



# BEeS

# The LifeWatch ERIC Biodiversity & Ecosystem eScience Conference

Seville  
22-24/05/23

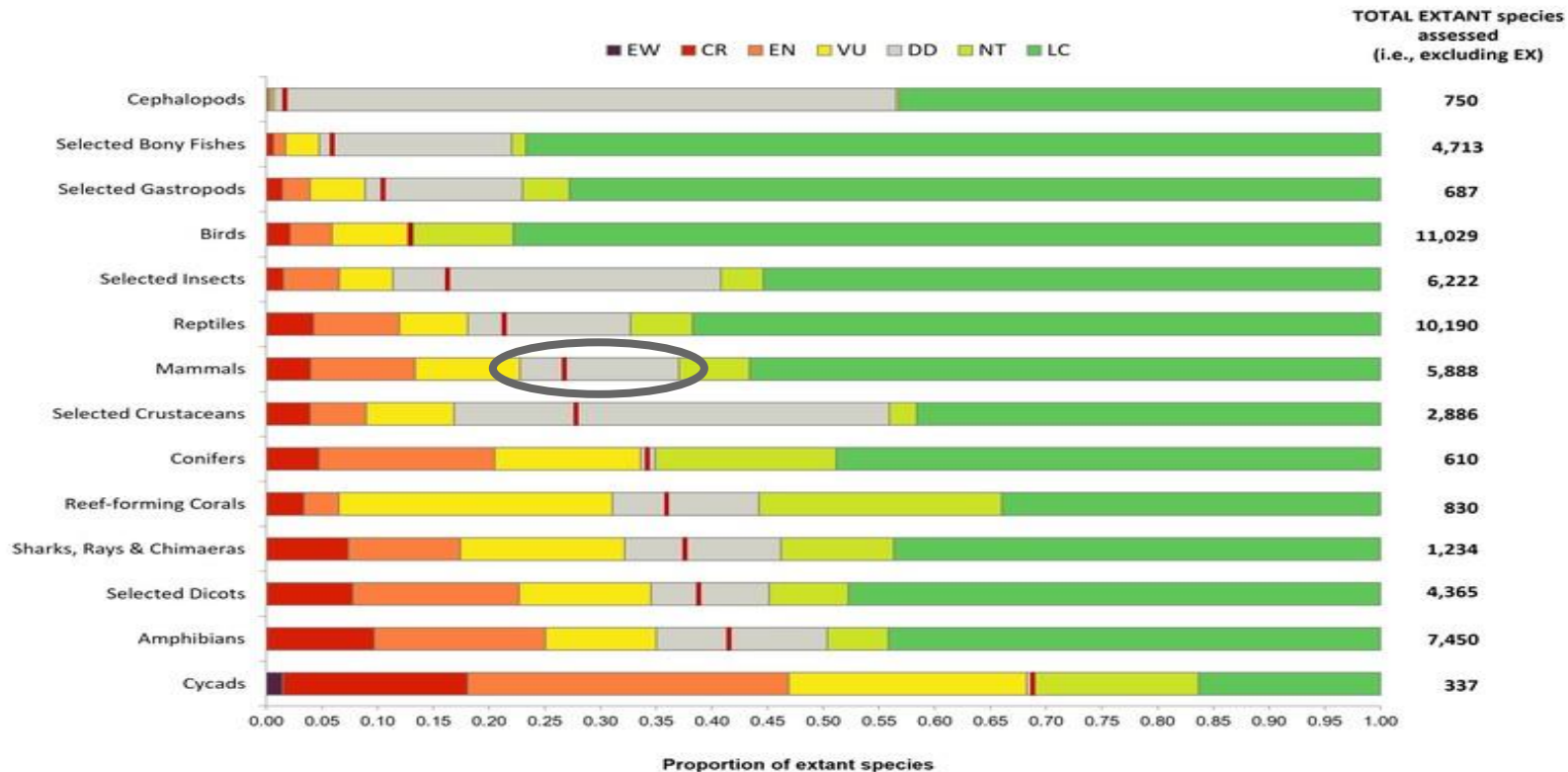


## Threats and challenges to biodiversity and ecosystem conservation from an eScience perspective



Camera trapping, artificial intelligence, citizen science,  
and hierarchical models for biodiversity monitoring: a  
promising journey

Simone Santoro, Manuel Gegúndez, Santiago  
Gutiérrez-Zapata, Nuria Selva, Alba Márquez  
Rodríguez, Cristian Díaz-Martín, Javier Calzada





# BEEs

Seville, 22-24 May 2023

## Threats and challenges to biodiversity and ecosystem conservation from an eScience perspective



### Mobile Sensors

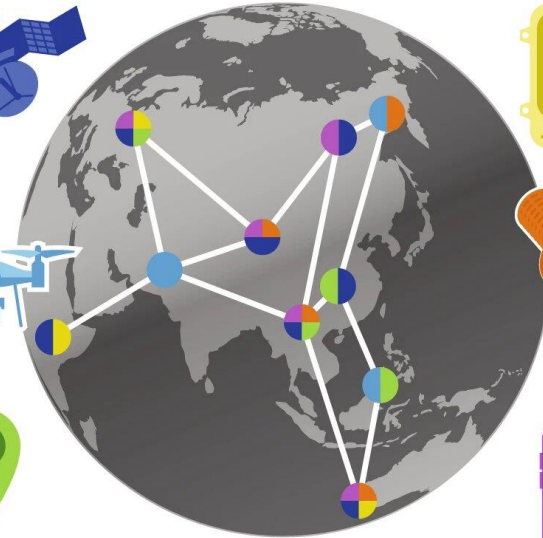
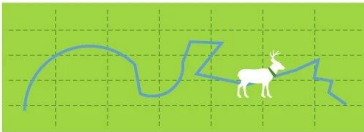
Satellite (optical, SAR, LiDAR)



UAV (RGB, thermal, LiDAR)



On-Animal Sensors

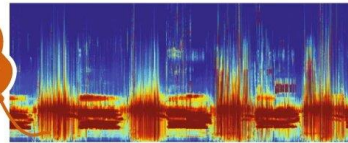


### Stationary Sensors

Camera Traps



Bioacoustic Sensors



### Community Science

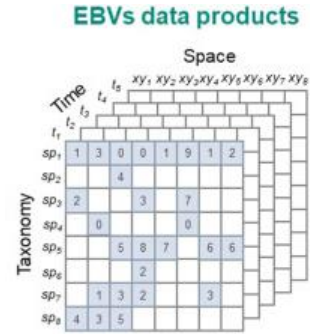
Images, labels, etc.



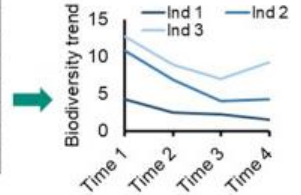
**UNIÓN EUROPEA**

Fondo Europeo de Desarrollo Regional  
Una manera de hacer Europa

Tuia et al. (2022).  
Perspectives in machine  
learning for wildlife  
conservation. *Nat Commun.*



**Indicators**





Storage



Management



Processing

## Labelling is not always simple



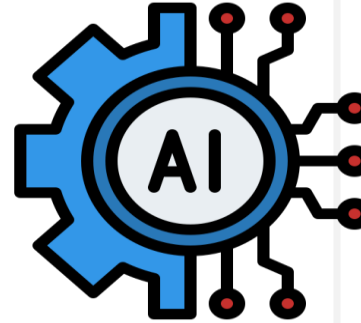
## Three systems to label images



**Experts**



**Citizen Science**



**Artificial intelligence**


# Citizen Science

**Iberian Camera Trap Project**

ABOUT CLASSIFY TALK COLLECT RECENTS LAB

Great work! Looks like this project is out of date at the moment!  
[See the results](#) or [dismiss this message](#)

**FINISHED!**



12°C 30.9 inHg 80 03/04/2023 09:07AM

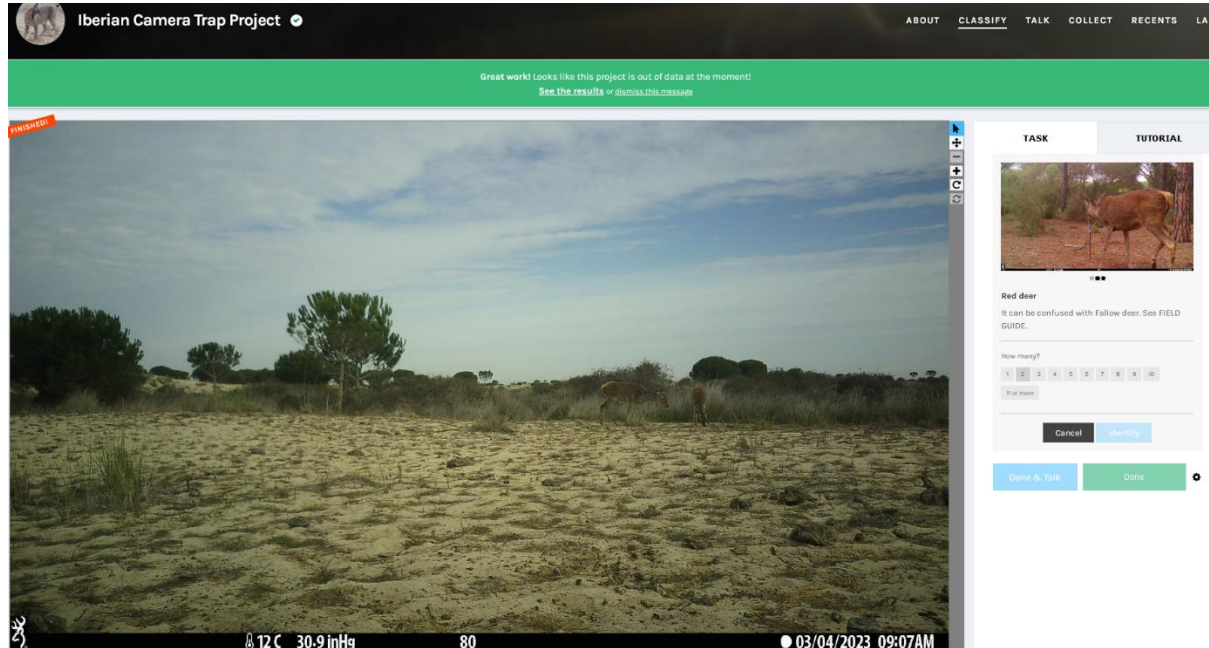
TASK	TUTORIAL
Red deer	Lepus (rabbit or hare)
Fallow deer	European badger
Carniv (died or fallow deer)	Egyptian mongoose
Wild boar	Common genet
Red fox	Iberian lynx
Cow	Other species
Horse	Human or vehicle
European rabbit	Unrecognizable
Iberian hare	No animal

Showing 18 of 18 Clear filters

Done & Talk Done

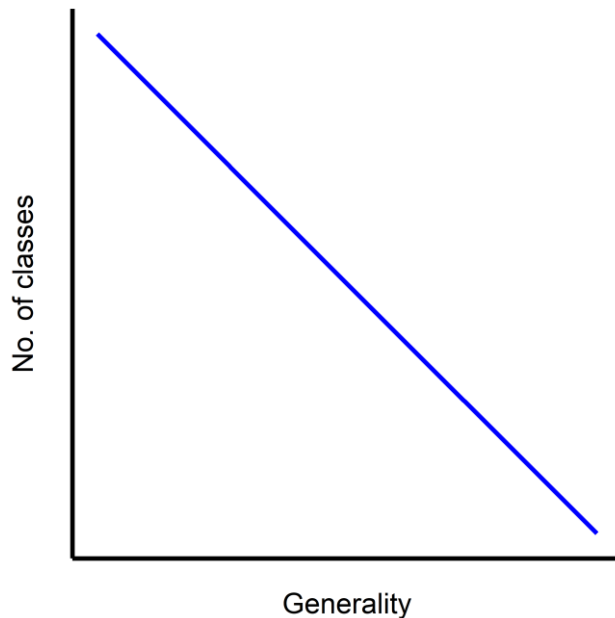


## Citizen Science



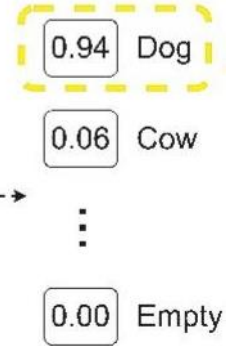
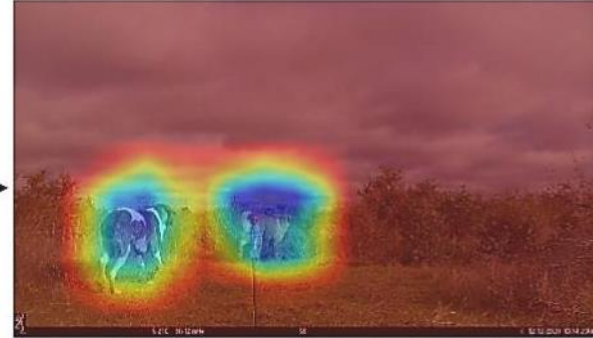
The screenshot shows the 'Iberian Camera Trap Project' interface. At the top, there is a navigation bar with 'ABOUT', 'CLASSIFY', 'TALK', 'COLLECT', 'RECENTS', and 'LAB'. Below this is a green banner with the text: 'Great work! Looks like this project is out of data at the moment! See the results or dismiss this message'. The main area features a large photo of a red deer in a field. To the right of the photo is a 'TASK' panel with a 'TUTORIAL' tab. The task panel includes a small image of a red deer, the text 'Red deer', a note 'It can be confused with Fallow deer. See FIELD GUIDE.', a 'How many?' section with a numeric keypad (1-9, 0), and 'Cancel' and 'Identify' buttons. Below the task panel are 'Done & Talk' and 'Done' buttons. At the bottom of the photo, there is a status bar showing '12 C 30.9 inHg 80' and '03/04/2023 09:07AM'.

## Artificial Intelligence – One-size-fits-all approach?



Class	Precision	Recall	F1
<b>Wildlife Insights</b>			
Black agouti	1.00	0.04	0.08
Blank	0.67	0.17	0.27
Collared peccary	0.90	0.43	0.58
Domestic dog	0.01	0.05	0.02
Giant anteater	1.00	0.13	0.23
Giant armadillo	0.93	0.08	0.14
Lowland tapir	0.98	0.03	0.06
Ocelot	0.94	0.05	0.09
Puma	0.95	0.27	0.43
South American coati	1.00	0.00	0.00
Spotted paca	1.00	0.36	0.52
Tayra	0.95	0.09	0.17
White-lipped peccary	0.97	0.02	0.04
<b>MegaDetector</b>			
Animal	0.98	0.93	0.96
Blank	0.77	0.93	0.84

## Local AI models typically outperform global AI models



## Our study system



60 randomly placed at  
least 1 Km apart

In the Park's non-floodable  
zone (250 km<sup>2</sup>)

On wooden poles, 50 cm  
from the ground

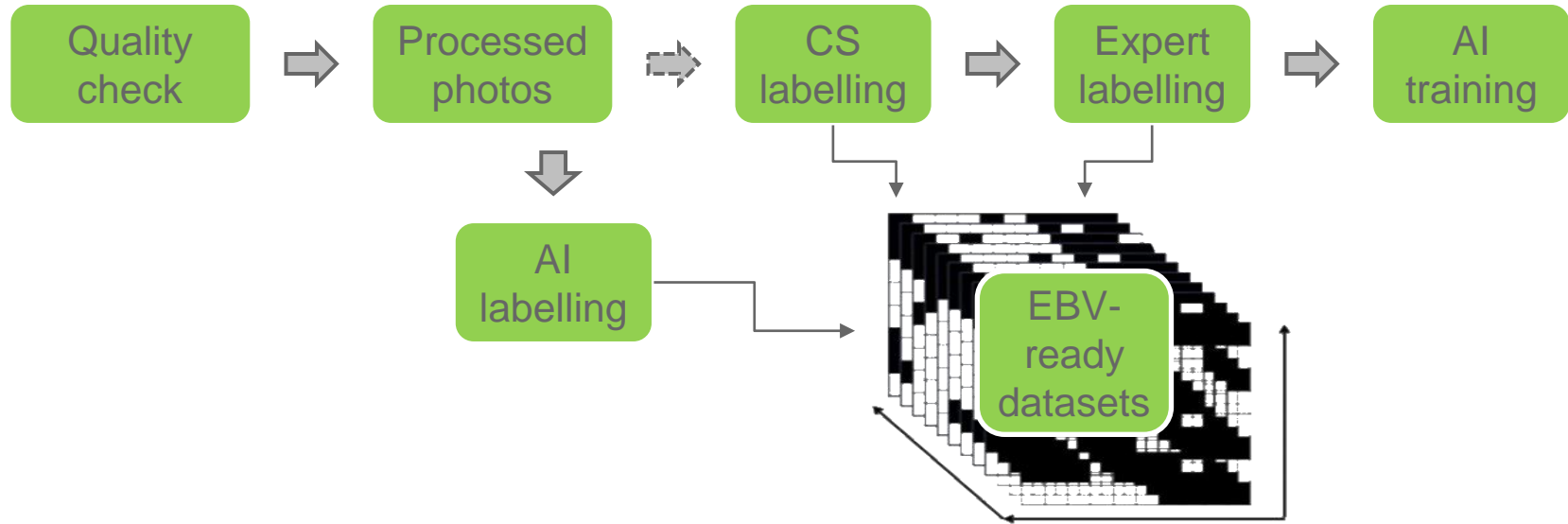


Check every 2  
months

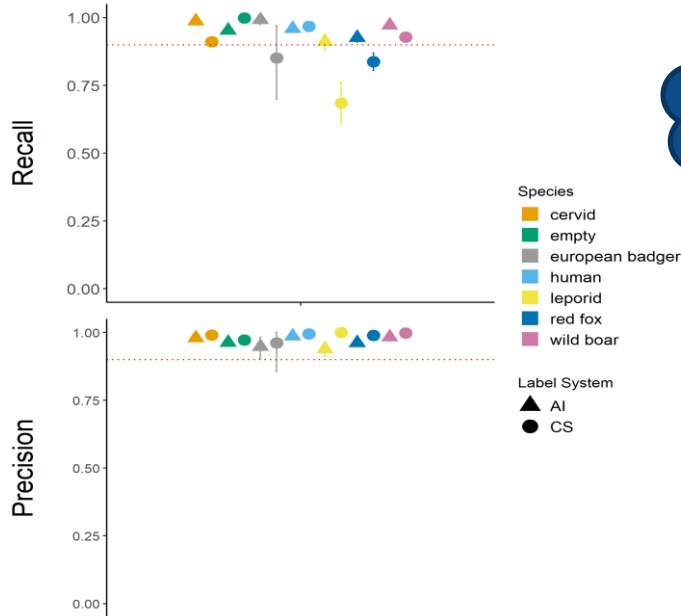
3-photos sequence,  
1" delay

32GB SD

## Our labelling protocol

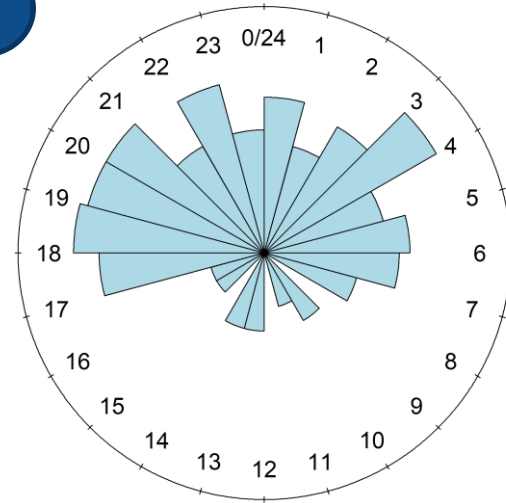


## Citizen Science vs Artificial Intelligence



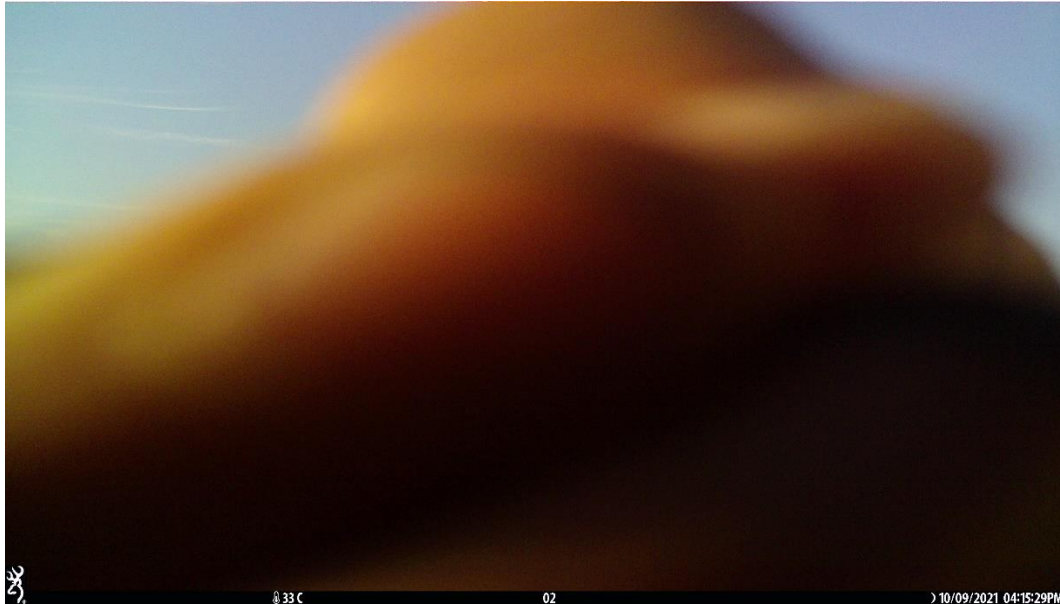
CS: 1 per minute  
AI: 10-15 per second

**CS vs AI - missed by Hour**



CS: 1 per minute  
AI: 10-15 per second

## Artificial Intelligence – and not CS – detects this **human**



## Artificial Intelligence – and not CS – detects this genet



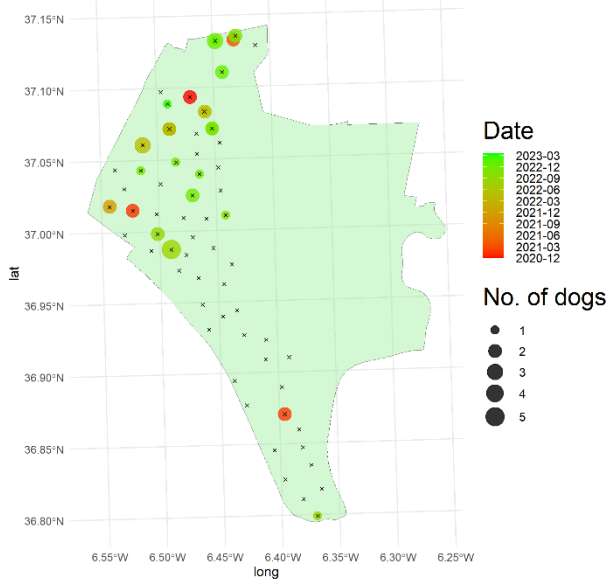


## Artificial Intelligence – and not CS – detects this **red fox**

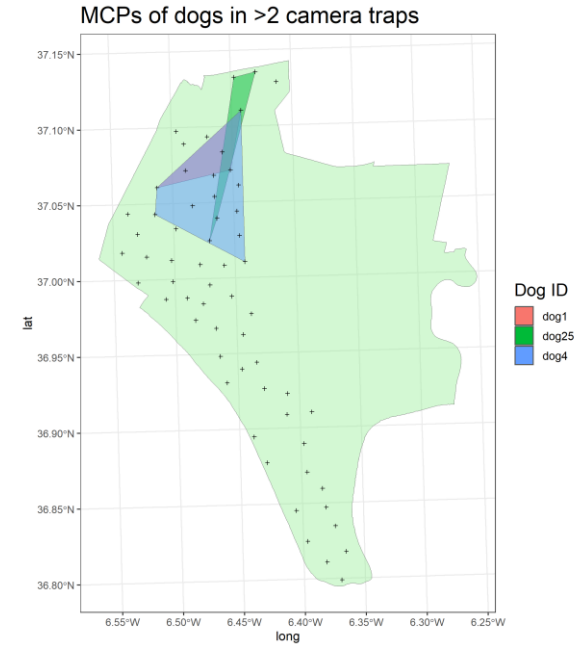


## Dogs at Doñana





Predation  
 Competition  
 Disease transmission  
 Wildlife disturbance





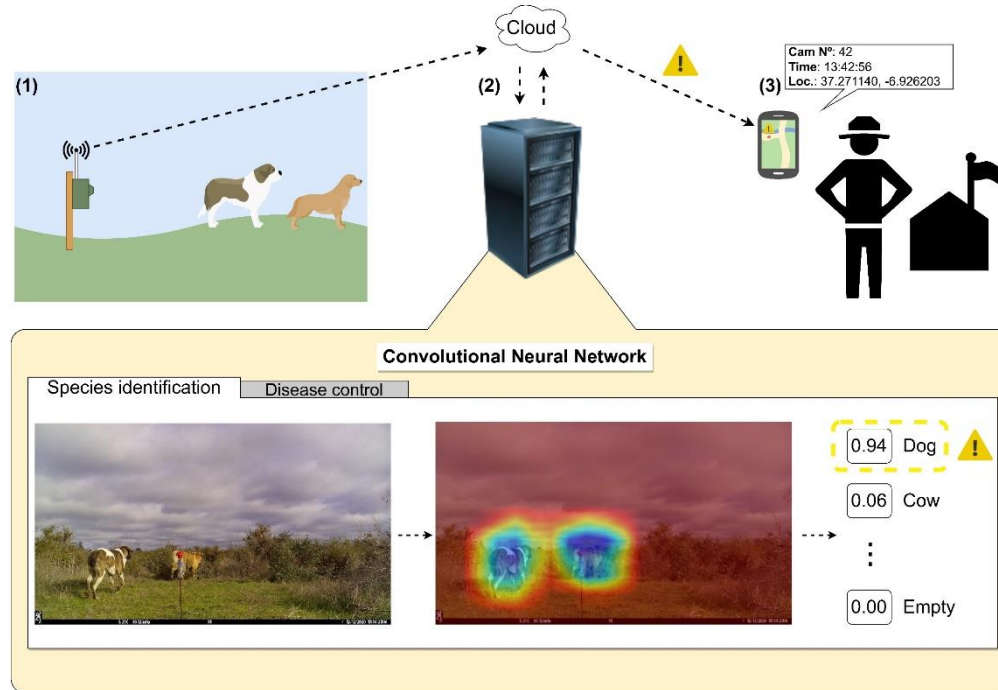
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Seville, 22-24 May 2023

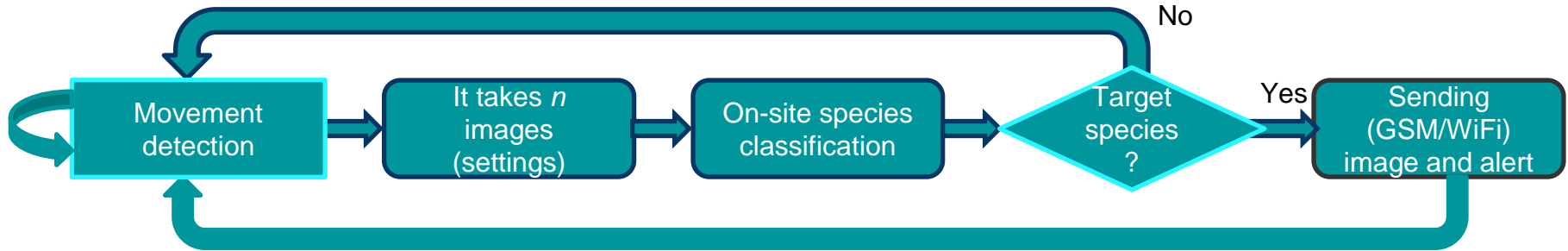
Threats and challenges to biodiversity and ecosystem conservation from an eScience perspective



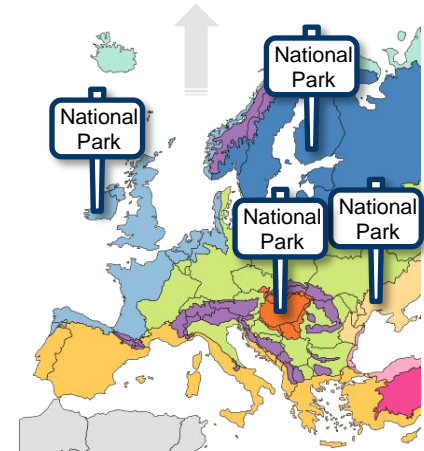
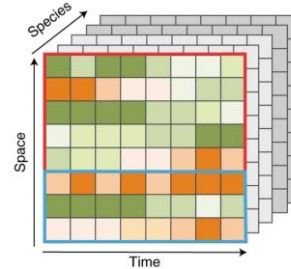
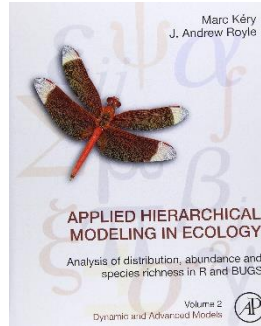
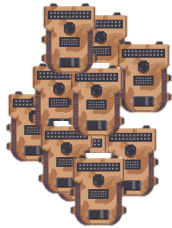
## Our prototypes for on-site classification and remote delivery



## Our prototypes for on-site classification and remote delivery



## Towards a semi-automatic, reliable wildlife monitoring...





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Thank you! | [www.lifewatch.eu/bees-2023](http://www.lifewatch.eu/bees-2023)

