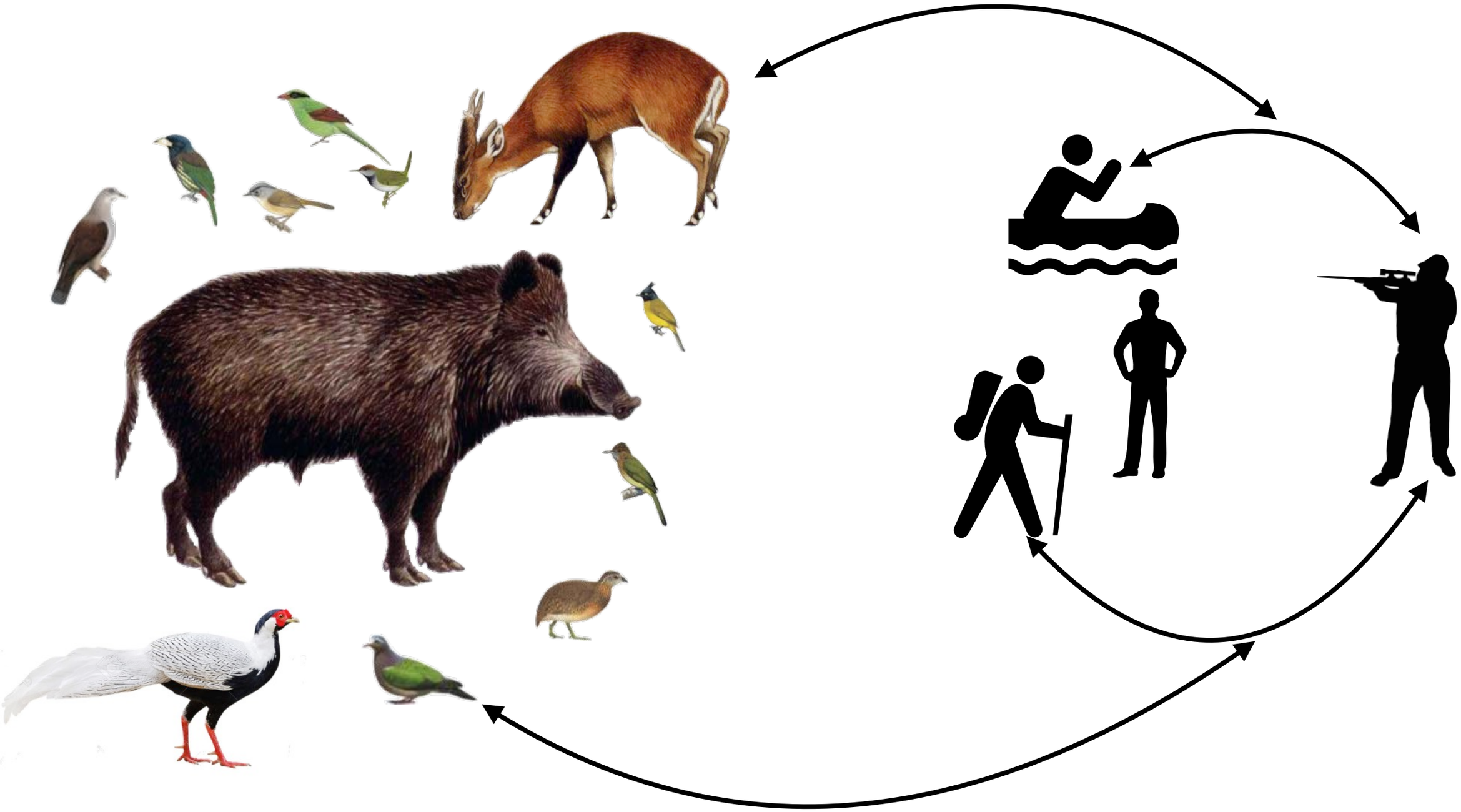
Sachs *et al.* 2009, *Science*

BIG KILLERS

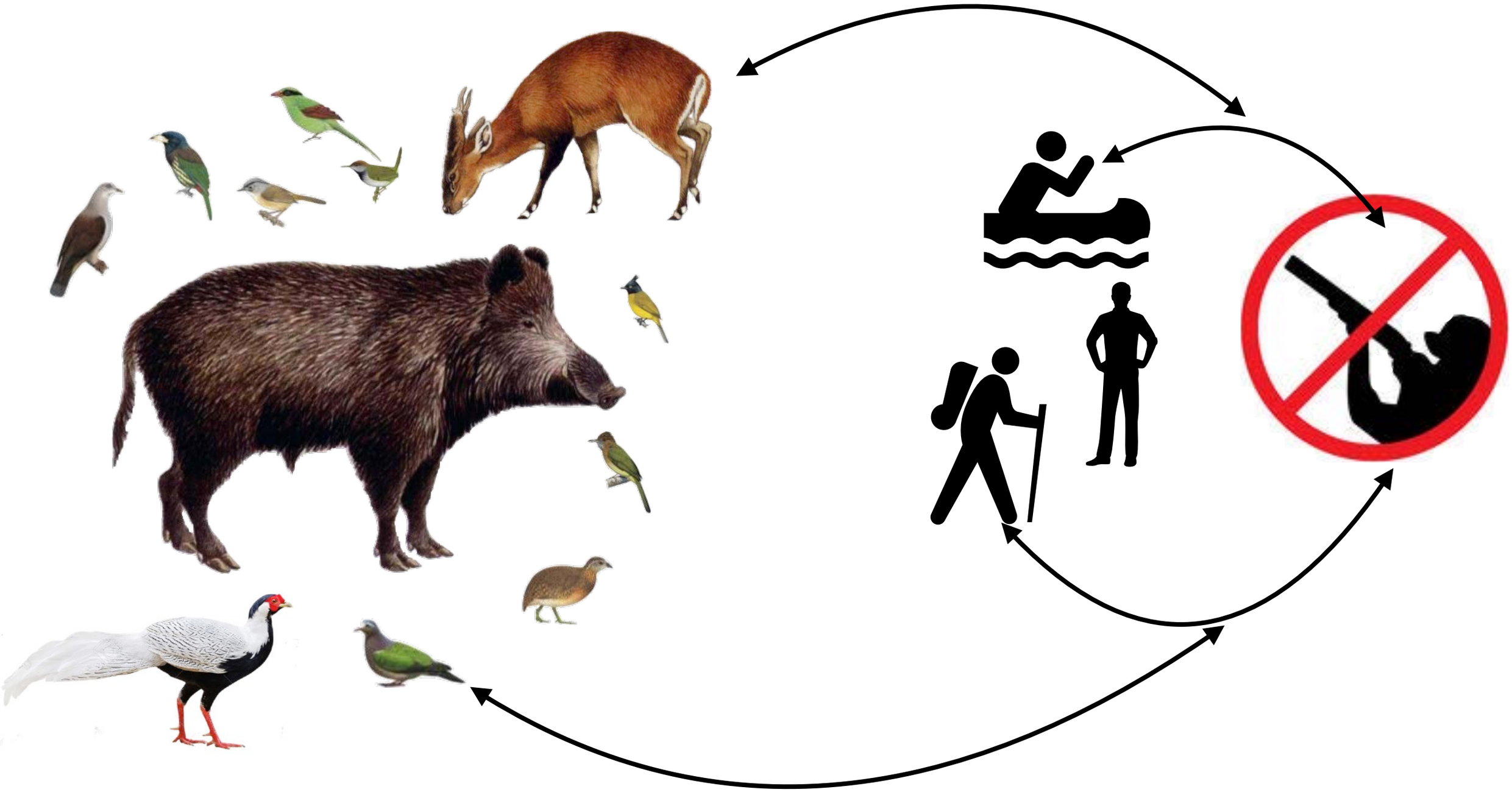
Overexploitation and agriculture are the most prevalent threats facing the 8,688 threatened or near-threatened species from comprehensively assessed species groups on the IUCN Red List.

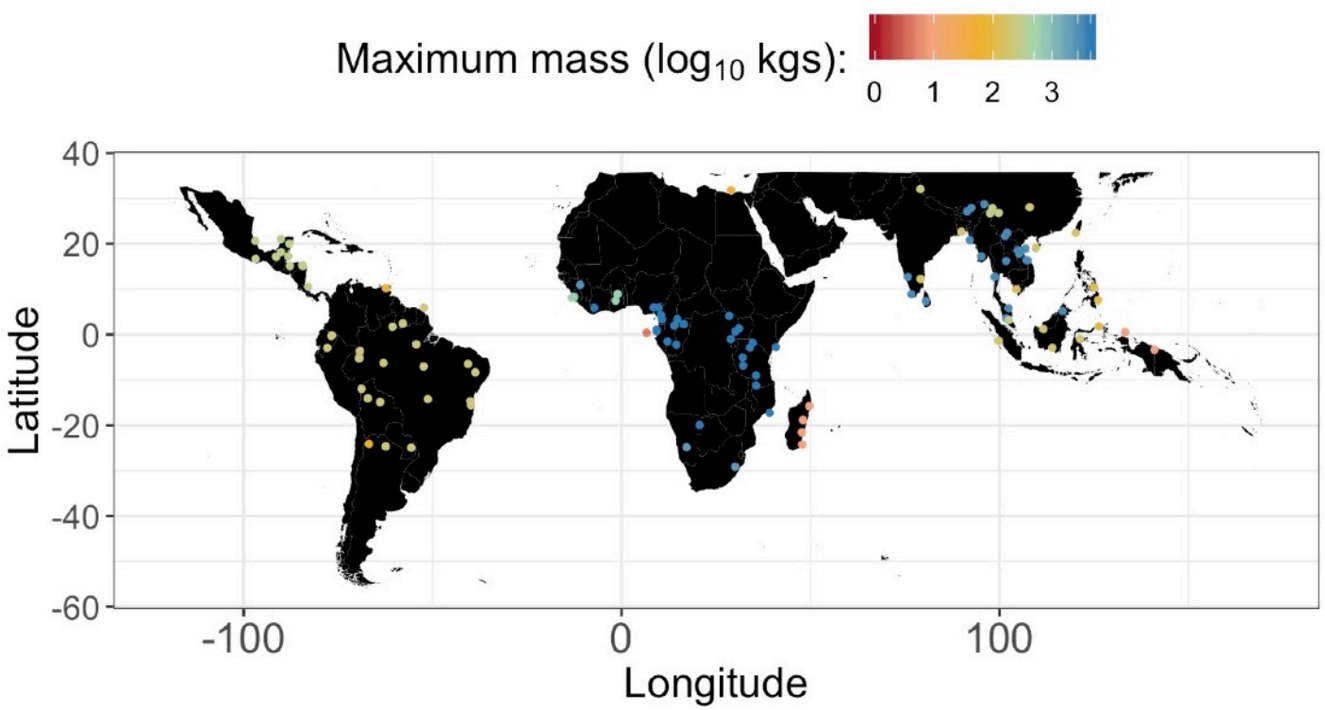
Maxwell et al. 2016

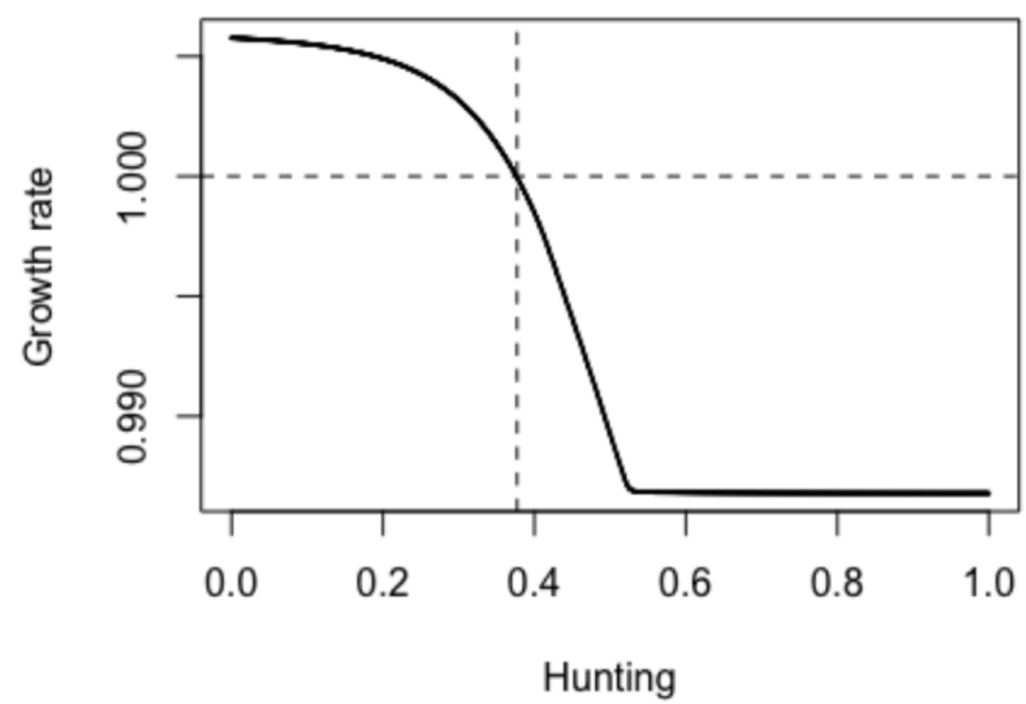
COUPLED NATURAL AND HUMAN SYSTEMS



COUPLED NATURAL AND HUMAN SYSTEMS

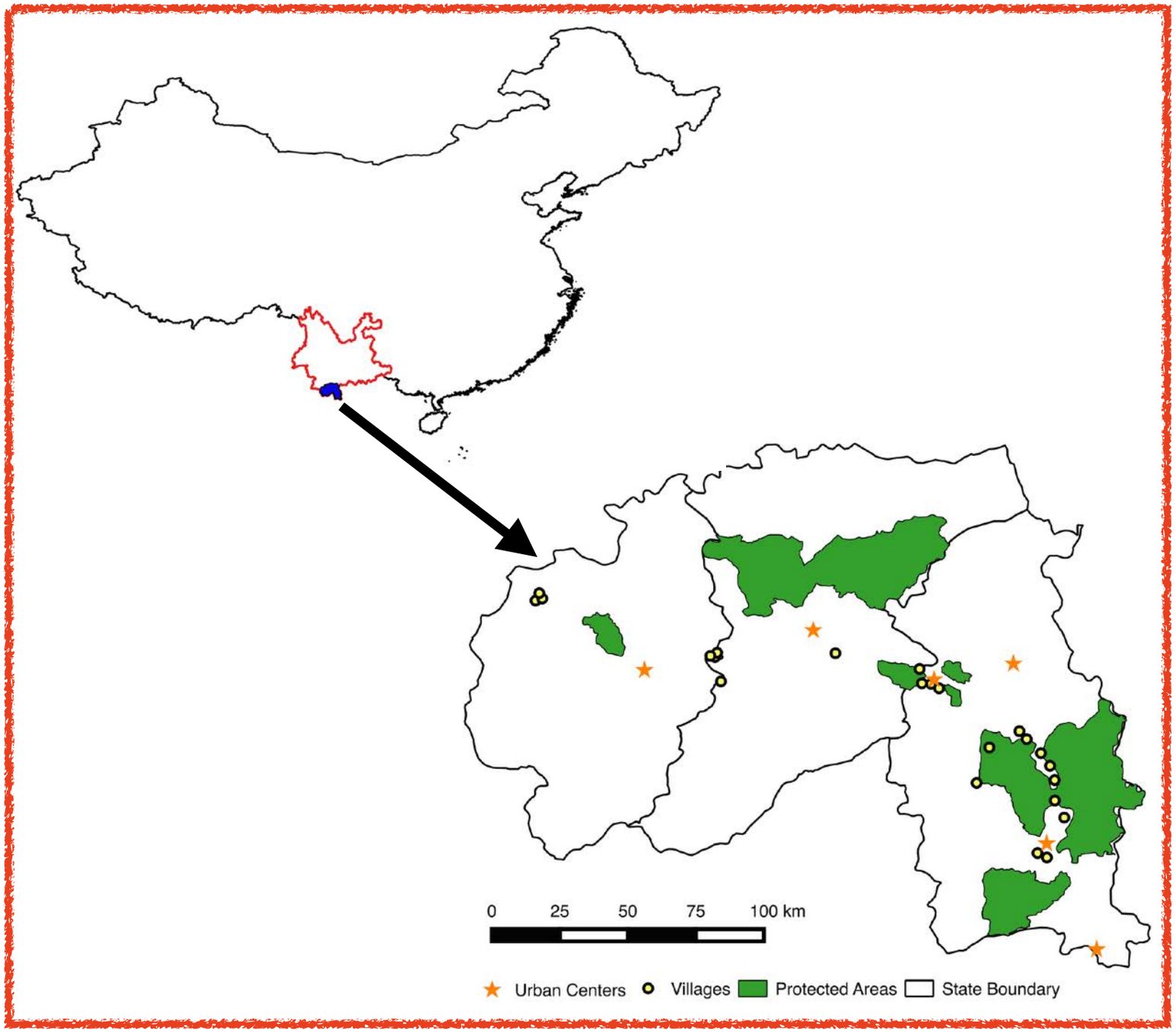



Maximum mass (log_{10} kgs):
0
1
2
3
40
20
0
-20
-40
-60
Latitude
-100
0
100
Longitude


Growth rate
1.000
0.990
0.0
0.2
0.4
0.6
0.8
1.0
Hunting

1: CONSERVATION COMPLIANCE

A case study in Southwest China



XISHUANGBANNA DAI AUTONOMOUS PREFECTURE

Chang *et al.* 2017, *Ecology and Society*
Chang, Cruyff, & Giam 2018, *Conservation Biology*
Chang *et al.*, *Biological Conservation (In Press)*

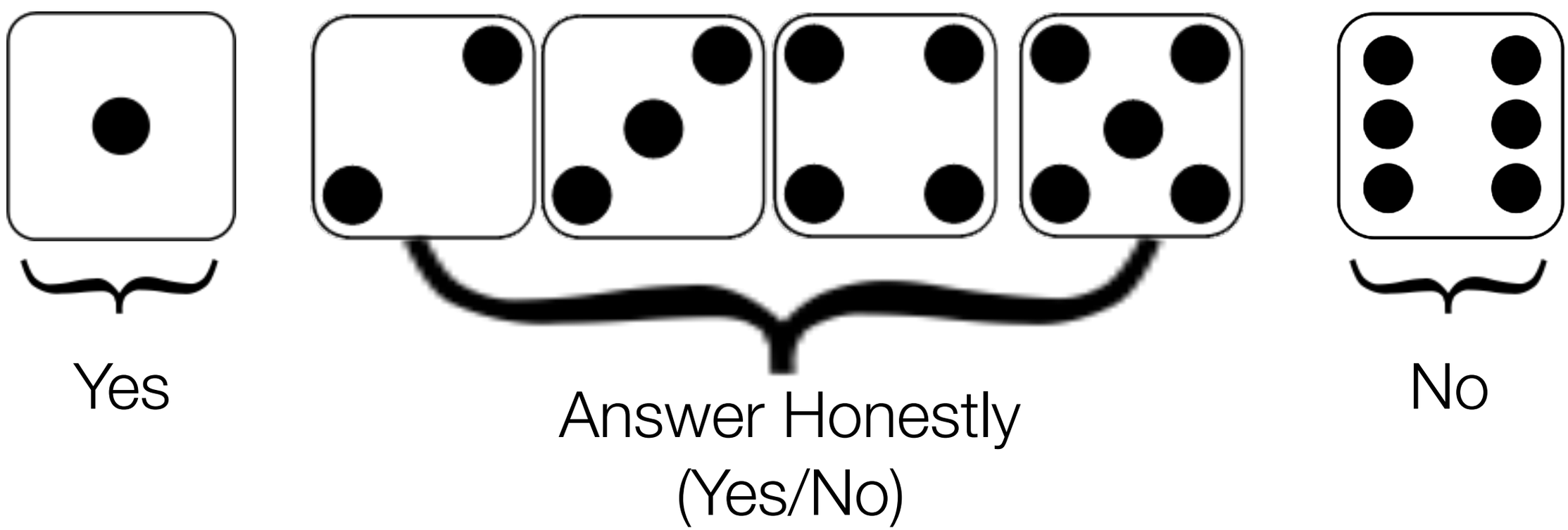
Q: In the past year, have you hunted …

A. Indirect question: Randomized Response Technique

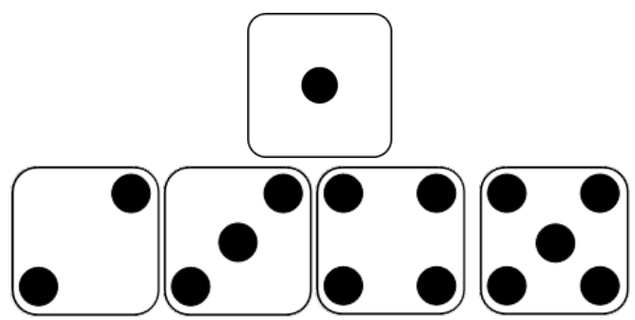
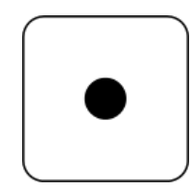
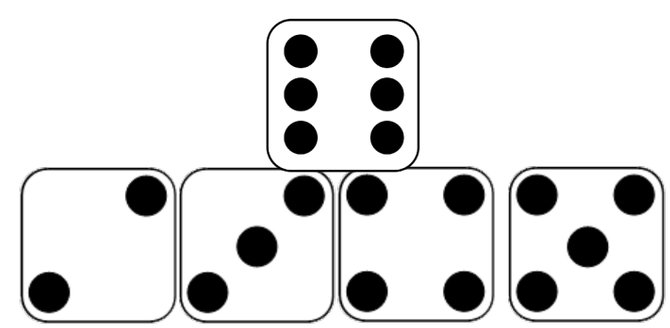
B. Direct questioning

Randomized response technique:
Forced Response

Q: Did you hunt bird *x* in the past year?

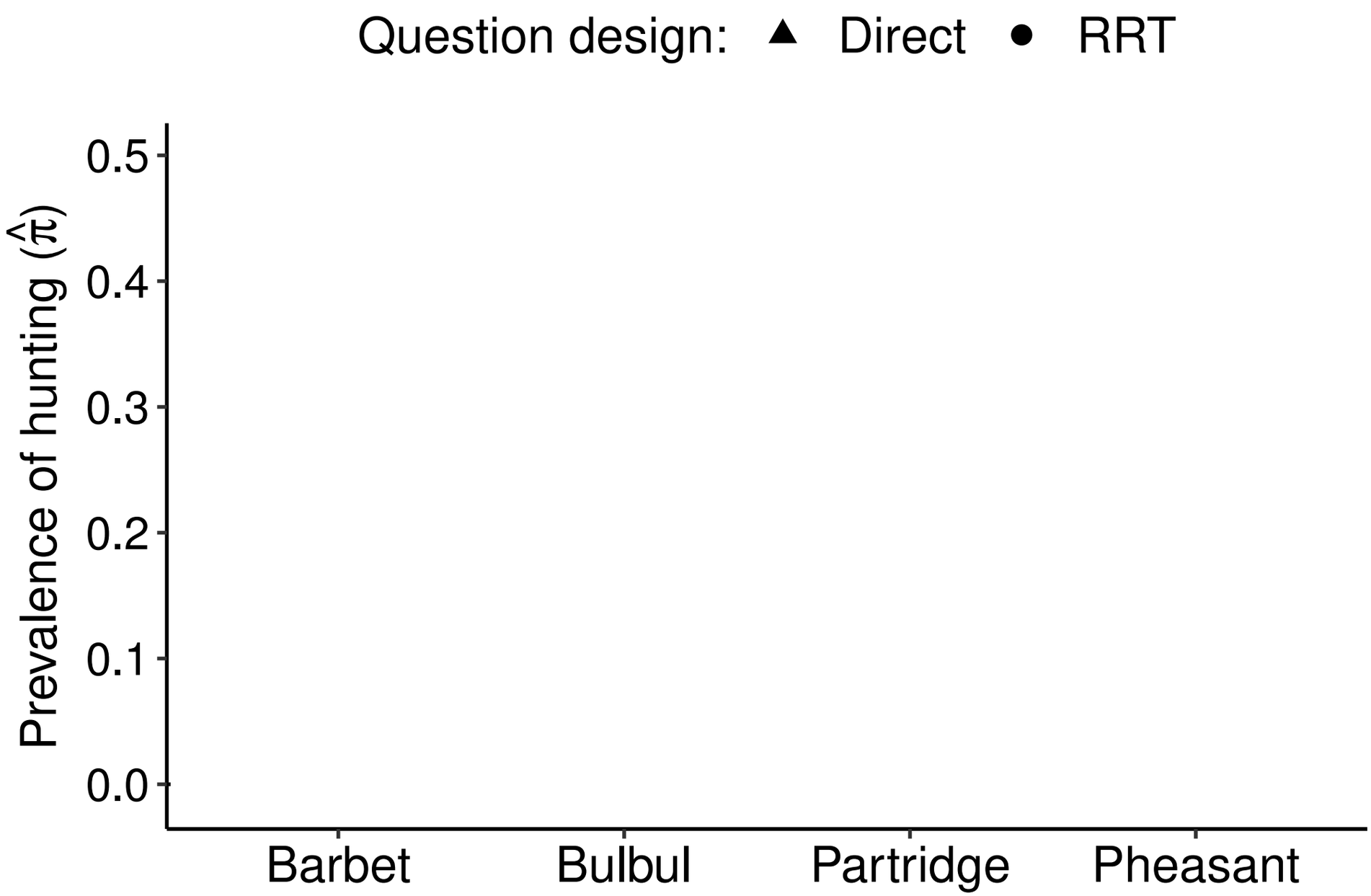


Randomized response technique:
Forced Response

True identity:		
Yes, I did hunt it.	 $p = 5/6$	 $p = 1/6$
No, I didn't.	 $p = 1/6$	 $p = 5/6$

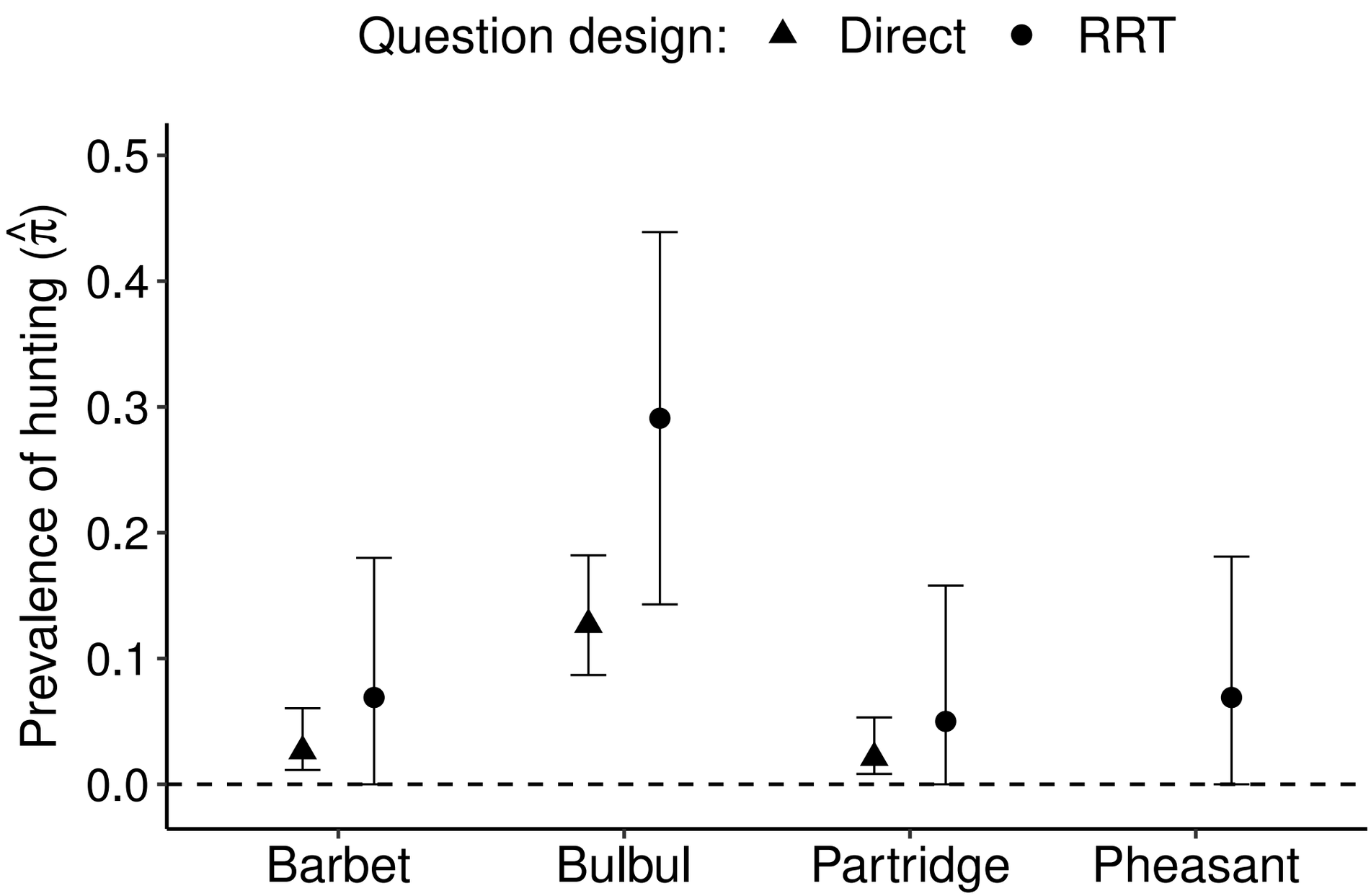
zapstR

QUANTIFYING NON-COMPLIANCE



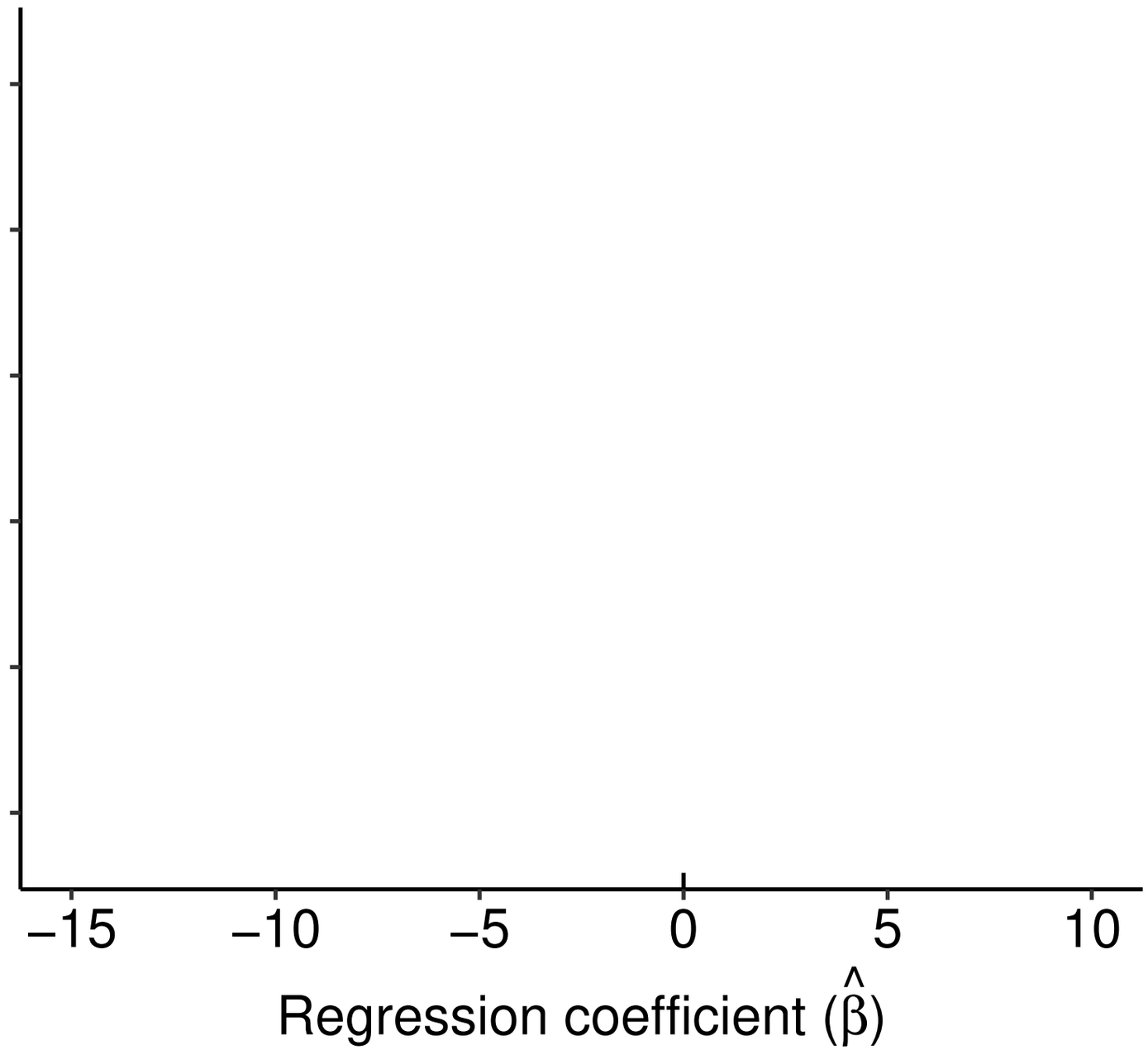
Chang *et al.* 2017, *Ecology and Society*
Chang *et al.*, *Biological Conservation (In Press)*

QUANTIFYING NON-COMPLIANCE



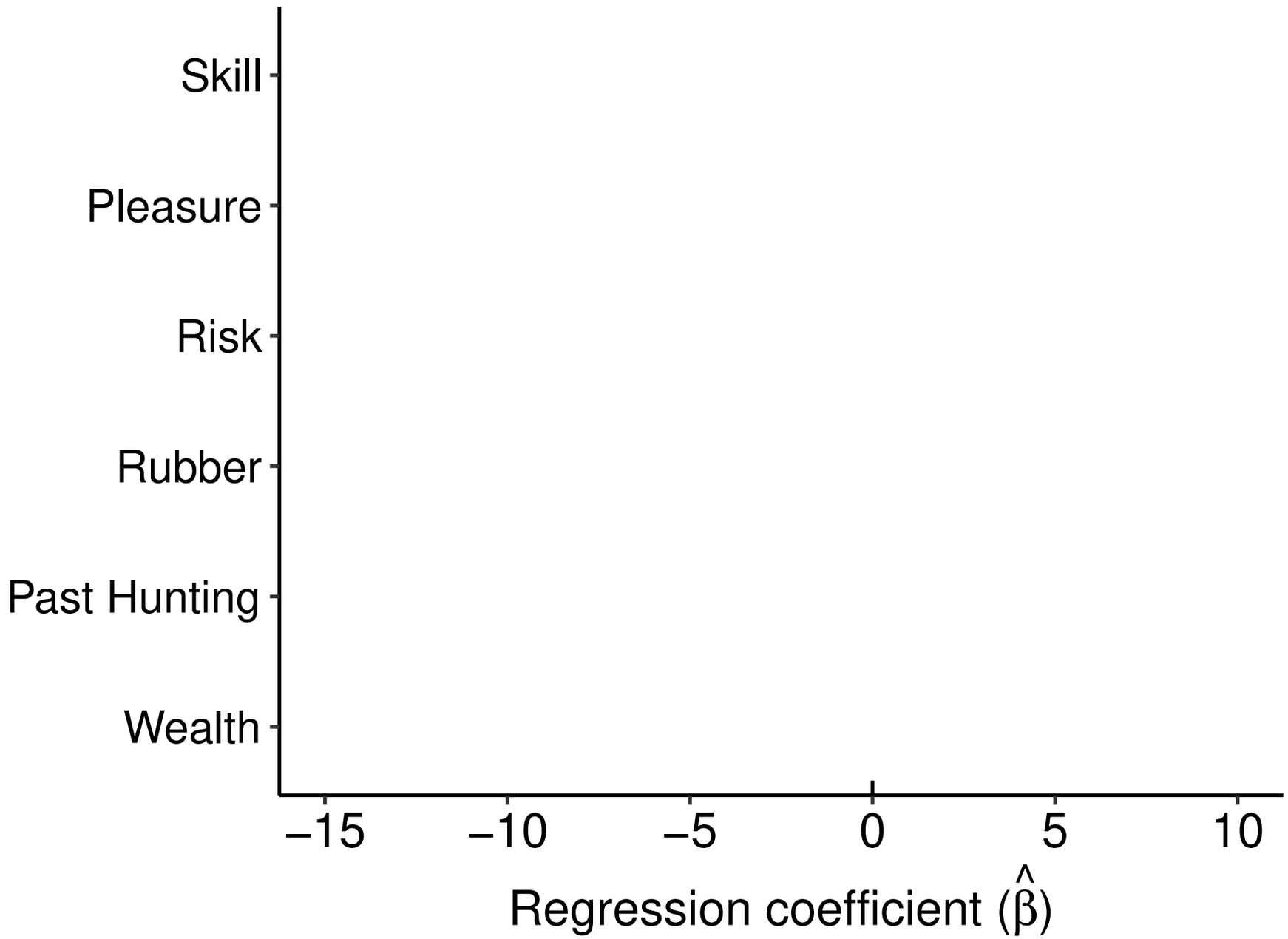
Chang *et al.* 2017, *Ecology and Society*
Chang *et al.*, *Biological Conservation (In Press)*

WHAT MAKES SOMEONE MORE LIKELY TO HUNT?



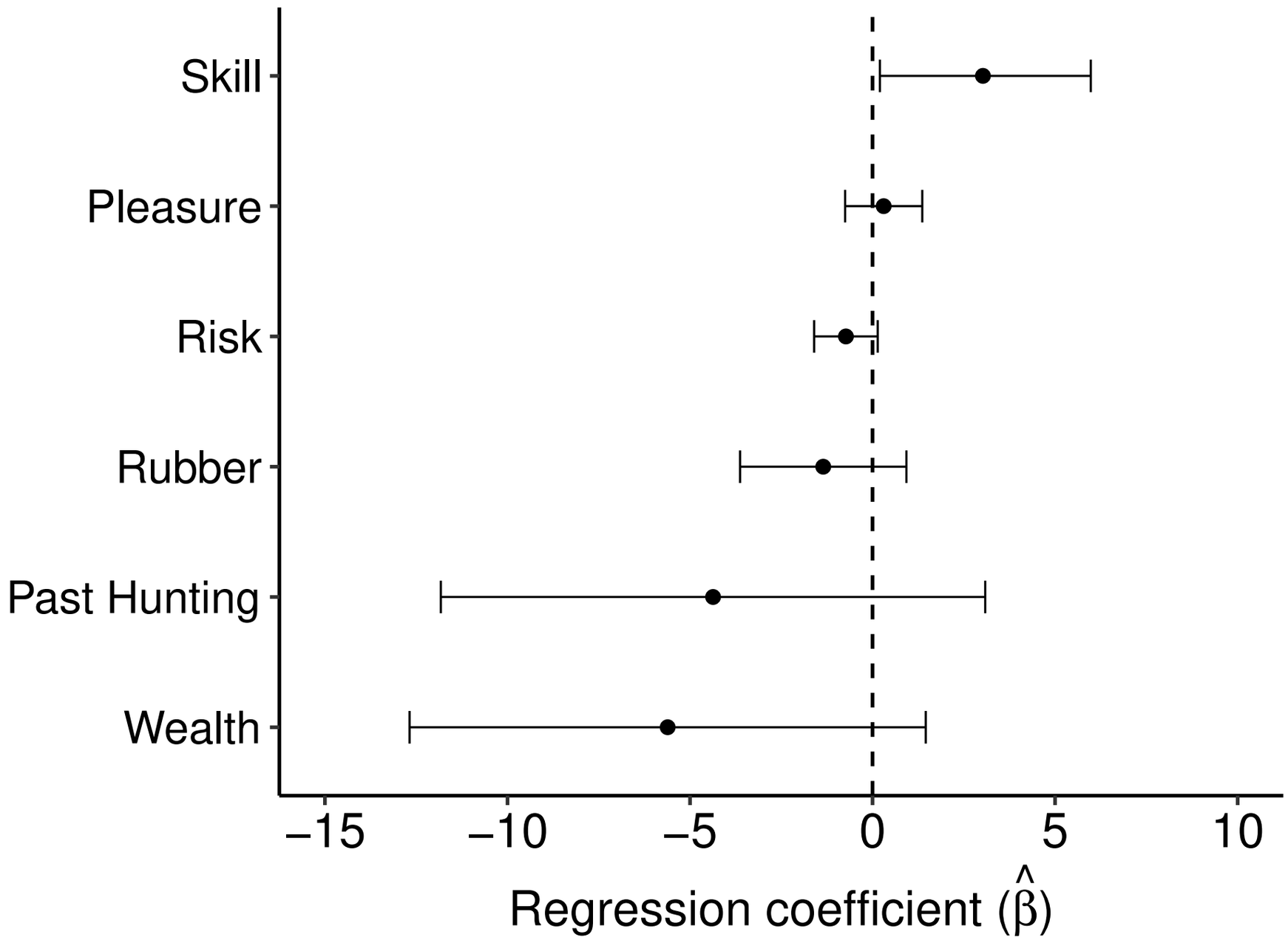
Chang *et al.* 2017, *Ecology and Society*
Chang *et al.*, *Biological Conservation (In Press)*

WHAT MAKES SOMEONE MORE LIKELY TO HUNT?



Chang *et al.* 2017, *Ecology and Society*
Chang *et al.*, *Biological Conservation (In Press)*

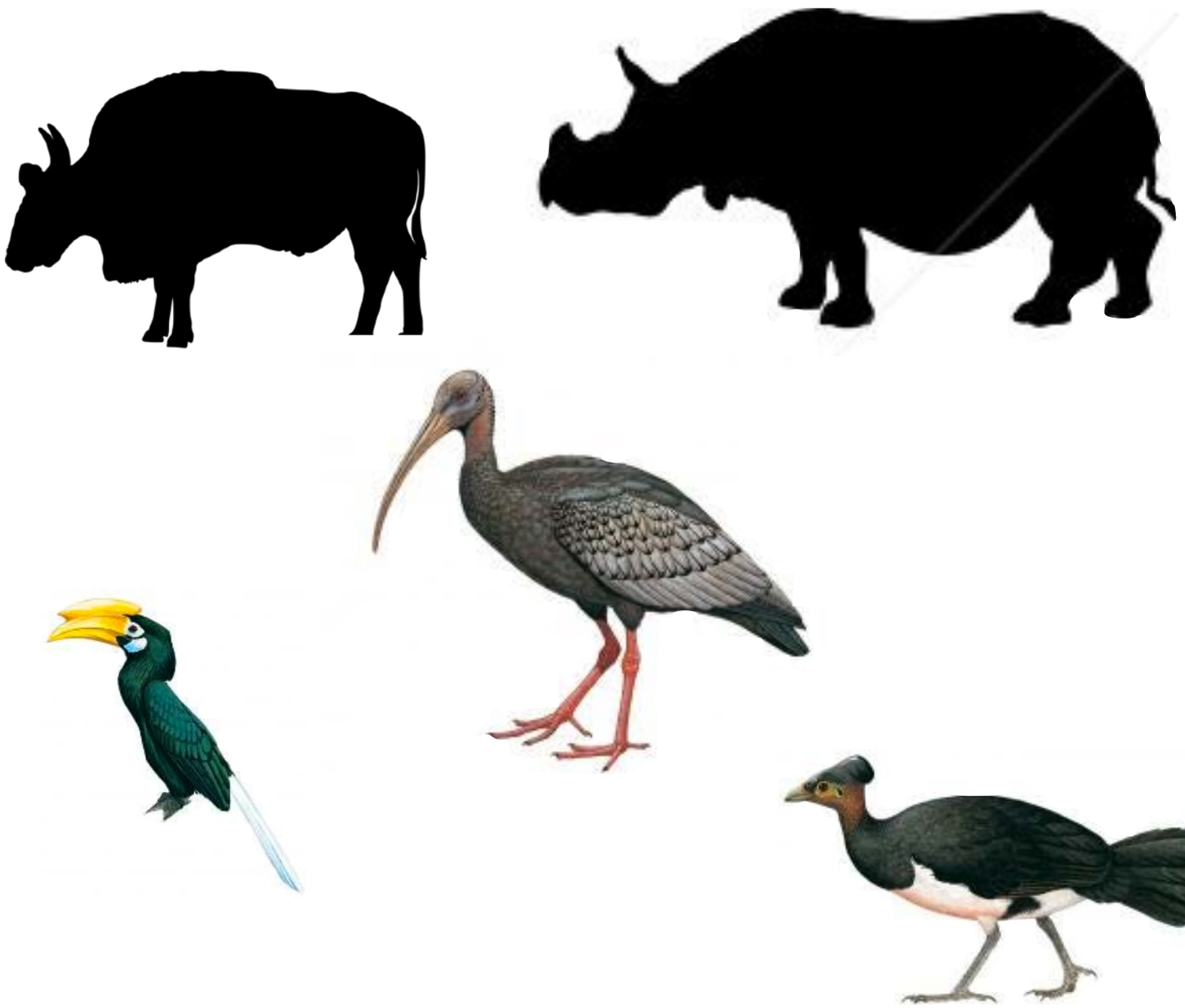
WHAT MAKES SOMEONE MORE LIKELY TO HUNT?



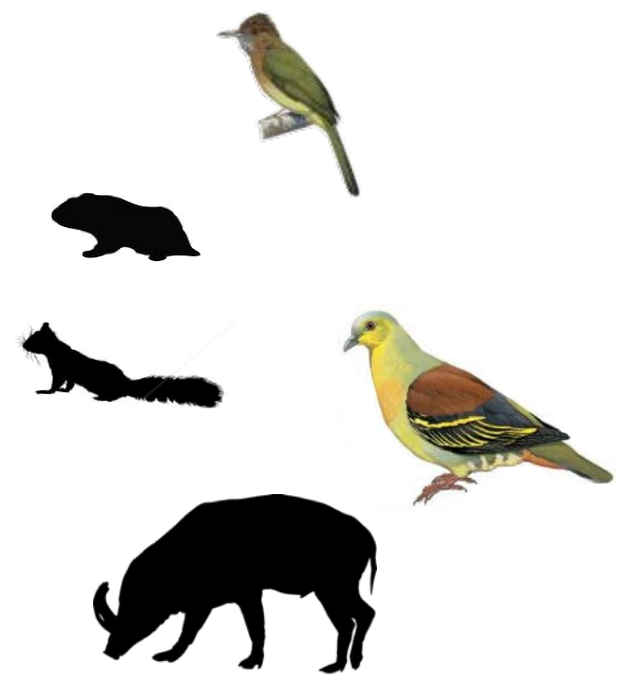
Chang *et al.* 2017, *Ecology and Society*
Chang *et al.*, *Biological Conservation (In Press)*

2: UNDERSTANDING HOW HUNTING AFFECTS COMMUNITIES

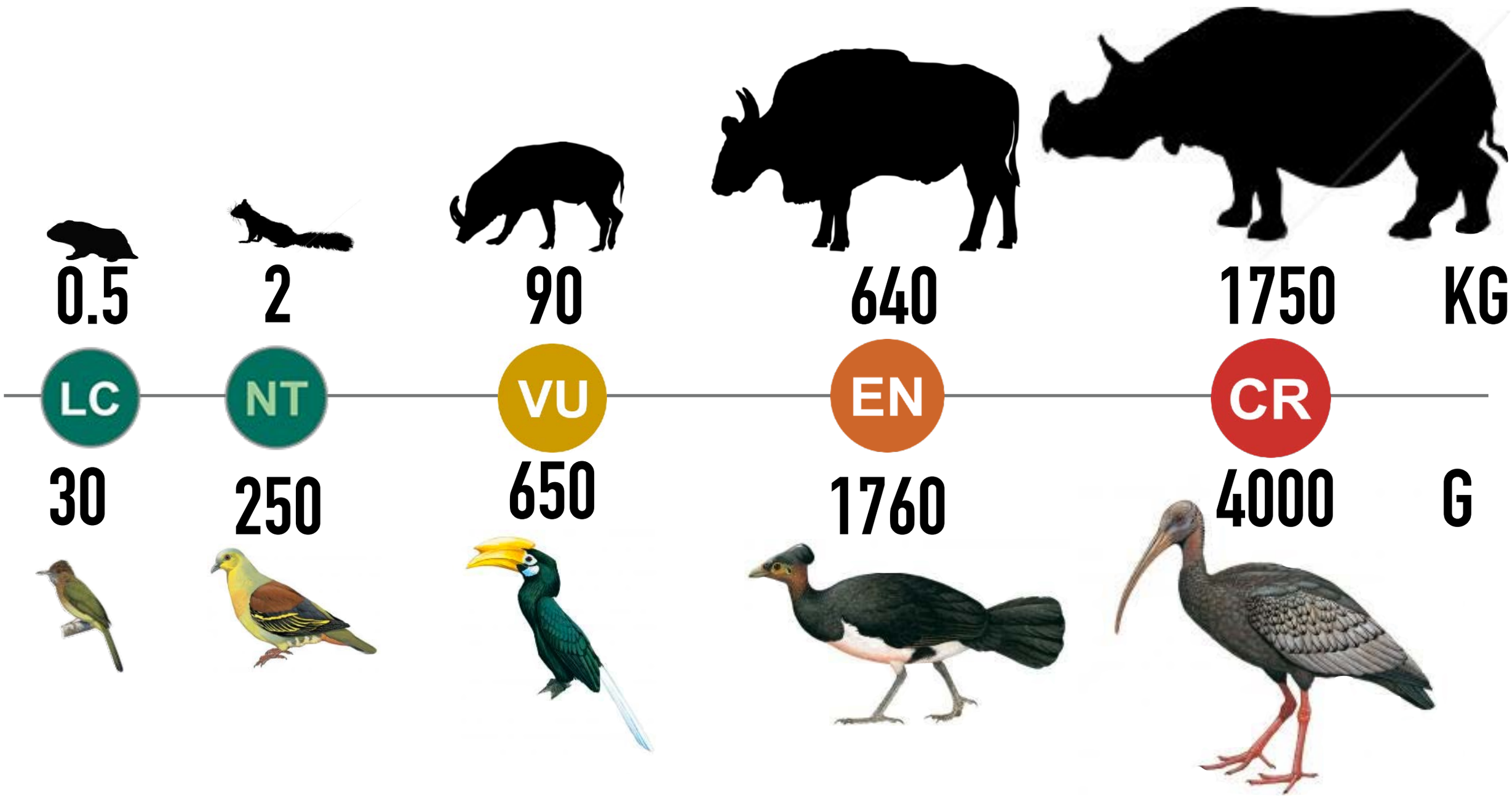
Hunted



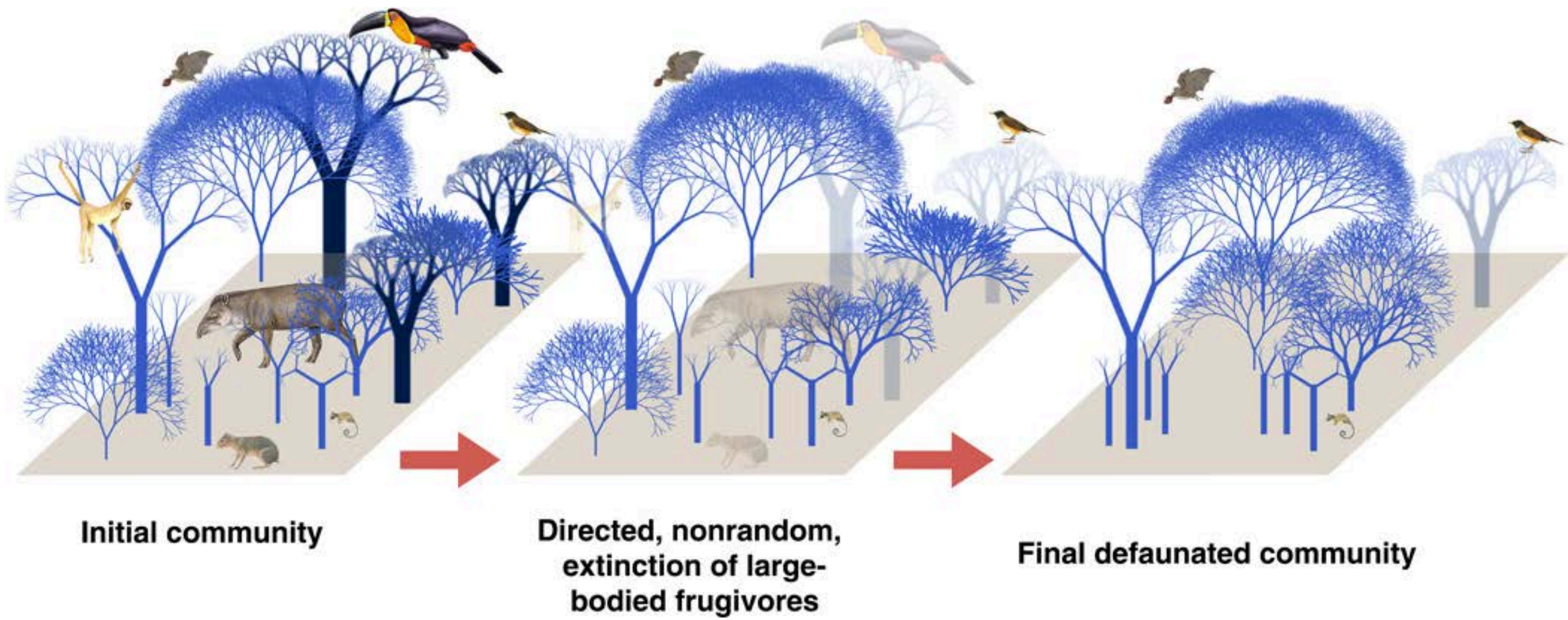
Not Hunted



MEGAFAUNA AT RISK

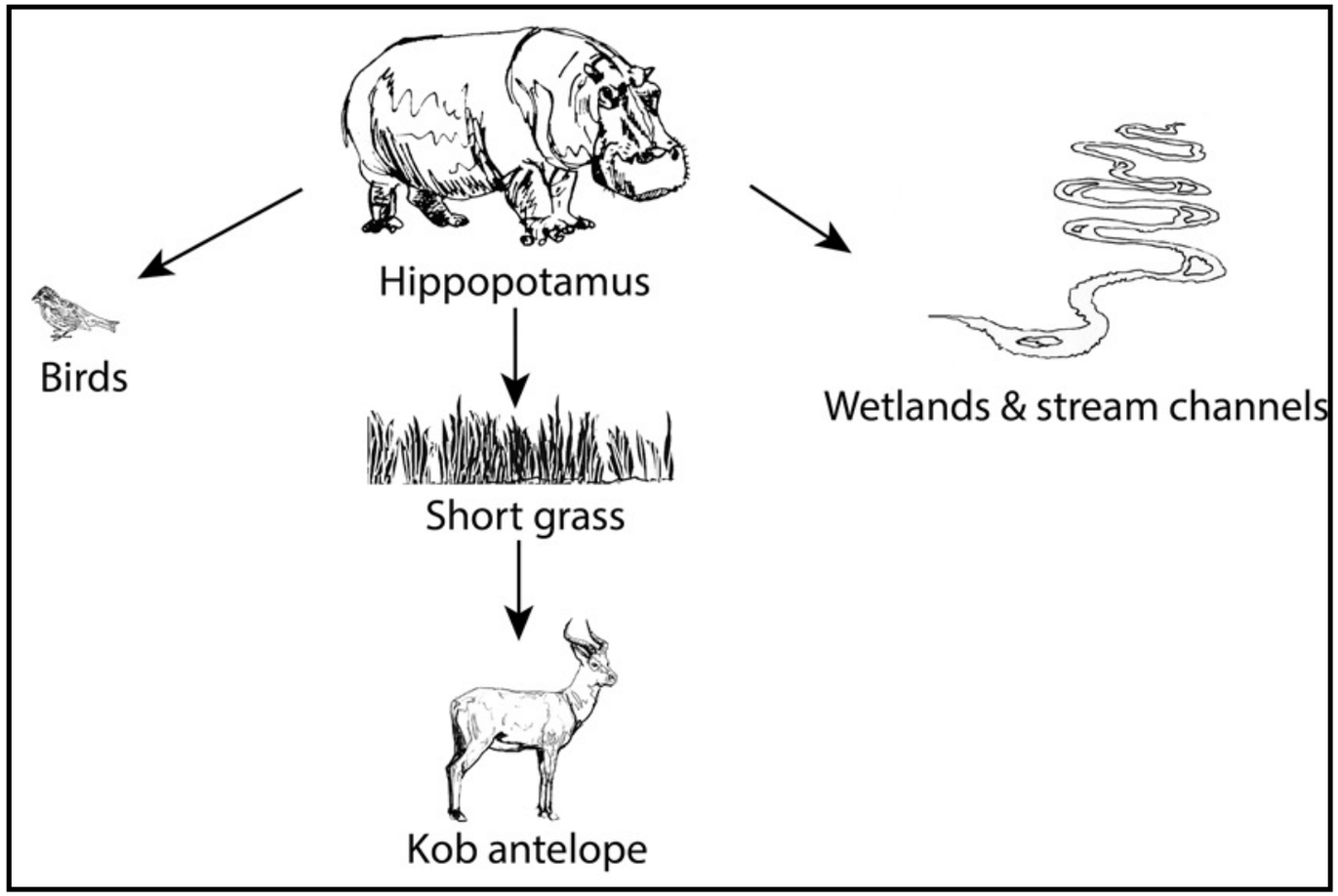


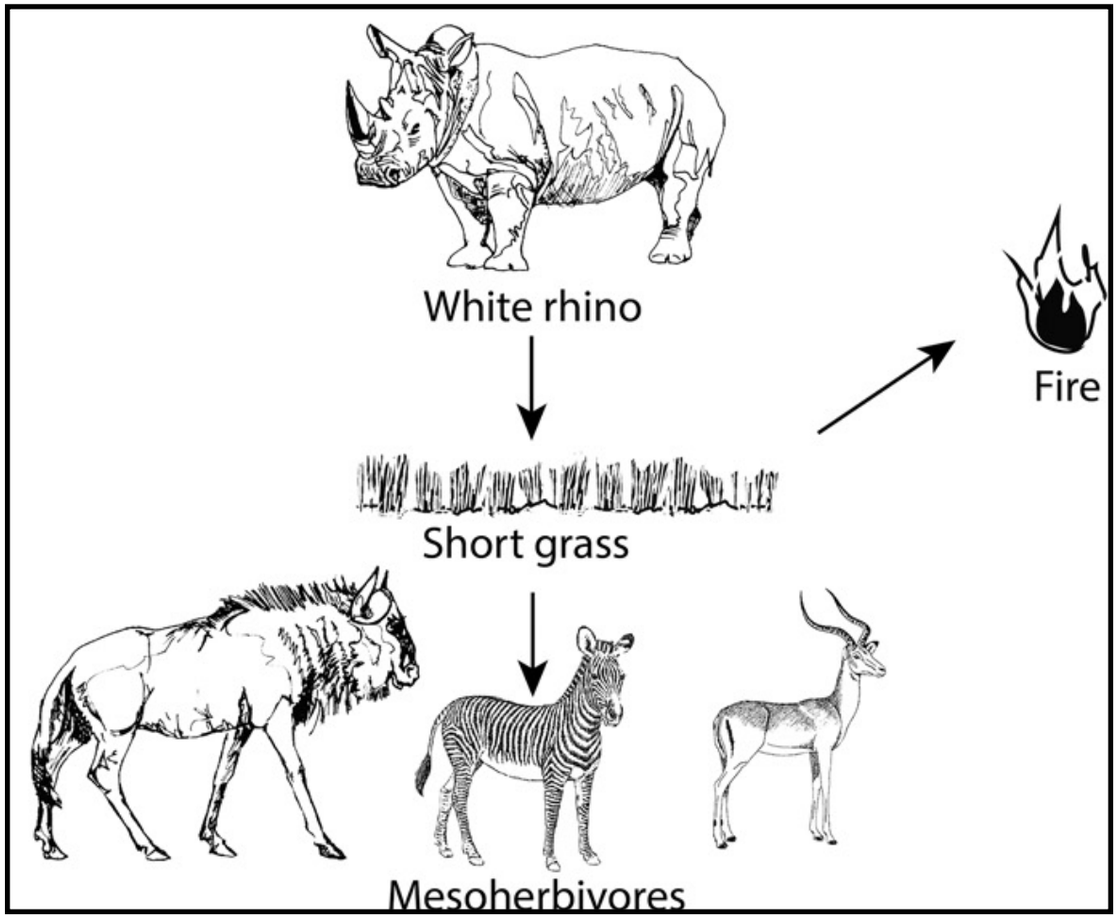
DECLINING ECOLOGICAL FUNCTION



Bello *et al*. 2015, *Sci. Adv.*

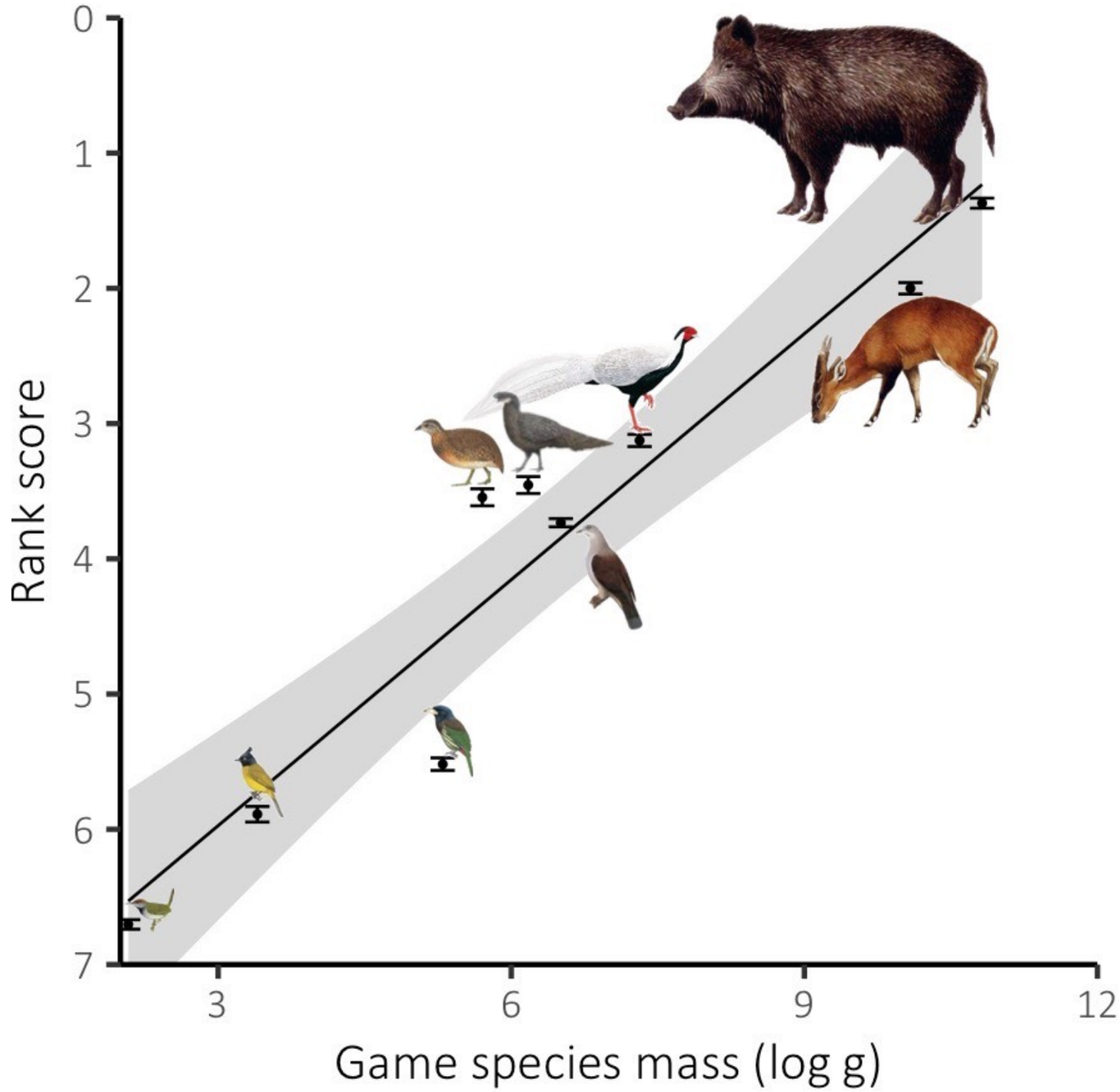
DECLINING ECOLOGICAL FUNCTION



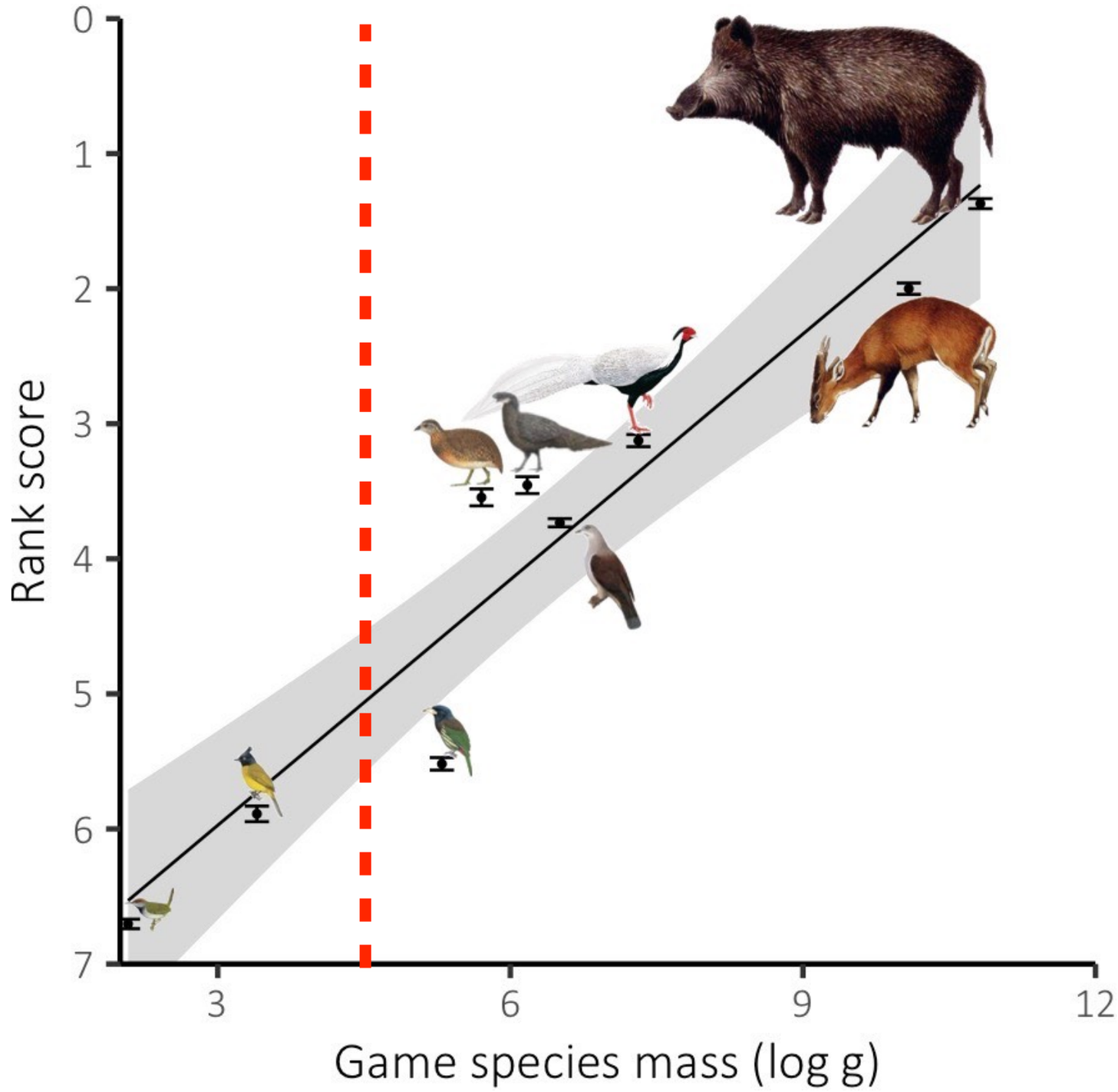


Ripple *et al.* 2016, *Sci. Adv.*

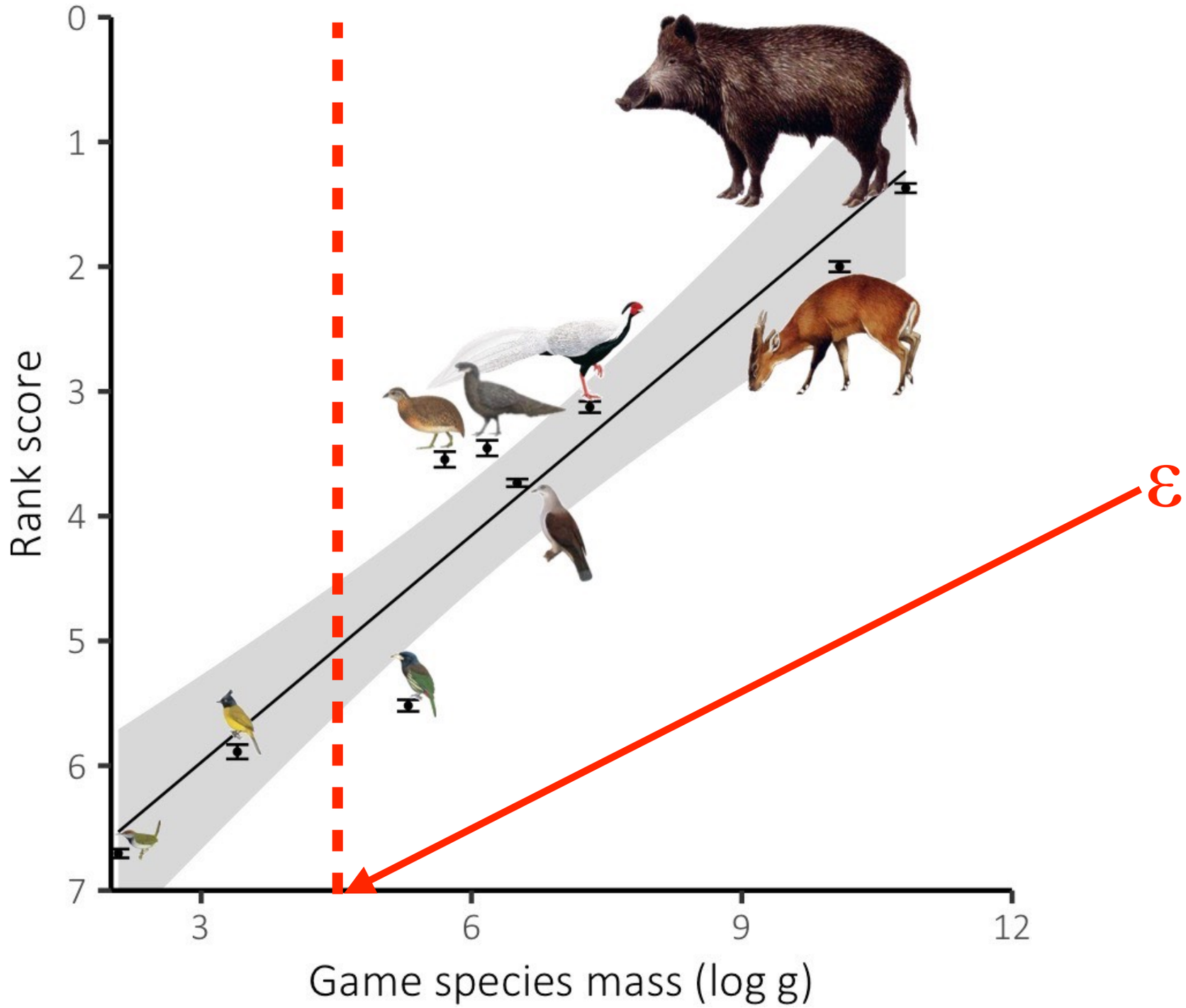
SIMPLIFYING TO A TRAIT: BODY MASS



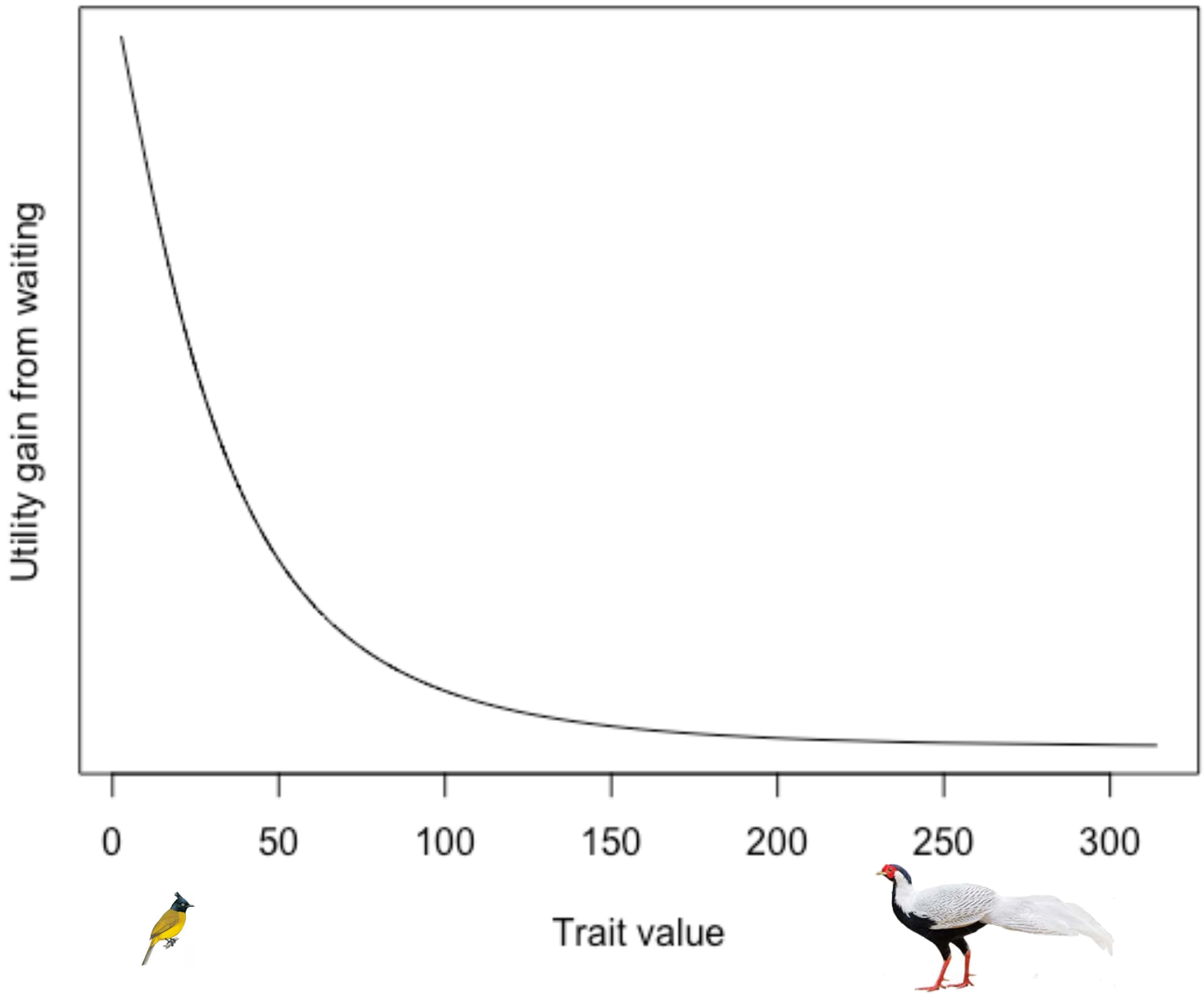
SIMPLIFYING TO A TRAIT: BODY MASS



SIMPLIFYING TO A TRAIT: BODY MASS

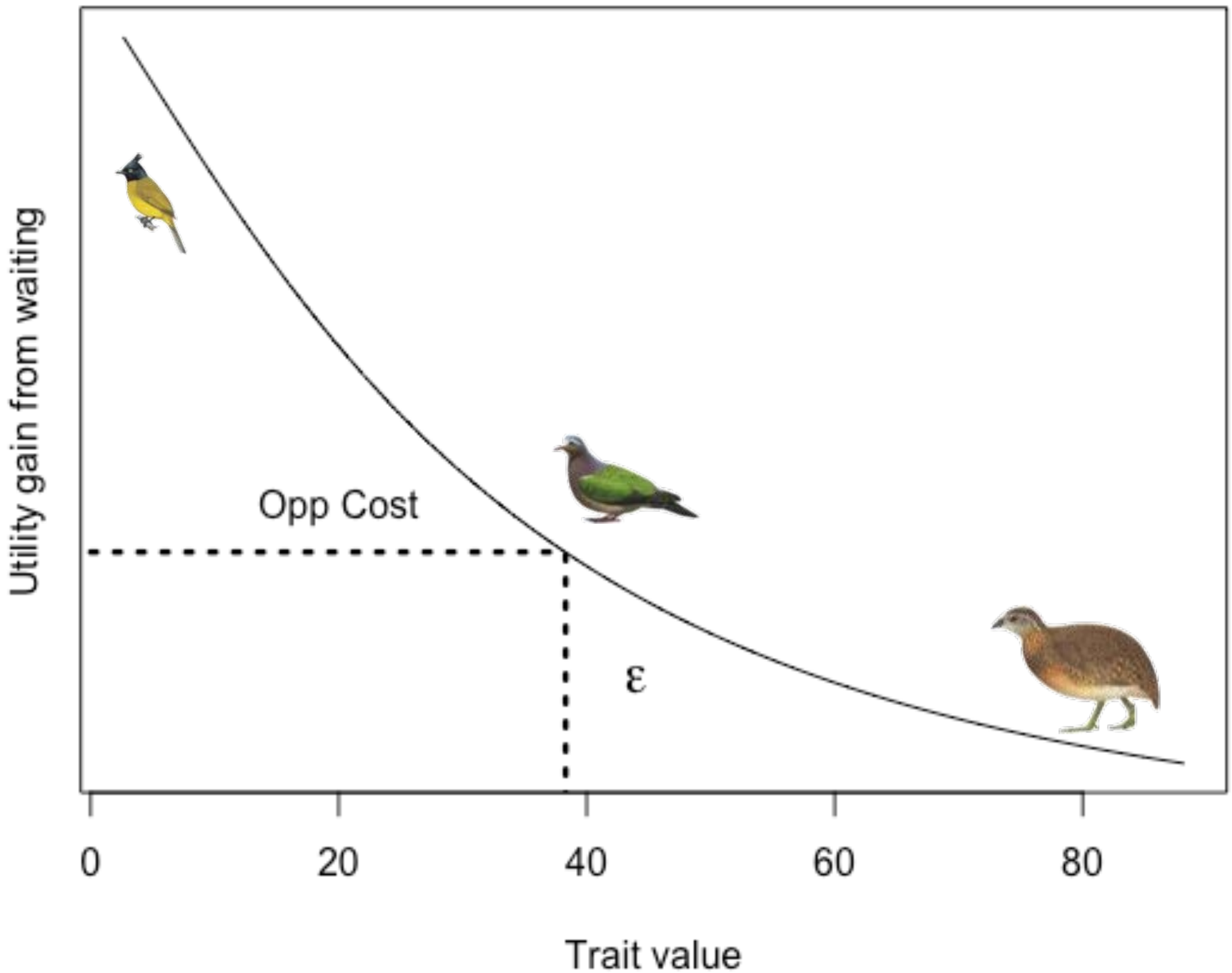


DERIVING HUNTER TARGET THRESHOLDS (ε)

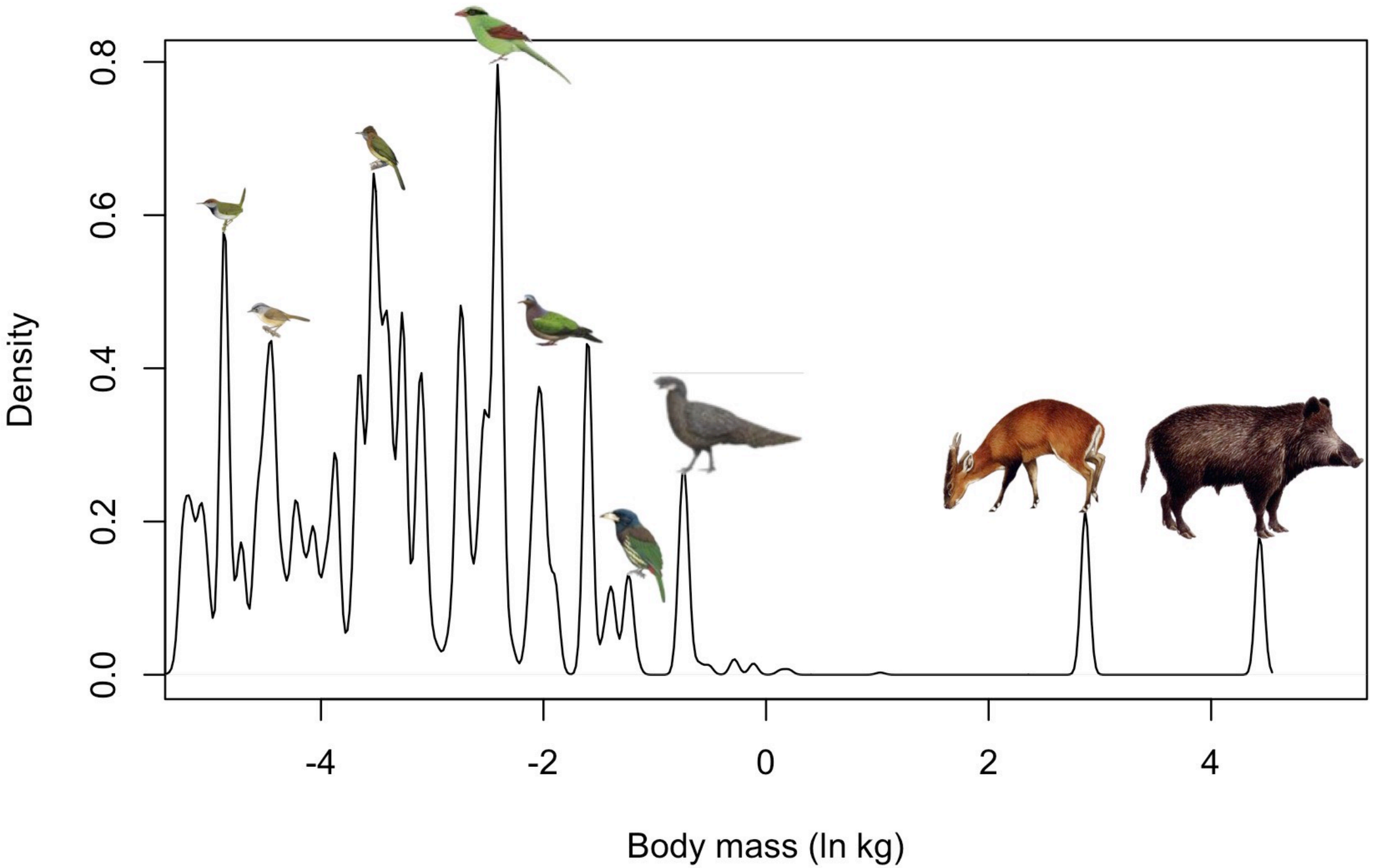


Lippmann and McCall 1976; Diekert *et al.* 2016

DERIVING TARGET THRESHOLDS (ε)

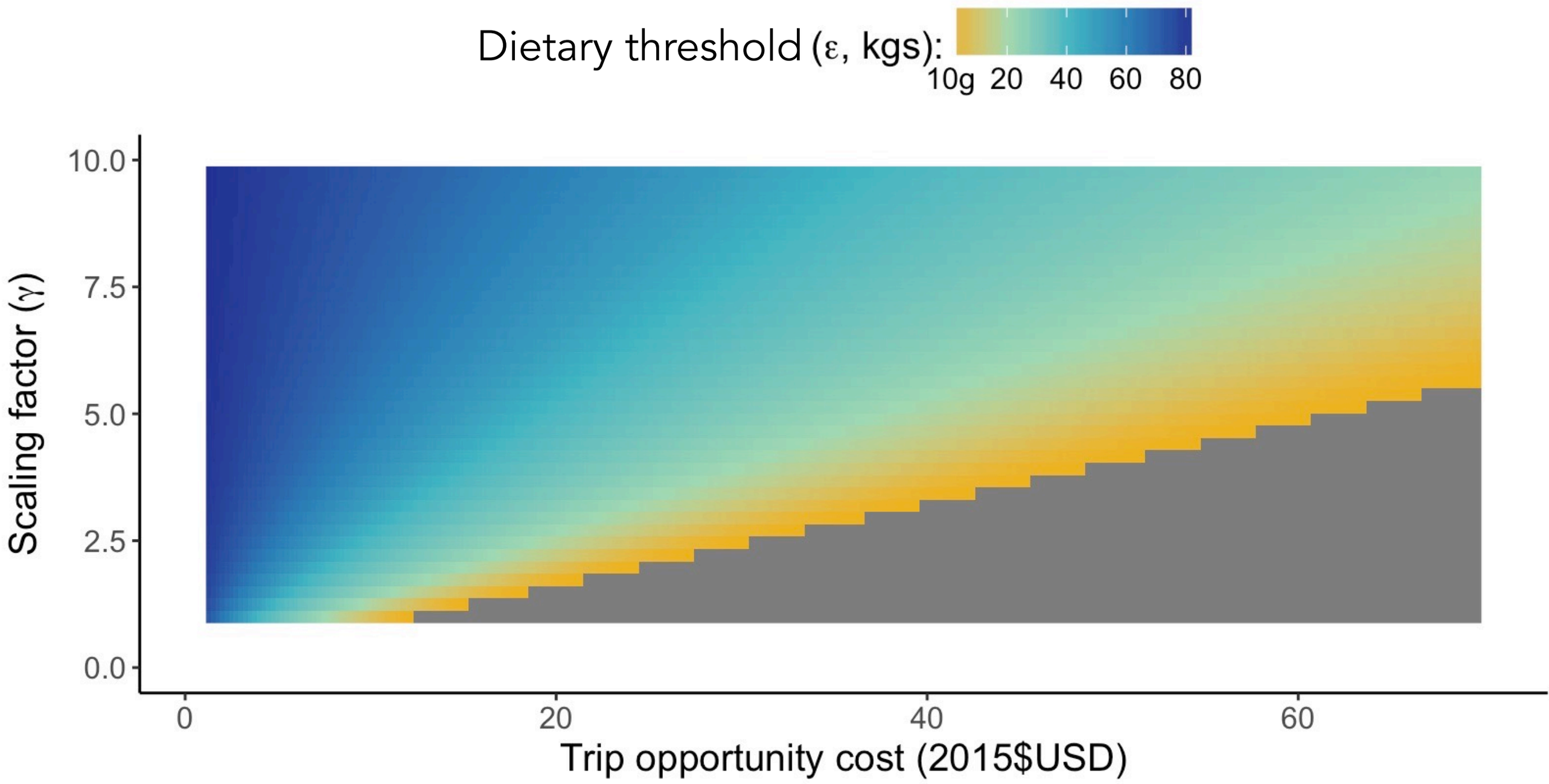


PREY TRAIT DENSITY IN CHINA



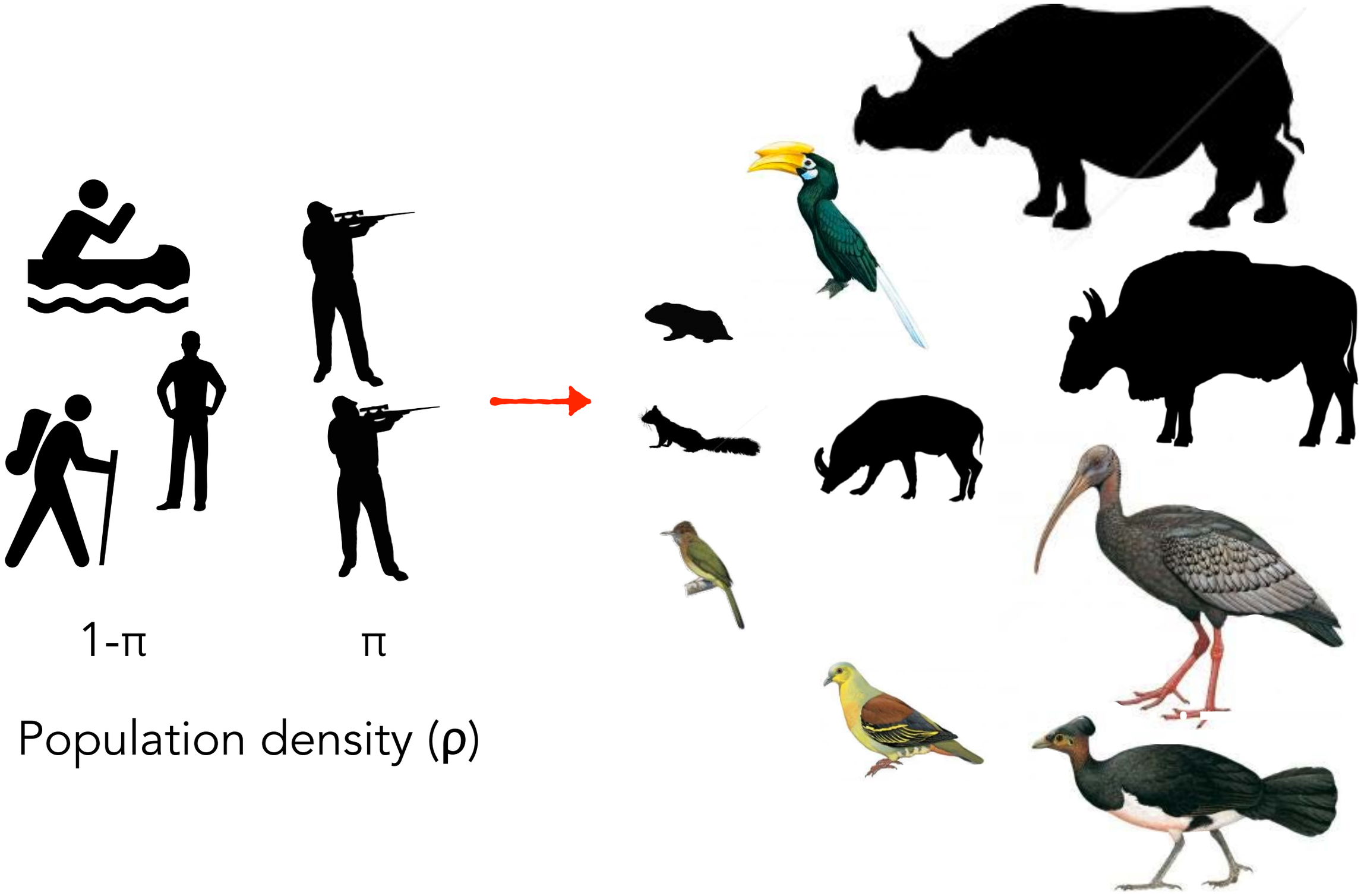
Chang & Drohan 2018, *Ecological Applications*

DIETARY THRESHOLDS IN SOUTHWEST CHINA



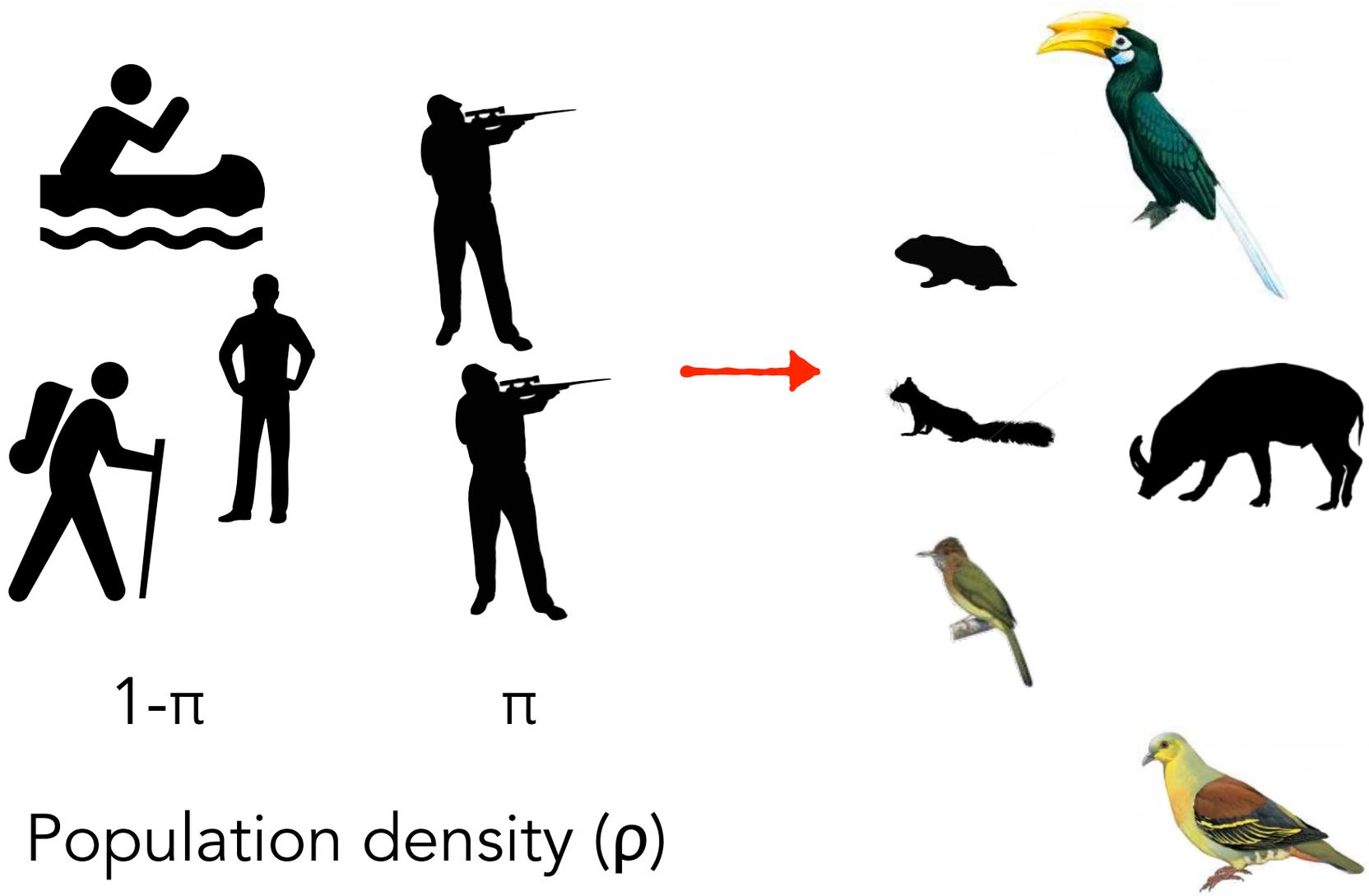
Chang & Drohan 2018, *Ecological Applications*

3: PROJECTING HUNTING IMPACTS

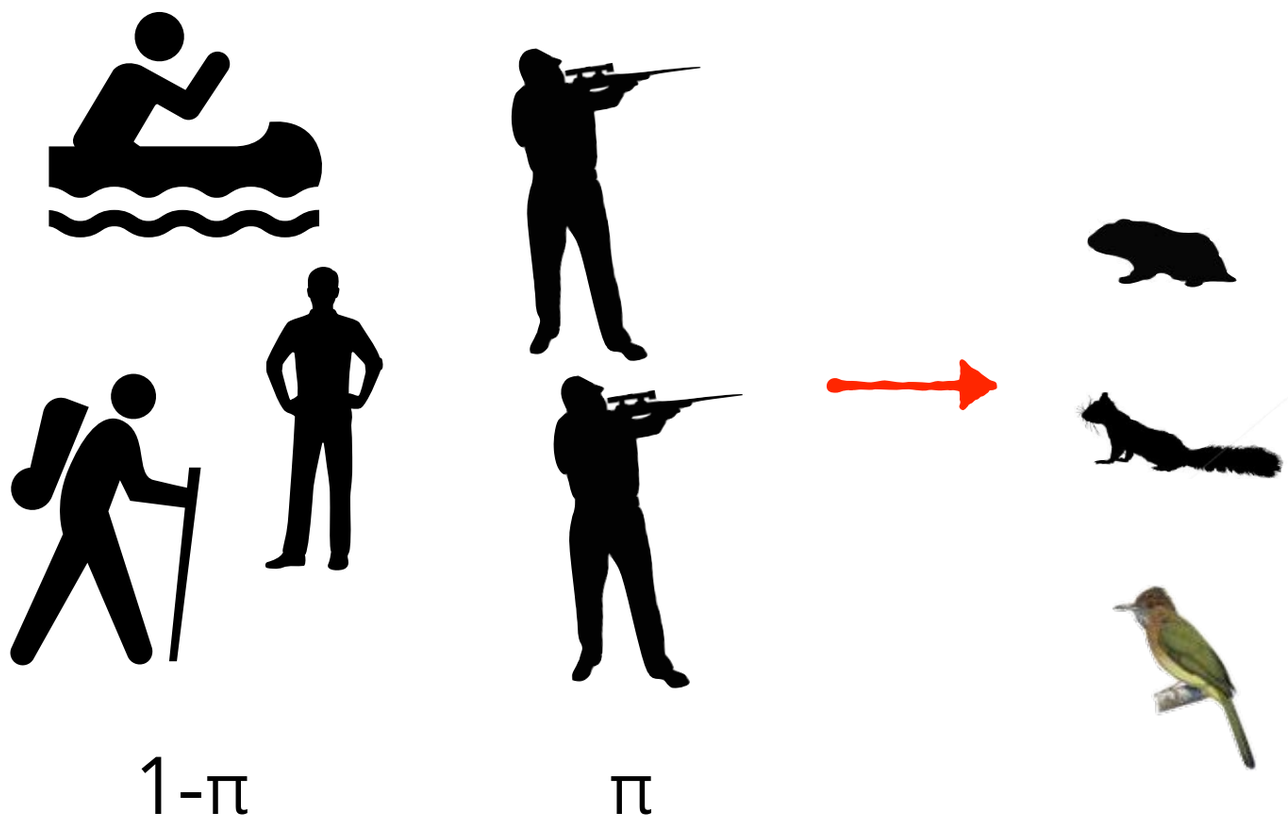


Population density (ρ)

3: PROJECTING HUNTING IMPACTS

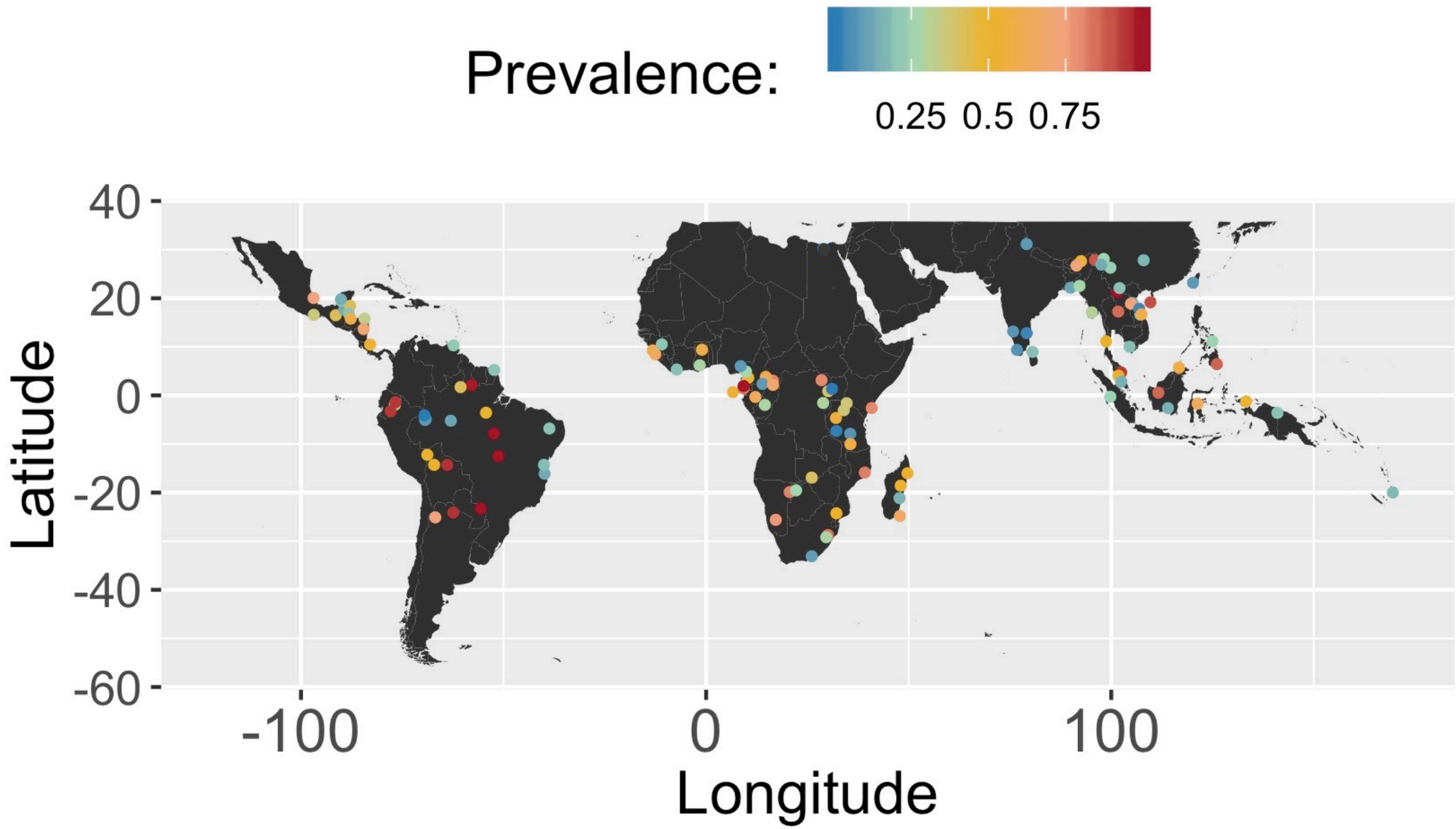


3: PROJECTING HUNTING IMPACTS



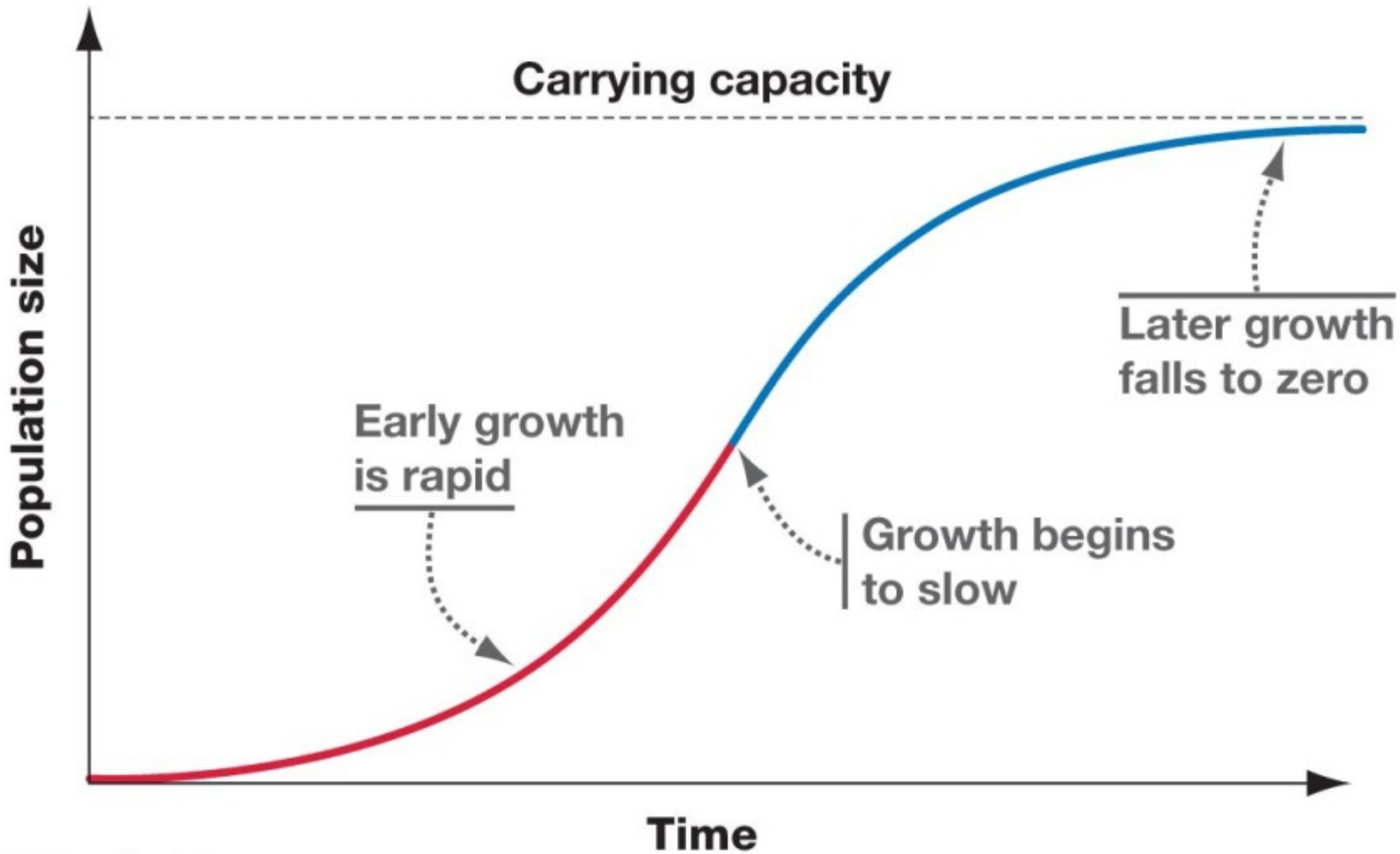
Population density (ρ)

3: A GLOBAL SYNTHESIS OF HUNTING



Chang, Burgess, & Giam, *In prep.*

PROJECTING IMPACTS: POPULATION DYNAMICS



POPULATION DYNAMICS: LOGISTIC GROWTH

Rate of change for N

Max per-capita population growth rate

$$\frac{dN}{dt} = r_{max}\, N\, (1 - \frac{N}{K})$$

Carrying capacity

POPULATION DYNAMICS WITH HARVESTING

$$\frac{dN}{dt} = r_{max}\, N\, (1 - \frac{N}{K}) - H\, N$$

Hunting removal

Prevalence of hunting

$$H = \rho\, \pi\, m$$

Human population density

Per-hunter per-capita mortality rate

CONDITIONS FOR EXTINCTION

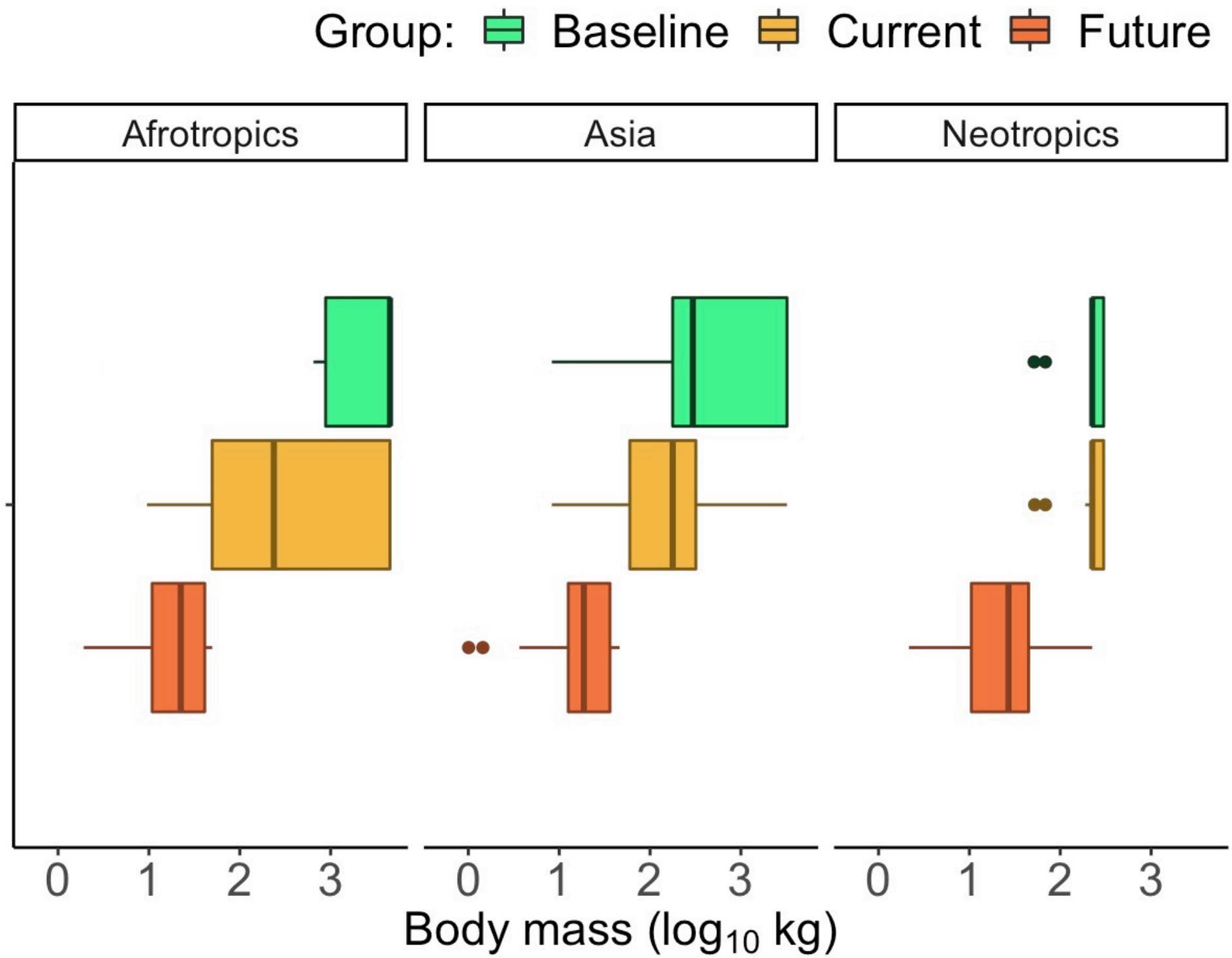
$$r_{max} < H$$

$$r_{max} = \alpha \, BM^{-\beta}$$

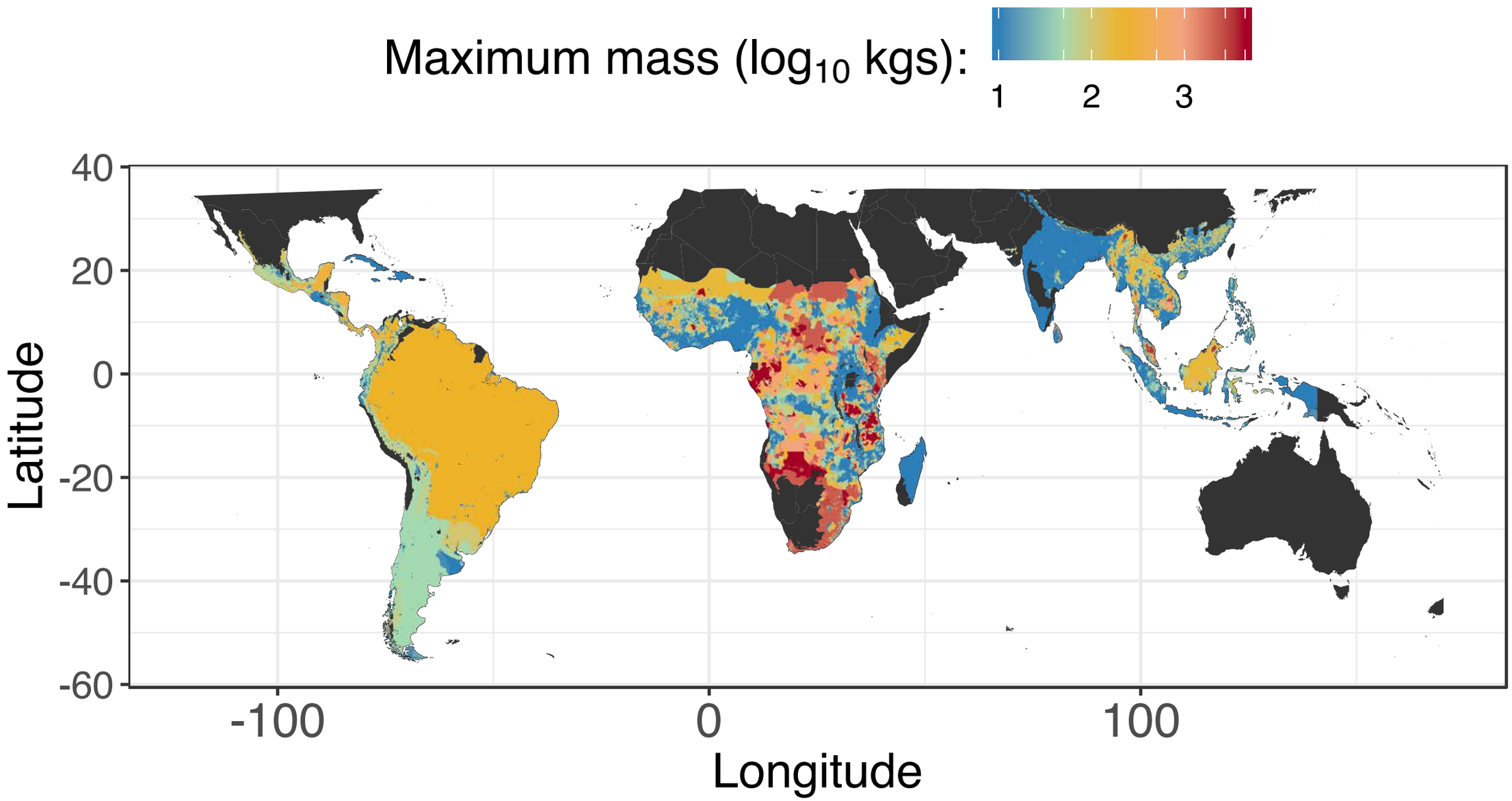
Allometric scaling intercept

Scaling exponent

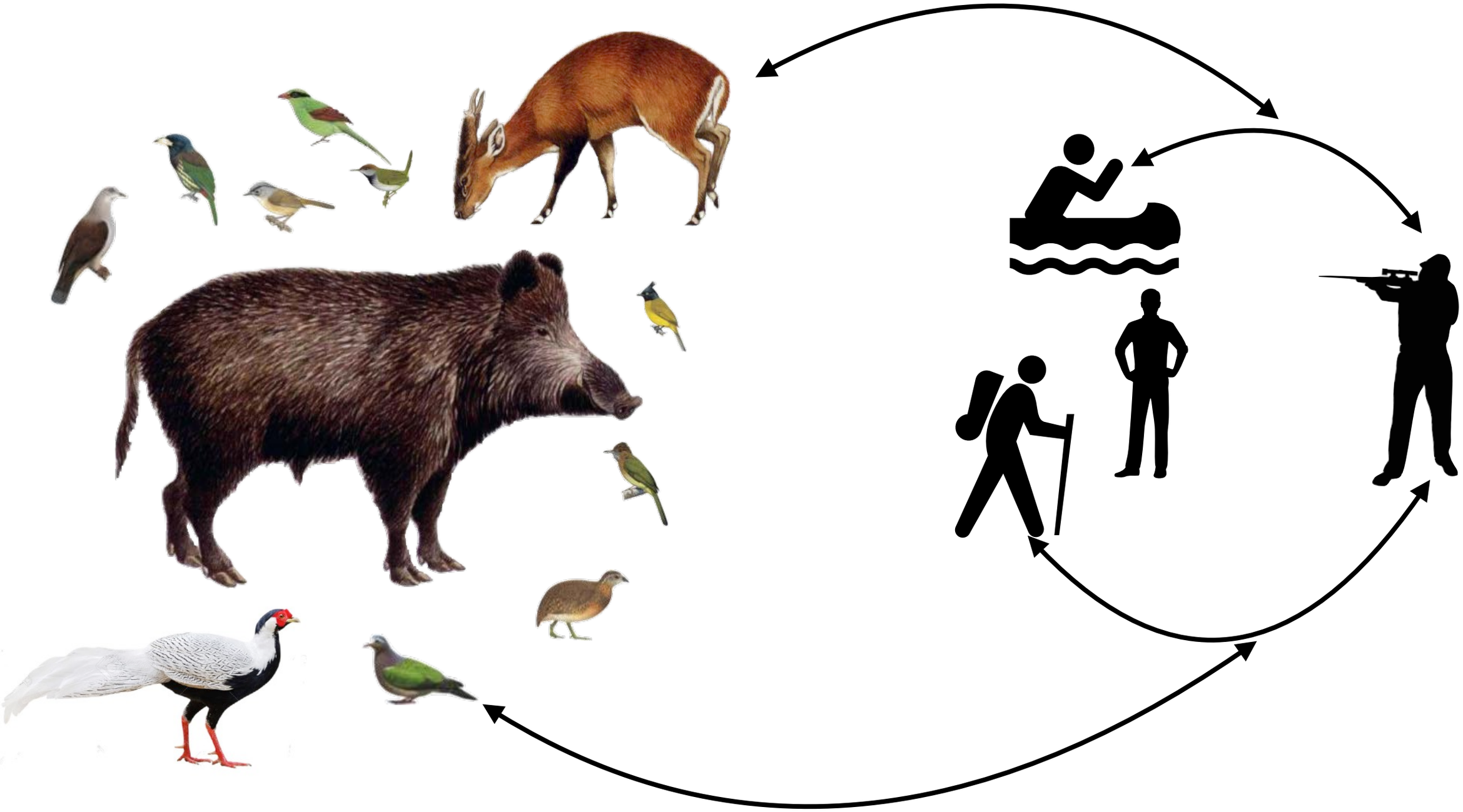
CONTEMPORARY HUNTING AND FUTURE SIZE STRUCTURE



MEGAFAUNA IN TROUBLE



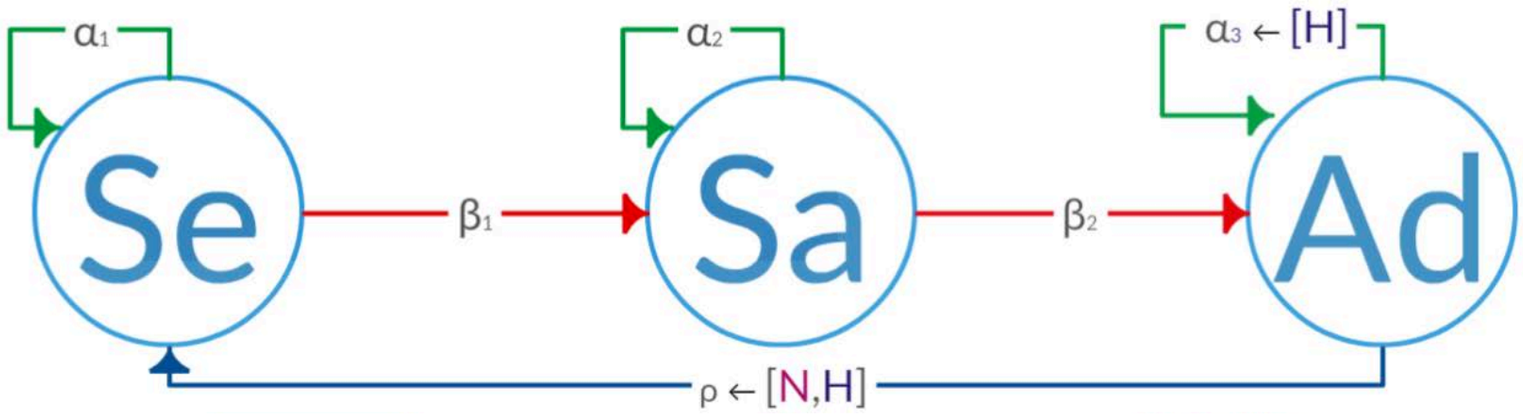
4: IMPROVING MANAGEMENT



MANAGEMENT UNDER UNCERTAINTY

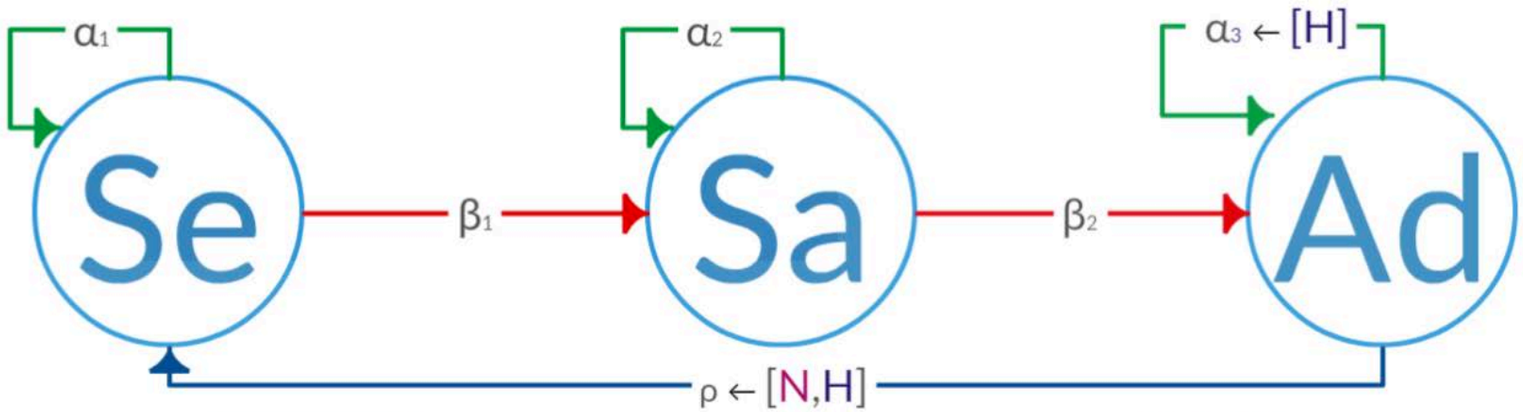
Abbasi, de Angeli, Gan, Giam, & Chang, *In prep*

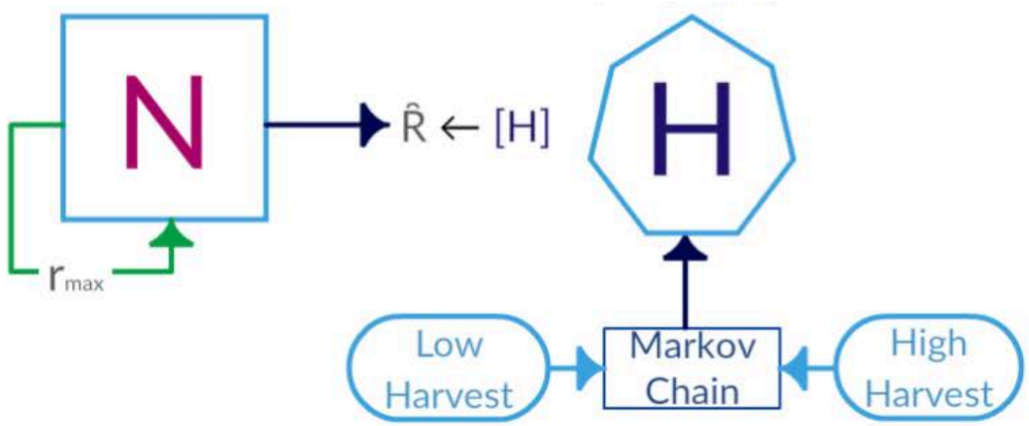
SIMULATION MODEL



Abbasi, de Angeli, Gan, Giam, & Chang, *In prep*

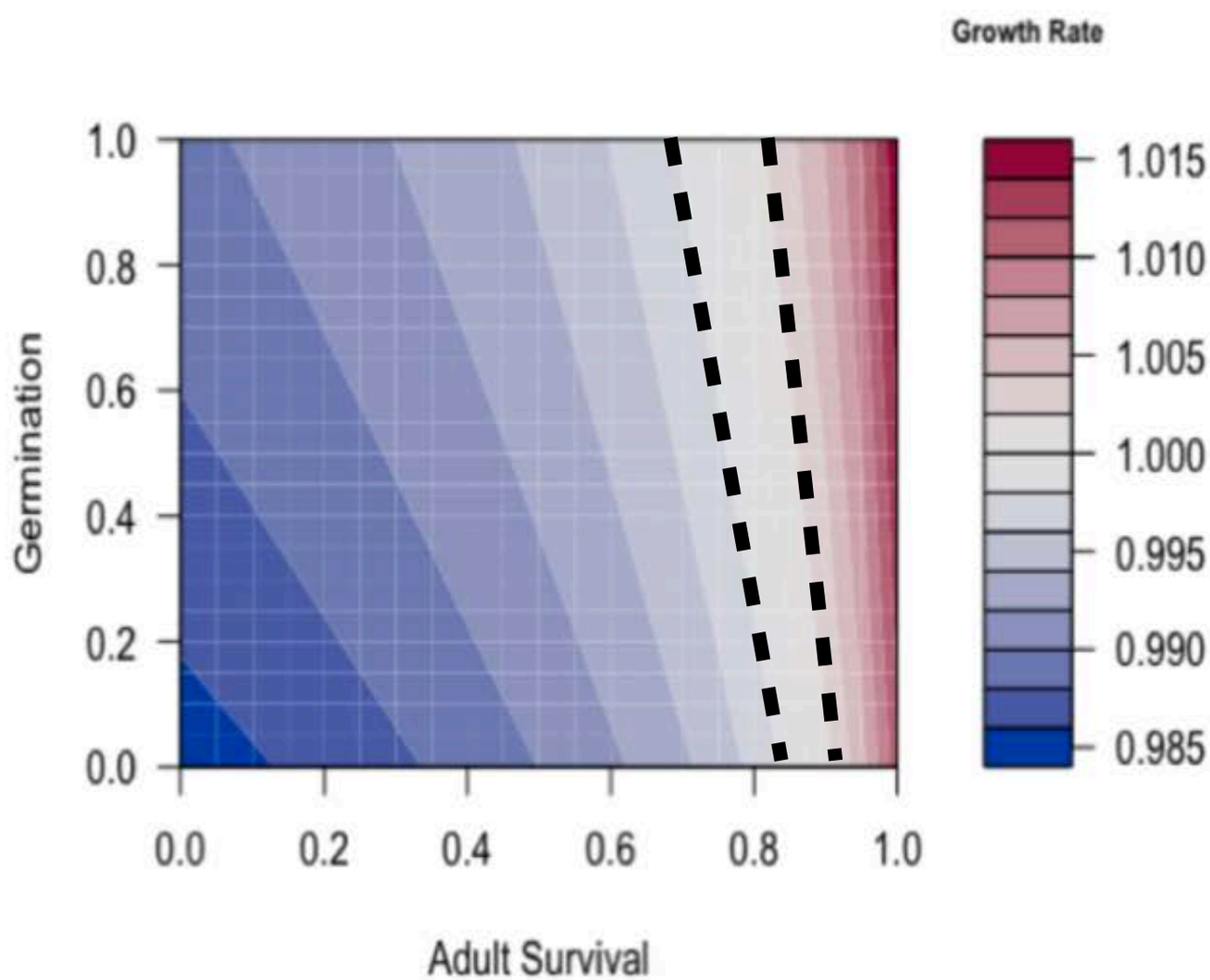
SIMULATION MODEL

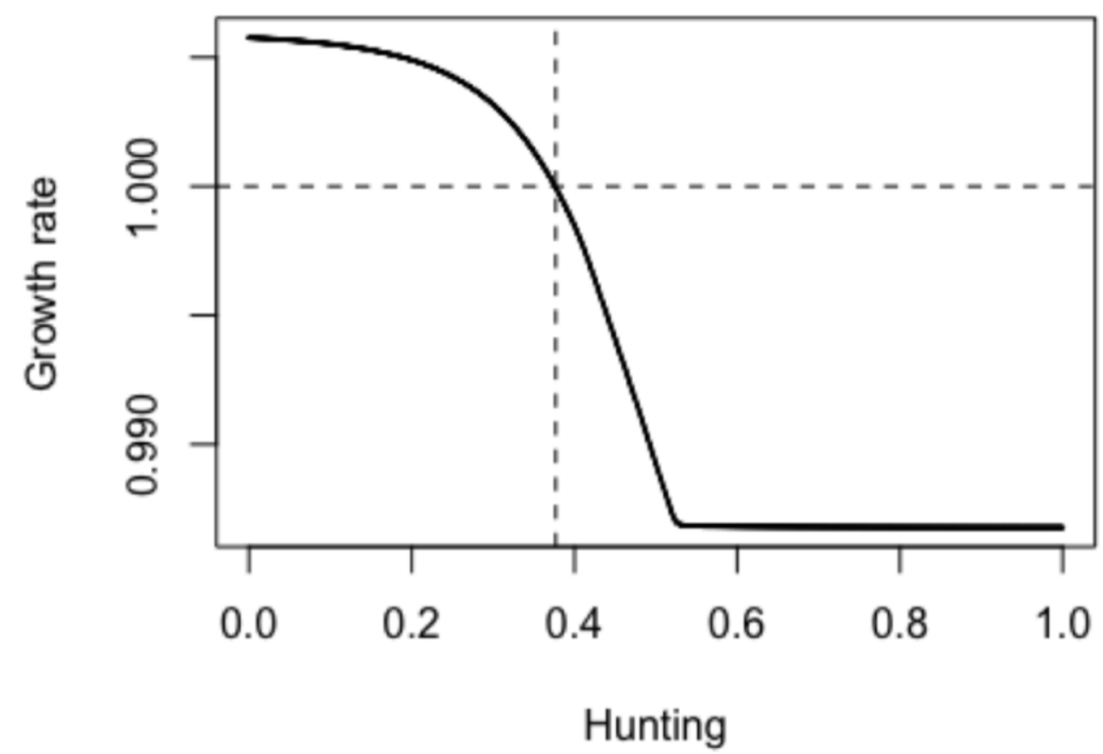




Abbasi, de Angeli, Gan, Giam, & Chang, *In prep*

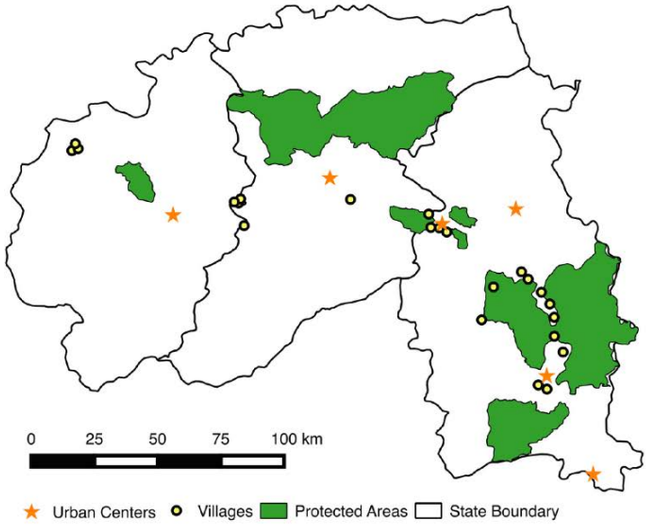
A TOOL FOR MANAGING INTERACTING SPECIES UNDER HARVEST





https://github.com/NIMBioSsreSPA

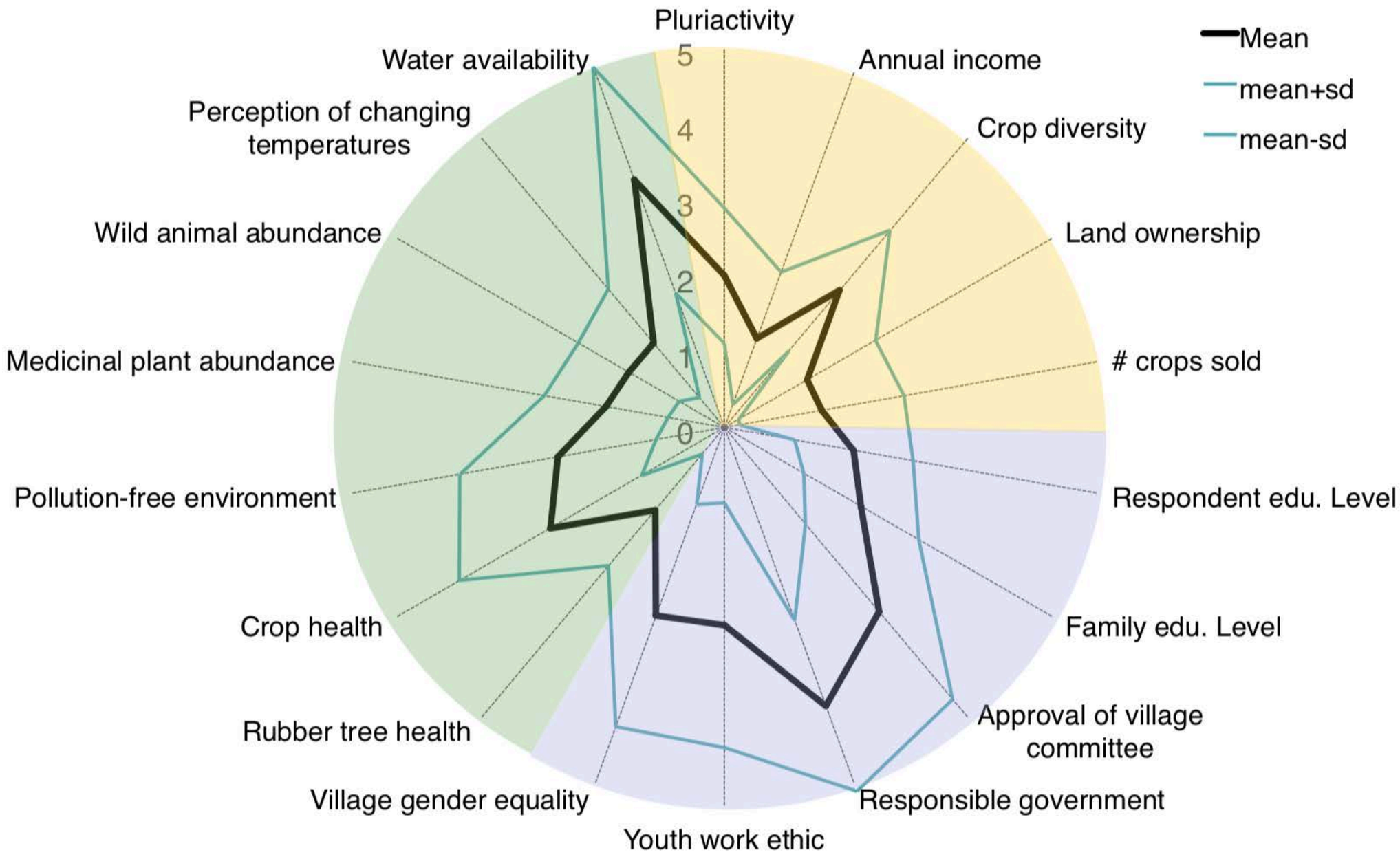
ENGAGING LOCAL COMMUNITIES: LAND CONSERVATION



High Meadows Foundation

Li, Levin, & Chang, *In prep.*

MEASURES OF PLURIACTIVITY



SMALLHOLDER FARMERS AND LAND CONSERVATION

Responses	Govt. PA %	Community PA %
I would participate in this form of land conservation for free.	0.0	17.0
I demand compensation	21.7	9.4
I would not agree to give land	55.2	23.6
The government will force me regardless	10.7	2.2

BIODIVERSITY IN AGROFORESTRY LANDSCAPES

Krithi Karanth

Mingxia Zhang

CENTRE FOR WILDLIFE STUDIES

XTBG

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Natural forest at landscape scale is most important for bird conservation in rubber plantation

Mingxia Zhang[a,*], Charlotte Chang[b], Ruichang Quan[a,*]

[a] Center for Integrative Conservation, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Xishuangbanna, Yunnan 666303, China
[b] Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544-1013, USA

SCIENTIFIC REPORTS

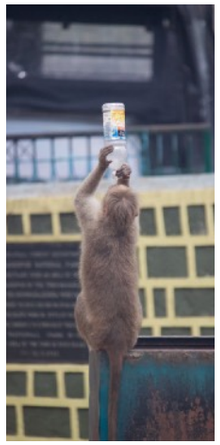
Correction: Author Correction

OPEN

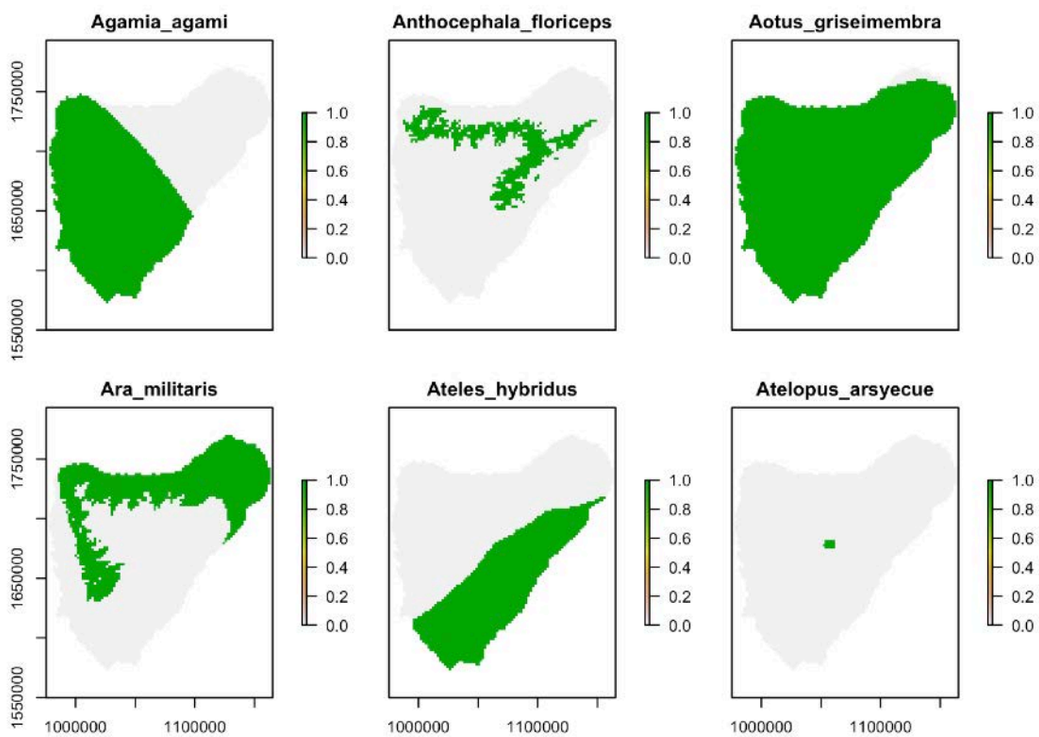
Birds and beans: Comparing avian richness and endemism in *arabica* and *robusta* agroforests in India's Western Ghats

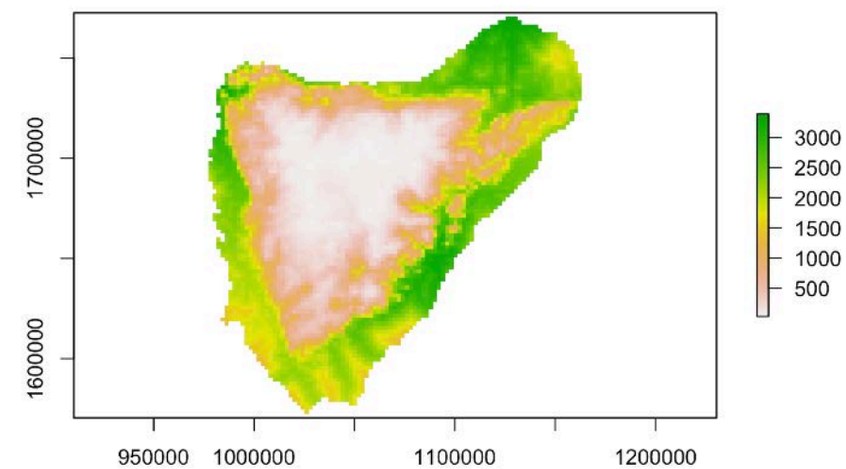
Received: 14 June 2017
Accepted: 29 January 2018
Published online: 16 February 2018

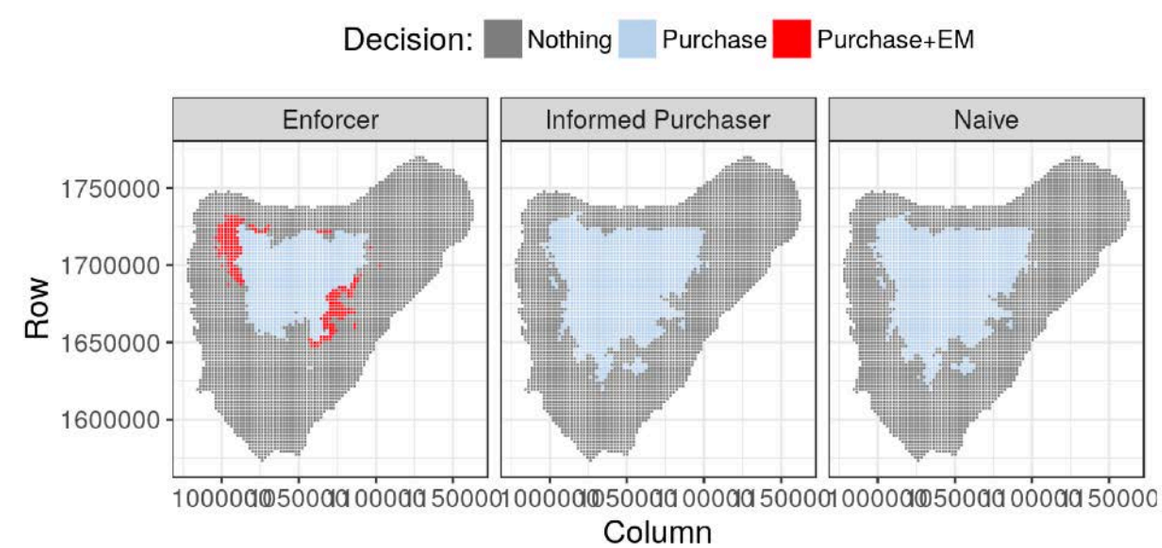
Charlotte H. Chang[1], Krithi K. Karanth[2,3,4] & Paul Robbins[5]



IMPROVING RESERVE SITE SELECTION ALGORITHMS



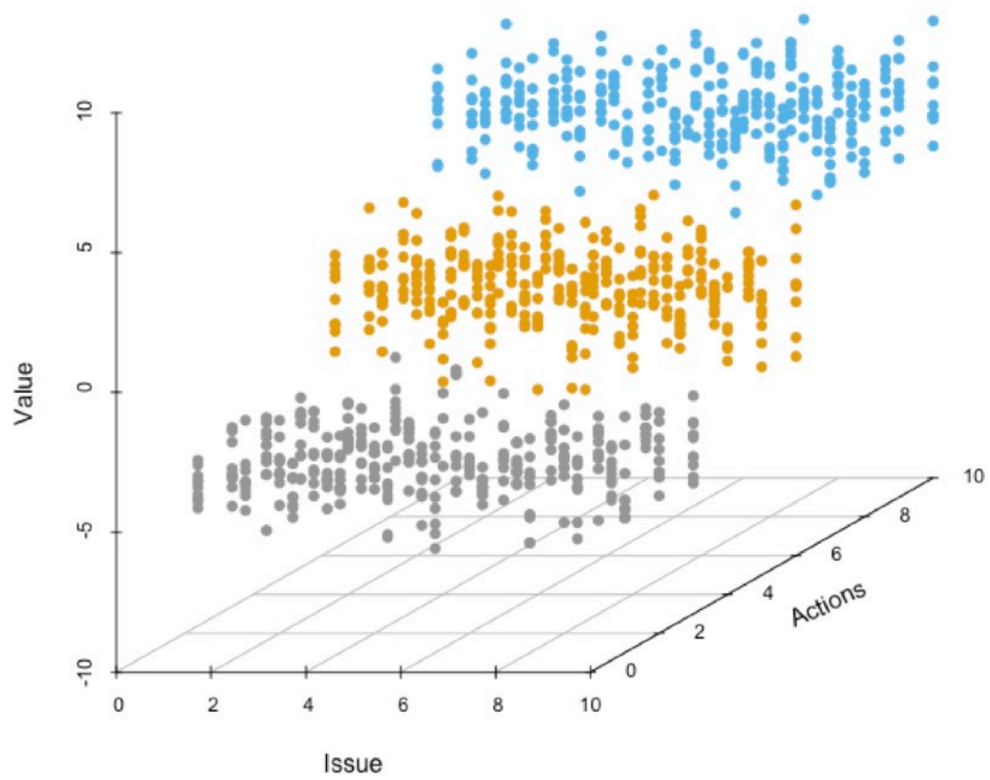


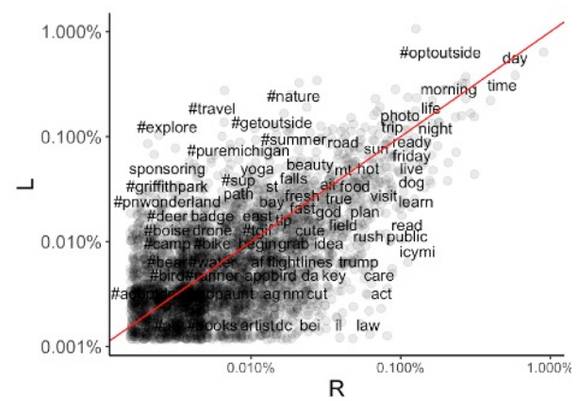


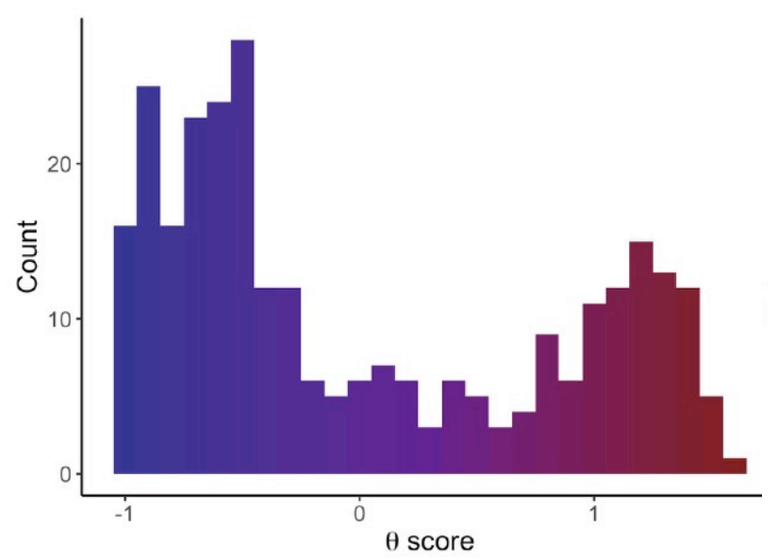
Albers, Chang, Dissayanake, Nolte, Helmstedt & Kroetz 2018, *WCERE*

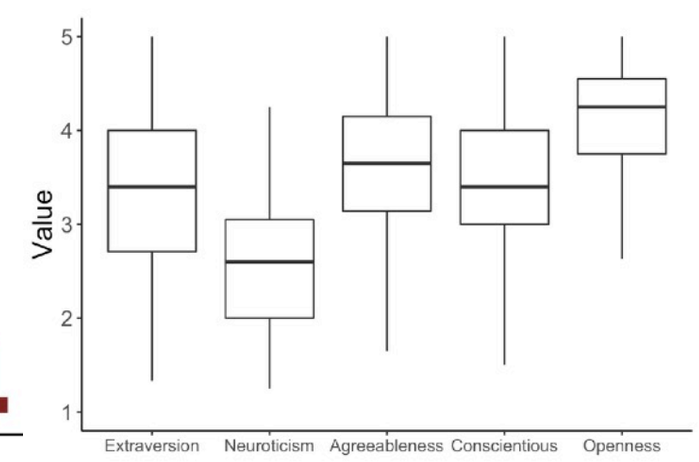
FUTURE WORK

How do we achieve collective action for the environment despite polarization?









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NIMBioS

Thank you!

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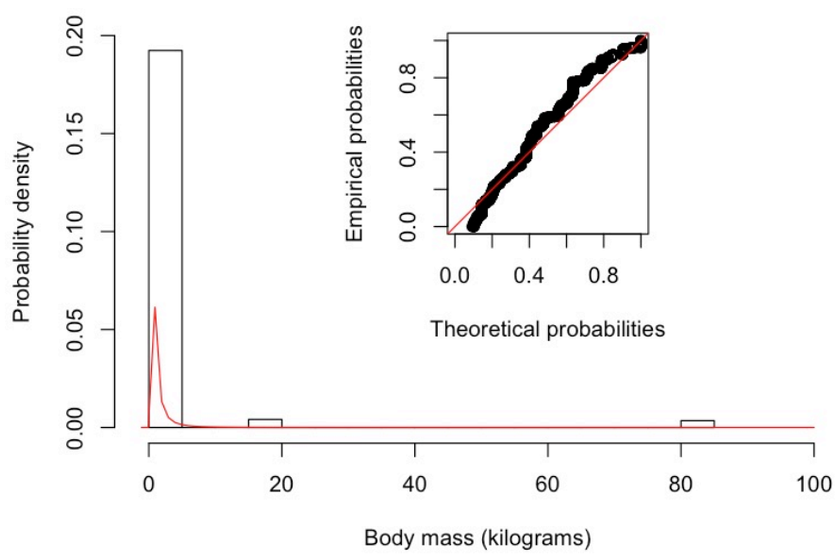
OPTIMAL STOPPING TIME PROBLEM

Distribution of Trait Value $f(X)$

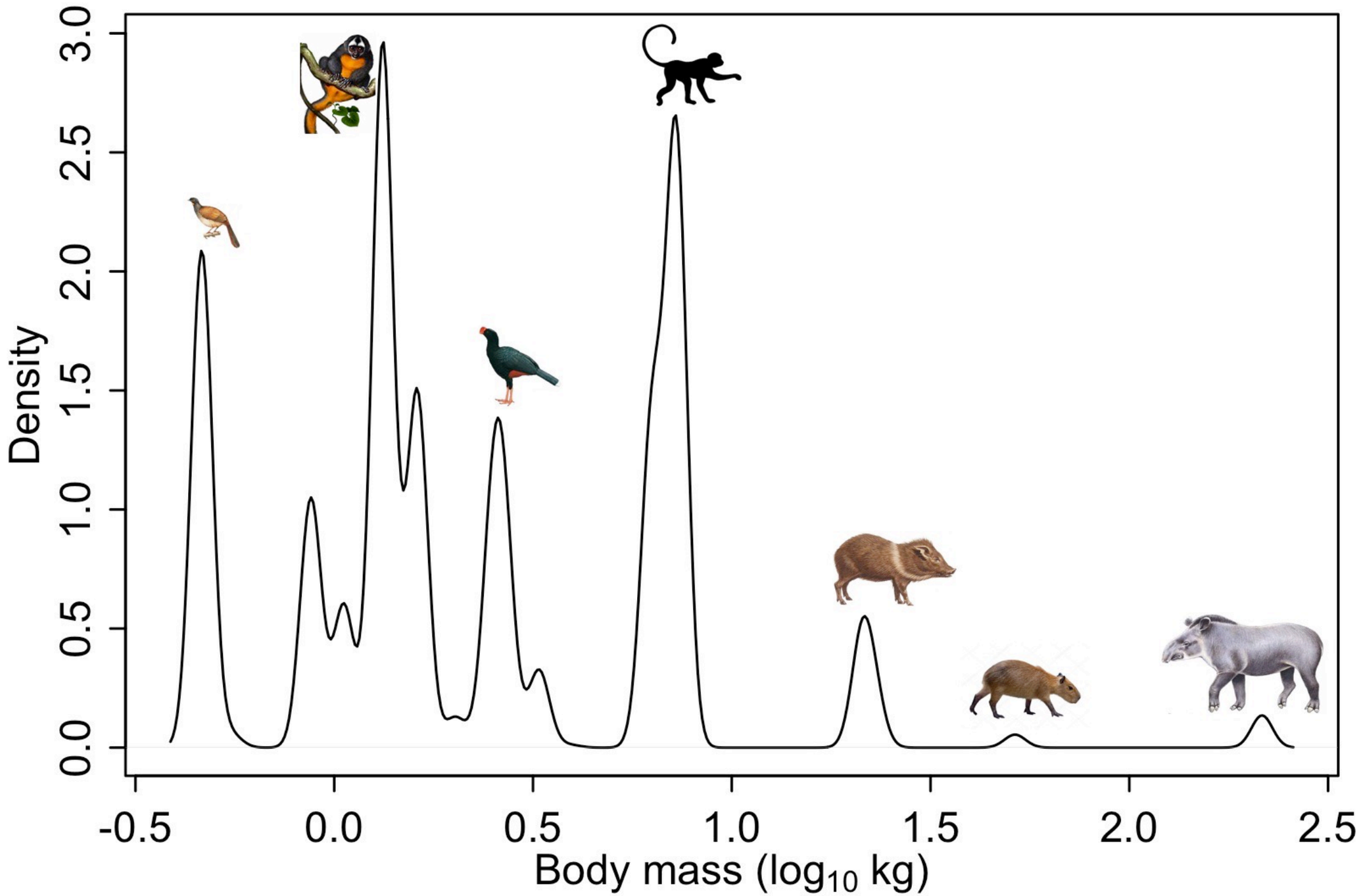


Trait Value Body mass X

- Hunter knows the distribution of trait value $f(x)$
- Pays some fixed cost c
- Only go hunting if $E[X] > c$
- Rule: shoot if $x > \varepsilon$ "reservation value"
- $U(-S|\varepsilon) = U(S|\varepsilon) = \varepsilon$

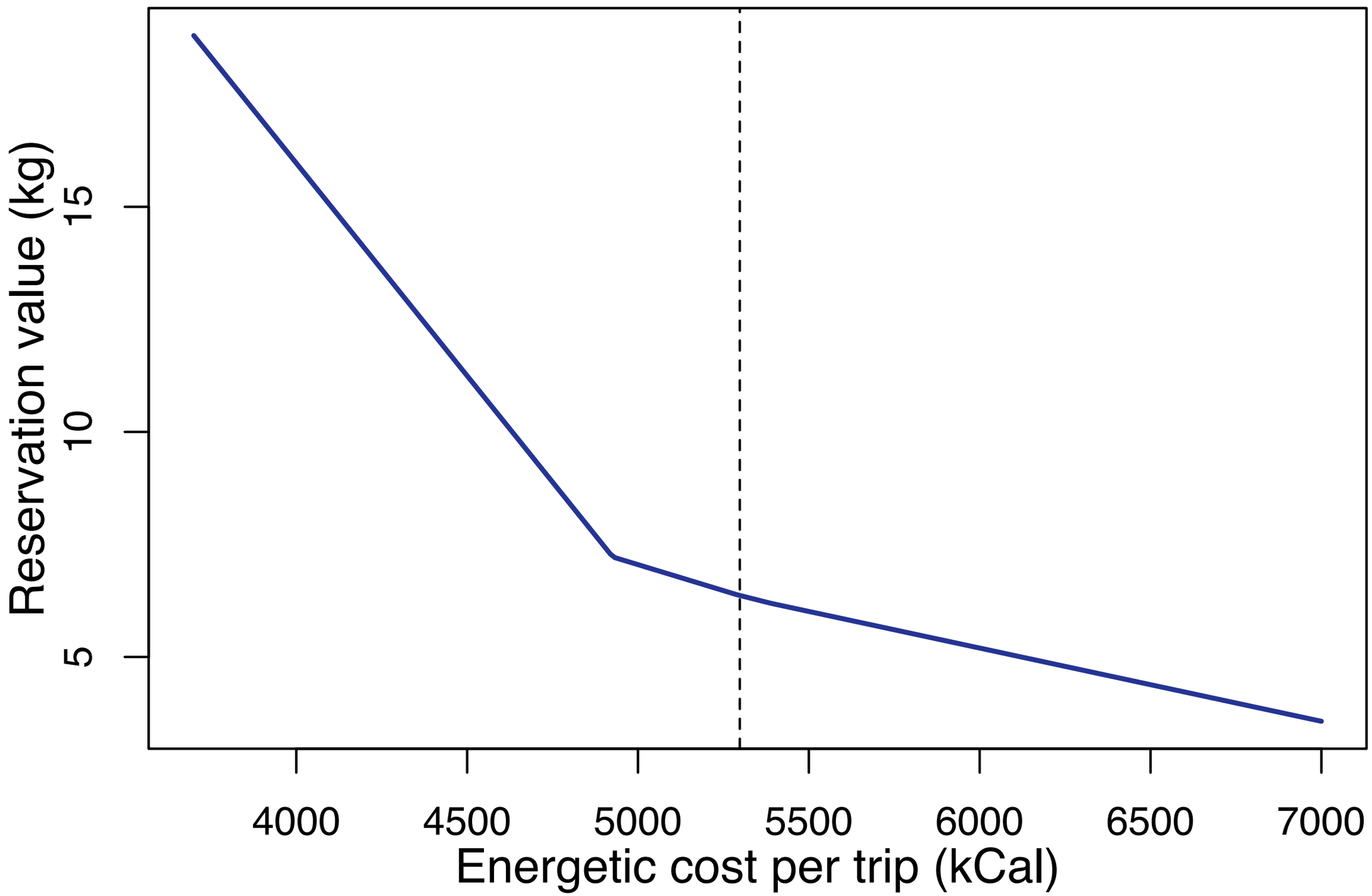
$$c = \int_{\varepsilon}^{\infty} (x - \varepsilon) f(x) dx$$

HUNTING IN MANU BIOSPHERE RESERVE: BODY MASS DENSITY

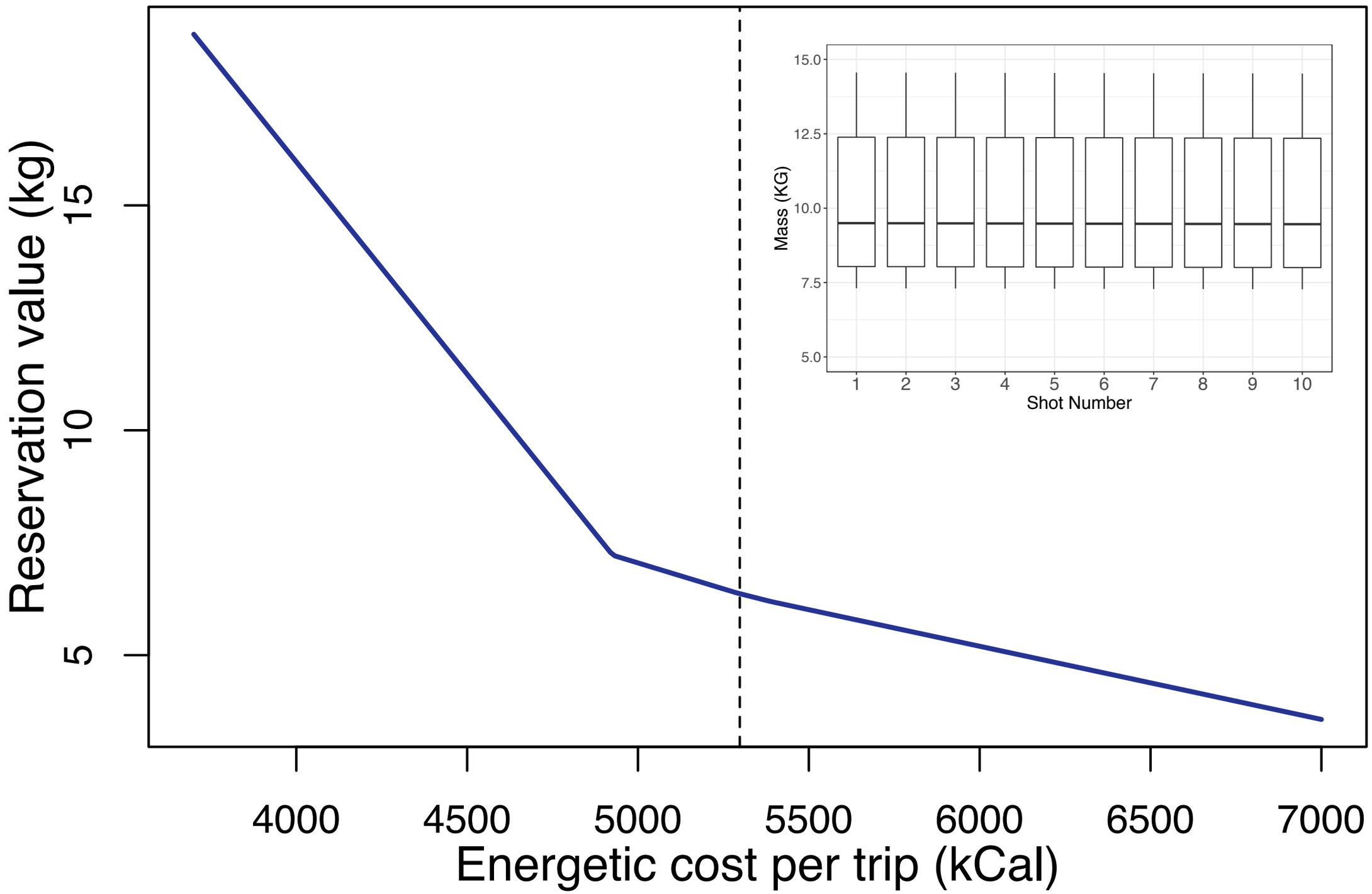


Ohl-Schacherer *et al.* 2007, Endo *et al.* 2010, Levi *et al.* 2011

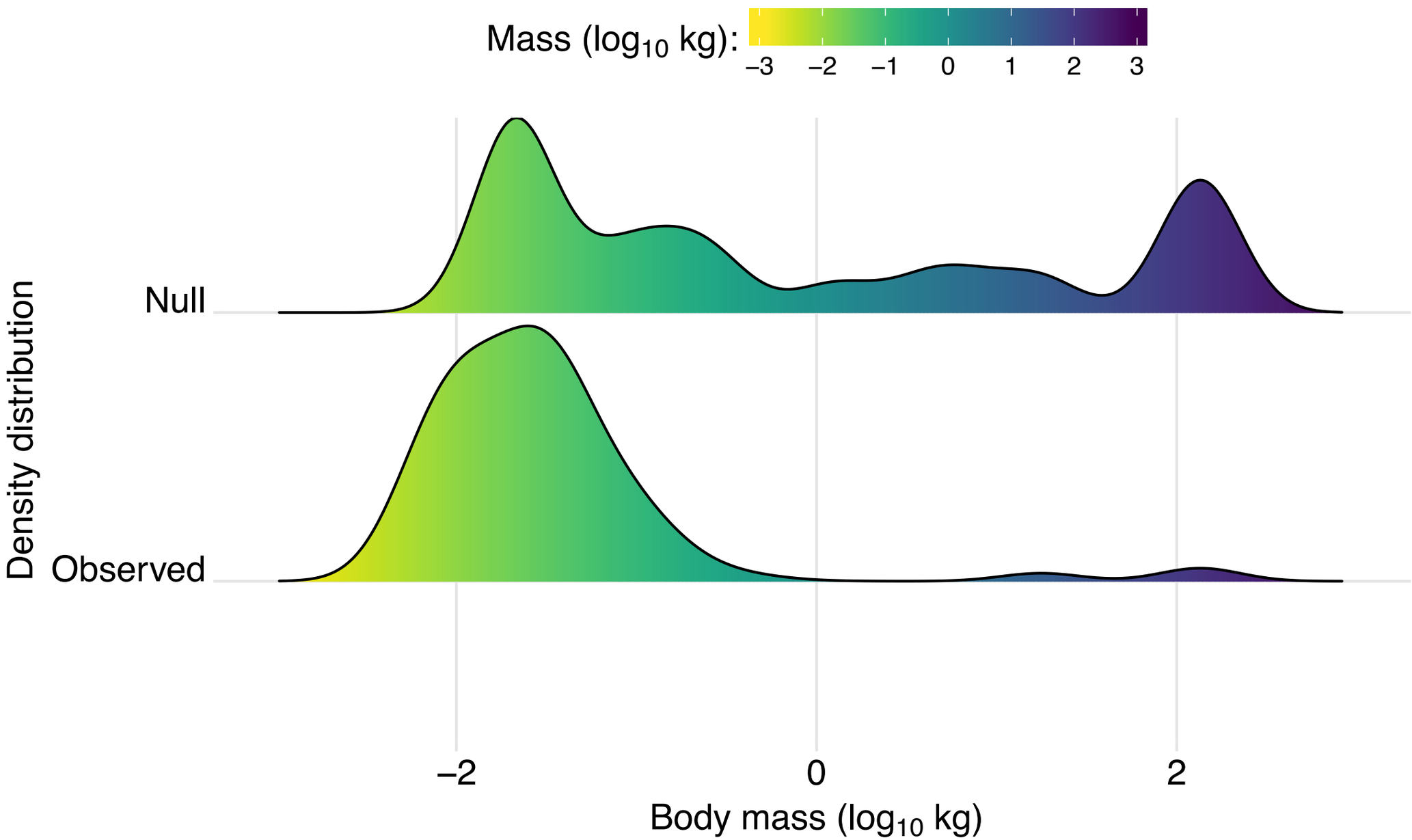
MANU RESERVATION VALUES



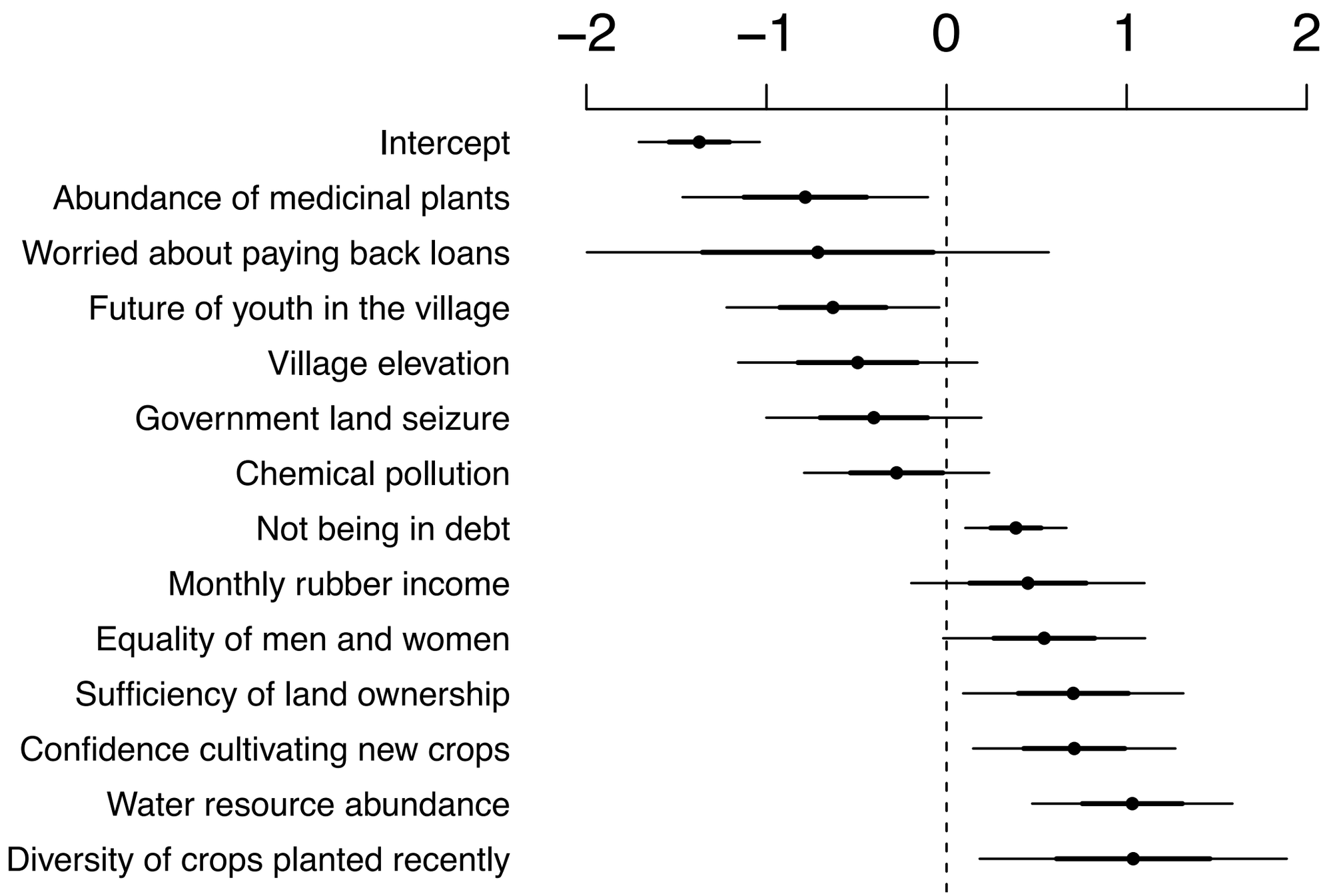
MANU RESERVATION VALUES



INFERENCE FROM HUNTER BAGS USING DIET THRESHOLDS



PREDICTORS OF ATTITUDES TOWARD PROTECTED AREAS



FUTURE WORK

How will farmers respond to a changing climate?

What are risks are ahead for bushmeat-dependent communities?

WILDLIFE CONSERVATION SOCIETY

CENTRE FOR WILDLIFE STUDIES

CIFOR

Smithsonian earth OPTIMISM SUMMIT