Ecological Sensing at Scale

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scale

resolution

Satellites
global coverage

Passive acoustic monitoring
continuous monitoring of vocal species

Drones
large scale species ids access to remote areas

Bio-loggers
species use of space and environment

eDNA
cryptic diversity

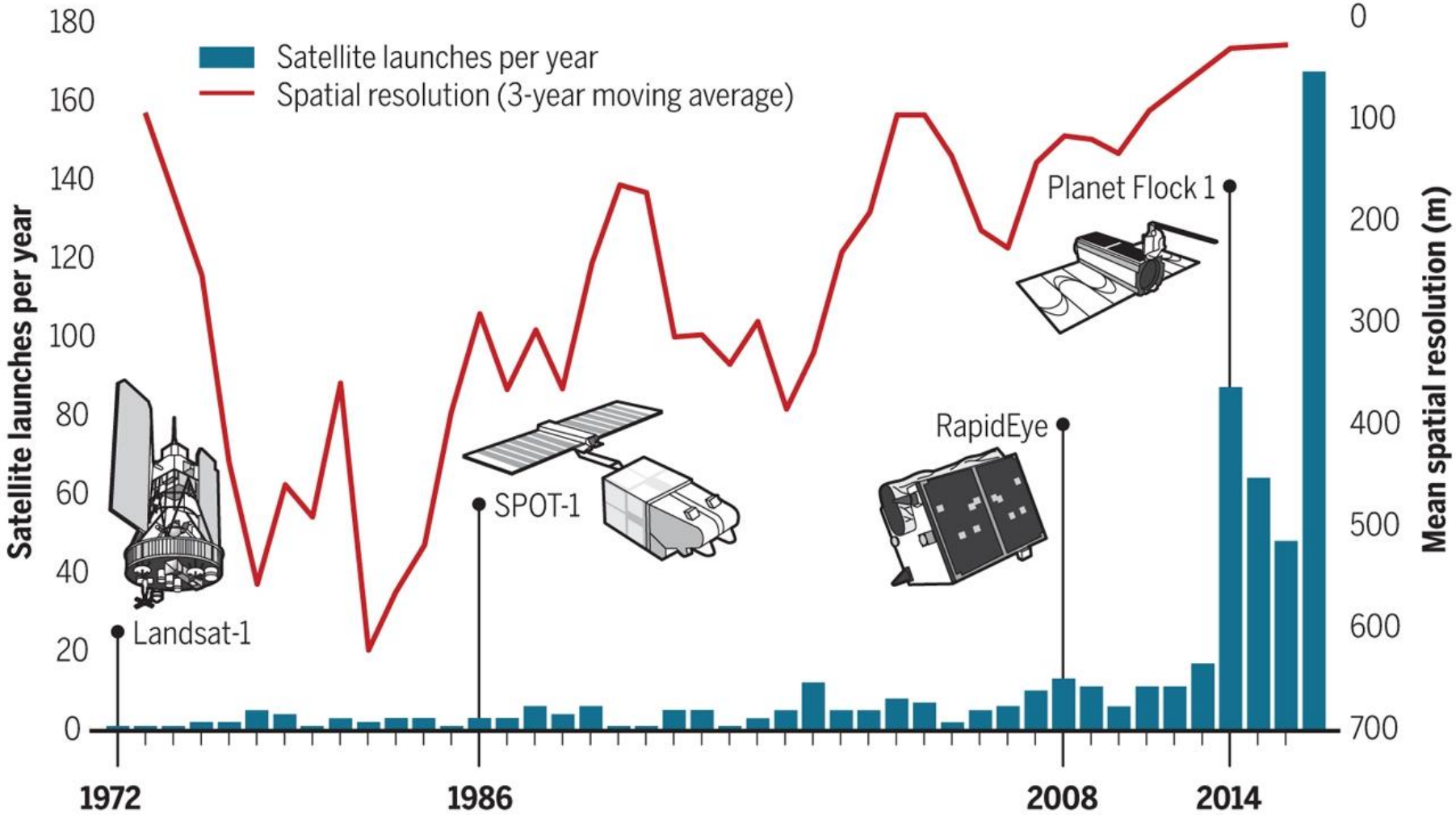
Camera traps
spatial and temporal resolution

Humans as instruments
taxonomic ids, links to past data

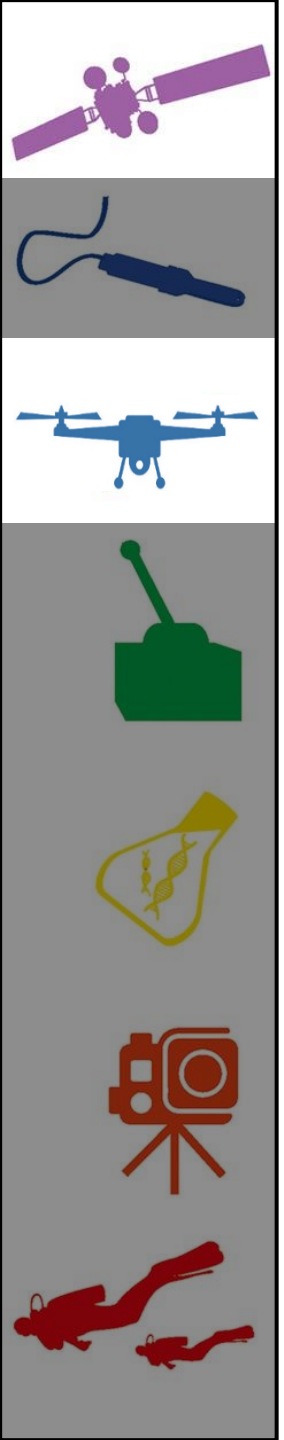
: slow, expensive, localised, often prone to error

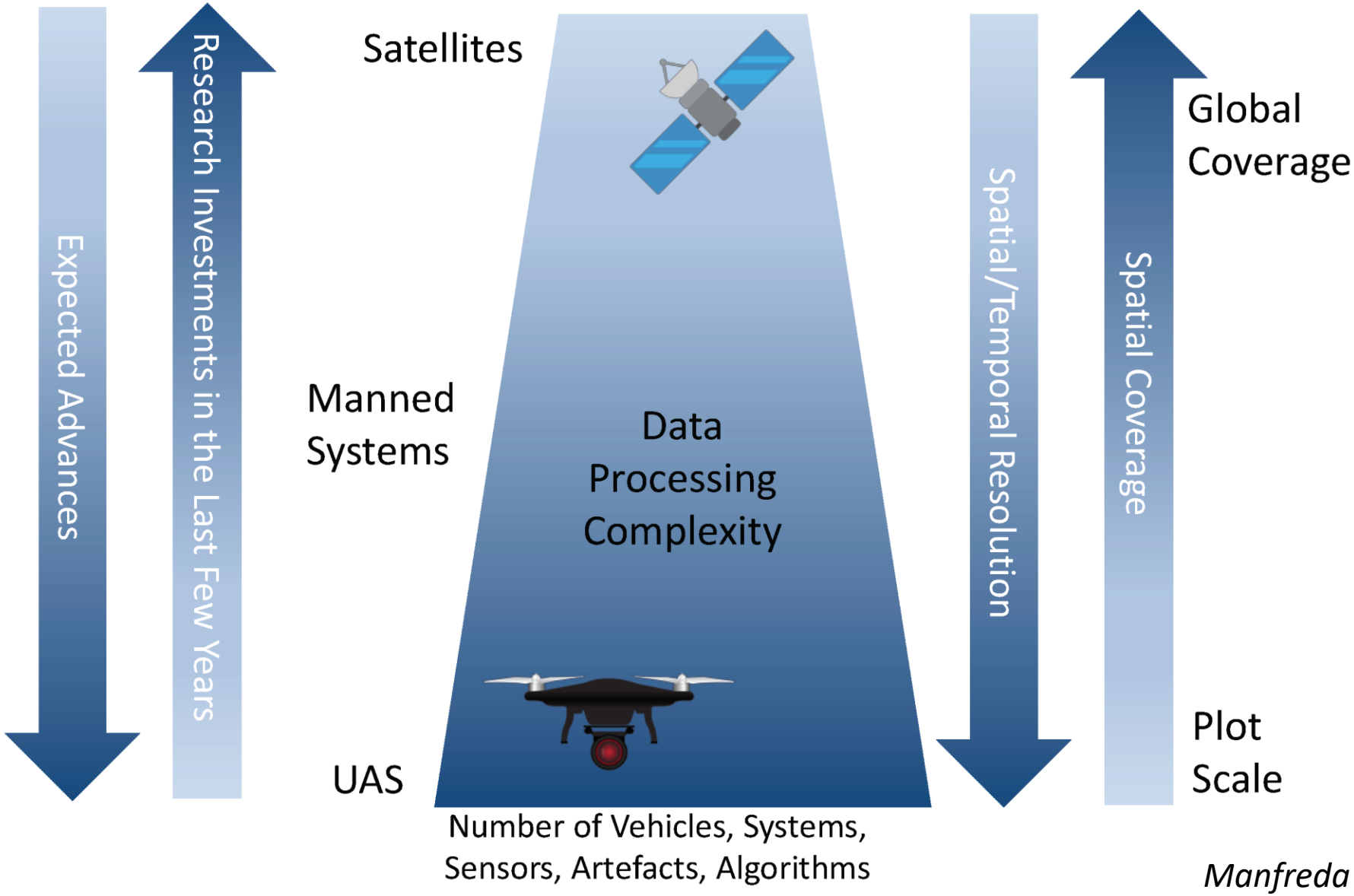
SATELLITES & DRONES

Since 1972, there have been >500 Earth Observation satellites launched by commercial and government organizations (excluding the military).



SATELLITES & DRONES

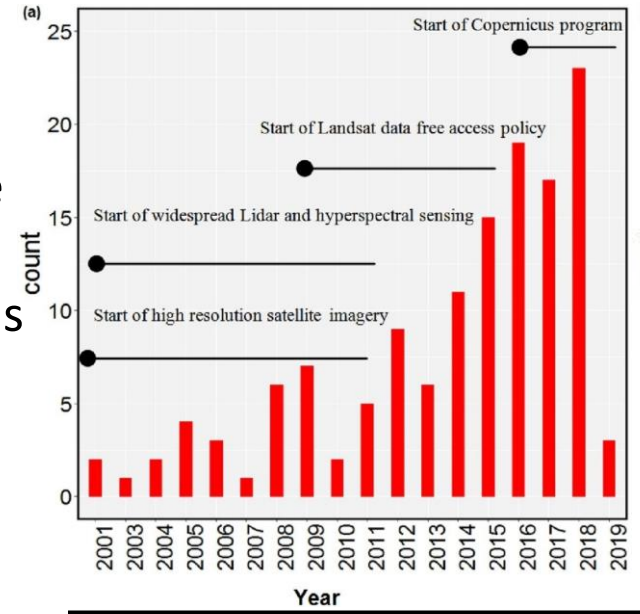


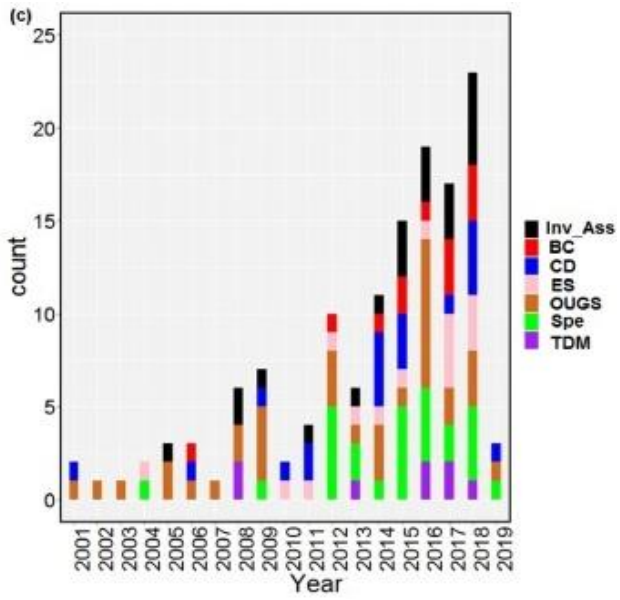


Manfreda et al. 2018

REMOTE SENSING

Sharp rise in urban remote sensing applications as data quality improves.

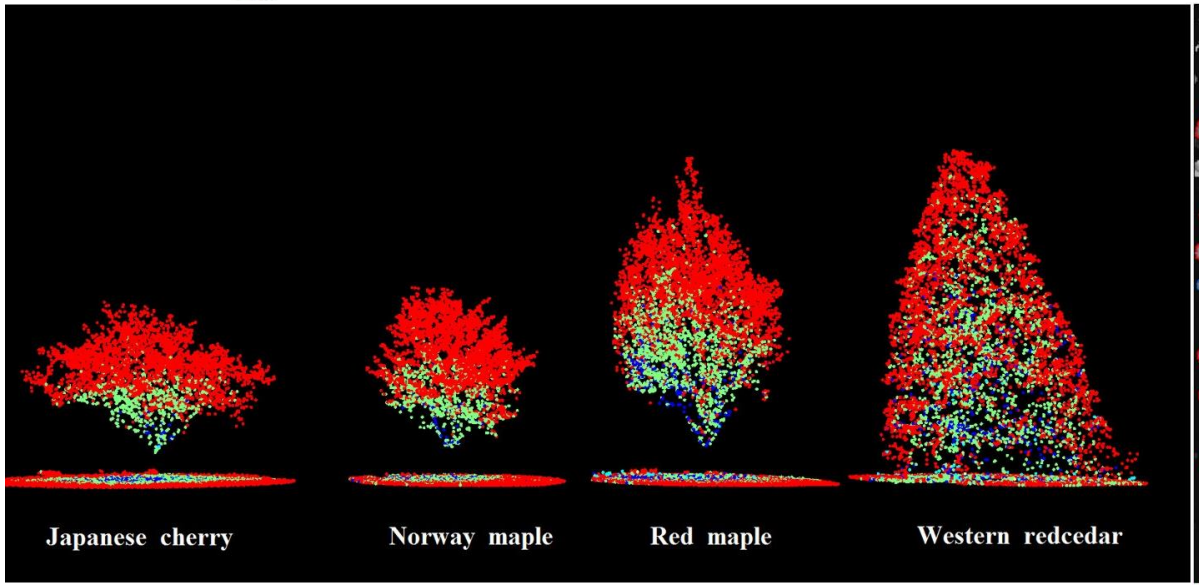


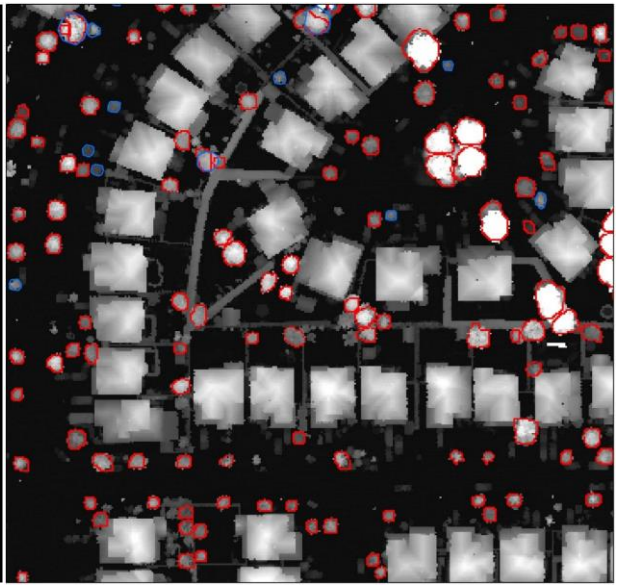


Main thematic areas include:

- Inventory and assessment
- Biomass and carbon
- Change detection
- Ecosystem services
- Urban Green Space
- Species mapping
- Three-dimensional modelling

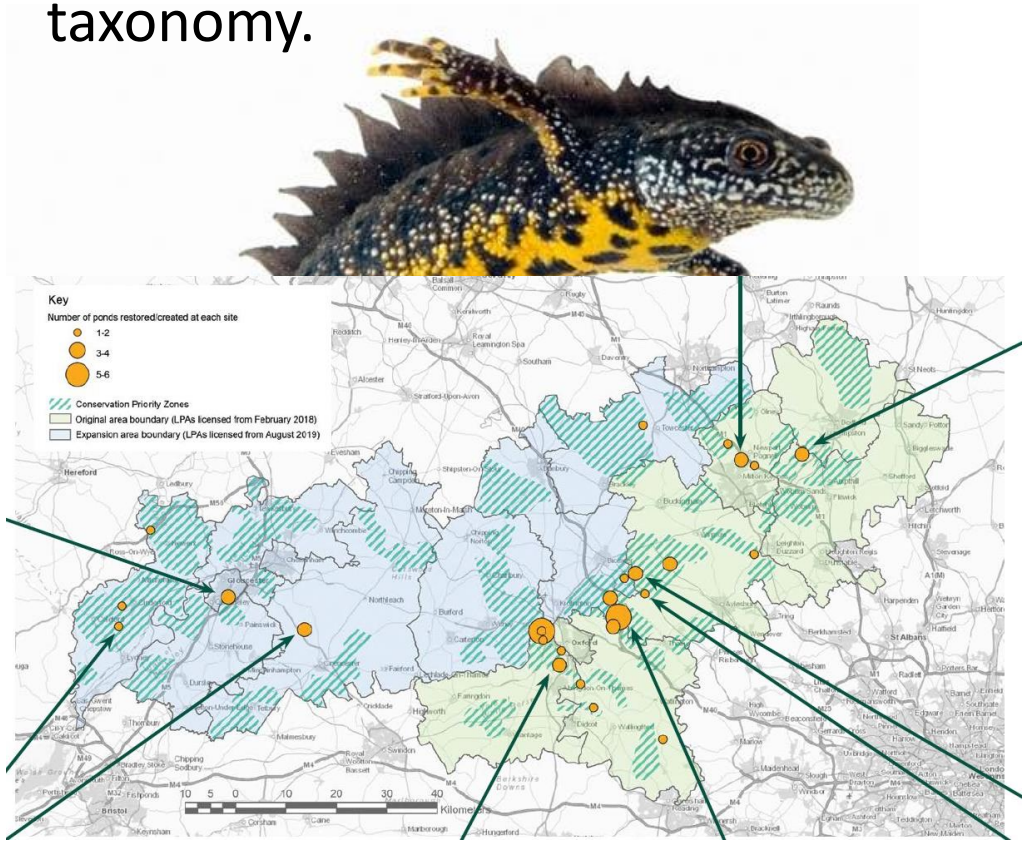
Understandably there has been a high focus on mapping of vegetation and identifying trees and the species of trees.



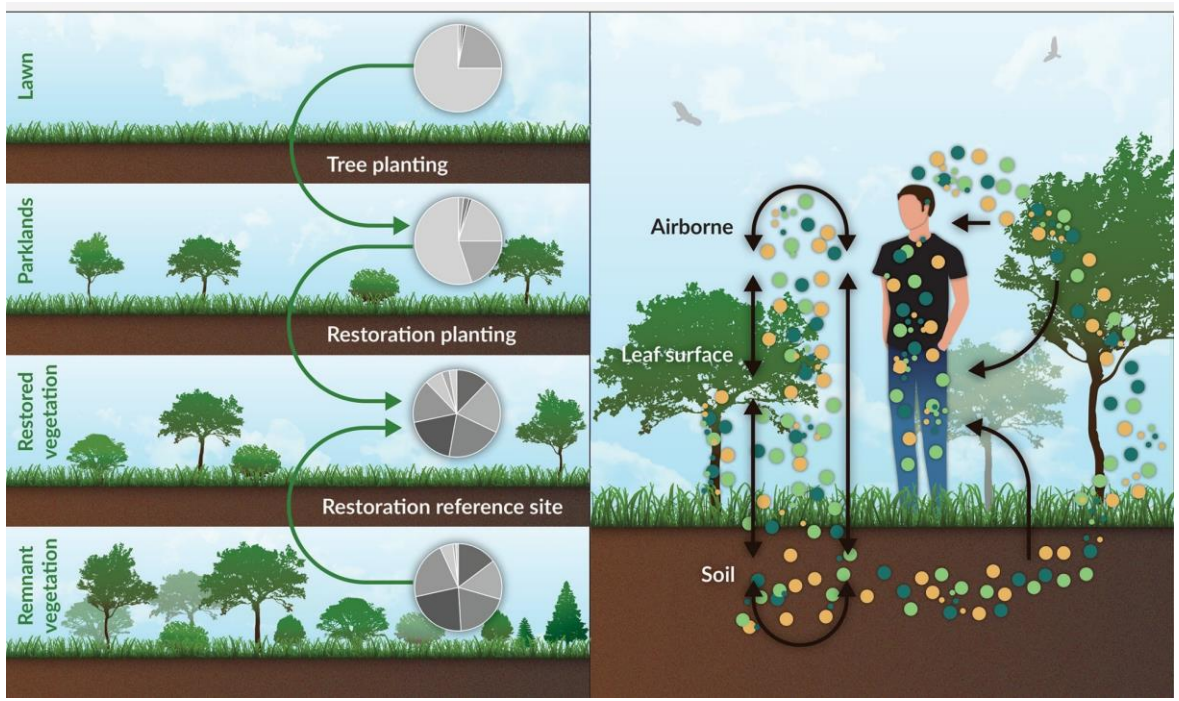


DNA

DNA-based monitoring is more sensitive, results are consistent, and data can potentially be updated to reflect different taxonomy.

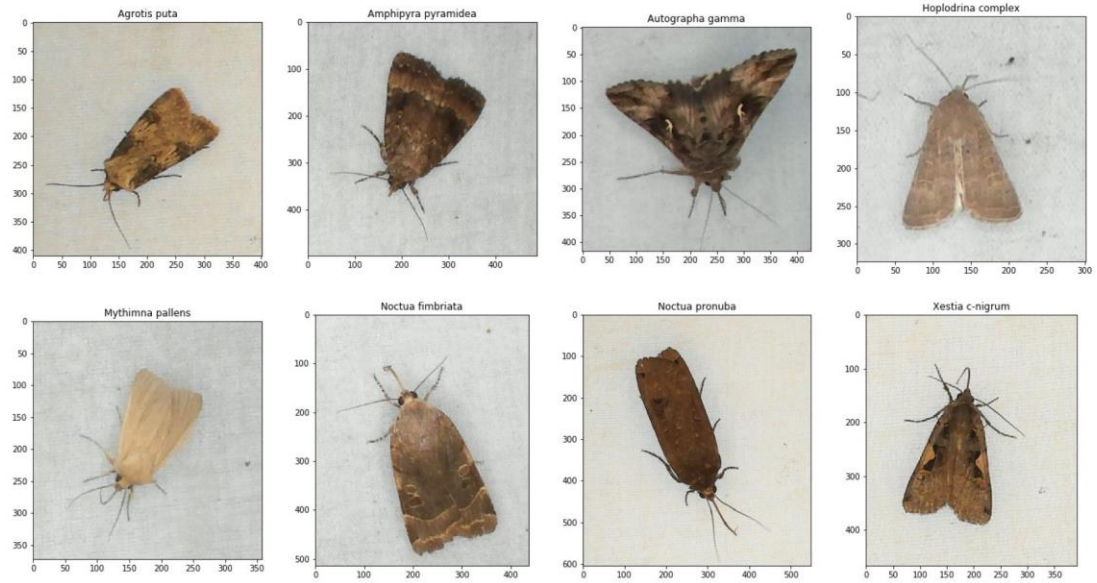


The Microbiome Rewilding Hypothesis argues urban habitat restoration provides a human health benefit through microbiome rewilding:

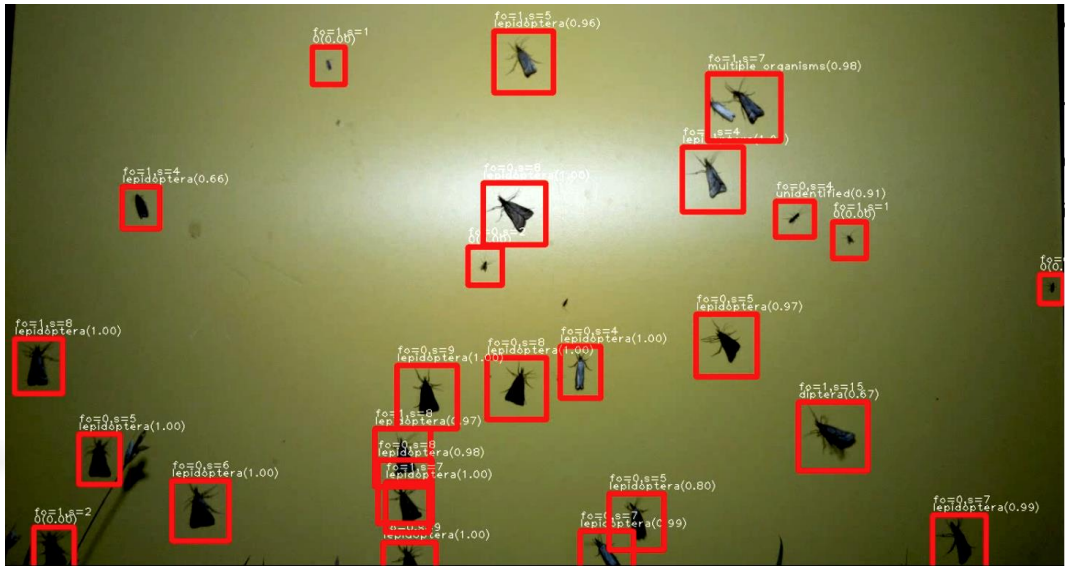


CAMERA-TRAPS

Automated moth (top) and pollinator (bottom) monitoring using camera images.



Machine learning identifies and tracks the insects in the images over days and weeks.

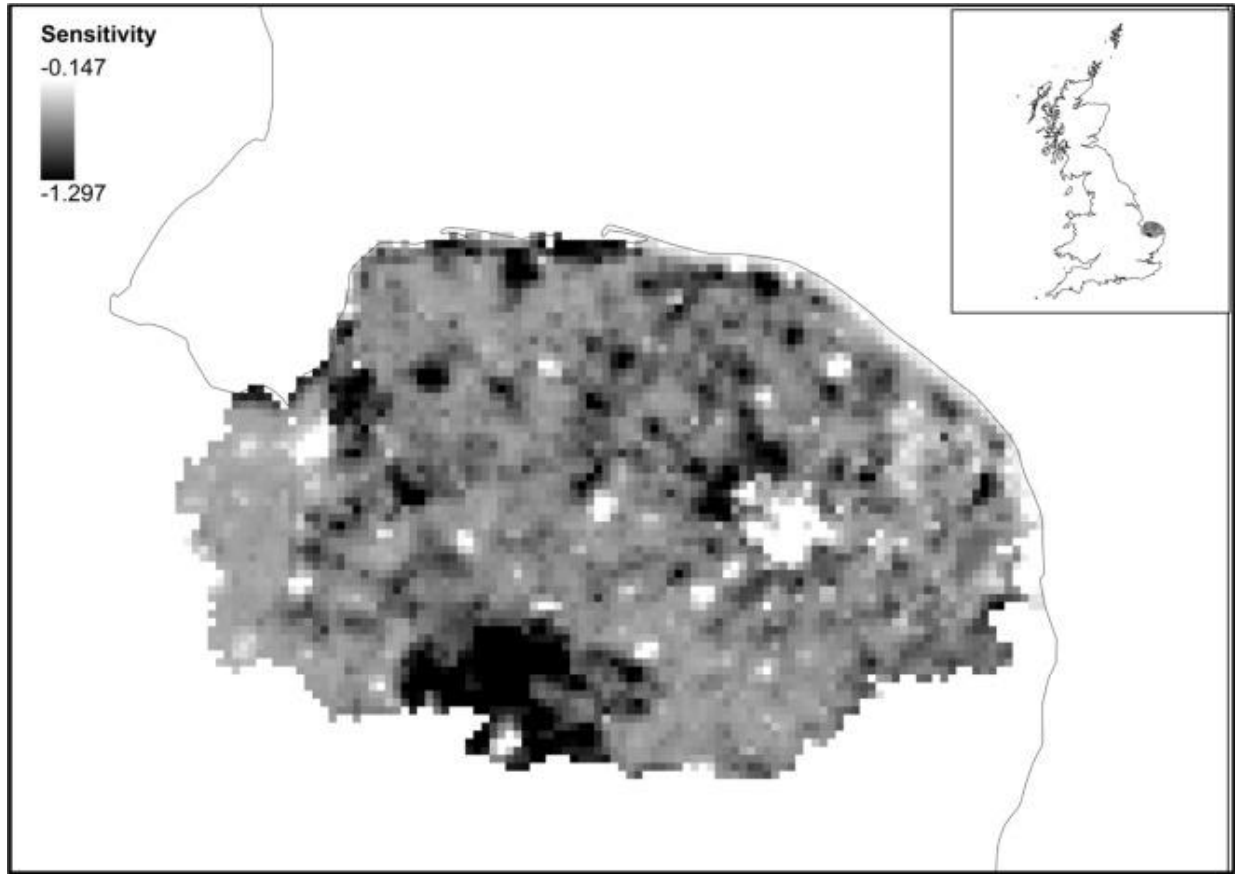


ACOUSTIC MONITORING

Passive acoustic monitoring is now widely applied in surveys of birds, bats, frogs, insects, cetaceans and more.

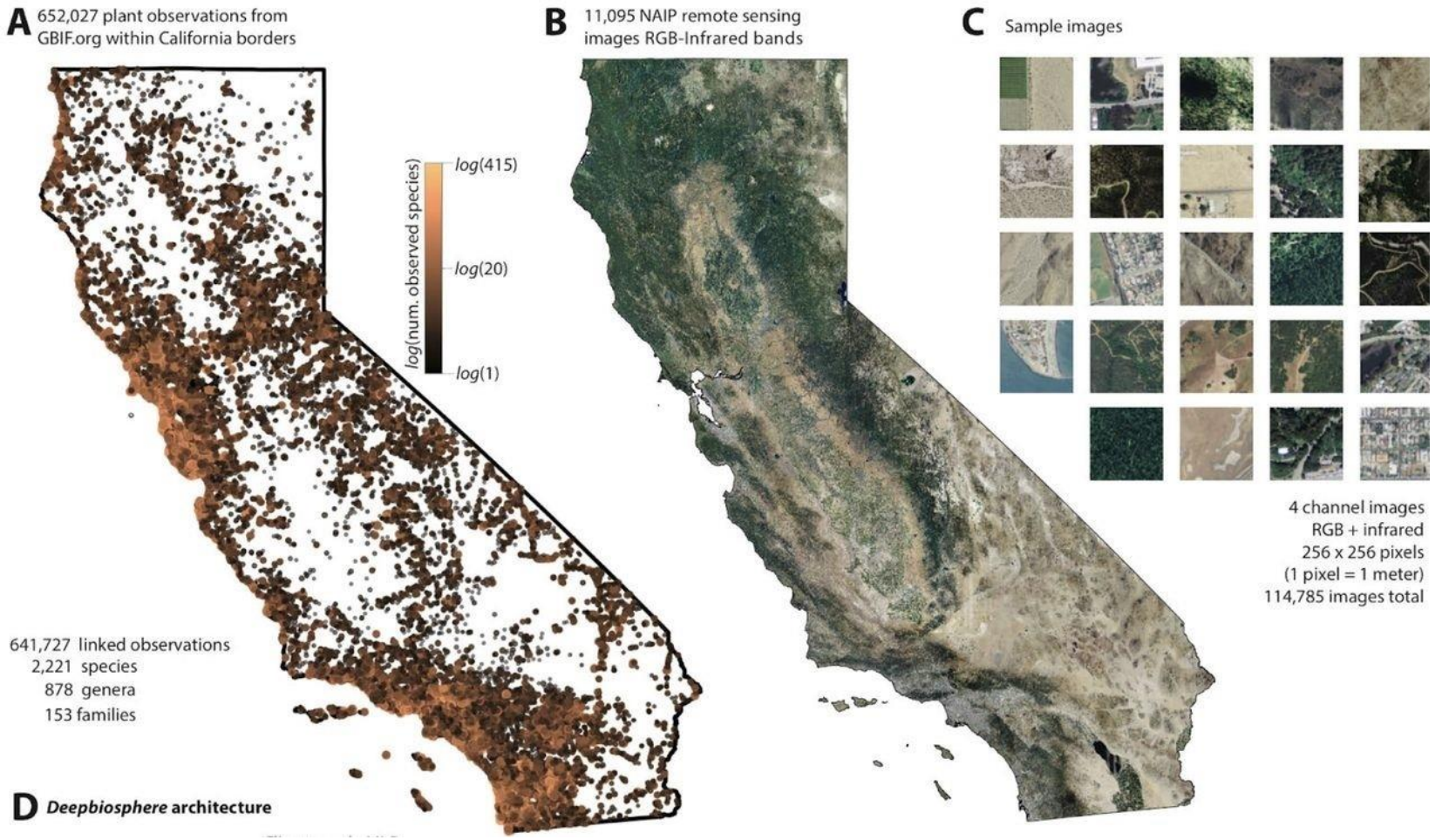
Monitoring can be expanded to many locations for much longer periods, and the data can be re-analysed if needed.

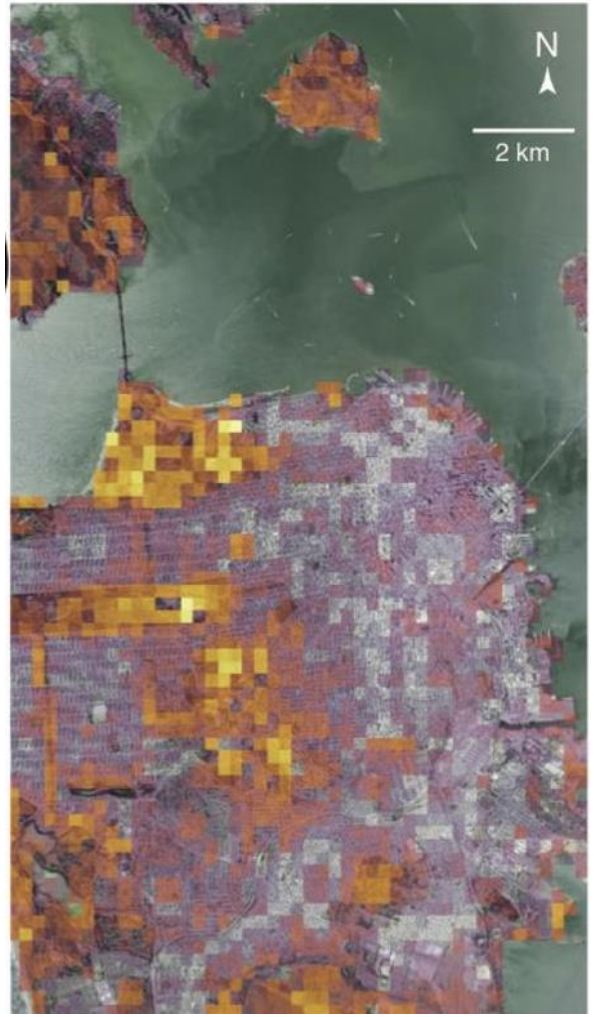
Automated programs are used to process the huge amounts of data generated.



Bat sensitivity to development in Norfolk. High probability of occurrence, many species and species' avoidance of urban areas contribute to make an area sensitive (darker areas) (Border et al. 2017).

SATELLITES +





Citizen science records from the app iNaturalist

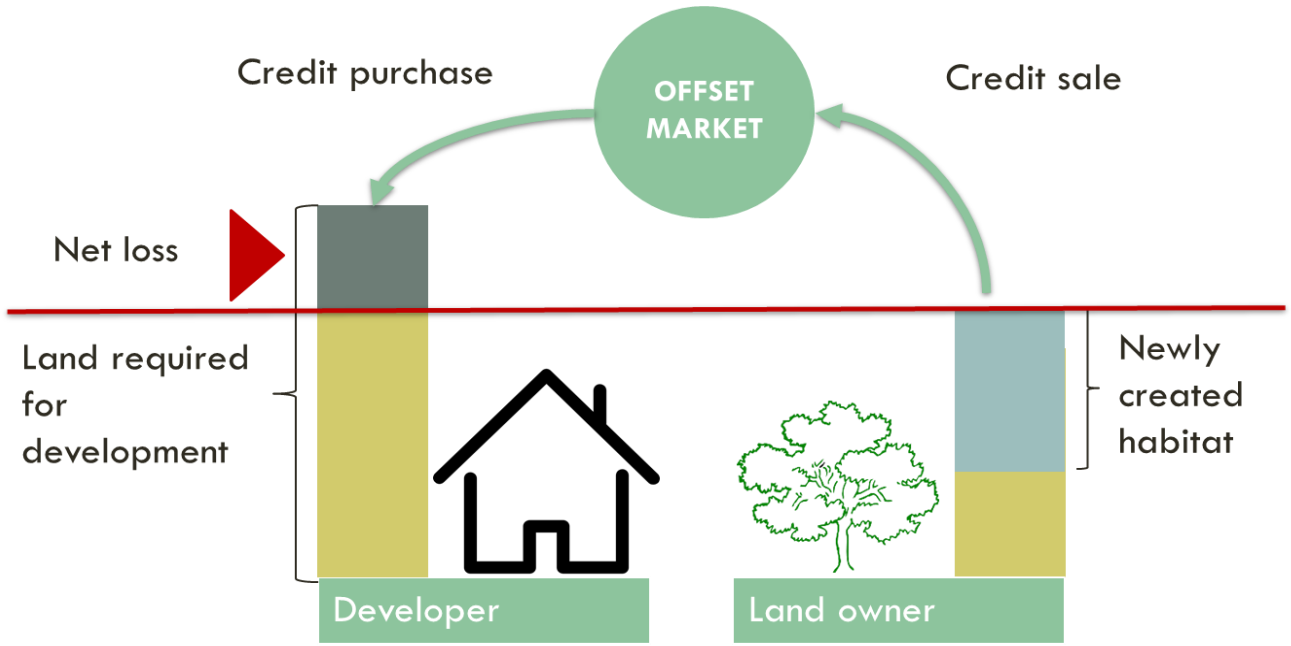
Aerial imagery from the National Agriculture Imagery Program

Detection of diverse urban green spots in San Francisco

NET GAIN ← STRATEGY ←TARGETS

Planning policy has been shifting towards Net Positive / Biodiversity Net Gain (BNG).

To combine individual actions and restore ecosystems it is vital goals are articulated as *targets*, such that decisions can be made *strategic*.

Monitoring is fundamental to informing targets, progress and verification (Bush et al. in prep).

Currently, developments claim gains from low-quality habitats that face high human pressure.