

GLOBAL EFFECTS OF ROADKILL ON **CARNIVORE PERSISTENCE** OVER THE NEXT 50 YEARS



Clara Grilo
Tomé Neves
Filipa Coutinho Soares
Jennifer Bates
Pablo Medrano-Vizcaíno
Aliza le Roux
Inês Silva
Yun Wang
Kylie Soanes



CARNIVORES UNDER THREAT FROM ROADS

RISKY 

PeerJ

Forecasting effects of transport infrastructure on endangered tigers: a tool for conservation planning

Nail H. Carter¹, Narendran Pradhan², Krishna Hengyot³, Chinnay Sorasone⁴, Abigail H. Sage⁵ and Volker Sukum⁶

Current Biology
Magazine

Correspondence
Roads threaten
Asiatic cheetahs
in Iran



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Research Paper

Simulating the consequences of roads for wildlife population dynamics

Priscilla Barbosa^{a,b,c}, Nathan H. Schumacher^{a,b,c}, Kristin R. Brandon^{a,c}, Alex Buge^{a,d}, Clara Grilo^{a,d,e}



Panthera tigris



Acinonyx jubatus venaticus



Chrysocyon brachyurus



Lynx pardinus

Prediction of **46** tigers over 20 years; reduced the adult population by

39%



16 deaths between 2004–2016 in a population of **43** individuals



36% risk of local extinction with observed roadkill



76% of mortality detected



FIGURE 2 Location of the species most vulnerable to roadkill ($F_{\text{RiskExt10}} < .2$). The scientific names framed in blue are those for which observed roadkill rates are estimated to lead to an increase risk of extinction in 50 years if the observed roadkill rates persist in the region. Coloured dots are the International Union for Conservation of Nature (IUCN) status (Endangered – orange; Vulnerable – yellow; Near Threatened – green). Asterisks indicate species with intermediate vulnerability to roadkill ($.2 < F_{\text{RiskExt10}} < .5$) (Supporting Information Appendices S1 and S6). Mammal species silhouettes from PhyloPic (<http://phylopic.org>)



GOALS



POPULATION IMPACT

changes in abundance and distribution



ROADKILL THRESHOLDS

levels above which populations decline



GLOBAL HOTSPOTS

regions with the highest number of species at risk

WORKFLOW



N=511 studies

N=288

N=738 roadkill rates

N=115 species

SPECIES TRAITS

ECOLOGY
ECOLOGICAL SOCIETY OF AMERICA

Data Paper  Free Access

PanTHERIA: a species-level database of life history, ecology, and geography of extant and recently extinct mammals

Ecological Archives E090-184



ECOLOGY
ECOLOGICAL SOCIETY OF AMERICA

Data Paper  Free Access

An amniote life-history database to perform comparative analyses with birds, mammals, and reptiles

Ecological Archives E096-200

Nathan F. Myhrvold, Elita Baldrige, Benjamin Chan, Dhileep Sharm, Daniel L. Freeman, S.K. Morgan Ernest

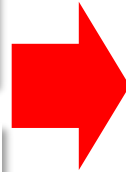
Global Ecology
and Biogeography

A Journal of
Macroecology

RESEARCH ARTICLE  Open Access 

Population density estimates for terrestrial mammal species

Luca Santini  Ana Benítez-López, Carsten F. Dormann, Mark A. J. Huijbrechts



SURVIVAL / ITERATION



Roadkill Rate



Survival Rates



Longevity



**DEMOGRAPHIC /
REPRODUCTIVE TIMING**



Age at First Birth



Average Litter Size



Min Interval Between Births



Average Interval Between Births



POPULATION / MOVEMENT



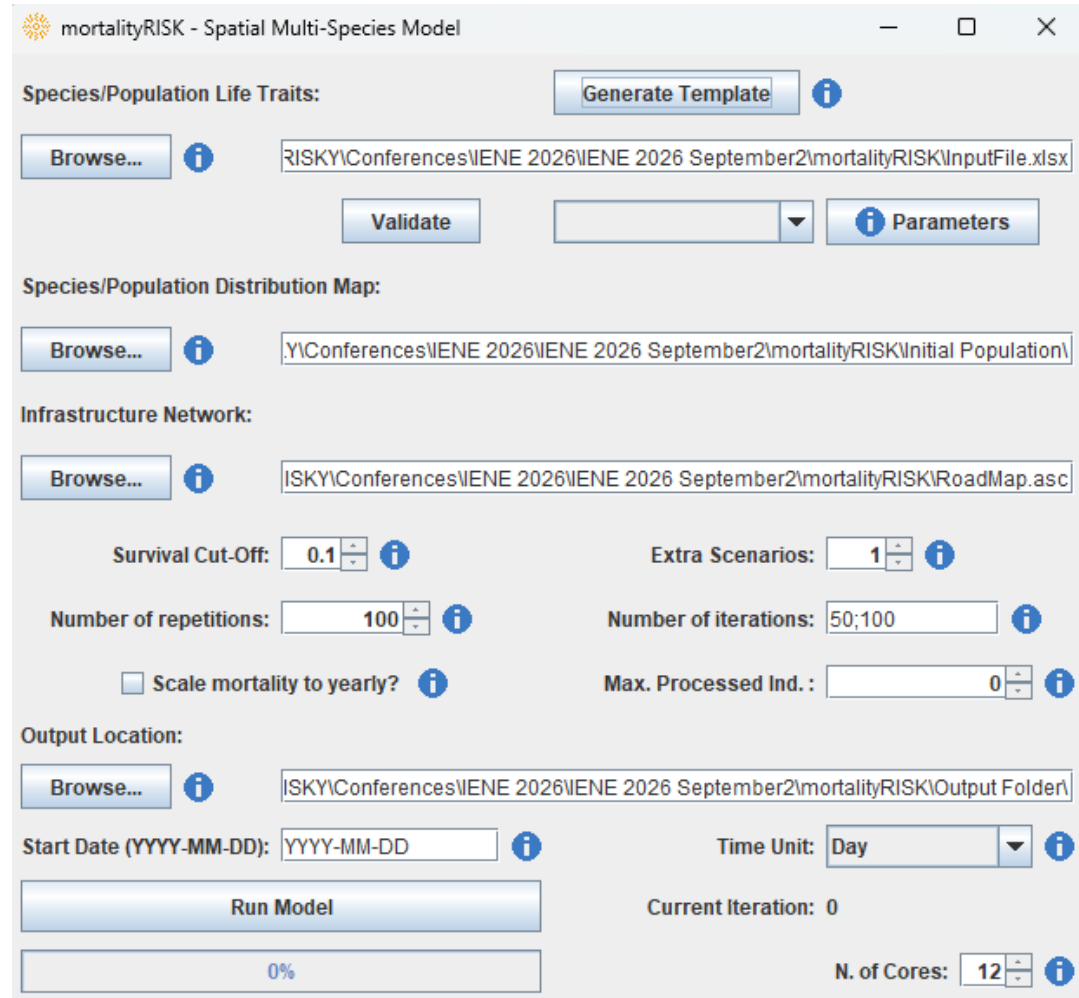
Population Density



Max Dispersal Length

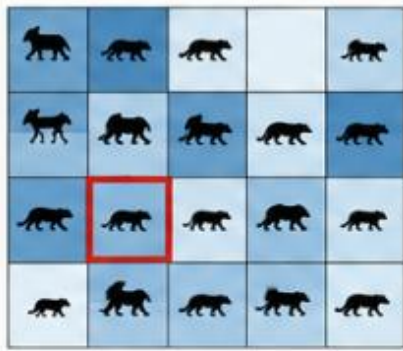


Mate Finding Radius (m)



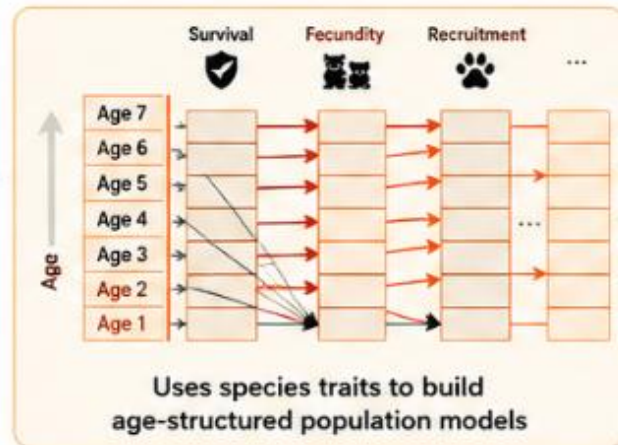


1. POPULATION DENSITY

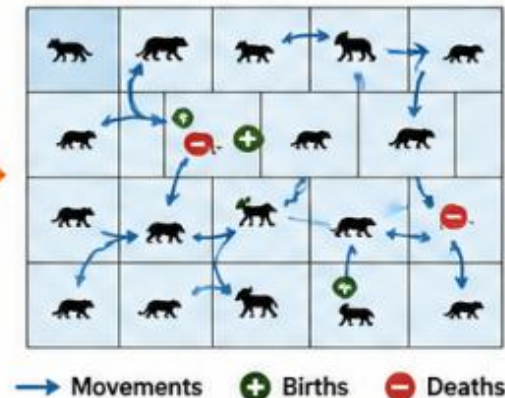


Low  High
Density

2. DEMOGRAPHIC MODEL



3. STOCHASTIC SIMULATION



- 50 years
- Max roadkill detected
- Grid square 50x50km
- Only in suitable habitat
- 50 repetitions of the model
- 95% confidence of risk of extinction

Highest roadkill rates



LC

Crab-eating fox
Cerdocyon thous

4.00 ind./km/year

Colombia

De la Ossa & Galvan-Guevara 2015



LC

Raccoon
Procyon lotor

3.90 ind./km/year

USA

Nelson & Scardamaglia-Nelson 2003



LC

Sechuran fox
Lycalopex sechurae

2.77 ind./km/year

Peru

Yesquen 2018



LC

Hog-nosed skunk
Conepatus chinga

2.06 ind./km/year

Brazil

Silva et al. 2013



CR

European mink
Mustela lutreola

0.02 ind./km/year

Ireland

Ludgate & Kelly 2013



EN

Dhole
Cuon alpinus

0.04 ind./km/year

India

Behera & Borah 2010



EN

African wild dog
Lycaon pictus

0.009 ind./km/year

Zambia

Mkanda & Chansa 2011



EN

Tiger
Panthera tigris

0.000006 ind./km/year

Nepal

Bhandari et al. 2024

Impact on Populations

5 species

EUROPEAN WILDCAT

Felis silvestris



0.31 ind./km/year

SPOTTED HYENA

Crocuta crocuta



0.94 ind./km/year

LEOPARD

Panthera pardus



0.05 ind./km/year

ONCILLA

Leopardus tigrinus



0.26 ind./km/year

COYOTE

Canis latrans



0.92 ind./km/year

Average Population change

with max and average observed roadkill rate

EUROPEAN WILDCAT
Felis silvestris



-15% (-3%)

SPOTTED HYENA
Crocuta crocuta



-13% (-0.26%)

LEOPARD
Panthera pardus



-28% (-21%)

ONCILLA
Leopardus tigrinus



-15% (-2%)

COYOTE
Canis latrans



-8% (-0.74%)

GLOBAL EFFECTS OF ROADKILL ON

CARNIVORE PERSISTENCE

OVER THE NEXT 50 YEARS

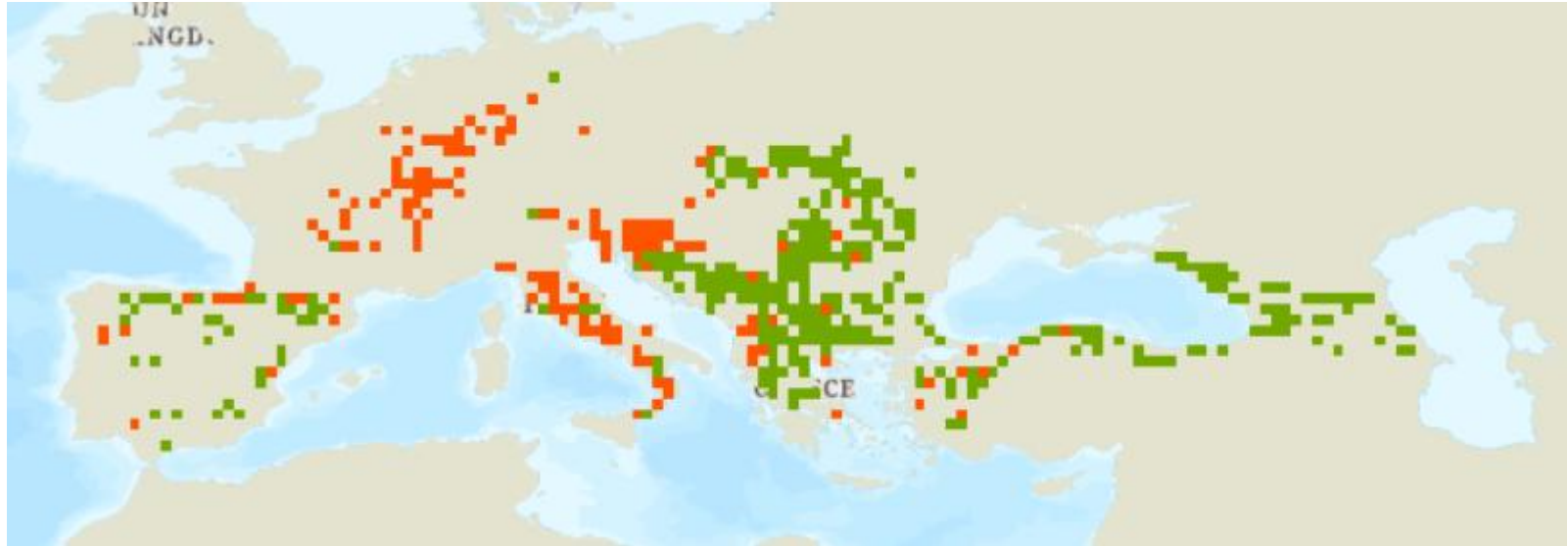
Reduction of species range

95% confidence of extinction
with max observed roadkill rate

-32%

EUROPEAN WILDCAT

Felis silvestris



GLOBAL EFFECTS OF ROADKILL ON

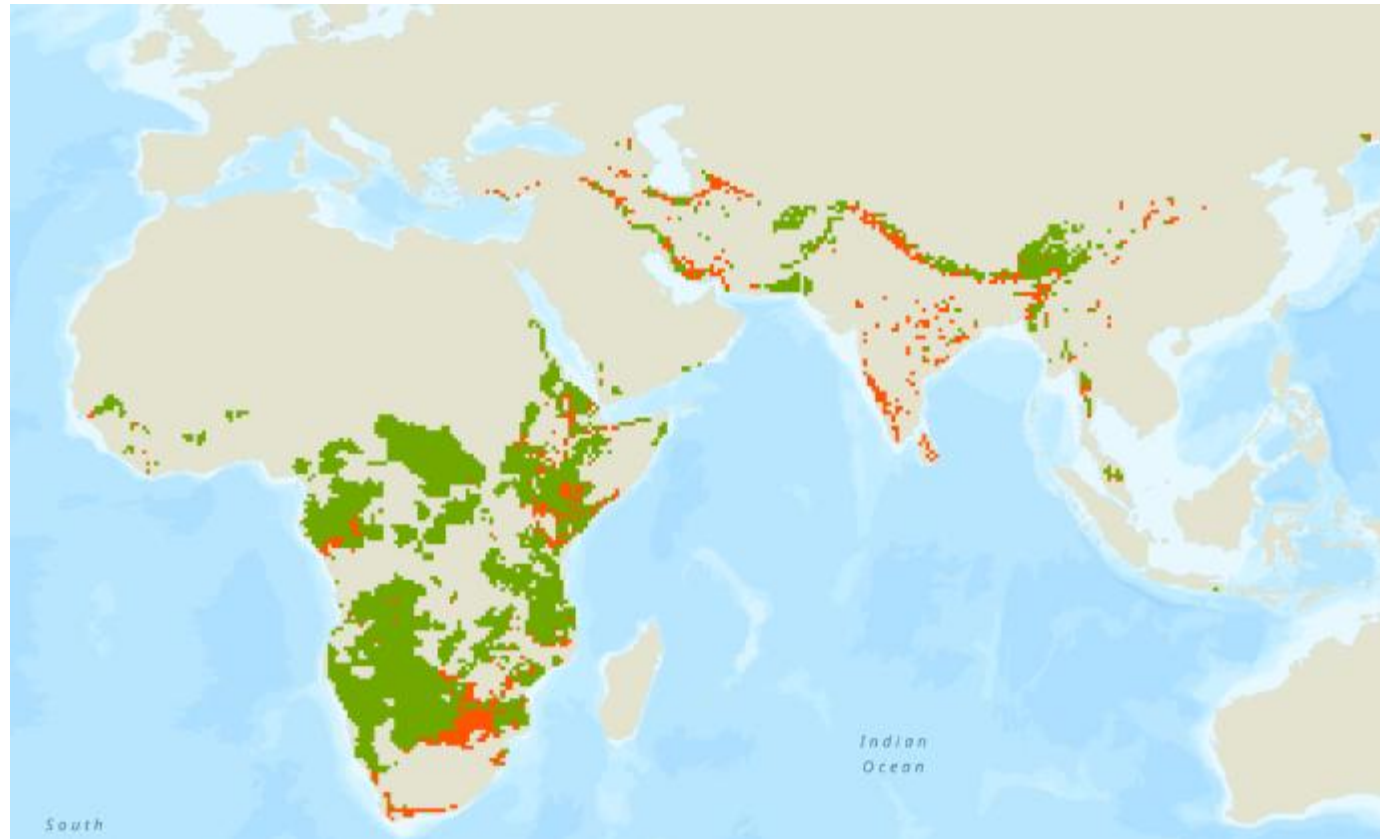
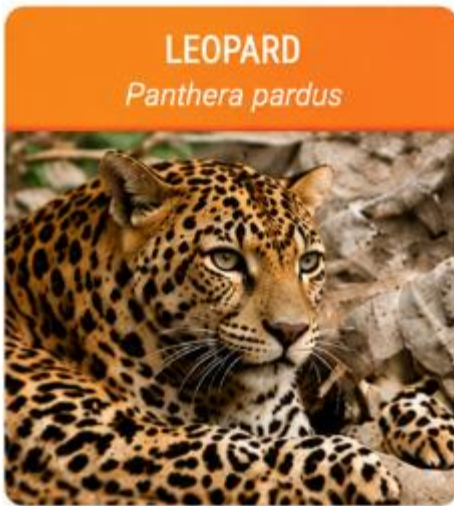
CARNIVORE PERSISTENCE

OVER THE NEXT 50 YEARS

Reduction of species range

95% confidence of extinction
with max observed roadkill rate

-18%



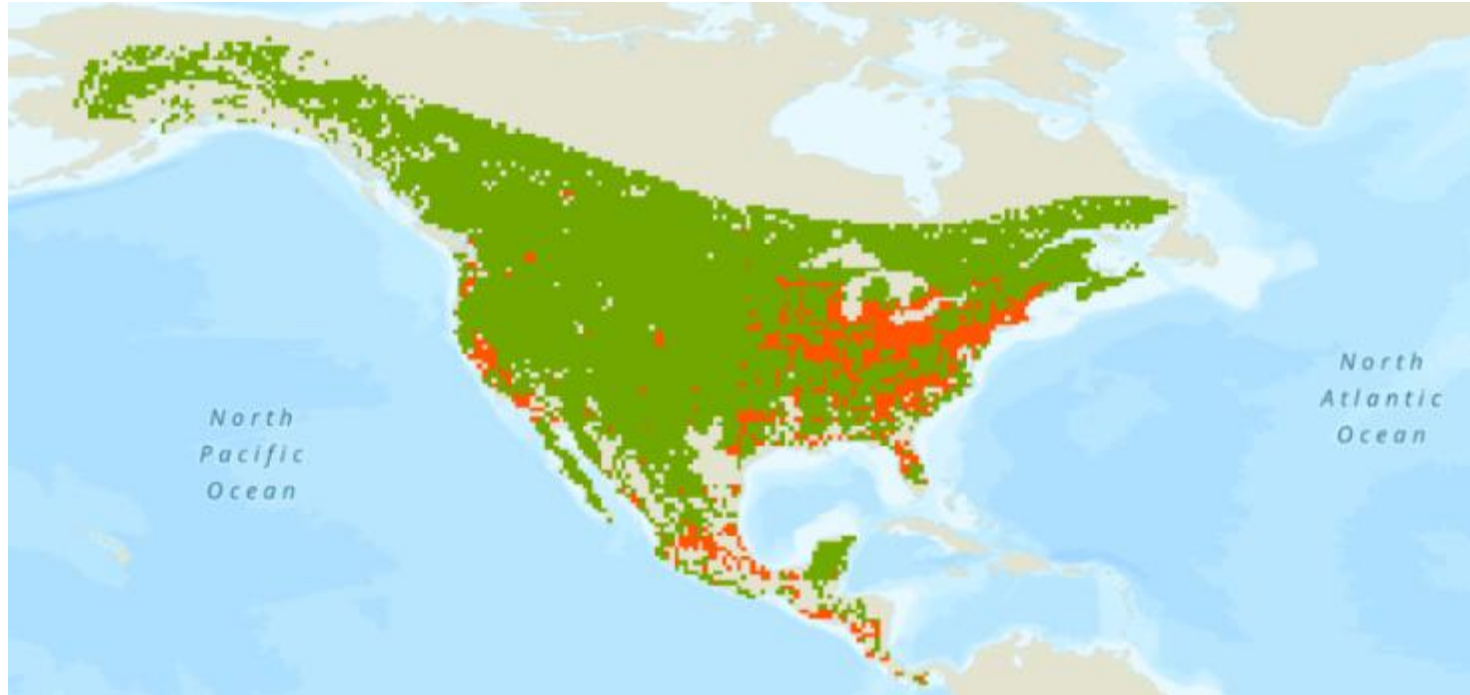
Reduction of species range

95% confidence of extinction
with max observed roadkill rate

-11%

COYOTE

Canis latrans



GLOBAL EFFECTS OF ROADKILL ON
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OVER THE NEXT 50 YEARS

Mortality thresholds

Average roadkill rate

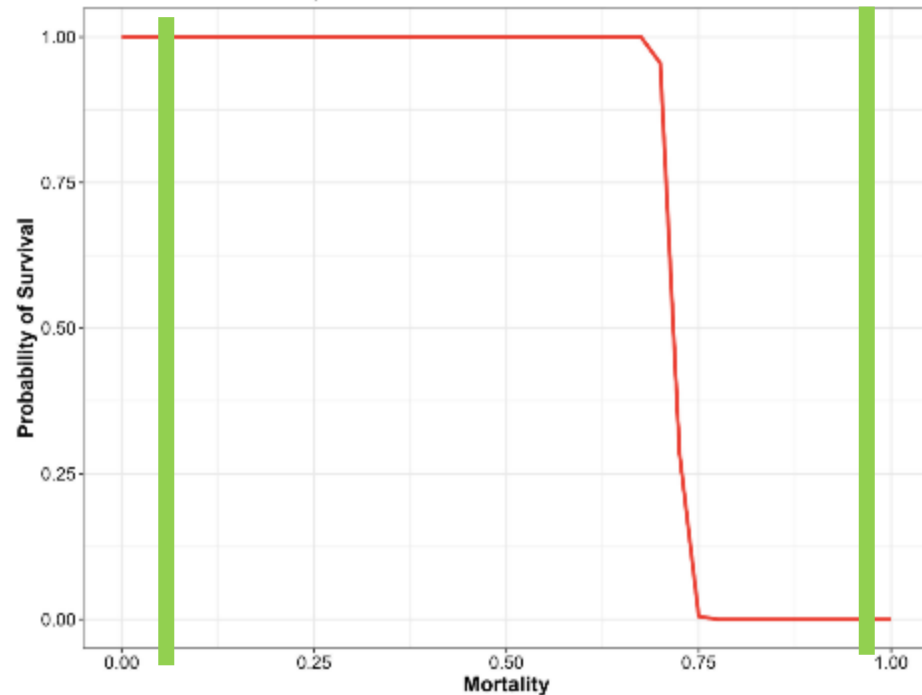
EUROPEAN WILDCAT

Felis silvestris



Probability of Survival over Mortality: *Felis silvestris*

Source: 600 iterations 200 repetitions



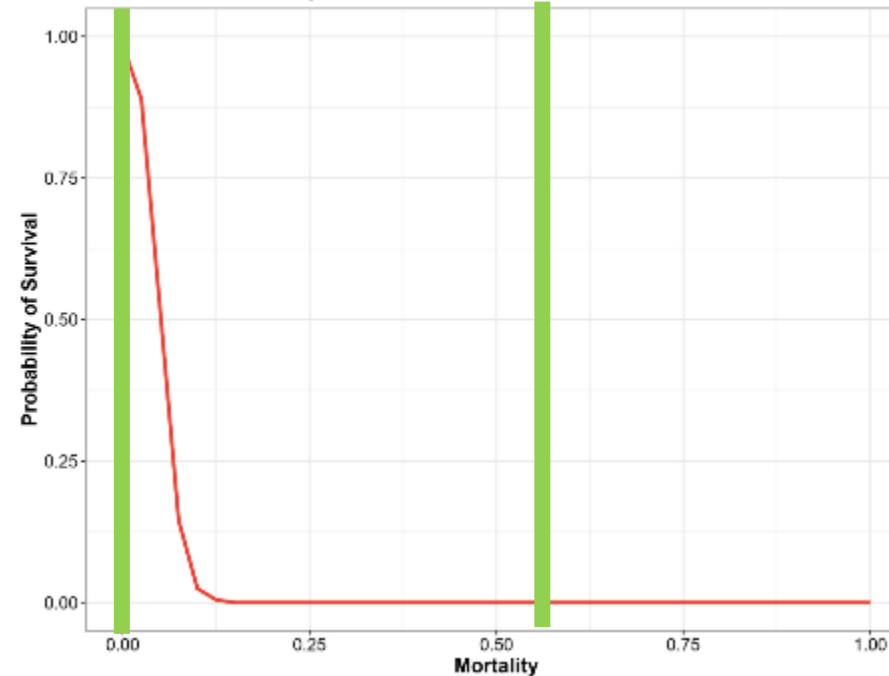
LEOPARD

Panthera pardus



Probability of Survival over Mortality: *Panthera pardus*

Source: 600 iterations 200 repetitions



— observed
proportion of
the population
roadkilled

— Probability of
survival/
proportion of
population
roadkilled

GLOBAL EFFECTS OF ROADKILL ON
CARNIVORE PERSISTENCE
OVER THE NEXT 50 YEARS

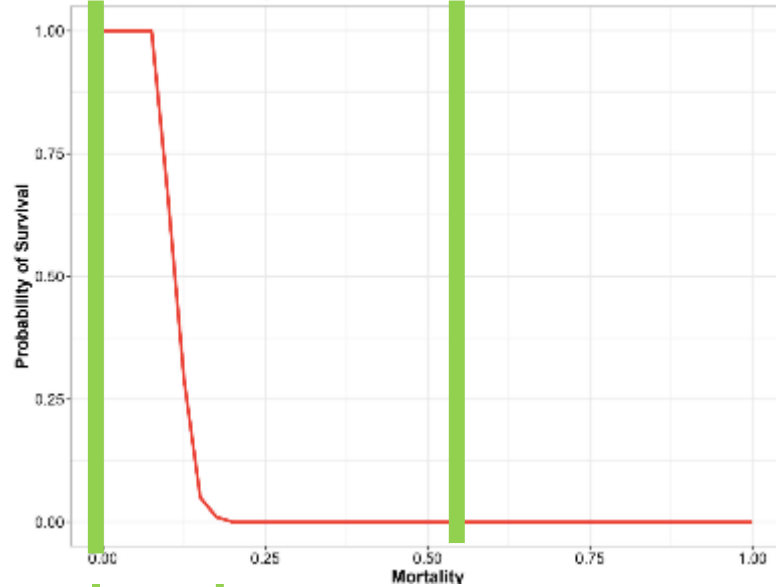


Mortality thresholds

Average roadkill rate

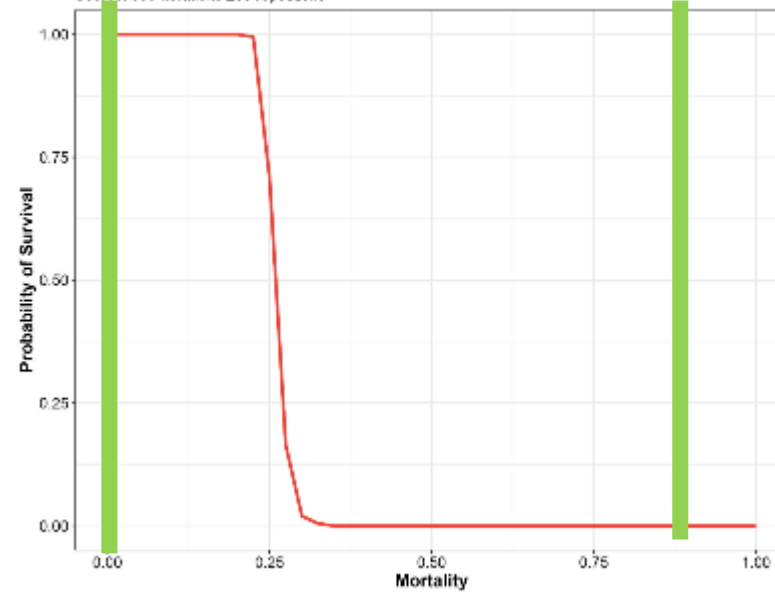
Probability of Survival over Mortality: *Leopardus tigrinus*

Source: 600 iterations 200 repetitions



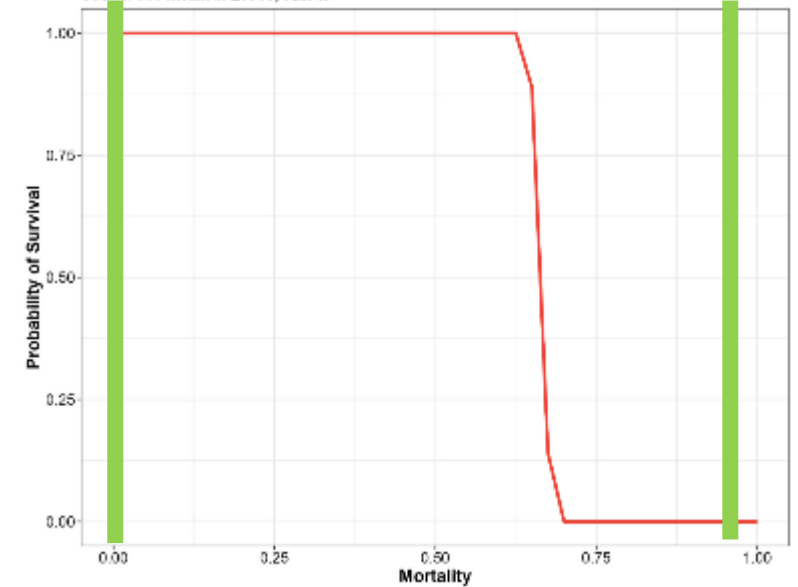
Probability of Survival over Mortality: *Crocuta crocuta*

Source: 600 iterations 200 repetitions



Probability of Survival over Mortality: *Canis latrans*

Source: 600 iterations 200 repetitions



UNDERSTANDING WHEN ROADKILL BECOMES A
POPULATION-LEVEL THREAT
IS ESSENTIAL TO KEEP CARNIVORES PERSISTING IN ROAD-DOMINATED LANDSCAPES.

1

ROADKILL CAN REDUCE CARNIVORE PERSISTENCE

Population decline, range contraction and extinction risk

2

MONITORING NEEDS TO MATCH THE SCALE OF POPULATION IMPACTS

Systematic road surveys at regional scale

3

BETTER DEMOGRAPHIC DATA ARE ESSENTIAL

Population-specific demographic parameters improve risk estimates

4

ROADKILL DOES NOT ACT ALONE

Models should incorporate other sources of mortality and habitat fragmentation

GLOBAL EFFECTS OF ROADKILL ON
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OVER THE NEXT 50 YEARS



Global platform for wildlife mortality
from energy and transport infrastructure

Thank you
for your attention!



Clara Grilo

CIBIO | BIOPOLIS
Universidade do Porto

✉ clara.grilo@cibio.up.pt

