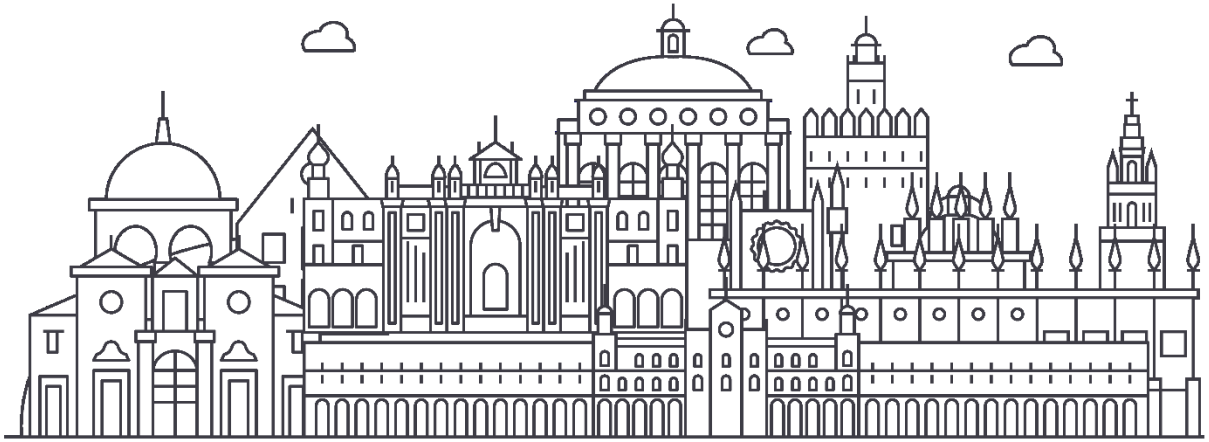
BEeS

The LifeWatch ERIC Biodiversity & Ecosystem eScience Conference

Seville
22-24/05/23



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

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INŠTITUT ZA RAZISKOVANJE KRASA · POSTOJNA

Challenges and preliminary results in building virtual laboratories to monitor *Proteus anguinus* and its karst groundwater habitat

Challenges and preliminary results in building virtual laboratories to monitor *Proteus anguinus* and its karst groundwater habitat

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BEeS Seville, 22-24 May 2023

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- Prirodoslovni muzej Slovenije — Slovenian Natural History Museum
- Park Škocjanske jame, Slovenija — Škocjan Caves Park
- Jamski laboratorij / cave laboratory TULAR — Tular Cave Laboratory
- University of Ljubljana
- Univerza v Mariboru — University of Maribor
- Univerza v Novi Gorici / Scientia Vincit 1995 — University of Nova Gorica
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Tular Cave Laboratory

Karst Groundwater Habitats vLab

ProteusWatch vLab

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Two virtual laboratories to assess subterranean biodiversity and its karst habitat

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Karst Research Institute ZRC SAZU

Jamski laboratorij TULAR
cave laboratory
Tular Cave Laboratory

Karst Groundwater Habitats vLab
mechanisms and processes of contaminant transport in aquatic karst systems…

ProteusWatch vLab
…effects on proteus ecology and behavior

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Karst Groundwater Habitats vLab

- plans to develope e-services to access, explore and analyze sensor data
- user-friendly interface to interactively assess the karst groundwater quality and possible pollution events of groundwater or karst spring habitats.

ProteusWatch vLab

- plans to developed e-services to access infrared videos and images captured in groundwater habitat of proteus (e.g., **behavioural response to polution**, etc.)
- develop new **safe** and **highly efficient** context-adaptive **data acquisition methods**
- implement **Machine Learning** and **Deep Learning** inference techniques
- vLab with **low energy consumption** and **electromagnetic pollution**

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A: **white proteus** *(Proteus anguinus anguinus)*; B: **black proteus** *(Proteus anguinus parkelj)*

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PROTEUS FACTS:

- ✓ flagship species of subterranean fauna
- ✓ top predator of groundwaters
- ✓ indicator of groundwater quality
- ✓ vulnearble, Habitat Directive & N2K

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PROTEUS FACTS:

- ✓ flagship species of subterranean fauna
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- ✓ lives up to 100 years?
- ✓ 7-year reproductive cycles?
- ✓ survives 10 years without food?
- ✓ one of the largest animal genomes

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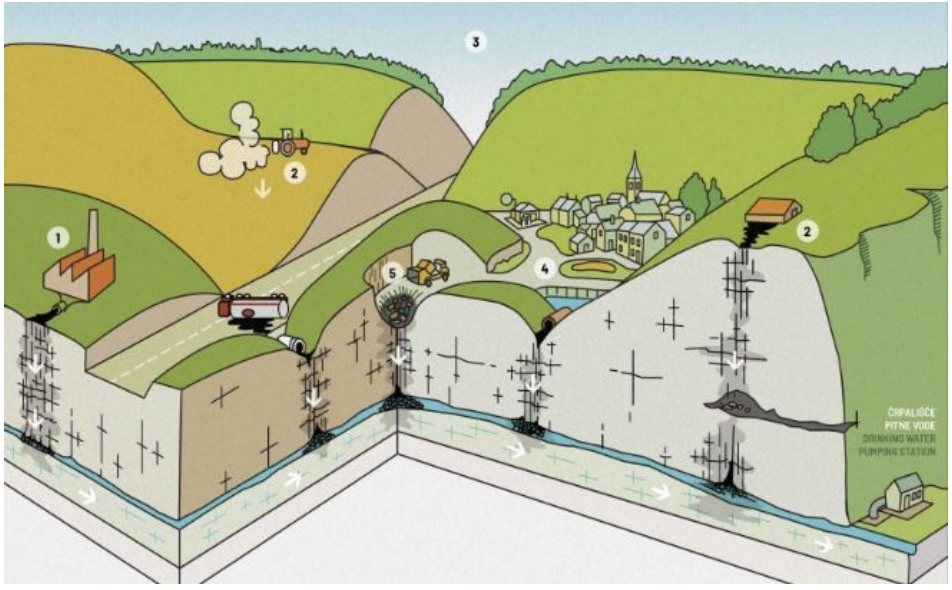
Challenges of monitoring in subterranean habitats

- inaccessible to man



Challenges of monitoring in subterranean habitats

- inaccessible to man
- total darkness

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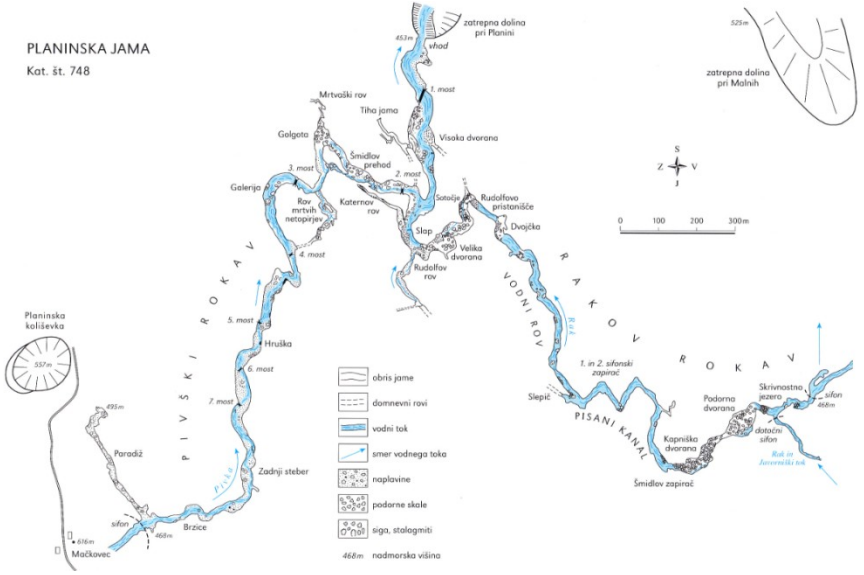
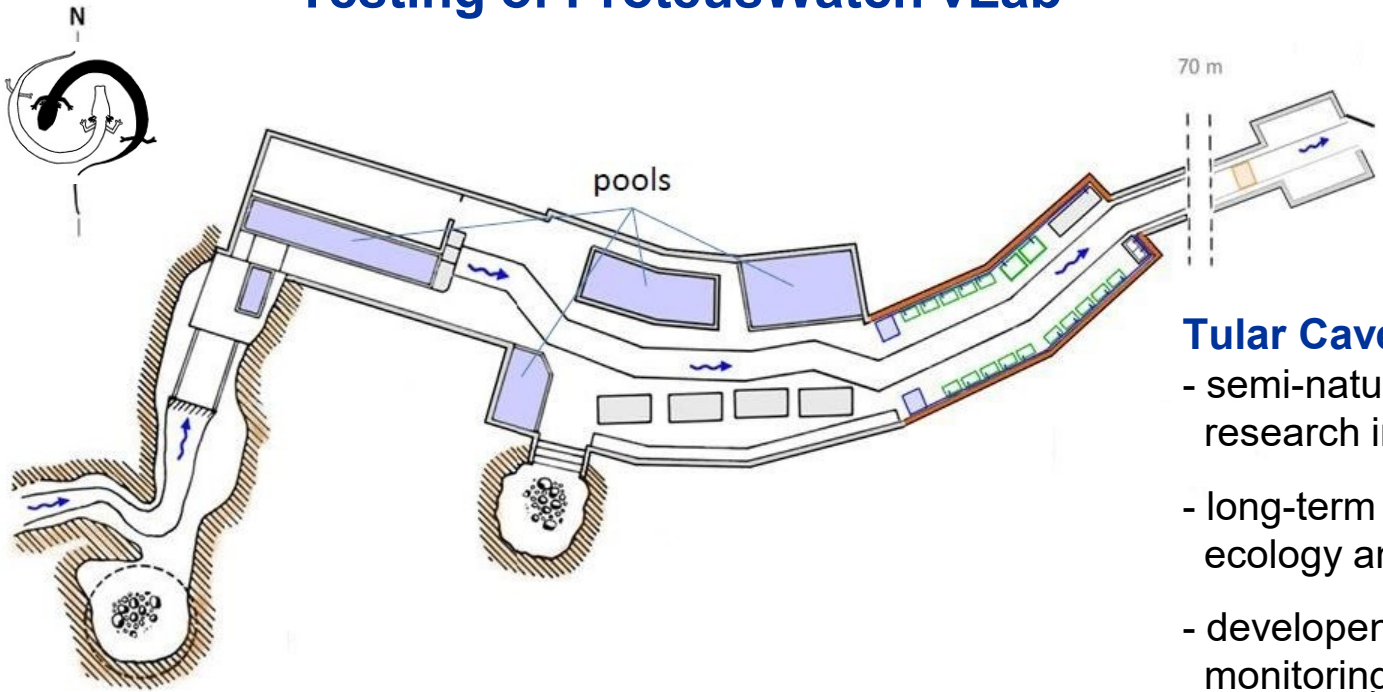
Challenges of monitoring in subterranean habitats

- inaccessible to man
- total darkness
- RI energy supply



Testing of ProteusWatch vLab



Tular Cave Laboratory

- semi-natural subterranean research infrastructure (est. 1960)
- long-term *ex-situ* observations in ecology and behaviour of proteus
- developent of photo and IR video monitoring

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Tular Cave Laboratory

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Classical observations under visible red light (M. Aljančič, ca. 1963)

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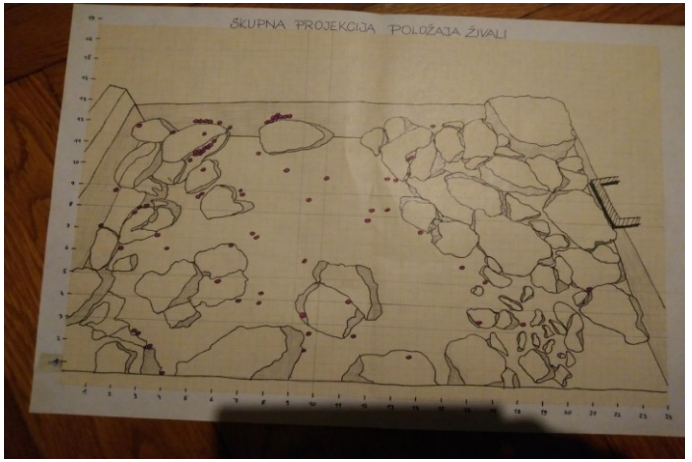

Early automated data collection on proteus space use, by georeferenced static photos (G. Aljančič & Klemenčič, 1989)

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Analogue IR video monitoring of proteus reproduction in laboratory pools (G. & M. Aljančič,1997-2007)

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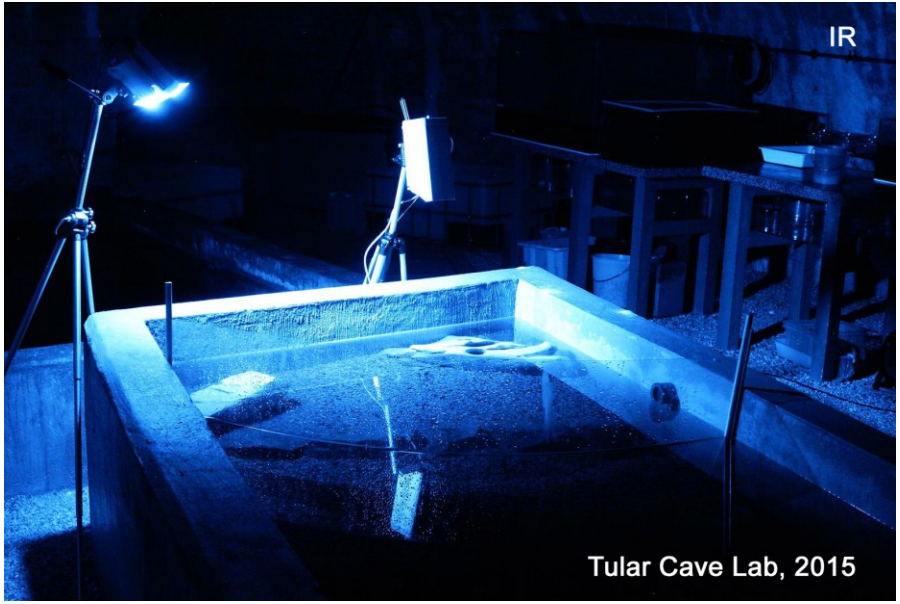

Digital (Internet Protocol) IR video monitoring of oviposition in Tular Cave Laboratory (2009 – onward)

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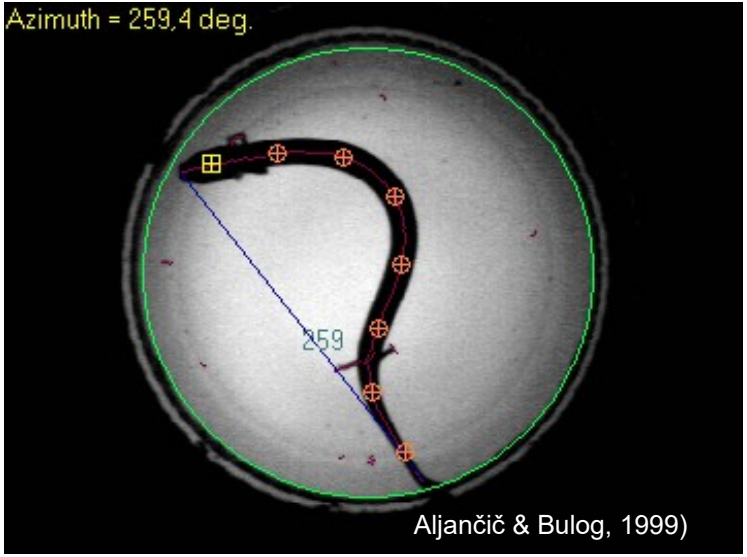
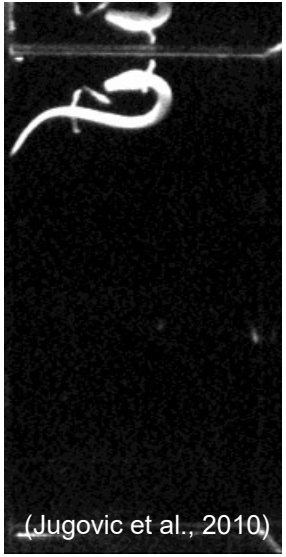


Aljančič & Bulog, 1999)


(Jugovic et al., 2010)

Chalenge: Simple single behavioural arena vs. unknown number of animals in natural situation

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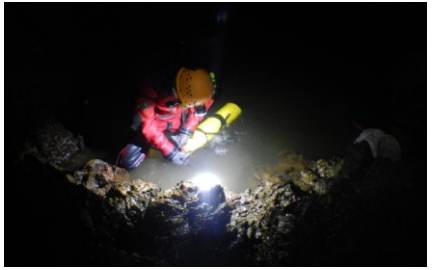
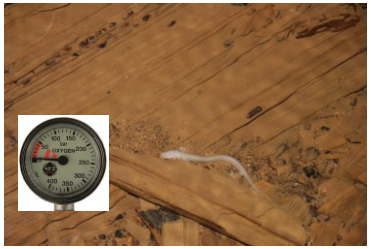
Turning towards *in situ* monitoring

development of IR monitoring of deep groundwater habitats

Postojna-Planina Cave System, Slovenia
world's hotspot of subterranean biodiversity





Monitoring of proteus through dangerous cave diving

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Turning towards *in situ* monitoring

development of IR monitoring of deep groundwater habitats or karst springs


(photo Matej Blatnik)

Camera traps in caves and karst springs

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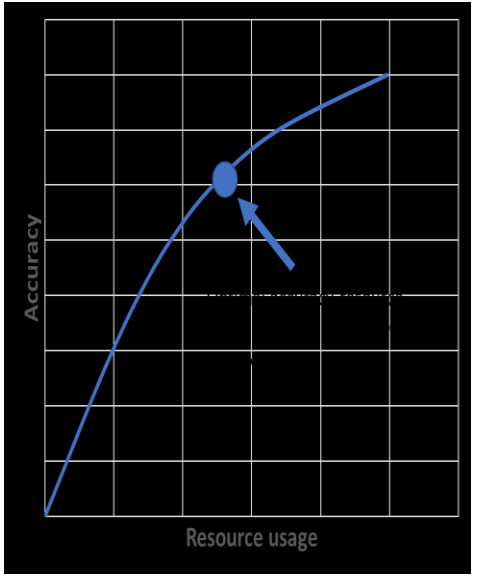
Towards Safe and Efficient Data Acquisition and Processing (FRI)

The sensing process is both **energy-intensive** and **electromagnetic polluting – concerns:**

- proteus is sensing EM radiation
- Increased EM load on subterranean environment

Thus, it is crucial to **sense as less as possible** while maintaining the **quality of the data**

New technologies for both the **sensing process** and the **computational** part are needed



AGOUTI
A platform for processing and archiving camera-trap images

Online data management platform for camera trap studies

Non-profit initiative of Wageningen University (NL) and Research Institute for Nature and Forest (INBO, B)

Financial support by (large) projects using the infrastructure: LifeWatch Flanders, MammalNet, EFSA,...

Mission and vision

- Provide a complete solution for organizations, students and professionals for camera trap data management
- Support open science, open data, FAIR principles
- Community supported infrastructure and metadata standards (camtrapDP)

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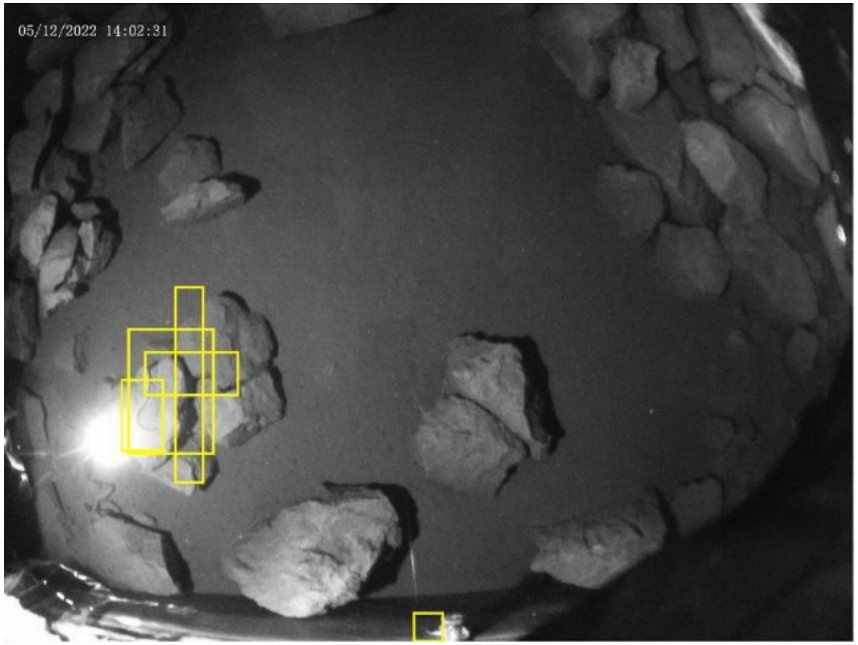
Results of preliminary *ex situ* testing



- **Training & evaluating of free detector models** (machine & deep learning models for object detection/ animal counting/ animal tracking (e.g., MegaDetector);
- **Development of software for capturing video data** from IR camera (configuration, acquisition, storage, accessing images);
- **Analysis of the acquired images**, assessing their **suitability for automated computer vision processing** (i.e., automated labeling, detection & tracking of proteus);
- **Preliminary review of existing image enhancement techniques and computer vision algorithms** suitable for IR image applications. Analysis on the feasibility of an automated labeling tool.

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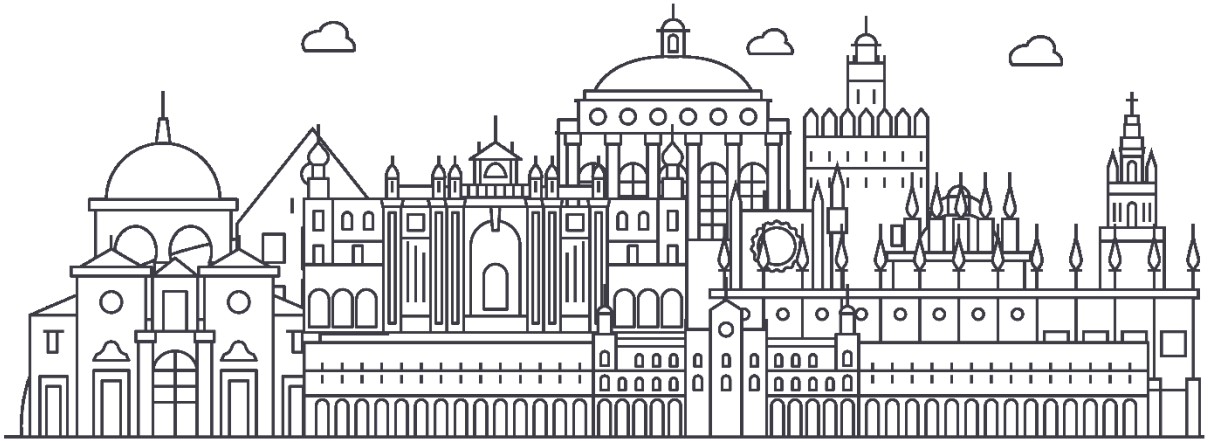

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Thank you! | www.lifewatch.eu/bees-2023