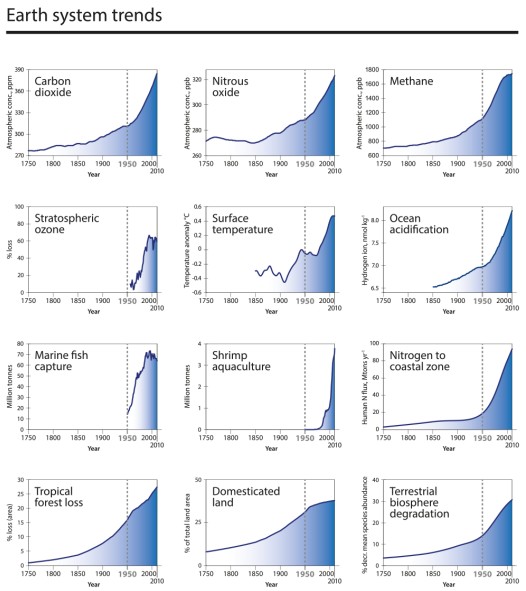
Nature of Cities: building happier, healthier and more resilient urban environments

Kate Jones | @ProfKateJones

Credit: Getty Images

Nature of Cities

Welcome to the Anthropocene



HOBOKEN LECTURE

Nature in Cities

Does does it matter?

'Tip of the iceberg': is our destruction of nature responsible for Covid-19?

As habitat and biodiversity loss increase globally, the coronavirus outbreak may be just the beginning of mass pandemics

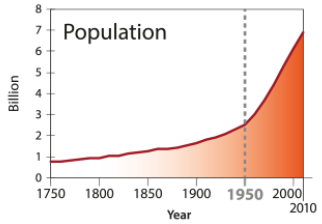
A dead monkey sold as bushmeat hangs outside a villager's house in north-east Gabon. Photograph: Christine Nesbitt/AP

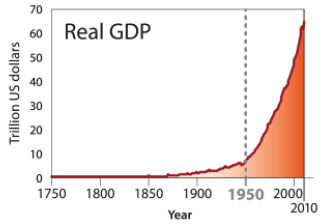
Mayibout 2 is not a healthy place. The 150 or so people who live in the village, which sits on the south bank of the Ivindo River, deep in the great Minkebe Forest in northern Gabon, are used to occasional bouts of diseases such as malaria, dengue, yellow fever and sleeping sickness. Mostly they shrug them off.

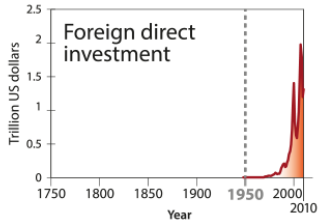
Solutions - Challenges & Opportunities

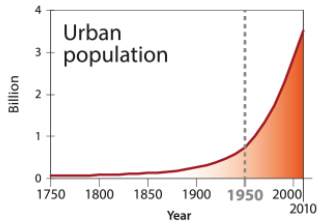
Welcome to the Anthropocene!

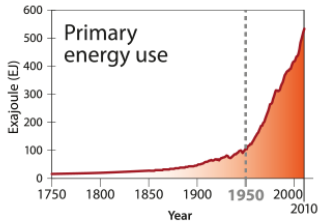
Socio-economic trends

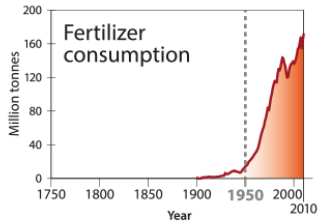


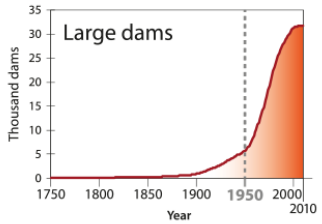


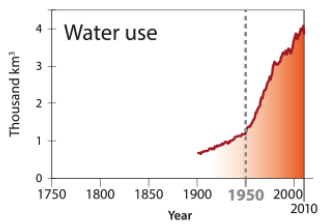


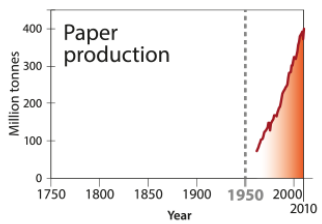


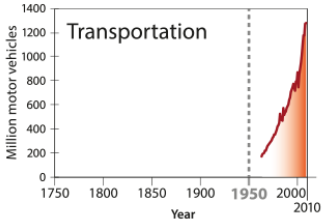


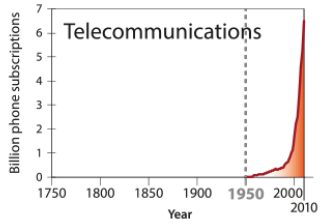


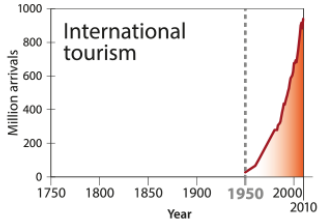




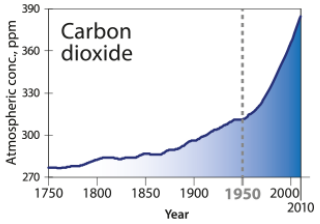


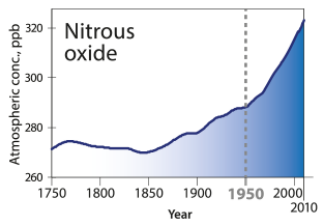


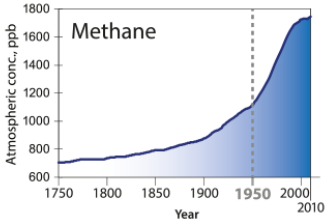


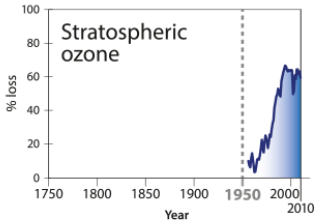


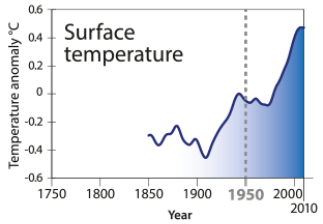
Earth system trends

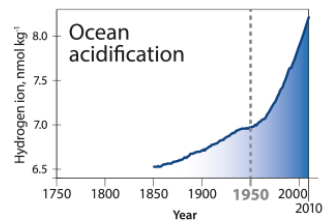


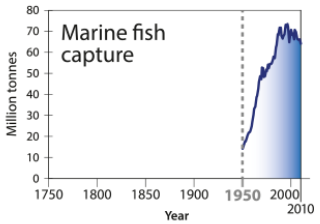


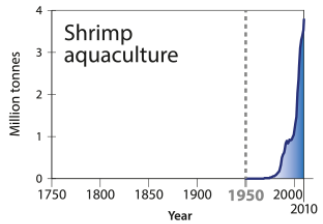


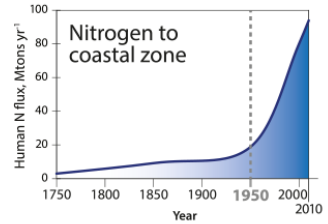


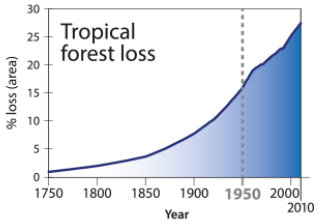


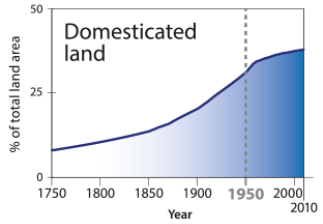


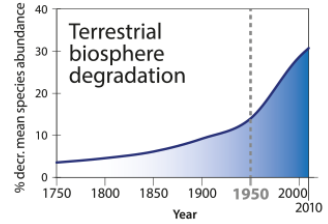


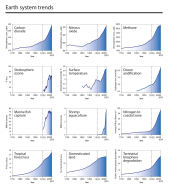




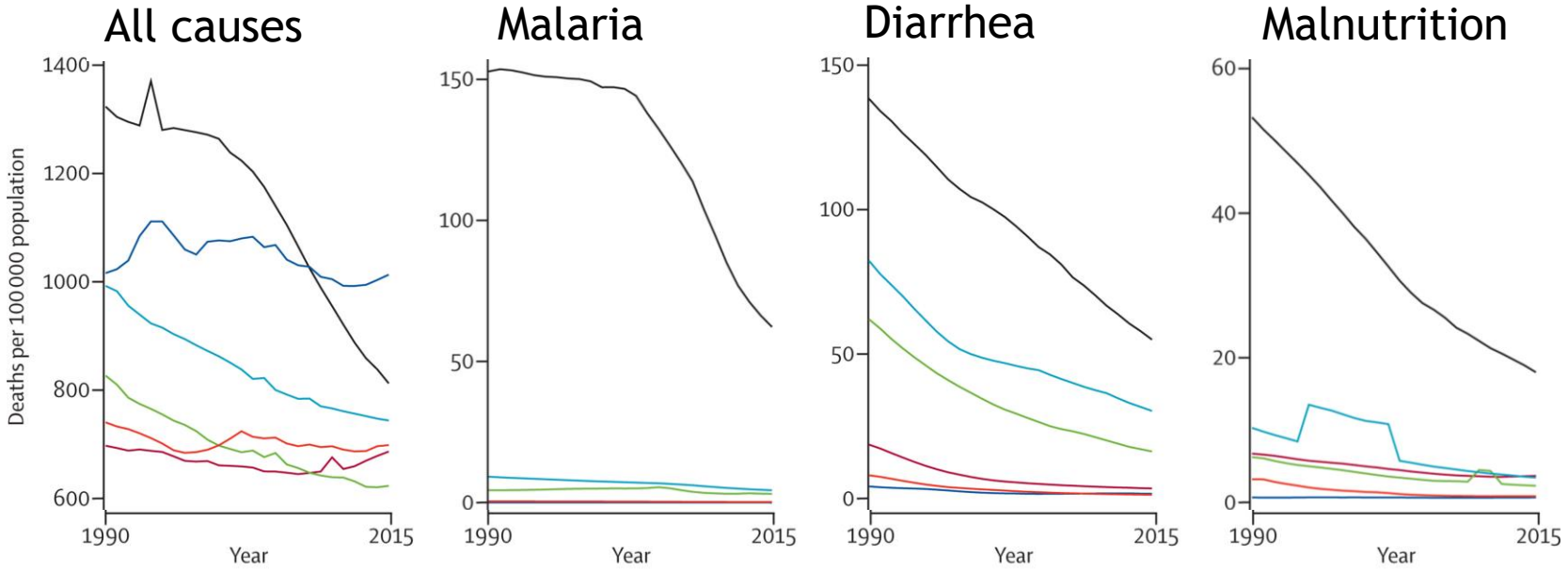


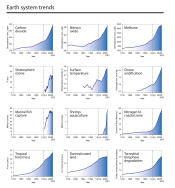






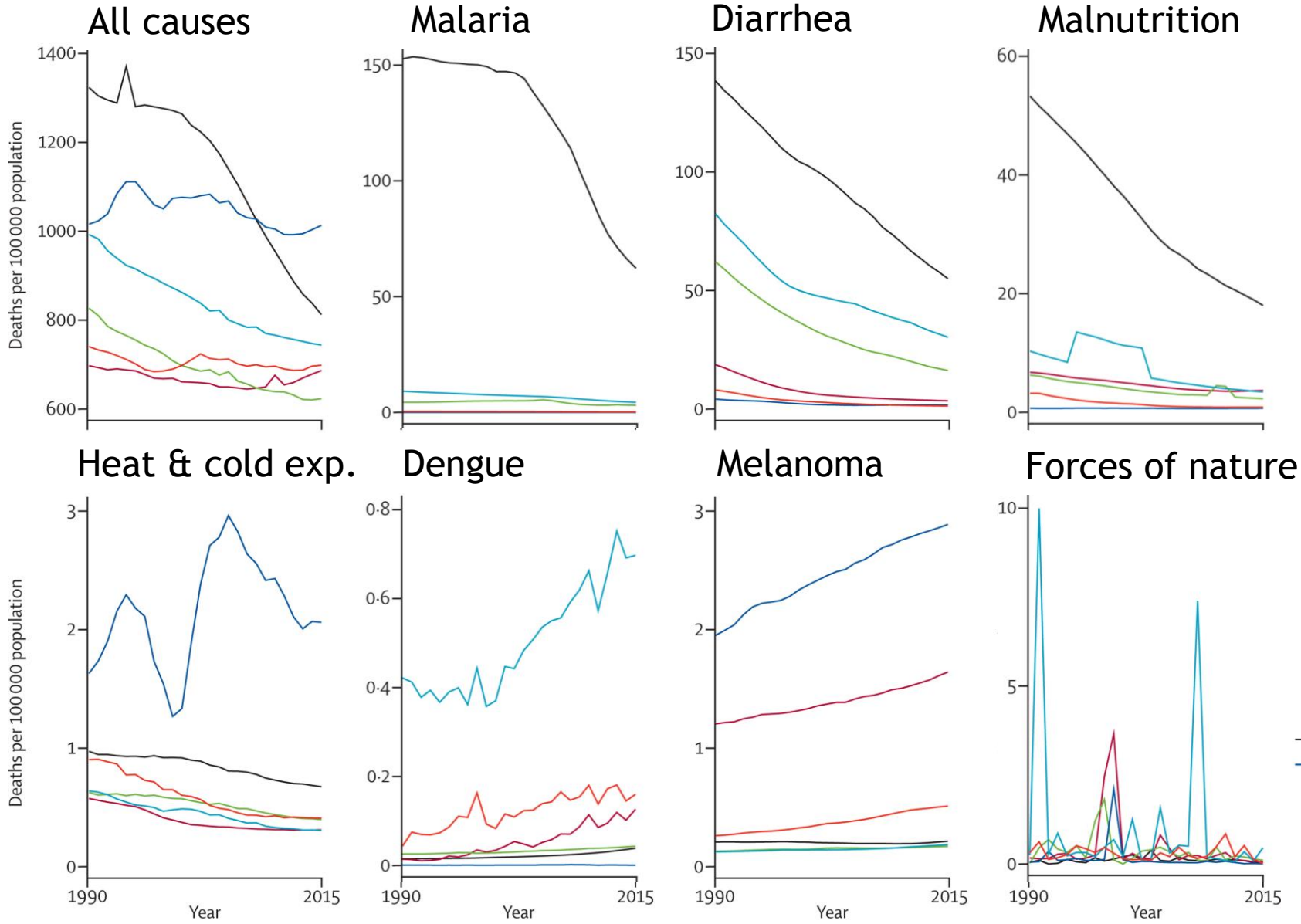
Global burden of disease is declining

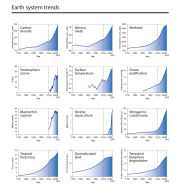




WHO GBD 2015
in Watts *et al*. 2017 *Lancet*

…but some diseases are increasing…

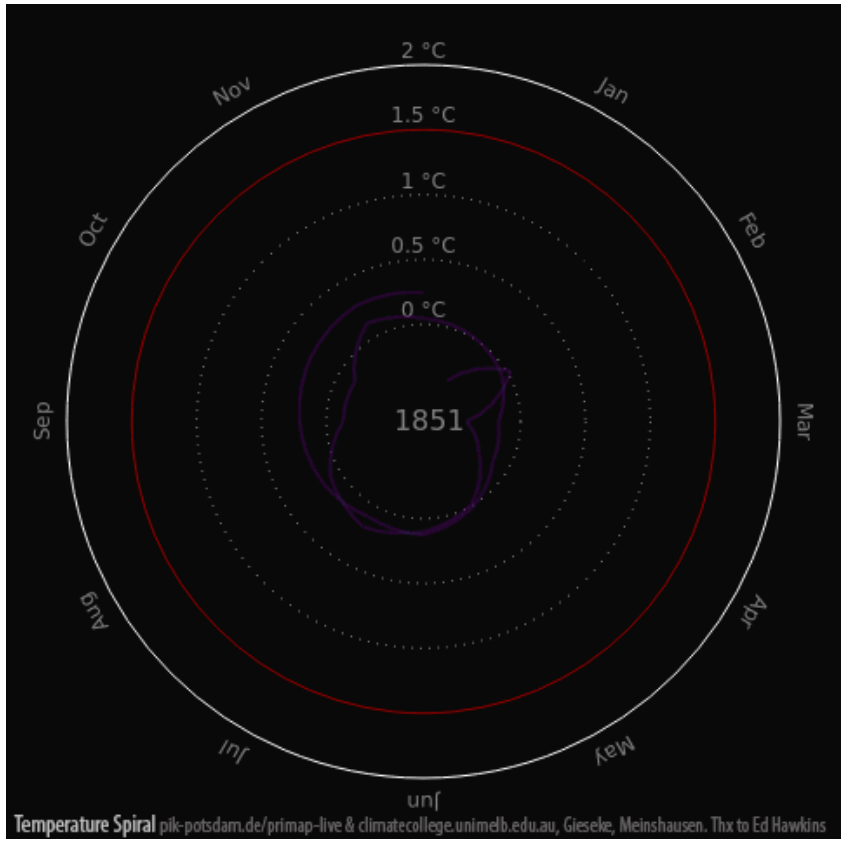




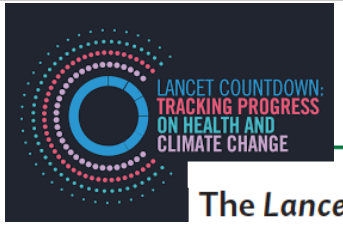
WHO GBD 2015
in Watts *et al*. 2017 *Lancet*

Links to public health and climate change

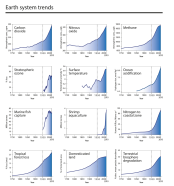
Global Temperature Change
1850-2016



@ed_hawkins



Review



The *Lancet* Countdown on health and climate change: from 25 years of inaction to a global transformation for public health

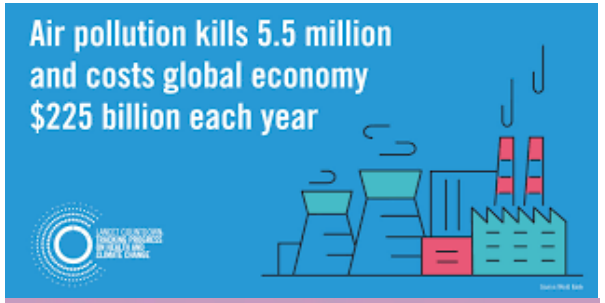
Nick Watts, Markus Amann, Sonja Ayeb-Karlsson, Kristine Belesova, Timothy Bouley, Maxwell Boykoff, Peter Byass, Wenjia Cai, Diarmid Campbell-Lendrum, Jonathan Chambers, Peter M Cox, Meaghan Daly, Niheer Dasandi, Michael Davies, Michael Depledge, Anneliese Depoux, Paula Dominguez-Salas, Paul Drummond, Paul Ekins, Antoine Flahault, Howard Frumkin, Lucien Georgeson, Mostafa Ghanei, Delia Grace, Hilary Graham, Rébecca Grojsman, Andy Haines, Ian Hamilton, Stella Hartinger, Anne Johnson, Ilan Kelman, Gregor Kiesewetter, Dominic Kniveton, Lu Liang, Melissa Lott, Robert Lowe, Georgina Mace, Maquins Odhiambo Sewe, Mark Maslin, Slava Mikhaylov, James Milner, Ali Mohammad Latifi, Maziar Moradi-Lakeh, Karyn Morrissey, Kris Murray, Tara Neville, Maria Nilsson, Tadj Oreszczyn, Fereidoon Owfi, David Pencheon, Steve Pye, Mahnaz Rabbaniha, Elizabeth Robinson, Joacim Rocklov, Stefanie Schütte, Joy Shumake-Guillemot, Rebecca Steinbach, Meisam Tabatabaei, Nicola Wheeler, Paul Wilkinson, Peng Gong*, Hugh Montgomery*, Anthony Costello*

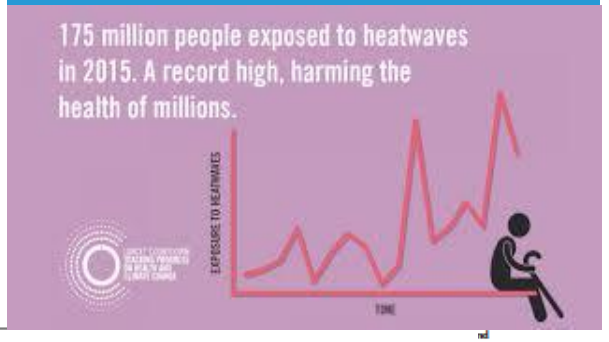
Executive summary

The *Lancet* Countdown tracks progress on health and climate change and provides an independent assessment of the health effects of climate change, the implementation of the Paris Agreement,[1] and the health implications of these actions. It follows on from the work of the 2015 *Lancet* Commission on Health and Climate Change,[2] which concluded that anthropogenic climate change threatens to undermine the past 50 years of gains in public health, and conversely, that a comprehensive response to climate change could be "the greatest global health opportunity of the 21st century".

The *Lancet* Countdown is a collaboration between 24 academic institutions and intergovernmental organisations based in every continent and with representation from a wide range of disciplines. The collaboration includes climate scientists, ecologists, economists, engineers, experts in energy, food, and transport systems, geographers, mathematicians, social and political scientists, public health professionals, and doctors. It reports annual indicators across five sections: climate change impacts, exposures, and vulnerability; adaptation planning and resilience for health; mitigation actions and health co-benefits; economics and finance; and public and political engagement.

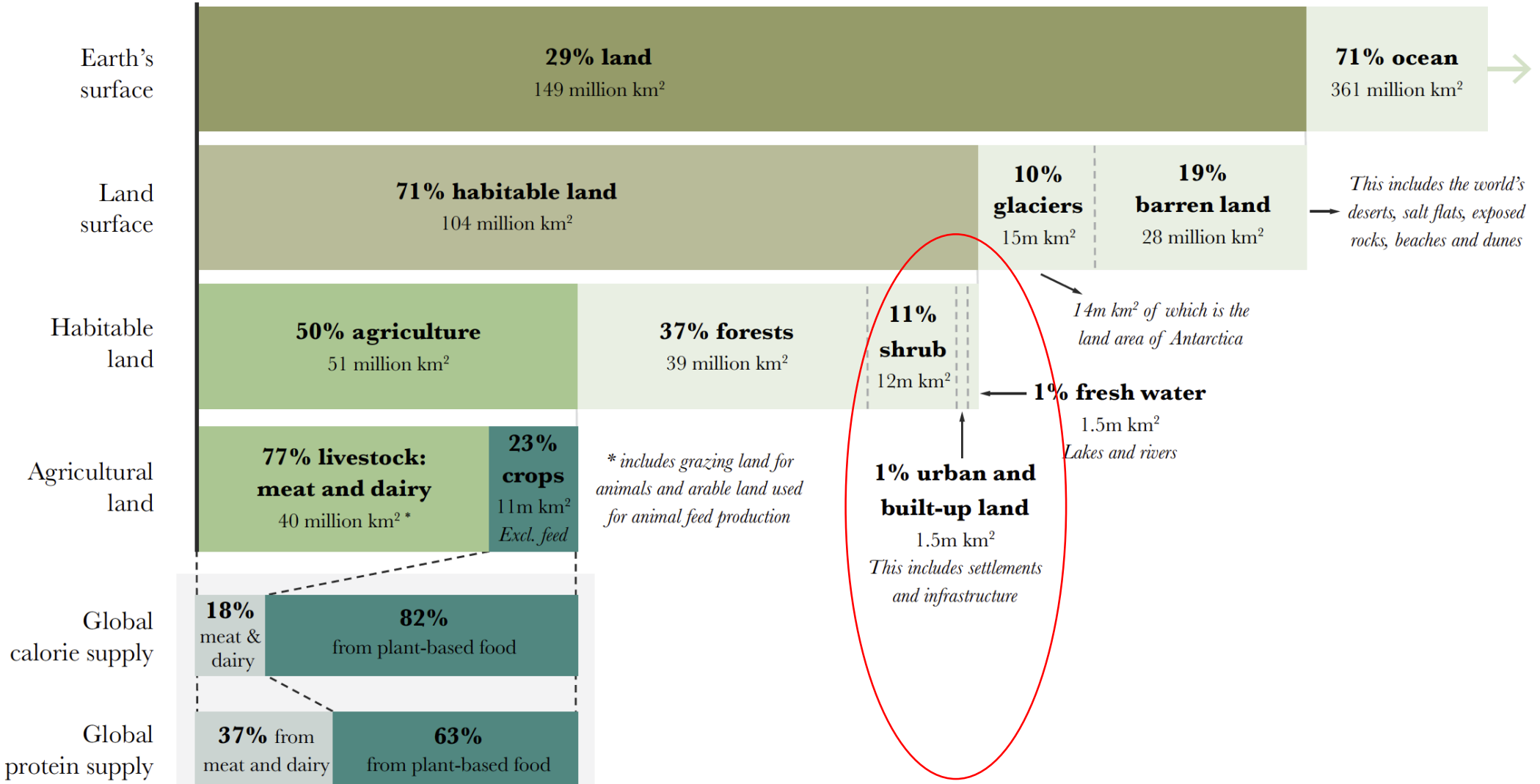
The key messages from the 40 indicators in the *Lancet* Countdown's 2017 report are summarised below.

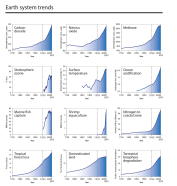




Watts *et al*. 2015 *Lancet*

Global land use for food production



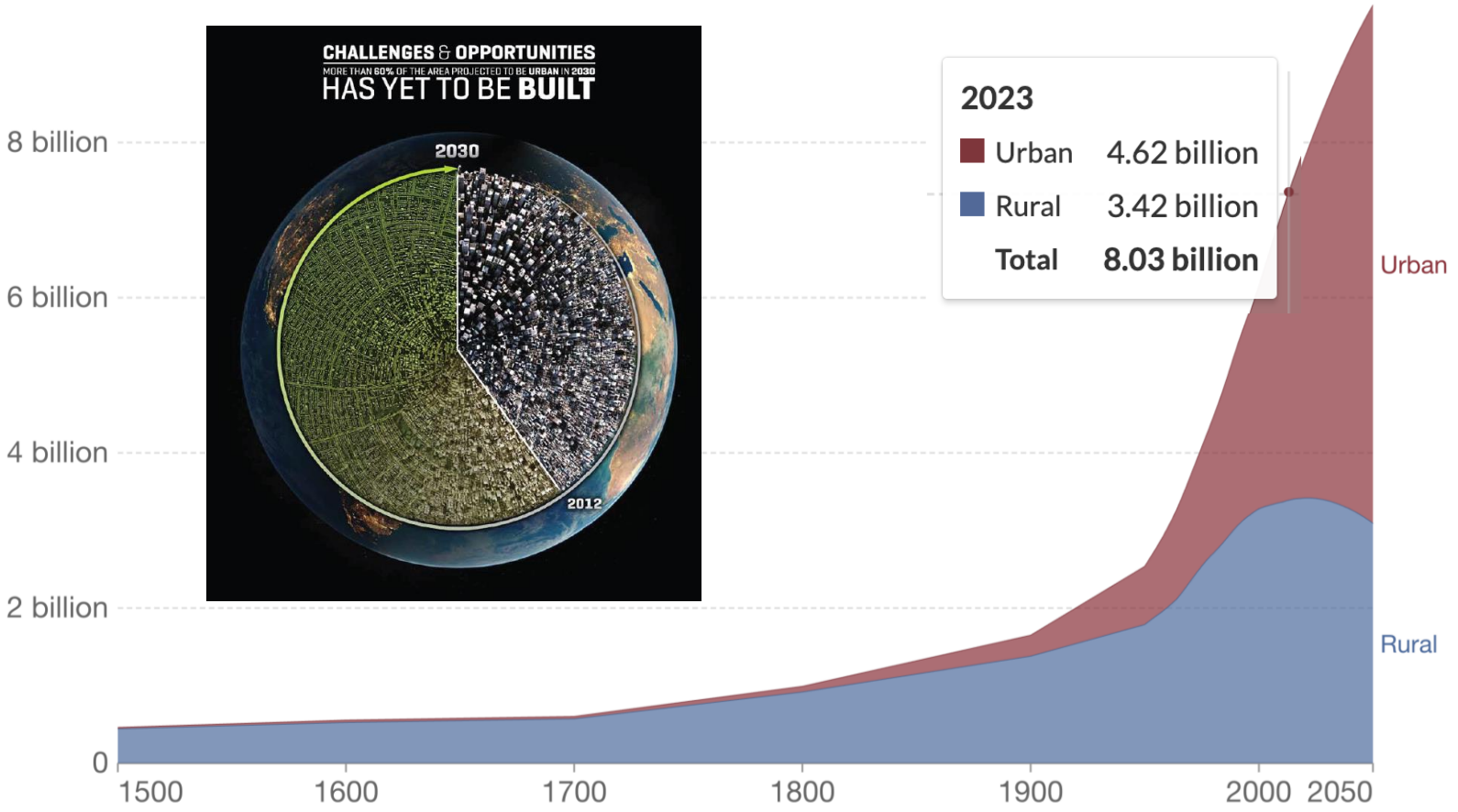


Global urbanisation trends

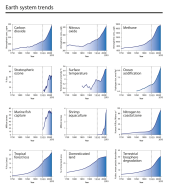
Urban and rural population projected to 2050, World, 1500 to 2050

Total urban and rural population, given as estimates to 2016, and UN projections to 2050. Projections are based on the UN World Urbanization Prospects and its median fertility scenario.

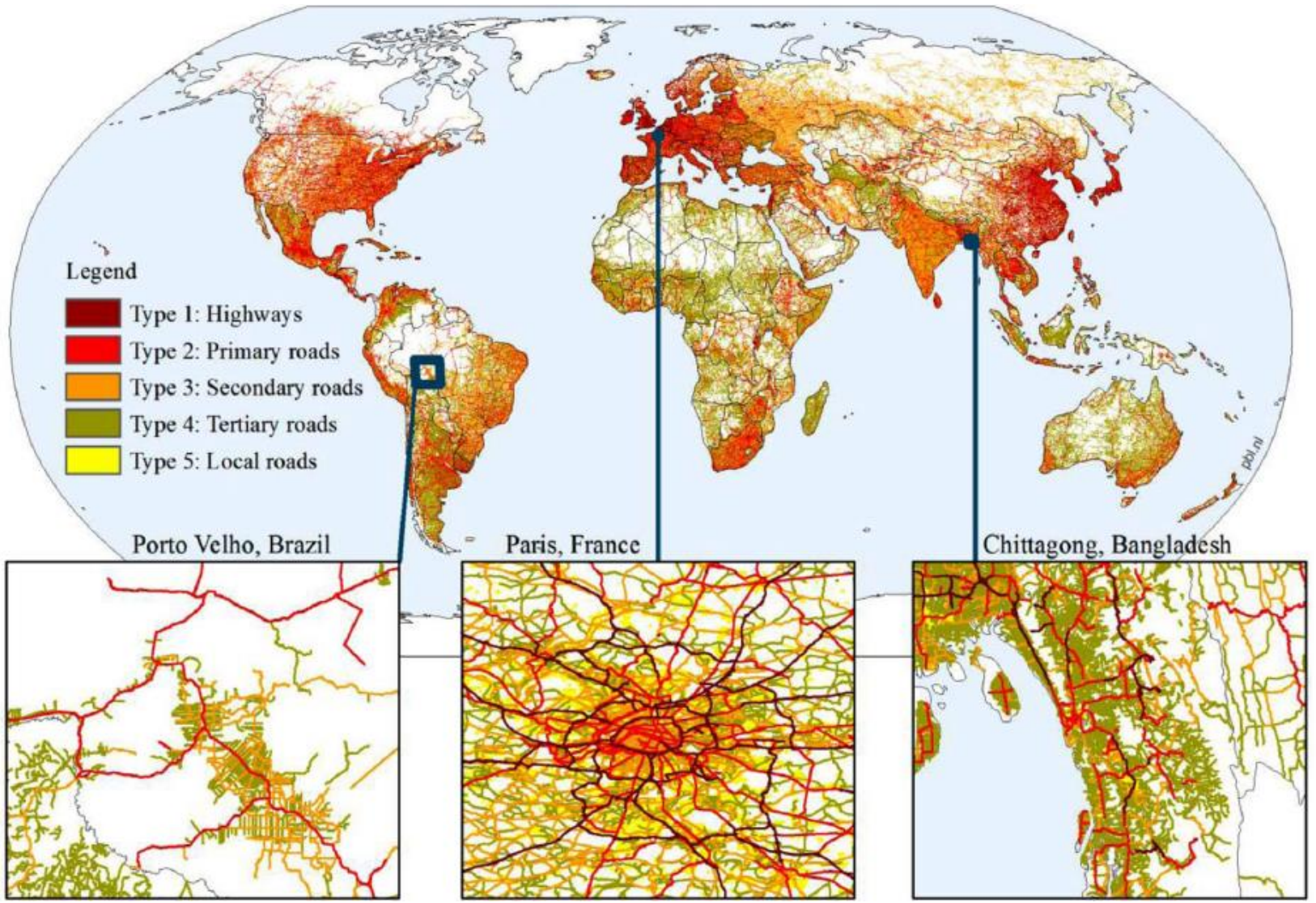
Our World in Data

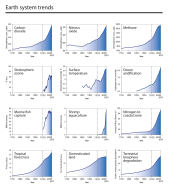


Source: OWID based on UN World Urbanization Prospects 2018 and historical sources (see Sources)
OurWorldInData.org/urbanization • CC BY



Global road-ization

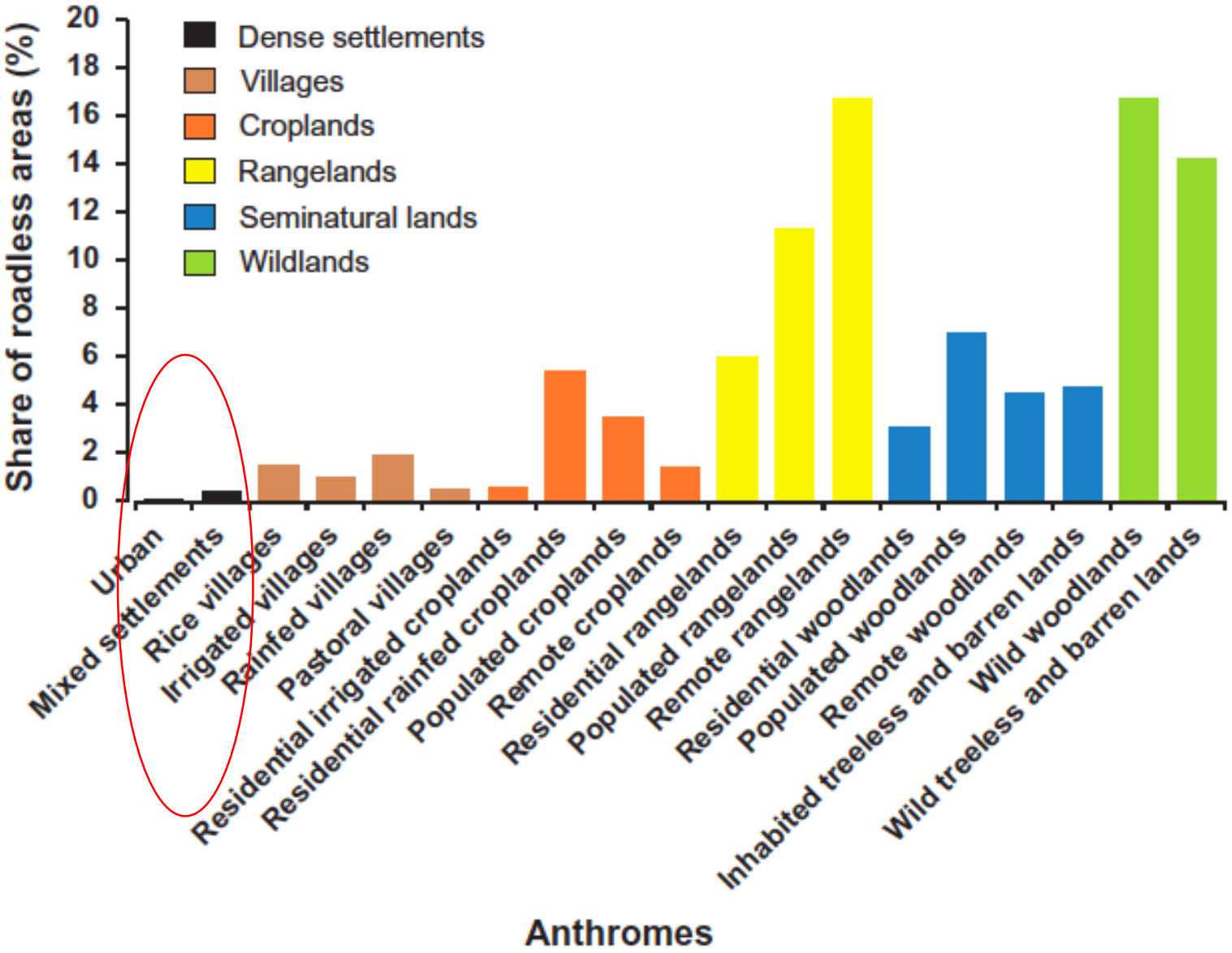


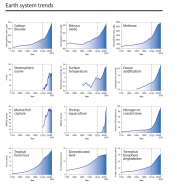


Highest road densities associated with more densely populated and wealthier countries

Meijer *et al* 2018 *Environmental Research Letters*

Most habitats are fragmented by roads

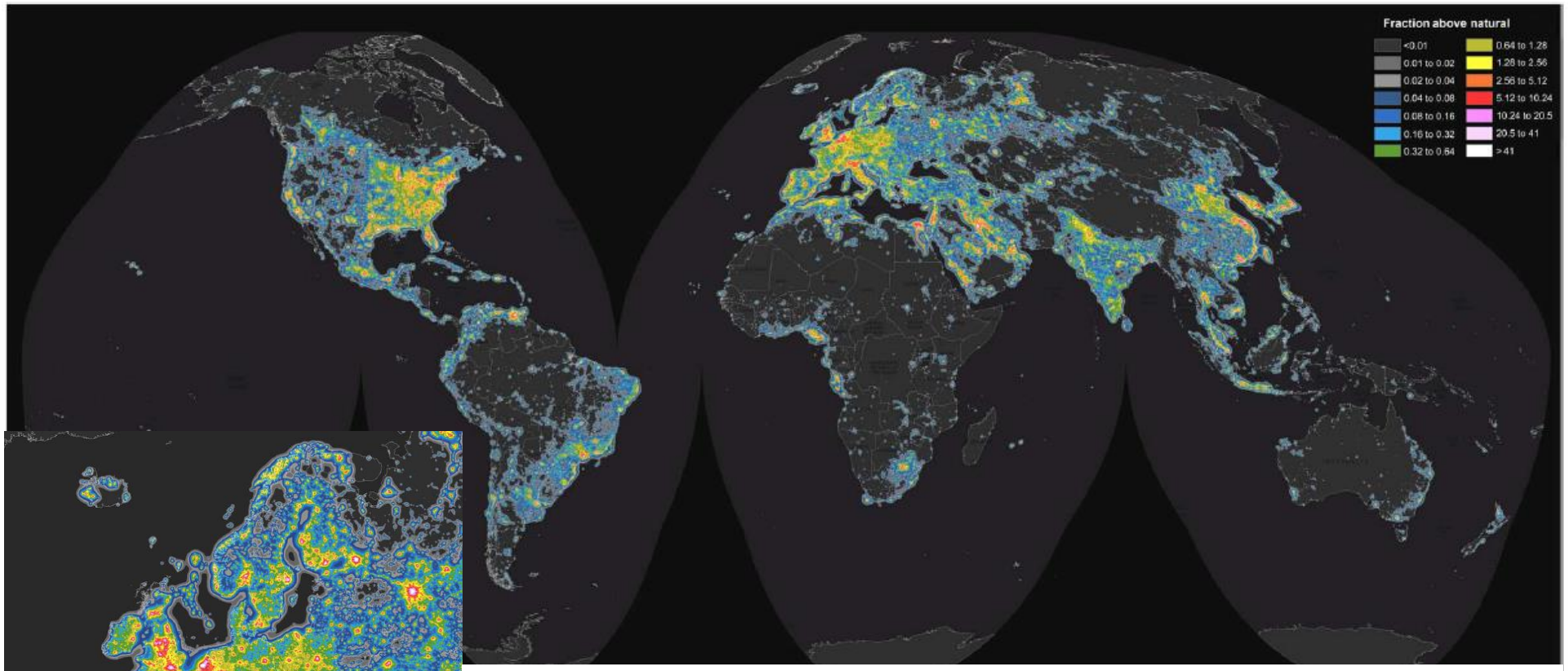




- 80% of globe remains roadless but roads act to fragment landscape into small patches (50% under 1km^2)
- Urban areas have the smallest share of roadless areas.

Ibisch *et al* 2016 *Science*

Global artificial light-ization



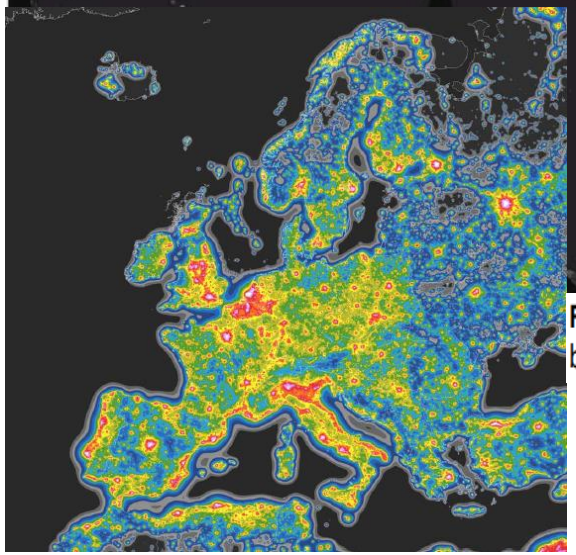
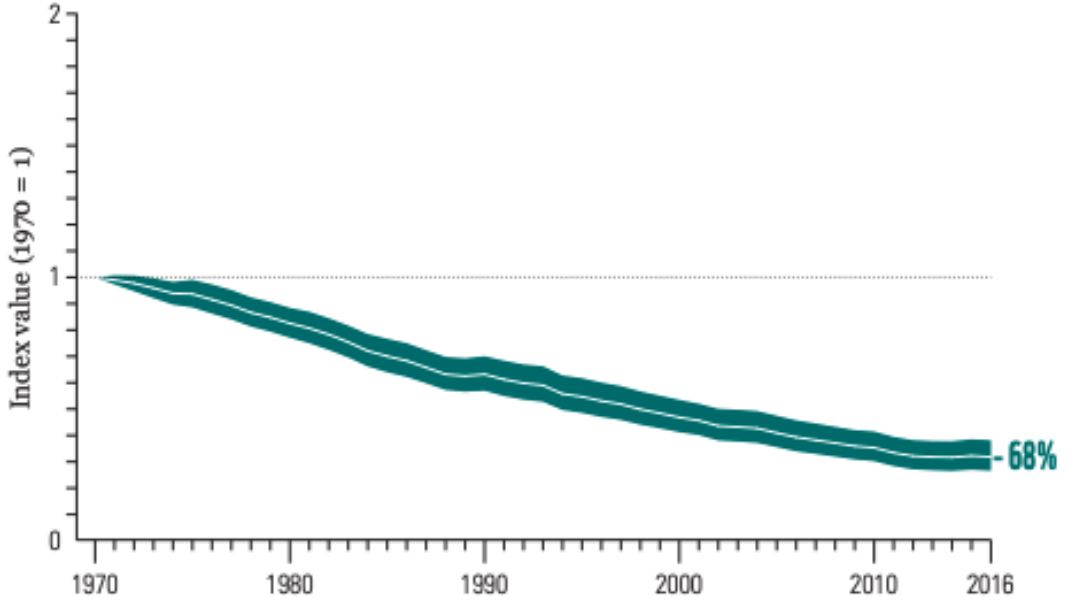


Fig. 2. World map of artificial sky brightness. The map shows, in twofold increasing steps, the artificial sky brightness as a ratio to the natural sky brightness (assumed to be 174 μcd/m^2). Table 1 indicates the meaning of each color level.

80% of the world, 99% of US and European populations live under light polluted skies

Falchi *et al* 2016 *Science Advances*

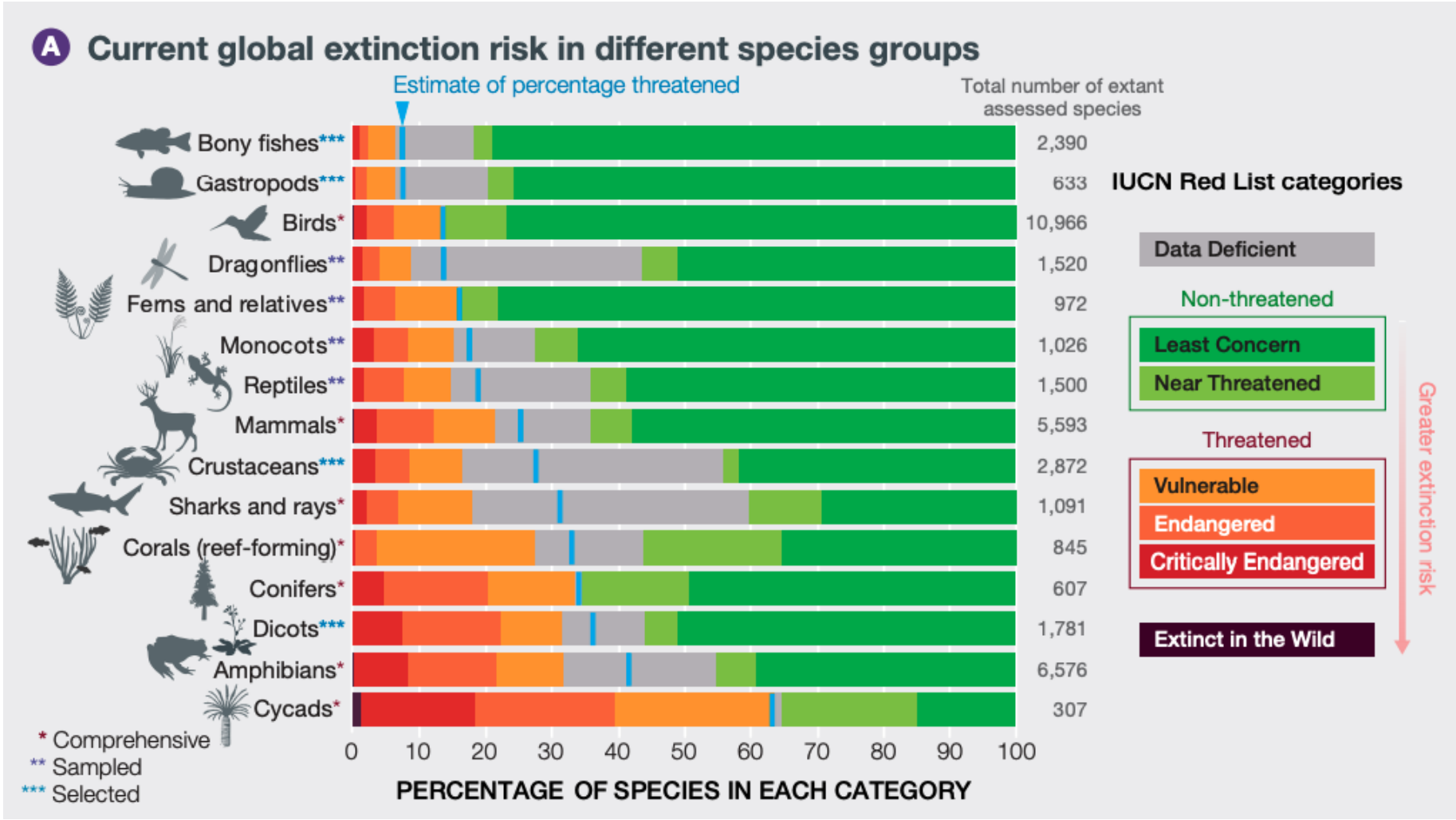
Global decline of wildlife population abundance

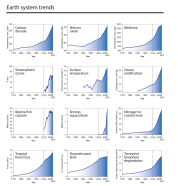


Living Planet Index

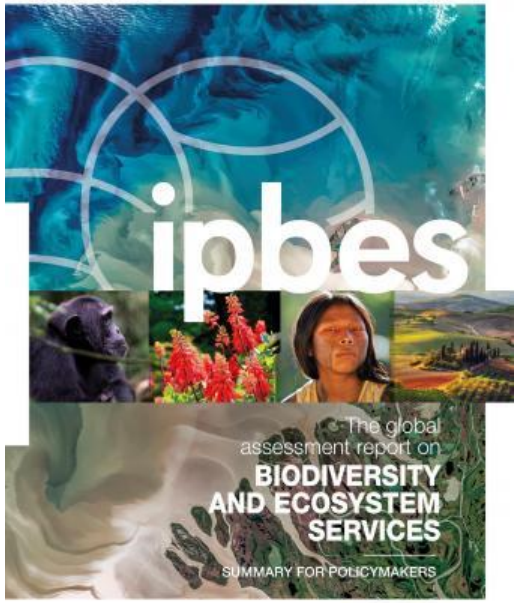
The Living Planet Index (LPI) now tracks the abundance of almost 21,000 populations of mammals, birds, fish, reptiles ***and amphibians around the world[107]. Using the data from 20,811 populations of 4,392 species, the 2020 global LPI shows an average 68% decline in monitored populations between 1970 and 2016 (range: -73% to -62%). The percentage change in the index doesn't represent the number of individual*** *animals lost but reflects the average proportional change in animal population sizes tracked over 46 years.*

Global risk of species extinction



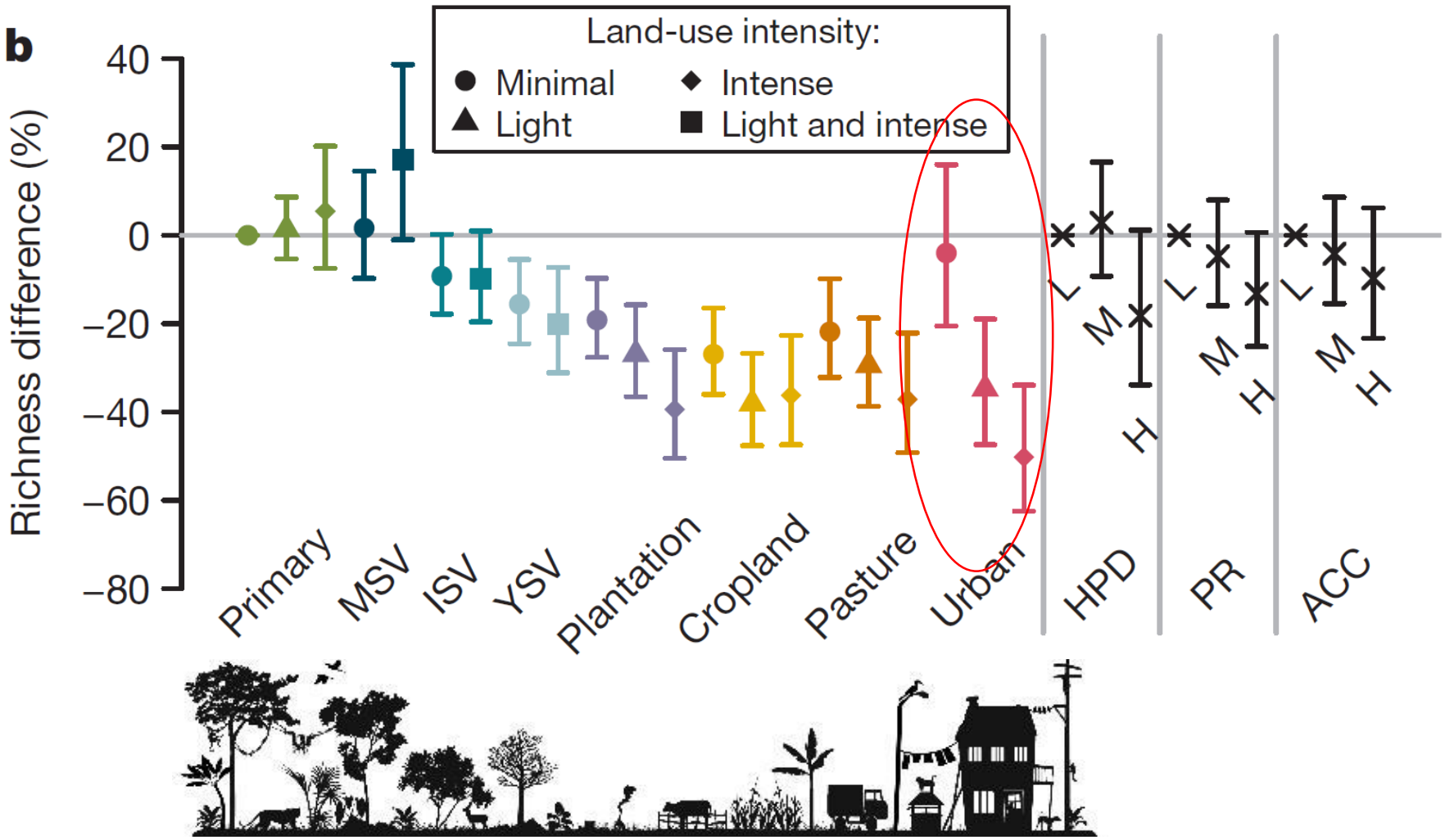


1 million species at risk of extinction



ipbes

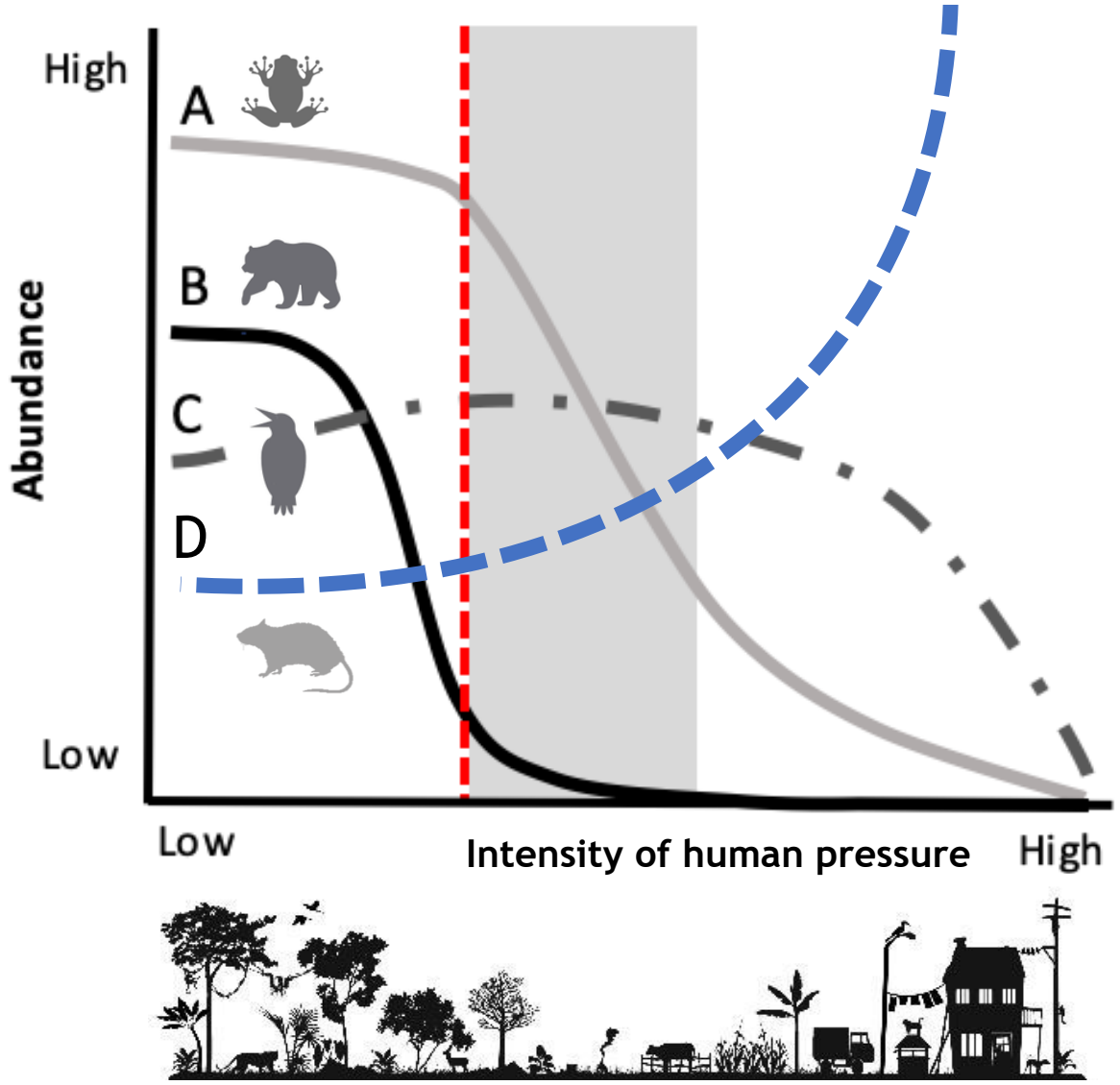
Cities are species poor

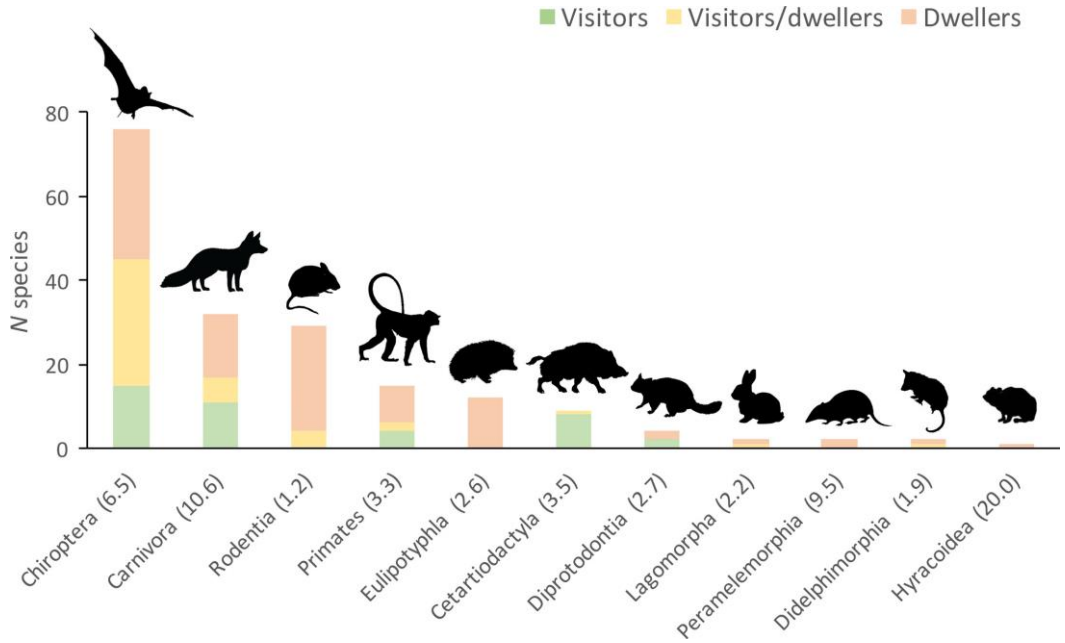


Increasing anthropogenic impact

Newbold *et al*. 2015 *Nature*

Cities are strong filters for species





Santini *et al.* 2018 Ecology Letters

Species adapt to cities – activity patterns

Adaptions to daily activity patterns

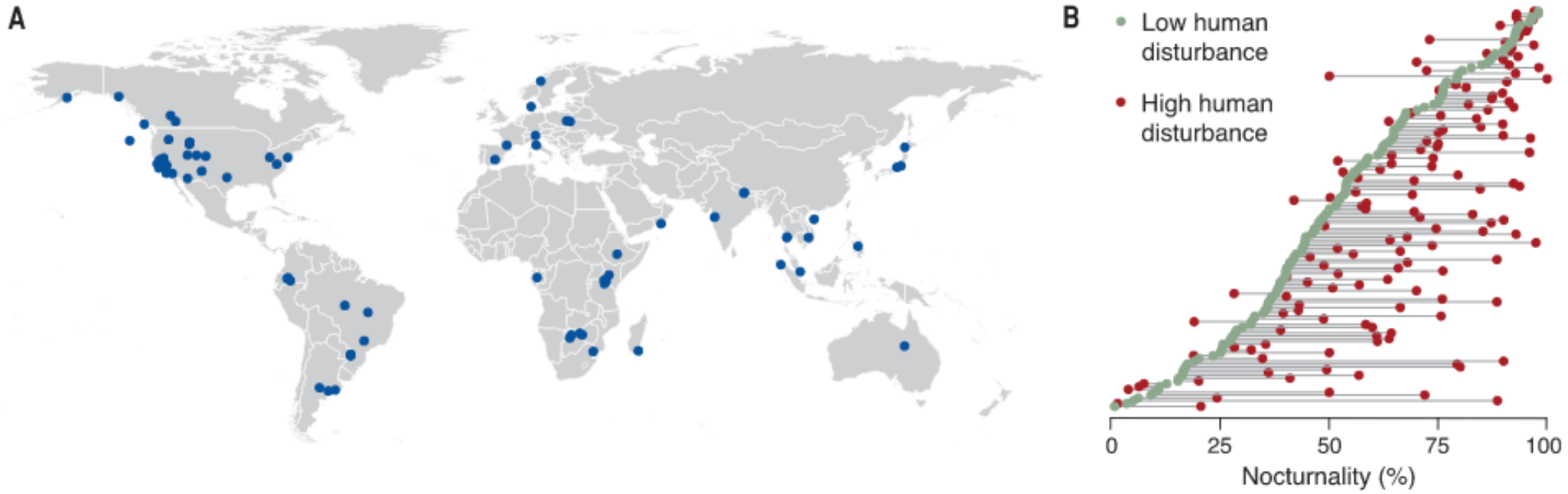


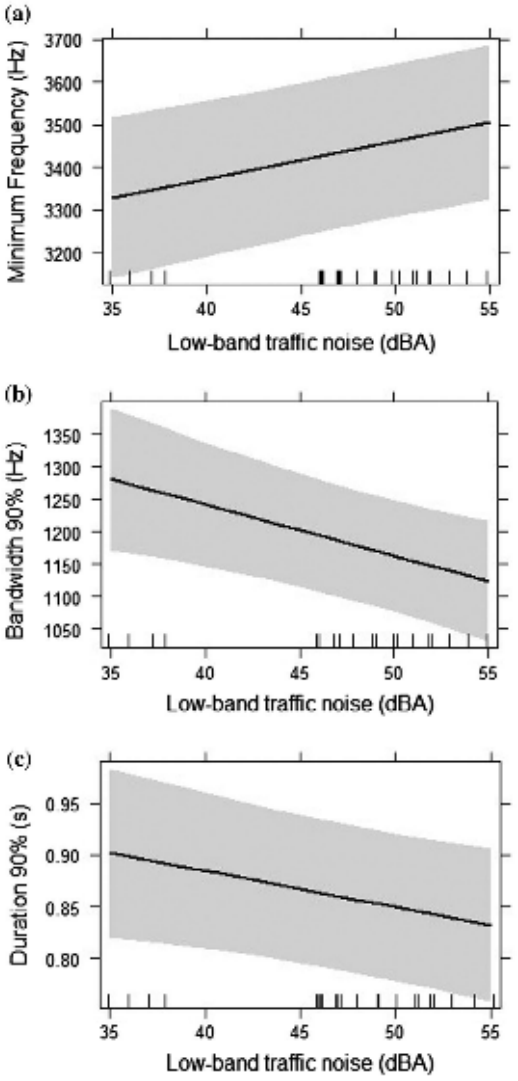
Fig. 1. Mammals become more nocturnal to avoid humans throughout the world. (**A**) Map illustrating the locations of the 76 studies included in the meta-analysis. (**B**) Paired measures of nocturnality (percentage of activity that occurs in the night) in areas of high human disturbance (X_h) and low human disturbance (X_l), displayed for each species in each study (n = 141 effect sizes, ordered from high to low X_l). The relative change in nocturnality in response to human disturbance was used to calculate the effect size (RR) for the meta-analysis, where RR = $\ln(X_h/X_l)$.

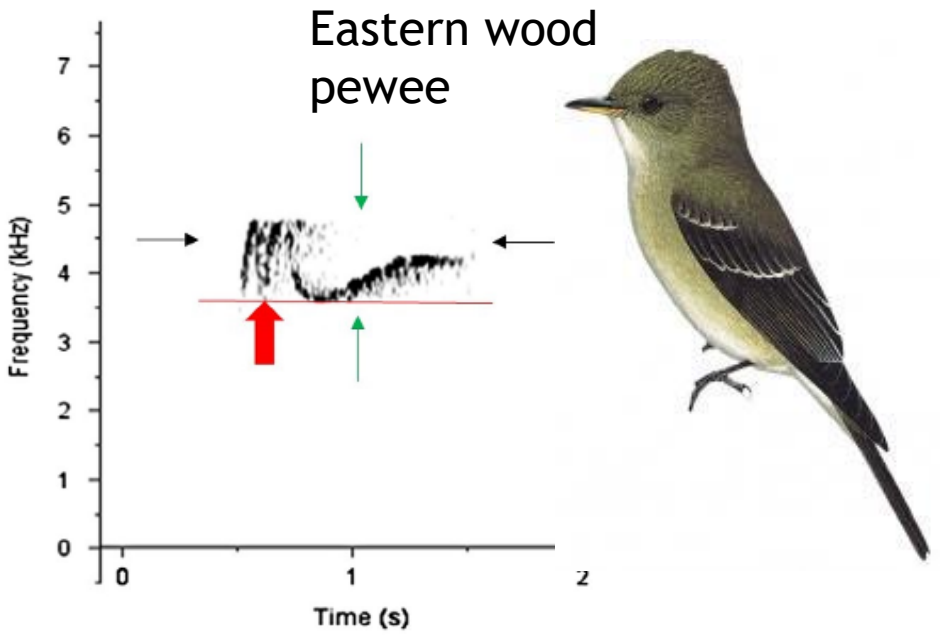
Under increasing anthropogenic pressure – mammals become more nocturnal

Gaynor *et al*. 2018 *Science*

Species adapt to cities – songs

Adaptions to communicating in noisier environments





After road closures, bird populations decreased min frequency, increased bandwidth and increased duration of their call

Gentry *et al* 2017 *Bioacoustics*

science.sciencemag.org

REPORT

Singing in a silent spring: Birds respond to a half-century soundscape reversion during the COVID-19 shutdown

Elizabeth P. Derryberry[1,*,†], Jennifer N. Phillips[2,3,†], Graham E. Derryberry[1], Michael J. Blum[1], David Luther[4]

[1]Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, TN 37996, USA.

[2]Department of Biological Sciences, California Polytechnic State University, San Luis Obispo, CA 93407, USA.

[3]Department of Science and Mathematics, Texas A&M University–San Antonio, San Antonio, TX 78224, USA.

[4]Department of Biology, George Mason University, Fairfax, VA 22030, USA.

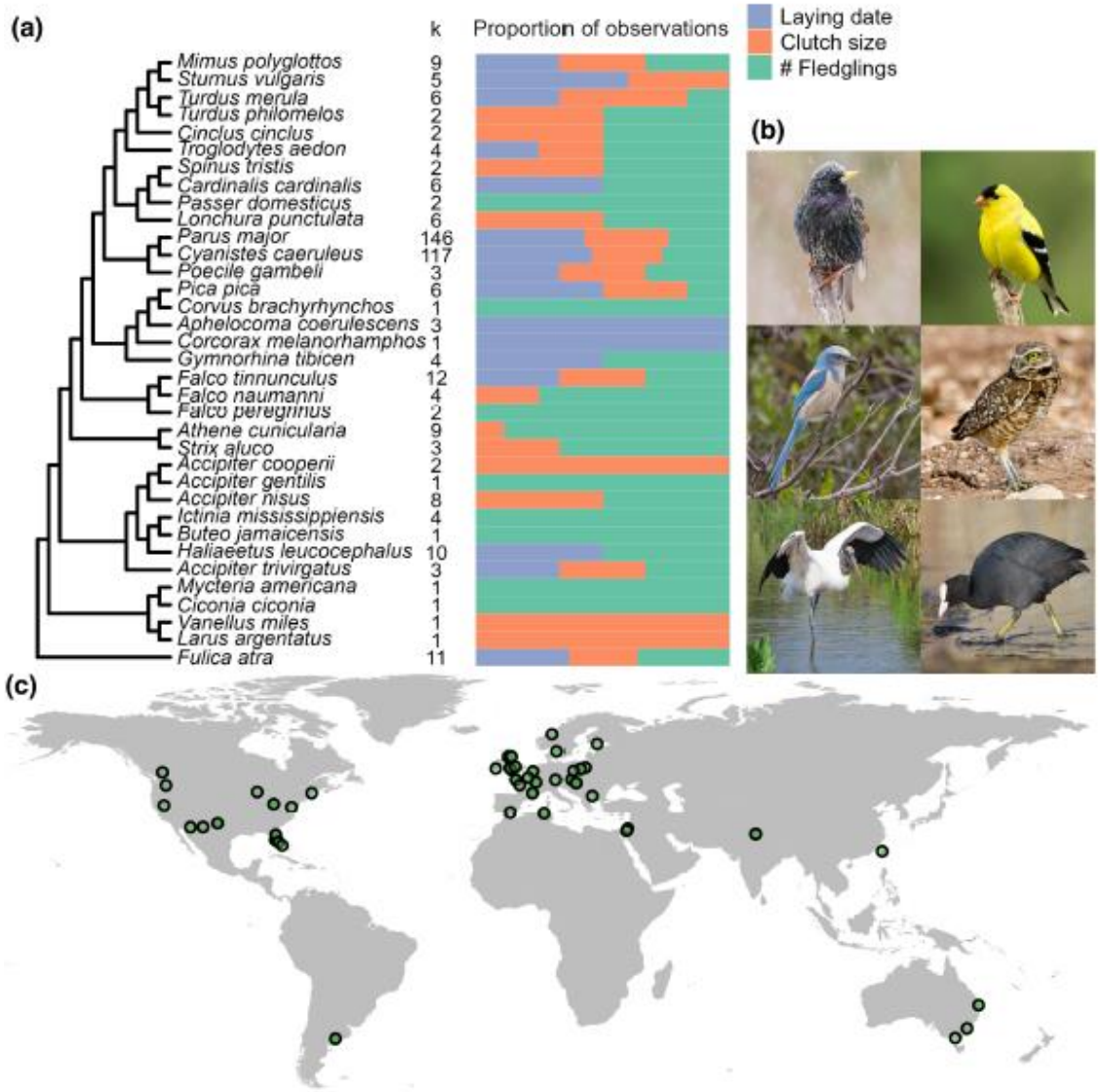
*Corresponding author. Email: liz@utk.edu

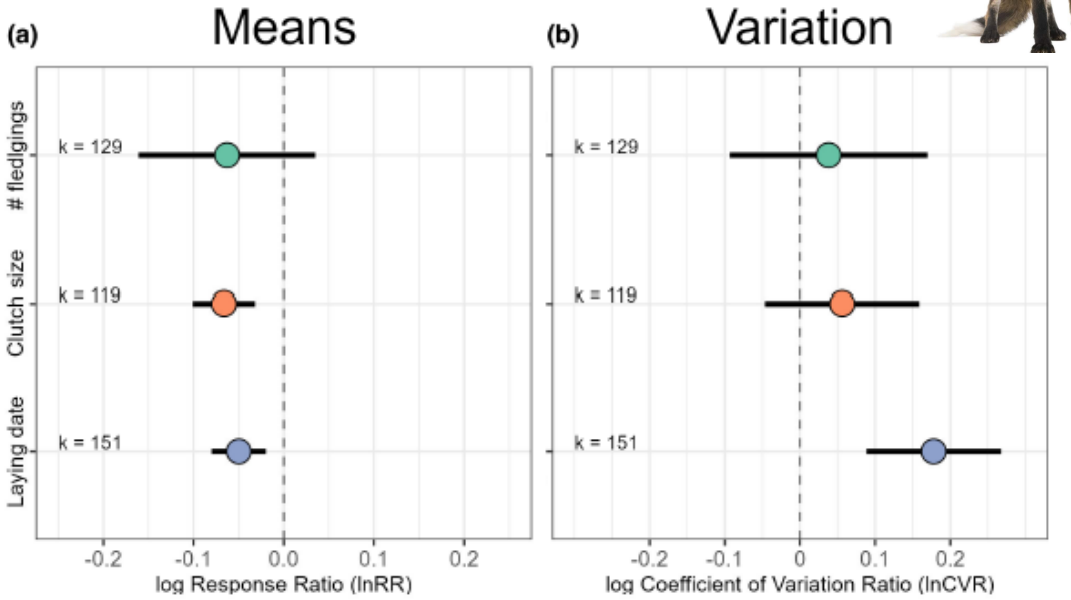
† These authors contributed equally to this work.

– Hide authors and affiliations

Science 24 Sep 2020:
eabd5777
DOI: 10.1126/science.abd5777

But city living has consequences – lower fitness

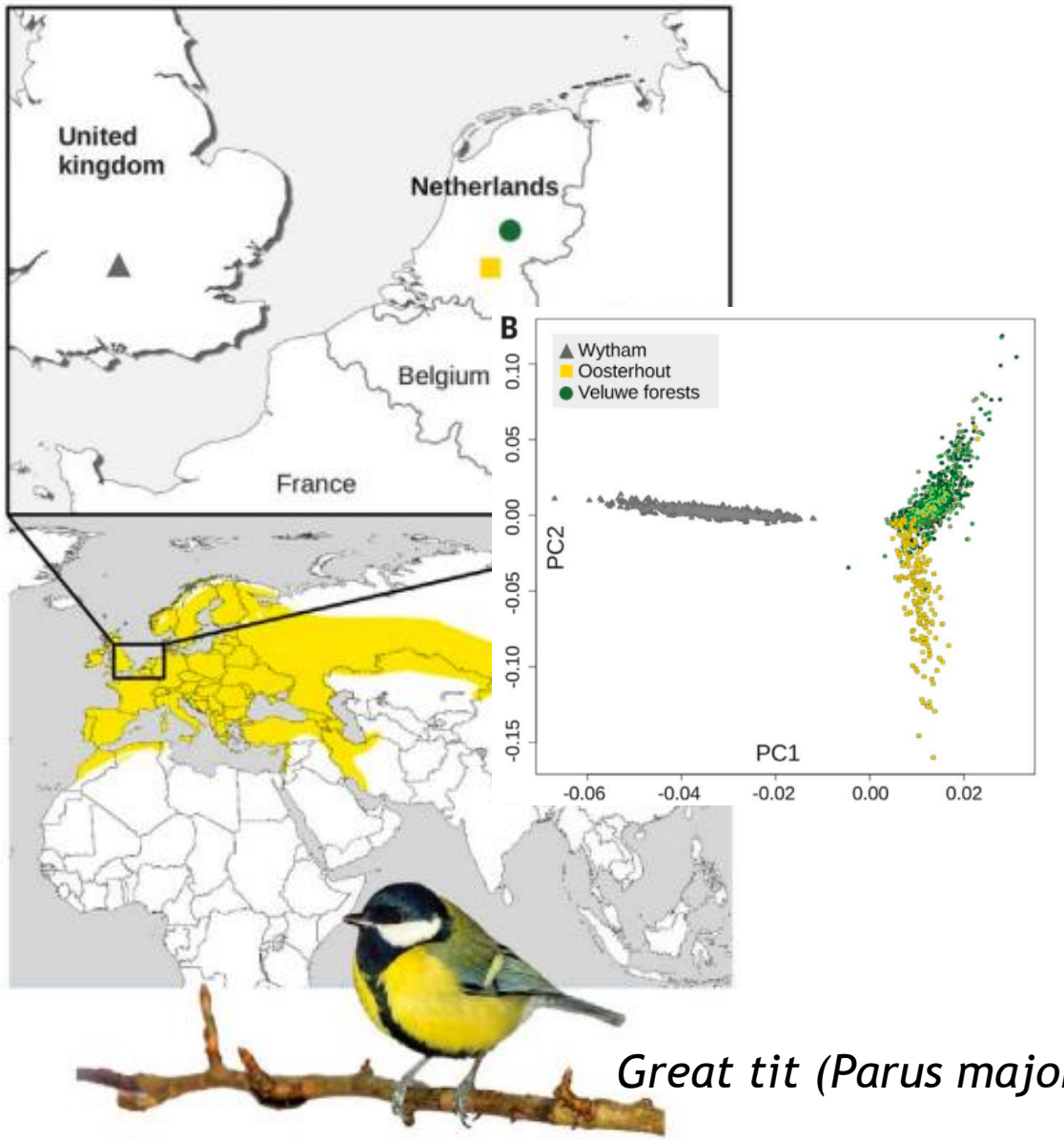




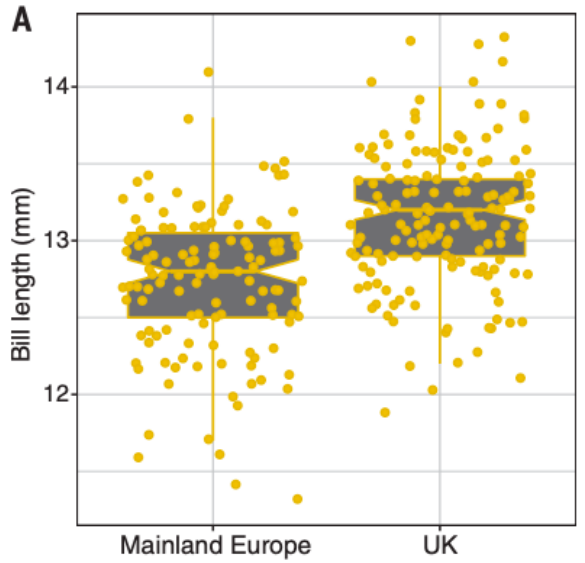
Urban populations reproduce earlier and have smaller broods & have higher phenotypic variation in laying date than non-urban populations

Capilla-Lasheras *et al*. 2022 *Ecology Letters*

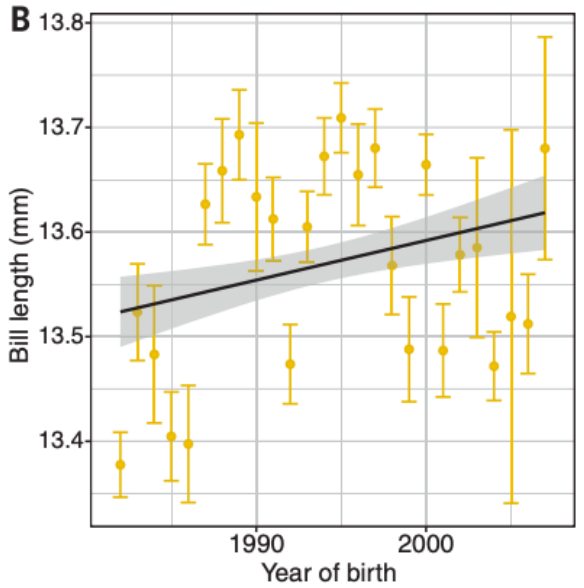
UK birds evolve bigger beaks for feeders



Great tit (Parus major)



Europe vs UK bill lengths



Bill length change in Wytham Woods, UK

Bosse *et al*. 2017. *Science*

Does disrupting nature matter?

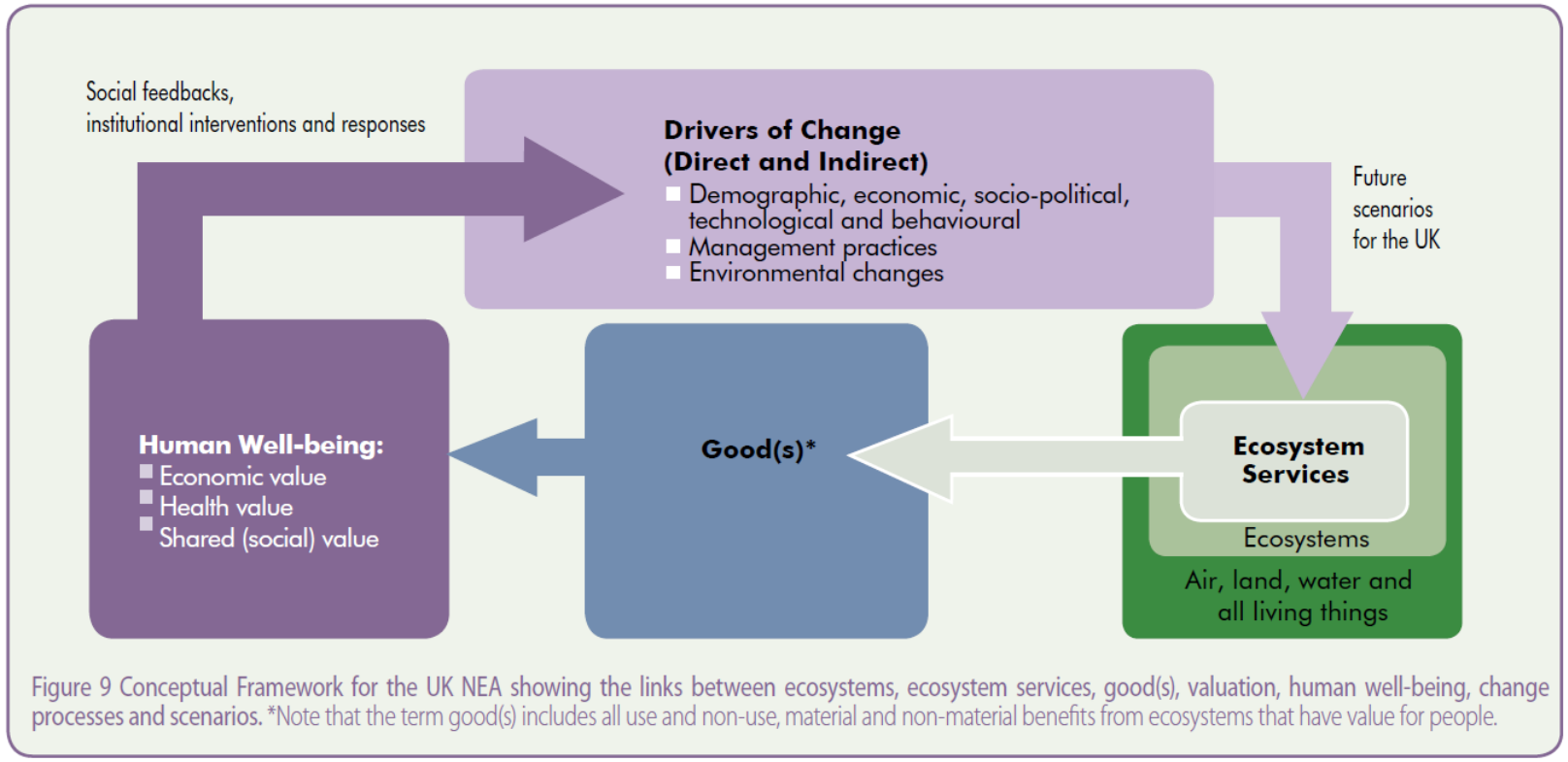
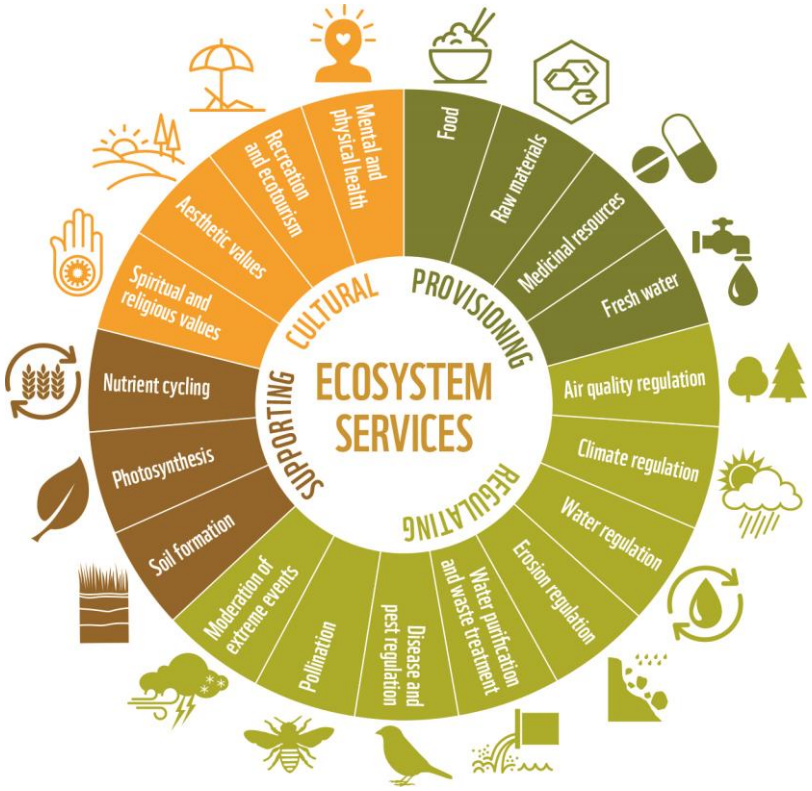


Figure 9 Conceptual Framework for the UK NEA showing the links between ecosystems, ecosystem services, good(s), valuation, human well-being, change processes and scenarios. *Note that the term good(s) includes all use and non-use, material and non-material benefits from ecosystems that have value for people.

'Tip of the iceberg': is our destruction of nature responsible for Covid-19?



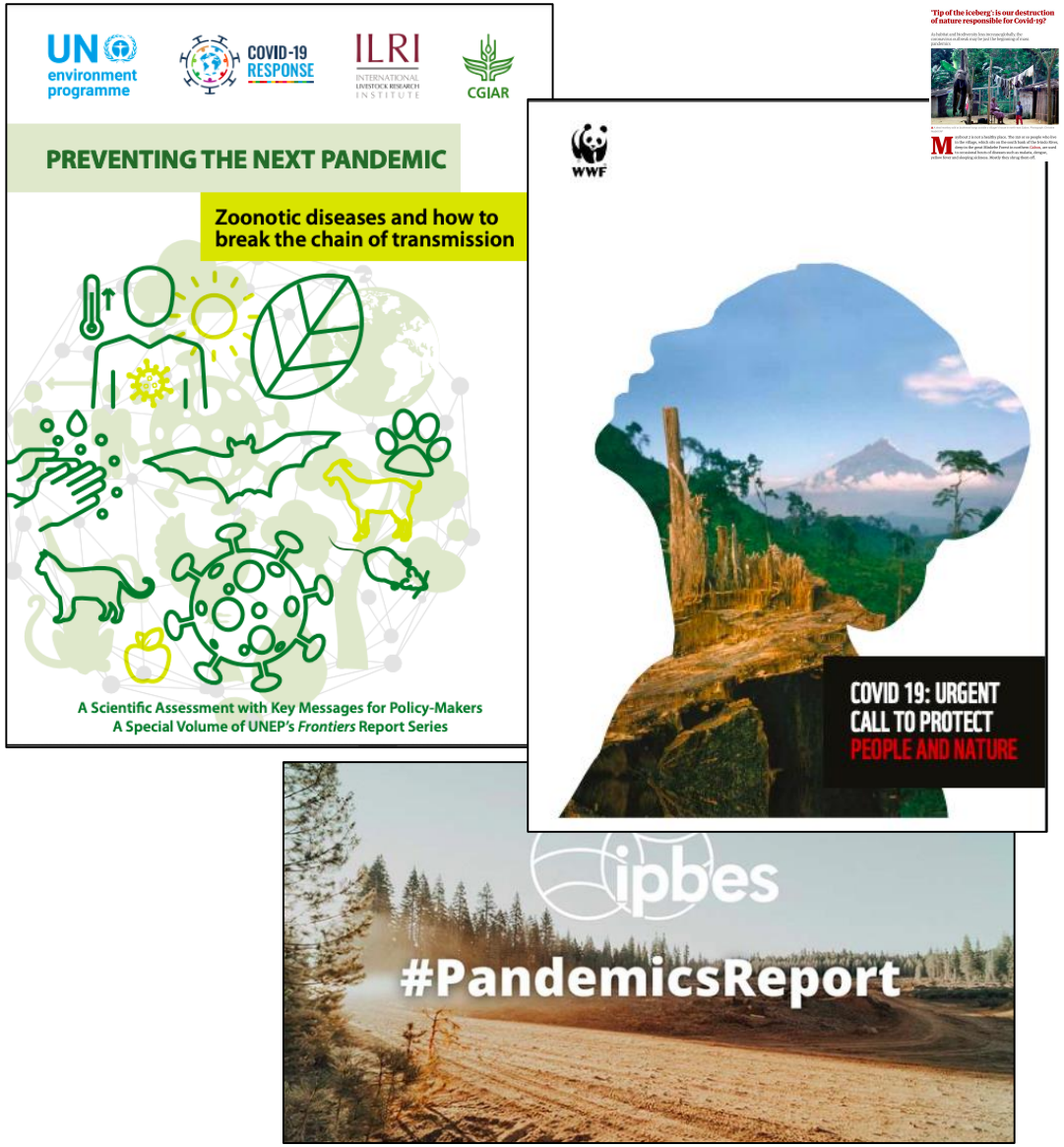
Covid-19? Raging headlines and reports

'Tip of the iceberg': is our destruction of nature responsible for Covid-19?

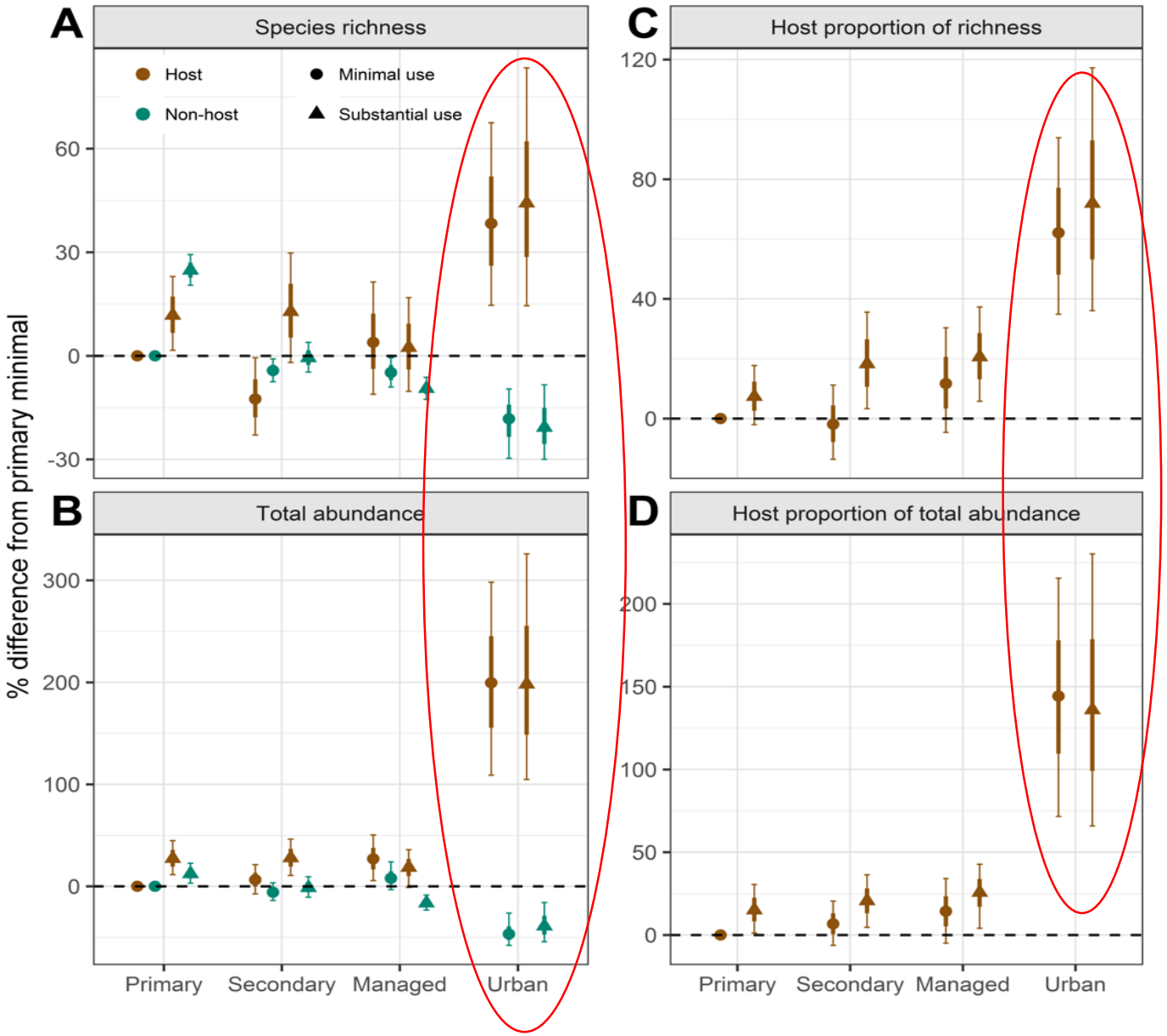
As habitat and biodiversity loss increase globally, the coronavirus outbreak may be just the beginning of mass pandemics

▲ A dead monkey sold as bushmeat hangs outside a villager's house in north-east Gabon. Photograph: Christine Nesbitt/AP

Mayibout 2 is not a healthy place. The 150 or so people who live in the village, which sits on the south bank of the Ivindo River, deep in the great Minkebe Forest in northern Gabon, are used to occasional bouts of diseases such as malaria, dengue, yellow fever and sleeping sickness. Mostly they shrug them off.



Species that make us sick thrive in degraded land

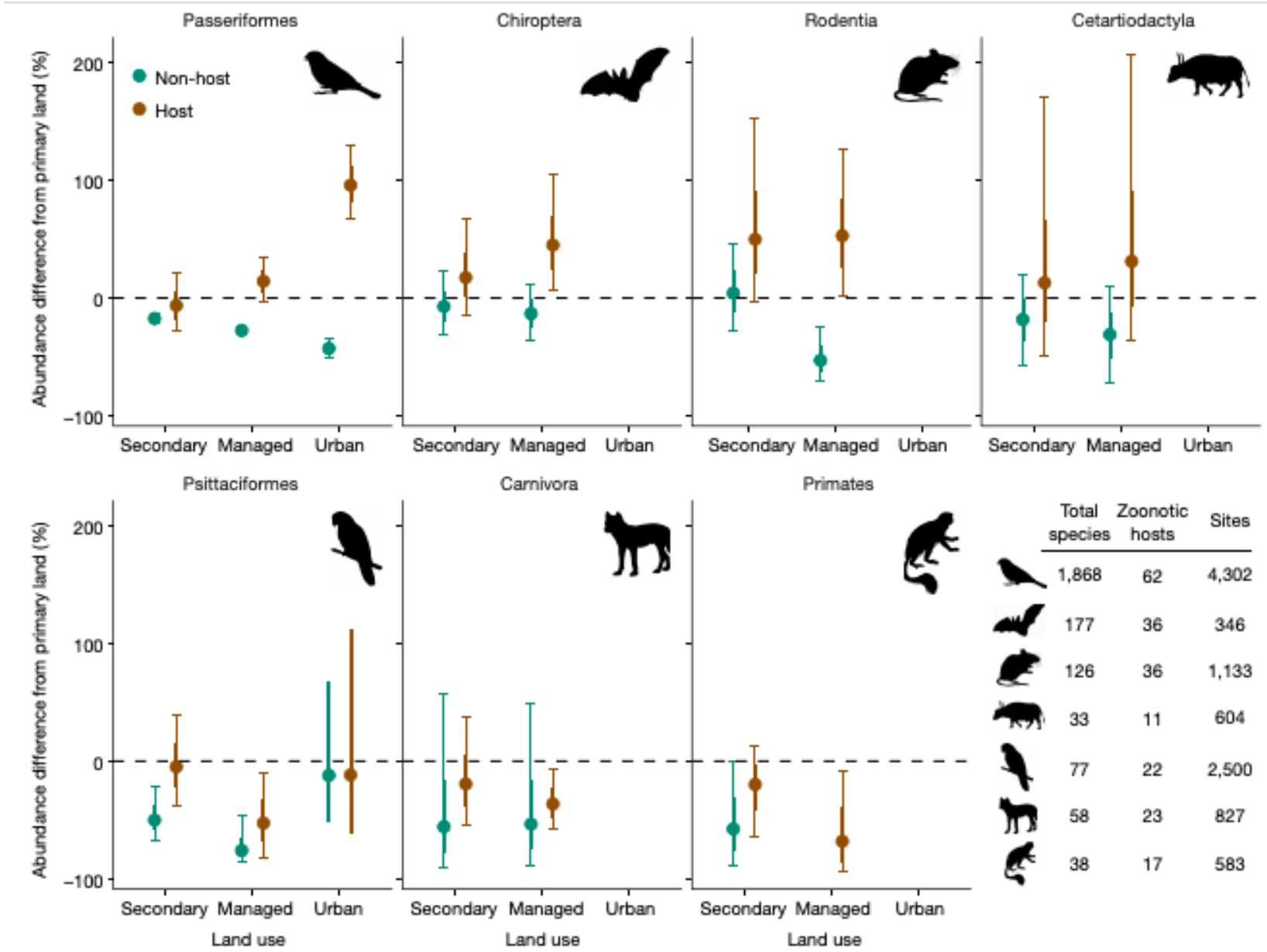


Zoonotic hosts are higher proportion of species richness and total abundance in intensely-used, human-managed and urban ecosystems than in nearby undisturbed habitats

6801 ecological assemblages, 376 host species

Gibb *et al. Nature* 2020

Taxa respond differently to anthropogenic drivers

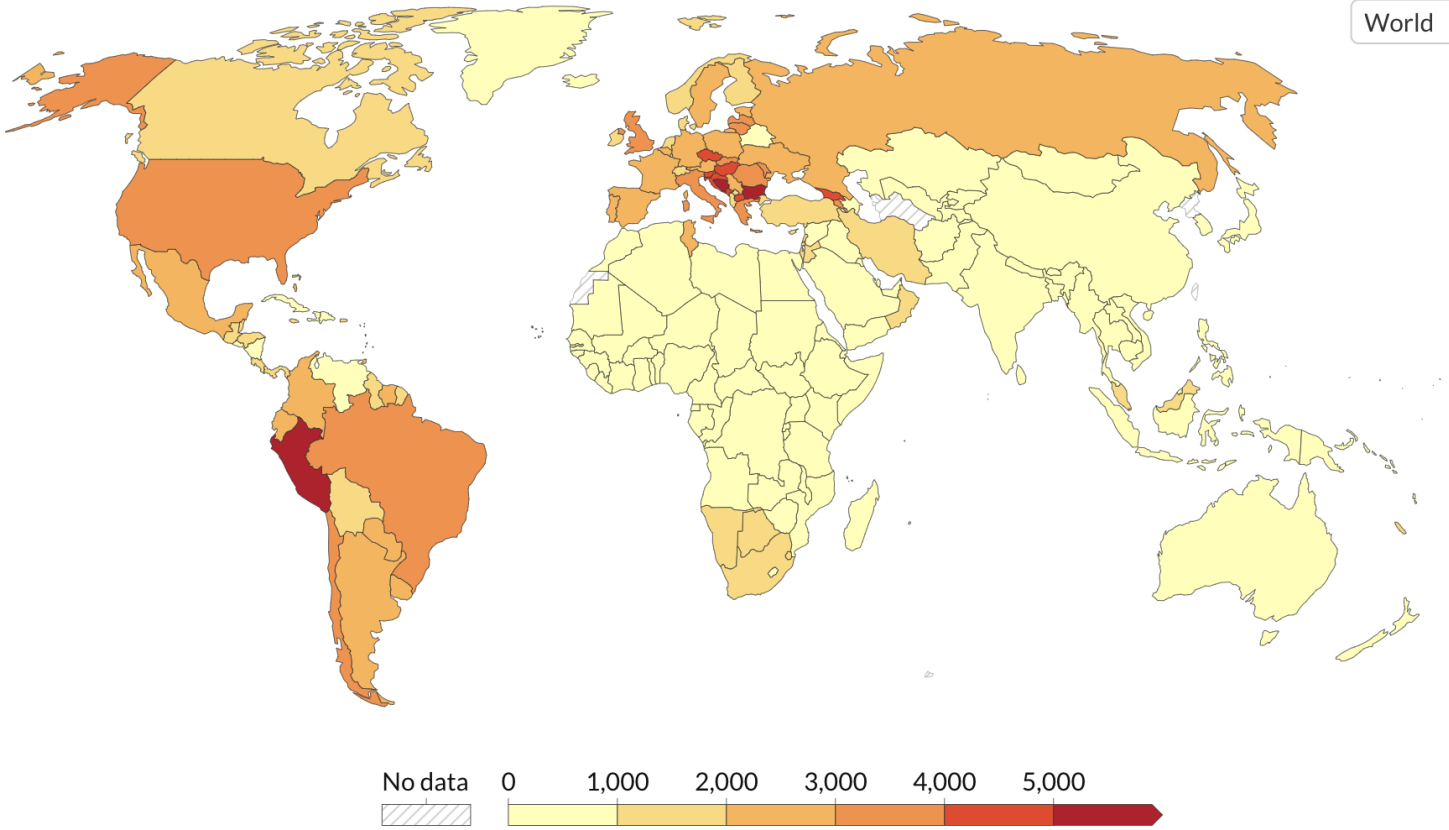


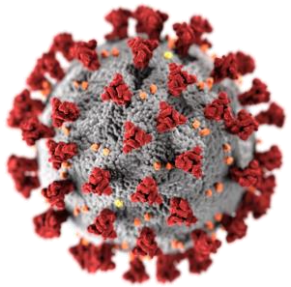
	Total species	Zoonotic hosts	Sites
	1,868	62	4,302
	177	36	346
	126	36	1,133
	33	11	604
	77	22	2,500
	58	23	827
	38	17	583

'Tip of the iceberg': is our destruction of nature responsible for Covid-19?

Gibb *et al*. *Nature* 2020

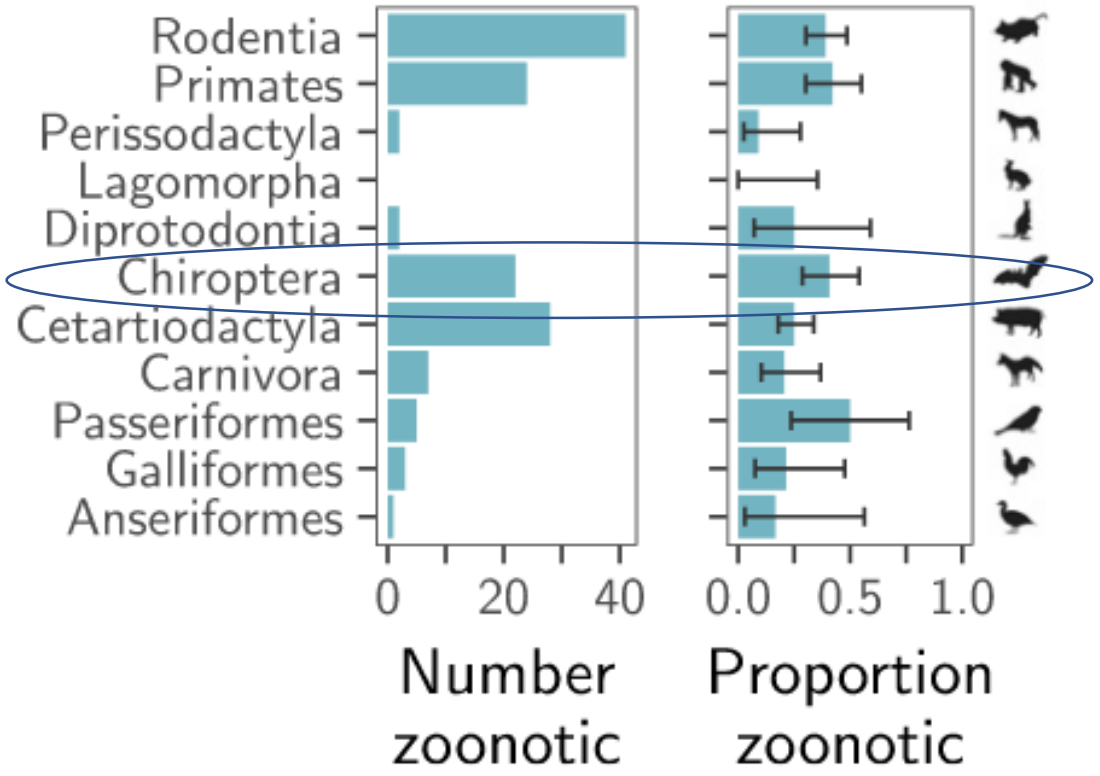
How bats changed the world





Andersen *et al*. 2020 *Nature Medicine*

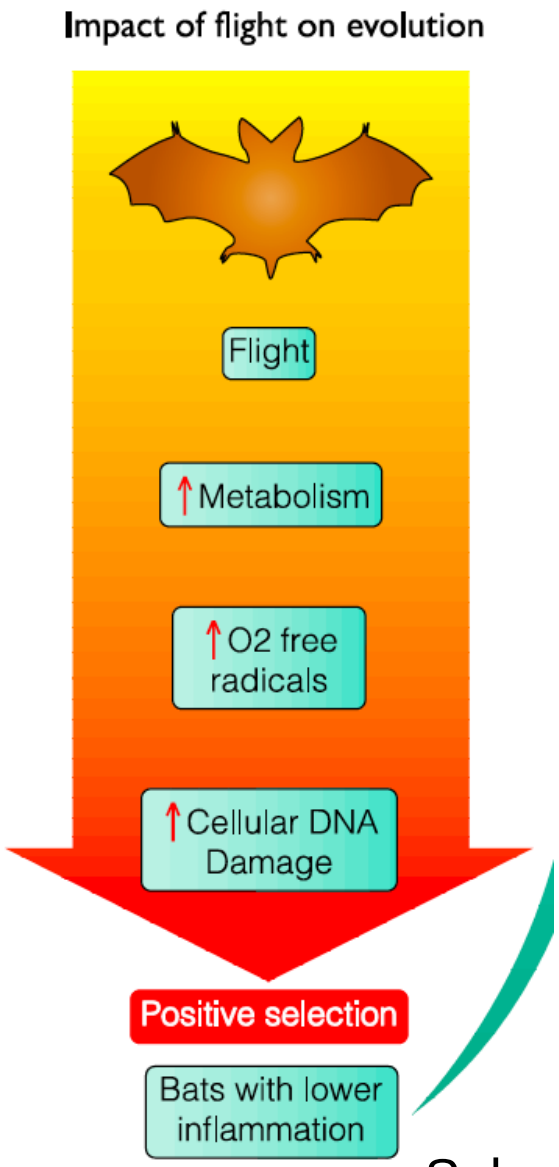
Are bats special hosts of viruses? …..no



Bats have a lot of zoonotic viruses but there are a lot of bat species – bats don't have proportionally more viruses

Mollentze & Streicker 2020 *PNAS*

Are bats special hosts of viruses? …maybe



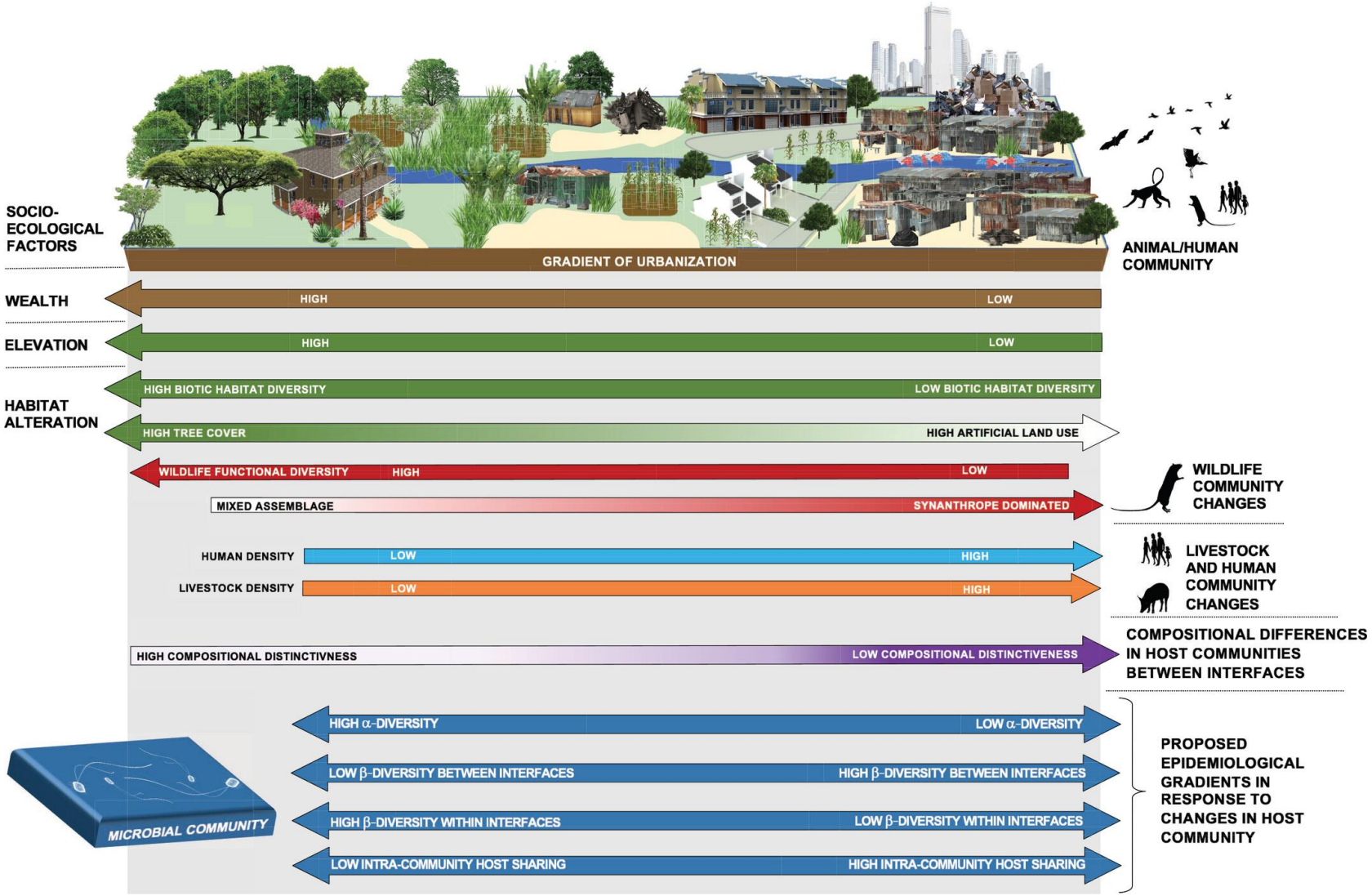
Subudhi *et al* 2019 *Viruses*

'Tip of the iceberg': is our destruction of nature responsible for Covid-19?

Bats may have adaptations to flight that make them better able to host viruses without showing symptoms and viruses that humans aren't adapted to

Brook & Dobson 2015 *Trends in Mircobio*

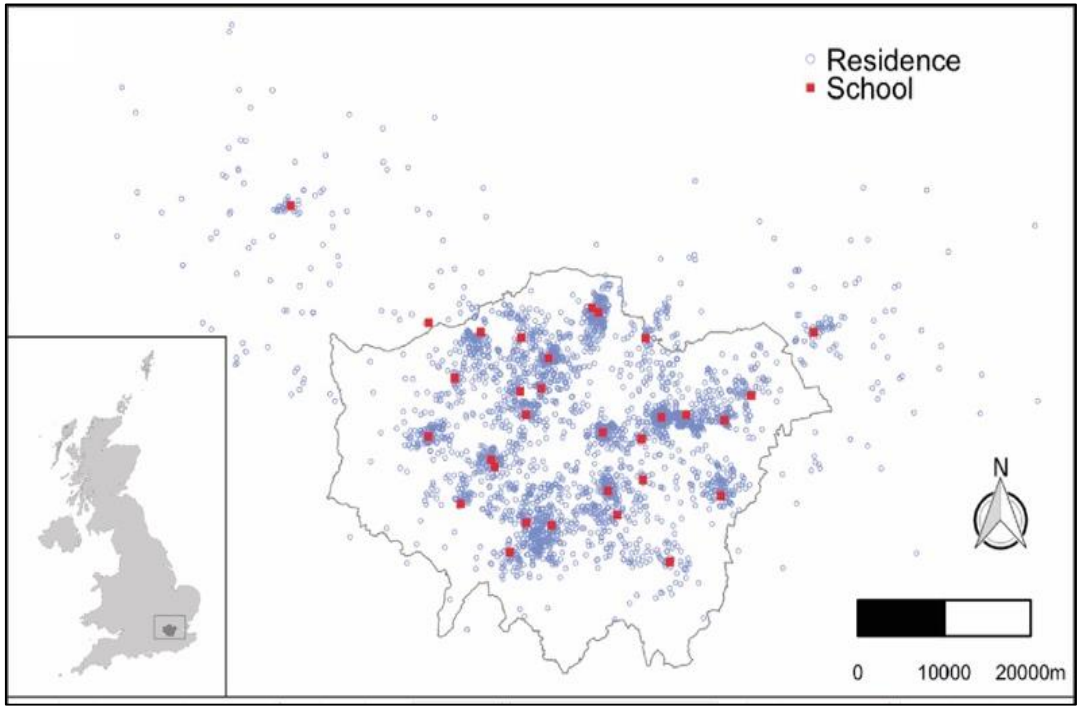
Cities may change zoonotic disease pathways



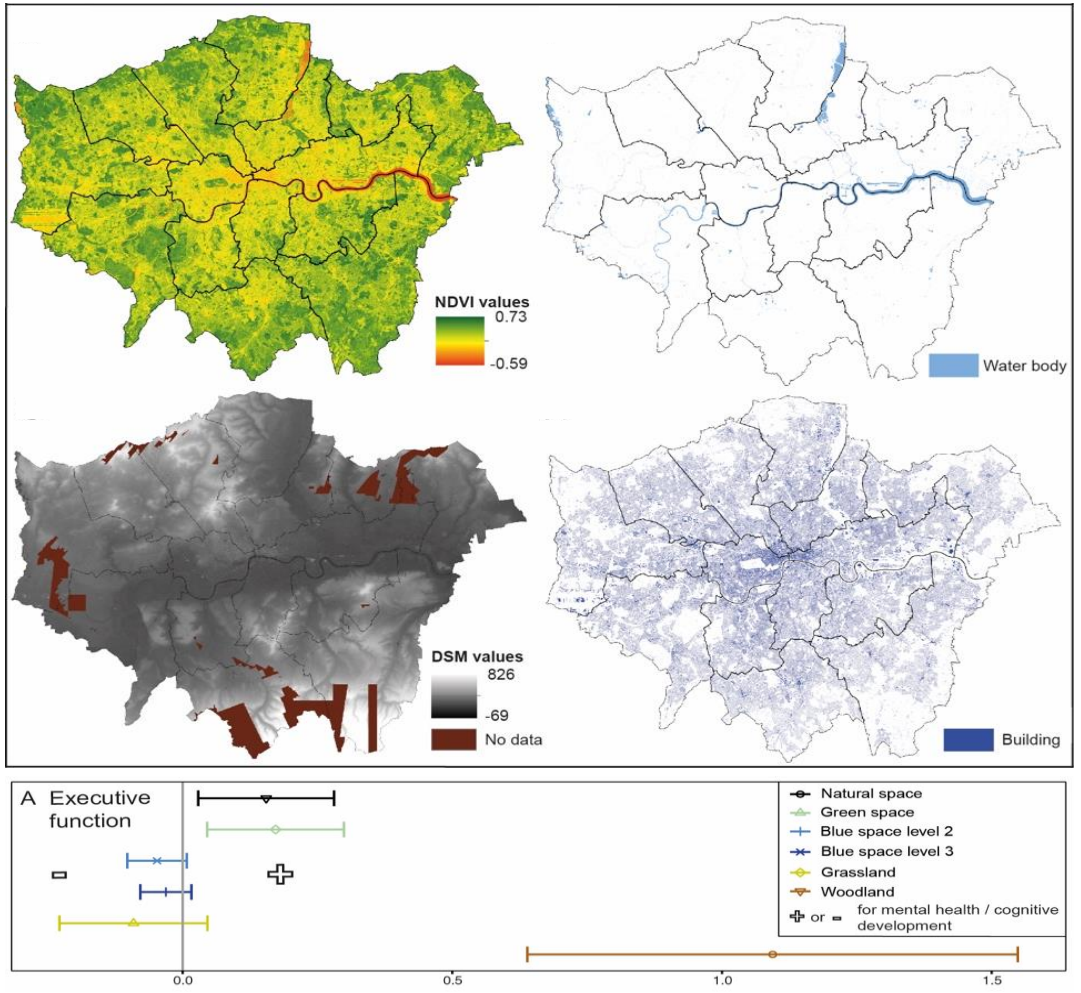
'Tip of the iceberg': is our destruction of nature responsible for Covid-19?

Hassel *et al.* 2020 *Global Change Biology*

Woodland helps children's cognitive function



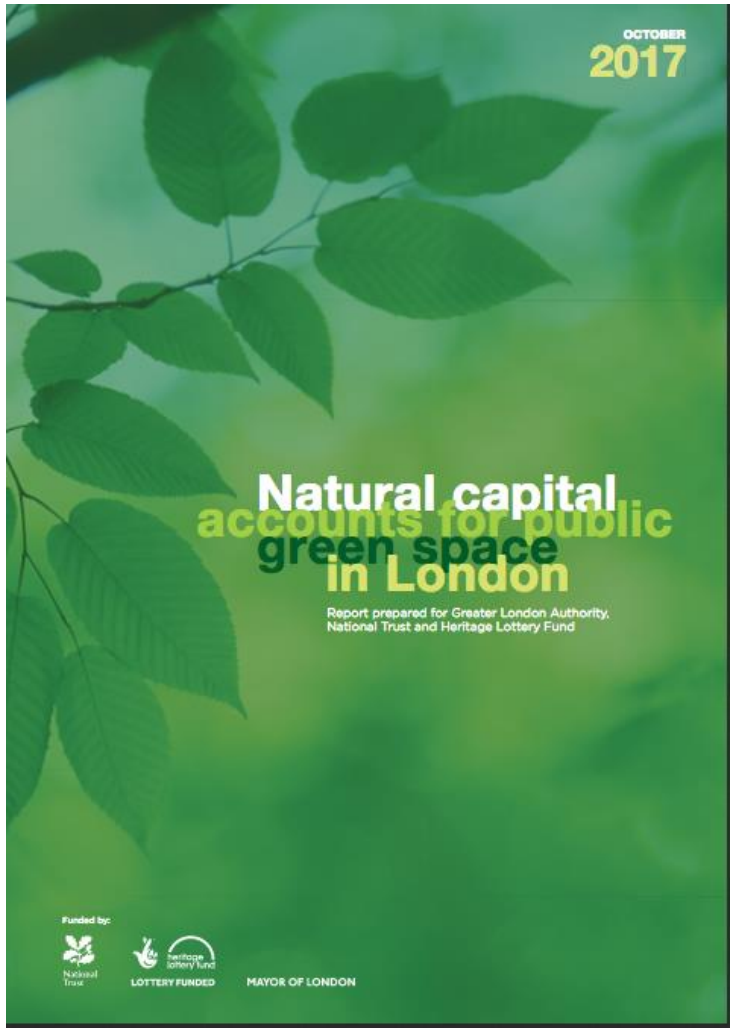
High levels of surrounding green space associated with higher cognitive function in children (Imperial SCAMP study 6000 children, 41 schools)



'Tip of the iceberg': is our destruction of nature responsible for Covid-19?

Maes *et al*. 2021 *Nature Sustainability*

City green space is a highly valuable asset



'Tip of the iceberg': is our destruction of nature responsible for Covid-19?

London's greenspace has gross asset value of £91 billion, providing annual services of £5 billion

For the average household in London, the monetary value of being in close proximity to a park or green space is over £900 per year

Benefits not spread equally across London

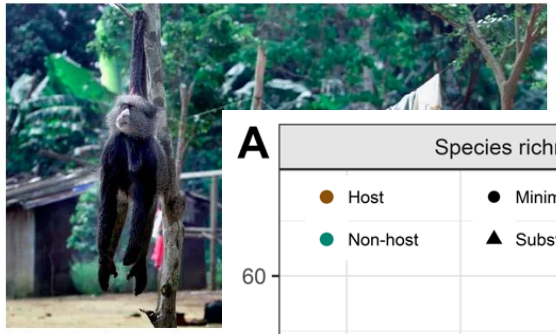
Vivid Economics 2017

Core shifts in understanding criticality of nature

Growing evidence base

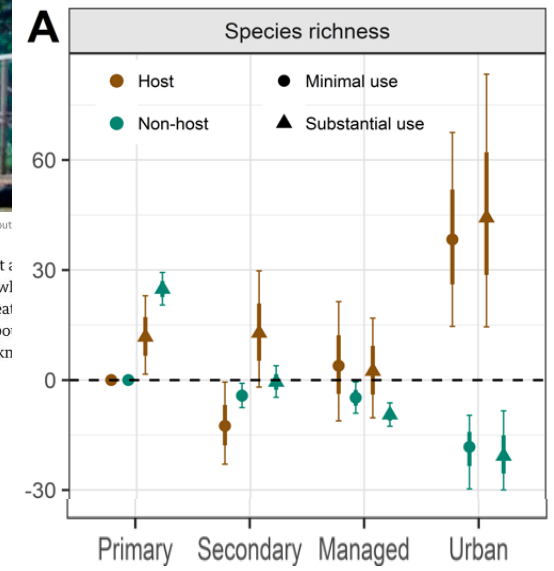
'Tip of the iceberg': is our destruction of nature responsible for Covid-19?

As habitat and biodiversity loss increase globally, the coronavirus outbreak may be just the beginning of mass pandemics



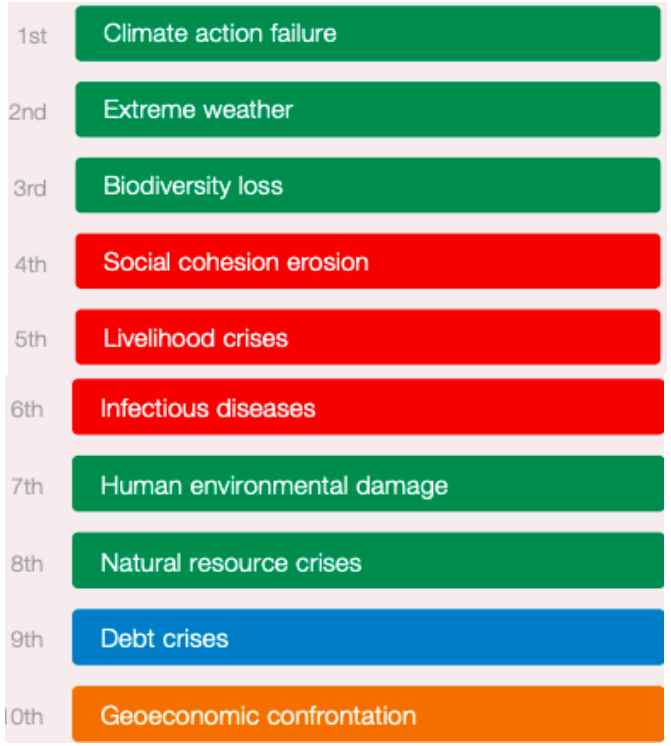
▲ A dead monkey sold as bushmeat hangs out
Nesbitt/AP

Mayibout 2 is not
in the village, wh
deep in the great
to occasional bo
yellow fever and sleeping sickn



Gibb *et al*. 2020 Zoonotic host diversity increases in human-dominated ecosystems. *Nature*

Problem recognition



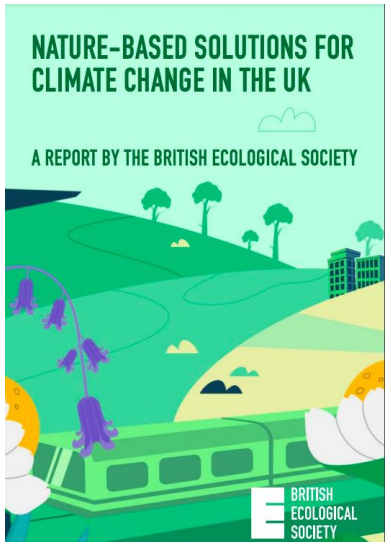
"Identify the most severe risks on a global scale over the next 10 years"

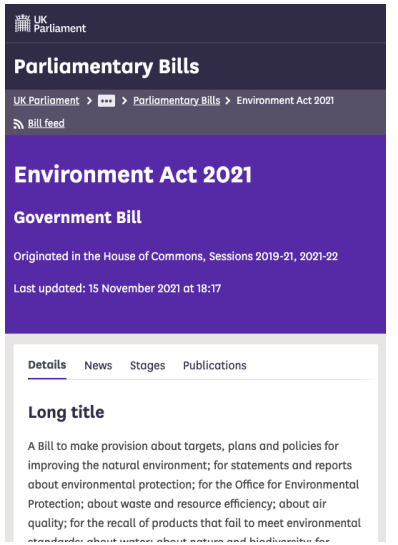
World Economic Forum Global Risks Perception Survey 2021-2022

(Young) People & Nature

David Attenborough on the Pyramid Stage @Glastonbury 2019

Nature-based solutions for societal goals





Nature-based solutions (NBS) are "*actions to protect, sustainably manage and restore natural ecosystems, which address societal challenges while providing human well-being and biodiversity benefits*"

Seddon *et al*. 2019 *Nature Climate Change*

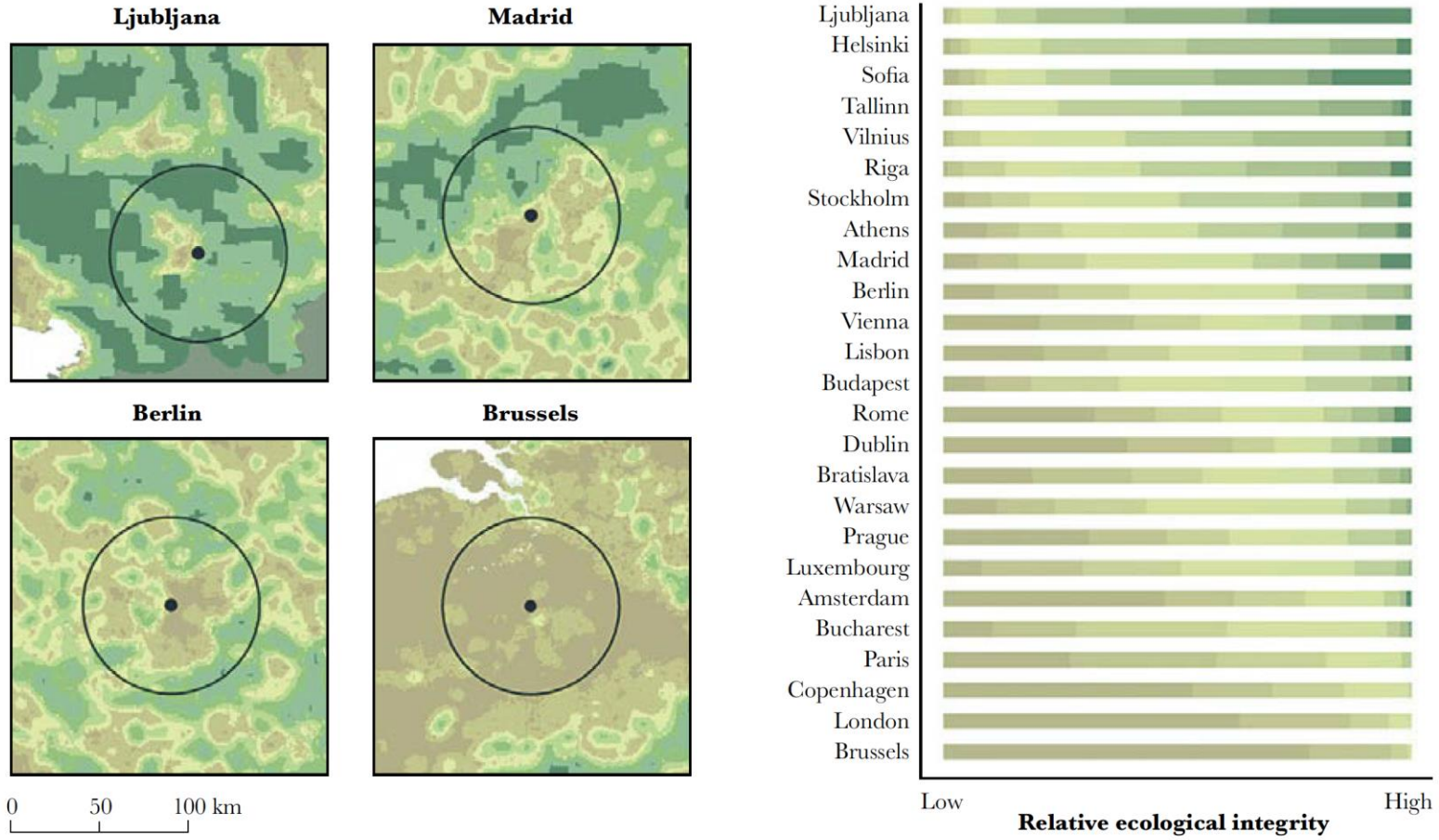
1. Urban agriculture
2. Greenhouses
3. Vertical farming
4. Beehives and highways
5. Wildlife corridors
6. Integrated habitat creation
7. Flood resilience
8. Water storage
9. Sustainable urban drainage
10. Bioremediation
11. Green wall –top down
12. Green wall
13. Modular plant walls
14. Seeded living walls
15. Moss walls
16. Tree facade
17. Bioreactive facade
18. Green roofs
19. Wildlife roofs
20. Wet roofs
21. Urban forestry
22. City gardens
23. Photovoltaic roofs
24. Energy generation

ARUP Opportunities

Wildling your spaces

Tree & Burrell 2023
Book of Wildling

Parks are not enough – connectedness is key



Maps (left) and ranking (right) of European capitals according to their ecological integrity. The colour gradient represents the areas with different ecological integrity values, with the lowest integrity in brown and the highest in dark green.

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Camden Highline walkway plans approved by council

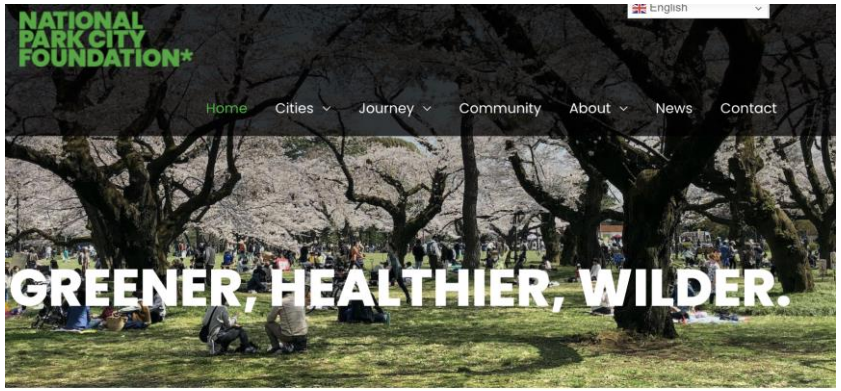
20 January

The route would run from Camden Gardens to York Way, near St Pancras station

Plans to create a walkway along disused railway tracks in north London have been approved by Camden Council.

Fernández *et al*. 2020 *Boosting Ecological Restoration for a Wilder Europe*

Community action & political will is growing



NATIONAL PARK CITIES ARE GRASSROOTS MOVEMENTS FOR PEOPLE MAKING THEIR CITIES GREENER, HEALTHIER AND WILDER

London became the first National Park City in 2019, with **Adelaide** joining in 2021. Dozens more cities around the world are on the journey including; Glasgow, Cardiff, Breda, Rotterdam, Southampton and Chattanooga – we are on course for at least 25 National Park Cities by 2025.

GOV.UK

Home

Press release

New developments to deliver for people and nature

'Biodiversity Net Gain' to be introduced from November helping deliver the nature friendly homes of the future

From: Department for Environment, Food & Rural Affairs, Natural England, The Rt Hon Michael Gove MP, and The Rt Hon Thérèse Coffey MP

Published 21 February 2023

Kidbrooke Village which is being developed by Berkeley Homes, adopted the Biodiversity Net Gain principles on a voluntary basis. The site includes species-rich meadows and wetland with benefits for wildlife and local residents alike.

Image: PCA-Stream / Time Out

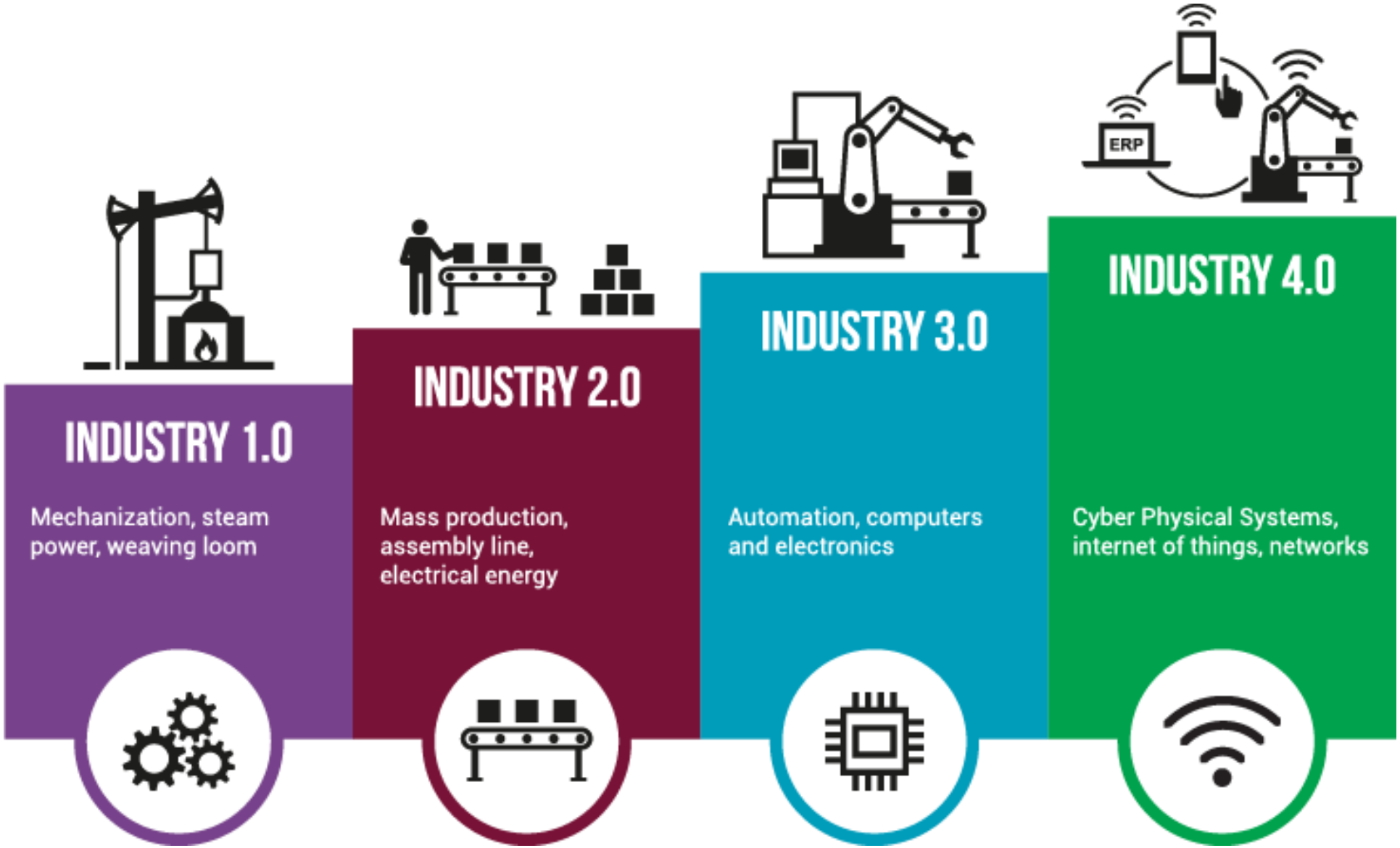
How Paris plans to become Europe's greenest city by 2030

From sweeping car bans to vast urban forests, the French capital is transforming itself for Parisians and the planet

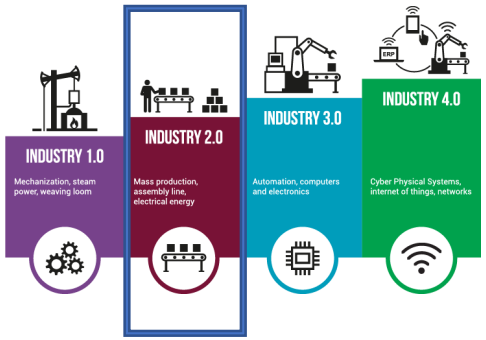
The New York Times

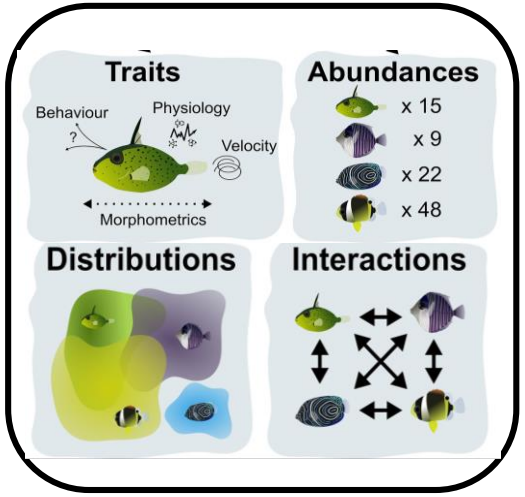
The Greening of Paris Makes Its Mayor More Than a Few Enemies

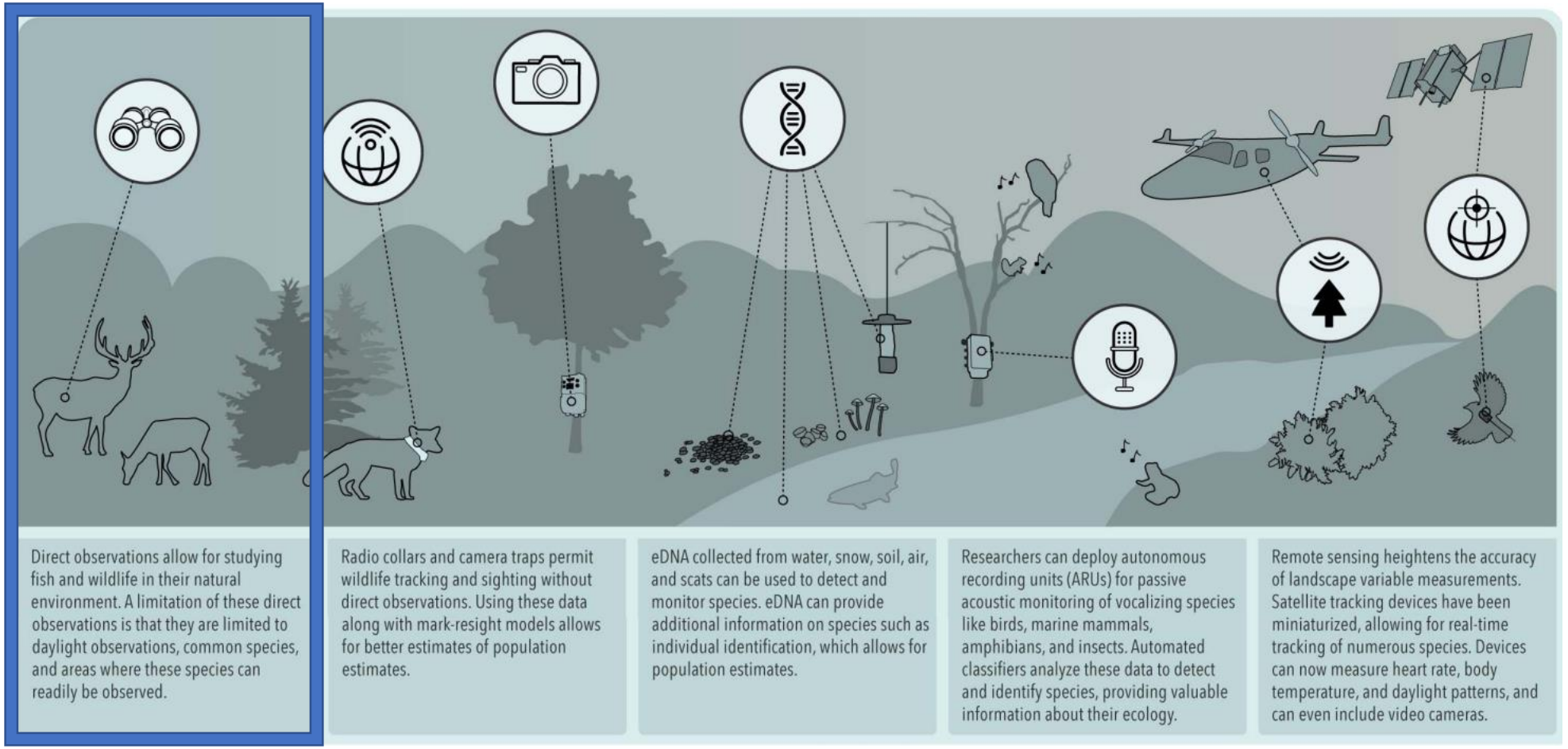
Industrial revolution for ecosystem monitoring



Direct Observational Monitoring







Direct observations allow for studying fish and wildlife in their natural environment. A limitation of these direct observations is that they are limited to daylight observations, common species, and areas where these species can readily be observed.

Radio collars and camera traps permit wildlife tracking and sighting without direct observations. Using these data along with mark-resight models allows for better estimates of population estimates.

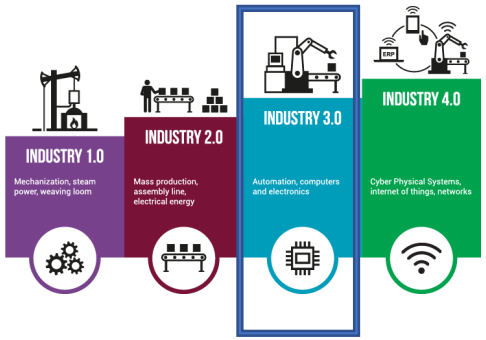
eDNA collected from water, snow, soil, air, and scats can be used to detect and monitor species. eDNA can provide additional information on species such as individual identification, which allows for population estimates.

Researchers can deploy autonomous recording units (ARUs) for passive acoustic monitoring of vocalizing species like birds, marine mammals, amphibians, and insects. Automated classifiers analyze these data to detect and identify species, providing valuable information about their ecology.

Remote sensing heightens the accuracy of landscape variable measurements. Satellite tracking devices have been miniaturized, allowing for real-time tracking of numerous species. Devices can now measure heart rate, body temperature, and daylight patterns, and can even include video cameras.

Tosa *et al.* 2021 *Frontiers in Ecol. & Evol.*

iNaturalist - collecting millions of observations



How It Works

1 Record your observations

2 Share with fellow naturalists

3 Discuss your findings

Nature At Your Fingertips

Keep Track
Record your encounters with other organisms and maintain life lists, all in the cloud.

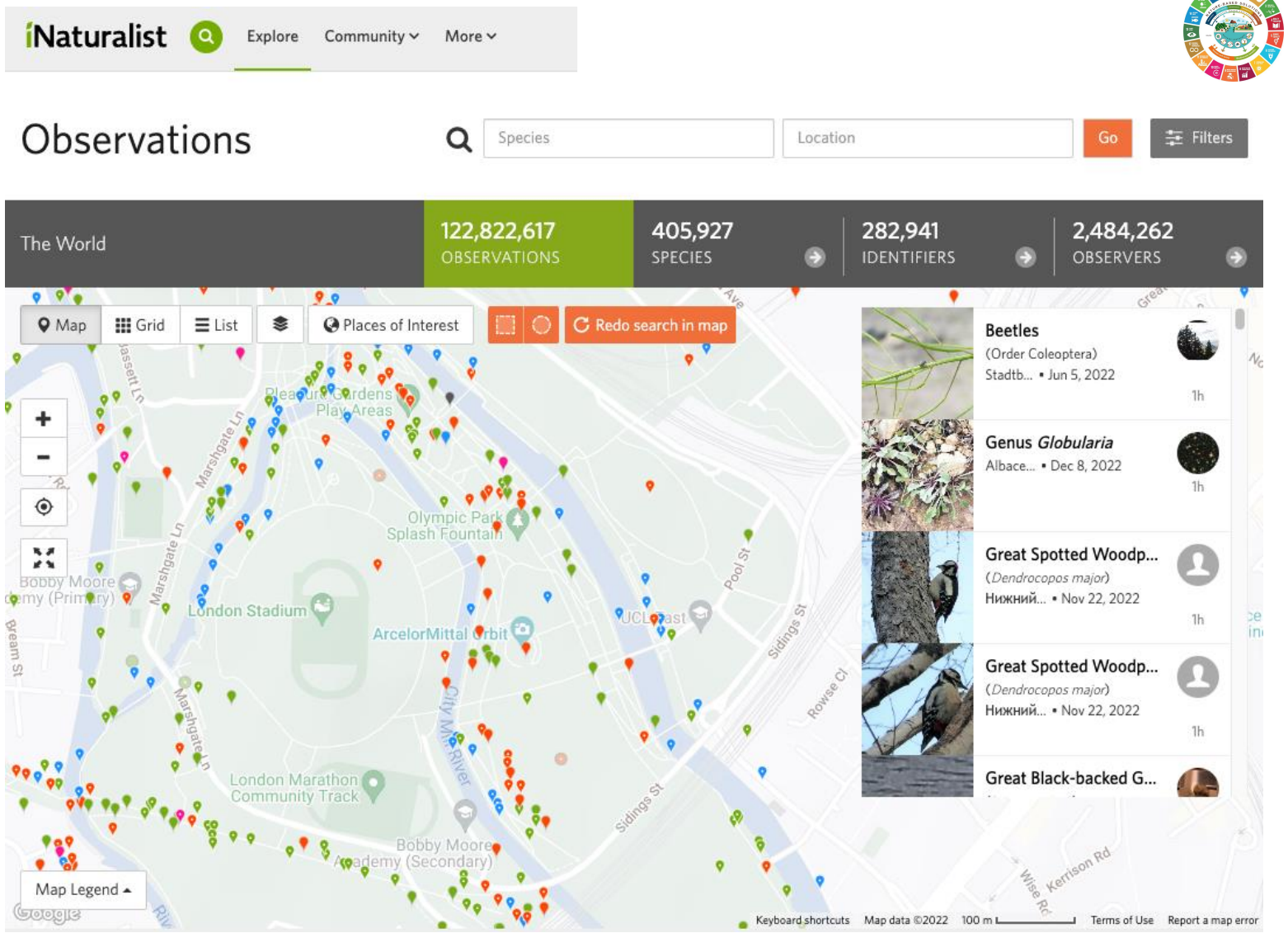
Create Useful Data
Help scientists and resource managers understand when and where organisms occur.

Crowdsource Identifications
Connect with experts who can identify the organisms you observe.

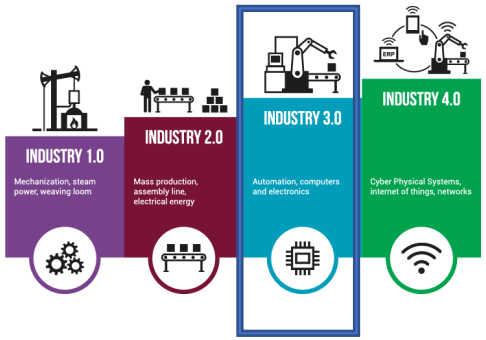
Become a Citizen Scientist
Find a project with a mission that interests you, or start your own.

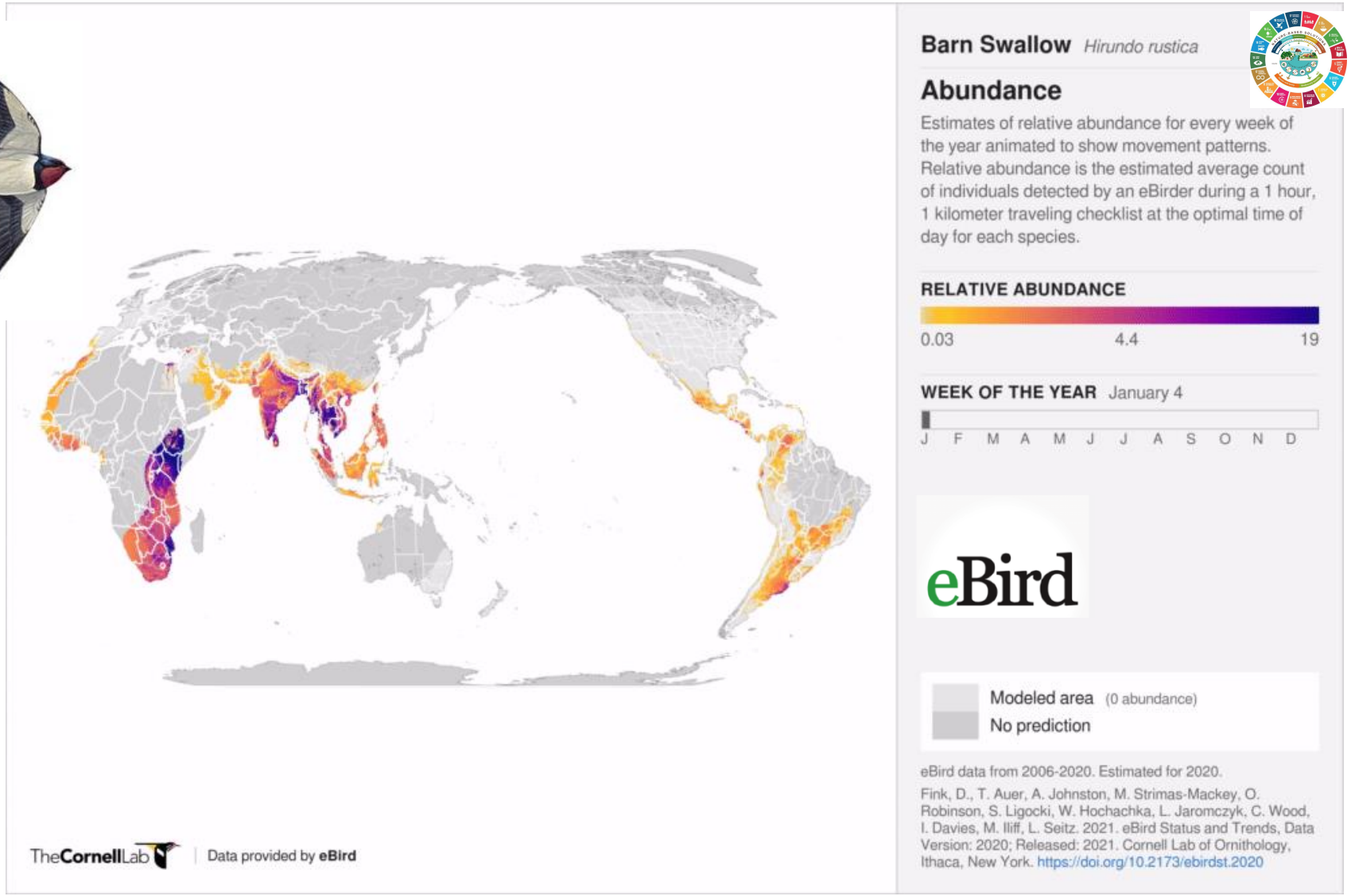
Learn About Nature
Build your knowledge by talking with other naturalists and helping others.

Run a Bioblitz
Hold an event where people try to find as many species as possible.



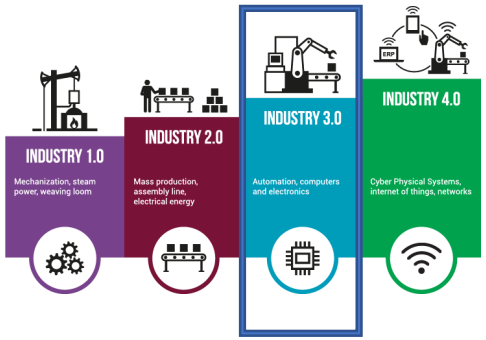
eBird - generating bird population trends

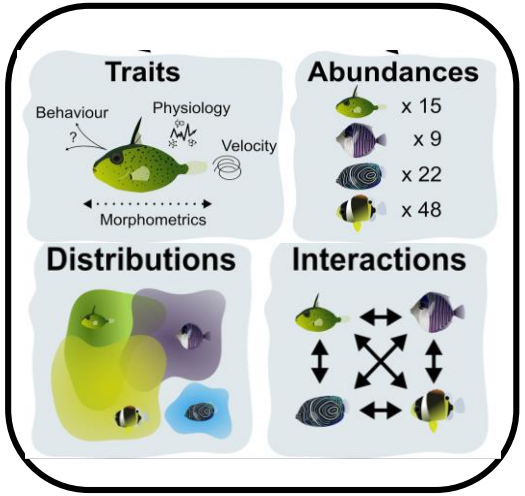


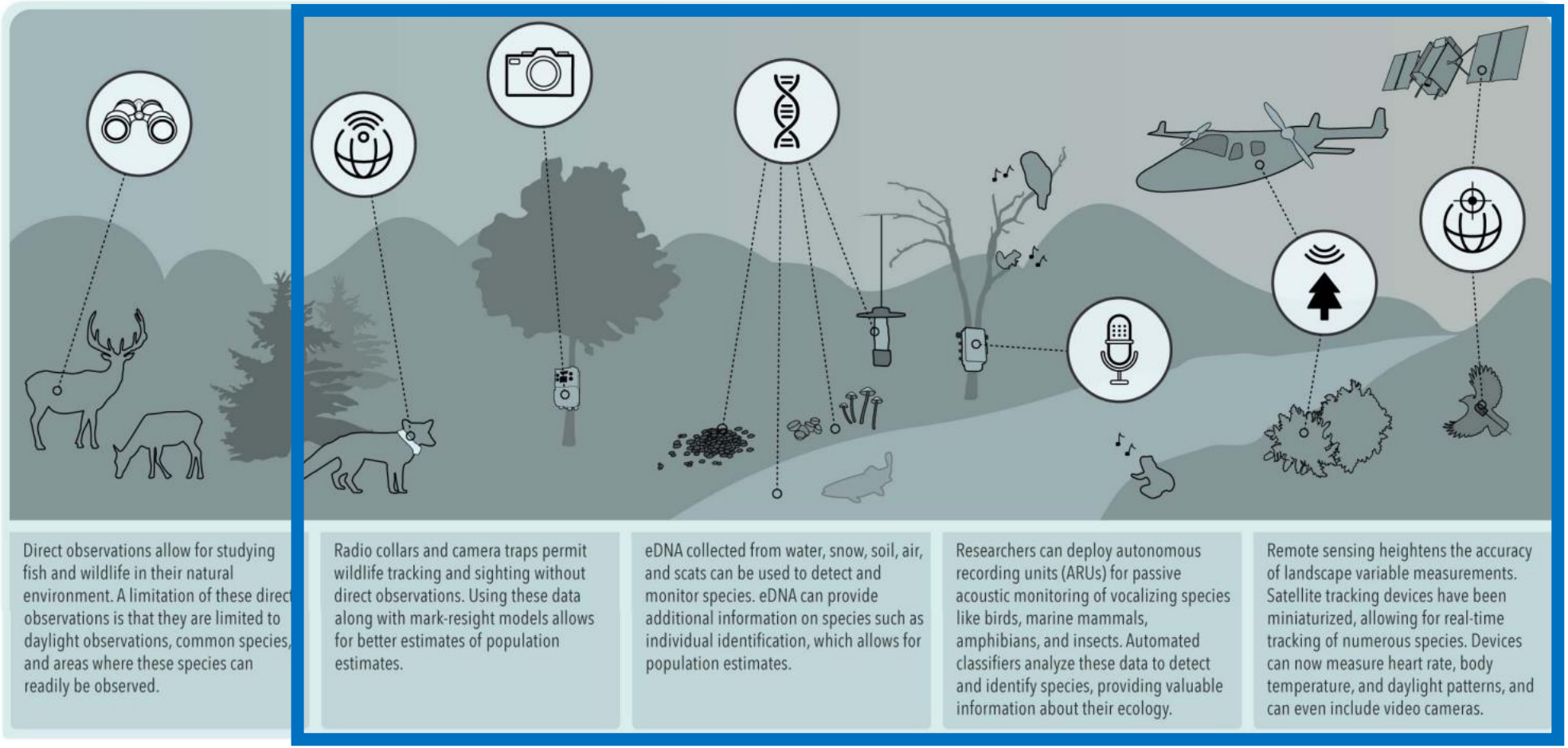


Fink *et al.* 2021 *eBird Status and Trends*

Rapid advances of sensor & AI tools







Direct observations allow for studying fish and wildlife in their natural environment. A limitation of these direct observations is that they are limited to daylight observations, common species, and areas where these species can readily be observed.

Radio collars and camera traps permit wildlife tracking and sighting without direct observations. Using these data along with mark-resight models allows for better estimates of population estimates.

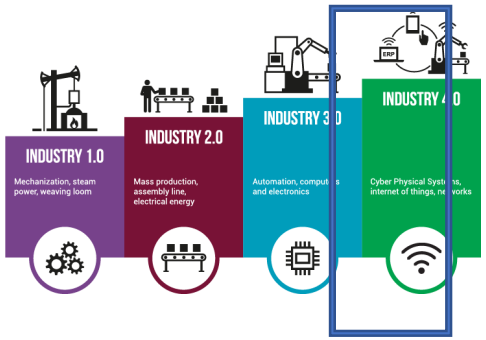
eDNA collected from water, snow, soil, air, and scats can be used to detect and monitor species. eDNA can provide additional information on species such as individual identification, which allows for population estimates.

Researchers can deploy autonomous recording units (ARUs) for passive acoustic monitoring of vocalizing species like birds, marine mammals, amphibians, and insects. Automated classifiers analyze these data to detect and identify species, providing valuable information about their ecology.

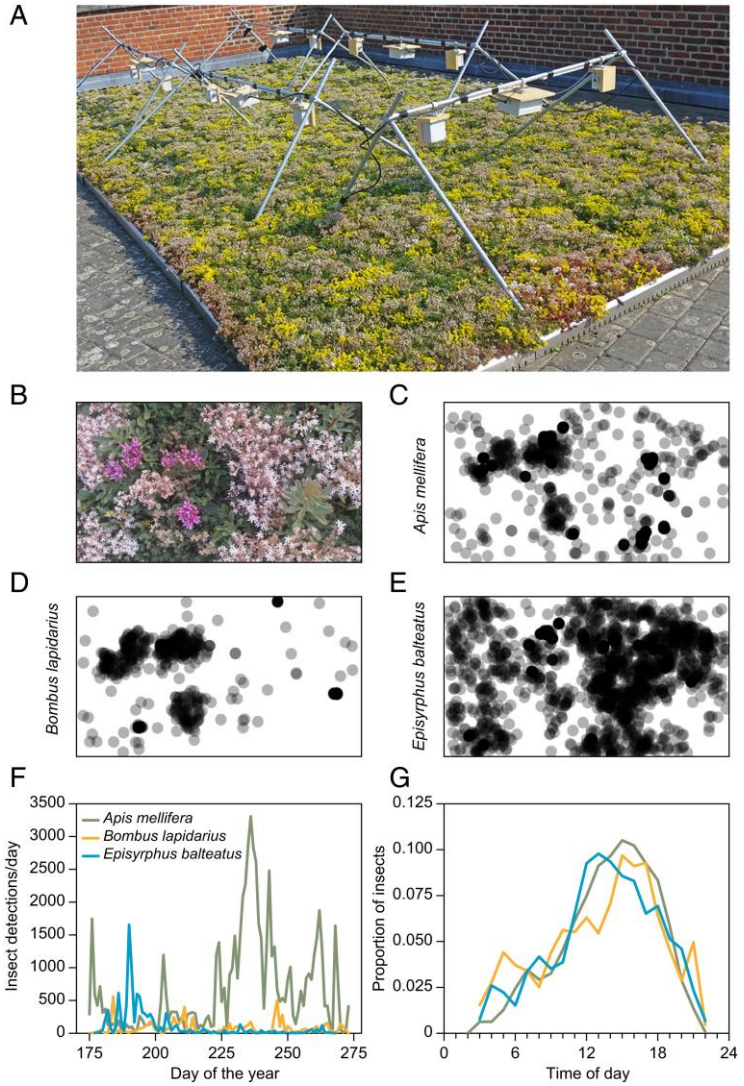
Remote sensing heightens the accuracy of landscape variable measurements. Satellite tracking devices have been miniaturized, allowing for real-time tracking of numerous species. Devices can now measure heart rate, body temperature, and daylight patterns, and can even include video cameras.

Tosa *et al.* 2021 *Frontiers in Ecol. & Evol.*
Besson et al. 2022 Ecology.

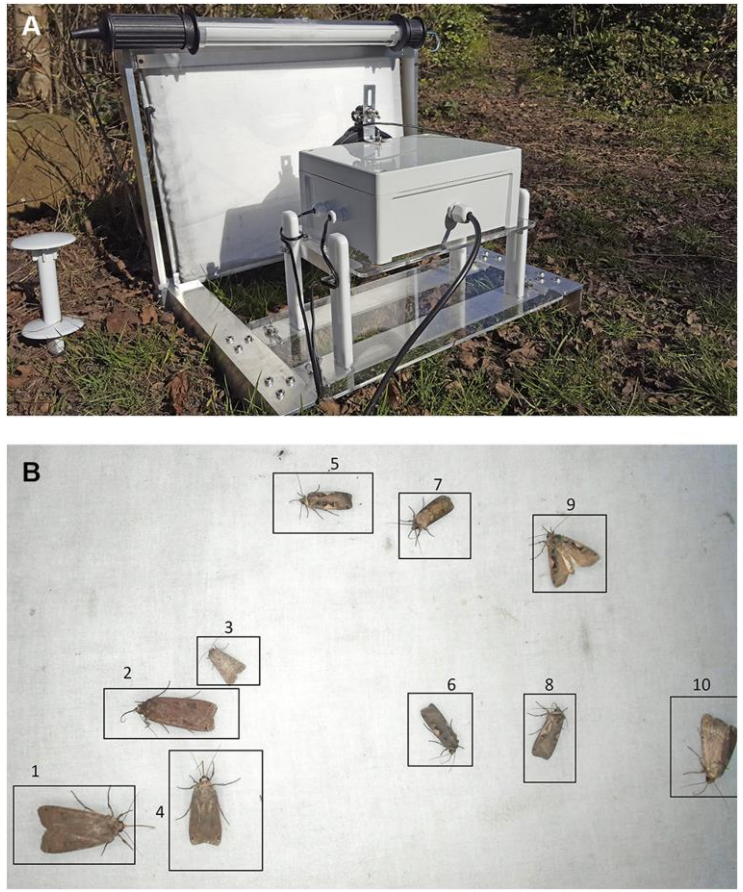
AI-enabled insect monitoring



Pollinator monitoring

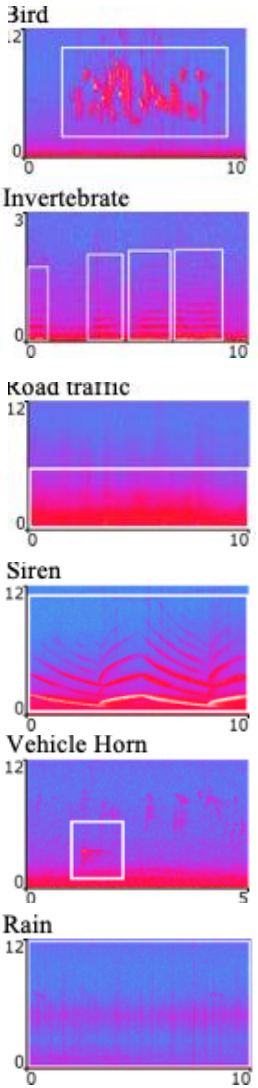


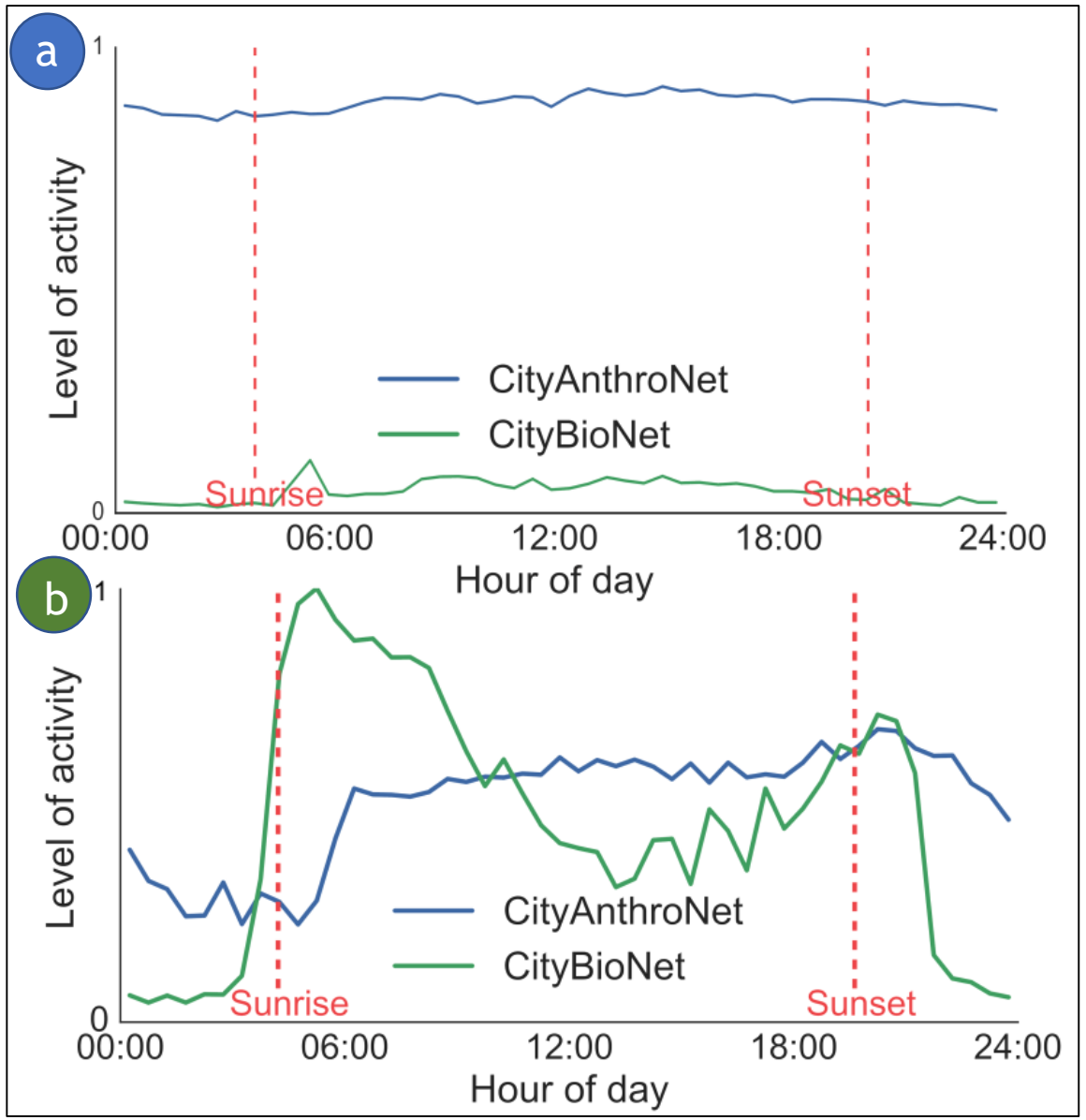
Moth monitoring



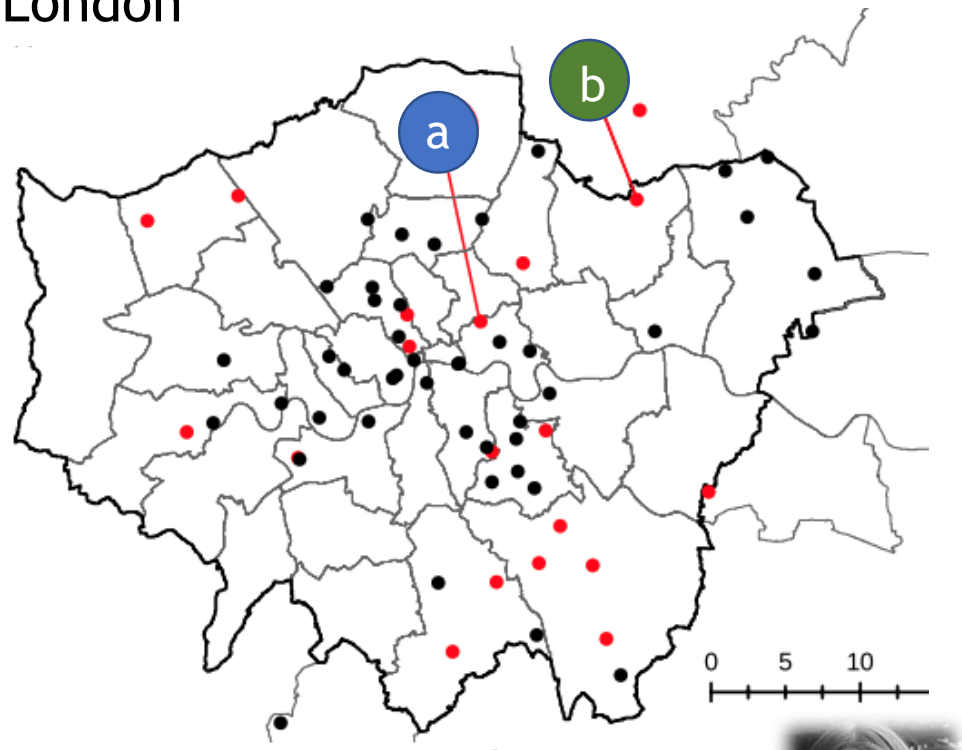
Hoye *et al.* 2021 *PNAS*.

AI-enabled bioacoustic monitoring



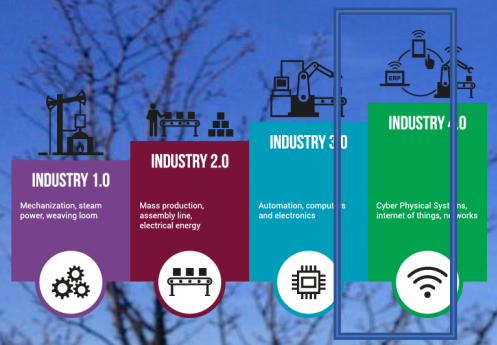


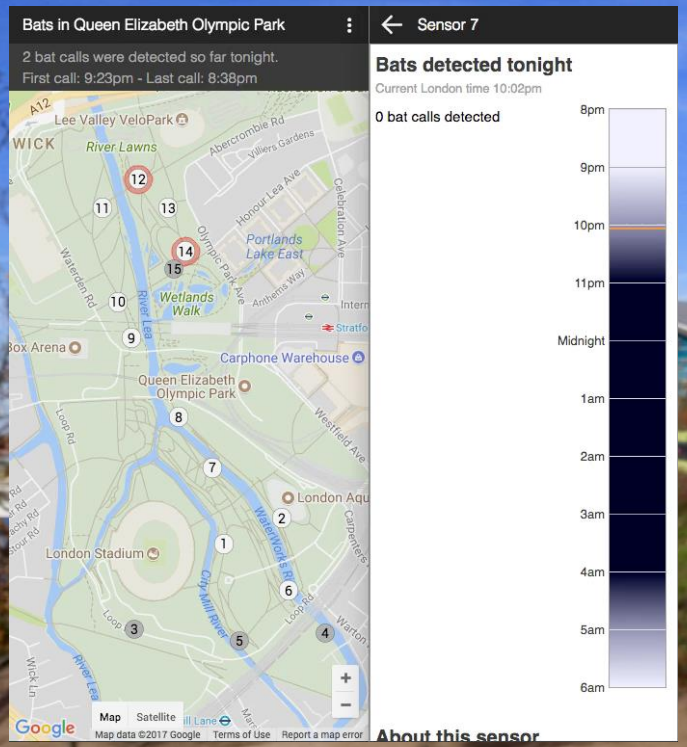
CityNet composition of sites across an urban gradient in London

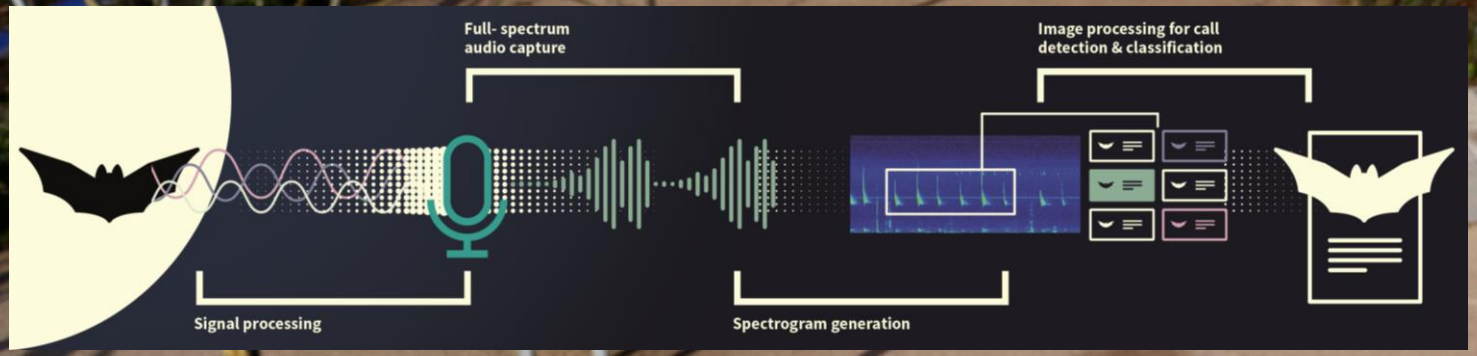


Fairbrass *et al*. 2019 MEE

Acoustic monitoring 4.0? Echoboxes in QEOP







Gallacher *et. al.* 2021 IET Smart Cities

UCL People & Nature Lab

Developing innovative cross disciplinary solutions to address biodiversity loss, ecosystem degradation, and climate change, promoting sustainable relationships between people and nature.

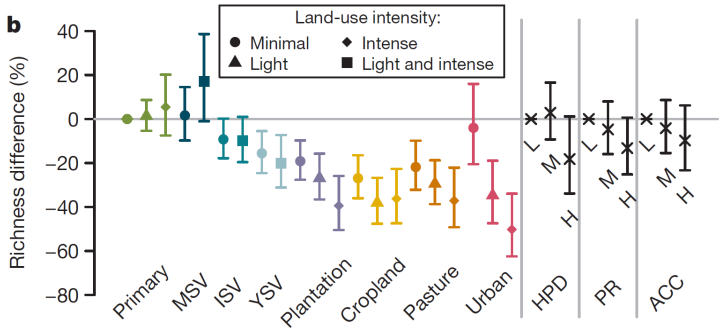
MSc **Ecology+** Data Science

MSc **Ecology+** Urban Engineering

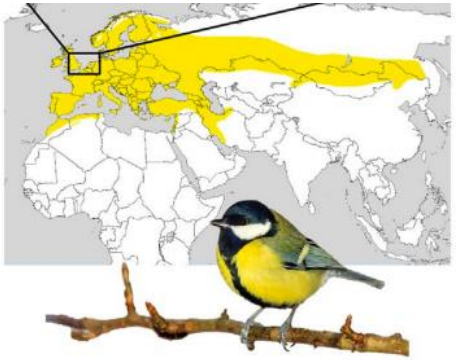
MSc **Ecology+** Climate Change & Health

Nature of Cities - Conclusions

Anthropocene is disrupting natural ecosystems



Land use changes species abundance, richness & behaviour – esp. in cities



City adaptions have fitness consequences

Value & criticality of nature increasingly recognized

Nature-based solutions play an important role in cities

Growing political will & actions but need better tools to ecosystem health & species