The Role of Community Science in DNA-Based Biodiversity Monitoring

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The Role of Community Science in DNA-Based Biodiversity Monitoring

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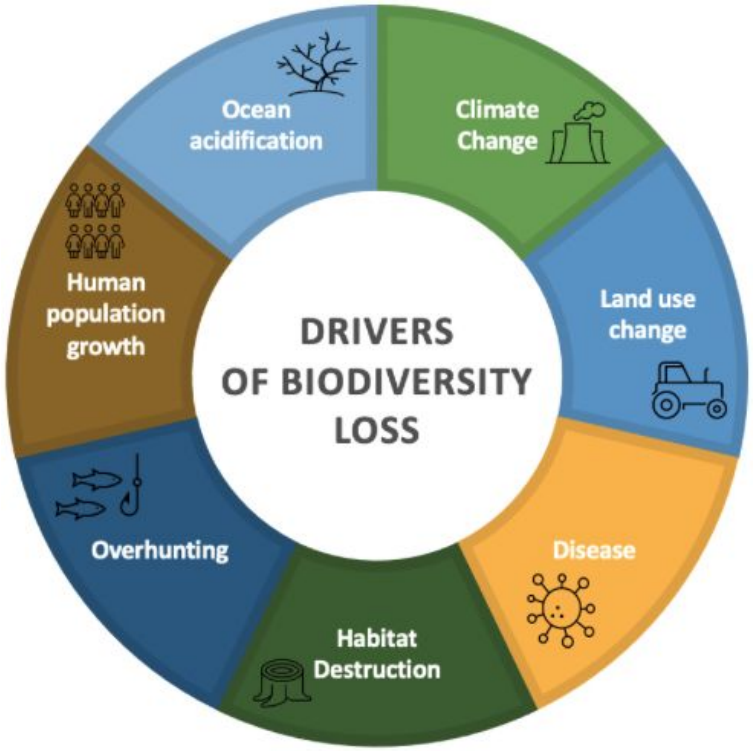
Biodiversity Loss and Biomonitoring

- Biodiversity is declining due to human-driver factors
- the Convention on Biological Diversity adopted the Kunming–Montreal Global Biodiversity Framework during COP15, aiming to protect and restore biodiversity by 2030
- Achieving these goals relies on biomonitoring to track changes in biodiversity and assess the efficacy of management interventions and restoration efforts.
- High-tech methods developed to complement traditional biomonitoring: bioacoustics, camera trapping, drones, sensor networks, imaging spectroscopy, satellite data and DNA-based methods.



Hernon, N. (2022)

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Community Science

- Active participation of non-professional volunteers (e.g., Indigenous peoples, local communities and general public) in scientific research and biodiversity monitoring by gathering data and conducting experiments under professional guidance.

- Biodiversity monitoring is not an exclusive activity that ‘only scientists’ are qualified to carry out. It should be a shared responsibility to reverse biodiversity loss.

CS Roles

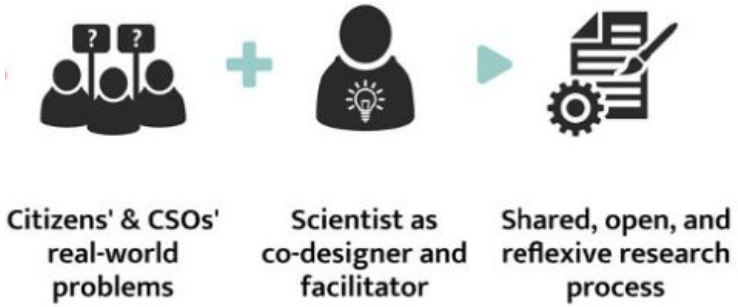
Contributory:

sample/data collector

vs.

Collaborative:

co-creation approaches provide a two-way interaction between researchers and CS participants, allowing the latter to be involved in the project design and implementation



(Senabre Hidalgo et al. 2021)

CS contributions to biomonitoring have been mainly restricted to visual observations and the collection of samples and their associated data

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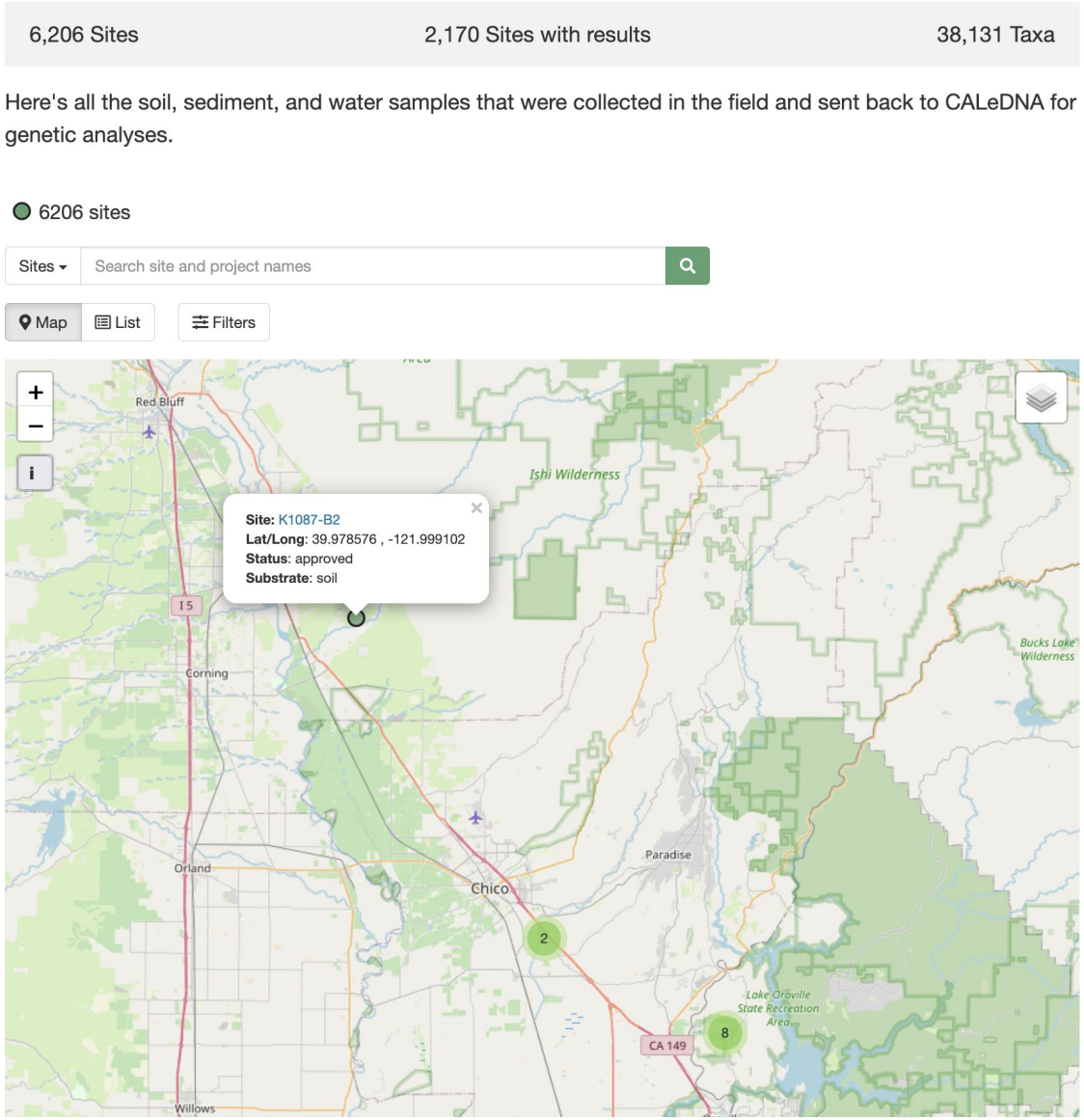
Contributory Role Examples

1. Register with our site.
2. Complete the Safety Training and Kit Training.
3. Complete the Safety Quiz and Kit Quiz.
4. Sign up for a bioblitz or contact us to get a kit.



>1000 community science volunteers

The Program was started by the University of California Conservation Genomics Consortium

https://ucedna.com/

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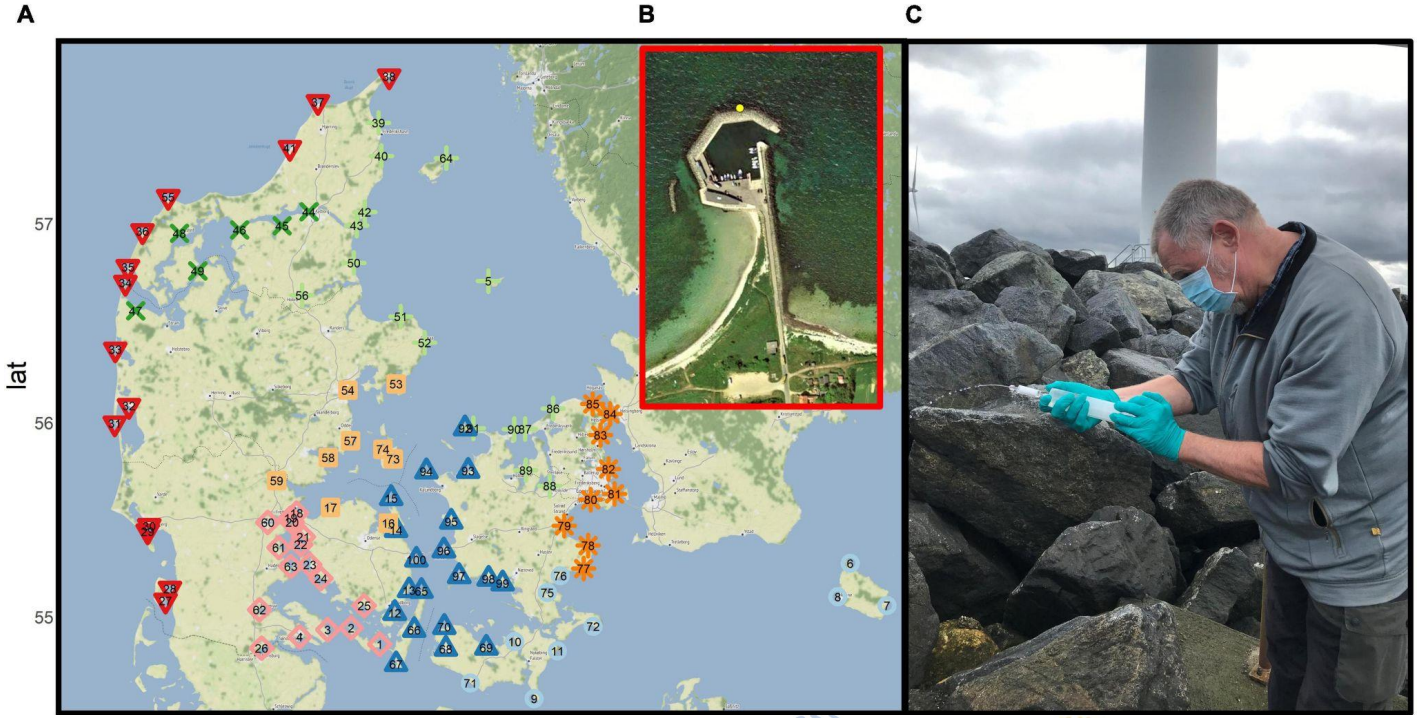
Contributory Role Examples

- Aarhus University and NHM Denmark
- 360 participants and 100 sites across Denmark
- Two events



Agersnap et al. (2022)

www.havblitz.dk

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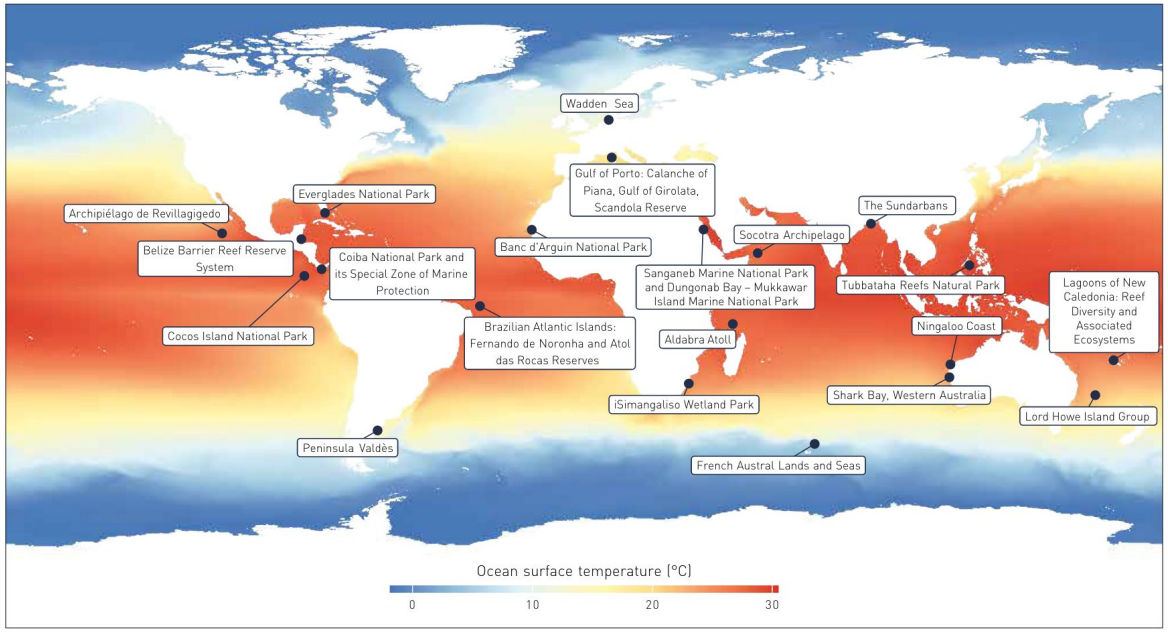
Contributory Role Examples

Contributory:

Suominen et al. (2024):

The expeditions inventoried marine biodiversity at 21 of UNESCO's 51 World Heritage marine sites

250 volunteers – ages 6 and up, from 19 countries – identified over 4,000 species



https://www.unesco.org/en/edna-overview?hub=66910

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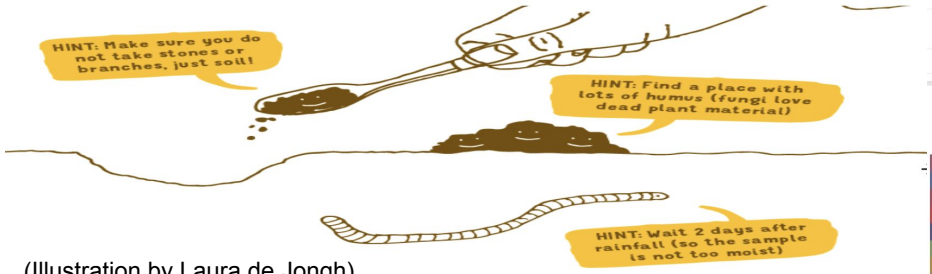
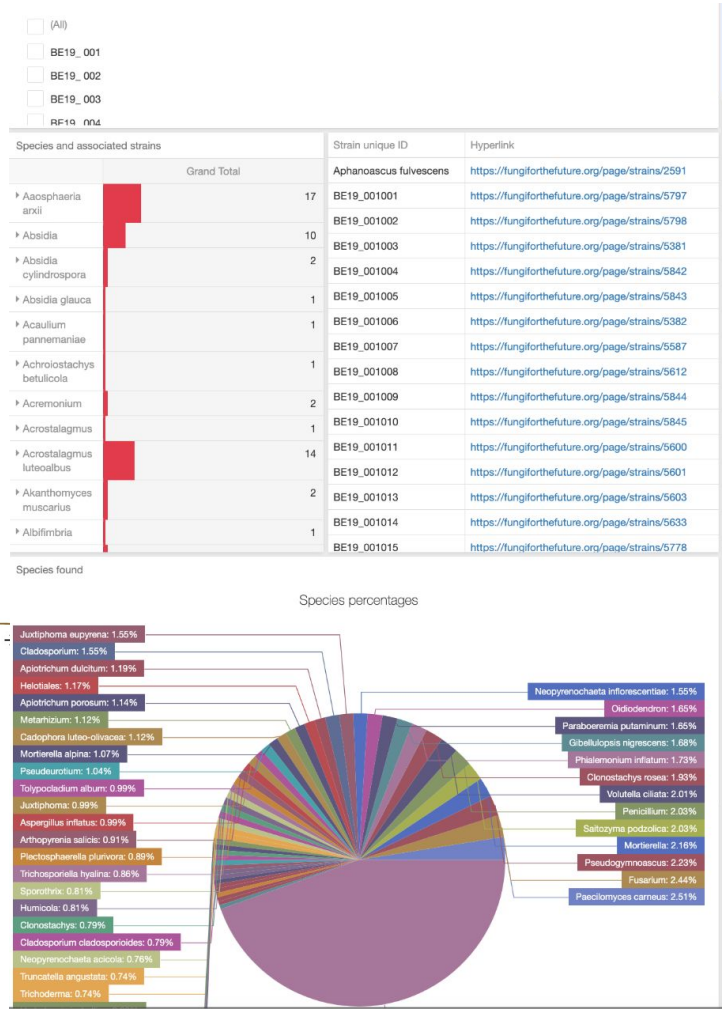
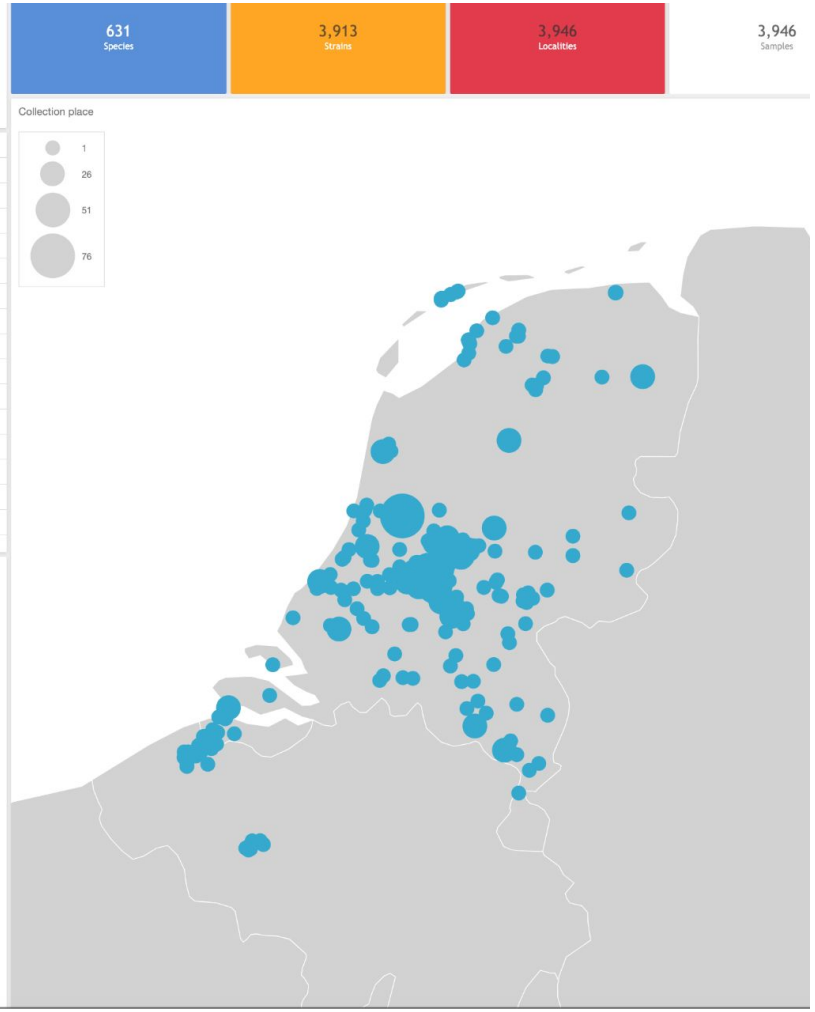
Contributory Role Examples

WESTERDIJK FUNGALBIO DIVERSITY INSTITUTE



(Illustration by Laura de Jongh)





https://fungiforthefuture.org/

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Contributory Role Examples

CITIZENS OF THE SEA

High-speed eDNA collection with TORPeDNA and semi-automated DNAutic devices for sailors in racing yachts and commercial oceanic vessels.

In 2024, 26 vessels collected over 800 eDNA samples across 1.5 million km² of ocean.

Vende Globe sailor Fabrice Amedeo with the DNAutic device for automatic eDNA filtering on an IMOCA offshore racing yacht.

https://www.citizensofthesea.org/news/revolutionizing-ocean-research-with-innovative-tools-for-citizen-scientists

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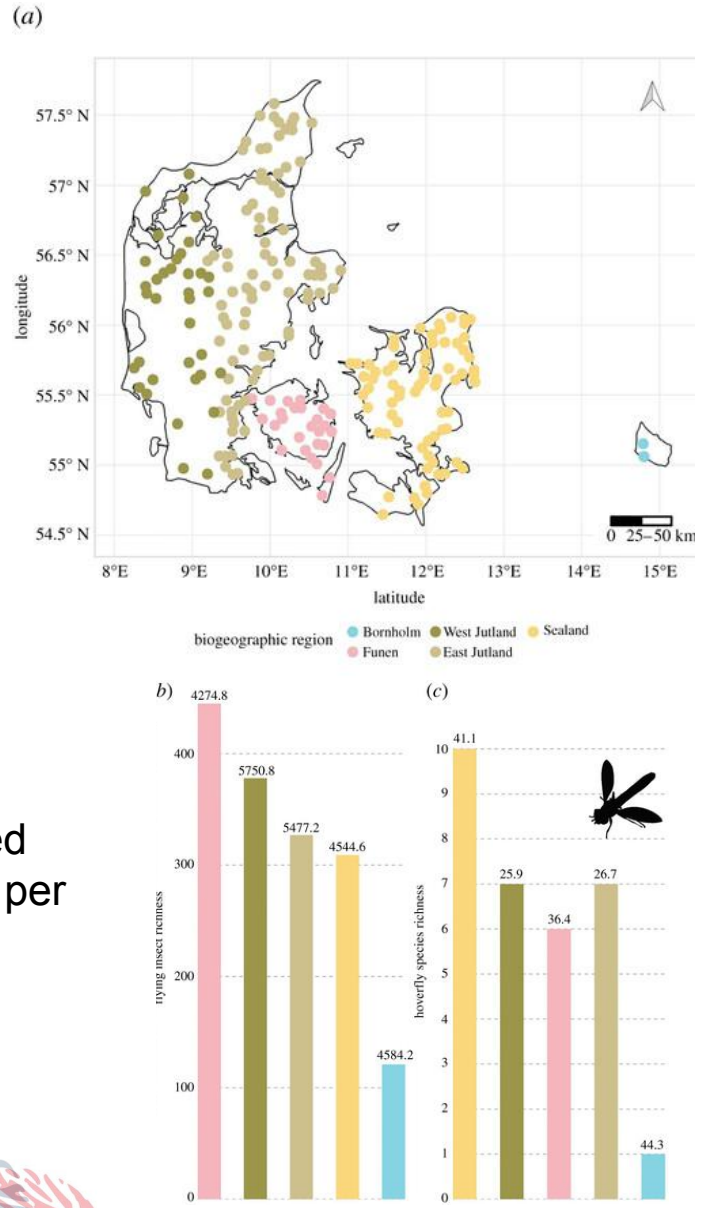
Contributory Role Examples

- Natural History Museum of Denmark
- one month's sampling in 2018
- 365 car net samples: 2114 species identified
- Car nets can sample over 1000 individuals per sampling trip (approx. 10–20 min)



Svenningsen et al. (2020, 2021)
https://insektmobilen.snm.ku.dk/

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Collaborative Role Examples

GainForest E.V. (2024) non-profit organisation based in Zürich + ETH BioDivX

Andrea Desiderato explaining eDNA to the Indigenous People of Aldeia Inhaâ-bé, who chair our Indigenous Data Council and are Indigenous members of our team.

https://biodivx.org/

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Collaborative Role Examples

- BeeCode Berlin Project: explores the genetic diversity of bees in Berlin's urban areas to promote biodiversity and sustainable beekeeping practices
- Mobile sequencing lab: DNA barcoding workshops for high school students regarding laboratory and computational techniques to identify honeybee subspecies

DNA barcode Kurs 2023, Foto MDC Communication Department

BeeCode workshop: co-organiser Sílvia Carvalho and students inspect a gel on Bento Lab

https://impetus4cs.eu/beecode-berlin/
https://ecocodedna.com/

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Collaborative Role Examples

- National Trust, Freshwater Habitats Trust, NatureMetrics in UK
- National Trust volunteers, members of the local angling club, members of local natural history groups
- Co-design project: Sampling locations, river Bure
- 35 water samples over a 9-day period. 69 vertebrate taxa were recorded

Questions to be addressed through co-designed study
How do barriers to fish movement affect fish assemblages?
How important are the headwaters of the Bure for overall fish diversity in the catchment?
Where are mink present?
Are there water voles in the catchment?
Where are eels in the catchment?

(Clarke et al. 2022)

Photo: Tom Sayer

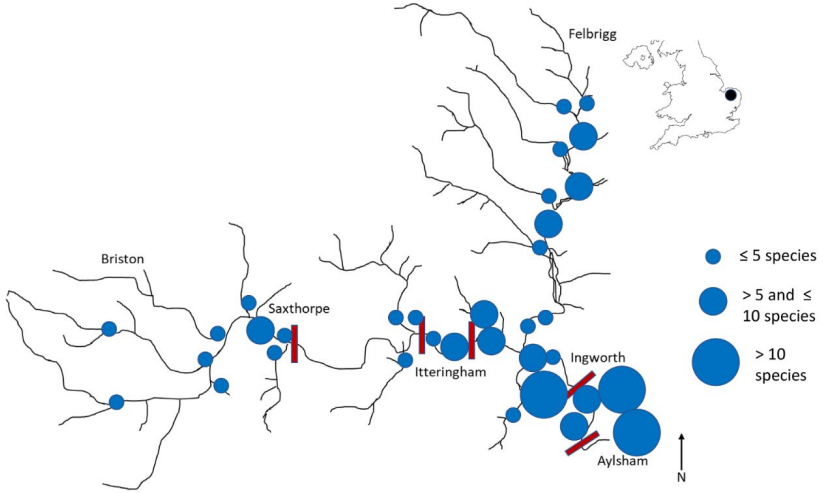

FIGURE 1 Map of sampling locations in Upper Bure catchment, Norfolk as determined by the citizen scientist group. Major barriers to fish movement shown in red and fish species richness per sample site indicated by size of points.

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Collaborative Role Examples

- “DNA & life” and “Extreme DNA & life” projects: collaborative partnerships with teachers and high school students
- Ca. 3000 students involved in the projects

Figure 3 Citizens at work in the DNA laboratory, working with eDNA samples and analyses, October 2015. Photo by Anders P. Schultz.

(Tøttrup et al. 2021, Leerhøi et al. 2024)
https://snm.dk/da/artikel/dna-paa-forkant

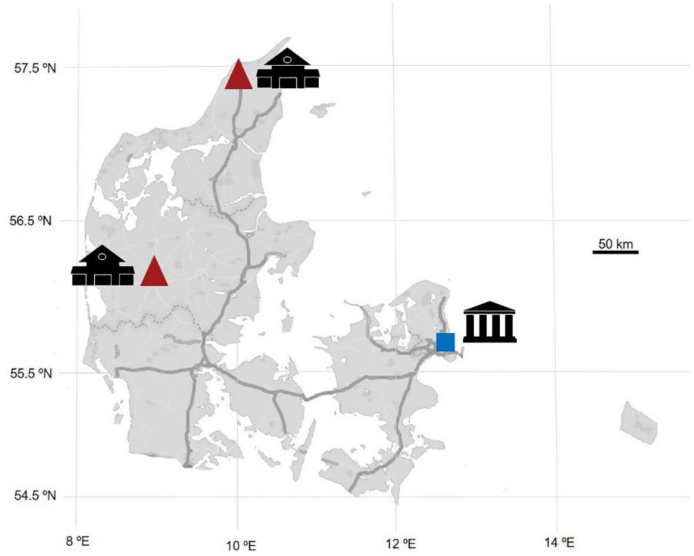

FIGURE 3
Location of DNA laboratories in the DNA & life project. Blue square represents the *Original DNA & life* laboratory at the Natural History Museum of Denmark and red triangles represent *Extreme DNA & life* DNA laboratories at Hjørring Gymnasium and Herning Gymnasium respectively.

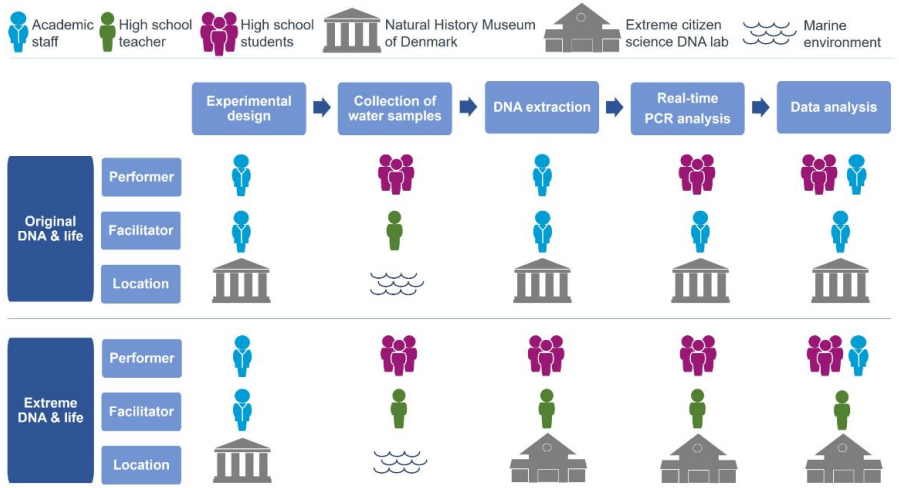

FIGURE 4
Development and distinction between the *Original DNA & life* project and the *Extreme DNA & life* project. The person/group performing or facilitating different phases of the scientific process, at different locations, is emphasized for both projects.

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What do these projects have in common?

Logistics
(Group to be engaged, geographic scope and sampling locations, sample type/number of replicates, sampling methods/sampling kits, metadata)

Communication strategy
(Advertisement and Engagement with volunteers: radio, news, social media, email, telephone)

Recruitment of participants
(Partnership with different entities e.g., environmental agencies, NHMs, schools, NGOs, conservation charities, hunting associations, fishing clubs, local/national scientific societies, farmers)

Educational and training material
(Videos, guidelines, workshops)

Communication of results and recognition
(Website, workshop)

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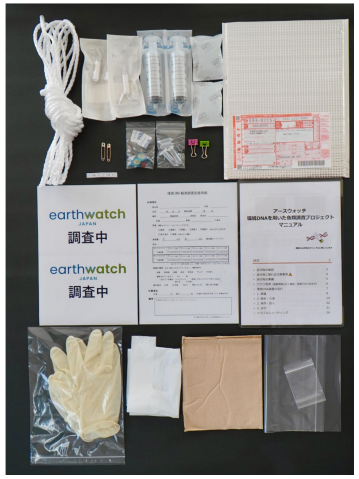
What do these projects have in common?

Logistics



unesco

Hoja de información de la muestra

Referencia de la muestra: _____
Nombre(s): _____
Correo(s) electrónico(s): _____
Sitio de la UNESCO: _____
Fecha: _____
Coordenadas: _____

Datos ambientales

Temperatura: _____

Muestra de salinidad: Recopilada/No recopilada

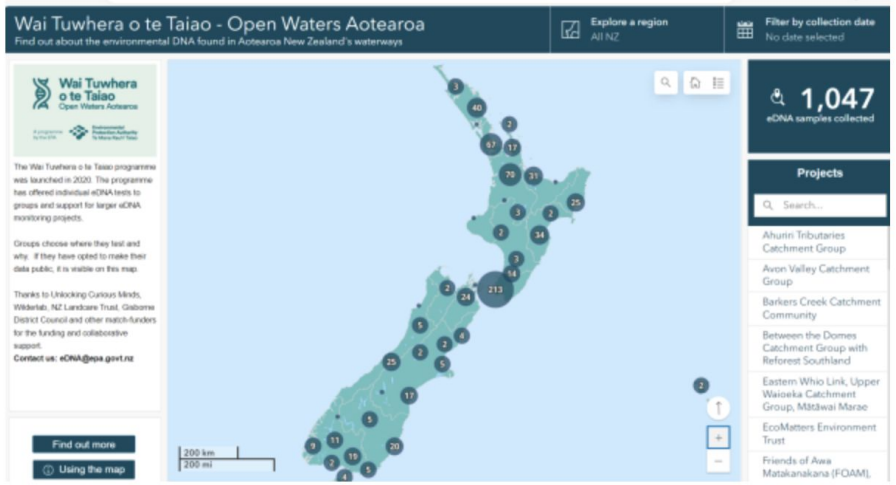
Filtrado de la muestra

Número de veces que se llena la jeringa (60 ml):

☐ 1	☐ 6	☐ 11	☐ 16	☐ 21	☐ 26
☐ 2	☐ 7	☐ 12	☐ 17	☐ 22	☐ 27
☐ 3	☐ 8	☐ 13	☐ 18	☐ 23	☐ 28
☐ 4	☐ 9	☐ 14	☐ 19	☐ 24	☐ 29
☐ 5	☐ 10	☐ 15	☐ 20	☐ 25	☐ 30

En total (ml): _____
Notas (p. ej.: información sobre el hábitat, profundidad):

Communication of results



Educational and training material

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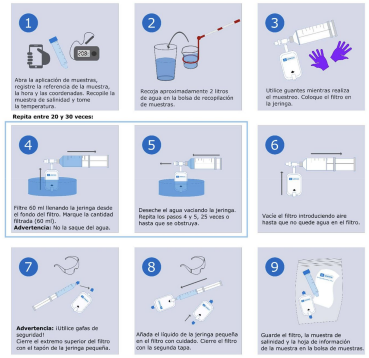
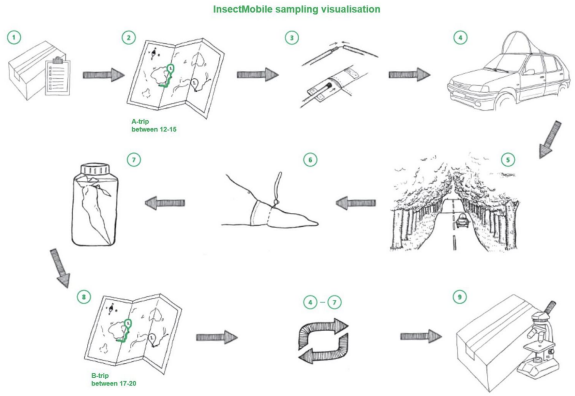
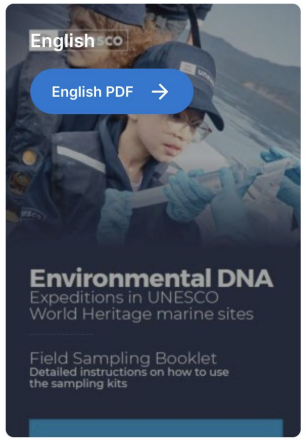




Insektmobilen - Sådan monterer du nettet



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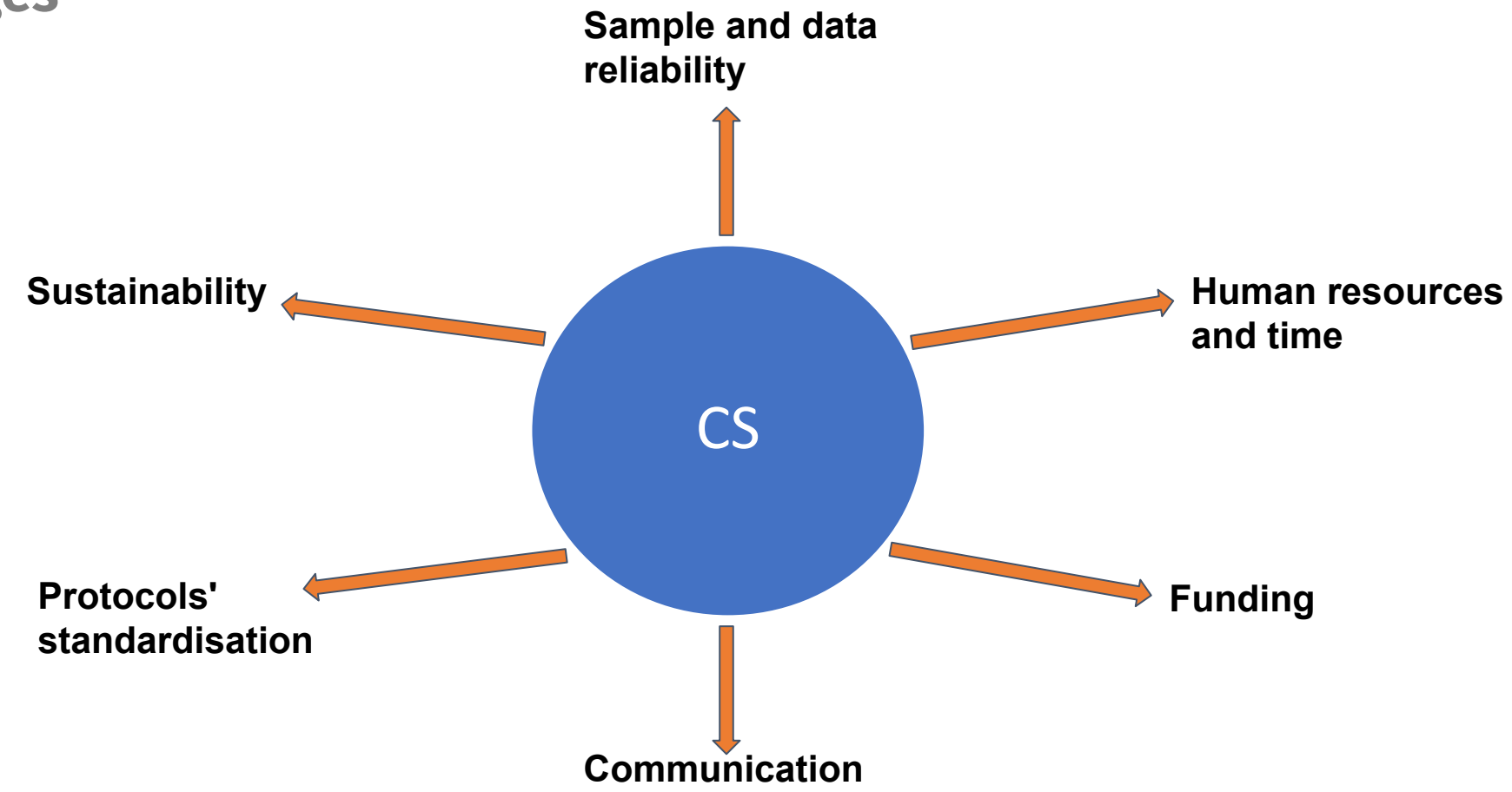
Challenges



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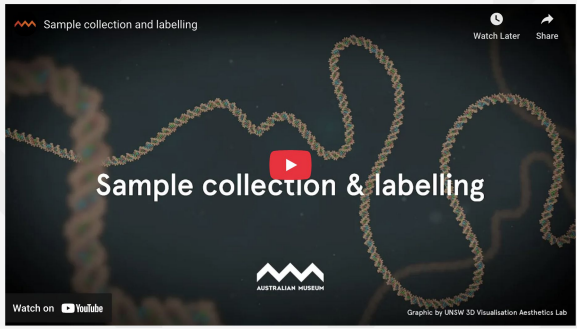
Get Help!

Partnerships are the key:

- Involve PhD students, postdocs, educators with molecular biology training, hobby experts or experienced para-taxonomists, or design a ‘train the trainers’ course if necessary
- Consider partnering with eDNA service providers (e.g., NatureMetrics, SpyGen, Wilderlab, and SimplexDNA)
- Take advantage of online resources to present new concepts ahead and ensure the same knowledge level.
- Consider collaborating with teaching and learning programmes or community science labs to develop your activities
- Contact the CS or education department at your institute

Some of these centres also offer in-person training

DNA Learning Center
BARCODING 101



GBIF Global Biodiversity Information Facility

bioCURIOUS

THE eDNA COLLABORATIVE

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