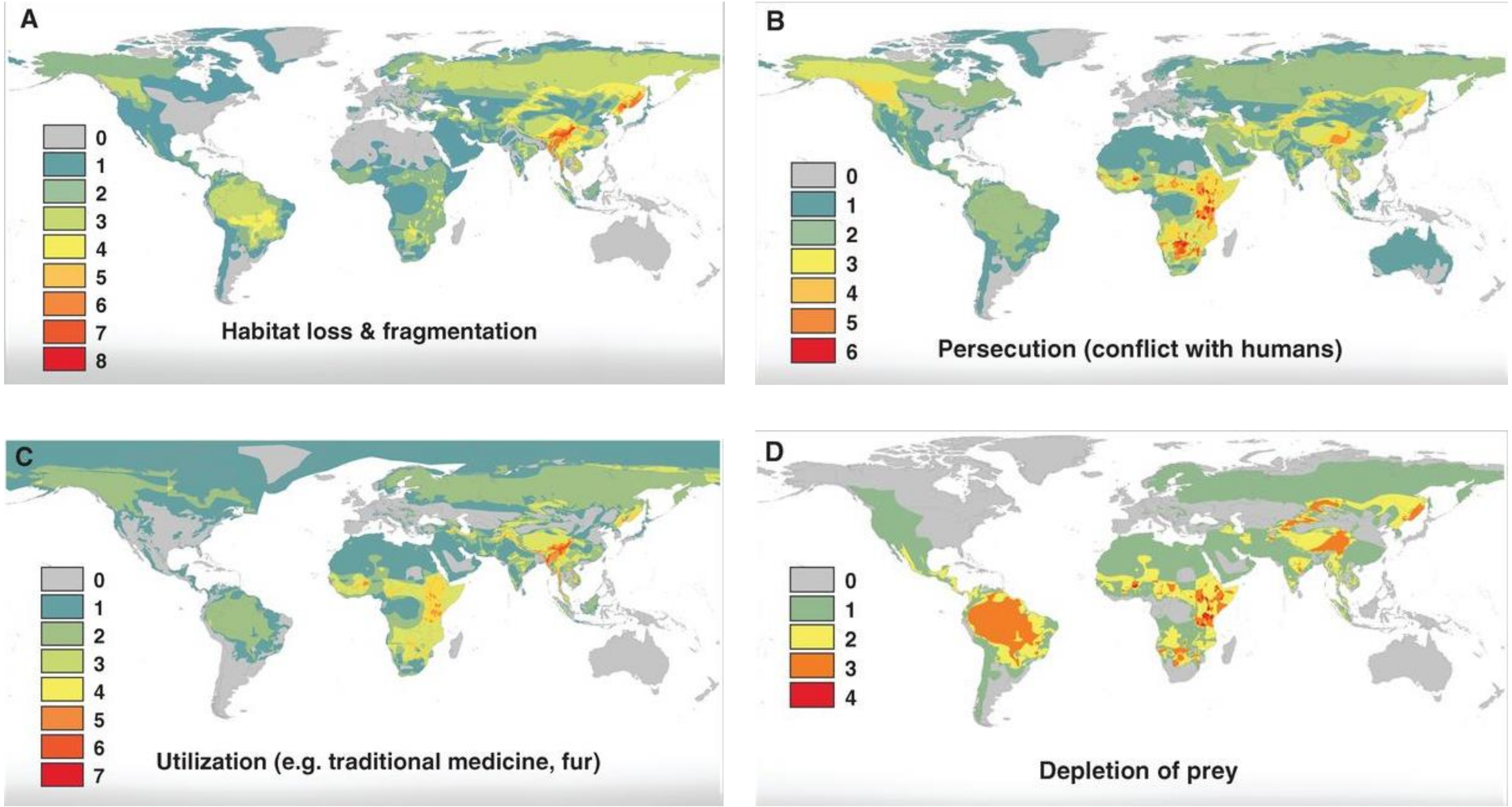
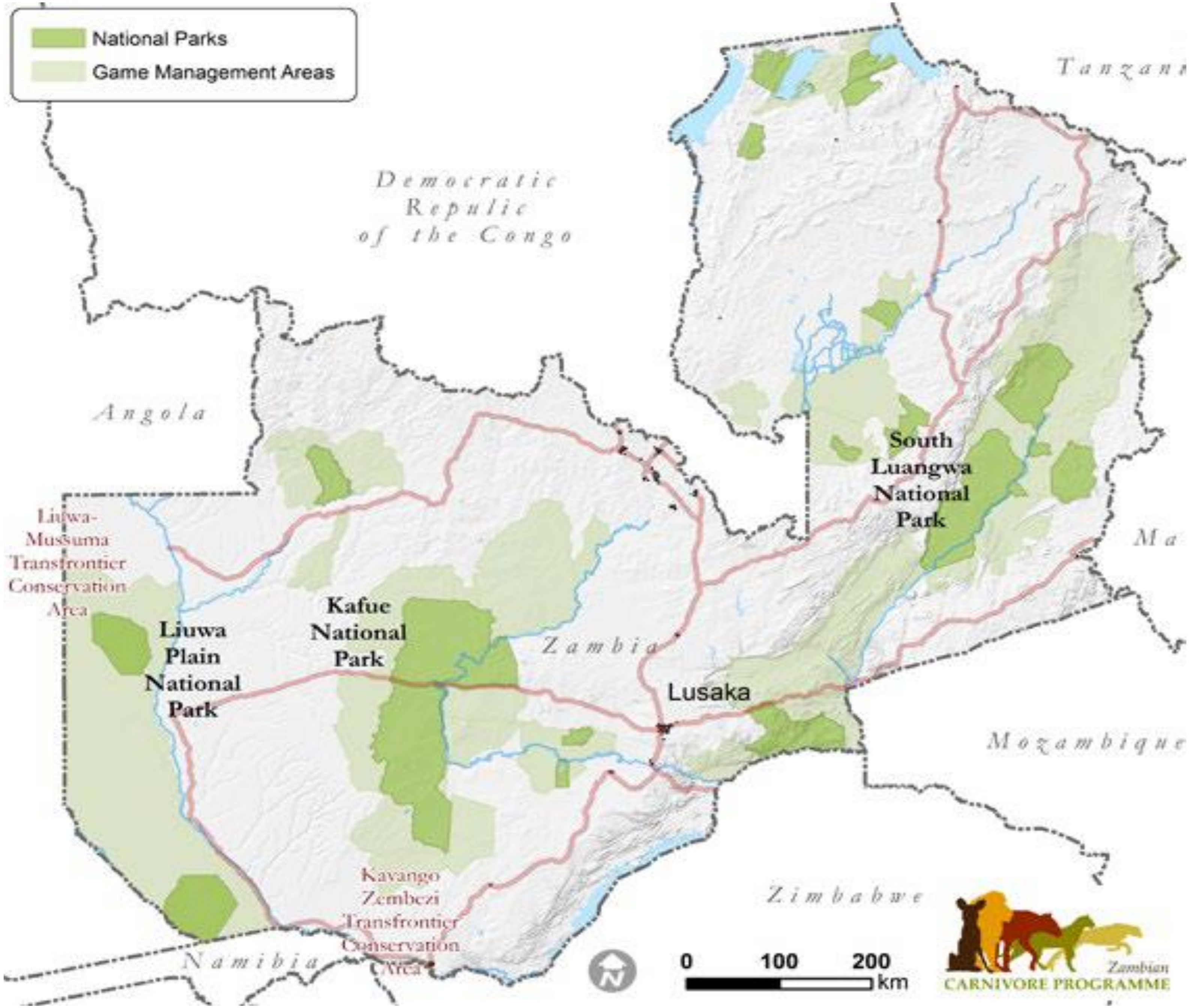
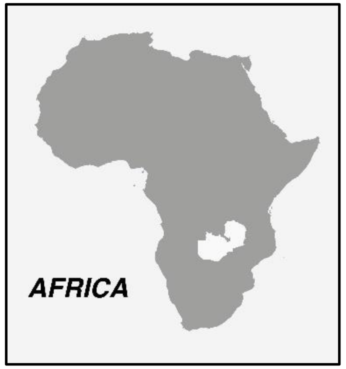
61 % of the world's large carnivores are considered threatened or endangered by the International Union for the Conservation of Nature (IUCN) Red List

Status and Ecological Effects of the World's Largest Carnivores

William J. Ripple,[1*] James A. Estes,[2] Robert L. Beschta,[1] Christopher C. Wilmers,[3] Euan G. Ritchie,[4] Mark Hebblewhite,[5] Joel Berger,[6] Bodil Elmhagen,[7] Mike Letnic,[8] Michael P. Nelson,[1] Oswald J. Schmitz,[9] Douglas W. Smith,[10] Arian D. Wallach,[11] Aaron J. Wirsing[12]




National Parks
Game Management Areas
Democratic Republic of the Congo
Tanzan
Angola
Liuwa-Mussuma Transfrontier Conservation Area
Liuwa Plain National Park
Kafue National Park
Zambia
Lusaka
South Luangwa National Park
Ma
Mozambique
Zimbabwe
Kavango Zembezi Transfrontier Conservation Area
Namibia
0 100 200 km
Zambian CARNIVORE PROGRAMME


AFRICA


Panthera leo

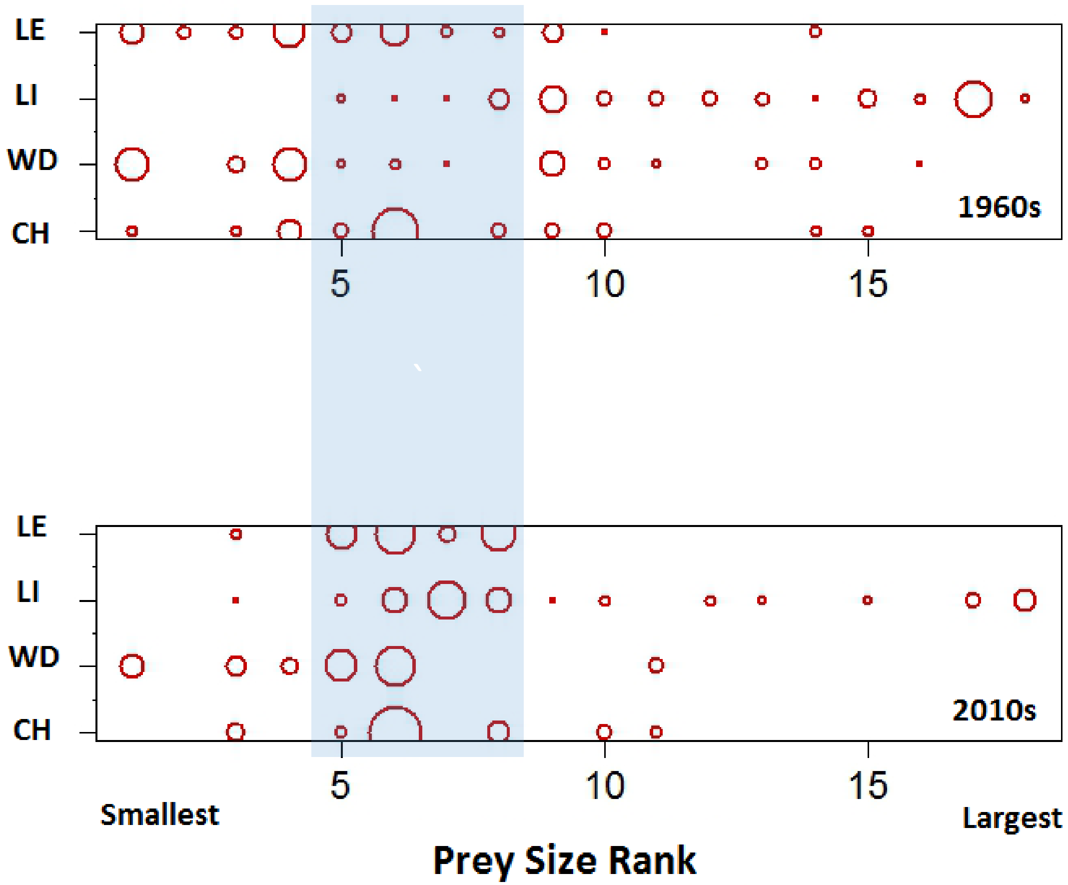

Crocuta crocuta


Panthera pardus


Lycaon pictus


Acinonyx jubatus

Species	Mean Herd Density (herds/km2)	Range Across Segments	Mean Individual Density (animals/km2)	Range Across Segments
Puku	1.31 (1.20 - 1.42)	(0.01 - 5.04)	15.87 (12.55 - 19.20)	(0.02 - 376.21)
Impala	0.74 (0.72 - 0.77)	(0.13 - 3.43)	6.46 (6.12 - 6.79)	(0.44 - 49.48)
Warthog	0.66 (0.63 - 0.70)	(0.04 - 2.68)	2.52 (2.36 - 2.68)	(0.09 - 17.97)
Reedbuck	0.09 (0.08 - 0.10)	(0.00 - 1.02)	0.47 (0.39 - 0.55)	(0.00 - 12.66)
Common Duiker	0.31 (0.29 - 0.34)	(0.00 - 1.84)	0.36 (0.33 - 0.39)	(0.00 - 2.10)
Hartebeest	0.13 (0.11 - 0.15)	(0.00 - 3.32)	0.57 (0.49 - 0.67)	(0.00 - 17.67)
Wildebeest	0.07 (0.06 - 0.07)	(0.00 - 0.53)	0.86 (0.76 - 0.96)	(0.00 - 10.30)
Roan	0.04 (0.04 - 0.05)	(0.00 - 0.32)	0.33 (0.29 - 0.37)	(0.00 - 4.89)
Zebra	0.03 (0.03 - 0.04)	(0.00 - 0.56)	0.22 (0.18 - 0.27)	(0.00 - 11.80)
Waterbuck	0.07 (0.07 - 0.08)	(0.00 - 0.43)	0.26 (0.23 - 0.28)	(0.00 - 1.74)



Changes in African large carnivore diets over the past half-century reveal the loss of large prey

Scott Creel[1,2,3] | Wigganson Matandiko[1,2] | Paul Schuette[4] | Elias Rosenblatt[5] | Carolyn Sanguinetti[2] | Kambwiri Banda[2] | Milan Vinks[1,2] | Matthew Becker[2]

J Appl Ecol. 2018;55:2908–2916.

	DECREASE	INCREASE
Prey Size		
SMALLER THAN MEDIAN	11	16
LARGER THAN MEDIAN	21	4

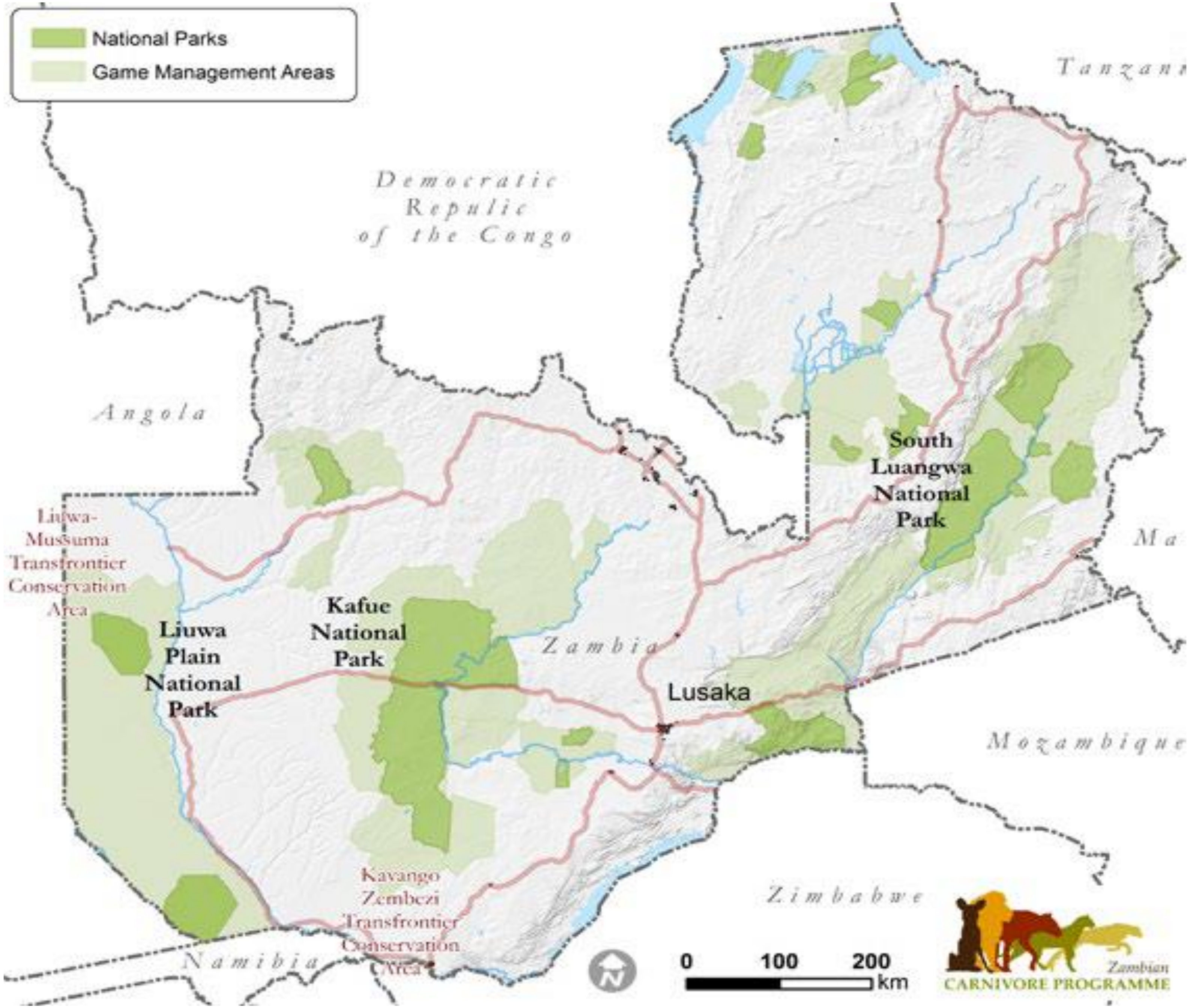
$\chi^2 = 8.52$, $P = 0.0035$

All carnivores now rely heavily on four prey species

↓

Increase in competition

With the depletion of large prey, four smaller species are now (by far) the most common herbivores in the ecosystem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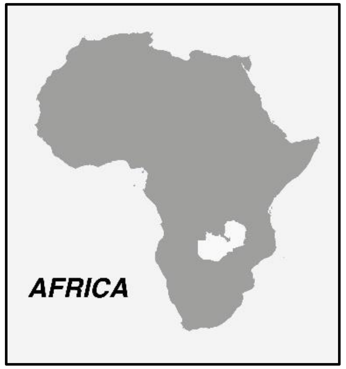
Zambian CARNIVORE PROGRAMME


AFRICA

Sixteen years of change in the global terrestrial human footprint and implications for biodiversity conservation

Oscar Venter[1,2,3], Eric W. Sanderson[4], Ainhoa Magrach[5,6], James R. Allan[2,7], Jutta Beher[2], Kendall R. Jones[2,7], Hugh P. Possingham[2,8], William F. Laurance[3], Peter Wood[3], Balázs M. Fekete[9], Marc A. Levy[10] & James E.M. Watson[4,7]

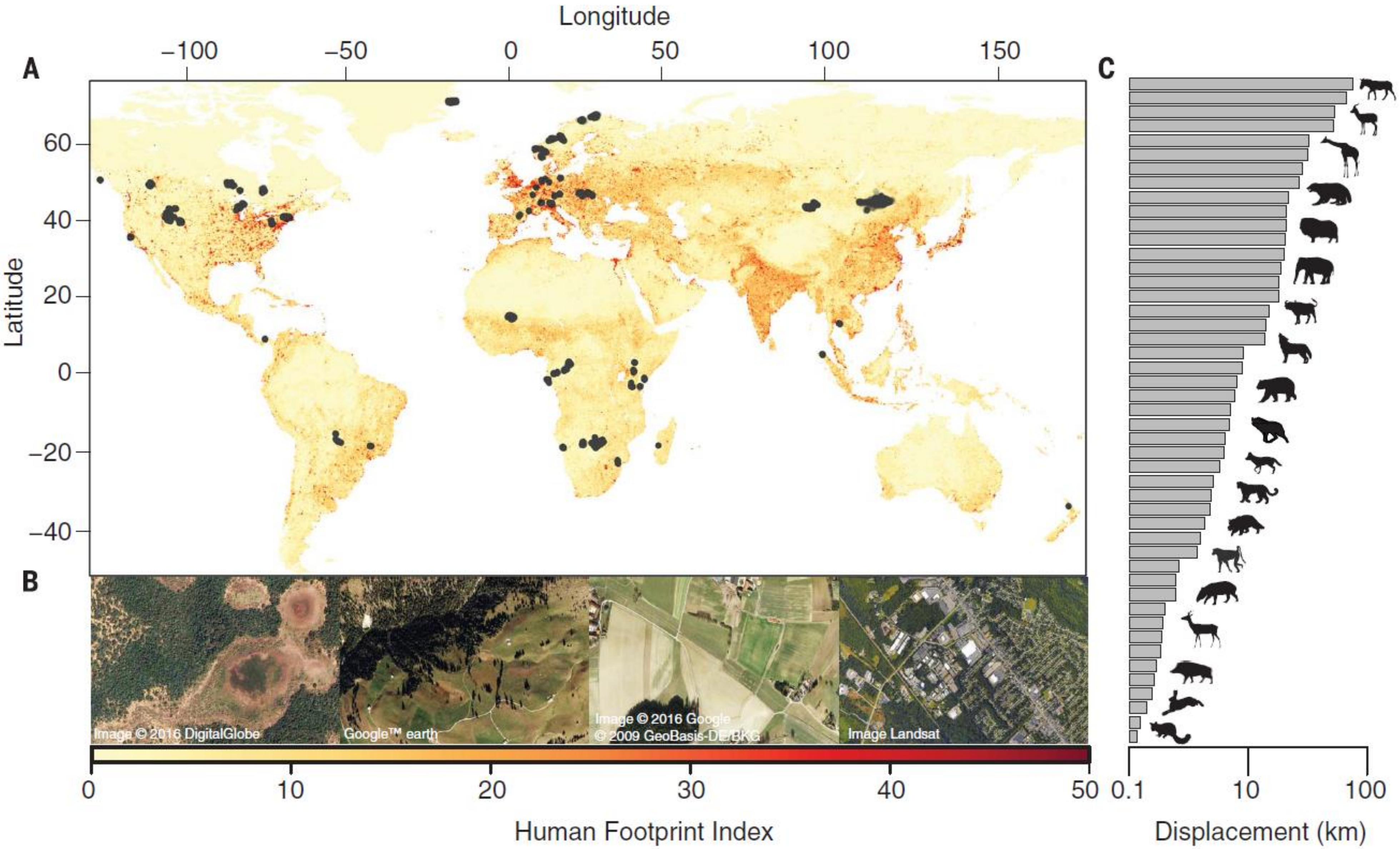
Table 1 | Human pressures used to construct the human footprint (HF).

Data set	Timing	Years	Mean HF score	
			1993	2009
Built environments	Dynamic	1994, 2009	0.17	0.19
Crop lands	Dynamic	1992, 2005	0.79	0.96
Pasture lands*	Static	2000	0.51	0.47
Population density	Dynamic	1990, 2010	2.10	2.32
Night lights	Dynamic	1993, 2009	0.29	0.36
Railways	Static	1960s–1990s	0.15	0.15
Major roadways	Static	1980–2000	1.32	1.32
Navigable waterways	Dynamic	1993, 2009	0.33	0.38
All combined	NA	NA	5.67	6.16

HF, human footprint; NA, not applicable.
Static data are available for only one time period.
*Pasture lands' global averages vary across years as pasture is not permitted to overlap with crop or urban lands, which are dynamic data sets.

Moving in the Anthropocene: Global reductions in terrestrial mammalian movements

Tucker *et al.*, *Science* **359**, 466–469 (2018) 26 January 2018



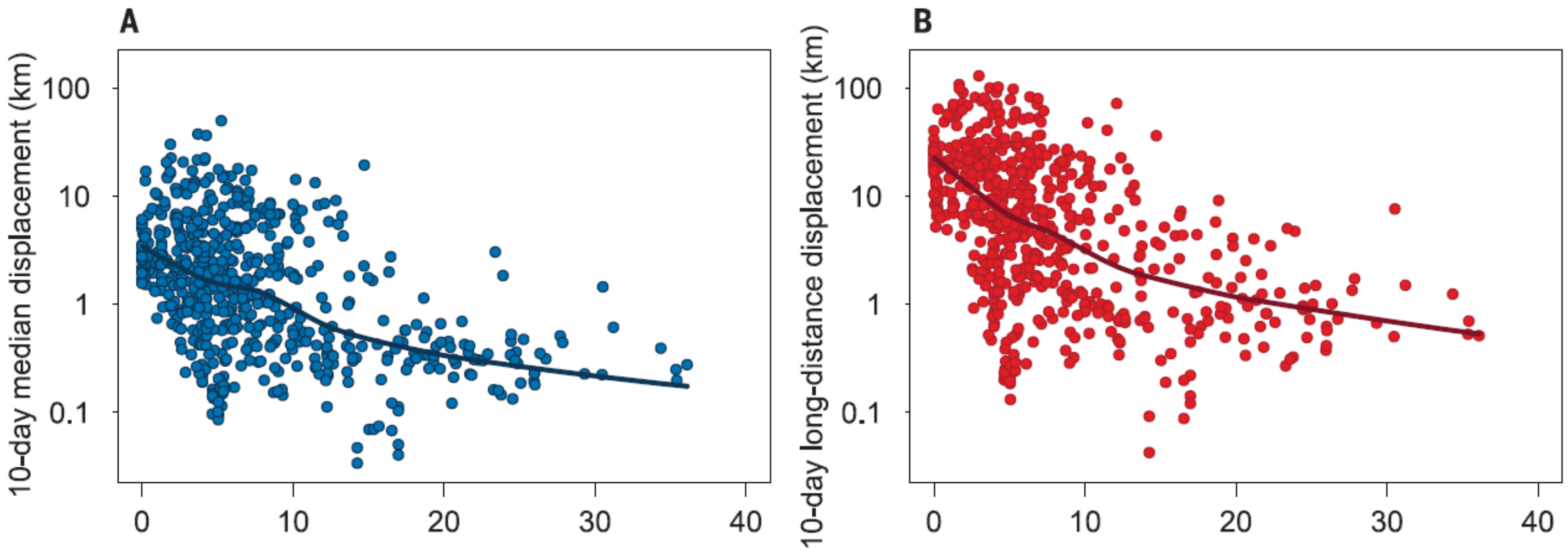
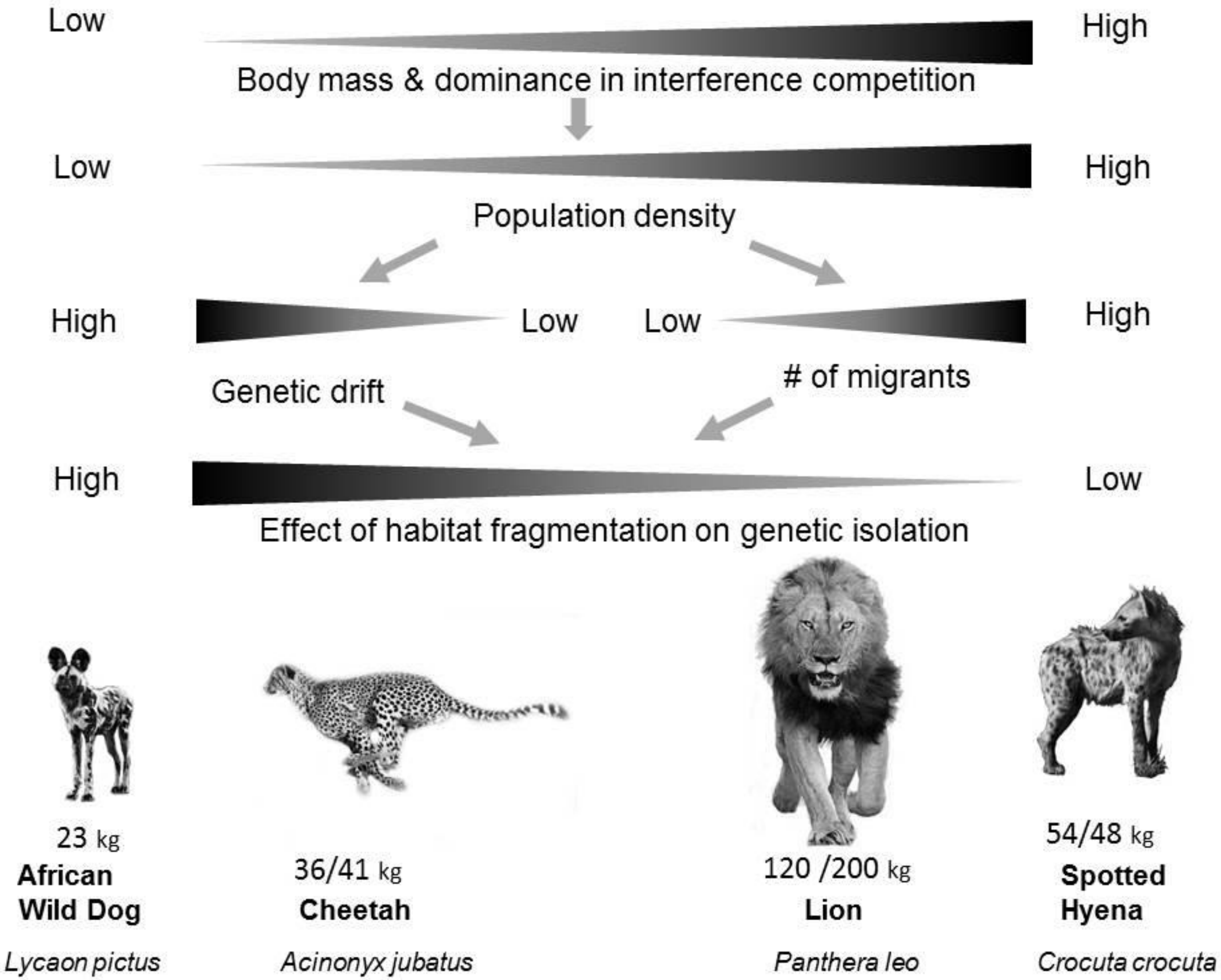
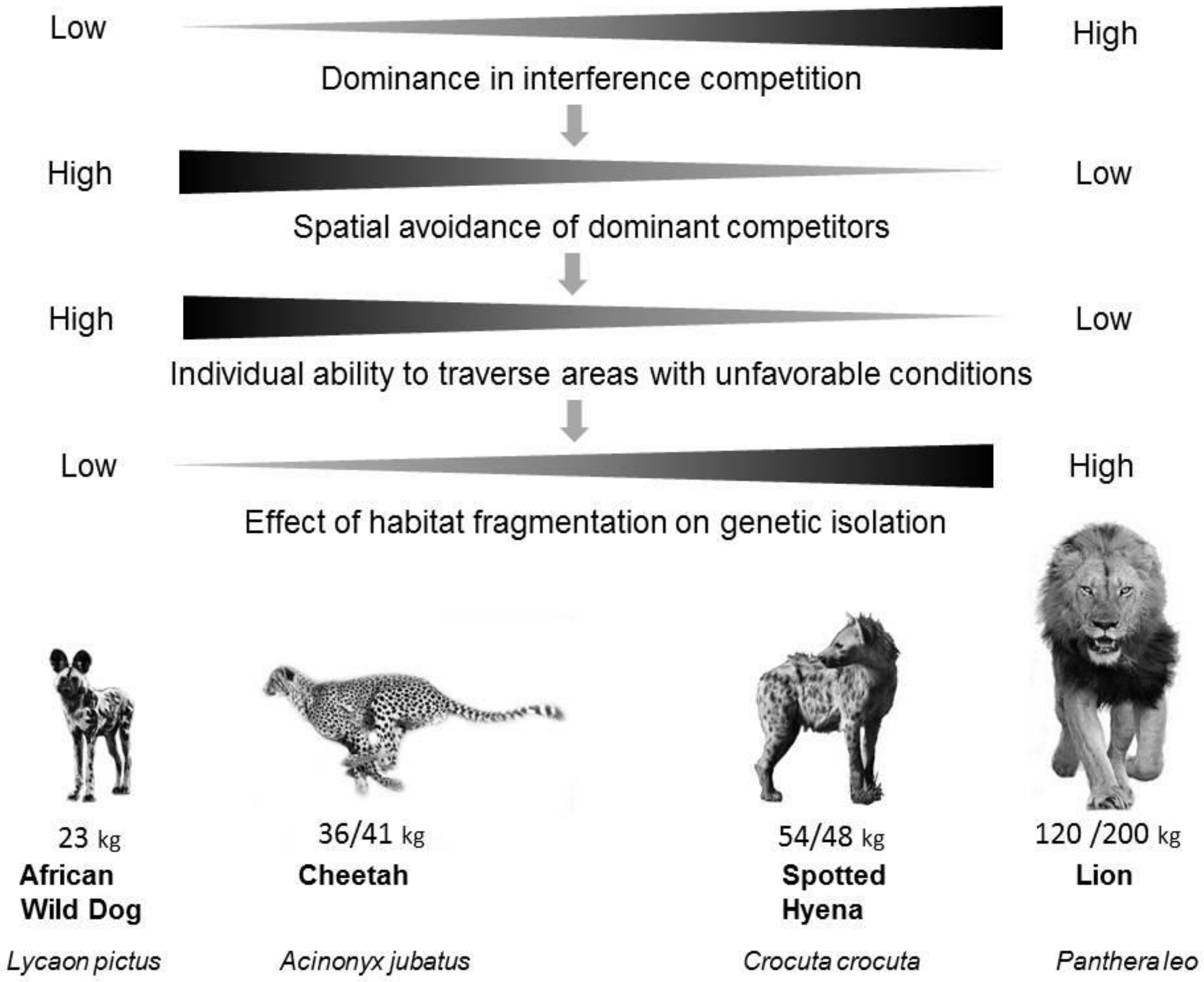


Fig. 2. Mammalian displacement in relation to the Human Footprint Index. (**A**) Median displacements; (**B**) long-distance (0.95 quantile) displacements. Both displacements decline with increasing HFI at the 10-day scale (*n* = 48 species and 624 individuals). Plots include a smoothing line from a locally weighted polynomial regression. An HFI value of 0 indicates areas of low human footprint; a value of 40 represents areas of high human footprint.

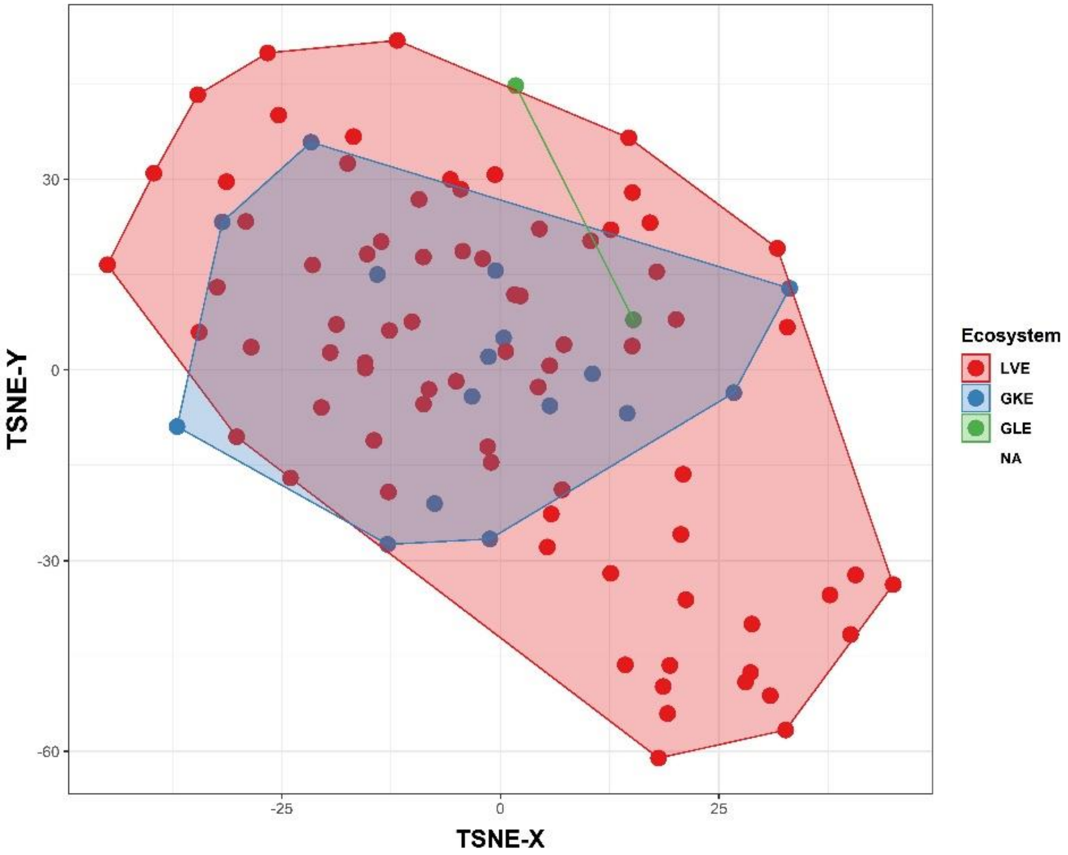
CDC: Competition Density Connection Hypothesis

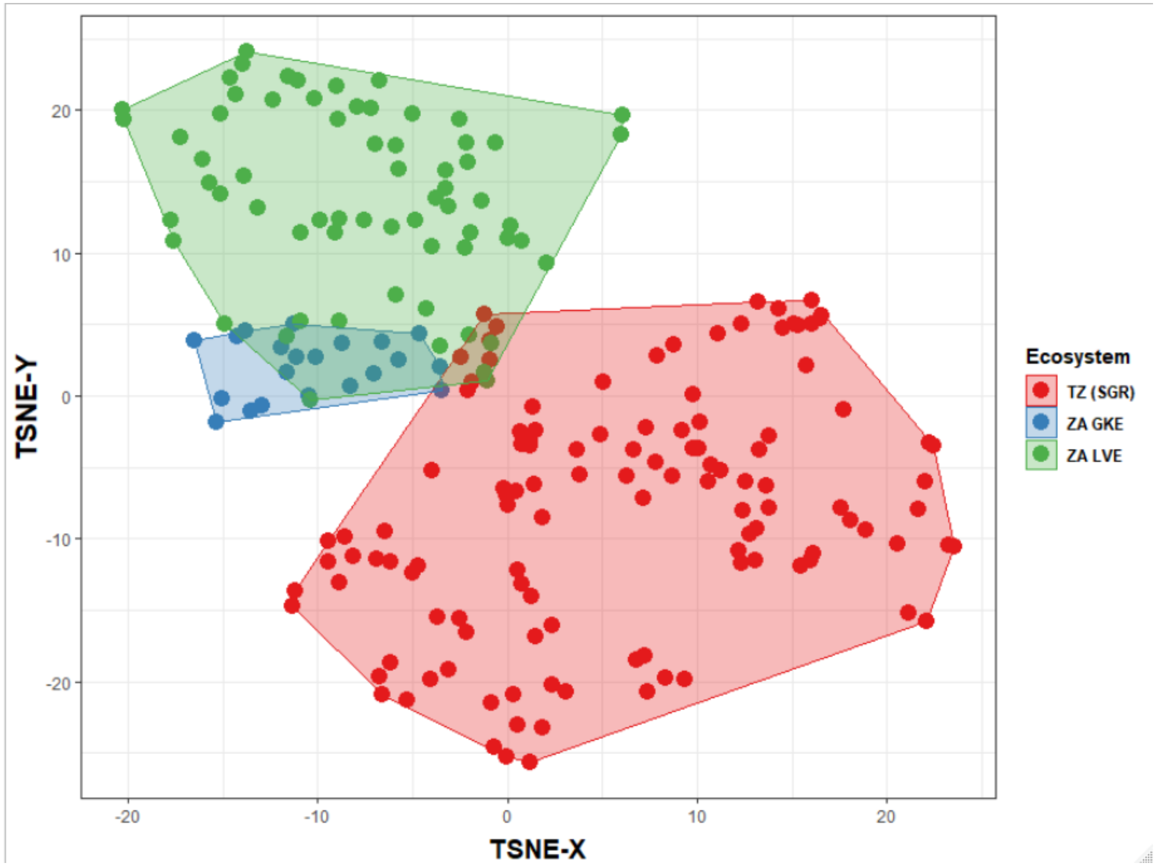


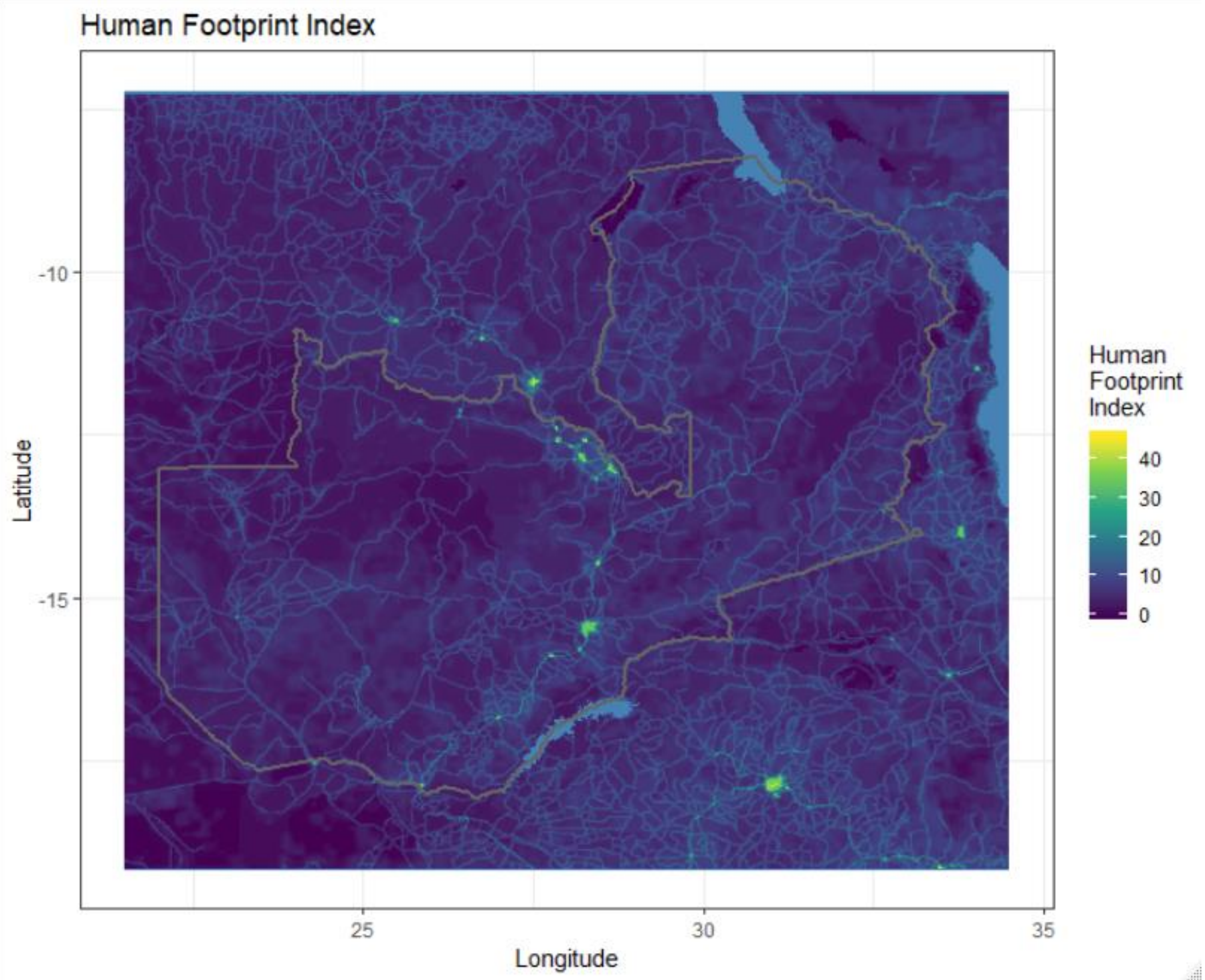
CMC: Competition Movement Connection Hypothesis



Much larger genetic differences between ecosystems for lions than for African wild dogs.






Human Footprint Index
Latitude
-10
-15
Longitude
25
30
35
Human Footprint Index
40
30
20
10
0

ISOLATION BY RESISTANCE

Evolution, 60(8), 2006, pp. 1551–1561

BRAD H. MCRAE

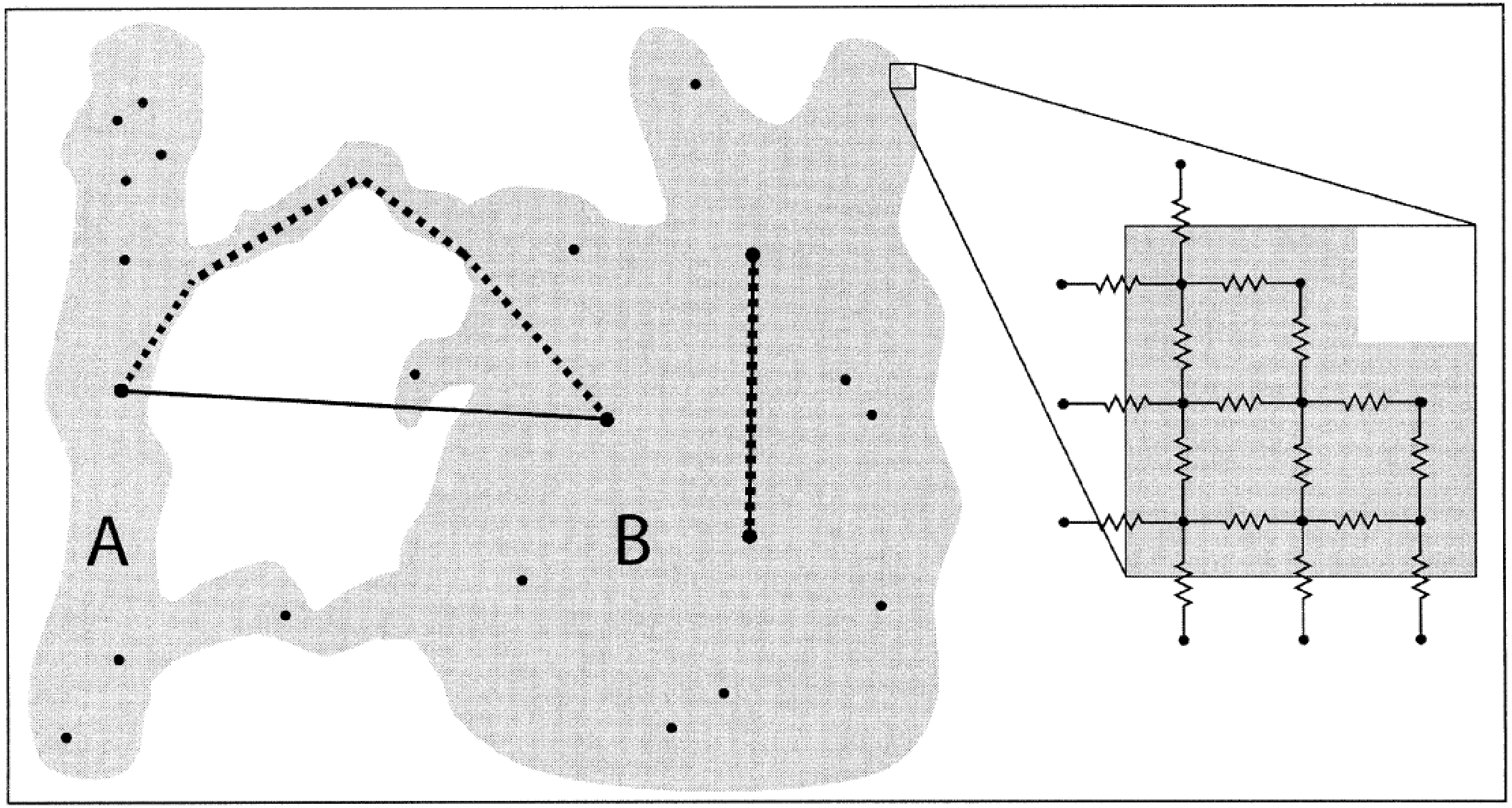


FIG. 1. Range or habitat map for a hypothetical species, with suitable habitat shown in gray. The species is assumed to be continuously distributed throughout the habitat and to have limited dispersal ability. Dots indicate locations of 21 samples from individuals or local populations. Two common distance measures between sample pairs are shown: Euclidean distances (solid lines), and cost-weighted distances from least cost path analyses (dashed lines). Inset shows discretized habitat represented as a network of nodes connected to their neighbors by resistors. Diagonal connections or connections between nonadjacent nodes could also be incorporated. Resistance distance calculations using this network would integrate all possible pathways connecting sample pairs.

ISOLATION BY RESISTANCE

BRAD H. MCRAE

Evolution, 60(8), 2006, pp. 1551–1561

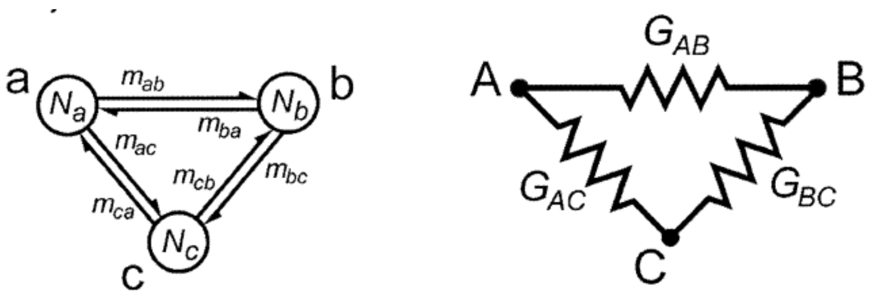


FIG. 2. (A) Three demes (open circles) connected by migration and analogous nodes (closed circles) connected by resistors. Theory discussed in this paper is limited to the balanced migration case,

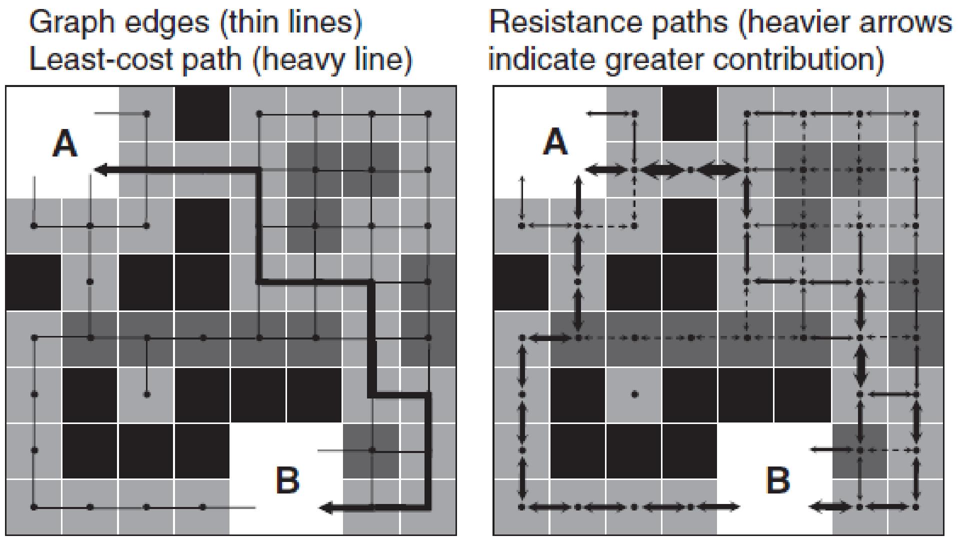
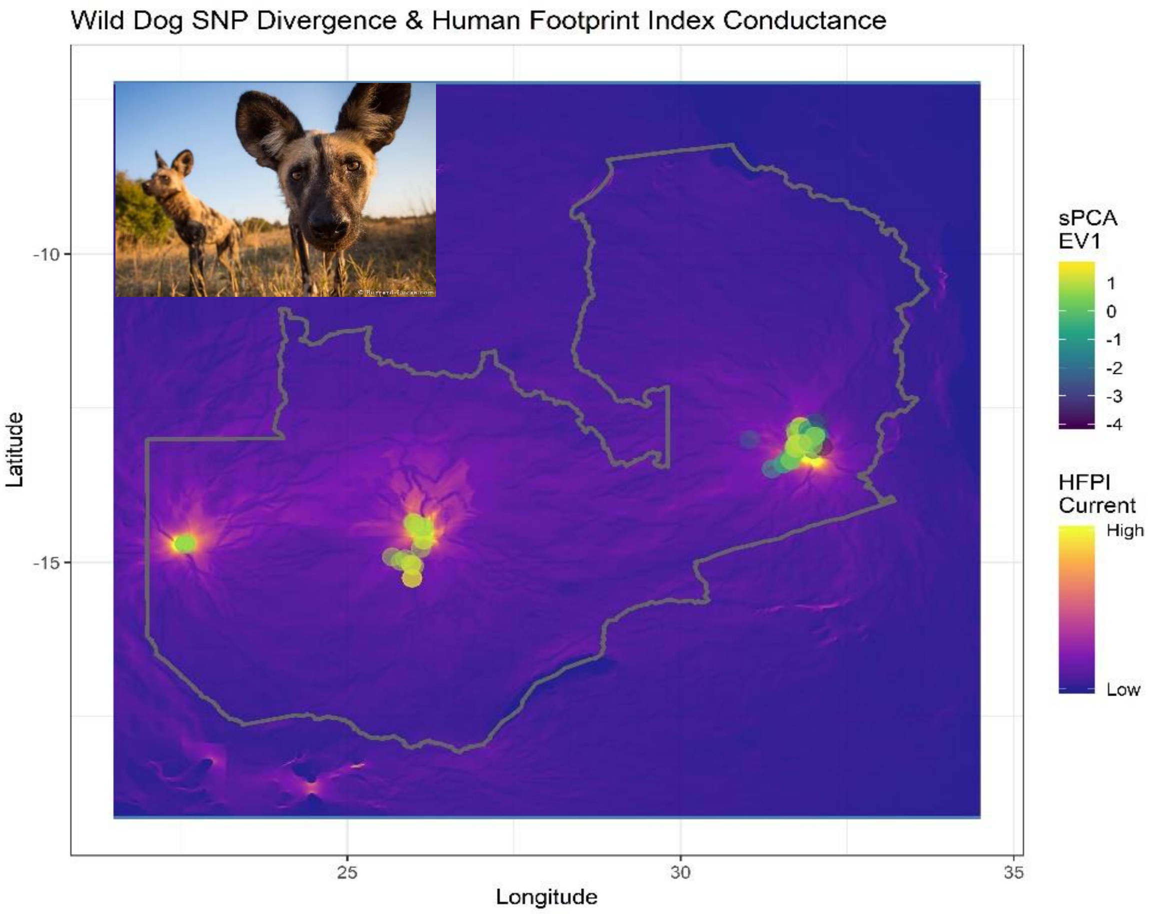
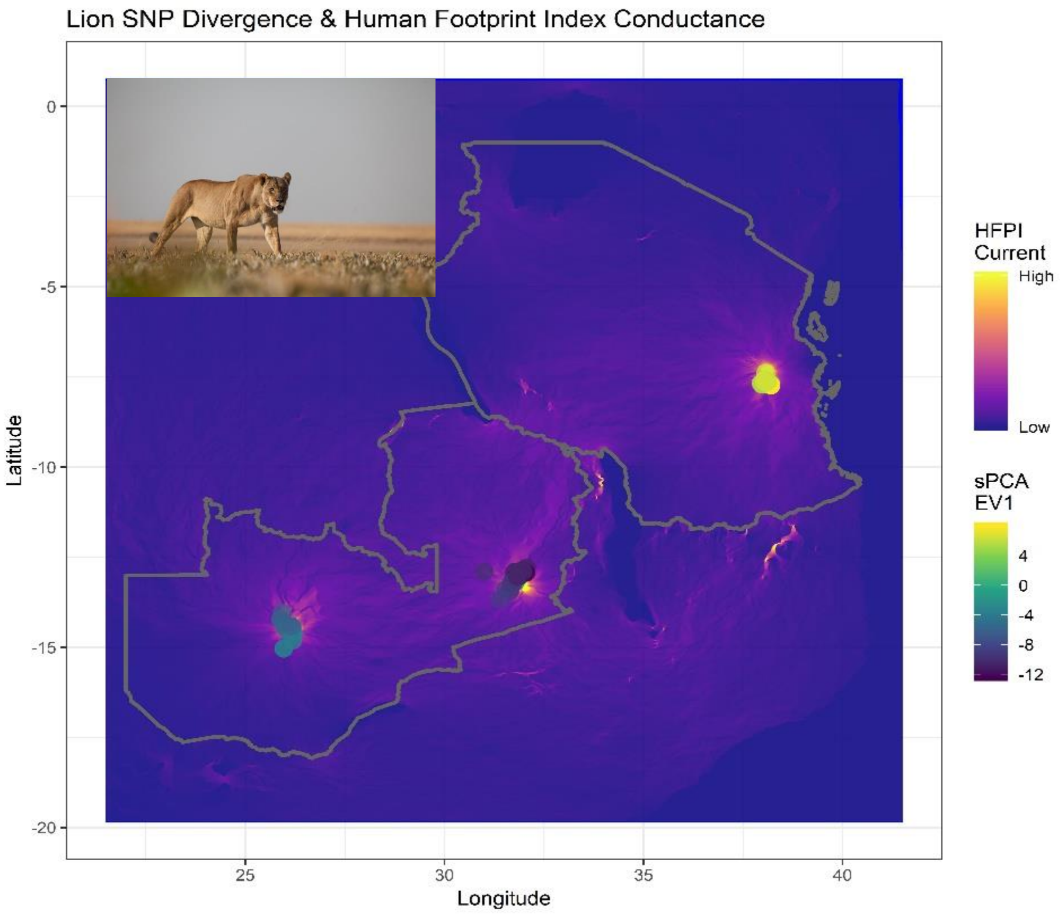


Fig. 4 Resistance values, graph edges, and least-cost and circuit solutions for connectivity between two habitat patches, A and B. Per-cell resistance increases with darker colours. Both least-cost and circuit theory algorithms construct a graph that connects cells. Typically, graph edge weights are inversely proportional to average cost or resistance of cells being connected. Left-hand panel shows graph and least-cost path (this example shows only four-neighbour connections for simplicity). Right-hand panel shows pathways for effective resistance calculations based on circuit theory. Heavier arrows indicate higher contribution/importance of pathways.





Correlation between Genetic Distance and:

Geographic Distance: Mantel = -0.04, *P* = 0.78
Human Footprint: Mantel = -0.05, *P* = 0.85

Geographic Distance: Mantel = 0.39, *P* < 0.001
Human Footprint: Mantel = 0.55, *P* < 0.001